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## Sustainable Port Planning in Future Indonesian Ports: A Case Study of Mafa Port based on UN SDGs

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# Sustainable Port Planning in Future Indonesian Ports: A Case Study of Mafa Port based on UN SDGs

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**Abstract.** As one of the biggest maritime nation in the world, Indonesia has big advantages and potential with its long coastline. Part of the maritime industry that Indonesia can provide is the port services. Port development hopes to carry the development of the area in many aspects with the sustainable approach. This study uses Mafa Port in Indonesia as the study case location. This study looks into the new port development effect in regard to 5 goals of United Nation Sustainable Development Goals (UN SDGs), to see the connection of new port to the regional development. As a result, this study identifies the related sustainable goals with the port development and also the approach being used by sustainable port base practices.

## 1. Introduction

Maritime industry is the business environment that includes port, shipping, shipyard, scrapping, insurances, classification society, fisheries, tourism, and others. One of the maritime nations with biggest maritime potential is Indonesia, with its 17,504 islands, sixth longest coastline country in the world, and located in the middle of biggest magnitude of shipping world: South China Sea - Indian Ocean – Pacific Ocean, Indonesia has a lot more to develop.

Port industry is one of the main potentials Indonesia could explore to help develop its economic stages. Port planning is a part of port engineering and design, with a sustainable approach of port planning and development, the technical side of the industries could help to reach the common goal of the sustainable world in the future. The current trend of developing more sustainable port to comply with the demanded environmental issues has to be considered seriously. For example, the IMO's regulation 2020 regarding sulphur's content and scrubber usage pushed ports around the world regulated as it means.

There is no certainty of which agenda related to the port development and how to implement the sustainable port practice with its benefit. This study will look into a new port in Indonesia, Mafa Port and see the connection between the area development to the nationals to see the contribution of that port to the UN SDGs criteria.

This study incudes literature review and data at Part 2, including sustainable aspects of port planning explanation from UN SDGs, current Indonesian port development study, and base practice of sustainable port, in this case, Port of Gothenburg. Part 3 covers the methodology used for the study, Part 4 explains of results, and Part 5 covers conclusion and discussion.



## 2. Literature Review and Data

### 2.1. UN SDGs and Port Planning

United Nation (UN) published the Sustainable Development Goals (SDGs) in 2015, which consisted of 17 important points to reach by 2030. This research analyses each of sustainable aspects of UN SDGs that has connection to port development with several references.

#### 2.1.1. No Poverty

Ending poverty in all its forms everywhere is the first and main goal in UN SDG. Poverty is not only about employment and people's ability to sustain their livelihood. One of the targets to eradicate poverty is currently measured as people living on less than US\$1.25 a day (using 2005 prices). According to World Bank, more than 700 million people or 10% of the world population still live on less than US\$ 1.90 a day (using 2011 prices). In SDGs, it is recognized that poverty is defined differently by national authorities. The main problem regarding poverty in Indonesia is the inequality across the regions. Indonesia's government -Badan Pusat Statistik (BPS) / Central Bureau of Statistics Republic of Indonesia, defines poverty as an economic inability to fulfil food and non-food basic needs which are measured by expenditure. BPS sets Property Line (PL) each year for each region to consider people as poor, whose expenditure per capita per month is below the PL number. Another way to measure poverty in Indonesia is Human Development Index (HDI) which explains how people can access development results in obtaining income, health, education and so forth. HDI was formed by three basic dimensions: a long and healthy life; knowledge; and a decent standard of living.

As an archipelago country, ports could be the answer to reduce the inequality of economic growth that could lead to poverty. By using quantitative data of PL and HDI of a region in the years before and after the construction and operation of a port could represent the idea that port, especially in an archipelago country, has great impact as the contributor of a nation to achieve one of the SDGs - eradicating poverty. The assumption being used in this study is that port development would be the only changes that count in the area.

#### 2.1.2. Zero Hunger

Zero hunger target in UN SDGs is to have zero hunger in 2030, of which in case in Indonesia there are 7.6% of people living undernourished. It ties with hunger issue; agricultural sector contributes to the 34% of Indonesian population and it is 13% of its GDP. The port development has tight connection to the agricultural productivity of an island area, the more effective the shipping the more probable product could enter the market and distributed. The measurable numbers regarding zero hunger would be the agriculture productivity and the ratio changes of people living undernourished of the area before and after the port development.

#### 2.1.3. Decent Work and Economic Growth

The magnitude of a port could bring to economic aspect an area is massive as it has direct connection of an area access to the market. With the target of 7% gross domestic product growth per annum for least developed country, the number is still pretty high compared to Indonesia's annual growth rate of 3.4% in 2015. There is an implementation of Port's Exclusive Economic Zone / *Kawasan Ekonomi Khusus Pelabuhan* (KEK Pelabuhan) that proposed to help to push the industrial activity around the port. The measurable index of this matter would be the differences annual growth of real GDP before the port development and after.

#### 2.1.4. Industry, Innovation, and Infrastructure

Manufacturing value added in GDP is 16.3% in 2017 globally, with the 1.1% growth from 2005. Small and medium sized enterprises is the important piece of a nation's economy backbone. The mentioned part contributes up to 60% of employment and almost covering 90% of the business. Indonesia as the top 10 manufacturers in the world, received 25% of its GDP from manufacturing by involving 25 million people (22% of the population). The measurable index to identify the effect of port

development to the industry is the number of annual income growth of manufacturing of an area before and after the port development.

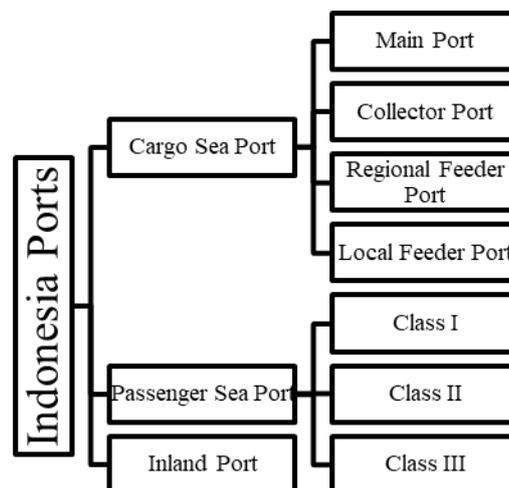
### 2.1.5. Life Below Water

Ocean, seas, and marine resources are big part of world economic, contributed to 5% of global GDP shares market value. Marine fisheries also directly or indirectly employ 200 million people around the world. In 2011, over 6 million people tied to inland and marine fishing. Port development is the main key in the fishing industries as it will open the gate for the economical scale of the industry. The measurement of this matter would be the income growth coming from the fisheries industry before and after the port development.

## 2.2. Indonesian Port Development Study

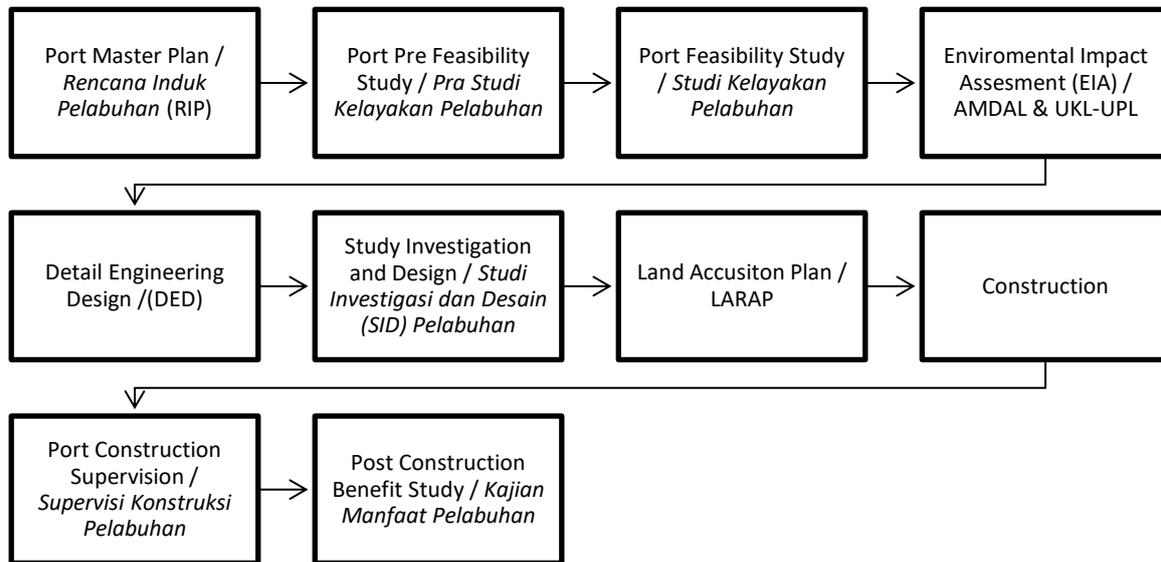
### 2.2.1. Rencana Induk Pelabuhan (RIP) / Port Masterplan

*Rencana Induk Pelabuhan Nasional* / National Port Masterplan is the regulation of which consists of port regulations, port location plan, and port hierarchy (Menteri Perhubungan Republik Indonesia, 2015). National Port Masterplan covering the regulations for cargo sea port, passenger sea port, and river and lake / inland ports. Detailed hierarchy of port regulations in Indonesia as below.



**Figure 1.** Indonesia Port Hierarchy.

Whereas, the *Rencana Induk Pelabuhan (RIP)* / Port Masterplan is the port layout study including the land and water layout part of the port. Port Masterplan has to consider National Port Master Plan, urban land use plan, technical side, and safety aspects. Port Masterplan covering the three timeline of port planning, short term (5-10years), middle term (10-15years), and long term (15-20 years). Along with port masterplan study, there are 10 (ten) stages of port studies in Indonesia.



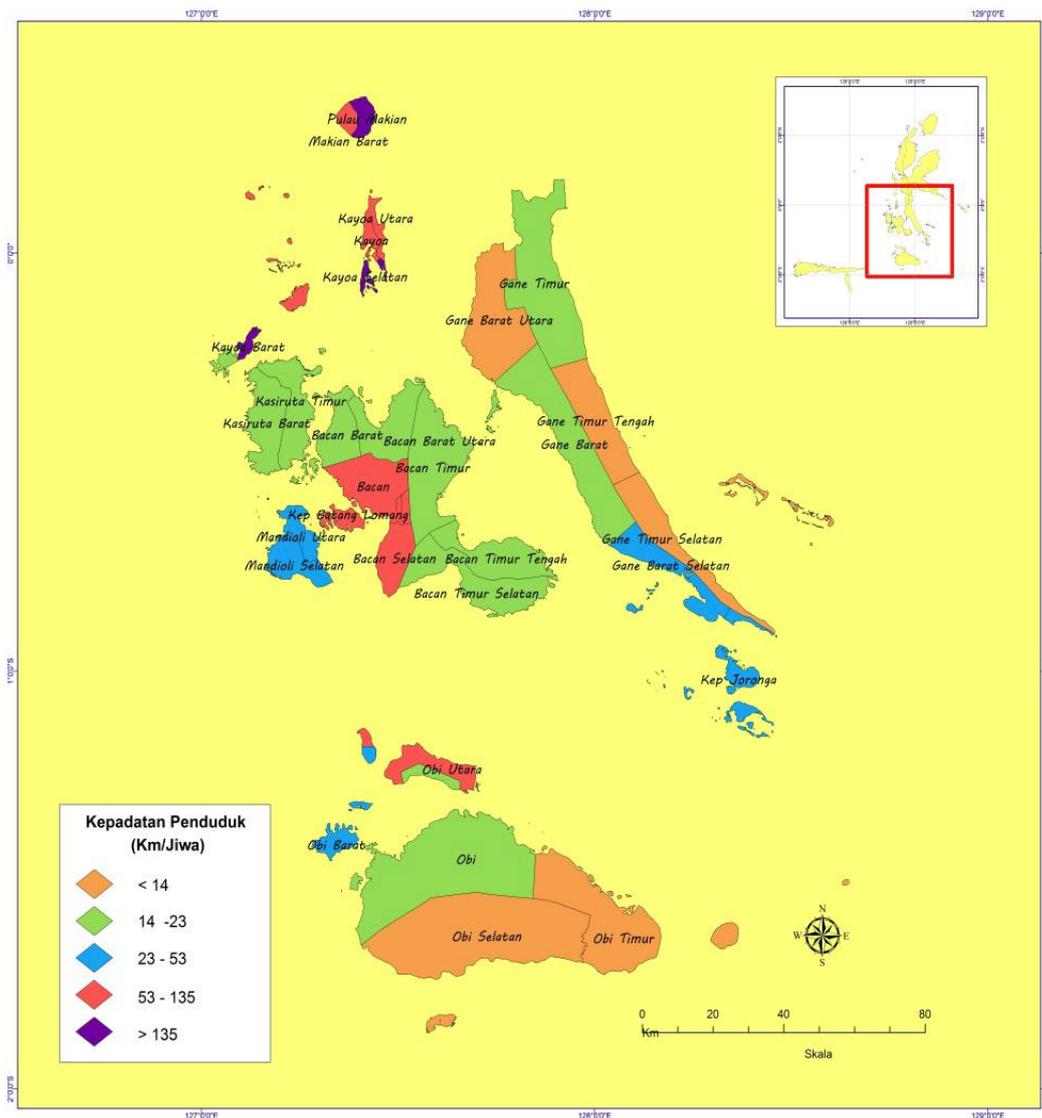
**Figure 2.** Indonesian Port Study

### 2.2.2. Environmental Studies Documents (AMDAL & UKL-UPL) / Environmental Impact Assessment (EIA)

There are two kind of environmental studies or Environmental Impact Assessment (EIA) in Indonesia regarding port development: *Analisis Dampak Lingkungan (AMDAL)* / and *UKL-UPL (Upaya Pengelolaan Lingkungan Hidup - Upaya Pemantauan Lingkungan Hidup)*. AMDAL study required for port construction that: with jetty longer than 200 meters or bigger than 6,000-meter square, massive jetty construction that has potential effect on environment, with breakwater longer than 200 meter, or floating facility of bigger than 10,000 DWT (Menteri Negara Lingkungan Hidup Republik Indonesia, 2012). The rest of port type construction in Indonesia required UKL-UPL study.

### 2.3. Study Case: Mafa Port

Mafa Port is a local feeder port located in Gone Timur sub-district, South Halmahera (Halmahera Selatan) district (Figure 3), North Maluku Province of Indonesia. South Halmahera is a district with 8,779.32 km<sup>2</sup> area with 227,280 number of population (1.71% growth rate), of which means the density of 26 people/km<sup>2</sup> (Badan Pusat Statistik, 2018). Labor force participation are 87.05% for the male and 47.35% for female in 2017. The biggest economy sector in South Halmahera is the Agriculture, Forestry, and Fishing, contributing 31.09% of the GDP, along with that the Trade contributes 17.33%, Administration and Defence 9.85%, and Mining and Quarry as 7.29%.



**Figure 3.** South Halmahera district where Mafa Port located.

Mafa port was built in 2015 as the local feeder port for South Halmahera. There are totally 19 port locations planned in South Halmahera, with Laiwui Port and Babang Port as Collector Ports, Wayaua Port as Regional Feeder Port.

**Table 1.** Port locations and Hierarchy of South Halmahera District (National Port Masterplan of Indonesia, 2019)

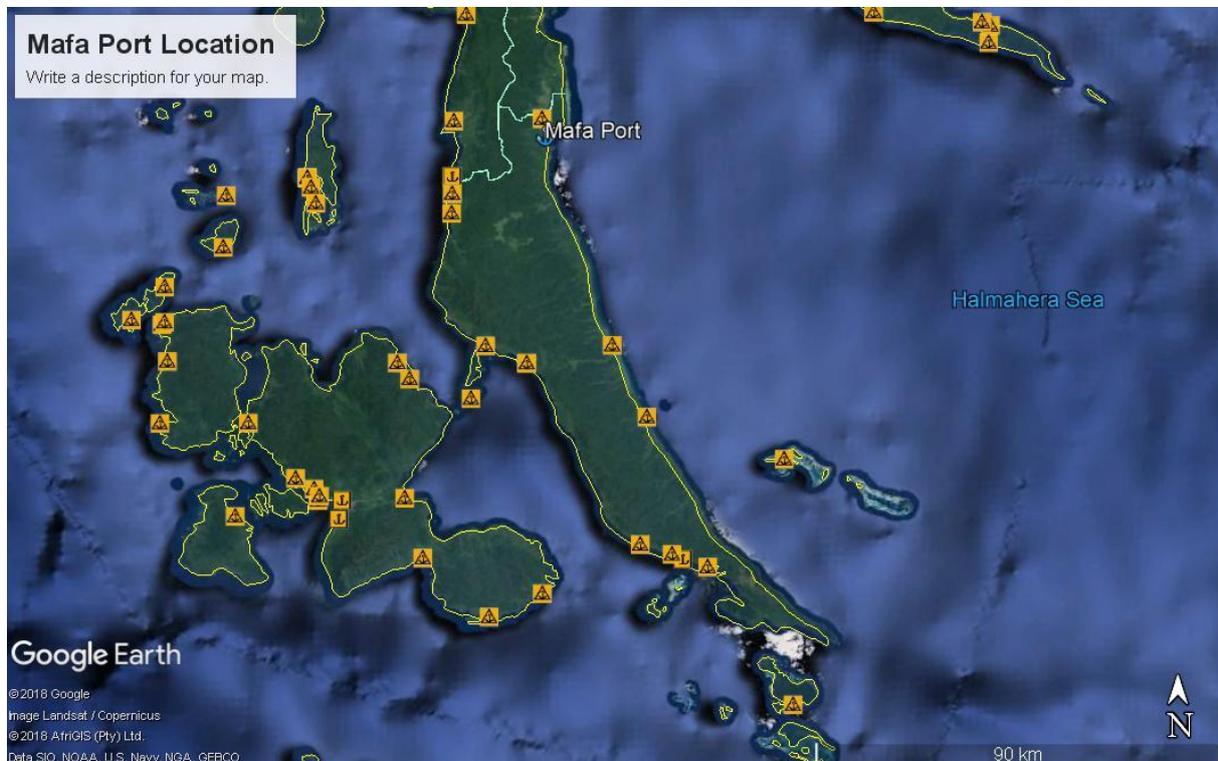
No	Port Locations Name	Hierarchy			
		2017	2022	2027	2037
1	<b>Babang</b>	PP	PP	PP	PP
2	<b>Busua</b>	PL	PL	PL	PL
3	<b>Laiwui</b>	PP	PP	PP	PP
4	<b>Mafa</b>	PL	PL	PL	PL
5	<b>Bisui</b>	PL	PL	PL	PL
6	<b>Manu/Gamunu</b>	PL	PL	PL	PL
7	<b>Pulau Kayoa</b>	PL	PL	PL	PL
8	<b>Indari</b>	PL	PL	PL	PL

9	<b>Koititi</b>	PL	PL	PL	PL
10	<b>Labuha</b>	PL	PL	PL	PL
11	<b>Leleo Jaya</b>	PL	PL	PL	PL
12	<b>Madopolo/Joame</b>	PL	PL	PL	PL
13	<b>Makian</b>	PL	PL	PL	PL
14	<b>Pasipalele</b>	PL	PL	PL	PL
15	<b>Pelita</b>	PL	PL	PL	PL
16	<b>Pigaraja</b>	PL	PL	PL	PL
17	<b>Saketa</b>	PL	PL	PL	PL
18	<b>Wayaua</b>	PL	PL	PL	PL
19	<b>Yaba</b>	PR	PR	PR	PR

Note PP: *Pelabuhan Pengumpul* (Collector Port)

PR: *Pelabuhan Pengumpan Regional* (Regional Feeder Port)

PL: *Pelabuhan Pengumpan Lokal* (Local Feeder Port)



**Figure 4.** Ports of South Halmahera District.  
(Google Earth)

Since the construction of 2015, Mafa Port has been operating serving type of general cargo with type of cargo such as cement, coconut trees, nutmeg, copra, rice, wood, bio diesel, and fish. There is also exception of shipping of heavy cars in February 2019.

**Table 2.** Mafa Port in Numbers (Port of Weda and Mafa Masterplan, 2019)

Type of Services		2017	2018	2019	
Mafa Port	<b>Ship call</b>	96	98	55	Ships
	<b>Ship Capacity</b>	65,323	75,601	29,887	GT
	<b>Cargo Unloading</b>	568,536	882	9,779	GT / m <sup>3</sup>
	<b>Cargo Loading</b>	11,042	1,414	1,593	GT / m <sup>3</sup>

<b>Passenger Unloading</b>	0	0	0	Passenger
<b>Passenger Loading</b>	80	0	0	Passenger

#### 2.4. Sustainable Port Base Reference: Port of Gothenburg

Port of Gothenburg is located in Sweden as the biggest port in Scandinavia area. The port first started in 1620s when the first harbour constructed on the Stora Hamnkanalen canal.



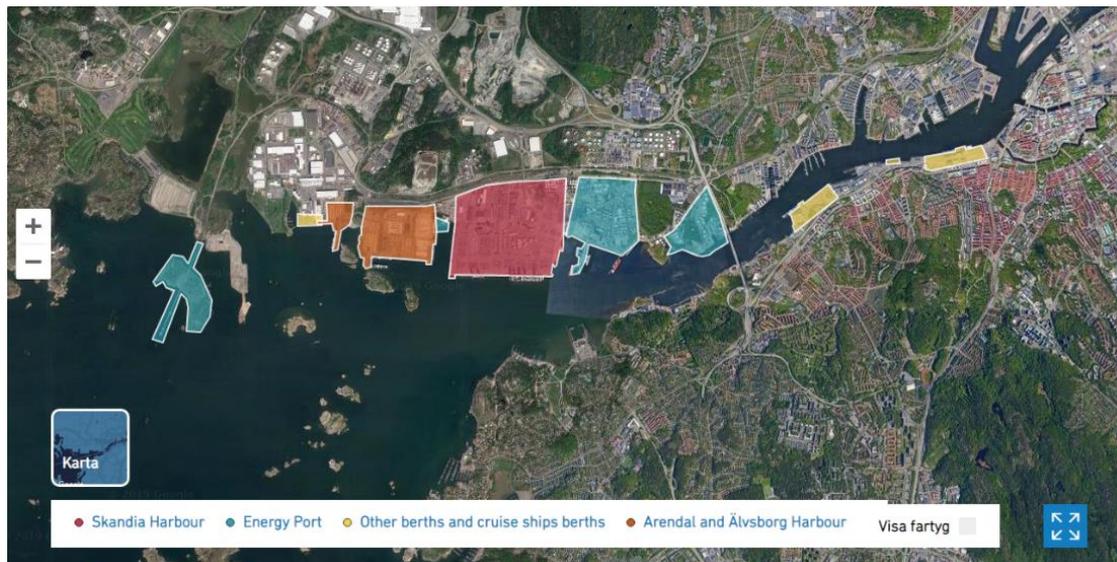
**Figure 5.** Port of Gothenburg interconnection (Port of Gothenburg, 2018).

Port of Gothenburg is the door to the Swedish Industry and 70% of Nordic region's population is located in radius of 500 kilometres from the port, consisting of balance weight of import and exports capacity of the country. Currently with the container, ro-ro, passenger, car, and oil and energy terminal, Port of Gothenburg serving 130 direct services to destinations in Europe, Asia, Middle East, Africa, and North America.

**Table 3.** Port of Gothenburg in Figures.

Port of Gothenburg	Type of Service	Numbers
	<b>Containers</b>	
	<b>Ro-ro Units</b>	593,000
	<b>Cars</b>	295,000
	<b>Passengers</b>	1.7 million
	<b>Oil</b>	23.5 million tonnes
	<b>Freight in Tonnes</b>	40.8 million

Port of Gothenburg has four major terminals in its area, consisting of Skandia Harbour, Energy Port, Other Berths and Cruise Ships Berths, and Arendal - Älvborg Harbour.



**Figure 6.** Port of Gothenburg Layout.

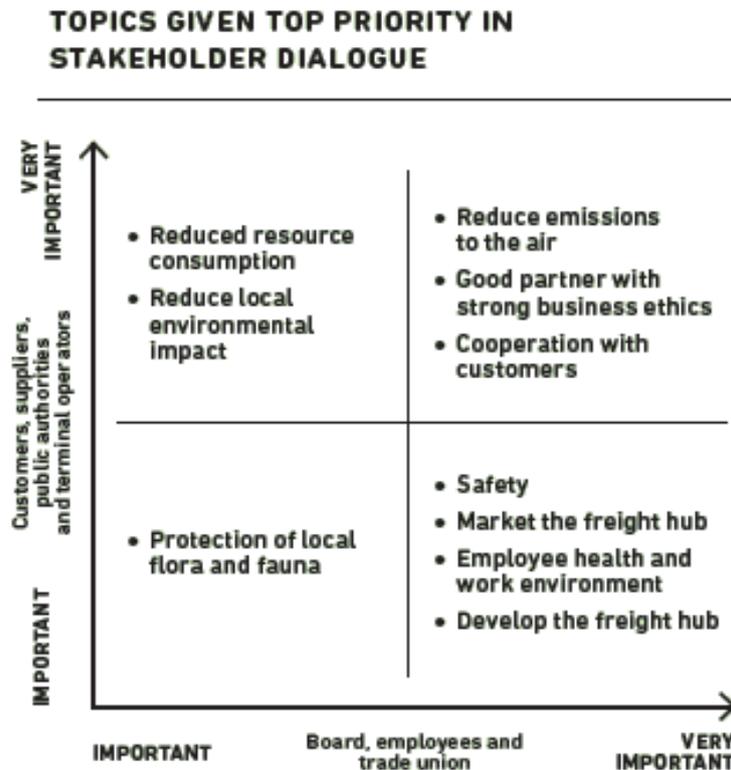
Sustainable has been an issue for Port of Gothenburg since long time ago. Nowadays, Port of Gothenburg is considered as one of the world's greenest port. Port of Gothenburg has been complied with GRI (Global Reporting Initiative) since 2012. GRI is an independent international organization that has pioneered sustainability reporting since 1997. The GRI Sustainability Reporting Standards (GRI Standards) are the first and most widely adopted global standards for sustainability reporting. The usage of companies using GRI reporting as theirs is to have the opportunity for a joint venture and global collaboration with other stakeholders in the industries that have the same sustainable goal with transparency. From 2016 to 2030, Port of Gothenburg has been committed to the UN SDGs program for the 2030 agenda, contributing 14 of the 17 goals and relevant to 40 of the 169 sub-goals (Port of Gothenburg, 2018).

Port of Gothenburg uses the GRI Standard guidelines of three steps: Identification, Prioritisation, and Validation to analyse sustainability issue of theirs. These methods are conducted and validated by the stakeholders with the dialogue.



**Figure 7.** GRI Standard guidelines for sustainability issue analysis.

The importance mapping of sustainability issues is separated by the stakeholders. Customers, suppliers, public authorities, and terminal operators belong to the same group, where board, employees, and trade union belong to the same group. Those issues that scaled as very important to the both groups are considered as paramount priority of port operation regulation.



**Figure 8.** Port of Gothenburg's sustainability issues priority.

The results of Identification and Prioritisation of sustainability issue show that issues regarding Port of Gothenburg are Biodiversity, Security, Diversity and Equality, Non-discrimination, Skill development, and Strong Business Ethics. These issues are validated by Port of Authority to be agreed and relevant to the Port of Gothenburg's operation.

### 3. Methodology

This study conducted by quantitative approach of a study location, Mafa Port in Indonesia. Data used consists of secondary data collection. Mafa Port's data is used to see the operation and technical aspect of the port are collected by site survey and desk study for the rest. Mafa Port was built in 2015 and has been operated since 2016. The year 2016 will be the milestone of the study.

To see the effect of port development whether it align with the sustainable goals or not, the comparison of South Halmahera Regency's data as the representative of Mafa Port area compared with the national data of Indonesia in case of economic, social development, and all data related to the study. Any assumption related to the numerical approach will be given for each part.

## 4. Results and Discussion

### 4.1. Result

#### 4.1.1. No Poverty Issue

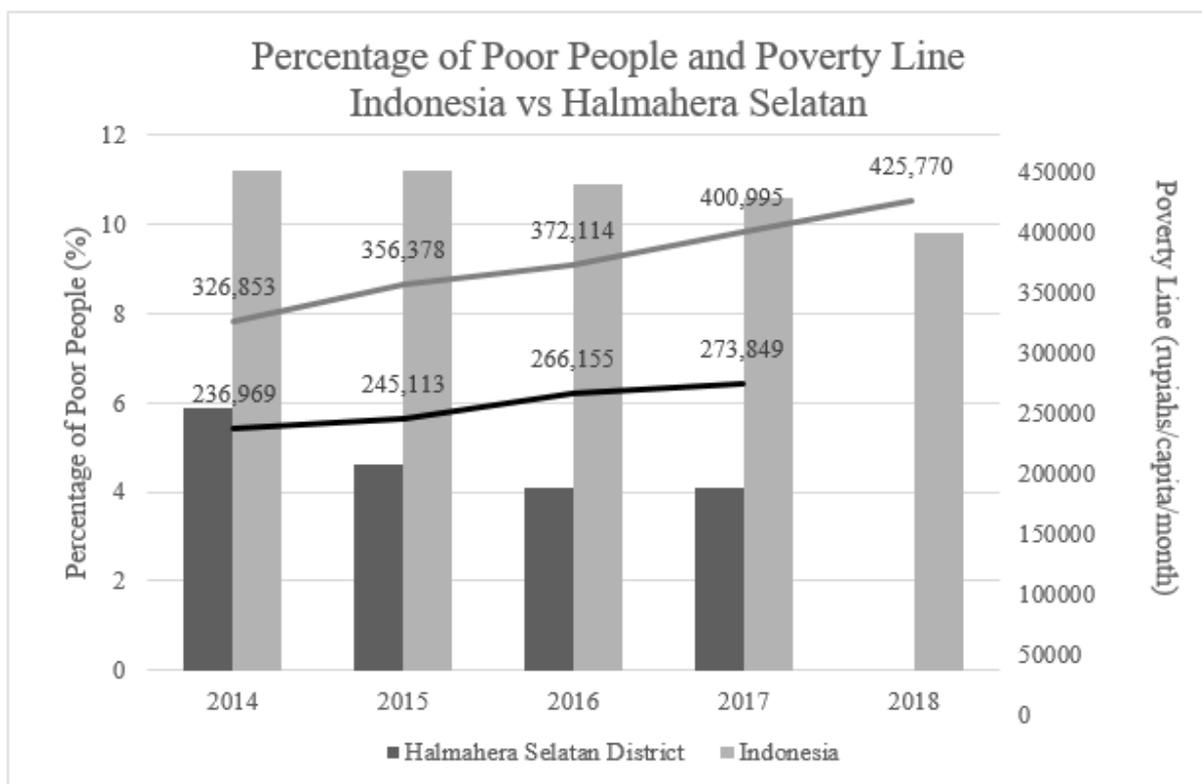
With the concern of no poverty, Indonesia development showing that the percentage of poor keep decreasing over the year, 0.3% in 2016 and 2017 and 0.8% in 2018. Where the decreasing percentage of poor people in South Halmahera shows significant decrease in 2015 (1.26%), keep decreasing but with lower rate in 2016 (0.50%) and 2017 (0.01%).

**Table 4.** Indonesia percentage of poor people, poverty line, and human development index 2014-2018 (Statistics Indonesia, 2019)

	2014	2015	2016	2017	2018
<b>Percentage of Poor People</b>	11.20	11.20	10.90	10.60	9.80
<b>Poverty Line (rupiahs/day)</b>	326,853	356,378	372,114	400,995	425,770
<b>Human development index</b>	68.90	69.55	70.18	70.81	71.39

**Table 5.** South Halmahera percentage of poor people, poverty line, and human development index 2014-2017 (Statistics Indonesia: South Halmahera in Figures, 2019)

	Halmahera Selatan District			
	2014	2015	2016	2017
<b>Percentage of Poor People</b>	5.87	4.61	4.11	4.1
<b>Poverty Line (rupiahs/day)</b>	236,969	245,113	266,155	273,849
<b>Human development index</b>	60.34	61.26	62.17	62.64

**Figure 9.** Percentage of Indonesia and South Halmahera poor and poverty line 2014-2017. (Statistics Indonesia: South Halmahera in Figures, 2019)

With the port operation which starts in 2017, it goes in-line with the decreasing number rate of poor people (0.01%) in South Halmahera still far from its target to decrease totally the poor by 2030 but it still showing a positive correlation to the issue.

#### 4.1.2. Zero Hunger Issue

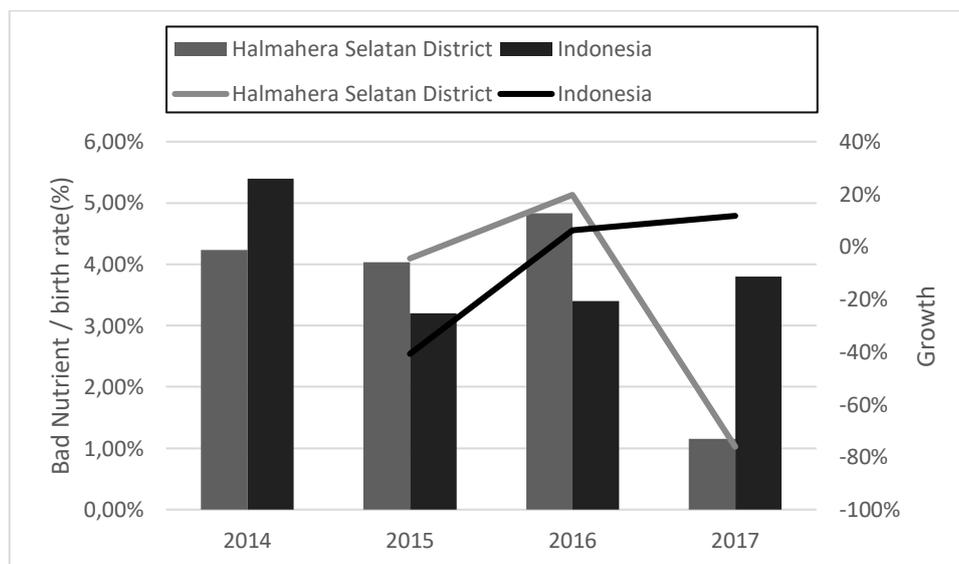
Zero hunger issues could be easily indicated by nutrition fulfilment of the people. The growth of mal nutrient / undernourished case compared to the total population of an area shows the development of zero hunger issue of an area affected. The bad nutrient case per total birth of Indonesia reached 5.40% in 2014, decreasing up to level of 3.80% in 2017. Different case of South Halmahera district, which ranged around 4% from 2014 to 2016, drop to 1.16% in 2017.

**Table 6.** Indonesia bad nutrient case compared to total birth 2014-2017

	Indonesia			
	2014	2015	2016	2017
<b>Bad Nutrient / Total Birth</b>	5.40%	3.20%	3.40%	3.80%
Growth		-41%	6%	12%

**Table 7.** South Halmahera bad nutrient case compared to total birth 2014-2017  
(Statistics Indonesia: South Halmahera in Figures, 2019)

	Halmahera Selatan District			
	2014	2015	2016	2017
<b>Bad Nutrient / Total Birth</b>	4.23%	4.04%	4.84%	1.16%
Growth		-5%	20%	-76%



**Figure 10.** Bad nutrient / birth rate of Indonesia and South Halmahera 2014-2017.  
(Statistics Indonesia: South Halmahera in Figures, 2019)

The data shows above give the picture that after the operation of port in South Halmahera, 2016-2017, there is a significant change of bad nutrient case per birth rate (-76% drop).

#### 4.1.3. Decent Work and Economic Growth Issue

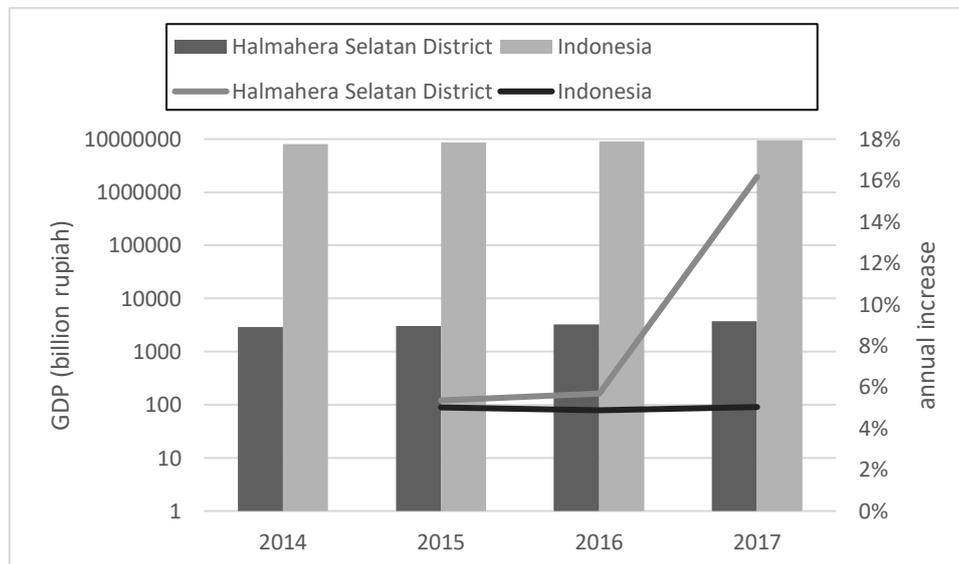
General economic situation of Indonesia is growing stably with the rate of around 5% from 2015 to 2017. Whereas the condition of South Halmahera is bloomed at 2017 with the increase of 16%.

**Table 8.** Indonesia total GDP at 2010 constant market price 2014-2017 (Statistics Indonesia, 2019)

Category	Indonesia				
	2014	2015	2016	2017	
GDP	8,156,497.80	8,564,866.60	8,982,517.10	9,434,632.00	billion rupiah
<b>Annual increase</b>		5%	5%	5%	

**Table 9.** South Halmahera Total GDP at 2010 constant market price 2014-2017 (Statistics Indonesia: South Halmahera in Figures, 2019)

Category	South Halmahera District				
	2014	2015	2016	2017	
GDP	2908.5	3064.25	3238.57	3762.39	billion rupiah
<b>Annual increase</b>		5%	6%	16%	

**Figure 11.** Total GDP of Indonesia and South Halmahera 2014-2017. (Statistics Indonesia, 2019)

The data shows that there is a significant increase of South Halmahera's total GDP income in 2017, of which during the operation of new port. The significant increase of 16% from the previous annual increase of 7%. Thus, the sustainable sector of decent work and economic growth goal has strong connectivity with port development.

#### 4.1.4. Industry, Innovation, and Infrastructure

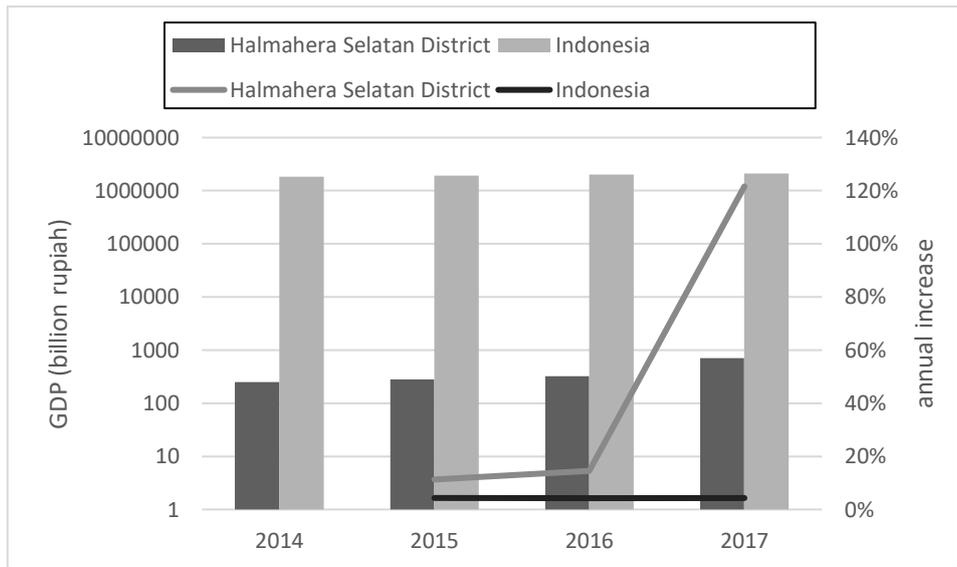
Indonesia manufacturing sector grows constantly around the number of 4% annually since 2015 to 2017, of when South Halmahera grows significantly, especially in 2017 with 122% growth percentage.

**Table 10.** Indonesia GDP of manufacturing at 2010 constant market price 2014-2017 (Statistics Indonesia, 2019)

Category	Indonesia				
	2014	2015	2016	2017	
Manufacturing GDP of 2010 price	1,854,256.70	1,934,533.20	2,016,876.90	2,103,466.10	billion rupiah
<b>Annual increase</b>		4%	4%	4%	

**Table 11.** South Halmahera GDP of manufacturing at 2010 constant market price 2014-2017 (Statistics Indonesia: South Halmahera in Figures, 2019)

Halmahera Selatan District					
	2014	2015	2016	2017	
Manufacturing	252.4	280.89	321.54	712.49	billion rupiah
<b>Annual increase</b>		11%	14%	122%	

**Figure 12.** Manufacturing GDP of Indonesia and South Halmahera 2014-2017. (Statistics Indonesia: South Halmahera in Figures, 2019)

The manufacturing has boom increase in South Halmahera in 2017 of more than 100%. With that, the industry is the most significant sector to be involved since the 2016 opening of the port.

#### 4.1.5. Life below water

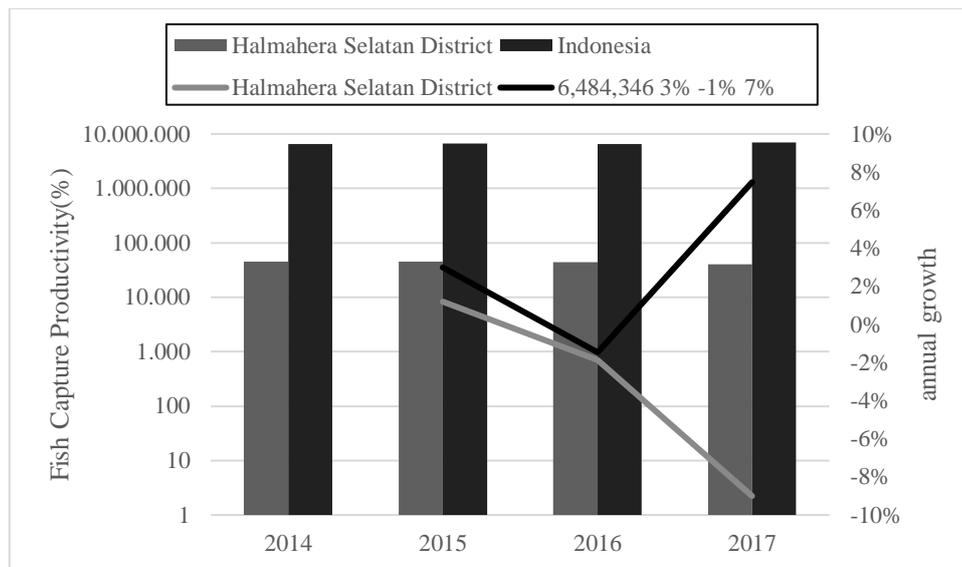
Fisheries has not been a good year for Indonesia generally until 2016, the productivity was around 6.5 million annually, but there is increase of production in 2017 until up to 7 million. The growth of 2017 production of Indonesia does not align with South Halmahera's that has decreasing productivity in 2016 and 2017.

**Table 12.** Indonesia fisheries productivity 2014-2017 (Statistics Indonesia, 2019)

Sector	Indonesia				
	2014	2015	2016	2017	
Marine Capture Fisheries	6,037,654	6,204,668	6,115,469	6,603,631	Tons
Inland Open Water Capture Fisheries	446,692	473,134	464,722	467,822	Tons
Fish Capture Productivity	6,484,346	6,677,802	6,580,191	7,071,453	Tons
Growth		3%	-1%	7%	

**Table 13.** South Halmahera district fisheries productivity 2014-2017 (Statistics Indonesia: South Halmahera in Figures, 2019)

Sector	Halmahera Selatan District				
	2014	2015	2016	2017	
Marine Capture Fisheries	44,703	45,241	44,405	40,407	Tons
Inland Open Water Capture Fisheries	6	4	0	0	Tons
Fish Capture Productivity	44,709	45,245	44,405	40,407	Tons
Growth		1%	-2%	-9%	

**Figure 13.** Fisheries production of Indonesia and South Halmahera 2014-2017. (Statistics Indonesia, 2019)

The number of South Halmahera's fisheries production does not impact by the port development from 2016-2017, with the downward trend from 2015. The factors that involved in fisheries production is not only by the port development, but it shows that the port development itself can not carry the mission of life below water.

## 5. Conclusion and Discussion

### 5.1. Conclusion

This study meant to identifying the connected sustainability issues to the port development, showing the current stages of port studies in Indonesia, comparing the best practice of Port of Gothenburg as sustainable port best practice, and showing the changes in indexes that related to the sustainability issues. Further research should be conducted to shows whether the concept of more modern port could be applied to the port development in Indonesia.

The main benefits of sustainable approach of port development is that, we have to consider the future of our planet and all of its inside. Port as one of the most importance infrastructure for a maritime state like Indonesia, could be the main agent of its goal. Identified sustainable goals that can benefited by port development are the poverty eliminations, undernourished abolition, work and economic growth, industry development, and viable fisheries sector.

To be able implementing the idea of sustainable goals, base practice sustainable port in this study, Port of Gothenburg, using the GRI Standard framework to comply with international level. This sophisticated approach has its benefit of being used worldwide, improving the transparency, and appalling to the future business collaboration. The idea of sustainable goals could be different from one

port to another, depending on the port's purposed, the issues, and also the importance level for stakeholders.

There are opportunities that could be improved from this study, the sustainability issues are conceived from the issues of developing countries like Indonesia, a maritime state with a lot of potentials.

The results shows that the new development of the port has positive connection to four goals that inspected: No poverty, Zero hunger, Decent Work and Economic Growth Issue, and Industry, Innovation, and Infrastructure. Especially Industry, Inovation, and Infrastructure that represented with regional GDP raised of more than 100%. There is a negative impact of port development, which is Life Below Water goal that shows declined improvement since port development.

## 5.2. Discussion

This part is the review of study's methodology, analzsis process, and other findings. This study uses 5 out of 17 Goals from UN SDGs and represents them with a numeric variable of regional development numbers. A further study could use this as base to look into all of the 17 Goals mentioned in UN SDGs to really look into the regional development.

Port of Gothenburg's way of sustainability is mentioned in this study as base practice of Sustainable Port. Although the idea of Sustainable Port is seems to work everywhere, but the future study have to consider the size and port's designation for comparisson. Other references for example PIANC study on Sustainable Port could be used to improve the result as well.

This study faced constrains due the time limitation, wide scope of the study, and multiple knowledge background needed, but however the study using the real data showing the real condition of the study object, of which an asset of this study's quality.

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