

# Identification of Flood Prone Areas for Natural Disaster Mitigation using Geospatial Approach (A Case Study in Bone Bolango Regency, Gorontalo Province)

*by Sri Maryati*

---

**Submission date:** 27-Mar-2023 01:00AM (UTC-0400)

**Submission ID:** 2047706335

**File name:** yati\_2018\_IOP\_Conf.\_Ser.\_Earth\_Environ.\_Sci.\_145\_012080-2-6.pdf (372.73K)

**Word count:** 2030

**Character count:** 11000

### 3

## Identification of Flood Prone Areas for Natural Disaster Mitigation using Geospatial Approach (A Case Study in Bone Bolango Regency, Gorontalo Province)

S Maryati\*

Department of Earth Science and Engineering, Faculty of Mathematics and Natural Sciences, Universitas Negeri Gorontalo, Gorontalo, Indonesia

\*sri.maryati@ung.ac.id

**Abstract.** Flood is a natural disaster that often occurs in Bone Bolango Regency, Gorontalo Province during the rainy season. There are some areas always flooded but there are also new areas affected by floods so that citizens and local governments were unprepared for the disaster. This caused a great impact and losses including flooded settlements, destruction of agricultural land, damage to infrastructure, significantly disrupt economic activity, and the impact on public health. This study aims to identify flood prone areas for natural disaster mitigation using geospatial approach in Bone Bolango Regency, Gorontalo Province. This research integrates geospatial data analysis including topography, rainfall data, mapping of land cover and field survey. This research is very important for disaster risk reduction. The results show that generally flood-prone areas are distributed in low land, around major river flows both in the middle and downstream of rivers, landform of floodplains and alluvial plains, and generally in areas with extensive settlements and farmland.

### 1. Introduction

Indonesia is prone to various natural disasters due to its geographic location and topographic conditions. The 12 common natural disasters in Indonesia include earthquake, flood, landslide, typhoon, etc. Flood is the most frequent natural disaster in various parts of Indonesia. Flood can be defined as inundation in areas near rivers or coastal areas due to water discharge that exceeds the capacity of the river and encroachment by the seawater [1] [2]. Floods are the most destructive natural hazard [3]. There are various damages and losses caused by floods both physical damage, environmental damage, and socio-economic impacts in flooded areas. The impacts of floods do not only in the physical damage but also in diseases and epidemics outburst [4]. 9

Gorontalo Province consists of five regencies and one city, namely, Gorontalo Regency, Bone Bolango Regency, Boalemo Regency, Pohuwato Regency, North Gorontalo Regency, and Gorontalo City. Each regency and city in Gorontalo Province has areas often hit by floods during the rainy season.

The research area is Bone Bolango Regency, where floods have enormous impacts such as damage to agricultural land, infrastructure damage, water building damage, damage to residential areas, water and sanitation problems, and disruption of economic activity during floods and after floods.

Several areas in Bone Bolango Regency are often flooded during high intensity rainfall and long duration of rainfall. Based on released information from the Indonesian National Disaster



1  
Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.

Management Authority, 1247 people displaced due to flooding that caused a 50 - 100 cm inundation [5]. Natural disaster risk reduction in Bone Bolango Regency is indeed very important to do. Flood-prone areas mentioned in Regional Regulations of Bone Bolango Regency Number 8 of 2012 [6]

Flood prone areas mapping is very important in decision making and watershed management for suitable flood management and sustainable development [7] [8] [9]. The use of remote sensing data tends to increase for flood area mapping, damage assessment, and analysing flood vulnerability [10]. This is because flood map in detailed scale and comprehensive is still limited [11]. Remote sensing and GIS role in flood hazard mapping is very useful include relief and rescue stage, impact assessment, early warning and decision support [12] [13].

The flood risk map should consider several factors including physical and social economic factor [14] [15]. The flood risk map derived from GIS and remote sensing used for relocation of infrastructure and emergency planning. The detailed flood hazard and vulnerability map is important for regional flood management [16] [17]. The application of geographic information system for flood risk mapping has some criterias and difficulties include need the appropriate decision rule, need special software, and good knowledge in software operation [18].

This research applied geospatial approach to determine flood prone area. The indicators used in this study include rainfall, distance to river, elevation, and land cover. Data processing was conducted using geographic information system software. This research produces map of flood prone area in Bone Bolango Regency. The results of this study are expected to be utilized for decision making and planning for disaster risk reduction in Bone Bolango District.

## 2. Study Area

Bone Bolango Regency, Indonesia is located between 00o18'26.916" – 00o48'21.854" North Latitude and between 123o2'11.735" – 123o33'7.891" East Longitude. Based on administrative boundary, Bone Bolango Regency is bordered to the east with Bolaang Mongondow Selatan Regency, bordered to the west with Gorontalo Regency and Gorontalo City, bordered to the north with Bolaang Mongondow Regency, and bordered to the south with Toraja Bay. The area of Bone Bolango Regency is 1,984.58 km<sup>2</sup>. Bone Bolango Regency area is 16.24 percent of the total area of the Gorontalo Province. Bone Bolango Regency consist of 18 districts [19]. Map of study area is shown in Figure 1.



Figure 1. Map of Study Area

### 3. Methodology

As mentioned in introduction, indicators used in this study include rainfall, distance to river, elevation, and land cover. The data source in this research are Landsat 8 satellite image Shuttle Radar Topography Mission (SRTM) data, topography map and rainfall data. Landsat 8 satellite image is utilized for mapping land cover. Shuttle Radar Topography Mission (SRTM) data is analyzed to get elevation map and slope map. Rainfall data is represented using isohyet map. Distance to river map is derived from topography data using buffer process. The indicator maps are scored based on their influence on the flood phenomena, then the overlay process is carried out to obtain a map of the flood prone areas in Bone Bolango regency.

### 4. Results and Discussion

In general, the factors considered for the identification of flood prone areas in Bone Bolango Regency include topography condition, hydrology factor, and land cover. This research begins with the collection, of data and data sources, namely, spatial data, remote sensing images and meteorological data. Analysis and research results are presented in detail in the following sections.

#### 4.1. Topography Condition

Topographic factors have a significant influence on flood disaster. The topographic factors considered in the study of flood prone area identification are elevation and slope. The higher the elevation the lower the flood risk, and the lower the elevation the higher the flood risk.

#### 4.2. Hydrology

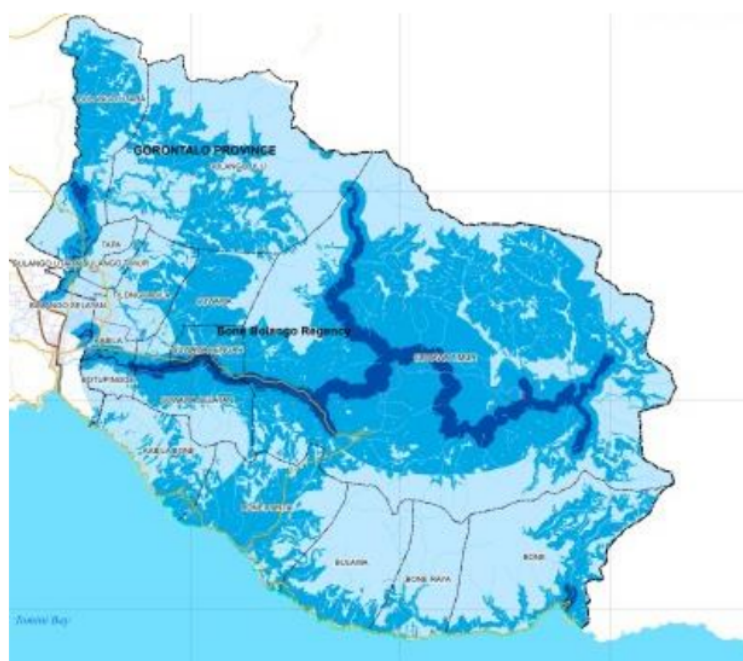
The hydrological factor is the most important factor in the flood disaster. These factors determine whether the flood occurred. The hydrological factor used in this research is rainfall and river buffer zone map. Buffer zone map represents that the closer an area to the river the higher the risk of flooding. Buffering is carried out by creating a buffer zone of 200 meters each.

#### 4.3. Land Cover

Land cover mapping is conducted using visual interpretation in Arcgis 10.1. Type of land cover include lake (water body), settlement area, bare land, paddy field, bush, cultivated area, and forest. The vulnerability level of each land cover is determined by percent of covered land by vegetation. In this case, the lowest risk of flood is forest and the highest flood risk is settlement and bare land.

#### 4.4. Flood Prone Area

Flood prone area map is obtained by overlaid rainfall map, river buffer zone map, elevation map, slope map, and land cover map. Each map is scored based on their level of influence on flood disaster. The greater the effect on the flood the greater the score given. Based on the final analysis, the map of flood prone areas is presented in Figure 1.



**Figure 2.** Flood Prone Area Showed on Dark Blue Colour

8 Based on Figure 1, only 5 % of study area is flood prone area, and the rest is moderate and non-flood prone area. The flood prone area is located along the river and in the lowland. Areas affected by flooding will be very dependent on rainfall. The greater the rainfall, the intensity and duration of rain then the affected area will be greater.

Based on the previous flood disaster, areas affected by flooding are settlement area and cultivated area, so that the flood victim, damage and losses is very great. Figure 2 clearly shows that areas along the river are flood-prone areas. Based on this, the local government can make various efforts to reduce the flood risk. The government should explain the public about the dangers of flooding along the river. In addition, the government can relocate community settlements in flood prone areas to non-prone area.

## 4 Conclusions

Based on the data analysis and research results, it can be concluded that five percent of study areas is flood prone area. The flood prone area mostly is area along the big river with land covers are settlement and cultivated area. The flood prone area map can be utilized for decision making in disaster risk reduction, future plan about flood management, and planning to relocate settlement to non-prone area.

## Acknowledgments

The author wishing to express the deepest gratitude to Directorate General Higher Education, Ministry of Research, Technology and Higher Education Indonesia for research funding. The author wishes to acknowledge Rector of Universitas Negeri Gorontalo, Head of Institute for Research and Community Services Universitas Negeri Gorontalo, 3<sup>rd</sup> Dean of Faculty of Mathematics and Sciences for permit and support to participate and to attend The 1st UPI International Geography Seminar 2017 (IGEOS 2017).



## References

- [1] Tim D 2008 *Fundamentals of Hydrology Second edition* (London and New York : Routledge Taylor and Francis Group)
- [2] S N Ghosh 2014 *Flood Control and Drainage Engineering Fourth Edition* (The Netherlands : CRC Press/Balkema)
- [3] G.Tsakiris 2014 *Natural Hazards and Earth System Sciences* **14**
- [4] Bhankaurally M Y, Nowbuth M D and Bhavana U 2010 *International Journal of Geomatics and Geosciences* **1** 3
- [5] BNPB 2014 *Info Bencana Informasi Kebencanaan Bulanan Teraktual. Agustus 2014*
- [6] Regional Regulations of Bone Bolango Regency Number 8 of 2012 concerning Regional Spatial Planning for Year 2011 - 2031
- [7] Mahyat S T, Biswajeet P and Mustafa N J 2014 *Journal of Hydrology* **512**
- [8] Jean H D, Samuel N O, Bachir M S, Joerg S, Michael T, Adjei K, Fernand K K and Lucette Y A 2016 *Geoenvironmental Disasters* **3** 10
- [9] Andi B R, Martiwi D S, Abu B S and Fusanori M 2017 *Urban Science* **1** 7
- [10] Victor K 2015 *Journal of Coastal Research* **31** 4
- [11] Salvatore M, Fernando N, Caterina S, Salvatore G, Angela C T, Giorgio R and Aurelia S 2014 *Journal of Hydrology* **517**
- [12] Druvesh K M, Praful M U and Aditya M V 2016 *RR Journal of Pure and Applied Physics* **4** 3
- [13] Mahyat S T, Biswajeet P and Mustafa N J 2013 *Journal of Hydrology* **504**
- [14] Nektarios N K and George P K 2017 *Science of the Total Environment* **601-602**
- [15] Joy S and Lu X X 2006 *Singapore Journal of Tropical Geography* **27**
- [16] Ajin R S, Krishnamurthy R R, Jayaprakash M and Vinod P G 2013 *Advances in Applied Science Research* **4** 3
- [17] Buechele B, Kreibich H, Kron A, Thieken A, Ihringer J, Oberle P, Merz B and Nestmann F 2006 *Natural Hazards and Earth System Sciences* **6**
- [18] Benjamin K N 2000 *International Archives of Photogrametry and Remote Sensing XXXIII* Part B7
- [19] Statistics of Bone Bolango Regency 2016 *Bone Bolango Regency In Figures 2016* (Statistics of Bone Bolango Regency)

# Identification of Flood Prone Areas for Natural Disaster Mitigation using Geospatial Approach (A Case Study in Bone Bolango Regency, Gorontalo Province)

## ORIGINALITY REPORT

15%

SIMILARITY INDEX

11%

INTERNET SOURCES

4%

PUBLICATIONS

7%

STUDENT PAPERS

## PRIMARY SOURCES

1

[futur.upc.edu](http://futur.upc.edu)

Internet Source

2%

2

Submitted to Texas A & M University, Kingville

Student Paper

2%

3

[china.iopscience.iop.org](http://china.iopscience.iop.org)

Internet Source

2%

4

[docplayer.net](http://docplayer.net)

Internet Source

1%

5

[www.mdpi.com](http://www.mdpi.com)

Internet Source

1%

6

Submitted to Nanyang Technological University

Student Paper

1%

7

[eprints.perbanas.ac.id](http://eprints.perbanas.ac.id)

Internet Source

1%

8

Hanni Yolina, Edy Irwansyah, Rojali.

"Modelling Flood Prone Area in North America

1%

with Geomorphic Flood Index Method", 2022  
International Conference on Informatics  
Electrical and Electronics (ICIEE), 2022  
Publication

9	Submitted to Napier University Student Paper	1 %
10	setic.futminna.edu.ng Internet Source	1 %
11	e-journal.iaingorontalo.ac.id Internet Source	1 %
12	giesed2018.interconf.org Internet Source	1 %
13	www.allsubjectjournal.com Internet Source	1 %
14	www.tandfonline.com Internet Source	1 %
15	ntnuopen.ntnu.no Internet Source	<1 %
16	M. M. Yagoub, Aishah A. Alsereidi, Elfadil A. Mohamed, Punitha Periyasamy, Reem Alameri, Salama Aldarmaki, Yaqein Alhashmi. "Newspapers as a validation proxy for GIS modeling in Fujairah, United Arab Emirates: identifying flood-prone areas", Natural Hazards, 2020 Publication	<1 %



---

Exclude quotes      On

Exclude matches      Off

Exclude bibliography      On

# Identification of Flood Prone Areas for Natural Disaster Mitigation using Geospatial Approach (A Case Study in Bone Bolango Regency, Gorontalo Province)

GRADEMARK REPORT

FINAL GRADE

/0

GENERAL COMMENTS

Instructor

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5