

# Sustainability status of small-scale fisheries resources in Jakarta Bay, Indonesia after reclamation

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**Abstract.** *Patawari AMY, Anna Z, Hindayani P, Dhahiyat Y, Hasan Z, Putri IAP. 2022. Sustainability status of small-scale fisheries resources in Jakarta Bay, Indonesia after reclamation. Biodiversitas 23: 1715-1725.* Reclamation in Jakarta Bay was initially implemented by constructing a giant 60 km long embankment in the area and 17 small islands in front of the coast of North Jakarta, but then it was stopped in 2018. After reclamation closures have affected fishery resources, especially small-scale ones that rely on catchment areas around the coastal waters of Jakarta Bay. To ensure the resource utilization level that meets the needs of the present and future generations, managing sustainably small-scale fish resources is crucial. This study aimed to analyze the sustainability status of small-scale fisheries in Jakarta Bay after reclamation. The results showed that efforts to manage small-scale fishery resources in the waters of Jakarta Bay-from the dimensions of fisheries, ecological, social, legal and institutional- are in unsustainable conditions. To improve the status, policy makers should consider 16 prioritized attributes on ecology, resource potential, economic, social, legal and institutional.

**Keywords:** Jakarta Bay, RAP after reclamation, small-scale fisheries

## INTRODUCTION

Jakarta is the capital city of Indonesia and the center of the economy. According to Abidin et al. (2011), in the last three decades, urban development in DKI Jakarta has taken place very quickly, including development, industrial estates, trade, transportation, luxury housing, and others. The reclamation in Jakarta Bay was originally aimed to reorganize the North Coast of Java by building a coastal area and making Jakarta a waterfront city, considering that the economic growth and population continue to increase. However, the expansion is no longer possible due to limited space (Abidin et al. 2011)

Coastal reclamation development does have not only positive impacts but also negative ones, such as the disruption of coastal ecosystems, increased potential for flooding, changes in ocean current patterns, changes in sedimentation rates, changes, and pollution on seawater quality, the spread of invasive species, social conflicts, disruption of shipping lanes and natural resources of capture fisheries (Kusumawardhani 2017; Marpaung 2017; Puspasari et al. 2018)

One of the activities most impacted by the reclamation of Jakarta Bay, both during implementation and after the reclamation, is small-scale fisheries, especially fishers who rely on fishing areas in the coastal area. The losses suffered

each year by fisher are estimated to be Rp. 94,714,228,734, Rp. 98,867,000,591 for clam farming and Rp. 13,572,063,285 for fish farming in ponds (Ramadhan et al. 2016). The other most important impacts from reclamation are changes in fishing areas, disruption of fishing lines, the disappearance of fish resources and their habitats, and the cultivation of green shellfish. According to the study, the directly affected fish catchment area is 1527.34 hectares with a direct benefit value of Rp198.5 billion (Adharani et al. 2019).

Based on the captured fisheries data in DKI Jakarta before and after reclamation, fisheries production has decreased significantly. In 2012 before reclamation occurred, capture fishery production was 219,835.80 tons, while in 2018, it was only 107,119.00 tons when the Jakarta's reclamation was officially shut down by the governor of DKI Jakarta (Indonesian Central Statistics Agency 2020). The number of fishers in DKI Jakarta in 2012 was 61,813, and it drastically reduced to 2863 in 2016 (Ministry of Marine Affairs and Fisheries 2019). This is a very concerning condition, especially for small fisher under 10 GT who rely on the coastal waters of Jakarta Bay which have long been their main source of livelihood.

In 2018, the Governor of DKI Jakarta stopped the reclamation project of the north coast of Jakarta, 13 from 17 reclamation islands. The governor reasoned that the

reclamation project had harmed the community, therefore the DKI Jakarta Provincial Government revoked the activity.

Based on the problems mentioned above, this study aims to determine the sustainability status of small-scale fisheries (below 10 GT) after the reclamation closure in Jakarta Bay. Parameters involved in determining the sustainability status are taken from multiple dimensions such as capture fisheries resources, economy, ecology or environment, social, legal and institutional (Fauzi and Anna 2002, 2005; Nababan et al. 2007; Fauzi 2019; Tetelepta et al. 2021). In the after reclamation sustainability analysis, the RAPFISH (rapid appraisal for Fisheries) model was developed by a team from the University of British Columbia and FAO (Pitcher 1999; Pitcher and Preikshot 2001; Anna 2003; Kavanagh and Pitcher 2004; Anna and Fauzi 2007; Fauzi 2019). Fisheries management in Indonesia using RAPFISH has been carried out by various methods, such as the sustainability status of small-scale tuna fisheries (Tetelepta et al. 2021), sustainability study of household-scale fisheries (Hartati et al. 2021), sustainability status for reef fisheries management (Kurnia et al. 2021), sustainability status for hammerhead shark (Anna et al. 2020), sustainability status of fisheries in the vicinity of tin mining area (Ramadona et al. 2020). This method is not only used in Indonesia, but other countries as well, such as Iran (Allahyari 2010), India (Adiga et al. 2015), Brazil (Jimenez et al. 2021), and Chile (Milagros et al. 2021). In addition, RAPFISH has been applied in coral reef sustainability (Yasir-Haya and Fujii 2020) and mangrove (Sahputra et al. 2022; Santoso et al. 2019). The

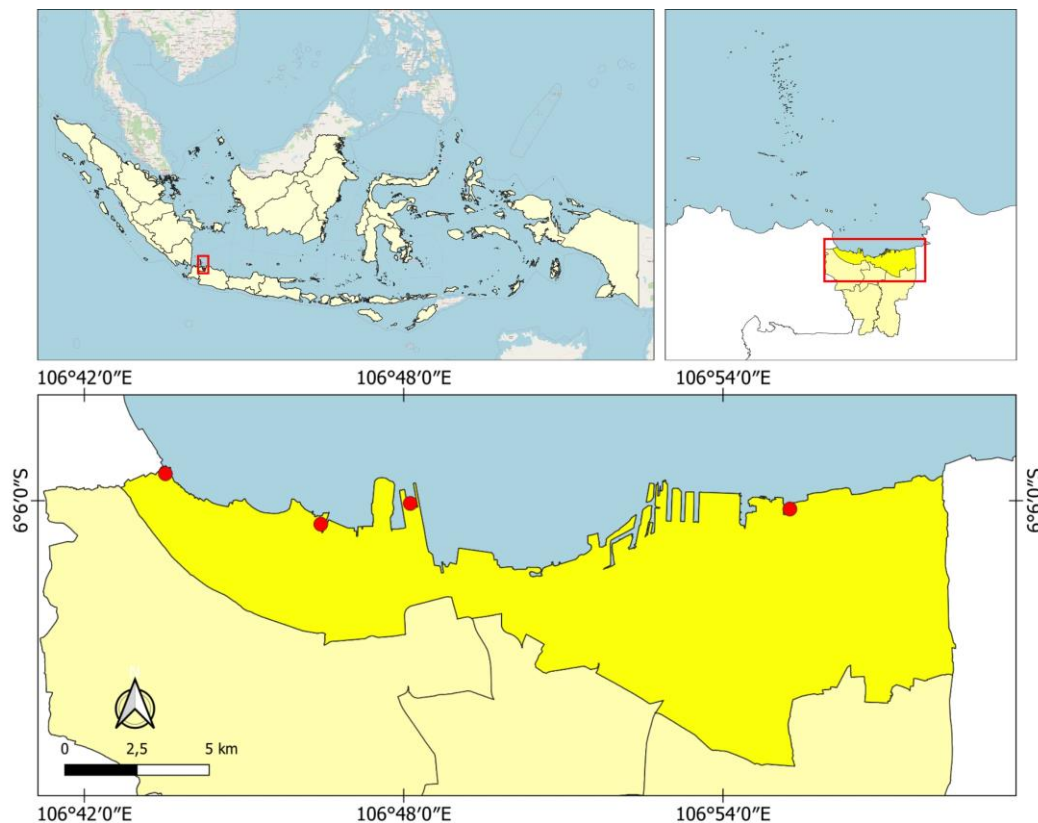
development in this study using ‘RAP after reclamation’ was to determine the sustainability status of small-scale fisheries (especially under 10 GT) in Jakarta Bay which is affected by the reclamation activities, examine the levers/sensitive attributes that affect the sustainability status of the small-scale capture fisheries management and formulate strategies/policy priorities that can be chosen for the small-scale capture fisheries development in the area to be sustainable.

## MATERIALS AND METHODS

### Study area

The research was carried out from September 2020 to July 2021 in four small-scale fisheries locations in Jakarta Bay, Indonesia, i.e., Cilincing District (Kalibaru Barat, Kalibaru, Marunda, Kalibaru Timur, Cilincing), Muara Angke District, Muara Baru District, and Kamal Muara District (Figure 1).

This is a descriptive quantitative study using primary and secondary data. Primary data were obtained by interviewing 221 respondents at Jakarta Bay (Cilincing, Muara Angke, Muara Baru, Kamal Muara), i.e., small-scale fishers (<10 GT) in the study area affected by the reclamation and stakeholders consisting of the government and academia. Secondary data were obtained from various journals, reports and other documents that support the research objectives.



**Figure 1.** Location of Study at Jakarta Bay, Indonesia (*right to left*: Cilincing, Muara Angke, Muara Baru, Kamal Muara)

**Data analysis**

The method used in this study is RAPFISH (Rapid Appraisal for Fisheries). RAPFISH is an analytical method to evaluate the sustainability of fisheries in a multidisciplinary manner based on the technique of ordination (positioning something in the order of measurable attributes) with Multi-Dimensional Scaling (MDS). MDS is basically a statistical technique that tries to transform multi-dimensions into lower dimensions (Fauzi and Anna 2005). In this after reclamation Rap-fish analysis, the five dimensions used to determine the sustainability status of after reclamation small-scale capture fisheries in Jakarta Bay are: (i) Capture fisheries resources; (ii) ecology; (iii) economy; (iv) social; (v) legal and institutional (Kavanagh and Pitcher 2004). Determining the dimensions and attributes is based on the performance indicators developed by Pitcher and Preiskhot (Pitcher 1999; Pitcher and Preikshot 2001; Kavanagh and Pitcher 2004; Fauzi 2019). In this study, the RAPFISH method was modified by taking into account the conditions of fishery activities before and after reclamation as well as the socio-economic conditions of the environment in Jakarta Bay, especially small-scale fisheries under 10 GT. Furthermore, the grouping of these dimensions is not important. However, indicators or criteria in each of these dimensions are more crucial so that it will cover the widest possible indicators that can be used to assess the sustainability status of small-scale fisheries in Jakarta Bay after reclamation.

Leverage analysis or sensitivity analysis is carried out to determine the sensitive attributes that affect sustainability. Each dimension requires an anomaly analysis which indicates the sensitivity of each attribute in each dimension. Furthermore, Monte Carlo analysis is used to determine the effect of calculation errors and misjudgments on attributes by respondents. If the difference between the Monte Carlo sustainability index and the MDS sustainability index is less than 1, the error effect in the analysis is small. Therefore, the smaller the difference between the sustainability index and the simulation on Monte Carlo, the more accurate the results will be (Kavanagh and Pitcher 2004). According to Kavanagh and Pitcher (2004) the ‘Goodness of Fit’ in the MDS calculation is indicated by the magnitude of the stress value (Pitcher and Preikshot 2001), whereas the validity of the model is indicated by the magnitude of the termination coefficient ( $R^2$ ). The analysis results that can present the model well are indicated by the stress value below 0.25 and  $R^2$ , which is close to 1 or 100%.

In the MDS analysis, the sustainability index of after reclamation Small-Scale Capture Fisheries (<10 GT) can be obtained. The sustainability index will show the likelihood of the program, which is assessed from various dimensions, to continue. The index values and categories for measuring the sustainability index of the area's development are divided into four categories, i.e.: (i) Not sustainable; (ii) less sustainable; (iii) moderately sustainable; and (iv) very sustainable.

The sustainability status analysis of small-scale capture fishery resources in Jakarta Bay consists of 41 indicators with 11 in the fishery resources domain, 10 in the

ecological domain, 8 in the economic domain, 8 in the social domain, and 9 in the legal and institutional domain.

Each of the five dimensions has a sustainability attribute (Table 2), with a scoring definition scheme of good and bad, which varies from 0 to 3. To find out the sustainability index in each dimension and the sensitive attributes which affect sustainability in each dimension and region, it is necessary to do a RAP after reclamation analysis and leverage analysis on each dimension.

**RESULTS AND DISCUSSION**

The four locations, i.e., Cilincing, Muara Angke, Muara Baru, and Kamal Muara, were analyzed for their sustainability status. Based on the calculation results of the average MDS value, the overall dimensions are below 50 on a sustainability scale of 0-100 which means “Bad” or unsustainable.

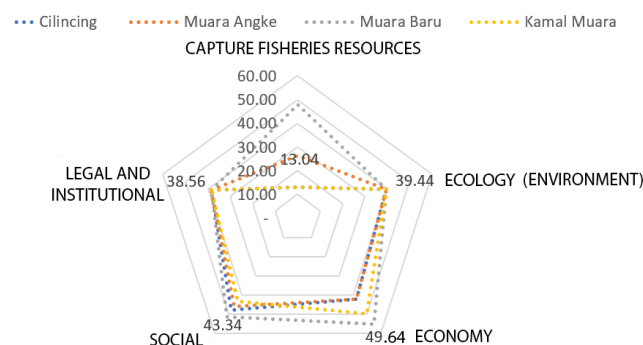
The determination coefficient value ( $R^2$ ) throughout all the dimensions is relatively high, 0.92 (the closer it is to 1, the better). Thus, the two statistical parameters imply that all the attributes used in each dimension in the sustainability model of the small-scale fisheries condition in Jakarta Bay are sufficiently good to explain the sustainability of the area (Table 3).

**Capture fisheries resources**

The dimensions of capturing fisheries resources using ordination techniques through the MDS method produce an index value and sustainability status below 50% and has a sustainability status of "Bad" which means it is not sustainable (Table 1).

**Table 1.** Index values and categories for the sustainability index measurement for after reclamation small-scale capture fisheries

Index value	Category
0.00-50.00	Bad: unsustainable
50.01-60.00	Less: less sustainable
60.01-70.00	Sufficient: quite sustainable
70.01-100.00	Good: very sustainable



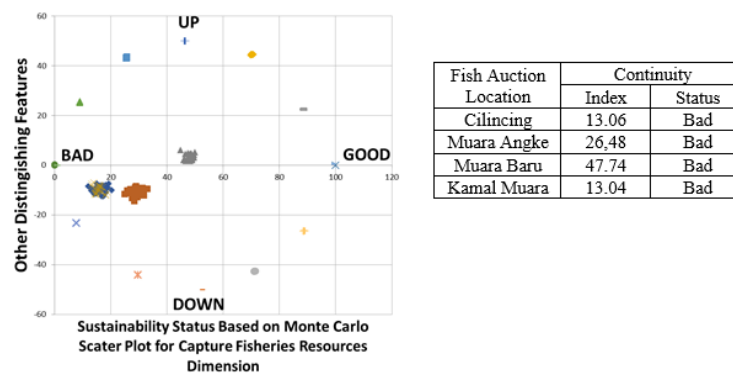
**Figure 2.** Flowchart RAPFISH after reclamation for sustainability analysis at Jakarta Bay, Indonesia

**Table 2.** Dimensions, attributes, definition scheme, and RAPFISH scoring definition after reclamation

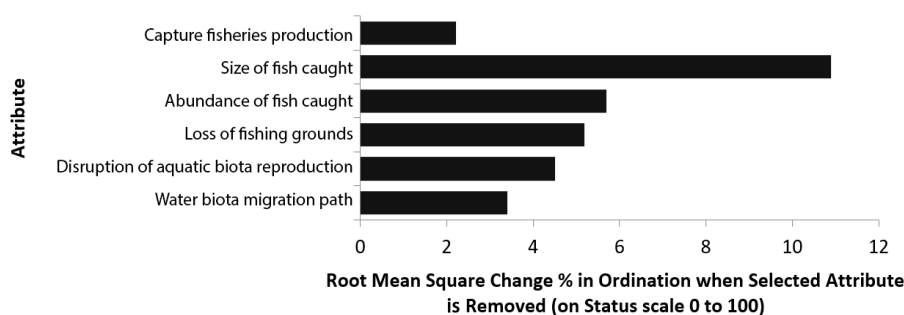
Dimension	Attribute
Capture fishery resources	Water biota migration path
	Disturbance of aquatic biota reproduction
	Loss of fishing area
	Abundance of fish caught
	Size of fish caught
	Capture fisheries production
Ecology (environmental)	Coral cover percentage
	Percentage/ area of mangrove
	Percentage/area of seagrass cover
	Seawater pollution level
	Function of the catchment area that increases runoff (tidal flooding)
	Sedimentation Rate
	Current change
	Phytoplankton diversity
	Benthos diversity
Frequency of flood events	
Economy	Number of fishers workers
	Livelihood Change
	Employment
	Increase original regional income in the capture fisheries sector
	Development of the informal sector
	Business opportunities
	Non-Fishers's Coastal Community Income
Loss of economic benefits from capture/aquaculture activities	
Social	Crime rate
	Spatial use conflicts
	Conflict between fishers
	Community conflict
	Poverty level
	Public Perception of Reclamation Development
	Coastal community unemployment rate
Level of knowledge and public acceptance towards reclamation development	
Legal and institutional	Local Government Support
	Central Government Support
	Protection and rehabilitation of coastal ecosystems
	Availability of reclamation development planning documents in RZWP3K
	Determination of marine conservation zones in reclamation areas
	Availability of law products for environmental pollution control
	Availability of Vulnerability Index Map for Coastal Areas and Small Islands in reclamation areas
	Availability of customary regulations and beliefs/religions
Availability of institutions that support the development of fishers/cultivators in the reclamation area	

**Table 3.** MDS analysis results, monte carlo analysis and sustainability status for Jakarta Bay, Indonesia After reclamation

Dimension	Average MDS Score for 4 locations in Jakarta Bay	Average Monte Carlo Rating for 4 locations in Jakarta Bay	Difference	Stress	R <sup>2</sup>	Sustainability Index Category
Fisheries	25.08	27.21	2.13	0.15	0.94	"Bad": unsustainable
Ecology	39.44	40.06	0.62	0.17	0.94	"Bad": unsustainable
Economy	47.31	47.40	0.38	0.17	0.92	"Bad": unsustainable
Social	47.03	47.41	0.38	0.15	0.95	"Bad": unsustainable
Legal and Institutional	38.52	39.55	1.03	0.13	0.94	"Bad": unsustainable



**Figure 3.** The sustainability status of capture fisheries resources for small-scale fisheries dimension in Jakarta Bay, Indonesia



**Figure 4.** Leverage analysis for capture fisheries resources of small-scale capture fisheries conditions in Jakarta Bay, Indonesia

According to the data analysis, fishery production in DKI Jakarta decreased after the reclamation. Capture fisheries production in 2012 before the reclamation was 219,835.80 tons and decreased drastically by 48.3% (107,119.00 tons) in 2018. In 2020, it was only 106,202 tons.

Based on the Leverage analysis results (the greater the Root Mean Square value, the more sensitive the attribute), three attributes are sensitive to the sustainability index value of the dimensions of capture fishery resources: (1) Size of fish caught; (2) Abundance of fish caught; (3) Loss of fishing grounds. The most sensitive attribute to the sustainability of small-scale capture fisheries in Jakarta Bay is the size of the fish caught. From the results of this analysis, if the three attributes experience a slight increase or decrease in conditions, they will have a significant impact on the sustainability dimension. Therefore, the policy implications of the dimensions of capture fishery resources should make it a priority. Thus, these sensitive attributes need to get more attention and be managed properly and carefully.

Fishery production in the Cilincing area before reclamation in 2012 was 97 tons and decreased by 44% in 2016 after reclamation to 55 tons; 289 tons in Kamal Muara in 2012 and decreased by 17% in 2016 after reclamation to 239 tons; 17 tons in Muara Angke in 2012 and decreased by 26% in 2016 after reclamation to 20 tons (Department of Food Security, Maritime Affairs and Agriculture DKI Jakarta, 2013, 2017). According to Puspasari et al. (2018), the potential decline in fish production that occurs was around 82.2 tons/year. Fishing productivity during and after reclamation decreased. In

2013, the CPUE (Catch per unit effort) or Catch rate was 0.133 and decreased in 2014 to 0.0085. This is also reinforced by previous research, which concluded that there was a decrease in the fishing rate for fishing gears like drift gillnet and sero (Puspasari et al. 2018).

The fish abundance in Jakarta Bay has changed, thus affecting changes in the composition of catches where the proportion of bycatch, which consists of small mixed fish, increased in 2014 compared to 2006 (Puspasari et al. 2018), both from sero fishing gear, rampus nets, and lift nets. This fact is reinforced by research from Hartati et al. (2014), which mentioned that the catch of lift nets in 2006 was composed of bycatch which made up 53.5% of the total catch, whereas the proportion of bycatch increased to 69% in 2014.

**Ecological dimension**

The index for the sustainability of small-scale capture fisheries after reclamation for the ecological dimension at 4 fish auctions is 39.4. Therefore, it is categorized as “Bad”; unsustainable. There are 10 attributes that are estimated to affect the sustainability level of the ecological dimension (Figure 6).

Based on the picture above, 10 attributes are sensitive for the sustainability of small-scale capture fisheries in Jakarta Bay and the three most sensitive are: (i) Sedimentation rate; (ii) Changes in currents; (iii) Tidal inundation and Flood frequency. According to the perception of fisher and residents, the flooding frequency increases during and after reclamation, especially around

the Cilincing, Muara Angke, Muara Baru, and Kamal Muara areas. Initially, the Jakarta reclamation program was based on regional regulation no. 8 of 1995, which stated that the purpose of reclamation was to protect Jakarta's coast from flooding. However, in reality, North Jakarta is an area that has a high potential level for flooding due to low topography and land subsidence. Reclamation can have an impact on decreasing and eliminating the function of the catchment area, which increases surface flow. This slows down the river flow, resulting in an increase in surface water and therefore, increases the flooding frequency because the river's damping capacity is exceeded by river discharge. Furthermore, the reclamation causes the water level in the rivers of Jakarta to increase up to 37% due to flow obstructions in the estuary (Republika 2016).

Changes in currents will occur if reclamation continues. Changes in sea currents in Jakarta Bay will affect the ecosystem around the waters, sedimentation from rivers will be restrained and worsen the water quality. According to Marpaung (2017), the artificial island in Jakarta Bay has an obstructed streamflow which causes the current pattern to be concentrated on the island's outskirts. Praditya (2018) indicates that there is a change in the movement of the current pattern; during the high tide, it moves towards the mainland, whereas at low tide, it moves towards the sea. In addition to increasing sedimentation, reclamation can also change the current velocity where the average current velocity during pre-reclamation reached 0.94 m/s while post-recovery reached an average of 0.88 m/s (Aprilia and

Pratomo 2017; Zulfikar and Kusratmoko 2017). The speed and changes in currents will cause changes in the ecosystem of Jakarta Bay.

According to Praditya (2018), the reclamation area (especially in K island) has experienced an increase in sedimentation rate. This is reinforced by research conducted by Aprilia and Pratomo (2017), who stated that after the reclamation, there was an increase in the thickness of the water bottom sediment up to 2.49 m. Before reclamation, it only reached a maximum thickness of 0.84 m. Reclamation will cause the material or sedimentation supply from the land that enters the sea to be restrained in the coastal area and reduce the current speed, decreasing the washing time, and the water quality becomes continuously concentrated in the area. Eventually, after reclamation, the water quality in Jakarta Bay has a higher concentration than pre-reclamation (Kusuma 2020). The sediment accumulation from suspended land activities is the main factor that affects water quality, especially the concentration of TSS and BOD, which has increased. Before reclamation, the water quality in the area was considered to be only lightly polluted (Department of Environment DKI Jakarta 2014, 2017; Kusumawardhani 2017). According to Wibowo (2018), the water quality (especially BOD, DO and salinity) experienced significant changes; the increase in BOD is 1.934-2.665 mg/L (88-154%), DO decrease about 0.4193-1.369 mg/L (11-43%), and water salinity decreased between 0.3950-0.9821% (1-3%).

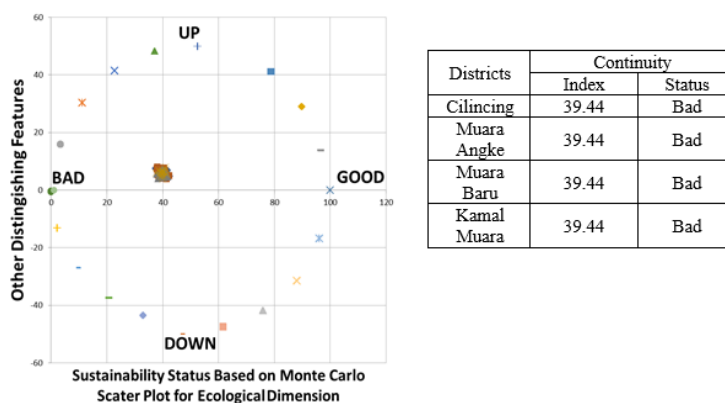


Figure 5. The sustainability status of ecological dimension for small-scale fisheries dimension in Jakarta Bay, Indonesia

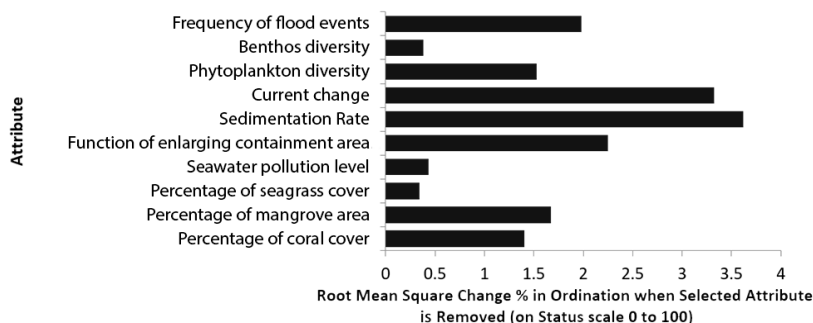


Figure 6. Leverage analysis for ecological dimensions of small-scale capture fisheries conditions in Jakarta Bay, Indonesia

To improve sustainability, efforts need to be made on sensitive indicators that significantly affect the sustainability index of the ecological dimension of small-scale fisheries in Jakarta Bay in the four fish auction areas. These factors need to be paid attention to seriously.

**Economic dimension**

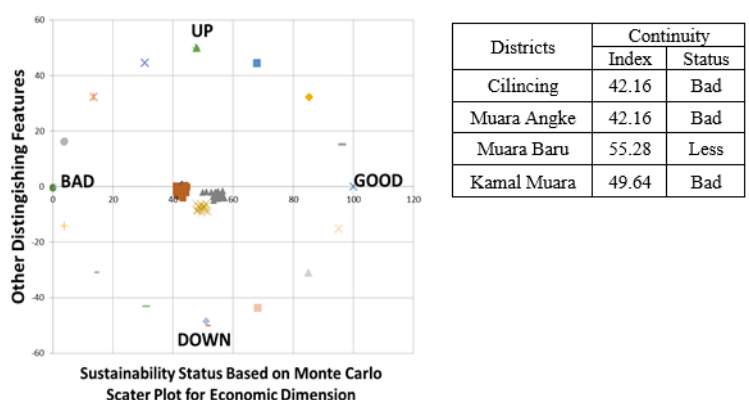
The calculation results show that the small-scale capture fisheries sustainability index for the economic dimension at the four locations has index values ranging from 42-55%. The highest sustainability index was obtained in Muara Baru, which could be categorized as “Less”, while the three other locations (Cilincing, Muara Angke, and Kamal Muara) in Jakarta Bay was categorized as “Bad”.

Based on the results of the leverage analysis (Figure 8), four indicators are sensitive to the sustainability index of the economic dimension, i.e., (i) Increase in regional original income in the capture fisheries sector; (ii) Informal sector development; (iii) Business opportunities; and (iv) Livelihood change.

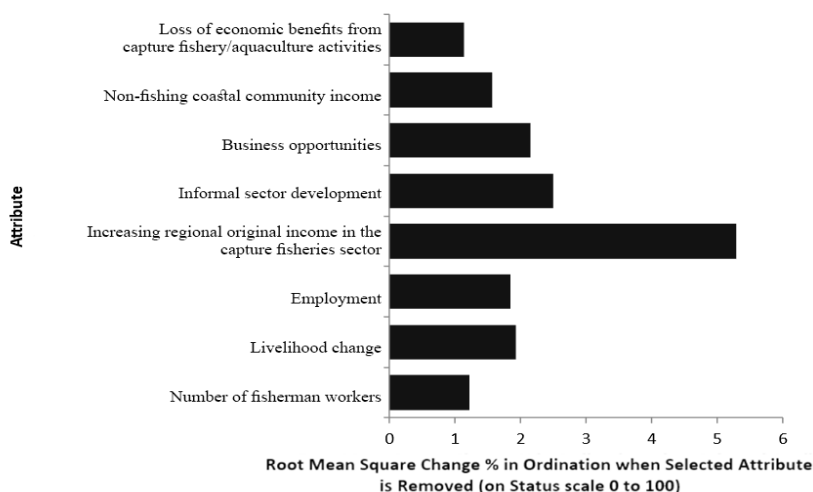
In 2013, the fisheries production of DKI Jakarta was 209 thousand tons with a production value of IDR 3420

billion, while in 2016 after reclamation, it was IDR 3443 billion. This indicates that there was no significant increase. In 2019, it became IDR. 2766 billion. This indicates that the original regional income from capture fisheries in Jakarta has decreased each year.

During and after reclamation, business opportunities and informal sectors in the area may develop, especially with changes and adaptation to livelihood. In the fields, fishers in Cilincing, Kamal Muara, and Muara Angke have side jobs such as taxi bikes, processing fishery products, grocery stalls, construction workers, electronic repairs, and others. The rest (especially crew members) become unemployed or change professions to become porters, taxi bikes, construction workers, etc. In general, fishers in Jakarta Bay still maintain their jobs as fishers but will look for other locations or move to other villages in search of fish (Sampono et al. 2012). Fisher will also look for new fishing grounds in the Thousand Islands, Muara Gembong, and beyond. As for the adaptation changes of these fishers, they open a social network to obtain fish supplies in other villages even though their fishing costs become relatively high.



**Figure 7.** The sustainability status of the economic dimension for small-scale fisheries dimension in Jakarta Bay, Indonesia



**Figure 8.** Leverage analysis for economic dimension sustainability status in small-scale fisheries in Jakarta Bay, Indonesia

Thus, the four sensitive attributes are considered priorities for sustainability, and policy interventions are needed, even though the real economic issue of the community in this area is the change or adaptation of livelihoods.

**Social dimension**

Based on the RAP after reclamation Ordination analysis, the sustainability index of small-scale fisheries in Jakarta Bay for the social dimension at the four locations ranges from 37.21-50.26 with an average of 46.82%. It is categorized as 'Bad'; unsustainable.

The social dimension in the sustainability status of small-scale fisheries after reclamation has eight attributes analyzed to find out which attributes are sensitive. Based on the results of the Leverage analysis, the two most sensitive attributes are (i) poverty level and (ii) conflict between fishers.

Sensitive attributes are the determinants of sustainability status in the social dimension. Fishers are identical to penury, where their socio-economic conditions are still marginalized, and they live in poverty. Based on the field survey results, during and after reclamation, fishers experienced a decrease in fishery production, which was exacerbated by pollution in Jakarta bay and the construction of reclamation. The decrease in fishery production and the estimated loss for fisher from reducing fishery areas reached Rp. 94,714,228,734 per year (Ramadhan et al. 2016). This decline reduces fishers's' income leading to an increase and worsening of poverty

levels. Even though the BPS data of North Jakarta from 2013 to 2017 shows a decrease in poverty levels, it has not been able to describe the actual conditions of fishers affected by reclamation on the coast of North Jakarta. The fishers generally obtained 300 kg per trip in peak season but reduced to 5-200 kg per trip.

Based on the field interview results, the majority of small fishers do not agree with the reclamation development because it would have an impact on decreasing their production and losing fishing grounds. About 86.57% of Muara Angke fishers, 79.31% of Cilincing and 27.27% Muara Baru felt disturbed by the reclamation of Jakarta Bay coast. Only a few Muara Baru fishers felt disturbed because the majority are large-scale capture fisheries actors and have vessels above 30 GT. The fishers's conflict over the reclamation development and the reclamation process continues. According to Bintari (2018), the conflict in Muara Angke is a latent type of conflict because the community does not know yet what reclamation is, its functions, and the impact G Island reclamation has due to the absence of socialization by the central and regional governments to the Muara Angke community, causing various conflicts that end in a settlement or post-conflict settlements. This leads to the administrative sanctions of temporarily suspending the reclamation of G Island by the Ministry of Environment and Forestry. Therefore, both attributes are sensitive in this social dimension and need to prioritize for improvement; poverty level and conflicts between fisher.

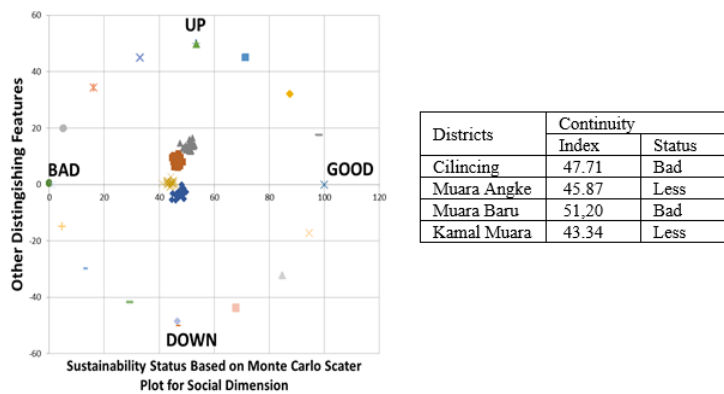


Figure 9. The sustainability status of social dimension for small-scale fisheries dimension in Jakarta Bay, Indonesia

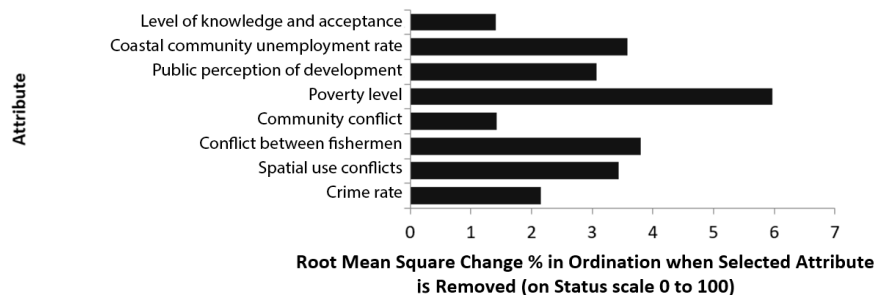


Figure 10. Leverage analysis for social dimensions in small-scale fisheries in Jakarta Bay, Indonesia

**Legal and institutional dimension**

Based on the analysis of the RAPFISH Post Reclamation Ordination, the sustainability index of small-scale fisheries in Jakarta Bay for the legal and institutional dimensions at the four locations ranged from 38.49-38.56%. It indicates that the sustainability status for this legal and institutional dimension is categorized as “Bad” and is not sustainable enough (Figure 11).

The sensitivity analysis in the RAP-FISH Post Reclamation method helps determine the legal and institutional dimensions’ sensitive attributes and sustainability index value. In total, there are 9 attributes (Figure 12).

The leverage analysis results show that there are attributes that are very sensitive to the sustainability index of the Legal and Institutional Dimensions, i.e., (i) Availability of legal products for controlling environmental pollution in the area; (ii) Availability of vulnerability index maps for coastal areas and small islands in reclamation areas; (iii) Determination of marine conservation zones in the reclamation area.

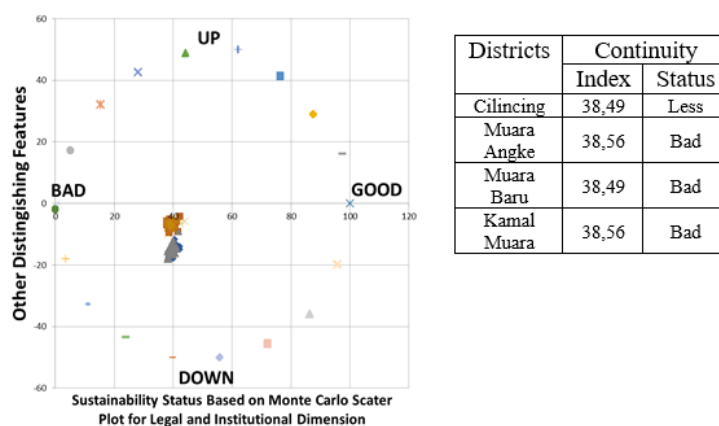
The product availability of environmental pollution control legal products is already available in Government Regulations No. 22 of 2021. However, supervision regarding after reclamation pollution control is required. Based on the Jakarta Coastal Vulnerability Index (Marine and Fisheries Research Agency 2020), coastal regions are

very vulnerable to climate change, especially the Tanjung Priok and Koja areas. In contrast, Penjaringan, Pademangan, and Cilincing areas are included in the vulnerable category. In these attributes, the three sensitive ones in the legal and institutional dimensions are the key to the sustainability of small-scale fisheries in Jakarta Bay.

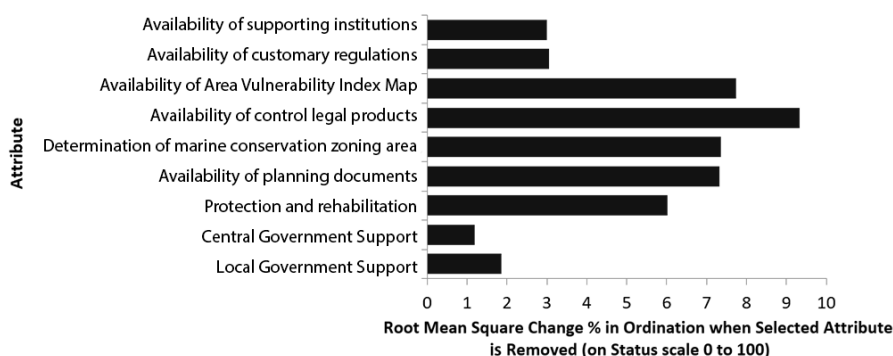
**Formulation of policy directions from the results of RAP after reclamation**

Based on the interpretation of the results and the formulation of policy directions based on the ordinance analysis using the RAP after reclamation, nearly all dimensions are categorized as “bad” or unsustainable. This is also strengthened by a study from Adharani et al. (2019), which mentioned the lack of suitability between the environment, social aspects, and policies in the management of coastal areas for the Jakarta Bay reclamation. The following is a comparison between the five dimensions in the sustainability analysis of small-scale fisheries after reclamation.

Table 4 is a summary of the sensitive attributes in each dimension. These attributes need to be prioritized and require policy intervention and significant improvements. With policy interventions, the sustainability index will significantly increase in all dimensions, and it is hoped that this matter is addressed immediately.



**Figure 11.** The sustainability status of legal and institutional dimension for small-scale fisheries dimension in Jakarta Bay, Indonesia



**Figure 12.** Leverage analysis for legal and institutional dimensions in small-scale fisheries in Jakarta Bay, Indonesia

**Table 4.** Sensitive attributes that affect the sustainability index of small-scale fisheries in Jakarta Bay, Indonesia after reclamation

Dimension		Sensitive attribute
Small-Scale Fisheries	Capture	Size of fish caught The abundance of fish caught Lost fishing grounds
Ecology/ Environment		Sedimentation rate Current change and Tidal inundation Flood frequency
Economy		Increase original regional income in the capture fisheries sector Development of the informal sector Business opportunities and Livelihood changes
Social		Poverty rate Conflict between fishers
Legal and Institutional		Availability of environmental pollution control legal products Availability of vulnerability index maps for coastal areas and small islands in reclamation areas Determination of marine conservation zones in reclamation areas

In conclusion, after reclamation closures affect fishery resources, especially small-scale ones that rely on fishing grounds around the coastal waters of Jakarta Bay. The results of the study show that nearly all five dimensions are not sustainable and less sustainable; index values: capture fisheries resources (25.08%), ecology (39.44%), economy (47.31 %), social (47.03%), legal and institutional (38.52%). Small-scale capture fisheries under 10 GT in coastal waters of Jakarta Bay require policy intervention, especially towards the sensitive attributes. 16 attributes must be prioritized, i.e., the dimensions of capture fisheries resources-size of fish caught, the abundance of fish caught and loss of fishing grounds; for the ecological dimensions-sedimentation rate, current change, tidal inundation, and flood frequency; for the economic dimension-increase regional original income in the capture fisheries sector, development of the informal sector, business opportunities and livelihood changes; for the social dimensions-poverty level and conflict between fishers; for the legal and institutional dimensions-the availability of environmental pollution control legal products (especially after reclamation), the availability of vulnerability index maps for coastal areas and small islands in the reclamation area, the determination of marine conservation zones in the reclamation area. These attributes are crucial for policy intervention, leading to the sustainability of small-scale capture fisheries in Jakarta Bay after reclamation.

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