Biophysical and economic feasibility status of the seaweed cultivation in Sabu Raijua Regency, East Nusa Tenggara, Indonesia

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Abstract. Seaweed is one of the aquaculture commodities with great potential to be developed in Sabu Raijua Regency, Indonesia. The purpose of this study was to determine the economic and biophysical feasibility status of seaweed cultivation in Sabu Raijua Regency, East Nusa Tenggara, Indonesia. This research was conducted in the Sabu Raijua Regency waters on April-June 2020, in the scope of 1 sub-district and 7 villages, by purposive sampling methods. The studied research criteria were environmental indicators (water quality) and economic indicators. The results showed that the financial feasibility indicators reached the following values: a profit of 49 USD, a profitability of 15%, an R/C Ratio of 1.5 and the break-even point value of 0.19 USD, which means that the aquaculture business can be developed as feasible and profitable. Meanwhile, from the water quality indicator perspective, the following values were determined: current velocity of 0.24 m s^{-1}, brightness of 4 m, depth of 0.45 m, salinity of 30 ppt, temperature of 30℃, pH 7.5 and dissolved oxygen 7.4 mg L^{-1}, demonstrating that seaweed cultivation in the Sabu Raijua waters is in accordance with the water quality standards. The seaweed cultivation business in Sabu Raijua Regency is classified as very feasible and profitable, based on the economic and biophysical feasibility status, and can be developed in a more professional direction, by looking at the appropriate cultivation management attributes.
Key Words: water quality, seaweed, renatbility, aquaculture, feasibility.

Introduction. Seaweed is one of the aquaculture commodities with great potential to be developed. Globally, Indonesia's seaweed production is in second place after China with a production level in 2016 of 11,631 tons (FAO 2018). The land potential for seaweed cultivation is estimated to reach 12,123,383 ha and only 281,474 ha have been utilized (Ministry of Marine Affairs and Fisheries 2015). One of the main zones of cultivation in marine mud is located in the Sabu Raijua Regency, East Nusa Tenggara Province, Indonesia. In 2016, the level of seaweed production in Sabu Raijua Regency reached 2,283.347 tons (FAO 2018).

Seaweed cultivation is in great demand by the Sabu Raijua residents, not only for its large business potential, but also because the wide coastline of their region is favorable to this kind of activity. For coastal communities, seaweed cultivation activities have high benefits and selling value so that they can increase their standard of living (Purnomowati 2015). In order to reach an optimal production value, non-technical seaweed cultivation activities must be supported by the existence of factors that play a role in sustainable growth and management of seaweed cultivation itself (Dianto at al 2017). Among the factors that play an important role in the level of seaweed cultivation are physical, chemical, biological, technological and economic factors (Akib et al 2015).

Based on the background description above, the purpose of this study was to determine the economic and biophysical feasibility status of seaweed cultivation in Sabu Raijua Regency, East Nusa Tenggara Province.

Material and Method

Research location. This research was conducted in the coastal area of Sabu Raijua Regency in April-June 2020, with 1 sub-district and 7 villages included in the scope of the research locations. For the economic data, samples were taken based on survey and interview methods, with 3 samples repetition of respondents from each research location. Meanwhile, biophysical data which includes water depth, brightness, flow velocity, temperature, salinity, dissolved oxygen and pH parameters were obtained by purposive sampling, with measurements carried out at 10 observation points based on village station.

To determine the status of the economic feasibility, several parameters of the cultivation analysis are calculated, such as the value of profit, profitability, R/C ratio, and the estimated value of the Break Even Point (BEP) (Primyastanto 2015).

Business profitability. The estimated value of profitability is calculated based on the formula introduced by Primyastanto (2015), as follows:

$$R = (L / M) \times 100$$

Where:
R - rentability (%);
L - amount of profit during a certain period (USD);
M - capital used (USD).

R/C ratio. The value of the R/C ratio of the business is calculated based on the formula introduced by Primyastanto (2015), as follows:

$$R/C = TR / TC$$

Where:
R/C - revenue cost ratio;
TR - total revenue (total revenue);
TC - total cost (total cost).

Break-even point (BEP). The value of BEP is the point where the income earned is equal to the capital issued. The BEP value in this study was estimated based on the formula introduced by Primyastanto (2015), as follows:

$$BEP = FC / (1-VC / S)$$

Where:
FC - fixed costs;
VC - variable cost;
S - sales value (number).

After an economic and biophysical analysis, the cultivation business was further tested using the Multi-Dimensional Scaling (MDS) analysis, with the Rapfish software. MDS analysis is used to determine the sustainability status of seaweed cultivation activities in Sabu Raijua Regency based on the existence of the identified attributes of biophysical parameters and economic feasibility (Aziz 2011).

Results. Data on business capital assets in seaweed cultivation was obtained based on the results of the interview survey and the distribution of the questionnaire (Table 1). Business capital assets are a representation of the amount of capital costs used for the operation of a business activity (Sriwati 2013). Based on the figures of the business capital asset value, an estimate of the economic feasibility values of the business can be obtained (Table 2).

Table 1

Basic operational modals of seaweed cultivation in Sabu Raijua

Modals	*Unit*	*Value (USD)*
	Fixed cost	
Depreciation		9.22
Labor	Person	2.67
Build investment		66.67
	Variable cost	
Seaweed seeds	Sack	6.67
Electricity cost		6.67
Total cost		91.89

Table 2

Business feasibility status of seaweed cultivation in Sabu Raijua

Indicator	*Value score*	*Criteria*
Profit	49 USD	Profit
Rentability value	15%	Profitable (>i)
R/C Ratio	1.5	Profitable (>1)
Break-even point	1.1 USD	Profitable (>TR)

Based on the financial analysis of the business, as presented in Table 2, the seaweed cultivation in Sabu Raijua Regency is classified as profitable. This can be seen mainly from a business profitability reaching 15%, which is greater than the average bank interest rate of 10% (Ariadi et al 2019a). In addition, the R/C ratio value can reach 1.5, which means that this business has the potential to be developed. The value of R/C ratio >1 means that cultivation business activities are profitable and feasible (Bosu et al 2016). The calculated values in a business financial analysis can be used as a projection for the development of a business activity (Intyas et al 2019) and they can also be used as a method of analyzing the efficiency of the aquaculture production activities (Kok et al 2020). Financial analysis also depends with the level of aquaculture productivity (Ariadi et al 2020).

Biophysical feasibility of seaweed cultivating. The values of the biophysical parameters of the water in the seaweed cultivation areas of the Sabu Raijua Regency can be seen in Table 3. The parameters measured include aura velocity, brightness, water depth, salinity, temperature, pH and dissolved oxygen during the cultivation period. Based on the values of water quality feasibility defined by the WWF (2014), these parameters are still considered feasible and good. The water quality parameters at the cultivation location can be stabilized at the appropriate operational levels, due to the environmental carrying capacity which creates natural conditions for the aquaculture (Ariadi et al 2021a).

Table 3

Water quality parameters in water seaweed cultivation

Parameter	*Value range*	*Optimum range*
Water flow (m s^{-1})	0.22–0.26	0.2–0.4
Visibility (m)	3.3–4.6	>1
Depth (m)	0.32-0.53	0.3-0.6
Salinity (ppt)	29-31	27–34
Temperature (℃)	29-31	26–32
pH	7.4-7.5	7–8.5
Dissolved oxygen (mg L^{-1})	7.1–7.8	3–8

Source: WWF 2014.

According to the biophysical water status in the seaweed cultivation areas of Sabu Raijua, this activity is very feasible (Table 3). The parameter values of pH, temperature, DO, salinity, brightness and current velocity that are above the quality standard threshold by WWF (2014) will greatly affect the growth rate and production of seaweed. These aquatic biophysical factors are the main components to support the level of carrying capacity for seaweed cultivation (Alamsyah 2016).

The multidimensional sustainability status. The multidimensional sustainability status is intended to see the sustainability status of five dimensions (ecological, economic, technological, socio-cultural and institutional) in seaweed cultivation in the East Sabu waters. Of the five dimensions, there are three dimensions that are quite potential, namely the ecological dimension, the institutional dimension and the socio-cultural dimension, and two less sustainable dimensions, namely the economic dimension and the technological dimension. Economic and ecological dimensions have major social and environmental impacts in an agricultural business activity (Van Zanten & Van Tulder 2021).

Based on the research analyzed, by knowing the dimensions that are less sustainable (economic and technological), we can carry out a form of technical engineering on the applied seaweed cultivation system. This technical engineering concept is intended to make cultivation run sustainably and productively (Ariadi et al 2019b). Analysis of business sustainability based on multi-dimensional has a qualitative level of analysis based on the range of values in the analysis (Muqsith et al 2021). The results of the kite diagram analysis on the index value of the five dimensions of sustainability are presented in Figure 1.

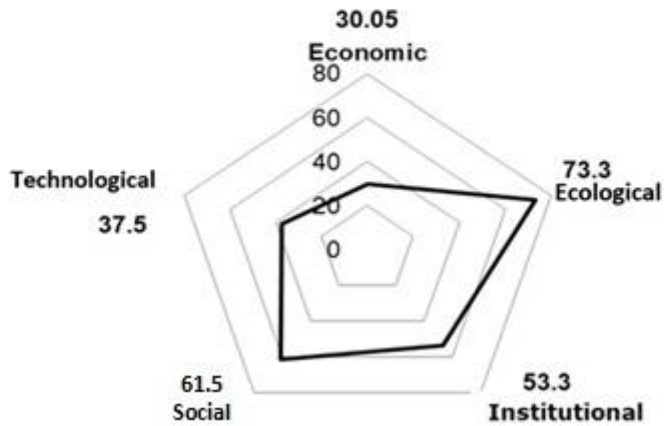

Figure 1. Values of the five dimensions of the sustainability index of the seaweed cultivation business in the natural waters of East Sabu District, Sabu Raijua Regency.

Based on the results of the multi-dimensional Rap-RL software on the multidimensional sustainability of seaweed cultivation in the waters of the East Sabu District, Sabu Raijua Regency, the exiting value obtained is 50.53%, which means this seaweed cultivation business unit is categorized as quite promising. The number 50.53 is a high number to determine the status of business continuity (Van Zanten & Van Tulder 2021). This value was obtained based on an assessment of 10 sample data from 5 dimensions of analysis, namely the ecological, technological, economic, socio-cultural and institutional dimensions. From the results of the analysis, the position of the sustainability index value point is in the positive quadrant (Figure 2), which means that management is going in a good direction (Huan et al 2020). The sustainability index value obtained is considered good, but efforts are still needed to improve the attributes that have a negative impact on the sustainability index value and maintain and even increase the attributes that have a positive impact on the sustainability index of seaweed cultivation. The implementation of the analysis is carried out with the hope that future activity projections will still be profitable (Ariadi et al 2019c).

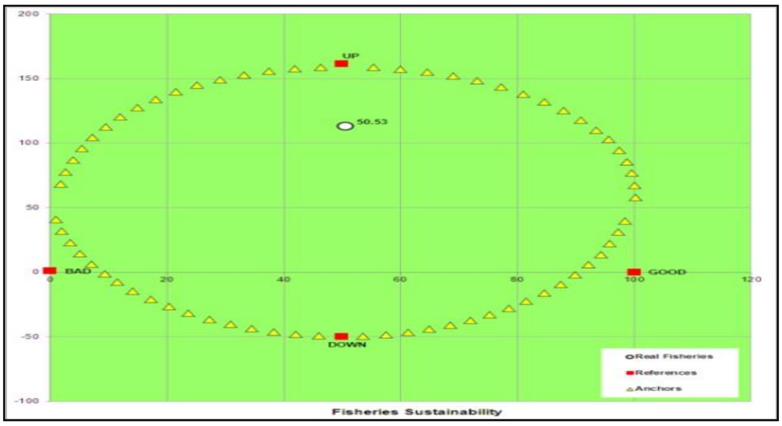

Figure 2. Multidimensional sustainability index of seaweed cultivation in the natural waters of East Sabu District, Sabu Raijua Regency.

The results of the analysis of the sustainability index of seaweed cultivation activities in East Sabu District, Sabu Raijua Regency are classified as very prospective and have the potential to be developed. This can be seen from the various attributes of biophysical and economic factors that exist in the current cultivation management system. Biophysical and economic feasibility factors are considered to play an important role in the sustainability of the aquaculture cycle (Kok et al 2020). So that it is expected to support the improvement of local people's livelihoods and economic income (Purnomowati 2015). Based on the above analysis, it is shown that ecological sustainability (water quality) and technology (cultivation methods) will determine the level of economic sustainability (profits). From the results of this modeling, a qualitative analysis was found based on the MDGs model to determine the projected status of the sustainability of seaweed cultivation in an analytical manner. Modeling analysis can be used for the evaluation of the biological sciences or economics (profits) (Ariadi et al 2021b).

Conclusions. Seaweed cultivation business in Sabu Raijua Regency, based on the analysis of economic and biophysical feasibility status, is categorized as very feasible and profitable to be developed in the future, with a note that the attributes of appropriate seaweed cultivation management are considered.

Conflict of interest. The authors declare no conflict of interest.

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