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Integrating Community Perspectives and Scientific Tools for Exploring the Potential of Sustainable Mariculture Development in Mohéli, Comoros

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ABSTRACT

Mariculture, or the cultivation of aquatic organisms, holds the potential of enhancing food security, income diversification, and overall economic sustainability. To ensure its growth in the long run, it had to be sustainable, particularly from the perspective of local communities, economically profitable, and environmentally friendly. This paper aimed to assess the acceptability of the feasibility of potential mariculture development in Mohéli, Comoros, a place with no existing mariculture activity, using Multi-Criteria Decision Analysis (MCDA), scenario planning, and stakeholder preference elicitation. To collect data, interviews and focus group discussions were conducted with key stakeholders, including local fishers, lawmakers, and environmental experts. The results of the study showed that economic gain was the main driving force behind the support for mariculture in the assessed communities, but acceptability was also influenced by environmental aspects. Of the many mariculture options, seaweed farming was found to be the most recommendable because of its short harvest period, minimal negative impact on the environment, and low costs. The study demonstrated a need for targeted awareness campaigns, collaborative decision-making, and strategic changes in management to address ecological and socio-economic challenges. The present research could be helpful in this regard as it suggested a method of integrating community interests with scientific decision-making tools to develop a roadmap for the growth of sustainable mariculture while ensuring that there is harmony between social, environmental, and economic aspects of development in coastal areas.

Keywords: Community Acceptance, Mariculture, Multi-Criteria Decision Analysis, Mohéli, Sustainability

INTRODUCTION

Mariculture, or the cultivation of marine species in coastal and open ocean environments, has notably accelerated over the past two decades globally (Alleway *et al.* 2019; Naylor *et al*. 2021). It contributes to solving the problems of food security by offering noteworthy economic opportunities and serving as a sustainable source of marine products (Gul *et al*. 2024). Nevertheless, the increasing relevance of sustainability in mariculture brings forward considerable environmental issues, primarily concerning industrial fish farming (Folke and Kautsky, 1992; Allsopp *et al.* 2013). The waste from soluble fish excretion, feces, and surplus feed promotes pollution, eutrophication, and degradation of the water and coastal ecosystems (Tovar *et al.* 2000). These issues illustrate the need for policies that ensure ecological preservation while also addressing social and economic development challenges.

Small Island states have specific opportunities and difficulties when it comes to mariculture (Liu *et al*. 2018). Given that the inhabitants of these islands usually rely greatly on the ocean for their employment and nutrition, the introduction of mariculture would enhance economic diversification, provide alternative employment, and reduce the pressure on capture fisheries (Bell *et al*. 2009). On the other hand, small islands are limited in regard, e.g., to their freshwater resources, space, and even ecological carrying capacity. Hence, there is a need for careful consideration of the space that is available, the involvement of the stakeholders, and the adoption of environmentally sustainable practices such as low-impact agriculture and Integrated Multi-Trophic Aquaculture (IMTA) to properly and sustainably implement mariculture (Santos *et al.* 2014). To prevent disputes and enhance acceptability over the long run, mariculture development must be in line with regional cultural customs, political systems, and financial requirements (Morgan *et al*. 2017; Pollnac 2019).

The present study assesses the preconditions for mariculture introduction in a small island environment without prior experience in mariculture activities, focusing in particular on the perspectives of local coastal communities and technical experts. The research was conducted on the island of Mohéli, which is part of the Comoros archipelago and famous for having diverse marine life, which includes coral reefs, seagrass meadows, and mangrove forests, as it houses

several marine life species (Granek and Brown, 2005). These ecosystems are nourishing and protective for coastal societies and cultures around the world (Gilbert 2006). However, the pressure on these resources is increasing (DGRH 2016). Most of the population depends on traditional and artisanal fishing as a source of income and food, although these activities are deemed insufficient to sustain the national demand (DGRH 2021). The country's marine ecosystems are jeopardized by this overreliance, mainly due to inefficient fishing techniques with low output, and by increasing climate change (Cowburn *et al.* 2018).

Mariculture offers an attractive alternative with the potential of filling the gap in food production, providing employment generation opportunities, and reducing threats to fragile ecosystems (Le Gouvello et al. 2017; Bush *et al.* 2010). It is important, though, that its promotion in Mohéli is based on a nuanced understanding of sociocultural and ecological aspects (Krause *et al.* 2015). Doing so necessitates a participatory stakeholder focus, local understanding, and a sound public policy process (Abreu *et al.* 2017). This study aims to evaluate the potential feasibility and social acceptability of mariculture in Mohéli by an integrated analysis of socio-economic and cultural factors, together with environmental aspects. It employs a Multi-Criteria Decision Analysis (MCDA) technique combined with scenario planning and preference elicitation to guide the sustainable development of mariculture in Mohéli (Zheng *et al.* 2016; Munda 2004; Montibeller *et al*. 2006). It considers key criteria like ecological sensitivity, economic viability, and social acceptability by engaging local stakeholders like fishermen, local leaders, technical experts, and staff (Albasri 2018). In particular, the study was designed to a) assess the main environmental and economic conditions that may favor the implementation of mariculture, b) investigate the opinions of community members and other stakeholders regarding mariculture, c) determine the type of mariculture that would be the best suited locally based on scientific and local information, and d) provide the basis for formulating a holistic long-term sustainability plan for mariculture.

MATERIAL AND METHOD

Study Area

The study was conducted in eight villages on Mohéli, Comoros, in September 2024. The island is located in the north of Madagascar and east of the African mainland (12.29°S, 43.75°E), and is bordered by the Mozambique Channel and the Indian Ocean (Figure 1).

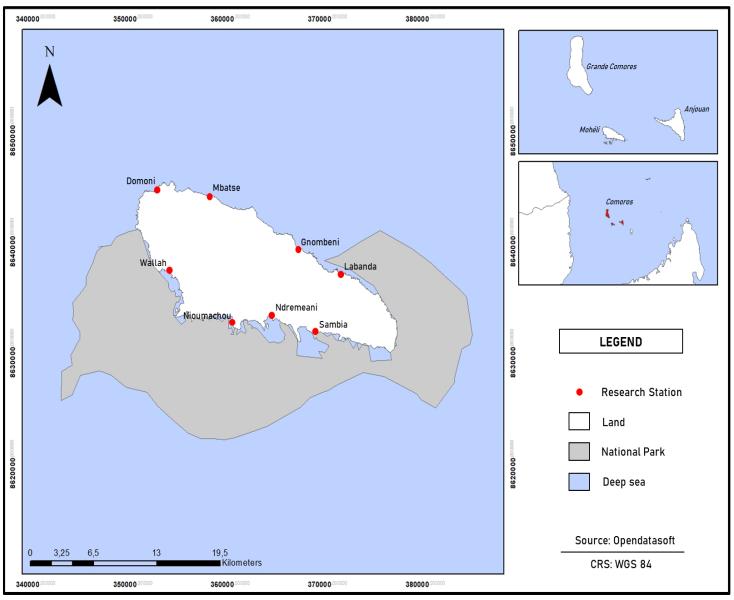

Figure 1. Research locations around Mohéli, Comoros

Mohéli, the smallest of the three main islands in the Union of the Comoros, was renowned for its unspoiled natural environment. The island boasted diverse ecosystems, including coral reefs, seagrass beds, mangroves, and tropical forests, which supported rich biodiversity and provided essential livelihoods and food sources for its inhabitants. As mariculture is not been introduced yet in Comoros, traditional and artisanal fishing remained the primary means of obtaining fish on the island. However, fish production has declined over time, failing to meet the growing demand of the community. While the number of fishers had been slowly increasing over the years, fish production has declined considerably over the

same period, indicating a dramatic decline in CPUE (Table 1).

Table 1. Evolution of the number of fishers vs production in recent years

Year	Fishermen with Boats	Shore Fishers	Production/tones
2016	442	526	1897
2018	473	572	1356
2020	473	572	1204

Source: General Direction of Fisheries Resources of Comoros (DGRH, 2021)

Methodology

The study began by establishing goals and standards using a systematic framework for decision-making for the growth of mariculture in Mohéli, Comoros (El-Gayar and Leung, 2001). It distinguished several possibilities according to social, economic, and environmental aspects (Bush *et al.* 2010). Throughout the process, stakeholders, including local community members, NGO leaders, and fishermen, provided feedback (Tompkins *et al.* 2008). Key informant interviews and interactive focus group discussions were used in the data collection process (Bryman 2016; Denzin and Lincoln, 2009). Scenario and sensitivity analyses looked at possible outcomes, and Multi-Criteria Decision Analysis (MCDA) assessed scenarios (Zheng *et al*. 2016). Following Samuel-Fitwi *et al*. (2012), the final phase integrated decision support tools to select feasible, potential alternatives that have community support and to develop a comprehensive framework for sustainable mariculture (Figure 2).

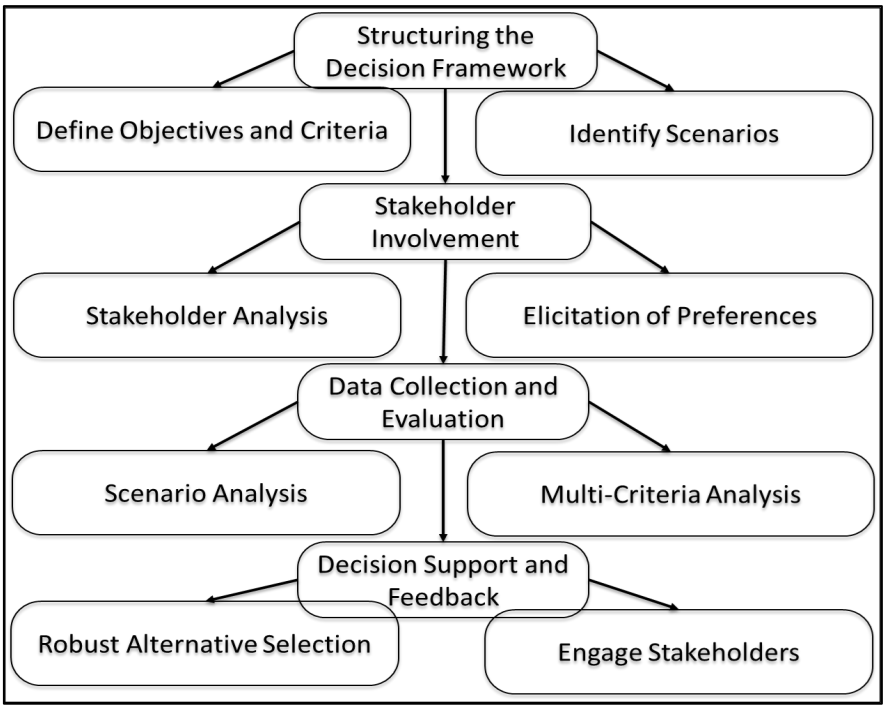

Figure 2. Structured Decision-Making Framework used in the present study

Scenario Planning and Sensitivity Analysis

Based on Mohéli-specific environmental and socioeconomic factors, such as trends in marine biodiversity and policy changes, scenarios were created (Bennett *et al.* 2016). Four different scenarios planning and sensitivity analysis, high sustainability and high acceptability, high scenarios sustainability but low acceptance, low sustainability but high acceptance, and low scenarios sustainability and low acceptance, were produced by the two-axis scenario model, as seen in Figure 3 (Behr *et al.* 2017). Using socio-economic and environmental data, scenario analysis assessed the results of mariculture tactics under these conditions. The analysis tested input parameters to reflect socioeconomic trends, stakeholder preferences, and prediction uncertainty. This gave the impression that the suggestions were sound and adaptable enough to adjust when circumstances changed.

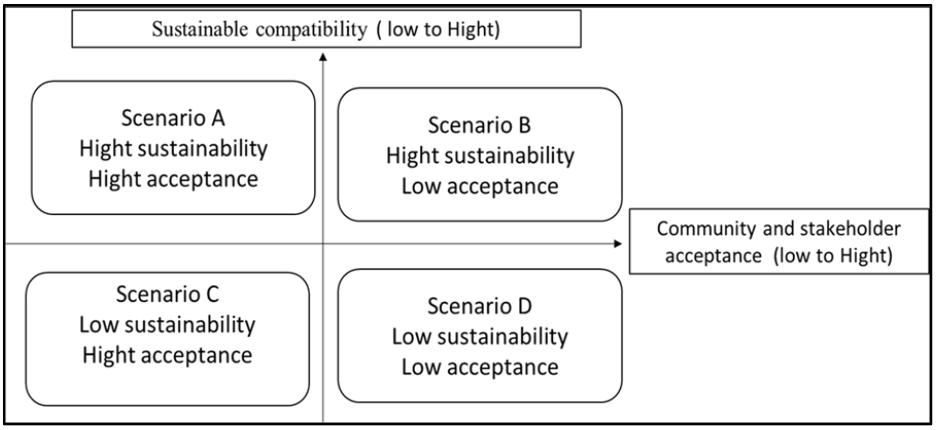

Figure 3. Scenarios for aquaculture implementation in Mohéli, ranging from low to high sustainability compatibility and stakeholder acceptance

Data Collection

The data collection approach employed the use of both primary and secondary sources data to assess potential mariculture growth in Mohéli, Comoros (Table 2). Secondary data were obtained from a literature review regarding characteristics of different types of coastal mariculture, from the National Park of Mohéli (PNM) Comoros, and the Research Institution of Marine Resources of Comoros. They provided data collection on the production, fishing, and environmental conditions of Mohéli as well as the feasibility of different mariculture in economic terms.

Table 2. Data types, their sources, and purpose

Criteria	Methods	Purposes
Perception and preference on mariculture	FGDs (O. Nyumba *et al.* 2018)	• Familiarity • Economic beliefs • Environmental concern • Livelihood perception • Support for sustainable mariculture • Preferences and Factors
Environmental and economic feasibility of mariculture	Literature review (Feng *et al*. 2021)	• Environmental Suitability • Financial practicality
Decision-making framework	Comparison interview through AHP (Saaty 1987 and 2008)	• Key perception for planning

The primary data were obtained by conducting three FGDs with different representative stakeholders (e.g., local fishermen, NGOs, and others) from each of the eight communities, resulting in ten participants for each FGD. The previously collected secondary data formed the basis for discussion in the FGDs, which aimed to develop different scenarios for the potential introduction of mariculture on Mohéli. Participants for these focus groups were identified according to their position and knowledge regarding the marine environment, based on guidance from local staff from the PNM. These focus groups aimed to explore the views, preferences, and considerations of participants concerning potential economic benefits, environmental compatibility, and potential support for mariculture implementation.

After the scenario development, which also brought forth factors that affect communities' perceptions towards the possible adoption of mariculture, these factors were analyzed using an Analytical Hierarchy Process (AHP) with the help of key informant interviews with ten different stakeholders (legislators, technical experts, and community people). Respondents again were identified according to their position and familiarity with the coastal environment, with the help of local PNM staff. This approach facilitated the identification of the most suitable decisions for the future development of mariculture in Mohéli by assessing priority needs for its implementation and promoting effective management of marine resources (Bricker *et al*. 2016). Fig. 4 shows the considered ecological, social, and economic criteria. These were compared pairwise, with values on a defined scale of 1 to 9 assigned to the criteria by the respondents, to explore alignment with community priorities and sustainability goals, which were jointly determined by the respondents (Saaty 1987 and 2008). Values given by each of the ten respondents were then averaged

and compared to obtain a composite view and to assess internal coherence and validity of the findings.

Data Analysis

To explore local attitudes and perceptions of potential mariculture introduction on Mohéli, the different kinds of information gathered in the study were analyzed through both qualitative and quantitative methods. These analyses were then used to evaluate the potential establishment of mariculture in Mohéli. Qualitative data (economic reward, social acceptability, mariculture preference) from three focus groups and stakeholder consultations were then used for thematic coding to examine trends and issues. This analysis provided rich contextual highlighting of local perspectives and problems. Quantitative data were analyzed utilizing software like Excel, Sphinx, and SPSS. Responses were recorded using descriptive statistics, and a Likert scale (1–5) analysis was used to evaluate alignment with mariculture acceptance goals (Jebb *et al.* 2021). Additionally, using SPSS, correlational analyses were performed to examine the connections between community members' mariculture-related familiarity, attitudes, and preferences (Cohen *et al.* 2009). To conduct this relationship analysis, hypotheses were developed to look at the factors influencing support for possible marine aquaculture. Four main hypotheses were put forth in the study: knowledge of mariculture boosts support for its potential (H1), belief in its financial advantages boosts support (H2), environmental concerns lower support (H3), and good livelihood consequences boost support (H4). This enabled an investigation of how different perceptions and beliefs impact attitudes toward possible mariculture. Together, these findings painted a clearer picture of the support that stakeholders had for the implementation of mariculture.

Relative Importance of Sub-Criteria Using the Analytic Hierarchy Process (AHP)

A pairwise comparison was made using the Analytic Hierarchy Process (AHP) to determine the relative importance of each sub-criterion concerning the main criterion, as shown in Fig. 4. The sub-criteria were compared using a scale of 1 to 9 to assess the relative importance of each sub-criterion in a pair, where 1 signified each factor being of equal importance and 9 signified one factor was extremely more important than the other. These comparisons were made using a pairwise comparison framework, where a comparison matrix was developed (Liu *et al.* 2017).

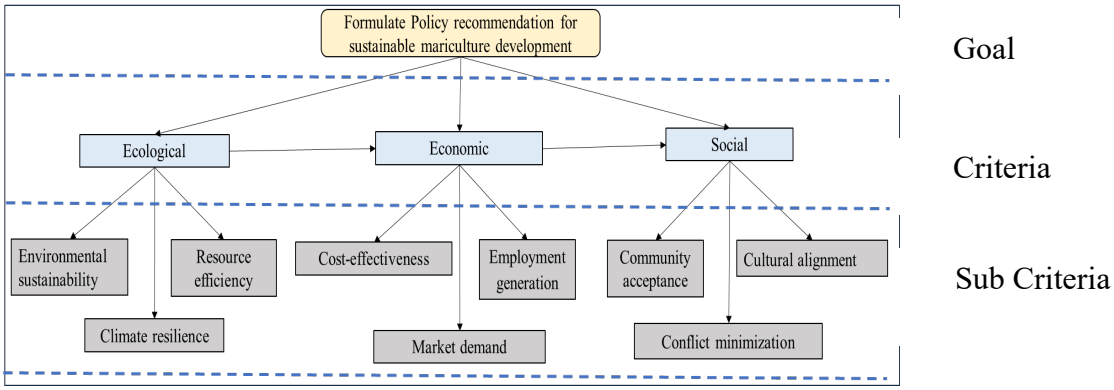

Figure 4. Criteria and sub-criteria explored in the Analytic Hierarchy Process

The first step in the AHP analysis was to normalize the pairwise comparison matrix. This was done by dividing all the values in the matrix (a_{ij}) by the total of their corresponding column. This process provided normalized values (n_{ij}), ensuring that all values were on a comparable scale. Following normalization, the values in each row of the normalized matrix were averaged to obtain the priority weights (Wi) for each sub-criterion. The following formula was used to determine the priority weight for a sub-criterion (Ci).

$$W = \frac{\sum_{j=1}^{n} nij}{n}$$

The calculated priority weights were multiplied by the weight of the primary criterion (W_{main}) to ascertain the relative importance of each sub-criterion to the integrated mariculture development framework. This phase made sure that each sub-criterion's relative value matched the significance of the larger criterion that it fell under.

$$W_i = w_i \cdot W_{main}$$

Verifying the consistency of the decisions made during the pairwise comparisons was an important part of the AHP technique (Liu *et al.* 2017). To determine the dependability of the comparisons, the consistency index (CI) was computed.

$$CI = \frac{\lambda max - n}{n - 1}$$

Here, n was the number of criteria being compared, and λmax is the pairwise comparison matrix's largest eigenvalue. Pairwise comparisons were considered consistent if the CI value was around zero (Liu *et al.* 2017).

$$CR = \frac{CI}{RI}$$

The Random Consistency Index, or RI, is a predetermined value that changes based on n data (Alonso and Lamata, 2005). The comparisons were considered if the CR value was less than 0.1. A greater CR indicated that discrepancies, necessitating additional study and adjustment of the pairwise comparisons.

RESULTS AND DISCUSSION

Perceptions of Mariculture

The survey results indicated that familiarity with mariculture varied among respondents. A significant majority, 73.3%, reported being somewhat familiar with the concept, suggesting a general awareness but possibly a lack of in-depth knowledge. Meanwhile, 20% of respondents stated that they were not at all familiar with mariculture, highlighting a gap in awareness. Only 6.7% of participants described themselves as very familiar, indicating that a small fraction possessed a strong understanding of the subject (Figure 5). These findings suggest that while mariculture was known to some extent, there is room for further education and awareness to improve familiarity with the field.

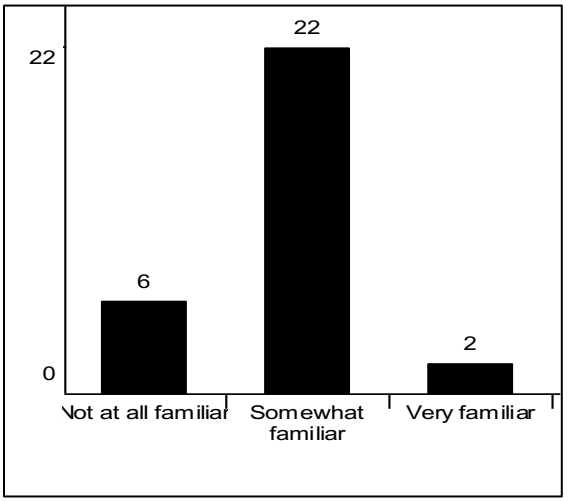

Figure 5. Mariculture familiarity

A significant portion of respondents (53.3%) agreed that mariculture has economic benefits, and 23.3% strongly agreed, totaling 76.6% who viewed mariculture positively in economic terms. Only a small minority disagreed (6.7%). These results showed a significant belief by local respondents in mariculture's potential economic contributions, such as job creation and improved revenue, despite their lack of knowledge about it. This positive perception provided a solid foundation for promoting mariculture by emphasizing its economic advantages (Figure 6).

Half of the respondents (50%) agreed, and 39.9% strongly agreed that environmental impacts are a concern (habitat destruction, water pollution, and ecological risks), with a combined total of 89.9% expressing concern to varying degrees. Only 6.6% either disagreed or strongly disagreed. These results highlighted a critical area that must be addressed. While concerns about environmental impacts may not necessarily hinder support, they emphasized the need for transparent environmental management plans and communities' involvement in sustainable practices to alleviate fears (Figure 7).

In terms of the perceived impact of mariculture on livelihoods, the majority of respondents expressed positive views. Specifically, 50% of those surveyed agreed and 40% strongly agreed that mariculture has the potential to positively influence local livelihoods, reflecting a favorable attitude toward its development according to the respondents (Figure 8). Many respondents referred to neighboring countries, such as Madagascar and Tanzania, where mariculture has already contributed positively to livelihoods in several ways. This indicates that many community members

recognize the potential benefits of mariculture. Despite this positive sentiment, a small segment of respondents expressed skepticism, with 3.3% disagreeing with the notion that mariculture positively impacts livelihoods. Additionally, 6.7% of respondents remained neutral, neither agreeing nor disagreeing, which could indicate uncertainty or a lack of sufficient information to form a definitive opinion. These results suggest a widespread belief that mariculture can coexist with or enhance traditional livelihoods, making it an attractive option for community development.

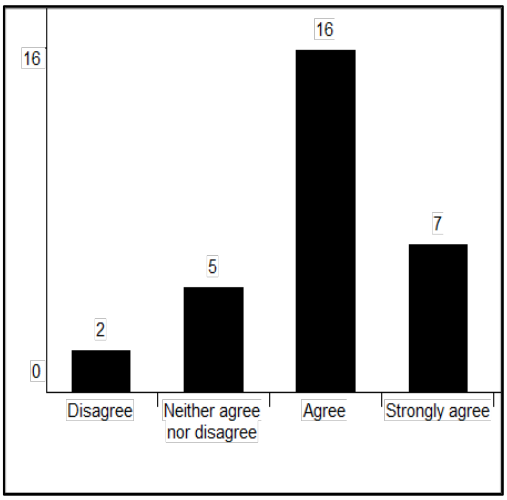

Figure 6. Belief in the economic benefits of mariculture introduction

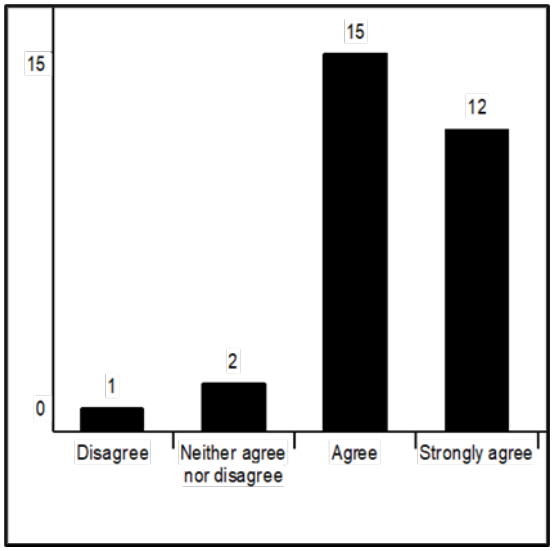

Figure 8. Belief in the positive livelihood impacts of mariculture introduction

Key Factors Influencing Attitudes Towards Mariculture

During discussions with various community representatives, concerns about different types of mariculture, the initiation procedure, and the most desirable characteristics of mariculture were raised to support their decisions. The points raised were based on their existing, limited knowledge of respondents, as well as comparisons to

There was strong support for potential mariculture, with 40% of respondents strongly agreeing and 33.3% agreeing with its implementation, totaling 73.3% support (Figure 9). Only 6.6% disagreed with potential mariculture, while 20% were neutral. These findings reflect a generally favorable attitude of respondents towards sustainable mariculture, which could be further strengthened by addressing specific concerns about environmental and livelihood impacts.

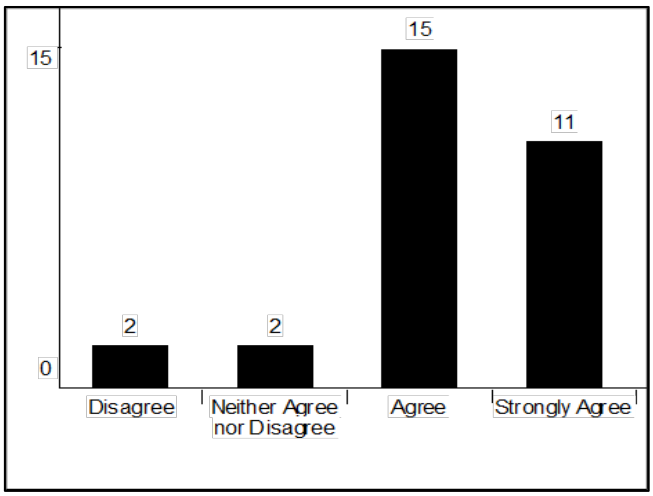

Figure 7. Concerns about the environmental impacts of mariculture introduction

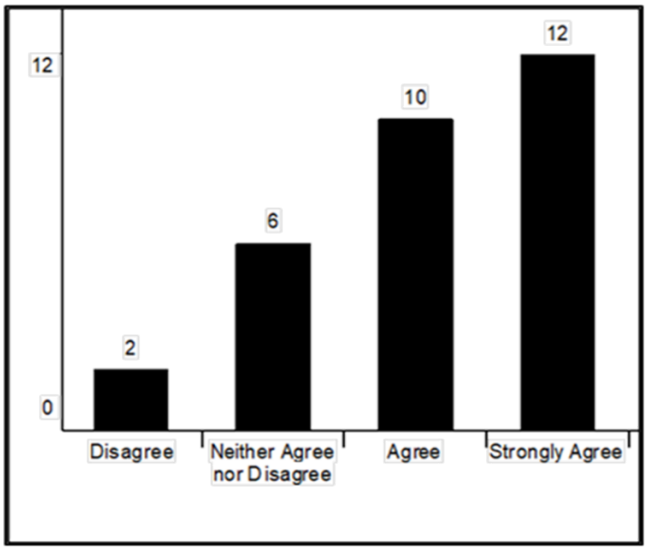

Figure 7. Support for the introduction of mariculture

neighboring countries' experiences. The analysis also investigated preferences for several types of mariculture, such as seaweed farming, fish farming, and shellfish farming. Among the respondents (n=30), when asked to choose one preferred option, 23.3% preferred fish farming and 76.7% preferred seaweed farming. The higher choice for seaweed farming was likely due to its perceived eco-sustainability, cost-effectiveness,

and lesser environmental concerns when compared to fish farming. According to respondents, the most valuable qualities of mariculture were cost-effectiveness, eco-sustainability, and economic rewards. Among them, environmental sustainability emerged as the most relevant factor, accounting for 40% of preferences (Figure 10). This emphasizes the growing role of environmentally conscious behaviors in affecting public opinion.

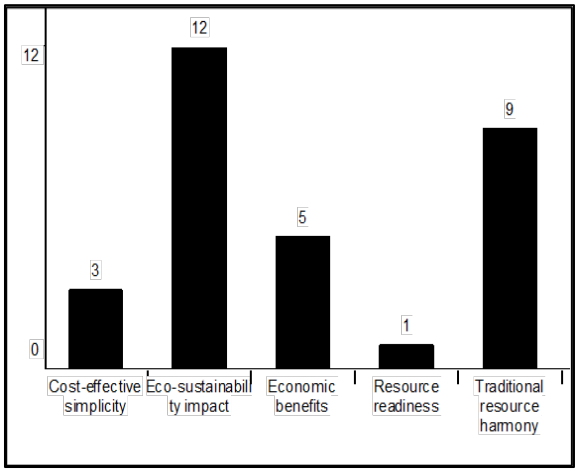

Figure 10. Positive characteristics of mariculture perceived by the respondents

Correlation Analysis

To assess which factors are linked to support for the potential introduction of mariculture, its correlation with a range of different factors was assessed. A belief in economic rewards emerged as the most important element related to support for mariculture introduction (Pearson correlation, r = 0.587, p = 0.001). Environmental concern is similarly significant, albeit at a lower level (Pearson correlation, r= 0.402, p= 0.028), showing that people who were concerned about the environmental impacts of mariculture were more supportive of its introduction. Familiarity with mariculture and perceived impact on livelihoods were not significantly related to support of mariculture introduction. In conclusion, perceived economic benefits are the primary motivator of support for sustainable mariculture, followed correation analysis study result by environmental concerns of mariculture (Table 3).

Table 3. Correlations of different perceptions of mariculture with support for mariculture introduction.

		Sustainable Mariculture Support	Mariculture Familiarity	Economic Benefit Belief	Environmental Impact Concern	Livelihood Impact Belief
Sustainable Mariculture Support	Pearson Correlation	1	0.195	0.587	0.402	0.288
	Sig. (2-tailed)		0.301	0.001*	0.028*	0.123
Mariculture Familiarity	Pearson Correlation	0.195	1	0.205	0.019*	-0.197
	Sig. (2-tailed)	0.301		0.278	0.920	0.396
Economic Benefit Belief	Pearson Correlation	0.587	0.205	1	0.370	0.368
	Sig. (2-tailed)	0.001*	0.278		0.044*	0.045*
Environmental Impact Concern	Pearson Correlation	0.402	0.019	0.370	1	0.167
	Sig. (2-tailed)	0.028*	0.920	0.044*		0.378
Livelihood Impact Belief	Pearson Correlation	0.288	-0.197	0.368	0.167	1
	Sig. (2-tailed)	0.123	0.296	0.045*	0.378	

(*) This symbol highlights the statistically significant correlations

Formulate a Policy Recommendation for Potential Mariculture Development

The AHP results showed that ecological, social, and economic factors influenced mariculture success according to the respondents, with the ecological aspect being the most significant (Table 5). This highlighted the need to protect marine ecosystems, use resources efficiently, and enhance climate resilience. Environmental sustainability and resource

efficiency were the most critical aspects, followed by climate resilience. The social aspect ranked second, emphasizing the importance of community involvement and social harmony. Conflict minimization was the key factor, ensuring that mariculture integrates smoothly with existing livelihoods. Community acceptance and cultural alignment were ranked next. The economic aspect, though relevant, had the lowest weight, indicating that, according to the respondents, financial feasibility should not override ecological and social concerns. Cost-effectiveness was the most important economic factor, followed by employment generation and market demand. The AHP results are credible, with a consistency ratio (CR) below 10% (α = 0.1), highlighting the necessity of prioritizing ecological and social issues from the participants' perspectives. (Table 6).

Table 4. Weighted Criteria for Mariculture Development Assessment

Criteria	Weight (%)	Sub-Criteria	Weight (%)
Ecological	39.9	Environmental sustainability	38.7
		Resource efficiency	37.9
		Climate resilience	32.4
Economic	20.7	Cost-effectiveness	52.3
		Employment generation	25.2
		Market demand	22.5
Social	39.4	Community acceptance	34.8
		Cultural alignment	22.9
		Conflict minimization	42.3

Table 5. Consistency Ratio and Criteria Evaluation Scores

Consistency ratio (CR) <0.1(10%)

Criteria and Sub-criteria		Value %
Criteria		8.5
Sub-criteria	Ecologic	9.0
	Social	9.9
	Economic	10.7

Discussion

Environmental, Economic, and Feasibility Aspects of the Different Types of Mariculture

Techniques in aquaculture need evaluation on their ecological and economic impacts. While each technique has its benefits, its sustainability relies on proper control and adjustment to the local environment (Table 7). Floating net cage systems are increasingly being used for aquaculture production of finfish (Tacon *et al.* 2007). To achieve sufficient oxygenation and proper dilution of organic waste while preventing its accumulation, this technique demands sheltered regions where water currents are moderate (Tett 2008; Olsen *et al.* 2008). But cage farming, if not appropriately managed, can also result in localized organic waste accumulation, which can disrupt or disturb ecosystems (Pillay 2008). From an economic viewpoint, this approach has a high initial investment for infrastructure, including floating cages and feeding systems (Chu *et al.* 2020; Aswathy *et al.* 2020). It is a longer-term investment because it takes several months to set up the system, and it usually takes an additional 6 to 18 months for species to reach market size (Beveridge 1984; Phillips and De Silva, 2006; Beveridge 2008).

The ideal environmental conditions for seaweed farming are shallow, clean seas with consistent salinity and adequate sunshine penetration (Mouritsen 2013). This approach contributes to marine sustainability because it has little negative effect on the environment and may even improve ecosystem health by absorbing excess nutrients (Duarte *et al.* 2022). Due to its low initial expenses, seaweed farming is the most economically accessible mariculture technique (van den Burg *et al.* 2016; St-Gelais *et al.* 2022). Furthermore, its 45–90-day harvest cycles enable prompt revenue generation and make it a desirable choice for communities looking for instant financial gains (García-Poza *et al.* 2020; Mariño *et al.* 2019).

Clean, nutrient-rich waterways are essential for shellfish aquaculture, which focuses on species like oysters and mussels (Burkholder and Shumway, 2011). By improving water quality through biofiltration, these filter-feeding organisms make this process environmentally friendly (Ferreira *et al.* 2018). Because of their inherent capacity for biofiltration and their minimal environmental impact, clam farming is a good fit for ecological preservation initiatives (Rennie *et al.* 2024). To ensure appropriate

management and efficient harvesting techniques, sufficient knowledge transfer and capacity building are needed. Shellfish are a viable choice for communities with the right resources and conditions because of their relatively quick growth period, as they can reach harvestable size in 12 to 24 months.

Table 6. Environmental impact, financial requirements, and harvest cycles of different types of mariculture

Farming Type	Environmental Impact	Financial Requirements	Harvest Cycle
Fish Farming	High negative	High	6–18 months
Shellfish Farming	Moderate negative	Moderate	45–90 days
Seaweed Farming	Low negative	Low	12–24 months

Balancing Sustainability, Economic Viability, and Community Acceptance in Mariculture Development

This study looked at how community acceptance, economic viability, and environmental sustainability combine to affect attitudes towards mariculture implementation in Mohéli, Comoros. A structured framework for decision-making is provided by Multi-Criteria Decision Analysis (McKenna *et al.* 2018). Seaweed farming was preferred over fish and shellfish farming by the respondents because it is a low-impact, economical, and quick-yielding technology (Charrier *et al.* 2017). This is consistent with earlier studies showing the ecological advantages of seaweed, including improved habitat and nutrient absorption (Cotas *et al.* 2023). The results support the notion that a community-based, small-scale strategy for mariculture introduction to reduce environmental deterioration is the most appropriate approach for Mohéli.

When policy is supported through participatory techniques, long-term support for mariculture can be increased, as people are more familiar with and willingly accept policies (Burbridge *et al.* 2001). But that is where the problem lies. Attitudes and acceptance are influenced by knowledge gaps, which arise from misinformation or lack of awareness. These gaps in misconceptions about environmental impact, economic opportunities, product safety, and resistance to new techniques, so the case of Moheli Island, necessitate targeted education and awareness campaigns focused on sustainability, economic benefits, scientific knowledge, and public perception (Li and Zhao, 2019). Apart from the long-term support policies, short-term policies can be incorporated to embrace economic possibilities. Finally, while the respondents generally reacted positively to the prospect of mariculture introduction, the results highlighted the importance of environmental protection to local respondents.

This research provides a more nuanced view whereby concern is mitigated by economic incentives as opposed to studies reporting extreme opposition to mariculture because of environmental threats. Unlike other locations where the growing of finfish and shellfish is practiced due to the demand in the market, seaweed farming was identified as the most suitable type of mariculture for Mohéli.

The paper stresses the significance of planning that is integrated and considers community preferences, feasibility, ecology, and economics. Addressing disagreements and setting priorities is easier with scenario-based planning. This is the framework within which policies should be crafted to ensure that growth is sustainable in mariculture (Barg 1992), and local concerns and conditions are adequately considered.

CONCLUSION

As this study highlights, the potential development of mariculture in Mohéli, Comoros, relies on consideration of socio-economic and environmental factors. The results showed that although perceived economic advantages fueled community support for mariculture, environmental concerns continue to play a major role in influencing public opinion. Because of its quick harvest cycles, little environmental effect, and affordability, seaweed farming is the most practical choice. Stakeholder participation and the use of Multi-Criteria Decision Analysis (MCDA) have given rise to an organized method for determining community preferences, evaluating viability, and creating sustainable development plans. Adopting adaptive management measures that combine ecological conservation, economic viability, and local community involvement is crucial to the long-term success of mariculture in Mohéli. To promote acceptance and reduce conflict, transparent environmental management plans, focused information efforts, and cooperative governance frameworks will be

essential. Future projects ought to concentrate on bolstering institutional support, refining policy frameworks, and building local capacity via training and education activities. Through the alignment of mariculture growth with ecological sustainability and community needs, this research offers a strategic roadmap for maintaining marine biodiversity and promoting resilient coastal livelihoods. Other small island governments looking to adopt sustainable aquaculture methods that strike a balance between conservation and economic development can use the lessons learnt from this study as a model.

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