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To cite this article: S A Adha Taridala *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **382** 012037

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Income and cost efficiency of lobster farming in Soropia, Southeast Sulawesi, Indonesia

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Abstract. Lobster is one of the main export commodities of the Indonesian aquaculture sector. Marine farmers often face challenges in developing their businesses; for example, both lobster seed and feeds are only available during certain periods. This study aims to analyze the cost efficiency and to quantify the income of lobster aquaculture farming, in Soropia, Konawe District, Sulawesi Tenggara Province. All the lobster farmers in the area (42 households) were studied. The results show that (1) lobster farming business achieves cost efficiency, with the R-C ratio of 1.85, and (2) the average lobster farming income is Rp 6.070.342 (Rp 10,000- 1 US \$) for each production cycle (10 months). Agribusiness system development is expected to help lobster farming become more sustainable, especially in its cultivation sub-systems.

1. Introduction

Efforts to increase fisheries production are always carried out by the Indonesian government to encourage increased exports and also to meet domestic consumption needs. According to [1], the main objective of the government policy is to encourage increased income in order to improve the welfare of farmers and fishers. These efforts continue to be carried out, even enhanced where the 2015-2019 marine and fisheries development policies are established by taking into account the three dimensions of national development: human resources, leading sectors and territories [2].

One of the commercially important commodities from the fisheries sub-sector is lobster. Due to its high-value lobster has high demand both in domestic and international markets. In addition, because the demand exceeds production, the price of lobster is high and it is generally consumed mostly in the developed countries [3]. Therefore, due to high market demand, lobster farming has developed rapidly and most noticeably in Indonesia, especially in Southeast Sulawesi [4-5].

The phenomenon of lobster business development does not only occur in developing countries like Indonesia and Vietnam [6], but also occurs in developed countries such as America and Australia. In Indonesia, there are a lot of suitable areas for lobster culture. Many lobster-related studies have already been conducted in areas in Indonesia, including West Nusa Tenggara [7-8]; Yogyakarta [9-10]; Central Java [11], and Southeast Sulawesi [5,12-13].

One of the suitable areas for lobster farming in Southeast Sulawesi is the coastal area of Konawe Regency, Southeast Sulawesi. Juvenile lobsters (*puerulus*) as seed are collected by fishers from the



wild. *Puerulus* collectors use hand-nets [5]. One of the sub-districts in Konawe District, whose people collect lobster juveniles for farming is in Soropia. Although the business scale is still relatively small, the highly motivated farmers continue to be engaged in this activity, because the high selling price of lobster attracts them.

The main species of lobster farmed in Soropia are the ornate spiny lobster (*Panulirus ornatus*), also known as pearl lobster (“mutiara”), painted spiny lobster or bamboo lobster (“bambu”) (*P. versicolor*) and long-legged spiny lobster (*P. longipes*). Among the three species, pearl lobsters were the most cultivated species because of its better sale price. On the other hand, lobster prices are very volatile and can vary every 2-3 days with a rate of decline or increase of 10-20%. However, most lobster prices tended to increase rather than decrease. The highest prices of lobster usually take place especially during the new year, Eid, Christmas and Chinese New Year.

Most lobster farming is still considered as an alternative occupation [14]. The scale of lobster cultivation is also still small, with the main problem faced being the availability of seed produced from hatchery to meet the business needs of lobster farmers. Lobster seed is entirely from by catch. In addition, artificial feeds are not yet available. The lobsters are fed almost exclusively on trash fish (small pelagic fish) fully supplied from by catch. Because this feed supply is very dependent on fishing activities, it is not available at any time, especially during the full moon. Therefore, the availability of seeds and feed are limiting factors that curtail the expansion of lobster farming [12] and need to be solved for supporting sustainable lobster farming.

The use of some inputs for supporting lobster farming is also a problem. It can lead to an increase in production costs. If the production costs increase, the efficiency of lobster cultivation can decrease, resulting even in losses. If this situation gets worse, the motivation to farm lobster will be lost. It will then finally cause a decrease in the lobster supply. Reduced lobster supply will create scarcity in the market and ultimately encourage price increases.

This research is vital for the development of the lobster farming business that has bright prospects, both from the aspect of supply and demand. Comparing with the latest lobster-related studies which mostly focussed on lobster productivity, this current study was taking an effort to fill such the gap which previously unconsidered, in this case, business development of lobster farming becomes one of the factors that can increase income. Achieving cost and income efficiency from lobster farming is significant to ensure business sustainability. If the charges in business are managed efficiently, then this will be one of the key points to achieve optimal revenue. This condition will finally encourage farmers to be more motivated in managing their sustainable business.

2. Methods

2.1 Location and data sources

The research was conducted in Soropia, Konawe Regency because this area is one of the production centers for lobster farming in Southeast Sulawesi. Data were collected from May to June 2012 in 5 (five) villages: Tapulaga, Bajo Indah, Mekar, Bokori, and Soropia. Primary data were obtained from interviews with all 42 farmers. Secondary data was from the Village Office, Soropia District Office, and other publications.

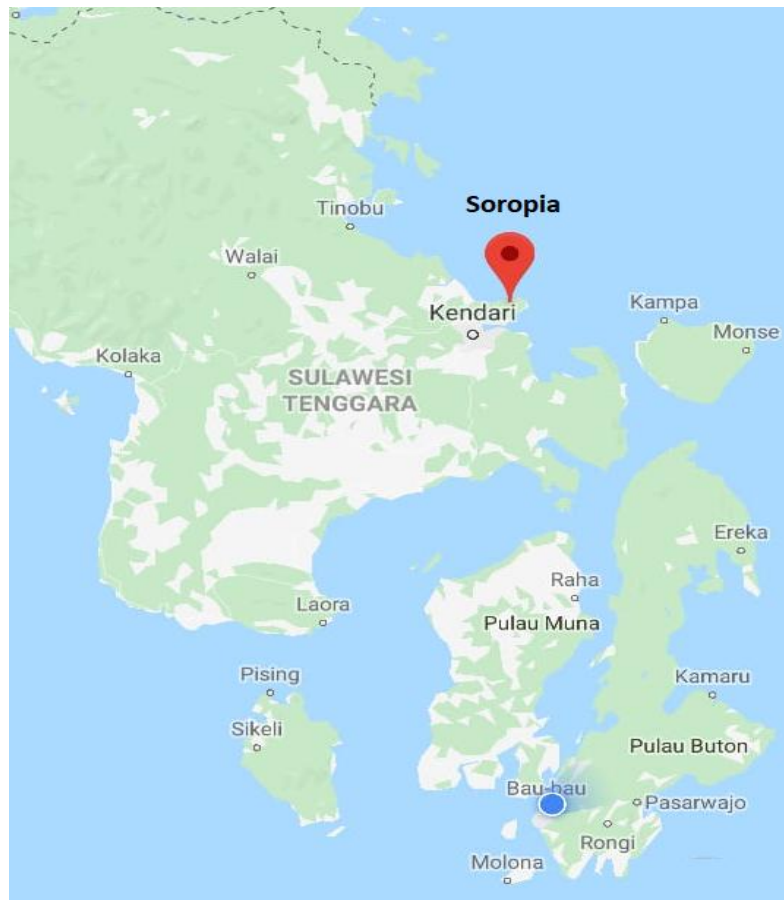


Figure 1. Soropia, Konawe Regency, Southeast Sulawesi (Source: Google Map).

2.2 Data analysis

The first research objective about cost efficiency was analyzed using R-C Ratio, while the second objective related to the income of farmers, income analysis was used R/C is the ratio between total revenues obtained to the total costs incurred. R is total revenue and C is the total cost. The criteria used are if the cost of $R/C > 1$, then the business is profitable; if the value of $R/C = 1$, then business activities are not profitable; and if the R/C value is < 1 , then the managed business suffers a loss.

The business income obtained was calculated by the formula:

$$\pi = R - C$$

where:

$$R = Y * P_y$$

$$C = TVC + TFC$$

$$= X_i * P_{xi} + TFC$$

Notes:

π = Income (IDR)

R = Total revenue (IDR)

Y = Lobster production (Kg)

P_y = Price per kilogram of lobster (IDR)

X = Amount of *i*-input

P_{xi} = Price of input to-*i*
 C = Total cost (IDR)
 TVC = Total variable cost (IDR)
 TFC = Total fixed cost (IDR)

3. Results and Discussion

The lobster farming area in Soropia district is located in coastal areas. It is very potential for the development of the lobster farming business. The objective of this study is substantially to provide such a piece of valuable information for related stakeholder in developing lobster farming to achieve sustainable business. Besides, it also would give supporting information for the future academicians who has the same effort in conducting lobster farming studies.

The northern part of the sub-district is directly adjacent to the Banda Sea. The location of the area thus encourages some people to farm the lobster as a primary source of income.

3.1 Cost efficiency of lobster farming

There are several analytical tools used to assess the efficiency or non-use of inputs in the production process. [15-16] used a frontier production model to analyze the efficiency of lobster production in India and New Zealand, respectively, while [17] uses the Data Envelopment Analysis (DEA) approach in Vietnam.

Production cost efficiency can also be analyzed using the R-C ratio. This method is easy to use and simple, especially in small-scale businesses managed by communities. With a relatively simple count, it can be concluded whether a business can provide benefits or not. Analysis of the R-C ratio also provides an overview of the efficiency of the costs incurred in the business managed. Some studies that apply this analysis can follow previous studies done by [18-19].

In the present study, the calculated cost component consisted of fixed costs (TFC) and variable costs (TVC). Fixed costs included the cost of net-cage maintenance, depreciation of equipment, and electricity for lighting net cages. Whereas variable costs or operating costs were expenses incurred by farmers for seed inputs, and feed in the form of fresh trash fish. In this study, the opportunity cost for the use of family labor and business land was not included in the cost component. Not taking into account the opportunity costs in studies on small scale businesses was very common in Indonesia. If taken into account, the results obtained of this business were not feasible, because the total costs were very large, so the business was not profitable. The information about the cost components and the number of costs incurred are presented in Table 1.

Table 1. Costs and their components of lobster farming in Soropia, Konawe Regency, SE Sulawesi

Parameters	IDR/year	Percentage of Total Cost (%)
a. Fixed costs		
– Net cage maintenance	33,474	0.47
– Depreciation	1,208,684	16.99
– Electricity	268,571	3.78
Total fixed cost	= 1,510,729	21.24
b. Variable costs/ operating costs		
– Seed	3,888,453	54.66
– Fresh trash feed	1,714,451	24.10
Total variable costs	= 5,889,049	78.76
c. Total cost	= 7,113,633	100.00

The results of this study show that variable costs were the highest component cost in lobster farming, reaching 78.76 percent of the total cost. If analyzed per input Component wise, lobster seed were the most top input (54.66 %) of variable costs. These findings are similar to the previous study done by [5] where they found the percentage for purchasing seed to be around 67%. Higher costs of seed caused by the price of mutiara lobster seeds were very expensive due to the difficulties in getting the seed. All seeds were obtained from local collectors or imported from outside of the study area such as from Bali and Pangandaran, West Java.

All lobster seed used were from fishing area as previously described [e.g. 3, 6-8], 10, 20-21]. Lobster seed are an uncertain input because they are very dependent on the local and abundant supply of naturally settling *puerulus* [5]. Moreover, seed availability is very seasonal. Until now, there is no commercial hatchery (hatchery) that provides lobster seed continuously [12]. [22] already emphasized that even in developed countries, it is difficult to establish a hatchery for lobster. Some problems still exist to establish the hatchery such as long-lived life cycles, slow growth rate, and complex reproductive behavior [23].

The second input component that incurs substantial costs of about 24.1 percent of the total cost was feed. Like a seed, feed is also still fully obtained from the wild fishery. No industry provides formulated feeds. [24] argue that for small-scale cultivation businesses, fresh, natural feed is still suitable. But for large-scale cultivation, the use of forage that relies on nature is not sustainable.

The present results showed that the total revenue of respondents ranged between IDR 2,532,000.00-IDR 59,913,000 (Rp 10,000 = 1 US \$) per production cycle. If average, each respondent receives a mean revenue of IDR 13,183,975 per cycle. The variation in the amount of revenue obtained by farmers was due to the difference in the number of lobsters sold and the selling price received by each respondent. The findings [14] in Lombok showed that the rate of return on investment in lobster cultivation depended largely on the price and availability of seed.

The price of lobster in Soropia increases during the holidays such as Chinese New Year, around September-October every year. Higher production followed by the higher selling price of the product, the more significant the total revenue received. Conversely, the fewer the number of products and the lower the selling price, then the income will decrease. For entrepreneurs, information about the comparison between total revenue and total costs incurred in one production cycle is essential. The value of R-C will give an idea of the state of the business, whether it is feasible to continue or not. Information about the value of R/C of lobster farming is presented in Table 2.

Table 2. Total cost, total revenue, and R/C ratio

No.	Parameters	Value (IDR/ cycle)
1.	Total Cost(C)	7,113,633
2.	Total Revenue(R)	13,183,975
R-C Ratio : R/C		1.85

The R/C value obtained was 1.85. It indicates that lobster farming business managed by farmers was profitable. Every cost incurred by IDR 100,000, will provide a revenue of IDR 185,000. Thus the profit earned was IDR 85,000 per production cycle. Some of the results of research related to lobster farming business in Indonesia provided R/C values > 1.00 [23], there were even cultivation businesses whose R/C values reached 12.88 [22].

3.2 Lobster Cultivation Income

The amount of income from lobster cultivation will significantly affect the sustainability of the business managed by farmers. If the profits obtained are large, the farmers will be motivated to continue to cultivate lobster. Conversely, if the income earned is low or even losers, then lobster farming will be stopped. In this study, the terms 'income' is used, not 'profit,' because opportunity costs are not calculated as components of production costs.

The commercial lobster business is an attractive proposition, because most of its species are of high value, due to high demand. This market demand encourages substantial research and development efforts throughout the world to develop lobster cultivation technology [25]. But on the other hand, cultivation related to marine carnivores, including lobsters, has come under heavy criticism because the amount of consumption is more significant than the cultivation effort. Therefore, sustainable cultivation efforts are needed [26]. The income earned by the farmer largely determines business sustainability.

Business income is calculated from the difference between total revenues and total costs. The results show the income from lobster farming in each harvest cycle or in each cultivation period as shown in Table 3.

Table 3. Total Costs, total revenues, and lobster farmer revenues

No.	Parameters	Value	Value (IDR/ cycle)
1.	Total Cost (C)		7,113,633
2.	Total Revenue (R)		13,183,975
R-C Ratio		= R-C	6,070,342

The mean income for lobster farming was IDR 7,113,633 per harvest cycle. The amount of income earned in lobster cultivation was determined not only by the volume of yields affected by the survival rate of lobsters but also by the price of seed and feed. Seed costs are the largest component in lobster farming (54.66%), and costs for feed (24.10%). The income from lobster farming could be still increased by providing seeds and feed sustainably as well as increasing the scale of business from what is currently available.

The amount of total income obtained by farmers was IDR 13,183,975 per harvest cycle. While the total cost incurred was IDR 7,113,633. The mean income of respondents from the lobster farming business in Soropia was IDR 6,070,342 per cycle. Since lobster farming takes around ten months per harvest cycle, then the monthly income was IDR 607,034/month. This income was lower than the Southeast Sulawesi Provincial Minimum Wage in 2012, which was IDR 1,032,300 or less than IDR 425,266.

4. Conclusions

Lobster farming in Soropia is efficient and the cost-effective. The farming was feasible thus can be developed as profitable source of income and a lucrative livelihood if it is managed commercially. An average income of lobster farming was IDR 6,070,342 per harvest cycle or equivalent to IDR 607,034 per month. At last, to achieve maximum profits from lobster farming, the inputs such as seed supply, cultivation method, post-harvest handling, and lobster marketing should be carried out in an integrated manner. This integrated activity is a manifestation of the lobster agribusiness system

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