The impact analysis of flood disaster in DKI jakarta: prevention and control perspective

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Abstract. Flooding in Jakarta is a frequent disaster. Of the 2,572 disaster events in Indonesia throughout 2018, floods and cyclones dominated more than half of the events, which made it the most frequent disaster throughout the year. This caused by various factors such as climate change, land subsidence, sea level rise and socio-economic growth. The high population in Jakarta, which reached 10.4 million due to the flow of urbanization in the past 30 years, has also added to the level of vulnerability to disaster risk. Based on secondary data that been studied from the results of previous studies, Jakarta has annual flood patterns and larger 5-year floods such as in 1996, 2002 and 2007. According to the risk assessment of flood exposure published by DKI Jakarta National Disaster Management Agency (BNPB) 10.177.570 people are potentially exposed to disasters. Physical losses reached Rp 2,967,433 million, and economic losses reached Rp 12,732 million. This is certainly needed to handle mitigation with well-organized disaster management. For this reason, government intervention is needed to integrate the stakeholders who will contribute. The concept of flood disaster management that is integrated with the role of government in it is expected to be a solution to overcome the problem of flooding that occurs in Jakarta this day, besides that, community participation is also very much needed.

1. Introduction

Flooding is one of the most dangerous disasters [1][2]. According to the records of National Disaster Management Authority (BNPB) in 2018 there were 679 flood events from 2574 disasters that occurred in Indonesia. Whereas at the beginning of 2019, of the 83 incidents, 82 people died. Peculiarly for the DKI Jakarta area, flooding is the most frequent disaster every year in the last 10 years (dibi.bnpb.go.id). The Indonesian government has made a policy regarding the handling of disasters as outlined in UU No. 24 of 2007 concerning Disaster Management. Exposure to potential floods will be experienced by urban areas such as DKI Jakarta, this is caused by factors of climate change, land subsidence and socio-economic changes. The population of Jakarta which reaches 10.4 million people also makes this city vulnerable when natural disasters occur [3]. Climate change is projected to cause rising water levels and rivers and result in increased rainfall in some regions. In addition, one of the causes of flooding in Jakarta is that there are still many drainage channels (PHB) in Jakarta that are not functioning properly.

Basically the handling of floods has been carried out since a long time ago, but it's just focused on engineering technology such as the making of embankments. But now there is a transition where flood handling methods are shifting towards a more adaptive and integrated system in managing flood risk management. In this case, flood risk is defined as the probability of flooding multiplied by potential...
consequences, such as loss of life and economic damage [4][5]. For this reason the government plays an important role in this matter. The government has access to integration between agencies that play a role in dealing with flooding issues, making regulatory arrangements, and regulating development planning and spatial planning that are oriented towards preventing floods in the future.

The administrative area of DKI Jakarta is located at 6 ° 12′S and 106 ° 48′E in the Northwestern of Java Island, Indonesia. The city of Jakarta has the characteristics of hot climates with maximum air temperatures during the daytime 32.7 °C - 34 °C and the minimum temperature of air at night 23.8 °C - 25.4 °C. In addition, Jakarta has year-round rainfall with an average of 237.96 mm. The data was taken from 2002 to 2006. In that time the highest rainfall occurred in 2005 of 267.4mm, and the lowest rainfall occurred in 2002 was 122 , 0mm (jakarta.go.id)

Based on data from National Disaster Management Authority (BNPB), the incidence of floods is still the dominant type of disaster and often occurs in DKI Jakarta. Reported from Jakarta government open source data, DKI Jakarta has 124 urban areas that are prone to flooding due to rivers, and 82 urban areas are prone to flooding.
2. Materials and Methods
The method used in this research is data elaboration from various primary sources. Data elaboration is a series of activities related to the method of collecting library data, reading, and recording and processing literature references only without the need for field study. The reference contains flood-prone areas, data on flood events in DKI Jakarta, forms of handling that have been carried out. Data used in this study were from National Disaster Management Authority (BNPB) and Meteorological, Climatological, and Geophysical (BMKG) in Indonesia, and DKI Jakarta open source data. Several literature studies were used to analyse the form of prevention and the perspective of the DKI Jakarta government's control of flood events.

3. Result and Discussion
The cause of flooding
The causes of flooding can be divided into two, namely natural causes and causes due to human activities. Natural factors that cause flooding include high rainfall, physiography, erosion and sedimentation, river capacity, rising sea water and drainage lines. Factors that cause flooding due to human activities include changes in watershed function (DAS), increasing settlements and changes in land use functions, damage to drainage, damage to forests due to uncontrolled logging, damage to flood control buildings and improper flood control systems [6].

Indonesia, which is a tropical country, only has two seasons, namely rain and dry season, which results in high rainfall in Indonesia. According to observations from Meteorological, Climatological, and Geophysical (BMKG) the trend of rainfall in Indonesia 1981 – 2016 is mostly positive. In addition, the problem that is currently being sought for a solution is land subsidence. According to observations of land surface in Jakarta, it has decreased 3 - 10 cm / year. This is certainly very crucial, land subsidence can result in damage to the drainage function, besides that, it can expand the area affected by the flood tide [7]. Land subsidence predicted can expand the flood coverage area to 88% [8]. Estimates from 2000 - 2050 are expected to expand the potential flood area due to land subsidence and sea level rise will expand to 110.5 km².

Areas of potential flooding
Floods have hit the Jakarta area since colonial times, based on historical records that the Dutch colonial government had been troubled from the start with floods and water management in Jakarta. After two years Batavia was built complete with its canal system, in 1621 the city experienced flooding. This is the first record in the history of the Dutch East Indies, where the main VOC defence post in East Asia was hit by a massive flood. In addition, small floods occur almost every year on the outskirts of the city, when the Batavia region extends to Glodok, Pejambon, Kali Besar, Gunung Sahari, and Tambora Village. It was noted that during the colonial period several major floods occurred, including in 1699 from the Ciliwung river, 1854 caused by a Ciliwung rampage, and then it...
happened in 1918. In Additional, recorded major floods occurred, among others, in 1654, 1872, and 1909 [9][10][11].

Regional Disaster Management Agency (BPBD) released a map of the distribution of potential areas and flood-prone areas in the following DKI Jakarta area:

Areas with increasingly red colour gradations show areas with the highest potential and vulnerability to flood disasters. In addition there is a flood risk assessment matrix data for each district /city published by BNPB below:

| Province/District/City | Social (inhabitant) | Physical (Rp. million) | Economy (Rp. Million) | Environment (ha) |
|------------------------|---------------------|------------------------|-----------------------|------------------|
| DKI Jakarta            | 3,709,327 5,613,446 695,127 | 2,967.433 | 8,560 | 4,172 |
| North Jakarta          | 110,278 1,381,978 239,029 | 983,173 | 7,271 | 3,497 |
| Central Jakarta        | 234,114 536,193 115,256 | 537,473 | - | - |
| South Jakarta          | 1,610,152 470,467 39,998 | 183,152 | - | - |
| East Jakarta           | 1,289,078 1,380,725 154,420 | 734,004 | 1,258 | 614 |
| West Jakarta           | 465,705 1,844,083 146,424 | 549,631 | 31 | 61 |

**Flood Prevention and Control**

Prevention and control of flooding is something complex because it involves various aspects which each influence each other such as social, economic, environmental, legal, institutional or other aspects. In addition, studies need to be carried out from various dimensions of the scientific discipline to engineering flood control techniques. Various disciplines need to be involved in it such as river engineering, morphology and sedimentation, hydrology, hydraulics, watershed, urban drainage systems and water buildings, engineering flood control systems, environment [13]. Philosophically, flood control is done in three steps:

1. Moves flooding from residents
2. Move the population from the flood location

3. Live harmony with floods

That philosophical approach was later revealed to be a normative approach. Then it is lowered again in structural and non-structural methods so that it can be implemented in the field. The method is depicted in figure 5. To assess flood risk reduction is done by identifying relationships based on stage-damage relationships, stage-discharge relationships and flood-flow frequency relationships. So that the relationship of the effects of flood control to risk reduction can be obtained [13][14].

![Figure 4. Flood control with structural and nonstructural methods](image)

4. Conclusion

The flood control system must pay attention to the impact of reducing the risk that will be caused. In addition, handling floods is not easy because it involves various kinds of disciplines that will complement each other. In this case the government is the key to the success of flood snacks because it has authority in policy making and can embrace various stakeholders who are expected to create synergy, so that the strategy for handling floods can be carried out optimally. Various types of businesses, both technically and non-technically, need to be sought from engineering to the formation of personalities who care about environmental conditions. So that it is expected to be able to increase the synergy in mitigating flood handling in Jakarta which until now is still being improved.

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