RES MILITARIS
REVUE EUROPEENNE D ETUDES EUROPEAN JOURNAL OF MILITARY STUDIES
Social Science Journal

Hydrometeorological Disaster Risk Reduction and the Achievement of Sustainable Development Goals (Case Study: 2020 Jakarta Flood)

By

Adi Subiyanto
Department of Disaster Management for National Security,Republic of Indonesia Defense University

Pujo Widodo
Department of Asymmetric Warfare for Defense Strategic, Republic of Indonesia Defense University

Herlina JR Saragih
Department of Disaster Management for National Security, Republic of Indonesia Defense University

Wilopo
Department of Disaster Management for National Security, Republic of Indonesia Defense University

Poetika Puspasari
Department of Disaster Management for National Security, Republic of Indonesia Defense University

Ernalem Bangun
Department of Disaster Management for National Security, Republic of Indonesia Defense University

Dian Efrianti
Department of Disaster Management for National Security, Republic of Indonesia Defense University

Abstract

Jakarta Province has a high risk of flood disaster. By nature, Jakarta is indeed a flooded area, so flood events will be very difficult to eliminate from the DKI Jakarta area. Thus, there has to be an understanding of the causes and triggering factors of flood disaster in Jakarta Province. The succession of flood management will have an impact on sustainable development goals. From the perspective of disaster risk management, it is impossible to eliminate all sources of danger but can be reduced. This research will analyse flood disaster risk reduction and sustainable development goals to examine the causes of flood disaster in Jakarta Province. This research will focus on the La Nina phenomenon which triggered massive flooding in Jakarta Province in 2020 using qualitative method. The results showed that the causes of flooding were geological, geomorphological, and river morphometric factors. The La Nina triggered significant floods in 2020. On the other hand, there is a link between the SDGs and SFDRR targets. According to the SFDRR targets, success in reducing disasters will encourage several SDG targets.

Keywords: disaster risk reduction, floods, SFDRR, SDGs

Introduction

The World Economic Forum has determined environmental issues as the main risk or threat faced at the global level [1]. These environmental issues include extreme weather, failure in adaptation/mitigation, and natural disasters. La Nina is one of the natural phenomena that trigger extreme weather causing hydrometeorological disasters (especially floods). This phenomenon occurs when the sea surface temperature in the central (tropical) Pacific Ocean decreases below normal. This condition causes cloud growth in the central Pacific Ocean and increases rainfall in various regions in Indonesia. The La Nina phenomenon repeats every 3-4 years and can last from several months to 2 years.

In 2020, La Nina occurred which caused high rainfall and floods in Jakarta Province area. The La Nina phenomenon that occurred in 2020 even lasted until 2021 and 2022. The severe flood event in early 2020 that occurred in the Jakarta Province area was allegedly triggered by La Nina and was exacerbated by the condition of the area traversed by 13 rivers. The impact of floods that hit the Jakarta Province area during the La Nina phenomenon has caused damage to infrastructure and thousands of people were displaced. Thus, the achievement of sustainable development goals (SDGs) for the Jakarta Province in 2020 is greatly affected by the La Nina phenomenon.

This research was conducted to understand the factors that cause and trigger 2020 Jakarta Province floods, and to describe the relationship between the achievement of the SDGs and the implementation of the Sendai Framework for Disaster Risk Reduction (SFDRR). The linkage in question is to map the indicators and targets that are the same between the SDGs and SFDRR towards the achievement of sustainable development goals. An understanding of the factors that cause and trigger floods in Jakarta Province, as well as the linkage between the targets in the SDGs and the SFDRR targets are expected to help sustain sustainable development in Jakarta Province. Based on the background and problems that have been described, the purpose of this study is to analyse the factors that cause and trigger flooding as well as the relationship between the implementation of the SDGs and SFDRR targets on the achievement of sustainable development in Jakarta Province.

Research Methodology

The approach method used in this study is a qualitative descriptive method. Researchers collect library materials from various sources to provide a review and a conclusion. The data collection stage is carried out through identifying the factors that cause and trigger floods in Jakarta Province area, local actions in implementing the SFDRR and SDGs targets which can be traced from the 2020 SDGs Achievement Report [2]. The measurable achievement indicators of this research are the mapping of the suitability of the SFDRR and SDGs targets and the success of Jakarta Province in implementing development that has minimized the impact of hydrometeorological disasters, especially floods. The assumption is that if the impact of flooding is not managed properly, it will have an impact on regional development activities.

Results And Discussion

The Sustainable Development Goals (SDGs) were declared on September 25, 2015 at the United Nations Headquarters New York by 193 countries as a global development commitment. The SDGs are a continuation and refinement of the Millennium Development Goals (MDGs) which have been implemented during the period 2000-2015 [3]. The SDGs are

based on three pillars: 1) Social Pillar, human development in the social sphere; 2) Economic Pillar, economic development; and 3) Environmental Pillar, including biodiversity [4]. The three pillars are based on 17 Sustainable Development Goals which are broken down into 169 targets/targets and 241 indicators that influence each other.

The Government of the Republic of Indonesia together with all the members states of the United Nations have agreed to implement the 2030 Global Agenda, namely achieving the Sustainable Development Goals (SDGs) in 2015. The commitment to the implementation of the global agreement was ratified in Regulation President of the Republic of Indonesia Number 59 of 2017 concerning Implementation of the Achievement of Sustainable Development Goals. Likewise, the Government of Jakarta Province has prepared a Regional Action Plan for the 2017-2022 Sustainable Development Goals.

Flood is one of the disaster threats faced by the people in Jakarta Province. With an area of 662.33 km2, 40% or 24,000 hectares is a lowland with an average height below sea level. Jakarta Province is also the confluence of rivers from the south and has a high amount of annual rainfall. There are 13 rivers that pass through and emptied into Jakarta Bay and the average rainfall is 2,000 mm per year where the highest rainfall is around January and the lowest is in September. Naturally, this condition positions the Jakarta Province area to have a high vulnerability to flooding.

III.1. the Causes and the Triggering Factors of Flood Disaster in Jakarta

By nature, Jakarta is indeed a flooded area, so flood events will be very difficult to eliminate from the DKI Jakarta area [5]. However, there has to be an understanding of the causes and triggering factors of flood disaster in Jakarta Province. The factors that cause flooding in Jakarta Province need to be reviewed from the point of view of geology, geomorphology, and morphometry of existing rivers. In addition, the phenomenon of land subsidence, rising sea levels which often cause tidal flooding (coastal flooding), and La Nina have further exacerbated the flooding that occurred in Jakarta Province area.

According to Jan Sopaheluwakan, a geologist at the Indonesian Institute of Sciences, the Jakarta flood cannot be solved by a canal system because the geological condition of Jakarta is a flood basin [6]. However, in the northern area of Jakarta (Ancol and Jakarta Bay), are experiencing uplift due to tectonic processes. As a consequence, water from rivers that empties into Jakarta Bay cannot flow smoothly into the sea and is often trapped in the large Jakarta basin. Unlike the Mahakam Delta of Kalimantan, Jakarta Bay cannot form a delta. The Great Jakarta Basin is formed from very thick young sedimentary soil but has not been consolidated. As a result, geologically, the land in Jakarta is slowly decreasing. This natural land subsidence is further exacerbated by massive groundwater extraction by the people of Jakarta [7]. Land subsidence in Jakarta varies in some places, at a rate of 1-20 centimetres per year (Figure 1).

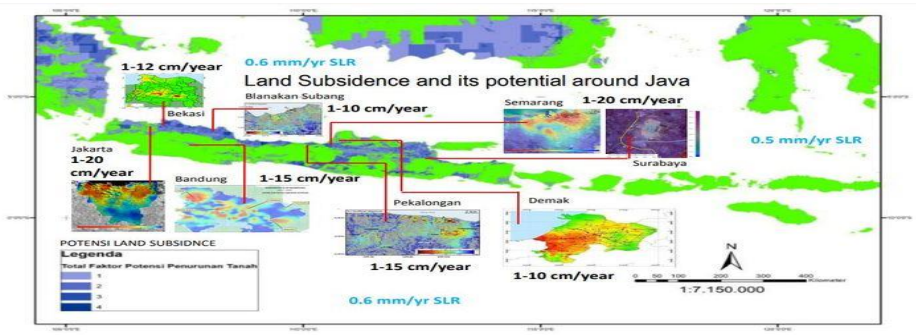

Figure 1. *Land Subsidence Rate in Java*
Source: *National Geographic Indonesia, 2021.*

Geomorphologically, Jakarta is also a flood plain. The flood plain is an area formed by the sedimentation process during a flood. Flood plains are generally located around meandering streams or at the meeting point of tributaries and main streams. The existence of 13 rivers, West Flood Canal, East Flood Canal, Cengkareng Drain, and Cakung Drain that cross the city of Jakarta resulted in many floodplains scattered in the Jakarta Province area. Therefore, it is quite understandable that the potential for flooding in the Jakarta Province area is very high.

Moreover, one of the causes of flood disaster in Jakarta Province is Ciliwung Watershed. Watershed morphometry is a quantitative value of the parameters that exist in the watershed. The parts of the watershed morphometry are the area of the watershed, the length of the main river, the density of the river, the slope of the river, the order of the river, the level of branching of the river, and the shape of the river. There are 6 watersheds that contribute to flooding in the Jakarta area, namely Cakung, Buaran, Sunter, Cipinang, Ciliwung, Krukut, Grogol, Pesanggrahan, and Angke [8].

Of all the river flows that cross the city of Jakarta, the Ciliwung River is the river that has the largest contribution to the potential for flood events in the Jakarta Province area. According to Ministry of Public Works and Housing of the Republic of Indonesia, the area of the Ciliwung Watershed is about 347 km2, the widest compared to other watersheds. The length of the Ciliwung River flow from its upstream in the area of Gunung Gede Pangrango (Bogor Regency) to its downstream area in the Pluit area (North Jakarta) is 117 km2, the longest compared to other river flows. In addition, the flow of the Ciliwung River in Jakarta Province crosses many villages, densely populated settlements and slums. The flow of this river also has direct access to the heart of Jakarta Province where the location of the central government is located, so that if this river overflows and floods in Jakarta in a relatively long time, the impact can paralyze all economic, social and government activities that are centred in the City of Jakarta.

III.2. La Nina, Rainfall, and Floods

The La Nina phenomenon which generally causes high rainfall can be seen from the interaction between sea level and the atmosphere in the tropical pacific. Changes in sea surface temperature affect the atmosphere above it which causes the temperature and ocean currents to experience a feedback mechanism (atmosphere – sea). The interaction that causes cold conditions is called La Nina, whereas the interaction that causes warm conditions is called El Nino. The La Nina phenomenon that triggers extreme rainfall and large floods needs to be anticipated as early as possible so as not to disrupt development activities.

One way to monitor La Nina is by monitoring the El Nino Southern Oscillation (ENSO) based on the value of the Multivariate ENSO Index (MEI). The new version of MEI (MEI.v2) uses 5 variables: sea surface pressure, sea surface temperature, surface zonal wind, surface meridional wind, and outgoing longwave radiation to generate a time series of ENSO conditions from 1979 to 2022. Positive MEI.v2 values represent the warm ENSO phase (El Niño) is shown in red while the negative MEI.v2 value represents the cold ENSO phase (La Nina) in blue.

Rainfall is closely related to water discharge, the higher the rainfall, the higher the river discharge, and vice versa if the rainfall is low, the flow rate is low. The potential for flooding in Jakarta is influenced by three main aspects, namely: 1) flooding caused by high local rainfall so that drainage channels and rivers overflow; 2) flooding caused by high rainfall in the upstream areas, namely Depok, Bogor, Puncak, and Cianjur so that the river overflows; and 3) flooding caused by ROB floods (rising sea level) so that water cannot be wasted into the sea,

especially for areas on the north coast of DKI Jakarta. Monthly rainfall in 2019, 2020, and 2021 can illustrate the potential for flooding in Jakarta (Table 1). Major floods that occurred in January and February 2020 were caused by high rainfall. Based on data from the Tanjung Priuk Observation Station, rainfall in January was 607.2 mm and February 784.5 mm [9].

Tabel 1. *Rainfall at Tanjung Priok Station by Month*

Month	Total Rainfall (mm)		
	2019	**2020**	**2021**
January	365.5	**607.2**	332.4
February	216.9	**784.5**	466.8
March	332.1	211.1	190.1
April	132.5	142.2	88.6
May	24.7	52.5	249.7
June	5	63.3	130.6
July	0	99.9	47
August	0	77.9	65.6
September	0	131.9	83.4
October	1	98.3	247.2
November	80	114.6	52
December	509.3	236.5	162.9
Total	1667	2619.9	2116.3

Source: *Meteorology, Climatology, and Geophysics Agency (2022).*

If the rainfall in Jakarta is still below 100 mm per day, the existing drainage system will still be able to accommodate it [10]. In other words, rainfall of 100 mm or more that occurs in one day can cause flooding, such as the flood incident in 2013. The problem is if the rainfall is above 100 mm, it will cause water overflow. For example, the occurrence of high rainfall in early January 2020 in the Halim Perdanakusuma Airport area, where the high rainfall in one day reached 377 mm, causing flooding that was inevitable. The runway and several airport facilities were submerged, paralyzing flight activities.

III.3. Flood Risk Reduction

Floods that occur in Jakarta are closely related to the amount of rainfall, the location of the rain falling, and rising sea levels which often cause ROB floods. There are seven flood scenarios that can occur in the DKI Jakarta area, namely: 1) flooding due to upstream rain, 2) flooding due to local rain, 3) flooding due to the rising sea level (ROB floods), 4) flooding due to upstream rain and local rain, 5) flooding due to local rain, 6) flooding due to upstream rain, and 7) flooding due to upstream, local, and ROB rain.

To reduce river overflow, Jakarta Province already has the West Flood Canal which was built during the Dutch East Indies period in 1922, while the East Flood Canal was completed in 2010. The Flood Canal is a collector water channel as one of the how to deal with the Jakarta flood which was first initiated by Prof. Ir. Hendrik van Breen in 1913. The core idea of the Flood Canal was to control the flow of water from upstream rivers originating from the Jonggol highlands in Bogor by regulating the volume of water entering the city of Jakarta and would make the river load in the north of the collective channel more controlled [11]. The canal becomes the city's macro drainage system which functions to reduce waterlogging in the city by draining it directly into the sea.

Even though Jakarta Province already has West Flood Canal and East Flood Canal, floods still occur frequently, especially during the heavy rainy season triggered by La Nina.

Several efforts have also been made to reduce the risk of flooding through river dredging and pumping. In addition, the Jakarta Province local government is also taking mitigation measures to ensure there are no fatalities. The mitigation is carried out by forming a community that is alert, responsive, and mobilized against flood disasters. Standby to continuously monitor potential disaster situations; respond when a disaster occurs respond together quickly; and gather all forces, all resources, and collaboration to be able to handle. Through community participation in dealing with floods, it is expected to be able to minimize the impact of the flood itself.

III.4. The Linkage Between SFDRR and SDGs Targets

There is a link between disaster risk reduction and sustainable development. For Indonesia, it can be traced from the 2020-2044 Disaster Management Vision, namely "Realizing a Disaster-Resilient Indonesia for Sustainable Development". This vision is implemented in the policy direction of the National Disaster Management Plan 2020-2024 which states increasing disaster resilience towards sustainable prosperity for sustainable development. In accordance with the direction of the national disaster management policy for 2020-2024 which focuses on community welfare for sustainable development, the target for disaster management can be measured by reducing economic losses to Gross Domestic Product (GDP).

Each region/province should have a regional action plan in reducing disaster risk and achieving sustainable development goals. The Report on the Achievement of the Sustainable Development Goals of Jakarta Province 2020 is a concrete manifestation of implementing the global agenda. Of the overall targets in the SDGs, there are several indicators that are actually targets in the SFDRR. The various activities to implement the targets in the SDGs and SFDRR are intended to make local governments more capable in dealing with disaster risk so that they are able to support sustainable development activities.

Sustainable Development Goals have 17 goals and 169 targets classified into 4 development pillars. The four development pillars include: Social Development Pillar (covering Goals 1, 2, 3, 4, and 5), Economic Development Pillar (covering Goals 7, 8, 9, 10, and 17), Environmental Development Pillar (covering Goal 6, 11, 12, 13, 14 and 15), and the Pillars of Legal Development and Governance (covering Goal 16) [12]. Thus, the connectivity of hydrometeorological disaster risk reduction based on SFDRR targets has indirectly supported the achievement of several targets in the SDGs.

In general, the connectivity includes: 1) Number of deaths, missing, and affected by disaster per 100,000 people (number of deaths, missing persons and persons affected by disaster per 100,000 people); 2) Economic losses due to disasters in relation to Gross Domestic Products (GDP) (direct disaster economic loss in relation to GDP; 3) Direct disaster economic loss in relation to GDP, including disaster damage to critical infrastructure and disruption of basic services (direct disaster economic loss in relation to GDP, including disaster damage to critical infrastructure and disruption of basic services); 4) Number of national or local disaster risk reduction strategies; and 5) Proportion of local governments adopting and implementing disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030 (Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030).

Based on the Report on the Achievement of the Sustainable Development Goals of Jakarta Province for the Period of 2020, several interconnected SFDRR and SDG targets are:

a. Goal 1 (Target 1.5) "Number of dead, missing, and affected by disaster per 100,000 people". The number of victims who died and disappeared was 19 people, while the victims who suffered and evacuated were 31,232 people. Meanwhile, the population of Jakarta Province 2020 is 10.56 million people, so the number of victims who died, disappeared, and was affected by the disaster per 100,000 people was 30 people.
b. Goal 2 (Target 2.4) "Eliminating Hunger, Achieving Food Security and Good Nutrition, and Promoting Sustainable Agriculture". The prevalence of stunting (short and very short) in children under two years old was recorded to have improved from 6.9% (2019) to 6.5% (2020).
c. Goal 3 (Target 3.9) "Ensuring a Healthy Life and Improving the Well-being of All Populations of All Ages." In this target, the national mortality rate per 1,000 live births from 2.31 deaths in 2019 decreased to 1.28 deaths in 2020.
d. Goal 11 (Target 11.5) "Proportion of direct economic losses due to disasters relative to GDP." Floods that occurred in 2020 have resulted in economic losses of Rp 960 billion and Jakarta's GDP of 701.98 trillion so that the proportion of economic losses due to disasters to GDP is 0.137%.
e. Goal 11 (Target 11.b) "Making Cities and Settlements Inclusive, Safe, Resilient and Sustainable". The target achievement is a decrease in the percentage of users of public transportation modes from 21.7% (2019) to 8.2% (2020).
f. Goal 13 (Target 13.1) "Take Rapid Action to Address Climate Change and Its Impacts". The handling of climate change is carried out by implementing the actions contained in the two-disaster risk reduction strategy (DRR) documents in the Jakarta Province. The documents are: 1) Jakarta Governor Decree Number 1245 of 2020 concerning the Designation of Head Village as Disaster Management Manager in Urban Villages; and 2) Jakarta Governor's Regulation Number 90 of 2021 concerning Climate Resistant Regional Low Carbon Development Plans.
g. Goal 13 (Target 13.2) "Potential for Reducing Greenhouse Gas (GHG) Emissions". Jakarta Province seeks to reduce GHG emissions, one of which is by applying the concept of an environmentally friendly building (green building). The percentage of GHG emission reductions achieved in 2020 is 0.93% or equal to 13,789 tons of CO2e.
h. Goal 13 (Target 13.b) "Support Capacity Building Mechanisms for Effective Climate Change-Related Planning and Management with A Focus On Women, Youth, and Local And Marginalized Communities". Efforts to control climate change require cooperation from all parties, from various circles, including women. The achievement of this target has not been measured, but activities involving women such as the use of vacant land for planting vegetables as land that has more usability and selling value for the community have been carried out.

Conclusion

Flood disasters in the DKI Jakarta area have become a routine occurrence, especially during the rainy season which is accompanied by the La Nina phenomenon. One of the main causes of frequent flooding is the existence of 13 rivers that pass through the Jakarta Province area. Various efforts have been made to deal with flooding problems, such as dredging rivers, pumping, and optimizing the west/east flood canals. The local government of Jakarta Province is also taking mitigation measures to minimize casualties caused by floods. The mitigation is carried out by forming a community that is alert, responsive, and mobilized against flood disasters. Standby to continuously monitor potential disaster situations; respond when a disaster occurs respond together quickly; and galang to gather all forces, all resources, and collaboration to be able to handle.

From the perspective of disaster risk management, it is impossible to eliminate all sources of danger but their impact can be reduced. Sources of danger will not turn into a major disaster if it is able to reduce the risk. The results showed that the causes of flooding (hydrometeorological disasters) were geological, geomorphological, and river morphometric factors; while the La Nina phenomenon is the trigger for major floods in 2020. On the other hand, there is a link between the SDGs and SFDRR targets. Success in reducing disaster risk according to the SFDRR target has indirectly boosted the achievement of several targets in the SDGs.

References

EF, "The Global Risks Report 2022," weforum.org, 2022.

Jakarta Province Government, "Laporan Pencapaian Tujuan Pembangunan Berkelanjutan," sdgs.jakarta.go.id, 2020.

UNISDR 2015 Sendai Framework For Disaster Risk Reduction 2015–2030. Geneva: UNISDR.

Ibid.

Harsoyo, Budi 2013 "Mengulas Penyebab Banjir Di Wilayah DKI Jakarta Dari Sudut Pandang Geologi, Geomorfologi Dan Morfometri Sungai." Jurnal Sains & Teknologi Modifikasi Cuaca, 14.

Kompas, "Bagi Jakarta, Banjir Seolah Menjadi Takdir," sains.kompas.com, 2013.

National Geographic Indonesia, "Banjir Jawa: Penurunan Tanah Jakarta, Pekalongan, Semarang Mengerikan," nationalgeographic.grid.id, 2021.

Ministry of Public Works and Housing of the Republic of Indonesia 1973 Masterplan for Drainage and Flood Control of Jakarta. Jakarta: Director General for Water Resources Ministry of Public Works and Housing of the Republic of Indonesia.

Indonesian Meteorological, Climatological, and Geophysical Agency, "Curah Hujan di Stasiun Tanjung Priuk Menurut Bulan (mm) 2019-2021 dalam Sta. Met. Kelas I Maritim Tanjung Priok - Jakarta Utara," bmkg.go.id, 2022.

Jakarta Province Local Disaster Management Agency 2022 Manajemen dan Kolaborasi Pentahelix dalam Upaya Penanganan Darurat di Provinsi DKI Jakarta.

Adhi Ksp R, Rainayati M, Yendra M 2010 Banjir Kanal Timur: Karya Anak Bangsa. Jakarta: Grasindo.

Indonesia National Development Planning Agency 2022 Metadata Indikator. Jakarta: Indonesia National Development Planning Agency.