



## Original Article

# Gandong River Overflow Flood Disaster Risk Analysis (Case Study: Sukorejo Village, Bojonegoro Subdistrict, Bojonegoro Regency)

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### Abstract:

Bojonegoro Regency is one of the areas in East Java that has lowlands and frequent floods. Recorded in Bojonegoro Regency BPBD data in 2022 there have been 7 flood disasters. The average flood occurs due to the inability of the river to accommodate the increasing volume of water due to high rainfall. So the higher the rainfall, the higher the risk of flooding. In this study, a risk analysis of flood disasters due to river overflows was conducted. The parameters used are threats, vulnerability (physical, economic, social and environmental), and government capacity. The research method used was qualitative. This research was conducted in Sukorejo Village. The results obtained were that the threat of the Gandong River overflow flood in Sukorejo Village was classified as low with a water level of 700 cm, the vulnerability of the Gandong River overflow flood disaster was in the low category, and the capacity of the Gandong River overflow flood disaster was also low, causing a high level of disaster occurrence, and the risk of the Gandong River overflow flood disaster in Sukorejo Village fell into the low category.

**Keywords:** Flood, Rainfall, Risk

### Introduction

Natural disasters often hit all countries, even every year. In Indonesia, natural disasters hit almost all regions ([Sri Wahyuni et al., 2021](#)). According to Law Number 24 of 2007, a disaster is an event that can threaten and disrupt community activities whether caused by natural or artificial causes, which can result in loss of life, damage to life, environmental damage, material and non-material impacts.



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Natural disasters that often occur in the regions are floods, landslides, volcanic eruptions, earthquakes and tsunamis. This is because Indonesia is a country with a ring of fire area. On the other hand, Indonesia is a country with a tropical climate, with rainy and dry seasons. During the rainy season, high rainfall will cause floods ([Sugianto, 2022](#)).

Floods are disasters that occur due to continuous high rainfall that inundates an area or can occur due to overflowing rivers until clogged drainage channels can also cause flooding ([Saifudin et al., 2023](#)). On the other hand, flood disasters can also be caused by an increase in the discharge of water flowing in a river or a body of water that exceeds the capacity that can be accommodated ([Rico Albani et al., 2023](#)). In Indonesia, flood disasters are almost always subscribed to the community, in addition to being supported by climatic and human factors ([Sulaiman et al., 2020](#)). So that flood disasters sometimes cannot be predicted with certainty, but prevention can be done as follows.

**Table 1. Areas Affected by Overflowing Floods in Bojonegoro Sub-district**

<b>Village Name</b>
Sumbang
Pacul
Kauman
Sukorejo
Klangon
Ngrowo
Campurejo

Source: Bojonegoro Regency BPBD Report (2022)

This overflow flood occurred due to the high volume of water and the overflow of the Gandong River. Gandong River is a river in Bojonegoro Regency, located in Sukorejo Village, Bojonegoro District. Gandong River flows through rice fields and the community utilizes the river for agricultural irrigation purposes. However, during the rainy season, the volume of water in the Gandong River will increase, until it flows into community settlements. In this case, the overflow of the Gandong River inundated areas in Sukorejo Village, especially in RT 29, which is inhabited by 60 households. This made it difficult for some people to carry out their daily activities ([BPBD Kab. Bojonegoro., 2022](#)).

Increased rainfall and an erratic climate make flooding difficult to predict. So the need for anticipation in handling floods. Risk is needed to determine the threat of river overflow flooding if it occurs at any time ([Mohammad et al., 2023](#)). Risk is the potential loss due to a disaster that occurs in an area and within a certain period of time so that it can result in death, injury, disease, threat to life, loss of sense of safety, displacement, damage or loss of property, and disruption of community activities ([Mantika et al., 2020](#)). A disaster risk assessment can show the possible negative impacts of a disaster (Maulana et al., 2023). The potential negative impacts that will occur can be calculated based on the capacity of the area and the level of vulnerability. This can be seen from the potential lives affected, material losses and damage to the environment. According to the regulation of the head of BNPB Number 2 of 2012 states that:

$$R = H \times V / C$$

Description:

R= Disaster risk

H= Hazard

V= Vulnerability

C= Capacity

Based on the above formula, it can be seen that disaster risk is the potential loss due to a disaster that occurs in an area and within a certain period of time so that it can result in death, injury, disease, threat to life, loss of sense of safety, displacement, damage or loss of property, and disruption of community activities ([Eldi, 2020](#)). A disaster risk assessment can show the possible negative impacts of a disaster. Meanwhile, hazards are a characteristic of geological, hydrological, biological, climatological, geographical, cultural, political, economic and technological conditions in the region at a certain period of time that can minimize the ability to prevent, reduce, achieve readiness and reduce the ability to respond to adverse effects to clear hazards ([Sutanto & Pranoto, 2020](#)). Vulnerability is the state of society related to being one of the causes of the inability to deal with threats to disasters ([Manakane et al., 2023](#)). Capacity is an ability for regions and communities to take action in reducing the level of threats and losses due to disasters ([Endarwati et al., 2021](#)).

In previous research conducted by [Widyantoro & Usman \(2021\)](#) stated that the Bengawan Solo river overflow flood in Kanor sub-district, Bojonegoro Regency was classified as low and high so that the community was still not ready to face flooding. Meanwhile, according to [Rahardjo \(2023\)](#), flood disasters in Bojonegoro sub-district are at very low risk in the last 5 years.

## Methods

The research location is located in Sukorejo Village, Bojonegoro District, Bojonegoro Regency. The research method used is qualitative. The qualitative method is a research method based on actual conditions so that the data collected can be analyzed qualitatively ([Sugiyono, 2019](#)). While the research approach uses a descriptive approach.

Data sources through primary and secondary data. Primary data is data obtained from sources, while secondary data is data obtained indirectly from sources ([Sugiyono, 2019](#)). Data collection techniques through interviews, observation and documentation. The data analysis techniques used are data reduction, data presentation and data verification ([Sugiyono, 2019](#)).

In this case, the data analysis used is data reduction, data presentation and data verification. Data reduction is selecting, summarizing and identifying important things in the data. Presentation of data is showing data in a simple form so that it is organized and easy to understand. Data verification is a conclusion drawn after collecting data from the beginning ([Sugiyono, 2019](#)). Meanwhile, the analysis technique used in measuring flood risk is the overlay technique. The overlay technique is a technique used in analyzing areas affected by flooding and using a value weighting technique on each indicator that has been determined in the BNPB Head Regulation No. 2 of 2012. 2 Year 2012. The following is the operational definition used, namely:

Table 2. Operational Definition

Risk Variables	Indikator	Keterangan
Threat Vulnerability	Map	Typology zone
	Physical	Built-up land, home ownership, damaged roads
	Social	Population density, vulnerable age, growth rate, education
	Economy	Households working in vulnerable sectors, poverty ratio, productive land area
Capacity	Environment	Protected forest area, percentage of production forest area, conservation forest area
	Natural Capital	Benefits of rivers and forests, value of ease of accessing clean water,
	Social Capital	Intensity of community meetings, relationship with neighbors, value of community participation
	Human Capital	Knowledge related to flood disaster, knowledge related to Gandong River vulnerability, involvement in protecting the environment
	Financial Capital	Extent of land ownership, community income, savings ownership, vehicle ownership, livestock ownership.

Source: Disaster Risk Assessment Guidelines Number 2 of 2012

## Results

Bojonegoro sub-district is a sub-district consisting of 11 urban villages and 7 villages. One of the villages located in Bojonegoro Sub-district is Sukorejo Village. Sukorejo Village is located in the southern area of the city center, has an area of 247,437 Ha which borders other villages, namely:

North: Mojokampung Village

West: Sumbang Village

South: Pacul Village

East: Ngampel village

## Hazard

The threat (hazard) of flood disaster is a variable in flood disaster risk assessment. In this case, the affected areas are divided into three, namely high threat, medium threat and low threat areas.

Table 3. Risk Classification Parameters in Bojonegoro District

Village Name	Level of Risk
Sumbang	Low
Pacul	Low
Kauman	Low
Sukorejo	Low
Klangon	Low
Ngrowo	Low
Campurejo	Low

Source: BPBD Bojonegoro Data Year 2022

Based on the data on the risk classification parameters above, it can be stated that Sukorejo Village has a low level of risk, this can be seen in the flood that occurred in 2022, which was 700 cm high.

### Vulnerability

Vulnerability is the inability of a person or group to minimize the impact caused by a disaster. In this case, vulnerability is used to calculate disaster risk, which includes physical, social, economic and environmental vulnerability. According to the Regulation of the Head of the National Disaster Management Agency Number 2 of 2012 states that vulnerability is divided into three, namely:

#### Physical Vulnerability

Physical vulnerability assessment is based on the percentage of built-up land, building density and road damage. This study uses scoring and classification with low, medium and high levels. Classification can show the size of a location's vulnerability to flood hazards.

**Table 4. Physical Vulnerability Paramater**

Class	Parameters		
	House (40%)	Public Facilities (30%)	Critical Facilities (30%)
Low	<400 Million	<400 Million	<400 Million
Medium	400-800 Million	500 Million – 1 Billions	500 Juta – 1 Billions
High	>1 Billions	> 1 Billions	> 1 Billions

Source: Disaster Risk Assessment Guidelines Number 2 of 2012

In this case, the physical vulnerability analysis that has been conducted in Sukorejo Village is as follows:

**Table 5. Sukorejo Village Physical Vulnerability Analysis**

Rate	Description
House (40%)	488.935.360
Public Facilities (20%)	30.563.818
Critical Facilities (40%)	0
House Score	1,00
Public Facility Score	1,00
Critical Facility Score	0
<b>Final Result</b>	<b>0,20</b>

Source: Data processed by the author (2024)

Based on Table 5. above, it can be stated that the physical vulnerability value of Sukorejo Village is 0.20, which means that Sukorejo Village has a low level of physical vulnerability.

### Economic Vulnerability

Economic vulnerability is the level of financial vulnerability of an area. This is based on the activities of the community in fulfilling their daily needs. The economic vulnerability parameters used in this study are:

**Table 6. Economic Vulnerability Parameters**

Class	Parameters	
	Productive Land (60%)	Public Facilities (40%)
Low	<50 Million	<100 Million
Medium	50-200 Million	50-200 Million
High	>200 Million	>200 Million

Source: Disaster Risk Assessment Guidelines Number 2 of 2012

In this research, the economic vulnerability analysis conducted in Sukorejo Village is:

Table 7. *Economic Vulnerability Analysis of Sukorejo Village*

Parameters	Value
Productive Land (60%)	32.166.800
GRDP (40%)	48.250.000
Productive Land Score	1
GRDP Score	1
<b>Final Result</b>	<b>1</b>

Source: Data processed by the author (2024)

Based on the analysis above, it can be stated that Sukorejo Village has a score of 1 on economic vulnerability, which means that Sukorejo Village has a low level of economic vulnerability.

### Social Vulnerability

Social vulnerability can be calculated through population density, growth rate and percentage of vulnerable groups, namely 0-5 years and >60 years ([Widyantoro & Usman, 2021](#)). The range used in this case is based on interval calculations where three different values will indicate the scoring value. The higher the scoring value, the higher the vulnerability of the area.

Table 8. *Social Vulnerability Parameters*

Cls	Parameters				
	Population Density (60%)	Gender Ratio (10%)	Age Group Ratio (10%)	Ratio of Poor Population (10%)	Disabled Population Ratio (10%)
ow	< 5 Souls/km	<20%	<20%	<20%	<20%
Mum	5-10 Souls/km	20-40%	20-40%	20-40%	20-40%
h	>10 Souls/Km	>40%	>40%	>40%	>40%

Source: Disaster Risk Assessment Guidelines Number 2 of 2012

Research that has been conducted related to social vulnerability analysis in Sukorejo Village is as follows:

Table 9. *Social Vulnerability Analysis of Sukorejo Village*

Parameters	Value
Population Density (60%)	0,043
Sex Ratio (10%)	1,03
Disabled Persons Ratio (10%)	0,04
Age Group Ratio (10%)	0,17
Poverty Ratio (10%)	0,02
<b>Final Result</b>	<b>0,15</b>

Source: Data processed by the author (2024)

Based on the results of the social vulnerability analysis above, it can be concluded that the average result of social vulnerability in Sukorejo Village is 15%, which is classified as low.

### Environmental Vulnerability

Environmental vulnerability is vulnerability based on the type of land use and land variation, the shape and benefits of the land for the community ([Triwulandari & Cahyonugroho, 2023](#)). According to the Head of BNPB Regulation No. 2/2012, the

parameters of environmental vulnerability include land cover such as protected forests, natural forests, mangrove forests, swamps and shrubs. In this research, the assessment parameters used are:

**Table 10. Environmental Vulnerability Parameters**

Class	Parameter		
	Planted Forest (40%)	Mangrove Forest (30%)	Scrub (30%)
Low	<400 Million	<500 Million	< 500 Million
Medium	400-800 Million	500 Million-1 Billion	500 Million- 1 Billion
High	>800 Million	>1 Billion	>1 Billion

Source: Disaster Risk Assessment Guidelines Number 2 of 2012

Meanwhile, in this research, the analysis of environmental vulnerability in Sukorejo Village is as follows:

**Table 11. Sukorejo Village Environmental Vulnerability Analysis**

Parameters	Value
Protection Forest	0,07
Natural Forest	0
Mangrove Forest	0
Scrub	0
Swamp	0
Protected Forest Score	1,00
Natural Forest Score	0
Mangrove Forest Score	0
Scrub Score	0
Swamp Score	0
<b>Final Result</b>	<b>0,10</b>

Source: Data processed by the author (2024)

Based on the environmental vulnerability parameters above, it can be seen that the result of the environmental vulnerability analysis is 0.10. Therefore, the level of environmental vulnerability in Sukorejo Village is low.

It can be seen that the results of the analysis above are physical, economic, social and environmental vulnerability parameters, so that the total vulnerability parameters are as follows:

**Table 12. Total Vulnerability Analysis**

Parameters	Value
Physical Vulnerability (0.40)	0,08
Economic Vulnerability (0.25)	0,25
Social Vulnerability (0.25)	0,03
Environmental Vulnerability (0.10)	0,01
<b>Final Result</b>	<b>0,37</b>

Source: Data processed by the author (2024)

In Table 12. it can be seen that the total vulnerability shows a value of 0.37. Therefore, the threat of vulnerability in Sukorejo Village is low.

### Capacity

According to [Widyantoro & Usman \(2021\)](#), capacity is determined based on the physical, economic and social capabilities of individuals and groups. Capacity is the ability of an area and community to prevent threats and potential losses caused by disasters in a structured, planned and integrated manner (Regulation of the Head of BNPB Number 3 of 2012 concerning Regional Capacity Assessment in Disaster Management). Based on the vulnerability classification above, Sukorejo Village has the following capacity scores:

Table 13. Capacity Analysis of Sukorejo Village

Priority	Total
Planning rules and institutions (0.1)	0,04
Early warning and disaster risk assessment (0.35)	0,11
Disaster education (0.35)	0,15
Basic disaster risk factor reduction (0.1)	0,03
Preparedness development in all regions (0.1)	0,14
<b>Total</b>	<b>0,47</b>

Source: Data processed by the author (2024)

Sukorejo Village has a total score of 3.8, which means that Sukorejo Village has low capacity. The lower the capacity, the higher the disaster risk.

### Disaster Risk

Disaster risk is the chance of a disaster occurring in an area within a certain period of time and can cause death, disease, injury, life threat, loss of security, displacement, loss and damage to property, and obstruction of daily community activities (Destiana et al., 2022).

The calculation of disaster risk in Sukorejo Village uses the parameters of hazard, vulnerability and capacity. Thus, the calculation of disaster risk in Sukorejo Village based on the regulation of the head of BNPB Number 2 of 2012 is as follows:

Table 14. Sukorejo Village Disaster Risk Analysis

H	V	C	HxV	1-C	(HxC) X (1-C)	R
1	0,37	0,47	0,37	0,53	0,19	0,62

Source: Data processed by the author (2024)

Based on the data above, it can be stated that Sukorejo Village has a flood disaster risk of, and is classified as low risk.

### Conclusion

Based on the research conducted, the results of this study can be concluded that the results of the analysis of the threat of flooding overflowing the Gandong River in Sukorejo Village are classified as low with a water level of 700 cm. Meanwhile, the vulnerability of the Gandong River overflow flood is also categorized as low. On the other hand, the disaster capacity of the Gandong River overflow flood is also classified as low, this will cause a high level of disaster occurrence. The results of the Gandong River overflow flood disaster risk analysis in Sukorejo Village are categorized as low.

From the results of this study, there are several suggestions that can be applied to minimize the risk of overflow flood disasters, namely the Bojonegoro Regency Government can plan strategies and mitigation of river overflow flood disasters. So that when a flood disaster occurs, it can minimize the risk. Can increase awareness through education to the community regarding flood disasters due to river overflows. Can carry out response and rehabilitation by influencing disaster risk data periodically as a strategy in reducing the risk of natural disasters.

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