

# Lesson learned from flood disaster management in Japan during the Covid-19 pandemic to increase community resilience in supporting sustainable development

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**Abstract :** *Japan is a country that has a long experience of disasters including floods that often hit Japan, so the Japanese people have resilience and success in dealing with natural disasters concurrent with the Covid-19 pandemic. The purpose of this study is to take lessons from Japan in dealing with floods in the midst of the Covid-19 pandemic sweeping the world in the hope of minimizing the losses incurred to ensure sustainable development. This study uses a qualitative approach with a descriptive method. Qualitative methods rely on text and visual data, while data collection techniques are carried out through observation, interviews, literature studies, as well as focus group discussions (FGD) through zoom meetings. Many risk reduction efforts have been carried out, starting at the local, national, regional and even global levels, including efforts to overcome the Covid-19 pandemic with the New-normal model of life and increasing vaccination achievements for herd immunity. These efforts require the support of all parties, starting from increasing individual awareness to the international level. Overall, the effort to reduce disaster risk is to build community resilience against all forms of disaster risk threats and sustainable development. In order to increase disaster resilience and sustainable development in the midst of the Covid-19 pandemic to reduce economic losses and fatalities, it is hoped that the cooperation of all parties, both the government and the affected community and surrounding communities. Providing the right information and providing continuous training to the community is expected to increase awareness and correct understanding of disaster management and some critical situations when a disaster occurs, the government and the community should understand what actions to take.*

**Keywords:** *Flood disaster management, Covid-19 pandemic, Community resilience, Sustainable Development.*

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## I. INTRODUCTION

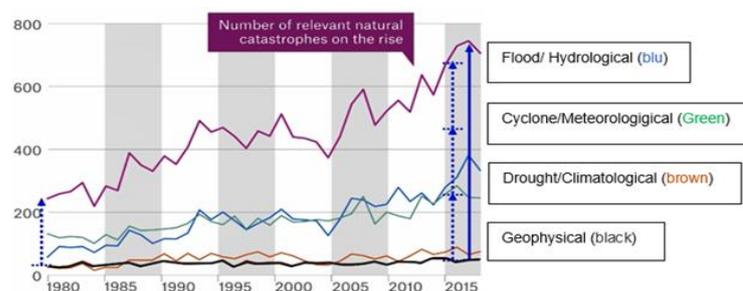
Japan is a country that has a long experience with disasters. Japan has experienced many disasters ranging from earthquakes, typhoons, landslides, to tsunamis and floods. Japan's geographical and climatological conditions make it prone to disasters such as volcanic activity, earthquakes, flood storms, and so on. Japan is in the Pacific Circum area where volcanic and seismic activity is constant (Satake, 2008). Japan's risk of natural disasters is similar to Indonesia's red zone. Japan is also in the ring of fire, so Japan has a series of mountains

that have disaster-prone conditions such as eruptions, earthquakes, and tsunamis. In addition, Japan is located in the open ocean (the Pacific typhoon belt) which can also affect climate change and the occurrence of hurricanes and floods. Thus Japan has a very high risk of natural disasters.

There are similarities in the geographical location of Indonesia with Japan where the geographical location of the Indonesian archipelago is located between the Asian continent and the Australian continent, as well as between the Indian Ocean and the Pacific Ocean. From this situation, the territory of Indonesia is in a cross position, which has an important meaning in relation to climate. In terms of geology, some parts of Indonesia are areas prone to natural disasters. This is because the territory of Indonesia is a meeting place between two series of young mountain paths in the world, namely the Pacific Circum (folding mountains that surround the Pacific Ocean) and the Mediterranean Circum (folding mountains starting from the Atlas mountains in North Africa to Nicobar and entering Indonesia) Warty (2002). BNPB data for 2022 shows that 700 floods have occurred in Indonesia, followed by 650 extreme weather events and 338 landslides, 69 forest fires, 12 earthquakes, 8 tidal waves and abrasion, and 1 drought with a total of disasters in 2022 as many as 1,798 times.

In accordance with Law No. 24 of 2007, it is stated that a disaster is an event or series of events that threatens and disrupts people's lives and livelihoods caused, both by natural factors and/or non-natural factors as well as human factors, resulting in human casualties, environmental damage, property losses, and psychological impact and flooding is one of the natural disaster events caused by many factors. Based on information submitted by the Head of the BNPB's (National Disaster Management Agency) Data Information and Public Relations Center, Sutopo Purwo Nugroho said that globally there has been an increase in the trend of natural disasters by 350% in the last three decades. This increase, especially in hydrometeorological disasters, or disasters affected by global climate change such as floods, landslides, cyclones and droughts, and 80% of these types of disasters occurred in Indonesia Nugroho (2016). According to BNPB, a flood is an event or condition in which an area or land is submerged due to an increased volume of water.

The same data was presented by International Center for Water Hazard and Risk Management (ICHARM) senior researcher Toshio Koike, who said that in recent years the number of disasters caused by water has increased significantly which can be seen in Figure 1 and on the other hand, disasters caused by land disasters such as earthquakes are almost unchanged, however, the number of occurrences of hydrological disasters (floods), meteorological disasters (cyclones), climatological disasters (drought) has more than tripled since 1980 Koike, T(2022). This data is supported by the BMKG from 2010 to 2019 showing that the most occurrences of hydrometeorological disasters are floods followed by landslides, cyclones, forest, and land fires and also drought BMKG (2019). With disasters that continue to increase from year to year, the number of economic losses will increase, especially those caused by an increase in water disasters which are strongly influenced by climate change.



**Figure 1. Graph of disasters caused by water around the world from 1980-2018**

**Source: Toshio Koike (2022)**

Non-natural disasters in the form of the Covid-19 pandemic that hit the whole world have made it difficult to deal with natural disasters that occurred, especially flood disaster management. A senior researcher

at ICHARM provides an overview of flood control during the Covid-19 pandemic that has hit the world. It was stated that if local government officials can anticipate crisis situations during emergency response before a disaster occurs they will be able to deal with disasters efficiently where there are 28 common critical situations during an emergency response effort. A critical situation is defined as a situation where local government officials do not know what to do, cannot make decisions, are confused or in a dilemma and so on.

Seeing Japan's experience in dealing with natural and non-natural disasters which is quite successful, in this study we aim to see how the experience of the Japanese government and society in dealing with flood disasters during the Covid-19 pandemic can be applied in Indonesia, which often experiences disasters, especially floods. It is known that as a result of climate change, the impact is an increase in extreme rainfall resulting in catastrophic floods that can cause casualties and economic losses and ultimately disrupt sustainable development. Along with flood disaster management, there are critical places that must be considered due to the transmission of Covid-19 so that the purpose of flood disaster management can be implemented and at the same time the spread of Covid-19 can be suppressed.

## II. LITERATURE REVIEW

### 2.1 The Flood Theory

Definition of flood is a natural phenomenon where there is excess water that cannot be accommodated by waterways or rivers in an area so there is an abundance of water that can be detrimental. Losses caused by floods such as loss of life and loss of property are often difficult to overcome, both by the community and related agencies. Floods are caused by various factors, namely the condition of the rain catchment area, duration and intensity of rain, land cover, topographical conditions, and the capacity of the drainage network. Flooding is also often understood as a flow or puddle of water that causes economic losses or even causes loss of life, while in technical terms 'flood' is the flow of river water that flows beyond the capacity of the drainage or flow of the river Asdak (2002). The opinion conveyed by Siswoko in 2002 stated that the flood event was an imbalance in the environmental system in the process of draining surface water which was influenced by the amount of water flow that exceeded the capacity of the drainage area. In addition to surface runoff, flooding is also influenced by the condition of the drainage area and local climate (rainfall).

### 2.2 Flood Management in Japan

Japan is a country that has a long history of flood disasters. From the record, the flood disaster that occurred in Japan began in the mid-6th century, while Typhoon Isewan in 1959 was responsible for the most enormous flood that caused damage in modern Japanese history Huang (2014). In 1896, a law was enacted regarding the regulatory usage of rivers in Japan with the aim: to drain flood waters into the sea as quickly as possible. Later, flood control was made to control the high water through river channel alignment and embankment construction. During the period (1926-1989), the Japanese government experienced difficulties in clearing land for upgrading or the construction of embankments that function to regulate water so the construction dominated by the multipurpose dam was carried out Fan (2020).

In 2003, the Law on dealing with flood damage caused by certain rivers flowing through cities was made for eight rivers that could potentially cause catastrophic flooding. It mandates that river management authorities aim to protect urban areas and take flood management measures in and around river basins. The regulations instruct the development of an integrated flood management plan between river and sewer management. This does not only involve horizontal collaboration between national and local governments but also involves various parties, namely collaboration between the government and the private sector. The law also stipulates requirements for the private sector, including rainwater storage and infiltration installation facilities, and cooperation with sewer administrators on flood management planning and implementation steps such as operators at pumping stations Fan (2020).

### **2.3 Flood Management in Indonesia**

Like Japan, Indonesia also often experiences floods and causes disasters that can cost lives and loss of property. Indonesia has high rainfall, which ranges from 2000-3000 mm/year, so flooding easily happens during the rainy season, which occurs between October and January. There are 600 large rivers scattered throughout Indonesia that are in poor condition and not managed properly, causing flooding. Floods are also experienced by certain areas in Indonesia caused by rising tides from sea level known as coastal flooding or tidal flooding, this is mainly caused by climate change due to global warming. Coastal flooding (rob) is a major problem in cities such as Semarang, Jakarta and cities on the north coast of Java, and will become a major problem in the future along with global warming and uncontrolled extraction of groundwater which results in land subsidence (land subsidence) Findayani (2015)

Indonesia carries out river management to reduce the impact, known as Water Resources Management and flooding cannot be limited by administrative areas, but natural resource management is limited by River Areas (RA). River area is determined by KEPPRES No. 12 of 2012 concerning the Determination of the River Areas. Based on data released by BNPB that the entire territory of the Unitary State of the Republic of Indonesia consists of: 5 RA across countries, 29 RA across provinces, 29 national strategic RA, 53 RA across regencies/cities, 15 regency/city RA. Floods can be caused by static natural conditions such as geography, topography, and river channel geometry. Dynamic natural events such as high rainfall, damming from the sea/tides on the main river, subsidence and siltation due to sedimentation, as well as dynamic human activities such as inappropriate use of land in floodplains, namely by establishing settlements on the river banks, lack of flood control infrastructure, land subsidence and sea level rise due to global warming BNPB (2016).

### **2.4 Community Resilience and Sustainable Development**

Community resilience to various disasters can be seen from various indicators as follows: (a) The ability of the community to reduce the impact on risk/damage through mitigation or adaptation; (b) the ability to maintain function and be able to recover after a disaster event. This includes the resilience that is created because of the community's capacity and character that supports the resilience of the community Twigg (2007). With another understanding that community resilience to disasters is the ability to manage disasters, through adaptation and mitigation processes and maintain basic functions in society which are the starting point in determining a sustainable life, as well as the ability to recover to its original state Sofhani (2016)

Strengthening community resilience in dealing with disasters, several important points have been made in disaster management based on Law Number 24 of 2007 including: a. Provide protection for individuals/communities from the threat of disaster, b. Adjusting the existing laws and regulations, c. Guarantee the implementation of disaster management in a planned, integrated, coordinated, and comprehensive manner, d. Respect local culture, e. Building public participation and private sector partnerships, f. Strengthening the spirit of mutual cooperation, togetherness, and generosity to create peace in society, nation and state.

Sustainable development according to Pertiwi (2017) defined as ensuring dignified living conditions related to human rights by creating and maintaining a wide range or alternative access in planning a lifestyle. The principle of justice between present and future generations must be taken into account in the use of environmental, economic and social resources. Comprehensive safeguards on biodiversity and genetic diversity should also be considered. In principle, sustainable development is a process of continuous change in it, various activities such as resource exploitation, investment direction, technological development orientation, and institutional change are on a path that is in line with increasing present and future potential in fulfilling human needs and aspirations. So the goals of economic and social development as well as resilience in the face of disasters must be pursued with sustainability.

## **III. RESEARCH METHODOLOGY**

The research method used in this research is qualitative. Qualitative research begins with assumptions and interpretational/theoretical frameworks that shape or influence the study of research problems related to the meaning influenced by individuals or groups on a related problem. In this study, the design used was

descriptive-analytical. Researchers emphasize notes with detailed, complete, and in-depth sentence descriptions that describe the actual situation to support the presentation of data Creswell (2014). 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 study describes the data submitted by the subject from the parties related to the research topic. In determining the research subject using purposive sampling, meaning that the informant mastered the topics related to the research to be discussed. The informant in this study was Miho Ohara, a senior researcher from the International Center for Water Hazard and Risk Management (ICHARM) Public Works Research Institute (PWRI) Japan.

Data collection was carried out in this study using Focus group Discussion (FGD) techniques, observation, and document review. The data in this study were sourced from primary data and secondary data. The primary data in this study were obtained through FGD using virtual zoom meetings and observation. The secondary data of this study were obtained through previous relevant literature studies, photos, documents, and data from the internet. This study uses data analysis techniques with interactive models. This analysis technique is carried out continuously during data collection in the field until the data obtained are saturated. The interactive model data analysis technique consists of data collection, condensation, presentation, and conclusions Miles (2014)

## **IV. RESULTS AND DISCUSSION**

### **4.1 Disaster management**

Based on the Law of the Republic of Indonesia Number 24 of 2007 concerning Disaster Management, there are several changes in the perspective of disaster management, namely: (1) From being responsive to risk reduction and preparedness; (2) Disaster risk reduction and its integration into regional or national development programs; (3) It is sufficient for the government and regional governments to allocate budget for disaster management in the APBN and APBD; (4) a strong legal basis for disaster management institutions; (5) Guarantee the fulfillment of the rights of community members affected by disasters and refugees fairly and in accordance with the minimum service standards Sumantri (2021).

The concept of disaster management in Law of the Republic of Indonesia Number 24 of 2007 is a shared responsibility between the central government and local governments as well as relevant stakeholders including the community (NGOs), universities, media and the private sector which includes: stages of disaster management implementation, disaster management objectives, and stages of activities consisting of planning and funding as well as the role of disaster agencies that are given the authority to carry out the functions of coordination, command, and implementation.

Some of the efforts made in disaster management as a whole are: a. Prevention against the emergence of the impact is the main action. In order to prevent flooding, efforts are needed to encourage community businesses to build infiltration wells, and vice versa to prevent deforestation; b. Mitigation is an effort to minimize the impact that occurs when a disaster does occur; c. Preparedness, namely carrying out activities to anticipate disasters through organizing appropriate steps, effective and alert, for example, preparing communication facilities, command posts and preparing evacuation locations. In this preparedness effort, the early warning system is also strengthened, namely an effort to provide warning signs that a disaster may soon occur; d. Emergency response is an effort that is carried out immediately at the time of a disaster to overcome the impact and reduce the bigger impact, especially in the form of saving victims and property; e. Recovery is an effort so that the impact is not prolonged on environmental conditions and communities affected by the disaster by re-functioning infrastructure and facilities in their original state. Paripurno (2014).

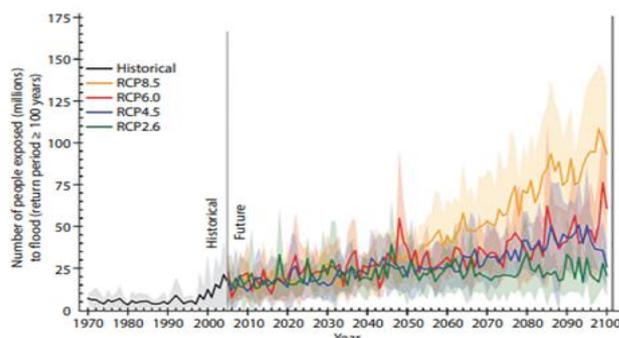
### **4.2 Causes of flooding**

Several factors are important causes of flooding, some of these factors are related to climate such as high rainfall, storms or snow that suddenly melts. Human-influenced factors contributing to flood risk include urbanization and the lack of water storage reservoirs, dams or embankments. Increased urbanization leads to the addition of impermeable surfaces to the ground which alters natural drainage systems making areas more prone

to flooding. Urbanization also leads to the construction of more houses on the floodplain. Poorly maintained urban infrastructure also increases the risk of flooding. However, most of the risks associated with flooding are related to dramatic climate change which is one of the main factors causing flooding, along with other natural disasters such as drought, heat waves, and forest fires Munawar (2020).

Flood disasters have various risks that have a wide impact, these floods can cause damage either directly or indirectly. Widespread flood disasters will cause distress to affected individuals or communities with different levels of damage according to the magnitude of the effects. The damage that occurs can be classified as direct or indirect effects. Flood disasters will be able to cause disadvantages for people, companies, the economy, industry, and government. Direct losses include loss of life, injuries, destruction of infrastructure, vehicles, and damage to plants and animals. Indirect damage refers to social disruption, psychological trauma, and disrupted patterns of production and consumption of goods.

Hirabayashi (2013) associates flood risk with various climate change factors, which are expected to occur until the end of the 21st century. The predictive analysis carried out confirms the possibility of a dramatic increase in flood events globally. The risk of flooding is estimated to double or even exceed the limit until the end of the 21st century with a large and dramatic level of destruction as shown in Figure 2 by following the Representative Concentration Pathway (RCP) 8.5, which refers to the Global Climate Model (GCM) Scenario or scenario of very high greenhouse gas emissions without any policies or interventions to mitigate the impacts of climate change as shown in yellow Kang (2021).

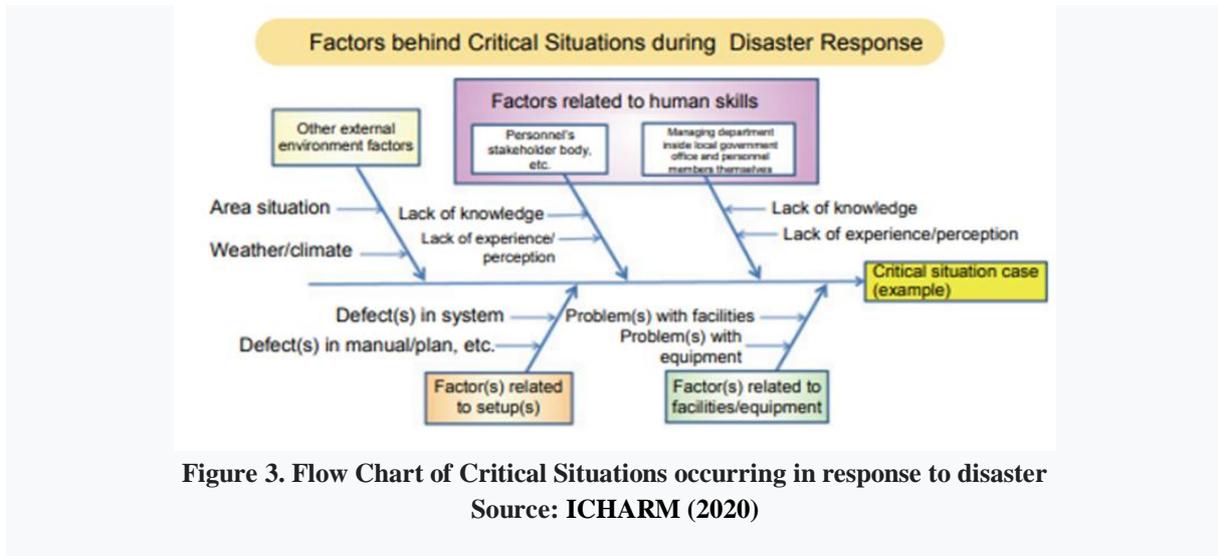


**Figure 2. Number of Communities Affected by Floods Based on the Global Climate Model (GCM) Scenario.**

**Source: Hafiz Suliman Munawar (2020)**

#### 4.3 Flood Disaster Management in Japan

There are several things that must be considered in order to carry out flood disaster management smoothly. These include local government has to learn from past disasters and oblige to develop the capacity of their members to accurately predict the kinds of difficulties that may occur in order to take advantage of future disasters. In places where disasters are common, the local government has to collect critical situations from areas with a high probability of disaster occurrences, paying close attention to protect/prevent their reoccurrence. A critical situation is defined as a situation where local government officials do not know what to do, and it is difficult to make decisions, confused, panicked, and there are doubts/worries to determine what action to take. Disaster management by the local government has been assigned to continue the action against the disaster that occurs even if the situation leads to a critical situation. It is necessary to understand the background of the actual critical situation in disaster response including many factors, such as human skills, facilities and procedures, all of which must be handled in a step-by-step approach in advance to prevent the recurrence of similar incidents. If such a critical situation can be predicted in advance by the disaster management department, there will be hope that the necessary follow-up measures can be implemented and the capabilities of personnel members enhanced for a smooth disaster response ICHARM (2020).



**Figure 3. Flow Chart of Critical Situations occurring in response to disaster**  
 Source: ICHARM (2020)

Several crisis situations that have become a concern in this study during flood disaster management together with the covid-19 pandemic include; The first is about the disaster control headquarters, which is set up in the city hall or public hall which creates 3CS conditions (*Closed Space, Crowded Space, and Close-contact settings*) or closed spaces, crowding places and the risk of close contact, which are conditions that have a high risk of being infected with COVID-19. In the disaster control headquarters conducting emergency response to protect the officers in charge of operations, it is very important to ensure a large, well-ventilated space, and prepare telephone or internet facilities at the head office in advance, which is recommended to reduce face-to-face communication between workers in headquarters and other organizations Ohara, M (2022).

The second concerns increasing contacts with outsiders, such as liaison officers from external government agencies at disaster management headquarters. During a disaster response, usually many people from outside make visits to the disaster management headquarters, but in the midst of the COVID-19 pandemic, this can increase the risk of infection at the response headquarters. One example is the case when the flood disaster in Japan occurred in one of the municipalities in the disaster-affected area, a mass media crew exposed to COVID-19 visited the disaster management headquarters as a result the disaster management headquarters needed to be disinfected. Thus, it is crucial to create a separate room for outside personnel which reduces contact with head office personnel. It is also recommended to ensure a long-distance communication environment in advance, to reduce as much as possible the frequency of direct contact with personnel from outside organizations.

The third is residents who are hesitant to be evacuated because they are worried about the conditions of closed spaces, crowded places and the risk of close contacts who are at high risk of getting infected by COVID-19. Delays in evacuation can lead to an increase in human deaths due to flooding. To reduce anxiety among evacuated communities, increasing the number of shelters is an effective measure. During a pandemic, evacuation sites or places are provided to reduce congestion in designated shelters, so that evacuated people can maintain a safe distance of 1 to 2 meters from others.

Fourth is the number of refugees in the refugee camps. Evacuation sites can easily create conditions of confined spaces, crowds and risk of close contact. Apart from adding alternative facilities for evacuation, in such situations, it is done by dividing the space with a partition and also by separating the refugees into different rooms for different purposes. If the common hall is being used as an emergency evacuation area or shelter, check to see if it is possible to divide the space with a partition or similar. When receiving a suspected case, elderly people, pregnant women or people who require special treatment, provide a separate room in the shelter if possible. During the disaster due to heavy rains in Japan the affected cities installed partitions to divide the space in evacuation shelters, to maintain a safe distance between refugees, according to the manual directive from the central government.

Fifth is the lack of medical supplies and infection prevention items in the shelters. Please check the stock of infection prevention items, such as masks, tissues, hand sanitizers and thermometers. During a disaster due to heavy rains, there will be a shortage of infection prevention items in many shelters, leading to a lack of disinfection among the refugees.

Sixth is the shortage of personnel in the shelters so more officers are needed at the shelter and must ask for help from outside parties with attention to infection prevention. During the disaster caused by heavy rains in Japan, relief staff was sent from other areas to help with the management of evacuation shelters. However, it turned out that the staff was infected with COVID-19, as a result, a total of 383 refugees, including staff, and the city task force team, were tested by PCR and the results were confirmed negative. After the incident, the dispatch of relief staff from remote urban areas was carried out with extreme caution. And the next critical situation is regarding the risk of infection during cooking and food storage. Cooking and providing proper food in shelters can be a source of high-risk COVID-19 infection.

The latest data regarding flooding in one area in Japan with heavy rainfall from July 3 to July 31, 2020 has caused extensive inundation due to the collapse of the embankment along the Kuma River in Kumamoto prefecture, on the island of Kyushu where 84 people died, 6,599 houses were damaged and this event occurred at the beginning of the second wave of the COVID-19 pandemic. Another problem during the disaster due to heavy rains in Japan was a critical situation in one of the cities in the affected area, an officer handling refugees infected with COVID-19 was at the city hall, so the city hall had to be closed for several days to disinfect the city hall rooms. Services at the city hall were also stopped during this disinfection. A critical situation like this could occur in Indonesia amid the COVID-19 pandemic, so disaster management that takes into account the existing critical situation is needed.

#### **4.4 Response of the Government and Society during a disaster**

In disaster management, the government must involve the community and strengthen community resilience so they can continue development in the midst of an ongoing disaster. Learning from the flood disaster management in Japan, there are eight parts that are of concern along with the actions that must be taken in disaster management so that it is expected to reduce losses that may occur including:

In the initial response:

- a. Install equipment such as emergency power boosters and internet servers as high as possible from the ground.
- b. Create a structure to enable the dispatch of personnel to the disaster site, and while making use of experienced retired disaster officers.
- c. The disaster control headquarters must be established immediately according to the criteria, and the head of the headquarters must declare that the city is in a state of emergency.
- d. Assembly rules and various forms of communication need to be implemented comprehensively to allow for meetings in the evenings and holidays

Management at the headquarters

- a. Ensure that the local community under normal conditions has a sufficiently independent office from the outside available as a disaster control headquarters.
- b. Create a “disaster response manual” that explains in detail “when and what” each person should do.
- c. The first thing to do is to create a system to handle a lot of information.
- d. Phone calls are handled by the system for all local governments and internal information must be shared with the public.
- e. Create clear support content and always carry out joint exercises.

Structures in government offices

- a. Establish structures that allow sharing of information in local government offices, such as in-house broadcasting and in-house LANs.

- b. Appropriately allocate work based on workload considering several disaster response scenarios.

#### Information gathering

- a. Don't just rely on one piece of information, collect a variety of information to understand the situation.
- b. Create a structure that allows not only personnel but also environmental leaders, flood mitigation corps and so on to know and share information.

#### Collaborate with existing stakeholders.

- a. Use joint training to determine whether information should be passed on or received.
- b. Each region must strive to firmly obtain information without waiting for it to come from other regions.

#### Discussing the evacuation policy

- a. Referring also to the existing manual, make criteria that officially announce evacuation information.
- b. Evacuation information is very important to make residents aware of the immediate danger, so follow the criteria for announcing an evacuation quickly.
- c. Collaborate with neighboring cities to ensure safe evacuation destinations outside the affected cities.

#### Disseminate information

- a. Uses multiple methods to transmit information. Citizens should also make an effort to go and gather information
- b. Communicate danger threats with sirens or similar alarms to encourage people to seek details.
- c. Awareness of the community as a whole at the level 3 alert announcement stage in preparation for evacuation/starting the evacuation of the elderly, children and vulnerable pregnant women.
- d. Hold regular press releases, and do not allow individual interviews.

#### Shelters (marking shelters and emergency evacuations)

- a. Check flood and landslide prediction results, and determine shelters.
- b. Allowing local residents to have the authority to open designated shelters and emergency evacuations.
- c. Make people aware that they have no choice but to take shelter on the top floor (vertical evacuation) or in an area higher than the puddle.
- d. Ensure that shelters (prepared emergency evacuation sites) have the equipment (TV, government emergency radio) to obtain sufficient information.

## V. CONCLUSION

There are similarities in the geographical location of Indonesia with Japan where the geographical location of the Indonesian archipelago is located between the continents of Asia and the continent of Australia, as well as between the Indian Ocean and the Pacific Ocean so the disaster that occurred in Japan also occurred in Indonesia. Therefore, Indonesia has to learn from Japan in disaster management, especially flood disaster management, particularly in the COVID-19 pandemic situation where Japan has successfully carried out disaster management. The data shows that in recent years the number of disasters caused by water has increased significantly, which can be seen in Figure 1 and on the other hand, disasters caused by land disasters such as earthquakes are almost unchanged, but the number of occurrences of hydrological disasters (floods), meteorological disasters (cyclon), climatological disasters (drought) have more than tripled since 1980.

Several factors causing flooding are influenced by humans, especially urbanization and the lack of water storage reservoirs, dams or embankments. Increased urbanization leads to the addition of impermeable surfaces to the ground which alters natural drainage systems making areas more prone to flooding. Urbanization also leads to the construction of more houses on the floodplain. Poorly maintained urban infrastructure also increases the risk of flooding. However, most of the risks associated with flooding are related to dramatic

climate change which is one of the main factors causing flooding, along with other natural disasters such as droughts, heat waves and forest fires.

Several crisis situations that have become a concern in flood disaster management along with the COVID-19 pandemic include paying attention to 3 CS (Closed Space, Crowded Space, and Close-contact settings) or closed spaces, people gathering places and the risk of close contact. Involving the community in disaster management is the best option by providing disaster management training and providing appropriate information when a threat occurs so that losses can be reduced and sustainable development can still be implemented.

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