

Hydrometeorological Disaster Risk Reduction Facing the La Nina Phenomenon in Supporting Sustainable Development

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Abstract: This study aims to explain hydrometeorological disaster risk reduction as part of the implementation of the targets of the Sendai Framework for Disaster Risk Reduction (SFDRR) in dealing with the La Nina phenomenon. Areas affected by the La Nina phenomenon will have high rainfall, causing more extraordinary flood events. Success in disaster risk reduction activities can be used as an indicator of success in achieving sustainable development targets or Sustainable Development Goals (SDGs). In this case, the achievement of several targets in the SFDRR and SDG targets can be used as indicators in reducing flood risk. The suitability of these targets is used to measure the success of local governments (districts/provinces) in implementing SFDRR which can also be used as an indicator of success in achieving several targets in the SDGs. The case study was conducted in North Jakarta. The choice of research location in North Jakarta is since every time a La Nina phenomenon appears, the area is affected by a hydrometeorological disaster (flood) which causes many houses and public facilities to be submerged and infrastructure damaged. It is not entirely wrong to state that the occurrence of major floods was triggered by the La Nina phenomenon, the impact of climate change, and extreme weather.

Keywords: SFDRR, SDGs, La Nina, North Jakarta.

1. Introduction

In the same year (2015), 187 member states of the United Nations expressed their support for continuing the disaster risk reduction (DRR) agenda beyond the Hyogo Framework for Actions (HFA) 2005-2015 (UNISDR, 2005). The agreed DRR agenda is the Sendai Framework for Disaster Risk Reduction 2015-2030 or the Sendai Framework for Disaster Risk Reduction (SFDRR) (UNISDR, 2015) which aims to drive the success of the HFA, with particular emphasis on resilience (Manyena, 2016). In 2015 the Paris Agreement on Climate Change was also agreed (United Nations, 2015b). In this regard, three important international agreements have been agreed, namely: SDGs, Paris Agreement, and SFDRR. All three are joint efforts at the global level to ensure sustainable development activities, safeguard biodiversity and conservation, climate change adaptation, and humanitarian goals.

Efforts to control climate change (climate change) are carried

out to ensure that the development needed to meet people's welfare still pays attention to protection of environmental and social aspects (Director General of PPI, 2016). For example, the event of severe flooding in early 2020 that occurred in the DKI Jakarta area was allegedly caused by anthropogenic factors (human activities) that did not prioritize aspects of sustainable environmental management or political ecology and was triggered by extreme weather (extreme weather). The impact of the floods that hit North Jakarta during the La Nina phenomenon has caused thousands of people to flee, damaged infrastructure, and thousands of hectares of rice fields and ponds threatened with crop failure.

La Nina, climate change, and extreme weather are often blamed. However, blaming weather factors or climate change phenomena as the cause of flooding is not a wise move. The flood events that occurred in North Jakarta also need to be reviewed from the standpoint of ecological (environmental) and political management known as the concept of political ecology. The importance of understanding political ecology is motivated by the view that ecological management problems cannot be separated from economic, social and political problems. One approach to understanding political ecology is the actor approach introduced by Bryant and Beiley (2005). There are several actors involved in environmental management and each has different interests.

In the end, understanding the potential for flood disasters and achieving targets in the SDGs through the implementation of the SFDRR targets that take into account political ecology and the phenomenon of climate change is expected to help sustain development so as to place a country in a state of formidable national security. Indonesia is a large country with a population of more than 270 million people, and also has the potential for a large flood disaster. Therefore, the impact of the flood disaster must be minimized through the implementation of the SFDRR target as well as achieving several targets in the SDGs so as to be able to encourage sustainable development, while at the same time being able to create national security. In other words, national security conditions need to be pursued through success in carrying out sustainable development by reducing disaster

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risk as much as possible.

2. Research Methodology

Research related to disaster risk reduction based on the SFDRR and SDGs targets uses a narrative qualitative research 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. The preliminary study that has been carried out is a literature study on various methods for evaluating the implementation of the SFDRR and SDGs targets, mapping the similarities in targets between the two, and the various problems faced in disaster risk reduction. The success of local governments (districts /provinces) in reducing disaster risk has indirectly implemented the global agenda (SFDRR and SDGs). Likewise with the Paris Agreement, regional success in reducing greenhouse gases (GHG) also contributed to efforts to reduce the increase in global average temperature. So far, various climate variability characterized by very heavy rains, tornadoes, and droughts are the impact of the instability of the Earth's atmosphere so that extreme weather becomes more frequent. The follow-up impact is that hydrometeorological disaster events are increasing from year to year. Climate change adaptation and mitigation activities should already be part of a "Regional Action Plan" (RAD). Likewise, the implementation of SFDRR and SDGs. All of this is intended to make regional governments more capable of dealing with disaster risks so that they are able to carry out sustainable development activities

3. Result and Discussion

The data needed in this study are primary data and secondary data. Primary data in this study can be obtained from the research field, both obtained from direct observation and filling out questionnaires and interviews with informants who describe the impact or loss of the flood disaster in 2021. Secondary data is obtained from photographs in the field immediately after the disaster occurred and data the basis of pre-disaster information, disaster impact data, as well as official district/provincial government documents, as well as other documents related to the implementation of SFDRR and SDGs by the North Jakarta City Government (Figure 1).

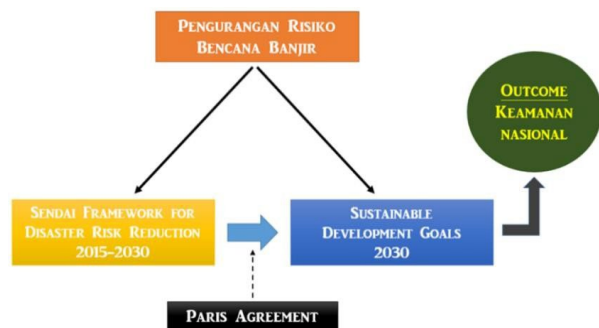


Fig. 1. Collection of SFDRR and SDGs Documents

In full, data sources will be obtained from several institutions, including: the Regional Meteorology, Climatology and Geophysics Agency (BMKG), the Regency/City Regional Disaster Management Agency (BPBD); District/City Regional Development Planning Agency (Bappeda); and the Indonesian Forum for the Environment (Walhi). These institutions, as a source of data both through data collection and interviews. Data sources were also obtained through literature review and various relevant documents. The process of collecting data in the field was carried out by dividing the data collection work team into several work teams, according to the target district which was the research location. The work team also determines the technical data processing to be used. Data processing is carried out by dividing it into 2 steps/parts. The data recap process is carried out immediately after completion from the field then data analysis activities are carried out centrally after the data is collected as a whole.

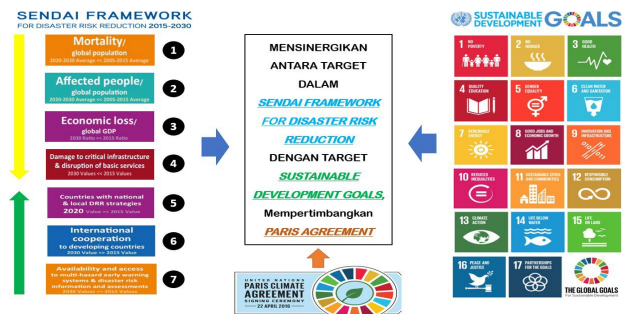


Fig. 2. Synergy of SFDRR and SDGs targets

A. The Causes and the Triggering Factors of Flood Disaster in Jakarta

Jakarta is the capital city which is the center of the implementation of the administrative functions of the government and the economy of the Republic of Indonesia. In addition, as a center for business, politics and culture, Jakarta is home to the headquarters of state-owned enterprises, private companies and foreign companies. The city is also the seat of government agencies and the ASEAN secretariat office. North Jakarta is part of the metropolitan city of Jakarta, which experiences rapid regional development every year, marked by the construction of high-rise buildings and increased population activity which indirectly causes an increase in the need for clean water and triggers massive groundwater extraction.

The results of measurements in 1925-2003, Jakarta's sea level always rose every year, the average increase was 0.5 centimeters (cm) per year. On the other hand, the rate of subsidence in Jakarta has reached 5 cm to 12 cm per year at a number of points over the past three decades, this condition has resulted in a higher accumulation of sea level which inundated Jakarta's soil. In 1982-2010 with flat nature survey technology and using a global positioning system radar tool, it was stated that land subsidence was spread over a number of places in Jakarta. The decrease varies greatly, 1-15 cm per year, and in some locations there is a decrease of 20-28 cm per year. The Pluit area, Penjaringan, North Jakarta is one of the areas that has experienced significant land subsidence (Chandra K and Supriharjo, 2017).

The situation mentioned above is exacerbated by the existence of reclamation activities on the north coast of Jakarta for the development of residential areas. The reclamation of the north coast of Jakarta has also displaced mangrove forests (mangroves) which function as a natural protector of the land area in the event of high tides/tide waves from the sea. Apart from changing the geomorphology (landscape), this has also disrupted the hydrological system of the coastal plains, making it difficult for water from the drainage system to flow into the sea (Chandra K and Supriharjo, 2017). These conditions have made Jakarta in the northern part the area most frequently hit by floods. Apart from that, the North Jakarta area is also frequently hit by tidal floods or tidal floods on the coast of North Jakarta.

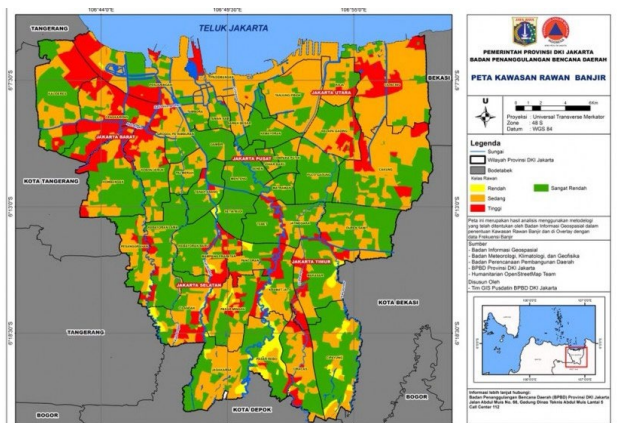


Fig. 3. Jakarta flood area map

The city of Jakarta generally has a hot climate with maximum temperatures ranging from 32.7°C - 34°C during the day, and minimum temperatures ranging from 23.8°C -25.4°C at night. The average rainfall throughout the year was 237.96 mm, during the period 2002-2006 the lowest rainfall was 122.0 mm in 2002 and the highest was 267.4 mm in 2005, with humidity levels reaching 73.0 - 78.0 percent and the average wind speed reaches 2.2 m/s - 2.5 m/s. Here is a map of DKI Jakarta Province. Geologically, the entire plain consists of Pleistocene deposits which are found at ±50 m below the ground surface. The southern part consists of an alluvial layer, while the coastal lowlands extend inland for about 10 km. Underneath there is an older layer of sediment which is not visible on the ground surface because it is completely buried by alluvium deposits. In the northern region, it is found at a depth of 10-25 m, the further south the hard surface is, the shallower it is 8-15 m. In certain parts there is also a hard surface layer of soil with a depth of 40 m. Apart from being geologically a basin area, Jakarta is also a floodplain geomorphologically.

Flood plains are areas that are formed as a result of sedimentation processes during floods (Harsoyo, 2013). Floodplains are generally located around meandering rivers or at the meeting point of a tributary with the main river (Harsoyo, 2013). With the existence of 13 rivers that cross the city of Jakarta, there are indeed quite a lot of floodplains spread across the DKI Jakarta area. Therefore, it is quite understandable that the potential for flooding in the DKI Jakarta area is indeed very

high. Of the 13 rivers that cross the City of Jakarta, the Ciliwung River is the river that has the greatest contribution to the potential for flooding in the DKI Jakarta area. Apart from the Ciliwung River, the Brantas River which is in North Jakarta also makes a significant contribution to the potential for flooding in the DKI Jakarta area, especially North Jakarta.

B. Analysis of the Triggering Factors of the Flood in North Jakarta and their Impact on Various Life Sectors

There has been an increase in the intensity of disasters globally, especially in the East Asia-Pacific region (Jha and Stanton-Geddes, 2013). Cities in this region, which are growing rapidly, are becoming more and more vulnerable to disasters, one example of which is Jakarta, the capital city of Indonesia. Jakarta's vulnerability to flooding is also exacerbated by urbanization which increases demand for land use, while land availability is limited. This constraint has led to the emergence of informal development in flood-prone areas with a high risk of exposure to flooding, such as in residential areas along rivers in Penjaringan which are inhabited by low-income people. Informal settlements along the riverbanks have existed for decades. This is because people with low incomes cannot afford to live elsewhere and because of their location close to their place of work (Dickson, et.al., 2012).

Several areas in North Jakarta are frequently hit by floods every year, namely the Kelapa Gading, Pademangan, Koja, Cilincing, Tanjung Priok and Penjaringan areas. Kapuk Muara, Kamal Muara, and parts of Sunter are areas that have other problems. During high tide, the area is always submerged due to tidal floods. As a coastal area, North Jakarta is the mouth of 13 rivers that flow in the Jakarta area. This also means that the area which has a land area of 154.11 square kilometers is also a gateway for tidal waves which often cause tidal floods. Currently, data from the North Jakarta City Government shows that the total length of macro waterways (rivers and rivers) in this area is 99.9 kilometers long. Meanwhile, the total length of all waterways, be it macro, micro or connecting channels, reaches 799 kilometers. In fact, not all of these waterways function properly because they are covered in sediment. Some of them are even occupied by buildings.

In North Jakarta, the triggering factors for flooding are caused by natural conditions and phenomena (topography, rainfall), geographical conditions of the area and human activities that have an impact on changes in spatial planning or land use in an area. High rainfall, which is more than 500 mm which usually occurs in January and February, has resulted in catastrophic flooding in several areas of DKI Jakarta, including North Jakarta (BMKG, 2013). North Jakarta itself has a river that has the potential for flooding, namely the Angke River. In addition, Kodoatie and Syarief (2006) explain the factors that cause flooding include changes in land use, waste disposal, erosion and sedimentation, slum areas along the river, inappropriate flood control systems, high rainfall, river physiography, inadequate river capacity. adequate, the influence of tides, land subsidence, water structures, damage to flood control buildings.

Apart from that, the North Jakarta area is also frequently hit

by tidal floods. The exact cause of tidal flooding is none other than sea level rise due to sea tides. However, tidal flooding can also be caused by external factors, including water pressure, wind or swell (waves that move very far away from the generating area), storms at sea, melting of polar ice which is triggered by global warming. Not only that, human activities can also trigger tidal floods. For example, excessive pumping of groundwater, dredging of shipping lanes, and reclamation of beaches. Exploitation of coastal land by humans can cause a decrease in the groundwater level, thus triggering subsidence of the land surface and seawater intrusion. In the North Jakarta area, Rob floods occurred due to beach reclamation.

It can be concluded that there are three main factors causing flooding in North Jakarta. First, extreme rainfall. Trends of extreme rainfall with high intensity and short duration are increasingly common. Extreme rainfall is a real impact of the climate crisis. Second, changes in land cover. Analysis of KLHK land cover data for 2000 and 2019 shows an increase in the area of plantation forests by up to 117.7% in the upstream area of the river that flows towards Jakarta, replacing the dominance of agricultural land. The area of settlements has also grown rapidly to 47.4%, replacing agricultural land and green open spaces in the middle and downstream areas. In Jakarta alone, the area of green open space is only 9.8% in 2019. This increases the chances of rivers and drainage networks overflowing due to large surface runoff, not to mention the threat of sedimentation in rivers due to high erosion rates in the upstream area. Third, land subsidence. Jakarta's land subsidence reaches an average of 12 cm/year, and is more extreme on the north coast of Jakarta with a subsidence rate of up to 25 cm/year. According to Takagi *et al.* (2015), until 2050 it is projected that the area of flooding due to land subsidence will increase to 110.5 km², equivalent to 75% of the area of North Jakarta. Building loads on the surface and excess groundwater extraction also accelerate the rate of land subsidence. Currently there are still 35% of Jakarta residents who use groundwater for their daily needs. As a result, the groundwater level in Jakarta is getting shallower and the water holding capacity is lower.

Seeing the triggering factors for flooding in the North Jakarta area can be linked to political ecology. The essence of meaning in political ecology is that environmental change is not neutral, but is a form of environmental politicization which involves many actors who have an interest in the environment itself, both at the local, regional and global levels. Referring to this definition, the flood disaster that occurred in North Jakarta was caused by changes in the environment that were not neutral. This means that many actors have interests in North Jakarta to construct buildings and even reclaim beaches, causing floods.

Issues regarding the management of natural resources are inseparable from socio-political aspects or management policies. Related to the management of natural resources, the state as a user actor as well as a protective actor, is identified as part of the operation of global capitalism. Cockburn and Ridgeway (1979) describe political ecology as a covert goal by industrialized countries to exploit the environment so that there is a link between socio-political science, economics, and ecology. Beach reclamation carried out to support various

economic activities in Jakarta has a huge environmental impact. By carrying out reclamation in the north coast area which is the estuary of several rivers in Jakarta, this will certainly have a negative impact on the hydrological system in Jakarta so that the problem of flooding will be increasingly difficult to overcome. Continued exploitation of the environment will also have an impact on achieving sustainable development.

The link between the political-ecological approach and the flood disaster that occurred in North Jakarta can be divided into 3 main issues. First, the issue of the source of environmental damage. Political ecologists such as Forsyth (2003) construct a new line of thinking that the rich use far more resources and therefore have a greater impact on the environment. In North Jakarta, building owners who violate spatial planning and have a negative ecological impact are the ones that cause flooding in the North Jakarta area. Only the rich have access to building permits and to ask for protection when they violate the spatial plan.

Floods that frequently hit the North Jakarta area have an impact on material and immaterial losses. Many of the flood victims, both at home and in refugee camps, were attacked by skin, diarrhea, respiratory diseases, and so on. The flood that hit the city of North Jakarta also had an impact on the cessation of the community's economic and social activities. Watershed management problems are also increasingly complex because many local governments do not yet understand the concept of ecosystem-based and cross-administrative watershed management.

To reduce the risk of flooding, the North Jakarta City Government is also carrying out normalization in 2 waterways. The first canal is located in the Cilincing area which is 105 meters long, 120 centimeters wide and 80-100 centimeters deep. The second normalization is the repair of a closed canal for 10 years on Jalan H. Nawar RT 07 RW 02 Tugu Selatan Village, Koja District. The canal was closed because previously residents closed the canal because water from the main road flowed into the village. However, the village's current position is lower, causing water to inundate the area. In early 2022, the North Jakarta City Government socialized plans to build or rehabilitate a number of polders to reduce flooding during the rainy season.

Flood disaster risk reduction must also be carried out together with the role and participation of the surrounding community. DKI Jakarta Deputy Governor Ahmad Riza Patria himself said that the government asked the people of Jakarta to work together to clean up the environment where they live, including making infiltration wells and biopores. Until now, training on flood disaster risk reduction aimed at the community has rarely been carried out. Based on the data obtained, in 2013 a community-based Point of Interest was formed which was initiated by UNESCO. Apart from that, MRI (Society of Indonesian Volunteers) and ACT (Action Fast Response) North Jakarta conducted water rescue training which was attended by volunteers. This underwater rescue training has the aim of introducing new volunteers in early rescue of flood victims. The reason is, not a few floods in Jakarta require more serious handling because of the water level or fast currents.

The second is strengthening disaster risk governance and disaster risk management. In disaster management in North Jakarta, BPBD DKI Jakarta is guided by the National Disaster Management Plan and Governor Regulation Number 13 of 2021 concerning Contingency Plans for Flood Disaster Management in DKI Jakarta Province in 2021. In this contingency plan, it is explained related to disaster risk, direction of tasks and responsibilities, and instruments in implementing coordination of flood management. Thus, when viewed from the aspect of disaster risk management, the government already has a legal basis and commitment to tackling flood disasters.

Fourth is to enhance disaster preparedness for effective response, and to “build back better” in recovery, rehabilitation and reconstruction. In flood disaster management in North Jakarta, post-disaster activities focused on the psychosocial recovery of the community, especially children. In addition, the government together with related agencies, Satpol PP, TNI and Polri are doing post-flood community service to clean up the location so that it can function normally again. However, in post-flood response, reconstruction was not carried out because no buildings collapsed due to flooding in North Jakarta. Barry Buzan (1983) in “People, State, and Fear: The National Security Problem in International Relations” mentions referent objects not only state security stability, but also individual (human security) and systems. Human security itself is closely related to the concept of disaster risk reduction, where a disaster that occurs will have an impact on every aspect contained in human security. Human security emphasizes the fulfillment of the basic rights of every individual citizen, including a decent living and safe from the risk of floods.

These basic rights are described as the gateway to achieving national security conditions. Indonesia's success in overcoming security threats, both traditional and non-traditional, is also influenced by the hard work of the Indonesian government in trying to fulfill the basic rights of a citizen. Furthermore, at a practical level, it is explained that the implementation of human security must include safety from physical threats, achieving a good quality of life, guaranteeing the most fundamental human rights, law enforcement, good governance, social equity, protection of civil society in conflict, and sustainable development. Achieving a good quality of life can be done with a clean and disaster-free environment, so that people get a decent living.

4. Conclusion

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References

- [1] Aldrian E, Karmini M, Budiman. (2011). Adaptasi dan mitigasi perubahan iklim di Indonesia. Pusat Perubahan Iklim dan Kualitas Udara Kedepkatan Bidang Klimatologi, BMKG, Jakarta.
- [2] BPS Provinsi DKI Jakarta. (2017). Provinsi DKI Jakarta Dalam Angka 2017. Jakarta: BPS Provinsi DKI Jakarta.
- [3] Bryant, RL dan Bailey, S. (2005). Third World Political Ecology. Taylor & Francis e-Library.
- [4] Buzan, Bary (1983). People, States, and Fear: The National Security Problem in International Relations. Department of International Studies: University of Warwick. Cockburn, A dan Ridgeway, J. 1979. Political Ecology. New York: Times Book.
- [5] Dickson, E., Baker, J. L., Hoornweg, D., dan Tiwari, A. (2012). Urban Development Series. “Urban Risk Assessments: Understanding Disaster and Climate Risk in Cities.” Washington, DC: The World Bank. Twigg, J. (2015). Disaster Risk Reduction. London: Overseas Development Institute.
- [6] WEF, “The Global Risks Report 2022,” [weforum.org](https://www.weforum.org), 2022.
- [7] Jakarta Province Government, “Laporan Pencapaian Tujuan Pembangunan Berkelanjutan,” sdgs.jakarta.go.id, 2020.
- [8] UNISDR 2015 Sendai Framework for Disaster Risk Reduction 2015–2030. Geneva: UNISDR.
- [9] Ibid.
- [10] Harsoyo, Budi 2013 “Mengulas Penyebab Banjir Di Wilayah DKI Jakarta Dari Sudut Pandang Geologi, Geomorfologi Dan Morfometri Sungai.” *Jurnal Sains & Teknologi Modifikasi Cuaca*, 14.
- [11] Kompas, “Bagi Jakarta, Banjir Seolah Menjadi Takdir,” sains.kompas.com, 2013.
- [12] National Geographic Indonesia, “Banjir Jawa: Penurunan Tanah Jakarta, Pekalongan, Semarang Mengerikan,” nationalgeographic.grid.id, 2021.
- [13] 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.
- [14] 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.”
bmg.go.id, 2022.
- [15] Jakarta Province Local Disaster Management Agency 2022 Manajemen dan Kolaborasi Pentahelix dalam Upaya Penanganan Darurat di Provinsi DKI Jakarta.
- [16] Adhi Ksp R, Rainayati M, Yendra M 2010 Banjir Kanal Timur: Karya Anak Bangsa. Jakarta: Grasindo.
- [17] Indonesia National Development Planning Agency 2022 *Metadata Indikator*. Jakarta: Indonesia National Development Planning Agency.