

Review of vocational education and training programs in informing the future seaweed industry in South Sulawesi

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The Partnership for Australia-Indonesia Research (PAIR) has launched a series of small-scale initiatives that employ a dual focus to shed light on the interplay between governance, policy and capacity building in key sectors. These initiatives are aimed at supporting four main research themes in the areas of commodities, transport, young people's health and young people's development.

The research adopts a dual strategy, focusing on both governance and policy, as well as capacity building, to reach its objectives. The study also takes into consideration important issues such as gender equality, disability and social inclusion.

This report provides policymakers with a rich source of information and up-to-date evidence that can inform their decision-making. The findings of these PAIR initiatives are essential reading for anyone interested in the future of these key sectors in Indonesia.



Dr Eugene Sebastian
PAIR Program Director
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EXECUTIVE SUMMARY

Improving the skills of the workforce is a key priority for the Indonesian government and this can be achieved by enhancing the quality of the curriculum, teaching staff and working closely with industry.

Indonesia is rich in renewable natural resources and South Sulawesi is the largest seaweed-producing area in the country.

This report finds the current education and training programs offered by vocational high schools (VET) and marine and fisheries polytechnics in South Sulawesi are not aligned to the region's economic potential when it comes to knowledge and skills in seaweed processing.

This study aims to address this challenge by:

- gaining a comprehensive understanding of the current VET programs offered by a sample of vocational high schools and polytechnics in South Sulawesi that prepare students for the seaweed processing industry
- identify the skills required by the seaweed processing industry in South Sulawesi
- mapping VET provider programs to industry needs with a focus on required skills and competencies
- developing recommendations for improving the current VET programs and offerings to meet the needs of the seaweed processing industry

The study used a qualitative approach and collected primary data through interviews with key representatives from VET providers and seaweed processing industries, including PT Sutracco, PT HAS, UD Masdin, PT Anugrah Agung Global and Kospermindo. Secondary data were collected from the Vocational Training Centre, the South Sulawesi Provincial Maritime and Fisheries Service and the South Sulawesi Regional Research and Development Agency (BAPPELITBANGDA).

The study found that much of the material taught at VET providers has little relevance to the needs of the South Sulawesi seaweed processing industry, which mainly produces semi-refined products.

We propose six recommendations to improve VET programs and support the development of the seaweed processing industry in South Sulawesi:

- Develop a curriculum that includes seaweed processing as a specific subject taught during at least one semester in both vocational high schools (Sekolah Menengah Kejuruan - SMK) and polytechnics. Non-formal VET providers like the Work Training Agency (BLK) should provide practical-short term training courses to enable workers to become independent and develop their own small businesses.
- Improve the practical modules and materials for seaweed processing in both vocational schools and polytechnics with consideration of the specific skills required by local industries that may change over time. Enhance the technical competency of teaching staff involved in seaweed processing-related subjects.
- Provide support to VET providers so training can be undertaken in seaweed processing with appropriate equipment and laboratory facilities.
- Align polytechnic student internships with the Merdeka Belajar Kampus Merdeka (MBKM) program to enable students to gain work experience in the seaweed processing industry.
- Provide more funding for research on seaweed processing, specifically from the provincial research and development agency (Balitbangda) with a focus on seaweed processing.
- Promote short term training programs by the work training agency (BLK) aimed at fresh graduates (SMK and polytechnic levels) on processing seaweed to produce value-added products. Incorporate seaweed processing training programs into the national pre-employment training program.

1.0 INTRODUCTION

An overview of seaweed industry in Indonesia and South Sulawesi

Indonesia aims to become the leading country in the seaweed industry. The nation is working towards creating a sustainable and competitive seaweed industry as outlined in the National Seaweed Industry Development Roadmap, a Presidential regulation issued in 2019. Indonesia is currently the second-largest producer of seaweed globally behind China and accounts for about 30 percent of the world's supply (Nuryartono et al., 2021).

Indonesia is the world's largest producer in cultivated seaweed with output increasing significantly in recent years. Indonesia accounted for 72 percent of global farmed seaweed production in 2016 with a total volume of three million tonnes. Among the Indonesian islands, Sulawesi produces the highest volume of seaweed, with the province of South Sulawesi contributing 3.66 million tonnes per year or approximately 11 percent of global seaweed supply. Seaweed cultivation in South Sulawesi is primarily concentrated along the southern and eastern coastlines. However production volume in most Indonesian provinces shows high inter-annual variability, which raises concerns about sustainable livelihoods (Waters et al., 2019). The seaweed industry is a significant source of income for more than 35,000 coastal households in South Sulawesi (Badan Pusat Statistik, 2020).

Indonesia has an exceptional opportunity to bolster its seaweed industry and create a sustainable source of income by utilising its 17,000 plus islands, tropical climate and a large and young labour pool. Cultivated marine algae offer versatile applications, including food, livestock feed, biofuel, pharmaceutical ingredients

and raw materials for eco-friendly alternatives to plastics. A green economy centred around seaweed can drive economic growth and reduce poverty by generating jobs for Indonesians living in coastal areas who often struggle despite their country's abundant natural resources. An improved industry can also promote environmental sustainability.

Most of the seaweed production in Indonesia is marketed as a raw material

The seaweed processing industry in Indonesia mainly produces carrageenan, which is widely used as raw material in the food processing industry (Loureiro et al., 2017). As Indonesia is the largest carrageenan producer globally, global prices for carrageenan generally follow Indonesia's prices (Campbell & Hotchkiss, 2017). China's food processing industry is the largest consumer of carrageenan, meaning that demand from China heavily influences the price. Few Indonesian carrageenan processing facilities have the capacity to create value-added products, so the domestic seaweed processing industry competes with the Chinese seaweed industry.

In 2019, the President of Indonesia issued a regulation (Presidential Decree No. 33/2019) on the importance of developing industries that produce value added products from seaweed, in areas such as the food, animal feed, fertiliser, cosmetics and bioethanol industries (Khatulistiani et al., 2020; Puspita et al., 2020). Indonesian red algae products exhibit promising potential in the development of cosmetic and pharmaceutical products. To enhance the quality of seaweed as a raw material, it is necessary to promote better integration between seaweed farmers and seaweed processing industries, particularly during the post-harvest handling stage.

In South Sulawesi the sale of seaweed as a raw material is widespread. A move into a higher value-add commodity requires the more downstream processing capacity and the development of a workforce that can become the brains and operators of this industry.

Skills needed in the seaweed processing industry

There is a shortage of skilled marine and fisheries workers in Indonesia and a strategy is needed to enhance local capacity in the sector. This can be done through various programs, such as improving the quality and competence of marine and fisheries education, training and outreach institutions. This would involve upgrading facilities and infrastructure relevant to human resource development in marine and fisheries, refining the curriculum and enhancing the competency of teaching staff through technical certification and competency tests in the marine and fisheries field. It is also crucial to increase cooperation with companies or countries that require competent personnel in this field.

Indonesia is a maritime nation, but unfortunately education related to maritime affairs has been given too little attention.

It is important for the government to focus more on educating students in marine and fisheries vocational schools to make the best of the nation's marine potential.



Figure 1: A field assistant interviewing industry an industry participant. Image credit: Funtly Septiyawati and PAIR.

The government recommends that every vocational high school and polytechnic should establish a professional certification institute known as LSP-P1. This will ensure that each graduate receives a certificate of competency to complement their academic diploma which will be beneficial when they are looking for work. This strategy will help produce graduates who have both relevant skills and certificates of competency.

There were 14,459 vocational high schools (known as SMKs) in Indonesia as of 2022 and only 560 of them (which is 3.87 percent of the total) were marine and fisheries SMKs. There are 428 SMKs in South Sulawesi and out of those, 24 SMKs (which is 5.61 percent of the total) specialise in marine and fisheries (Directorate of Vocational Secondary Schools, 2023). Out of the 24 fisheries SMKs in South Sulawesi, however, only SMK Negeri 9 Makassar includes seaweed processing as a part of their study program. Marine and Fisheries SMKs, as well as polytechnics, provide education in various recognised competencies such as aquaculture, fisheries post-harvest processing, as well as both freshwater and marine fisheries agribusiness.

Several previous studies have identified a significant discrepancy

between the skills that are taught during formal schooling and the skills that are required by the marine and fisheries industries. These studies (Kadir et al., 2016; Muttaqien, 2018; Supriadi et al., 2023) have shown that the competency-based skills taught to students and the course materials used have been developed based on national and international industry needs, without sufficient consideration for the needs of local industrie, such as seaweed processing industries (Prima et. al., 2016).

In addition, Mukhadis et al. (2018) conducted a study examining the relevance of SMK programs in 26 Indonesian provinces and found that there was a 50 percent mismatch between SMK programs and the economic potential of the regions. This was due to poor coordination between stakeholders involved in SMK policy-making, a lack of alignment between priorities and recommendations for SMK program development and a lack of post-implementation evaluation of SMK development programs. Furthermore, the SMK curriculum was more focused on global and national orientation rather than the local orientation necessary to prepare the local workforce in the regions (Afriansyah et al., 2018).

There are two types of senior secondary education in Indonesia:

high schools/senior secondary schools (Sekolah Menengah Atas; SMA) and the vocational high schools/vocational senior secondary schools (Sekolah Menengah Kejuruan; SMK). The difference between these two types of schools is that the vocational stream (SMK) emphasises practical work by offering a curriculum that is 70 percent practical and 30 percent theoretical, while the high school stream (SMA) emphasises theory by offering a curriculum that is 70 percent theoretical and 30 percent practical. The purpose of the vocational education provided by SMK is to prepare students for the workforce after they graduate. In terms of post-secondary education, polytechnics offer courses with a 70 percent practical and 30 percent theoretical curriculum, while university courses have a 70 percent theoretical and 30 percent practical curriculum. This study focuses on the curricula of SMK and polytechnic. In addition to SMKs and polytechnics, the Indonesian government also provides short-term training for individuals seeking employment. These training courses are offered by the industrial work training centres (Balai Latihan Kerja industri or BLK) under the Ministry of Employment and Industry. The aim of these courses is to provide trainees with skills that can be directly applied in local industries or for those who wish to become

entrepreneurs or self-employed. To summarise, the vocational education system in Indonesia is divided into formal and informal categories. The formal education system includes SMKs and polytechnics, while the informal education system includes short-term training courses offered by BLK:

- Formal: vocational high schools (SMK) and 3- and 4-year diplomas (Diploma 3 and Diploma 4) typically offered by polytechnics (and sometimes universities).
- Informal: work training centres (balai latihan kerja, BLK).

The seaweed processing industry requires workers with particular skills and it would be beneficial if vocational education and training (VET) curricula provided students with those skills. Unfortunately, there has been a shortage of research in identifying any skill gaps between VET providers and the seaweed processing industry's skill requirements.

The seaweed sector in Indonesia, especially in South Sulawesi, faces a significant challenge due to low technical skill levels among its processing workers. As a result, small-scale seaweed companies can only sell raw materials to the seaweed industry.

It is essential to enhance the skills of seaweed processing workers to improve the quality of the commodity and value of seaweed products

This requires conducting a training needs analysis to identify and map the specific skills that are required by labourers in the seaweed processing industry.

VET providers in South Sulawesi that focus on seaweed processing include:

- Vocational senior secondary schools (SMK). The SMK system provides students with general skills and knowledge in the field of agribusiness. Seaweed processing is taught as a subject within the fisheries processing industry study program.
- Marine and fisheries polytechnics (politeknik kelautan dan perikanan) and agriculture polytechnics (politeknik pertanian).
- Work training centres (balai latihan kerja, BLK).

This study identifies the gap between the skills taught by VET providers and the skills needed by workers in the seaweed processing industry. To achieve this we set out to:

- Gain an accurate and impartial understanding of the scope, quality, strengths and any weaknesses of the current vocational education and training (VET) programs offered by vocational senior secondary schools (SMK) and polytechnics in South Sulawesi that prepare students to enter the seaweed processing industry.
- Identify the skills that are required by the seaweed processing industry in South Sulawesi.
- Map the programs that are delivered by VET providers (i.e., SMK and polytechnics) against the industry's needs, focusing on the required skills and competencies.
- Develop recommendations for enhancing the current VET programs and offerings across SMK and polytechnics in South Sulawesi so that they align with the needs of the seaweed processing industry.

The information generated by this study is intended to aid South Sulawesi and other regions of Indonesia in achieving their goal of becoming a world leader in the seaweed processing sector.

2.0 METHODOLOGY

This qualitative study comprised four main research activities:

- Mapping the curriculum that is related to seaweed processing provided by three types of institutions: (a) fisheries vocational high schools, (b) fisheries polytechnics, and (c) agricultural and fisheries polytechnics.
- Identifying the skills that are required by the seaweed processing industries.
- Investigating whether there is a discrepancy between the skills that are in demand by the industry and those that are currently being supplied. This was done through in-depth interviews with key participants in the industry and vocational education and training (VET) providers.
- Providing recommendations for educators, employers and policy makers based on the findings of the study to address the problems that were identified.

Table 1. Participants and data collection

Participants	Activities	Note
Seaweed processing industry		
<p>Three seaweed processing companies in South Sulawesi:</p> <ul style="list-style-type: none"> PT Hasil Indo Sejahtera (PT HAS), Makassar Koperasi Serikat Pekerja Merdeka Indonesia (Kospermindo) PT Sutracco, Makassar <p>Two small companies located in Palopo:</p> <ul style="list-style-type: none"> UD Masdin* PT Anugrah Agung Global 	<p>Conduct semi-structured interviews with key representatives from each company</p> <p>Total 23 participants (owners, top managers, supervisors and workers)</p>	<p>We proposed to collect data from the following companies but we were unable to approach them due to the following reasons:</p> <ul style="list-style-type: none"> PT Wahyu, Makassar and PT Batimurung Indah, Maros did not respond to the invitation to participate in the study. UD Alfred Makassar was inactive PT Cahaya Cemerlang, Takalar did not agree to participate in the study. <p>Data were collected from PT Sutracco, PT HAS, UD Masdin, PT Anugrah Agung Global and Kospermindo</p>
VET providers		
<p>One fisheries vocational senior secondary school in Makassar, South Sulawesi (<i>Sekolah Menengah Kejuruan/SMK Negeri Perikanan 9</i>)</p>	<p>Conduct semi-structured interviews with one principal and four teachers.</p> <p>Collect curriculum documents (i.e. lesson plans, list of subjects taught).</p>	As planned.
<p>One marine and fisheries polytechnic in Bone Regency (<i>Politeknik Kelautan dan Perikanan/Poltek KP Bone</i>)</p> <p>One agriculture polytechnic in Pangkep Regency (<i>Politeknik Pertanian Negeri Pangkajene Kepulauan/Polipangkep</i>)</p>	<p>Conduct semi-structured interviews with four lecturers from the Bone polytechnic and six lecturers from the Pangkep polytechnic.</p> <p>Collect curriculum documents (i.e. lesson plan, list of subjects taught).</p>	As planned.
<p>Work training centres (<i>balai latihan kerja</i>, BLK):</p> <p>BLK in Makassar</p> <p>BLK in Takalar</p> <p>BLK in Pangkep</p> <p>BLK in Bantaeng</p>	<p>The initial plan was to collect secondary data (eg: type of training and target participants relating to seaweed processing). However there were no relevant programs found in BLKs so the research team was not able to collect secondary data.</p>	<p>BLK in Takalar - did not respond to the invitation to participate in the study.</p> <p>The research team visited three BLKs and found the following:</p> <p>BLK in Pangkep offers fisheries training programs that are related to various aspects of the industry. However, they do not have a specific program on seaweed processing. Instead, they offer training based on requests from the industry without any pre-designed program for participants. While they do offer programs aimed at small-scale or home-based industries, such as producing food made from seaweed (such as noodles, crackers, and nuggets), the other programs they offer have not generated enough interest from the community.</p> <p>BLK in Makassar did not offer fisheries-related training programs.</p> <p>BLK in Bantaeng - there were training programs offered for seafood processing but there was no program offered specifically for seaweed.</p>
Provincial-level government		
<p>South Sulawesi Marine and Fisheries Office (<i>Dinas Kelautan dan Perikanan</i>)</p>	<p>Collect secondary data (ie: statistics on aquaculture commodity production, type of cultivation).</p>	As planned.
<p>Provincial Research and Development Agency (<i>Badan Penelitian dan Pengembangan Daerah/ BAPPELITBANGDA</i>)</p>	<p>Investigate current government policies in relation to the seaweed processing industry (ie.: number of prior projects on research and development related to seaweed)</p>	At the provincial level, only three out of the 67 research projects conducted by Balitbangda during the period 2015-2021 were related to seaweed.

Note: *UD = Usaha Dagang, the term used for a company established and owned by an individual with a capital investment of less than 25 million rupiah. In contrast, the term Perseroan Terbatas (PT) designates a limited liability company that is usually owned by several people/institutions and has a higher capital investment (minimum 500 million rupiah).

Data collection

The study was conducted from July to November 2022 and received ethics approvals from Universitas Hasanuddin and Monash University. Data were collected from various sources and participants, as shown in Table 1.

The research team collected publicly available curriculum documents from selected fisheries-specific vocational senior secondary schools and polytechnics in South

Sulawesi. These documents included lesson plans, number of students enrolled, number of graduates/program completion rate, list of general and specialist subjects offered and the proportion of theoretical and practical components.

Semi-structured individual interviews were conducted with key representatives from seaweed-related SMK subject teachers and polytechnic lecturers to identify the strengths and limitations

of VET programs and explore perceptions of quality, relevance and value of the programs. The research team also collected data and conducted semi-structured individual interviews with key representatives from seaweed processing companies to identify the qualification and prior training of workers, the skills needed by the industry/employer and internal assessments conducted by the companies to assure and maintain quality.

Table 2. Background data on VET providers

	SMKN 9, Makassar	Bone Marine and Fisheries Polytechnic	Pangkep Agricultural Polytechnic
Address	Jl. Salodong, Untia, Kecamatan Biringkanaya, Kota Makassar, Sulawesi Selatan 90243	Jl. Sungai Musi No. Selatan, Pallette, Kecamatan Tanete Riattang Timur, Kabupaten Bone, Sulawesi Selatan 92719	Jalan Poros Makassar - Parepare Km. 83, Mandalle, Pangkep, Kabupaten Pangkajene Dan Kepulauan, Sulawesi Selatan 90761
Number of teachers/lecturers	36 teachers	32 lecturers Aquaculture study program: 12 lecturers	Aquaculture study program: 28 lecturers
Number of students	Male students: 310 Female students: 114	321 students (data disaggregated by gender not available)	Aquaculture study program: 82 male and 82 female students
Proportion of graduates working in relevant businesses or industries	<20 percent in seaweed-related fields	Approximately 70 percent in the marine and fisheries field, but none working in the seaweed processing industry	N/A
Proportion of graduates working in non-relevant businesses or industries	N/A	Approximately 30 percent	N/A
Facilities for practical sessions/activities related to seaweed processing	Fisheries processing laboratory	Teaching factory; teaching farm	Water quality laboratory, biology laboratory, ring culture laboratory, marine hatchery

*Data based on interviews.



Figure 2: Sun-drying seaweed at a processing company in Palopo. Image credit: Funtiy Septiyawati and PAIR.

3.0 ANALYSIS AND RESULTS

The following section provides information on three institutions in South Sulawesi that offered VET programs related to seaweed processing. The VET providers that were included in this study are: vocational high school SMKN 9 in Makassar, Bone Marine and Fisheries Polytechnic and Pangkep Agricultural Polytechnic. Table 2 provides additional details on these institutions.

State Vocational High School No. 9 (SMKN 9)

The SMK fisheries curriculum typically consists of three-year programs in aquaculture, fisheries processing and fisheries utilisation. During the first and second years, students must take general subjects, with specialised subjects being offered in their third year. In 2022, the Ministry of Education, Culture, Research and Higher Education mandated a new curriculum called Merdeka Belajar for all higher secondary schools (SMK/SMA). This new curriculum was introduced for students in class 10, while classes 11 and 12 continued to use the 2013 curriculum. Since this study focused on specialised subjects taught in class 12, SMKN 9 was still using the 2013 curriculum (as shown in Table 3).

State Vocational High School No. 9 (SMKN 9) is in the Biringkanaya district of Makassar City and has received B accreditation for the 2022/2023 school year. Based on the collected data, the school had 37 teachers, 308 male and 115 female students, 16 classrooms, one library and one laboratory (Directorate of Vocational Secondary Schools, 2022; Ministry of Education, Culture, Research, and Technology; 2022). SMKN 9 only offers one subject related to seaweed processing, which is the production of processed seaweed and fishery by-catch products

Table 3. Curriculum of the fisheries vocational high school (SMKN 9)

Subject	Class and semester					
	X		XI		XII	
	1	2	1	2	1	2
Group A (Compulsory)						
1 Religion and good behaviour	3	3	3	3	3	3
2 Pancasila and civic education	2	2	2	2	2	2
3 Indonesian language	4	4	4	4	4	4
4 Mathematics	4	4	4	4	4	4
5 Indonesian history	2	2	2	2	2	2
6 English language	2	2	2	2	2	2
Group B (Selective)						
7 Arts and culture	2	2	2	2	2	2
8 Handicrafts and entrepreneurship	2	2	2	2	2	2
9 Physical education, sports and health	3	3	3	3	3	3
Group C (Elective)						
C1. Basic Science Subjects						
10 Physics		2	2	2	-	-
11 Chemistry	2	2	2	2	-	-
12 Biology	2	2	2	2	-	-
C2. Basic skills program	18	18	-	-	-	-
C3. Specific skills package	-	-	18	18	24	24
Total	48	48	48	48	48	48

(produksi olahan rumput laut dan hasil samping perikanan). The school does not offer any other study programs or subjects related to seaweed processing.

The previously mentioned subject specifically focuses on the production of processed products from seaweed and fishery by-catch or by-products. This subject has a total of 280 learning hours per year, each being 45 minutes long (jam pelajaran). Of these hours, 30 percent is allocated for theoretical lessons while the remaining 70 percent is dedicated to practical sessions. Ten topics are included in this subject (as shown in Table 4), with three topics focused on seaweed processing (topics 1, 2 and 4). While two other topics do not have a direct focus on seaweed processing, they can still be useful for students who want to work in seaweed-related industries (topic 3 on marketing skills and topic five on bookkeeping and administrative skills). This suggests a need to increase the amount of subject matter related to seaweed processing.

The head of SMKN 9 has stated that highly skilled workers are unnecessary in the seaweed processing industry as the sector does not require employees to possess a high level of competency. He also said the industry perceives its production scale to be limited and relatively small, which means highly skilled workers are not needed. The current seaweed industry also does not produce high-value-added products such as processed and ready-to-use products. For example, Batimuring Indah in South Sulawesi only produces half-dried seaweed that requires further processing, while in Java, most seaweed processing industries are capable of producing jelly and ready-to-eat products from seaweed.

This study learned that students tend to show less interest in choosing a fisheries program. They often have a preference for other study programs which results in fisheries programs being their last option for study.

This is a statement by the school principal:

“...if seaweed production is only done in this way, it doesn’t require a high level of schooling because there is no need for any complicated activities, and the price will just be the same, anyway; on the other hand, students also see that there are no other creative aspects that need to be learned regarding seaweed production, because it’s just done by the seashore, it is not difficult. In addition, students nowadays consider fisheries as the umpteenth choice; fisheries majors do not appeal much to students.”

Another challenge in delivering subjects related to seaweed processing is the limited facilities and equipment owned by the school to support practical sessions for students.

A teacher who specialised in the fisheries subject revealed:

“...here we don’t really teach students much about seaweed cultivation because there (at the seaweed warehouse) they don’t look for specific skills needed to be able to do the work because it is still only raw materials that are being produced, so there are very few lessons related to seaweed. At most, what is taught is only an introduction, such as the types of seaweed and how to cultivate them in the sea; but we do not yet go as far as processing, such as making carrageenan powder, especially as the school does not have anywhere for practical sessions on the processing involved.”

One of the subjects taught from grades 10 to grade 12 is handicrafts and entrepreneurship (see Table 3, Subject 8). If this were linked to the subject of seaweed processing, students could develop their entrepreneurship potential and apply it to seaweed-based products.

Bone Regency Marine and Fisheries Polytechnic (Politeknik Kelautan dan Perikanan/Poltek KP Bone)

The Bone Regency Marine and Fisheries Polytechnic (Poltek Bone) opened in September 2016, managed by the Ministry of Marine Affairs and Fisheries. It has 32 academic staff and 321 students. In 2022, the polytechnic achieved a ‘very good’ or ‘baik sekali’ accreditation grade. Poltek Bone offers three study programs: fishing technology (teknik penangkapan ikan), aquaculture (teknik budidaya ikan) and marine engineering (teknik kelautan). The polytechnic allocates 55 percent of their intake to students from families engaged in fishing, aquaculture or sea salt production. The remaining 45 percent of places are open to the general public. In 2022, the polytechnic produced 333 graduates, with 70 percent of them currently employed in relevant industries (Politeknik Kelautan dan Perikanan Bone, 2022)

There is no specific study program offered for seaweed processing, although there is a course subject

Table 4. Basic competencies for the subject: Production of processed seaweed and fishery by-catch products

Basic Competency (Theory)	Basic Competency (Practical)
3.1 Learn the basic principles and processing flow of seaweed products	4.1 Apply the basic principles and processing flow of seaweed products
3.2 Learn about the packaging of processed seaweed products	4.2 Apply the packaging of processed seaweed products
3.3 Learn marketing techniques for seaweed products	4.3 Apply marketing techniques for seaweed products
3.4 Study the formulations required for the processing of seaweed	4.4 Evaluate the formulations required for the processing of seaweed
3.5 Study bookkeeping and the administration of processed seaweed product production	4.5 Apply bookkeeping and the administration of processed seaweed product production
3.6 Learn the basic principles and flow of fishery by-product/by-catch processing	4.6 Apply the basic principles and flow of fishery by-product/by-catch processing
3.7 Learn about the packaging of fishery by-product/by-catch products	4.7 Apply the packaging of fishery by-product/by-catch products
3.8 Learn marketing techniques for fishery by-product/by-catch products	4.8 Apply marketing techniques for fishery by-product/by-catch products
3.9 Study the formulations required for the processing of fishery by-product/by-catch	4.9 Evaluate the formulations required for the processing of fishery by-product/by-catch
3.10 Study bookkeeping and the administration of processed fishery by-product/by-catch products	4.10 Apply bookkeeping and the administration of processed fishery by-product/by-catch products

Note. Seaweed processing topics in bold. This subject requires 280 learning hours (with 45 minutes per learning hour) to complete. There were different perceptions of the skills needed between the SMKN 9 and industry.



on handling aquaculture produce (penanganan hasil budidaya perikanan). This subject is taught in 16 lessons, with seaweed post-harvest processing included in the subject and addressed in three lessons (as shown in Table 5, point 4 on seaweed handling and packaging).

The lecturer teaching aquaculture-related subjects made the argument that students were showing little interest in seaweed-related study topics. The reason for this lack of interest, according to the lecturer, was that most of the students came from families who were involved in seaweed farming and had already gained experience in seaweed cultivation by assisting their parents. As a result, these students were more interested in learning about non-seaweed-related subjects. This was the point expressed by the lecturer.

“Most students here are children of fishermen who specialise in seaweed, so they don’t gain any new experience. Because they’ve already worked in this sector before coming here to study.”

The Bone polytechnic offered a one-hectare area of coastal water for students to practise seaweed cultivation techniques. However, the campus lacked facilities for seaweed processing and the course materials related to seaweed processing were limited. As a result, the polytechnic could only provide limited facilities for practical sessions related to seaweed processing. This means that students who graduate from Bone polytechnic will have skills in seaweed cultivation, but not in seaweed processing.

Another lecturer said that students are required to allocate 30 percent of their time to learning relevant theory and 70 percent of their time to practical sessions. The goal is for students to become prepared to work as aquaculture technicians or entrepreneurs who can start their own fishery-related businesses, rather than solely seeking employment in the seaweed processing industry.

Pangkep Regency Agriculture Polytechnic (Politeknik Pertanian Negeri Pangkajene Kepulauan/ Polipangkep)

The Pangkep polytechnic is located at Pangkajene dan Kepulauan Regency and has a total of 28 lecturers and 164 students. The polytechnic offers a study program on the processing and storage of fisheries products (pengolahan dan penyimpanan hasil perikanan), which includes a specific and compulsory course subject on seaweed processing (teknik pengolahan rumput laut) during the second year. This subject covers a range of topics related to seaweed processing technology, including the chemical composition and types of seaweed, as well as the processing of agarose, carrageenan and alginate. Further, the course also covers the diversification of seaweed products.

The Pangkep polytechnic, like the Bone polytechnic, allocates 30 percent of student learning time to relevant theory and 70 percent to practical components. According to a lecturer, around 40 to 50

Table 5. Subjects related to seaweed processing offered by the Bone Polytechnic

Course subject	:	Handling Aquaculture Produce
Code/Weighting/Semester	:	TBP 2.27.4.3/3 SKS (1-2)/IV
Learning achievement	:	Able to handle aquaculture produce properly and correctly in accordance with applicable regulations.

No	Competency	Sub-Competency / Main Topic	Lesson No.
1.	Basic principles of handling aquaculture produce (fish, crustaceans, molluscs, aquatic plants)	1.1 Principles of handling aquaculture produce	1
		1.2 Technological developments in handling aquaculture produce	2
		1.3 Benefits of handling aquaculture produce	3
2.	Aquaculture produce product quality	2.1 Characteristics of products from aquaculture produce (nutritional value, physical conditions, chemical properties of fresh/wet fish)	4-5
		2.2 Factors causing a reduction on the quality of aquaculture produce	6-7
	Mid-Semester Examination		8
3.	Aquaculture produce handling techniques (fish, crustaceans, molluscs)	3.1 Handling and packaging of live fish (broodstock, seeds, and food fish)	9
		3.2 Handling and packaging of fresh fish	10
		3.3 Wet and dry methods	11
		3.4 Anaesthesia and transport techniques	12
4.	Seaweed (algae) handling and packaging techniques	4.1 Cleaning techniques	13
		4.2 Drying techniques	14
		4.3 Packaging techniques and transportation	15
	End of Semester Examination		16



students graduate from the program each year. However, only a small proportion of graduates, about five percent, go on to work in the seaweed processing industry. The majority of graduates opt to work in fish cold storage plants as there are more companies and job opportunities available in this field.

A summary of the interviews with teaching staff at the three VET providers (SMKN 9 in Makassar, Bone and Pangkep polytechnics) is provided in Table 7.

Table 6. Course subjects related to seaweed processing at the Pangkep Polytechnic that are taught in semester 4

Course subject	Study topics/modules
Seaweed processing	Scope of seaweed processing technology Types of seaweed and their chemical composition Agar-agar processing Carrageenan processing Alginate processing Seaweed product diversification

Table 7. Summary of interviews with VET providers

	Vocational high school SMKN 9	Bone Polytechnic	Pangkep Polytechnic
What programs/courses/subjects related to seaweed processing are offered to students?	Area of expertise: Maritime. Study program: Fisheries post-harvest processing. Specific competency: Fisheries processing agribusiness Subject 1: Basics of handling and processing fisheries produce. Subject 2: Production of seaweed and fisheries by-catch processed products.	Course subject 1: Aquaculture processing techniques. Main topic: Seaweed handling and packaging Course subject 2: Breeding /seedling production Course subject 3: Grow-out technology Course subject 4: Fishery Business Management	Course subjects: seaweed seedling production, seaweed growing/cultivation and industrial internships for students. Main topics: seaweed production from seedlings to grow-out and prospects for seaweed in the industrial world
How are subjects/courses related to seaweed processing taught to students?	Lessons related to seaweed are taught as one of the local content subjects due to the location of the school, which is located in a coastal area. Subjects are only taught to students majoring in Processing of Fishery Produce Agribusiness (APHPi)	Course components related to seaweed are taught in the Cultivation/Aquaculture course. There are no special courses on seaweed	The course components are taught to students of the aquaculture technology study program.
What learning methods are used in this program?	Current learning methods: lectures and practical sessions. Output: an exhibition of student work was held	Courses are taught in a block system. The first and second months focus on theoretical learning, and the third month on applied/practical learning	Student-centred learning methods. Lessons on theory, independent learning, and practical sessions.
What learning outcomes are expected after graduation?	Students should have seaweed processing skills and can introduce processed seaweed products to the public. Students are expected to become entrepreneurs.	Students are active and skilled in fisheries management and practice. Students are expected to work in fishing companies and/or become entrepreneurs.	Students are more competent in terms of their perception and utilisation of seaweed.
What type of approach is used in assessing student competence and learning outcomes?	Written examination, interviews (oral examination) and practical examinations/tests	Mid-semester and end-of-semester examinations, and final assignment examination for final semester students. The examinations consist of written, practical and competency components.	Examination which comprise written, practical and competency exams.
Do you offer internship opportunities for students?	Nothing has been put into practice yet, but there are plans to collaborate with companies that offer apprenticeship programs	There is a fieldwork internship program, but not specifically for subjects related to seaweed.	There are apprenticeship programs run by government agencies and industry
What do seaweed processing companies think of your vocational high school (SMK)/polytechnic graduates?	There has been no specific opinions expressed by companies regarding SMKN 9 graduates, but one company has offered to recruit alumni to work for the company.	Opinions have been varied. Some companies feel that we help in terms of recruiting workers and are quite satisfied with the abilities of students and alumni. There are also some companies that consider the alumni and students are lacking certain skills, and their abilities need to be improved.	Several companies consider that the alumni and student interns perform quite well.

Skills needed by the seaweed processing industry in South Sulawesi

Background information on the seaweed processing industries that took part in this research is shown in Table 8.

After conducting interviews with owners/managers, supervisors and workers from the five seaweed processing companies mentioned earlier, several interesting findings emerged regarding the skills required in the seaweed processing industry. These included the following:

- the industry does not require workers with any special skills for processing seaweed
- larger seaweed processing companies require workers with Hazard Analysis Critical Control Point (HACCP) skills
- the majority of the seaweed processing industry has not yet implemented a quality control system for worker performance

A more detailed overview of the responses regarding the skills

required by the seaweed processing companies can be found below.

PT. Hasil Indo Sejahtera (HAS)

This company specialises in processing seaweed and transforms it into semi-raw materials starting from the raw material stage.

At PT HAS, managerial positions generally require a bachelor's degree in fisheries science. However, casual workers don't need any specific educational qualifications and most of them are primary or junior secondary graduates. Communication skills are particularly important for workers in the production section as they need to give instructions to casual workers.

The warehouse manager at PT HAS clarified that they don't require specific skills for casual workers as the company provides necessary training before they start working. However supervisors must have a bachelor's degree in fisheries.

The company maintains a list of casual workers and contacts them when required. All workers receive

Hazard Analysis Critical Control Point (HACCP) training which is compulsory for all workers in food production companies under government regulations. This training imparts knowledge and skills related to food processing, including food safety and hazardous materials, and is facilitated by senior workers and company facilitators.

PT HAS doesn't have a formal system to evaluate the performance of its workers.

Kospermindo

In contrast to PT HAS, most workers in Kospermindo have either completed high school or obtained a bachelor degree. Kospermindo business is classified as a medium-scale industry with a focus on hospitality, where they sell home-made seaweed products. High school graduates are mostly employed as hospitality workers in cafes, whereas those with bachelor's degrees hold positions as cafe managers and supervisors. The director of Kospermindo said they recruit people who are competent and enthusiastic about

Table 8. Background information on seaweed processing industries

	PT HAS	Kospermindo	PT Sutrac	UD Masdin	PT Anugrah Agung Global
Location:	Head office: Blok. G Komp. Pergudangan Karunia Sulawesi, Jl. Ir. Sutami No.8, Parang Loe, Tamalanrea, Makassar City, South Sulawesi 90241 Warehouse: Jalan Sultan Hasanuddin, Jaya, Kec. Watang Sawitto, Kabupaten Pinrang, Sulawesi Selatan 91213	Jalan Kima 8 Kav. 3A1 Makassar, Sulawesi Selatan	Pergudangan Pattene 88 Cluster Green Park Blok C 18-26, Temmapadaue, Kec. Marusu, Kabupaten Maros, Sulawesi Selatan 90552	Jalan Ratulangi, Palopo, Sulawesi Selatan	Jalan Bakau, Palopo, Sulawesi Selatan
Activities related to seaweed processing	The company buys semi-dry raw materials seaweed (<i>Eucheuma cottonii</i> and <i>Eucheuma spinosum</i>) from farmers. The company then carries out the washing and drying processes; they press and wrap the dried seaweed into bulk packages. They sell these packages to the seaweed industry in Java.	The company cleans <i>Gracilaria</i> , <i>Eucheuma cottonii</i> and <i>Eucheuma spinosum</i> bought from seaweed collectors/middlemen in Bone. Further processing is carried out in Makassar.	When raw materials are received from collectors/middlemen, the quality of the seaweed is first checked, especially its water content. The seaweed is then dried, after which it is screened or sieved and cleaned to remove any dirt. The seaweed is then pressed and packed. It is then stuffed into sacks and further compacted/pressed.	<i>Gracilaria</i> is dried. It is then weighed, pressed and packaged.	<i>Gracilaria</i> is dried. It is then weighed, pressed and packaged.
Operated since	2019	1999	2015	2003	2016
Number of workers	30 people	9 people	30-40 people	30-40 people	30-40 people

creating homemade seaweed products such as crackers, cake and ice cream. He also added they prefer staff who are willing to work hard throughout the day and night.

To work in this industry, workers need basic skills related to the production of seaweed products, relevant knowledge, as well as cooking and culinary skills. The company offers free culinary training to its workers, facilitated by staff from the Ministry of Trade, the local government and academic staff from universities in South Sulawesi.

PT Sutracco

Sutraco's staff have a diverse range of educational backgrounds and levels. Managerial staff hold bachelor of fisheries degrees, administrative staff have bachelor degrees in economics, laboratory staff hold bachelor degrees in biology or chemistry, while other workers have graduated from primary, secondary or vocational secondary schools.

The company primarily requires workers to have the ability to operate processing machines, check seaweed quality and manage packaging. As explained by one of the Sutracco managers, the company doesn't require a high level of education for its workers as they only manage raw materials. When raw seaweed arrives, workers need to check for dryness and quality. If the seaweed is high quality, it is immediately pressed, packed and sold. Therefore, the company doesn't require staff to have certificates of competency in seaweed processing. If the company moves towards producing value-added products from seaweed in the future then they may need to recruit staff who specialise in seaweed processing.

Relevant work experience was the most important requirement for managers, administrative and laboratory staff at Sutracco. For workers, a willingness to work hard

and the ability to operate pressing machines with precision and accuracy were crucial.

In addition to these requirements, Sutracco staff are required to undergo laboratory testing training, facilitated by the Fish Quarantine, Fisheries Product Quality Control, and Safety Agency (BKIPM - Badan Karantina Ikan, Pengendalian Mutu dan Keamanan Hasil Perikanan). Sutracco has a quality assurance system in place to assess the performance of both its staff and workers and the company itself. Only those dealing with hazardous materials are required to follow the ISO standards.

UD Masdin

The majority of workers at PT Masdin are graduates of primary, secondary and vocational secondary schools. The company has around 30 to 40 employees with the majority working on a daily basis. This means that relevant data were only collected through interviews with the owner of UD Masdin.

Warehouse managers should possess the skills to assess the dryness level of seaweed material and supervise the pressing and packing processes. When asked about the training provided to workers to improve their skills, the owner of the company said "Currently, we don't provide formal training to our workers. We only give them some basic training when they start working in our company".

Regarding training and skills needs analysis, the owner responded that they don't require such training or a comprehensive assessment as their workers only need to dry and pack the seaweed.

PT Anugrah Agung Global

Most of the workers at PT Anugrah are graduates of primary, secondary, or vocational secondary schools and the company doesn't provide specialised training.

When asked about the company's training programs, the owner of PT Anugrah replied, "We only provide training for those who operate the pressing machinery and warehouse managers when they start working for our company".

The warehouse manager shared her experience of attending a training program facilitated by the provincial government but found it irrelevant. She stated that if she were offered the same training, she would not be interested in attending. The owner of the company regularly visits all sections, including production areas, seaweed drying areas and storage/warehousing, to assess worker performance by checking the end product. The company doesn't conduct any skill needs analysis and they only provide training to their workers once they start working in the company.

Table 9. Summary of interviews with seaweed processing companies

Interview questions	PT HAS	Kospermindo	PT Sutrac	UD Masdin	PT Anugrah Agung Global
What is the educational level of your workers?	Employees: Bachelor's degrees in marine and fisheries fields Workers: primary or lower secondary school graduates	Bachelor's degrees and high school (SMA) graduates	Employees: Bachelor's degrees in fisheries Administration staff: Bachelor's degrees in economics Laboratory staff: Bachelor's degrees in Biology, Chemistry Workers: primary to high school graduates	Workers: primary to high school graduates	Workers: primary to high school graduates
What skills are needed for each part of the production process?	No special skills are required other than communication. The company provides training.	Seaweed washing section: must know how to use the equipment. Seaweed processing section: skills to measure the composition of food.	Quality control and operational posts: work experience. Workers: Willingness to work, accuracy and good timing of the pressing process.	Workers: willingness to work Warehouse manager: needs to know how to measure the water content in seaweed and supervise the packing process.	Seaweed drying section: physical strength/endurance Other workers: willingness to work.
How does your company recruit workers?	Calls on the daily workers when they are needed.	Open recruitment, conduct interviews with prospective workers	Employees: advertise online. Workers: recruit daily workers	Recommendations from other workers, prospective workers apply to the company.	Recommendations from other workers, prospective workers apply to the company.
What training do workers in your company need?	<i>Hazard Analysis Critical Control Point</i> (HACCP) training.	Training in culinary skills, for example making noodles and donuts using seaweed	Training in seaweed sample analysis and testing	No special training needed.	No special training needed.
Where do you find facilitators for training workers in your company?	Internally, from among the senior workers and company facilitators.	From within the company, partners, the local government industry and co-operative agencies, and from universities.	The Agency for Fish Quarantine, Fisheries Product Quality Control and Safety (BKIPM)	There are none	Local government, facilitators from within the company.
How do you assess worker performance?	There is no assessment of worker quality yet. So far only the presence of daily workers has been assessed.	Assessments were conducted through interviews and direct assessments from senior/higher-up staff. Evaluation meetings by senior staff regarding the performance of their subordinates, cleanliness and compliance with Standard Operating Procedures.	Assessed based on the presence and daily performance	Assessed based on the work done and whether work targets are met.	Assessment of the work done, periodic visits by higher-up staff and evaluation of the quality of the seaweed produced.
Have you done an analysis of the training needed by your workers? If so, how did you carry out the training needs analysis?	Not in this company.	Yes. It has been done through observation, there is no training structure needed.	Never.	None.	Only done once, when workers are recruited.
Do you have a quality assurance system for worker performance in your company? If so, what system do you use?	There is none in this company	Not yet	Yes. But only for areas where Hazard Analysis Critical Control Point (HACCP) is needed to comply with International Organisation for Standardisation (ISO) standards.	There is none	There is none

Mapping the programs delivered by VET providers (i.e., SMK and polytechnics) against industry needs focusing on the required skills and competencies

There were only two courses related to seaweed processing available from the VET providers. The first course was called *Produksi olahan rumput laut dan hasil samping perikanan* (Production of processed products from seaweed and fisheries by-catch/by-products) and it was offered by SMKN 9 (as shown in Table 4). The second course was called *Teknik pengolahan rumput laut* (Seaweed processing technology) and it was offered by the Pangkep Agricultural Polytechnic (Table 6).

We conducted gap analyses for these two courses (refer to Tables 10, 11 and 12).

Table 10. Analysis comparing the material taught at SMKN9 in the 'Produksi olahan rumput laut dan hasil samping perikanan' course subjects to the skills needed by the seaweed processing industry

Basic competency	Practical component(s)	Needed by the industry	Analysis
Know the basic principles and workflow of processing seaweed products	Apply the basic principles and workflow of processing seaweed products	Yes	Basic seaweed processing skills are in widespread demand and needed by the industry.
Know about the packaging of processed seaweed products	Apply knowledge/skills in the packaging of processed seaweed products	Yes	Most companies we interviewed produce semi-raw seaweed products. Hence packaging seaweed as a raw material is a needed skill. There is a need for the VET providers at the secondary level [SMK] to teach students about seaweed harvesting/post-harvesting procedures (e.g. drying techniques) as these are the skills most needed in the industry to produce dry seaweed materials of high quality at the pre-processing stage. This would equip students with relevant knowledge and skills matched to the needs of the industry.
Knowledge and skills in seaweed marketing	Apply seaweed marketing knowledge and skills	Yes	Marketing skills are needed by one of the industries we interviewed, Kospemindo, as they sell value-added seaweed products. Students are able to produce seaweed products. They also gain specialised skills that are needed to educate their community as well as promote and sell new products.
Understanding formulas used in seaweed processing	Evaluating formulas used in seaweed processing	Yes	Students need to understand how to calculate the composition/ingredients used to transform seaweed into particular seaweed products. For example, the ingredients of cakes or noodles are made from seaweed. This particular skill is key to producing value-added seaweed products. Kospemindo was one of the companies in the study requiring this skill.
Bookkeeping and the administration of processed seaweed product production	Apply bookkeeping and the administration of processed seaweed product production	Yes	Students need to learn about the various administrative tasks, such as keeping accounts and bookkeeping, that are needed by seaweed production businesses (e.g. creating purchase orders, processing accounts payable and accounts receivable). These skills are required by small seaweed industries such as PT Masdin, Kospemindo and PT Anugrah Agung Global, where the current staff need to be able to perform a number of tasks due to the limited number of employees.

Table 11. Analysis comparing the material taught at the Pangkep polytechnic in the 'Teknik pengolahan rumput laut' course subjects to the skills needed by the seaweed processing industry

Module taught at Politani Pangkep	Content	Needed by the industry	Analysis
Scope of processing technology	Methods and techniques of seaweed processing	No	Interview participants from the industry suggested that methods and techniques of seaweed processing were not needed due to the scale and activities of their companies. They were mainly focused on processing raw materials rather than producing high-level/end products from seaweed.
Seaweeds	Characteristics of seaweed, especially the main species cultivated: <i>Gracilaria</i> sp., <i>Kappaphycus alvarezii</i> , <i>Euचेuma spinosum</i>	Yes	Workers need to have knowledge regarding the different varieties of seaweed, particularly for the three main species that are currently cultivated in South Sulawesi.
Seaweed types and chemical composition	Chemical composition of seaweed	Yes	Although the content focuses on theory and may not be practical, it is needed by industries that employ graduates with bachelor degrees in fisheries and marine science. We also suggest that this topic is important for students to understand at a basic knowledge level.
Agar processing	Agar processing	No	There is no agar processing activity by local companies. Although this could be an important skill for students, the knowledge may not be practical and cannot be used in the industry.
Carrageenan processing	Carrageenan processing	Yes/No	The companies we interviewed do not produce carrageenan products. We acknowledge that there might be a few companies in the area that produce semi-refined carrageenan.
Alginate processing	Alginate processing	No	There is no alginate processing activity by the local industry. Although this could be an important skill for students, the knowledge may not be practical and cannot be used in the industry.
Diversification of seaweed products	Seaweed product diversification	Yes	Interview participants from Kospemindo suggested that this skill is important. Graduates are able to produce seaweed value-added products, so they have options to be entrepreneurs and not rely heavily on the current seaweed industry companies.

Supporting documents and secondary data

To better understand the current state of the seaweed industry in South Sulawesi we present several references below as secondary data along with a brief analysis of their content.

Table 12. List of relevant references with the data source and brief analysis

Document	Source	Analysis
Competency-based training: Fish and seaweed processing program	Ministry of Manpower, Directorate General of Training and Productivity Development (Kementerian Ketenagakerjaan, Direktorat Jenderal Pembinaan Pelatihan dan Produktivitas, 2022)	The Indonesian Ministry of Manpower has published guidelines for competency-based training focused on producing seaweed-related products. Although the guidelines are useful, there is no training agency (BLK) in South Sulawesi that offers this training program. Some of our interview participants stated that there was a lack of interest from the community with respect to attending the training. People in the community prefer training that provides simple and practical skills which enable them to work, e.g. as tailors/dressmakers, heavy equipment operators, electricians, printing operators or hotel staff.
List of training provided by the provincial government of South Sulawesi	Makassar Vocational and Productivity Training Centre (Balai Besar Pelatihan Vokasi dan Produktivitas Makassar, 2019, 2022)	There is no training program provided to support the seaweed processing industry. Programs offered include automotive courses, courses in electronics, business and management, building and construction, dressmaking and tailoring, etc.
List of training provided by the provincial government of South Sulawesi	Makassar Industrial Education and Training Centre, Makassar City (Balai Pendidikan dan Pelatihan Industri Makassar, Kota Makassar, 2023)	There was a six-day training course on <i>Pembuatan aneka olahan berbasis rumput laut</i> (How to make various seaweed-based processed products) targeted at people seeking jobs.
Data on the extent of marine and brackish-water seaweed cultivation areas from the Ministry of Marine and Fisheries Affairs (Kementerian Kelautan dan Perikanan, Badan Riset dan Sumber Daya Manusia Kelautan dan Perikanan, 2020); Details and area of space allocated under the South Sulawesi Zoning Plan for Coastal Zone and Small Islands (<i>Rencana Zonasi Wilayah Pesisir dan Pulau-Pulau Kecil/RZWP3K</i>)	South Sulawesi provincial Marine and Fisheries Office (<i>Dinas Kelautan dan Perikanan</i>)	Information on the area allocated for seaweed cultivation is needed for planning and to be able to fulfil the demand for raw materials from the seaweed processing industry.
Research to support the seaweed processing industry	Provincial Research and Development Agency (<i>Badan Penelitian dan Pengembangan Daerah/ BAPPELITBANGDA</i>)	Over the period 2015-2021, just three out of 57 research projects funded by the provincial government were focused on seaweed. None of these projects was focused on seaweed processing.

4.0 FINDINGS AND RECOMMENDATIONS

After analysing the data we find that:

- The curriculum taught at vocational high schools and polytechnics fails to match the skills required by the seaweed processing industry. Some of the material being taught is irrelevant to seaweed processing.
- There is very little time devoted to relevant practical activities under the current curriculum.
- The low percentage of graduates from vocational schools and polytechnics who are employed in the seaweed processing industry supports these findings.
- VET providers' facilities for student practical sessions, particularly in the field of seaweed processing, are inadequate.
- The majority of the seaweed processing industry in South Sulawesi produces semi-raw materials. Although there are some companies, such as Kospermino, that produce value-added products, they remain on a small (home industry) scale.

Recommendations

Below are some recommendations to improve the current VET programs and support the development of the seaweed processing industry in South Sulawesi:

Develop a curriculum that includes seaweed processing as a specific subject taught during at least one semester in both vocational high schools (SMKs) and polytechnics.

To support the development of the seaweed processing industry, both vocational high schools (SMKs) and polytechnics should develop at least one course subject specifically on seaweed processing. The content of this subject should be aligned with the skills needed by the industry,

including the ability to produce more value-added products. Non-formal VET providers like BLK should provide practical-short term training courses to enable workers to become independent and develop their own small businesses, such as producing seaweed-based ice-cream/iced drinks or setting up companies producing seaweed-based products as self-employed entrepreneurs.

Improve the practical modules and materials for seaweed processing in both SMKs and polytechnics.

To improve students' practical skills in seaweed processing, it is necessary to enhance the practical modules within each course subject. For example, a three-credit unit course subject should have at least one unit allocated to practical sessions.

VET providers must consider the specific skills required by local industries that may change over time. Currently, the seaweed industry requires skills primarily focused on semi-raw materials. If the industry moves to a processing industry in the future more skills training will be required to ensure a workforce that can develop and sell value-added products. It is recommended that stakeholders collaborate to develop appropriate curriculum elements for both vocational high schools (SMKs) and polytechnics. These elements should be based on local industry needs and aligned with the regional long-term development plan (Rencana Pembangunan Jangka Menengah Daerah/RPJMD).

Enhance the technical competency of teaching staff involved in seaweed processing-related subjects.

It is crucial for teachers and lecturers of seaweed processing to have adequate technical competence. They currently acquire their skills through training courses provided by the Ministry of Marine

Affairs and Fisheries. To ensure their competency, teachers and lecturers are advised to take the technical competency tests organised by Indonesia's national body for professional certification (Badan Nasional Sertifikasi Profesi).

Improving the quality and competitiveness of human resources in vocational schools and polytechnics is a top priority. The marine and fisheries sector requires a skilled and readily-employable workforce, particularly graduates of vocational schools and polytechnics, to support the growth of the seaweed processing industry. The program should not only target educators but also have a positive impact on students by enhancing their competence.

Provide support to VET providers for seaweed processing facility development, including appropriate equipment and laboratory facilities.

There is a shortage of laboratory facilities for activities related to seaweed processing. Specifically, although Pangkep and Bone polytechnics have laboratories equipped for processing some fisheries products such as smoked fish, they lack the necessary equipment and facilities for seaweed processing. Vocational high schools (SMKs) also require appropriate facilities to enable students to practise their seaweed processing skills, such as creating market-ready processed seaweed products.

Align polytechnic student internships with the Merdeka Belajar Kampus Merdeka (MBKM) program to enable students to gain work experience in the seaweed processing industry.

Merdeka Belajar Kampus Merdeka is a program initiated by the Ministry of Education, Culture, Research and Higher Education (Kemendikbudristek) that permits students to study any subject at any campus for three months.

Students who participate in the MBKM scheme are required to complete a three-month work-experience period that counts as 20 SKS (credit units). The grades and credits obtained through this program will be converted into subject grades and credits in their respective study programs. Upon successful completion of the MBKM program, students will be awarded a certificate that will be appended to their degree or diploma.

These appended certificates demonstrate to employers that students have acquired soft skills in addition to the formal academic skills. Currently, students must obtain at least five certificates appended to their degree or diploma before they can graduate. The MBKM certificates can be obtained through various means, such as participating in scientific activities and internships and can be beneficial for students when applying for jobs.

We suggest that an MBKM program scheme for activities related to seaweed processing should be established, including work experience in seaweed industry companies in other provinces. Polytechnic students should select and participate in this scheme, which would offer them opportunities to observe and learn how seaweed can be processed to produce a variety of finished products. This will open up business and entrepreneurial possibilities for them, beyond simply becoming workers or employees in existing seaweed processing companies, after graduation.

Provide more funding for research on seaweed processing, specifically from the provincial research and development agency (Balitbangda), to focus on seaweed processing.

Our study discovered that researchers in South Sulawesi had conducted only three local

government research projects on seaweed over the past decade. These projects mainly focused on seaweed cultivation and the social aspects of seaweed farmers. None of them were related to seaweed processing. Therefore, we recommend that the provincial research and development agency (Balitbangda) should initiate more research projects that concentrate on seaweed processing.

Promote short term training programs by the Work Training Agency (BLK) aimed at fresh graduates (SMK and polytechnic levels) on processing seaweed to produce value-added products.

Although South Sulawesi has an abundance of seaweed as a raw material, the ability to process it is still limited. One approach to change this situation is to create specialised training on seaweed processing that focuses on producing value-added products. The training should specifically target graduates of fisheries vocational schools and fisheries and marine polytechnics, providing them with the essential skills

required to develop the seaweed processing sector.

The government is currently promoting pre-employment training programs for high school (SMA/SMK) and tertiary graduates who are not yet employed. Therefore, we strongly recommend that the Ministry of Manpower should incorporate seaweed processing training programs into the national pre-employment training program. Moreover, the South Sulawesi Manpower Office should prioritise this seaweed processing training scheme as it aligns with the needs of the region/province.

Overall

These recommendations aim to improve the quality and competitiveness of human resources in the marine and fisheries sector, particularly vocational school and polytechnic graduates. By doing so, the expansion of the South Sulawesi seaweed processing sector can be supported to its full potential.



Figure 3: Gathering information from people working in the seaweed industry. Image credit: Funtty Septiyawati and PAIR.

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