Shrimp Improvement Program (SIP)

A Multi-Stakeholder Initiative to Improve Shrimp Aquaculture Across a Whole Jurisdiction in Banyuwangi, East Java, Indonesia

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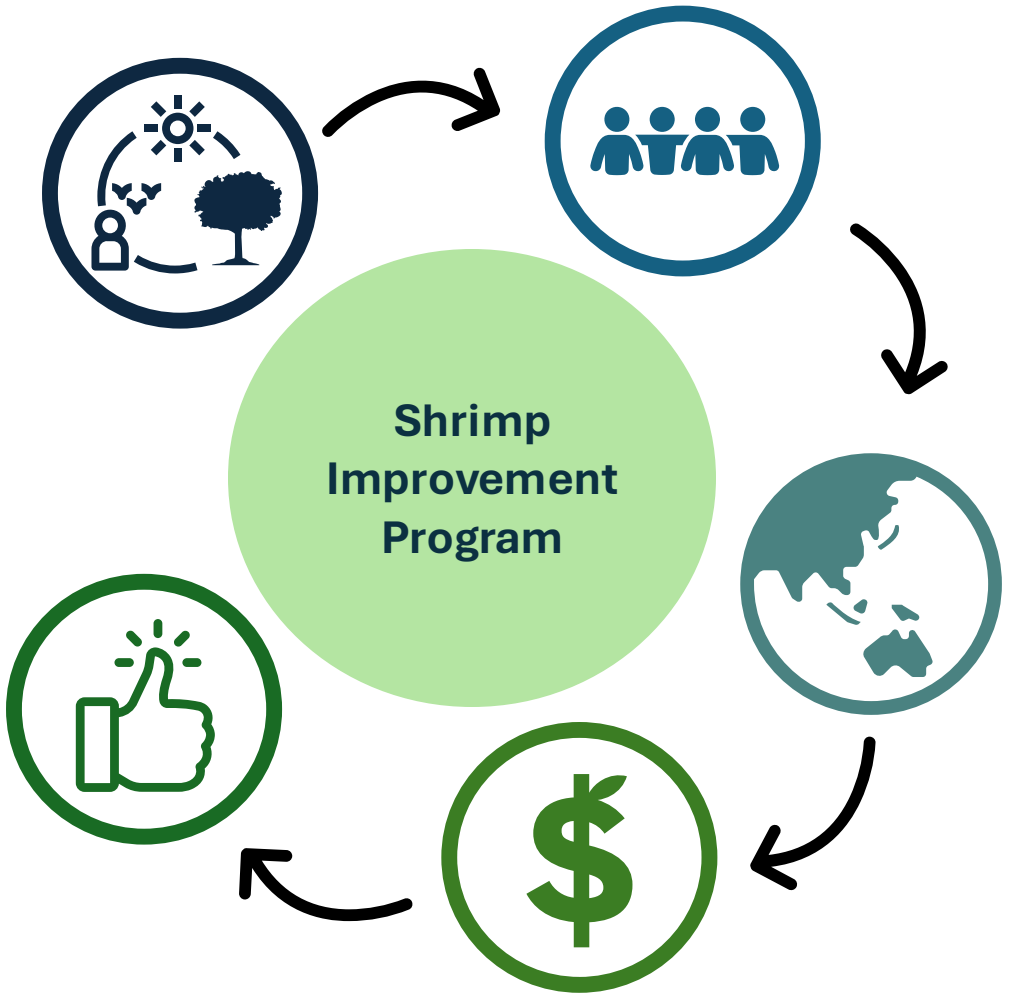
Konservasi Indonesia

Adaptation Futures 2025

Outline



- Background
- The Jurisdiction
- SIP Solution
- Next Phase
- Conclusion

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About Konservasi Indonesia

Konservasi Indonesia is a national foundation that aims to **support** the **sustainable development** and **environmental protection** of **critical ecosystem** in Indonesia.
In achieving this goal, we believe in the importance of **multi-stakeholder partnerships** that **cross sectors and jurisdictions**.

Supporting the government and collaborating with partners, we design and deliver innovative nature-based solutions and integrated and sustainable land and seascape management strategy approaches to generate long-term positive impacts for people and nature in Indonesia.

Glance of Shrimp Production

Indonesia

5th largest producer in the world

214 Thousand tons volume of export annually

2.5x Targeted increase in production and exports

Banyuwangi

1st largest producer in east Java

19 Thousand tons volume of production

±9% Estimated contribution to national production

Problems

If massive production continues:

Unaccounted growth & expansion

Habitat loss & mangrove conversion

Impaired effluent & disease outbreak

Also impacted:

Reduce livelihood benefits

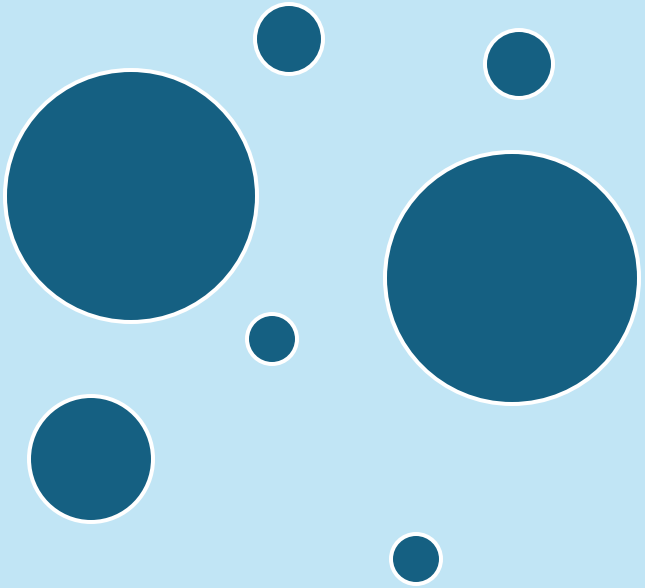
Vulnerable supply chains

Resource use conflicts

Jurisdictional initiative

Improve Impact, Permanence, and Scale

FARM-LEVEL PROJECTS

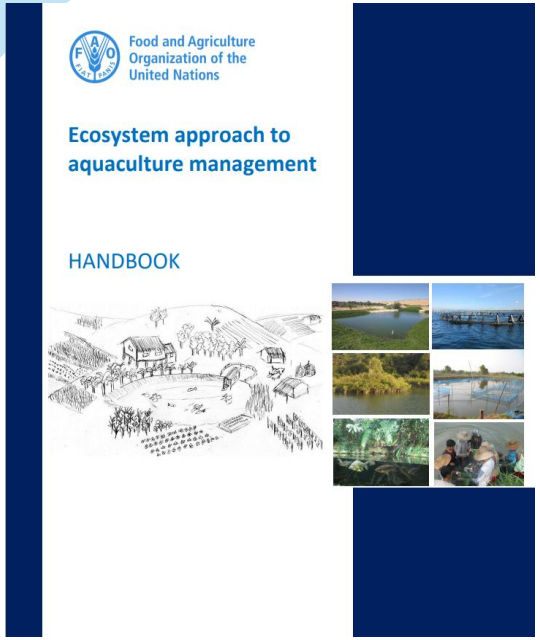


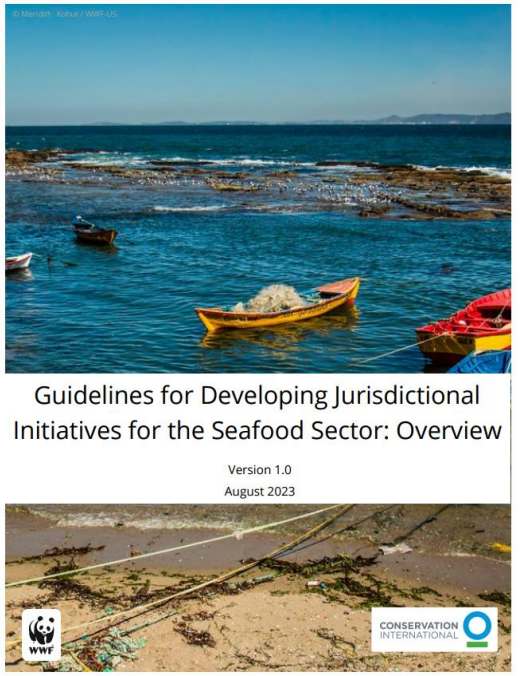
Certification **only covers 3.5%** of global aquaculture production

Certification also tends to **focus on individual farms**

It is often **not accessible for smallholder** farmers due to cost and complexity

It highlights need for changes **– a new model that is inclusive for smallholders**

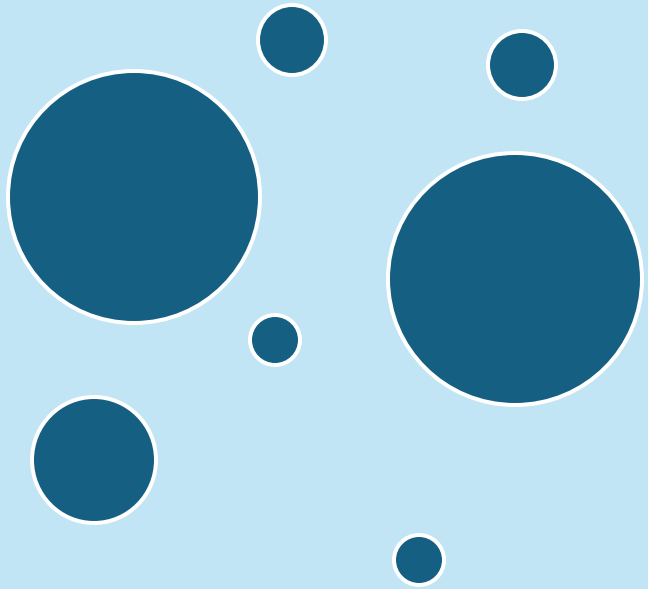




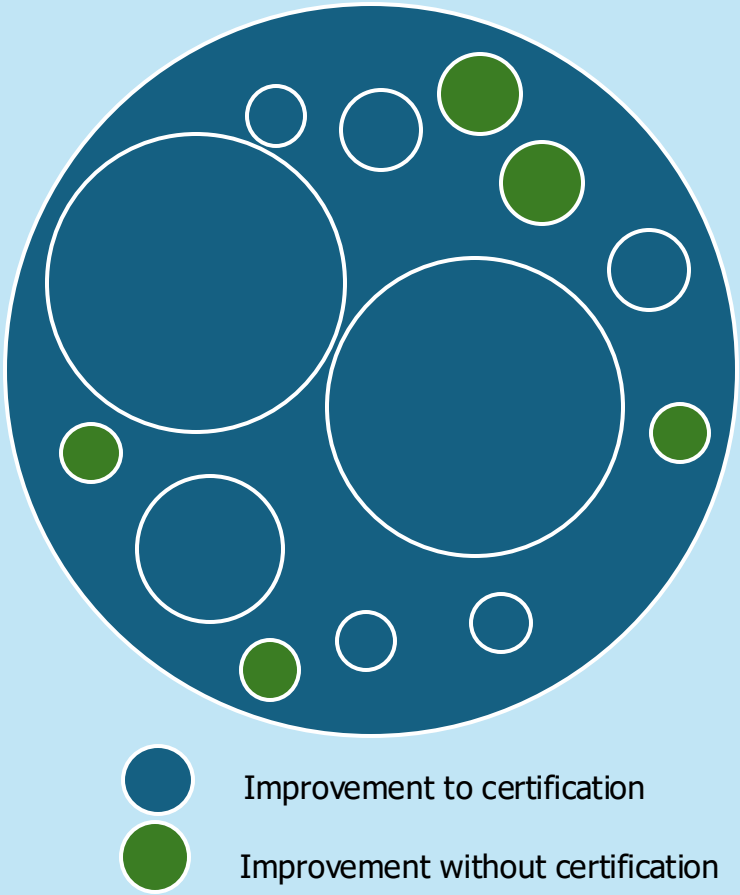
Jurisdictional initiative

Improve Impact, Permanence, and Scale

FARM-LEVEL PROJECTS

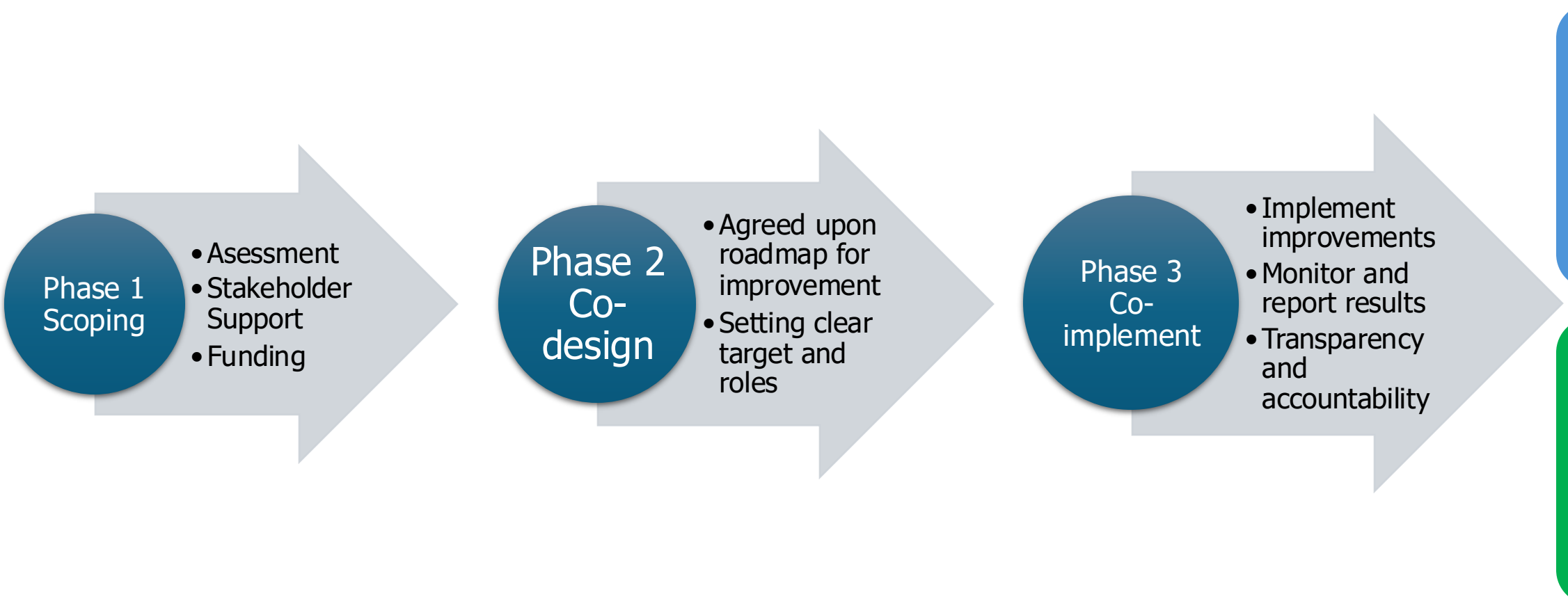


JURISDICTIONAL INITIATIVE

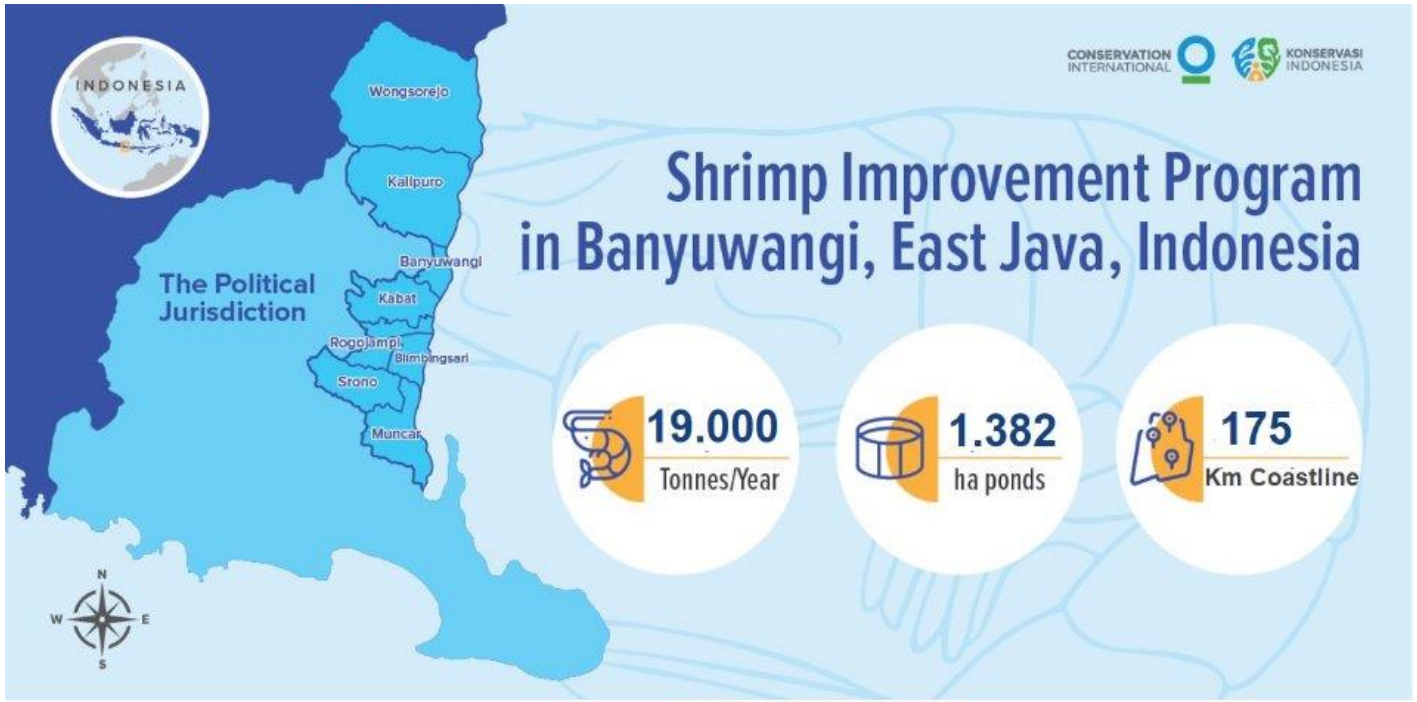


- **Place-based approach** to conservation and sustainable development.
- **Aligns policy and market incentives** to secure durable outcomes.
- Guided by **multi-stakeholder bodies** that set targets, define actions, and report on progress.
- **Achieves social, economic, and environmental objectives** through stakeholder participation and government engagement.

Process for Executing a Jurisdictional Initiative



Shrimp Improvement Program – Banyuwangi, Indonesia



Enabling conditions:

- Strong stakeholders supports
- Community inclusion
- Ecological significance

Multi Stakeholders:

- Farmers group and association
- Supply chain companies
- National and local government
- Finance and innovation
- University and research Institution

Beneficiaries:

166 famers

6 villages

SIP Roadmap

Including several activities such as:

- ❑ **Roadmap coordination and Taskforce establishment**
- ❑ Wastewater management and reporting
- ❑ Water quality monitoring
- ❑ Coordinated disease monitoring
- ❑ Improving access to finance and market
- ❑ Farm certification and business license assistance
- ❑ **Support for farmers organization and cooperatives**
- ❑ **Knowledge exchange program**
- ❑ Scoping and expand JI to another region
- ❑ Other activities based on stakeholders' input

Convened a task force for local leadership

Established the first shrimp farmer cooperative

Knowledge exchange program

Farm certification assistance

Roadmap Coordination and Taskforce Establishment

- Previously, many **stakeholders operated in isolation**, focusing on their individual goals and priorities.
- Establish Taskforce **comprises various stakeholders**, including the local government, farmer representatives, cooperatives, and the private sector **for coordination mechanism** and **bring everyone** together **under one roadmap.**
- Building trust among **stakeholders has not been easy;** it takes time, but it is crucial.
- Taskforce will become a legal entity that **adopt SIP Roadmap** for Improvement **into agency objectives** with measurable reporting requirements (KPI's).

"The SIP assists the government in developing traditional shrimp farmers in capacity building and group strengthening. Through this program, we hope that stakeholders will not only consider about shrimp production increase but also maintain the environment and ecosystem for sustainability."

Banyuwangi Regency Fisheries Agency

Assistance and Development of Shrimp Farmer Cooperative

- Previously, farmers operated individually, facing challenges in accessing quality inputs, financing, and markets.
- Through the SIP initiative, these cooperatives focus on empowering and strengthen capacity of small-scale farmers.

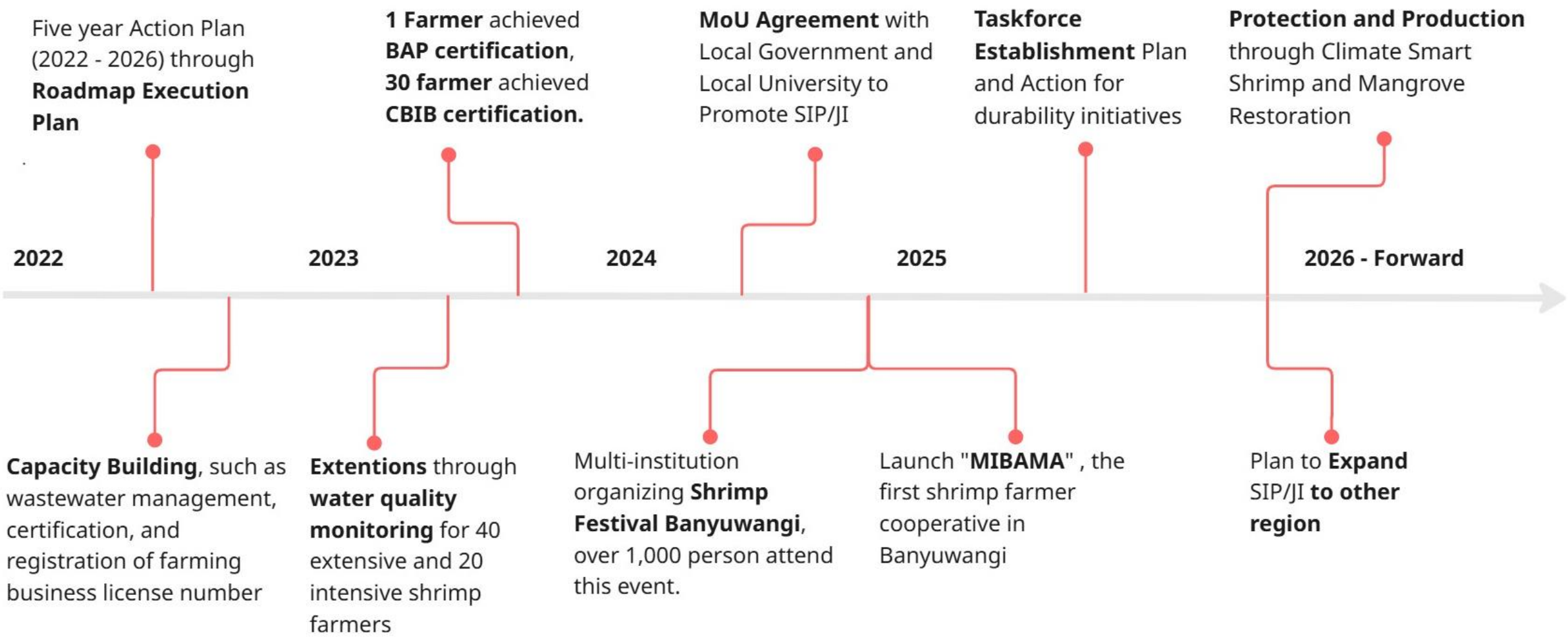
OUTPUTS

1. Established the first shrimp farmer cooperative in Banyuwangi.
2. Organized trainings and workshops for capacity building in financial literacy, organizational structure, and study tour.
3. Preferential payment terms of feed, better feed quality with payment schedules that match their production cycles (i.e., 60 days credit).

Knowledge Exchange Program
(Banyuwangi Shrimp Festival)

- The first event **focused exclusively on shrimp** and **aimed to improve the local market** and introducing nature-based solution.
- It was **attended by over 1,000 people** including invited guests, students, shrimp farmers groups – cooperatives, and Banyuwangi residents.
- The festival **become a symbol of collaboration and local branding effort** for sustainable shrimp aquaculture in Banyuwangi.
- This year, the Shrimp Festival continues. We hope this **initiative will not be a one-time event** and **become a lasting legacy** for the community.

SIP Implementation: Process and Timeline



Comparison of SIP with Other Jurisdictional Initiatives

	Shrimp Improvement Program	Sabah RSPO Jurisdictional Initiatives	South Sumatra Green Growth Plan	Mato Grosso Jurisdictional Initiative
Commodities	Shrimp	Palm oil	Palm oil	Cattle, soy, and other terrestrial commodities
Location	Banyuwangi District, Indonesia	Sabah State, Malaysia	South Sumatra Province, Indonesia	Mato Grosso State, Brazil
Implementation	2022–2026 (with potential for extension and scaling)	2015–2025*	2015–2025*	2016–2030*
Lessons learned	Strong government leadership, multi-stakeholder collaboration, and inclusive participation are key enablers	Clear mandates, blended financing, and transparent monitoring build credibility and effectiveness	Economic and environmental incentives must be balanced, with smallholder participation remaining essential	Embedding commitments into formal policies reduces vulnerability and long-term financing ensures continuity
Relevance to SIP	-	Shows how formal provincial/ national government **support**, **financing**, and **monitoring** can support SIP's credibility	Underscores how **incentive alignment accelerates** adoption of sustainable practices by the shrimp farmers	Highlights the value of **embedding commitments into policy and securing sustainable financing** for SIP continuity

Next Phase

Regency Level

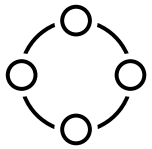
2 Scoping SIP/JI to other regions

1 Climate Smart Shrimp Aquaculture Pilot & Mangrove Restoration in Banyuwangi

Farm Level

Conclusion

The Shrimp Improvement Program in Banyuwangi shows that a jurisdictional initiatives is **a practical and inclusive** model **for advancing sustainable aquaculture** — ensuring that **no stakeholder is left behind**.



While facing many challenges, **SIP** uniquely **adapts the approach** to aquaculture-specific risks, **offering** a **valuable blueprint for replicable model** in other regions in Indonesia.

Looking ahead, the program seeks to **further strengthen institutional co-management** and **incorporate nature-based solutions**, thereby **promoting a more productive, responsible, and resilient aquaculture sector** in Indonesia.

Partners in Banyuwangi Shrimp Development

IDRC · CRDI
International Development Research Centre
Centre de recherches pour le développement international

In partnership with Canada

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KI Contribution Series **004**

Stakeholder and Policy Analysis on Shrimp Aquaculture, Mangrove, Gender Equity, Social Inclusiveness, and Nature-based Solutions in Banyuwangi

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AQUADAPT

Program Introduction

Aquaculture Adaptation to Climate Change (AQUADAPT) is a four-year partnership (2023–2027) jointly funded by International Development Research Centre (IDRC) and the Government of Canada. It aims to address the interconnected challenges of climate change, biodiversity loss, and food insecurity through applied research on nature-based solutions in aquaculture, with a focus on inclusivity for all genders and marginalized groups in Southeast Asia and the Pacific. This CAD 24 million initiative supports a diverse portfolio of 11 applied, collaborative, and results-driven research projects across Cambodia, Fiji, Indonesia, Kiribati, Malaysia, the Philippines, Thailand, Samoa, the Solomon Islands, and Vietnam.

AQUADAPT-Indonesia supports the Indonesian government's efforts to strengthen the blue economy and promote the sustainable development of marine and fisheries sectors. This initiative is led by a consortium consisting of the World Resources Institute Indonesia, Konservasi Indonesia, and Universitas Padjadjaran. The consortium launched the Climate Smart Shrimp Aquaculture project, integrating mangrove restoration and the sustainable intensification of existing aquaculture to enhance the environmental sustainability of shrimp farming. This approach delivers positive impacts on ecosystems, the economy, and social equity.

AQUADAPT Indonesia Consortium Members

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LIST OF ACRONYMS

BAPPEDA	Regional Development Planning Agency or *Badan Perencanaan Pembangunan Daerah*
BAPPENAS	National Development Planning Agency or *Badan Perencanaan Pembangunan* Nasional
BRGM	Peatland and Mangrove Restoration Agency or *Badan Restorasi Gambut Mangrove*
BRIN	National Research and Innovation Agency or *Badan Riset dan Inovasi Nasional*
CBIB	Good Aquaculture Practices or *Cara Budidaya Ikan yang Baik*
CDK	Forestry Service Branch Agency or *Cabang Dinas Kehutanan*
CPIB	Good Hatchery Practices or *Cara Pembenihan Ikan yang Baik*
CSO	Civil Society Organization
CSSA	Climate Smart Shrimp Aquaculture
DLH	Environment Agency or *Dinas Lingkungan Hidup*
FGD	Focus Group Discussion
GESI	GEDSI (Gender Equality, Disability, and Social Inclusion)
GOI	Government of Indonesia
IoT	Internet of Things
KII	Key Informant Interview
KI	Konservasi Indonesia
KKP	Ministry of Marine Affairs and Fisheries or *Kementerian Kelautan dan Perikanan*
KLHK	Ministry of Environment and Forestry or *Kementerian Lingkungan Hidup dan Kehutanan*
KTH	Shrimp Cooperatives in Banyuwangi or *Kelompok Tani Hutan*
KUB	Shrimp Cooperatives in Banyuwangi or *Kelompok Usaha Bersama*
MIBAMA	Shrimp Cooperatives in Banyuwangi or *Mina Bangkit Bersama*
MMAF	Ministry of Marine Affairs and Fisheries
NbS	Nature-based Solution
NGO	Non-governmental Organization
SCI	Shrimp Club Indonesia
WWTP	Wastewater Treatment Plant

FOREWORD

Shrimp is one of Indonesia's export commodities currently intensively promoted by the nation-al gov-ernment, particularly through large-scale shrimp industry development. The government also prioritiz-es the revitalization of small-scale or traditional shrimp farming and reuses aban-doned ponds by culti-vating non-shrimp species and polyculture.

Konservasi Indonesia (KI) has been working with the government and other partners to initiate Climate Smart Shrimp Aquaculture (CSSA) for the last four years. The CSSA approach is a method of stabilizing shrimp ponds and mangrove ecosystems by maintaining a proper percentage of mangroves within and surrounding the ponds. The CSSA has been applied in Lalombi, Central Sulawesi Province, and is now being introduced in Banyuwangi Regency, East Java Province.

This is the report of the study to determine the possibility of implementing the CSSA in Banyu-wangi. KI has previously completed a jurisdictional analysis of the Banyuwangi shrimp industry and found that Banyuwangi has great potential for shrimp industry development. That study was followed by a trial introduction of the CSSA approach at the farm level.

This study was supported by World Resources Institute (WRI) Indonesia, Universitas Padjajaran (UNPAD), and Universitas Tujuh Belas Agustus (UNTAG). It is a part of a continuous process to identify and develop nature-based solutions in aquaculture, and AQUADAPT project's vision is sponsored by the IDRC Canada and executed in Indonesia by a consortium including KI, WRI, and UNPAD. Importantly, the study arrived at an important conclusion that there are various shrimp farming stakeholders in Banyuwangi whose voices should be heard.

With the completion of this report, we would like to offer our deepest gratitude to all part-ners, particularly to the various agencies under the government of Banyuwangi. We hope that the findings of the study can guide us to advance and chart a concrete, sustainable and thriving shrimp industry in Banyuwangi.

Jakarta, 26 February 2025

Meizani Irmadhiany
Konservasi Indonesia
Chairperson and Vice President

CONTENTS

TABLE

FIGURE

EXECUTIVE SUMMARY

Climate Smart Shrimp Aquaculture (CSSA) is a novel model that integrates mangrove restoration and pond infrastructure for a sustainable shrimp farming practice. For a CSSA implementation in Banyuwangi, this study focuses on three key aspects: stakeholder analysis, policy analysis, and Nature-based Solutions (NbS). The overarching objective of this stakeholder and policy analysis is to comprehensively map, assess, and analyze key stakeholders involved in the CSSA, with a specific focus on shrimp farming and mangrove restoration initiatives.

This study adopts a qualitative research approach to explore stakeholder dynamics, policy frameworks, Gender Equity and Social Inclusion (GESI) within CSSA, shrimp farming, and mangrove restoration initiatives. Qualitative methods are suitable for capturing the nuanced perspectives, relationships, and governance challenges associated with these complex issues. The study used three primary methods: literature review, Key Informant Interviews (KII), and a focus group discussion (FGD). The literature review provides a comprehensive understanding of the interconnected dimensions of the CSSA while identifying opportunities for policy alignment and stakeholder engagement. The KIIs were conducted to capture local insights, identify challenges, and gather recommendations to ensure effective CSSA integration. KIIs were conducted through interviews with approximately 20 actors from district government, provincial government, and local community (shrimp farmers, mangroves group, women's group). Lastly, the FGD was conducted to share stakeholders' perspectives, experiences, and challenges while fostering dialogue on collaborative solutions for sustainable aquaculture development. More than 50 actors joined this FGD, representing: government, private sector, NGO, community leaders, and marginalized groups, particularly women. By integrating stakeholder and policy analysis with NbS evaluation, the study provides a comprehensive understanding of the enabling conditions and challenges in implementing CSSA.

A comprehensive stakeholder map has been created, highlighting the influence and interest of each stakeholder in two study villages: Karangrejo and Wringinputih, as well as at the district level. Based on the stakeholder map, an engagement plan was developed. The existing regulations on aquaculture, mangroves, and GESI have been garnered and analyzed. Best practices and scientific findings from CSSA implementation were used to construct evidence-based policies and to improve current regulations.

In Banyuwangi, shrimp farmers encounter various technical challenges. Insights from interviews and FGDs reveal that these farmers have implemented both non-nature-based and nature-based solutions to address these challenges. This result highlights the need for increased efforts to support farmers transitioning from unsustainable practices to a wider adoption of nature-based solutions.

Principal Conclusions and Recommendations

- The stakeholder analysis for the Climate Smart Shrimp Aquaculture (CSSA) program reveals a diverse range of actors whose roles and levels of engagement are critical to achieving sustainable aquaculture and mangrove restoration objectives. Key stakeholders in the High-influence, High-Interest category, such as shrimp farmer groups, mangrove conservation groups, village heads, and local agencies, are integral to the program's

success. These actors are expected to be actively involved in planning, implementing, and monitoring activities, making them central to driving sustainable practices and ensuring program alignment with community and environmental needs. Their deep involvement is supported through regular discussions, capacity-building sessions, and collaborative decision-making processes.

- Stakeholders in the High-Influence, Low-Interest category, including women's groups and district army representatives (Babinsa), possess significant power to influence program outcomes but display limited direct engagement. Efforts to enhance their interest involve targeted communication strategies that emphasize the program's benefits and tailored training sessions to highlight their potential roles in promoting social inclusion, community coordination, and livelihood diversification.
- Meanwhile, stakeholders in the Low-Influence, High-Interest category, such as ecotourism managers, non-targeted mangrove groups, and educational institutions, demonstrate a strong motivation to support the program despite their limited decision-making authority. Their contributions will be encouraged through regular updates, capacity-building initiatives, and inclusion in program-related activities.
- Currently, some regulations at the national and provincial levels have guaranteed a sustainable aquaculture paradigm, yet no technical regulation can support climate resilience. The CSSA program can provide examples of evidence-based regulations, such as pilot plans of communal Wastewater Treatment Plants (WWTP) that support shrimp ponds in the same location.
- Detailed mangrove restoration programs need to be manifested at the Banyuwangi level by strengthening mangrove restoration regulations. The CSSA program can provide periodic mangrove monitoring data feedback to implement NbS.
- Directives for Gender Equality, Disability, and Social Inclusion (GEDSI) policies have been recognized in several regulations at the national level. Policy strengthening should be programmed at the provincial and district level by providing concrete examples of how marginalized people and women are involved and impacted by environmentally friendly shrimp farming programs. The CSSA program can illustrate how marginalized people and women are involved in the initiation, implementation, and program evaluation stages.
- There are no specific regulations stipulating the integration of mangrove and shrimp aquaculture in the context of climate resilience. Scientific findings and best practices with the community from CSSA implementation are required to improve current aquaculture regulations that will lead to nature-based solutions and climate resilience regulations.
- Banyuwangi shrimp farmers face technical challenges such as land management, water supply, post-larvae sourcing, feed optimization, disease control, pest management, and water quality. NbS such as mangrove planting, has been implemented to combat coastal erosion, while eco-friendly additives like phytobiotics and vitamins have been used to enhance shrimp disease resistance. While most farmers avoid harmful chemicals, and control pests and disease by applying eco-friendly methods like saponin and phytobiotics, some still rely on synthetic pesticides and antibiotics.
- The fact that the farmers are not implementing NbS highlights the need for increased efforts to support farmers transitioning from unsustainable practices to the wider adoption of the NbS practices.

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01
BACKGROUND

Shrimp aquaculture has been a significant driver of mangrove deforestation, with up to 50% of mangroves globally lost due to land conversion for shrimp farming (Valiela *et al*., 2001). Between 2009 and 2019 alone, aquaculture pond expansion in Indonesia contributed to 36% of total mangrove deforestation, covering approximately 80,696 hectares (Arifanti *et al*., 2021). The mangrove degradation not only threatens biodiversity but also increases the vulnerability of coastal communities to extreme weather events and exposure to harmful farm effluents. Mangroves could store up to five times more carbon than tropical upland forests, making their loss a major contributor to climate change (Donato *et al*., 2011; Chatting et. Al, 2022). Additionally, mangrove ecosystems act as nurseries for marine life, supporting numerous species of larger fish, a habitat for smaller fish, crabs, shrimp, and mollusks, and also serves as a nesting ground for birds. Their destruction disrupts fragile ecosystems and diminishes fish stocks that coastal communities rely on for food and livelihoods (Nagelkerken *et al*., 2008).

As the second-largest producer of-farmed shrimp (after China), Indonesia faces ongoing challenges in balancing environmental sustainability, equitable livelihoods, and climate change resilience (Napitupulu *et al*., 2022). In response, the AQUADAPT Indonesia consortium seeks to implement Climate Smart Shrimp Aquaculture (CSSA)—a nature-based climate solution designed to integrate mangrove restoration and water treatment infrastructure with sustainable shrimp farming practices. CSSA is a novel model that incentivizes mangrove restoration while increasing shrimp production. The CSSA aims to reduce environmental pressures and is expected to contribute to reducing land and mangrove ecosystem conversion for shrimp aquaculture, improving shrimp farm productivity, enhancing the welfare of small-scale farmers in coastal areas, and restoring blue carbon ecosystems to promote climate resiliency. To prepare for CSSA implementation, this study focuses on three key aspects: stakeholder analysis, policy analysis, and the adoption of Nature-based Solutions (NbS) in shrimp aquaculture.

Effective environmental management requires collaboration among diverse stakeholders whose roles and interests intersect in shrimp aquaculture and mangrove ecosystems. Stakeholder analysis is essential to identify key actors, map power dynamics, and understand relationships to foster cooperation and address challenges (Bryson, 2004; Adil *et al*., 2022). Research methods such as in-depth interviews, focus group discussions (FGDs), and respondent surveys are employed to gain a holistic understanding of stakeholder perspectives (Varvasovszky & Brugha, 2000; Reed *et al*., 2009). In this study, we conducted FGDs and interviews at village and district levels to identify synergies, challenges, and opportunities for more inclusive and sustainable shrimp aquaculture.

Mangrove degradation resulting from unsustainable shrimp aquaculture often stems from weak regulatory frameworks and enforcement (Ilman *et al*., 2016; Do & Thuy, 2022). Therefore, policy analysis focuses on evaluating the existing regulatory landscape surrounding sustainable shrimp farming, mangrove restoration, and Gender Equality, Disability, and Social Inclusion (GEDSI). By reviewing national and local government documents, gaps and opportunities for effective policies are identified to promote environmentally responsible and socially inclusive shrimp farming practices (FAO, 2010).

NbS offers an innovative approach to balancing environmental sustainability and aquaculture productivity. Techniques such as mangrove restoration and biofiltration systems harness natural processes to improve water quality, manage effluents, and enhance farm resilience against climate change (Goto *et al*., 2023). Additionally, NbS contributes to long-term economic benefits by reducing operational costs and opening access to premium, eco-friendly markets (Phong *et al*., 2022). This study examines the effectiveness of NbS, the challenges in adoption, and potential scalability as a solution for sustainable shrimp aquaculture.

By integrating stakeholder and policy analysis with NbS evaluation, this study provides a comprehensive understanding of the enabling conditions and challenges in implementing CSSA. The findings will serve as a foundation for advocacy and pilot projects to promote sustainable, inclusive, and climate-resilient shrimp farming in Indonesia's coastal areas as intended by the consortium.

1.1. Objectives

The overarching objective of this stakeholder and policy analysis is to comprehensively map, assess, and analyze key stakeholders involved in the CSSA, with a specific focus on shrimp farming and mangrove restoration initiatives. The specific objectives are to:

1. Identify roles, interests, and influence of the stakeholders across government, private sector, civil society, and local communities in supporting CSSA initiatives.
2. Evaluate policy frameworks that enable or hinder sustainable aquaculture practices, particularly those aligned with NbS to promote environmental conservation and resilience.
3. Integrate social inclusion, gender equality, and farmer empowerment perspectives, highlighting the involvement and impact of marginalized groups, including women and smallholder shrimp farmers.
4. Provide actionable recommendations to foster collaborative stakeholder engagement and strengthen policies that support sustainable shrimp farming and mangrove restoration for long-term ecosystem sustainability.
5. Identify the extent to which the NbS approach has been implemented.

1.2. Research Questions

The following are the umbrella research questions used in this assessment:

1. How do stakeholder dynamics, including roles, interests, and power relations, influence the development and implementation of the CSSA initiatives, particularly in shrimp farming and mangrove restoration?
2. What are the strengths, gaps, and opportunities in the current policy frameworks and governance structures to promote sustainable aquaculture, ecosystem restoration, and inclusive economic empowerment?
3. What challenges do shrimp farmers in Banyuwangi face in the technical aspects of their farming, and what NbS and non-NbS have been implemented to address these challenges?

1.3. Deliverables

Stakeholder Mapping and Analysis Report

- A detailed map of stakeholders involved in shrimp farming, mangrove restoration, and the CSSA.
- Stakeholder power-interest matrix identifying their roles, influence, and relationships.
- Analysis of stakeholder engagement strategies, including social inclusion, gender equality, and farmer empowerment.
- Recommendations for enhancing collaboration and stakeholder involvement.

Policy and Regulatory Review Report

- Analysis of relevant policies, regulations, and governance frameworks supporting the CSSA, shrimp farming, and mangrove restoration.
- Identification of policy gaps, challenges, and opportunities for alignment with NbS.
- Assessment of how policies promote social inclusion, gender equality, and community empowerment.
- Policy recommendations to support sustainable aquaculture and ecosystem conservation.

NbS Assessment Report

- A comprehensive list of aspects/topics in shrimp farming identified as problematic by farmers.
- Detailed information on the challenges faced by shrimp farmers.
- An overview of NbS and non-NbS implemented by shrimp farmers.
- An analysis of the potential impact of the solutions implemented on shrimp farming operations.

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02
METHODOLOGY

This study adopts a qualitative research approach to explore stakeholder dynamics, policy frameworks, and social inclusion within CSSA, shrimp farming, and mangrove restoration initiatives. Qualitative methods are suitable for capturing the nuanced perspectives, relationships, and governance challenges associated with these complex issues. The study used two primary methods: literature review and focus group discussions (FGDs) catered to meet the study's objectives.

Table 2.1. Data collection methods and analysis

Activities	Variable	Respondent/ Data Source	Data Collection Methods	Data Analysis
Stakeholder Analysis	Stakeholder roles: Stakeholder sectors (government, private, NGO, community)	Government officials, private sector, NGOs, smallholder farmers	FGDs, literature review	Identification of all relevant stakeholders and categorization by sector and role.
	Interests of stakeholders: • Motivation and engagement • Perceived benefits and challenges	Government officials, farmers, fisherfolk, women's groups	FGDs	Thematic analysis
	Power and Influence: Stakeholder power • Influence levels • Power dynamics between stakeholders	Government officials, farmers, private sector	FGDs, literature review	Power interest matrix
	Stakeholder Engagement Plan: • Engagement strategies • Inclusion of marginalized groups • Collaboration strategies	Insights from FGDs	FGDs and literature review	Design of engagement strategies to ensure inclusion and collaboration, especially focusing on women and marginalized farmers.
Policy Analysis	Regulation Identification: Mapping Out Existing Policy/ Regulation	Policy documents, national and provincial government regulations	Policy review	Policy extraction and identification relevant to CSSA, including national, provincial, and local levels.

Activities	Variable	Respondent/ Data Source	Data Collection Methods	Data Analysis
Policy Analysis	Gaps Identification	Policy documents	Policy review	Comparison between ideal and existing policies, identifying gaps, challenges, and needs for reform.
	Policy Recommendation: • Actions to address policy gaps • Suggested reforms	Policy Documents Insights from FGDs	Policy Review, Insights from FGDs	Creation of an actionable policy recommendation plan
Nature-based Solution Assessment	Identification of challenges: Technical aspects discussed • Land management, water supply, post-larvae, seed, diseases, pests, water quality management, harvest, and labor	Smallholder shrimp farmers	In-depth interview and FGDs	Content analysis based on farmer responses
	Classification of Implemented solutions: • Implemented nature-based solutions • Implemented non-nature-based solutions	Smallholder shrimp farmers	In-depth interview, FGDs, literature review	Content analysis and compare farmer-reported solutions with evidence-based practices found in the literature
	Assessment of potential impact of the implemented solutions: • Impact on farm production • Impact on coastal environment	Smallholder shrimp farmers	In-depth interview, FGDs, literature review	Integrate farmer-reported impacts with insights from literature to identify alignment or gaps

Literature Review

The literature review lays the groundwork for the stakeholder and policy analysis. It provides a comprehensive understanding of the interconnected dimensions of CSSA—environmental sustainability, economic viability, and social equity—while identifying opportunities for policy alignment and stakeholder engagement. This data collection draws upon academic research, policy documents, and reports from civil society and international organizations to identify key trends, challenges, and best practices. It offers insights into the principles of CSSA, the application of nature-based solutions (NbS), and the importance of integrating social inclusion, gender equality, and farmer empowerment into sustainable aquaculture practices.

Key Informant Interview (KII)

A KII was conducted to map out key issues in the CSSA implementation. These interviews are expected to provide valuable insights into the dynamics of local governance, community engagement, and environmental management. Key Informant Interviews (KII) were conducted to explore critical issues surrounding the implementation of CSSA. These interviews engaged key stakeholders from two primary locations—Karangrejo and Wringinputih Village— and representatives from district-level government institutions and Geopark Ijen. The KII aims to capture local insights, identify challenges, and gather recommendations on effective CSSA integration.

Focus Group Discussions (FGDs)

The FGDs provided primary qualitative data, offering valuable insights from key stakeholders involved in aquaculture, shrimp farming, and mangrove restoration. This method allows participants to share their perspectives, experiences, and challenges while fostering dialogue on collaborative solutions for sustainable aquaculture development.

The FGDs engaged representatives from a wide range of stakeholder groups, including:

- Government officials at the district level are responsible for aquaculture, environmental conservation, and coastal management.
- Private sector actors from shrimp farming association and aquaculture industries.
- Civil society organizations, NGOs, and community leaders involved in ecosystem restoration efforts.
- Smallholder farmers, fisherfolk, and marginalized group representatives, including women's organizations.

2.1. Sampling and Respondents

The study employed a purposive sampling approach to select respondents directly involved in the CSSA, shrimp farming, and mangrove restoration initiatives. The purposive sampling is appropriate for qualitative research as it ensures that participants with specific knowledge, roles, and experiences relevant to the study's focus are included. The selection criteria emphasize diversity among stakeholders, such as representatives from local communities, government, aquaculture cooperatives/practitioners, and environmental institutions.

2.2. Sampling criteria

The criteria of the respondents are as follows:

1. Direct involvement in shrimp aquaculture, mangrove restoration, or CSSA initiatives.
2. Key roles in governance at village, subdistrict, or institutional levels.
3. Cooperatives, farmer groups, and shrimp clubs (associations) directly and indirectly participate in government programs.
4. Representation of both men and women from the local community to ensure social inclusion.
5. Stakeholder diversity, including community leaders, aquaculture practitioners, environmental institutions, and government agencies.

2.3. Data Analysis

The data collected from the literature review and focus group discussions (FGDs) were analyzed in alignment with the study's objectives to provide a robust understanding of stakeholder dynamics, policy frameworks, and gaps within CSSA practices. The analysis focused on stakeholder interests, power relations, and engagement strategies, as well as policy gaps related to sustainable shrimp aquaculture, mangrove restoration, and social inclusion, with specific attention to gender equity and NbS.

1. Steps of the Stakeholder Analysis

The stakeholder analysis followed three steps to map stakeholder roles, interests, and power relations, and to develop actionable engagement strategies.

Step 1: Stakeholder Identification

Data from FGDs were used to identify all relevant stakeholders involved in CSSA, shrimp aquaculture, and mangrove restoration. These stakeholders included government agencies, private sector actors, smallholder farmers, NGOs, and women's organizations. Each stakeholder's role, level of influence, and interest in CSSA were noted.

Step 2: Stakeholder Analysis

This step involves analyzing qualitative data from FGDs to uncover the interests and motivations of different stakeholders, as well as the power dynamics between them. Stakeholders are positioned on a power-interest

matrix to be categorized based on their influence and level of engagement. This mapping helped to understand potential collaboration opportunities and conflicts between stakeholders, with a focus on how smallholder farmers and marginalized groups, including women, are positioned within these dynamics.

The analysis explores the intersection between stakeholders' actions and NbS principles, climate resilience strategies, and gender inclusion to identify gaps in existing practices. Specific attention is be given to the barriers smallholder farmers and women face in accessing aquaculture opportunities and ecosystem restoration initiatives.

Step 3: Stakeholder Engagement Plan Development

Based on the stakeholder analysis, an engagement plan is developed to enhance collaboration between stakeholders. The plan includes tailored strategies to increase the involvement of marginalized groups, promote farmer empowerment, and ensure equitable participation in aquaculture development and environmental restoration.

2. Policy Analysis and Recommendations

The policy analysis assessed the existing regulatory framework for sustainable shrimp aquaculture, mangrove restoration, and social inclusion across national, provincial, and regional levels. The goal is to identify policy gaps and provide recommendations for improving governance and promoting CSSA practices.

Step 1: Policy Identification

Policies and regulations relevant to shrimp aquaculture, mangrove restoration, social inclusion, and gender equity are identified through the literature review. These includes:

1. National and local aquaculture development policies.
2. Mangrove protection and restoration frameworks.
3. Policies promoting Gender Equality, Disability, and Social Inclusion (GEDSI) in environmental projects.
4. The identified policies are analyzed to determine how they align with CSSA principles, focusing on climate resilience, gender-responsive governance, and nature-based solutions.

Step 2: Policy Analysis

The analysis compares the ideal conditions for CSSA and Gender Equality, Disability, and Social Inclusion (GEDSI)implementation with the current policy and regulatory landscape in Indonesia. This involves:

1. Identifying details of policies that support or hinder sustainable shrimp aquaculture and mangrove restoration.
2. Evaluating the extent to which current policies address gender equality, social inclusion, and smallholder farmer empowerment.

Step 3: Policy Recommendation Plan

Based on the gap analysis, the study develops a policy recommendation plan that provides actionable steps for policymakers. The plan is to:

1. Improve policies to align aquaculture and mangrove restoration with NbS principles and GESI goals.
2. Assess the integration of NbS principles and climate resilience strategies into aquaculture policies.
3. Highlight policy gaps, challenges, and opportunities and identify areas where legal or regulatory reform may be necessary to promote sustainable, inclusive practices.
4. Recommend strategies to improve coordination between national, provincial, and local governments.

A summary of the data analysis is given in Table 2.2.

Table 2.2. Data analysis strategy

Activities	Step
Stakeholder Analysis	**Step 1: Stakeholder Identification** **Step 2: Stakeholder Analysis:** • Exploring Stakeholder Interest • Mapping Stakeholder Influence/Power Relation Dynamics **Step 3: Stakeholder Engagement Plan Development**
Policy Analysis	**Step 1: Regulation identification:** • Shrimp Aquaculture • Mangrove • Gender Equity and Social Inclusion **Step 2: Policy Analysis:** • What are existing policies and regulations on sustainable shrimp aquaculture (National/Provincial/ Region)? • Determining policy gap (what can be done to address policy gap, policy and legal reform required or not?) • What is the Ideal condition of CSSA/ GESI implementation? **Step 3: Policy Recommendation Plan**
NbS Assessment	**Step 1: Challenges identification** • Identifying challenges through discussing several technical aspects **Step 2: Implemented solutions classification** • Nature-based solutions • Non-nature-based solutions **Step 3: Potential impact assessment** • Impact NbS on farm production • Impact NbS on the coastal environment

2.4. Timeline

This study is undertaken in Banyuwangi, East Java Province, Indonesia between July–December 2024. Activity and its timeline are shown in Table 2.3.

Table 2.3. Research activity and timeline

Step	Activity	Time
1	Data Collection and Literature Review for Stakeholder and Policy Identification	July–November 2024
2	Stakeholder and Policy Analysis	November 2024
3	Final Report for Stakeholder and Policy Mapping	December 2024
4	Internal Consultative Workshop	December 2024

2.5. Risk and Mitigation

This study maps the risks and their mitigation strategies, as follows:

1. Low Participation from Key Stakeholders

Limited involvement from key stakeholders—such as government officials, cooperative leaders, or environmental organizations—can hinder the quality of insights gathered during FGDs. This may result from stakeholder fatigue, competing priorities, or lack of clarity about the study's relevance.

Mitigation:

The project conducts early stakeholder engagement and targeted outreach, emphasizing the relevance of the study to policy development, sustainable aquaculture, and governance improvements. Trusted local actors, such as Karangrejo and Wringinputih Village Head, and representatives from Geopark Ijen and farmer cooperatives (MIBAMA, KUB Mina Sero), help promote the importance of participation. The project also offers flexible scheduling for FGDs to accommodate stakeholders' other commitments. Clear communication about the study's goals ensures that participants understand how their input contributes to improving regional policies and governance frameworks.

2. Governance and Stakeholder Coordination Issues

Challenges in aligning diverse stakeholder interests, such as those of local governments, cooperatives, and NGOs, may result in miscommunication or slow down decision-making processes. Conflicting priorities or differing perspectives on aquaculture governance or mangrove conservation could create tension among stakeholders.

Mitigation:

The project adopts a collaborative governance model, ensuring open communication and inclusive discussions. Multi-stakeholder meetings are held to align interests and foster cooperation across government bodies, environmental organizations, and community groups. Village heads and cooperative leaders facilitate communication at the community level, ensuring alignment between grassroots and institutional stakeholders. Where needed, a neutral facilitator is engaged to mediate discussions and resolve emerging conflicts.

3. Limited Integration of Gender and Social Inclusion Perspectives

There is a risk that Gender Equality, Disability, and Social Inclusion (GEDSI) aspects may not be adequately addressed during stakeholder analysis or policy discussions, which could limit the development of inclusive recommendations. Marginalized voices, particularly women and smallholder farmers, might be underrepresented in discussions.

Mitigation:

The project embeds gender-transformative approaches into the stakeholder analysis, ensuring that FGDs provide safe spaces for diverse voices. Specific outreach efforts target women's organizations and community groups to ensure balanced representation. Leaders from cooperatives (such as KUB Mina Sero and MIBAMA) play a role in encouraging marginalized groups to participate. Findings are analyzed with a gender and social inclusion lens, ensuring that policy recommendations address barriers faced by vulnerable groups.

4. Environmental and Contextual Challenges Affecting Policy Relevance

Changes in environmental conditions or national priorities (e.g., shifting policy focus or economic disruptions) may affect the relevance of the study's findings and recommendations for CSSA, shrimp farming, or mangrove restoration policies.

Mitigation:

The study maintains flexibility in its analysis framework, ensuring that findings remain adaptable to changing environmental or policy conditions. Ongoing consultations with stakeholders, such as government agencies and environmental institutions like Geopark Ijen, help track emerging trends and policy shifts. This allows the project to adjust its focus and recommendations to ensure they remain relevant and actionable in the evolving context.

2.6. Research Limitation

The study acknowledges several limitations that may impact the scope and outcomes of the research. These limitations include time restrictions, and human resources, each of which presents challenges to the data collection process and overall project execution.

1. Time Restrictions

   The research must be completed within a limited timeframe, which poses challenges in coordinating fieldwork schedules among the stakeholders.

2. Limited Human Resources
   The research primarily depends on the availability of internally trained personnel to conduct the FGDs. Although these individuals possess the necessary specialized skills, their involvement is challenged by competing responsibilities within the organization.

03
FINDINGS AND DISCUSSION

3.1. Stakeholders Analysis

Stakeholder analysis is a crucial stage in implementing environment-based activities in an interconnected world. This is because the issue of natural resource management, especially ponds and mangrove areas, can affect many individuals, groups, organizations, and institutions. The presence of stakeholders is key to partial role-sharing in CSSA activities. Therefore, understanding the background and needs, and getting solutions to the problems faced by the stakeholders requires good relationship management and engagement with the stakeholders involved (Bryson, 2004).

Stakeholder analysis involves three main interconnected steps, namely: 1) Identification of stakeholders relevant to the program; 2) Mapping and classification of stakeholders based on their level of influence and interest in the program; and 3) Analysis of relationships between stakeholders to identify patterns of cooperation, potential conflicts, and opportunities for synergies that can be developed (Bryson, 2004; Adil *et al*, 2022). The data used for this mapping process was obtained through various methods, including in-depth interviews, questionnaires distributed to relevant parties, focus group discussions (FGDs), informal discussions in small groups, or a combination of several methods to ensure the breadth and depth of the data obtained (Varvasovszky & Brugha, 2000; Reed *et al*., 2009).

In this research, we organized FGDs involving stakeholders from various levels, from Karangrejo Village and Wringinputih Village to the Banyuwangi Regency level. The analysis process was enriched with in-depth interviews with farmers, village government, mangrove and pond group representatives, and local tourism actors to ensure a holistic perspective. This multifaceted approach was designed to identify needs, challenges, opportunities for collaboration and potential synergies between stakeholders to support more inclusive, adaptive, and sustainable farm management (Adil *et al*., 2022).

In determining the interest and influence of stakeholder positions, a scoring method was used with aspects described in Table 3.1., in accordance with the research of Adil *et al*. (2022) was used and modified according to the context of stakeholder mapping for the CSSA program in Banyuwangi.

Table 3.1. Interest and Influence Scores and Criteria for Stakeholders

Aspect		Score	Criteria
Interest	Stakeholder engagement • Planning • Procurement • Implementation • Monitoring/evaluation	5	Involved in every step of program development
		4	Involved in 3 steps of program development
		3	Involved in 2 steps of program development
		2	Involved in 3 steps of program development
		1	Have not involved in program development
	Benefits of program development for stakeholders • Source of livelihood/Compatibility with agency programs • Value chain enhancement • Economic improvement • Maintaining environmental sustainability • Opening cooperative relationships • Encourage regional development • Capacity building	5	Received all the benefits from the program
		4	• Received 5-6 benefits from the program
		3	Received 3-4 benefits from the program
		2	Received 1-2 benefits from the program
		1	Have not yet benefited from the program
Influence	How stakeholders can support program implementation through • Policy • Program implementation • Technical assistance • Financial support • Persuasive opinion	5	Able to provide all support
		4	Able to provide 3-4 supports
		3	Able to provide 2 supports
		2	Able to provide 1 support
		`1	Have not yet able to provide support
	Ability to influence program development • Organizing a forum for the smooth running of the program • Facilitate cooperation • Mutual influence between stakeholders • Encourage activities according to the program	5	Has 4 abilities
		4	Has 3 abilities
		3	Has 2 abilities
		2	Has 1 ability
		1	Has not yet able to perform ability

3.1.1. Village Level (Karangrejo)

Karangrejo Village is an important location option for the implementation of Climate Smart Shrimp Aquaculture (CSSA), with various stakeholders such as targeted and non-targeted shrimp farmers groups, community figures, women's groups, input suppliers, mangrove groups, fishermen groups, Santan Island tourism manager, Karangrejo village head, and national army representative for the village (Babinsa). Through interviews and FGDs, the role of these stakeholders in supporting sustainable pond management, mangrove restoration, and communal wastewater treatment plant

(WWTP) development was assessed. The following is an identification of stakeholders adapted from the "Stakeholder Engagement Handbook" by Durham *et al*. (2014) which contains information about interest, influence, roles, and engagement plans in supporting sustainable shrimp aquaculture in Karangrejo Village. We used acronyms for each actor which are useful to identify stakeholders in Figure 3.1.

Table 3.2. Identification of Stakeholders in Karangrejo Village in Supporting CSSA

Stakeholders	Interest	Influence	Role
MIBAMA Shrimp Farmers Group (MBM)	• Increase pond productivity efficiently, with the concept of environmentally friendly aquaculture • Pond wastewater management using WWTP •	• As the main actors/ beneficiaries of the program, they can help implement communal WWTP and ecosystem restoration	• Become the main implementer in implementing sustainable farming practices • Promote sustainability to fellow farmers through farm group networks • Contribute to environmental and water quality improvement
Shrimp Supplier/Middlemen (SUP)	• Support if it does not cause additional burden	• Do not have a significant role in the decision-making process	• Facilitate and bridge coordination with other farmers
Karangrejo Village Head (LKR)	• Capacity building and improvement of shrimp pond technology • Environment-based management of the area and ponds	• Supporting the installation of communal WWTP and mangrove integration • Provide recommendations related to the installation of communal WWTP in the Karangrejo village area	• Coordination and socialization to improve community welfare • Conveying information related to the program to the community to increase understanding and active participation in Karangrejo. • Coordinate with related parties if there are reports of complaints from the community
Shrimp Farmer Community Figures (TMP)	• A respected figure whose opinion is heard by the community • As farmers, they can also support environmentally based pond management, and protect natural heritage for future generations	• Provide program input related to the norms and culture prevailing in the community • Influence in shaping community opinions and attitudes regarding the importance of maintaining and supporting sustainable aquaculture programs	• Indirect development or improvement of the village economy • Voicing the importance of environmental conservation in community activities to build awareness and support • Helping to invite people who were against the program to participate
Santan Island Tourism Management (WPS)	• Support mangrove ecosystem preservation to mitigate climate change impacts and village ecotourism	• Play a key role in the implementation of ecosystem restoration aligned with sustainable aquaculture	• Conduct integrated mangrove planting and maintenance to support pond ecosystems

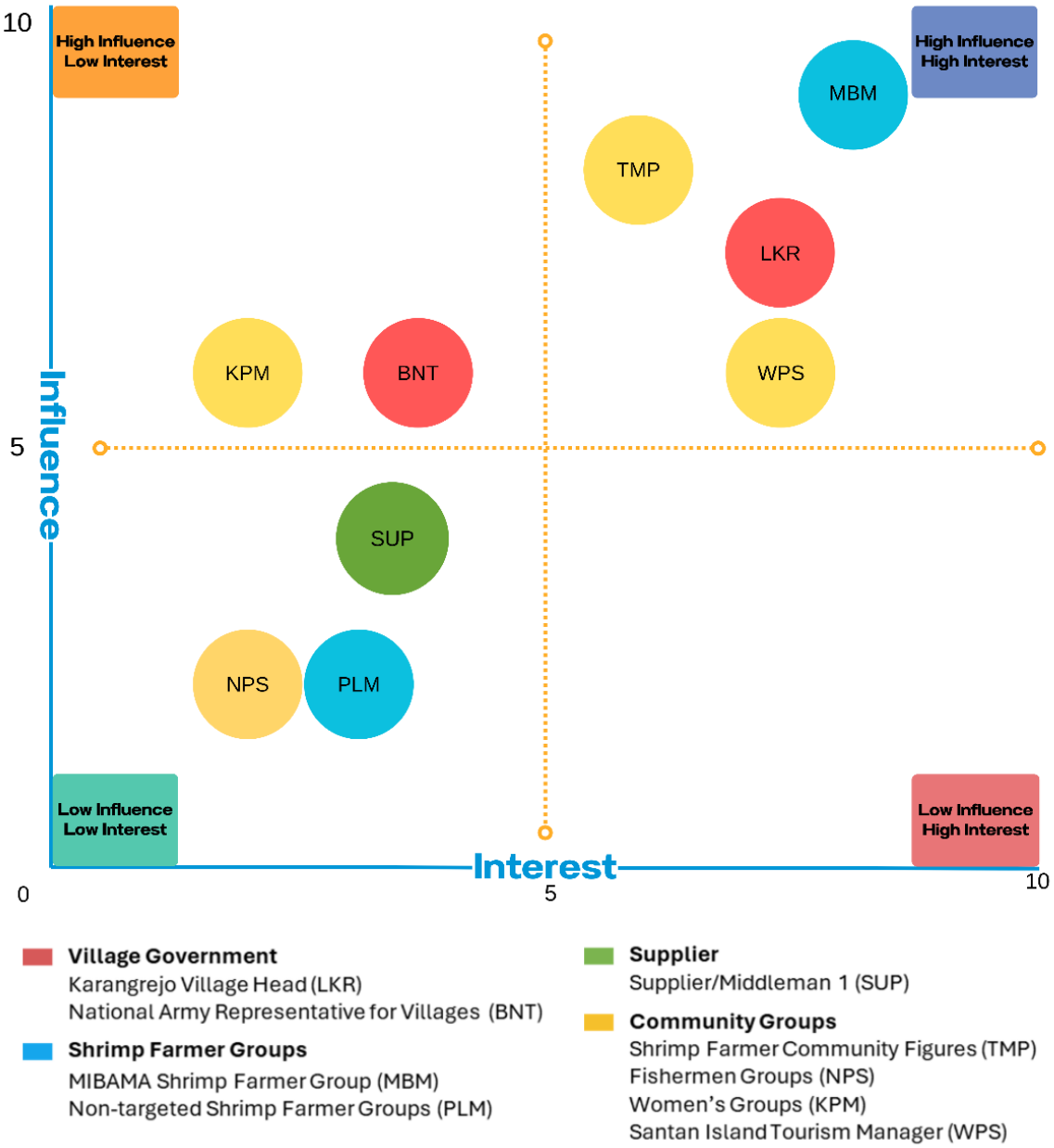
Stakeholders	Interest	Influence	Role
National Army Representative for Village/Babinsa (BNT)	• Area security management in Karangrejo	• Has influence in order and society	• Being a liaison with the TNI as the owner of some land in Karangrejo • Coordinating activities around Karangrejo village
Women's Groups (KPM)	• Gain new skills that are beneficial for personal and group economic development • Processing products derived from mangroves and/or shrimps • •	• Be a driver of social inclusion and demonstrate that sustainable programs are accessible to all • Actively engage in mangrove conservation and processing activities	• Attend specialized training and actively participate in program activities • Set an example to encourage the involvement of other vulnerable groups • Improve livelihoods through mangrove and/or shrimp product diversification activities
Fishermen Group (NPS)	• Enhancing resource stability and biodiversity through coastal ecosystem improvement	• Sustainable marine management and education of other coastal communities	• Sustainable management of coastal areas and fisheries
Non-Targeted Shrimp Farmers Group (PLM)	• Increase pond productivity efficiently, with the concept of environmentally friendly aquaculture • Management of pond wastewater using WWTP •	• As the secondary implementer/ beneficiary of the program	• Being the secondary implementer in the application of sustainable farming practices • Promote sustainability to fellow farmers through the pond group network • Contributing to the improvement of environmental quality and water quality

At the Karangrejo Village level, the roles of stakeholders in supporting environmentally friendly aquaculture activities are diverse. MIBAMA Shrimp Farmers Group (MBM), as owners and operators of aquaculture businesses, hold the primary responsibility in ensuring environmentally friendly pond management. Karangrejo Village Head (LKR) has a significant role in facilitating, coordinating and fostering program activities, particularly at the local level. Karangrejo Village Head is willing to provide space and facilitate the training needed to increase the capacity of the community to support these activities. Then, community leaders play an important role as a communication between the program and the community, providing input, and maintaining community involvement so that program goals are achieved. So far, the relevant roles of women in this activity are pond admin and laboratory staff, contributing to the administrative management and technical aspects of the pond, supporting efforts to implement sustainable and efficient aquaculture in Karangrejo.

The stakeholder identification process involves understanding their interests, influence, roles, and engagement plans for the success of the eco-friendly shrimp farming program. Stakeholders contribute in a various of ways, from program execution to on

the ground facilitation and community awareness raising. The level of risk is determined by the extent to which the success of the program depends on stakeholder commitment, with engagement strategies such as training, program involvement, and regular communication to ensure support for the program (Durham, 2014). The mapping of stakeholders' level of influence and interest is presented in the matrix table in Figure 3.1.

Figure 3.1. Influence and Interest of Karangrejo Village Stakeholders in Supporting CSSA



After stakeholders in Karangrejo Village had been identified based on their level of influence and interest as shown in the previous table and figure, the stakeholder engagement plan was implemented according to the quadrant to support the involvement of all actors according to their respective roles in supporting sustainable shrimp aquaculture. The information is presented in Table 3.3. below.

Table 3.3. Engagement Plan of Karangrejo Village Stakeholders in Supporting CSSA

Category	Actors Involved	Engagement Plan
High-Influence, High-Interest (Manage Closely)	MIBAMA Shrimp Farmers Group (MBM)	• Intensive discussion and visit twice a month • Involvement in activity planning • Involvement in activity implementation (sustainable cultivation) • Involvement in monitoring and evaluation • Training and group capacity building
	Shrimp Farmer Community Figures (TMP)	• Discussion and visit once a month • Involvement in activity implementation (sustainable cultivation) • Involvement in monitoring and evaluation
	Karangrejo Village Head (LKR)	• Discussion and visit once a month • Involvement in activity planning • Involvement in monitoring and evaluation
	Santan Island Tourism Manager (WPS)	• Discussion and visit once a month • Involvement in activity planning • Involvement in activity implementation (mangrove restoration) • Involvement in monitoring and evaluation • Training and group capacity building
High-Influence, Low-Interest (Keep Satisfied)	National Army Representative for Villages/Babinsa (BNT)	• **Specialized discussion related to the program plan** • Discussion when relevant activities will be implemented • Involvement in the implementation of relevant activities
	Women's Groups (KPM)	• **Specialized discussion related to the program plan** • Involvement in the implementation of relevant activitie • Training and capacity bBuilding for groups
Low-Influence, High-Interest (Keep Informed)	N/A	• N/A

Category	Actors Involved	Engagement Plan
Low-Influence, Low-Interest (Monitor)	Fishermen Group (NPS)	• Involvement in relevant activities (training/seminars/ ceremonial)
	Non-Targeted Shrimp Farmers Group (PLM)	• Engagement in relevant activities (training/seminar/ ceremonial)
	Shrimp Supplier/Middlemen (SUP)	• Discussion of developments on relevant topics • Involvement in relevant activities (training/seminar/ ceremonial)

In Karangrejo Village, stakeholder mapping shows the need for different communication and engagement strategies according to their level of influence and interest. Stakeholders with high influence and high interest such as the MIBAMA Shrimp Farmers Group (MBM), Santan Island Tourism Manager (WPS), Head of Karangrejo Village (LKR), and Shrimp Farmer Community Figures (TMP) require an intensive approach or belong to the 'manage closely' category, including in-depth discussions and active involvement in program planning, implementation, and evaluation. The involvement of these groups is very important because they have a significant influence on the success of the program (Hollman *et al*., 2022).

Groups with high influence and low interest (or 'keep satisfied' category), such as the National Army Representative for Villages/Babinsa (BNT) and Women's Groups (KPM), require strategic approaches to increase their interest. Communication that emphasizes the benefits of the program and provides capacity-building training can be effective. For the low interest and low influence (or 'monitor' category), such as Fishermen Group (NPS), Non-Targeted Shrimp Farmers Group (PLM), and Shrimp Supplier/Middlemen (SUP), minimal monitoring is required. Stakeholder engagement for these stakeholders can be done through informative activities, such as training, seminars or ceremonial events. This approach is aligned with the principle of stakeholder mapping, where communication and engagement are designed to ensure all groups contribute according to their capacity and role. This strategy not only creates synergy but also supports the overall sustainability of the program (Hollman *et al*., 2022).

3.1.2. Village Level (Wringinputih)

In Wringinputih Village, the parties involved in environmentally friendly aquaculture activities include targeted and non-targeted shrimp farmer groups, village heads, community figures, mangrove groups, shrimp suppliers/middlemen, fishermen groups, women's groups, and ecotourism managers. Stakeholders play a role in sustainable pond management, mangrove restoration, WWTP construction, and ecotourism-based economic development. The interest, influence, roles, and engagement plan of each stakeholder are listed in Table 3.4. (Bryson, 2004; Durham *et al*., 2014).

Table 3.4. Identification of Stakeholders in Wringinputih Village in Supporting CSSA

Stakeholders	Interest	Influence	Role
Raja Vanamei Shrimp Farmer Group (KPR)	• Increase pond productivity efficiently, with the concept of environmentally friendly aquaculture • Pond wastewater management using WWTP	• As the main actors/ beneficiaries of the program, they can help implement communal WWTP and ecosystem restoration	• Become the main implementer in implementing sustainable farming practices • Promote sustainability to fellow farmers through farm group networks • Contribute to environmental and water quality improvements
Kerajaan Vanamei Shrimp Farmer Group (KPK)	• Increase farm productivity efficiently, with environmentally friendly aquaculture concepts • Management of pond wastewater using WWTP	• As the main beneficiaries of the program, they can help implement communal WWTPs and ecosystem restoration	• Become the main implementer in the implementation of sustainable farming practices • Promote sustainability to fellow farmers through farm group networks • Contribute to the improvement of environmental quality and water quality
KTH Makmur Mangrove Group (KTM)	• Support the preservation of mangrove ecosystems to mitigate the impacts of climate change	• Play a key role in the implementation of ecosystem restoration aligned with sustainable aquaculture	• Conduct integrated mangrove planting and maintenance to support pond ecosystems
Non-Targeted Mangrove Groups (KML)	• Support the preservation of mangrove ecosystems to mitigate the impacts of climate change	• Play a key role in the implementation of ecosystem restoration aligned with sustainable aquaculture	• Conducting integrated mangrove planting and maintenance to support the pond ecosystem
Wringinputih Village Head (KDS)	• Support sustainable and environmental based management of the pond area to improve the welfare of the village community and preserve the surrounding environment	• Have the authority to support program socialization, grant permits, and facilitate communication with villagers involved in aquaculture.	• Promote program socialization and education to the community regarding sustainable shrimp farming and mangrove integration • • Coordinate village activities that support the implementation of communal WWTP and mangrove conservation with villagers • • Mediate between the consortium and the community to ensure the program runs smoothly and according to local needs

Stakeholders	Interest	Influence	Role
Shrimp Supplier/Middlemen (SUG)	• Support activities that can improve productivity or efficiency	• Contribute directly to the implementation and monitoring of activities	• Willing to provide land for WWTP construction • Facilitate and bridge coordination with other farmers • Participate in program planning • Conduct regular monitoring and evaluation of activities
Shrimp Supplier/Middlemen (SUP)	• Support if it does not cause additional burden	• Do not have a significant role in the decision-making process	• Facilitate and bridge coordination with other farmers
Shrimp Farmer Community Figures (TMP)	• Respected figure whose opinion is heard by the community • Support environmental based pond management and protect natural heritage for future generations	• Provide program input related to the norms and culture prevailing in the community • Influential in shaping community opinions and attitudes regarding the importance of and support for sustainable aquaculture programs	• Indirect development or improvement of the village economy • Voicing the importance of environmental conservation in community activities to build awareness and support
Women's Group (KPM)	• Gaining new skills that are beneficial for personal and group economic development • Processing products derived from mangroves and/or shrimps	• Promote social inclusion and demonstrate that sustainable programs are accessible to everyone • Actively engage in mangrove conservation and processing activities	• Attend specialized training and actively participate in program activities • Set an example to encourage the involvement of other vulnerable groups • Improve livelihoods through diversification of mangrove and/or shrimp products
Ecotourism Managers (PES)	• Develop environmental-based tourism that supports mangrove conservation and increases community income through tourism activities	• Create local economic opportunities linked to ecosystem-based tourism, and community empowerment, and actively introduce eco-friendly practices to tourists and local communities	• Educate communities and facilitate welfare-enhancing activities, such as renting boats for mangrove or garden tours, and facilitating communities to provide local cuisine
Fishermen Groups (KNY)	• Increase resource stability and biodiversity through coastal ecosystem improvements	• Sustainable marine management and community education	• Coastal area management • Voicing urgency regarding marine ecosystem balance for sustainable fisheries
Non-Targeted Shrimp Farmer Groups (KPL)	• Increase pond productivity efficiently, with the concept of environmentally friendly aquaculture • Management of pond wastewater using WWTP	• As the secondary actor/ beneficiary of the program	• Being the secondary implementer in the application of sustainable pond practices • Promote sustainability to fellow farmers through the pond group network • Contributing to the improvement of environmental quality and water quality

The Focus Group Discussion (FGD) held in Banyuwangi revealed the important role of the village government in group empowerment, coaching, and administrative and licensing services. Local communities contribute through farm supervision, while community leaders provide input and maintain social values. The farmer and mangrove groups are the main implementers of the program, responsible for sustainable aquaculture and mangrove restoration, which are key elements of CSSA's success.

The stakeholders in Wringinputih Village include various groups with different roles, influences, and levels of risk in the CSSA program. The Shrimp Farmer Groups, Mangrove Groups, and Village Government have key roles in eco-friendly pond management, mangrove restoration, and WWTP construction and monitoring. To the program's success, regular training and communication are required to ensure its sustainability and commitment. In addition, community leaders play an important role in shaping public opinion, while fishermen and ecotourism managers support the program through ecotourism-based economic development and increased environmental awareness. The mapping of stakeholders' level of influence and interest in supporting CSSA is shown in Figure 3.2 (Durham *et al*., 2014).

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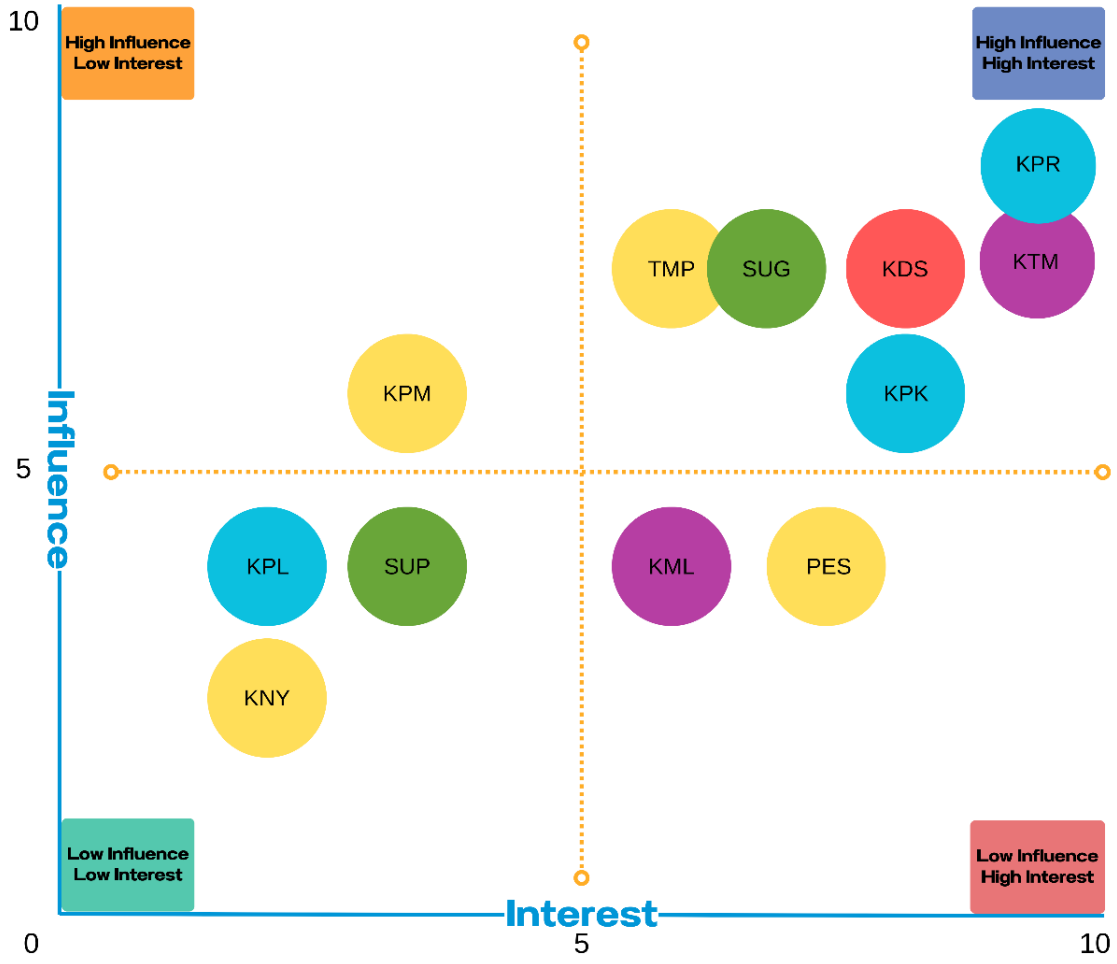
Figure 3.2. Influence and Interest of Wringinputih Village Stakeholders in Supporting sustainable shrimp aquaculture



Village Government
Wringin Putih Village Head (KDS)

Shrimp Farmer Groups
Raja Vanamei Shrimp Farmer Group (KPR)
Kerajaan Vanamei Shrimp Farmer Group (KPK)
Non-targeted Shrimp Farmer Groups (KPL)

Mangrove Groups
KTH Makmur Mangrove Group (KTM)
Non-targeted Mangrove Groups (KML)

Supplier
Shrimp Supplier/Middleman 1 (SUG)
Shrimp Supplier/Middleman 2 (SUP)

Community Groups
Shrimp Farmer Community Figures (TMP)
Fishermen Groups (KNY)
Women's Groups (KPM)
Ecotourism Managers (PES)

Once the stakeholders in Wringinputih Village were identified based on their level of influence and interest as shown in the previous table and figure, the next step was to design an engagement plan for each group. These plans are organized according to the position of the stakeholders in the quadrant matrix to ensure optimal engagement of all actors. Each actor will be directed to play their respective roles in supporting sustainable shrimp aquaculture practices. Information related to this engagement can be seen in Table 3.5. below.

Table 3.5. Wringinputih Village Stakeholders Engagement Plan in supporting sustainable shrimp aquaculture

Category	Actors Involved	Engagement Plan
High-Influence, High-Interest (Manage Closely)	Raja Vanamei Shrimp Farmer Group (KPR)	• Intensive discussion and visit twice a month • Involvement in activity planning • Involvement in activity implementation (sustainable cultivation) • Involvement in monitoring and evaluation • Training and group capacity building
	Kerajaan Vanamei Shrimp Farmer Group (KPK)	• Intensive discussion and visit twice a month • Involvement in activity planning • Involvement in activity implementation (sustainable cultivation) • Involvement in monitoring and evaluation • Training and group capacity building
	KTH Makmur Mangrove Group (KTM)	• Intensive discussion and visit twice a month • Involvement in activity planning • Involvement in activity implementation (mangrove restoration) • Involvement in monitoring and evaluation • Training and group capacity building
	Wringinputih Village Head (KDS)	• Discussion and visit once a month • Involvement in activity planning • Involvement in monitoring and evaluation
	Shrimp Supplier/Middlemen (SUG)	• Discussion and visit once a month • Involvement in activity planning • Involvement in monitoring and evaluation
	Shrimp Farmer Community Figures (TMP)	• Discussion and visit once a month • Involvement in activity planning • Involvement in monitoring and evaluation
High-Influence, Low-Interest (Keep Satisfied)	Women's Group (KPM)	• Involvement in the implementation of relevant activities • Training and Capacity Building for groups
Low-Influence, High-Interest (Keep Informed)	Ecotourism Managers (PES)	• Discussion of developments on relevant topics • Involvement in relevant activities (training/seminar/ceremonial) • Training and Capacity Building for groups
	Non-Targeted Mangrove Groups (KML)	• Discussion of developments on relevant topics • Involvement in relevant activities (training/seminar/ceremonial) • Training and Capacity Building for groups

Category	Actors Involved	Engagement Plan
Low-Influence, Low-Interest (Monitor)	Shrimp Supplier/Middlemen (SUP)	• Discussion of developments on relevant topics • Involvement in relevant activities (training/seminar/ ceremonial)
	Non- Targeted Shrimp Farmer Groups (KPL)	• Involvement in relevant activities (training/seminar/ ceremonial)
	Fishermen Groups (KNY)	• Involvement in relevant activities (training/seminar/ ceremonial)

In Wringinputih Village, stakeholders who fall into the category of high influence and high interest ('manage closely') need to be intensively involved in every stage of the program. The Raja Vanamei Shrimp Farmer Group (KPR), Kerajaan Vanamei Shrimp Farmer Group (KPK), KTH Makmur Mangrove Group (KTM), and the Wringinputih Village Head (KDS) have strategic roles in the success of the sustainable aquaculture and mangrove restoration programs. Therefore, they should be involved in in-depth discussions, regular visits, as well as planning, implementation, monitoring, evaluation and capacity building training. The involvement of this group is crucial as they have a significant influence on the smooth implementation of the program and its long-term success (Hollman *et al*., 2022).

Stakeholders in the high influence and low interest ('keep satisfied') category, such as the Women's Group (KPM), require an approach to increase their interest in the program. This can be done by involving them in relevant training and implementation activities. Meanwhile, stakeholders with low influence and high interest ('keep informed'), such as Ecotourism Managers (PES) and Non-Targeted Mangrove Groups (KML), need to be updated on program developments and involved in relevant activities, such as training for capacity building. This approach ensures that they remain connected to the program and can make meaningful contributions (Hollman *et al*., 2022).

For stakeholders in the low interest and low influence ('monitor') category, such as Shrimp Supplier/ Middlemen (SUP), Non-Targeted Shrimp Farmer Groups (KPL), and Fishermen Groups (KNY), their involvement can be done through ceremonial activities or related training. This aims to maintain good communication and ensure that they stay abreast of program developments. This approach, which is tailored to each stakeholder's level of influence and interest, is essential to ensure the success and sustainability of the eco-friendly aquaculture and mangrove restoration program in Wringinputih Village (Hollman *et al*., 2022).

3.1.3. District and Sub-district Levels

The implementation of CSSA at the district and sub-district levels involves various stakeholders who play an important role in supporting the success of the program. These stakeholders include government agencies such as the Fisheries Agency, Environmental Agency, Forestry Service Branch Agency, Regional Development Planning Agency (Bappeda), Cooperatives Agency, and Fisheries Training and Counselling Center as well as associations, educational and community institutions such as IJEN Geopark, Shrimp Club Indonesia (SCI) Banyuwangi, academician/universities and media. Through FGDs, it was recognized that each stakeholder has a different level of interest, influence, role and risk in supporting sustainable pond management, mangrove restoration, WWTP installation and ecotourism-based economic development. An engagement plan was developed with the mitigation and collaboration strategies listed in the identification table (Table 3.6.), to ensure each contribution was aligned with the CSSA program objectives.

Table 3.6. Identification of District and Sub-district Level Stakeholders in Supporting CSSA

Stakeholders	Interest	Influence	Role
Banyuwangi Fisheries Agency (DPI)	• Shrimp farm management and capacity building	• Create work plans, make policies	• Coordinate implementation related to shrimp farming. • Coordinate the reporting of farmer's WWTP usage. • Legality/Legitimization that this activity is supported or local government • Synergy with programs currently run by the Fisheries Agency
Banyuwangi Forestry Service Branch Agency (CDK)	• Mangrove area restoration	• Support the implementation of mangrove restoration in accordance with the targets set	• Coordinate in the mangrove restoration program • Support mangrove restoration carried out in the pond area • SOPs and technical training for mangrove restoration monitoring
Ijen Geopark (IJG)	• Autonomous initiative under the local government that manages the area around Ijen (across districts) • One of its fields is conservation (mangrove)	• Increase the capacity of mangrove restoration actors • Exploration of potential cooperation in the field of sustainable shrimp farming	• Coordinate mangrove restoration and other conservation activities
Universitas 17 Agustus (UTG)	• Research and training for students and the community	• Increase the capacity of teachers and students in various research topics related to the program • Conduct community service activities according to the program	• Coordinate the use of data, innovation, and information sharing
Banyuwangi Environmental Agency (DLH)	• Communal WWTP and Wastewater Quality Management (WQM)	• Support the implementation of communal WWTP installation • Provide recommendations related to the installation of communal WWTP	• Coordinate implementation related to water quality monitoring in shrimp farming. • Synergy with the current program run by DLH • Coordinate reporting on the use of communal WWTP. • SOPs and technical training for communal WWTP management
Banyuwangi Regional Development Planning Agency/Bappeda (BPD)	• General regional development (economic and environmental) • • Development of sustainable shrimp farming	• Improve integration of mangrove restoration and sustainable shrimp farming in line with regional development	• Coordinate the sustainable shrimp farming program • Ensure the program is in line with the economic and environmental development of the Banyuwangi area, as well as community capacity building

Stakeholders	Interest	Influence	Role
Banyuwangi Cooperatives Agency (DKP)	• Cooperative capacity building	• Increase the capacity of cooperatives to support the regional economy • Improve understanding of shrimp/mangrove processed products	• Coordinate in providing cooperative capacity-building • Will be involved in diversification activities of the aquaculture/ mangrove programs
Fisheries Training and Counselling Center (BPP)	• Capacity building of farmer	• Improving the capacity of farmers in sustainable fisheries management	• Coordinate in providing appropriate training for farmers • Will be involved in diversification activities of aquaculture/ mangrove program
Shrimp Club Indonesia for Banyuwangi (SCI)	• Shrimp farm management in Banyuwangi • Support capacity building, facilitate discussions, and find solutions to pond issues	• Increase the capacity of shrimp farming actors • Invite members to participate in the program	• Coordinate and discuss activities to increase farmer productivity • Supports the group's vision to develop farm management for farmer members • Influencing the decisions of its farmer members
Universitas Airlangga (UNR)	• Research and training for students and the community	• Increase the capacity of teachers and students in various research topics under the program • Conduct community service activities	• Coordinate and involve the campus in relevant activities
Universitas PGRI Banyuwangi (UNB)	• Research and training for students and the community	• Increase the capacity of teachers and students in various research topics under the program • Conduct community service activities	• Coordinate and involve campus parties in relevant activities
Politeknik Negeri Banyuwangi (PLW)	• Research and training for students and the community	• Increase the capacity of teachers and students in various research topics under the program • Conduct community service activities	• Coordinate and involve the campus in relevant activities
Media (MDA)	• Information related to cultivation activities/ economic improvement of local communities	• Dissemination of actual and factual information related to activities	• Informing relevant activities that require dissemination of activity information

The Focus Group Discussion (FGD) in Banyuwangi was held as part of the stakeholder analysis process in the CSSA program. The FGD involved various stakeholders, including relevant agencies, farmer groups, as well as community leaders, with the aim of understanding their interest, influence, and contribution in supporting CSSA implementation. The Fisheries Service and Forestry Service are able to facilitate activities according to their respective main tasks and functions, such as coaching and supervision of farmer groups and ecosystem protection efforts. On the other hand, the Banyuwangi Environmental Agency (DLH) considered that the

CSSA program is in line with their mission, particularly in sustainable waste management. However, it emphasized the importance of additional coordination to build a communal wastewater treatment plant (IPAL). The Cooperative Office is also considered to recognize the importance of education related to processing pond products as an effort to increase added value.

The stakeholder identification process at the district and sub-district levels involved an analysis of interest, influence, roles and engagement plans in supporting the success of sustainable aquaculture and environmental conservation-based programs. These stakeholders make diverse contributions, ranging from policymaking to on-the-ground facilitation, to community awareness and capacity building related to environmentally friendly pond management. The level of risk for each stakeholder is determined by the extent to which the program relies on their involvement, with engagement strategies including regular communication, technical training, and synergy in program implementation to ensure success (Bryson, 2004).

An additional site visit was conducted by the research team in Banyuwangi for stakeholder analysis research. On this occasion, in-depth discussions were held with representatives of Banyuwangi Fisheries Agency (DPI), Banyuwangi Forestry Service Branch Agency (CDK), and Banyuwangi Environmental Service (DLH). During the discussion, Banyuwangi Fisheries Agency (DPI) demonstrated its strategic role by having significant power and interest in supporting the implementation of the CSSA program. This is reflected in their initiative to utilize ponds in the Banyuwangi area through a community empowerment approach and collaboration with other agencies, such as the Cooperative Agency, to increase the capacity of farmers. Their main focus is to open access to farmers from all walks of life, including the younger generation, without compromising ecosystem sustainability. This approach is aligned with CSSA's goal to integrate sustainable shrimp farming with environmental conservation and strengthen the capacity of local communities.

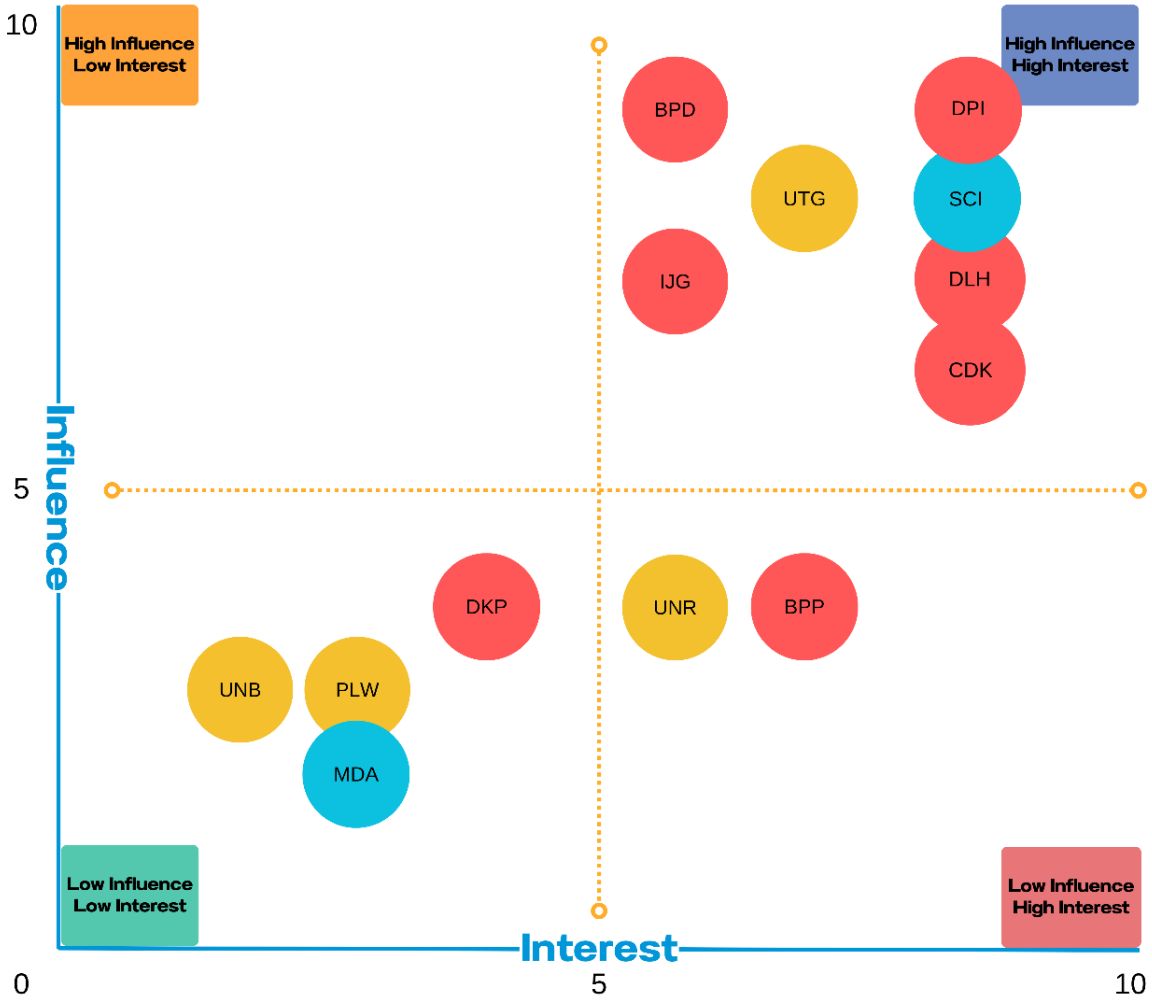
Banyuwangi Forestry Service Branch Agency (CDK) has the potential for program integration with CSSA due to its responsibility for land cover rehabilitation, including mangroves, outside the state forest area, particularly in the Muncar area and Wringinputih Village. Land cover rehabilitation by CDK is conducted through partial approaches, community education, and collaboration with farmer groups such as KTH Makmur and KUB Mina Sero. CDK also works closely with the Fisheries Agency, village governments, and NGOs to support funding and program implementation, although challenges such as marine debris and damage from human activities remain major obstacles. With an annual target of increasing land cover, CDK has made mangroves the focus of essential ecosystem restoration, which requires collective commitment across sectors to ensure program sustainability.

Banyuwangi Environmental Service (DLH) plays an important role in supporting the sustainability of the CSSA program, particularly in the management of waste generated from shrimp farming activities. DLH recognizes the importance of environmentally friendly waste treatment and supports efficient WWTP management efforts, although further coordination is required for the construction of communal Wastewater Treatment Plants (WWTPs). In addition, DLH also has a role in monitoring and educating the community on good environmental management practices, as well as supporting ecosystem rehabilitation activities such as mangroves. DLH hopes to strengthen the community's capacity to maintain the sustainability of the coastal ecosystem, which strongly supports the CSSA program's long-term goal of creating environmentally friendly and sustainable shrimp farming.

Based on data collected through FGDs and interviews, it can be identified that at the district level, high-risk stakeholders such as the Banyuwangi Fisheries Agency (DPI), Environmental Service (DLH), and Regional Development Planning Agency/Bappeda (BPD) play a strategic role in policy development and program implementation. Medium-risk stakeholders, such as the Forestry Service Branch Agency (CDK)

and the Fisheries Extension Training Center, are involved in capacity building and technical monitoring, while low-risk stakeholders, including educational institutions and local communities, support capacity building and information dissemination. The mapping of stakeholders' level of influence and interest is presented in the following matrix (Figure 3.3.) (Durham *et al*., 2014).

Figure 3.3. Influence and Interest of Sub-district and District Level Stakeholders in Supporting CSSA



Once stakeholders at the sub-district to district level have been identified along with their level of influence and interest, a stakeholder engagement plan should be developed. The engagement of each stakeholder is tailored to their position in the influence and interest matrix. This approach, which is aligned with the level of influence and interest, is intended to ensure that each stakeholder can play their role effectively. Further details on stakeholder engagement to support sustainable shrimp farming are presented in Table 3.7.

(Hollman *et al*., 2022).

Table 3.7. District-level Stakeholder Engagement Plan in Support of CSSA

Category	Actors Involved	Engagement Plan
High-Influence, High-Interest (Manage Closely)	Banyuwangi Fisheries Agency (DPI)	• Intensive discussions and visits twice a month • Involvement in activity planning • Involvement in activity implementation (sustainable cultivation) • Involvement in monitoring and evaluation
	Banyuwangi Forestry Service Branch Agency (CDK)	• Intensive discussions and visits twice a month • Involvement in activity planning • Involvement in activity implementation (sustainable cultivation) • Involvement in monitoring and evaluation
	Ijen Geopark (IJG)	• Intensive discussions and visits twice a month • Involvement in activity planning • Involvement in activity implementation (sustainable cultivation) • Involvement in monitoring and evaluation
	Universitas 17 Agustus (UTG)	• Intensive discussions and visits twice a month • Involvement in activity planning • Involvement in activity implementation (sustainable cultivation) • Involvement in monitoring and evaluation
	Banyuwangi Environmental Agency (DLH)	• Intensive discussions and visits twice a month • Involvement in activity planning • Involvement in activity implementation (sustainable cultivation) • Involvement in monitoring and evaluation
	Banyuwangi Regional Development Planning (BPD)	• Intensive discussions and visits twice a month • Involvement in activity planning • Involvement in activity implementation (sustainable cultivation) • Involvement in monitoring and evaluation
High-Influence, High-Interest (Manage Closely)	Shrimp Club Indonesia Banyuwangi (SCI)	• Intensive discussions and visits twice a month • Involvement in activity planning • Involvement in activity implementation (sustainable cultivation) • Involvement in monitoring and evaluation • Training and capacity building for groups
High-Influence, Low-Interest (Keep Satisfied)	N/A	N/A

Category	Actors Involved	Engagement Plan
Low-Influence, High-Interest (Keep Informed)	Fisheries Training and Counselling Center (BPP)	• Involvement in relevant activities (training/seminars/ ceremonies) • Training and capacity building for groups
	Universitas Airlangga (UNR)	• Discussion on the development of relevant topics • Involvement in relevant activities (training/seminars/ ceremonies)
Low-Influence, Low-Interest (Monitor)	Banyuwangi Cooperatives Agency (DKP)	• Involvement in relevant activities (training/seminars/ ceremonies)
	Universitas PGRI Banyuwangi (UNB)	• Involvement in relevant activities (training/seminars/ ceremonies)
	Politeknik Negeri Banyuwangi (PLW)	• Involvement in relevant activities (training/seminars/ ceremonies)
	Media (MDA)	• Involvement in the dissemination of relevant activity information

Based on the table and data collected through FGDs and interviews, stakeholders at the district level can be divided based on their level of influence and interest in the program. Stakeholders with high risk and included in the high-influence and high-interest category ('manage closely'), such as Banyuwangi District Fisheries Office (DPI), Banyuwangi Forestry Service Branch Agency (CDK), IJEN Geopark (IJG), Universitas 17 Agustus (UTG), Environmental Agency (DLH), Regional Development Planning (BPD), and Shrimp Club Indonesia for Banyuwangi (SCI), play a very strategic role in policy development and program implementation. This group is intensively involved in discussions, field visits, activity planning, sustainable cultivation implementation, and program monitoring and evaluation. In addition, these stakeholders also play a role in the training and capacity-building of the group (Hollman *et al*., 2022).

Stakeholders with high influence but low interest ('keep satisfied'), currently do not exist in this category. Meanwhile, stakeholders with low influence and high interest (keep informed), such as the Fisheries Training and Counselling Center (BPP) and Universitas Airlangga (UNR), will be involved in relevant activities, such as training, seminars, or ceremonies, and provided with training and group capacity building to explore related topics. Finally, stakeholders with low influence and low interest (monitors), including Banyuwangi Cooperatives Agency (DKP), Universitas PGRI Banyuwangi (UNB), Politeknik Negeri Banyuwangi (PLW), and Media (MDA), will be involved in relevant activities such as trainings, seminars, or ceremonies, and in the dissemination of information on activities to maintain communication and their contribution in supporting the program. This approach ensures that each stakeholder is engaged according to their level of influence and interest in supporting the success of the program (Hollman *et al*., 2022: 5–7).

3.1.4. National Level

The CSSA implementation will also certainly involve stakeholders at the national level, especially regarding

involvement in policymaking. In this study, stakeholders at the national level are only listed (Table 3.1.), considering that coordination with these stakeholders will be carried out in the second and third years of implementation of this activity.

Table 3.8. Identification of National-Level Stakeholders in Supporting CSSA

Stakeholders	Interest	Influence	Role	Engagement Plan
Ministry of Marine Affairs and Fisheries (MMAF/KKP)	Develop regulations and supervision related to technical aquaculture	Provide regulations, policies, and technical support related to sustainable aquaculture	Develop national policies related to sustainable aquaculture, provide technical guidance and training, and support the implementation of activities	Regular coordination and collaboration
Ministry of Environment and Forestry (MoEF/ KLHK)	Environmental quality monitoring and mangrove restoration	Regulate mangrove ecosystem management and conservation policies and environmental rehabilitation programs	Provide support in the preparation of preservation guidelines, implementation of mangrove restoration programs, and monitoring of environmental impacts	Collaboration in the implementation of mangrove restoration Provision of technical guidelines
Previously the Coordinating Ministry for Maritime Affairs and Investment (CMMAI), now the Coordinating Ministry of Food Affairs	Assist cross-sector coordination related to fisheries product management, ecotourism, and conservation activities	Facilitate and coordinate cross-ministerial policies and mobilize investment for sustainable programs	Promote integrative policies, build cross-sector coordination, and encourage investment in the sustainable fisheries sector	Regular collaboration and coordination
National Development Planning Agency (Bappenas)	Provide advice and support in CSSA program planning	Facilitate and coordinate policies in long-term sustainable development plans	Integration of CSSA program in national development agenda	Regular collaboration and coordination
National Research and Innovation Agency (BRIN)	Development of technologies and innovations that support environmentally friendly aquaculture	Provide related research and innovation data	Provide supporting research and technology, environmental and social impact evaluation, and technology training for farmers	Collaboration and coordination on research and innovation

3.2. Policy Analysis

Several studies have shown that land conversion of shrimp ponds is one of the causes of mangrove degradation. This is partly due to weak law enforcement that supports environmental conservation efforts (Ilman *et al*., 2016; Do & Thuy, 2022). Therefore, the analysis of sustainable shrimp farming regulations is an important part of this research to ensure farming practices that are not only economically profitable but also environmentally responsible and consider the socio-cultural aspects of the community. Through the implementation of effective regulations, sustainable management can be implemented, negative impacts of environmental degradation can be reduced, and a profitable aquaculture model can be created while simultaneously aligning with mangrove conservation as a vital part of coastal ecosystems (FAO, 2010).

The stages carried out in this regulatory analysis are identification and analysis of regulations relevant to

sustainable shrimp farming, mangrove restoration, and Gender Equality, Disability, and Social Inclusion (GEDSI) topics; and analysis of gaps, challenges, and opportunities and their relevance to CSSA programs. Data used for this regulatory mapping process was obtained through literature review methods from several government documents such as national laws, government regulations, ministerial regulations, governor decrees, and local government documents.

3.2.1. Identification and Analysis of Existing Regulations related to CSSA

A regulatory analysis starts from the highest order, namely (1) National Laws (Undang-undang), (2) Government Regulations (Peraturan Pemerintah), (3) Ministerial Regulations (Peraturan Menteri), (4) Governor Regulations (Peraturan Gubernur) and Local Government Strategic Documents (Rencana Strategis Pemerintah Daerah).

National laws are made by the legislative institution (DPR) together with the President and regulate matters of a general and fundamental nature. Therefore, the national law has a higher hierarchy as the main source of law in Indonesia. This is followed by government regulations issued by the President as implementing instructions or details of the national law. Thus, there are ministerial regulations, which are made by ministers to regulate technical matters within the scope of a particular ministry. Lastly, there are governor regulations and local government documents issued by the governor and regional institution to regulate matters within the scope of a particular province or region. Table 3.9. refers to the legal basis related to CSSA activities.

Table 3.9. National laws related to CSSA

Law	Concerning	Purposes
National Law No. 45/2009	Fisheries	A paradigm shifts towards sustainable fisheries management.
National Law No. 32/2009	Environmental Protection and Management	Protect and manage the environment and prevent ecological damage.
National Law No. 1/2014	Management of Coastal Areas and Small Islands	Integration of mangroves in coastal spatial planning.
National Law No. 6/2023	Omnibus Law on Job Creation	Laws that include various amendments or updates to various existing regulations in one legislative package.

Law No. 45/2009 on fisheries explains that fish farming is an activity to maintain, raise, and/or breed fish and harvest the results in a controlled environment. This law also states that shrimp, crab, crab, and their relatives (crustaceans) are included in the fish species. This law recognizes a paradigm shift in fisheries management through an ecosystem approach. This law regulates all matters related to fisheries at the national level.

Law No. 32/2009 on Environmental Protection and Management regulates the direction of sustainable development that considers environmental aspects through planning, development, maintenance, recovery, supervision, and control policies. This regulation is comprehensive and discusses environmental management in Indonesia. Article 21 paragraph 3 states that one of the standard criteria for ecological damage is mangrove degradation. Article 98 paragraph 1 also explicitly states that criminal sanctions and fines will be given to those who deliberately commit acts that exceed seawater quality standards or standard criteria for environmental damage.

Law No. 1/2014 on the Management of Coastal Areas and Small Islands aims to protect, conserve, rehabilitate, and utilize coastal resources and small islands in a sustainable manner, as stated in Article 1 paragraph 20. This law regulates the use of zoning plans for marine resources and marine areas. The law also mentions mangroves as part of the resources that need to be managed sustainably in coastal spatial planning.

Law Number 6 of 2023 on Job Creation regulates efforts to create jobs through efforts to facilitate, protect, and empower cooperatives and micro, small, and medium enterprises, improve the investment ecosystem and ease of doing business, and central government investment and acceleration of national strategic projects. This law is an omnibus law that regulates many different things in one legal platform.

Besides national laws that have been identified and analyzed, there are some regulations from the government and technical ministries that are related to CSSA activities. These regulations are divided into three clusters that are presented in three different tables, Sustainable Shrimp Farming (Table 3.10), Mangrove Restoration (Table 3.11), and GESI (Table 3.12).

Table 3.10. National regulations related to sustainable shrimp farming

Regulation	Concerning	Purposes
Government Regulation of the Republic of Indonesia No. 60/2007	Conservation of Fish Resources	Ecosystem conservation is carried out in all types of ecosystems related to fish resources. Among them are artificial water ecosystems, such as ponds
Minister of Marine Affairs and Fisheries Regulation No. 75/2016	General Guidelines for Growing Tiger Shrimp (*Penaeus monodon*) and Vaname Shrimp (*Litopenaeus vannamei*).	Sets out technical guidelines for shrimp rearing and regulates all technical aspects of aquaculture.
Minister of Marine Affairs and Fisheries Regulation No. 25/2022	Procedure for Rehabilitation of Cultivation Environment	Rehabilitation efforts in aquaculture activities and planning in support of sustainable aquaculture.
Minister of Marine Affairs and Fisheries Decree No. 25/2022.	General Guidelines for Area-based Vaname Shrimp (*Litopenaeus vannamei*) Development	Provide examples of the stages of sustainable aquaculture by incorporating mangroves in their design integration.
Head of the National Standardization Agency Decree No. 521/2022	Stipulation of SNI 8680:2022 Shrimp Pond Wastewater Treatment Plant as a Revision of SNI 8680:2018	Update and improve shrimp farming waste management standards, particularly in terms of wastewater treatment plants.

Government Regulation No. 60/2007 explains that fish resource conservation is an effort to protect, preserve and utilize fish resources, including ecosystems, species, and genetics to ensure their existence, availability, and sustainability while maintaining and improving the quality value and diversity of fish resources. This regulation also mentions that ponds are part of an artificial aquatic ecosystem and need to be conserved, as stated in Article 5. Sustainability is also a goal for increasing public awareness of the importance of fish resources and environmental conservation in Article 46.

Regulation of the Minister of Maritime Affairs and Fisheries No. 75/2016 on general guidelines for enlargement of tiger shrimp (Penaeus monodon) and vaname shrimp (Litopenaeus vannamei) is a reference in conducting enlargement of tiger shrimp and vaname oriented to increase production, competitiveness, and sustainability. The purpose of this general guideline is to provide guidelines for the government, local governments, businesses, and communities to manage and develop shrimp enlargement that is productive, efficient, profitable, and sustainable. The paradigm shift towards sustainable fisheries is an important highlight

in this regulation mentioned in Article 1 and the main objectives in the opening of the appendix section.

Regulation of the Minister of Maritime Affairs and Fisheries of the Republic of Indonesia Number 25 of 2022 states that rehabilitation is an effort to restore the environmental quality of aquaculture areas that experience pollution and/or environmental damage. Pollution of fish resources and/or the environment is the entry or inclusion of living things, substances, and/or other components into the habitat where fish resources live and breed so that the quality of the habitat decreases and is no longer in accordance with the established environmental quality standards. Therefore, rehabilitation activities carried out by cross-stakeholders are very important to continue to support sustainable aquaculture. This technical regulation does not specifically target shrimp farming, but with careful rehabilitation planning, it will have a better impact on sustainable aquaculture.

Decree of the Minister of Maritime Affairs and Fisheries No. 15 of 2022 states that in order to develop export-oriented vannamei shrimp aquaculture, it is necessary to increase the production and productivity of vaname shrimp in a sustainable manner, therefore general guidelines for the development of area-based vaname shrimp farming must be prepared. An explanation of the meaning of sustainability itself can be seen more in the appendix which has captured in detail the activities from planning, development, implementation, monitoring, evaluation, and reporting of sustainable shrimp farming activities. The document also mentions mangroves as an important element in shrimp farming design.

Decree of the Head of the National Standardization Agency Number 521 of 2022 stipulates SNI 8680: 2022 concerning Shrimp Pond wastewater treatment plants as a revision of SNI 8680: 2018 Facilities and infrastructure for waste management of Penaeid shrimp farming. Details and references of WWTPs for aquaculture in accordance with SNI are contained in the appendix, which can later become a reference for making WWTPs that suit the needs of the community to support sustainable shrimp farming.

Table 3.11. National regulations related to mangrove restoration

Regulation	Concerning	Purposes
Presidential Regulation No. 73/2012	National Mangrove Ecosystem Management Strategy	Division of tasks in mangrove ecosystem management
Government Regulation of the Republic of Indonesia No. 13/2017	National Spatial Plan	Zonation regulations for mangrove ecosystem areas
Coordinating Minister for Economic Affairs Regulation No. 4/2017	National Mangrove Ecosystem Management Policies, Strategies, Programs, and Performance Indicators	Establish national mangrove ecosystem management policies, strategies, programs, and performance indicators that need to be used as guidelines for related parties to carry out mangrove ecosystem management.
Minister of Environment Regulation No. 23/2021	Forest and Land Rehabilitation Implementation	Technical and procedures for mangrove restoration
Coordinating Minister for Maritime Affairs and Investment Decree No. 121/ 2023	National Mangrove Ecosystem Management Working Group	Establish a National Mangrove Ecosystem Management Working Group, hereinafter referred to as Pokja

Presidential Regulation No. 73/2012 discusses the National Strategy for Mangrove Ecosystem Management, which is an effort in the form of policies and programs to realize sustainable mangrove ecosystem management and sustainable prosperous communities based on available resources as an integral part of the national development planning system, as stated in Article 2. To implement this strategy, a National Coordination Team for Mangrove Ecosystem Management was formed.
Government Regulation No. 13/2017 discusses that zoning regulations for mangrove ecosystem areas need to be prepared by considering the use of space for nature tourism, research and development, and science; provisions prohibiting the use of mangrove wood; and provisions prohibiting activities that can change, reduce the area, and/or pollute mangrove ecosystems, as stated in Article 103.

Coordinating Minister for Economic Affairs Regulation No. 4/2017 sets out the virtues, strategies, programs, and performance indicators of national mangrove ecosystem management that need to be used as guidelines for relevant parties to carry out mangrove ecosystem management, as stated in Article 1 and Article 2. In the introduction of the appendix, it also mentions at least four important values of mangrove ecosystems, namely ecological importance, socio-economic importance, institutional importance, and legislative importance.

Minister of Environment Regulation No. 23 of 2021 regulates the procedures for implementing forest and land rehabilitation, including mangrove and peatland ecosystems, as stated in Article 4. This rehabilitation activity can be carried out through the stages of reforestation activities and the application of civil technical soil conservation techniques through the construction of soil and water conservation buildings, as stated in Article 19. This regulation in more detail also discusses several technical planting patterns for mangrove ecosystems specifically discussed in Appendix VI, including pure planting patterns, Silvo fishery, and plant enrichment.

Decree of the coordinating minister for Maritime Affairs and Investment No. 121/2023 focuses on the discussion of establishing a National Mangrove Ecosystem Management Working Group, hereinafter referred to as the Pokja. The functions of this working group include problem identification, policy development, and monitoring and evaluation of national mangrove management in accordance with the annual mangrove roadmap; preparation of national mangrove management regulations and institutions; and updating and verification of the National Mangrove Map. This regulation is also made to facilitate coordination between cross-policy stakeholders.

Table 3.12. National regulation related to GESI

Regulation	Concerning	Purpose
Presidential Instruction of the Republic of Indonesia No. 9/ 2000	Gender Mainstreaming in National Development	Integrating gender mainstreaming into all national development processes
Minister of State for Women's Empowerment and Child Protection Regulation No. 1/2011	National Socio-Cultural Strategy to Achieve Gender Equality	Become a reference for all government agencies and the community in changing mindsets, attitudes and patterns of action through a socio-cultural approach to realize gender equality.
Minister of Marine Affairs and Fisheries Regulation No. 51/2016	Guidelines for Mapping the Implementation of Gender Mainstreaming in the Marine and Fisheries Sector in the Region	Strategies to integrate a gender perspective in all aspects of development to achieve gender equality and equity between women and men at the regional level

Presidential Instruction No. 9/2000 states that gender mainstreaming into the entire development process is an integral part of the functional activities of all government agencies and institutions at the Central and Regional levels, to encourage, streamline, and optimize gender mainstreaming efforts in an integrated and coordinated manner.

The Minister for Women's Empowerment and Child Protection Regulation No. 1/2011 on the National Socio-Cultural Strategy to Achieve Gender Equality is intended to serve as a reference for all government agencies and the community in changing mindsets, attitudes and patterns of action through a socio-cultural approach to achieve gender equality. Gender equality is an equal condition and position that describes a harmonious and balanced partnership between men and women in access, participation, control and obtaining equal and fair benefits from development results.

The Minister of Marine Affairs and Fisheries Regulation No. 51/2016 explains the strategy to improve the effectiveness of the implementation of gender mainstreaming in the marine and fisheries sector in the regions. it is necessary to integrate gender mainstreaming between the national and the regional level through mapping the implementation of gender mainstreaming. The guidelines for Mapping the Implementation of Gender Mainstreaming in the Marine and Fisheries Sector in the Region are a reference for the Ministry of Maritime Affairs and Fisheries in implementing gender responsive programs/activities in the marine and fisheries sector in the region.

In addition to the national-level regulations identified and analyzed, Table 3.13 describes provincial-level regulations plus the strategic plans of relevant district-level agencies.

Table 3.13. Provincial Regulation and Regency Document Strategic Plans

Regulation	Concerning	Purpose
East Java Governor Regulation Number 37/2022	Guidelines for Environmental Orientation and Sustainable Management of Traditional Ponds of Tiger Shrimp and Vaname Shrimp	Improving sustainability and efficiency in shrimp farming and protecting the environment in East Java.
Banyuwangi Regency Fisheries Agency	Strategic Plan of Banyuwangi Regency Fisheries Agency 2021 - 2026	The purpose of preparing this strategic plan is to realize the desired situation in the field of fisheries and aquaculture in the period 2021-2026 in accordance with the vision, mission and program of the Regional Head.
Banyuwangi Regency Environmental Agency	Strategic Plan of Banyuwangi Regency Environmental Agency 2021 – 2026	Regional development planning document for the implementation of environmental management in Banyuwangi in the period 2021-2026, in line with the RPJMD and Regional Head.

East Java Governor Regulation No. 37 of 2022 states that traditional pond management must be carried out with due regard to the balance of environmental ecosystems in environmental oriented and sustainable pond management. The management of traditional tiger shrimp and vaname shrimp ponds can be carried out simultaneously with mangrove restoration, so that it is expected to realize a harmonious and sustainable environmental ecosystem.

At the district level, the Banyuwangi Fisheries Service strategic plan document contains every activity that will be carried out in the 2021-2026 period related to improving the economy of the fisheries community, including aquaculture. Attention to the development

of aquaculture is implemented through fiscal and non-fiscal support aimed at improving the welfare of small-scale aquaculture business actors. In addition, government policies are also directed at preserving fish resources and the environment. The Banyuwangi Fisheries Service itself has carried out several activities and will continue for years to come. The activities include, among others, capacity building of traditional farmers through proper aquaculture training; assistance in certification of Good Aquaculture Practices (CBIB); assistance program to increase shrimp farmer production through round pond grants; revitalization of shrimp pond waterways; and assistance to traditional shrimp farmer infrastructure facilities. All these activities are in line with the program's objective to increase the production of traditional shrimp farmers with sustainable environmentally friendly farming techniques.

Meanwhile, the Banyuwangi Environmental Agency (DLH) in the 2021-2026 strategic plan document describes future activity plans that focus on environmental supervision, control and management. In the strategic plan, DLH also mentions pollution control activities through industrial waste monitoring facilities and public waters. Although until now the DLH Banyuwangi was very rarely involved in the shrimp pond area, they have begun to actively socialize the process of obtaining environmental permits and facilitate pond discharge tests for periodic reporting. DLH Banyuwangi also has a working structure in the field of conservation and rehabilitation where in the coastal area they focus more on capacity building activities for conservation actors.

3.2.2. Policy Recommendation: Gap, Challenges, and Opportunities for the development of Integrated sustainable aquaculture regulations.

At this stage, there are no specific regulations stipulating that the integration of mangrove and shrimp aquaculture must be conducted to support climate resilience. However, the current regulatory paradigm at the national and regional levels is already directed towards sustainability goals. For instance, the East Java Governor Regulation No. 37 of 2022 suggests the combination of mangroves near pond areas. This is also reflected in the regulation of the Decree of the Minister of Marine Affairs and Fisheries of the Republic of Indonesia Number 15 of 2022, which states similar suggestions.

The implementation that can be supported in the CSSA program is strengthening technical regulations and examples of mangrove and shrimp pond integration that align with sustainable aquaculture and climate resilience. MMAF in one of its presentations stated that currently, several issues need to be addressed in shrimp farming, namely low compliance with licensing, no quality standard for shrimp pond discharge water, no standardized WWTP model, and a mangrove-integrated shrimp farming pilot is needed (KKP, 2024). Applying WWTP models and integrated shrimp farming will later be strengthened in line with the objectives of the CSSA program, apart from law enforcement which must remain a concern of the central and regional government.

In the future, the implementation of CSSA is expected to support blue economy-based shrimp farming programs and policies launched by MMAF. Sustainable shrimp farming itself can support blue economy development goal number 3, namely the development of sustainable marine, coastal, and inland aquaculture (KKP, 2024). The CSSA concept that integrates shrimp farming, mangrove restoration, and communal WWTP construction is expected to support the blue economy program to achieve sustainable aquaculture production targets and increase the mangrove restoration area that has been set by the government. In the long term, if the implementation of CSSA is successful, this practice can be implemented in other parts of Indonesia.

Peatland and Mangrove Restoration Agency (BRGM) in one of its presentations explained that one of the problems often faced is that there is still a negative stigma from shrimp farmers that planting mangroves

in ponds will interfere with pond productivity (BRGM, 2024). As for the CSSA concept, mangroves are the focus of the nature-based solution concept to make pond discharge water of better quality.

CSSA activities will also focus on strengthening the capacity of the community by conducting several mangrove restoration training courses and creating a guidebook for preparing mangrove restoration stages in accordance with aquaculture activities. Regular monitoring will also be an important part of this program. Thus, after implementation, this activity can be proof that mangroves can synergize well with ponds and coastal ecosystems. Some of these things are expected to strengthen the regulations that came from evidence-based research.

The aquaculture sector still lacks the involvement of marginalized people and women. Although women are often involved in aquaculture-related activities, such as fishery product processing, they are often marginalized from key management and decision-making roles. Existing aquaculture sector policies are generally not inclusive enough to empower women and marginalized groups, preventing them from fully participating in the development of the sector (FAO & World Fish, 2017; World Bank, 2022).

In Table 4, several regulations have recognized the importance of gender mainstreaming in various national activities. However, there is a need to strengthen regulations at the local level (provincial and regency), which should be proven by concrete examples of how the involvement of marginalized groups and women is more inclusive from design to implementation to program evaluation. It is also aligned with the targets in CSSA activities, to increase the capacity of marginalized groups and women in the aquaculture and shrimp farming sectors. CSSA practice is expected to become a model for other sustainable aquaculture and other activities with a wider scope in Indonesia.

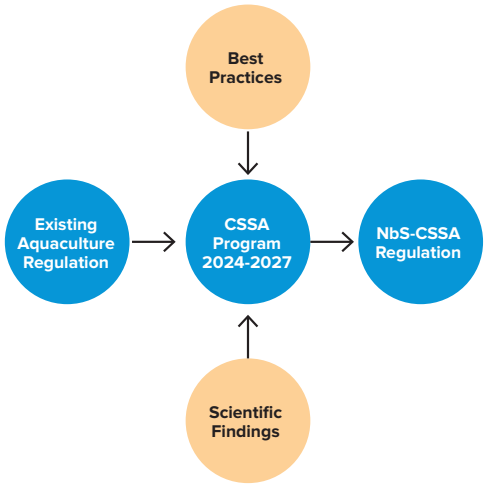
In addition, the Government of Indonesia (GoI) has already put gender equality and inclusive society as a part of the objective of the Long-Term Development Plan 2025-2040, which is also an opportunity for GESI implementation in the CSSA program. A summary of the analysis of sustainable aquaculture policies and their relation to the CSSA program can be seen in Table 3.14.

Table 3.14. Summary of the Gap Analysis, Challenges, and Opportunities.

Gap	Challenges	Opportunities
Currently, several regulations at the national and provincial levels have led to the paradigm of sustainable cultivation, but there are no technical regulations that specifically regulate sustainable shrimp aquaculture that can support climate resilience.	Pilot location and document of mangrove-shrimp pond integration and communal WWTPs are required, which will be combined as supporting data and a new approach to sustainable aquaculture.	The CSSA program can provide examples of evidence-based regulation, such as pilot plans of communal WWTPs that are also integrated with shrimp-mangrove ponds, which are ideal for supporting sustainable aquaculture and resilience to climate change.
Details of the mangrove implementation phase have been highlighted in sufficient detail at the national level. This can still be improved by strengthening mangrove restoration regulations at the provincial and district levels.	Provide concrete evidence that mangroves are a nature-based solution for shrimp farming. As well as the planning and implementation of mangrove restoration that is appropriate for shrimp farms and coastal areas.	The CSSA program can provide periodic mangrove monitoring data that can serve as robust data for mangrove restoration in line with shrimp farm productivity and sustainability. The CSSA program is also targeted to produce a mangrove restoration guidebook that suits the needs of the pond and coastal areas, accompanied by strengthening the capacity of community groups and providing other alternatives for implementing NbS in the shrimp pond area.
Directives for Gender Equality, Disability, and Social Inclusion (GEDSI) policies have been recognized in several regulations at the national level. Policy strengthening can be done at the provincial and district levels.	Provide concrete examples of how marginalized people and women are involved in environmentally friendly shrimp farming programs to increase their individual and group capacity.	The CSSA program can illustrate how marginalized people and women are involved in initiation, implementation, and program evaluation.

Figure 3.4. below illustrates how the CSSA program can support the reform of sustainable aquaculture regulations. Through best practices that will be implemented together with local communities and scientific findings and data collection, it is expected that regulations targeting nature-based solutions and climate resilience can influence the direction of sustainable shrimp aquaculture and produce evidence-based policies and practices.

Figure 3.4. Illustration of the process of reforming sustainable cultivation regulations in Indonesia



3.3. NbS in Shrimp Aquaculture

Nature-based solutions (NbS) have emerged as a vital approach to addressing environmental, social, and economic challenges in aquaculture. In shrimp farming, the adoption of NbS offers a sustainable alternative to conventional methods, enabling farmers to reduce their environmental footprint while enhancing productivity and resilience. These solutions, such as mangrove restoration and the use of mangrove biofiltration systems, leverage natural processes to improve water quality, manage farm effluent, and mitigate climate-related risks (Goto *et al*., 2023). Beyond their environmental benefits, NbS contributes to long-term economic efficiency by lowering operational costs and fostering access to premium markets that prioritize eco-friendly practices (Goto *et al*., 2023; Phong *et al*., 2022). Furthermore, they align with national and global policies on sustainability in aquaculture, providing opportunities for certification and improved marketability (Goto *et al*., 2023). By analyzing the implementation of NbS in shrimp farming, it becomes possible to evaluate their effectiveness, examine the challenges faced by farmers in implementing NbS, and promote scalable solutions that ensure the sustainability of shrimp aquaculture.

Based on the results of in-depth interviews and focus group discussions with several shrimp farmers in the Karangrejo and Wringinputih villages, it was found that respondents were already implementing nature-based solutions to address various challenges in their farming activities. Farmers encountered issues in seven of the nine topics discussed, namely land management, water supply, post-larvae, feed, diseases, pests, and water quality. In contrast, the other two topics, labor and harvesting, were considered non-problematic by all three farmers interviewed. All respondents indicated that they employed nature-based solutions to tackle challenges in all areas except pest management. At least one farmer continued to use chemical pesticides to manage pest populations in their ponds. Additionally, the respondents revealed that some farmers in their village continue to rely on non-nature-based solutions for six of the problematic topics, excluding water quality management. A summary of the overall findings from the in-depth interviews is presented in Table 3.15.

Table 3.15. Challenges and Solutions Implemented by Shrimp Farmers in Karangrejo and Wringinputih Villages

Topics	Challenges	Nature-based Solutions	Non-Nature-based Solutions
Land management	• Coastal erosion damages production infrastructure and erodes land intended for farming. • Several sites within the owned land, suitable for constructing production facilities, remain unused due to budget constraints.	• Sustainable coastal erosion control through mangrove planting in appropriate locations. • Maximizing the use of existing production facilities and optimizing yield by implementing efficient stocking density.	• Altering land structure by building artificial low-cost embankments to mitigate erosion effects.
Water supply	• Water used for production is contaminated with high organic substances due to pollution from large-scale intensive farms, leading to harmful algal blooms	• Ensuring polluted water does not enter active ponds and delaying pond activation until the overall water quality returns to normal.	• Insisting on attempting pond activation using water supplies, despite the overall water quality still not meeting the applicable standards.
Post-larvae	• In previous years, farmers relied on wild-caught post-larvae, but availability has become scarce and inconsistent, and quality is now inferior to hatchery-produced post-larvae.	• Using high-quality post-larvae from hatcheries certified for Good Hatchery Practices (CPIB) and seek free post-larvae from the regional fisheries agencies.	• Continuing to use wild-caught and/or uncertified hatchery post-larvae, which vary in quality and quantity, either consistently or opportunistically.

Topics	Challenges	Nature-based Solutions	Non-Nature-based Solutions
Feed	• Difficulty in balancing feed protein content and the amount of feed that can maintain proper nitrogenous compound levels in the water, while also optimizing shrimp growth. • The essential micronutrient composition of factory-produced feed is considered inadequate to maximize disease resistance and optimize shrimp growth.	• Using live feed during the appropriate phase before switching to artificial feed, ensuring the protein content in the artificial feed adheres to national standards, and providing feed at satiation based on the results of leftover feed observations. • Increasing feed micronutrients by adding papaya leaf, *Moringa oleifera* leaf, and/or garlic extract, and vitamins C and B complex.	• Using synthetic chemicals, hormones, and antibiotics as growth promoters and disease resistance enhancers.
Disease	• Acute hepatopancreatic necrosis disease, white spot syndrome, and white feces disease, often affect shrimp when water parameters, especially nitrogenous compounds, exceed the standards and/or the seeds used are suboptimal.	• Implementing effective water quality management and using vitamin and/or phytobiotic-fortified feed to prevent disease occurrence. If mortality and disease symptoms show no improvement, partial harvest will be carried out.	• Using antibiotics in curative efforts for shrimp diseases. The commonly used antibiotics are those that are sold over the counter and are affordably priced, such as ciprofloxacin and norfloxacin.
Pests	• Crabs, snails, and small fish often enter production ponds and increase competition for feed and oxygen, raising disease risks and predation threats.	• Using saponin in an adequate dose as a natural pest remover and manually removing visible pests.	• Using pesticides containing harmful chemicals, with endosulfan and triphenyltin being commonly found in the inorganic pesticides used.
Water quality management	Maintaining overall water parameters that support the physiological needs of shrimp is challenging due to unstable weather, fluctuating contaminant levels in the water supply, and difficulties in determining a balanced amount of feed.	Periodically adding probiotics and agricultural lime to pond water, conducting water quality testing, and for some equipped farmers, siphoning shrimp waste and using a protein skimmer and/or supply water filter.	N/A

The land and production facilities owned by the three interviewed shrimp farmers were partially located in buffer zones affected by coastal erosion. The farmers reported that erosion had reduced their land area and damaged the ponds they had built. Constructing production facilities in buffer zones is generally prohibited, as these areas are classified as protected zones under state control, as stipulated in Article 5, Section 2 of Act No. 26 of 2007. However, indigenous communities, local residents, and traditional coastal communities have special rights to manage buffer zones, as stated in Article 61 of Act No. 27 of 2007. While shrimp farming operations may be permitted in buffer zones, businesses must balance environmental conservation with operational sustainability to minimize potential negative impacts. The management and utilization of land in coastal buffer zones must remain under strict control, both in terms of policy and implementation in the field, particularly if the buffer zones are utilized for aquaculture activities (Yati *et al*., 2023).

The farmers interviewed have implemented mangrove planting along the coastline near their ponds as a strategy to mitigate further erosion of their land. The farmers mentioned financial constraints as a major challenge in repairing damaged production facilities, leaving them to focus solely on preventing erosion through mangrove planting. Additionally, limited funds have hindered the utilization of their

remaining unproductive land for developing ponds or other production facilities. As a result, the farmers have adopted aquaculture practices suggested by researchers and fisheries agencies, such as optimizing stocking density and providing balanced feed, to maximize production outcomes. The integration of mangrove planting around shrimp ponds with effective management practices has been shown to have a positive correlation with harvest yields in other regions. The harvests of black tiger shrimp (Penaeus monodon) and various local shrimp species, including Penaeus indicus, Penaeus merguiensis, Metapenaeus ensis, and Metapenaeus lysianassa, are significantly higher when good management practices and mangrove planting are integrated into the aquaculture system (Tran *et al*., 2021).

Nearly all respondents cultured their shrimp in traditional and semi-intensive systems, while a small portion employed intensive systems. The non-intensive farmers relied on seawater from coastal areas as their cultivation medium, utilizing tidal phenomena. Pond water was filled during high tide, and just before harvest, wastewater was discharged back through the same channel into the mangroves area during low tide. Aquaculture operations employing this system have the potential to pollute coastal waters if not properly managed, and the cultivation process is also susceptible to the impact of contaminated water supplies (Shen *et al*., 2010). Poorly managed pond wastewater has been shown to cause eutrophication, oxygen depletion, sedimentation, and the spread of diseases in water supplies (Wu *et al*., 2014; Cui *et al*., 2017). The farmers reported instances of postponing pond operations due to substandard water quality. Based on their experiences, other farmers who continued to use water supplies of poor quality often ended up in harvest failures. They argued that the wastewater from their ponds did not contribute to the degradation of water quality. Instead, the interviewed farmers believed that the primary cause of water supply degradation was untreated wastewater discharged by large-scale intensive shrimp farming companies.

All shrimp farmers interviewed primarily cultured Pacific white shrimp (Litopenaeus vannamei) using post-larvae sourced from hatcheries certified under the Good Hatchery Practices (CPIB) and/or from government-supported post-larvae distribution programs provided by Regional Fish Larvae and Fingerlings Center. Before using these sources, the farmers typically relied on wild-caught local shrimp post-larvae (Fenneropenaeus indicus) collected by local fishers. The farmers revealed that wild-caught shrimp post-larvae have become increasingly scarce, prompting a shift to hatchery-sourced post-larvae, which are considered more consistently available and of higher quality than their wild counterparts. The declining availability of wild shrimp post-larvae is associated with overfishing and coastal environmental degradation (Richardson *et al*., 2023). A case study in Bangladesh indicated that harvesting shrimp post-larvae from the wild has led to decreased biodiversity and habitat destruction, contributing to the decline in populations of both target shrimp species and other pelagic organisms (Ahamed *et al*., 2012). Additionally, wild-caught post-larvae are known to exhibit variability in both quantity and quality and are a potential source of pathogen introduction into aquaculture systems (Coman *et al*., 2005; Meng *et al*., 2009).

Some shrimp farmers face challenges in determining the optimal protein level in feed that can promote shrimp growth while minimizing the impact on pond water quality. Currently, the farmers interviewed typically do not feed newly cultured post-larvae with anything other than naturally occurring live feed in the pond. The shrimp consume this feed until they reach a size appropriate for artificial feed. Once this size is reached, artificial feed with protein content that meets national standards is provided to satiation. Anco is used as a tool to assess whether the amount of feed given during each feeding session satisfies the post-larvae. This method aligns with responsible feed management practices, as overfeeding not only negatively affects shrimp health but also increases waste production. Excessive feeding can deteriorate water quality (Cook

& Clifford, 1997) and elevate ammonia levels, which are toxic to shrimp. The protein content in the feed is also directly correlated with ammonia concentration in water (Brunty *et al*., 1997). Furthermore, uneaten feed and waste excreted by shrimp pose environmental risks when discharged in excess into coastal waters (Goto *et al*., 2023).

All respondents do not use harmful substances, either to accelerate shrimp growth or to prevent and manage shrimp diseases. However, they mentioned that some other farmers in their village still use synthetic chemicals and antibiotics in their farming practices. The interviewed farmers enrich artificial feed, which they consider nutritionally suboptimal, with eco-friendly additives to enhance the shrimp's disease resistance. The additives used are generally phytobiotics, such as papaya leaf, Moringa oleifera leaf, and garlic extracts, or supplements like vitamin C and B complex. Additionally, responsible water quality management is implemented to prevent stress in shrimp, ensuring that their disease resistance is maintained. The use of herbal ingredients and vitamins is considered a safer and more efficient alternative to prevent disease compared to the use of antibiotics and other chemicals typically employed in curative measures (Seethalakshmi *et al*., 2021). The use of antibiotics in shrimp farming has been restricted due to the risk of pathogens developing resistance and the potential for antibiotic residues to remain in the shrimp (Seethalakshmi *et al*., 2021). Several measures have been shown to effectively reduce the use of antibiotics and other chemicals by farmers, including providing technical training, offering premium prices for organic shrimp, and providing antibiotic residue testing results for the farmed shrimp (Suzuki *et al*., 2023).

Similarly, in efforts to control pests, most of the interviewed farmers choose not to use harmful chemicals. Most respondents were found to manually remove pests from the pond and use saponin to eradicate pests. Saponin, a natural pesticide commonly derived from Camellia sinensis plants, has been confirmed to have no significant toxic effects on shrimp (Lu *et al*., 2000; Yasir *et al*., 2021). Saponin is effective only against organisms with erythrocytes, such as snails and fish. Since shrimp do not have erythrocytes, they are not directly affected by the toxicity of saponin at low doses (Yasir *et al*., 2021). The use of saponin at doses of 100-200 kg/ha has proven effective in controlling pests like tilapia without causing mortality in farmed shrimp (Yasir *et al*., 2021). However, despite the effectiveness of saponin, one of the interviewed farmers continues to use a commercial chemical-based pesticide containing endosulfan and triphenyltin, both of which are considered hazardous. Therefore, efforts to introduce saponin and support access to it, or similar natural alternatives, are necessary to help more farmers adopt more environmentally friendly farming practices.

The water quality management practices implemented by the farmers include the application of lime and probiotics, water quality monitoring, siphoning, and the use of IoT-based water quality monitoring systems, physical filters, and protein skimmers. Lime is used to stabilize pH and supply calcium (Ca) and magnesium (Mg), while probiotics help maintain the balance of microbiomes in the pond water and the shrimp itself. The use of lime and probiotics has been reported to have a minimal environmental impact compared to their absence (Mustafa *et al*., 2010; Vieira *et al*., 2021). Additionally, some farmers have adopted IoT-based technology to monitor water quality in real-time, enabling more accurate and quicker assessments. Some farmers also use protein skimmers, siphons, and physical filters to assist in managing pond water quality. Protein skimmers and siphons have been shown to reduce suspended solids, ammonia levels, and nitrite concentrations resulting from uneaten feed or metabolic waste settling at the bottom of the pond (Djunaedi *et al*., 2016; Renitasari *et al*., 2020). Similarly, physical filters can reduce the number of suspended solids with larger particles from the water used in the culture medium (Djunaedi *et al*., 2016).

The respondents stated that they did not face any challenges in the aspect of labor management in their shrimp aquaculture operations. Traditional and small-scale semi-intensive farmers interviewed were found to hire workers only during the preparation and harvest periods. Workers are paid based on the number of workdays, with daily wages ranging from IDR 120,000 to 150,000. In one cycle, labor is typically required for 5 to 7 days to assist in pond preparation and 1 day during shrimp harvesting. In contrast, intensive and larger-scale semi-intensive farmers not only hire daily workers for preparation and harvest but also employ permanent staff, including technicians, administrators, and feeders. The wages given for technicians and administrators align with the regional minimum wage (UMR), while feeders receive slightly lower compensation. Workers are provided with facilities such as accommodation (including food and housing), health insurance, adequate days off, reasonable working hours, religious holiday allowances, and harvest bonuses at a certain percentage.

Harvesting can be done either partially or fully, and no special treatment is carried out before harvesting. Partial harvesting is usually done to reduce pond density, thereby increasing the carrying capacity of the pond, allowing some shrimp to grow larger, or as an emergency measure when disease outbreaks are uncontrollable. During harvesting, nets are installed at the outlet, and the pond water is drained to a certain level. Then, shrimp can be collected using a net. Although the respondents did not perform special treatments before or during harvesting, some farmers, according to Khumaidi *et al*. (2012), ideally monitor the condition of the shrimp before harvesting. If the shrimp are molting, lime is applied to accelerate the molting process. Harvesting can then be conducted after the shrimp have finished molting and their exoskeletons have hardened.

04
CONCLUSION AND RECOMMENDATIONS

» There are more stakeholders in the high-influence, high-interest category than in the other three categories. They include village government officers, shrimp farmers, community leaders, academicians, scientists, and tourism operators. They should be prioritized to be engaged in the CSSA program implementation. Those in the high-influence, low-interest category especially women groups in the two villages should be prioritized to their awareness and understanding of the CSSA program.

» Women play important roles in the shrimp industry, both in on-farm and off-farm activities. Their involvement in the CSSA program manifests and embodies gender transformative principles in the program. Although they may intensively influence and even determine all their farm decision-making, they do not have the capacity and opportunity to make decisions at the community level. Hence, women's groups or organizations should be strengthened. Their involvement and participation in the communal and village levels of decision-making should be guaranteed and improved. The Banyuwangi's Fisheries Agency should deliberately design and implement training, learning, education, extension, and knowledge exchange programs to upskill women's capacity and strengthen their organization.

» Stakeholders with low influence but high interest, such as the Fisheries Training and Counselling Center should be involved in technical activities that support program development. Meanwhile, actors with low influence and interest, such as fishermen groups, Banyuwangi Cooperatives Agency, as well as Universitas PGRI Banyuwangi, and Politeknik Negeri Banyuwangi, should still be involved when relevant, such as in training activities or ceremonial events, to ensure their support for the sustainability program.

» Although regulations on aquaculture, mangrove, and GESI are available at the national level, they cannot be automatically applied in Banyuwangi due to the lack of technical directives. The local government especially the Fisheries Service should actively request technical guidance from the Central Government, then adapt and apply these regulations with respect to the local condition.

» The local shrimp stakeholders, including large-scale intensive and small-scale traditional pond owners and operators have recognized the importance of sustainability shrimp culture. They also have understood that sustainability practices will determine the values of their products in international markets. Hence the sustainability of shrimp aquaculture, manifested by the CSSA, could be a solution to very competitive and stringent global market requirements. Therefore, the CSSA should be developed and implemented in Banyuwangi. Details of shrimp pond management, sustainable mangrove utilization and management, and communal WWTP as ideally planned by the CSSA program intervention should be implemented.

» Science-based evidence and community best practices resulting from the CSSA implementation in Banyuwangi are expected to provide inputs and recommendations for regional or national policy improvement. The CSSA hence needs to be designed and implemented in Banyuwangi and later in other regions of Indonesia through government education and training programs, Shrimp farmers in Banyuwangi encounter technical challenges such as land management, water supply, post-larvae sourcing, feed optimization, disease control, pest management, and water quality. NbS such as mangrove planting, have been implemented to combat coastal erosion, while eco-friendly additives like *phytobiotics* and vitamins are used to enhance shrimp disease resistance. Water quality is managed through lime application, probiotics, and advanced tools like monitoring systems, protein skimmers, and physical filters. While most farmers have avoided harmful chemicals and substances in pest and disease control by choosing eco-friendly methods (i.e., saponin and phytobiotics) others use synthetic pesticides and antibiotics. Additionally, the transition from wild-caught to hatchery-labeled seeds has improved the reliability and quality of harvest. The presence of farmers still implementing non-NbS solutions highlights the need for increased efforts to support farmers transitioning from unsustainable practices to the wider adoption of NbS practices.

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001	*Feasibility Study of MPA 30% by 2045 Vision*
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