ASSESSMENT OF THE SEAWEED VALUE CHAIN

in Sulu and Tawi-Tawi

Funded by the European Union

People in Need

MARADECA, Inc.

UnYPhil-Women

Bangsamoro Agri-enterprise Programme -**Leveraging and Expanding Agri-Aqua Production in Bangsamoro (BAEP-LEAP)**

People in Need (PIN) is an international non-governmental organization founded in the Czech Republic, that has been providing aid in troubled regions and supporting respect for human rights since 1992. Being one of the largest NGOs in Central Europe, PIN has implemented hundreds of humanitarian and development projects in crisis and poverty-stricken areas across Europe, Asia, Africa, and Central America.

The organization began its operations in the Philippines in 2013 as a response to the devastation brought by Super Typhoon Yolanda. Ever since then, PIN's programs in the Philippines have evolved and spread to a variety of sectors, such as market systems development, sustainable livelihoods, disaster resilience, renewable energy, peace, and social cohesion.

Transforming Fragilities Inc. (TFI) is a Philippine NGO that focuses on research, monitoring, and evaluation (M&E), capability building, organizational development, and data-driven project management and implementation. Experts in peace and development, technical and management specialists, and cadres of provincial field researchers skilled in gathering qualitative and quantitative data all comprise the organization. They have come together to provide high-quality monitoring and evaluation, research and learning, capability development, organizational development support, and evidence-based project management and implementation with local and international development agencies, as well as programs that help transform fragile communities and situations in Mindanao and select provinces in Luzon and Viasayas.

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This study conducted in the Philippines is the result of a collaborative effort between People in Need Philippines and Transforming Fragilities, Inc. (TFI). This was made possible through the generous support of the European Union (EU).

In line BAEP-LEAP project mandate, this study gave TFI the opportunity to work closely with seaweed farmers, cooperatives, traders and input suppliers, academia, decision-makers, and other key players in the island provinces of Sulu and Tawi-Tawi.

Ms. Elsie S. Villanueva worked with Ms. Judith Joy G. Libarnes and Mr. Ahmed Harris R. Pangcoga of Transforming Fragilities, Inc. to write this report, while Jocelyn Sumail and Shermahal Akip, respectively, provided the primary data collection in Sulu and Tawi-Tawi.

The assessment team would like to thank People in Need Philippines for their guidance and for overseeing this study. The assessment team would also like to thank Ms. Jocelyn A. Sumail and Ms. Shermahal S. Akip for their leadership in managing enumeration teams across each province.

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Preface

This study is part of the Leveraging and Expanding Agri-Aqua Production (LEAP) in Bangsamoro project funded by the European Union as part of the Bangsamoro Agri-Enterprise Programme. It is also part of an extensive internal assessment and in-depth interviews carried out by People in Need (PIN) and the partners in mainland BARMM and the island provinces. This will eventually contribute to the systemic development of the seaweed value chains (VC) in the region. The evaluation found deficiencies in the areas of financial services, support for product quality, and access to nurseries and multipurpose processing facilities. Requirements were also identified, including maximizing intercropping opportunities, and enhancing the participation of women, indigenous people, and young people in the value chains.

Seaweed makes up seventy percent (70%) of all aquaculture production in the Philippines, making it one of the most economically significant fisheries products. It is also among the top three fisheries sector exports on a regular basis, of which Mindanao accounts for two-thirds of the production.

Sulu and Tawi-Tawi are the top seaweed producers in the BARRM region. Therefore, it is important to recognize that there is a huge potential for economic growth not only for the fisheries sector but also for its socio-economic impact among the communities involved in the seaweed farming industry.

In line with this, Transforming Fragilities, Inc. (TFI) has answered the call to assess the value chains in the island provinces. Our field experts have collaborated with seaweed farmers, cooperatives, traders and input suppliers, academia, and decision-makers in the island provinces of Sulu, Basilan, and Tawi-Tawi. We hope that the efforts of our field experts and secretariat staff will provide insights for policymakers and key players that will lead to positive outcomes for the long-term sustainability of the local seaweed industry, with the broader goal of promoting peace and development in the BARMM region.

We thank People in Need Philippines for giving us the opportunity to practice our area of expertise once again and to contribute to the ongoing transitional development of the BARMM region. We also thank our partners, the communities and academia, and the key players in the island provinces; without their solid contributions, this study would not have been possible.

TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

ACDI / VOCA	Agricultural Development Cooperative International/Volunteers in Overseas Cooperative Assistance
ACPC	Agricultural Credit Policy Council
ATC	Alkali Treated Chips
BARMM	Bangsamoro Autonomous Region in Muslim Mindanao
BFAR	Bureau of Fisheries and Aquatic Resources
DA	Department of Agriculture
FAO	Food and Agriculture Organization of the United Nations
FGD	Focus Group Discussion
IP	Indigenous People
KII	Key Informant Interview
LBP	Land Bank of the Philippines
LEAP	Leveraging and Expanding Agri-Aqua Production
LGU	Local Government Unit
MAFAR	Ministry of Agriculture, Fisheries and and Aquatic Resources
MIMAROPA	Mindoro, Marinduque, Romblon and Palawan
MMO	MAFAR Municipal Officer
MOST	Ministry of Science and Technology
MTIT	Ministry of Trade, Investments and Tourism
NDJC	Notre Dame of Jolo College
NGO	Non-Government Organization
PCIC	Philippine Crop Insurance Corporation
PCIP	Provincial Commodity Investment Plan
PIN	People in Need
PLEA	Production Loan Easy Access
PMSD	Participatory Market Systems Development
PNG	Philippine Natural Grade
PRDP	Philippine Rural Development Project
PSA	Philippine Statistics Authority
RC	Refined Carrageenan
RDS	Raw dried seaweed
RFS	Raw Fresh seaweed
RSBSA	Registry System for Basic Sector in Agriculture
SAIP	Seaweed Industry Association of the Philippines
SEARDEC	Seaweed Research and Development Center
SRC	Semi-refined Carrageenan
TFI	Transforming Fragilities, Inc.
UNYPHIL	United Youth of the Philippines - Women
VCA	Value Chain Analysis

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

The Philippines is one of the major producers of seaweed in the world. In 2019, the country ranked 4th next to China, Indonesia, and South Korea in terms of contribution to world production. Seaweed is an important component of the Philippine aquaculture industry, as it comprises nearly seventy percent (70%) of the total aquaculture production. Domestically, seaweed production is mainly centered in Mindanao, which accounts for almost two-thirds of the total production in the country. Major production areas in the country include the Bangsamoro Autonomous Region for Muslim Mindanao (BARMM), Mindoro, Marinduque, Romblon, and Palawan (MIMAROPA), and the Zamboanga Peninsula.

Sulu and Tawi-Tawi are the major-producing provinces of the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM). Eighteen (18) municipalities in Sulu and ten (10) municipalities in Tawi-Tawi are engaged in the production of seaweed. BARMM has an existing seaweed area of 69,303 hectares and a potential area of 26,359 hectares, for a total of 95,662 hectares. Out of this, the current utilization is only 72.45%. The country is endowed with 1,065 seaweed species; however, the seaweed industry is predominantly utilizing *Kappaphycus alvarezii/Kappaphycus striatum(*cottonii*)* and *Eucheuma denticulatum (*spinosum*)*. In Sulu and Tawi-Tawi, most of the farmers preferred cottonii species.

Generally, the value chain of seaweed in the Philippines is composed of several segments, which include input provision, production, post-harvest, trading, marketing, and processing. However, the number of key players and stakeholders and some aspects of the value chain are varied and diverse across regions and provinces, depending on the final form of the seaweed products being produced. Philippine seaweed is produced and marketed in various product forms, namely: 1) Raw Fresh Seaweed (RFS), 2) Raw Dried Seaweed (RDS), 3) Refined Carrageenan (RC), 4) Semi-Refined Carrageenan (SRC), 5) Philippine Natural Grade (PNG), 6) Alkali Treated Chips (ATC), 7) Carrageenan Blended Products, 8) Agar, 9) Seaweed Pickles, 10) Seaweed Chips, and 11) Seaweed Noodles.

The value chain of seaweed in the two provinces can be mostly analyzed within the context of raw fresh seaweeds (RFS) and raw dried seaweeds (RDS). In terms of input provision, farmers sourced out their seedlings to be used i n the next cropping cycle from their own farm, from the farms of other farmers in their respective production areas, or from other barangays/municipalities. Other input and seaweed farm implements, such as soft ties, PE ropes, stakes, and others, are usually purchased from any hardware and fishing supply stores in the locality. Government agencies and other organizations, such as the MAFAR, LGUs, and others, are also giving seedling dispersals and seaweed farm implements to the identified beneficiaries.

In terms of production, 70%–95% is usually intended for RDS, and only 5%–30% is intended for seedlings and food consumption. Farming is done near-shore and off-shore/deep-sea. Culture methods used for near-shore farming are fixed off-bottom monolines, while those used for off-shore or deep-sea farming are floating monolines. Seaweed farming and fishing are the main livelihoods and sources of income for the people in the community. Seaweed farming is undertaken as a family enterprise. Aside from that, some farmers are also engaged in crop production as an alternative source of income. Crops planted include bananas, coconuts, vegetables, and cassava. Although many of the farmers are members of the cooperatives or associations, they are not engaged in corporate farming.

For fresh raw seaweeds, postharvest activities involve cleaning and packing the seaweed in preparation for disposal to identified buyers. For RDS, on the other hand, the drying process is a significant activity in the postharvest segment, as there is a need to consider the moisture content of the product as well as the volume of weight lost in the drying process. The most common practice is sun drying. Sun drying of fresh seaweed is done either on stilt dryers or by hanging on a wooden platform. The lack or insufficiency of drying facilities in the production areas makes it difficult for the farmers to ensure proper drying of seaweed as well as observe good sanitation and hygiene in the drying areas. There are narratives of the seaweed being dried on the concrete roads or cemented pathways, especially during peak season. Moreover, due to a lack of standards on the proper drying and moisture determination of the dried seaweeds, this becomes a source of disagreement between the farmers and traders, especially since this is just based on the visual and physical inspection during delivery.

Trading in RFS is usually restricted in the local area. Small local buyers, wet market vendors, and farmers (MAFAR/LGUS) all purchase them for use as planting materials. RDS, on the other hand, are sold in the various municipalities and eventually further traded to big traders and consolidators in Jolo and Bongao. Products are then delivered to Zamboanga, where export traders and carrageenan processors source their supply for carrageenan processing.

In terms of product and market diversification, women and youth could take advantage of the increasing awareness and acceptability of the food-enriched value-added products of seaweed, like chips, noodles, *yema*, *polvoron*, pickles, and others. This can be a unique business enterprise opportunity for women and youth not only in the two provinces but in the entire region, given that it is the major producer of seaweed.

The results of the study necessitate the need for short-term, medium-term, and long-term interventions through the implementation of programs, projects, or activities to improve the local seaweed industry not only in the provinces of Sulu and Tawi-Tawi but the whole region as well. These interventions may include establishment of village-type seaweed nurseries for farmers to have easy access to good quality seedlings; provision of access to sources of working capital/funding support to finance production and post-production activities; provision of guarantee to seaweed farmers through crop protection/crop insurance program; crafting of local policies as well as exploring of alternative solution to address the prevalence in the use of synthetic fertilizers in seaweed farming; provision of drying facilities to address concerns on moisture content, sanitation and hygiene as well as the overall quality of the raw dried seaweed product; crafting of a comprehensive capability building program to enhance the knowledge and skills of the farmers, women, youth and other actors in the value chain; explore opportunities for value-addition and diversification to provide alternative livelihood such as processing of seaweed value-added products, crop production or other fishery-related farming enterprises to increase and sustain farmer's income; enhance the capacity of farmers' cooperatives and association operating in the area to engage in viable and diversified business enterprises relative to seaweed industry; crafting of strategies to maximize utilization of solar technologies in production and post-postharvest operation; and crafting of a plan of action to incorporate halal practices in the various segments of the value chain.

SECTION 1. INTRODUCTION

A. BACKGROUND INFORMATION AND OBJECTIVES

Seaweed, also called macroalgae, are non-flowering plant-like organisms that live in the sea. They are categorized into three main groups based on their pigmentation: red algae (*Rhodophyceae*), brown algae (*Phaeophyceae*), and green algae (*Chlorophyceae*). They are considered marine water plants and can be readily available in coastal environments.

Seaweed may be consumed directly as food or used for industrial (food and non-food) purposes. Consumption of fresh and processed seaweed is common in countries like Japan, China, Korea, and even the Philippines. Today, seaweed has been considered a supplement to promote health because it is low in calories and rich in vitamins and minerals, as well as dietary fiber (PRDP, 2018).

For industrial use, it is typically in the form of hydrocolloids extracted from seaweed and utilized as a component or additive in food, cosmetics, medicine, animal feed, and fertilizers, among others. Hydrocolloids can be categorized into three (3) types: carrageenan, agar, and alginate. Carrageenan and agar are extracted from red algae, while alginate comes from brown algae. Carrageenan is commonly used in dairy products and processed meat, salad dressings and other beverages, dairy products, and tomato sauce, among others. Cottonii species is predominantly kappa carrageenan, and Spinosum is commonly iota carrageenan (PRDP, 2018).

B. RATIONALE OF VCA

People in Need (PIN), one of the largest international NGOs in Central Europe and founded in the Czech Republic, is implementing the project "Leveraging and Expanding Agri-Aqua Production (LEAP) in Bangsamoro. The project aims to support the economic development of the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) by focusing on the seaweed and coffee value chains in the island provinces of Basilan, Sulu, and Tawi-Tawi. One of the project's objectives is to strengthen the resilience of agri- and aquaculture value chains, particularly seaweed, in the island provinces of Sulu and Tawi-Tawi. This will be achieved through concrete interventions to improve access to inputs, extension services, financial products, and processing facilities. The project also emphasizes coordination among different actors in the value chains, with particular focus on looking at the role and involvement of women, youth, and indigenous people in the seaweed value chain.

To achieve the above objective, PIN calls for a market assessment of the seaweed value chain with a strong focus on women, youth, and indigenous people in the provinces of Sulu and Tawi-Tawi. This is in line with the specific objective of improving seaweed production in terms of quality, diversity, consolidation, and market responsiveness.

C. OBJECTIVES OF THE VALUE CHAIN ASSESSMENT

This study focused on market assessment for the seaweed value chain in Sulu and Tawi-Tawi to achieve the following objectives, with a strong focus on farmers, youth, women, and indigenous people. Specifically, the study will be centered on the following:

1. ***Stakeholder Analysis, Value Chain Overview, and Market Dynamics***
   - Identification and mapping of the key stakeholders, actors, and institutions involved in the seaweed value chain.
   - Identification of existing service delivery actors active in the value chains.
   - Analyze the existing market linkages, dynamics, trends, and demand patterns.

- Examine the involvement and support provided by local and provincial government units in promoting and developing seaweed farming.
- Gather data on the current average income of seaweed farmers in the target areas.

2. ***Seaweed Varieties, Cultivation, and Production Practices***

- Assess the availability and profile of different seaweed varieties cultivated in Sulu and Tawi-Tawi.
- Gather information on seaweed farming profiles.
- Gather data on the average production quantity of seaweed in the local market over the past few years.
- Assess the current production and post-harvest practices.
- Examine the availability and adoption of innovative agricultural practices within the seaweed value chain and provide recommendations for facilitating their implementation among local farmers.

3. ***Involvement of Women, Youth, and Indigenous/Marginalized Groups***

- Identify the challenges and opportunities faced by women, youth, and indigenous people in their participation and engagement in the seaweed value chain and propose targeted strategies for their empowerment within the value chain.
- Assess the level of youth engagement in seaweed farming and value-added activities, identifying opportunities to attract and retain youth in the aquaculture sector.
- Identify avenues to attract and retain youth in seaweed farming and value addition, promoting their engagement in the aquaculture sector.
- Explore opportunities for indigenous people and marginalized communities to participate in the value chain, addressing their unique challenges.
- Analyze the potential for value addition, market diversification, and intercropping within the seaweed value chain, considering the benefits for farmers, youth, women, and indigenous people.

4. ***Market Access, Productivity Enhancement, and Value Addition***

- Identify market access constraints and opportunities for seaweed farmers and value chain actors in the region, considering barriers like security concerns, lack of capital, access to finance, ice-ice disease, etc.
- Analyze the production capacity and constraints faced by seaweed farmers and recommend measures to increase productivity and sustainability.
- Assess the potential for value addition, market/product diversification, and intercropping opportunities within the seaweed value chain, and explore how these opportunities can benefit and involve farmers, youth, women, and indigenous people.
- Evaluate the extent of technology adoption and innovation within the value chain. Identify opportunities for integrating technology to improve efficiency, product quality, and market competitiveness.
- Explore existing market linkages for seaweed products, including domestic and international markets, and propose ways to strengthen market connections, improve price realization, and reduce intermediaries in the value chain.

5. ***Quality Enhancement, Collaboration, and Recommendations***

- Evaluate the availability and accessibility of financial services for seaweed farmers and value chain actors, proposing tailored financial products and support mechanisms.

- Assess the existing quality standards and practices within the seaweed value chain, including post-harvest handling, grading, and processing, with a focus on identifying areas for improvement and enhancing market competitiveness.
- Identify successful and well-functioning seaweed cooperatives and farmer groups in the region, analyze their best practices, and assess the availability of such organizations to facilitate knowledge-sharing and collaboration.
- Assess opportunities for value addition and diversification within the seaweed value chain

6. ***Sustainability, Climate Resilience, and Recommendations***

- Conduct a risk analysis of the seaweed value chain, including market risks, climate risks, and financial risks, and provide risk mitigation strategies for the anticipated introduction of new financial products and solar technologies.
- Examine the impact of climate change on seaweed production and identify climate-resilient practices and technologies, especially solar technologies, that can be integrated into the value chain to enhance sustainability and adaptability.
- Identify existing integration of solar and other technologies in the seaweed post-harvesting processes.
- Identify potential partnerships and collaboration opportunities between stakeholders, including public-private partnerships, to strengthen the seaweed value chain and create a more inclusive and sustainable ecosystem.
- Suggest ways in which halal certification and solar technologies can enhance productivity and market presence.
- Recommend measures to increase productivity and sustainability, along with strategies for enhancing market competitiveness and ensuring the empowerment of marginalized groups, with a particular focus on women and youth.

D. METHODOLOGY

Design and Approaches

Participatory Market System Development

TFI has employed the Participatory Market Systems Development (PMSD) Framework and Toolkit by Practical Action in assessing the seaweed value chain in Sulu and Tawi-Tawi Provinces. Participatory Market Systems Development (PMSD) is a non-conventional approach for looking at markets using the principles of 1) systems thinking; 2) facilitation; 3) participation; and 4) gender. This approach is useful in designing an inclusive program where all the actors along the various segments of the value chain will not be left out but instead will be empowered as members of the system. In this system, opportunities are created for better understanding, linkage, and trust between and among the actors and stakeholders. This is particularly useful in coming up with actionable recommendations or proposed interventions, such as programs and projects, for PIN to consider that are aimed at developing the seaweed industry in the coverage areas.

Gender Analysis

Actors and key players in the seaweed value chain do not only involve men but also women and children. Gender analysis was employed to analyze the gender roles, responsibilities, and participation of both men and women in the seaweed value chain. The manual and toolkit for gender analysis, assessment, and audit developed by the Agricultural Development Cooperative International/ Volunteers in Overseas Cooperative Assistance (ACDI/VOCA) were also used as references in the study.

Value Chain Analysis

The value chain analysis framework was also considered, as it provides a holistic view of the various segments of the seaweed value chain. Value chain analysis (VCA) provides a better understanding of the relationships and linkages among the value chain participants (Brown et al., 2010). The study's quantitative aspect focused on estimating the value that each actor contributes to the product as it moves through the various stages of the chain. This can also be useful in analyzing further potential inefficiencies and inequities along the chain and helping identify possible value chain enhancement strategies and interventions for the value chain actors.

Market/Commodity Flow Mapping

Market mapping was used to show the flow of seaweed products from the production areas to the market. This involves tracing the chain of activities from seaweed farmers up to their key customers, such as processors, traders, and exporters.

Study Area, Data Sources, and Data Gathering Techniques

This assessment was focused on the two (2) island provinces of Sulu and Tawi-Tawi of the Bangsamoro Autonomous Region of Muslim Mindanao (BARMM).

Specifically, coverage areas of the study include the municipalities of Hadji Panglima Tahil, Kalingalan Caluang and Panglima Estino, Jolo, and Parang in Sulu, and the municipalities of Simunul, South Ubian and Tandubas, Sitangkai, and Bongao in Tawi-Tawi. Three (3) municipalities in the two provinces are the priority areas of PIN for project implementation relative to seaweed.

This assessment focused on the different municipalities of the two (2) island provinces of Sulu and Tawi-Tawi in the Bangsamoro Autonomous Region of Muslim Mindanao. Specifically, coverage areas of the study include the municipalities of Hadji Panglima Tahil, Kalingalan Caluang and Panglima Estino, Jolo, and Parang in Sulu and the municipalities of Sapa-sapa, South Ubian and Tandubas, Sitangkai, and Bongo in Tawi-Tawi. In addition, respondents to the study include the different actors and stakeholders within the value chain of seaweed, particularly farmers, processors, and traders, as well as enablers in the value chain. Focus was also given to women, youth, and Indigenous Peoples (IP), or marginalized sectors.

The preliminary analysis was done through a review of the available secondary data from various sources for the team to acquire an overall picture of the project. This also served as preliminary input for the initial draft of the study. Documents reviewed include, but are not limited to, the following (subject to availability):

1. Existing value chain studies on seaweed have been conducted by government agencies or other institutions.
2. Production reports (reflecting volume of production, major production areas, and other data) on seaweed in the agriculture offices of the various LGUs in Sulu and Tawi-Tawi, Ministry of Agriculture, Fisheries, and Aquatic Resources (MAFAR), and Ministry of Trade, Investments, and Tourism Offices of the BARMM.
3. Provincial Commodity Investment Plans (PCIP) of the two provinces.
4. Reports on distribution, marketing systems, and commodity flows.
5. Fisheries Profiles.
6. Other available documents related to the study.

On the other hand, primary data was gathered using data gathering tools to cross-reference with secondary data available. Primary data came from the results of FGDs and KIIs conducted and some documentation during the farm visit in some identified areas.

SECTION 2: OVERVIEW OF THE INDUSTRY

A. PRODUCT DESCRIPTION

Seaweed is considered a macroscopic algae. They are non-flowering plant-like organisms that live in the sea. They are non-vascular plants, which means they do not have roots, stems, or leaves. These organisms are categorized into three main groups based on their pigmentation: the red algae (*Rhodophyceae*), the brown algae (*Phaeophyceae*), and the green algae (*Chlorophyceae*). They are considered a low-investment crop and usually thrive in coastal environments.

Seaweed may be used for various purposes. It can be consumed directly as food since it is low in calories, rich in vitamins and minerals, and high in dietary fiber; hence, it has been considered a healthy food product. However, the country's population only consumes a small portion of the production. The bulk of the production is utilized for industrial purposes (BFAR, 2022).

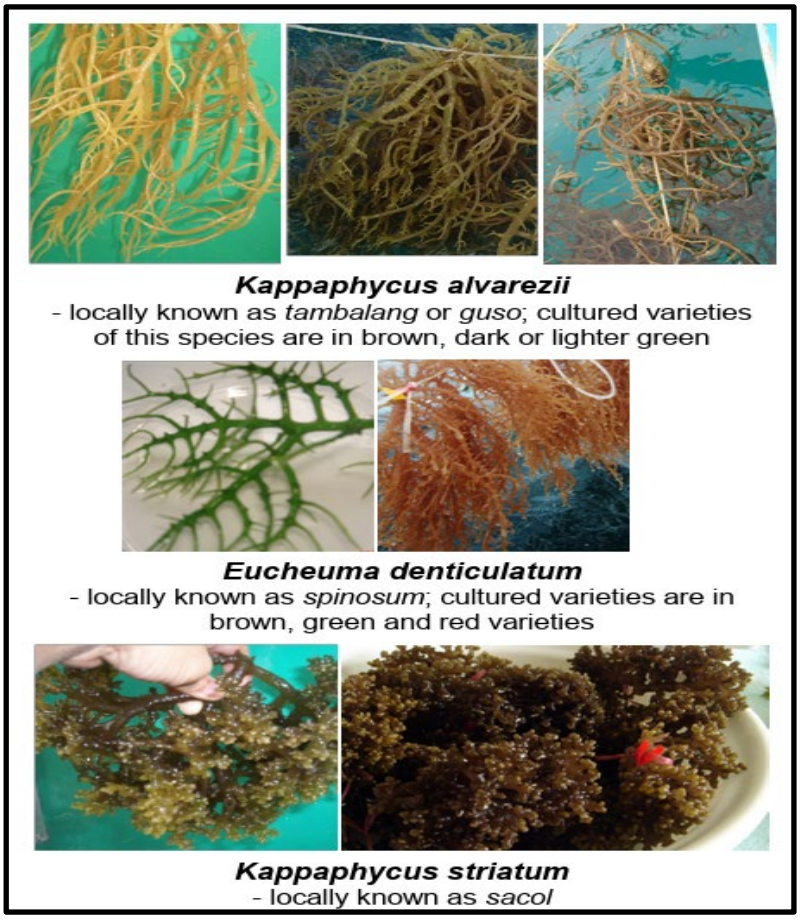
Hydrocolloids are extracted from seaweed and commercially used as a component or additive in food, cosmetics, medicine, animal feed, and fertilizers, among others. It can be categorized into three (3) types: carrageenan, agar, and alginate. Carrageenan and agar are extracted from red algae, while alginate comes from brown algae. Carrageenan is further classified into iota, kappa, and lambda carrageenan. Iota carrageenan yields a soft, elastic gel that is utilized for salad dressings and other beverages, while kappa carrageenan produces a strong, firm gel commonly utilized in dairy products and processed meat. In addition, lambda carrageenan is a thickening agent used in dairy products and tomato sauce, among others (PRDP, 2018).

The Philippines is primarily producing kappa carrageenan from *Kappaphycus alvarezii* (trade name *Cottonii*) and iota carrageenan from *Eucheuma denticulatum* (*spinosum*) species. Kappa carrageenan has a wider range of utilization, both in food and pharmaceutical products, than iota carrageenan (PRDP, 2014).

Seaweed Species

The country has 1,065 species of seaweed (Lastimoso and Santianez, 2021; National Seaweed Industry Roadmap 2022–2026). However, *Kappaphycus alvarezii/Kappaphycus striatum* (*cottonii*) and *Eucheuma denticulatum* (*spinosum*) are the main types used in the seaweed industry. These are the main species that farmers cultivate and use to make carrageenan in the nation. Other species that are commercially grown include *Caulerpa and Gracilaria,* which are utilized in other parts of the country.

Figure 1. Major Commercial Seaweed Species



Source: BFAR Technology Series, 2014

Table 1 shows a list of seaweed species being cultivated in the various areas of Mindanao. Particularly in the BARMM, farmers primarily culture *cottonii*. This species has a relatively high growth rate compared to other species. It also grows well at sites with very strong water currents at low temperatures. However, a major constraint with this variety is its high susceptibility to ice-ice disease (PRDP, 2014).

Kappaphycus alvarezii does well on reefs with sand- and rock-covered substrates where water flow is slow to moderate. *Eucheuma denticulatum*, on the other hand, does well on reefs with sand- and rock-covered substrates that are always exposed to moderate to strong water currents (McHugh, 2003).

Table 1. List of Seaweed Species Available In Mindanao

AREA	SEAWEED SPECIES
Mindanao	**Kappaphycus alvarezii* (cottonii) and ***Eucheuma denticulatum* (spinosum)
Region 9 (Zamboanga del Norte, Zamboanga del Sur, Zamboanga Sibugay, Zamboanga City, Isabela City)	**Kappaphycus alvarezii* (cottonii) and ***Eucheuma denticulatum* (spinosum)

Region 10 (Misamis Oriental, Misamis Occidental, Lanao del Norte, Camiguin)	**Kappaphycus alvarezii* (cottonii) and ***Eucheuma denticulatum* (spinosum)
Region 11 (Davao del Norte)	**Kappaphycus alvarezii* (cottonii) and ***Eucheuma denticulatum* (spinosum)
Davao Oriental, Davao del Sur, and Davao City	**Kappaphycus alvarezii* (cottonii) and ***Eucheuma denticulatum* (spinosum)
Region 13 (Agusan del Norte, Surigao del Norte, Surigao del Sur, Dinagat Islands)	**Kappaphycus alvarezii* (cottonii) and ***Eucheuma denticulatum* (spinosum), *Caulerpa, Gracilaria*
Bangsamoro Autonomous Region of Muslim Mindanao (Tawi-Tawi, Basilan, Sulu, and Maguindanao)	**Kappaphycus alvarezii (*cottonii*)*

Source: PRDP, 2018; BFAR Technology Series, 2014; McHugh, 2003
**Kappaphycus alvarezii was formerly Eucheuma cottonii, and commercially was and is called "cottonii."*
***Eucheuma denticulatum was Eucheuma spinosum and, commercially, was and is called "spinosum."*

Product Forms

Figure 2. Seaweed Product Forms

Source: PRDP, 2018; Some photos were taken from the fieldwork
Clockwise Top Left: Dried Seaweed, Top Right: Alkali Treated Chips, Bottom Left: Fresh Seaweed, Bottom Right: Seaweed Snack Chips, Center: Carrageenan

In general, seaweed in the Philippines is marketed in various product forms, namely:

1. **Raw Fresh Seaweed (RFS):** This is the most basic product form. This is the harvested seaweed from the farm. Fresh seaweed is mainly used as seedlings by the farmer for the next cropping cycle. Usually, RFS are sold to fellow farmers within the community or neighboring areas. Also, a very negligible amount is consumed as raw/fresh salad.

2. **Raw Dried Seaweed (RDS):** This is the dried form of the RFS. This is the common output of the farmers, as most of its production is intended for carrageenan extraction.

3. **Refined Carrageenan (RC):** This is the pure form of hydrocolloid carrageenan extracted from raw dried seaweed. RC can be extracted through alcohol precipitation or gel pressing. Gel-pressed RC is cheaper than alcohol-precipitated RC. Alcohol-precipitated RC is usually used to maintain the true color of the food product. While alcohol precipitation can be used for any carrageenan, gel pressing can only be used for kappa carrageenan.

4. **Semi-refined Carrageenan (SRC):** Semi-refined carrageenan is obtained through several washings to remove everything that will dissolve in the alkali and water. The remaining insoluble residues are then dried, chopped, and milled into powder form. This is mainly applicable for kappa carrageenan. This product can either be food-grade or pet-grade.

5. **Philippine Natural Grade (PNG):** This is a product variation of SRC where the seaweed residues after alkali treatment and washing are chopped and bleached, then dried and milled afterwards.

6. **Alkali Treated Chips (ATC):** This is alkaline-treated raw dried seaweed that is chopped and pelletized. It serves as a raw material for refined carrageenan. Converting into this product form will enhance the gelation properties of the carrageenan.

7. **Carrageenan Blended Products**: These are blended products of both RC and SRC that use other ingredients such as salt, sugar, and gum.

8. **Agar:** This is a pure hydrocolloid extract from *Gracilaria* seaweed, in white or yellow color. Agar can be derived through gelation, bleaching, and syneresis process before drying and milling. This is in powder, or strips form and used for food products.

9. **Seaweed-Enriched Food Products**: Seaweed pickles are made from fresh seaweed immersed in vinegar and combined with onions, ginger, carrots, and other flavorings such as pepper, salt, and sugar. It can be served fresh or stored in a jar for future consumption. Seaweed chips, on the other hand, are seaweed-based products made of ground raw dried seaweed combined with flour, salt, and other seasonings. The product is molded in a machine to achieve the desired appearance; then it is fried and packed in plastic in several sizes. Moreover, seaweed noodles are another seaweed-based product made of ground raw dried seaweed mixed with flour, palm/coconut oil, salt, and other seasonings. It is cut into long, thin strips through a machine, then cooked and packed.

Table 2. Product Forms of Seaweed Produced in Mindanao

AREA	SEAWEED PRODUCT FORMS
MINDANAO	RFS, RDS, SRC, RC, ATC, and Seaweed Pickles
Region 9 (Zamboanga del Norte, Zamboanga del Sur, Zamboanga Sibugay, Zamboanga City, Isabela City)	RFS, RDS, SRC, RC, and ATC
Region 10 (Misamis Oriental, Misamis Occidental, Lanao del Norte, Camiguin)	RFS, RDS, SRC, RC, ATC, Seaweed Pickles, Seaweed Noodles, Seaweed Chips, and Seaweed Crackers
Region 11 (Davao del Norte, Davao Oriental, Davao del Sur, Davao City)	RFS, RDS, SRC, RC, and ATC
Region 13 (Agusan del Norte, Surigao del Norte, Surigao del Sur, Dinagat Islands)	RFS, RDS, SRC, RC, ATC, Seaweed Pickles, and Seaweed Strips
Autonomous Region of Muslim Mindanao (Tawi-Tawi, Basilan, Sulu, Maguindanao)	RFS, RDS, SRC, RC, ATC, Seaweed Chips, Seaweed Noodles, Yema, Polvoron, and Pastillas

Source: PRDP, 2018

Table 2 shows the various product forms of seaweed being produced in Mindanao. In the BARMM (Basilan, Maguindanao, Sulu, and Tawi-Tawi), product forms include RFS, RDS, SRC, RC, ATC, seaweed chips, seaweed noodles, *yema*, *polvoron*, and *pastillas*. SRC, RC, and ATC are produced in other areas like Zamboanga, Cebu, and Tacloban, but the source of raw seaweed is in BARMM, particularly Sulu and Tawi-Tawi. Although the region has diversified into seaweed chips, seaweed noodles, *yema*, *polvoron*, and *pastillas*, these products have yet to be produced commercially (PRDP, 2018).

B. SUPPLY ANALYSIS

Global Production

Globally, seaweed production continues to expand. The Philippines is one of the major producers of seaweed. In 2019, the country was the 4th highest-producing country next to China, Indonesia, and South Korea in terms of contribution to world production, having contributed 4.20% of the total world's production (Table 3). Seaweeds are important components of the Philippine aquaculture industry, as they comprise nearly seventy percent (70%) of the total aquaculture production. It is one of the most economically important fishery products and is ranked third as the top fishery export in the country (PRDP, 2018).

Table 3. Global Seaweed Production, 2019

Country/Area	Total (Farmed and Wild) Production (Tonnes)	Share of World Total (%)	Aquaculture Share in Total Production (%)
World	**35,762,504.00**	**100.00**	**96.97**
Asia	**34,826,750.00**	**97.38**	**99.10**
China	20,296,592.00	56.75	99.14
Indonesia	9,962,900.00	27.86	99.55
Republic of Korea	1,821,475.00	5.09	99.52

Philippines	1,500,326.00	4.20	99.98
Korea, Dem People's Rep	603,000.00	1.69	100.00
Japan	412,300.00	1.15	83.80
Malaysia	188,110.00	0.53	100.00
Americas	**487,241.00**	**1.36**	**4.69**
Chile	426,605.00	1.19	5.08
Peru	36,348.00	0.10	-
Canada	12,655.00	0.04	-
Mexico	7,336.00	0.02	0.14
United States of America	3,394.00	0.01	7.75
Europe	**287,033.00**	**0.80**	**3.88**
Norway	163,197.00	0.46	0.07
France	51,476.00	0.14	0.34
Ireland	29,542.00	0.08	0.14
Russian Federation	19,544.00	0.05	54.1054.10
Iceland	17,533.00	0.05	-
Africa	**144,909.00**	**0.41**	**81.29**
United Republic of Tanzania	106,069.00	0.30	100.00
Morocco	17,591.00	0.05	1.55
South Africa	11,155.00	0.03	19.32
Madagascar	9,665.00	0.03	91.72
Oceania	16,572.00	0.05	85.32
Solomon Islands	5,600.00	0.02	100.00
Papua New Guinea	4,300.00	0.01	100.00
Kiribati	3,650.00	0.01	100.00
Australia	1,923.00	0.01	-

Source: FAO, 2021 www.fao.org/fishery/statistics/software/fishstatj/en)

Domestic Production

Domestically, seaweed production is mainly centered in Mindanao, which accounts for almost two-thirds of the total production in the country. Major production areas in the country include the Bangsamoro Autonomous Region for Muslim Mindanao (BARMM), Mindoro, Marinduque, Romblon, and Palawan (MIMAROPA) and Zamboanga Peninsula (Philippine Fisheries Profile, 2019).

Table 4. Seaweed Farming Areas in Selected Regions of the Philippines, 2018

Region	Existing Seaweed Area (ha)	Potential Seaweed Area (ha)	Total Seaweed Area (ha)	Current Utilization Rate (%)
ARMM	69,303.00	26,359.00	95,662.00	72.45%
Palawan (MIMAROPA)	5,567.00	8,206.50	13,773.50	40.42%
Zamboanga Peninsula	11,888.00	17,497.00	29,385.00	40.46%
Western Visayas	2,924.60	2,014.31	4,938.91	59.22%
Central Visayas	4,024.03	504.62	4,528.65	88.86%
Bicol Region	534.00	387.00	921.00	57.98%
Eastern Visayas	1,074.47	5,285.00	6,359.47	16.90%
CARAGA Region	876.65	1,265.50	2,142.15	40.92%

Source: PRDP, 2018; BFAR, 2022

BARMM has an existing seaweed area of 69,303 hectares and potential areas of 26,359 hectares, for a total of 95,662 hectares. Out of these areas, the current utilization is only 72.45%. Among the provinces of the region, about 91 percent of the existing farms are situated in Tawi-Tawi, and the remainder is divided among Basilan, Maguindanao, and Sulu, in which Basilan and Maguindanao farms just make up a little over 1 percent of the total seaweed area of the region (PRDP, 2018 as cited in BFAR, 2022).

Table 5 below shows the top-producing provinces of the country as of 2022. In terms of provinces, Tawi-Tawi and Sulu are the top 1 and top 3 major seaweed-producing provinces, respectively. As of 2022, Tawi-Tawi contributes 40.59% and Sulu contributes 15.68% to the total national production (see Figure 3).

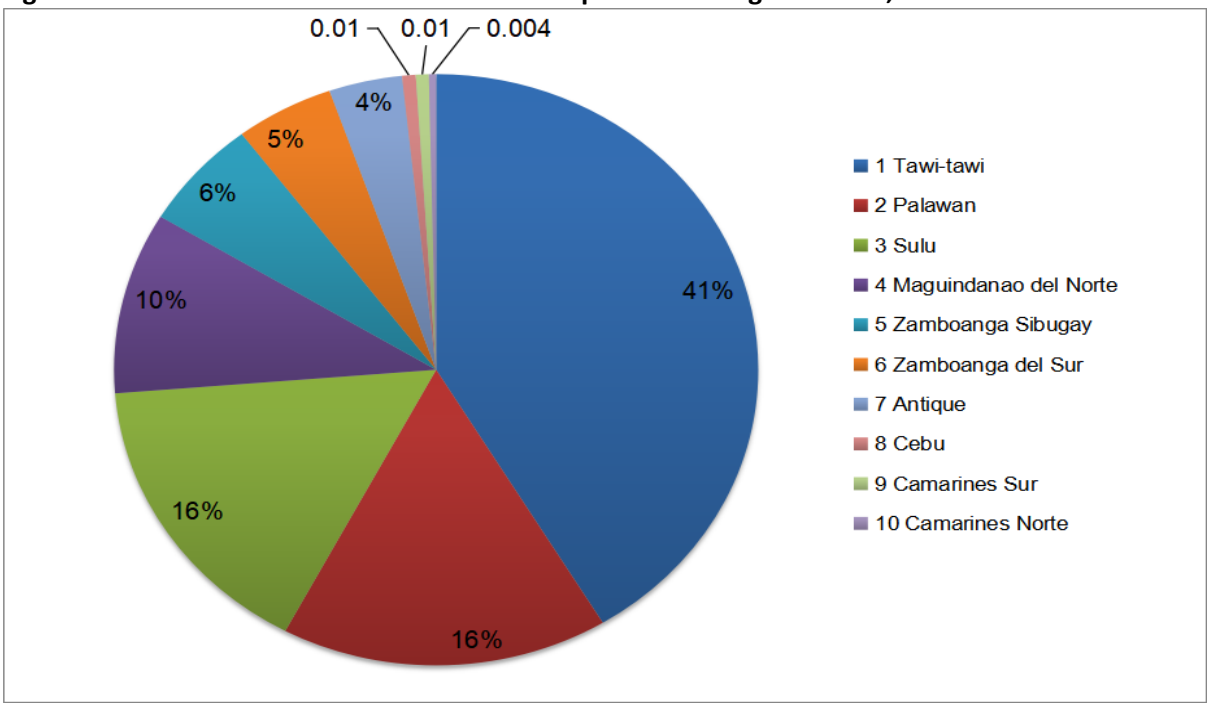
Table 5. Seaweed-Top Producing Provinces in the Philippines, 2022

PROVINCE	2022 Production	% Share in National Production*
Tawi-Tawi	627,070.42	40.59%
Palawan	248,930.91	16.11%
Sulu	242,205.37	15.68%
Maguindanao del Norte	150,642.60	9.75%
Zamboanga Sibugay	91,391.94	5.92%
Zamboanga del Sur	74,973.64	4.85%
Antique	55,758.53	3.61%
Cebu	10,335.64	0.67%
Camarines Sur	9,867.85	0.64%
Camarines Norte	5,492.70	0.36%
Zamboanga del Norte	4,410.61	0.29%
Zambales	3,845.76	0.25%
Surigao del Sur	3,355.03	0.22%
Lanao del Norte	3,306.80	0.21%
Bohol	2,845.74	0.18%
Philippines Total	**1,544,959.87**	

Source: PSA, 2022

**% share in national production is computed based on PSA data*

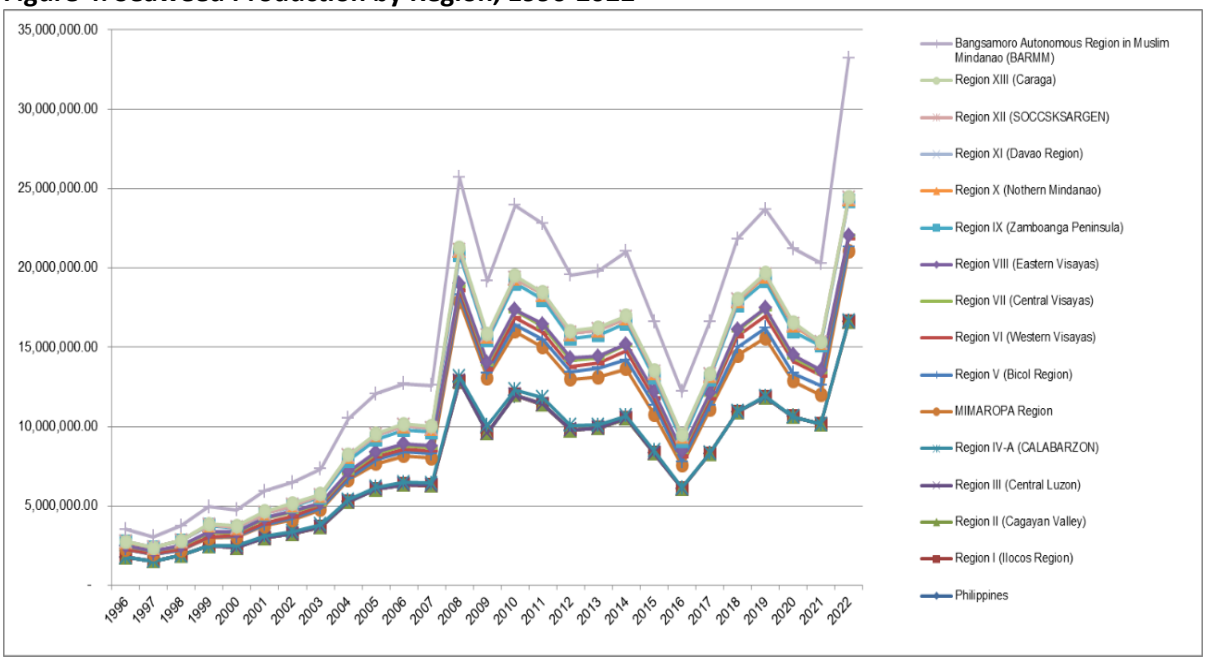
Figure 3. Share in the National Production of Top 10 Producing Provinces, 2022



Source: Computed based on PSA data

Furthermore, Figure 4 shows historical seaweed production data for the country by region from 1966-2022. As exhibited in the diagram, production was expanding until 2011. A downward trend was observed in 2019-2020 with a drop of 1.47 million metric tons in 2020 from 1.5 million metric tons in 2019. In recent years, from 2021 onwards, an upward trend was also noted in the volume of seaweed produced in the country.

Figure 4. Seaweed Production by Region, 1996-2022



Source: PSA, 2022

Seaweed Production in the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM)

The vast area of water in the region is home to different species of aquatic resources, like seaweed. In fact, commercial farming of seaweed in the country started in the region. Also, the wide expanse of coastlines in the area makes it suitable for seaweed farming. Residents, mostly Tausug and Sama, rely heavily on seaweed farming and fishing as their main livelihood. No dedicated data on ethnic distribution in the seaweed production industry is available. However, the majority (71.45 percent) of the household population in Tawi-Tawi classified themselves as Sama Dilaya or Tausug (35.82 percent and 35.63 percent, respectively). Others classified themselves as Sama (Samal)/Abaknon (15.21 percent), Jama Mapun (5.84 percent), Badjao/Sama Dilaut (2.52 percent), or belonged to other ethnic groups (4.43 percent). In Sulu, about 85.27 percent of the household population classified themselves as Tausug. Other ethnic groups included Sama (Samal)/Abaknon (7.96 percent), Badjao, Sama Dilaut (2.13 percent), Ibanag (0.44 percent), and Kinaray-a (0.19 percent) (PSA, 2020). In both provinces, the predominant ethnic groups cited are the ones engaged in the seaweed production industry. Seaweed farming has been a part of their way of life for generations. They are both Muslim/Moro and indigenous to these provinces. The other ethnic groups cited are not indigenous to the provinces and are predominantly found in non-aquaculture related industries, instead. Aside from that, some of them are also engaged in crop production as alternative sources of income. Crops planted include bananas, coconuts, vegetables, and cassava. Other aquaculture activities such as crab farming, caged fishing, abalone farming, and others were not specifically mentioned during the FGDs and KIIs.

BARMM has the most farmable areas in the country. With an existing production area of 69,303 hectares and potential farmable areas of 26,359 hectares, the region still dominates the production of seaweed in the entire country. However, the region still has room to expand its production, as it is currently cultivating 72% of its total seaweed area (see Table 6).

In terms of economy, the Island Province of Sulu is predominantly agri-fishery based and 2/3 of the population is directly or indirectly dependent on fishing as their source of livelihood. Seaweed is one of the major commodities in the province. Two of the potential seaweed species being cultured in the

seaweed farms are the *Eucheuma* and the *Kappaphycus spp.* 90% of the total coastal water in Sulu is suitable for seaweed culture. Sulu contributes 40% of the export of carrageenan, one of the world's foremost food and industrial additives today.

The shallow depth of the sea coupled with the short intervals of currents from the Sulu and Celebes Seas make Tawi-Tawi very conducive for seaweed farming (*Eucheuma*), which is the major source of carrageenan. To date, Tawi-Tawi is still the leading supplier of seaweeds throughout the country, 70% of the country's total production. Tawi-Tawi stands to maintain this status in 2020 and beyond.

Table 6. Existing and Potential Areas of Seaweed Farming in BARMM

Location	Existing Area		Potential Area		Current Area Utilization	2017 Productivity
	(ha)	% share	(ha)	% share	(%)	MT/ha/year
Basilan	435	0.63	350	1.33	55.41	2.50
Lanao del Sur	-	-	-	-	-	-
Maguindanao	336	0.49	92	0.35	78.50	278.97
Sulu	5,621	8.11	3,893	14.77	59.08	42.58
Tawi-Tawi	62,911	90.78	22,024	83.55	74.07	5.11
TOTAL	**69,303**		**26,359**		**72.45**	**9.29**

Source: PRDP, 2018

Among the provinces of the region, Tawi-Tawi and Sulu are the top 1 and top 3 major seaweed-producing provinces, respectively. As of 2022, Tawi-Tawi contributes 40.59% and Sulu contributes 15.68% to the total national production, respectively, as shown in Figure 3.

Tawi-Tawi is dubbed the "Seaweed Capital of the Philippines" and the "Carrageenan Capital of the World." Seaweed is one of the major industries in the province that benefits most of the fisherfolk/seaweed farmers. In fact, 90% of the coastal waters of the province is suited for seaweed culture. It is the main source of livelihood for the province, wherein 10 out of the 11 municipalities are engaged in seaweed cultivation, specifically, the municipalities of (1) Sitangkai; (2) Sibutu; (3) Panglima Sugala; (4) Tandubas; (5) Sapa-Sapa; (6) South Ubian; (7) Simunul; (8) Languyan; (9) Mapun; and (10) Bongao.

Like Tawi-Tawi, seaweed is also one of the major industries in the province of Sulu. In fact, 18 of the 19 municipalities of Sulu are engaged in seaweed production, with the top-producing municipalities, namely: Parang, Panglima Tahil, Tapul, Siasi, and Kalingalan Caluang.

Both provinces are devoted to the production of *Kappaphycus alvarezii* (*cottonii*), which is the most economically important variety in the Philippines, accounting for 98% of the total Philippine production. It is the source of carrageenan, one of the world's foremost food and industrial additives today (PRDP, 2014; PRDP, 2018).

Table 7 shows the annual seaweed production in the region in the past 5 years (2018-2022). Tawi-Tawi posted the highest growth rate at 11.31%, while Sulu has an average growth rate of 5.86%. The BARMM region, posted a growth rate of 11.86% for the past 5 years. Specifically, the island provinces of Sulu and Tawi-Tawi are considered major producers of the region, accounting for 31% and 54.36%, respectively, of the region's total volume of production.

Table 7. Seaweed Annual Production in BARMM, 2018-2022 (in MT)

Province	2018	2019	2020	2021	2022	Average Growth Rate (%)
Basilan	847.74	867.98	1,098.71	1,116.13	775.90	2.27
Lanao del Sur	-	-	-	-	-	-
Maguindanao del Norte	96,809.65	99,803.38	103,780.01	103,835.38	150,642.60	7.84
Maguindanao del Sur	-	-	-	-	-	-
Sulu	227,001.67	227,299.01	230,645.26	232485.12	242,205.37	5.86
Tawi-Tawi	344,354.38	368,795.10	375,617.36	382,864.31	627,070.42	11.31
BARMM	**669,013.44**	**696,765.47**	**711,141.33**	**720,300.95**	**1,020,694.28**	**11.86**

Source: PSA data; growth rate is computed

SECTION 3. NATURE AND STRUCTURE OF THE INDUSTRY

A. VALUE CHAIN MAPPING

Seaweed Commodity Map

The commodity map indicates the location of production areas, local traders/buyers, big traders/consolidators in the island provinces of Sulu and Tawi-Tawi. Figures 5 and 6 show the commodity maps of the two provinces, respectively.

Figure 5. Seaweed Commodity Map of Sulu

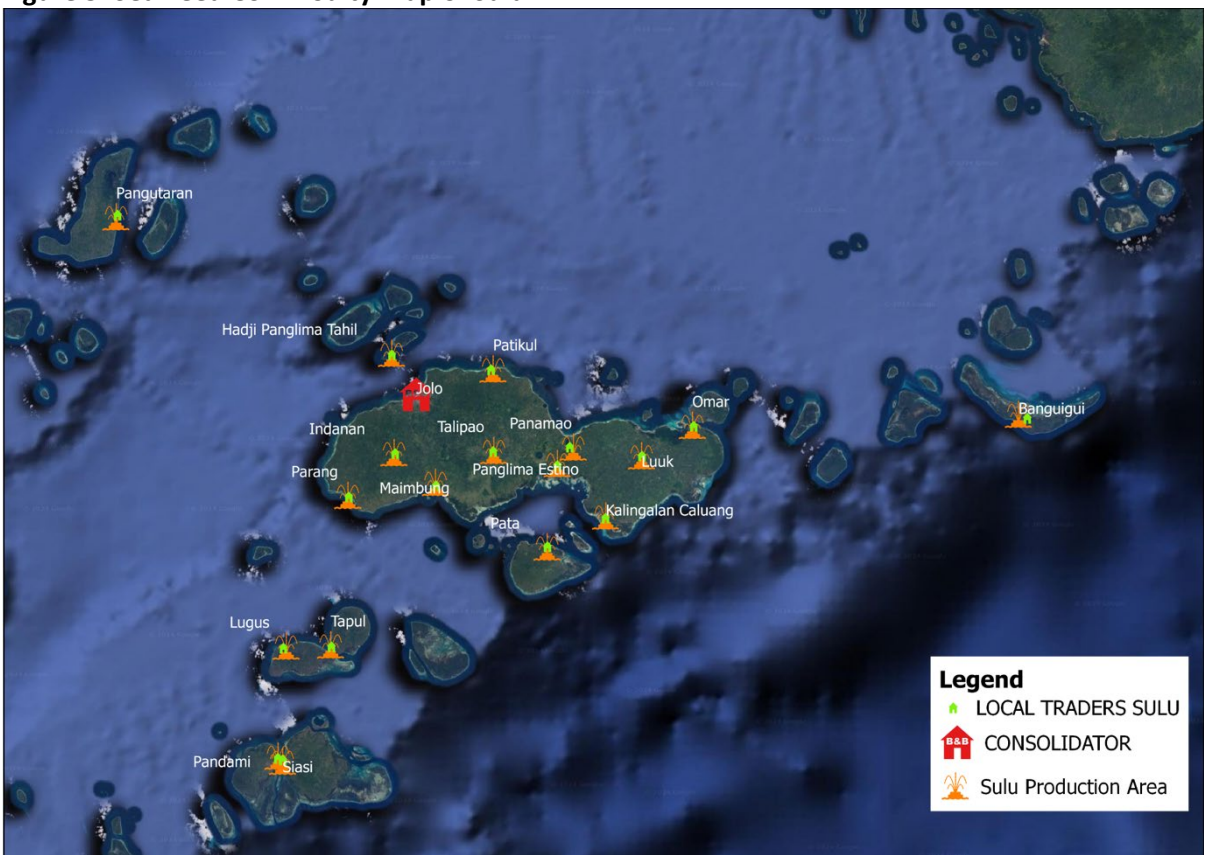


Figure 5 shows the seaweed commodity map of Sulu. Production of seaweed is scattered in almost all the municipalities of the province. In fact, eighteen (18) out of the nineteen (19) municipalities are engaged in seaweed production. Jolo is the only seaweed non-producing municipality in the province. Top-producing municipalities include Parang, Panglima Tahil, Tapul, Siasi, and Kalingalan Caluang. Farmers are primarily cultivating cottonii species of seaweed.

Production inputs such as seedlings can be sourced-out from farmers within the community or in neighboring areas. Seaweed farm implements (SFIs) can also be bought from the hardware fishing supply stores in the locality or in Jolo, where most of the business establishments are present.

Also shown in the map are the barangays and local traders operating in the various municipalities of the province. They are the direct contacts of the farmers in marketing. Based on the FGDs and KIIs conducted, there are at least 2–5 traders present in each barangay of the province, although some of the participants narrated that some barangays do not have barangay traders. Instead, they deliver their produce directly to Jolo. Seaweed products coming from most of the municipalities are brought to Jolo to be marketed directly to the big traders and consolidators. There are at least 100 traders in Jolo based on the estimates of the FGD participants.

Figure 6. Commodity Map for Seaweed of Tawi-Tawi

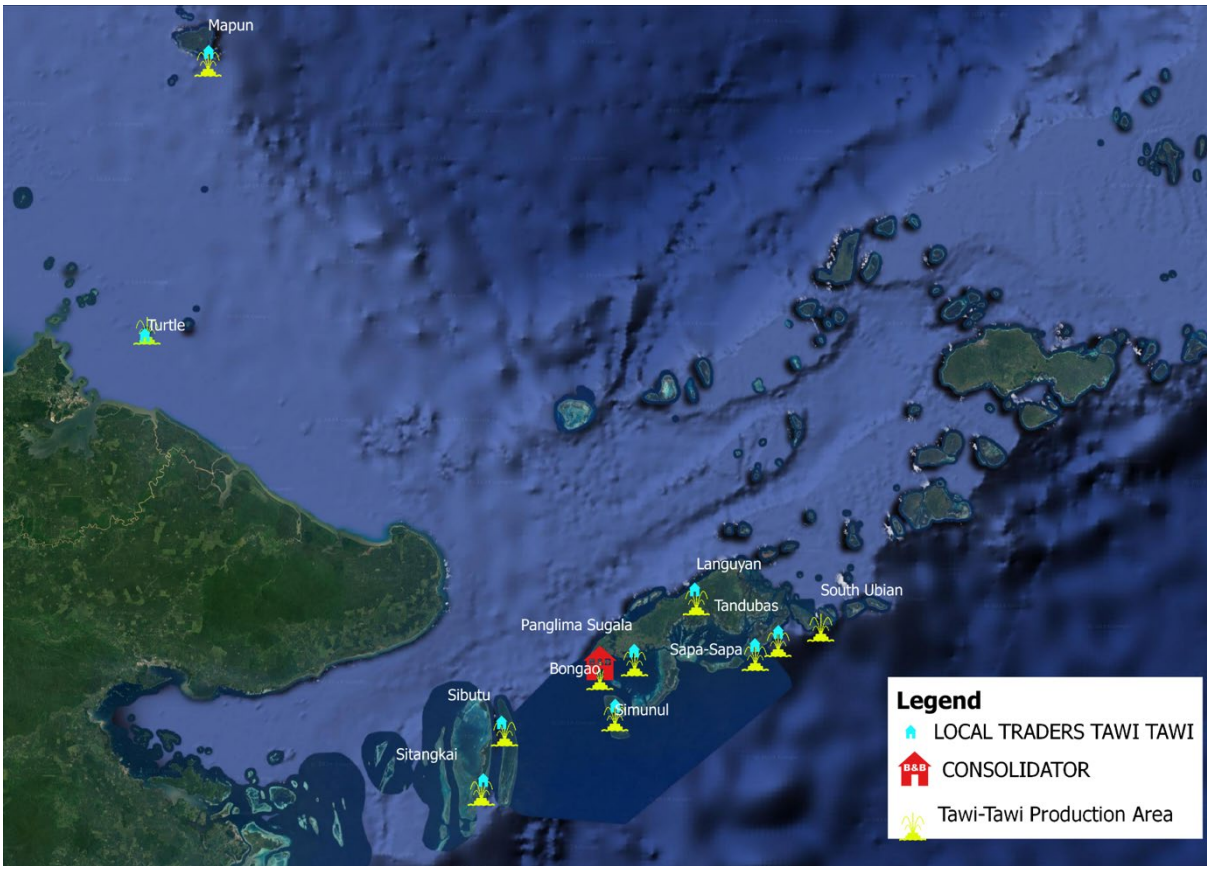


Figure 6 shows the seaweed commodity map of Tawi-Tawi. Like in Sulu, most of the municipalities in the province are also engaged in seaweed production. Out of the 11 municipalities of Tawi-Tawi, ten (10) are engaged in the production of seaweed. These include (1) Sitangkai; (2) Sibutu; (3) Panglima Sugala; (4) Tandubas; (5) Sapa-Sapa; (6) South Ubian; (7) Simunul; (8) Languyan; and (9) Mapun and (10) Bongao. Turtle Islands, which lies within the Sulu Sea, is the only municipality that is not producing seaweed. Farmers are also primarily cultivating cottonii species of seaweed.

Sources of production inputs, such as seedlings, are readily available within the community or neighboring areas. For instance, seaweed seedlings can be sourced from farmers within the community or in neighboring areas. Seaweed farm implements (SFIs) can also be bought from the hardware and fishing supply stores in the locality or in Bongao, the capital town of the province.

There are also barangays and local traders in the various municipalities of Tawi-Tawi where the farmers can deliver their products. In some instances, farmers in the municipalities near Bongao deliver their products directly to the traders and consolidators in the area. There are at least 10 big traders and consolidators located in Bongao (FGDs).

Geographical Flow of Seaweed Products

Geographically, the flow of seaweed products is not only within the two provinces but throughout the entire domestic economy. In general, the geographical flow of seaweed products is not fluid across the country. Products are taken from the outskirts and brought to the commercial centers. Water transportation is the main modality of bringing the products from the point of production to the market, although land transportation is also used for areas connected with land (PRDP, 2018).

In the case of fresh seaweed, it has a very short channel of distribution. Usually, production and marketing of fresh seaweed are confined to the same municipality or province, as this is commonly used for seedlings and food consumption. Farmers in the neighborhood or nearby sell the fresh seaweed they use as seedlings. Fresh seaweed for consumption is sold in the wet markets located within the community or nearby places. This is true for most of the seaweed-producing areas across the country (PDRP, 2014; PRDP, 2018).

The geographical flow for the raw dried seaweeds (RDS) is entirely different from that of the raw fresh seaweeds. Its marketing channel is more diverse and expanded as the product traverses outside the boundaries of the two provinces (PDRP, 2014; PRDP, 2018). RDS from the different municipalities of Sulu are being sold and consolidated in Jolo, the capital town of the province. From there, consolidated products flowed to Zamboanga City, where carrageenan processors in Cebu and Tacloban sourced their respective supplies of RDS for processing. Like in Jolo, big traders in Bongao consolidate RDS from the various municipalities in Tawi-Tawi and channel it to Zamboanga City.

Figures 7 and 8 show the geographical flow of the main product (RDS) from the two provinces. As noted, the destination of the RDS from both provinces is Zamboanga City. This is where big traders, consolidators, and processors from other places like Cebu and Tacloban get their respective supplies for carrageenan processing.

Figure 7. Geographical Flow of Seaweed Products in Sulu

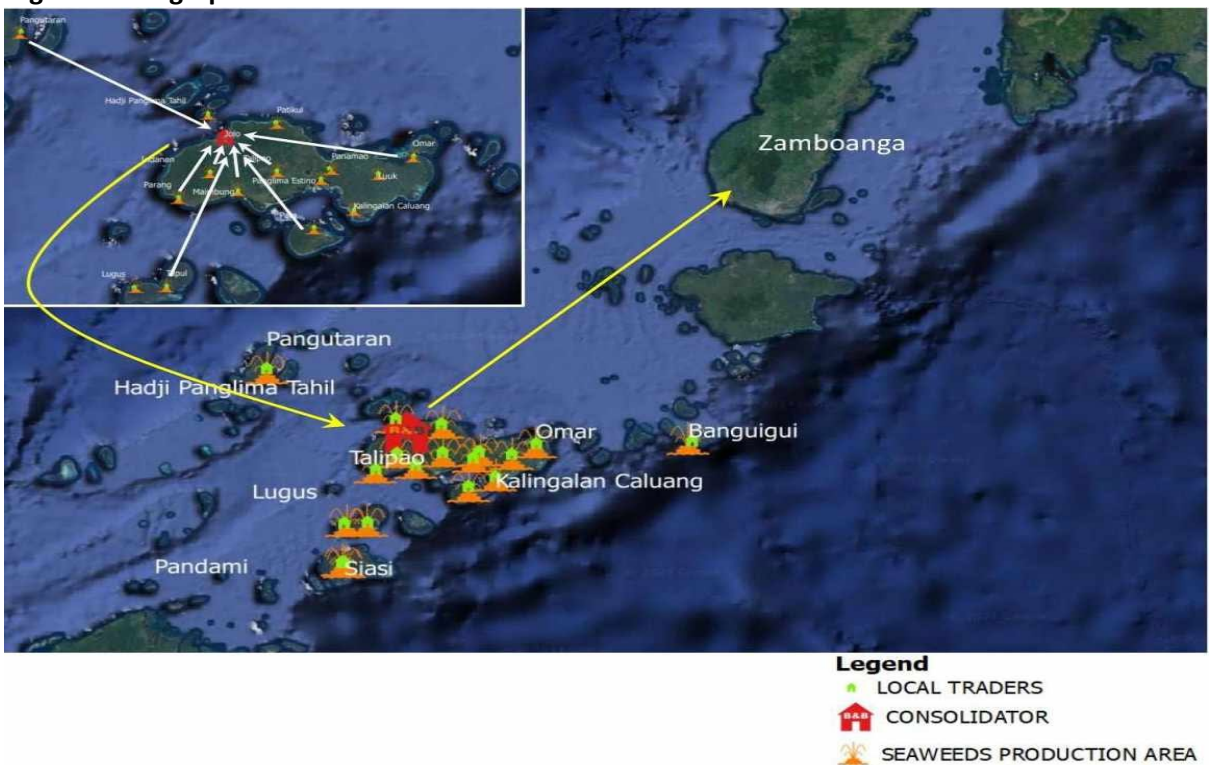
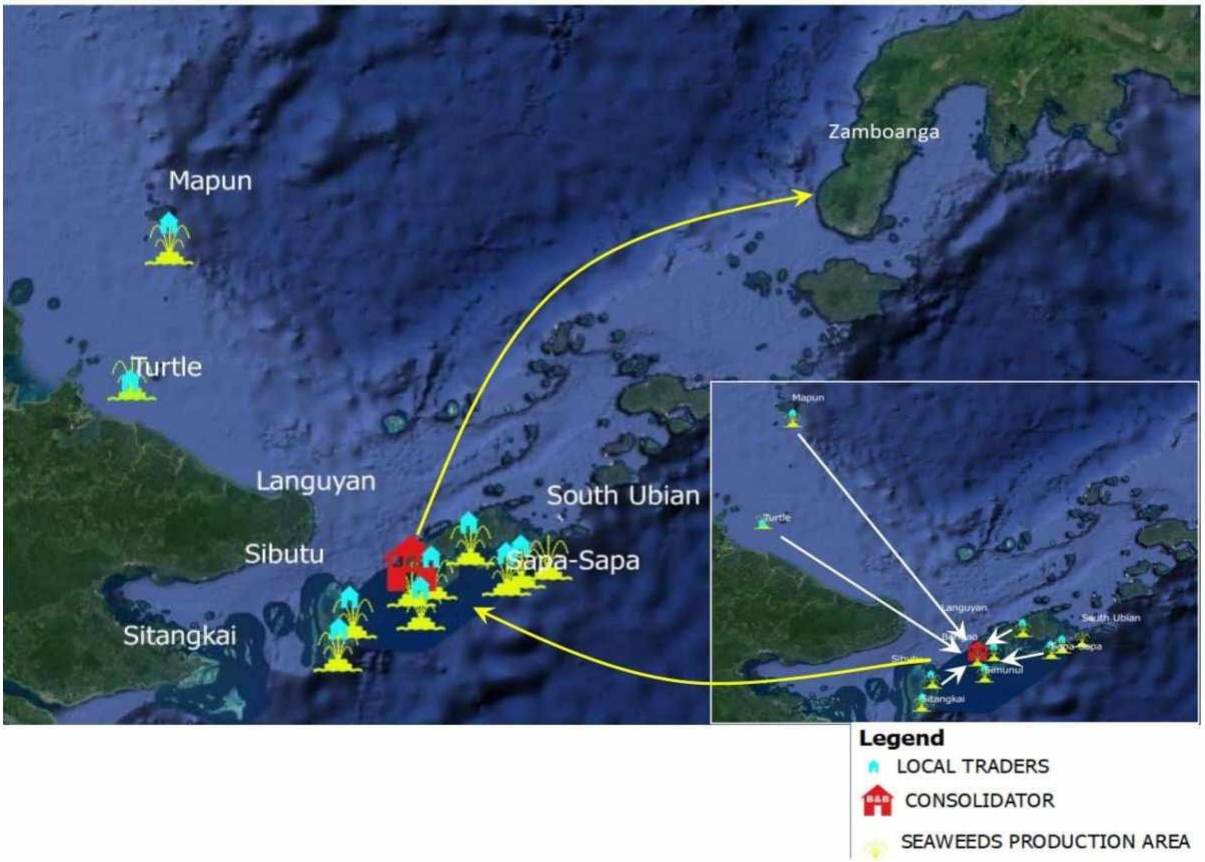


Figure 8. Geographical Flow of Seaweed Products in Tawi-Tawi



Seaweed Value Chain Maps

The value chain maps of seaweeds vary depending on the product form. Generally, this is composed of several segments, which include the provision of inputs, production, post-harvest, trading, marketing, and processing. The number of key players and stakeholders and some aspects of the value chain operation also vary across locations. For Sulu and Tawi-Tawi, the value chain can be analyzed within the context of raw fresh seaweed (RFS) and raw dried seaweed (RDS).

Value Chain Map for Raw Fresh Seaweed (RFS)

The basic product form of seaweed is fresh raw seaweed (RFS). It is either consumed as food or utilized as seedlings or input material for the next cropping cycle. The value chain of RFS is composed of four segments: 1) input provision; 2) production; 3) postharvest; and 4) trading. The RFS value chain is usually common in many parts of the country.

Figure 9. Value Chain Map for Raw Fresh Seaweed (RFS)

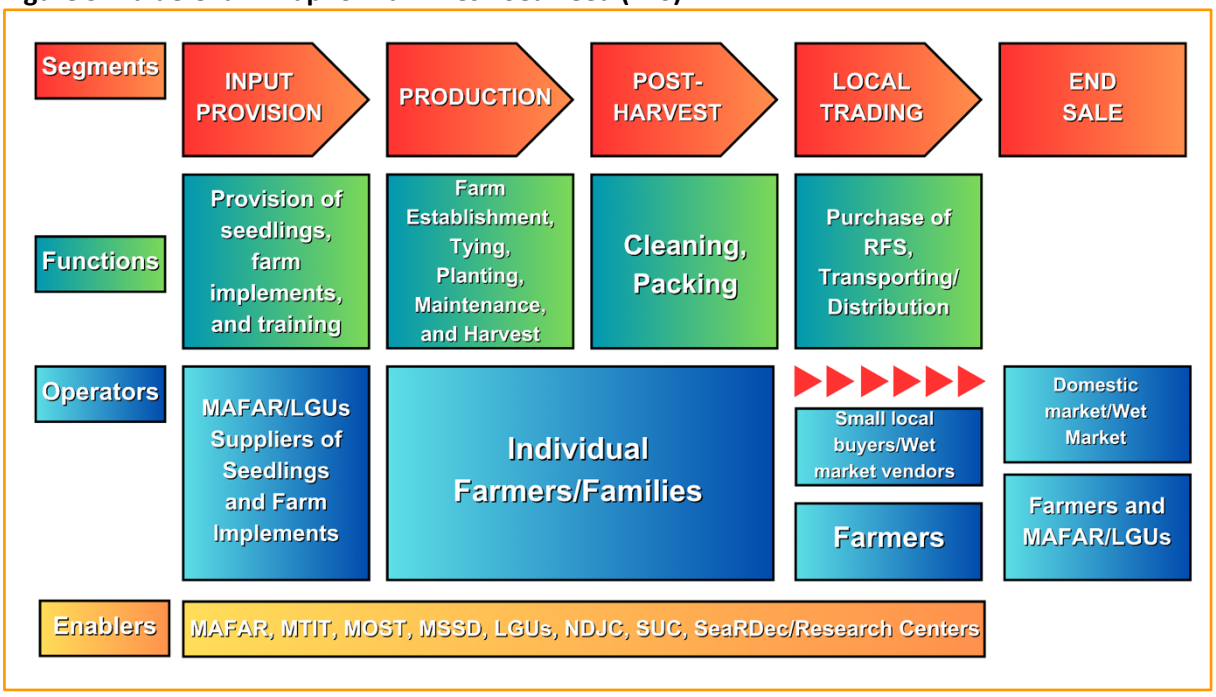


Figure 9 exhibits the value chain map for RFS. The input provision segment represents the suppliers of inputs in the cultivation of seaweeds. These include seedlings, seaweed farm implements, and even labor. Also included in this segment is the provision of necessary training in the form of technology and other technical assistance to the farmers.

In the production segment are the farmers who undertake the cultivation and farming of seaweed. Activities in the production segment include farm establishment, tying, and planting of seaweeds. Crop maintenance is also done until the time of harvest. After harvest, post-harvest activities are performed in the post-production segment. This includes cleaning and packing the RFS ready for disposal.

Trading is the last segment in the value chain where it involves the purchase, transport, and distribution of RFS. Following this, farmers either sell the RFS to wet markets for direct food consumption or value-adding and as seedlings to farmers, MAFAR, or LGUs who are also extending input assistance to other farmers.

Value Chain Map of Raw Dried Seaweed (RDS)

A major alternative product form is raw dried seaweed (RDS). This product form involves the additional activity of drying the seaweed after harvest. Most of the outputs of the farmers, not only in BARMM but also all over the country, are in the form of RDS. This is the product form from which carrageenan is being extracted. RDS is further processed into RC and SRC. Like RFS, the value chain of RDS is composed of four functional segments: 1) input provision; 2) production; 3) postharvest; and 4) trading.

Figure 10: Value Chain Map for Raw Dried Seaweed (RDS)

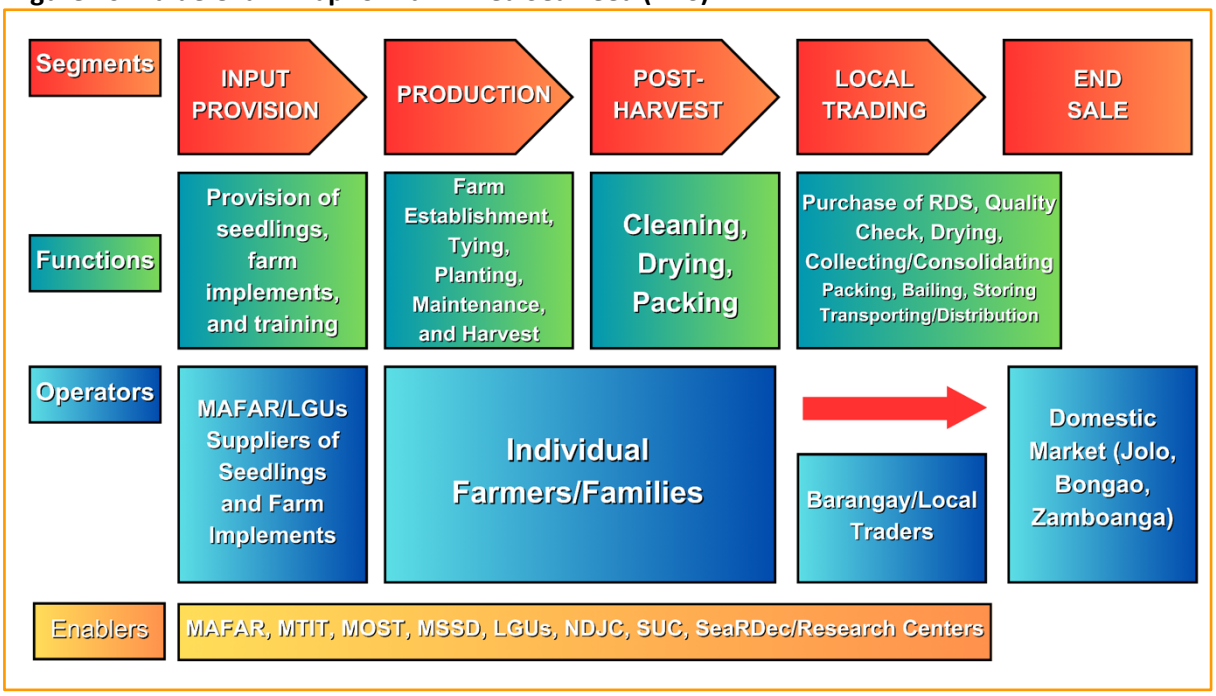


Figure 10 exhibits the value chain of raw dried seaweeds (RDS). The first two segments of the chain (input provision and production) mirror the activities of the RFS value chain. However, drying activity is incorporated into the postharvest segment. Fresh seaweeds are cleaned, dried, and packed ready for disposal.

Drying is a significant component of this segment. It establishes the moisture content or the degree of dryness or wetness of the dried seaweeds. Moisture content is a gauge of the quality of RDS, which eventually determines prices.

Purchasing, transporting, and distributing seaweeds form part of the traditional activities in the trading segment. However, this is the most variable of all segments in the value chain, as there are additional activities performed depending on the context of a certain location. This involves quality inspection, further redrying (if needed), collection or consolidation, storing, packing, and baling of the RDS.

The value chain of the provinces of Sulu and Tawi-Tawi can mostly be understood in terms of raw fresh seaweed (RFS) and raw dried seaweed (RDS). This was proven during focus groups and key informant interviews.

B. KEY PLAYERS AND FUNCTIONS

Input Suppliers

The input supply sector is composed of providers of various material and labor inputs for seaweed farming. These include seedlings or propagules and seaweed farm implements (SFIs) such as nylon, polyethylene (PE) ropes, floaters, and wooden stakes, among others.

Suppliers of seedlings and propagules

Seedlings, or propagules, are planting materials needed in seaweed cultivation. It is considered the biggest cost item in seaweed farming. Seedlings are usually sourced from the following (based on FGDs and KIIs conducted):

1. From the farmer's themselves
   In the case of Sulu and Tawi-Tawi, there are no distinct and identified input suppliers who specialize in the provision of seaweed seedlings, such as nursery operators. Hence, the most common practice is for the farmer to select good-quality seaweed from his own production as a source of planting materials for the next cropping season. Usually, farmers allocate 5%–30% of their production as seedlings, depending on the size of the area they will be cultivating.

1. Outsourced from fellow farmers
   When farmers do not have production from the previous cropping, they also source their seedlings from the farms of their fellow farmers within the community or even in neighboring barangays and municipalities.

2. Donors
   Some farmers also receive seedling dispersals from the Ministry of Fisheries and Aquatic Resources (MAFAR) and local government units (LGUs) of both the provincial and municipal governments, NGOs, and other organizations. This served as input assistance to the identified beneficiaries in the locality.

In some writings, it was said that cooperatives and associations backed by MAFAR/BFAR, LGUs, and other donor institutions were already running nurseries at sea. However, this was not confirmed by the people who answered the questionnaires and took part in the focus groups and key informant interviews. Also, there was no other data from secondary sources to support this.

One of the strategies taken to address concerns about the availability of planting materials is the establishment of gene banks in Tawi-Tawi and Zamboanga, supported by sea-based and land-based nurseries. However, existing gene banks lack the production capacity to sustain the distribution of seedstock in the production areas of the entire Mindanao. So, one thing that could be done to address this issue is the creation of tissue-cultured seed stocks. These will not only provide enough planting materials, but they will also help with issues like high ice disease rates, the effects of climate change, and low yields (PRDP, 2014). Specific to Tawi-Tawi, the Seaweed Research and Development Center (SeaRDec) is currently gene-banking different varieties of seaweed. In fact, they are also doing tissue culture to mass-produce seed stocks and seedlings for distribution to farmers soon. At present, the center is still in pilot testing for the said project.

Suppliers of SFIs

Other inputs and seaweed farm implements (SFIs), such as soft ties, PE ropes, stakes, and others, are usually purchased from hardware stores and fishing supply stores. Farmers also used empty bottles of mineral water or styrofoam as floaters.

The MAFAR and Local Government Units (LGUs) of both the provincial and municipal governments are also extending Seaweed Farm Implements (SFIs) to the farmers aside from seedlings. Specifically, it became clear during the FGDs and KIIs that MAFAR has set aside money to provide SFIs to specific beneficiaries, though only in small amounts at this time because of limited funds.

Figure 11. Seaweed Farm Implements

Source: PRDP, 2018

Primary data from Sulu and Tawi-Tawi indicated that most of the farmers still procure these SFIs from the suppliers in Jolo, Sulu, Bongao, and Tawi-Tawi, where most of the business establishments can be found. According to some FGD participants in Sulu, they must purchase the inputs in Jolo due to lower prices, and at the same time, these stores have a wider selection of inputs than the municipalities throughout the province.

Suppliers of Labor

Seaweed farming is basically a family enterprise. Family members are the main suppliers of labor necessary for production. In case of a shortage, they must hire people in the community. The cost of labor is dependent on the kind of work to be done in farming. As practiced, farmers usually hire the Sama Tribe (they are also called Badjao in other areas) to plant seaweeds, especially in deep-sea areas, because of their expertise in swimming in deep waters.

> *"Kasali naman ang mga bata sa pag hugas at pagpapatuyo ng seaweeds namin. Madalas sila ang nag hihintay at nagbabantay kung tuyo na ang mga ito."*
>
> "Our children help in washing and drying our seaweeds. They often wait and watch if the seaweeds are already dry."
>
> \- Female Farmer, Caluang, Sulu, FGD

"Pami-pamilya talaga ang nagtutulungan pag dating sa production at pag harvest ng seaweeds, minsan nga sinasama ang mga bata sa pag tali. Hindi naman sila pinipilit, pero yun ang iyong naging hanap buhay ng pamilya. Hindi na ito nagiging issue kase tulong na din 'to sa pamilya nila, nakasanayan na. Madalas meron din talaga mga binabayarang tao para sa pagtatanim at pag harvest ng seaweeds lalo na pag sa deep-sea na."

"Families work together when it comes to producing and harvesting seaweeds; sometimes the children help in tying. They were not forced since it's their family's source of income; it's also not an issue since they consider it a help to the family. There are also people hired to plant and harvest seaweeds in deep-sea areas."

- Female Key Informant, Tawi-Tawi, KII

Input Prices

The prices of inputs vary across locations. For instance, in Tawi-Tawi, seedlings are sold by lines (Php1,000.00 for 3 lines with 6–8 meters long per line); there is a Php3.00 per line labor fee for tying the seedlings. This is also practiced in the province of Sulu. For SFIs, prices are higher from the suppliers within the various municipalities than in the capital towns of Jolo and Bongao. Table 7 shows the average prices of some selected SFIs from hardware stores in Tawi-Tawi.

Table 8. Prices of some Selected SFIs in Sulu and Tawi-Tawi

Item	Description	Unit	Price
1	PE Rope #10	Roll	680
2	PE Rope #8	Roll	470
3	PE Rope #4	Roll	370
4	PE Rope #4	Roll	200
5	Softie	Roll	195
6	Floating Balls	Piece	40
7	Sakuline 12ft	Roll	6000

Source: Hardware Stores, Tawi-Tawi

Capability-Building Activities

This segment also includes the provision of training to equip farmers with the needed skills and technology for production, processing, and value-adding. In the case of Sulu and Tawi-Tawi, providers of training include those as reflected in the value chain map, such as MAFAR (previously BFAR), MTIT, MOST, LGUs, and other donor organizations such as NGOs. Additionally, the farmers have claimed that their ancestors have passed down to them the knowledge of seaweed farming from generation to generation.

Women, Youth, and IP's Role in this Segment

The role of women in the input segment cannot be neglected. She takes on the role of her husband as a supplier of seedlings in his absence. In the absence of their parents, the youth also take on this role. This empowers them to be more enterprising and take an active role in the family enterprise. Also, one of the roles performed by the wife/mother as well as the children is to procure the inputs necessary for production. This develops their negotiation and decision-making skills along the way. However, the decision as to the kind of inputs as well as the needed volume to be procured still rests on the husband or father, as he is the one who is more focused on the livelihood aspect of the family.

> *"Kapag nangingisda ang asawa ko, madalas ako na din nagtatrabaho mula sa pagtatali, paglilinis, pagpapatuyo, at hanggang sa pagbebenta ng dried seaweeds sa traders."*
>
> "When my husband is busy fishing, I usually do all the work, from tying, cleaning, drying, and selling the dried seaweeds to traders."
>
> - Female Farmer, Panglima Estino, Sulu, FGD

In addition, the Sama Tribe (also called Badjao in other areas) takes on the role of a seedling supplier, as they have their own farmers being cultivated. In fact, they are selling 20% of their production as seedlings in the province of Sulu.

Producers/Farmers

In the past, seaweed farming was just considered an alternative livelihood; however, it has emerged as an important and major source of income in coastal communities, particularly in the southern part of the Philippines (PRDP, 2018). The production segment includes farmers who undertake farming activities such as farm preparation, tying, planting, maintenance, and harvesting.

Number of Farms, Farm Sizes, and Number of Farmers

Table 9 shows the number of farmers and average farm size in selected areas of the country. The BARMM has a total production area of 69,303 hectares, the majority of which is in Tawi-Tawi Province. It was noted that there are some data gaps for the BARMM region in terms of the number of farmers and average farm size. During the fieldwork, the research team was only able to gather a list of farmers based on their membership in the association or cooperative in the Province of Sulu. Moreover, in the case of Tawi-Tawi, the research team was not able to get a specific list of seaweed farmers due to a lack of available data from the MAFAR and their respective MMOs in the various municipalities of the province. What was provided to the team is the list of farmers included in the Registry System for Basic Sector in Agriculture (RSBSA), which is a national database system for both farmers and fisherfolk. However, this is not only for seaweed but for all commodities in the agriculture and fishery sectors.

Discussions during the FGDs in Tawi-Tawi uncovered some issues and concerns about data banking. According to most of the MAFAR Municipal Officers (MMOs) who attended the activities and production areas, the number of seaweed farmers will still be subjected to comprehensive profiling in the whole province in coordination with the LGUs for enrollment in the Registry System for Basic Sector in Agriculture (RSBSA). To date, MMOs have very limited data relative to the above since they were just newly installed government officers during the start of the BARMM government. In fact, as per our interview with our key informant, Ms. Evelyn Martinez, Senior Agriculturist, Ministry of Agriculture, Fisheries, and Agrarian Reform (MAFAR) in Tawi-Tawi, they still have to request access to the "FishR", a national database system of the Bureau of Fisheries and Aquatic Resources (BFAR), to retrieve various fisheries data and information relative to the production areas, number of farmers, and other information in the provinces under BARMM. During the conducted focus group discussions (FGDs), the MMOs from various municipalities and provinces also confirmed this.

Table 9. Number of Farmers and Average Farm Size in Selected Areas, 2018

Region/Province	Production Area (ha)	Number of Farmers	Average Farm Size (ha/farmer)
Philippines	102,000.00	400,000.00	0.25
Region 2	15.10	147.00	0.10
Cagayan	15.10	147.00	0.10
Region 4-B	No data yet	No data yet	No data yet
Palawan	5,567.00	7,604.00	0.73
Region 5	559.00	2,963.00	0.18
Sorsogon	55.50	370.00	0.15
Region 7	4,023.03	12,586.00	0.32
Bohol	2714.36	7,225.00	0.38
Region 8	1,074.47	3,228.00	0.33
Leyte	925.00	1,471.00	0.63
Region 9	11,888.00	26,800.00	0.44
Zamboanga City	2,345.00	8,424.00	0.28
Zamboanga Sibugay	5,310.00	10,394.00	0.51
Region 13	876.65	1,365.00	0.64
Surigao del Sur	377.00	873.00	0.43
BARMM	69,303.00		
Tawi-tawi	62,911.00		

Source: PRDP, 2018; BFAR, 2022

Species cultivated

Kappaphycus alvarezii/*Kappaphycus striatum* (*cottonii*) and *Eucheuma denticulatum* (spinosum) are the common species used in seaweed farming. These are the main species that seaweed farmers cultivate and use in the nation's carrageenan production. Kappaphycus *alvarezii* and *Kappaphycus striatum* (*cottonii*) are the most cultured species in Tawi-Tawi and other areas in the BARMM (BDA/JICA, 2016). It has a relatively high growth rate compared with other species. It also grows well at sites with very strong water currents at low temperatures. However, a major constraint with this variety is its high susceptibility to ice-ice disease (PRDP, 2018). During the FGDs, the farmers confirmed the characteristics of the species.

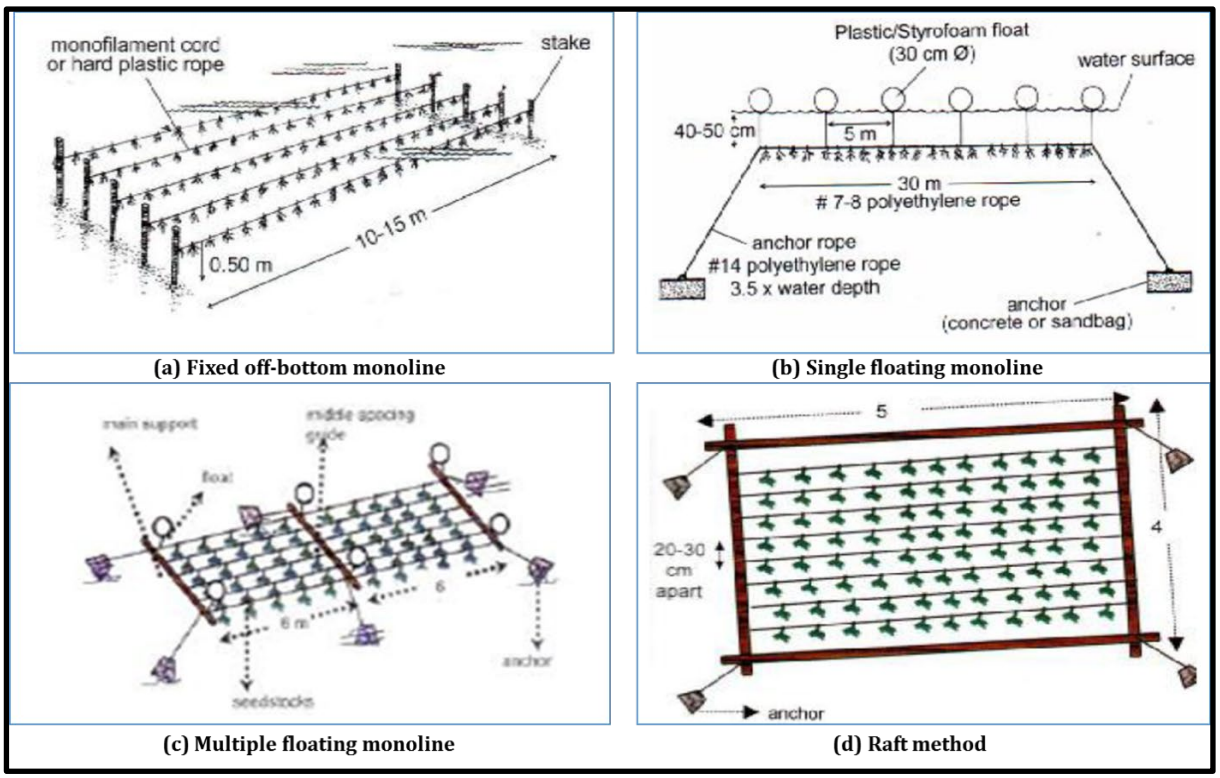
Prices typically have an impact on the species chosen to produce. Farmers opt to grow cottonii because it has a better price than spinosum. Accordingly, some farmers prefer spinosum because it is more resilient to diseases and sturdy to strong winds and waves than cottonii.

Culture methods

Cultural methods vary across locations. It may vary from floating monoline, fixed off-bottom, raft, net wild collection, and direct planting or broadcast. At present, farmers have generally adopted two methods in the culture of seaweeds: the fixed off-bottom monoline method and the floating monoline method.

The fixed-off-bottom monoline method is used in areas where the level of water is shallow. This involves the use of two stakes pounded into the bottom of the sea and a monofilament line tied to the strands at each end. Floaters are subsequently tied in between the seedlings. On the other hand, the floating monoline involves the use of anchors and wooden stakes that are used in deeper areas. Seedlings are tied to the lines before being tied to the stakes, and floaters are tied in between the seedlings.

Figure 12. Types of Seaweed Culture Methods



Source: PRDP 2014; PRDP 2018; BFAR Fisheries Technology Series, 2014

Seaweed Farming/Cultivation

Figure 13. Seaweed Farming in Tawi-Tawi

Seaweed farming plays a vital role in poverty alleviation not only in the provinces of Sulu and Tawi-Tawi but also in Mindanao and the country. Because of the increasing demand for people in remote or isolated communities to plant and locate market channels.

Seaweeds have a very short production cycle lasting for 30–60 days; hence, income can be generated in a short period of time. It can provide much-needed cash flow for the provision of basic needs for farming communities. Also, seaweed farming needs very minimal capital to start the operation. Moreover, technological requirements are also very simple and easily learned. With this, it provides a very important economic opportunity for our farmers who have limited financial resources, especially those in coastal communities, as a livelihood option.

There are narratives from the fishermen in the coastal communities who say that seaweed farming served as their alternative livelihood, and income generated from seaweeds reduced the incentive for overfishing. On the technical side, seaweed farming has a positive impact on the environment; it can serve as a carbon sequester, hence the potential for carbon credits. Lastly, seaweed farms using rafts serve as an attractant as a haven of fishes.

Since seaweed farming is considered a family enterprise, the actual farming activities, which include farm preparation, procurement of seedlings, tying, planting, crop maintenance, harvesting are undertaken by the members of the family. It can be noted that although many of the farmers are members of the associations and cooperatives, they do not practice corporate farming, which may involve farming to be financed and undertaken by the association or cooperative itself.

Farm preparation includes preparing the area where the actual planting will be done. For the floating monoline method, anchor posts and mainlines should be installed. For the fixed-off-bottom method, wooden stakes served as posts. Cultivation lines where the seaweeds will be planted should also be established. This activity is usually undertaken by husbands and male members of the household, the female family members can also assist in this task.

Once the farm is prepared, the procurement of seedlings is done, all family members can complete this task. In the absence of the husband to perform this task, the wife as well as female children can do the task of canvassing or sourcing out seedlings in case they have not planted in the previous cropping. The actual buying and transporting of the seedlings from the point of origin to the farmer's area is part of this task. Seedlings are sold either o- a per weight (per kilo)-or per line basis.

Cutting and tying seedlings is one of the most laborious tasks in seaweed farming. Seedlings are cut and tied to a straw or soft tie. Usually, women and children of the family do this task right inside their respective houses.

When all the seedlings have been cut and tied, actual planting in the sea farm is done. Planting involves tying the monolines to the mainlines to ensure that the seedlings are firmly established in the area. In the past, this was more of a husband's/men's work. However, nowadays, the roles of the husband and wife including children have evolved. Wives are helping the husbands even in the actual planting of seaweeds. Children are also helping during off-school days.

Inter-cropping would not be possible with seaweeds since fish species and turtles will be feeding in the crop. Although, this can still be further studied on how to apply intercropping schemes in seaweed farming (FGDs/KIIs).

After planting, crop maintenance follows. This involves regular monitoring of the farm area. Activities include shaking culture lines to remove dirt, silt, and weeds attached to the seaweeds, removing grazers, and checking culture lines and mainlines to ensure the support system is still intact. Crop maintenance also involves relocating the seaweeds when environmental factors are not favorable. Another salient activity in the crop maintenance aspect is pruning and replanting to expand the production area. As practiced, farmers do not plant their area in full due to budget constraints. As a matter of strategy, they will prune the seaweeds at about 15 days after planting and replant them in other portions of the farm.

The last activity in the farming segment is harvesting. An 8-meter line can harvest about 30 kilograms when harvesting "by line."

The production cycle usually lasts between 30 and 60 days. However, with the prevalence of fertilizer use by most farmers in the two provinces, one cropping cycle can only last 20–30 days. In some of the narratives by the farmers, they are using fertilizers to shorten the production period of the seaweed. This is for them to have more cropping in a year. However, this has a detrimental effect on the carrageenan content of the seaweed. As per discussion with the research and technical staff from SeaRDec, to ensure higher carrageenan content, seaweed should be harvested at the right maturity, that is, 45 days and above. All the MAFAR Municipal Officers (MMOs) and traders who participated in the FGDs have also confirmed this.

Figure 14. Harvesting of Seaweeds

A typical seaweed farmer usually cultivates an average of 1/4 to 1 hectare (PRDP, 2014; PRDP, 2018; BFAR, 2022). As indicated in the Provincial Commodity Investment Plan (PCIP) of both provinces, seaweed farmers in the province generally cultivate only small areas due to an inadequate supply of seedling materials and capitalization constraints. In fact, they are compelled to avail cash advances from the traders to finance their farming activities due to a lack of capital. With this, their harvest is already tied up to trader-financiers who control the prices of their products. This puts the farmers in a very disadvantageous position, as they have no choice but to dispose of their products at the trader's set prices. The respondents to the FGDs conducted in the coverage areas confirmed this situation.

One of the most pressing concerns in the production of seaweeds is the prevalent use of synthetic/chemical fertilizers by farmers. Specifically, farmers use diluted, complete fertilizer (14-14-14) to fertilize their seaweed crop. This is done with what they termed "recharging" activities, wherein they soak the seedlings overnight in a diluted fertilizer before planting. This will be repeated 2-3 times throughout the season. With this, seaweeds can be harvested earlier, say, 20–30 days only. This will enable the farmer to undergo several cropping cycles in a year. However, the recovery rate during drying is very low; the same is true with the carrageenan content of immature seaweeds. This is one of the issues confronting the production segment of the seaweed industry, not only in the BARMM but in other areas as well.

Pests and Disease Management

Health management on seaweed farms is very important to ensure optimum production. This can be done through proper site selection and farm maintenance. Seaweed is usually infected by ice-ice disease or the paling or loss of color of the crops/whitening of the branches, which affects the quality of the seaweeds caused by bacteria, which will lead to disintegration and die-off. This is brought about by low salinity, changes in temperature, and light intensity, which cause stress for marine plants. This occurs during the southeast monsoon (locally termed "*uttara*") and will disappear after 2-3 months; hence, it is seasonal in nature. The practical remedy is to remove the affected parts, harvest them, and transfer them to other locations for seedling and farming purposes (BDA/JICA, 2016; BFAR, 2022). This practice is also confirmed during the conduct of FGDs and KIIs. In fact, some of the mitigating strategies practiced by the farmers in the area include the removal of infected plants from the farm so as not to further spread the infection and not utilizing the farm for the next cropping season to break the disease cycle.

On Halal Aspects

Seaweed is an important industry in countries like Malaysia, Japan, Indonesia, and the Philippines. Since seaweed is used as the main ingredient in the preparation of many products that people are using, there is a need to ensure the quality and cleanliness of these products. Hence, halal practices must be incorporated.

There is a dearth of literature about halal relative to seaweeds. In fact, there was not even any specific mention of incorporating halal standards in the many aspects of seaweed operations along the value chain, although halal can be used as a standard relative to the production and processing of seaweed products.

The application of halal technology in all aspects of the value chain operation will help ensure the utmost quality, especially in food and supplement products that people are consuming every day. However, knowledge of halal is still limited in marine production, such as seaweed. Seaweed farmers usually use traditional farming methods (which do not yet consider halal in the production) that have been passed on from one generation to the next over the years.

During the conduct of FGDs and KIIs, participants and respondents were asked about the application of halal technology in the production of fresh seaweeds and value-added products. They narrated that halal standards were not incorporated into their production and post-production practices. Although some key informants said that making seaweed products halal is part of their plans for the future, this was not yet reflected in the programs and projects of the MAFAR (FGDs; KIIs).

Women, Youth, and IP's Role in this segment

As previously discussed, seaweed farming is undertaken as a family enterprise where all family members, both male and female, work and perform various farming activities. Although it was emphasized in the discussion during the conduct of FGDs that there were no distinct functions specifically performed by women and youth, there are still some activities in the farming segment that can be most likely performed by women and even youth. In particular, the task of sourcing out seedlings and other inputs can be done by women and even children in the absence of the husband. Also, cutting and tying of seedlings before the actual planting can be mostly done by the wife and women's children, as this is usually undertaken in their respective houses. Women could also help, even in the actual planting of the sea area, especially if it is near the shore. In near-shore farm areas, women and children can also maintain and harvest crops.

Postharvest Handlers

The farmers are also the ones performing the necessary postharvest operations. This is the third segment of the value chain. For RFS, postharvest activities involve cleaning and packing fresh seaweed in preparation for disposal to identified traders. For RDS, fresh seaweed will be dried first before packing. Hauling of the RFS from the farm to the drying area is done using a small boat (non-motorized banca).

The drying process is a significant activity in the postharvest segment, as there is a need to consider the moisture content of the product as well as the volume of weight being lost during the drying process. The most common practice is sun drying. Sun drying of fresh seaweed is done on stilt dryers, found in "*Pondohan*," or clusters of community houses. Stilt dryers are both for household and community use because not all of them have their own place (stilt house) where they can dry their seaweeds. Some farmers are also practicing drying by hanging the seaweed per line on a wooden platform along the seashore. Both above practices are prone to contamination as the product is left in the open, which can be subjected to many environmental contaminants. Unfavorable weather conditions lower the quality of the products, delay the drying time, and cause inefficiencies, which will eventually reflect in the overall production of seaweed.

The lack/insufficiency of drying facilities in the production areas makes it difficult for the farmers to ensure good sanitation and proper drying of seaweeds. Aside from drying in stilt dryers or hanging, there are narratives of drying the seaweeds on concrete roads or cemented pathways, especially during peak season. Moreover, due to a lack of standards on the proper drying of the seaweeds, most of the time, farmers and traders do not agree on the moisture content, especially since this is just based on the estimate of the checker using visual and physical inspection during delivery. These concerns need to be addressed with proper interventions.

Demand for dried seaweed has increased substantially over the years. Therefore, there is a need to explore several drying techniques for commercial-level applications (Santhoshkumar, 2023). One drying technique that can be further explored is the use of a floating solar dryer. It was designed and constructed in such a way that it can be easily towed near the farm to save time on hauling. This technology allows faster drying times, produces market-grade seaweed products, and reduces post-harvest losses (Pangan et al., 2020). This technology was developed to address inefficient drying practices. Currently, SeaRDec in Tawi-Tawi and even MAFAR have been pilot testing floating dryers. However, this initiative has not yet fully materialized in the region.

The degree of dryness or wetness determines the price of the RDS. This is one of the main challenges faced by farmers. In most cases, farmers and traders are not in agreement when it comes to the moisture content of the RDS. This is because upon delivery, the trader will determine moisture content through visual and physical inspection of the product. This is not a reliable measure; however, this method has been in practice for so long already. Usually, it is the trader's call on how much the price of the RDS is. Hence, as a result, most of the time the trader will give a "discounted price" to the dried seaweeds of the farmers.

The ratio of fresh to dried seaweeds is 7:1; that means that every 7 kilograms of fresh seaweeds is equivalent to 1 kilogram of dried seaweeds. This is roughly a 14% recovery rate from fresh to dried seaweeds. Ideally, the reduction in quantity of seaweed upon drying is compensated by the higher price of the dried seaweed compared to fresh seaweed. However, this is not usually what happens, as the prices of RDS are driven by market forces, quality attributes, and location considerations.

All the family members can participate in the drying activity. Dried seaweeds are packed in sacks, usually weighing 60-70 kilograms per sack. The farmer will have the option of either directly selling the RDS in small quantities or storing it in their respective homes for consolidation before selling.

Insufficient drying facilities are a common problem for farmers in the two provinces. Hence, this is one of the interventions that they would like to receive from the government or any other donor organization. As observed, farmers just find their own means to dry their seaweeds, as there are not enough dryers for them.

Drying, sorting, and cleaning activities are usually done by women (the wife and female members of the family), while packing and hauling are mostly done by the male members of the household. Since the Sama tribe are also farmers, they still undertake these activities for their own produce.

On Solar Technologies

There was no mention of the use of solar technologies aside from the usual sun drying activities of the farmers as part of the postharvest operation. Currently, SeaRDec in Tawi-Tawi and even MAFAR have been pilot testing floating dryers that use solar panels individually attached to the roof of the dryer. However, this initiative has not yet fully materialized in the region.

Traders

Trading follows as the final segment. The movement of RFS is usually restricted in the local area. They are purchased by small local buyers, wet market vendors for food consumption, or fellow farmers/BFAR/LGUS and other farmers for planting materials purposes.

Several significant activities are also performed in the trading segment of the RDS, which are not done in the trading segment of the RFS. Dried seaweed passes through several intermediaries from the farmer's level until it reaches its final market. The number of actors as well as the series of activities performed within this segment is variable since, aside from the traditional purchasing, transporting, and distribution of seaweed products from the RFS, it also involved quality inspection, further re-drying (if needed), collection or consolidation, storing, packing, and baling of the RDS. With this, additional players are also involved in all these processes.

Intermediaries involved in this segment include, but are not limited to, collector/buying agents, *viajeros*, salaried agents, export traders, and local seaweed processors who are mostly based in Zamboanga, Cebu, and Tacloban. As RDS is intended for the export market, several large traders are consolidating bigger volumes of the product. Despite the higher price of RDS in the country, it is still the most preferred product compared with that of other countries, as our RDS is perceived to be of better quality than that of suppliers in other countries (PRPD 2014; PRDP 2018).

In the case of Sulu and Tawi-Tawi, trading activities involved farmers, barangay/local traders, and big traders/consolidators. RDS is usually sold by the farmer to the traders in their own locality (barangay/municipality). These traders will consolidate the product and sell it in bulk to the big traders/consolidators located in Jolo or Bongao. Some farmers directly deliver their produce to Jolo or Bongao without passing through the barangay/local trader, especially if they are near the town centers. In turn, big traders/consolidators assemble the produce in large volumes and deliver it to much larger traders or carrageenan processors in Zamboanga City. All the RDS coming from Sulu and Tawi-Tawi ended in Zamboanga City. From there, traders and processors buy the product and bring it to other places, such as Cebu and Tacloban.

Women, Youth, and IP sector in this segment

Women, youth, and even IPs can still take part in the trading operation. They can take on the role of a seller or buyer. Nowadays, women are already taking an active role in business activities like trading operations.

Value Addition/Product Diversification

Aside from the increasing demand for RDS, the family, especially women and youth, could take advantage of the increasing awareness and acceptability of seaweed-enriched value-added products like chips, noodles, *yema*, *polvoran*, pickles, and others. This can be a unique business enterprise opportunity for women and youth, not only in the two provinces but of the entire region, given that it is the major producer of seaweed. Venturing in the processing of these products will be very easy for the province due to the availability of abundant and cheap supply of fresh seaweeds. With these value-added products, new marketing channels can be developed that are specific to these products, apart from the existing marketing channels of RFS and RDS. However, there was no data available as to the volume of fresh seaweed being utilized for this purpose, as these products are not yet produced commercially.

D. PRICE AND COST STRUCTURE

Incomes and Profits

Incomes and expenses in seaweed farming vary across locations. Even farmers in the same community have varied incomes and expenses as prices of finished products and inputs are also variable. Generally, the main source of income in seaweed farming is the sales of fresh and dried seaweeds. Consequently, costs associated with farming include the material and labor inputs used in the production. Table 16 shows cost and return analysis based on the given assumptions.

Assumptions

Species	Cottonii
Farming method	Fixed off-bottom method
Farm area	0.25 ha
Number of lines	280
Plants per line	47
Seedling/Propagule weight	25 grams
Culture period	1.5 months
Activity cycle/number of croppings per year	7

Table10: Cost and Return Analysis

Cost and returns per activity cycle	Quantity	Unit	Unit Cost	Lifespan (in years)	Total Cost
TOTAL REVENUE					
Total yield (fresh)	3,920	kilograms			
Seedling allocation	330	kilograms	5		1,650
Total seaweed for drying	3,520	kilograms			
Gross Income	513	kilograms	85		43,605.00
PRODUCTION COST					
A. Fixed cost					
Culture preparation					
Stainless steel knife	15	pieces	50	4	26.97
PE rope #6	13	rolls	370	1	687.14
Soft tie	10	rolls	195	0.5	557.14
Mangrove stick	150	pieces	5	1	107.14
Styrofoam	100	pieces	200	1	285.71
Non-motorized banca	1	unit	15,000.00	5	428.57
Harvest and Post-harvest					
Basket	2	pieces	500	1	142.86

Cover tent	5	meters	100	1	71.43
Screen dryer	5	meters	70	1	50.00
B. Operating cost					
Culture Preparation					
Seedlings	330	kilograms	5		1,650.00
Labor for tying of seedling	280	lines	2		560
Labor for installation/planting	1	man/day	250		250
Culture					
Labor for farm maintenance	2	months	3,000.00		6,000.00
Repair and maintenance expense	-	-	-		2,625.00
Harvesting					
Labor for harvesting	280	lines/bo	10		2,800.00
Labor for cleaning seaweed harvest	2800	lines	5		1,400.00
Drying					
Labor for drying	2	man/day	250		500
Packing					
Straw	0.02	roll	220		3.96
Labor for packing	0.375	man/day	250		93.75
Transportation cost for selling of seaweed	9	sacks	10		90
Labor for loading/unloading of seaweed	9	sacks	10		90
TOTAL COST					**20,069.50**
NET INCOME					**23,535.50**
RETURN ON INVESTMENT (%)					**117.27**
PAYBACK PERIOD					
BREAK EVEN VOLUME					**236.211**

(Dried seaweed in kg)					

Source of data used in the assumptions: KIIs, FGDs, PRDP,2018; BFAR, 2022

Table 10 shows the cost and return analysis for a ¼ hectare seaweed production. Given assumptions on the fixed and operating costs, yield, and average price of RDS as the product form, the return on investment (ROI) is 117%. This reflects the profitability of the seaweed enterprise. However, using the average price of RDS in 2023 which is Php45.00/kilogram, profitability dropped to only 15%. Using the average price of RDS in 2021 which is Php150.00/kilogram, profitability can reach as high as more than 200%. Hence, profitability of seaweed farming is largely affected by the fluctuating prices of RDS coupled also with fluctuating prices of both material and labor inputs. It can be further noted also that the costs and incomes vary among farmers and across locations.

SECTION 4. MARKETS AND MARKET OPPORTUNITIES

A. MARKETS AND MARKET TRENDS

Export Markets

In the global scenario, demand for seaweed products and its derivatives continue to increase especially in America and Europe. In fact, the United States is the main market of the world's seaweed products. This is due to the varied uses of the product, both for food and commercial purposes. Seaweed extracts are used as one of the ingredients in the food gels and thickeners, processed meats and sausages, pharmaceuticals including medical syrups and antibiotics, cosmetics, fertilizers, and biotechnology, among others. Due to development of food science and technology, demand for carrageenan is trending upwards for the last 20 years as a result of the awareness against high fat and cholesterol, and identifying seaweed as a fat replacement additive in many food products (Favis-Villafuerte, 2017 as cited in PRDP, 2018; BFAR, 2022).

Moreover, Food and Agriculture Organization (FAO, 2014) data shows a steady increase in the amount of seaweed consumed globally for food from 2000-2013. In fact, there is a growth rate of 5% for this period (PRDP, 2018). FAO data also reveals that consumption of seaweed as human food has been rising from 1990 to 2013 registering 2.1 million metric tons in 2013. It posted an average growth rate of 25% for that given period. Over-all, consumption of seaweed globally has had a substantial upsurge 5.05 million metric tons in 1990 to 32.9 million metric tons in 2018 from, resulting in a six-fold growth (FAOSTAT, 2021 as cited in BFAR, 2022).

China also took part as a major importer of RDS. In 2013, 65% of our total production (RDS) was exported to China as the country is aiming to dominate global production of carrageenan (PRDP, 2014).

Domestic Markets

In the Philippines, seaweed is used mainly for food consumption, as fresh and to produce carrageenan. Although the seaweed industry is considered as an export industry of the country, demand in the domestic market is equally increasing due to the increasing demand of carrageenan from seaweed by the processors. However, it can be noted that there was no recorded food consumption (as fresh) of seaweed (FAO, 2018). Although fresh seaweed is brought from the local market for culinary purposes, this volume is very meager compared to the volume used for carrageenan processing. In fact, about 90% of the seaweed produced in the country goes to the local carrageenan processors (PRDP, 2018).

Local Market

Results of the FGDs and KIIs conducted revealed that demand for fresh seaweed in the two provinces is mainly for seedling and drying purposes. As estimated by the participants, only 5%-30% of the fresh seaweed harvested is utilized as planting materials for the next cropping season while the 70%-95% is dried and sold as RDS in the local market (FGDs; KIIs).

B. PRICE TRENDS

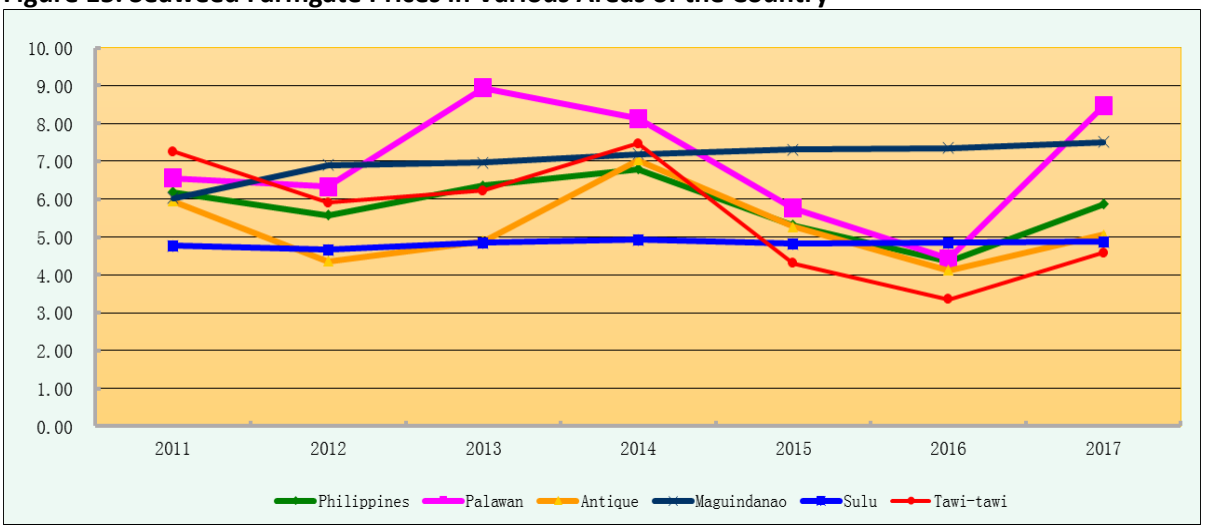
Export Market

Prices of dried seaweed in the international market are said to be dictated by China, being the largest importer of dried seaweed in the world. As noted, prices of dried seaweed from countries like Indonesia, Malaysia, and the Philippines are lower compared to those of seaweed coming from Chile, Japan, and Taiwan (FAO, 2018 as cited in BFAR, 2022). For carrageenan, export prices of China, Indonesia, and the Philippines, tend to be in the same price range for those originating from Chile and France (FAO, 2018 as cited in BFAR, 2022).

Domestic Markets

Seaweed is an internationally- traded commodity, hence, the volatility of prices in the international markets has also a trickle-down effect in the domestic economy. Figure 15 exhibits varied farmgate prices of seaweeds in various production sites across the country from 2011 to 2017.

Figure 15. Seaweed Farmgate Prices in Various Areas of the Country



PRDP, 2018

Local Market

In the local setting, farmgate prices of RDS in the past 3 years have reached as high as Php200.00/kg in Sulu and Php160.00/kg in Tawi-Tawi. Prices have gradually declined to PHP 100.00/kg in Sulu and PHP 80.00/kg Tawi-Tawi in 2022. In the late months of 2023, farmgate prices plummeted to their lowest range which was Php45.00/kg in Sulu and Php35.00/kg in Tawi-Tawi (FGDs; KIIs).

Table 11. Local Farmgate Prices of Raw Dried Seaweed (RDS)

Sulu			
Year	2021	2022	2023
Price Range	150-200	80-100	40-50
Average	**175**	**90**	**45**
Tawi-Tawi			
Year	2021	2022	2023
Price Range	140-160	70-90	35-45
Average	**150**	**80**	**40**

Soure: based on the estimates of participants and key informants during FGDs and KIIs

SECTION 5. FINANCIAL AND NON-FINANCIAL SUPPORT SERVICES

A. FINANCIAL SERVICES FOR SEAWEED FARMERS AND VALUE CHAIN ACTORS

Money to finance is the lifeblood of any business operation. One of the identified constraints confronting the seaweed industry stakeholders is the lack of capital and access to financial services. This is true not only in the BARMM but to all the seaweed producing areas across the country. As a matter of fact, this is also one of the main constraints in the agri-fishery sector.

Provision of capital to farmers for the purchase of inputs and finance day-to-day operations is requisite to seaweed production. One of the identified interventions to address this concern is to provide farmers with the necessary access to source of funds by presenting options and/or linking them to loan providers, and/or provision of seaweed propagules and farm implements. Specifically, this can be done through information dissemination by the appropriate government agencies on the various loan windows they could access, assisting them in preparing the required documents to qualify for the loan or formulating special non-collateral and easy repayment loans for seaweed farmers.

In the National Seaweed Value Chain study conducted in 2018, below are the available credit and insurance services a certain farmer could avail from the given institutions.

Table 12. Financial Services Available to Seaweed Farmers and other Value Chain Actors

Institution	Program Details
Land Bank of the Philippines (LBP)	Seaweed Financing Program ● A loan program for individuals, cooperatives, associations, and corporations of the seaweed industry. ● Eligible projects are seaweed farming/production, trading, processing, and acquisition of postharvest facilities. ● Repayment period is 90-180 days.
Development Bank of the Philippines	Sustainable Agribusiness Financing Program ● Provides credit for agribusiness projects in the production, harvest, processing and marketing of crops, livestock, poultry, and fishery.
Agricultural Credit Policy Council (ACPC)	Production Loan Easy Access (PLEA) ● A non-collateralized loan facility for small and marginal farmers and fisherfolk.
Rural and Cooperative Banks	Rural and Cooperative Banks provide financial services to all farmers and fisherfolk in rural communities in all stages of production.
Philippine Crop Insurance Corporation (PCIC)	Fisheries Insurance Program ● Provide protection to farmers and fisherfolk for unharvested crops due to calamity/fortuitous events. RSBSA ● Provide insurance to fishing boats and gears to subsistence fisherfolk.

Source: PRDP, 2018

As per discussions during FGDs and KIIs, the participants unanimously agreed that they have not availed of any of the above services. Reasons include lack of documents to support loan application and at the same time very stringent documentary and processing requirements. Some are not even aware of the existence of these financing programs.

Based on the narratives of the participants, they mostly relay financing from their own pockets, cash advances from the traders and short-term loans from the micro finance companies present in the area. These entail corresponding interest rates charged to the loan. As noted, there was no specific mention of Islamic financing schemes in the area.

B. NON-FINANCIAL SUPPORT SERVICES

Aside from the key stakeholders who are actively involved in the various segments of the value chain, it is very important to note the contribution of the enablers or service delivery actors who have their own stake in the various segments of the value chain. They include the national and local government units, non-government organizations and even private sectors such as the Seaweed Industry Association of the Philippines (SAIP) who extend support services to the key actors of the value chain as indicated in the various literature. These enablers provide support services to the various actors in the value (PRDP, 2014; PRDP, 2018; BFAR, 2022).

In the case of Tawi-Tawi, enablers include the MAFAR and its MMOs in the various municipalities of the province. Interventions extended by the agency include technical assistance, capability building activities and provision of seaweed farm implements needed by the farmers in their farming endeavors. Another agency involved in the industry is the Ministry of Science and Technology (MOST). This agency is continuously searching for innovative ways to help the seaweed industry. For instance, MOST is also involved in giving technical assistance and capability building activities in the form of training to enhance the knowledge and skills of the women's group on the different technologies on value-adding/processing. In fact, the agency has initiated training on seaweed chips processing for women. Some of the women who have undergone training are the ones who started the processing of seaweed chips at present.

As per interview with an MTIT officer in Tawi-Tawi, they have yet to include interventions specific to seaweed stakeholders in their plan. Moreover, Provincial and Municipal LGUs are also extending interventions for the seaweed industry. In fact, based on the PCIP of Sulu and Tawi-Tawi, both provinces have included in their matrix of interventions some programs/projects/activities geared towards improving the whole industry. Further, there are Non-Government Organizations (NGOs) operating in the area, however, participants of the FGDs and KIIs were not able to identify specific interventions given relative to the seaweed industry.

Particularly for Sulu Province, government agencies like MAFAR were also identified giving support to the seaweed farmers, although in limited quantities. The participants also identified UnYPhil-Women - an organization doing regular visits to some communities; Matawkasi Incorporated - an organization that has extended training to youth and women on sewing malong and seaweed chips processing; and also they received assistance from Tumikang Sama-Sama (TSS) organization under Accelerate Sulu project.

Table 12 shows various proposed interventions to address various concerns of the industry as reflected in the Provincial Commodity Investment Plan of the province (this is not exhaustive) .

Table 13. Matrix of Intervention for Seaweed, Sulu Province

Key Gap / Constraints in VC Development in the Province (from the national and regional VCA results)	*Brief Description of Potential Intervention (subprojects: enterprise or infrastructure)*	*Target Result/ Outcome, including # of farmers/ fisherfolk reached, if applicable*	*Target Areas to be covered (Mun. & Brgys.)*	*Proposed Lead & Other Players for subproject Implementation*
INPUT PROVISION				
Lack of access to and availability of steady supply of high yielding varieties planting materials	a) Provision of high yielding seaweed planting materials. b) Establishment of Municipal Seaweed Nurseries	a) Provided & planted HYV seaweed planting materials. b) Established 18 municipal seaweed nurseries	18 municipalities (except Jolo	LGU, BFAR, DA, Nurseries Operators, seaweed farmers/growers
PRODUCTION				
Lack of know-how on sustainable seaweed farming practices	Conduct trainings on seaweed production, processing & marketing to seaweed farmers	Enhanced capability of seaweed farmers & improved yield	18 municipalities	BFAR, DA, LGU
POSTHARVEST AND PROCESSING				
Lack of access to postharvest facilities	Provision of postharvest facilities a) Stilt Dryers b) Warehouse c. Farm to Market Road d. seaports	Efficient & proper postharvest handling of seaweeds; establishment of stilt dryers & warehouse	18 municipalities	BFAR, LGU

Source: PCIP, Sulu

In the same manner, the Province of Tawi-Tawi has its own Provincial Commodity Investment Plan (PCIP) which reflects the various priority commodities of the province. Seaweed is one of its top priority commodities. Table 13 shows the various proposed interventions relative to the seaweed industry in the province (this is not exhaustive).

Table 14. Matrix of Intervention for Seaweed, Tawi-Tawi Province

Key Gap / Constraint in VC Development in the Province	*Brief Description of Potential Intervention*	*Target Result / Outcome*	*Target Areas to be covered*	*Proposed Lead & other Players for*
INPUT SUPPLY				
Scarcity of seedlings for seaweeds farming that results to high price of seedlings	*Establishment of Seaweeds Nursery*	*One hectare lot for the establishment of Seaweeds Nursery with facilities*	*Sibutu* *- Brgy. Sheik Makdum,* *- Brgy. Tandu Banak* *- Brgy. Taungoo*	*MLGU, BFAR, Federations / Cooperatives, POs*
Inadequate source of capital in acquiring seaweeds farm	*Provision of capital*	*1000 seaweeds farmers / fisherfolks provided with capital*	*South Ubian, Sibutu*	*LGU (Lead); BFAR and Coop / POs / Associations, Farmers / Fisherfolks*
Lack of Seaweeds input/planting materials such as Soft-tie, Rope, and Floating Balls.	*Provision of seaweeds input / planting materials and technology*	*Provided good planting materials equivalent to 1000 seaweeds farmers*	*South Ubian, Sibutu*	*LGU (Lead); BFAR and Coop / POs / Associations, Farmers / Fisherfolks*
High cost of seaweeds input/planting materials	*Establishment of Mariculture (seaweeds) to be managed by organized farmers / fisherfolks*	*Low-cost farm inputs*	*South Ubian*	*LGU (Lead); DOST, BFAR agri/fishery dealers and suppliers*
PRODUCTION / PROCESSING				
Inadequate information dissemination on farm technology and pricing	*Link with Fishery Market Information* *System Capacitate fishery Extension. Workers on seaweeds technology production, management, and marketing* *Provide technology updates/conduct of seminars on seaneeds production and climate resilient technology, and GAP*	*Updated fisherfolks on current information regarding pricing of seaweeds in the market*	*South Ubian*	*LGU (Lead); BFAR and Coop /POs / Associations*

Occurrence of diseases (Ice-lce)	*Provided technology that would stop / cure ice-ice disease/s*	*Sustain good quality harvest*	*South Ubian*	*LGU (Lead), BFAR and Coop /POs / Associations*
Very low price during peak season	*Establishment of Buying Station and Trading Post and sustain direct market linkages to buyers*	*Sustain seaweeds price*	*South Ubian*	*LGU (Lead) DOST, BFAR agri / fishery dealers and suppliers*
Lack of Solar Drier	*Provision / construction of Solar Dryers*	*Seaweeds will be dried in the solar drier to maintain the quality and assures good quality and price*	*South Ubian*	*LGU (Lead), BFAR and Coop /POs / Associations*
Lack of Fish Landing Port	*Provision / Construction of Fish Landing Port*	*Seaweeds is easily transported with the presence of port*	*South Ubian, Turtle Island*	*LGU (Lead), BFAR and Coop /POs / Associations*
Lack of Multi-Purpose Facilities	*Provision / Constructions of Multi-Purpose Hall*	*Serve as storage area of seaweeds before transported to final market area*	*South Ubian*	*LGU (Lead), BFAR and Coop /POs / Associations*
Lack of post-harvest facilities & warehouse	*Provision of postharvest facilities*	*Solar drier on stilt / on grade with warehouse 8-units (BFAR Standard)*	*Sibutu Brgy. Tandu Banak - Brgy. Taungoo - Hii. Mohtar S. Ligayan (Tanduovak) - Ambutong S. Hji. Taha Nunukan*	*Cooperatives, POs, DAR, DPWH*
Unavailability of Roro port / wharf resulting to undesirable time in delivery / hauling of seaweeds & other marine products	*Provision / Construction of Roro port*	*(20m x 40m) Roro Port constructed in Sibutu wharf*	*Sibutu Municipality Wharf*	*MLGU, DPWH*

MARKETING				
Lack of / seldom availability of transportation resulting to high transport cost (seaweeds area to final market)	*Provision of transportation (tor transporting seaweeds product)*	*Transportation provided*	*South Ubian*	*LGU (lead) BFAR*
Lack of motorized Boat to transport seaweeds (wet / dry)	*Provision of motorized boat with complete accessories*	*50 fisherfolks provided with motorized boat*	*South Ubian*	*LGU (lead) BFAR*
Lack of seaweeds trader/s	*Establishment of Trading Cooperatives*	*Trading Cooperative established*	*South Ubian*	*LGU (lead) BFAR*
Traders control prices of seaweeds products	*Conduct investment forum on seaweeds product industry players*	*Two (2) Meetings / Forums per annum*	*Sibutu*	*Assemblers / Traders; Inputs / Info Purchase agreements Support in development of system, DTI*
	Establishment and Accreditation of Marketing Cooperatives	*Two (2) Meetings / Forums per annum*	*Sibutu*	*Assemblers / Traders; Inputs / Info Purchase agreements Support in development of system, DTI*
	Organized federated seaweeds farmers and cooperative / Establishment of buying station and warehouse with facilities to sustain direct market linkages to buyers	*Two (2) Buying Station with warehouse and facilities*	*Brgy. Tandu Banak, Brgy. Ambutong Sapal*	*MLGU, DA, Seaweeds Farmer Cooperative, POs*
Lack of capital to compete buyers in Sandakan	*Training / Organize & strengthen fisherfolks / farmers association*	*Reasonable Price*	*Turtle Island*	*LGU /BFAR / DTI*
Controlled prices of marine products by business middleman that compels. fisherfolks to sell their products at lower price	*Establish price control mechanism*	*1 Price Control Committee*	*Municipal Wide*	*LGU / BFAR / DTI*

SUPPORT SERVICES				
Limited knowledge on nursery operations and management	*Training and capacity development (Provision of trainings on nursery management)*	*5 days training (done in two batch)*	*Fisherfolks organization of Sibutu, Tawi-Tawi*	*MLGU, Agal Agal Federation / Cooperatives, BFAR*
Limited information on sustainable seaweeds farming practices	*Conduct forums on effective seaweeds farming system*	*5 days training (done in two batch)*	*Fisherfolks organization of Sibutu, Tawi-Tawi*	*MLGU, Agal Agal Federation / Cooperatives, BFAR*
Occurrences of diseases (ice-ice and kapu-kapu) when bad consequences of nature struck, the farmers are forced to harvest immaturely	*Conduct of seminars on seaweeds production and climate resilient technology, and GAP (annually)*	*Update fisher folks on current information technology of seaweeds in the market*	*Sibutu*	*Fisherfolks' organization, PO's, BFAR*
Insufficiency of pre-harvest equipment and facilities for marginalized fisherfolks	*Provision of fishing boats and fishing-related paraphernalia to fisherfolks*	*30 motorized fishing boats with complete paraphernalia*	*Ipil, Pababag, Karungdong, Lamion, Tubig-Tanah*	*LGU / BFAR*

Source: PCIP, Tawi-Tawi

Farmers' Cooperatives and Associations Operating in Sulu and Tawi-Tawi

Below is the list of farmers' cooperatives and associations (FCAs) operating in the two provinces. This list is not exhaustive as the research team have not secured any documented information relative to the existence and operation of these organizations. This is gathered and validated through the FGDs and KIIs conducted in the study areas. However, according to the respondents of the study, most of these organizations are basically involved in the production of seaweed only. In Tawi-Tawi, for instance, the President of Larap Seaweeds Farmers Marketing Cooperative in Sitangkai was one of the participants in one of the FGDs conducted. According to her, the cooperative is basically involved in the production of seaweeds only and its operation is reliant on whatever interventions coming from the government.

Table 15. List of Seaweed Cooperatives and Farmers Groups in Sulu*

Municipality	Name of Cooperative/Farmer Group
Pangutaran	• Kawitan Seaweed Association • Tubig Maasin Association • Kiha Niog Seaweed Association • Tonggasang Association • Pag-asa Association • Manubal Taysai Association • Patutol Seaweed Association • Tubig Sallang Association
Minis Island	• Minis Fisherfolk Association
Sucuban	• Sucuban United People Association
Omar	• Andalan Fishermen Cooperative • Sitio Kalang-Kalang Seaweeds Association • Parmata sin Capual Association • Mussahlaud Association • Luuktampal Association • Niangkaan Seaweeds Farmer Association • Kahayangan Association
Panamao	• Brgy Suuh Sitio Tambun Association
Tandu Bagua	• Tandu Bagua HH Farmers Association

Source: FGDs/ KIIs; The list is not exhaustive

Table 16. List of Seaweed Cooperatives and Farmers Groups in Tawi-Tawi*

Municipality	Name of Cooperative/Farmer Group
Bongao	• Sama Dilaut Seaweeds Farmers and Fishermen Marketing Cooperative
Sitangkai	• Sitangkai Seaweeds Farmers and Fisherfolks Marketing Cooperative • Larap Seaweeds Farmers Marketing Cooperative
Panglima	• Panglima Sugala Seaweeds Farmers Producers Cooperative
Simunul	• Tabba Integrated Seaweeds Farmers Multi-Purpose Cooperative
South Ubian	• Bunay-Bunay Seaweeds Farmers Multi-Purpose Cooperative
Tandubas	• Parhimpunan Karandahan Kepeng Producers Cooperative • Magdaraing Ma Barangay Kepeng Producers Cooperative • Tongbangkaw Seaweed Farmers and Fisherfolks Producers Cooperative • Butun Agri Fishery Women Association*

Source: FGDs/KIIs; *The list is not exhaustive

Identify potential partnerships and collaboration opportunities between stakeholders.

Linkage and collaboration between and among the various actors in the value chain is very important to ensure the efficient functioning of the system. Based on KII of a big trader in Bongao, she has suggested that the government or any other organization who would want to channel interventions for the farmers can forge linkages and collaboration with the traders. For example, in the case of coconut farmers, fertilizer intervention to be given to the farmers was channeled through the traders. The traders, in turn, distributed these fertilizers to the farmers who delivered copra to them. These traders facilitated transport/hauling of these fertilizers. This is one of the possible partnerships of the enablers like the government to actors of the value chain like farmers and traders. This will promote efficiency in terms of distribution and at the same time wider coverage in terms of identification of beneficiaries. Specifically, this can be a very effective strategy since the traders have more direct access/contact to the producers because of their trading relationship. The traders can actually help the government or any organization determine the actual farmers/producers of a particular commodity as they serve as the final destination of the products, hence, they have more logistical capabilities and they can assist the government in reaching a greater number of legitimate beneficiaries during distribution of interventions.

SECTION 6. CONSTRAINTS AND OPPORTUNITIES

Production Constraints & Opportunities

The following are some of the production constraints and opportunities for seaweed (PRDP, 2014; PRDP 2018). This list is not exhaustive.

Table17. Production Constraints and Opportunities for seaweed

Production Constraints	Production Opportunities
Limited outreach of existing extension services.	Management strategies in seaweed farming anchored on sound scientific knowledge and understanding will help reduce incidence of diseases, enhance the capability of farmers to monitor possible outbreaks of diseases, and improve yield.
Low adoption of good aquaculture practices/ Lack of know-how on the technical aspects of seaweed farming including enterprise management.	
Low appreciation on benefits of complying with good aquaculture practices.	
Lack of access to financial resources to grow a business and to facilitate upgrading (adoption of better technology/ lack of economies of scale.	Scaling up of farms to at least ½ to 1 hectare can reduce per unit cost of production thereby improving price competitiveness and income/asset generation capacity of farmers.
Lack of capacity to pay upfront for planting materials and materials for farm establishment.	Deep water farming can help reduce risks of ice-ice infestation and damage during typhoon.
Lack of updated seaweed zoning supported with conduct of scientific site suitability assessment.	A balanced approach to coastal resource use and development based on sound science can optimize the socioeconomic benefits of seaweed farming and reduce risks of crop failure. Availability of experts with extensive experience to conduct studies and assessments on site suitability. A database on site selection can form part of the investment promotion tool of the province.

During the conduct of FGDs and KIIs in the study areas, these are some of the specific concerns and challenges confronting the production segment of the value chain:

1. Lack of capitalization for farmers to continue farming coupled with Increasing prices of materials inputs.
2. Change in weather condition and temperature and other environmental factors; northeast monsoon causing strong winds affecting their farming activities.
3. Presence of grazers like fish and turtles feeding on the seaweeds
4. The prevalence of ice-ice disease.
5. High cost of transportation for both water and land transportation

6. Most of the farmers are still using non-motorized boats which is inefficient in their farming activities.
7. Prevalent use of fertilizer which affects the health of the seaweeds.

In terms of postharvest operation, the lack of proper drying facilities and common standards of drying as well as lack of uniform understanding on the moisture content of the RDS are some of the major concerns by the farmers.

Market Constraints & Opportunities

The following are some of the market constraints and opportunities for seaweed (PRDP, 2014; PRDP, 2018). This list is not exhaustive.

Table 18. Market Constraints and Opportunities for seaweed

Market Constraints	Market Opportunities
Current seaweed food products (noodles, etc.) are not yet produced and distributed in a commercial scale	Seaweed food products can potentially be positioned as healthy/ gluten-free food which has a growing demand both in local and export markets
Weak product and market development	
Lack of access to GMP and Halal compliant processing facilities	
Farmers are only price takers; traders set the price of their produce	Farmers' Cooperatives and Associations can serve as marketing arm of the individual farmers to command higher prices

SECTION 7. ACTIONABLE RECOMMENDATIONS

The results of the study necessitate the need for short-term, medium-term, and long-term interventions through the implementation of programs, projects or activities to improve the local seaweed industry in the region. Below are some actionable recommendations targeted at the various segments of the value chain:

A. Input Provision Segment

1. Establishment and maintenance of village-level seaweed nurseries in the production areas for easy access to farmers. Also, culture laboratories in both provinces should be established and operationalized.

B. Production Segment

1. Making seaweed farming activities efficient through provision of motorized boats to be used in the monitoring and maintenance of the seaweed farms especially those in the off-shore areas.

2. Provide guarantee to seaweed production through crop protection (to be covered by the Philippine Crop Insurance Corporation).

3. Relative to the concern about the use of synthetic fertilizer in farming, there is a need to:
    a. conduct a comparative study between shorter and longer cropping cycles as to its productivity and profitability (to show farmers which cropping cycle is more advantageous for them).
    b. craft local ordinance to regulate the use of synthetic fertilizer.
    c. find alternative sources of fertilizer that is environment-friendly (the use of organic fertilizers like concoctions could be one of the best possible alternatives).

4. Engage in other alternative livelihood such as processing of seaweed value-added products, crop production or other fishery-related farming enterprises to increase and sustain income.

C. Postharvest/Processing Segment

1. Provision of dryers and other post-harvest facilities to improve drying practices and enhance overall quality of RDS.

2. Coming up with common standards of RDS; the use of moisture meters of both farmers and traders could address this concern.

D. Trading/Marketing Segment

A. Across Various Segments

1. Crafting of a comprehensive capability building (CapDev) program by MAFAR together with the LGUs with the following objectives:
    a. For the farmers to be updated with the new technologies on seaweed production, postharvest handling (drying technologies, hygiene and sanitation, determination of moisture content, etc.).

b. For women and youth to be capacitated on the various food processing technologies for them to be able to engage in the commercial production of seaweed-enriched value-added food products.
c. For the youth to be capacitated on how to use multi-media channels to market value-added seaweed products not only in the locality but also in other places;
d. For both the farmers and traders to have the common understanding and standards as to determination of quality, moisture content, carrageenan content, hygiene and sanitation, and other considerations in drying seaweeds.

2. Providing access to working capital/funding to be used in the purchase of inputs and day-to-day operations by presenting options and/or linking to loan providers, and/or provision of seaweed propagules and farm implements. There is a need to consider crafting specific credit programs for the seaweed farmers giving considerations on the nature of production, the risks involved, and the capacity of the farmers for repayment. In the same manner, a working capital is also necessary to augment trader's capacity to buy seaweed products.

3. Enhancing economic gains of the actors in the value chain through diversification of seaweed products. The capacity building on value-added products should be complemented with the provision/establishment of processing facilities, tools, and equipment that will serve as common service facilities for women and youth who would like to engage in value-adding enterprises.

4. Piloting of a viable Cooperative/Association to engage in diversified business ventures to ensure sustainable operation. This could be done in various strategic clusters of municipalities in the two provinces to address concerns about the availability and access to these inputs. Business ventures could include, but is not limited to, the following:
    a. Supply of seedlings, seaweed farm implements, and other agricultural inputs.
    b. Trading operation; to serve as buyer of seaweeds for the individual farmers.
    c. Processing/value-adding of seaweed-enriched food products.
    d. Other business ventures related to the seaweed value chain.

5. Since halal products have a huge market potential in the domestic and export markets, there is a need for the BARMM, specifically the two major seaweed-producing provinces of Sulu and Tawi-Tawi to seriously consider halal practices to be incorporated in the various segments of the value chain operation. This is to gradually incorporate and institutionalize halal practices in the seaweed industry. This will facilitate expansion of more markets, specifically the halal consuming population. This should be part of the short-term, medium-term and long-term plan of the two provinces. This can include the following:
    a. Part of the short-term plan will be identifying the various activities in each segment of the value chain where halal practices can be incorporated such as production, postharvest (drying) as well as processing.
    b. Establish halal standards which can be part of the Philippine National Standards for Seaweeds Culture, Postharvest and Processing as part of the medium-term plan.
    c. Continuous capability building activities for all the stakeholders in the value chain on the ways and strategies on how to incorporate halal in their practices in preparation for halal certification.
    d. For the government (MAFAR/MOST) to identify and assist certain organizations as halal certifying bodies.

REFERENCES

Basic Manual: Seaweed Farming, Postharvest Improvement and Marketing
Accessed from: https://openjicareport.jica.go.jp/pdf/12263109_05.pdf

Brown, E. et al (2010): Framework for Value Chain Analysis
Accessed from: https://www.researchgate.net/figure/Framework-for-value-chain-analysis-Brown-et-al-2010_fig1_363461096

Caballero, EJ. (2002). Basis of Conflict in ARMM in Relation to Land and Resources. Department of Environment and Natural Resources-United States Agency for International Development's (DENR-USAID) Philippine Environmental Governance (EcoGov)
Accssed from:
https://faspselib.denr.gov.ph/sites/default/files//Publication%20Files/BASIS%20OF%20CONFLICT%20IN%20ARMM%20IN%20RELATION%20TO%20LAND%20AND%20RESOURCES.pdf

FAO Global Fishery and Aquaculture Production Statistics (FishStatJ), 2021
Accessed from: www.fao.org/fishery/statistics/software/fishstatj/en)

National Seaweed (Kappaphycus) Industry Roadmap 2022-2026
Accessed from: https://www.bfar.da.gov.ph/wp-content/uploads/2022/11/Seaweed-Industry-Roadmap.pdf

Favis-Villafuerte, N. (2017). The Future of Seaweed Industry
Accessed from: https://business.mb.com.ph/2017/04/28/the-future-of-seaweed-industry/.

Gender Analysis, Assessment, and Audit Manual and Toolkit
ACDI-VOCA, 2012
Accessed from: https://www.acdivoca.org/2012/07/gender-analysis-assessment-and-audit-manual-toolkit/

Guidance Note 3.1: Integrating gender equality in monitoring and evaluation
International Labor Organization, 2020
Accessed from: https://www.ilo.org/wcmsp5/groups/public/---ed_mas/---eval/documents/publication/wcms_746716.pdf

McHugh, D.J. (2003). A Guide to the Seaweed Industry
FAO Fisheries Technical Paper 441, Rome
Accessed from: https://www.fao.org/3/y4765e/y4765e00.htm

Montaño, M. et al (2003): Science Interventions for Sustainable Marine Products Production: The Case of Sardines and Seaweeds
Accessed from: doi.org/10.57043/transnastphl.2017.1065

National Value Value Chain Analysis for Seaweeds

Philippine Rural Development Project
2018

Pangan, S. et al (2020). Optimization of the Floating-Type Seaweed Dryer
Accessed from: https://www.ukdr.uplb.edu.ph/journal-articles/315/

Participatory Market System Development Toolkit
Accessed from: https://beamexchange.org/resources/141/

Philippine Fisheries Profile 2019
Accessed from: https://www.bfar.da.gov.ph/wp-content/uploads/2021/05/Philippine-Fisheries-Profile-2019.pdf

Philippine Fisheries Profile 2021
Accessed from: https://www.bfar.da.gov.ph/wp-content/uploads/2022/11/2021-Fisheries-Profile-FINAL-FILE.pdf

Philippine Statistics Authority
Accessed from:
https://openstat.psa.gov.ph/PXWeb/pxweb/en/DB/DB__2E__FS/0072E4GVAP0.px/?rxid=bdf9d8da-96f1-4100-ae09-18cb3eaeb313t&fbclid=IwAR3UN38e2DD4OgNjmMPbPPH9gwnQVSP6_2nyzlhNhfTtnd676kwQcWEIO80

Philippine National Standard - Raw Dried Seaweed Specification
PNS/BAFS, 2012
Accessed from:
https://bafs.da.gov.ph/bafs_admin/admin_page/pns_file/PNS%20BAFPS%2085_2012%20Dried%20raw%20seaweed%20(1).pdf

Provincial Commodity Investment Plan
Sulu, 2018

Provincial Commodity Investment Plan
Tawi-Tawi, 2018

Santhoshkumar, P. (2023). Drying of Seaweed: Approaches, Challenges and Research Needs
Accessed from:
https://www.researchgate.net/publication/371481849_Drying_of_seaweed_Approaches_challenges_and_research_needs

Seaweeds – Code of Good Aquaculture Practices (GAqP), 2021
Accessed from: https://bafs.da.gov.ph/bafs_admin/admin_page/pns_file/2021-10-19-PNS%20BAFS%20208-2021%20Seaweeds%20-%20Code%20of%20Good%20Aquaculture%20Practices%20(GAqP).pdf

Seaweed Farming - Kappaphycus and Eucheuma
Technology Series 1, November 2014
Accessed from https://region8.bfar.da.gov.ph/wp-content/uploads/2022/12/3.pdf

The Door to the Six Industry Clusters in the Bangsamoro Autonomous Region in Muslim Mindanao: An Investor's Guide to the Business Opportunities in the Six Clustered Industries in the BARMM
Department of Trade and Industry – BARMM Comprehensive Capacity Development Project for the Bangsamoro (CCDP) Japan International Cooperation Agency, 2019
Accessed from:
https://www.jica.go.jp/Resource/philippine/english/office/others/c8h0vm0000d3hsdw-att/materials_02.pdf

Value Chain and Competitiveness Strategy: Carrageenan Seaweed Mindanao
Philippine Rural Development Project, 2014

People in Need

People in Need (PIN) is an international non-profit organization providing humanitarian and development assistance and has operated in over 40 countries worldwide since 1992. PIN began in the Philippines serving communities affected by Super Typhoon Yolanda in 2013. Ever since then, our actions in the Philippines have focused on sustainable livelihood, social cohesion, women and youth empowerment, renewable energy, health, disaster resilience, and good governance.

MARADECA, Inc.

Maranao People Development Center Inc. (MARADECA) is a non-stock, non-profit service oriented institution catering to the needs of the Moro People in their quest for socio economic advancement and to struggle for peace and development. It adopts a people-based, community based, integrated and sustainable development framework that creatively reflects the aspirations of one Moro People.

UnYPhil-Women

United Youth of the Philippines-Women (UnYPhil-Women) is a non-profit women and youth focused organisation based in Cotabato City. The focus of its work with women is to help women who are subjected to violence, sexual and physical abuse, trafficking and other forms of discrimination. Over the years, its services have expanded to include peacebuilding, reproductive health and humanitarian response especially in the conflict-affected areas in the Bangsamoro.

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