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Lesson Learned from Japan for Flood Disaster Risk Reduction in Indonesia

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Abstract. Indonesia and Japan have experienced hydrometeorological disasters, primarily floods disasters every year. The two countries must experience few losses due to improper disaster management. However, along with the times, Japan, an expert in technology development, can reduce flood risk. Japan has established itself as a country that is an example for countries in disaster risk reduction. The Japanese government promotes a concept, namely "Build Back Better" to build a post-disaster area to restore the area to its original state and take opportunities to develop better than before. Meanwhile, Indonesia, a developing country incidentally, is still trying to reduce the risk of flood disasters that cause considerable losses to the nation. Therefore, this study aims to analyze the lessons learned from Japan for flood risk reduction in Indonesia. This study uses a qualitative descriptive method with data collection techniques through Focus Group Discussions (FGD) with professors and researchers from Japan and reviewing disaster risk reduction documents. The results of this study indicate that there are several keys to success that Japan has in reducing flood risk, such as a) a mindset to be able to make disasters a challenge for the better; b) policies and disaster management systems structure from the center to the

regions; c) encourage the development of SETI (Science, Engineering, Technology, and Innovation) for disaster risk reduction to many sectors; and d) Japan's ambition in implementing Society 5.0 which is relevant to Disaster Risk Management (DRM).

Keywords. Lesson Learned, Flood, Disaster Risk Reduction

1. Introduction

Countries worldwide are busy looking for solutions to global warming caused by climate change. Based on a report from the World Economic Forum (2021), the highest probability in the next 10 (ten) years is extreme weather, climate control failure, and environmental damage caused by humans [1]. Therefore, experts and state actors in the world focus on the impact of climate change and natural disasters. Based on a 2014 report from the Intergovernmental Panel on Climate Change (IPCC), it is known that heat waves will occur more frequently and last longer to extreme rainfall will hit several regions of the world [2].

A flood disaster is a natural disaster often encountered with high losses in the world [3]. Flood disasters have existed throughout human history and are challenging to respond to unforeseen disturbances [4]. Floods are the highest natural disaster and affected more than 2 billion people in 1998-2017 worldwide, as shown in Figure 1. The risk of flood disasters will continue to increase, especially in low-middle income countries, where people in these countries live in areas prone to flooding and have low capacity to deal with these threats [5]. It was the region most affected by flooding, accounting for nearly 50% of flood deaths in the last quarter of the 20th century [6-7]. The countries with the most considerable losses in Asia are Japan and Indonesia.



Figure 1. Nature disaster in the world 1998-2017

Source: UNDRR, 2018

Japan is a small country covering only 0.25 percent of the earth's area. Japan is very vulnerable to various natural hazards, hefty rains, typhoons, blizzards, earthquakes, tsunamis, and floods from a geographical, topographic, and meteorological perspective. Japan is a country with a long history of floods. The first recorded flood disaster in Japan occurred in the mid-6th century. Meanwhile, Typhoon Isewan in 1959 caused floods and caused severe damage and killed more than 5000 people [8]. In 1896, the Japanese River Law was established to get

floodwaters out to sea as quickly [9]. Then, flood control emphasized controlling high water levels by revitalizing river channels and embankment construction. During 1926-1989, the government struggled because of the difficulty of securing land for upgrading or upgrading the embankment. The construction of multipurpose dams dominates flood control [10-11]. Flood disasters cause suffering for the community. Therefore, the Japanese government continues to reduce the risk of flood disasters.

The Japanese government has given much attention to disaster risk reduction and emergency management through self-help and cooperation mechanisms between communities [12]. The government continuously undertakes initiatives that come from public support. It includes pre-disaster measures, such as building embankments, structural and non-structural mitigation, and disaster simulation exercises [10]. Japan is one of the best pilot countries in disaster management.

We are seeing the condition of Indonesia, which has the same disaster risk as Japan. Indonesia is a country with a high level of vulnerability. Based on a report from the World Risk Report 2020, Indonesia is in the 40th position out of 181 countries prone to natural disasters globally, with a risk index of 10.39. Because of hydro-climatologically, Indonesia experiences the El-Nino Southern Oscillation (ENSO) and La Nina phenomena, so droughts, hurricanes, landslides, and floods often occur [13]. Flood is the most frequent disaster in Indonesia. Based on data from the National Disaster Management Agency (BNPB) in 2011-2020, there were 7,574 flood disasters, as shown in Figure 2. Meanwhile, the total number of people exposed to flood risk reached 40,890,352 people in all provinces in Indonesia, with potential losses reaching 2.2 trillion.

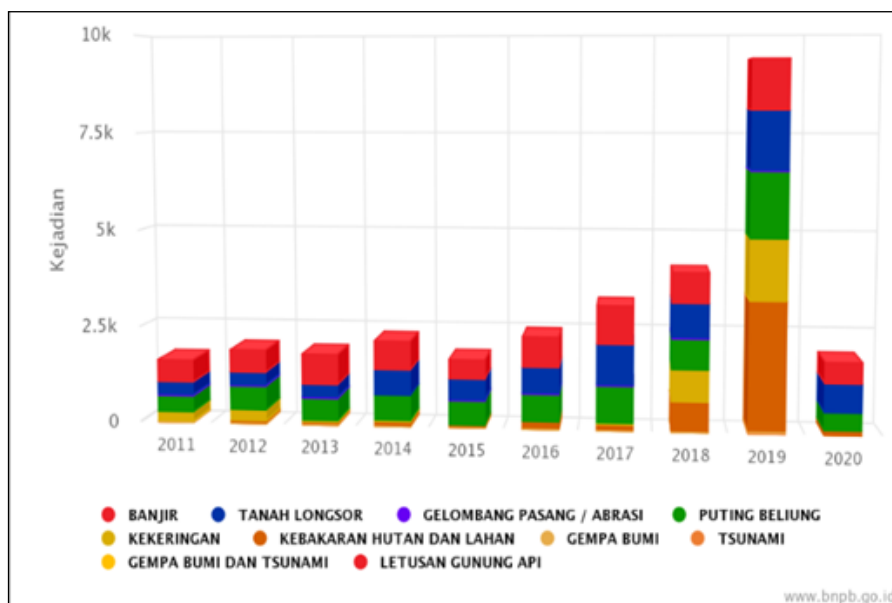


Figure 2. Trends in Natural Disasters in Indonesia 2011-2020
Source: BNPB, 2020

Flood disasters can cause by several natural factors, such as prolonged heavy rains, river silting, and tidal waves [14-15]. Meanwhile, flood disasters can cause by human activities, such as littering in waterways and illegal logging of forests [16]. These actions do not directly affect nature, however slowly and surely, these actions can damage the environment and cause

flooding. In addition, the lack of public awareness, the slow revision of disaster management guidelines and policies, urbanization that causes slum settlements, and development activities that are not by the spatial plan are the major causes of turning a hazard into a devastating disaster [17]. This phenomenon must receive special attention from the Government of Indonesia to reduce the risk of flooding.

As the initiator of other countries, Japan has implemented good practices in disaster risk reduction. That should be followed by Indonesia, which has similar characteristics of flood disasters. The Indonesian government has done several things, namely making the Master Plan for Disaster Management (RIPB) 2020-2044 and the National Disaster Management Plan 2020-2024, which have adopted the Sendai Framework for Disaster Risk Reduction 2015-2030. However, this is not enough to reduce the risk of flooding. Other more effective and targeted efforts are needed. Therefore, this study aims to analyze lessons learned from Japan for flood risk reduction in Indonesia.

2. Research Method

The research method used in this research is qualitative. Qualitative research begins with assumptions and an interpretive/theoretical framework that shapes or influences the study of research problems related to the meanings imposed by individuals or groups on a social or human problem [28]. In this study, the design used is descriptive-analytical. The researcher emphasizes notes with detailed, complete, in-depth sentence descriptions that describe the actual situation to support the presentation of the data. Therefore, in general, qualitative research is often referred to as a descriptive qualitative approach. The researcher tries to analyze the data in various nuances according to its original form as when it was recorded or collected.

This research has the subject of the parties related to the research topic. In determining the research subjects using purposive sampling, that is means that the informants as informants know about the research topic. The informants in this study are as follows:

- a. Mr. Hiroyuki Ito (Deputy of International Centre for Water Hazard and Risk Management (ICHARM), Japan).
- b. Dr. Tomoki Ushiyama (International Centre for Water Hazard and Risk Management (ICHARM), Japan).
- c. Dr. Masatoshi Denda (International Centre for Water Hazard and Risk Management (ICHARM), Japan).
- d. Dr. Masakazu Fujikane (International Centre for Water Hazard and Risk Management (ICHARM), Japan).
- e. Mizan Bustanul Fuady Bisri, Ph.D. (Kobe University, Japan).
- f. Prof. Fumihiko Imamura (International Research Institute of Disaster Science (IRIDeS), Tohoku University, Japan).
- g. Prof. Iuchi Kanako (International Research Institute of Disaster Science (IRIDeS), Tohoku University, Japan).
- h. Prof. Takahashi Makoto (Nagoya University, Japan).
- i. Mr. Satoru Yusa, M.Sc. (National Research Institute for Earth Science and Disaster Resilience (NIED), Japan).

The data collection techniques used were Focus group Discussion (FGD), observation, and document review. The data used in this study are primary data and secondary data. The primary data was obtained through FGD using virtual zoom meetings and observation. While the secondary data is obtained through relevant previous research, annual reports, maps, photographs, regulations, and data from the internet. In this study, the data analysis technique

used is an interactive model. This analytical technique is carried out continuously during data collection in the field until data collection is completed so that the data obtained is saturated [29]. The interactive model data analysis technique consists of data collection, condensation, presentation, and concluding [29].

3. Result and Discussion

Looking at the current conditions, Japan is one of the countries with the best disaster management in the world. Japan is also a pioneer in technological advances in disaster risk management. Despite having similarities with Indonesia regarding disasters, Japan has different thoughts in solving disaster problems.

3.1 Natural and Social Characteristics of Japan

Japan is a country with a long history of flood disasters as it is located in a region known as the Temperate Monsoon Asia. According to the Ministry of Land, Infrastructure, Transport, and Tourism, Japan typically suffers from local downpours caused by seasonal rain front and typhoons in summer. Both of which are induced by southeast winds from the Pacific Ocean. Most of the flooding in Japan is caused by heavy local rain that makes river water levels rise rapidly.

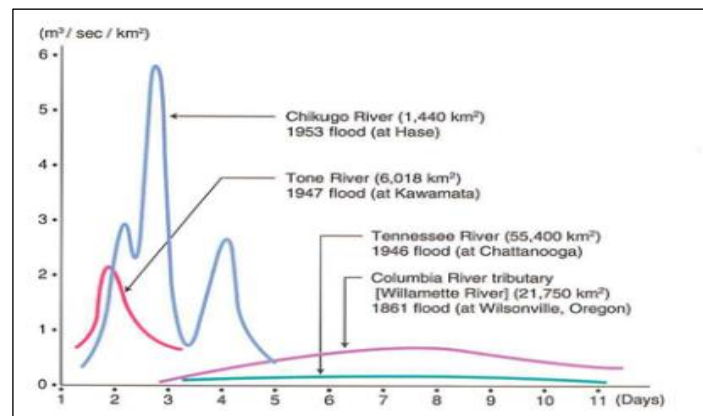
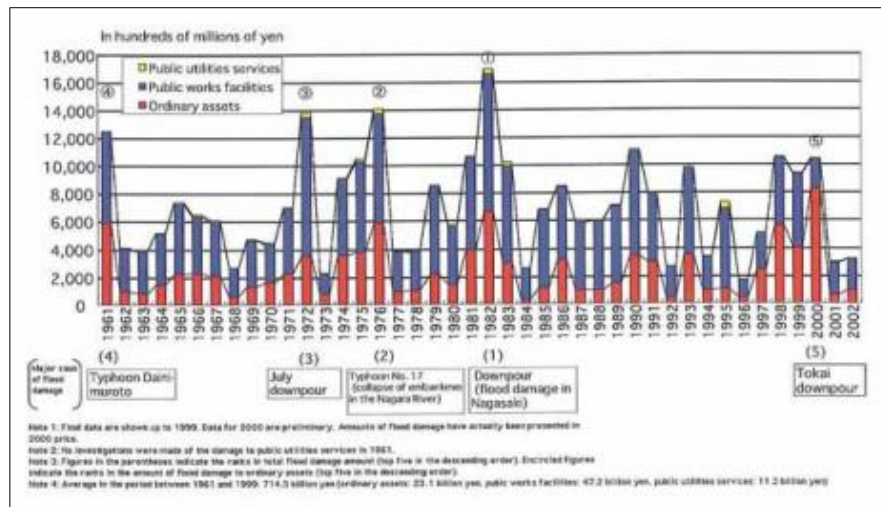


Figure 3. Characteristics of Flood in Japan
Source: narbo.jp, 2021

Based on Figure 3, it is known that Japan's steep-sloped rivers with small catchment areas experience quick rises in water levels that follow with heavy rainfalls and will dry quickly. We can see a comparison of the floods that occurred in 1953 due to the rising water level of the Chikugo River and in 1946 due to the rising water levels of the Tennessee River. The narrower the river area and the higher the rainfall, the shorter the flood duration. On the other hand, the wider the river and the lower the rainfall, the longer the flooding will occur.

The existence of the flood disaster also impacted the social conditions of the Japanese people. Based on data from the Ministry of Land, Infrastructure, Transport, and Tourism, 50% of Japan's total population and 75% of total physical assets are in flood-prone zones. Therefore, a catastrophic flood can cause severe damage. The physical damage that occurs can be seen in Figure 4, which fluctuates every year depending on rainfall and environmental conditions.



In Figure 4, it is known that since 1961-2002 there has been much physical damage caused by the flood disaster. The most significant physical damage due to flooding occurred in 1982 in the Nagasaki area, with a total loss of 17,000 billion yen. Overall, the most physical damage occurred to public works facilities and ordinary assets.

Floods threaten Japan every year. The most recent incident occurred in August 2021, caused by heavy rains. Not only flooding but also landslides in the city of Unzen in Nagasaki prefecture early on 13 August 2021. Some flooding was also reported in parts of Hiroshima prefecture. More heavy rain was expected across southern and western Japan. Authorities issued evacuation orders across 13 prefectures, affecting 3.4 million people, causing up to 4 fatalities and property loss [18]. However, this flood disaster was assessed by the Global Disaster Alert and Coordination System in the green category with a value of 0.5, which can be controlled with the number of victims less than 100 people killed or 80,000 people displaced. Many flood disasters result in much physical damage and loss of life. It requires Japan to create an appropriate and accurate disaster management system in reducing disaster risk. Efforts were made by utilizing science and technology development for disaster risk reduction management.

3.2 Flood Disaster Risk Management in Japan

Japan has the same risk as Indonesia in the red zone in terms of flood risk. Japan is in the Pacific Ocean, affected by frequent typhoons and floods. However, Japan has very effective flood risk reduction management. It should be understood that disaster management is an arrangement and management of resources and responsibilities in handling matters related to aspects of human safety, both in the stages of preparedness, response, and recovery from disaster events, to reduce the negative impacts caused by the disaster [19]. The response from the Japanese government and all elements of society is generally very fast in dealing with post-disaster situations, restoring disaster-affected areas, and overcoming health problems and the lives of survivors [20]. Several things are the key to Japan's success in implementing Flood

Disaster Risk Management, namely:

3.2.1 Mindset to be Able to Make Disasters a Challenge for the Better

Instilling awareness of the disaster situation is a form of disaster risk reduction. Bisri said in Japanese society is known that the word crisis in kanji writing (危機 = kiki) has interrelated meanings, namely 危=danger and 機=opportunity [21]. It means that the word crisis in Japanese contains two meanings that can change people's mindsets in disaster management. The word "danger" can be accompanied by "opportunity" if the community knows about reducing disaster risk. The Japanese people interpret disaster risk reduction and prevention measures as Bousai. The Japanese government instills disaster awareness in the community starting from childhood. Children are taught to save themselves from disasters at school at least two times a year. There is no unique curriculum for disasters, but regular training and simulations to form awareness in dealing with disasters. In addition, to provide awareness to the public, the Japanese government commemorates Disaster Prevention Week or known as Bousai Shuukan. Disaster awareness in Japan involves cooperation from various parties, from the government to the community.

3.2.2 Policies and Disaster Management Systems that are Structured from the Center to the Regions

Japan is a country that adheres to a monarchical system of government, in which an emperor leads the head of state, and a prime minister leads the head of government. The government system in Japan has three levels, namely the center, prefecture/province, and city. The mayor is the party most responsible for flood disaster management. The mayor has the authority to determine prohibited areas, order evacuation, determine the use of land and private sector facilities in an emergency. It is by Law No. 223 of 1961, namely the Basic Law on Disaster Management. The regulation explains the basic strategy for disaster management and the responsibilities of the government, community, and community organizations in disaster management. In addition to making the Law on Disaster Management, Japan also focuses on river management to reduce the risk of flood disasters. The formation of river management policies was started in 1896 until 1997. Japan made a Law on River Management which includes river environmental conservation, water use, and flood control. Currently, river management is used for flood management and water use and becomes waterfront spaces for the community to enjoy with a clean and beautiful environment.

3.2.3 Encourage the Development of SETI (Science, Engineering, Technology, and Innovation)

Japan is one of the more sophisticated countries in developing SETI (Science, Engineering, Technology, and Innovation). The development carried out is not only in the industrial sector but also in the disaster sector. The Japanese government utilizes SETI to reduce disaster risk, especially in economic, social, and environmental vulnerabilities. It is known that Japan uses advanced technology and methods that are too complicated in calculating the level of flood risk in an area [22]. They use dynamic downscaling and statistical downscaling methods to determine the risk of flooding and drought. Meanwhile, to create a simulation model of river flow and inundation depths used for water resources management, we can use the hydrological WEB-RRI [23].

In addition, Japan is also developing widening of river channels and construction of

embankments. It is to reduce the increase in river water due to heavy rainfall. Then when river water overflows, Japan also builds drainage basins as temporary shelters until the river water recedes. There are also efforts to slow downriver flow with the construction of reservoirs. SETI has also been applied to mapping flood-prone areas in real-time. It aims to determine the height of the river water discharge directly to provide an early warning system to the public about flood disasters. Therefore, the use of SETI has proven to reduce the level of flood heights and accelerate the reduction of puddles.

3.2.4 Japan's Ambition in Implementing Society 5.0 Which is Relevant to Disaster Risk Management (DRM).

Prime Minister of Japan, Shinzo Abe, on January 23, 2019, delivered a speech at the World Economic Forum entitled "Toward a New Era of "Hope-Driven Economy". The vision of a future society called Society 5.0 was presented in the speech. Shinzo Abe stated that in Society 5.0, it is no longer capital but data that connects and encourages all aspects of life. The Japanese government said it would play an active role in developing Society 5.0 globally. Japan is committed to being a role model for other countries with Society 5.0. Society 5.0 for the Government of Japan is a vision-oriented towards optimizing technological innovation to improve the lives of global people, including in the field of disaster prevention [24].

The number of disasters that occurred in Japan made Japan a disaster-science production. In dealing with disasters, Society 5.0 is very concerned about human safety aspects. The use of digital technology, especially digital media, has an essential role in the Disaster Mitigation process so that information can be known accurately by the entire community [25]. Society 5.0 provides technology-based rain and hurricane forecast data to prevent flood disasters. The application of Society 5.0 provides information on disaster-prone areas and evacuation routes through personal smartphones or other devices. Help find disaster victims quickly using robots. In addition, optimally deliver relief materials via drones, self-driving delivery vehicles. It will help the community be prepared before a flood disaster occurs and speed up the recovery process.

The number of disasters that occurred in Japan made Japan a disaster-science production. It is in line with Japan's ambition to implement Society 5.0 for Sustainable Development Goals (SDGs). Japan is advanced in disaster-related science and technology development by compiling Japan's Practices for SDGs. Efforts made by Japan to realize the goals of the SDGs related to disasters, especially in point 13 on Climate Change, are by developing and utilizing the Earth Observation extensive data system or referred to as the Data Integration and Analysis System (DIAS). This step addresses global issues such as climate change, disaster risk management, and infectious diseases. In addition, DIAS contributed to evaluating the impact of future climate change on flood risk [21].

Based on the 2018 Book of Japan's Practices for SDGs, another effort made by Japan for water management in reducing flood risk is the Global Satellite Mapping of Precipitation (GSMaP) program. The steps taken in this method are combining satellite data and in-situ data to predict a flood of the lower river region several days before. The warning and evacuation calls are sent to residents directly based on this information. Global satellite data is adequate to grasp the situation on the water level of International cross-border rivers. This program can realize the SDGs goals: clean water and sanitation, sustainable cities and communities, and climate action.

3.3 Lesson Learned Flood Disaster Risk Management in Japan for Indonesia

After knowing Japan's efforts in Flood Disaster Risk Management, it is known that many things we can learn for the Indonesian people. Despite having similar disaster characteristics, Japan is still superior in reducing the risk of flood disasters by utilizing the development of science and technology. Japan, which is known as a developed country with various advanced technologies, can make discoveries in the field of disaster. Judging from the various efforts of Japan in carrying out disaster risk reduction management, especially in the case of floods, it requires Indonesia to introspect and learn from the efforts that Japan has made.

The first thing that is a lesson for Indonesia is the mindset of the people to be aware of the threat of flooding. It is difficult to change the mindset of the Indonesian people to be aware of disasters due to disasters into political interests in the name of providing social assistance. The opportunity to take advantage of disasters makes it easy for people who act like victims to be manipulated [26]. The government's many promises that have not been realized have caused people to become disappointed and ultimately indifferent to the threat of disaster. Therefore, cooperation from all stakeholders of the disaster Penta helix is needed to create the same mindset towards disaster risk reduction.

The second thing that has become a lesson for Indonesia is river management for flood risk reduction. River management in Indonesia is still overlapping, which causes the responsibility for river care and supervision to become out of control. Learn from Japan, which already has a law on river management since 1977 with various river normalization programs from upstream to downstream. Meanwhile, Indonesia only had a regulation on rivers in 2011. The difficulty of carrying out a river normalization program in Indonesia is due to the difficulty of land acquisition on the river banks. A broad enough riverbank is needed to increase the river's flow capacity [27]. Riverbanks should not be used for human activities during the rainy season because, at any time, they can flood. The use of floodplain land must adapt to the fact that there will be flooding or inundation one day. Therefore, when Japan sees that Japan can make rivers a waterfront space, Indonesia must also implement the program in rivers in Indonesia. So that later the slum environment on the banks of the river as one of the causes of flooding it can eliminate, and river normalization achieved.

The third thing that we can learn from Japan is about the use of SETI in the field of disaster. Japan is known as a country with advanced technology to create tools and methods to predict the occurrence of floods, such as Dynamic downscaling and Statistical downscaling methods. Seeing these conditions, Indonesia should learn from Japan to improve the early warning system to the public. As a policymaker and program implementer, the Indonesian government should cooperate with Japan to utilize SETI in flood disaster risk management in Indonesia. Thus, it hopes that the early warning system provided to the community can better reduce the risk of flood disasters.

The last thing that we can learn from Japan is the willingness to develop and implement Society 5.0 in DRM. Without determination and strong will, a country cannot develop. Therefore, Indonesia should emulate Japan's persistence in advancing its country. Indonesia must also start to utilize big data to make disaster management innovations. Like Japan, which uses satellite data and in-situ data to predict a flood of the lower river region several days before. If Indonesia can implement Society 5.0, the disaster management system in Indonesia will be faster and better coordinated so that the goal of zero victims is achieved.

4. Conclusion

Based on the research results this study aims to provide lessons on the importance of improving flood disaster risk management in Indonesia. Lessons are drawn from Japan as a pioneer in Disaster Risk Reduction through the 2015-2030 Sendai Framework. Many things can be learned from the Japanese way of dealing with flood disasters. Starting from changing the community's mindset to be aware of disaster risk, making disaster management policies from the center to the corresponding regions, using SETI to improve the flood disaster early warning system, and ambitions to implement Society 5.0 in DRM. The four main points learned from Japan's efforts in DRM must be put into practice so that the Indonesian people can feel the benefits.

This research is expected to reference readers, especially the government, policymakers, and program implementers. Seeing the importance of this research for sustainable development in Indonesia, further research is needed to find out Japan's efforts in other disaster risk management. In addition, it is also necessary to conduct more in-depth research on how the efforts that have been made by the Indonesian government in disaster management in Indonesia, especially in disadvantaged areas.

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