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# Flood Vulnerability Study for Preparation of Flood Contingency Plans in Kendari City

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## ABSTRACT

This study aims to identify: (1) flood vulnerability in Kendari City, and (2) flood contingency plans in Kendari City. The research was carried out in the Kendari City area from May to October 2021. The research population is the Kendari City area. The research sample is the area of Kendari City affected and not affected by flooding. The data collected is in the form of primary and secondary data, collected by documentation techniques, interviews, and field checks. Data analysis technique with quantitative analysis and flood parameter overlay using GIS. Research results: (1) Overlay analysis and GIS application can map the level of flood vulnerability in Kendari city areas with vulnerable categories in the Kadia, Baruga, Kambu, Poasia, and Mandonga Districts, West Kendari, Abeli, Puuwatu, Wua-wua, Kendari , and non-vulnerable areas are found in parts of Abeli, Baruga, Kambu, Kendari, West Kendari, Mandonga, and Poasia Subdistricts, (2) The distribution of flood vulnerability supports the preparation of flood contingency plans so that the disaster preparedness actions of all relevant parties are more focused and appropriate and effectively mitigate floods in Kendari City.

**KEYWORDS:** Vulnerability; Flood; Overlays; Contingencies; Kendari.

## 1. INTRODUCTION

Every year, various disasters, including natural, man-made, and social ones, have the potential to occur in Kendari City and cause losses, deaths, and damage to a number of the community's physical infrastructure and facilities. The astronomical location of Kendari City is between 3°54'40" and 4°5'05" South Latitude and between 122°26'33" and 122°39'14" East Longitude, with a mainland area of 271.76 $Km^2$. (Badan Pusat Statistik Kota Kendari, 2021). Kendari City is made up of 11 districts: Baruga, Puuwatu, West Kendari, Wua-Wua, Mandonga, Abeli, Kambu, Kendari, and Kadia Districts. These districts each have 11 urban villages: Mandonga, Baruga, Puuwatu, Kadia, Wua-Wua, Poasia, Abeli, Kambu, Nambo, Kendari, West Kendari, and Kendari (Badan Pusat Statistik Kota Kendari, 2021).

Due to its position as an estuary for the Wanggu River, which originates in South Konawe, Kendari City experiences annual flooding. In June 2013, water runoff from the Wanggu River caused floods in several sub-districts, causing damage to public infrastructure, gardens, rice fields, and residential areas, particularly in the vicinity of the Wanggu river channel and estuary. Information on Kendari City catastrophe occasions between 2014-2017, shows that floods are the second most elevated fiasco that happened after 26 occurrences of fire calamities, in 2016 there were 8 episodes spread more than 4 sub-locale specifically, Poasia, West Kendari, Kadia, and Baruga. In 2014, there were also flooding disasters, with two occurring in the Poasia District and Kambu District (BPBD Kota Kendari, 2017).

In flood situations, the river is an important factor to take into account (Hamdani et al., 2014; Mahfuz, 2016; Masyhuri, 2019). Kendari's mainland is a lowland, which is the target of water runoff from the highlands and large rivers that empty into Kendari Bay. This is one of the reasons why Kendari floods. Flooding will occur when rivers are no longer able to handle surface water. The rapid development of residential areas, which reduced the catchment areas, was another factor that contributed to the flooding in Kendari City. Penetration and permeation are likewise expected reasons for flooding in the event that the penetration is little or decreased in a space (Prima & Nurman, 2019).

Flood mapping is one of the efforts to control floods and their losses and advances in spatial technology in geography allow the identification of flood-prone areas quickly and accurately. The development of GIS technology has made it easier for users of spatial data to store, process, and analyze their data more easily, quickly, and interactively (Hamdani et al., 2014). GIS is a computer technology system that is very good at working with both spatial and non-spatial databases. It moves geographic locations with descriptive information so that users can easily make maps and analyze the data in different ways (Mahfuz, 2016).

The study of flood-prone areas in Kendari City needs to be carried out by identifying flood-prone areas in an effort to manage flood-prone areas more effectively. The existence of data on the distribution of flood locations in the form of maps will be very helpful in planning and making decisions or taking further actions regarding flood problems both now and in the future. According to Sejati et al. (2019) disaster preparedness can be carried out with community participation by following disaster directions that contain explanations of disasters, one of which is a disaster map. The purpose of this study was to determine the distribution of flood vulnerability and flood contingency plans in Kendari City.

## 2. METHOD

This research was conducted in Kendari City, Southeast Sulawesi Province. The selection of the Kendari City area was based on: 1) It is a target area for floods, which often occur almost every year, and 2) There has not been much research on vulnerability and risk of flooding in the study area. Research activities were carried out from May to October 2021. The population in this study is from the Kendari City area. The research sample consisted of: 1) Kendari City areas that were affected by the floods; and 2) Kendari City areas that were not affected by the floods.

The flood hazard is mapped through several parameters and continues by assessing the level of flood disaster risk. Parameters and data sources used include: 1) flood-prone areas, using DEM SRTM 2000 data with data sources from USGS; 2) slope, using DEM SRTM data in 2000 with data sources from USGS; 3) distance from river, using river network data for 2013 based on data sources from BIG; and 4) rainfall, using regional rainfall data for 1998–2018 sourced from NOAA. This research is also supported by other data sources, both primary data in the form of data obtained directly from the field and secondary data in the form of data obtained from books, research results, journals, maps, or other facilities taken from related agencies, for example map data at the Badan Pertanahan Nasional (BPN), and rainfall data at the Badan Meteorologi Klimatologi Geofisika (BMKG).

The analysis technique uses quantitative analysis techniques with an overlay approach to flood parameters using a Geographic Information System (GIS). The overlay uses thematic maps as input, including slope maps, soil infiltration maps, and land use maps. Based on the overlay analysis of the parameters that have been prepared, it is known that the area and class of flood hazard in the Kendari city area are per sub-district.

## 3. RESULTS AND DISCUSSION

In order to determine the distribution of flood vulnerabilities and flood contingency plans, this research was carried out in several stages, including risk assessment, event determination, scenario development, strategy development, sectoral planning, as well as monitoring and follow-up plans for flood contingency in the Kendari City area.

### 3.1 Risk Assessment

Risk assessment is carried out based on two parameters, namely assessing the probability of a disaster occurring and the impact of losses incurred with scoring assumptions, in the form of a probability scale: 5: certain (almost certain 80%–99%); 4: Most likely (60%–80%, occur in the next year, or once in the next 10 years); 3: Likelihood to occur (40%–60%, occurs in the next year, or once in 100 years); 2: Low Probability (20%–40%, occurs next year, or once more than 100 years); and 1: Very Low Probability (up to 20%); and the impact of the event: 5: very severe (80%–99%, the area destroyed and completely paralyzed); 4: severe (60%–80 %, destroyed); 3: moderate (40%–60%, damaged area); 2: light (20%–40%, damaged area); 1: very light (less than 20%, broken region) (BNPB, 2011). From this instruments, the probability and impact of the types of disasters that occurred in Kendari City were calculated using a matrix like Table 1.

Table 1. Risk Assessment

| No. | Threat Type | P | I |
|---|---|---|---|
| 1 | Flood | 4 | 4 |
| 2 | Landslide | 4 | 2 |
| 5 | Earthquake | 2 | 2 |
| 4 | Whirlwind | 3 | 3 |
| 5 | Abrasion and Tidal Waves | 2 | 2 |
| 6 | Land and Forest Fires | 1 | 1 |
| 7 | Drought | 1 | 1 |

Note: P = Probability (the possibility of a disaster occurring), I = Impact (losses incurred)

Source: the City Renkon drafting team (2021)

The hazard level is mapped using the hazard level scale matrix as shown in Figure 1, which is based on Table 1. From the hazard assessment matrix, it shows that Kendari City has a disaster with a high probability and impact risk, namely Flood (4), based on the calculation results of the red pool matrix assumption.

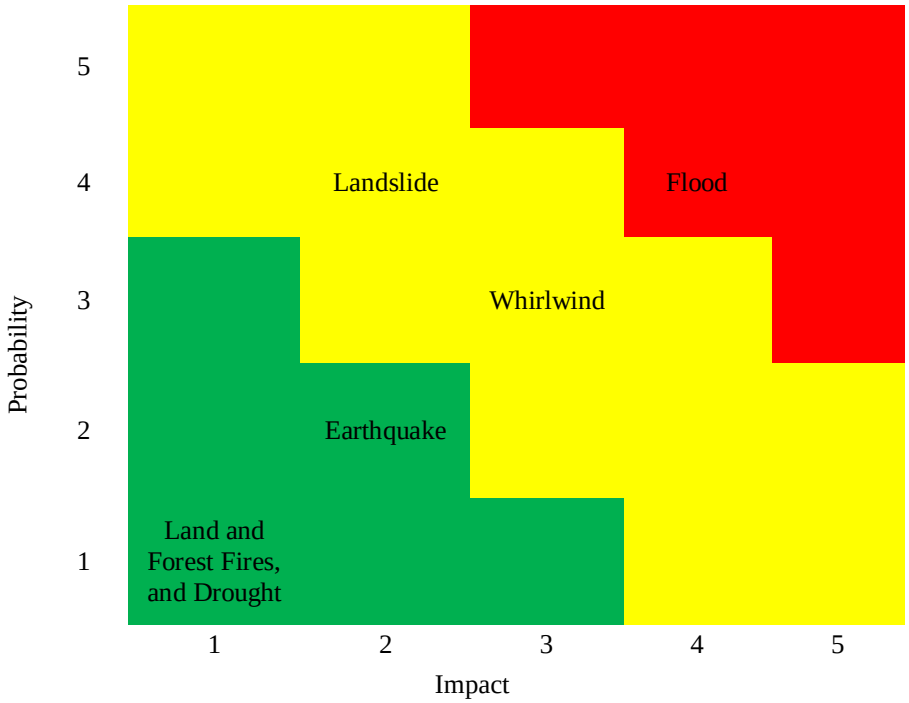


Figure 1 Matrix for Risk Assessment

Risk assessment involves an analysis of flood disaster potential, vulnerability, capacity, and the flood disaster risk map. This is to ensure that related parties have the same motivation to encourage a contingency plan in the context of flood disaster mitigation.

A flood is an event or situation in which an area or land is submerged due to an increase in water volume (BNPB, 2011). Flood hazards can be mapped through several parameters, as described in the previous method section, to obtain the area and class of flood hazards per sub-district in Kendari City (Table 2).

According to Table 2, the potential flood-prone area per sub-district in Kendari City is 342.62 ha, which is a high level. The maximum hazard class of each sub-district exposed to flood hazards is used to determine this flood hazard class.

Table 2. Potential Flood Hazards Per District in Kendari City

| No. | District | Class (Ha) | | | |
|---|---|---|---|---|---|
| | | No Potential | Low | Medium | High |
| 1 | Abeli | 2140,84 | 29,18 | 14,24 | 12,96 |
| 2 | Baruga | 3733,58 | 676,57 | 355,10 | 158,17 |
| 3 | Kadia | 155,39 | 206,43 | 165,73 | 128,28 |
| 4 | Kambu | 1402,07 | 399,01 | 236,90 | 160,37 |
| 5 | Kendari | 1432,22 | 0,96 | 2,44 | 8,72 |
| 6 | Kendari barat | 1793,27 | 131,51 | 94,69 | 19,57 |
| 7 | Mandonga | 1887,67 | 172,80 | 89,08 | 17,10 |
| 8 | Nambo | 1708,04 | 30,31 | 12,04 | |
| 9 | Poasia | 3567,64 | 108,03 | 315,49 | 231,21 |
| 10 | Puwatu | 4100,12 | 182,13 | 46,82 | 7,69 |
| 11 | Wua-wua | 670,95 | 106,40 | 194,91 | 86,62 |

Sources: KRB Kota Kendari (2019)

A flood vulnerability assessment is carried out to determine the potential for exposed populations and potential losses (physical, economic, and environmental) that may arise as a result of a flood disaster. The population exposed to flooding can be seen from the number of people living and doing activities in areas prone to flooding. The more people who are active in areas with high potential for disasters, the more the number of people exposed to disasters. The total population exposed to floods in Kendari City is 91,133 people who are in the high class (Table 3).

Table 3. Flood-Affected Population in Each District in Kendari City

| No. | District | Exposed Population (Spirit) | Vulnerable Group (Spirit) | | | Class |
|---|---|---|---|---|---|---|
| | | | Vulnerable Age | Poor People | Disabled People | |
| 1 | Abeli | 4.724 | 2.649 | 237 | 15 | High |
| 2 | Baruga | 6.889 | 1.423 | 345 | 0 | High |
| 3 | Kadia | 25.592 | 6.978 | 1.282 | 34 | High |
| 4 | Kambu | 13.396 | 3.130 | 668 | 0 | High |
| 5 | Kendari | 2.985 | 1.045 | 150 | 6 | High |
| 6 | Kendari Barat | 12.119 | 3.754 | 607 | 16 | High |
| 7 | Mandonga | 3.489 | 1.102 | 174 | 0 | High |
| 8 | Nambo | 1.473 | 825 | 73 | 0 | Medium |
| 9 | Poasia | 10.656 | 3.695 | 529 | 0 | High |
| 10 | Puwatu | 1.247 | 417 | 62 | 0 | Medium |
| 11 | Wua-Wua | 8.563 | 2.749 | 430 | 0 | High |

Source: KRB Kota Kendari, (2019)

Furthermore, the results of a vulnerability study on potential physical, economic, and environmental losses due to floods per sub-district in Kendari City are presented in Table 4.

Table 4. Potential Losses for Floods Per District

| No. | District | Losses (Million Rupiah) | | | | Environmental Damage (Ha) | |
|---|---|---|---|---|---|---|---|
| | | Physique | Economy | Total | Class | Total | Class |
| 1 | Abeli | 55,393.57 | 7,934.82 | 63,328,381,117.00 | High | 0 | Low |
| 2 | Baruga | 283,163.08 | 40,162.18 | 323,325,263,203.00 | High | 1 | Moderate |
| 3 | Kadia | 3,526,128.08 | 503,022.96 | 4,029,151,037,105.00 | High | 1 | Moderate |
| 4 | Kambu | 1,197,095.03 | 127,238.55 | 1,324,333,584,794.00 | High | 6 | Moderate |
| 5 | Kendari | 43,304.85 | 10,305.93 | 53,610,779,816.00 | High | 0 | Low |
| 6 | Kendari Barat | 140,679.99 | 27,110.92 | 167,790,907,996.00 | High | 0 | Low |
| 7 | Mandonga | 104,966.16 | 18,266.15 | 123,232,311,099.00 | High | 17 | High |
| 8 | Nambo | 0.00 | 0.00 | 0.00 | Low | 0 | Low |
| 9 | Poasia | 928,439.05 | 88,061.65 | 1,016,500,703,972.00 | High | 0 | Low |
| 10 | Puwatu | 33,871.54 | 3,295.68 | 37,167,227,042.00 | High | 0 | Low |
| 11 | Wua-Wua | 1,163,825.61 | 129,109.03 | 1,292,934,640,236.00 | High | 0 | Low |

Source: KRB Kota Kendari (2019)

Overall, the total potential loss (physical, economic, and environmental) of the flood disaster in Kendari City is 7,476,866.96 billion rupiahs, which is in the high class, while the total environmental damage is 25 ha in the high class. The class determination is obtained from the maximum class per district.

Vulnerability is a condition of a community or society that leads to or causes an inability to face the threat of disaster. The vulnerability assessment is calculated based on the socio-cultural, physical, economic, and environmental components.

The parameters for the social vulnerability component refer to the general guidelines for disaster risk assessment presented in Table 5.

Table 5. Social Vulnerability Parameters

| Parameters | Bobot (%) | Class | | |
|---|---|---|---|---|
| | | Low | Medium | High |
| Population density | 60 | <5 | 5-10 | >10 |
| Vulnerable Groups<br>Gender Ratio (10%) | 40 | >40 | 20-40 | <20 |
| Vulnerable Age Group Ratio (10%)<br>Poor Population Ratio (10%)<br>Disability Ratio (10%) | | <20 | 20-40 | >40 |

Source: KRB Kota Kendari (2019)

Sources of data used for each parameter of social vulnerability in disaster risk assessment include 1) total population using data from the 2015 District in Figures; 2) age group population using data from the 2015 District in Figures; 3) disabled population using data from the 2014 Podes; and 4) the poor using data from TNP2K 2017.

Data sources used for physical vulnerability parameters in disaster risk assessment are presented in Table 6.

Table 6. Physical Vulnerability Parameters

| Physical Vulnerability Parameters | Weight (%) | Class | | |
|---|---|---|---|---|
| | | Low | Medium | High |
| House | 40 | <400 Million | <400 -800 Million | >800 Million |
| Public facilities | 30 | <500 Million | 500 Million – 1 Bilion | >1 Bilion |
| Critical Facility | 30 | <500 Million | 500 Million – 1 Bilion | >1 Bilion |

Source: KRB Kota Kendari (2019)

In disaster risk assessment, physical vulnerability parameters include: 1) the number of houses based on Podes data from 2015; 2) Public offices (instructive offices and wellbeing offices) utilizing information from the 2014 Podes; 3) For data on the number of airports and seaports, critical facilities use data from the Ministry of Transportation in 2015, while power plants use data from ESDM/PLN in 2015.

Data sources for each parameter of economic vulnerability in disaster risk assessment are shown in Table 7, consisting of: 1) Productive land, using data from the 2014 Ministry of Environment and Forestry; and 2) GRDP using data from the Badan Pusat Statistik Kota Kendari (2015).

Table 7. Economic Vulnerability Parameters

| Economic Vulnerability Parameters | Weight (%) | Class | | |
|---|---|---|---|---|
| | | Low | Medium | High |
| Productive Land | 60 | <50 1 Bilion | 50 - 200 Million | >200 1 Bilion |
| Gross Rational Domestic Income (PDRB) | 40 | <100 1 Bilion | 100 - 300 1 Bilion | >300 1 Bilion |

Sumber: KRB Kota Kendari (2019)

The sources of data used for environmental parameters in the flood disaster risk assessment are shown in Table 8.

Table 8. Environmental Vulnerability Parameters

| Environmental Vulnerability Parameters | Class | | | Score |
|---|---|---|---|---|
| | Low | Medium | High | |
| Protected forest | <20Ha | 20-50Ha | >50Ha | Grade/Max. Class |
| Natural Forest | <25Ha | 20-75Ha | >75Ha | |
| Mangrove forest | <10Ha | 10-30Ha | >30Ha | |
| Shrubs | <10Ha | 10-30Ha | >30Ha | |
| Swamp | <5Ha | 5-20Ha | >20Ha | |

Source: KRB Kota Kendari (2019)

Data sources used for environmental vulnerability parameters in disaster risk assessment are: 1) forest area status (protected forest, natural forest, mangrove forest) using data from the 2014 Ministry of Environment and Forestry; and 2) land cover (shrubs and swamps) using data from the Kementerian Lingkungan Hidup dan Kehutanan (2014).

Regional capacity in implementing disaster management is an important parameter that determines the success of disaster risk reduction. Assessment of regional capacity (resilience) was carried out using the Focus Group Discussion (FGD) method regarding the list of required data from all agencies and institutions related to disaster management in Kendari City. Regional resilience studies were obtained based on Regional Resilience Indicators (IKD) listed in the 2015–2019 National Disaster Management Plan (RENAS PB).

Measurement of regional resilience is carried out using 71 achievement indicators in the IKD, then grouped into 7 Disaster Management Activities (BNPB, 2014). The results of a study on the resilience of Kendari City in facing the threat of a possible flood disaster can be seen in Table 9.

Table 9. Results of the Kendari City Capacity Study

| Priority | Priority Index | Regional Capacity | |
|---|---|---|---|
| | | Index | Class |
| Policy and institutional strengthening | 0,62 | 0,35 | Low |
| Integrated risk assessment and planning | 0,23 | | |
| Development of information systems, training, and logistics | 0,31 | | |
| Thematic Handling of Disaster Prone Areas | 0,32 | | |
| Increasing the effectiveness of disaster prevention and mitigation | 0,30 | | |
| Strengthening disaster preparedness and handling | 0,37 | | |
| Disaster recovery system development | 0,40 | | |

The capacity study for Kendari City is at a low capacity level, and the index is 0.35. This indicates that Kendari City is an area that is still in a low class in disaster management efforts. The low resilience of the Kendari City Government in disaster management requires a clear and directed effort to be able to increase regional capacity in implementing disaster management. For better disaster management, the achievement of the regional resilience level in Kendari City needs to be increased at least to level 4 of the existing regional resilience.

The disaster risk map, which forms the basis for determining the level of disaster risk, is one of the components of the Disaster Risk Assessment Document (KRB), which provides minimum regional disaster management policies to reduce the number of exposed lives, loss of property, and environmental damage. A map of Kendari City's flood-risk situation is presented in Figure 2.

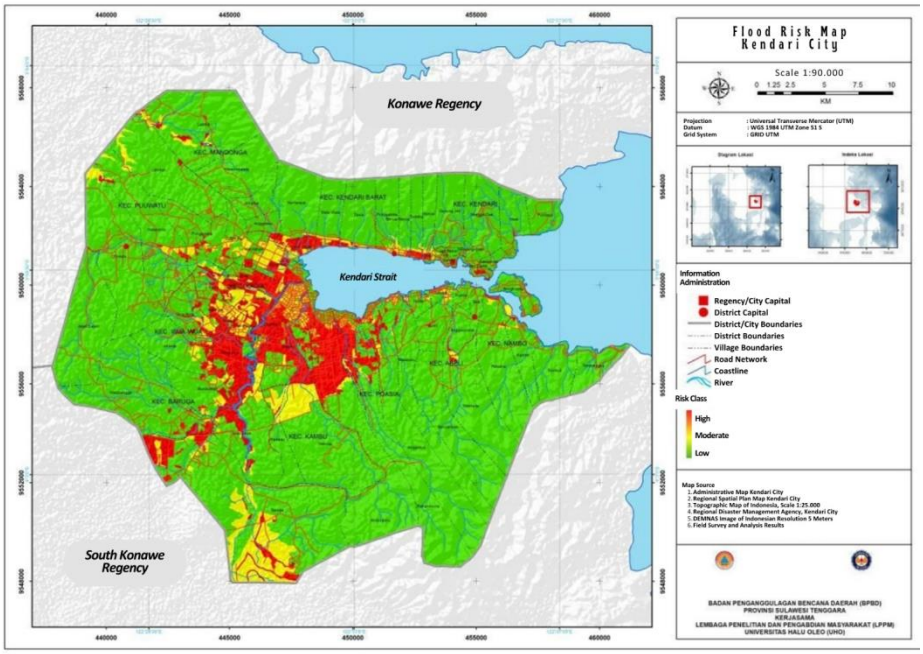


Figure 2. Flood Disaster Risk Map in Kendari City

Information on the level of risk and risk maps for flood disasters is the basis for regions to formulate disaster management policies (BNPB, 2012). In this study, disaster management policies in an effort to reduce the risk of flood disasters were developed in the form of flood disaster contingency plans in the Kendari City area.

### 3.2. Event Determination

Flood hazard risk assessment can be followed up with the preparation of flood disaster contingency plans by stakeholders. Contingency plans are prepared by selecting the threat of flooding in scenarios for high (severe) risk classes. Scenario development begins with determining the agreed-upon flood events, namely: 1) Flood events are predicted to occur when high rainfall occurs in Kendari City and South Konawe Regency, which can cause flash floods. Flooding will occur if the intensity of rain occurs for more than 24 hours; 2) when it rains with a duration of more than 24 hours, flooding will occur in 4 (four) locations, namely Mokoau Village, Lepo-Lepo Village, and Kampung Salo Village; 3) the impact of the flood incident occurred for 4 days of evacuation; and 4) under these conditions, the Kendari City Government took action to reduce the impact by taking preparedness steps for an emergency situation that might occur.

### 3.3. Scenario Development

Scenario development for contingency plans is carried out through the steps of determining targets: Event Scenario, Population, Facilities and Infrastructure, and Economy. Floods occurred in several sub-districts in the Kendari City area. Floods occur very quickly, together with heavy rains lasting > 1 day. This incident occurred at night, precisely at 24.00 WIB. The worst impact was that many settlements were damaged, so there were evacuations in several places. In developing the flood event scenario in this contingency plan, several sub-districts and villages were affected by the flood for 4 days. The affected areas are estimated to include: 1) Mokoau Village; 2) Lepo-Lepo Village; and 3) Kampung Salo Village.

From the scenario above, it is estimated that there will be an evacuation process to a safe place for 4 days because most of the residents' settlements are heavily damaged. The scenarios and impacts of the exposed

population are found in Baruga, Kambu, Mandonga, Rahandouna, and Kendari Districts. The total population at risk reaches 138 people out of the total population in the sub-district of 22290 people.

The flood disaster disrupted infrastructure functions such as houses, schools, electrical installations, and communication towers. The facilities and infrastructure affected by the floods are in the form of threatened facilities, including houses (134 units) with a high level of damage, schools (32 units), electrical installations (6580 units), and telecommunications towers (8 units). In addition to the aspects of facilities and infrastructure, other aspects that have an impact as a result of the flood disaster are the economic sector in the form of types of threatened facilities, including industry (559 units), shops (8 units), and hotels (4 units).

**3.4. Policy and Strategy**

In order to deal with emergency situations caused by floods, the Kendari City government's flood contingency plan needs to adopt several policies and strategies that form the basis of Kendari City's flood disaster management activities so that it is able to carry out disaster management activities effectively and in a well-coordinated manner. When it happens, the Kendari City Government can establish policies, namely: 1) All sectors carry out rapid assessments by deploying their rapid assessment teams, namely: 2) Mobilizing all available resources to be used in disaster management, 3) Immediate assistance to victims, especially vulnerable groups and victims, 4) Determine directions/steps/actions that need to be taken in analyzing the impact of disasters that arise, 5) Coordinate disaster management activities carried out by various government, private and volunteer institutions, 6) Provide convenience to volunteers and donors, both local and foreigners in providing assistance, 7) Manage assistance both from within and outside the country in a transparent manner in accordance with applicable regulations, 8) Ensure assistance can reach the evacuation areas by deploying all transport fleets, 9) Prepare facilities and infrastructure for flood victims, 10 ) Monitor and report losses incurred by disasters, both property and life, and 11) Maintain continuity of public services.

The strategy for implementing the contingency plan by the government is in the form of: 1) Each sector forms a team that conducts a quick review and reports to the sector coordinator, 2) Orders all Regional Work Units (SKPD) / agencies / institutions / communities to mobilize all available resources to be used in disaster management based on standard procedures that have been made previously, 3) Ensuring all victims can be helped immediately: injured victims are given free treatment and victims who have lost their homes are accommodated in evacuation sites, while those died immediately buried, 4) Prioritize handling of victims for elderly victims (elderly), children, pregnant women, disabled people, hospital patients, and traumatic patients, 5) Make an inventory of all losses/victims that arise, 6) Due to the intensity of If a major disaster occurs, it is necessary to coordinate with the provincial government, national and international institutions, through standard procedures that have been prepared, 7) Collect and distribute aid evenly and on target, 8) Provide basic needs services for victims and refugees, 9) Providing mobilization of refugees including ambulances, medical personnel (medicine), refugee tents and public kitchens, food (clean water, toilets, and sanitation), 10) Placing security forces to protect disaster victims both in aid distribution and in evacuation, 11) Provide accountability reports for assigned tasks; and 2) Evaluate all implementation of activities that have been carried out and planned follow-up.

**3.5 Sectoral Planning**

Contingency plans require sectoral planning aimed at achieving natural disaster management that can protect the whole community. Sectoral planning is carried out as a function of disaster management, which has evaluated the level of threats that occur, the principles of evacuation of shelters for temporary community protection, and reorganizing life after a post-disaster. Sectoral planning consists of the Command Post Sector, SAR and Evacuation Sector, Health Sector, Facilities and Infrastructure Sector, Social Sector, and Industrial Sector. With this sectoral planning, it is hoped that all activities can be carried out in a coordinated manner and have clear job descriptions so that activities can be carried out properly.

**3.6. Monitoring and follow-up plans**

This flood contingency plan document was jointly prepared by relevant stakeholders from government and non-government elements within Kendari City who have the task (mandate) related to emergency management, with a disaster event scenario that is expected to occur in 2021/2023; The flood contingency plan document is signed by each head/representative of the agency/institution/organization involved in preparing the document and as a commitment to be actively involved when a flood disaster occurs in Kendari City. Monitoring of the situation and changes in conditions is carried out every 1 year to update data and information in order to adjust the contents of the Contingency Plan document, and if by 2023 no disaster is expected, then this Contingency Plan will be extended to the following year after updating. Evaluation of the contents of the Contingency Plan

document can be carried out every 2 years to adjust the contents of the Contingency Plan document with coordination for monitoring and updating the Contingency Plan carried out by the Kendari City Regional Disaster Management Agency. Contingency plan documents are prepared as well as preparing follow-up activities that must be carried out, namely: 1) Trial/Simulation/Rehearsal, 2) Formalization, 3) Data Review and Update, and 4) Compilation of Standard Operating Procedures (SOP).

## 4. CONCLUSION

This research was able to map the level of vulnerability and risk of flooding in the Kendari City area with a level of vulnerability in the very vulnerable category in the districts of Kadia, Baruga, Kambu, Poasia, and Mandonga, West Kendari, Abeli, Puuwatu, Wua-wua, Kendari and areas categorized not prone to flooding, found in parts of Abeli, Baruga, Kambu, Kendari, West Kendari, Mandonga, and Poasia sub-districts. Information on the level of vulnerability and risk of flooding becomes the basis for the preparedness efforts of related parties to disasters, in the form of preparing a flood contingency plan document as a technical reference when a flood disaster occurs, a guide for all parties in disaster management, and so that all parties can understand their respective roles and functions. – each in the emergency response to the flood disaster in Kendari City.

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**Conflict of interests**

The authors declare that in the research and preparation of this article, there were no conflicts of interest related to certain organizations, institutions, individuals, or groups.

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