Thesis for the Degree of Master of Business Administration

A Financial Analysis of Lobster Aquaculture: Reviewing Indonesia Lobster Regulation Management

by

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Department of Marine & Fisheries Economics and Business

The Graduate School

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August 2020

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바닷가재 양식업의 재무 분석: 인도네시아 바닷가재 규제 관리 검토

Advisor: Prof. Hee Dong Pyo

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A Financial Analysis of Lobster Aquaculture: Reviewing Indonesia Lobster Regulation Management

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Abstract

One of the aquaculture commodities that have high economic value and potential to be developed in Indonesia is lobster aquaculture. The potential number of Indonesian lobster seeds reaches 12.3 billion (Puerulus/transparent lobster). Indonesia has 6 tropical lobster species that located in Indonesian waters: 1) Sand green lobster (*Panulirus Homarus*); 2) Batik lobster (Panulirus longipes); 3) Pearl Lobster (*Panulirus Ornatus*); 4) Rock lobster (Panulirus penicillatus), 5). Brown bamboo lobster (Panulirus polyphagus); and 6) Green Bamboo lobster (Panulirus versicolor).

Tropical lobster or spiny lobster (Panulirus spp. or Palinurus spp.) is one of the four main categories of commercial lobster species in the world: European lobster (Homarus Gammarus), American lobster (Homarus americanus), rock lobster (Jasus spp.), and tropical lobster or thorny (Panulirus spp. or Palinurus spp.).

The most dominant seed lobster species which is caught by fishers are *Panulirus Ornatus* and *Panulirus Homarus*. Most of the lobster seeds caught are exported to other countries to raise in lobster farming. This study aims to analyze the financial feasibility of lobster farming (for the two species) using capital budgeting models such as Net Present Value (NPV), Internal rate of Return (IRR), Benefit Cost Ratio (BCR), Payback Period and sensitivity analysis is employed according to the changes in key parameters (+/- 10%).

Discount rate that used in this study is 5% for 20 years. The result of this research shows that the NPV value of Panulirus Ornatus aquaculture in the next 20 years is US$14,392, IRR value of

43%, B/C Ratio 1.28, and getting payback in the second year. While the result of lobster analysis *Panulirus Homarus* aquaculture is that the NPV aquaculture is US$ 11,564, IRR value is 35.8%, the B/C ratio is 1.27, and gaining payback is in the second year.

Through switching value, lobster selling price and production results are the most sensitive parameters. The figure shows that the price of Panulirus ornatus lobster could not go down more than -15% which is USD $ 22.59 while the selling price of Panulirus Homarus lobster also could not decrease over -13% which is US $ 17.74. If both lobsters price decline to -15% for Panulirus ornatus lobster and -13% for Panulirus Homarus lobster, the NPV of the project or activity will be 0. This score highlights that the project has equal value with the social opportunity of cost capital. Whereas the most non-sensitive level of the parameter in both lobster farming are lobster seed price and interest rate. In figures 8 and 9, the line graph illustrates that the rate of seed price (blue line) and interest rate (red line) is lower compared to other parameters.

A recommendation that can be considered by the government is to review the lobster management regulation. From the studies that have been carried out, it is known that growth-out the lobster is quite beneficial. While in existing scientific journals that the survival rate of lobster seeds in nature is only 1% and lobster seeds are cultured in cages with husbandry and good nutrition consistently, the survival rate can be up to 90%. The recommendation for seed lobster farmers is to try to raise the seed lobsters to the optimal size demanded by the market. Given, by raising lobster it will be more profitable.

Acronyms and Abbreviations

ACIAR – Australian Center for International Agriculture Research

BCR – Benefit Cost Ration

CBA – Cost Benefit Analysis

DKP – Fisheries and Marine Agency

FCR – Food Conversion Ration

IDR – Indonesia Rupiah

IRR – Internal Rate of Return

KKP – Ministry of Fisheries and Marine Affair

PBP – Payback Period

PERMEN KP – Regulation of Ministry

NPV – Net Present Value

NCF – Net Cash Flow

SR – Survival Rate

USD – United State Dollar

CHAPTER 1. INTRODUCTION

1.1. Background of study

The marine and fisheries commodities are one of the sectors driving the Indonesian economy. The marine and fisheries sector contributed 6.25% to the national gross domestic product at IDR 62.24 Billion or USD 4.4 Million (Kompas.com. 2019). One of the commodities of fisheries that has high economic value and potential to be developed in Indonesia is lobster fisheries. The potential areas of marine culture are 290,000km2 and it was only utilized 24.21%. Otherwise, lobster seeds are extremely easy to find in some areas in Indonesia which can support developing lobster industry (Ervin at all, 2017).

Based on data released by the ministry of maritime and fisheries affairs, the number of lobster eggs in Indonesian waters is predicted to reach 278 billion eggs, lobster larvae 250 billion, puerulus (lobster seed transparent) 12.3 billion. That means Indonesia considers a huge lobster potential to be developed.

However, at the beginning of 2015, the KKP established rules for managing the utilization of lobster resources that were contra-productive, which then drew much criticism. The regulation is contained in Permen KP No. 1 of 2015 concerning catching lobster (Panulirus spp), Crab (Scylla sp), and Rajungan (Portunus pelagicus spp). The lobster with carapace length <8cm with a minimum weight of 200g should not be caught. In 2016 the minimum weight will be 300g based on a regulation of the Minister of Fisheries and Maritime Affairs No.18/MEN-KP / 1-2015. The regulation is contra-productive with the effort of developing the lobster industry. Whereas in terms of ecology, scientific research states that the survival rate (SR) of lobster seeds in nature is terribly low. The results of research conducted by the Australian Center for International Agriculture Research (ACIAR) that SR lobster seeds in nature are only 1%. If lobster seeds are

cultured in cages with husbandry and good nutrition consistently, the SR will be above 90% (Priyambodo and Sarifin, 2009).

Economically sales of lobster seed and lobster farming have contributed a beneficial impact on the local livelihood of coastal communities. For long term, the farmer able to earn more than one million rupiahs (80 USD/day) and socially many people who used to work as a migrant laborer in a foreign country can have a business in its area.

One of the lobsters producing areas in Indonesia is West Nusa Tenggara (NTB) in Lombok Island. Lobster farming from transparent seed size to consumption size only exists in the east and central Lombok. Most of lobster seed catches that are still transparent are sold to collectors to export to Vietnam illegally.

Demand for lobster seeds from Vietnam cannot be dammed because of the high price of lobster seeds. For example, in 2008, the price of seeds in Lombok was only around 1500 - 2500 IDR/piece (Suastika at all, 2008) while in 2014 it rose to 14,000-24,000 IDR/piece (Witomo, 2015). Therefore, there are many lobster exporters who still export lobster seeds even though there is regulation prohibiting them. Since 2015-2018 there have been at least 7.4 million lobsters which will be exported illegally.

1.2. Problem of study

In 2015, the Ministry of Fisheries and Maritime Affairs made regulations relating to the management of lobster catching (Permen KP No. 1 of 2015 and Permen KP No.56 2016). In these policies, many are drawn criticism because according to the research conducted by ACIAR aquaculture is one way to increase lobster survival rate in nature. Therefore, the authors conducted a study related to the feasibility analysis of lobster aquaculture by using the Cost-Benefit Analysis Method to measure lobster culture from transparent size to a certain size.

1.3. Objective of Study

This study aims to determine alternative policies on managing lobster utilization by considering economic aspects by analyzing the financial lobster farming. This research is conducted at one of the lobster farming centers in the village of Telong Elong, East Lombok, Indonesia. Additionally, Panulirus Homarus and Panulirus Ornatus lobster species become the main objects. The core of this research is to analyze the economic feasibility and the potential profit on both species. Then, it can be one of the considerations in making policy.

1.4. Benefit of the study

The benefit of the study is:

1. To find out the financial feasibility of lobster aquaculture business
2. To find out which is more profitable whether the sale of seeds or aquaculture
3. To get an alternative view of making policy.

CHAPTER 2. INDONESIA LOBSTER AQUACULTURE & PREVIOUS STUDY

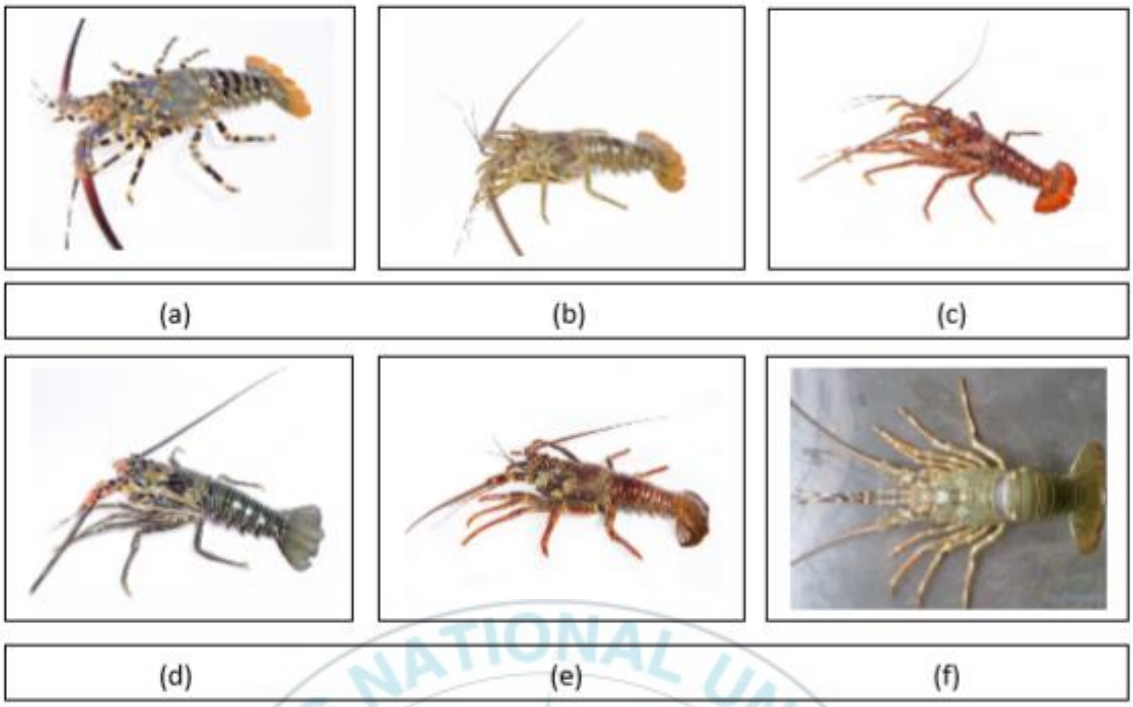
2.1. Spiny Lobster

In English term, lobster is identified as spiny or rock lobsters. Spiny lobster is one of the Palinuridae classes divided into eight genera and 47 species. However, there are only 33 commercial species spread in tropical to subtropical zones. (Lipcius & Eggleston, 2000).

According to Hilal (2015), there are six species of spiny lobsters in Indonesian waters: 1) Sand green lobster (*Panulirus Homarus*); 2) Batik lobster (Panulirus longipes); 3) Pearl Lobster (*Panulirus Ornatus*); 4) Lobster rock (Panulirus penicillatus); 5). Brown bamboo lobster (Panulirus polyphagus); and 6) Green Bamboo lobster (Panulirus versicolor).

The 6 species of spiny lobster which were discovered in Indonesia waters, they can be found in Lombok Island. Based on the surveyed data of lobster seeds (Samsul et all, 2014) from 2007 to 2014, it has been confirmed that there are six species found in the waters of Lombok namely *Panulirus Homarus*, *Panulirus Ornatus*, P. Versicolour, P. Longipes, P. Penicillatus, and P. Polyphagus.

Lobster aquaculture was first started in Indonesia in the southeast of Lombok Island, in the province of West Nusa Tenggara (Figure 1). In this case, lobster seeds were first discovered, and targeted fishing was developed.



Source: Cornelia 2015

Figure 1. (a). Panulirus Ornatus (Mutiara), (b). Panulirus Homarus (Pasir), (c). Panulirus longipes (Batik), (d). Panulirus versicolor (Bambu), (e). Panulirus pemicillatus (Batu), and (f). Panulirus polyphagus.

2.2. Seed Supply

The supply of seed lobster however depends on the natural capture. According to the data released by the Indonesia Ministry of fisheries and marine affair 2020, the total estimation of lobster seed is 12.2 billion pieces. The seed sink to some areas in Indonesia included in Lombok waters. Between 2009 and 2012, the number of lobster seeds in Lombok was relatively stable, which was at 600,000 seeds per year. In 2013, there was a significant increase in the number of lobster seeds' catches. This rise is due to the modification of fishing gears by fishermen, as well as the number of fishermen in the early of 2013. The amount of lobster seeds' catches in 2013 has rose dramatically to 3 million seeds. Moreover, there are two dominant species: *Panulirus Homarus*

and *Panulirus Ornatus* which contribute more than 99% of the captured seed. Between 2012 and 2013, the *Panulirus Homarus* seeds rose significantly from 63.27 % to 86.65 %. Whilst *Panulirus Ornatus* seeds showed a dramatic decrease to twice (35.73 % to 13.35 %).

Figure 2. Seed Lobster (transparent)

2.3. Seed Fishing

Fishing methods of seed lobsters were first developed in Vietnam in the mid-1990s (Jones et al. 2010). Indonesia fishermen generally make their equipment using bamboo to form rectangular frames with styrofoam floats. This frame is then positioned at a depth from 5 to 20 m and usually located 100 to 500 m from the beach adjacent to the village. Every morning, traps are taken from the water and lobster seeds. Typical frame sizes range from 3 × 3 m, with around 10 to 30 trap lines suspended from each frame. The material used for trapping was originally a plastic rice sack that had been cut into pieces and bundled to make a rosette that contained many sides and gaps (Figure 3). These rice bag bundles are tied to a rope at 1 m intervals, so that each row can have five to 20 bundles per row, depending on its depth. Thus, the frame may have 200 to 300 traps installed. Traplines are usually arranged so that the terminal traps are 1 m above the seabed. Since 2010, fishermen have increasingly used recycled cement bags to make habitat traps. Rice bags and cement bags are the cheapest, but cement bags seem to support better catch rates. In addition to replacing materials, cement bags have been used to make different trap styles. The bag with

two layers of plastic and paper is folded in a concertina style. Afterwards, it tied in the middle to make a 'bow-tie' like a unit with a few gaps. In this case, the trap is very similar to the gap collector used in Australia and New Zealand for lobster stock valuation studies (Booth and Tarring, 1986). Bow ties are attached to a rectangular piece of the web that is held taught by a wood frame, creating a trap wall (Figure 4), which is then suspended from a floating frame.

Figure 3. Typical bow tie collector from Indonesia (Jone, 2019)

Figure 4. Floating frame

2.4. Feeding

Farmers feed lobsters with low-value fish. Telong Elong lobster farmers purchase low-value fish when they could get it cheaply at Rp 3,000-10,000 per kg. They also use golden snails and freshwater fish as food resources for lobster which is cheaper at Rp 3,000-8,000 per kg. The

farmers could not estimate the real amount of needed feed per day or for the total of the harvesting period. It might be 500 g/cage per day for lobster under 3 months and 1 kg/cage per day for lobster for more than 3 months.

Figure 5. Golden Snail and Freshwater Fish

2.5. Grow-Out and Harvest

There are two sorts of grow-out phases which are distinguished by the lobsters' movement to cages with various sizes, stocking densities, and feeding pattern. The average grow-out of phase 1 is 1-3 months and the initial stocking density in the first phase is 9 lobsters/m3, where the seed grows to approximately 13 - 30 g. Phase 2 takes longer between 6 and 7 months and the density in this phase is 3 lobster/m^3. The length of both grow-out phases combined is approximately 8–10 months, with an average harvest size of 200–300g per lobster. *Panulirus Homarus* can grow up to 1 kg in size. It matures at approximately 300–500g. afterwards, its growth rate slows significantly (Jones 2011). The average survival rate from stocking to harvest was about 70 percent. The harvest price received by farmers was IDR 350,000-450,000/kg (USD 21-30/kg).

(a) (b)

Figure 6. a). Panulirus Ornatus (mutiara) size 1-2kg, b). Panulirus Ornatus (mutiara) size 200-250gr.

2.6. Market

Indonesia has 6 tropical lobster species that located in Indonesian waters: 1) Sand green lobster (*Panulirus Homarus*); 2) Batik lobster (Panulirus longipes); 3) Pearl Lobster (*Panulirus Ornatus*); 4) Rock lobster (Panulirus penicillatus), 5). Brown bamboo lobster (Panulirus polyphagus); and 6) Green Bamboo lobster (Panulirus versicolor).

Tropical lobster or spiny lobster (Panulirus spp. or Palinurus spp.) is one of the four main categories of commercial lobster species in the world: European lobster (Homarus Gammarus), American lobster (Homarus americanus), rock lobster (Jasus spp.), and tropical lobster or thorny (Panulirus spp. or Palinurus spp.).

The lobster commodity in international trade is listed in 10 HS codes. The 10 HS lobster codes record the trade of lobsters in the form of live, frozen, processed. the ten HS codes can be seen in the table 1.

Table 1. HS Code Lobster Commodity

No	HS CODE	Description
1	30611	Crustaceans; frozen, rock lobsters and other sea crawfish (Palinurus spp., Panulirus spp., Jasus spp.), in shell or not, smoked, cooked or not before or during smoking; in shell, cooked by steaming or by boiling in water
2	30612	Crustaceans; frozen, lobsters (Homarus spp.), in shell or not, smoked, cooked or not before or during smoking; in shell, cooked by steaming or by boiling in water
3	30615	Crustaceans; frozen, Norway lobsters (Nephrops norvegicus), in shell or not, smoked, cooked or not before or during smoking; in shell, cooked by steaming or by boiling in water
4	30621	Rock lobster & other sea crawfish (Palinurus Sp,. Panulirus spp., Jasus spp.), other than frozen
5	30622	Lobster (Homarus), not frozen
6	30631	Crustaceans; live, fresh or chilled, rock lobsters and other sea crawfish (Palinurus spp., Panulirus spp., Jasus spp.), in shell or not
7	30632	Crustaceans; live, fresh or chilled, lobsters (Homarus spp.), whether in shell or not
8	30694	Crustaceans; Norway lobsters (Nephrops norvegicus), smoked, cooked or not, whether in shell or not, whether or not cooked before or during smoking

9	30691	Crustaceans; rock lobsters and other sea crawfish (Palinurus spp., Panulirus spp., Jasus spp.), smoked, cooked or not, whether in shell or not, whether or not cooked before or during smoking
10	160530	Crustacean preparations; lobster, prepared or preserved

Lobster is also an export product. Based on export data sourced from comtrade.un.org, from 2018-2019 export volume grew by only 0.3% while the value of exports grew by 0.7%. However, if it is seen from 2010, which was 10 years before, export volume has grown by 53% while the exposure value has grown by 60%. In addition, from figure 7 it is also seen that the value of lobster continuously increases from year by year.

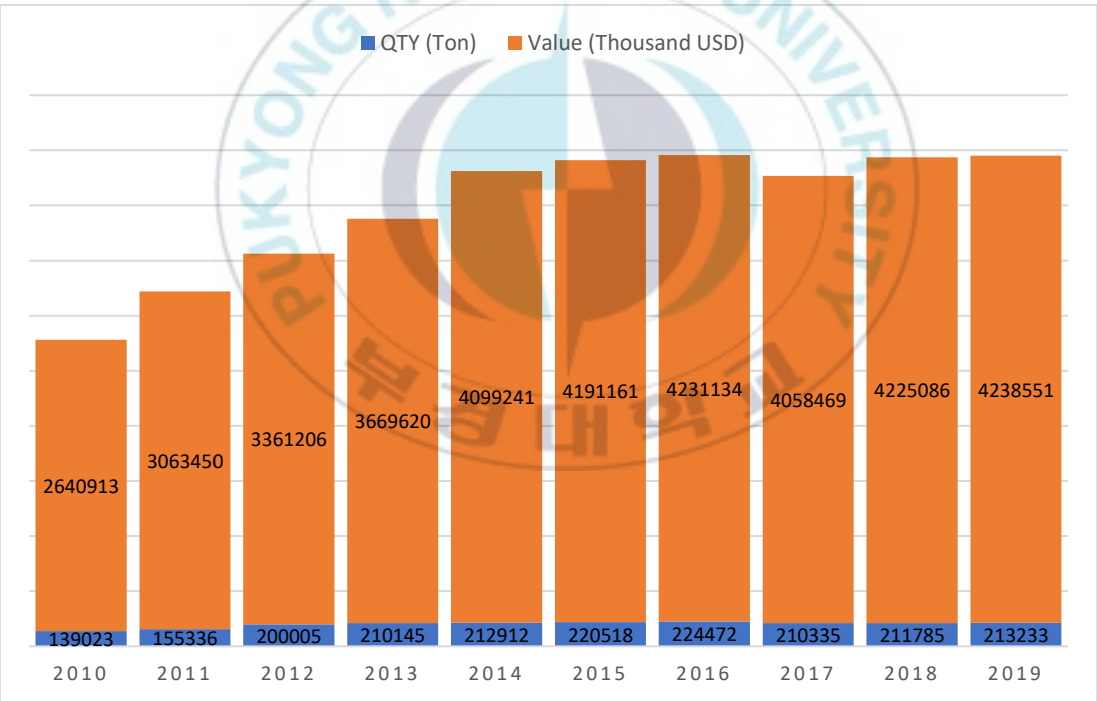


Figure 7. World: Quantity and Value of lobster import 2019. Source: Comtrade, 2020

Table 2. World: Quantity and Value of lobster import 2019

No	Country	Volume (Kg)	Value (USD)
1	USA	55381564	1,512,869,729
2	Canada	25957481	340,890,817
3	Italy	13910845	185,733,088
4	Spain	11250721	175,184,948
5	France	9746736	189,361,853
6	Hongkong	6557646	117,541,101
7	South Korea	5558964	124,276,918
8	UK	5023597	64,342,121
9	Belgium	3955630	90,450,969
10	Japan	3379820	82,360,761

Source: Comtrade, 2020 (Processed)

In 2019, the top 10 lobster importing countries are the USA, Canada, Italy, Spain, France, Hong Kong, South Korea, the UK, Belgium, and Japan. Of the ten lobster importing countries, the USA is a country that has quite high lobster prices. The average price of lobster sold in the USA is USD 27.32 per kg, the second country to buy the highest lobster is Japang, Japan buys lobster an average of 24.37 per kg. Furthermore, the price of Belgium, with an average lobster price of 22.87 per kg, and Korea with an average lobster price of 22.36.

While, in 2018 Indonesia exported 1,958 tons of lobster with an export value of $ 29,903,683. Indonesia's main export market is China. The number of Indonesian exported lobster to China is 442,522 kg (22.6%) with an export value of $ 9,208,872. The second lobster export market is Hongkong, it generated 293,784 (15%) with an export value of $ 5,452,973. The third lobster export market is the USA which was at 816kg (0.04%) with an export value of $ 8.219.

2.7. Previous Study

In this research, it is used some data resources such as journals, thesis, and dissertation to obtain information. For instance, the research from Nugroho (2012) is that about The Analysis of The Impact of Legal-Size Input Production Minimum Policy on The Profitability Level of Mini Plant of rajungan (Crab). This study aim is to analyze the profitability of the mini plant. If the minimum legal-size input production policy is applied to the small crab processing plant. There are some methods that used in this study namely productivity analysis, efficiency analysis, NPV, IRR, BCR, and PBP analysis. The research results that the minimum legal-size input production policy can push the crab stock more stable, streamline the crab processing with optimal production, and increase the profitability of the small crab processing plant in the long term. Based on CBA calculations before applying the policy, it is known that the results of the CBA on Mr. Maulana's mini plant obtained NPV value = 1,194,566,292, IRR = 28%, and NET B / C = 4.67. After applying the minimum legal-size input production policy, the CBA calculation results on the mini plant of Mr. Maulana obtained NPV value = 1,508,365,375 IRR = 37%, and NET B / C = 6.45.

The second reference research is from Ilham (2018), it is about The Economic Analysis of Policy Making on Chondrichtyans Fishing Prohibition in Berau Regency, East Kalimantan. The background of this research is the applied policy regarding the prohibition of catching shark species in Berau region. The purpose of this study reveals the impact of this policy to local fisherman. The methods that are used namely Cost Benefit Analysis, Regulatory Impact Assessment, and CIIP Evaluation Model. The result of this study is the components that are impacted divided into two industry: fisheries and tourism. The fisheries industry's actual value is IDR 750,653,298 per month with a productivity rate of 16.92. The tourism industry brings the total value of Rp 35,067,076,021 per month. In conclusion, the policy that applied gives benefits to the societies.

The last reference is thesis by Razak (2015), he was used a CBA, NPV, IRR, BCR analysis as its approaches. In addition, the object in this study is How the Organic Waste Processing Unit could bring benefits from the side of employment retribution, and waste management particularly how this OWPU will perform on the private management. Afterwards, it will be found the strategy for the development of the OWPU entitled Analysis of Economic Benefits and Strategies for Development of Organic Waste Processing Unit in Depok City. It estimates the economic value from the side of employment, retribution, and waste processing. This will calculate the feasibility aspects of the OWPU, SWOT analysis to develop the OWPU. The output of this analysis is more than IDR 400 million from waste processing, and the NPV is more than IDR 500 million with the discount factor of 14%. The calculation of NPV, IRR, and Net B/C shows a significant score of feasibility. Then, the SWOT results to supporting the government's policy.

Table 3. Previous Study

NO	Sources	Problem of Study	Objective of Study	Research Method	Result of Study
1	Nugroho, 2012: Analysis of The Impact of Legal-Size Input Production Minimum Policy on The Profitability Level of Mini Plant of Rajungan (Crab)	What is the profitability level of small crab processing plants if using small crab production inputs with a size of more than eight centimeters (applying the minimum legal-size input production policy)?	Analyzing the profitability of the mini plant if the minimum legal-size input production policy is applied to the small crab processing plant.	Productivity analysis, Efficiency, NPV, IRR, B/'C Ratio and, PBP Analysis.	Based on CBA calculations before applying the policy, it is known that the results of the CBA on Mr. Maulana's mini plant obtained NPV value = 1,194,566,292, IRR = 28%, and NET B / C = 4.67. After applying the minimum legal-size input production policy, the CBA calculation results on the mini plant of Mr. Maulana obtained NPV value = 1,508,365,375 IRR = 37%, and NET B / C = 6.45.

					The minimum legal-size input production policy can push the crab stock more stable, streamline the crab processing with optimal production, and increase the profitability of the small crab processing plant in the long term.
2	Ilham, 2018: Economic Analysis of Policy Making on Chondrichtyans Fishing Prohibition in Berau Regency, East Kalimantan	What are the components that are affected by the implementation of the chondrichtyans fishing prohibition policy?	To estimate the components that will be impacted by the policy and to find an appropriate policy alternative.	Cost Benefit Analysis, Regulatory Impact Assessment, and CIPP Evaluation Model	The components that are impacted divided into two industry: fisheries and tourism. The fisheries industry's actual value is IDR 750,653,298 per month with a productivity rate of 16.92. The tourism industry brings the total value of Rp 35,067,076,021 per month.

3	Razak, 2015: Analysis of Economic Benefits and Strategies for Development of Organic Waste Processing Unit in Depok City	How the Organic Waste Processing Unit could bring benefits from the side of employment retribution, and waste management. How this OWPU will perform on the private management. And finding the strategy for the development of the OWPU	To estimate the economic value from the side of employment, retribution, and waste processing. To calculate the feasibility aspects of the OWPU. And to perform a SWOT analysis to develop the OWPU	Total net benefit, NPV, IRR, Net B/C, and SWOT analysis	More than IDR 400 million from waste processing, and the NPV more than IDR 500 million with the discount factor of 14%. The calculation of NPV, IRR, and Net B/C shows a significant score of feasibility. And as the SWOT result to supporting the government's policy.

CHAPTER 3. RESEARCH METHODS

3.1. Location of the study

The study conducted in Telong Elong located in the south of East Lombok. Administratively Telong Elong belongs to the Pemongkong Village area, Jerowaru District, East Lombok Regency. In Telong Elong, there are several floating net cage centers as lobster culture sites with an area of 42.13 hectares (KKP, 2020).

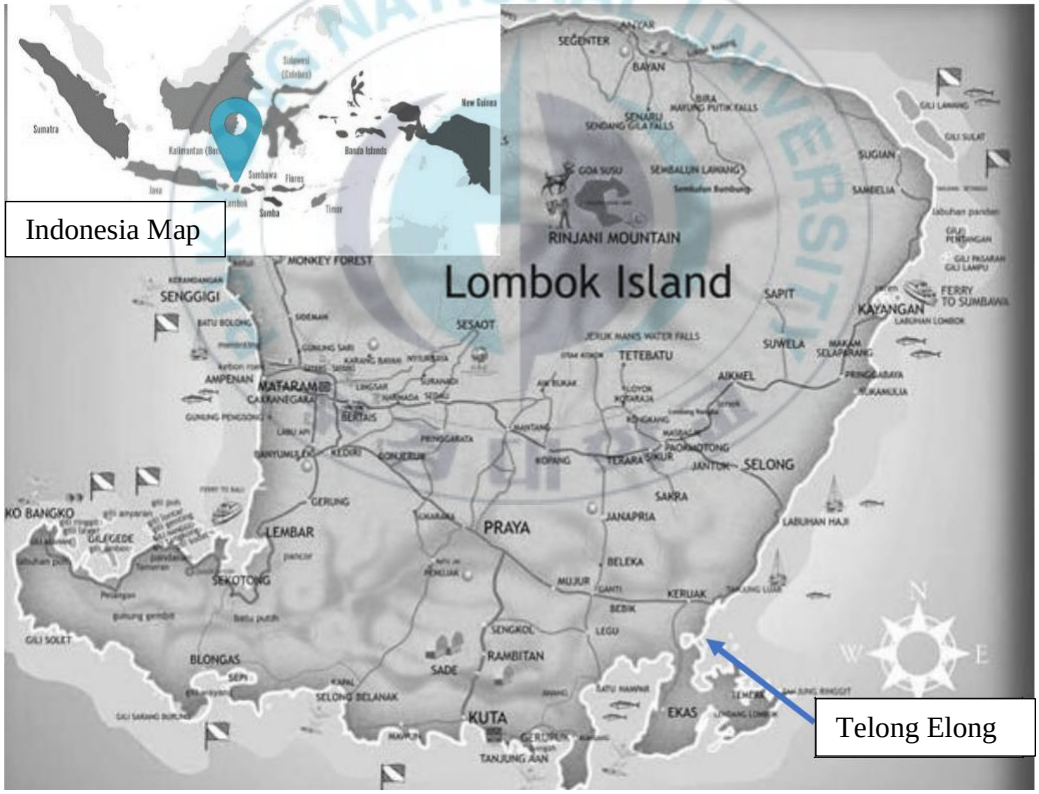


Figure 8. The location of the main lobster grow-out regions on Lombok Island and the key-informant interviews. (Google Map, 2020)

3.2. Types and sources of data

In this research, the researcher uses primary and secondary data. Primary data are data collected directly on the research object and secondary data is data collected from previously published publications and literature related to the research object. Primary data collected are investment and operational cost for lobster enlargement, lobster seedlings, lobster feeds, lobster sales, lobster business challenges, and risks. Secondary data obtained from academic publications and literature are lobster export data, lobster seed catch data, lobster prices, and other related data in this study.

3.3. Financial Feasibility Parameters and Indicators

To estimate costs and benefits, it depends on certain time horizon. Economic feasibility indicator is a comprehensive measure as the basis for acceptance or rejection for an activity that is usually called the investment criteria (eligibility criteria).

In order to find a comprehensive measure, various methods have been developed which is called investment criteria. This measurement becomes a basis for assessing the feasibility of the project. The criteria commonly used and recommended to evaluate this project are as follows:

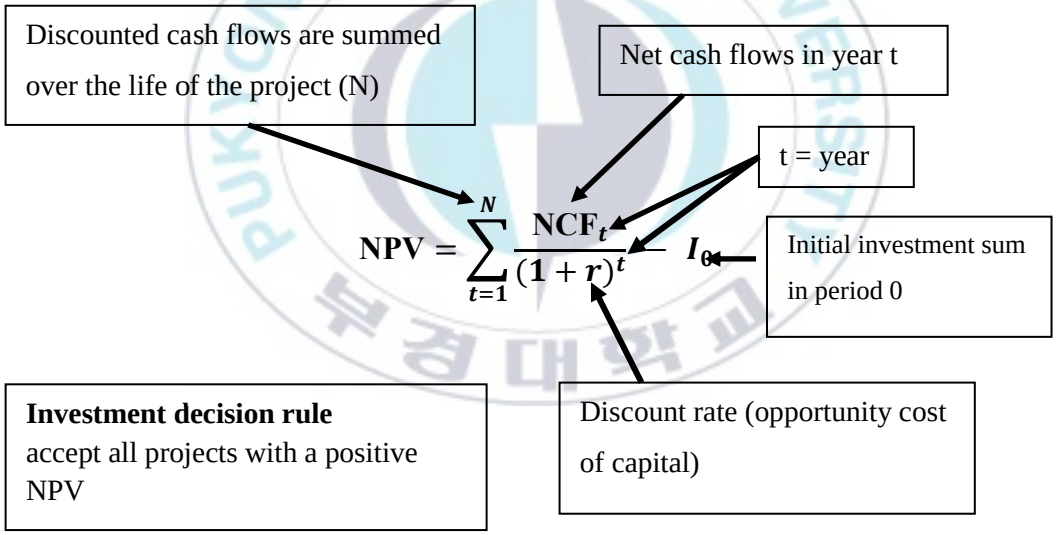
1. Net Present Value (NPV)

2. Internal Rate of Return (IRR)
3. Benefit Cos Ratio (BCR)
4. Payback Period (PBP)

One of the advantages conducting a reliable economic evaluation is individuals or businessmen could estimate the project result. If they will face unpredictable problems which do not be planned in initial plan project. Consequently, due to the irrelevance of assumptions, it needs to conduct sensitivity analysis (Iman, 2018).

3.3.1. Net Present Value (NPV)

NPV is cost deviation which generally formulated to calculate Net Present Value as follows:

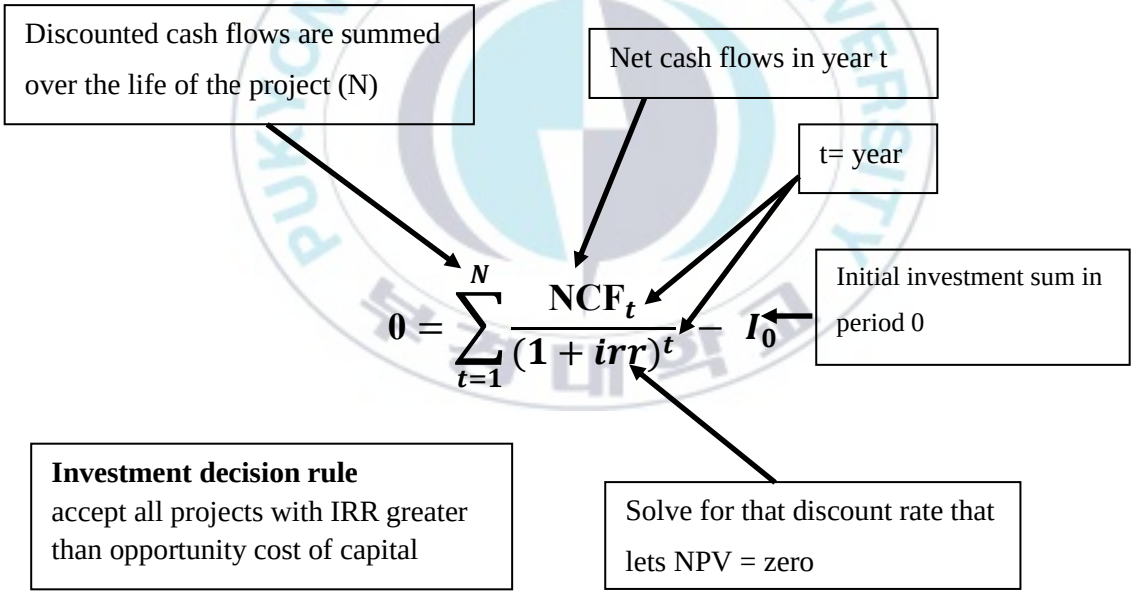


In evaluating economic activities, it will be accepted if NPV ≥ 0. If NPV = 0, it indicates that activity returns exact value such the social opportunity cost of capital. If the NPV <0, the activity is better canceled since there are other uses that are more profitable.

3.3.2. Internal Rate of Return (IRR)

The internal rate of return method (IRR) is the most widely used rate of return method to explain technical economic analysis. This method provides a solution for the discount rate (interest rate) or average discount which shows the equivalent of the equivalent value of cash inflows (revenues or savings) to the equivalent value of cash outflows (payments, including investment costs).

IRR is the value of the discount rate *r* that makes NPV over activities at 0, namely:



If the IRR value of a project is the same as the value of *i* which applies as a level of social discount, then the NPV of the activity is 0. If the IRR < social discount rate means NPV < 0. Therefore, the IRR value ≥ level of social discount shows the activity accepted, while the IRR < social discount rate highlights that the activity is rejected.

The feasibility calculation is calculated by two methods, namely the with-without project approach and with the project approach in total. The with-without project approach assumes that the investments made are financed with additional profits due to the development. The single approach or with project approach assumes that old and new investments are financed by the total profits obtained.

The NPV, BCR, and IRR calculations are based on the net cash flow of each approach taken. For a with-without project, the calculation is based on the difference between the net cash flow with the project and the net cash flow without the project then compared to the investment costs.

The proposed project is considered feasible if NPV ≥ 0, BCR ≥ 1 and IRR ≥ social discount rate. In Indonesia, there is no general social discount rate set by BAPPENAS, but the figures used usually to refer to criteria applied by the World Bank or the Asian Development Bank, which is 10-15%.

3.3.3. Benefit Cost Ratio (BCR)

Benefit Cost Ratio is a comparison between the present value of the benefits and the present value of the costs. The equation used to calculate BCR is as follows:

$$BCR = \frac{\sum_{t=0}^{n} \frac{Bt}{(1+r)^t}}{\sum_{t=0}^{n} \frac{Ct}{(1+r)^t}}$$

or

$$\text{B/C Ratio} = \frac{\text{present value of benefit stream}}{\text{present value of cost stream}}$$

Where Bt, benefits in period t; Ct, costs in period t; n, life of the investment; r, discount rate

If the value of BCR = 1, then the value of NPV = 0. If the equation gives a higher result than 1, then NPV> 0. If BCR ≥ 0 then the project is feasible to work on, if BCR <1 then the project is not feasible to work on.

3.3.4. Payback Period (PBP)

The payback period method comes to be the desired thing. This method calculates the number of years needed for cash inflows to equal cash outflows. In general, the formula for PBP calculation is as follows:

$$PBP = \sum CIF - \sum COF = 0$$

Variations from the simple payback period produce the breakeven life of a project based on the value of money to the time. This method does not consider the economic life of physical assets.

Thus, will be misleading if one alternative has a longer (less desirable) payment period than the other, resulting in a higher rate of return (or present value, PW) on the invested capital.

Through two approaches, namely by subtracting without the project (with-without) and with the project (with a project) only, it produces different PBP values. For a with-without approach, since investment is only financed with additional PBP profit, it takes longer than the with-only approach. PBP results from the calculation by with approach become faster because the assumption is that investment is financed with all profits earned each year.

3.4. Sensitivity Analysis

Sensitivity analysis is an analysis method to determine the effect of changes in production parameters into transformation in the performance of production systems in generating profits (Kasmir, 2010). The possible consequences of these changes can be recognized and anesthetized beforehand. The reason for doing a sensitivity analysis is to anticipate the following changes: 1. Cost overrun or costs increase, such as construction costs, raw material costs, production, etc. 2. Declining productivity 3. Pulling back from the project implementation schedule.

Sensitivity is also one of analysis method that determine uncertainty in business. It assesses the rate of business sensitivity of the variable changes such as: if there is down price (x%) or the increasing expense of operating cost (y%).

The steps in sensitivity analysis:

- calculate base case NPV
- decide key factors that are likely impact the project outcome

- determine the most likely changes in value or quantity of each key variable
- rework the analysis to determine effect of a change in each key variable
- interpret the results
    - calculating switching values

The switching value is a calculation to measure the maximum change of an inflow component changes (output prices declining, production decreasing) or change in outflow components (rising input prices or production costs) that can still be allowed for business to remain viable. This calculation refers to how much the change occurred until the NPV is equal to zero (NPV = 0).

3.5. Incremental Net Cash Flow

An incremental cash flow is the key to capital budgeting. According to Stephen, at all, (2015) Cash flow is not accounting income, there is a big different between corporate finance courses and financial accounting courses. Techniques in corporate finance generally use cash flows, whereas financial accounting generally stresses income or earning numbers. Certainly our text follows this tradition: our net present value techniques discount cash flows, not earning. When considering a single project, we discount the cash flows that the firm receives from the project. When valuing the firm as a whole, we discount dividends-not earning-because dividends are the cash flows that an investor receives.

Always discount cash flows, not earnings, when performing a capital budgeting calculation. Earning do not represent real money. You cannot spend out of earning, you cannot eat out earnings, and you cannot pay dividends out of earnings. You can do these things only out of cash flows.

In addition, only cash flows that are incremental to the project should be used. These cash flows are the changes in the firm's cash flows that occur as a direct consequence of accepting the project. That is, we are interested in the difference between the cash flows of the firm with the project and the cash flows of the firm without the project.

The equation as follows:

$NCF = (\Delta R - \Delta C - \Delta D) \times (1 - t) + \Delta D$

$NCF = [(R2 - R1) - (C2 - C1) - (D2 - D1)] (1 - t) + (D2 - D1)$

Note:

R2 = Revenue with a project

R1 = Revenue without a project

C2 = Cost with a project

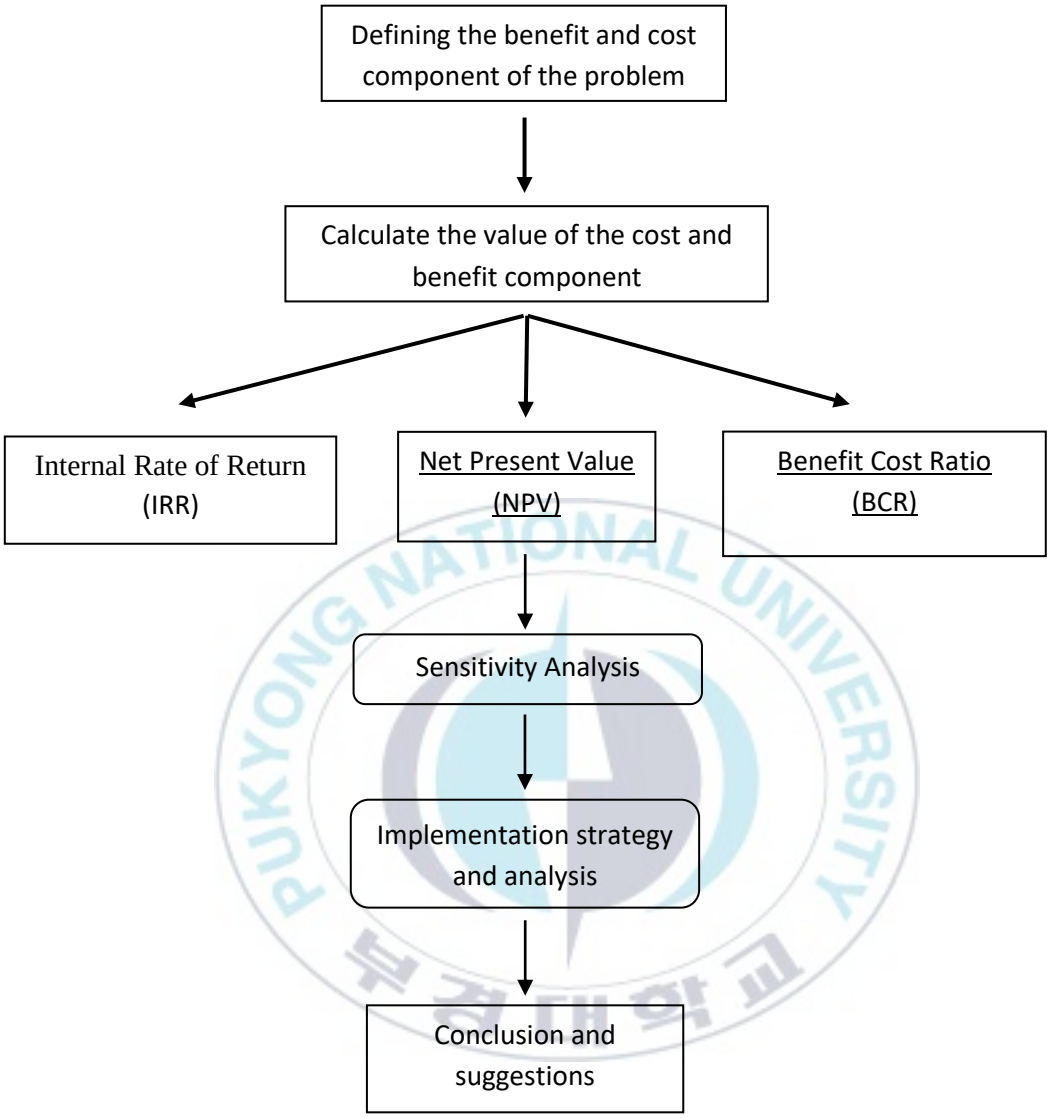
C1 = Cost without a project

D2 = Depreciation with a project

D1 = Depreciation without a project

t= time

3.6. Framework



CHAPTER 4. RESULT & DISCUSSION

4.1. Aquaculture Operation

4.1.1. Cage Information

In Telong Elong, East Lombok, Indonesia, lobster farming particularly for *Panulirus Ornatus* and *Panulirus Homarus* species is divided into two different phases (age group) namely lobster who live under 3 months and more than 3 months. Hence, those phases relate to the size of lobster cage that have to provide by the farmers for its growth which shows in table 1. Overall, it is obviously seen that both average cage of length (3 m), width (2.7), depth/height (2.7) and average size of cage (21) in phase 1 and 2 are similar. The difference is merely the average of mise size which is measured in (m^3) at 3 and 21, respectively.

Table 4. Cage Information

	Phase 1	Phase 2
Average cage length (m)	3	3
Average cage width (m)	2.7	2.7
Average cage depth/height (m)	2.7	2.7
Average size of cage (m3)	21	21
Average of mise size (ml)	3	17

Source: Primary Data (2020)

4.1.2. Aquaculture Operation

Based on the survey, most of lobster aquaculture are belonging to local fisherman. The owner raises the lobsters by themselves until harvesting process, so they do not expense extra money to

pay the employee salary or wage. In this following table, there are two data of aquaculture which is the Panulirus Ornatus and Panulirus Homarus lobster of aquaculture.

Table 5. Panulirus Ornatus and Panulirus Homarus Aquaculture Operation

	Panulirus Ornatus (Lobster Mutiara)	Panulirus Homarus (Lobsrer Pasir)
Number of Cages	16	16
Boat/unit	1	1
Production Period (month)	12	8
Seed (piece)	1075	1714
Feed Consumption (kg)	4680	2760
Fuel (liter)	360	360
Labor (person)	1	1
Sale Price (kg)	26.43	20.36
Average Size (kg)	0.4	0.2
Survival Rate (%)	70%	70%
FCR	15.6	11.7
Total Production	301	236

Source: Primary Data (2020)

Overall, it can be seen that there are some differences in both lobster farming. The first difference is duration. It needs 12 months to raise Panulirus ornatus while Panulirus Homarus lobster spends 8 months. Secondly, the food consumption ratio (FCR) shows a different score, the FCR of the Panulirus ornatus and Panulirus homarus accounted at 15.6 and 11.7, respectively. The third factor is the stocking density, the renewed solid Panulirus ornatus average is 2 records per m3. In stark contrast, the Panulirus homarus has an average thickness of 4. The difference in FCR and stocking density greatly affects the number of feed requirements for both lobster farming. During a year,

with the same amount of cage, the feed needs of Panulirus ornatus lobster is 4680 kg. It is higher compared to the Panulirus homarus which requires 2760 kg feed. The fourth difference is the average of harvest size, the farmer will harvest at 250-500gr of Panulirus ornatus. Other species (Panulirus homarus) will be harvested in a smaller size, it is 180-300gr. On the other hand, the growth in both lobster farming also shows in a different size. Panulirus ornatus lobster can grow up more than 2 kg. While Panulirus Homarus only grow 300-500gr. The last difference is the price. Panulirus ornatus lobster has a higher price compared to Panulirus Homarus lobster. Panulirus ornatus price for 250-500gr lobsters can reach IDR 350,000-400,000. While the price of the Panulirus homarus lobster is merely 200-300 thousand (rupiah).

4.1.3. Annual Operating Cost

Annual operating cost of *Panulirus Ornatus* and *Panulirus Homarus* is quite different regarding to the seed price and harvesting period factors. As the result, it impacts to the feed cost. To raising 300-500 gr of *Panulirus Ornatus*, it will need 11-13 months. Compare to *Panulirus Homarus* which has shorter time at 6-8 months, the size of this species is smaller approximately 180-300 gr. Furthermore, the size of harvested *Panulirus Ornatus* which is normally at 300-500 gr could reach in bigger size. It is more than 2 kg. Whilst the optimum size of *Panulirus Homarus* is only 180-300 gr. If the weight of this lobster reaches more than 300 gr, the growth will be slowly.

The operation period of the aquaculture lobster is depending on the lobster size (harvesting) and lobster species. Mutiara lobster will be harvested when they gain weight at 300 gr which takes 12-15 months. Other species, Pasir lobster spends shorter time for 6-8 months (since transparent seeds) with 200 gr sized. Moving to more detailed analysis of annual operating cost will be explained in this following data in table 8 and table 9.

Table 6. Cost Structure of Lobster *Panulirus Ornatus* Aquaculture

Unit	Quantity	Cost per Unit (USD)	Annualized Total Cost (USD/year)	Percentage (%)
Boat / unit	1	714.3	714.3	7.9%
Cage / unit	16	196.4	3142.9	34.8%
Seed / piece	1075	1.21	1305.4	14.4%
Feed / kg	4680	0.50	2340.0	25.9%
Fuel / year	360	0.47	169.7	1.9%
Labor / person / year	12	142.9	1714.3	19.0%
Contingency 10%			365.0	4.0%
Total			9037.2	100.0%

Source: Primary Data (2020)

Table 7. Cost Structure of Lobster *Panulirus Homarus* Aquaculture

Unit	Quantity	Cost per Unit (USD)	Annualized Total Cost (USD/year)	Percentage (%)
Boat / unit	1	714.29	714.29	8.4%
Cage / unit	16	196.43	3142.86	36.8%
Seed / piece	1714	0.43	1101.86	12.9%
Feed / kg	2760	0.50	2070.00	24.3%
Fuel / year	360	0.47	169.71	2.0%
Labor / person / year	1	142.86	1714.29	20.1%
Contingency 10%			334.00	3.9%

Total	8532.71	100.0%

Source: Primary Data (2020)

There is a difference in both lobster farming cost even it has a similar number of the cage. However, the percentage of annual costs of both lobster farming does not illustrate a significant distinction. The cage cost contributes the highest expense rather than other outcomes where it reaches 34% for Panulirus ornatus cost and 36% generated by the Panulirus Homarus farming. The second-largest cost is feed cost. The feed cost of both Panulirus ornatus and Panulirus ornatus was quite a difference at 25.9% and 24.3% respectively. Other costs are for employees, seeds, boat, and fuel costs.

4.2. Cost – Benefit Analysis of Policy Implementation

Cost – benefit analysis (CBA) is used to estimate the profitability of marine lobster cage farming. It is a tool that decision-makers use to choose among alternative courses of action and in deciding whether a proposed project should go ahead or not. The author uses net present value (NPV) and the internal rate of return (IRR) for evaluating the project. The calculation of cost-benefit analysis is by projecting the future income and transform it as present value (Net Present Value).

Discount rate that used in this study is 5% during 20 years. The result of this research shows that the NPV value of *Panulirus Ornatus* aquaculture in the next 20 years is US$14392, IRR value of 43%, B/C Ratio 1.28, and getting payback in the second year. While the result of lobster analysis *Panulirus Homarus* aquaculture is that the NPV aquaculture is US$ 11564, IRR value is 35.8%, the B/C ratio is 1.27, and gaining payback is in the second year.

Table 8. *Panulirus Ornatus Lobster* (Lobster Mutiara) Cash Flow Statement

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Sale Revenue		7942	7942	7942	7942	7942	7942	7942	7942	7942	7942	7942	7942	7942	7942	7942	7942	7942	7942	7942	7942
Residual Value of Boat						71					71					71					71
Residual Value of Cage					629				629				629				629				629
Total Cash Inflow		7942	7942	7942	8570	8013	7942	7942	8570	7942	8013	7942	8570	7942	7942	8013	8570	7942	7942	7942	8642
Cash Outflow																					
Investment																					
Boat	714	0	0	0	0	714	0	0	0	0	714	0	0	0	0	714	0	0	0	0	0
Cage	3143	0	0	0	3143	0	0	0	3143	0	0	0	3143	0	0	0	3143	0	0	0	0
Total of Investment	3857	0	0	0	3143	714	0	0	3143	0	714	0	3143	0	0	714	3143	0	0	0	0
Operating Cost																					
Seed		1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305
Feed (kg)		2340	2340	2340	2340	2340	2340	2340	2340	2340	2340	2340	2340	2340	2340	2340	2340	2340	2340	2340	2340
Fuel		170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170
Labour		1714	1714	1714	1714	1714	1714	1714	1714	1714	1714	1714	1714	1714	1714	1714	1714	1714	1714	1714	1714
Contingency 10%		365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365
Total of operating cost		5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894
Tax		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Cash Outflow	3857	5894.4	5894.4	5894.4	9037.2	6608.6	5894.4	5894.4	9037.2	5894.4	6608.6	5894.4	9037.2	5894.4	5894.4	6608.6	9037.2	5894.4	5894.4	5894.4	5894.4
Net Cash Flow	-3857	2047	2047	2047	-467	1405	2047	2047	-467	2047	1405	2047	-467	2047	2047	1405	-467	2047	2047	2047	2747
Pay Back	$ (3,857)	$ (1,810)	$ 238	$ 2,285	$ 1,818	$ 3,223	$ 5,270	$ 7,318	$ 6,851	$ 8,898	$ 10,303	$ 12,350	$ 11,883	$ 13,931	$ 15,978	$ 17,383	$ 16,916	$ 18,963	$ 21,011	$ 23,058	$ 25,806
NPV	14392																				
IRR	43%																				
B/C Ratio	1.28																				

Source: Primary Data (2020)

Table 9. *Panulirus Homarus* Lobster (Lobster Pasir) Cash Flow Statement

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Sale Revenue		7210	7210	7210	7210	7210	7210	7210	7210	7210	7210	7210	7210	7210	7210	7210	7210	7210	7210	7210	7210
Residual Value of Boat						71					71					71					71
Residual Value of Cage					629				629				629				629				629
Total Cash Inflow		7210	7210	7210	7839	7282	7210	7210	7839	7210	7282	7210	7839	7210	7210	7282	7839	7210	7210	7210	7910
Cash Outflow																					
Investment																					
Boat	714	0	0	0	0	714	0	0	0	0	714	0	0	0	0	714	0	0	0	0	0
Cage	3143	0	0	0	3143	0	0	0	3143	0	0	0	3143	0	0	0	3143	0	0	0	0
Total of Investment	3857	0	0	0	3143	714	0	0	3143	0	714	0	3143	0	0	714	3143	0	0	0	0
Operating Cost																					
Seed		1102	1102	1102	1102	1102	1102	1102	1102	1102	1102	1102	1102	1102	1102	1102	1102	1102	1102	1102	1102
Feed (kg)		2070	2070	2070	2070	2070	2070	2070	2070	2070	2070	2070	2070	2070	2070	2070	2070	2070	2070	2070	2070
Fuel		170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170
Labour		1714	1714	1714	1714	1714	1714	1714	1714	1714	1714	1714	1714	1714	1714	1714	1714	1714	1714	1714	1714
Contingency 10%		334	334	334	334	334	334	334	334	334	334	334	334	334	334	334	334	334	334	334	334
Total of operating cost		5390	5390	5390	5390	5390	5390	5390	5390	5390	5390	5390	5390	5390	5390	5390	5390	5390	5390	5390	5390
Tax		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Cash Outflow	3857	5389.9	5389.9	5389.9	8532.7	6104.1	5389.9	5389.9	8532.7	5389.9	6104.1	5389.9	8532.7	5389.9	5389.9	6104.1	8532.7	5389.9	5389.9	5389.9	5389.9
Net Cash Flow	-3857	1820.5	1820.5	1820.5	-693.8	1177.7	1820.5	1820.5	-693.8	1820.5	1177.7	1820.5	-693.8	1820.5	1820.5	1177.7	-693.8	1820.5	1820.5	1820.5	2520.5
Pay Back	$ (3,857)	$ (2,037)	$ (216)	$ 1,604	$ 911	$ 2,088	$ 3,909	$ 5,729	$ 5,036	$ 6,856	$ 8,034	$ 9,854	$ 9,160	$ 10,981	$ 12,801	$13,979	$ 13,285	$ 15,106	$ 16,926	$ 18,747	$ 21,267
NPV	11565																				
IRR	35.8%																				
B/C Ratio	1.27																				

Source: Primary Data (2020)

4.3. Sensitivity Analysis

Sensitivity analysis is a method to forecast with the results of a project analysis if there is a mistaken or a change in the basics of calculating of costs or benefits (L. Grant, 1996). Sensitivity analysis assesses what happens with the results of the feasibility analysis of an investment or business activity if there is a change in the calculation of costs or benefits (Kasmir, 2010). In this session, the parameters analyzed for sensitivity are lobster market prices, feed prices, seed prices, survival rates (SR), food conversion ratio (FCR) and interest rate values.

Table 10. Parameter levels used in the sensitivity analysis on the Lobster *Panulirus Homarus*

	Original Value	Value where NPV = 0	% Change
Seed Cost	1.21	2.29	88%
Feed Cost	0.50	0.75	49%
Sale Price	26.43	22.59	-15%
Production	301	257	-15%
Discount Rate	5%	43%	756%
SR	70%	50%	-29%
FCR	15.6	22.01	41%

Table 11. Parameter levels used in the sensitivity analysis on the Lobster Panulirus Homarus.

	Original Value	Value where NPV = 0	% Change
Seed Cost	0.43	0.79	84%
Feed Cost	0.50	0.72	45%
Sale Price	20.36	17.74	-13%
Production	240	206	-14%
Discount Rate	5%	36%	617%
SR	70%	52%	-26%
FCR	11.7	15.76	35%

Tables 10 and 11 are the results of sensitivity analysis using the switching value method. From 7 parameters that have been analyzed, lobster selling price and production results are the most sensitive parameters. The figure shows that the price of *Panulirus ornatus* lobster could not go down more than -15% which is USD $ 22.59 while the selling price of Panulirus Homarus lobster also could not decrease over -13% which is US $ 17.74. If both lobsters price decline to -15% for Panulirus ornatus lobster and -13% for Panulirus Homarus lobster, the NPV of the project or activity will be 0. This score highlights that the project has equal value with the social opportunity of cost capital.

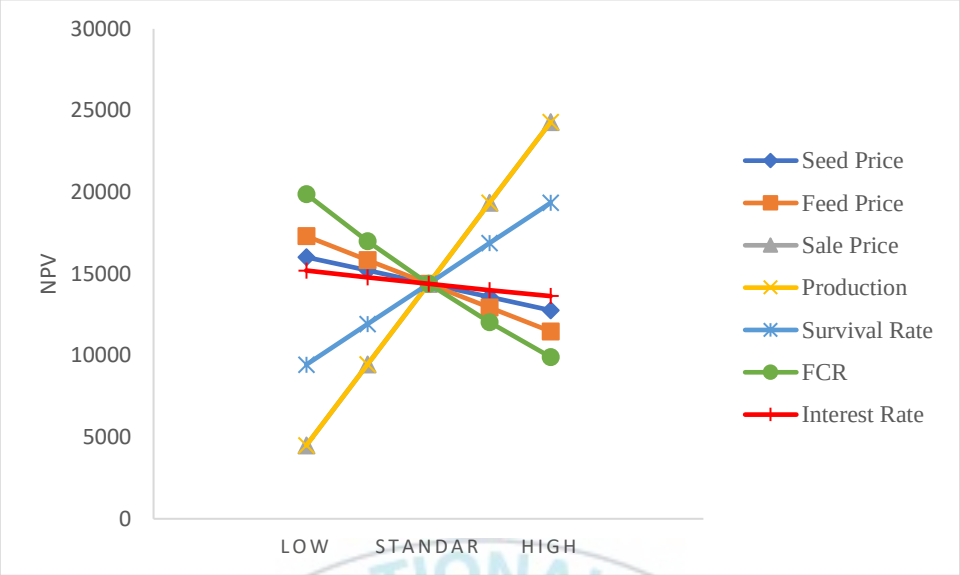


Figure 9. The sensitivity analysis shows the effect on the NPV due to the changes on lobster Panulirus ornatus farming key parameters

The most sensitive level parameter after selling price and total lobster production is the survival rate. The survival rate of *Panulirus ornatus* lobster farming should not go down to -29. If the survival rate reaches that number, the NVP of the two lobsters farming will be 0.

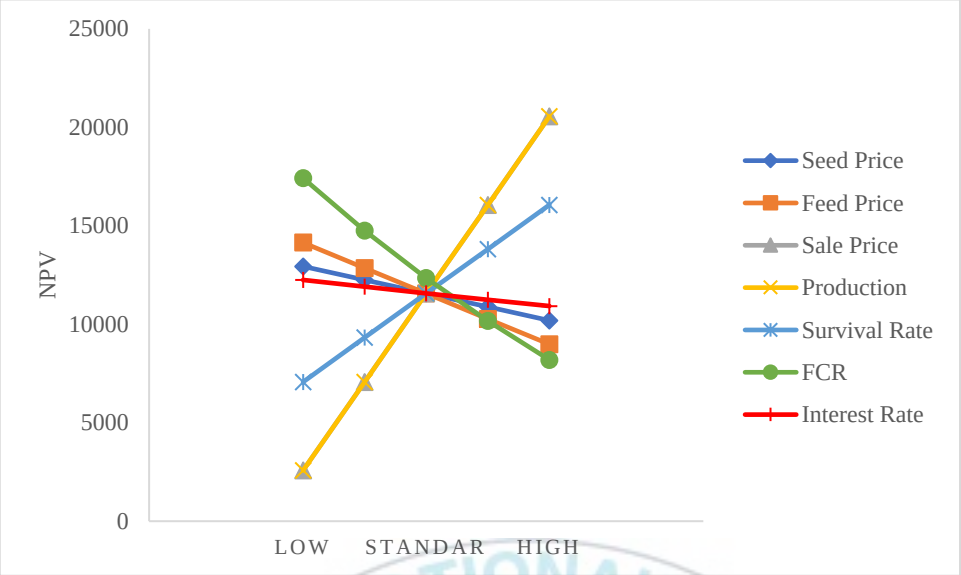


Figure 10. The sensitivity analysis shows the effect on the NPV due to the changes on lobster Panulirus Homarus farming key parameters

The third sensitive level parameter after selling price and total lobster production on the Panulirus Homarus farming is the survival rate. The survival rate on this farming should not go down to -26. If the survival rate reaches that number, the NVP of the two lobsters farming will be 0.

Whereas the most non-sensitive level of the parameter in both lobster farming is lobster seed price and interest rate. In figures 9 and 10, the line graph illustrates that the rate of seed price (blue line) and interest rate (red line) is lower compared to other parameters.

4.3.1. Sensitivity of Market Price

Market price changes dynamically which are influenced by demand and supply. The changes of supply and demand will influence the market price. Therefore, a price becomes one of the important parameters in this sensitivity analysis. In this study, when the price of *Panulirus Ornatus* and *Panulirus Homarus* lobsters dropped to 5-10%, the NPV value was still positive, while the cost declined to 21.14 USD and 16.3 USD, which comprised 20%, this business became very unfeasible since NPV changes to minus. In conclusion, the selling price of lobster is one of the quite sensitive parameters of both the lobster *Panulirus Ornatus* and *Panulirus Homarus*.

4.3.2. Sensitivity of Seed Price

The price of lobster seeds is influenced by the availability of seeds on the market. Commonly, the price of seeds will increase tremendously during the end of seed harvesting in nature. In striking contrast, it will be cheaper in the peak of seeds season. The lobster seeds will be abundant in May, June, and July (Samsul, 2014). After a sensitivity analysis was conducted on both *Panulirus Ornatus* and *Panulirus Homarus* farming. As a result, the price change of lobster seed is up to 20 % did not make the NPV reached 0 rates. NPV would reach in minus point when the lobster seeds of *Panulirus Ornatus* rise by >2.29 USD and *Panulirus Homarus* was >0.79 USD.

4.3.3. Sensitivity of Feed Price

Lobster farmers in Telong Elong, Lombok, Indonesia used trash fish feed when the price is low at 0.24-0.9 USD/kg. While, if the price increase, they will use freshwater fish as well as golden snails that collected from the field or buy from local farmers approximately at 0.2-0.71 USD/kg. Sensitivity to the rising of the feed price is not classified as a sensitive measurement. The local business of *Panulirus Ornatus* will not gain profitability when the price of fish feed rises to 0.75 USD (49%). For the *Panulirus Homarus* lobster farming, the business will not obtain a considerable profit when the nutrient feed rises to 0.72 USD (45%).

4.3.4. Sensitivity of Interest Rate

The interest rate determines the types of investments that will benefit entrepreneurs. The entrepreneurs will do the investment that they have planned only if the rate of return on the capital they obtain exceeds the interest rate. Thus the amount of investment in a certain period is equal to the value of all investments whose return on capital is greater or equal to the interest rate. If the interest rate is lower, more businesses have a higher rate of return on capital than the interest rate. The lower the interest rate that entrepreneurs must pay, the more business entrepreneurs can do. The lower the interest rate, the more investment is made by entrepreneurs (Sukirno, 1998).

Indonesia Bank as a central bank has an obligation to make the monetary policies of the country. Indonesia Bank decides how much money to print and determine the interest rates

of the loans given to banks. Interest rate used to overcome the overheated economy as a strategy in improving economic. The highest interest rate of indonesia is 12.75 while the lowests interest rate is 4.25

Table 12. Recent Indonesia Interest Rate

Actual	Previous	Highest	Lowest	Dates	Unit	Frequency
4.50	4.50	12.75	4.25	2005 - 2020	percent	Daily

Calendar	GMT	Reference	Actual	Previous	Consensus	TEForecast
2020-01-23	07:30 AM		5%	5%	5%	5%
2020-02-20	07:30 AM		4.75%	5%	4.75%	4.75%
2020-03-19	07:30 AM		4.50%	4.75%	4.5%	4.5%
2020-04-14	08:10 AM		4.50%	4.50%	4.5%	4.5%
2020-05-19	07:30 AM			4.50%		4.25%
2020-06-18	07:30 AM					4%
2020-07-16	07:30 AM					
2020-08-19	07:30 AM					3.75%

Go to our Calendar for more events. Or learn more about the Calendar API for direct access.

Figure 11. Interest Rate of Indonesia from 2010-2020

The discount rate is the most insensitive parameter. When the discount rate rises to 20% on the Panulirus Ornatus and Panulirus Homarus lobster farming, the NPV score is still positive. The NPV will become 0 when the discount rate increases by 43% in Panulirus Ornatus and 36% in Panulirus Homarus lobster farming, respectively.

4.3.5. Sensitivity of SR

Australian Center for International Agriculture Research (ACIAR) stated that SR lobster seeds in nature are only 0.01%. If lobster seeds are raised in cages with husbandry and good nutrition consistently, the SR will be above 90% (Priyambodo and Sarifin, 2009). Generally, based on data collected during the survey, the survival rate of lobster culture in Lombok is around 60-80%.

The sensitivity of the survival rate is quite sensitive when the survival rate of the two Panulirus Ornatus and Panulirus Homarus lobster farming dropped to 30%, the NPV value will be negative.

4.3.6. Sensitivity of FCR

The feed conversion ratio is a reliable indicator to evaluate feed efficiency as well as feeding proficiency. Currently, lobster aquaculture in Indonesia thoroughly relies on the trash fishes, gold snail, and freshwater fish; hence, the feed conversion ratio is higher comparing to the pellet feed because of high water ingredients and low concentration of nutrients (Li Nguyen, 2009). In this research, the FCR of lobster culture is estimated based on the reported information from farmers. Generally, the average FCR in Telong Elong area is 11.7-17.8, which means that to produce one kg of lobster, the needed fresh fish is 11.7-17.8kg.

The value of the food conversion ratio is received by dividing the total feed with a total of lobster. The FCR of Lobster *Panulirus Ornatus* was calculated to be 15.6 and *Panulirus Homarus* is 11.7. The business will not obtain profit when the nominal value of FCR in the aquaculture of *Panulirus Ornatus* lobster rises to 22.01 (41%). Whereas in the *Panulirus Homarus* lobster farming, it will not get the benefit when the FCR value rises to 15.76 (35%).

4.3.7. Sensitivity of Production

The survival rate (SR) of lobster seeds in nature is only around 1%. If lobster seeds are cultivated in floating nets by providing consistently adequate nutrition, SR will be above 90% (Priyambodo and Sarifin, 2009). In this study, the survival rate of lobster culture is 70. The sensitivity analysis of both species production, a 5-15% declining still shows stable productivity. Hence, the government should make a specific policy for farmers to provide 2% of their production as restocking. When the production -2%, it is still positive.

4.4. Challenge

The main challenge of lobster farming in Indonesia is the implement of advanced technology. Admittedly, in Telong Elong as well as some regions in Indonesia, farmers traditionally used natural food resources such as golden snails and trash fish. They do not applicate feeding technology which strongly believe could increase the amount of production. Moreover, the availability of lobster seeds only depends on natural ecosystem. Other contributing factors of the lower quality and quantity of lobster commodities are water management, diseases, and FCR. The lack of government support particularly in the lobster industry exacerbates this condition. The adverse effect in lobster aquaculture business is that the FCR in Indonesia is higher than Vietnam's. Besides, the lobster export market is still concentrated in China and Hongkong, so that when China is hit by a pandemic Covid-19 the price of lobster directly drops dramatically.

CHAPTER 5. CONCLUSION & RECOMMENDATION

5.1. Conclusion

The government prohibits the lobster seeds caught through the Minister of Fisheries and Maritime Regulations to maintain their ecological sustainability. However, scientific research that has been published by ACIAR states that the survival rate of lobster seeds in nature is 1%.

Therefore, the main objective of this work is to analyze the financial feasibility of lobster farming (for the two species) using capital budgeting models such as Net Present Value (NPV), Internal rate of Return (IRR), Benefit Cost Ratio (BCR), Payback Period and sensitivity analysis is employed according to the changes in key parameters (+/- 10%). This reveals the feasibility of whether lobster farming should be operated or not.

This research conducted in Telong elong, East Lombok. In the surveyed location, there are two dominant species that is caught by lobster seed fishermen namely Panulirus Homarus (Mutiara Lobster) and Panulirus Ornatus (Pasir Lobster). Both species contribute more than 99% of the seed caught. In 2012, 63.27% of the seeds caught were Panulirus Homarus and 36.73% were Panulirus Ornatus, whereas in 2013 Panulirus Homarus and Panulirus Ornatus seed caught represented 86.65% and 13.35% respectively (Samsul, at all, 2014). It shows that the number of the lobster seed of Panulirus Homarus was higher than Panulirus Ornatus proportion.

Discount rate that used in this study is 5% for 20 years. The result of this research shows that the NPV value of Panulirus Ornatus aquaculture in the next 20 years is US$14392, IRR value of 43%, B/C Ratio 1.28, and getting payback in the second year. While the result of lobster analysis

Panulirus Homarus aquaculture is that the NPV aquaculture is US$ 11564, IRR value is 35.8%, the B/C ratio is 1.27, and gaining payback is in the second year.

The sensitivity calculation used 7 parameters: seed cost, feed cost, market price, production, interest rate, SR, FCR. The sensitivity analysis using the switching value method. From 7 parameters that have been analysed, lobster selling price and production results are the most sensitive parameters. The figure shows that the price of Panulirus ornatus lobster could not go down more than -15% which is USD $ 22.59 while the selling price of Panulirus Homarus lobster also could not decrease over -13% which is US $ 17.74. If both lobsters price decline to -15% for Panulirus ornatus lobster and -13% for Panulirus Homarus lobster, the NPV of the project or activity will be 0. This score highlights that the project has equal value with the social opportunity of cost capital.

The third sensitive level parameter after selling price and total lobster production on the Panulirus Homarus farming is the survival rate. The survival rate on this farming should not go down to -26. If the survival rate reaches that number, the NVP of the two lobsters farming will be 0. Whereas the most non-sensitive level of the parameter in both lobster farming is lobster seed price and interest rate. In figures 8 and 9, the line graph illustrates that the rate of seed price (blue line) and interest rate (red line) is lower compared to other parameters.

5.2.Recommendation

The recommendation results of this study are that the government needs to review regarding lobster resource management policy. The financial analysis shows that both of lobster farming is quite feasible to run. By allowing fishermen to catch lobster seeds aquaculture, they will be able to create jobs for local community and other societies. However, the conditions of farming in the study site may be different from other locations. There are some factors such as the wave conditions, the availability of feed, and other things that can make investment costs, operational

costs differ. Therefore, further research is needed in other locations that have lobster seed availability. As the results, the policies that will be implemented will support better lobster management.

In addition, the government should consider building a lobster research center. This measure hopefully could help the farmers in providing a cheaper lobster seed. Next, the survival rate and FCR of lobster farming is more optimal. Lastly, Indonesia lobster industry could produce their own seeds in the future and reduce the depend on natural seeds.

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