JURTEKSI (Jurnal Teknologi dan Sistem Informasi) ISSN 2407-1811 (Print)
Vol. IX No 2, Maret 2023, hlm. 151 - 160 ISSN 2550-0201 (Online)
DOI: https://doi.org/10.33330/jurteksi.v9i2.1666
Available online at http://jurnal.stmikroyal.ac.id/index.php/jurteksi

ANALYSIS AND FORECASTING LEVELS OF FLOOD SEVERE IN PONTIANAK CITY USING ARCGIS

Ludovicus Manditya Hari Christanto[1], Firda Islamaya Farhan[1*], Ahmad Cahyono Adi[2]
[1]Pendidikan Geografi, UniversitasTanjungpura
[2]SistemInformasi, UniversitasTanjungpura
email: *f1241201008@student.untan.ac.id

Abstract: Flood disasters often occur in areas with certain geographical conditions, such as proximity to rivers, high rainfall especially during the wetseason and soil types that contain clay so that they are not good enough to absorb water. One of the cities in Indonesia whichhas frequent floods. The planned mitigation strategy must be more targeted so that it is more effective in tackling flood disasters. Therefore, mapping with Geographic Information Systems can be used to map areas that are prone to flooding specifically by combining spatial data on each predetermined parameter. Not only that, the integration of Geographic Information Systems and forecasting with multiple linear regression methods can predict the level of flood vulnerability based on the parameters determined in the following year. Based on the analysis that has been done, the areas in Pontianak City that are prone to flood disasters are spread over several subdistricts, namely East Pontianak District, Pontianak City District and parts of North Pontianak District.

Keywords: Flood vulnerability; Geographic Information System; Multiple Linear Regression

Abstrak: Bencana banjir seringkali terjadi di wilayah dengan kondisi geografis tertentu sepertijaraknya yang dekat dengan sungai, curah hujan cukup tinggi khususnya pada musim hujan hingga mayoritas jenis tanah yang memiliki kandungan lempung sehingga tidak cukup baikdalam menyerap air. Kota Pontianak merupakan satu diantara kota di Indonesia yang sering dilanda bencana banjir. Oleh karena itu, pemetaan dengan Sistem Informasi Geografis dapat digunakan untuk memetakan wilayah-wilayah yang rawan bencana banjir secara spesifik dengan menggabungkan data spasial pada setiap parameter yang sudah ditentukan. Tidak hanya itu, integrasi sistem informasi geografis dan peramalan dengan metoderegresi linier berganda dapatmemprediksi tingkat kerawanan banjir berdasarkan parameter yang ditentukan pada tahun berikutnya. Berdasarkan analisis yang telah dilakukan, daerah di Kota Pontianak yang rawan bencanabanjir tersebar di beberapa kecamatan yaitu Kecamatan Pontianak Timur, Kecamatan Pontianak Kota dan sebagianKecamatan Pontianak Utara.

Kata kunci: Kerawanan Banjir; Regresi Linier Berganda; Sistem Informasi Geografis

JURTEKSI (Jurnal Teknologi dan Sistem Informasi) ISSN 2407-1811 (Print)
Vol. IX No 2, Maret 2023, hlm. 151 - 160 ISSN 2550-0201 (Online)
DOI: https://doi.org/10.33330/jurteksi.v9i2.1666
Available online at http://jurnal.stmikroyal.ac.id/index.php/jurteksi

INTRODUCTION

Approximately 60% of Indonesia's territory is dominated by water areas and rainfall with a fairly high intensity has a variety of impacts, including the potential for catastrophic flooding in several areas. In addition, Indonesia has high rainfall so that during the rainy season, floods often occur in certain areas [1]. Stagnant water on dry land is caused by water discharge in rivers and drainage flows that are more than their capacity to flow. Human activity can be disrupted because the inundation is quite high and occurs over a long period of time. These disturbances include difficulties in terms of accessibility, damage to infrastructure and the spread of disease viruses[2]

One of the big cities in Indonesia that is often hit by floods is Pontianak City. Particularly during the rainy season, stagnant water and flooding have hit a number of locations in Pontianak City from 2016 to 2020. Rain with high intensity and geographical conditions traversed by rivers such as in Pontianak City will certainly increase the possibility of flooding in the area[3]. Several areas to a number of main roads in the capital city of West Kalimantan Province are also frequently inundated by floods with varying heights, ranging from 10 to 30 cm. This condition causes various losses, ranging from traffic jams, damage to infrastructure, to fatalities due to accidents on slippery roads and so on[4]

The problem of flood disasters that often occurs every year requires effective and more targeted efforts. Not only in the form of infrastructure improvements or planning for the construction of embankments, it is necessary to have a scale of priorities in determining which areas should be built first. Not only that, predictions of flood events in the following year will facilitate the government in formulating policies and solutions that are more effective in reducing the impact of losses due to flood disasters.

The instrument that functions to process and analyze spatial data into new data is a Geographic Information System[5] Determination of disaster-prone zoning is one of the new data that can be obtained through the use of Geographic Information Systems. Mapping of disaster-prone zoning including floods in an area is processed using spatial data from each predetermined flood parameter. Utilization of Geographic Information Systems in combining spatial data on specified flood parameters can identify and analyze areas that have the potential to flood in an area such as Pontianak City. By knowing areas that have a higher potential for flooding compared to other regions, the government can formulate policies and strategies for flood mitigation that are more effective and on target[6]

In addition to knowing the flood-prone zones or areas in Pontianak City, it is also important to know the conditions or levels of future flood-proneness so that mitigation strategies can be more relevant to the possibility of a disaster occurring. The technique used to predict a condition in the next time based on current or past conditions with a mathematical model is Forecasting. Forecasting functions as a basic action for a person or an institution to develop a strategy to deal with future conditionsPrasetyo [7] et al.,. There are several methods that can implement forecasting in predicting certain conditions in the future. One of them is the Multiple Linear Regression method[8]

JURTEKSI (Jurnal Teknologi dan Sistem Informasi) ISSN 2407-1811 (Print)
Vol. IX No 2, Maret 2023, hlm. 151 - 160 ISSN 2550-0201 (Online)
DOI: https://doi.org/10.33330/jurteksi.v9i2.1666
Available online at http://jurnal.stmikroyal.ac.id/index.php/jurteksi

The Multiple Linear Regression method can make predictions under specified conditions over a period of months to years. Integration between spatial data processing with Geographic Information Systems and flood-prone predictions by forecasting using the Multiple Linear Regression method can present data on flood-prone areas in Pontianak as well as predictions of flood-proneness in the coming year. This aims to facilitate the government and related institutions in developing effective and targeted flood disaster mitigation policies and strategies in Pontianak City.

METHOD

The method in this research is qualitative analysis in interpreting map results. This analysis utilizes certain tools and materials in the form of software and hardware, namely spatial data and attributes. The overlay method and giving weights or scores are used for each existing parameter, namely Rainfall, Soil Height, River, Land Use and Soil Type. The spatial data and attributes will be processed using ArcGIS 10.8 software.

The data used in this study are Shapefile data of river maps, land elevation, and rainfall in the city of Pontianak as map analysis data and non-spatial data of Pontianak city rainfall (2018-2020), humidity data (2018-2020), and data temperature (2018-2020) Pontianak City.

For forecasting or predicting flood hazard in Pontianak City, the method used is multiple linear regression method. The multiple linear regression method is a regression analysis which explains the correlation between the variable to be predicted (the dependent variable) and more than one influencing variable (the independent variable). The following is a multiple linear regression formula.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k$$

Y = dependent variable
X_i = independent variable (i +1,2,4,...,k)
β_0 = intersep
β_i = regression coefficient
(1)

Analysis of the level of vulnerability to flooding uses a mathematical calculation with the following formula:

Flood Vulnerability Formula

$$x = \sum (Wi \times Xi)$$

x = Vulnerability value
Wi = Weight for parameter i
Xi = Class score for parameter I
(2)

RESULT AND DISCUSSION

Mechanism for Compiling a Flood Vulnerability Map in Pontianak City

Overlay analysis is used by researchers to determine the level of vulnerability to flooding from the specified parameters. The parameters that can be used in determining flood vulnerability are rainfall intensity, land cover and soil texture [9]. In addition, the area's distance to the river affects the level of flood vulnerability in the area (Kusumo & 'Nursari, 2016). Giving a score to each parameter is done before the overlay or overlay method. The level of vulnerability to flooding is determined by the greater the total score for each parameter, the greater the level of vulnerability to flooding in the study area.

Pontianak City Administration

The location of this research was conducted in Pontianak City, West

JURTEKSI (Jurnal Teknologi dan Sistem Informasi) ISSN 2407-1811 (Print)
Vol. IX No 2, Maret 2023, hlm. 151 - 160 ISSN 2550-0201 (Online)
DOI: https://doi.org/10.33330/jurteksi.v9i2.1666
Available online at http://jurnal.stmikroyal.ac.id/index.php/jurteksi

Kalimantan. Pontianak City is the capital of West Kalimantan Province. Pontianak City has administrative boundaries which are divided into 6 sub-districts, namely West Pontianak District, Pontianak Kota District, South Pontianak District, Southeast Pontianak District, East Pontianak District, and North Pontianak District. Furthermore, for administrative locations can be seen in Image 1.

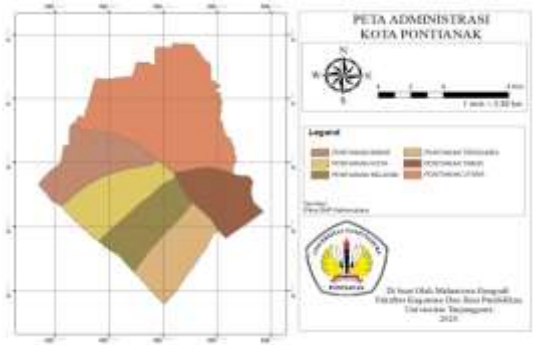

Image 1. Administrative Map of Pontianak City

Rainfall Intensity

The triggering factor for the flood of money affecting the amount of river flow discharge is rainfall. In this study, only Pontianak City rainfall data was used. There is only one class of rainfall, namely 1000 mm-1500 mm/month. Scoring is done to give a level value of the amount of rainfall that falls affecting the flow rate of the Kapuas River. Furthermore, the scoring steps can be seen in Table 1.

Table 1. Scoring of Rainfall Parameters

No.	Class	Score
1	>2500(Very Heavy)	5
2	2001-2500(Heavy)	4
3	1501-2000(Moderate)	3
4	1000-1500(Mild)	2
5	<1000(Very Mild)	1

Based on data from the Badan Pusat Statistik, the intensity of rainfall in Pontianak City in 2020 is 1000-1500 mm/year which is included in the dry category. From the results of adjustments to the scoring, a map of rainfall intensity in Pontianak City is obtained in Image 2.

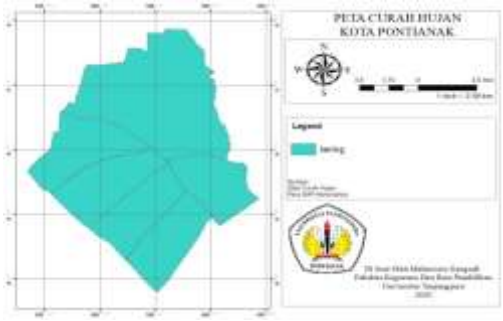

Image 2. Map of Rainfall Intensity in Pontianak City

Based on the Pontianak City Rainfall Map above, the location of this research was Pontianak City, West Kalimantan. Pontianak City has a dry rainfall intensity, reaching from 1000 mm-1500 mm/month. The distribution of rainfall on the map tends to be evenly distributed in all sub-districts in Pontianak City.

Distance to River

To determine the distance of the area to the river specifically, a buffering process is carried out. Buffering function to form new spatial data in the form of circles or polygon lines at certain points or lines. Each polygon generated from the buffering process will be weighted according to its level. The process of buffering the proximity of the river, because the river becomes the flattest area before the sea becomes a channel for flowing water as well as a natural reservoir for water. Areas adjacent to rivers with distances below 50 m from the river are very vulnerable, 50 m-100 m are still vulnerable and above 100 m can be said to be safe from flooding. The next scoring step can be seen in Table 2.

JURTEKSI (Jurnal Teknologi dan Sistem Informasi) ISSN 2407-1811 (Print)
Vol. IX No 2, Maret 2023, hlm. 151 - 160 ISSN 2550-0201 (Online)
DOI: https://doi.org/10.33330/jurteksi.v9i2.1666
Available online at http://jurnal.stmikroyal.ac.id/index.php/jurteksi

Table 2. Scoring Parameter of Distance to River

Distance	Score	Status
<50 m	3	Very Vulnerable
50 m – 100 m	2	Vulnerable
>100 m	1	Low Vulnerable

From the buffering process that has been carried out, the results are in the form of a River Buffer Map in Pontianak City which can be seen in Image 3.

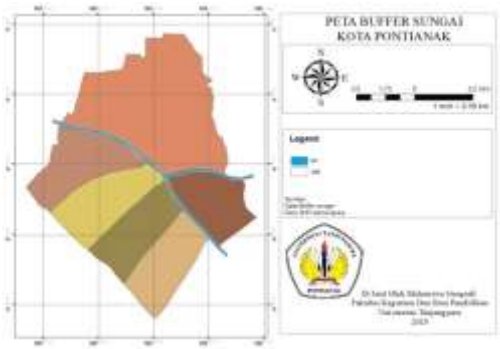

Image 3. Map of the Pontianak City River Buffer

Land Cover

The parameter that contributes to the absorption of surface runoff water is land cover. In this research area areas with land cover such as settlements have the highest score level, namely a score of 5. Residential land does not have a good ability to absorb water. Then, the area with the lowest score is vegetation, namely a score of 1. Land with a sufficient amount of vegetation is very good for carrying out the in-filtration process. Next, the scoring step is carried out, which can be seen in Table 3.

Table 3. Land Cover Parameter Scoring

Class	Score
Vegetation	1
Water Body	2
Open Field	3
Rice fields/Grass	4
Settlement	5

Based on data obtained from the Central Bureau of Statistics, the distribution of land cover in Pontianak City is shown in Image 4.

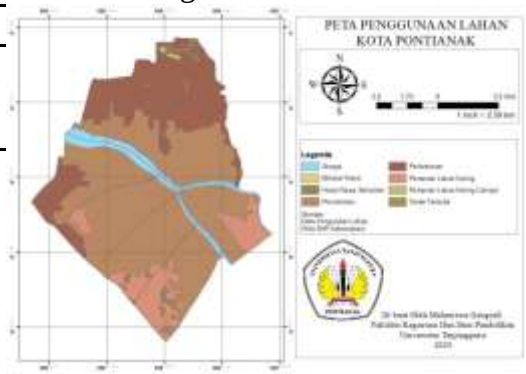

Image 4. Land Cover Map in Pontianak City

Soil Texture

Soil texture is the basis for determining the bocobenbot or score on soil type parameters. In the study area there are two types of soil, namely alluvial soil and entisol (peat) soil type based on the equivalent of the National Soil Classification (BBSDLP) with the 2014 Soil Taxonomy (Subardja et al, 2014). Next is the classification of soil type classes and scores in Table 4.

Table 4. Soil Texture Parameter Scoring

Class	Score
Sand	1
Loamy Sand	2
Clay	3

From the results of the scoring, a Map of Soil Texture Distribution in Pontianak City was obtained which can be seen in Image 5.

Image 5. Soil Texture Map of Pontianak City

JURTEKSI (Jurnal Teknologi dan Sistem Informasi) ISSN 2407-1811 (Print)
Vol. IX No 2, Maret 2023, hlm. 151 - 160 ISSN 2550-0201 (Online)
DOI: https://doi.org/10.33330/jurteksi.v9i2.1666
Available online at http://jurnal.stmikroyal.ac.id/index.php/jurteksi

Based on the Pontianak City soil texture map above, the location of this research was Pontianak City, West Kalimantan. Based on the soil texture on the map above, it is known that most of the soil texture in Pontianak City, namely alluvial, is clay in nature and the least is littoral (Peat) which is sandy in nature.

Map of Flood Vulnerability in Pontianak City with the Overlay Method

Through an analysis of the parameters that have been described and their distribution, it is possible to identify flood-prone areas in Pontianak City. Modification of flood hazard class is based on the highest total score for each parameter. In this study, flood-prone areas are classified into 3 classes. Next, the following is a classification of flood hazard in Table 5.

Table 5. Classification of Flood Vulnerability in Pontianak City

Class	Score
<8	Low Vulnerable
8-11	Vulnerable
>11	High Vulnerable

From the results of the overlay process and scoring for each parameter, a Flood Hazard Map in Pontianak City is obtained which can be seen in Image 6.

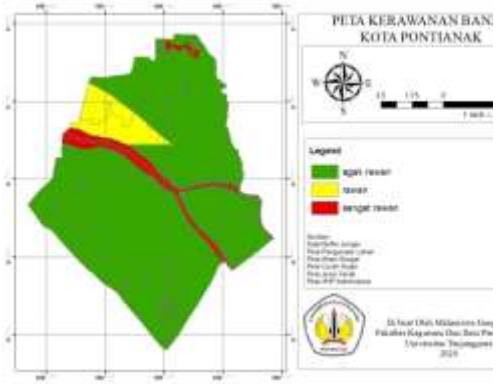

Image 6. Flood Hazard Map in Pontianak City

Based on the Flood Vulnerability Map in Pontianak City, most areas in Pontianak City are categorized as somewhat prone to flooding. These areas are quite far from the river but most of them are covered by settlements with alluvial clay soil types that are not good enough to absorb water. Meanwhile, in the vulnerable category, it is found in parts of the North Pontianak District, to be precise in the Batulayang District. The area is adjacent to a river, but part of the area is covered by plantations with littoral soil types that tend to have a sandy texture, so they absorb water quite well. The categories are very vulnerable to spread in several areas, especially those on the banks of rivers. These areas are part of North Pontianak District, namely in SiantanHilir Village and Central Siantan Village, parts of West Pontianak District, namely in Sungai Beliung Village and Sungai JawiDalam Village, parts of East Pontianak District, namely a small part of Saigon Village and Parit Mayor Village and parts of the Southeast Pontianak District, namely in parts of the Bangka Belitung Laut Village.

Flood Disaster Prediction Mechanism in Pontianak City

Rainfall prediction analysis is carried out to determine the amount of rainfall in the next few years. This analysis uses SPSS software to obtain modeling from multiple linear regression analysis. The parameters used for prediction of rainfall are temperature and humidity parameters with a range of 2018-2020.

By including temperature and humidity variables as parameters and rainfall as outcome variables, the results of multiple linear regression analysis with SPSS are presented in Image 7, 8 and 9.

JURTEKSI (Jurnal Teknologi dan Sistem Informasi) ISSN 2407-1811 (Print)
Vol. IX No 2, Maret 2023, hlm. 151 - 160 ISSN 2550-0201 (Online)
DOI: https://doi.org/10.33330/jurteksi.v9i2.1666
Available online at http://jurnal.stmikroyal.ac.id/index.php/jurteksi

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,252[a]	,064	-,144	2067,16651

a. Predictors: (Constant), V3, Rata-rata Kelembaban (Persen)

Image 7. Model summary of multiple linear regression analysis of rainfal

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2614876,547	2	1307438,274	,306	,744[b]
	Residual	38458596,370	9	4273177,374		
	Total	41073472,917	11			

a. Dependent Variable: VAR00004
b. Predictors: (Constant), V3, Rata-rata Kelembaban (Persen)

Image 8. ANOVA of multiple linear regression analysis of rainfall

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	62439,649	78605,561		,794	,447
	Rata-rata Kelembaban (Persen)	-272,056	499,372	-,209	-,545	,599
	V3	-1341,498	1749,094	-,294	-,767	,463

a. Dependent Variable: VAR00004

Image 9. Coefficients of multiple linear regression analysis of rainfall

Based on the results of the analysis, the rainfall parameters can be projected using the model that has been obtained. The parameters used in the analysis of the level of flood vulnerability are the annual rainfall level, the height of the soil and the river buffer in the following scoring table 6,7,8.

Table 6. Rainfall Parameters

No.	Class	Score
1	>2500(Very Heavy)	5
2	2001-2500(Heavy)	4
3	1501-2000(Moderate)	3
4	1000-1500(Mild)	2
5	<1000(Very Mild)	1

Table 7. Soil Height

No.	Class	Score
1	0 m – 20 m	5
2	21 m – 50 m	4
3	51 m – 100 m	3
4	101 m – 300 m	2
5	>300 m	1

Table 8. River Buffer Parameters

No.	Class	Score
1	61,5%-100%(Very Vulnerable)	5
2	50,1%-51,4%(Vulnerable)	4
3	32,1%-50%(Moderate)	3
4	17,7%-32%(Low Vulnerable)	2
5	0%-17,6%(Very Low Vulnerable)	1

Then each parameter is weighted with the weight table in Table 9

Table 9. Parameter weights

No.	Class	Weight
1	Rainfall	0.4
2	Soil Height	0.35
3	River Buffer	0.25

After carrying out the weighting process, a flood vulnerability level score is then made based on the weighted attributes in Table 10.

Table 10. Flood Vulnerability Score

No.	Flood Vulnerability Class	Score
1	Low Vulnerable	<3
2	Vulnerable	3-<3,4
3	High Vulnerable	>3,4

Furthermore, an analysis of the rainfall prediction is carried out to determine the amount of rainfall in several years. This analysis uses SPSS software to obtainmodeling from multiple linear regression analysis. The parameters used for rainfall prediction are temperature and humidity, ranging from 2018-2020.

Calculations are made by performing mathematical calculations based on some of the data that has been

JURTEKSI (Jurnal Teknologi dan Sistem Informasi) ISSN 2407-1811 (Print)
Vol. IX No 2, Maret 2023, hlm. 151 - 160 ISSN 2550-0201 (Online)
DOI: https://doi.org/10.33330/jurteksi.v9i2.1666
Available online at http://jurnal.stmikroyal.ac.id/index.php/jurteksi

obtained. Table 11,12,13 and 14 are parameter data. calculation of the flood vulnerability level

Table 11. Soil Height

No.	District	Height
1	Pontianak City	7 meters
2	West Pontianak	6 meters
3	East Pontianak	7 meters
4	North Pontianak	6 meters
5	South Pontianak	7 meters

Table 12. River Buffer

No.	Districs	Wide (km^2)	Length of Riv-er per District	Persentage (%)
1	Pontianak City	15,51	12,72	82,011
2	West Pontianak	16,71	5,99	35,85
3	East Pontianak	8,78	10,23	116,51
4	North Pontianak	37,22	10,91	29,31
5	South Pontianak	15,54	2,1	14,44

Table 13. Average Rainfall in Pontianak (2018-2020)

No.	District	Average Rainfall (2018)	Average Rainfall (2019)	Average Rainfall (2019)	Average Annual Rainfall
1	Pontianak City	234,65	112,56	225	190,7366667
2	West Pontianak	345,67	234,56	785,23	455,1533333
3	East Pontianak	457,45	234,34	123,56	271,7833333
4	North Pontianak	345,34	345,56	144,55	278,4833333
5	South Pontianak	123,45	454,34	512,34	363,3766667

Table 14. Prediction of Flood Vulnerability in Pontianak

No.	District	Rain-fall	Soil Height	River Buffer	To tal	Description
1	Pontianak City	0,4	1,75	1,25	3,4	Vulnerability
2	West Pontianak	0,4	1,75	0,75	2,9	Low Vulnerability
3	East Pontianak	0,4	1,75	1,25	3,4	Vulnerability
4	North Pontianak	0,4	1,75	0,5	2,5	Low Vulnerability
5	South Pontianak	0,4	1,75	0,25	2,4	Low Vulnerability

By using the model that has been obtained, the analysis for the following year can be carried out by predicting the annual rainfall level, which is then car-

ISSN 2407-0769
e-ISSN 2549-4694

ried out by calculating the existing parameters. Land height and river buffer tend to be constant so that the forecasted parameters are rainfall parameters with dynamic data every year.

CONCLUSION

Pontianak City is one of Indonesia's major cities that is vulnerable to flooding. This is because rivers go through geographical conditions where settlements predominate the land cover, and the soil is primarily clay-textured, which is poor at absorbing water

Based on the Flood Vulnerability Map in Pontianak City and the results of the analysis from the overlay and forecasting methods, several areas in Pontianak City that are identified as prone to flooding are spread across several subdistricts, namely Pontianak Kota District, East Pontianak District and parts of North Pontianak District. Even though they have the same average rainfall, the type of soil, the type of land cover and the distance to the river are several parameters that differentiate the level of vulnerability in each sub district.

BIBLIOGRAPHY

[1] A. Findayani and S. Artikel, "KESIAP SIAGAAN MASYARAKAT DALAM PENANGGULANGAN BANJIR DI KOTA SEMARANG," 2015.

[2] A. 'Rosyidie, "Banjir: Fakta dan Dampaknya, Serta Pengaruh dari Perubahan Guna Lahan ," *Jurnal Perencanaan Wilayah dan Kota*, vol. 24, no. 3, pp. 241–249, 2013.

[3] S. Hotlan Sitorus, D. Marisa Midyanti, J. Rekayasa Sistem Komputer, and F. H. MIPA Universitas Tanjungpura Jalan Hadari Nawawi Pontianak, "PRAKIRAAN DAERAH POTENSI RAWAN BANJIR DENGAN MENGGUNAKAN LOGIKA FUZZY TSUKAMOTO BERBASIS WEBSITE (STUDI KASUS KOTA PONTIANAK)."

[4] G. 'Hediyanti, R. 'Rianti, and P. 'Pynanjung A, "Perspective of the Application of Low Impact Development (LID) to Deal with Floods to Strengthen the Economic Structure of Pontianak City," *Jurnal Borneo Administrator*, vol. 18, no. 1, 2022.

[5] I. 'Garrido, H. 'Lorenzo, and P. 'Arias, "Use of Geographic Information Systems (GIS) in higher education: practical geomatics applications with Quantum GIS software," *Use of Geographic Information Systems (GIS) in higher education: practical geomatics applications with Quantum GIS software*, 2022.

[6] K. 'Uddin and M. A. 'Matin, "Potential flood hazard zonation and flood shelter suitability mapping for disaster risk mitigation in Bangladesh using geospatial technology," *Progress in Disaster Science*, vol. 11, 2021.

[7] A. Prasetyo and J. Teknologi Informasi dan Komputer Politeknik Negeri Lhokseumawe, "Prediksi Produksi Kelapa Sawit Menggunakan Metode Regresi Linier Berganda," *Multimedia & Jaringan*, vol. 6, no. 2, 2021.

[8] M. 'Flores-Sosa, E. 'Leon-Castro, J. M. 'Merigo, and R. R. 'Yager, "Forecasting the exchange rate with multiple linear regression and heavy ordered weighted aver-

ISSN 2407-0769
e-ISSN 2549-4694

age operators," *Knowl Based Syst*, vol. 248, 2022.

[9] Haryani, " Analisis Zona Potensi Rawan Banjir Menggunakan Data Penginderaan Jauh dan SIG di Kalimantan Timur," *Proceedings of the Seminar Nasional Penginderaan Jauh ke-4 Tahun.*, 2017.

[10] P. 'Kusumo and E. 'Nursari, "Zonasi Tingkat Kerawanan Banjir dengan Sistem Informasi Geografis pada DAS Cidurian Kab. Serang, Banten," *Satuan Tulisan Riset dan Inovasi Teknologi*, vol. 1, no. 1, 2016.