

# Empowerment of Coastal Communities through the Development of a Sustainable Sea Fish Processing System in the Bohowo Environment, Tongkaina Village, Bunaken District, Manado City, North Sulawesi Province

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## ABSTRACT

*This community empowerment program aims to enhance the economic independence and welfare of the coastal community in the Bohowo area, Tongkaina Village, by developing a sustainable and hygienic sea fish processing system. The main issues identified include the low quality of processed fish products due to the use of traditional methods, limited market access, and the lack of knowledge and technology for hygienic and value-added processing. The program employs a participatory approach through training, mentoring, and the implementation of appropriate technology in fish processing. Activities include training in good handling and processing practices (GHP), the introduction of simple processing technologies (such as smoking and drying with improved equipment), product diversification, and business management. The results of the program show a significant increase in the quality and shelf life of processed fish products, the creation of new product variants with higher economic value, and the establishment of a local business group that manages production and marketing collectively. Furthermore, this program strengthens social capital and environmental awareness within the community through the application of environmentally friendly processing principles and sustainable resource management. This initiative serves as a model for sustainable and empowering community-based economic development in other coastal areas.*

**Keywords:** Community Empowerment, Coastal Communities, Fish Processing, Appropriate Technology, Sustainability, Tongkaina.

## INTRODUCTION

The empowerment of coastal communities represents a critical pathway toward sustainable development, particularly in archipelagic nations like Indonesia, where millions depend on marine resources for their livelihoods. However, these communities often face systemic challenges, including limited access to modern technology, low-value addition to marine products, environmental degradation, and economic marginalization. In North Sulawesi, a province renowned for its rich marine biodiversity and coastal ecosystems, communities such as those in the Bohowo area of Tongkaina Village, Bunaken District, Manado City, continue to rely on traditional fish processing methods. While these methods are culturally embedded, they often result in low product quality, short shelf life, and minimal market competitiveness, thereby perpetuating cycles of poverty and underdevelopment. This scenario underscores the urgent need for strategic interventions that enhance the capacity of coastal communities to engage in more sophisticated and economically viable processing activities, thereby elevating their socio-economic status while simultaneously promoting environmental stewardship (Merdeka, 2023). Such initiatives are crucial for transforming raw fishery products into high-value commodities, thereby increasing income and improving the welfare of coastal populations (Merdeka, 2023; Wula et al., 2023).

Globally, the shift toward sustainable and value-added processing of marine products has been identified as a key driver of economic resilience and environmental stewardship. Sustainable fish processing not only enhances product quality and marketability but also reduces post-harvest losses, promotes resource efficiency, and minimizes ecological footprints. In Indonesia, governmental and non-governmental initiatives have increasingly emphasized community-based approaches to marine resource management, aligning with the Sustainable Development Goals (SDGs), particularly SDG 1

(No Poverty), SDG 8 (Decent Work and Economic Growth), SDG 12 (Responsible Consumption and Production), and SDG 14 (Life Below Water). Despite these policy directives, the implementation of effective community empowerment programs, particularly those focused on sustainable processing systems, remains a considerable challenge in many remote coastal areas (Siswoyo & Faqih, 2019). This gap often stems from a lack of tailored training, insufficient capital investment, and limited access to critical market information and infrastructure (Siang, 2023).

Despite these macro-level efforts, localized interventions tailored to the specific socio-economic and ecological contexts of communities like Bohowo remain limited. Existing studies highlight gaps in the adoption of appropriate technologies, access to training and capital, and the integration of traditional knowledge with modern sustainable practices. Furthermore, the unique environmental setting of Bunaken—a region famed for its marine tourism and conservation areas—necessitates a careful balance between economic development and ecosystem preservation. This paper therefore aims to address this critical gap by proposing and evaluating a sustainable sea fish processing system tailored for the Bohowo community, integrating advanced processing techniques with local ecological considerations to foster economic growth and environmental sustainability (Rozikin et al., 2024).

This community empowerment program, titled *Empowerment of Coastal Communities through the Development of a Sustainable Sea Fish Processing System in the Bohowo Environment, Tongkaina Village, Bunaken District, Manado City, North Sulawesi Province*, seeks to address these multifaceted challenges. By introducing a participatory, technology-integrated, and ecologically conscious approach to fish processing, the program aims to enhance the socio-economic well-being of the community while promoting environmental sustainability. Through a combination of training, mentoring, and the implementation of appropriate technologies, this initiative strives to transform traditional practices into innovative, market-oriented, and sustainable enterprises. Specifically, this program will focus on diversifying processed fishery products beyond traditional salted or dried fish, exploring options such as smoked fish, fish floss, or fish crackers, to enhance their market value and appeal (Mendo et al., 2024). This diversification is essential not only for increasing income streams but also for reducing post-harvest losses and improving food security within the community (Ubwarin et al., 2019).

The significance of this program lies not only in its potential to improve household incomes and food security but also in its contribution to a scalable model of community-led marine resource management. By focusing on empowerment rather than mere aid, the program emphasizes capacity building, local ownership, and long-term resilience. This introduction outlines the contextual background, identifies key challenges and opportunities, and frames the objectives and anticipated impacts of the intervention, thereby setting the stage for a detailed discussion of the methodology, implementation, and outcomes of this community-focused initiative. Ultimately, this initiative aims to create a replicable framework for sustainable coastal community development, fostering economic self-sufficiency while safeguarding vital marine ecosystems (Dewanti et al., 2023). The program draws insights from community-based empowerment theories, recognizing that interventions designed to build local capacity are often more successful in alleviating poverty and improving overall welfare (2025).

## METHODS

### Participants

The participants involved in this empowerment program are coastal community members from **Bohowo, Tongkaina Village, Bunaken District, Manado City**, who are engaged in traditional fish processing activities. A total of **35 participants** were initially targeted, with **32 participants** actively involved in the implementation phase. Participants include:

1. **Traditional fish processors** (especially women) · Local community leaders; and Representatives from women's groups involved in small-scale fishery activities (Misrina et al., 2022; Yantu et al., 2025). These participants were selected based on their existing involvement in the fisheries sector, willingness to adopt new technologies, and potential to serve as local change agents within the community (Rozikin et al., 2024).

2. **Local fishermen** as raw material suppliers This inclusive selection strategy ensures that the program benefits from diverse perspectives and integrates various community stakeholders into the sustainable development framework ([Rozikin et al., 2024](#)). This approach is consistent with theories of social empowerment, which emphasize the importance of broad community participation and access to economic resources and opportunities for effective development initiatives ([2025](#)).
3. **Youth community members** interested in sustainable fisheries Such engagement fosters a generational transfer of sustainable practices and innovation, ensuring the long-term viability of the processing system ([Prasetyani et al., 2023](#)). Moreover, this multi-stakeholder engagement is crucial for establishing robust feedback mechanisms and fostering collective ownership, thereby enhancing the program's adaptability and resilience against unforeseen challenges ([Malihah et al., 2022](#)).
4. **Local community leaders** and representatives from women's groups involved in small-scale fishery activities were also included to ensure that the program aligns with local governance structures and empowers marginalized groups, such as fisherwomen ([Prasetyani et al., 2023](#); [Susilowati & Mafruhah, 2022](#)). This broad involvement aims to overcome pseudo-participation and foster sustainable, self-reliant empowerment programs, contrasting with past top-down approaches ([Aminah & Syafri, 2023](#)).

## IMPLEMENTATION APPROACH

The program follows a **participatory action research** framework with three main phases:

### PHASE 1: COMMUNITY NEEDS ASSESSMENT AND SOCIALIZATION (Weeks 1-2)

#### Activities:

- Participatory Rural Appraisal (PRA) to map existing fish processing practices
- Focus Group Discussions (FGDs) to identify community needs and challenges
- Socialization sessions on sustainable fish processing concepts and benefits
- Baseline data collection on current processing methods, production volumes, and economic conditions

#### Tools Used:

- Semi-structured interviews
- Observation checklists
- Community resource mapping
- Seasonal calendars of fishing activities

### PHASE 2: CAPACITY BUILDING AND TECHNOLOGY TRANSFER (Weeks 3-8)

#### Activities:

- Technical training workshops on hygienic fish processing techniques
- Demonstration sessions on improved processing technologies:
  - Solar dryer construction and operation
  - Improved smoking kiln techniques
  - Cold storage management
  - Packaging and labeling methods
- Hands-on practice sessions with mentoring from technical experts
- Business development training covering:
  - Quality control and standardization
  - Product diversification
  - Basic financial management
  - Market access strategies

#### Training Methods:

- Learning by doing approach
- Peer-to-peer learning sessions
- Master trainer model (training of trainers)
- Visual aids and local language materials

### PHASE 3: SUSTAINABLE SYSTEM ESTABLISHMENT AND MONITORING (Weeks 9-12)

Activities:

- Establishment of community processing unit with improved infrastructure
- Development of sustainable supply chain linking fishermen to processors
- Creation of community-based quality control system
- Formation of cooperative or business group for collective marketing
- Regular mentoring and technical support visits
- Environmental impact monitoring of processing activities

**SUSTAINABLE TECHNOLOGY IMPLEMENTATION**

Appropriate Technology Components

The sustainable fish processing system includes:

- Energy-Efficient Solar Dryers
  - Capacity: 50 kg per batch
  - Construction: Local materials (bamboo, polyethylene sheets)
  - Features: Adjustable ventilation, insect-proof design
- Improved Smoking Kilns
  - Type: FAO-Thiaroye Processing Technique (FTT) kiln
  - Benefits: Reduced smoke exposure, better temperature control
  - Fuel efficiency: 50% less wood consumption
- Hygiene and Sanitation Facilities
  - Stainless steel processing tables
  - Clean water supply system
  - Waste management system for processing by-products
- Quality Control Equipment
  - pH meters
  - Moisture content testers
  - Packaging equipment (vacuum sealers)

**Environmental Sustainability Measures**

- Water conservation through recycling systems
- Waste utilization (fish waste for fertilizer or animal feed)
- Renewable energy integration (solar-powered equipment)
- Sustainable fuel sourcing (fast-growing wood species for smoking)

**DATA COLLECTION AND EVALUATION**

**Quantitative Data Collection**

Pre- and Post-Intervention Surveys measuring:

- Economic indicators: Income levels, production costs, profit margins
- Productivity metrics: Processing time, yield percentages, product quality
- Environmental indicators: Water usage, waste generation, energy consumption
- Social indicators: Women's participation, working conditions, community satisfaction

**Table 1: Baseline Economic Indicators of Participants**

Indicator	Pre-Intervention	Target Post-Intervention
Average Monthly Income (IDR)	1,200,000	3,500,000
Product Loss Percentage	35%	15%
Market Price Premium	0%	25%
Processing Time (hours/kg)	8	4

### Qualitative Data Collection

- In-depth interviews with key informants
- Participant observation of processing activities
- Case studies of successful adopters
- Regular feedback sessions with community members

### Participatory Monitoring and Evaluation

#### Community-Based Monitoring System:

- Monthly progress meetings with participants
- Participatory impact assessment using Most Significant Change technique
- Community scorecards for program evaluation
- Regular environmental audits of processing site

## COMMUNITY ENGAGEMENT STRATEGY

### Stakeholder Involvement

1. **Local government** (Fisheries Department, Environment Agency) officials were engaged to ensure alignment with regional development plans and to facilitate regulatory support for the sustainable fisheries initiative ([Ajith et al., 2022](#)).
2. **Academic institutions** (Fisheries University of Manado) and research bodies were partnered with to provide scientific expertise, validate sustainable practices, and facilitate technology transfer, thereby grounding the project in robust empirical evidence.
3. **Non-governmental organizations** (Marine conservation groups) provided crucial on-the-ground support, facilitating community mobilization and ensuring the effective dissemination of sustainable processing technologies ([Snider et al., 2023](#)).
4. **Private sector partners** (Equipment suppliers, market buyers) were engaged to facilitate market linkages for improved fish products, contributing to enhanced economic viability and sustainability of the value chain ([Grantham et al., 2022](#)).

### Gender Mainstreaming Approach

1. **Women-focused training** sessions to enhance their skills in advanced fish processing techniques, business management, and quality control, acknowledging their pivotal role in the artisanal fisheries sector ("[Implementing the Small-Scale Fisheries Guidelines for Gender-Equitable and Climate-Resilient Food Systems and Livelihoods](#)," 2024).
2. **Gender-balanced participation** in decision-making bodies was actively promoted to ensure equitable representation and integration of their perspectives in project planning and implementation ("[Implementing the Small-Scale Fisheries Guidelines for Gender-Equitable and Climate-Resilient Food Systems and Livelihoods](#)," 2024).
3. **Recognition of women's traditional knowledge** and practices was integrated into the training modules, valuing their historical contributions to sustainable resource management ([House et al., 2022](#)).

**Support for women's leadership** in the processing group to foster a more inclusive and effective governance structure within the community ([Community-Based Management of Land and Forests in the Grand Kivu and Lac Télé-Tumba Landscapes in the Democratic Republic of Congo \(DRC\), n.d.](#))

## SUSTAINABILITY AND SCALABILITY FRAMEWORK

### Economic Sustainability

- Revolving fund mechanism for equipment maintenance
- Market linkage development with premium buyers
- Value-added product development training
- Group savings and loan association establishment

**Environmental Sustainability**

- Environmental management plan for processing site
- Regular environmental impact assessments
- Adoption of cleaner production principles
- Integration with marine conservation efforts in Bunaken area

**Social Sustainability**

- Formalization of community processing group
- Development of local bylaws for sustainable practices
- Knowledge documentation and traditional practice preservation
- Youth engagement programs for intergenerational transfer

**ETHICAL CONSIDERATIONS**

- Free, Prior and Informed Consent from all participants
- Respect for traditional knowledge and practices
- Fair benefit sharing mechanisms
- Transparent decision-making processes
- Environmental justice considerations

**Table 2. Timeline and Implementation Schedule**

Phase	Duration	Key Activities	Responsible Parties
Preparation	Month 1	Community mobilization, baseline study	University team, local leaders
Training	Months 2-3	Technical workshops, equipment installation	Technical experts, community facilitators
Implementation	Months 4-8	Production operations, quality control	Community processing group
Monitoring	Months 9-10	Data collection, impact assessment	University team, community monitors
Evaluation	Month 11	Participatory evaluation, reporting	All stakeholders
Sustainability Planning	Month 12	Business planning, follow-up strategy	Community group with facilitators

This methodology ensures a **comprehensive, participatory, and sustainable approach** to community empowerment through improved fish processing systems, aligning with both community needs and environmental conservation goals in the ecologically sensitive Bunaken region. This holistic framework facilitates the transition towards green industrial development by integrating sustainable practices and fostering resilient local economies (Siswoyo & Faqih, 2019). It also addresses critical social deficiencies, such as gender inequality and limited opportunities for women, within the industrial sector by promoting inclusive governance and recognizing women's contributions (Damayanti et al., 2025; Yosep et al., 2024). Such initiatives, by integrating gender-sensitive income-generating activities and fostering community-based natural resource management, further contribute to household resilience and broader resource sustainability (Community-Based Management of Land and Forests in the Grand Kivu and Lac Télé-Tumba Landscapes in the Democratic Republic of Congo (DRC), n.d.;

[Plasus et al., 2025](#)). Moreover, empowering women in resource governance can lead to beneficial outcomes for resource sustainability and biodiversity conservation ([Leisher et al., 2015](#)).

## CONCLUSION

1. The level of community participation and initial motivation to adopt sustainable fish processing technologies in Bohowo remains relatively low, as traditional practices are deeply ingrained and immediate economic benefits are not clearly visible without demonstration. The community often expects direct material assistance rather than capacity-building interventions.
2. Participants in the training sessions frequently associate the empowerment program with immediate financial compensation or material aid, such as transport allowances, viewing their participation time as lost income from daily fishing or vending activities rather than a long-term investment in skill development.
3. Scheduling and conducting field visits to individual households or processing sites proves challenging due to the irregular daily routines of fishers and processors, who prioritize immediate livelihood activities over engagement in program activities.
4. Most community members possess limited understanding of essential aspects of sustainable business management, including licensing requirements (such as BPOM and halal certification), quality control, packaging, branding, customer service, bookkeeping, and market networking – all crucial for improving product value and expanding market reach.
5. The reliance on traditional fish processing methods often leads to inconsistent product quality, limited shelf life, and low market competitiveness, reinforcing a cycle of low income and missed opportunities despite the area's rich marine resources and proximity to tourism markets in Bunaken.
6. Environmental awareness regarding sustainable resource use, waste management, and energy-efficient processing remains underdeveloped, with practices often contributing to local environmental degradation.
7. Gender dynamics play a significant role, as women – who are primarily responsible for fish processing – often lack access to decision-making, technology adoption, and market linkages, limiting the potential for inclusive economic improvement.
8. There is an absence of a cohesive community-based organization or cooperative structure to collectively address common challenges, access financial services, negotiate better prices, or share knowledge and resources for scaling up sustainable practices.

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