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International Journal of Advances in Social Sciences and Humanities

Journal homepage: https://journal.srnintellectual.com/index.php/ijassh

Original Article

Enhancing Seagrass Cultivation in Southeast Maluku: A Strategic Approach to Sustainable Development

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Citations: Sutaman, S., Hartanti, N.U., & Dina, K.F. (2024). Enhancing Seagrass Cultivation in Southeast Maluku: A Strategic Approach to Sustainable Development. *International Journal of Advances in Social Sciences and Humanities*, 3(4), 236-247.

Received: 12 August 2024 Revised: 24 October 2024 Accepted: 7 November 2024 Published: 30 November 2024

Abstract: Seagrass cultivation plays a vital role in supporting the coastal community economy and has become a strategic sector with significant potential, particularly in Southeast Maluku. The region possesses favorable environmental conditions and abundant marine resources that offer great opportunities for the development of seagrass cultivation. However, several critical challenges hinder its optimal growth, including inadequate infrastructure, limited access to high-quality seeds, and unstable market prices. These issues not only affect productivity but also reduce the potential socio-economic benefits for local communities. This study aims to formulate strategic recommendations for the sustainable development of seagrass cultivation in Southeast Maluku by examining the technical, social, and economic dimensions of the sector. The research involves a comprehensive analysis of the region's environmental conditions, resource availability, cultivation practices, and the specific needs and capacities of local communities. It also considers policy frameworks and market dynamics that influence the success of cultivation initiatives. By integrating environmental assessments with community-based needs analysis, this study proposes actionable strategies that can enhance the productivity and quality of seagrass products. The findings are expected to guide the formulation of development programs and policies that not only promote sustainable practices but also increase the added value of seagrass commodities. Ultimately, the implementation of these strategies is anticipated to contribute significantly to improving the livelihoods of coastal populations and fostering long-term economic resilience in Southeast Maluku.

Keywords: Seagrass cultivation; Marine resources; Cultivation technology; Government policy; Sustainable development

1. Introduction

Southeast Maluku, Indonesia, has tremendous potential for developing seagrass cultivation. With favorable geographical and climatic conditions, this region can become a center for high-quality seagrass production (Rustiawan & Suryani, 2021; Santoso & Aulia, 2018; Sarwidi, Aji, & Satyarno, 2019). Good water quality, potential land area, high market demand, processed seagrass products have high economic value and increasing market demand, as well as the importance of community involvement in having traditional knowledge and experience in seagrass cultivation (Antunes do Carmo, 2019; Cahyadinata, 2021). Challenge is farmers' knowledge of modern cultivation techniques still needs improvement with implementation of the breakthrough program is carried out focusing on 2 programs, namely:

e-ISSN: 2948-4723 @ 2024 SRN Intellectual Resources
DOI: 10.56225/ijassh.v3i4.368

1) the development of export-oriented aquaculture with superior commodities, including shrimp, lobster, crab, and seagrass; and 2) development of a local wisdom-based Aquaculture Village to alleviate poverty while maintaining extinction. However, a comprehensive and sustainable development strategy is needed to achieve this potential (Carlos Mestanza-Ramón, Fausto Guapi-Guamán, Guido Mazón-Fierro, Hilter Figueroa-Saavedra, 2023; S. Khairilmizal , M.F. Hussin, Mohd Faizal Yusof, A. Mohd Azimie, A.F. Ashwin, K. Ainul Husna, 2023).

One of the potential marine biological resources in Southeast Maluku Regency is Seagrass. The potential of seagrass greatly supports Indonesia's position as a significant producer of seagrass commodities in the seagrass market (Azlina Musa, Elia Syarafina Abdul Shakur, Rabiu Muazu Musa, 2023; Peng & Oleson, 2017). This condition is very reasonable because this commodity has a high economic value considering its considerable role in various products related to daily life, both through simple processing that can be consumed directly or through more complex processing, such as pharmaceutical products, cosmetics, and food, as well as other products (Deli, 2018; Hadiyanto & Sudarsih, 2022; Nadhira, Wulandari, & Pramastyaningtyas, 2023). Best strategy is needed to develop seagrass cultivation in Southeast Maluku. A more in-depth study of the strategy is required. Opportunity exists in various ways, mainly the prospect of future planning, to realize a more knowledgeable society with this research. Research examines current and future cultivation planning. Circular economy with minimize waste generation by exploring the use of biodegradable materials and implementing closed-loop systems for nutrient recycling, maximize the value of all byproducts, such as using seaweed biomass for biofuel production, animal feed, or fertilizer, and encourage the development of community-based processing facilities to reduce transportation costs and create local employment opportunities. By incorporating these novelties into the development strategy, Southeast Maluku can not only enhance the economic benefits of seaweed cultivation but also contribute to environmental sustainability, social equity, and community resilience.

2. Materials and Methods

The SWOT analysis is a strategic planning method used to evaluate a job, project, or business venture's strengths, weaknesses, opportunities, and threats. SWOT aims to systematically identify internal and external factors in formulating strategies. Analysis is based on efforts to maximize strengths and opportunities while at the same time minimizing weaknesses and threats (Aspiany, Anggoro, Purwanti, & Gunawan, 2019; Khan, Chang, & Bibi, 2024). The strategic decision-making process is carried out with an approach to developing missions, goals, strategies, and policies by previously identified strategic conditions and issues. SWOT analysis provides advantages in determining a good strategy for maximizing strengths by utilizing existing opportunities and minimizing weaknesses to suppress the impact of threats that will arise. The plan for developing seagrass cultivation areas in Southeast Maluku Regency is carried out by identifying internal and external factors by considering conditions, existing problems, challenges, and issues that are determined by taking into account the opportunities and potentials that are owned (Sholeh & Farid, 2021; Wirahayu, Purwito, & Insani, 2019).

3. Results and Discussion

3.1. Internal and External Factors

The development of seagrass cultivation in Southeast Maluku Regency is influenced by various internal and external strategic factors. Among its key strengths, the region possesses vast potential seagrass cultivation land that supports expansion efforts. The availability of adequate human resources dedicated to seagrass farming also contributes positively, alongside strong institutional support from local aquaculture groups (Pokdakan). Additionally, the local government plays an active role in promoting the sector, and according to seagrass agents, the quality of seagrass in the area is high, with premium carrageenan content. Infrastructure access is another advantage, as cultivation areas are relatively close and accessible by both land and sea routes. Despite these strengths, there are several internal weaknesses that hinder optimal development. Seagrass productivity and land utilization remain low, and many cultivators lack official permits, leaving them without legal recognition or defined cultivation areas. The availability of high-quality seeds is still limited, and capital investment in the sector remains constrained. Essential cultivation tools, such as boats for maintenance and harvesting, are insufficient. Current practices for buoying seagrass maintenance rely on non-eco-friendly materials like used plastic bottles. Furthermore, drying facilities are rudimentary, limiting both the volume and quality of dried seagrass. Most farmers also lack proper storage and pressing equipment for their harvest, and no processing facility currently exists to convert dried seagrass into semi-finished carrageenan products (chips).

On the external front, there are promising opportunities to leverage. Both local and international markets for seagrass products are still widely open, and there is strong potential for investment collaboration. This industry also holds the promise of increasing employment opportunities, boosting local incomes, and contributing to national foreign exchange earnings. However, several external threats could impact the sustainability of seagrass cultivation. Farmers currently face a weak bargaining position in price negotiations, and the cultivation cycle is limited by seasonal

constraints. Seagrass is prone to diseases such as ice-ice and is heavily affected by weather conditions, particularly during the western season when cultivation is often halted. Price volatility further adds to the risk, with significant fluctuations in seagrass market prices.

Table 1. Result of internal factors—strengths and weaknesses—related to the development of SEAGRASS cultivation

No	Factor	Weight	Rating	Score
Strengths				
1	Has a seagrass-significant land potential	0.08	4	0.32
2	The number of SEAGRASS cultivator human resources is sufficient	0.10	5	0.5
3	Pokdakan is very adequate	0.08	4	0.32
4	Support from the Local Government	0.08	4	0.32
5	Rapid growth	0.08	4	0.32
6	SEAGRASS quality has good carrageenan content	0.10	5	0.5
Subtotal Strengths		0.52		2.28
Weaknesses				
1	Seagrass productivity is still relatively low	0.04	2	0.08
2	Land utilization level still low	0.06	3	0.18
3	Cultivation development not equipped with PKPSEAGRASS permit	0.04	2	0.08
4	Availability of SEAGRASS seeds is still inadequate	0.06	3	0.18
5	Cultivation development capital is still limited	0.04	2	0.08
6	Cultivation facilities (boats) are still limited	0.04	2	0.08
7	Buoys still use environmentally unfriendly materials	0.04	2	0.08
8	The drying area is still basic	0.06	3	0.18
9	Most cultivators need storage/pressing equipment	0.04	3	0.12
10	No facility to process semi-finished carrageenan	0.04	3	0.12
Subtotal Weaknesses		0.46		1.26
TOTAL		1.00		3.53

Table 1 presents a comprehensive analysis of the internal factors—strengths and weaknesses—related to the development of SEAGRASS cultivation. The evaluation is based on the weight and rating assigned to each factor, with the final score derived from the product of these two variables. The total score of 3.53 reflects the overall internal condition of the SEAGRASS cultivation initiative. On the strengths side, six main factors were identified, carrying a total weight of 0.52. Among the most significant is the presence of sufficient human resources for SEAGRASS cultivation and the high quality of SEAGRASS with good carrageenan content, each receiving the highest rating of 5.00 and contributing scores of 0.50. Other notable strengths include the adequate support from local government, the rapid growth of the sector, sufficient Pokdakan (local aquaculture groups), and land potential for cultivation—each with consistent ratings of 4.00 and individual scores of 0.32. These strengths indicate a solid foundation for developing SEAGRASS cultivation, particularly in terms of resources, institutional support, and biological potential.

In contrast, the analysis also identifies ten weaknesses, with a cumulative weight of 0.46 and a total score of 1.26. These weaknesses primarily reflect infrastructural and regulatory challenges. The most pressing issues include the relatively low productivity of SEAGRASS, limited capital for development, inadequate seed availability, and lack of official cultivation permits (PKPSEAGRASS). Additionally, insufficient cultivation infrastructure—such as boats, drying areas, and processing facilities—further hampers efficiency. The use of environmentally unfriendly materials for buoys and the lack of equipment for storage and pressing also underscore the need for improvements in operational support and sustainability. Overall, the internal factor scores of 3.53 suggests that the strengths slightly outweigh the weaknesses, providing a moderately favorable environment for SEAGRASS cultivation. However, to maximize this potential, strategic actions must be taken to address key limitations—especially in infrastructure, licensing, and input availability—while leveraging the strengths to enhance productivity and sustainability.

Table 2. Calculation of weights and ratings of opportunities and threats

No	Factor	Weight	Rating	Score
Opportunities				
1	Local and international marketing opportunities are still wide open	0.20	5.00	1.00

No	Factor	Weight	Rating	Score
Opportunities				
2	Opportunities for collaboration with investors are wide open	0.12	3.00	0.36
3	Increasing employment opportunities and income and foreign exchange	0.12	3.00	0.36
Threats				
1	The bargaining position of farmers towards low SEAGRASS prices	0.12	3.00	0.36
2	Seagrass planting season cannot be all year round	0.12	3.00	0.36
3	SEAGRASS is susceptible to ice ice disease	0.08	2.00	0.16
4	Weather factors, where during the western season, SEAGRASS cultivation is often stopped	0.12	3.00	0.36
5	SEAGRASS prices fluctuate greatly	0.12	3.00	0.36
	Total Score	1.00		3.32

Table 2 presents an analysis of external environmental factors—opportunities and threats—that influence the development of SEAGRASS cultivation. Each factor is assessed based on its assigned weight and rating, with the resulting score indicating its relative impact. The total score of 3.32 suggests that the external environment is generally favorable, offering more opportunities than threats. Among the opportunities, the most significant is the wide-open potential for both local and international marketing of SEAGRASS. This factor carries the highest weight (0.20) and the maximum rating of 5.00, resulting in a score of 1.00. This indicates a strong demand and market growth potential for SEAGRASS products, which can be a major driver for industry expansion. Other opportunities include the availability of collaboration with investors and the potential to increase employment, income, and foreign exchange earnings—each with a weight of 0.12 and a rating of 3.00, contributing scores of 0.36. These highlight the broader socio-economic benefits that SEAGRASS cultivation can bring, not only in terms of financial returns but also in creating livelihoods and attracting investment.

On the other hand, several threats were identified that could hinder progress. These include the low bargaining position of farmers due to unstable SEAGRASS prices, the seasonal nature of planting that limits year-round cultivation, vulnerability to the “ice-ice” disease, and weather disruptions, particularly during the western monsoon season when farming activities are often halted. Each of these threats (except disease, which had a slightly lower score of 0.16) was rated with moderate impact, contributing individual scores of 0.36. These risks reflect both biological and market-related uncertainties that could affect productivity and profitability if not adequately managed. Overall, the external factor analysis underscores that while SEAGRASS cultivation faces some notable challenges—especially environmental and economic—there is a strong potential for growth and development if opportunities are strategically leveraged. Efforts to strengthen market access, attract investment, improve farmer capacity, and mitigate climate-related risks will be essential to fully realize the benefits of this promising sector.

3.2. Internal and External Matrix

Internal-External Matrix is used to determine the position of Seagrass Cultivation Assistance Development based on the combination of IFE and EFE matrices in the quadrant matrix. This matrix consists of 2 dimensions, namely the total score of the IFE matrix on the X-axis and the EFE matrix on the Y-axis. Based on the IFE and EFE table calculations, the IFE value is 3.63, and the EFE value is 3.35. When entered into the IE Matrix diagram, both values are in the 1st quadrant(Kong, Xue, & Zhang, 2012; Wirahayu et al., 2019). Quadrant I means that Seagrass Cultivation *Modeling* enters the *Growth Oriented Strategy phase,* namely growing and building that can be carried out by supporting Seagrass farmers to continue to maximize their strengths and existing opportunities to continue to advance and achieve tremendous success(Yavuz, 2014).

Table 3. Internal and external matrix of Seagrass Cultivation Assistance

Internal Factors	Strong Financial Position	Moderate Financial Position	Weak Financial Position
External Factors	High Growth Market	Stable Market	Declining Market
Medium	Market Development	Maintain Market Share	Cost Reduction
Low	Market Penetration	Niche Market	Liquidation

3.3. SWOT Matrix

The SWOT matrix was developed to provide an overview of the opportunities and threats from the external environment in the development of seagrass cultivation in North Maluku Regency(Haryanti, Fahrudin, & Susanto, 2020; Opa et al., 2021). The SWOT matrix matches the IFE and EFE factors, which will then be used to develop four types of strategies. SO Strategy (Strengths and Opportunities), WO Strategy (Weaknesses and Threats), ST Strategy (Strengths and Threats), and WT Strategy (Weaknesses and Threats). SO (Strengths and Opportunities) strategy is made by utilizing the strengths to seize and use the most significant opportunities. WO (Weaknesses and Threats) strategy is applied to utilize existing opportunities by minimizing existing weaknesses. ST (Strengths and Threats) strategy is based on the strengths of identifying existing weaknesses. WT's (Weaknesses and Threats) strategy is based on defensive activities, *which* minimize existing weaknesses to avoid threats, as shown in **Table 4** below.

Table 4. Alternative Strategies for Seagrass Cultivation Development

INTERNAL / EKSTERNAL	**STRENGTHS** 1. It has a considerable seagrass land potential and supports the development of seagrass cultivation. 2. The number of seagrass cultivator human resources is sufficient 3. Institutionally (Pokdakan), it is very adequate for developing seagrass cultivation. 4. There is support from the local government for the development of seagrass cultivation.	**WEAKNESSES** 1. Seagrass cultivation productivity is still low 2. The land utilization rate is still low 3. The availability of seagrass seeds in terms of quality and quantity still needs to be improved. 4. Capital for developing seagrass cultivation is still limited 5. Cultivation development is not equipped with PKPSEAGRASS permits 6. Cultivation facilities (boats) for maintenance and harvesting are still limited 7. Seagrass maintenance buoys still use materials (used mineral water bottles/plastic-based materials) that are not environmentally friendly. 8. The place for drying/drying the harvested seagrass is still straightforward. 9. Most cultivators still need storage facilities and tools for pressing dried seagrass. 10. We do not yet have a seagrass processing facility that can process dried seagrass into semi-finished carrageenan (chips)
OPPORTUNITIES 1. Marketing opportunities, both locally and	**SO Strategy** 1. Development of SEAGRASS cultivation through Modeling	**WO Strategy** 1. Construction of Plant tissue isolation method Laboratory (W1, W2, W3,

internationally, are still wide open. 2. Opportunities for collaboration with investors are wide open 3. Increasing employment opportunities and community income as well as state foreign exchange	(S1, S2, S3, S4, S5, S6, O2, O3) 2. Increasing market access through cooperation with government and private sector. (S5, O2) 3. Intensification of seagrass cultivation land (S1, O2)	W4, W5, W6, W7, W8, W10, O1, O2, O3) 2. Development of starter gardens for the provision of plant tissue isolation method seedlings (W1, W2, W4, W5, W6, W7, W10, O1, O2, O3) 3. KBSEAGRASS development to improve seed quality (W1, W2, W4, W5, W7, W10, O1, O2, O3) 4. Extensive development by utilizing available potential land. (W1, W2, W5, W10, O1, O2, O3) 5. Legalization of land use (PKPSEAGRASS permit) (W1, W2, W4, W7, O1, O2, O3) 6. Assistance/procurement of boats and coconut shells (W1, W2, W7, O1, O2, O3) 7. Provision of adequate drying/drying areas (W1, W2, W7, W10, O1, O2) 8. Construction of adequate storage warehouses for cultivators (W1, W2, W4, W5, W7, W10, O1, O2, O3) 9. Procurement of dry seagrass pressing machines (W1, W2, W9, W10, O2, O3) 10. Procurement of seagrass processing machines into semi-finished materials (W1, W2, W5, W10, O1, O2, O3) 11. Cooperate with capital institutions (cooperatives, etc.) to strengthen capital (W1, W2, O1, O2, O3)
THREATS 1. The bargaining position of farmers towards low SEAGRASS prices 2. Seagrass planting season cannot be all year round 3. SEAGRASS is susceptible to ice-ice disease	**ST Strategy** 1. Building a seagrass factory or a machine to process dried seagrass into carrageenan. (S4, T1, T5)	**WT Strategy** 1. Cultivation Certification (W1, W2, T1, T2, T3, T4) 2. SEAGRASS cultivation management and planning training (W1, W2, T1, T2, T3)

4. Weather factors: Seagrass cultivation is unsuitable and often stopped during the western season. 5. Seagrass prices fluctuate considerably.		

On the basis of the SWOT analysis of seagrass cultivation development in Southeast Maluku Regency, 17 alternative strategies were identified by considering the interaction between internal and external factors. The Strengths-Opportunities (SO) strategy focuses on leveraging the internal strengths of seagrass cultivation to capitalize on existing opportunities. Strategies under this category include the development of seagrass cultivation through modeling, enhancing market access through cooperation with both government and private sectors, and intensifying the use of seagrass cultivation land. The Weaknesses-Opportunities (WO) strategy aims to address internal weaknesses by utilizing external opportunities. Proposed strategies include the construction of a plant tissue isolation method laboratory, development of starter gardens for seedling provision, improvement of seed quality, implementation of area-based cultivation modeling, expansion of cultivation by utilizing available land, legalization of land use through seagrass permits, provision of boats and coconut shells, adequate drying facilities, construction of proper storage warehouses, procurement of dry seagrass pressing and processing machines, and collaboration with capital institutions such as cooperatives to strengthen funding.

The Strengths-Threats (ST) strategy seeks to mitigate threats by utilizing internal strengths. Applicable strategies in this category include reactivating seagrass factories using a direct production scheme from the sea, constructing seagrass warehouses, and implementing warehouse receipt systems to stabilize seagrass prices. Lastly, the Weaknesses-Threats (WT) strategy is designed to minimize weaknesses and avoid threats. Strategies in this category involve the certification of seagrass cultivation and providing training in cultivation management and planning. From the various strategies generated through the SWOT matrix, several were identified as priority strategies for the development of seagrass cultivation in Southeast Maluku Regency. These priorities were determined based on the scores assigned to each alternative, with higher scores indicating greater strategic importance (Mandela & Harini, 2021; Wartono, Muntasib, & Arifin, 2022). The priority strategies are detailed in Table 5.

Table 5. Alternative strategies for developing seagrass cultivation in Southeast Maluku Regency

No	Alternative Strategy	Category	Total Score	Ranking
SO Strategy				
1	Seagrass Cultivation Development through Modelling	S1, S2, S3, S4, S5, S6, O2, O3	2.40	4
2	They are increasing market access through cooperation with the government and private sector.	S5, O2	0.69	16
3	Intensification of seagrass cultivation land	S1, O2	0.69	17
WO Strategy				
4	Construction of plant Tissue isolation Method Laboratory	W1, W2, W3, W4, W5, W6, W7, W8, W10, O1, O2, O3	2.80	1
5	Development of starter gardens for the provision of plant tissue isolation method seedlings	W1, W2, W4, W5, W6,W7, W10, O1, O2, O3	2.72	2
6	KBSEAGRASS development to improve seed quality	W1, W2, W4, W5, W7, W10, O1, O2, O3	2.45	3
7	Extensive development by utilizing available potential land	W1, W2, W5, W10, O1, O2, O3	2.38	5
8	Legalization of land use (PKPSEAGRASS permit)	W1, W2, W4, W7, O1, O2, O3	2.25	6

No	Alternative Strategy	Category	Total Score	Ranking
9	Assistance/procurement of boats and coconut shells	W1, W2, W7, O1, O2, O3	2.23	7
10	Provision of adequate drying/drying facilities	W1, W2, W7, W10, O1, O2,	2.20	8
11	Construction of adequate storage warehouses for cultivators	W1, W2, W4, W5, W7, W10, O1, O2, O3	2.15	9
12	Procurement of dry Seagrass pressing machine	W1, W2, W9, W10, O2, O3	2.05	10
13	Procurement of seagrass processing machines into semi-finished materials	W1, W2, W5, W10, O1, O2, O3	2.00	11
14	Cooperate with capital institutions (cooperatives, etc.) to strengthen capital	W1, W2, O1, O2, O3	1.99	12
ST Strategy				
15	Reactivating seagrass factories with a direct production scheme from land in the sea	S4, T1, T5	0.85	15
WT Strategy				
16	Cultivation Certification	W1, W2, T1, T2, T3, T4	1.51	13
17	SEAGRASS cultivation management and planning training	W1, W2, T1, T2, T3	1.15	14

Table 5 outlines various alternative strategies for developing seagrass cultivation in Southeast Maluku Regency, categorized by different strategic orientations: SO (Strength-Opportunity), WO (Weakness-Opportunity), ST (Strength-Threat), and WT (Weakness-Threat). These categories help identify how the strategies capitalize on existing strengths and opportunities or address weaknesses and threats. The SO strategies focus on leveraging strengths and opportunities. The highest-ranking strategy is the construction of a plant tissue isolation method laboratory (ranked first, score 2.80), which aims to build essential infrastructure for improving seedling production. This is followed by the development of starter gardens for seedlings (ranked second, score 2.72) and KBSEAGRASS development to improve seed quality (ranked third, score 2.45), both of which aim to enhance the quality and availability of seagrass seeds. The seagrass cultivation development through modeling strategy (ranked fourth, score 2.40) utilizes modeling techniques to improve cultivation practices. On the other hand, strategies like increasing market access through cooperation with government and private sectors (ranked 16th, score 0.69) and intensification of seagrass cultivation land (ranked 17th, score 0.69) rank lower, suggesting that these strategies are less viable or urgent at this stage.

The WO strategies address weaknesses while taking advantage of opportunities. They include high-priority initiatives such as the construction of a plant tissue isolation method laboratory (ranked first) and the development of starter gardens (ranked second), which both focus on building the necessary infrastructure for successful seagrass cultivation. Other key strategies, like the procurement of equipment such as boats, drying facilities, and processing machines, ensure operational effectiveness and are ranked in the middle range, with scores ranging from 2.23 to 2.05. Legal and logistical strategies, like legalization of land use (ranked sixth, score 2.25) and cooperation with capital institutions (ranked 12th, score 1.99), also play crucial roles in supporting the financial and regulatory aspects of seagrass cultivation.

The ST strategy, which aims to address threats while leveraging strengths, is represented by the reactivation of seagrass factories with a direct production scheme (ranked 15th, score 0.85). This strategy faces significant challenges, leading to its lower ranking. Similarly, the WT strategies focus on addressing weaknesses while countering external threats. These include cultivation certification (ranked 13th, score 1.51) and seagrass cultivation management and planning training (ranked 14th, score 1.15), which are important for ensuring long-term sustainability but are ranked lower due to their more administrative focus. The highest-ranking strategies focus on building the necessary infrastructure, improving seed quality, and enhancing cultivation techniques, while lower-ranked strategies address operational, financial, and certification needs. The strategic mix ensures that both immediate and long-term goals are addressed, with a focus on overcoming current weaknesses and challenges to foster sustainable seagrass cultivation. The priority scale sequence for alternative seagrass cultivation development strategies in Southeast Maluku Regency is explained in Table 6.

Table 6. Alternative Strategy Priority Scale Order

Alternative Strategy	Category	Score	Ranking
Construction of plant Tissue isolation Method Laboratory	W1, W2, W3, W4, W5, W6, W7, W8, W10, O1, O2, O3	2.80	1
Development of starter gardens for the provision of plant tissue isolation method seedlings	W1, W2, W4, W5, W6, W7, W10, O1, O2, O3	2.72	2
KBSEAGRASS development to improve seed quality	W1, W2, W4, W5, W7, W10, O1, O2, O3	2.45	3
Seagrass cultivation development through modeling	S1, S2, S3, S4, S5, S6, O2, O3	2.40	4
Extensive development by utilizing available potential land.	W1, W2, W5, W10, O1, O2, O3	2.38	5
Legalization of land use (PKPSEAGRASS permit)	W1, W2, W4, W7, O1, O2, O3	2.25	6
Assistance/procurement of boats and coconut shells	W1, W2, W7, O1, O2, O3	2.23	7
Provision of adequate drying/drying facilities	W1, W2, W7, W10, O1, O2,	2.20	8
Construction of adequate storage warehouses for cultivators	W1, W2, W4, W5, W7, W10, O1, O2, O3	2.15	9
Procurement of dry Seagrass pressing machine	W1, W2, W9, W10, O2, O3	2.05	1 0
Procurement of Seagrass Processing Machines into semi-finished materials	W1, W2, W5, W10, O1, O2, O3	2.00	11
Cooperate with capital institutions (cooperatives, etc.) to strengthen capital	W1, W2, O1, O2, O3	1.99	1 2
CBIB training/certification	W1, W2, T1, T2, T3, T4	1.51	1 3
SEAGRASS cultivation management and planning training	W1, W2, T1, T2, T3	1.15	1 4
Reactivating seagrass with a direct production scheme from land in the sea	S4, T1, T5	0.85	1 5
Increasing market access through cooperation with government and private sector	S5, O2	0.69	16
Intensification of seagrass cultivation land	S1, O2	0.69	17

Table 6 shows a prioritization of various strategies aimed at improving seagrass cultivation and plant tissue isolation methods. Each strategy is evaluated based on its related factors, including organizational strengths, resources, opportunities, and technical considerations, and is assigned a score that reflects its potential effectiveness or feasibility. The strategies are ranked based on their scores, with higher-ranking strategies seen as more crucial for the success of the project. The highest priority strategy, ranked first with a score of 2.80, is the construction of a plant tissue isolation method laboratory. This is followed closely by the development of starter gardens for seedlings (ranked second with a score of 2.72), which focuses on ensuring viable seedlings for further cultivation. Other high-ranking strategies, such as the development of KBSEAGRASS to improve seed quality (ranked third with a score of 2.45) and seagrass cultivation through modeling (ranked fourth with a score of 2.40), emphasize improving cultivation practices and seed quality. Several strategies in the middle priority range address practical operational needs, such as utilizing available land (ranked fifth with a score of 2.38), legalizing land use (ranked sixth with a score of 2.25), and procuring necessary equipment like boats and drying facilities (ranks seventh and eighth with scores of 2.23 and 2.20, respectively). These strategies focus on ensuring that the logistical and infrastructural needs of the project are met.

Lower-ranking strategies, such as the procurement of pressing machines (ranked tenth with a score of 2.05), strengthening financial support through partnerships (ranked twelfth with a score of 1.99), and training programs for cultivation management (ranked thirteenth with a score of 1.51), while important, are seen as less urgent compared to the high-priority strategies. Some strategies, such as reactivating seagrass with a direct production scheme (ranked fifteenth with a score of 0.85) and increasing market access (ranked sixteenth with a score of 0.69), are ranked the lowest, indicating they are considered less feasible or important at this stage of the project. This table provides a strategic framework for addressing the challenges of seagrass cultivation and plant tissue isolation, with clear priorities

identified for both high-impact initiatives and essential operational support. These strategies are designed to work together, ensuring the project's long-term success by prioritizing critical infrastructure, seedling production, legal frameworks, and financial stability, while also providing room for future improvements and expansions.

On the basis of SWOT analysis, several strategic approaches have been developed to foster the growth of seagrass cultivation in Southeast Maluku Regency, focusing on production, income generation, and marketing. The first strategy, aimed at increasing seagrass cultivation production, includes a series of programs such as the construction of a plant tissue isolation method laboratory, procurement of necessary laboratory equipment, the development of starter and nursery gardens, and the implementation of seagrass cultivation modeling. Additionally, it incorporates training and certification in CBIB (Good Seagrass Cultivation) and seagrass management, along with the intensification of seagrass cultivation land. The second strategy is designed to boost the income of cultivators, which includes programs like extending seagrass cultivation, building seagrass warehouses, providing adequate drying facilities, and constructing proper storage warehouses for cultivators. Furthermore, it calls for the procurement of dry seagrass pressing machines and processing machines for creating semi-finished products, as well as offering assistance for the procurement of boats and coconut shells.

The third strategy focuses on marketing development, with programs to increase market access through collaboration with the government and private sectors, particularly MSMEs and cooperatives. It also emphasizes developing the processing of dried seagrass into semi-finished materials like carrageenan and encourages investment in seagrass factories that can serve as exporters for local cultivation. Additional measures include providing subsidies, grants, and low-interest loans to support farmers and entrepreneurs, offering tax incentives for businesses in the sector, and simplifying licensing and permitting procedures to reduce bureaucratic hurdles. These policy strategies provide a clear framework for the sustainable development of seagrass cultivation in Southeast Maluku, aiming to unlock the full potential of this valuable resource, improve the livelihoods of coastal communities, and contribute to the region's sustainable development (Frohlich et al., 2023; Nurhidayah & McIlgorm, 2019).

4. Conclusions

This study highlights the tremendous potential of Southeast Maluku to emerge as a leading hub for seagrass cultivation, offering significant opportunities for economic growth and the enhancement of livelihoods for coastal communities. However, the region faces key challenges, including inadequate infrastructure, inconsistent seed quality, and fluctuating market prices. These issues necessitate a comprehensive, multi-faceted strategy to address both technical and socio-economic factors. By conducting thorough research into environmental conditions, resource availability, and community needs, this study aims to develop an optimal development strategy. This strategy will not only improve the productivity, quality, and market value of seagrass products but also ensure the sustainability of this vital sector. With a focus on long-term impact, the approach aims to drive economic growth, empower local communities, and preserve the region's environmental integrity. Ultimately, this study underscores the importance of a holistic approach to seagrass cultivation, urging collaborative efforts that will secure the future of Southeast Maluku's coastal communities. Through sustained innovation and investment in both infrastructure and capacity-building, the region can unlock its full potential, positioning itself as a model for sustainable economic development in coastal areas.

Author Contributions: Conceptualization, S.T.M. and N.U.H.; methodology, S.T.M.; software, N.U.H.; validation, N.U.H. and K.D.F.; formal analysis, S.T.M.; investigation, S.T.M. and N.U.H.; resources, N.U.H.; data curation, K.D.F.; writing—original draft preparation, S.T.M. and N.U.H.; writing—review and editing, S.T.M., N.U.H. and K.F.D.; visualization, K.D.F.; project administration, S.T.M.; funding acquisition, S.T.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: The authors would like to thank the Pancasakti University Tegal, Indonesia supporting this research and publication. The authors would also like to thank the reviewers for their constructive comments and suggestions.

Conflicts of Interest: The authors declare no conflict of interest.

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