



Strategy for the Development of Seaweed Cultivation in Karawang Regency, West Java Province

M. F. A. Pratama^{1*}, A. Nurhayati¹, A. Rizal¹ and A. A. H. Suryana¹

¹*Faculty of Fisheries and Marine Science, Universitas Padjadjaran, West Java, Indonesia.*

Authors' contributions

This work was carried out in collaboration among all authors. Author MFAP designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors AN and AR managed the analyses of the study. Author AAHS managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJFAR/2021/v11i430209

Editor(s):

(1) Dr. Luis Enrique Ibarra Morales, State University of Sonora, Mexico.

Reviewers:

(1) Leonel Pereira, University of Coimbra, Portugal.

(2) Diana Medeiros Pacheco, University of Coimbra, Portugal.

(3) Silva Larson, Cook University, Australia.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/65426>

Received 15 December 2020

Accepted 11 February 2021

Published 02 March 2021

Original Research Article

ABSTRACT

Seaweed is one of the leading commodities in the marine sector which has a high selling value. However, this potential is currently not optimally utilized in Karawang Regency. Karawang Regency has a large enough potential for aquaculture ponds, has a pond area of 18,273.30 hectares, and only 1% is cultivated for seaweed. This research aims to formulate a seaweed cultivation business development strategy that has not developed optimally. The respondents in this research were all 60 seaweed cultivators in Karawang Regency. The data used were primary and secondary data. Primary data were obtained through an interview with seaweed cultivators and using the questionnaire. Secondary data were obtained from institutions/agencies related to research, such as the Karawang Regency Fisheries Service. The data analysis method used in this research is qualitative analysis. Qualitative analysis was used to determine a seaweed cultivation development strategy using a SWOT analysis. The results showed that the relative position of seaweed cultivation development based on the SWOT analysis is in the first quadrant which means the strategy used is a progressive or aggressive. The progressive strategy of developing seaweed cultivation can be carried out with strategies such as increasing production to meet the demand for seaweed,

*Corresponding author: Email: muhammad17253@mail.unpad.ac.id;

expanding the area for seaweed cultivation, empowering local communities about seaweed cultivation and diversifying processed seaweed products.

Keywords: Seaweed; development strategy; SWOT; cultivation.

1. INTRODUCTION

Seaweed is one of the main commodities of aquaculture with high economic value and wide market opportunities, both national and export-oriented [1]. It is not only economically valuable, but seaweed is also good for human health and nutrition. In Indonesia itself the use of seaweed for industry starts for the agar industry (*Gelidium* and *Gracilaria*) (Rhodophyta) then for the handicraft industry (*Eucheuma*) (Rhodophyta), and the alginate industry (*Sargassum*) (Ochrophyta, Phaeophyceae) [2]. Agar from the genus *Gelidium* can be used for pharmaceutical applications, while agar from the genus *Gracilaria* is used as a food industry ingredient [25]. One of the areas in West Java that has the potential to develop seaweed cultivation is the Karawang Regency for the cultivation of *Gracilaria* sp. [3].

Karawang Regency has a very large potential for fisheries and marine resources [4]. In the catchment fishery sector, Karawang Regency has a wide variety of fish potentials and has a fairly high economic value. This condition is supported by the length of the coast that it has that stretches to the north along 84.23 km [5]. The aquaculture sector of Karawang Regency has the potential for ponds around 18,275.00 ha, calm water ponds with an area of 1,088.80 ha, and Minna Padi around 9,241.23 ha, and fish cage 148 units [5]. The people of the north coast of Karawang are currently trying to develop seaweed. The Karawang Regency Government is optimizing the cultivation of seaweed in people's ponds on the north coast of Karawang. From the potential of 18,000 hectares of seaweed land, around 2,500 hectares can be used for seaweed ponds [5].

Karawang Regency has the potential for the development of *Gracilaria* sp cultivation, which is recorded at 18,870 ha and only 1,224 ha has been utilized [5]. This shows that seaweed cultivation has not developed well considering the area of Karawang Regency waters has large fishery resources. Constraints in the development of seaweed cultivation in the waters of Karawang Regency include the low level of knowledge and skills of the community regarding agricultural resource processing, especially seaweed farming [3].

Seaweed is one of the leading commodities in the marine and aquatic sector which has a high selling value [6]. However, this potential is currently not optimally utilized in Karawang Regency. Besides, large market opportunities are not matched by optimal seaweed production, so seaweed demand is often not fulfilled [7]. A development strategy is needed for seaweed cultivation so that seaweed production in the coming year will be better so that the income of seaweed cultivators can increase [8].

Business development strategy is a process of determining action that requires management decisions in developing a business in a better direction. Therefore, the nature of the business development strategy is future-oriented [9]. The development of a business is the responsibility of every entrepreneur or entrepreneur who needs foresight, motivation, and creativity [9]. If this can be done by every entrepreneur, there is the great hope of being able to make a business that was originally small to medium scale and even into a large business [9]. The business development strategy has the function of formulating and considering internal and external factors faced by an entrepreneur [10]. Strategy formulation is the development of a long-term plan for effective management of environmental opportunities and threats, considering the company's strengths and weaknesses. The formulated strategy is more specific depending on the functional activities of management [10]. Based on this description, it is necessary to conduct research aimed at developing a strategy for developing seaweed cultivation in Karawang Regency.

2. METHODOLOGY

This research was conducted from July to November 2020 in Karawang Regency in 2 sub-districts, namely Tirtajaya District and Cibuaya District. These two sub-districts are the center of seaweed cultivation activities, with details in Tirtajaya Subdistrict as many as 46 business units and in Cibuaya District 14 business units out of a total of 60 cultivation business units in Karawang Regency. Determination of the research location is done purposively with the consideration that the area is one of the seaweeds cultivation centers in Karawang Regency.

The population in this study amounted to 60 seaweed cultivators. According to [11], if the research subject is less than 100 units (people), it is better if all of them are taken as research respondents. Referring to the opinion [11], the respondents in this study were all seaweed cultivators in Karawang Regency.

The types of data used are primary data and secondary data. Primary data obtained through interview techniques with seaweed cultivators and using a questionnaire. Secondary data were obtained from institutions/agencies related to research, such as the Karawang Regency Fisheries Service.

The data analysis method used in this research is qualitative analysis. Qualitative analysis was used to determine a seaweed cultivation development strategy using a SWOT analysis. SWOT analysis is used to obtain a basic view of the strategies needed to achieve a certain goal, in this case, an assessment of what efforts can be used as alternative solutions in strategy management and development [12].

3. RESULTS AND DISCUSSION

3.1 The Condition of Seaweed Cultivation in Karawang Regency

Karawang has a large enough potential for aquaculture ponds, has a pond area of 18,273.30 hectares, which is used for milkfish cultivation land and only 1% is cultivated seaweed. A long coast reaching 84,23 km, then the potential for this fishery activity is very large to be developed sustainably [5]. The pond cultivation area in Tirtajaya and Cibuaya Districts is a pond that has brackish water content, the source of which comes from a mixture of fresh water and saltwater from the sea. Most of the pond area is used for the cultivation of milkfish ponds by monoculture and only a small portion of the pond area has been used for the cultivation of polyculture ponds for milkfish and seaweed *Gracilaria* [5].

The pond area in Karawang Regency consists of the ponds owned by Forestry and the ponds. The majority of these owned pond areas are used as an area for the cultivation of milkfish ponds in a monoculture manner, while only a small portion has been used as a poly-culture pond business area [7]. With a pond area of 190 hectares, polyculture cultivation has the potential to be developed more optimally in Karawang Regency. The results of the interview indicated that the low

utilization of the pond area for polyculture cultivation was due to the influence of local culture and the mindset of farmers. Farmers think that the most suitable pond business for them to do is milkfish. The new aquaculture system being implemented is considered quite difficult to develop even though it has a higher potential in terms of income.

The poly-culture pond that has developed in the research location is the polyculture of milkfish and seaweed. Polyculture pond cultivation is a system of cultivating two or more types of commodities/species in the same pond area [13]. This is done because the two commodities have high economic value, so that polyculture cultivation can increase the production output per unit of pond area and the income of these farmers. The harvest period for milkfish commodity is once every 6 months and *Gracilaria* seaweed commodity can be harvested every 2 months. Polyculture cultivated seaweed is a type of *Gracilaria*. This type of seaweed has characteristics that are most suitable for cultivation in pond areas compared to other types of seaweed and can help create natural food for milkfish [14].

Based on observations, the implementation of polyculture pond cultivation consists of the process of sowing seeds, controlling and routine management, harvesting until reaching the post-harvest process. Routine control and management that is carried out include the activity of leveling seaweed which collects in a place in the pond due to being carried by the wind and eliminating disturbing organisms, water replacement activities, and fertilizing activities. During the harvest period, the activities carried out include harvesting milkfish using nets and harvesting seaweed *Gracilaria* which is suitable for harvesting using rubber carpet harvesting tools. Post-harvest process, milkfish that has been harvested from the ponds are sorted before being sold to the market, while seaweed *Gracilaria* that has been harvested needs to go through the drying process first. This was done to achieve the level of dryness of the seaweed *Gracilaria* as required by the Mina Agar Makmur Cooperative. After that, the dried seaweed can be packed in a sack and sold through the cooperative.

The method of cultivating seaweed in Karawang Regency uses the sowing method. According to Decree of The Minister Of Marine And Fishery of The Republic of Indonesia Number 1 of 2019, the

method of sowing is a way to cultivate seaweed in ponds or in ponds with the following conditions

- a) location of ponds close to the coast and freshwater sources to reduce water salinity;
- b) a minimum tidal difference of 30 (thirty) cm so as to facilitate water circulation in the ponds;
- c) bottom muddy sand waters;
- d) annual fluctuations in water quality, as stated in Table 1.

3.2 Characteristics of Seaweed Cultivators in Karawang Regency

This research was conducted in Karawang Regency, precisely on the coast or north coast area. There were 60 respondents or seaweed cultivators in Karawang Regency. As many as 46 respondents carried out seaweed cultivation activities in Tirtajaya District and 14 respondents in Cibuaya District. This happens because the area of land for seaweed cultivation is indeed wider in Tirtajaya Subdistrict than in Cibuaya District, and farmers prefer to carry out seaweed cultivation activities adjacent to the Mina Agar Makmur Cooperative to make it easier in terms of sales.

Male respondents were 56 people with a percentage of 93.3% and female respondents were 4 people with a presentation of 6.67%. This is because we interviewed head of household and only 4 households were headed by women, as they had to replace their husbands who were sick or died.

The characteristics of seaweed cultivators in Karawang Regency have an age ranging from 25-70 years. As many as 60 respondents with an average age of 44.3 years, 66.7% were aged 15-50 years. This means that most respondents are of productive age [15].

There are 3 people or 5% of the respondents who did not complete elementary school (ES). Generally, the level of formal education of the respondents in the study area was completed (SHS) / equivalent, namely 50%. The primary (ES) and junior secondary (JHS) levels

respectively were 11.7% and 25% and respondents who were able and graduated in college were 8.33%. People who have higher education are more able to take advantage of the technology used by society and education is part of human capital which plays a role in increasing one's productivity [16].

3.3 Strategy for the Development of Seaweed Cultivation in Karawang Regency

The strategy for developing seaweed farming in Karawang Regency is obtained from internal and external factors. The first step taken is capturing information and identifying external (opportunities and threats) and internal (strengths and weaknesses) factors related to this seaweed cultivation by conducting discussions and interviews using questionnaires to the perpetrators or an expert. From this analysis, several alternative strategies were obtained including the SO strategy, the WO strategy, the ST strategy, and the WT strategy. Several alternative strategies that can be used by seaweed cultivators in Karawang Regency can be seen in Table 1.

In facing competition, a business unit must recognize its environment, both internal and external. The internal environment is the state of the business unit itself, such as the advantages and disadvantages of the business [17]. Meanwhile, the external environment is the condition around the business unit such as competitors, conditions, economy, government, and others that can affect the business unit [18]. Therefore, a SWOT analysis is required which consists of Strength, Weakness, Opportunity, and Threat. Based on the results of data collection and analysis on seaweed cultivation in Karawang Regency, a SWOT analysis can be compiled as follows.

IFE matrix analyzes internal factors strategy that consists of strength (strength) and weakness (weakness) [17]. The IFE matrix is used to determine the weight, rating, and score of each variable of internal strengths and weaknesses of seaweed cultivation in Karawang Regency using

Table 1. Fluctuation of Water Quality in Ponds

Parameter	Unit	Range
Temperature	°C	25-28
Salinity	g/L	15-30
pH	-	6,5-9,0
Clarity	cm	50-70

data obtained from questionnaires that have been filled in by seaweed cultivators in Karawang Regency. The IFE matrix for seaweed cultivation in Karawang Regency consists of eight internal factors. IFE matrix analysis for seaweed cultivation in Karawang Regency can be seen in Table 2.

Based on Table 2, it is known that among the factors of internal strategy, the greatest strength factor is the product quality factor with a score of 0.68. This shows that good quality seaweed products in Karawang Regency are indeed true, and also shows that the quality of seaweed products is the main factor that can have a positive influence on the development of seaweed cultivation in Karawang Regency. Therefore, the quality of seaweed in Karawang Regency needs to be maintained to remain an advantage for seaweed cultivators in Karawang Regency. The biggest weakness factor is seaweed production which has not been maximized with a score of 0.36. This shows that seaweed production that has not been maximized is a very influencing factor, this is due to limited capital, seeds, and a lack of instructors related to technology for seaweed cultivation, and poor financial management. This weakness needs to be overcome with the assistance of providing capital and counseling by experts from the government. EFE matrix analysis for seaweed cultivation in Karawang Regency can be seen in the Table 3.

Based on the EFE matrix table, it is known that external strategic factors, the greatest opportunity factor is the existence of a supporting cooperative with a score of 0.68, which means that seaweed cultivation in Karawang Regency has an institution that can empower local communities and build resource-based rural industries local (seaweed). The existence of this cooperative is also very helpful for farmers to sell their harvest seaweed to a wider market. The biggest threat factors for seaweed cultivation in Karawang Regency are climate change and weather with a score of 0.24. This shows that climate change and weather greatly affect the production of seaweed in Karawang Regency which is at risk of experiencing failure in harvesting. Climate and weather affect decreasing salinity in seaweed aquaculture ponds [19].

The strategy matrix aims to determine the position of business activity through the values obtained from the IFE and EFE analysis. Through this position, it will be known where the business position and the strategies that must be taken to overcome the obstacles experienced [20].

The strategy matrix analysis was carried out by calculating the scores on the EFE (External Factor Evaluation) matrix tables and IFE (Internal Factor Evaluation) for seaweed cultivation in Karawang Regency. From the results of the IFE and EFE matrix analysis, the first step in determining the position of the cultivation business is carried out by calculating the total strength score and the total weakness score on internal factors, as well as calculating the opportunity and threat scores on external factors.

Based on the total score of internal and external factors of seaweed cultivation in Karawang Regency, a diagram can be made, namely by finding the intersection point of the X-axis and Y-axis by calculating the difference between the values of internal and external factors. The intersection point of the X-axis (W-S axis) is obtained from the difference between the total strength and weakness factors, namely 1.42, and the intersection point of the Y-axis (O-T axis) is obtained from the difference between the total opportunity and threat factors, namely 1.39. The internal and external matrix diagrams can be seen in Fig. 1.

Based on the results of the strategy matrix graph on seaweed cultivation in Karawang Regency, it is known that the position of seaweed cultivation is in quadrant I which supports aggressive strategies. This position indicates an advantageous position, that the business is facing a large market opportunity and the business has several advantages or strengths. The focus of this strategy is to use strength to get or seize bigger market opportunities [18].

The strategy that can be applied to the cultivation of seaweed in Karawang Regency is the SO strategy. SO strategies that can be carried out are increasing production to meet the demand for seaweed, expanding the area for seaweed cultivation, empowering local communities about seaweed cultivation, and diversifying processed seaweed products in Karawang Regency.

Table 2. Seaweed Cultivation Business Development Strategy in Karawang Regency

Internal Factors	Strength(S)	Weakness(W)
	<ol style="list-style-type: none"> 1. Extensive cultivation land 2. The workers available 3. Good quality yields 4. Cheap and simple cultivation technology 	<ol style="list-style-type: none"> 1. Availability of seeds 2. Limited capital 3. The development of science and technology is difficult to follow 4. The production has not been maximized
External Factors	SO Strategy	WO Strategy
Opportunities(O) <ol style="list-style-type: none"> 1. High demand for seaweed 2. The existence of a cooperative that supports 3. Export market potential 4. Regional government superior commodities 	<ol style="list-style-type: none"> 1. Increase production to meet the demand for seaweed 2. Expanding seaweed cultivation area 3. Empowerment of local communities regarding seaweed cultivation 4. Diversification of processed seaweed products 	<ol style="list-style-type: none"> 1. Increase the source of business capital 2. Build a seed garden. 3. Increasing cooperation with stakeholders to increase the continuity of seeds and production 4. Optimizing the role of the extension agent
Threats(T)	ST Strategy	WT Strategy
<ol style="list-style-type: none"> 1. Tides of seawater 2. Pests and weeds attack 3. Climate change and weather 4. Competitors from other regions 	<ol style="list-style-type: none"> 1. Increase production to be able to expand the seaweed marketing network 2. Apply the pattern/planting season schedule 	<ol style="list-style-type: none"> 1. Improve the facilities and infrastructure to support seaweed cultivation activities. 2. Increased access to capital 3. Optimizing the role of extension agents

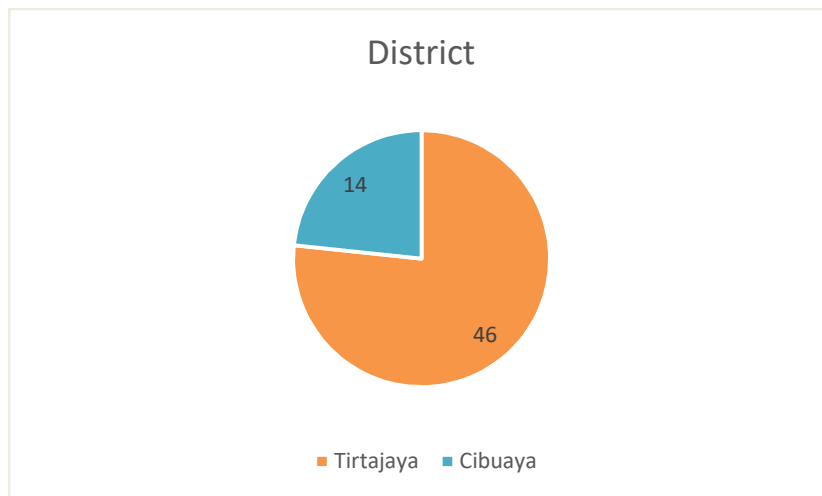


Fig. 1. Respondent's district

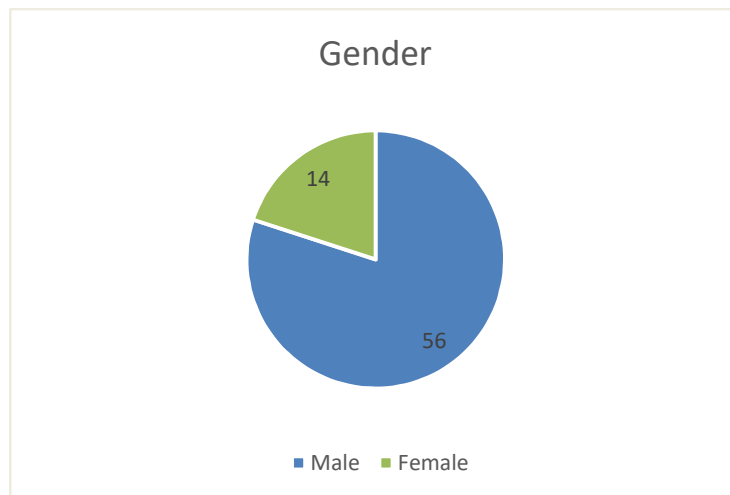


Fig. 2. Respondent's gender

Table 3. Matrix analysis of IFE (Internal Factor Evaluation)

	Rating	Weight	Score
Strength			
Potential of cultivated land which is still wide	4	0.16	0.64
The workers available	3	0.15	0.45
Good quality yields	4	0.17	0.68
Cheap and simple cultivation technology	3	0.15	0.45
			2.22
Weakness			
Availability of seeds	1	0.06	0.06
Capital limitations	2	0.11	0.22
The development of science and technology that is difficult to follow	2	0.08	0.16
The production has not been maximized.	3	0.12	0.36
			0.80
Total		1.00	3.02

Seaweed is Indonesia's leading commodity. The marketing of seaweed is quite widespread, not only for domestic markets but also for foreign markets (exports). In 2019, the export value of Indonesian seaweed reached the US \$ 324.84 million or grew by 11.31% compared to 2018 which amounted to US \$ 291 83 million. In the period 2014-2019, the average national seaweed export was also recorded to have grown by 6.5% per year [21]. The increasing world demand is a great opportunity for Indonesia, especially for Karawang Regency, to maximize the potential for seaweed production, both as raw material and as a processed product. This large demand should be able to motivate cultivators to be even more productive.

Seaweed cultivation in Karawang Regency is a profitable business for the Karawang community, especially in Tirtajaya and Cibuaya Districts. Karawang has a pond area of 18,273.30 hectares, which is used for milkfish cultivation and only 1% is cultivated seaweed [5]. The expansion of the cultivation area is needed so that the distribution of cultivation activities occurs in every coastal area of Karawang and can increase seaweed production and increase employment.

In addition to a large cultivation area, there are quite a lot of workers in the Karawang Regency. This, if used properly, can increase seaweed

production. Besides, community empowerment or training on the cultivation of seaweed also needs to be carried out by cooperatives and the local Fisheries Service so that many workers can cultivate and process seaweed properly.

Seaweed is beneficial for humans, namely as an antioxidant, antibacterial, anti-cholesterol, anti-inflammatory, and anti-diabetic [22]. The content of seaweed makes seaweed one of the food commodities that has the potential to become a variety of healthy food diversification. The lack of diversification of seaweed products in Indonesia is still a challenge for the seaweed sector to increase the economic value of seaweed. Seaweed product diversification is needed as an effort to increase seaweed demand [23]. Apart from providing added value to seaweed, the diversification of seaweed products can also create jobs and increase income [24].

Besides, there are still strengths and opportunities that confirm that the internal and external environment is indeed very supportive of cultivating seaweed. The problem is how serious and consistent the farmers are in the building and utilizing this potential by continuing to dedicate thoughts, knowledge, and others to try to increase the income and welfare of the cultivators, as well as making efforts to ensure food security through local resource-based development.

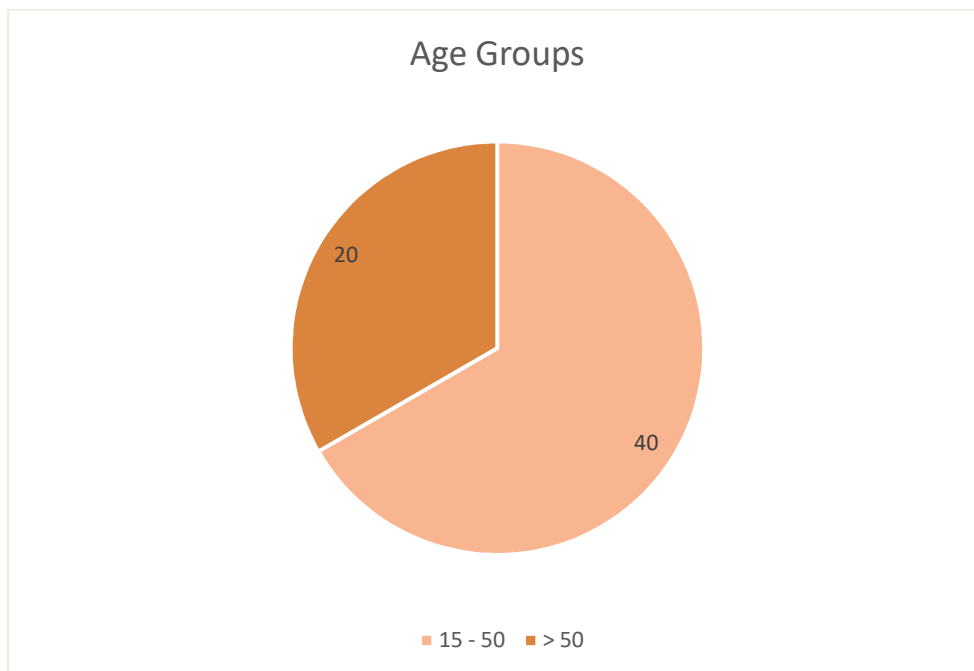


Fig. 3. Respondent's age groups

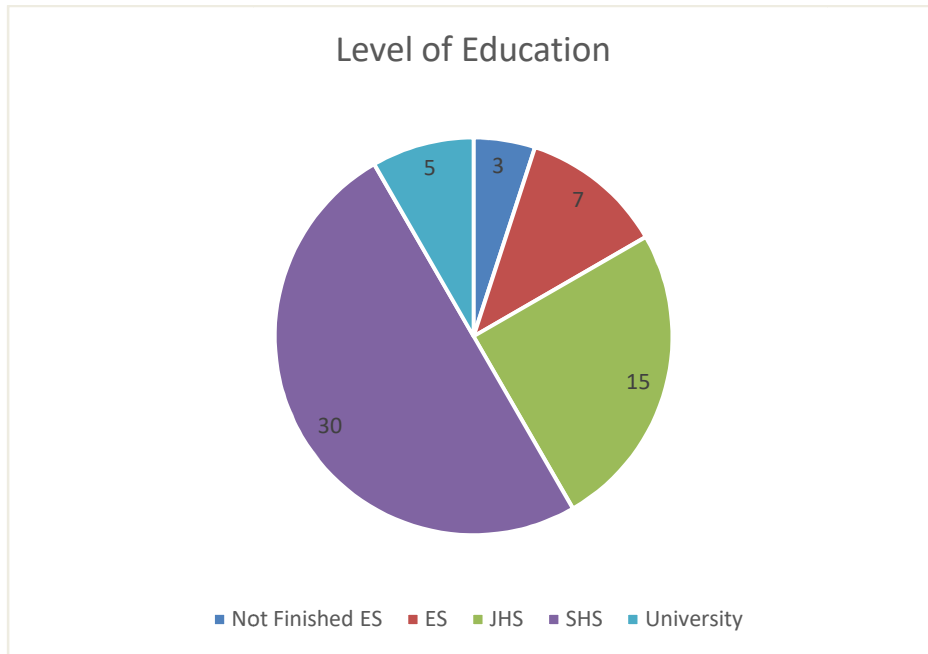


Fig. 4. Respondent's level of education



Fig. 5. Matrix of seaweed cultivation business strategy in Karawang regency

Table 4. Matrix analysis of EFE (External Factor Evaluation)

Opportunity	Rating	Weight	Score
High demand	3	0.15	0.45
The existence of cooperatives that support Export market potential	4	0.17	0.68
Prime government commodities	3	0.16	0.48
			2.06
Threat			
Tides of seawater	2	0.09	0.18
Pest and weed attack	2	0.09	0.18
Climate and weather changes	2	0.12	0.24
Competitors from other areas	1	0.07	0.07
			0.67
Total		1.00	2.73

Based on observations, several additional strategies can be able to answer problems of seaweed cultivation in Karawang Regency. First, conducting mutually beneficial cooperation with various parties, both private and university, in improving cultivation, processing, and marketing technology in improving the welfare of members (cultivators) and group partners. Second, providing education and health bailout services for cooperative members and cultivators. Third, increasing partnerships that have been well established, through family gatherings can forge closer cooperation between members and cultivators in general.

4. CONCLUSION

Based on the results of research and discussion, it can be concluded that the relative position of the development of seaweed cultivation based on the SWOT analysis is in the first quadrant, which means the strategy used is the progressive or aggressive strategy. The strategy for the progressive development of seaweed cultivation can be carried out by increasing production to meet the demand for seaweed, expanding the area for seaweed cultivation, empowering local communities about seaweed cultivation, and diversifying processed seaweed products.

CONSENT

As per international standard or university standard, Participants' written consent has been collected and preserved by the author(s).

ACKNOWLEDGEMENTS

Thanks are conveyed to the entrepreneurs of seaweed cultivation in Karawang Regency and

the FPIK UNPAD lecturers who have contributed to this research.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Maharany F, Nurjanah SR, Anwar E, Hidayat T. The content of bioactive compounds from *Padina australis* seaweed and *Euclima cottonii* as raw materials for sunscreen cream. *Journal of Indonesian Fisheries Product Processing*. 2017; 20(1):10-7.
2. Sahri A. Knowing the potential of seaweed: A study of the use of seaweed resources from industrial and health aspects. *Sultan Agung Scientific Magazine*. 2020;44(118): 95-116.
3. Waluyo W, Permadi A, Fanni NA, Soedrijanto A. quality analysis of *Gracilaria verrucosa* Seaweed in Tambak Karawang Regency, West Java. *Grouper*. 2019;10(1):32-41.
4. Nurmalia N. The productive role of coastal women in supporting fisheries business in Tempuran District, Karawang Regency. *Socio-Economic Journal of Marine and Fisheries*. 2019;13(2):229-37.
5. Karawang regency fisheries service. Profile of Fishery Potentials in Karawang Regency;2019.
6. Dolorosa MT, Nurjanah PS, Anwar E, Hidayat T. The content of bioactive compounds of *Sargassum plagyophyllum* and *Euclima cottonii* pulp as raw materials for skin lightening creams.

- Journal of Indonesian Fisheries Product Processing. 2017;20(3):633-44.
7. Aliah RS. Multi-Tropical integrated fisheries cultivation model show on the north coast of Karawang, West Java. *Journal of Environmental Technology*. 2012;13(1):47-58.
 8. Priono B. Cultivating seaweed to increase fisheries industrialization. *Aquaculture Media*. 2016;8(1):1-8.
 9. Anoraga P. Introduction to business: Business management in the age of globalization. Jakarta: Rineka Cipta; 2007.
 10. Hunger JD, Wheelen TL. Essentials of strategic management. New Jersey: Prentice Hall; 2003.
 11. Arikunto S. Research procedure a practice approach. Jakarta: Rineka Cipta; 2002.
 12. Salim MA, Siswanto AB. SWOT analysis using questionnaire method. Semarang: Archipelago Pillars; 2019.
 13. Reksono B, Hamdani H. Effect of the distribution density of *Gracilaria* sp. on the growth and survival of milkfish (*Chanos chanos*) in polyculture system culture. *Journal of Marine Fisheries*. 2012;3(3).
 14. Kordi MGH, Ghufuran H. Tips for successful cultivation of seaweed in sea and ponds. Jogjakarta: Publisher Andi; 2011.
 15. Tjiptoherijanto P. Projections of population, labor force, labor, and the role of trade unions in increasing welfare. *Development Planning Magazine*. 2001;23:1-0.
 16. Widyastuti A. Analysis of the relationship between worker productivity and workers' education level on family welfare in Central Java. *Economics Development Analysis Journal*. 2012;1(2).
 17. Rangkuti F. SWOT - balanced scorecard. Jakarta: Gramedia Pustaka Utama; 2013.
 18. Rangkuti F. Personal SWOT analysis. Jakarta: Gramedia Pustaka Utama; 2015.
 19. Asni A. Analysis of seaweed production (*Kappaphycus alvarezii*) based on season and distance of cultivation location in Bantaeng Regency Waters. *Akuatika Journal*. 2015;140:153.
 20. Rangkuti F. SWOT analysis technique of dissecting business cases. Jakarta: Gramedia Pustaka Utama; 1998.
 21. Directorate general of aquaculture. Export profile of fishery commodities. KKP; 2019
 22. Sanger G, Kaseger BE, Rarung LK, Damongilala L. The potential of several types of seaweed as a functional food ingredient, a source of natural pigments and antioxidants. *Journal of Indonesian Fisheries Product Processing*. 2018;21(2): 208-17.
 23. Putri RD, Megasari R, Rachmawati D. Fostering entrepreneurial spirit through diversification of processed seaweed. *Jurnal KARINOV*. 2018;1(3).
 24. Winarti S, Anggreini RA. Product development and production process of oromy (Seaweed Processed) drinks at UD Inokam Putat Jaya. *JATI EMAS (Jurnal Aplikasi Teknik dan Pengabdian Masyarakat)*. 2019;3(1):113-7.
 25. Leandro A, Pacheco D, Cotas J, Marques JC, Pereira L, Gonçalves AM. Seaweed's bioactive candidate compounds to food industry and global food security. *Life*. 2020;10(8):1-37.

© 2021 Pratama et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
<http://www.sdiarticle4.com/review-history/65426>