Environmental Monitoring and Assessment Sustainable Model Impact of Reclamation in Coastal Area in North Jakarta

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Abstract

Indonesia is a maritime country has the most islands in the world with many islands in Indonesia, where between one island to the other islands are separated by the sea. Indonesia has a long coastline that is 95.181 km, of which about three-quarters (5,8 million km2) of marine waters of Indonesia is composed of sea coast, seas, bays and straits. North Jakarta coastal areas are being reclaimed and is seen disturbing the balance three aspects of coastal areas, such as environmental, social, and economic, as well as coastal zone management strategy is needed. Analysis of North Jakarta coastal zone management with system dynamics models to show the relevance of social aspects (Level Fishermen welfare), economic aspects (Revenue fishermen) and environmental aspects (Area of ponds, mangrove forests, and total of fishing). Models are designed to validate with the values obtained, AME (pond area) = 49,54%, Average Mean Errors (AME) of validation for (Mangrove) = 5,60%, and AME (total of fishing) =5,64%. Simulation models has done up in 2019. The impact on the economic aspect is the decrease of fishermen's income from Rp. 5.000.000,00-Rp.10.000.000,00 to around Rp 2.000.000,00-Rp. 3.000.000,00. The impact on the social aspect is the reduced level of welfare. The impact on the environmental aspect is the reduction in mangrove area, and accompanied by increased area of the pond. The design of two scenarios on the model of intervention to resolve the existing problems, the first intervention scenario by using of technology and the second intervention scenario is a combination of using technology and restoration of mangrove forests program. Obtained in the simulation results, that both scenarios can show the desired trend in the future.

Keywords
Sustainability (Ecosystem of Mangrove, Area of Ponds, Income and Wealth Level of Fishermen), System Dynamics, Reclamation

1. Introduction

Indonesia is a maritime country with many islands in Indonesia, where between one island to the other islands are separated by the sea. Indonesia has a long coastline that is 95 .181 km, of which about three- quarters (5.8 million km2). In fact, several marine areas in Indonesia is composed of sea coast, seas, bays and straits. Altogether is a territorial sea waters with an area that approximately 3.1 million km2. Potential marine waters and coastline is so vast and many natural resources are extremely spill out, both biological and non- biological resources (UN, 2008). Dependence of communities on the maritime sector provides its own identity as a coastal community with a lifestyle that has known as coastal cultures (Geertz, 1981).

The coastal area are the meeting between land and sea, hence this region is a region that is unique geologically, ecologically, and is the domain biologically very important for a lot of life on land and in water, including humans (Beatley et al., 1994). The coastal area is also unique in terms of the economy since this region providing space for human activities that produce huge beneficial. In addition, the coastal region are the result of mosaic ecosystems and resources, so the coast are called as a strategic region for economic conditions and social welfare as well as the development of the country (Ring-Sain and Knecht, 1998). There are loads of variety livelihoods in coastal areas one of which is a fisherman.

Fishermen are the term of village people who daily work to catch fish and other organisms that live in the waters. Bodies which become the fishing activity can be freshwater, brackish and sea. Fishermen are a group of people whose lives depend directly on the sea, either by arresting or cultivation. They generally live off the coast, a residential neighborhood close to the location of activities. Indonesia has a population with diverse livelihood, one of which is the fishermen.

Several other research that has been done previously, it is explained that the fishermen in Indonesia has a very important role in people's lives, in order to promote economic growth in Indonesia. The increases in the welfare of fishermen can be a jack in promoting growth in Indonesia, by optimizing the potential of marine products make advanced nations Indonesia, because Indonesia has a huge potential to develop coastal and marine areas. By Seeing the potential of coastal areas are so large, the fishermen should have been able to achieve welfare (Mulyadi, 2016). Coastal and marine areas will deliver benefits that are vital to the growth and development of the Indonesian economy, especially in the economic sector in terms of trade.

Traditional fishermen consist of fishermen owners, laborers of fishermen, fish farmers and other marine organisms, fish traders and fish processors. The number of traditional fishermen according to survey results BPS 2003-2013, has declined from 1.6 million to 864 thousand households. While fishermen cultivation (farmers) actually rose, from 985 thousand to 1.2 million households. Factors that influence of the decline was the distribution of subsidized fuel, capital, facilities, and infrastructure, and completed by human resources and institutional fishermen, market access, safety, and regulatory. The increases in dollar prices in Indonesia, the condition of fisheries in Indonesia. Potential fisheries Indonesia reached 65 million tons / year and 57.7 million tons is potential for aquaculture. Potential fisheries catching at sea and open waters (freshwater)

amounted to 7.3 million tons, consisting of 6.4 million tonnes of potential arrest and 0.9 million tons of marine fisheries are potential public waters (Ghufran and Kordi, 2015). By looking at this potential, the fishermen have opportunities to catch fish below 6.4 million tonnes. The decline in the number of fishermen caused by several things, such as the rapid development of the area until finally demanded a new land so did a reclamation activities.

The development of coastal areas quite rapidly begins with the emergence of phenomena, like many elite built housing projects and high-rise buildings. Rapid development requires adequate space while the existing space in coastal areas have a fixed area and tend to be limited, so often found in coastal areas reclamation activities. The main aim of reclamation activities is to increase space. This beach reclamation activities will also be able to play a very important role in the rearrangement and can give a distinctive character to the area of North Jakarta and is named after the reclamation activities in Jakarta Bay Reclamation

2. Materials and Methods

The study was conducted in the Coastal area in North Jakarta which consists of In previous studies has been explained that reclamation has disrupted three major aspects of equity, but has not seen clearly how the management of the impact of the reclamation. Analysis of North Jakarta coastal zone management with system dynamics models to show the relevance of social aspects (the level of welfare of fishermen), economic aspects (Revenue fishermen) and environmental aspects (Area of ponds, mangrove forests, and catch fish).

3. Result

Post-reclamation conditions meprihatinkan enough for society, especially reclaimed island of C and D, in the Village of Kamal Muara. This analysis was conducted to explain that the desire and the conditions that should happen is the aspect of social, environmental, and economic in the coastal area of North Jakarta remained seimbaang so it can be an area of sustainable coastal region. In fact, social, economic, and environmental reclamation after experiencing imbalances, especially to the surrounding community that acts as a fisherman and businessman pond. The coastal area is a place for fishermen and farmers catch fish, has now changed disappear and turn into the mainland. The coastal area is converted into the mainland indicate that impaired coastal ecosystem and the most visible is the destruction of mangrove forests and dwindling fish catches.

3.1 Economic Aspects of Post Reclamation

The economy has been very decreased by fishermen in terms of fishing. Fishing diminishing causes fishermen's income also declined. Based on the results of the questionnaire are accompanied by interviews conducted by the researchers, it can be concluded that the income of fishermen down dramatically or decreases by almost 50%. Kamal Muara Fishermen interviewed by investigators revealed baha, originally (before the reclamation) is still possible to bring the money back home, or so-called net income of Rp. 5,000,000.00 to Rp. 10,000,000.00 per month, but after the reclamation, the income of fishermen has dropped to around Rp. 2,000,000.00 to Rp. 3,000,000.00 per month. The data is get from the questionnaire has been designed by researchers. It can be concluded that prior to the reclamation, there are about 60% of the total fishermen who were interviewed by the researchers obtained a net income of Rp. 5,000,000.00 to Rp. 10,000,000.00 per month. Kondsi post reclamation almost 95% of the total fishermen who were interviewed by the researchers obtained net income in the range of Rp. 2,000,000.00 to Rp. 3,000,000.00 per month.

3.2 Social Aspects of Post Reclamation

A discussion of aspects of social level or in this case the researchers focused on the welfare of fishermen where, a comparison of revenue generated fishermen compared to the standard minimum wage set by the government for the

location of Jakarta. Jakarta has a standard minimum wage for the people of Rp. 2,000,000.00 to Rp. 3,000,000.00 per month. Depreciation of the income of fishermen would cause fishermen switched professions to become farmers. Increasing the number of farmers who will trigger additional number of new embankment land resulting in social conflict. Social conflicts that occur between farmers is competition for land where the land is minimal need mampus meet the needs of the pond area for new farmers.

3.3 Environmental Aspects of Post-Reclamation

Data marine fish catch is used as reference data ranging from 2011 to 2015. The number of fish stocks initially rose and eventually, decrease by 40% from 2012 to the year 2013 and going beyond. This decline occurred in the same year while the Coastal Zone Reclamation activities. Data catches can be seen in Table 1.

Table 1. Catch Fish Of The Year 2008-2015

Year	Production of Sea Fish (Kg)
2008	315,152.00
2009	317,218.00
2010	321,284.00
2011	325,350.00
2012	329,416.00
2013	278,589.00
2014	324,632.00
2015	327,621.67

Source: Department of Fisheries Kamal Muara, 2016

When we see the trend of the catches in Figure 1, the first year is likely to increase until 2012 and then decreased drastically when heading 2013, 2014, and 2015.

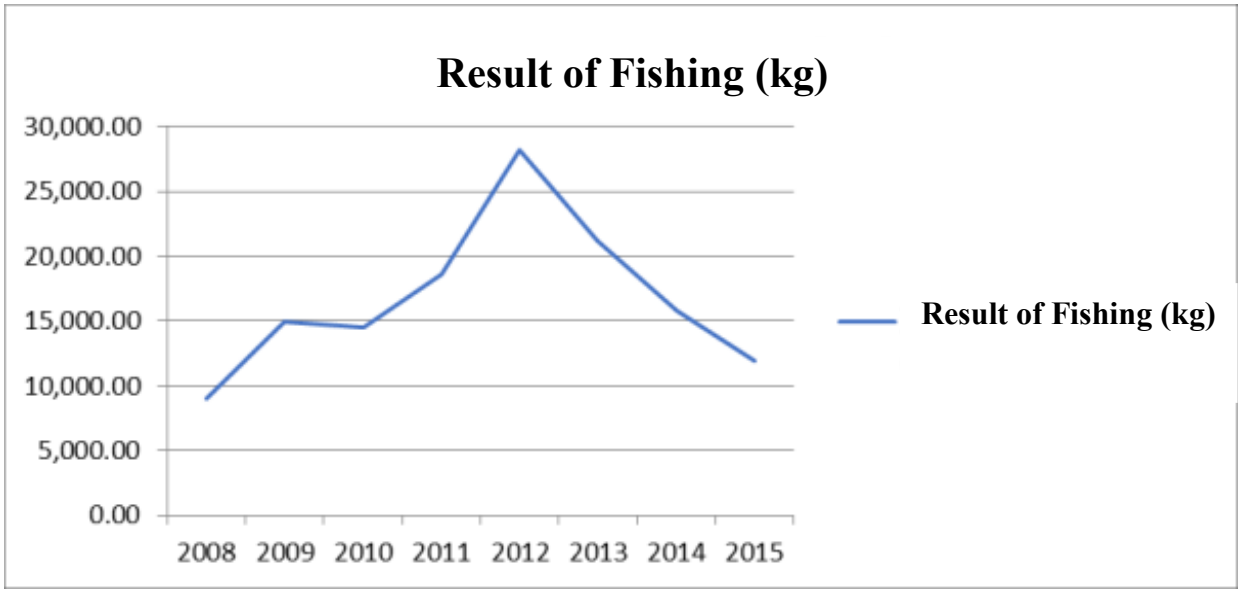

Figure 1. Trend Data for Result of Fishing

Table 2. Recalculation And Size Size Mangrove Pond

Year	Mangrove Forest (ha)	Size of Pond
2008	99.9	0.021
2009	96.3	0.5
2010	93.924	0.5
2011	87.0	7.02
2012	81.27	6.38
2013	80.46	7.41
2014	87.39	9.75
2015	84.96	11.45

Source: Recalculation SIG, 2016

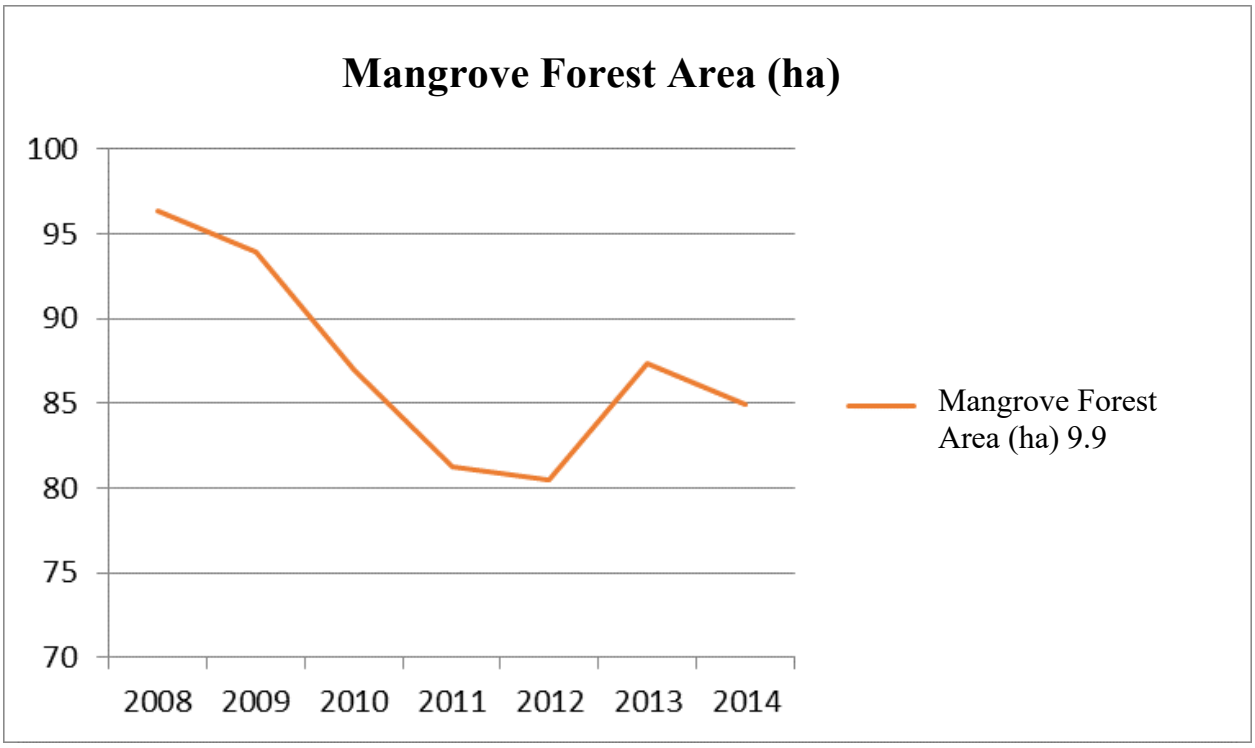

Figure 2. Graph Mangrove Forest Area

Based on Figure 4.4 shows that the forest area has fluctuated. The decline seen in 2008, the mangrove forest area of 99.9 ha to 84.96 ha in 2015.

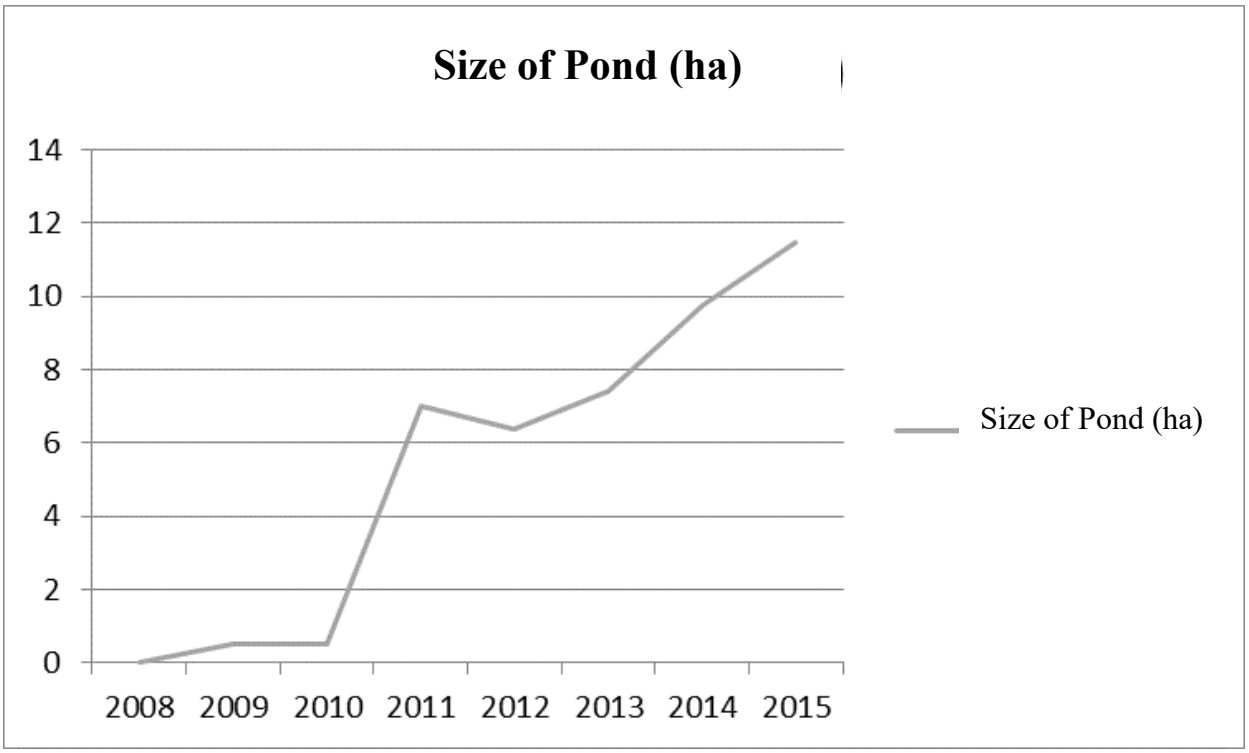

Figure 3. Trend Data for Size of Pond

In contrast to the mangrove area that luasanya often decreases, spacious pond in a residential area fishermen have increased from the initially only 0,021 ha up to now has reached 11.49 ha. Pningkatan tendency spacious ponds can be seen in Figure 3.

4. Discussion

Intervention on the model aimed at more sustainable development of coastal areas. Interventions in sustainable model the impact of reclamation is to conduct restoration of mangrove forests and the use of technology to increase the ponds. The aim is that the farmers no longer opens a new embankment land. Restoration activities intended that the mangrove forests of mangrove forest ecosystems are not degraded and can meet the demand for fish for the fishermen in the future. In the process of this model of intervention, reclaiming variable omitted for reclamation has been completed and will be analyzed how the impact will occur in the future. In the process of intervention, will be made two main scenarios, namely:

1. Intervention Scenario 1 (Use of Technology): Sustainable management of reclamation impact through technological interventions
2. Intervention Scenario 2 (Use of technology and the restoration of mangrove forests): Sustainable management of reclamation impact through technological intervention and mangrove restoration activities

The fraction of each scenario can be seen in Table 3. The fraction obtained from the simulation results with the addition or subtraction value with a certain interval. For example for a fraction of the figure of shrimp ponds, increased in value by 0.10% / year to obtain the desired condition that is 33.10%/year.

Table 3. Fraction for Intervention Scenarios 1 and 2

No.	Type of Fractions	BAU	Intervention Scenario 1	Intervention Scenario 2
1	Figures of Shrimp Pond	15 years	33.10%/year	33.10%/year
2	Figures Conservation Pond	0%/year	25 years	30 years
3	Figures Reduction of Mangrove	4.2%/year	6 years	4 years
4	The Growth Rate of Mangrove	0%/year	4.2%/year	4.2%/year
5	Figures Reduction of Fish	15 years	15 years	15 years
6	Figures Addition of Fish	1.03%/year	1.03%/year	1.03%/year
7	The Increase in the Price of Fish	18.18%/year	18.18%/year	18.18%/year
8	The Rate of Increase in Minimum Wages	10 years	10 years	10 years
9	Use of Technology	-	300%/year	300%/year

4.1 Scenario Intervention 1

Variable role of technology in the pond to see that in the future, the pond area will not increase, but the pond still abundant even increased up to 3x or increased to 300%. The forest area of mangroves growing which will affect the increase in the catch. Result of scenario 1 simulation can be seen in Table 4.

Table 4. Results of Simulation Scenario 1

Year	Forest Mangrove (ha)	Catch Fish (kg)	Pond Size (ha)
2008	99.90	8991.25	0.021
2009	99.24	10726.63	0.67
2010	98.75	20399.65	1.17
2011	98.38	34683.96	1.54
2012	98.10	51299.90	1.82
2013	97.89	68718.36	2.02
2014	97.73	85944.18	2.18
2015	97.62	102359.36	2.30
2016	97.53	117603,58	2.38
2017	97.46	131501,68	2.45
2018	97.42	143994,42	2.50
2019	97.38	155101,46	2.53

The simulation results showed that the area of the pond will be relatively constant at range 2-3 ha. Forest mangrove can increase its range than the state forests of mangrove current, so that the existence of forest ecosystem mangrove non-existant. Similarly, the value of fishing which would tend to increase with an increase in forest area of mangroves , because fishing ground for the wider region and make the amount of fish that can be caught increases.

Intervention scenario simulation graph 1 which can be seen in Figure 4, indicating that the fishing is likely to increase since the first year or 2008 and simulated until 2019.

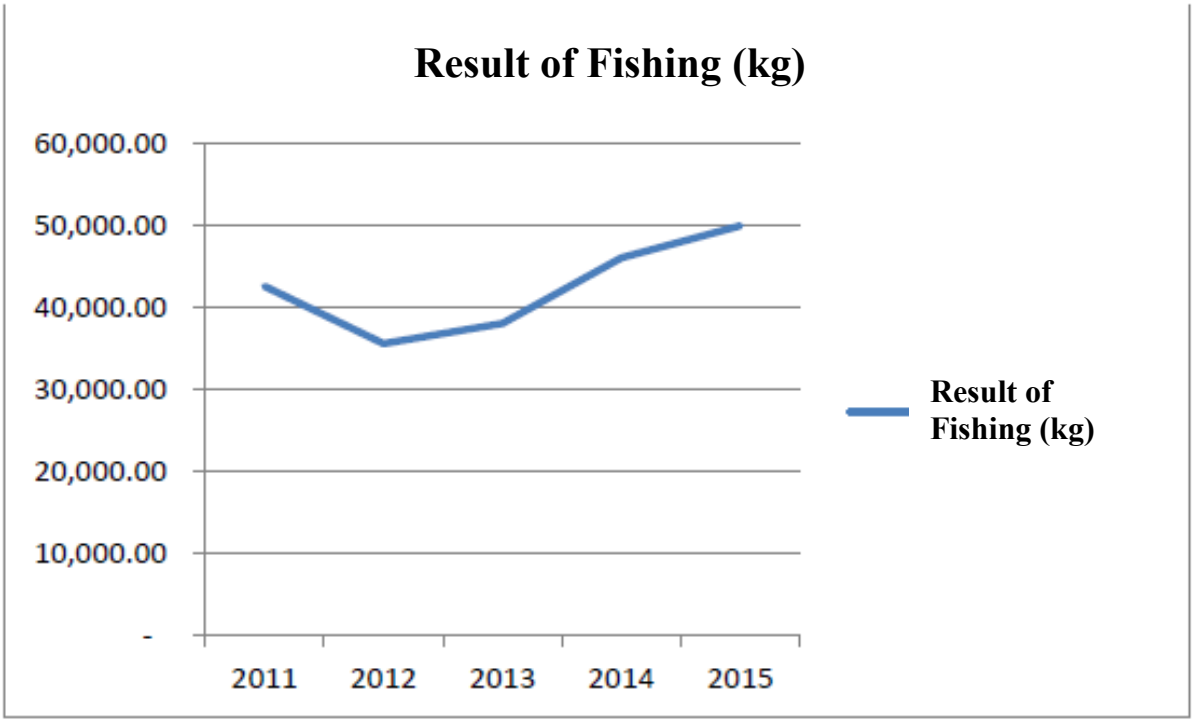

Figure 4. Graph Intervention Simulation Scenario 1

In the first scenario simulations showed that the intervention of the mangrove forest area relative decline. The tendency of mangrove forest simulation results obtained inversely proportional to the extensive pond. The simulation results of mangrove forest can be seen in Figure 5.

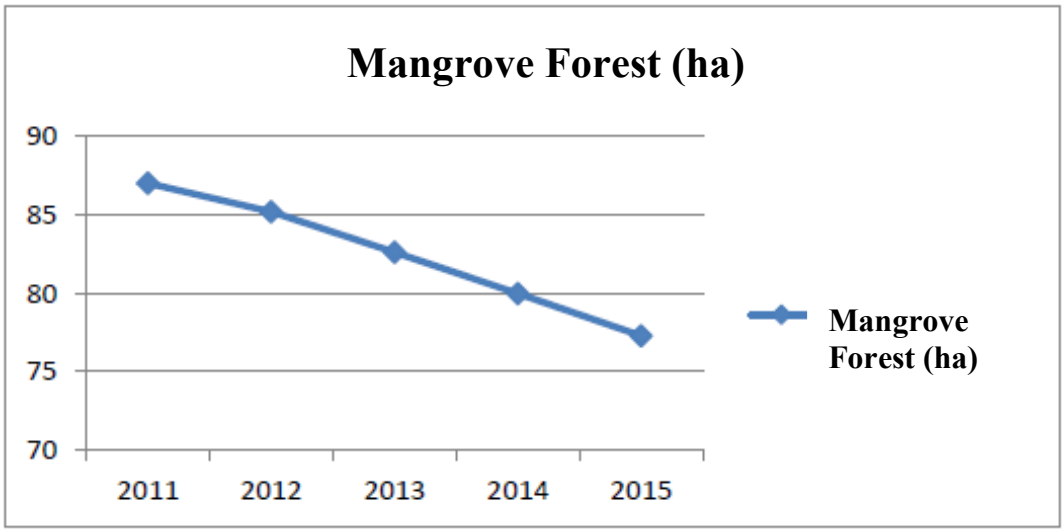

Figure 5. Graph Simulation of Mangrove Forest on Intervention Scenario 1

Spacious pond to increase up to a point where it will stop and grow and not be expanded again (constant). This is influenced by the technology that makes the pond remain abundant without having to open new land for activities of the farm. It can be caused due to the current use of technology, society needs to adapt in order to get used to using technology. The adaptation process is carried out by farmers led to fishing communities still opening new lands for activities of the farm.

Sustainable management of the impact of reclamation through technological interventions that can increase the yield of 300% sebeser ponds and restoration activities mangrove which is considered to decrease the rate of reduction of forest mangrove . In this case, the two main variables in the intervention in the process simultaneously in reclamation impact management model to describe the condition of coastal areas that continues until a few years of 2019. According to data obtained by researchers, the influence of technology and the restoration of mangroves is a scenario that is visible to be used as an intervention in the model and were able to create a sustainable coastal areas.

A total of 2 (two) variables intervent in this scenario the role of technology and restoration activities mangrove to see that the future of pond area will not grow, the forest area of mangroves growing, as well as an increase in the catch. The simulation results with the intervention of the role of technology in accordance with the intervention scenario 2, can be seen in Table 5.

Table 5. Intervention of Scenario 2 Simulation Results

Year	Fishing Data (kg)	Spacious Mangrove Forest Data (ha)	Size of Pond Data (ha)
2008	8991.25	99.90	0.021
2009	10726.62	99.45	0.67
2010	20392.55	99.20	1.13
2011	34257.19	99.10	1.45
2012	49925.05	99.10	1.68
2013	65901.32	99.16	1.83
2014	81292.52	99.28	1.95
2015	95601.56	99.41	2.03
2016	108588.26	99.57	2.10
2017	120175.01	99.75	2.12
2018	130383.47	99.93	2.14
2019	139292.64	100.12	2.16

Mangrove forest expected can grow more than the state of mangrove forest this time that the existence of the ecosystem is not extinct. Similarly, the value of fishing which would tend to increase with an increase in mangrove forest area, because the ground fishery for the wider region and multiply. The catches will still tend to increase as a result of increased ponds and forest restoration has been carried out mangrove so every year extensive mangrove can grow up to 2 ha.

The forest of mangrove had declined but after the intervention, it happened again the increase in forest area of mangroves and prevent the extinction of forest ecosystems mangrove for their restoration program mangrove which makes the growth rate of mangrove increased by 2%/year.

The vast pond will tend to increase and then constant due to the use of technology to make the fishermen do not need to open up new land for the pond. Pond area reduction is intended for forest restoration program mangrove (reforestation of mangrove).

5. Conclusion

Researchers produced conclusions and suggestions for the management of coastal areas of North Jakarta. Based on the analysis and discussion presented in the previous chapter, we can conclude some of the following:

1. Impact reclamation on coast kelurahan Kamal estuary consist from three aspects, namely social, economic, and environmental. Impact on aspect economy is decreasing income fisherman from Rp. 5,000,000.00-Rp. 10,000,000.00 to around Rp. 2,000,000.00-Rp. 3,000,000.00. Impact on aspect social is decreasing level welfare community. Impact on aspect environment life is lessening as well as the mangrove area accompanied with m eningkatnya extents pond. too increase mangrove area. The intervention among others: increase number opening fishpond up 33.10%/ year, increasing number conservation fishpond as big as 30%/year, increasing number mangrove growth to 4.2%/year. Impact from increase number opening fishpond is increasing number reduction of mangrove 4%/year.
2. Strategy management The best coastal by modeling consist from two scenario namely:
   a. On Scenario 1 things to do is use technology for increase productivity fishpond so that mangrove area will increase on years next. The intervention among others: increase number opening fish pond up 33.10%/year, increasing number conservation fishpond as big as 1.5% / year, increasing number mangrove growth to 4.2% / year. Impact from increase number opening fishpond is increasing number mangrove reduction of 6%/year.
   b. On Scenario 2 things to do is merge use technology for increase productivity fishpond with increase mangrove restoration program. With scenario this be expected productivity fishpond increase to reach point maximum and too increase mangrove area. The intervention among others: increase number opening fishpond up 33.10%/year, increasing number conservation fishpond as big as 30%/year, increasing number mangrove growth to 4.2%/year. Impact from increase number opening fishpond is increasing number reduction of mangrove 4%/year.

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