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# Use of management frameworks and risk assessment for flood handling in some countries: A meta-analysis

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**Abstract.** Flood is one of the natural disasters that occur in Indonesia and cause many losses. Although this disaster is considered frequent and threaten human life, the countermeasures and prevention are still not optimal. So that when the flood hit, there were still many people who suffered both physical losses and physical damage. Efforts to handle this flood need to be done through proper and appropriate management and action. Therefore, we need a proper flood risk management and also the cost of flood risk. Through review articles from several countries, information on risk and management frameworks for flood mitigation will be obtained that can be used in flood journals in Indonesia. The method used is meta-analysis, by analyzing data from 12 journal articles from several countries, both developed and developing countries in 2010-2020. The criteria for the country taken as the research sample is having an event that occurs floods in Indonesia

**Keywords:** Flood Management, Management Framework, Risk Assessment.

## 1. Introduction

Many countries have conducted research related to management frameworks and risk assessment. However, there are no articles in Indonesia that review and combine various kinds of frame work and risk assessments from several countries into new products that are effective as flood prevention and mitigation in Indonesia. This review article is needed to obtain information regarding the framework and risk assessment that is commonly used in various countries in terms of flood management.

The danger of flooding is increasing due to climate change, urban planning that does not pay attention to the flow of water distribution and human actions that lead to silting of rivers or clogging of water flows with improper disposal of waste and garbage. In fact, of all the natural risks, flooding is the natural risk that occurs most frequently today. Risk management is a fundamental activity aimed at evaluating schemes in reducing risk but not at eliminating all risks, because risks in some cases it is unlikely that it will remain. The “water problem” is also related to “people problem”. Flood Risk Management requires a scientific and holistic approach to address the engineering issues of rainfall, rainwater, rivers, flood inundation and problems related to planning management and infrastructure development. Risk Management for natural disasters floods is one technique that has been present and is the most significant challenge for communities around the world [1].

Natural disasters are a very serious threat to human life, which causes physical and social losses that extend beyond the control of the community due to limited resources. Floods have a dangerous effect on life. There are three types of flood hazards, namely primary hazards, this can occur when objects come into direct contact with water. Secondary hazards due to flooding include disruption of services,



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physical health problems, psychology, and hunger. Tertiary hazard effects can include shifting of river flow locations. at the end of this century the phenomenon of flooding can be said to be a dangerous and destructive disaster both in the field of infrastructure and casualties [2]. There are three important components in flood risk management, namely determining risk from hazards, vulnerability and exposure from flooding [3].

Flood risk in the hazard literature can be interpreted in several ways. Flood hazard is a natural phenomenon that can threaten and are likely to occur. Exposure, is the value/people involved and how much damage occurs at the site. Vulnerability, is a lack of resistance to destructive power. The hazard and vulnerability components will collaborate with each other to produce disasters [3]. Flood risk can be calculated as an impact resulting from the hazard, exposure and vulnerability. Through this approach, a GIS database can be designed and developed to describe the spatial aspects of the three risks. Flood risk management has the aim of reducing the likelihood that the impact of flooding is in the form of economic and social impacts. It aims to reduce the likelihood of the impact of flooding, both social and economic impacts. Flood risk evaluation widely used as economic exposure to physical assets and Gross Domestic Product (GDP) in relation to losses experienced directly or indirectly [4].

Experience shows that combining flood risk management programs is the most effective approach. The combination of these elements is; (1) prevent damage caused by flood disasters by suppressing the current and future construction of residential houses and industrial buildings in locations that have the potential for flooding. Through adjustments in future development efforts for the risk of flooding and by campaigning for appropriate land use in agriculture and forestry. (2) Protection, through the creation and implementation of measures at structural and non-structural levels to minimize the impact of flooding in locations that have the potential for flooding. (3) Preparation, providing information to the public regarding flood risks and flood mitigation measures. (4) Emergency response, develop emergency response plans related to flood problems. (5) Recovering and taking lessons from an incident, rising immediately to normal conditions and taking care of victims affected by disasters both social and economic impacts.

Mapping of risk areas is the main basis for all programs in minimizing flood damage as well as the follow-up that is carried out. Maps often have legal connotations that include zoning and structural and non-structural measures; therefore, maps must be accurate and credible [1]. One of the key outputs of the flood risk management plan is the creation of flood risk maps in the watershed. The purpose of the map is to open up insights so as to increase public awareness of flood risk areas. In addition, providing knowledge related to flood risk areas by zoning flood risks, as input for spatial policy makers, and supporting the process of targeting investment.

## 2. Method

The method used in this research is the literature review. The research design is a meta-analysis. The data collection technique is using documentation of several articles in the form of international journals. Like research conducted by [18]. The articles used as a literature review is time-limited from 2010-2020 so that it is not too past and still has similarities to the current condition.

The population used is all articles about the use of management frameworks and risk assessments for handling floods in various countries. Of the 15 articles that have been obtained, we have reviewed them so that only 12 articles can be made as samples. Samples were chosen because they have the same factors causing flooding in Indonesia.

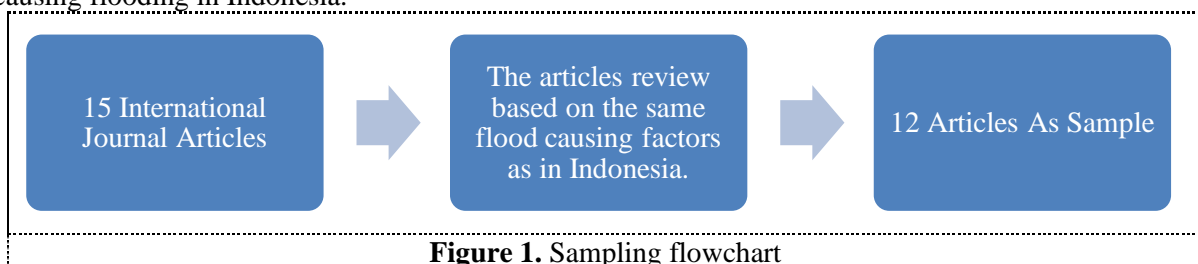


Figure 1. Sampling flowchart

### 3. Results and Discussion

The articles taken as research samples are documentation of international journal articles in English. The journals obtained were then translated into Indonesian. The related journals are [4-16]. The characteristics of the article can be seen in the following Table 1.

**Table 1.** Characteristics of Research Samples

No	Title	Name	Years	Journal/ Prosiding
1	Assessment of Flood Risk Exposure for the Foshan-Zhongshan Region in Guangdong Province, China	Q. Zhang, W. Jian, and E. Y. M. Lo	2020	<i>Water</i> , 2020.
2	Flood risk analysis: causes and landscape-based mitigation strategies in Dire Dawa city, Ethiopia	S. H. Erena and H. Worku	2018	<i>Geoenvironmental Disasters</i> , vol. 5, no. 1, pp. 1–19, 2018.
3	Flood risk assessment of major river basins in the philippines	C. D. Q. Alfonso, M. B. Sundo, R. G. Zafra, P. P. Velasco, J. J. C. Aguirre, and M. S. Madlangbayan	2019	<i>Int. J. GEOMATE</i> , vol. 17, no. 64, pp. 201–208, 2019
4	An Assesment of causes and effects of flood in Nigeria	Nwigwe C and T. Emberga	2018.	<i>Geoenvironmental Disasters</i> , vol. 5, no. 1, pp. 1–19, 2018.
5	Floods in Malaysia: Historical Reviews, Causes, Effects and Mtigations Approach	S. G. Diya, M. B. Gasim, M. E. Toriman, and M. G. Abdullahi	2014	<i>Int. J. Interdiscip. Res. Innov.</i> , vol. 2, no. 4, pp. 59–65, 2014.
6	Flood risk assessment and management: Review of concepts, definitions and methods	L. Solín and P. Skubinčan	2013	<i>Geogr. Cas.</i> , vol. 65, no. 1, pp. 23–44, 2013.
7	Probability assessment of flood and sediment disasters in Japan using the total runoff-integrating pathways model	G. Mouri <i>et al</i>	2013	<i>Int. J. Disaster Risk Reduct.</i> , vol. 3, no. 1, pp. 31–43, 2013.
8	Ecosystem Approach To Flood Disaster Risk Reduction	R. Kamble, A. Walia, and M. Thakare	2013	<i>Int. J. Environ.</i> , vol. 2, no. 1, pp. 70–82, 2013.
9	Assessment of Japanese and Chinese flood control policies	P. Luo, Y. Yamashiki, K. Takara, D. Nover, and B. He	2010	<i>Annu. Disaster</i> , pp. 61–70, 2010.
10	Methodology for future flood assessment in terms of economic damage: Development and application for a case study in Nepal,	M. Delalay, A. D. Ziegler, M. S. Shrestha, and V. Gopal	2020	<i>J. Flood Risk Manag.</i> , vol. 13, no. 3, pp. 1–14, 2020
11	Comparison of two flood risk assessment methods in the case of the Turiec River, Slovakia	S. Ruman	2014	<i>Acta Univ. Carolinae, Geogr.</i> , vol. 49, no. 2, pp. 127–134, 2014.

No	Title	Name	Years	Journal/ Prosiding
12	A quantitative flood risk analysis methodology for urban areas with integration of social research data	I. Escuder-Bueno, J. T. Castillo-Rodriguez, S. Zechner, C. Jöbstl, S. Perales-Momparler, and G. Petaccia	2012	<i>Nat. Hazards Earth Syst. Sci.</i> , vol. 12, no. 9, pp. 2843–2863, 2012.

### 3.1 Meta-analysis research methods

The research method used is descriptive and qualitative descriptive. Descriptive research method is more widely used because it relates to existing themes, namely the use of management frameworks and risk assessments for flood management in various countries. So, more use descriptive research methods to find out how the causes, effects and mitigation of flood disasters in various countries. detailed description can be seen in the Table 2.

**Table 2.** Research Methods

Number	Research methods	Frekuensi	Percentage
1	Quantitative descriptive	4	33,3%
2	Descriptive	8	66,6%
3	Quantitative	0	0%
	Total	12	100%

### 3.2 Meta data collection analysis

In general, data collection techniques use primary and secondary data. Secondary data was chosen because it has accurate accuracy and can be obtained relatively quickly. Primary data is chosen because the capability of the data can be obtained as desired by the researcher so that it is suitable for the purpose of his research, but to obtain the data, a longer time is used as well as greater costs and energy. detailed description can be seen in the table 3.

**Table 3.** Data collection techniques

Number	Research Methods	Frequency	Percentage
1	Primary and Secondary Data	4	33,3%
2	Primary data	0	66,6%
3	Secondary Data	8	0%
	Total	12	100%

### 3.3 Meta-analysis based on mitigation

The form of analysis based on flood mitigation carried out in several countries can be seen in Table 4 below.

**Table 4.** Forms of flood mitigation in several countries

Number	Country	Flood mitigation
1	Ethiopia	Landscape-based flood mitigation strategies
2	Filipina	QGIS to analyze the 2020 and 2050 A1B1 inundation maps Flood Mitigation
3	Malaysia	Best mitigation by going away from lowland areas and respond quickly
4	Nigeria	Mitigation of unstable development
5	Japan	Total Runoff-Integrating Pathways Model
6	China	Flood control is achieved primarily through the construction of dams, embankments and other structures

Number	Country	Flood mitigation
7	Nepal	(a) Working with a loss curve over the limit; (b) make human death a modeled consequence (c) Develop a FRAM for an area that has the same characteristics as the study area of this work.
8	Slovakia	Arc Gis, Method I and Method II
9	Polandia	The deterministic approach used to reduce flood risk

### 3.3.1 Causes of flooding:

Factors of high rainfall, topographical conditions, illegal logging in the riverside and institutional problems. Flood risk was found to be sensitive to variations in the distribution of rainfall every hour and varies in sub-watershed locations. After that, sub-watershed flood susceptibility is classified based on rank based on linear morphometric parameters and shape where higher values of linear values and lower values of shape parameters are associated with high flood risk [5].

In the Philippine region Inundation is analyzed by municipalities. This study provides another example of QGIS's ability to analyze large amounts of information. It was observed that the Agno, Cagayan and Mindanao River Basins had problems with inundation around their main rivers. Riverside municipalities, especially those located at river estuaries, experience the heaviest inundation [6].

In Nigeria, urban functioning continues to increase and so is skilled rural-urban migration. So that this has an impact on urban spatial planning and a reduction in open land. Until now, cities and towns have experienced floods that come and last for weeks [7]

Meanwhile in Malaysia, improper drainage conditions (a major problem of flooding. 33% of the population agree that poor drainage is the cause of flooding. The best way to minimize flood casualties is to evacuate people from flood prone areas to safer zones [8].

Then in Japan, the river route scheme provides a digital river network that includes Japan. Floods are caused by social factors and changing climatic conditions. This factor is the main factor causing flooding in Japan.

Next to China, the Yangtze River, which runs from Yunnan Province to Jiangsu and Shanghai, has experienced a massive increase in water. This contributed to the increasing volume of water rising in the giant Three Gorges reservoir.

Nepal lately, this relationship has deteriorated during the annual rainy season which runs from June to September. The length of the Indian and Nepalese borders is 1,800 km long, and more than 6,000 rivers and tributaries flow into India from Nepal. Nepal also accounts for 70% of the Ganges during the dry season. the plains of Nepal and India. (Alan D. Ziegler Mandira et al., 2020)

### 3.3.2 Some of the consequences caused by flooding

Floods can have serious impacts on human life, both physical and non-physical. The physical impact is in the form of the large number of people who have died, many livestock that have died washed away, damaged settlements so that many people have lost their homes, destroyed infrastructure and social facilities. Post-flood health impacts also hit many people, such as diarrhea, infectious wounds, hypothermia, malaria, and others.

Apart from physical impacts, non-physical impacts are a serious threat to humans. Some of the non-physical impacts that often occur are psychological, social, and economic problems. Psychological problems can occur due to depression due to loss of property, paralyzed business and loss of jobs which then have an impact on social problems in society. Based on this, it is necessary to develop a prevention strategy in the form of flood risk management so that the impact can be minimized.

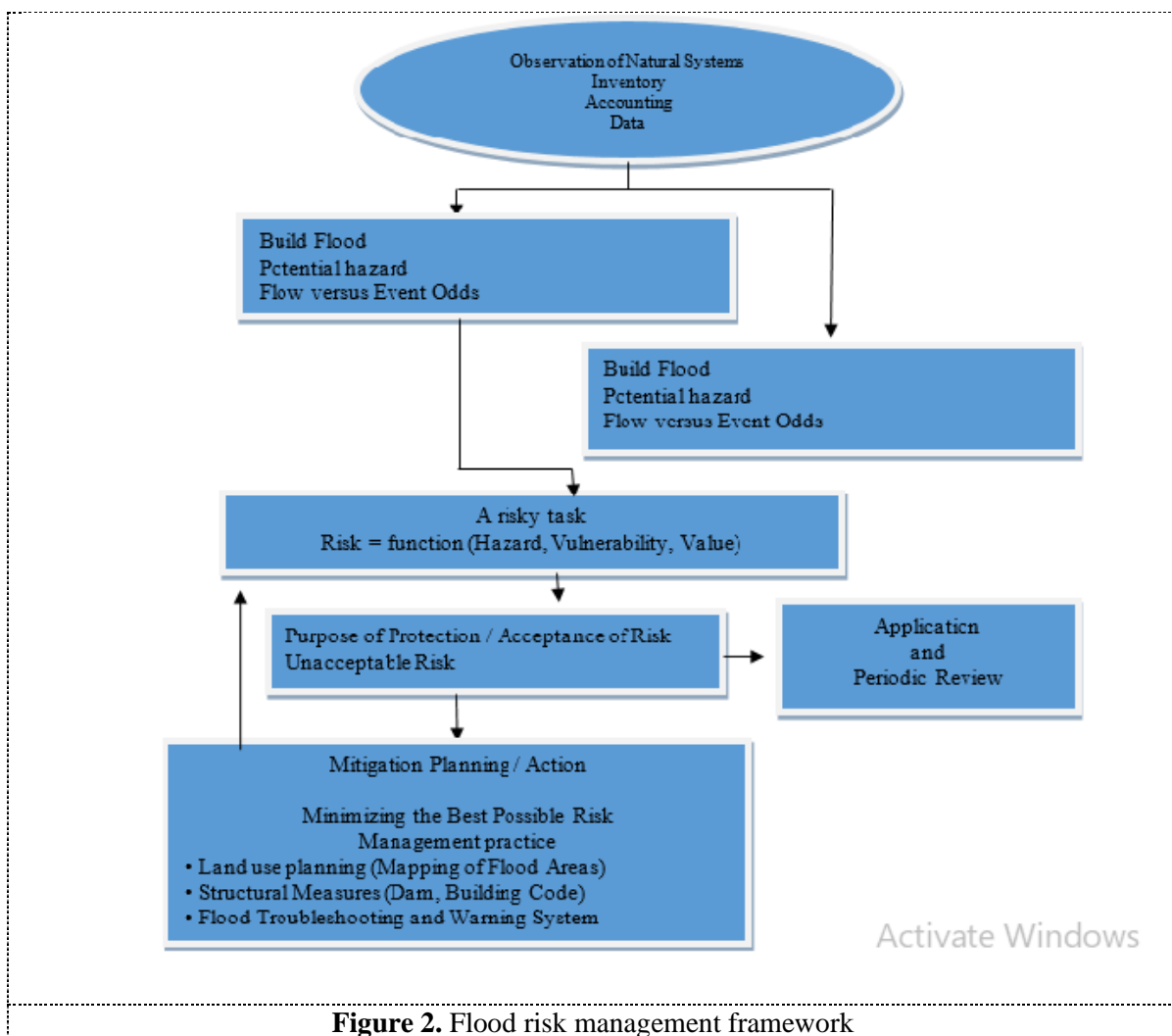
### 3.3.3 Flood risk assessment

Efforts that can be made to prevent and minimize risks are flood disaster mitigation. Flood disaster mitigation is an effort made to prevent or reduce the risk of flood disasters (Government Regulation No. 21 of 2008 on Disaster Management). Flood risk assessment is complex and therefore requires cross-

disciplinary research. Two steps as an approach can be used in conducting a flood risk assessment, namely; (1) important in detecting flood hazards using a set of indicators in the form of spatial distribution of flow velocity, propagation speed, duration, water level. (2) Estimating what flood hazard indicators can disrupt human activities in the flood zone. Areas of agricultural activity will be damaged in a different way from industrial and urban areas. Civil protection aspects also need to be carried out, such as evacuation efforts and the availability of transportation routes in flooded areas

3.3.4 Flood risk management framework

In addition to mapping and assessing flood risk, there is a framework issued by the World Meteorological Organization (WMO) that can be used as a guideline for what should be done in flood risk management activities. The flood risk management framework is shown in Figure 2 below.



3.3.5. Use of framework for flood handling

The full integration of flood risk management with other aspects of water management and spatial planning leads to the integrated concept of flood risk management. The basic characteristics of IFRM are that it strives to reduce the occurrence of flooding, acting on flood likelihood, speed, depth and duration, reducing the harmful consequences of flooding, acting to reduce potential exposure to floods or reduce vulnerability and helping individuals and organizations to act wisely during floods, promote sustainable development to enable future generations to meet their flood risk management needs.

#### 4. Conclusion

Floods are natural disasters that often occur in the world, there are many causes that cause flooding such as improper land cultivation, irresponsible human activities, and natural factors themselves. Floods are the third leading cause of economic loss from all-natural disasters worldwide. Therefore, the assessment and management of flood risk needs to be studied to reduce the negative impact of flooding on humans, the environment, as well as cultural and economic goods and activities. This represents a major paradigm shift in dealing with natural hazards such as floods.

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