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The strategy of development of seaweed (*Kappaphycus alvarezii*) cultivation in Takalar district

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Abstract. Seaweed is an important commodity for the Indonesian economy. The development of seaweed cultivation in South Sulawesi offers promising prospects. The length of the coastline reaches 1,937 Km. The area of marine aquaculture in South Sulawesi reaches 193,700 Ha and around 10% is utilized for the development of seaweed. Takalar Regency has the potential of marine fisheries' natural resources. One of the potential marine resources that can improve the welfare of the Takalar district community is seaweed cultivation. The purpose of this study was to determine the cultivation of business income, marketing includes (costs, margins, efficiency). The determination of the sample was done intentionally. This research used a quantitative analysis method. The results of this study indicate that the seaweed cultivation business profits of IDR 16,030,218 per year and IDR 2,003,748 per cycle. The marketing institute consists of only 2 institutions, i.e., seaweed farmers and collector traders. Marketing costs incurred in the amount of IDR 199 per Kg, marketing margin received by the collecting traders is IDR 3,625 per Kg. Marketing efficiency was considered efficient for collecting traders which is equal to 0.87%.

5

1. Introduction

Seaweed is an important commodity for the Indonesian economy. The significance is because seaweed commodities have high economic value and the potential for the development of seaweed cultivation in Indonesia. Various processed products derived from seaweed also show that seaweed commodities have high economic value if they can be processed domestically so that the added value created can be enjoyed more by cultivators and processing producers in Indonesia [1-3]. One of the centers of potential seaweed development in Indonesia is South Sulawesi. In addition to agricultural food production that still dominates, seaweed cultivation has also become one of the leading commodities in the fisheries revitalization program in South Sulawesi [4].

The development of seaweed cultivation in South Sulawesi offers promising prospects. The length of the coastline reaches 1,937 Km. The area of marine aquaculture in South Sulawesi reaches 193,700 Ha and around 10% is utilized for the development of seaweed, while the area of aquaculture for seaweed cultivation is around 32,000 Ha. Types of commercial seaweed with high economic value that are cultivated in South Sulawesi are *Kappaphycus alvarezii* (aquaculture) and *Gracilaria* sp (aquaculture ponds) [5].



2

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1

South Sulawesi is one of the biggest seaweed producing regions in Indonesia. Total seaweed produced by Indonesia in 2016 was 11,269,342.00 tons, 30% of which came from South Sulawesi, equivalent to 3,409,048.20 tons. Great seaweed potential, can improve the economy of the community, especially fishermen with seaweed cultivation [6].

Takalar Regency has the potential of natural resources of marine fisheries, agriculture, plantations, and animal husbandry as well as tourism. One of the potential marine resources that can improve the welfare of the Takalar district community is seaweed cultivation. Among the hundreds of types of grass that are widely distributed in Takalar waters, various types of seaweed have high economic value, including the Marga *Gracilaria*, *Gelidium* and *Gelidiella* as producers of agar, and the Marga *Hypnea* and *Eucheuma* as producers of Carrageenan. The types of seaweed that are widely cultivated by seaweed farmers in Takalar are the types of *Cottonii*, *Gracilaria*, and *Spinosum*. The potential of seaweed in Takalar Regency is considered very promising for the future of seaweed farmers. This is the priority of the South Sulawesi Provincial Government to become Takalar District as one of the seaweed production centers to be developed.

2. Methods

This research was conducted in Takalar Regency for two months starting from July to September 2019. The type of research used is quantitative research. Regarding income from aquaculture, marketing includes (costs, margins, efficiency). The population in this study was the *Kappaphycus alvarezii* seaweed farmers in Manggarabombang and Sanrobone sub-districts. Sampling was conducted in a cluster sampling. Sampling is a group sampling technique. This type of sampling is done based on certain groups/areas so that the number of respondents in this study was 69 people.

2.1. Data analysis for marketing a cultivation business

Analysis of the data used to answer the problem formulation to achieve predetermined goals were a quantitative descriptive analysis using the formula by [7,8] for cost, revenue, profit, and analysis of total revenue per total cost.

2.2. Data analysis for cost, margins, seaweed marketing efficiency

The data for the purpose of cost, margins, seaweed marketing efficiency were analyzed by quantitative descriptive with the formula as follow:

$$Mp = Pr - Pf$$

Where Mp: marketing margin
Pr: Prices at the consumer level (IDR)
Pf: Price at the producer level (IDR)

$$Bp = Bp1 + Bp2 + Bp3 + \dots + Bpn$$

Where Bp: Seaweed marketing costs
Bpn: The marketing costs of each seaweed marketing agency

$$\text{Marketing efficiency} = \frac{\text{total cost marketing}}{\text{value of the product being marketed}}$$

3. Results and discussion

Based on the results of the study consisting of a description of the characteristics of respondents and a discussion of the income of aquaculture, marketing includes (costs, margins, efficiency) *Kappaphycus alvarezii* seaweed farming in Takalar Regency. There are two subdistricts which are the locations of the study, namely Manggarabombang and Sanrobone subdistricts. The results of descriptive analysis

that illustrates the characteristics of respondents based on age, education, number of dependents and the number of stretches can be seen in the table 1.

Table 1. Data on cultivation respondents by age level

No.	Age (years)	Respondent number (person)	Percentage (%)
1.	20–30	15	22
2.	31–40	19	27
3.	41–50	26	38
4.	51–60	9	13
Total		69	100

Table 2. Data on cultivation respondents by education level.

No.	Education	Respondent (person)	Percentage (%)
1.	Elementary school	37	54
2.	Junior high school	13	19
3.	Senior high school	16	23
4.	Bachelor degree	3	4
Total		69	100

Table 3. Data on cultivation respondents by the number of dependents.

No.	Dependents	Respondent (person)	Percentage (%)
1.	1 – 3	43	62
2.	4 – 6	24	35
3.	7 – 10	2	3
Total		69	100%

Table 4. Characteristics of respondents by the number of expansions in Takalar District.

No.	Intervals	Respondent (person)	Percentage (%)
1.	100	9	14
2.	100 – 250	39	60
3.	250	17	26
Total		65	100

Based on the table above the number of respondents sampled in this study were 69 people, based on age level, the highest number of cultivators at the age level of 41-50 years were 26 people with a percentage of 38% and the lowest was in the age range 51-60 years as many as 9 people with a percentage of 13% percent. Furthermore, based on education, the highest level of education is at the elementary school level as many as 37 people with a percentage of 54%. The lowest level of education is S1 3 people with a percentage of 4%. Furthermore, based on the number of dependents, the highest dependents are 1-3 people with a percentage of 62% and the lowest is 2 people with a percentage of 3% and finally, the characteristics of the highest number of stretches are 100-250 stretches with a percentage of 60% and the lowest is below 100 intervals with a percentage of 14%.

In this study, we want to see how much seaweed cultivation business revenue in Takalar Regency and seaweed marketing aspects of marketing costs, marketing margins and marketing efficiency of seaweed cultivation in Takalar Regency.

3.1. Business revenue of *Kappaphycus alvarezii* seaweed cultivation in Takalar Regency.

The costs used in the *kappahycus alvarezii* seaweed farming business were showed in table 5. Table 5 showed that the average depreciation of investment goods in seaweed cultivation is the highest, that is on a boat of IDR 174,452 per cycle and IDR 1,395,614 per year. While the lowest depreciation value is seed cords, which was IDR 91,346 per cycle and IDR 216,750 per year, with the total costs incurred after calculating the depreciation of IDR 384,626 per cycle and the overall cost of IDR 3,077,008 per year.

Table 5. Value of Fixed Costs in the seaweed aquaculture business in Takalar Regency in 2019

No.	Equipments	Investment (IDR)	Depreciation/Year (IDR)	Depreciation/Cycle (IDR)
1.	Boat	7,361,538	1,395,614	174,452
2.	Main Rope	1,793,077	476,308	59,538
3.	Rope Stretch	1,425,846	326,900	40,863
4.	Seed cords	100,385	91,346	11,418
5.	Bottle	556,558	134,380	16,797
6.	Tarp	252,308	203,077	25,385
7.	Rack	1,753,077	382,973	47,872
8.	Net	228,846	66,410	8,301
	Total	13,471,635	3,077,008	384,626

3.1.1. *Variable Cost.* Variable costs are the number of costs incurred for production activities, changing according to changes in the number of goods or services produced. The more the number of goods or services produced, the greater the variable costs incurred or vice versa. Included in the variable costs in seaweed cultivation are seedlings and labor wages. The variable costs of seaweed cultivation vary depending on the needs of the cultivator.

Table 6. Variable costs for seaweed aquaculture business in Takalar Regency in 2019

No.	Cost type	Per year (IDR)	Per cycle (IDR)
1.	Seeds	2,409,808	2,409,808
2.	Labor wages	9,326,154	1,165,769
	Total	11,735,962	3,575,577

Table 6 showed that the average variable cost spent on *Kappaphycus alvarezii* seaweed cultivation in Takalar Regency was IDR 3,575,577 per cycle, and for a year was IDR 28,604,615. The largest average expenditure was on seedlings, which was as much as IDR 2,409,808 per cycle and for one year IDR 2,409,808. For the use of seeds, farmers usually use 2–4 kg per one stretch with a price per kilo of IDR 4,500–5,000. The average variable cost is the least spent, i.e., the labor of IDR 1,165,769 per cycle and for a year IDR 9,326,154 per year. For labor wages divided into five parts, i.e., 1) binding the seedlings with a wage of IDR 2,000 per span for one person, 2) planting with a wage of IDR 125,000 per person, 3) harvesting with a wage of IDR 75,000 per person, 4) cleaning with a salary of IDR 50,000–100,000 per person which depends on each farmer determination, and 5) drying with a wage received of IDR 75,000–100,000 per person this has been determined from each of the farmers.

3.1.2. *Total cost.* Total cost is the sum between fixed costs and variable costs to be clearer the amount spent in the seaweed cultivation business in Takalar Regency. It can be seen the average total costs

incurred in *Kappaphycus alvarezii* seaweed cultivation in table 7. Table 7 showed that the total cost is the sum of fixed costs and variable costs, where the total average cost is IDR 1,851,621 per cycle and for a year was IDR 14,807,200.

Table 7. Total costs of seaweed aquaculture business in Talakar Regency in 2019

No.	Cost Type	Per year (IDR)	Per cycle (IDR)
1.	Fixed Cost	3,077,008	384,626
2.	Variable Cost	11,735,962	1,466,995
Total		14,807,200	1,851,621

3.1.3. Revenue. Business revenue is obtained from the sale of *Kappaphycus alvarezii* seaweed production. Production value is obtained from total seaweed production (kg) multiplied by sales price. The following is the total revenue from seaweed cultivation in table 8.

Table 8. Total revenue of seaweed cultivation fisheries in Takalar Regency in 2019

No.	Description	Per year	Per cycle
1.	Production (Kg)	1,619	299
2.	Price/Kg (IDR)	19,046	19,046
Total Revenue (IDR)		30,837,188	5,691,870

Table 8 showed that the total average of *Kappaphycus alvarezii* seaweed cultivation produced is IDR 5,691,870 per cycle and for a year IDR 30,837,188. Where the average amount of production in one harvest was 299 kg of seaweed in the dry form and 1,619 kg/year. With an average price per kilo obtained at IDR 19,046.

3.1.4. Profit. Benefits can be obtained when there is a difference between total revenue and the largest total cost. Analysis of business income is used to determine the benefits of *Kappaphycus alvarezii* seaweed cultivation per year. Each *K. alvarezii* seaweed cultivation has a different amount of profit because in the calculation of profit is influenced by the total cost component and revenue component. For more details, the average profit of *Kappaphycus alvarezii* seaweed in Takalar Regency in one year can be seen in table 9.

Tabel 9. Profits at the seaweed aquaculture business in Takalar Regency in 2019

No.	Description	Per year (IDR)	Per cycle (IDR)
1.	Total Revenue	30,837,188	3,854,648
2.	Total Cost	14,806,970	1,850,900
Total profit		16,030,218	2,003,748

Table 9 showed that the average total profit gained from *Kappaphycus alvarezii* seaweed cultivation in Takalar Regency is based on production results of IDR 1,850,900 per cycle, while the annual profit is IDR 16,030,218.

3.1.5. Revenue and cost balance analysis (R/C ratio). The balance analysis of revenue and cost (R/C) aims to find out the results obtained from a business activity. If $R/C > 1$, then the business gets a profit, if $R/C < 1$ then the business suffers losses and if $R/C = 1$ then the business is at the break-even point. The total income received by seaweed cultivator *Kappaphycus alvarezii* in Takalar Regency which is produced is IDR 30,837,188 and the total cost spent is IDR 14,812,970.

Based on the description above it can be stated that the cultivation of *K. alvarezii* seaweed in Takalar Regency is good and can be carried out because the R/C ratio obtained is 2.08, where if the R / C obtained is more than 1, then the business will get a profit and can be run.

3.2. Cost, margin, marketing efficiency of *Kappaphycus alvarezii* seaweed in Takalar Regency

3.2.1. *Marketing cost.* Marketing costs are a very important thing to consider in a marketing business because marketing costs include post-harvest costs. The cost is a sacrifice incurred by the seaweed farmer *Kappaphycus alvarezii* in managing his business to get maximum results [9]. The following are marketing costs for seaweed aquaculture business in table 10 below.

Table 10. Marketing Costs in the seaweed aquaculture business in Takalar Regency in 2019

Marketing institute	Marketing fee (IDR/kg)
Farmers	0
Collectors	199

Table 10 showed that the average marketing costs that exist in each marketing institution are IDR 199/kg in each time marketing for collecting traders where the costs borne by the collecting traders in the form of costs for transport workers at IDR 50,000–75,000 per person in one shipment and purchase of dried seaweed usually 10–20 sacks per purchase, wherein one sack contains 100 kg of dried seaweed.

3.2.2. *Marketing margin.* The marketing margin of seaweed *Kappaphycus alvarezii* is the difference between the price of seaweed sales and the purchase price. The difference between the purchase price and the selling price in marketing requires a fee so that the costs incurred are expected to be covered from the difference in price. The average marketing margin of seaweed aquaculture business, was presented in table 11.

Table 11. Marketing Mmrgins in seaweed aquaculture business in Takalar Regency in 2019

Marketing institute	Selling (IDR/Kg)	Purchase (IDR/Kg)	Marketing margin (IDR/Kg)
Farmers	19,046		
Collectors	22,875	19,046	3,625

Table 11 showed that the average margin obtained by the institutions involved in the marketing process. The difference between the price paid by traders for *Kappaphycus alvarezii* seaweed and the price received by seaweed farmers amounted to IDR 3,625/Kg.

3.2.3. *Marketing efficiency.* In the process of marketing, a product from the hands of producers to the hands of consumers, an institution that will be involved in the marketing process needs to be able to act as an intermediary between the interests of producers and consumers so as not to harm both parties. In this case, the producer considers a trading system to be said to be efficient if the sale of Seaweed brings a lot of profit to him. Conversely, consumers consider the trading system can be said to be efficient for him if consumers easily get seaweed at low prices. [10] states that trading system can be said to be efficient if it can convey production results to consumers at the lowest possible cost and be able to make a fair distribution of profits from the overall price paid by consumers to all parties participating in production activities.

Table 12. Marketing Efficiency in the seaweed aquaculture business in Takalar Regency in 2019

Marketing institute	Selling (IDR/Kg)	Marketing cost (IDR/Kg)	Marketing efficiency (%)
Farmers	19,046		
Collectors	22,875	199	0.87

Table 12 showed that the average marketing efficiency that exists in marketing institutions, the collecting traders, marketing efficiency obtained by 0.87% which can be said to be efficient because the efficiency obtained is less than 1, which is due to the small amount its marketing chain.

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