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Effect of Changes in Land Use in Flood Disasters in Baleendah District, Bandung Regency

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ABSTRACT

Population growth and urbanization in Bandung Regency causes the need to increase. This encourages land conversion in open areas to become a built area to meet the needs of the community. Changes in land use avoid ecological imbalances between catchment areas and built areas. The flood phenomenon occurs in several districts in Bandung Regency every year, one of which is Baleendah District. The purpose of this study is to discuss changes in land use that occur in Baleendah District and discuss it with a flood disaster index. This study uses qualitative analysis of the exploration of secondary data and literature studies. Secondary data consisted of satellite image superimposition in 2003, 2006, 2009, 2013 and 2015. Then, the flood index used quantitative to increase the impact of the flood index that occurred in 2003, 2006, 2009, 2013 and 2015. Based on the results of the study, identified the existence of changes in flow in the river flow which increases the increase in the flood index.

Keywords: Land Use, Flood, and Baleendah.

1. Introduction

Baleendah District is one of the districts in Bandung Regency which is prone to flooding, especially when rainfall is high. Floods are defined as the inundation of an area that is normally dry due to overflowing of water that exceeds the capacity to store water and cause physical, social and environmental losses. Floods due to overflow of the Citarum River occur every year and are increasing and expanding over time.

Floods can be classified into two categories based on factors such as natural flooding and flooding due to human actions. This study will focus on flooding due to human actions, namely on the change of land into built-up land which results in flooding. This study was conducted to determine the effect of changes in land use into built land to the flood disaster index in Baleendah District. This study will use the periodicals in 2003, 2006, 2009, 2013 and 2015 so that changes in land use can occur and flood indexes occur.

2. Literature Review

2.1. Definition of Land Use

Land is a physical and biotic environment that is related to its carrying capacity towards the life and welfare of human life. The physical environment includes climate, soil, water, and

relief, while the biotic environment includes, humans, animals and plants that potentially affect land use¹.

Meanwhile, land use is the use of humans for land. So that land use (land use) can be interpreted as a form of human intervention in the land to meet their needs both materially and spiritually. General land use as an effort to plan land use includes the division of areas for certain functions depending on the ability of the land.

The purpose of land stewardship is based on Government Regulations No. 16/2004 concerning Land Stewardship is: a. regulate the control, use and utilization of land for various needs of development activities in accordance with the Regional Spatial Plan; b. realizing the mastery, use and utilization of land in accordance with the direction of regional functions in the Regional Spatial Plan; c. realizing orderly land which includes control, use and use of land including land maintenance and control of land use; and d. Guarantee legal certainty to control, use and utilize land for the community that has a legal relationship with land in accordance with the stipulated Regional Spatial Plan.

2.2. *Flood Disaster*

Floods are defined as the inundation of a place due to overflowing of water that exceeds the water discharge capacity in an area and causes physical, social and economic losses.² Flooding is a condition where water is not collected by a river or channel.

Floods are usually dry land phenomena that are flooded by water, this is caused by high rainfall and low topographic conditions. Furthermore, flooding can also be caused by runoff with volume exceeding the capacity of the river flow system or drainage system. Flooding is also caused by the low ability of soil infiltration which causes water not to be absorbed into the soil.

Factors in the occurrence of flooding can be classified into two categories, namely natural flooding and flooding due to human actions. Natural flooding is a flood caused by natural factors such as rainfall, physiography, erosion, sedimentation, river capacity, and the effects of tides. Whereas floods caused by human actions are caused by human activities that change environmental conditions such as changes in watershed conditions, damage to natural

¹ FAO. (1976). *A Framework for Land Evaluation. Soil Resources Management and Conservation Service Land and Water Development Division*. Roma: FAO Soil Bulletin No. 32. FAO- UNO

² Rahayu. Et al. (2009). *Banjir dan Upaya Penanggulangannya*. Bandung: Pusat Mitigasi Bencana (PMB-ITB)

vegetation (forest), drainage damage, changes in catchment areas to build areas, and improper planning of flood control systems.

2.3. Region Description

2.3.1. Overview of the Bandung Basin

The Bandung Basin is an urban area in West Java Province that has a basin-shaped topography of approximately 343,087 hectares. Urban Areas The Bandung Basin consists of Core Urban Areas and Urban Areas Surrounding the Metropolitan Area. The Bandung Basin Urban Area covers five administrative regions, namely Bandung City and Cimahi City as the core city, Bandung Regency, West Bandung Regency, and part of Sumedang Regency (Cimanggung, Tanjungsari, Sukasari, Jatinangor, Rancakalong, and Pamulihan).

The Bandung Basin is a basin surrounded by hills and mountains which are a catchment area for the Citarum River. Rivers flowing in the Bandung Basin can be grouped into several Watershed Sub-Areas (Sub-watersheds) namely Cihaur watershed, Cikapundung watershed, Citrarik sub-watershed, Cirasea sub-watershed, Cisangkuy sub-watershed, Ciwidey sub-watershed and Ciminyak sub-watershed.

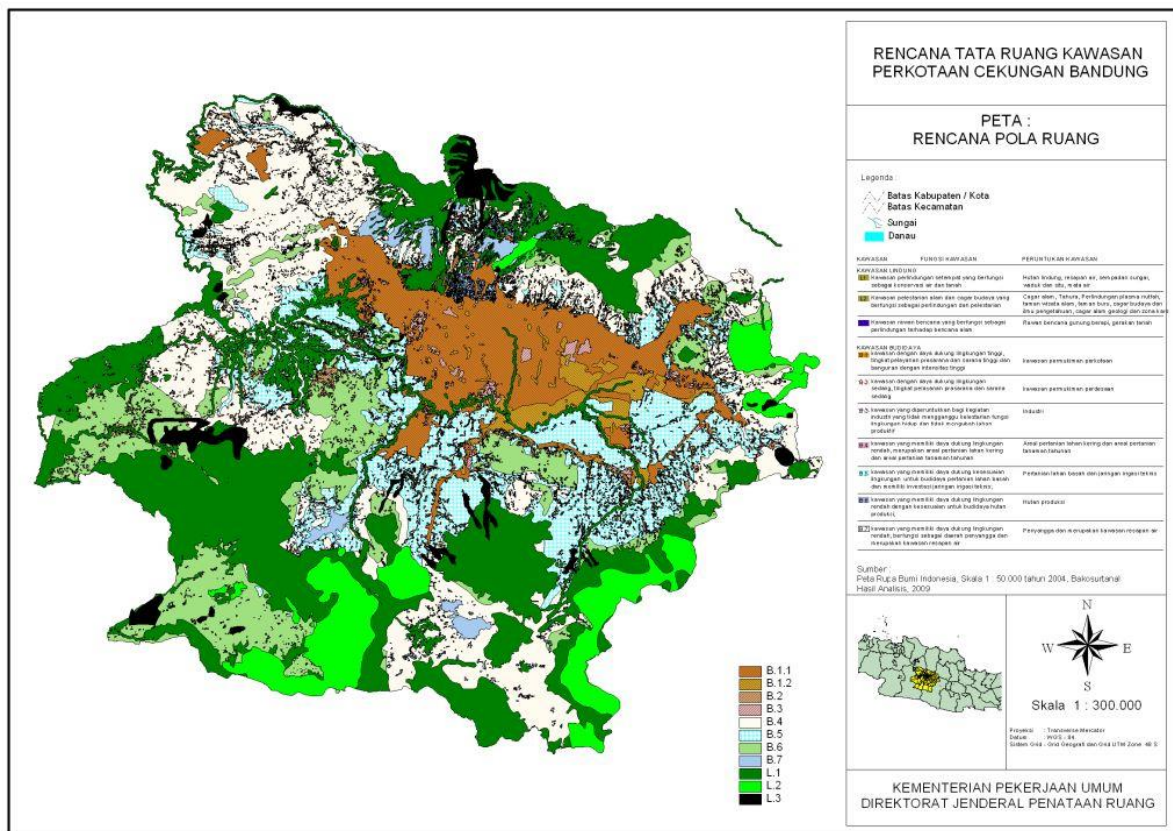


Figure 1 Spatial Planning for Bandung Basin Urban Areas
(Source: Ministry of Public Works Director General of Spatial Planning)

2.3.2 Overview of Bandung Regency

Geographical Conditions of Bandung Regency

Geographically, Bandung Regency is one of the districts in West Java Province. Topography is mostly in the area of Bandung Regency which is mountainous or hilly area with altitude above sea level that varies from 500 - 1,800 m. Bandung Regency is located at 6 ° 49' - 7 ° 18' South Latitude and between 107 ° 14' - 107 ° 56' East Longitude, with an area of Bandung Regency 176,238.67 Ha.

Administratively, Bandung Regency consists of eight Development Areas (DA) namely DA Soreang, DA Baleendah, DA Banjaran, DA Majalaya, DA Cicalengka, DA Cileunyi, DA Cimenyan-Cilengkrang, and DA Margasih-Margahayu, 31 sub-districts, and 276 sub-districts.

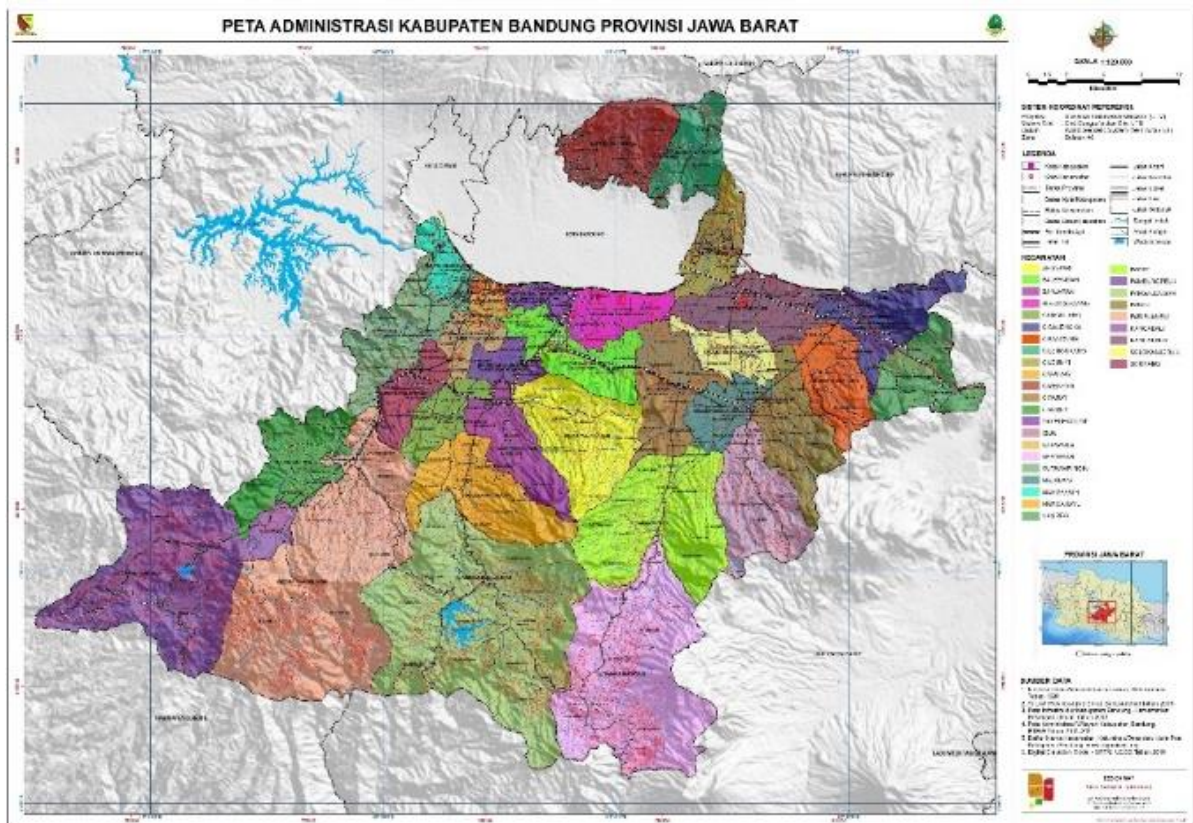


Figure 2 Map of Bandung Regency Administration

(Source:<https://petatematikindo.wordpress.com/2014/12/07/administrasi-kabupaten-bandung/>)

Bandung Regency Topographical Conditions

In general, the topographic conditions of Bandung Regency consist of two topographic units, namely the slope / ridge and valley / watershed. Most of the Bandung regency is mountainous. Among its peak peaks are: North side is Bukit Tunggul Mountain (2,200 m),

Tangkuban Perahu Mountain (2,076 m) on the border with Purwakarta Regency (both now included in the West Bandung Regency area). Whereas in the south there are Mount Patuha (2,334 m), Mount Malabar (2,321 m), and Mount Papandayan (2,262 m) and Mount Guntur (2,249 m), both on the border with Garut Regency.³

The plain of Bandung Regency lies wide in the central part of the Bandung Basin with a slope of 0 - 2% and 2 - 8% to the west and towards the Citarum River which divides the area from east to west. This area is a fertile area of rice fields, some of which are prone to flooding. Cities that are satellites and counterpoints (counter magnets) from the City of Bandung are located in this region.

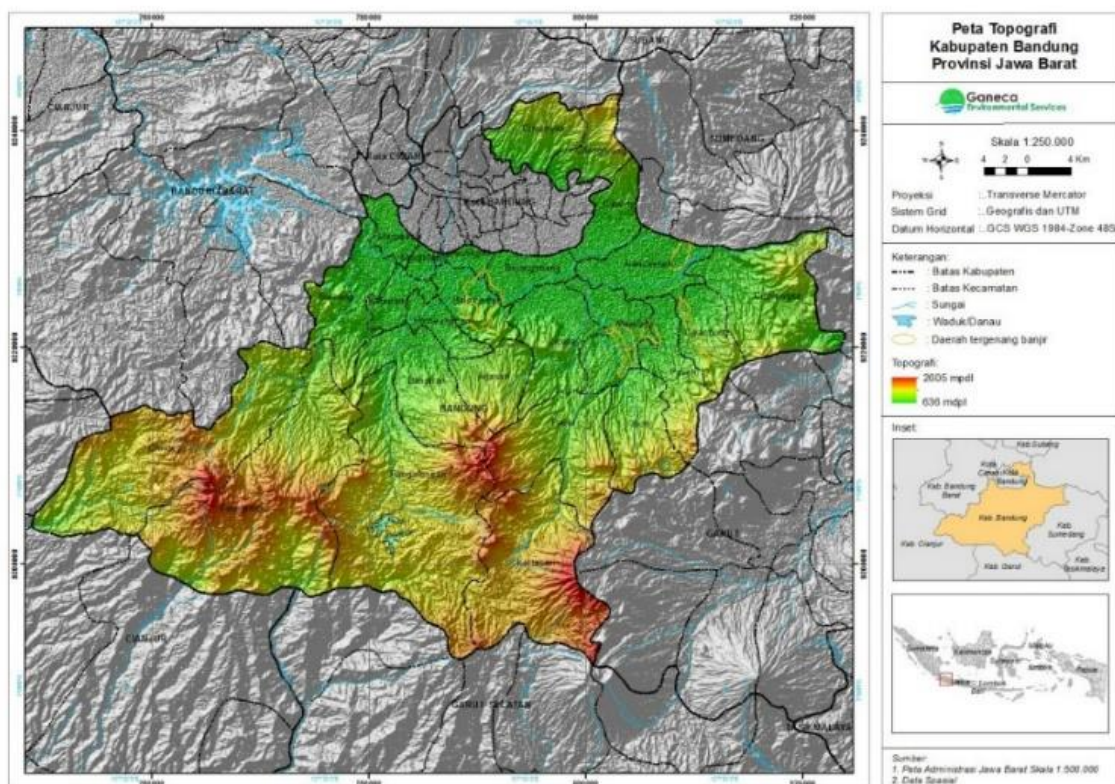


Figure 3. Topographic Map of Bandung Regency

(Source: Tonanga, Theresa. (2017) Bandung Regency Flood Area. <https://www.gesi.co.id/menelusuri-banjir-di-kabupaten-bandung/>)

2.3.2. Overview Baleendah District

Geographical Conditions of Baleendah District

Baleendah District has a strategic location in Bandung Regency. Astronomically Baleendah sub-district is located at coordinates 7 ° 13 ' - 7 ° 71' LS and 107 ° 31 ' - 107 ° 40' BT. While

³ Penyusunan Rencana Pengembangan Ekonomi Kreatif Kabupaten Bandung Tahun 2014-2019. Bappeda Kabupaten Bandung.

geographically the sub-district which has an area of 41.56 km² is located in the middle of Bandung Regency, with the northern part bordering Dayeuhkolot District, on the south bordering Pameungpeuk District and Arjasari District, on the west bordering Katapang District and on the east bordering Ciparay District.

Baleendah District consists of 5 villages and 3 villages namely Jelekong Village, Manggahang Village, Baleendah Village, Andir Village, Malakasari Village, Bojongmalaka Village, Rancamanyar Village, and Wargamekar Village. The condemnation of Baleendah is located at an altitude of around 680 masl to 715 masl.

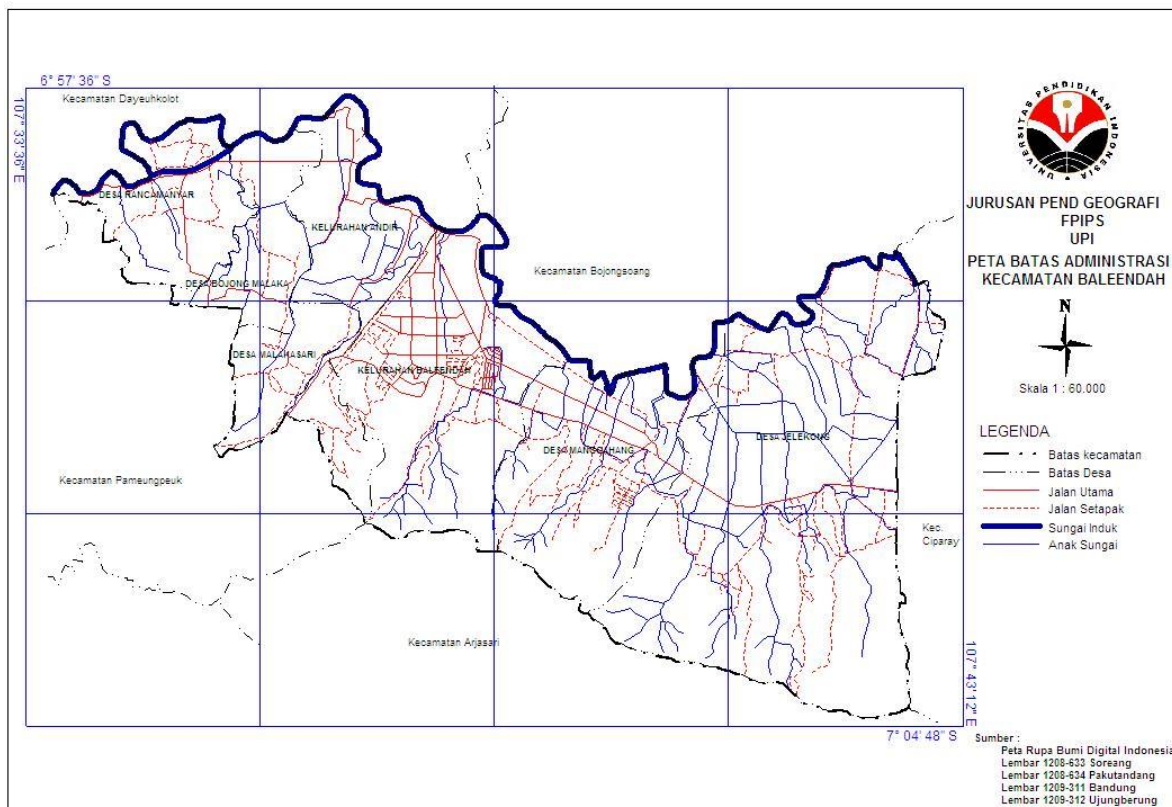


Figure 4 Administrative Map of Baleendah District

(Source: Damayanti, Arini D. (2012) Analysis of Tourist Characteristics and Tourist Perception Regarding Tourism Facilities in Batu Malakasari Village, Bandung Regency. Bandung: UPI)

Morphological Conditions of Baleendah District

Baleendah Sub district is one of the sub-districts in Bandung regency which is passed by the Citarum River which is the longest river in West Java. In addition, the Baleendah sub-district is also crossed by the Cisangkuy River, so this region has great potential in the agricultural sector and other sectors.

Morphologically, most of the Baleendah District is located at the bottom of the Bandung Basin. The character of the Citarum watershed (2011) resulted in around 1,651.5 ha (39%) of the Baleendah area potentially being affected by flooding every year.

3. Research Methods

This study uses qualitative and quantitative methods related to flood disasters that occur in Baleendah District. The data used is secondary data in the form of BPBD reports, satellite imagery maps, journals, papers, sources from online, and newspapers. The data is used as the basis for the analysis considered to support the purpose of this study.

Data processing on land use changes is done by taking pictures of Satellite Image Maps in 2003, 2006, 2009, 2013 and 2015 on a 1: 7000 scale with qualitative approaches. The image is then processed using the AutoCAD application to determine whether there is a change in land use into built-up land.

The next data processing is the flood disaster index that occurred in Baleendah District through qualitative approaching. The data used are secondary data from BPBD reports, sources from online, and newspapers. Data is processed based on parameters and classification. These results are then used to identify changes in the flood disaster index that occurred in 2003, 2006, 2009, 2013 and 2015.

4. Analysis and Results

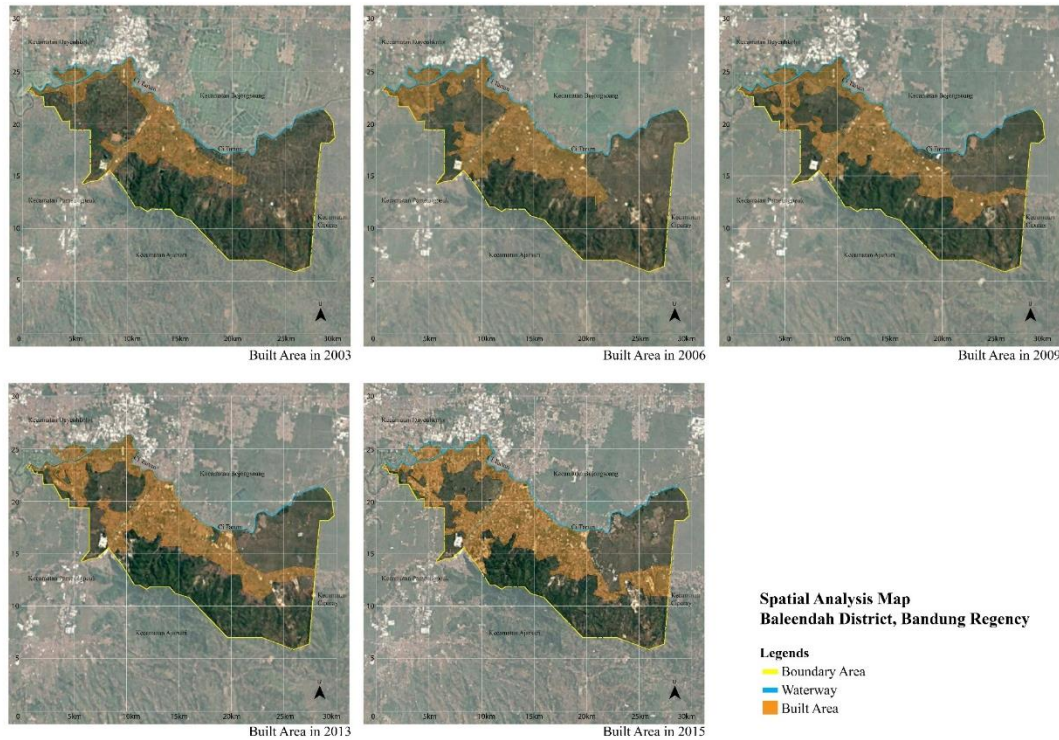
4.1 Changes in Land Use

Analysis of land use change uses spatial analysis and periodization from 2003, 2006, 2009, 2013 and 2015. Changes focused on built-up land in Baleendah District from that period.

Based on the results of the analysis, it was found that there were changes in land use from open land to built-up land that occurred from 2003-2015. Changes in land use occur mainly in riverbanks and creeks which cause an increase in density in the area and changes occur on the East side of Baleendah District. Through spatial analysis using superimpose of aerial photographs by measuring using the AutoCAD application, it is known that the area of change in the built up area is:

Table 1. Results of Analysis of Built-in Land Changes

Year	Area of Built-in Land	Percentage of Built Land
2003	8.95 km²	21.50%
2006	13.08 km²	31.27%
2009	13.89 km²	33.21%
2013	14.09 km²	33.68%
2015	16.07 km²	38.42%



Source: Results of Author Analysis

4.2 Flood Disaster Index at Baleendah

Analysis of the flood disaster index in Baleendah Subdistrict was based on rainfall characteristics data, namely inundation height, inundation duration, and inundation frequency in one year of occurrence. Data on height, duration and frequency uses secondary data from ring letters and Bandung BPBD reports, which are then classified into three classes.

The flood disaster index was analyzed based on three flood characteristics parameters in accordance with Table 2. The flood hazard level was divided into three classes, namely low, medium and high.

Table 2. Weight and class classification for flood disaster index

Parameter	Weight	Classification	Value
Frequency	30%	<1 times	1
		1 – 3 times	2
		> 3 times	3
Duration	30%	< 30 minute	1
		30-60 minute	2
		> 60 minute	3
Depth	40%	< 50 cm	1
		50-100 cm	2
		>100 cm	3

Source: Arfiana, et al. (2016, has been reprocessed)

The flood disaster index in Baleendah District from 2003-2015 can be seen in Table 3. Based on Table 3, the flood disaster index increased from 2003 to 2015. The lowest index was 1, namely in 2003. In 2003, frequency, duration and depth inundation is included in the low class. In 2006 and 2009 the flood disaster index was of moderate class. This year, there was an increase in the frequency of flooding, namely in 2006 and 2008, the frequency and depth were classified into the middle class, while the duration was classified into the high class. The high class disaster index was found in 2013 and 2015. In 2013 the duration and depth were classified into the high class, but the frequency was classified into the medium class. Whereas in 2015, the frequency and duration were classified into the high class and the inundation depth included the medium class.

Table 3. Results of Flood Disaster Index Analysis

Year	Total	Index	Level
2003	1	1	Low
2006	2.3	2	Medium
2009	2.3	2	Medium
2013	2.7	3	High
2015	2.6	3	High

Based on the analysis above, it was found an increase in the flood disaster index that occurred in Baleendah Sub district.

4.3 Results

One of the things that triggers flooding according to Chapin (1995) is the reduction in land that functions as water absorption. Based on the results of the study, Baleendah District

experienced changes in land use from open land to built land. From 2003-2015, there was an increase in built-up land of 7.12 km².

Changes in land cover have an impact on changing hydrological properties such as flow coefficient, flow rate and flow hydrograph characteristics. The function shift of land influences changes in flood discharge through the ability of the soil to absorb rainwater. This change also causes a reduction in surface runoff and accelerates the flow of water towards the river channel.

Water that directly flows into the river channel causes additional water discharge in a short time. If the river discharge exceeds the capacity of food can cause flooding, generally occurs during the rainy season. This is in line with the condition of Baleendah which experienced an increase in built up land so that the flood index increased.

5. Conclusions and Recommendations

Based on the results of data processing and analysis, it can be seen that there is an increasing trend in the frequency, duration and depth of floods that occur. The increasing trend of built-up land has an influence or contribution to the increase in the frequency, duration and depth of floods that occur in Baleendah District, Bandung Regency.

Overall and sustainable handling of floods is the duty and responsibility of all parties, both technical agencies and other related institutions and communities. Regional and City spatial planning and collaborative efforts of various parties and regions are expected to contribute to the management of flood disasters, especially to minimize the possibility of negative impacts that occur and to utilize the potential and opportunities available in the flood disaster area while taking into account the conditions of the local community.

This study is limited to identifying the effects that occur on land change. This study can be developed for further studies, namely knowing the relationship and influence of land built on the potential for flooding.

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