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Analysis productivity of seaweed cultivation (*Glacilaria. sp*) in Takalar Regency, South Sulawesi

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Abstract. Seaweed is one of the leading commodities that has enormous potential supported by sea area of 5.8 million km^2 with a total area of seaweed cultivation reaching 1.110.900 ha. One type of kelp cultured in ponds is *Glacilaria sp.* Seaweed production is a strategic step at the level of crop development as it involves a high workload, a simple growing technology, a relatively short planting time of about 45 days (fast yield), and relatively cheap production costs. The increasing demand for seaweed from year to year is not followed by an increase production volumes and fluctuating prices. The purpose of this research is to determine the description of the agrifood subsystem and to determine the productivity of the seaweed company *Glacilaria sp.* in the regency of Takalar. The design of the research used qualitative and quantitative types. The number of samples used was 63 people. The results of this study were to look at the productivity of the seaweed cultivation of *Glacilaria sp.* The productivity in the Mappakasunggu District was 1.37, while the productivity in the Sanrobone District was 1.43. Good productivity, namely the use of inputs, is less than the output results obtained so that the income of fishers who cultivating seaweed *Glacilaria sp.* is more increasing.

1. Introduction

Seaweed is one of the leading commodities in the fisheries and marine sector, which has enormous potential. Indonesia's potential for seaweed commodities is supported by sea area of 5.8 million km^2, with a total area of seaweed cultivation reaching 1,110,900 ha [1-3]. Based on data [4], it states that Indonesia is the second-largest producer in the world after China and the largest seaweed exporter in the world. South Sulawesi Province became the main center of seaweed in Indonesia with the most substantial contribution (29%) in 2016 [5]. The growth trends of seaweed production in Takalar Regency from 2012-2016 was 5.2 percent [6].

Glacilaria sp. seaweed production in Takalar Regency in 2015 - 2018 every year has decreased quite rapidly, but in terms of the potential of the planting area is very large, and the potential demand for seaweed is increasing every year [7]. *Gracilaria sp.* seaweed cultivation carried out in ponds is one of the purposes of the lake as an effort to meet the increasing demand for seaweed, besides that, seaweed cultivation in ponds has more benefits when compared to aquaculture in the sea.

Recognizing the tremendous potential seaweed market opportunities in the global market, there are some problems with seaweed production, namely price fluctuations. One of the driving factors that can increase the interest of seaweed fishers/ farmers to produce is the price of the productive output. The

higher the selling price of seaweed, the anglers will be more motivated to increase their production. In increasing seaweed selling prices, proper management is needed starting from the input sector to the output by conducting adequate supervision, the quality of seaweed, along with the selling price increases.

Success in improving the seaweed input-output sector will have a multi-functional impact on the development of seaweed cultivation. Proper management can act as a deterrent in increasing production, productivity, and product quality, and all of that will, in turn, be the primary key in increasing cultivation income. For this reason, research on how effective the seaweed cultivation of *Glacilaria sp.* which can affect the level of revenue obtained from farmers who carry out seaweed farming business activities in Takalar Regency.

2. Materials and methods

This research conducted in Takalar Regency, which conducted for two months (July - September 2019). The type of research used is qualitative and quantitative research. Qualitative research on the description of the agribusiness sub-system that will be obtained from seaweed cultivators *Glacilaria sp.*, While quantitative analysis consists of field observations, interviews, and distributing questionnaires to seaweed farmers to produce and measure data on productivity. The study population was seaweed farmers *Glacilaria sp.* located in Mappakasunggu and Sanrobone sub-districts [5]. Sampling in this study was conducted by *cluster sampling*. *Cluster Sampling* is a group sampling technique. This type of sampling is done based on specific groups/areas so that the number of respondents in this study was 63 people.

Analysis of the data used in this study is presented in table 1 as follows:

Table 1. Data analysis matrix

Research	Required data	Data type	Data source	Data analysis method
To find out the description of the seaweed agribusiness subsystem *Gracilaria sp.* in Takalar Regency	The upstream-downstream agribusiness subsystem	Primary data	Seaweed cultivator	Description analysis
To know the productivity of grass business Sea *Gracilaria sp.* in Takalar Regency	Factors production of seaweed cultivation *Gracilaria sp.*	Primary data	Seaweed cultivator	Productivity analysis

Technically, productivity is a comparison between output and input. The productivity formula can be stated as follows [8]:

$$\text{Productivity} = \frac{\text{Output}}{\text{Input}}$$

The factors that affect the productivity of seaweed *Glacilaria sp.*, which consists of internal and external factors. Internal factors consist of seed, pond area, facilities and infrastructure, labor, planting, and harvesting processes. While external factors consist of government policies, demand, and consumer selling prices.

3.Results and discussion

Based on the results of research consisting of a description of the characteristics of respondents and a discussion of the productivity of the seaweed farming *Glacilaria sp.* in Takalar Regency. Two Districts cultivate seaweed species *Glacilaria sp.* in the ponds, namely Mappakasunggu and Sanrobone Districts. The results of the descriptive analysis that describe the characteristics of

respondents based on age, education, number of dependents, and land area are presented in table 2 as follows:

Table 2. Descriptions of respondents by age, education, number of dependents and land area

No	Description	Frequency (Person)	Percentage (%)
I.	Age (years)		
	- 30 – 40	8	13
	- 41 – 50	30	48
	- 51 – 60	24	38
	- 61 - 70	1	2
	Total	63	100
II.	Education		
	- Elementary school	29	46
	- Secondary school	11	17
	- Tertiary school	23	37
	Total	63	100
III.	Number of dependents (person)		
	- 1 – 3	31	49
	- 4 – 6	28	44
	- 7 - 10	4	6
	Total	63	100
IV.	Fishpond Area (Ha)		
	- 0 – 1	49	78
	- 1,1 – 2	11	17
	- 2,1 – 3	2	3
	- 3,1 - 4	1	2
	Total	63	100

Based on table 2, the number of respondents sampled in this study was 63 people. Based on the age level, the number of dominant cultivators is 51-60 years old as many as 24 people, and the lowest is in the age range of 61-70 people as many as one person.

Furthermore, based on education, the highest level of education is 29 elementary school students, with a percentage of 46%. The third is the characteristics of the number of dependents; the highest number of dependents is 1-3 people with 31 farmers — the fourth based on the area of the pond. The most widely used pond area is 0 - 1 Ha with cultivators who have the area of the lake as many as 49 people with a presentation of 78%.

In this study, we want to see an overview of the agribusiness subsystem in the cultivation of *Glacilaria sp.* and find out how much productivity the cultivation of seaweed *Glacilaria sp.* in Takalar Regency.

3.1 Agribusiness sub-system

The description of seaweed agribusiness subsystem in Takalar Regency is as follows:

3.1.1. Agribusiness upstream sub-system. The upstream agribusiness subsystem involved in the cultivation of seaweed *Glacilaria sp.*, namely the process of supplying seedlings, providing land (ponds), fertilizers, cultivation facilities, and infrastructure (guardhouses, cork boats, carts, nets, and sluice gates). The characteristics of good seedlings in the process of cultivating seaweed are elastic thallus, having many branches, the tip of the thallus is straight, the base is more significant than the tip of the office, there are no spots, uniform seed shape, bright color and fresh smelling and clean from pests.

3.1.2. Agribusiness farming sub-system. The farming subsystems involved in the seaweed cultivation process *Glacilaria sp.*, namely the transportation and handling of seedlings and the maintenance of seedlings. The farming subsystem explanation is as follows:

a) Pond Preparation
In the process of providing land, that is, each aquaculture pond plot has a water intake and discharge gate that serves to gravity water circulation so that it will maintain water quality in the pond. The substitution of water is done by relying on tides. The optimal water depth in the lake is 50 cm.

b) Seedling and Handling
The selection of seeds taken comes from the closest location because the seeds are already suitable for the area of cultivation. When transporting seeds, avoid heat (direct sunshine), and the seeds are wet.

c) Planting
In the planting process, the seedling is spread evenly in the morning or evening with a density of seeds 1 ton/ha at the beginning of farming. The duration of stocking in one hectare of the pond is usually 1 or 2 days.

d) Maintenance
Maintenance in the cultivation of seaweed *Glacilaria sp.* That is doing a change of water at least every three days or three times a week. The use of fertilizer in 1 ha as much as 15-30 kg by using urea fertilizer.

3.1.3. Downstream agribusiness sub-system. The downstream agribusiness subsystem involved in the process of seaweed cultivation *Glacilaria sp.*, namely the process of 1) harvesting and post-harvesting and 2) marketing. The following is an explanation of the downstream subsystem of *Glacilaria sp.* seaweed cultivation as follows:

a) Harvest
After maintaining seaweed for about 45 days, the plant is ready for harvest. The seaweed harvesting process is carried out for 5-7 days. Harvesting has done when the age of *Gracilaria sp.* seaweed reaches 40-45 days. Drying the *Gracilaria sp.* takes place on waring along the embankment ponds. Long drying is one day, depending on weather conditions. Seaweed harvesting should be doing in the morning and evening.

b) Post Harvest
After the harvesting process, seaweed can be dry on pond embankments or particular land for drying. Gracilaria sp. can be drained with a thickness of 5-10 cm and air-conditioned to speed up the drying process during the rainy season. Postharvest handling, including proper drying, is necessary, given its direct effect on the quality and price of sales in the market.

c) Marketing
The marketing involved in the process of seaweed cultivation *Glacilaria sp.*, that is, after the post-harvest process of seaweed, is put into the warehouse. The group of farmers can obtain price information directly from potential buyers by requesting a price quote for *Gracilaria sp.* dry or cooperation agreement for sale and purchase of *Gracilaria sp.* based on contracts with collecting traders. After there is an agreement on the price and method of payment (for example, payment by cash, there is no upfront payment), sending *Gracilaria sp.* dry can use a truck or container to the warehouse or factory agar. *Gracilaria sp.* shipped in boxes with dry and clean container floor conditions and free of chemicals for export shipments.

3.1.4. Supporting institutions sub-system. The supporting subsystems involved in the process of cultivating seaweed *Glacilaria sp.* namely, not yet optimal assistance from institutions, both government agencies, research, and development. The service included in the cultivation of seaweed *Glacilaria sp.*, namely the marine and fisheries service that provides counseling about good and right seaweed cultivation such as how to dry, plant, maintain, and control water quality by the

environmental conditions at the cultivation site. In the support system, there is no counseling on the processing of Glacilaria sp., still to other types of seaweed.

3.2. The productivity of Gracilaria sp. seaweed cultivation in Takalar Regency

Productivity is the production produced by a broad unity of a commodity cultivated by farmers. To explain the products, a relationship between factors of production (input) and product (output) is needed. This relationship between input and output is called the relationship factor [9]. As for the costs used in the cultivation of seaweed *Glacilaria sp.* namely as follows:

Table 3. Types and costs of depreciation in *Gracilaria sp.* seaweed cultivation business per cycle / ha

No	Cost Types	Regency	
		Mappakasunggu	Sanrobone
1	Guardhouse (IDR)	11.834.524	6.521.429
2	Sluice (IDR)	8.481.667	2.888.333
3	Net (IDR)	1.168.571	478.333
4	Cart (IDR)	2.181.071	896.875
5	Cork boat (IDR)	3.995.238	1.838.889
	Total	27.661.071	12.623.859
	Totality	40.284.931	

Based on table 3 shows that the depreciation investment costs of the equipment incurred in the business process of cultivating seaweed *Glacilaria sp.*, which consists of farm tax and tool depreciation. The fixed costs incurred by farmers in Mappakasunggu Subdistrict were IDR. 27,661,071 hile the costs incurred by farmers in the District of Sanrobone, that is IDR. 12,623,859. The overall total fixed cost in Takalar Regency is IDR. 40,284,931.

The variable costs used in each cycle explained as follows:

Table 4. Types and variable costs of *Gracilaria sp.* seaweed cultivation business per cycle / ha

No	Type Cost	Regency		Total (IDR)
		Mappakasunggu	Sanrobone	
1	Seeds (IDR)	33,471,429	23,600,000	57,071,429
2	Fertilizer (IDR)	1,732,500	1,080,000	2,812,500
3	Labor (IDR)	36,102,000	16,858,333	52,960,333
4	Consumption (IDR)	29,657,143	14,350,000	44,007,143
	Total	100,963,071	55,888,333	156,851,405

Based on table 4 shows that the variable costs incurred in the process of cultivating seaweed *Glacilaria sp.*, which consists of the cost of seeds, fertilizer, labor, and consumption. The variable costs incurred by farmers in Mappakasunggu District are IDR. 100,963,071, while the costs incurred by farmers in the District of Sanrobone is IDR. 55,888,333. The total variable cost as a whole in Takalar Regency is IDR. 156,851,405 / Cycle.

The revenue costs used in each cycle explained as follows:

Table 5. Average acceptance per respondent in the seaweed farming *Glacilaria sp.* dry per cycle.

No	Regency	Dried Seaweed	
		Production Amount (Kg)	Acceptance (IDR)
1	Mappakasunggu	1,232	4,551,598
2	Sanrobone	1,094	4,099,948
	Total	2,326	8,651,546
Average of Acceptance		4,379,541	

Based on table 5, the amount of revenue obtained by seaweed cultivators Glacilaria sp. consists of sub-districts of Mappakasunggu and Sanrobone in the amount of IDR. 8.651.546 / cycle with a total dry production of 2.326kg / cycle/ Ha.

Table 6. Average revenue per respondent in the seaweed farming *Glacilaria sp.* per cycle / ha

No	Description	Regency		
		Mappakasunggu	Sanrobone	Total (IDR)
1	Average Amount of Production (Kg)	1,232	1,094	2,326
2	Average acceptance (IDR)	4,551,598	4,099,948	8,651,546
3	Average Total Cost (IDR)	3,318,256	2,876,818	6,195,074
Average Revenue (IDR)		1,233,342	1,223,130	1,229,452

Based on table 6, shows that the income earned on the cultivation of seaweed *Glacilaria sp,* in Takalar Regency, The income earned by Mappakasunggu District cultivators is IDR, 1,233,342, while the income earned by the District of Sanrobone was IDR, 1,223,130, So that the total income obtained from seaweed farmers *Glacilaria sp,* in Takalar Regency, which is IDR, 1,229,452/ cycle/ha,

Table 7. Average productivity per production of seaweed cultivation business *Gracilaria sp*, per cycle / ha

No	Regency	Output (IDR)	Input (IDR)	Productivity
1	Mappakasunggu	4,551,598	3,318,256	1.37
2	Sanrobone	4,099,948	2,876,818	1.43
	Total (IDR)	8,651,546	6,195,074	-
Average Per Cycle / Ha (IDR)			1.40	

Based on table 7 shows that productivity in the seaweed cultivation *Glacilaria sp,* in Takalar Regency, The productivity obtained from the District of Mappakasunggu is 1.37, while the productivity gained from the District is 1.43.

4. Conclusion

The conclusions obtained from the results of research into the productivity analysis of seaweed farming *Glacilaria sp.* in Takalar Regency, namely: 1) The description of agribusiness Seaweed *Glacilaria sp.* in Takalar Regency which is divided into 4 subsystems including upstream subsystems,

farming subsystems, downstream subsystems and supporting subsystems. Of the four agribusiness sub-systems, which have not yet been developed are the supporting subsystems. To obtain good quality seaweed, an active role in each of the agribusiness subsystems involved in the business process of cultivating seaweed *Glacilaria sp.*2) Productivity obtained from the District of Mappakasunggu is equal to 1.37 while productivity obtained in the District of Sanrobone is at 1.43. Productivity results show that the output produced is higher than the use of resource inputs. Where it has been proven that the effectiveness of the activities of the seaweed cultivation of *Glacilaria sp.*.

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