Development strategy and increased production of seaweed in Takalar District

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Abstract. This study aimed to examine the development of seaweed in Takalar District. The method used in this study is a survey and direct interview using questionnaires and FGD (Focus Group Discussion) to various parties and stakeholders related to the production and development of seaweed. The study location is located in Takalar District. Results The study of strategies for various aspects of development and productivity of seaweed can be applied with; 1) Expanding cultivation land and innovation and developing the latest cultivation technology, 2) Conducting gradual extension of seaweed farmers, 3) Development of seaweed processing industries, 4) Building nurseries to meet the availability of good quality seeds, 5) Conducting Training and Assistance in implementing the latest technological innovations, 6) Providing venture capital assistance and system improvement Warehouse Receipt 7) Scheduling seaweed cropping patterns, 8) Building and developing seaweed storage warehouses, 9) Developing new technologies to overcome pests and diseases in plants seaweed, 10) Conducting seaweed farmer institutional strengthening to strengthen the bargaining position of seaweed prices 11) Improving the quality of seaweed

1. Introduction

Seaweed is one of the commodities mariculture reliable, easily cultivated and has a good market prospect and can increase the income of farmers in coastal areas. Seaweed is the name in the trade for algae species harvested from the sea. In terms of morphology, seaweed does not show the existence of roots, stems, and leaves. Overall, this plant has the same shape, although it is actually different [1]. Seaweeds are increasingly seen as an alternative to land-grown products in food and feed applications. Interest in the production of seaweeds in temperate waters is rising, in particular in combination with offshore wind energy generation [2].

Development of seaweed, a few things become major considerations among which are wide open export opportunities, prices are relatively stable, there are no trade quotas for seaweed; the cultivation technology is simple, so it is easy to master, the cultivation cycle is relatively short, so it quickly provides benefits; capital requirements are relatively small; is an irreplaceable commodity, because there are no synthetic products; The effort to cultivate seaweed is classified as a labor-intensive business, so it is able to absorb labor [3]. With these various advantages and benefits, with the potential for cultivating land that is still quite extensive, the development of seaweed cultivation is still wide open.

Cultivating grass with such great results, various limitations must be overcome. Therefore for the development of seaweed cultivation, policy measures are needed, such as providing cheap capital through microfinance institutions or cooperatives. With the limitations of the transfer of seaweed cultivation technology to increase the quality of crop yields, further counseling is needed through piloting, training, and internships. For this reason, we need trained human resources through structured education and training according to the cultivation segment that seaweed farmers are interested in. Lack
of business actors act as marketing actors for seaweed production at the local level so that the price of seaweed is still below the standard which can affect the willingness of farmers to carry out seaweed cultivation activities.

Some of the things that are the advantages of seaweed include: (1) wide open export market opportunities, (2) there are no restrictions or trade quotas for seaweed, (3) the cultivation technology is simple, so it is easy to master, (4) the cultivation cycle is relatively short, so that it quickly provides benefits, (5) capital requirements are relatively small, and (6) is an irreplaceable commodity, because there are no synthetic products [4]. Therefore seaweed is a superior commodity that needs priority in handling it.

The intensity of growing international trade makes the productivity and competitiveness are increasingly important to note, especially importing countries apply various requirements, especially concerning the quality requirements for seaweed imported commodities in securing and protecting as well as customer satisfaction. One of the policies of the importing country concerning the quality or the quality of the seaweed is an ISO (International Standards Organization) 9000 requirements regarding food quality and safety of export commodities such as seaweed carried out by an international intergovernmental organization that develops standards of security protection for consumers and facilitate trade in the world. The institute is implementing testing of more than 750 food additives, using more than 240 commodity standards and 40 hygienic and technological codes [5].

Increasing the competitiveness and production of seaweed is very necessary, the study not only concerns various aspects of competitiveness and development. It is very necessary for a thorough study of seaweed from the side of cultivation activities to post-harvest and market mechanisms, especially in Takalar District with seaweed as its flagship commodity.

2. Research methods

2.1. Time and place of research
The research was conducted from September to November 2018. The study was conducted in Takalar District with the consideration that this area is the largest seaweed production area in Indonesia.

2.2. Sampling technique
The population in this study were all stakeholders in seaweed agribusiness in Takalar District using a purposive sampling method that is deliberate sampling. The basic criteria of the informant are understanding the conditions of the local area, having direct involvement (repeatedly or always doing), having sufficient time (not too busy so that they are easily interviewed).

Based on these criteria, the number of samples taken was 55 people consisting of 25 seaweed farmers, 25 Fisheries Extension Officers, 5 seaweed traders.

2.3. Data source
The data sources used in this study are primary data and secondary data. Primary data is obtained by collecting directly from the object of research, which is directly distributing questionnaires to selected respondents. Primary data is obtained from direct observation at the research location. While Secondary Data in the form of written and unwritten information obtained from agencies, companies, the internet, magazines, newspapers, and books related to this research.

2.4. Data collection technique
Data collection techniques used in this study were interviews, observations, questionnaires, focus group discussions (FGD), and literature studies.

2.5. Data analysis
The data analysis used in this study is as follows.

2.5.1. Quantitative and qualitative data analysis. The method used in this study is a quantitative and qualitative descriptive analysis research approach to describe and analyze the prospects, potential, and direction of the development of seaweed cultivation.
2.5.2. Financial feasibility analysis. The business feasibility analysis used in this study is as follows.

2.5.2.1. Net present value (NPV). Net Present Value is the present value of the net profit that will be obtained in the future. Mathematically, NPV is expressed by the formula [6]:

$$NPV = \sum_{t=0}^{n} \frac{(B_t - C_t)}{(1 + i)^t}$$

Where:

- $B_t =$ Annual benefits
- $C_t =$ Annual fee
- $i =$ Discount rate
- $t =$ year 0, 1, 2, 3, ..., $n$
- $n =$ Age project

With business criteria:
- $NPV > 0$: The business is feasible
- $NPV < 0$: Business is not feasible

2.5.2.2. Net benefit-cost ratio (B/C). Net B / C is the ratio between the present value of net benefits are positive ($B_t - C_t > 0$) with the present value of its net profit is negative ($B_t - C_t < 0$). Mathematically, Net B / C is expressed by the formula [6]:

$$\frac{Net B}{C} = \frac{\sum_{t=0}^{n} (B_t - C_t)}{(1 + i)^t} \div \frac{\sum_{t=0}^{n} (C_t - B_t)}{(1 + i)^t}$$

With business criteria:
- $Net B / C > 1$: Business is feasible
- $Net B / C < 1$: Business is not feasible

2.5.2.3. Internal Rate of return (IRR). IRR is the value of an interest rate that makes the NPV of the business equal to zero. Mathematically, the IRR is expressed by the formula [6]:

$$IRR = i' + \left( i'' - i' \right) \frac{NPV'}{NPV' - NPV''}$$

Where:

- $i'$ = Interest rate that produces $NPV > 0$
- $i'' =$ Interest rate that produces $NPV < 0$
- $NPV' =$ NPV at interest rate $i'$
- $NPV'' =$ NPV when the interest rate $i''$

With business criteria:
- $IRR >$ applicable interest rate: A business is feasible
- $IRR <$ applicable interest rate: Business is not feasible

2.5.2.4. Break-even point (BEP). This analysis is to see the break-even point which aims to find out to what extent the business can benefit. This analysis states as an example the minimum number of catches that must be obtained each year at the level of profit or no loss [6]:

$$BEP = \frac{\text{Fixed Costs}}{\frac{1 - \text{Variable Costs}}{\text{Selling}}}$$

2.5.2.5. Payback period. Payback period (PP) is a technique of evaluating the period (period) of return on investment in a project or business. Payback Period is an analysis of return on capital that aims to find out how long it will take (in years or months) to cover the investment with the formula [7]:


The assessment criteria for the payback period are:

If the payback period is < maximum time, then the proposed project can be accepted.
If the payback period is > maximum time, then the project proposal is rejected.

2.5.2.6. Analysis SWOT. The use of the SWOT analysis was carried out to develop strategies for increasing productivity and production of seaweed commodities in Takalar District.

3. Results and discussion

3.1. Result

3.1.1. Business analysis seaweed in Takalar District. The seaweed business in Takalar District is mostly cultivated by coastal communities. The ease of accessing facilities and infrastructure for businesses is very easy to obtain and cultivation methods are relatively easy when compared to other fisheries, such as fishing and fish farming. In running a business, carefulness is required in weighing the gains and losses obtained if a business is carried out. The importance of this business analysis for seaweed farmers is to provide clarity regarding the net benefits obtained and can be taken into consideration in running their business, wisely using existing production factors. The following will be explained about the types of investments, revenues, costs of seaweed business and the financial feasibility of seaweed businesses in Takalar District.

| No  | Type of Investment | Quantity | Price (IDR) | Total (IDR) | Economic Age (Year) | Depreciation Value (IDR) |
|-----|--------------------|----------|-------------|-------------|---------------------|-------------------------|
| 1   | Boat               | 1        | 3,000,000   | 3,000,000   | 10                  | 300,000                 |
| 2   | Main Rope          | 40       | 50,000      | 2,000,000   | 5                   | 400,000                 |
| 3   | Small Rope         | 20       | 25,000      | 500,000     | 2                   | 250,000                 |
| 4   | Buoy (Bottle)      | 6,000    | 300         | 1,800,000   | 2                   | 900,000                 |
| 5   | Sheetin            | 4        | 250,000     | 1,000,000   | 2                   | 500,000                 |
|     | Total              |          |             | 8,300,000   |                     | 2,350,000               |

The biggest investment in seaweed farming is a boat at a price of IDR 3,000,000. The boat is used for transportation to the cultivation location to control seaweed and transport seaweed crops. The function of the boat is very important in aquaculture so it is necessary to procure seaweed even though the price is quite expensive.

The biggest depreciation costs in floating seaweed farming with a depreciation per year are IDR 900,000. The buoy or bottle of mineral water that is often used by seaweed farmers as a buoy is needed in large quantities. The total depreciation value in seaweed farming is IDR 2,350,000 which consists of depreciation from boat investment, main rope, small rope, buoy (bottle) and sheeting.

3.1.1.2. Acceptance of Seaweed Cultivation Business. The amount of seaweed production produced by seaweed farmers is an average of 400 kg of seaweed with dry conditions. In the year the seaweed cultivators were able to cultivate as much as five times doing seaweed cultivation. With the price of
dried seaweed, which is around IDR 16,000 per kilogram, if calculated, the gross revenue of seaweed farmers is IDR 32,000,000 per year.

3.1.1.3. Business costs for seaweed cultivation. The cost for seaweed farming which is usually used is labor for binding seaweed seeds, labor to harvest seaweed, transporters of crops and labor used to dry seaweed. In some seaweed farmers, the labor force used is family and neighbor workers who are called to help harvest seaweed. For variable costs in seaweed farming business is dominated by labor. For more details, see the table below.

| No. | Cost Type          | Quantity | Price (IDR) | Total (IDR) |
|-----|--------------------|----------|-------------|-------------|
| A.  | Variable Costs     |          |             |             |
| 1   | Seeds              | 600      | 3,000       | 1,800,000   |
| 2   | Seedling Binder    | 35       | 250,000     | 8,750,000   |
| 3   | Harvest            | 30       | 200,000     | 6,000,000   |
| 4   | Harvesters         | 10       | 400,000     | 4,000,000   |
| 5   | Dryer              | 20       | 60,000      | 1,200,000   |
| B.  | Fixed Cost         |          |             |             |
| 1   | Depreciation       |          |             | 2,350,000   |
| 2   | Maintenance        |          |             | 350,000     |
|     | **Total**          |          |             | **31,650,000** |

Harvesting is a complicated matter for some seaweed farmers because seaweed must be transported little by little. Very little boat capacity with wet seaweed conditions so that seaweed has a heavyweight. The total value for variable costs for seaweed farming is IDR 21,750,000. The biggest variable cost in this business is seedling binder costs, which is IDR 8,750,000 per year. The cost of grass used is IDR 1,800,000 for a year. This value can be said to be small because the cost of procuring seaweed seeds because seaweed farmers use the harvest and then re-use it for use as seedlings. In addition, the government also provides seaweed seedlings annually for seaweed farmers. The assistance provided can be in the form of seaweed seeds and stretch ropes.

3.1.1.4. Business Feasibility Analysis of Seaweed Cultivation

3.1.1.4.1. Net Present Value (NPV). Based on calculations using a 12.5% interest rate, the NPV value of IDR 32,030,668 is obtained. This shows that the profit for 5 years of investment brings a profit of IDR 32,030,668. The accumulation of positive NPV values indicates that seaweed farming is profitable and feasible to manage.

3.1.1.4.2. Net Benefit/Cost (B/C). Based on the analysis of the calculation of Net B / C Ratio obtained by Net B / C Ratio 4.86. Net B / C Ratio value greater than 1 indicates that seaweed farming is feasible when viewed from the social impacts that are generated and from a financial perspective.

3.1.1.4.3. Internal Rate of Return (IRR). The IRR calculation is done to find out the number of interest rates that can cause the NPV value to be zero. Based on the calculation of the IRR value with an interest rate of 12%, the yield is 62.56%, which means that seaweed farming can cause the NPV value to be zero at the interest rate of 62.56%. This shows that seaweed farming is feasible.

3.1.1.4.4. Break-even point. This analysis is used to determine the break-even point of a sale so that a company is not profitable and does not lose. This analysis can be calculated based on a comparison between variable costs, fixed costs, and total revenues during the 1-year production of seaweed cultivation. The results of the calculation of BEP in seaweed farming show the results of IDR 7,493,878, which means that seaweed farming will break even if the income is IDR 7,493,878.
3.1.1.4.5. Payback period. The calculation of Payback Period in seaweed farming in Takalar Regency shows the results of 3.6 months or about 3 months, 6 days which means that investments invested in seaweed farming will return after a period of 3 months 6 days. The rate of return on capital is classified as very fast. This is because the capital used is IDR. 8,300,000 with a Net Present Value (NPV) of IDR. 32,030,668.

3.1.2. Strategy for Increasing production and productivity of seaweed commodities in Takalar District

3.1.2.1. Matrix IFAS and EFAS

Table 3. Matrix of the internal evaluation factor

| No. | Internal Strategic Factors                                      | Weight | Rating | Weight Score |
|-----|----------------------------------------------------------------|--------|--------|--------------|
|     | **Strength:**                                                   |        |        |              |
| 1   | The potential for cultivation land is very broad                | 0.118  | 3.8    | 0.447        |
| 2   | The potential for large numbers of human resources              | 0.112  | 3.0    | 0.335        |
| 3   | Simple and easy to cultivate technology                         | 0.076  | 2.6    | 0.199        |
| 4   | Seaweed Farmer Experience                                      | 0.094  | 2.6    | 0.245        |
| 5   | The availability of the processing industry                     | 0.094  | 3.2    | 0.301        |
| 6   | Facilities and infrastructure are easily available              | 0.071  | 2.8    | 0.198        |
|     | **Weakness:**                                                   |        |        |              |
| 1   | The availability of quality seeds is not yet fulfilled           | 0.094  | 3.8    | 0.358        |
| 2   | Seaweed quality standards have not been fulfilled               | 0.082  | 3.4    | 0.280        |
| 3   | Capital limitations                                             | 0.094  | 4.0    | 0.376        |
| 4   | Seaweed farmers are less innovative                             | 0.082  | 2.8    | 0.247        |
| 5   | The bargaining position of seaweed farmers is still low         | 0.087  | 2.8    | 0.231        |
|     | **Total**                                                       | 1.00   |        | 3.216        |

The internal strategy factor in the table above shows that the average cumulative value for the power factor is 1.725 greater than the cumulative value of the average weakness factor of 1.492. This condition identifies that the most influential factor for increasing seaweed production in Takalar District is greater than the factor weaknesses that will hinder it.

Table 4. External matrix of evaluation factors

| No. | External Strategic Factors                                      | Weight | Rating | Weight Score |
|-----|----------------------------------------------------------------|--------|--------|--------------|
|     | **Opportunity:**                                               |        |        |              |
| 1   | Demand for seaweed continues to increase                       | 0.113  | 3.4    | 0.383        |
| 2   | The support of the central government (Ministry of Maritime Affairs and Fisheries) | 0.134  | 3.8    | 0.508        |
| 3   | The technology of seaweed cultivation that has developed       | 0.120  | 3.0    | 0.359        |
| 4   | Development of an open seaweed industry                        | 0.099  | 2.8    | 0.276        |
| 5   | The presence of fisheries extension officers (PPL)             | 0.106  | 2.8    | 0.296        |
|     | **Threats:**                                                   |        |        |              |
| 1   | Fluctuating prices of seaweed.                                 | 0.120  | 3.8    | 0.455        |
| 2   | Weather                                                        | 0.106  | 2.6    | 0.275        |
| 3   | Pests and Diseases of the seaweed                              | 0.106  | 2.8    | 0.296        |
| 4   | Aquatic Environment                                            | 0.099  | 2.8    | 0.276        |
|     | **Total**                                                      | 1.00   |        | 3.124        |

External factors in the table above show that the average cumulative value for opportunity factors of actually 1.823 is greater than the cumulative value of the average threat factor of 1.301, this condition indicates that the opportunity factor for increasing seaweed in Takalar District is higher than the threat factor will inhibit it.
3.1.2.2. **Matrix SWOT**

**Table 5. Matrix SWOT**

| Internal Factors | Strength (S): | Weakness (W): |
|------------------|---------------|---------------|
|                  | 1. The potential for cultivation land is very broad | 1. The availability of quality seeds is not yet fulfilled |
|                  | 2. The potential for large numbers of human resources | 2. Seaweed quality standards have not been fulfilled |
|                  | 3. Simple and easy to cultivate technology | 3. Capital limitations |
|                  | 4. Seaweed Farmer Experience | 4. Seaweed farmers are less innovative |
|                  | 5. The availability of the processing industry | 5. The bargaining position of seaweed farmers is still low |
|                  | 6. Facilities and infrastructure are easily available | |

| External Factors | Opportunity (O): |
|------------------|------------------|
|                  | 1. Demand for seaweed continues to increase |
|                  | 2. The support of the central government (Ministry of Maritime Affairs and Fisheries) |
|                  | 3. The technology of seaweed cultivation that has developed |
|                  | 4. Development of an open seaweed industry |
|                  | 5. The presence of fisheries extension officers (PPL) |

| Strategy S-O | Strategy W-O |
|--------------|--------------|
| 1. Increased production by expanding cultivation land and innovation and developing the latest cultivation technology | 1. Build nurseries to meet the availability of good quality seeds. |
| 2. Carry out gradual counseling on seaweed farmers | 2. Conduct training and mentoring in applying the latest technological innovations |
| 3. Development of seaweed processing industry | 3. Providing business capital assistance |

| Threats (T): |
|--------------|
| 1. Fluctuating prices of seaweed |
| 2. Weather |
| 3. Pests and Diseases of the seaweed Aquatic Environment |

| Strategy S-T | Strategy W-T |
|--------------|--------------|
| 1. Create a schedule cropping seagrass | 1. Strengthening institutional seaweed farmers to strengthen the bargaining position of seaweed prices |
| 2. Build and develop storage facilities seaweed | 2. Improving the quality of seaweed by controlling pests and diseases in seaweed |
| 3. Develop new technology to overcome pests and diseases in seaweed plants. | |

3.2. **Discussion**

The seaweed cultivation business in Takalar District is mostly in the coastal communities. Along the coast of Takalar District, the people carry out *Euchemacottoni* seaweed cultivation. This type of seaweed is more resistant to the weather and adjusts to the climate in Takalar District, especially Takalar Regency. The amount of seaweed produced by seaweed cultivators is an average of 400 kg of seaweed in dry conditions. Within a year, seaweed cultivators are able to do cultivation five times doing a business of seaweed cultivation. With the price of dried seaweed which is around 16,000 IDR per kilogram, if calculated, the gross revenue of seaweed farmers is IDR 32,000,000 per year. While the net profit on the seaweed cultivation business is IDR 29,909,856. With the potential of land and seaweed cultivators...
in Takalar District, seaweed productivity and production can be maximally increased to improve the welfare of coastal communities.

To increase seaweed production several alternative strategies were formulated: 1) Increasing production by expanding cultivation land and innovating and developing the latest cultivation technology. Efforts to increase production need to take advantage of the existing land area by increasing land area and developing the simple and latest technology to solve existing problems. By increasing the area of land it is expected to provide increased production and supported by a lot of human resources so that this business is very much cultivated by the coastal communities in Takalar District, 2) Conducting education in stages to seaweed farmers. Counseling is an effort to transfer knowledge and skills to seaweed farmers. With education, it can gradually improve the ability of seaweed farmers to implement good and right cultivation. 3) Development of the seaweed processed industry. The development of processed seaweed industry will result in absorption of seaweed raw materials. Seaweed raw materials are needed for the processed seaweed industry players to be used as new products. In addition to adding value, this also makes it easier for seaweed farmers to market their crops. 4) Establish nurseries to meet the availability of good quality seeds. The problem of seed availability is often complained of by seaweed farmers. However, not many farmers use crops to be reused as seeds. Of course, this is not good for the growth and quality of seaweed. The government needs to establish nurseries in every area that has seaweed cultivation potential. Seed garden with good quality seedlings is very helpful for seaweed farmers in the procurement of seeds. 5) Conduct Training and Assistance in applying the latest technological innovations. The training is intended so that seaweed farmers can improve their skills in implementing efficient seaweed cultivation. Lack of innovation from seaweed farmers can cause the production results obtained are not optimal. In this strategy, the innovation and knowledge of seaweed farmers are increased by conducting training in stages so that it is easily absorbed and remembered by seaweed farmers. Government support is highly expected to help seaweed farmers to participate in training and mentoring on an ongoing basis in order to improve the skills of seaweed farmers. 6) Providing venture capital assistance. The thing that is often complained about by seaweed farmers is business capital. When viewed this business does not require a lot of capital but with the addition of production inputs certainly adds to the production costs for this cultivation business. Capital assistance and the convenience of seaweed farmers in accessing capital are very important, the government needs to pay special attention in providing assistance evenly to seaweed farmers. The government needs to provide financial institutional strengthening such as cooperatives in each region that allows seaweed farmers to access capital for business. For some seaweed farmers who have difficulty in accessing capital to banks with high conditions and interest, so they are more likely to borrow a family even from their neighbors. 7) Make a schedule of seaweed planting patterns. Weather and season are very influential on the seaweed cultivation business, so it is necessary to schedule seaweed planting patterns. This schedule makes it easy for seaweed farmers to plan and overcome crop failure due to weather and seasons that are not suitable for growing seaweed. 8) Build and develop seaweed storage sheds. One obstacle for seaweed farmers is that there is no storage place for their seaweed after harvest. After drying is done and sold at a price set by the seller. Even though they are not satisfied with the price given, farmers still have to sell at the price set by the seller, because seaweed farmers need capital back to buy the need for facilities for re-cultivation or the cost of repairing cultivation facilities. 9) Develop new technologies to deal with pests and diseases in seaweed plants. Management of pests and diseases need to be handled properly. Knowledge and technology are very important to be known by seaweed farmers. The role of the Government, researchers to provide the best solution to overcome this. 10) Strengthen seaweed farmer institutions to strengthen the bargaining position of seaweed prices. Currently, seaweed farmers as producers do not have a bargaining position to determine seaweed prices. With the institutional strengthening through seaweed, farmer groups are expected to be able to exchange information and improve bargaining position about seaweed prices. 11) Improve the quality of seaweed. Seaweed quality is the main thing in determining seaweed prices. To get good seaweed is certainly not easy. Need to pay attention to many things, especially on the quality of seeds and how to maintain and control the cultivated seaweed.
4. Conclusion
The potential for seaweed in Takalar District is very large. Opportunities to increase productivity and production of seaweed are still open. The role of the government is needed to provide more support to all stakeholders in the seaweed business in Takalar District.

The strategy for increasing productivity and production of seaweed can be done by; 1) Expanding cultivation land and innovation and developing the latest cultivation technology, 2) Conducting gradual extension of seaweed farmers, 3) Development of seaweed processing industries, 4) Building nurseries to meet the availability of good quality seeds, 5) Conducting Training and Assistance in implementing the latest technological innovations, 6) Providing venture capital assistance, 7) Scheduling seaweed cropping patterns, 8) Building and developing seaweed storage warehouses, 9) Developing new technologies to deal with pests and diseases in seaweed plants, 10) Conduct seaweed farmer institutional strengthening to strengthen the bargaining position of seaweed prices 11) Improve the quality of seaweed.

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