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Article

Economic Impact Analysis of Reclamation Activities on *Rampus* (Gillnet) Fishery in Kaliadem, Muara Angke, North Jakarta

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Abstract: The Jakarta Bay reclamation has impacted capture fisheries, such as *rampus* (gillnet) fishermen in Kaliadem. This study aims to analyze the economic impacts of reclamation including its adaptation strategies, fishing business unit feasibility, fishermen's welfare, and post-reclamation policy options. Data were collected through surveys and a census and analyzed using analyses of spatial characteristics, feasibility, Fishermen Exchange Rate (NTN), qualitative description, and policy alternatives. The results indicate that the primary fishing grounds of *rampus* fishermen are directly affected by reclamation. The fishing units remain viable both before and after reclamation. Fishermen experienced a 41.86% decrease in income per trip, a 59.19% reduction in crew wages per trip, and a 38.16% increase in fuel consumption per trip. The Net Present Value (NPV) decreased from IDR 456,251,850 before reclamation to IDR 141,900,795 after reclamation. The Net B/C ratio dropped from 4.43 to 2.58, the Internal Rate of Return (IRR) declined to 30.22%, and the payback period extended by 1.13 years. NTN analysis showed a decline of 0.22 or 22.44% compared to pre-reclamation conditions. Adaptation strategies involve relocating fishing grounds and continuing fishing activities. Proposed alternative policies include increasing vessel size, providing fuel quota subsidies, and fisher relocation.

Keywords: economic impact; gillnet; reclamation; small scale fisheries; welfare economy

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1. Introduction

The management of the coastal area of Jakarta is carried out through the development of the Jakarta waterfront city. One form of the application of the Jakarta waterfront city concept is reclamation in Jakarta Bay (Coordinating Ministry for Economic Affairs, 2016). Based on the Regulation of the Governor of DKI Jakarta No. 121 of 2012, the reclamation area of the North Coast of Jakarta is a new land development area through the formation of small islands resulting from reclamation activities in the sea waters of Jakarta Bay in order to increase the benefits of land resources from an environmental and socio-economic perspective.

Reclamation has an economic impact on capture fisheries activities on the coast of Jakarta. Research conducted by Sampono (2013) shows that the reclamation of Jakarta Bay has an impact on the fisheries activities such as *payang*, *dogol*, *bubu*, gillnet, and green mussel cultivation with the economic benefit value of capture fisheries affected by reclamation of IDR 314.5 billion and the area of fishing grounds for fishermen that will be directly affected by reclamation activities of 1,527.34 ha. Reclamation was carried out along the eastern to western part of Jakarta Bay along 32 km by filling in the sea area, thus affecting the capture fisheries business on the coast of Jakarta (Jury *et al.* 2011). *Rampus* fishermen in Kaliadem, Muara Angke is one of the types of small-scale fisheries, affected by reclamation. Therefore, research is needed to analyze the economic and welfare impact of the reclamation project on *rampus* fishermen so that alternative policies for *rampus* fishermen can be identified.

Recent research increasingly shows that coastal reclamation and blue economy–driven development can place significant pressure on small-scale fishing communities, especially in densely populated urban coastal areas. Studies have documented how reclamation alters marine space, reduces access to traditional fishing grounds, and triggers competition over coastal resources, ultimately affecting fishers' livelihoods and income stability (Bennett *et al.*, 2021; Fabinyi *et al.*, 2022; Spijkers *et al.*, 2021). While coastal development is often framed as an engine of economic growth, several scholars argue that its social costs—particularly for traditional fishers—are still insufficiently acknowledment in planning and policy processes (Campbell *et al.*, 2021; Blasiak *et al.*, 2021). In many Asian coastal settings, environmental degradation associated with reclamation has also been linked to declining ecosystem services and increased livelihood vulnerability, yet most existing analyses remain broad in scope and do not capture the everyday realities of specific fishing communities or gear types (Islam *et al.*, 2021; Hossain *et al.*, 2021; Arkema *et al.*, 2021).

Despite this growing body of literature, key gaps remain in understanding how reclamation affects fishers at the household and business levels. Research on Jakarta Bay and comparable coastal areas has largely emphasized ecological change, governance challenges, or general sustainability assessments, with far less attention given to changes in business feasibility, welfare conditions, and income dynamics before and after reclamation (Patawari *et al.*, 2022; Lestari *et al.*, 2023). Although some studies acknowledge that fishers adopt various adaptation strategies in response to coastal transformation, few have systematically evaluated whether these strategies are economically viable or sufficient to sustain livelihoods over time (Harper *et al.*, 2022; Said *et al.*, 2024). Moreover, the limited use of micro-level and causal analytical approaches constrains the ability of existing studies to inform targeted and evidence-based policies for affected fishing groups (Queiroz *et al.*, 2021; Stephenson *et al.*, 2022; Bennett & Checkel, 2020). Addressing these gaps requires research that closely examines the lived experiences, economic performance, and adaptive responses of specific fishing groups—such as rampus fishers—within the context of urban coastal reclamation.

Based on the background and formulation of the problems that have been described, the objectives of this study are: (1) to analyze the impact of reclamation on the fishing areas of *rampus* fishermen; (2) to analyze the feasibility of *rampus* fishermen's businesses before and after reclamation; (3) to analyze the level of welfare of *rampus* fishermen before and after reclamation; (4) to identify adaptation strategies carried out by *rampus* fishermen to the impacts of reclamation, and (5) to analyze alternative policies for *rampus* fishermen impacted by reclamation.

2. Methods

2.1. Research Methods

The research method used is survey method. The study was conducted in Kaliadem, Muara Angke, Penjaringan District, North Jakarta. The location of the study was chosen intentionally (purposively) with the consideration that Kaliadem has the largest number of *rampus* fishermen among other traditional fishing bases in North Jakarta. The study was conducted in December 2017 - January 2018.

2.2. Data Types and Sources

The types of data used in this study are primary data and secondary data. Primary data were obtained through direct interviews using questionnaires to *rampus* fishermen and related stakeholders. Secondary data were obtained from literature studies, the internet, scientific journals, and related agencies such as Pluit Sub-district, the Technical Implementation Unit for the Management of the Muara Angke Fishery Port and Fish Landing Base Area, the DKI Jakarta Food Security, Maritime Affairs, and Agriculture Service and the DKI Jakarta Regional Development Planning Agency.

2.3. Data Collection Methods

The sampling method in this study was by census of 42 respondents. The respondents interviewed were daily *rampus* fishermen in Kaliadem, Muara Angke. Daily *rampus* fishermen are fishermen who carry out fishing activities at least once a day/ require 1 day (±9-12 hours per trip or one day trip). The stakeholders selected were 10 respondents. The determination of stakeholders used purposive sampling technique. This technique determines the sample by considering that the selected stakeholders are aware of the policy regarding the reclamation of Jakarta Bay. The stakeholders interviewed were the Technical Implementation Unit for the Management of the Muara Angke Fishery Port and Fish Landing Base Area, the DKI Jakarta Food Security, Maritime Affairs, and Agriculture Service, the DKI Jakarta Regional Development Planning Agency, and representatives of the *rampus* fishermen group in Kaliadem.

2.4. Data Analysis Methods

The data obtained in the study were analyzed qualitatively and quantitatively. Data processing was carried out with the help of computer programs, namely Microsoft Excel 2010 and ArcMap 10.1. The data were then processed and analyzed descriptively and presented in the form of tables, diagrams, curves, and mathematical calculations.

2.5. Spatial Analysis

Fishing ground data collection was conducted by direct interviews with respondents who fish around Jakarta Bay. Respondents were asked to indicate the location of the fishing ground on a map and mark the location. The map used was a map of Jakarta Bay before and after reclamation. The fishing ground data was then digitized using ArcMap 10.1. The map of Jakarta Bay before and after reclamation was obtained from research by Jury *et al*. (2011) and Sampono (2013). Data analysis to see changes in fishing areas before and after reclamation was carried out by overlay using ArcMap 10.1.

2.6. Feasibility Analysis of Fishing Business Unit

Feasibility analysis is carried out on financial aspects to obtain Net Present Value (NPV), Net B/C, Internal Rate Return (IRR), and payback period (Pasaribu 2012).

- NPV

NPV is the present value of revenue from the sale of the catch of *rampus* fishermen. NPV value ≥ 0 indicates that financially the fihermen's business unit is in the category of feasible to be implemented, NPV value = 0, indicates that financially the business is in the Break Event Point (BEP) category, and NPV value ≤ 0 indicates that financially the business is in the category of not feasible to be implemented. The calculation of NPV is as follows (Hasanah *et al* 2023):

$$\text{NPV} = \sum_{t=0}^{n} \frac{Bt - Ct}{(1+i)^t} \tag{2.1}$$

- Net B/C

Net B/C shows the comparison between the benefits and the costs. The calculation of net B/C is as follows (Hasanah *et al* 2023):

$$\text{Net B/C} = \frac{\sum_{t=0}^{n} \frac{Bt - Ct}{(1+i)^t}\text{, for } B_t - C_t > 0}{\sum_{t=0}^{n} \frac{Bt - Ct}{(1+i)^t}\text{, for } B_t - C_t < 0} \tag{2.2}$$

A fishing unit is in the feasible category to be implemented if the Net B/C value obtained is > 1. In conditions where the Net B/C value is < 1, then the fishing unit is in the category of not being feasible to be implemented financially and the business will be in the BEP condition when the value is:

- IRR

IRR is the interest rate value that produces an NPV value equal to zero. If the IRR value is greater than the bank interest (the discount rate used) then the business is considered profitable and financially feasible to be implemented. If the IRR value is smaller than the bank interest then the business is considered unprofitable and not feasible to be implemented. The IRR calculation is as follows (Hasanah *et al* 2023):

$$\mathrm{IRR} = \left| i_1 + \frac{\mathrm{NPV}_1}{\mathrm{NPV}_1 + \mathrm{NPV}_2}(i_1 - i_2) \right| \quad (2.3)$$

- Payback period

There are two methods of calculating the payback period depending on the amount of net benefit obtained each year, namely:

- Payback period calculation with the same amount of net benefit each year: $Payback\ period = \frac{Total\ invesment}{Net\ benefit/year} \times 1$ year (2.4)
- Payback period calculation with different net benefit amounts each year: $Payback\ period = n + \frac{a-b}{c-b} \times\ 1\ year$ (2.5)

The payback period calculation in the fishing business unit feasibility analysis used equation 2.5 with the amount of net benefit obtained by fishermen varying each year.

2.7. Fishermen Exchange Rate (NTN) Analysis

Fishermen Exchange Rate is the ratio of total income to total expenditure of fishermen's households during a certain period of time (Basuki *et al*. 2001 in Ustriyana 2005). The calculation of NTN is as follows:

NTN = Y_t / E_t (2.6)
Y_t = $Yf_t + Ynf_t$ (2.7)
E_t = $Ef_t + Ek_t$ (2.8)
Y_t = total income of fishermen's families (Rp)
E_t = total expenditure of fishermen's families (Rp)
Yf_t = fishermen's income from fishing business unit (Rp)
Ynf_t = fishermen's income from non-fishing business unit (Rp)
Ef_t = fishermen's expenditure for fishing business unit (Rp)
Ek_t = fishermen's expenditure for family consumption (Rp)
t = time period (year)

2.8. Descriptive Analysis

Descriptive analysis is used to identify fishermen's adaptation strategies to the impacts of reclamation. Fishermen's adaptation strategies are divided into 2 categories, namely adaptation strategies when the amount of production decreases and adaptation strategies carried out when they can no longer carry out fishing activities due to the loss of fishing grounds.

2.9. Pareto Optimal

The definition of efficiency in exchange is the allocation of a given quantity of goods in an economy. Exchange is said to be (Pareto) efficient if it involves a reallocation of resources. No individual can gain welfare without reducing the welfare of another individual. Therefore, an allocation is said to be efficient if conditions cannot be clearly and definitively made better. The goal is to allocate existing resources in the most efficient manner. The conditions that must be met for exchange efficiency include (Nababan *et al* 2025) :
For example: two goods, namely X and Y, and two people, namely A and B.
Utility function: U = U (X,Y):

a. $\boldsymbol{MU_x = MRS_{xy}}$

$$\boldsymbol{MU_x = \frac{\partial U}{\partial x}, MU_y = \frac{\partial U}{\partial y}}$$

b. $\boldsymbol{MRS^A xy = MRS^B xy}$

$$\boldsymbol{\left(\frac{\partial y}{\partial x}\right)_A = \left(\frac{\partial y}{\partial x}\right)_B}$$

Boadway (1979) in Nababan *et al* (2025) stated that if goods are allocated in such a way that the exchange rates of the two goods differ between two individuals, then the situation can be improved by reallocation. There may be many other allocations that are more efficient, and the best way to explain this is with the Edgeworth box diagram (Figure 1).

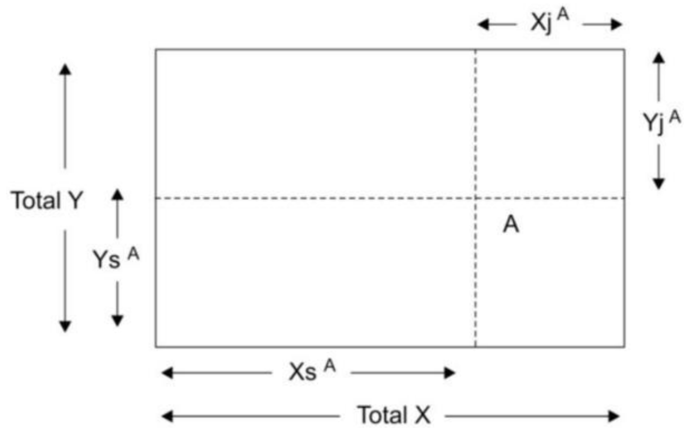


Figure 1. Edgeworth box diagram

The public welfare analysis was conducted according to Vilfredo Pareto to determine the optimal allocation of both, parties carrying out reclamation and fishermen's welfare. The contract curve in an exchange economy is defined as all the most efficient allocations located along the curve. Points outside the contract curve are inefficient because individuals can obtain higher welfare by moving away from that point toward the contract curve. Along the contract curve, individual preferences compete with each other, meaning that the welfare gained by one individual can only be achieved at the expense of others (Figure 2) (Nababan *et al* 2025).

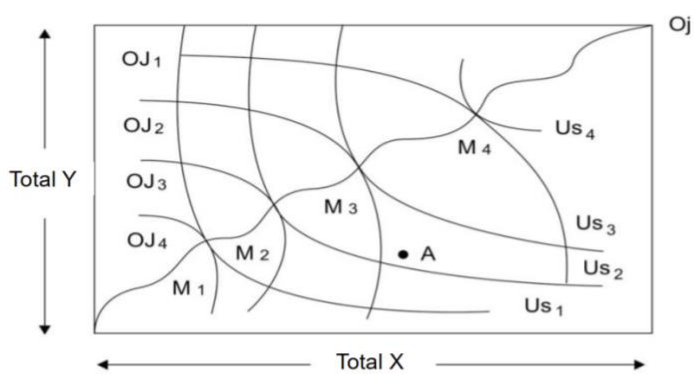


Figure 2. Edgeworth box diagram of efficiency in exchange

2.10. Weighted Sum Model (WSM) Method

Decision-making using the Weighted Sum Model (WSM) method involves quantifying the likelihood of an event and expressing it as a numerical value between 0 and 1 or on a conventional scale (Marimin and Maghfiroh, 2010). The WSM approach evaluates decision alternatives by aggregating the weighted criteria values, enabling a comprehensive assessment of each alternative. The equation for calculating the value of each decision alternative can be formulated as follows:

$$\text{Total value}_i = \sum_{j=i}^{m} \text{Score}_{ij}\left(\text{Criteria}_j\right) \tag{2.9}$$

3. Results and Discussion

3.1. Reclamation Impact on Fishing Grounds of Rampus Fishermen in Kaliadem

Based on the results of spatial analysis, the fishing grounds of *rampus* fishermen are mostly in the western part of Jakarta Bay and around the islands near to Kaliadem (Figure 3). There are also several fishermen who have fishing grounds in the middle of the bay and around Damar Island, Bidadari Island, Untung Jawa Island to Tanjung Pasir and Tanjung Kait (waters of Tangerang Regency). Based on interviews with respondents, prior to the reclamation, access to the fishing grounds was easier because there were no land-use conflicts associated with the reclamation project. Fishermen also experienced a change in travel distance to be further after the reclamation, which affected the increase in the amount of diesel per trip. This is because fishermen have to go through a route that does not have an island boundary (buoy) and must avoid shallow parts of the island. If in the waters near the fishermen do not get fish, then the fishermen have to take a detour to get to a location with more fish.

Based on the overlay results (Figure 3 and 4), reclamation will have a direct impact on the fishing grounds of *rampus* fisheries because the location of the new island as a result of reclamation (filling) will later eliminate the water area and replace it with land (island) and will make fishermen look for new fishing areas further away. The fishing grounds of *rampus* fishermen have mostly moved to the central (Ancol, Binaria, Priok) and eastern parts of Jakarta Bay (Kalibaru, Cilincing, Marunda) to Muara Gembong. Fishing areas that are not directly affected are around Damar Island and Untung Jawa Island, the west (Tangerang Regency waters) and the east of Jakarta Bay (Bekasi Regency waters), so that these two areas can be used as alternative fishing grounds if fishermen cannot fish around the coast that is the location of the reclamation. However, the impact of sedimentation from the construction process causes the fishing boat routes through the canals between the reclaimed islands to be prone to shallowing. According to Jury *et al.* (2011), the potential impact of sediment runoff from the construction process occurs in all reclamation island development projects (island A to island P) which affects fishing areas for both capture fisheries and aquaculture (network lift nets and green mussel cultivation).

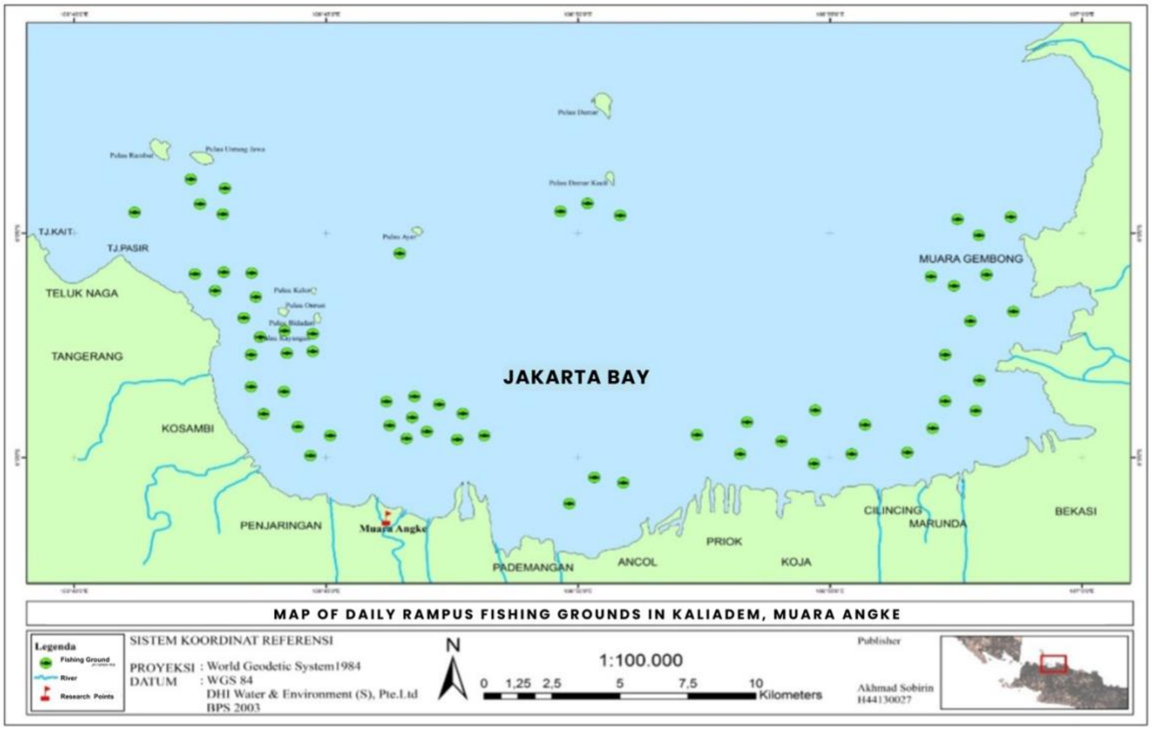


Figure 3. Spatial distribution of the fishing grounds of *rampus* fishermen in Jakarta Bay

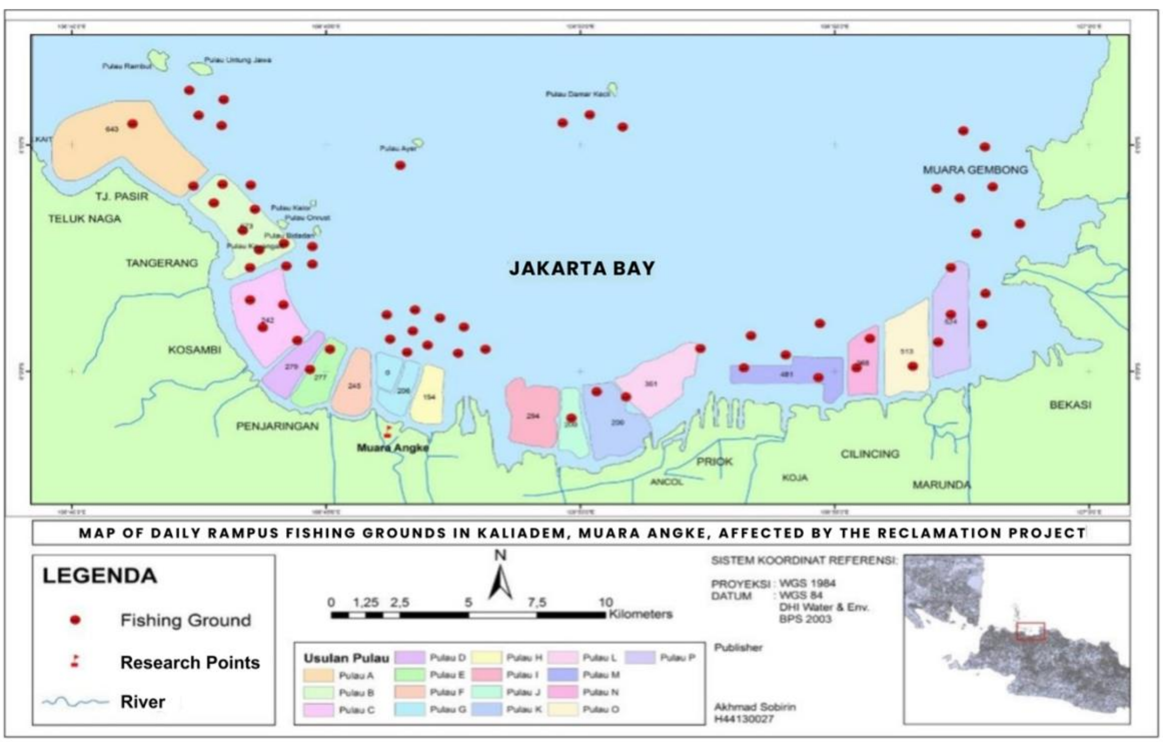


Figure 4. Spatial distribution of the fishing grounds of *rampus* fishermen affected by coastal reclamation activities in Jakarta Bay

3.2. Feasibility of Rampus Fishing unit

The criteria used for financial unit feasibility are NPV, Net B/C, IRR, and payback period. The value of each criterion is obtained after grouping the income (benefits) and expenses (costs) in the form of cash flow. The cash flow calculated is for 10 years using the 1-year deposit interest rate of Bank Rakyat Indonesia (BRI) in May 2018 of 5.3%.

3.3. Inflow

3.3.1 Sales of catch

The main catch of *rampus* fishermen is mackerel (*Rastrelliger spp*.). The average number of trips per month carried out by fishermen during the peak, medium, and lean seasons is 20 times, 14 times, and 8 times, respectively. Based on interviews with respondents, there is a difference in the amount of fishermen's income before and after reclamation. The amount of fishermen's income per trip before and after reclamation is shown in Table 1.

Table 1. Changes in income per fishing trip of *rampus* fishermen before and after reclamation activities with a decrease in income

No	Parameter	Before reclamation	After reclamation
1	Average production/ trip (kg)	86	50
2	Price (Rp/kg)	22.000	22.000
3	Income (Rp/trip)	1.892.000,00	1.100.000,00

Source: Data Analysis (2018)

3.3.2. Residual value

The residual value of the *rampus* fishing unit is obtained from the sale of used fishing equipment that can still be resold in the final year of the business's life.

Table 2. Residual value of *rampus* fishing unit

No	Types of investment	Technical age (year)	Tota l	Unit	Buying price (Rp)	Residual value (Rp)
1	Machine	4	1	Unit	7.047.600	2.500.000
2	Fishing gear	2	22	*Ting-ting*	12.142.600	2.000.000
3	Ris rope	4	29	Kg	1.174.050	400.000
4	Generator	5	1	Unit	3.790.500	1.500.000
5	Anchor	3	18	Kg	350.000	50.000
6	Cool box	4	3	Unit	1.678.550	400.000
	Total residual value					6.850.000

Source: Data Analysis (2018)

3.4. Outflow

The expenses of a *rampus* fishing unit consist of investment costs, operational costs and maintenance costs.

3.4.1 Investment costs

Investment costs are costs incurred at the beginning of running a business in a relatively large amount and can be utilized in the long term for several productions. The investment costs of *rampus* fishermen are shown in Table 3.

Table 3. Invesment costs of *rampus* fishing unit

No	Types of investment	Unit	Technical age (year)	Total cost (Rp)
1	Boat	Unit	10	24.071.450
2	Machine	Unit	4	7.047.600
3	Fishing gear (*rampus* net)	*Ting-ting*	2	12.142.600
4	Lead (weight)	Kg	4	2.191.000
5	Ris rope	Kg	4	1.174.050
6	Lifebuoy	Unit	4	1.940.600
7	Anchor	Kg	3	350.000
8	Anchor rope	Kg	3	522.850
9	Cool box	Unit	4	1.678.550
10	Generator	Unit	5	3.790.500
11	Tools	Set	5	350.000
12	*Blong*	Unit	4	432.600
13	Cooking ware	Set	1	440.500
14	Jerrycan	Unit	5	72.150
	Total investment cost			56.204.500

Source: Data Analysis (2018)

3.4.2. Investment costs

Based on interviews with respondent fishermen, there were differences in the amount of operational costs before and after reclamation, namely changes in the components of diesel costs and crew wages.

Table 4. Operational costs of *rampus* fishing unit before and after reclamation

No	Variable costs	Cost per trip (Rp)		Number of trips per year	Cost per year (Rp)	
		Before	After		Before	After
1	Solar	168.350	232.600	173	29.124.550	40.239.800
2	Ice	54.500	54.500	173	9.428.500	9.428.500
3	Fishermen's supplies	130.000	130.000	173	22.490.000	22.490.000
4	Gasoline	36.400	36.400	173	6.297.200	6.297.200
	Total cost	389.250	453.500		67.340.250	78.455.500

Source: Data Analysis (2018)

3.4.3. Fixed costs

Fixed costs are costs incurred in the same amount for several productions and do not depend on the production produced. Fixed costs of *rampus* fishing businesses are shown in Table 5.

Table 5. Fixed costs of *rampus* fishing unit

No	Types of fixed costs	Fixed costs per year (Rp)	Annual maintenance intensity
1	Ship maintenance costs	3.500.000	1
2	Machine maintenance costs	906.000	6
3	Generator maintenance costs	380.000	12
4	Fishing gear maintenance costs	1.039.600	25
	Total fixed costs	5.825.600	

Source: Data Analysis (2018)

3.5. Analysis Results of Rampus Fishing Unit Financial Aspect

Based on the results of the financial analysis, there is a significant difference in the value of each business feasibility criteria between before and after reclamation. The difference in the value of each business feasibility criteria for *rampus* fishermen before and after reclamation is shown in Table 6.

Table 6. Results of the feasibility analysis for *rampus* fishing unit before and after reclamation

No	Eligibility criteria	Before	After	Difference	Percentage (%)
1	NPV (Rp)	456.251.850	141.900.795	314.351.055	68,89
2	Net B/C	4,43	2,58	1,85	41,76
3	IRR (%)	49,85	30,22	19,63	39,30
4	Payback period (year)	4,36	5,49	1,13	25,91

Source: Data Analysis (2018)

The results of the financial analysis on the NPV criteria indicate that the *rampus* fishing unit is feasible to run both before and after reclamation. The NPV value after reclamation is IDR 141,900,795.00, meaning that during the 10 years of the *rampus* fishing unit, the net profit obtained is IDR 141,900,795.00. The decrease in NPV of 68.89% from the NPV before reclamation indicates that the *rampus* fishermen received a significant economic impact after reclamation in the form of a decrease in fishermen's income from the business being run. The decrease in NPV value after reclamation is directly proportional to the decrease in Net B/C value. The Net B/C value after reclamation is 2.58, meaning that every IDR 1.00 of costs incurred by fishermen for fishing efforts will increase income (benefits) by IDR 2.58. The feasibility criteria for businesses based on IRR also show that the *rampus* fishing unit is feasible to run with an IRR value > the interest rate which is the basis of reference, namely 5.3%. The decrease in the IRR value in the business being run resulted in the rate of return-on-investment capital after reclamation each year becoming less. It takes a longer time for the return-on-investment capital (payback period) from the initial 4.36 years to 5.49 years after reclamation.

3.6. Rampus Fishermen's Welfare Level

NTN can be less than, equal to, or more than one. If NTN is less than one, it means that the fishing family has low purchasing power and has the potential to experience a household budget deficit. If NTN is around one, it means that the fishing family is only able to meet its subsistence needs. Conversely, if the NTN value is more than one, it means that the fishing family has a level of welfare good enough to meet its subsistence needs and has the potential to consume secondary or tertiary needs, or save in the form of investment goods (Basuki *et al*. 2001 in Ustriyana 2005). The difference in NTN of *rampus* fishermen before and after reclamation is shown in Table 7.

Table 7. Results of NTN analysis of *rampus* fishermen before and after reclamation

No	Before reclamation	Value (Rp)	After reclamation	Value (Rp)
1	Yf_t	215.489.600	Yf_t	126.679.300
2	Ynf_t	4.171.450	Ynf_t	4.171.450
3	$Y_t = Yf_t + Ynf_t$	219.661.050	$Y_t = Yf_t + Ynf_t$	133.850.750
4	Ef_t	168.856.900	Ef_t	120.759.550
5	Ek_t	53.714.300	Ek_t	53.714.300
6	$E_t = Ef_t + Ek_t$	222.571.200	$E_t = Ef_t + Ek_t$	174.473.850
	NTN = Y_t / E_t	0,98	NTN = Y_t / E_t	0,76

Source: Data Analysis (2018)

The results of the NTN analysis show that the level of welfare of *rampus* fishermen before and after reclamation is 0.98 and 0.76 of the total fisheries and non-fisheries income, respectively. This shows that the NTN of *rampus* fishermen is below one, meaning that the income of *rampus* fishermen families before and after reclamation is still unable to meet their subsistence needs. The difference or decrease in the NTN of *rampus* fishermen before and after reclamation is quite significant, namely 0.22 or 22.44%.

3.7. Rampus Fishermen's Adaptation Strategy to the Reclamation Impact

The results of the study showed that the reclamation impact on fishing activities was responded to in various ways by *rampus* fishermen. Fishermen's adaptation strategies when production volumes decreased are shown in Table 8.

Table 8. Fishermen's adaptation strategies when production volume decreases

No	Adaptation strategy	Number of respondents	
		Frequency (of people)	Percentage (%)
1	Increasing frequency	3	7,14
2	Relocating fishing ground	32	76,2
3	Looking for another job	4	9,52
4	Changing fishing gear	2	4,76
5	Not doing adaptation	1	2,38
	Total	42	100

Source: Data Analysis (2018)

In general, there are 2 main strategies carried out by *rampus* fishermen if the amount of production decreases, namely moving fishing locations and looking for alternative jobs other than being fishermen. As many as 32 respondents or 76.2% stated that they would continue to carry out fishing activities even though they had to move fishing locations. This was done because fishermen only have the skill of going to sea. As many as 4 respondents or 9.52% stated that they would look for alternative jobs other than being fishermen. This was done to increase family income in addition to income from going to sea. The adaptation strategies of *rampus* fishermen if they are no longer able to carry out fishing activities due to the loss of fishing locations are shown in Table 9.

Table 9. Adaptation strategies for fishermen facing inability to continue fishing activities

No	Adaptation strategy	Number of respondents	
		Frequency (of people)	Percentage (%)
1	Trading	2	4,76
2	Farming	1	2,38
3	Remain fishing	20	47,6
4	Looking for another job	6	14,28
5	None	13	30,95
	Total	42	100

Source: Data Analysis (2018)

As many as 20 respondents or 47.6% stated that they would continue fishing even if they moved locations or moved to other villages. This shows that most fishermen will not change their jobs due to decreasing catch production or if they are no longer able to carry out fishing activities. Fishermen will continue their fishing business even if they have to move fishing areas or have to move villages. Another adaptation pattern that will be carried out by fishermen is looking for other jobs in the fisheries sector such as fish processors, namely 6 respondents or 14.28%.

3.8. Alternative Policies for Rampus Fishermen After Reclamation

The first stage is determining alternative policies. Alternative policies for *rampus* fishermen after reclamation are relocation of fishermen to new places, increasing fishermen's capacity by increasing the size of boats, and subsidizing fuel quotas. The second stage is determining the decision criteria. The decision criteria that will be the basis for policy making are capital, profit, and sustainability. The third stage is determining the level of importance of each decision criterion. Determination of the weight is carried out according to stakeholder perceptions through interviews with a weight assessment of 1 meaning the criterion is not important, 2 is less important, 3 is quite important, 4 is important, and 5 is very important. The fourth stage is to assess all alternatives for each criterion. Stakeholders who are resource persons in the assessment of alternative policies are parties from the Technical Implementation Unit for the Management of the Muara Angke Fishery Port and Fish Landing Base Area, the DKI Jakarta Food Security, Maritime Affairs, and Agriculture Service, the DKI Jakarta Regional Development Planning

Agency, and representatives of the *rampus* fishermen group in Kaliadem. The fifth stage is to calculate the score for each alternative. The calculation results are shown in Table 10.

Table 10. Alternative policy ranking for *rampus* fishermen

No	Alternative policy	Criteria			Alternative value	Ranking
		Capital	Profit	Sustainability		
1	Relocating fishermen to new fishing grounds	4	4	3	3,6	3
2	Increasing the capacity of fishermen by increasing the size of their ships	4	5	5	4,7	1
3	Fuel quota subsidy	5	4	4	4,3	2
	Criteria weight	0,3	0,3	0,4		

Source: Data Analysis (2018)

Based on the results of the alternative policy ranking, the first prioritized policy alternative is:

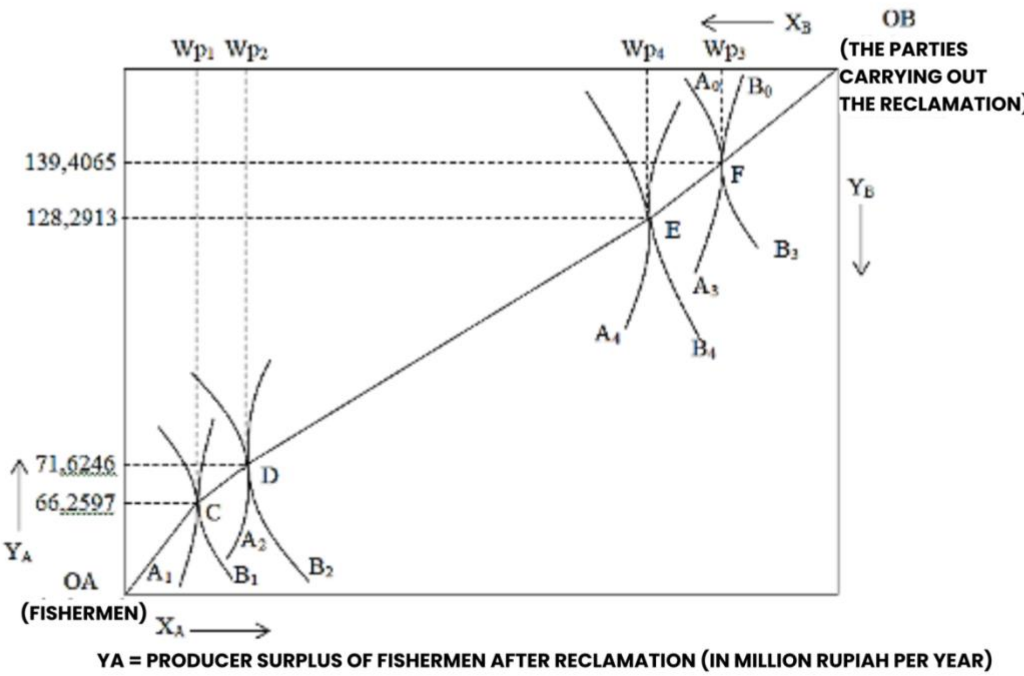
a. Increasing the capacity of fishermen by increasing the size of the boat

The increase in the size of the boat aims to allow fishermen to reach further fishing ground and increase the potential number of catches per trip. Most *rampus* fishermen catch fish in the western part of Jakarta Bay and the islands closest to Kaliadem (no more than 12 nautical miles). Based on the results of the analysis of the impact of reclamation on fishing ground, reclamation will affect the fishing grounds of *rampus* fishermen in the eastern, central, and western parts because reclamation will be carried out along the North Coast of Jakarta. However, increasing the size of the boat for fishermen will change the characteristics of fishermen's fishing, namely increasing operational costs. Larger boat sizes (tonnage) and more distant fishing grounds require more fuel. In addition, the duration of fishermen's time at sea, which previously caught in one day (one day fishing), will change to be longer so that the cost of supplies and ice cubes will also increase. On the other hand, fishermen have the potential to increase the number of catches per trip so that operational support is needed in the form of operational cost assistance in the first 1 or 2 years of fishing operations. In addition to operational costs, increasing the knowledge and skills of fishermen (owners and crew) is also needed as a form of adaptation to run a larger fishing unit.

b. Fuel quota subsidy

Fuel quota subsidy is a form of compensation/restitution (direct financial transfer) that can be given to *rampus* fishermen who experience an increase in the amount of fuel. The fuel quota subsidy in this case is the average amount of increase in fuel consumption of fishermen before and after reclamation which should be borne by other parties. The impact of fuel quota subsidies on *rampus* fishermen is known by using a feasibility analysis of producer surplus with several conditions including: 1) without quota subsidies and reduced production (actual conditions), 2) with quota subsidies and reduced production, 3) with quota subsidies and fixed production (minimum conditions), 4) without quota subsidies and fixed production. Changes in the value of the eligibility criteria and producer surplus if quota subsidies are implemented with several conditions. Based on the results of the calculation of the feasibility analysis and producer surplus, quota subsidies as a form of compensation have not been able to increase the NPV and producer surplus of fishermen as in the minimum condition (approaching the NPV value and producer surplus before reclamation) if the amount of production is still reduced.

Fuel quota subsidies in the short-term aim to maintain/ restore the producer surplus of fishermen as in the condition before reclamation. Changes in producer surplus if quota subsidies are implemented can be described using the Edgeworth Box curve shown in Figure 5 as follows:



Source: Data Analysis (2018)

Figure 5. Edgeworth Box curve of the impact of quota subsidies on the surplus of fishermen producers with several conditions

In Figure 5, OA is the affected *rampus* fishermen and OB is the party carrying out the reclamation. YA is the fishermen's producer surplus after reclamation and XA is the welfare level of the party carrying out the reclamation. Each point in the box (points C, D, E, and F) indicates the tangency point of the indifference curve of party A (fishermen) and party B (who carries out the reclamation).

The fishermen's producer surplus before reclamation is IDR 139,406,550/year (A0). At point C (condition 1), the fishermen's producer surplus after reclamation is IDR 66,259,700/year. In condition 1, the welfare of the party carrying out the reclamation (welfare of the reclamation developer) is assumed to be Wp1. At point D (condition 2), the fishermen's producer surplus increases by 8% from condition 1 to IDR 71,624,600/year. The increase in producer surplus is due to the impact of the quota subsidy. Developer welfare decreases to Wp2 because part of the developer welfare is allocated for quota subsidies for fishermen. At point E (condition 4), the fishermen's producer surplus increases by 79% from condition 2 to Rp 128,291,300/year. Developer welfare decreases to Wp4. The increase in producer surplus at point E (condition 4) is greater than point D (condition 2) because it is followed by an increase in the amount of fishermen's production. At point F (condition 3), the fishermen's producer surplus increases by 9% from condition 4 to Rp 139,406,550/year. The producer surplus is returned to the condition before reclamation and developer welfare decreases to Wp3. Point F is the Pareto optimal point on the contract curve (line OAFOB). According to the welfare economic theory in Salvatore (2006), the allocation of production factors/resources has reached Pareto optimality if the production/resource extraction process can no longer be arranged in such a way as to increase the output/utility/welfare of one or more parties without having to reduce the output/utility/welfare of other parties.

c. Relocation of fishermen to a new location

The relocation of fishermen aims to bring fishermen closer to fishing locations and develop alternative livelihoods for fishermen. Relocation of fishermen to artificial islands resulting from reclamation is one of the long-term options for fishermen included in the draft masterplan for the PTPIN/NCICD (National Capital Integrated Coastal Development) program. The island reclamation project and PTPIN are different programs so that integration of the PTPIN concept into the reclamation plan is needed. The integration of PTPIN into the reclamation plan is only limited to the phase an embankment (coastal embankment) of PTPIN which is currently being built. In addition to bringing fishermen closer to fishing locations, relocation of fishermen is expected to provide economic benefits through the development of maritime communities consisting of residential areas, fishing industries, and fisheries marketing (ports, temporary and permanent shops, food stalls, etc.). However, efforts to reduce the impact of reclamation and PTPIN on fishermen by relocating to a new location need to be carried out carefully and require consideration of the high-cost requirements, vulnerability to social conflict, population administration problems, guarantees of marketing of catches, and other supporting facilities for relocated fishermen such as places of worship, health facilities, and education. According to Sampono (2013), relocation compensation is the last alternative of 4 policy alternatives for fishermen, including compensation in the field of education, compensation in the field of facilities and infrastructure, compensation in the field of economy, and relocation compensation due to the complexity of the impacts caused by relocation, namely high social costs and vulnerability to social conflict.

3.9. Policy Implications in Reclamation Regulations and Spatial Planning in Jakarta Bay

The reclamation of Jakarta Bay has had an economic impact on *rampus* fishermen in Kaliadem, so alternative policies are needed for affected fishermen. However, before implementing alternative policies, it is necessary to first know about the legal aspects of the reclamation of Jakarta Bay so that the authority in implementing the alternative policies is clear. This authority aspect is the most important thing to know whether or not the issuance of a reclamation permit is valid in addition to the procedural and substantive aspects, therefore harmonization of legal products (statutory regulations) is needed to ensure legal certainty and avoid differences in perception between authorized agencies in organizing spatial planning including reclamation in coastal areas.

In its implementation, these alternative policies require supporting instruments that are interrelated with each other, so integration of alternative policies is needed to find out whether the spatial planning regulations in Jakarta Bay already contain alternative policies for fishermen affected by reclamation. There are several supporting instruments for alternative policies, including:

a. Environmental intervention through new fishing grounds by creating artificial fishing grounds and increasing the capacity of fishermen

This supporting instrument is related to the second alternative policy, namely fuel quota subsidies. In the previous discussion, namely the impact of quota subsidies on the feasibility of businesses and surplus producers of *rampus* fishermen, it was stated that quota subsidies as a form of compensation have not been able to increase NPV and producer surplus as in minimal conditions (approaching the NPV value and producer surplus before reclamation) if the amount of production is still reduced. In addition, changes in the distance to the fishing ground will also affect fishermen's income. Thus, a solution is needed to maintain or increase the amount of fishermen's production such as the amount of production before reclamation and provide new fishing grounds for fishermen. Based on the results of interviews with the DKI Jakarta DKPKP (Food Security, Maritime Affairs, and Agriculture Service), in the long term, environmental intervention is needed through the addition of new fishing grounds by creating artificial fishing grounds (artificial fishing grounds) because the fishermen's fishing grounds were lost due to reclamation. The location of the planting/sinking area for this artificial fishing ground is in the western, central, and eastern parts of Jakarta Bay which are not included in the reclamation project area and PTPIN.

The location of the planting/sinking of artificial fishing grounds should consider the distance fishermen travel to the new fishing ground so that it is necessary to take into account that the location of the new fishing ground is at a distance that is easy to reach and is able/has the potential to increase the fishermen's NPV. Artificial fishing ground is a fishing area by placing a tool to attract schools of fish to gather around the tool, so that the fish are easy to catch. Module 3 types of recommended artificial fishing ground are fish apartments, fish shelters, and fish aggregating devices.

b. Support for operational costs in the first and 2nd years of fishing operations and increasing fishermen's knowledge and skills

Support for operational costs and increasing fishermen's skills are related to alternative policies for increasing fishermen's capacity (the first alternative). This supporting instrument is a form of adaptation for fishermen in running a larger fishing business. Increasing fishermen's capacity by increasing the size of the boat will increase operational costs because the time at sea is longer, diesel consumption is greater, and supplies increase. However, on the other hand, increasing fishermen's capacity is expected to increase the amount of fish production so that operational cost support is needed in the first and 2nd years of fishing operations.

c. Development of alternative livelihoods

This supporting instrument is related to the third alternative. Fishermen's relocation must be able to provide opportunities for new economic activities for affected fishermen, both through fishing and non-fishing activities. Development of alternative livelihoods can be intended for fishermen and fishermen's wives/families. The development of alternative livelihoods from fisheries activities can be done by increasing the added value of the catch by fishermen's wives in Community Business Groups (KUB), especially KUB of *rampus* fishermen and marketing access. When developing alternative livelihoods, it should be done with proper planning. Several aspects that must be considered in planning the development of alternative livelihoods include (Kusumastanto 2016):

- Alternative livelihoods that are developed must be easily adopted by the community that will implement them and in accordance with the characteristics of the local community.
- The balance between supply (supply based) and demand (demand based) of goods or services produced and from alternative livelihoods that will be developed must be balanced and sustainable, so that assistance is needed both before and during the alternative livelihood is running and also marketing access.
- Alternative livelihoods that are developed have a low risk of failure, fast time, and affordable capital.
- Livelihoods that will be developed still pay attention to aspects of environmental preservation in general (carrying capacity, characteristics, and so on).
- If in the development of alternative livelihoods, financial assistance or subsidies are needed for living expenses before the alternative livelihood produces, then the financial assistance must pay attention to the category of subsidy recipients, the amount of the subsidy is the same as the minimum living expenses (according to the initial income or less than the income that will be obtained from the results of the livelihood to be developed), the period of subsidy provision is limited until the alternative livelihood can produce, mutual agreement, and so on.

Therefore, in determining alternative livelihoods, there are several steps that can be taken to obtain optimal results, including:

a. Identifying the types of alternative livelihoods to be developed that are adjusted to the requirements mentioned previously.
b. Conducting a success test of the livelihood before it is implemented.
c. Preparing tools, both technical and non-technical in planning, implementation, monitoring, and evaluation.

4. Conclusions

The reclamation of Jakarta Bay has significantly affected fishing grounds, compelling *rampus* fishermen to relocate their operations to alternative areas. While the *rampus* fishing unit remains viable both before and after the reclamation, the activity results in a measurable decline in the Fisher Exchange Rate (NTN) compared to pre-reclamation conditions. The primary adaptation strategies adopted by fishermen in response to declining catchment include relocating to new fishing grounds or transitioning to alternative jobs. Fishermen who choose to remain in the fishing sector often relocate their operations or move to other coastal villages. Proposed policy alternatives to enhance the resilience and capacity of fishermen include increasing boat sizes, providing fuel subsidies, relocating fishermen to new fishing grounds, establishing artificial fishing grounds, promoting skills development, supporting the transition to alternative livelihoods, and subsidizing operational costs during the initial one to two years post-reclamation.

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