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Building Model of Flood Cases in Central Java Province using Geographically Weighted Regression (GWR)

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ABSTRACT

Indonesia is one of the countries hit by many disasters. During the last five years the disaster increased in the last year, namely in 2016. In terms of the types of disasters, most were floods. The flood disaster has the highest incidence rate in Central Java Province. Flood is a natural phenomenon where there is excess water which is not accommodated by drainage in an area. To be able to identify the risk of flooding that affects humans and their environment, it is necessary to know the causes. The causes of flooding can come from natural and non-natural factors. Seeing the high incidence of flooding in Central Java, the authors drew attention to research whether the factors that influence flooding in the province and how to model it by looking at the spatial effects in it using Geographically Weighted Regression (GWR) analysis. The results showed that the incidence of flooding using GWR analysis had four significant variables, namely rainfall, rainy days, humidity and area. From the model obtained, it has R2 of 56%, and has as many as six models of variables that are significant for each region.

I. Introduction

Indonesia is one of the countries hit by many disasters. During 2016 there were 2,369 disasters. A highest new record in recording disaster events since 2002. In comparison in 2016 there were 2,369 disasters, in 2015 there were 1,732 disasters, in 2014 there were 1,967 disasters, in 2013 there were 1,674 disasters, in 2012 there were 1,811 disasters. So that in this case it can be compared to the incidence of disasters in 2015 there was a 35 percent increase. As in the following Fig 1.

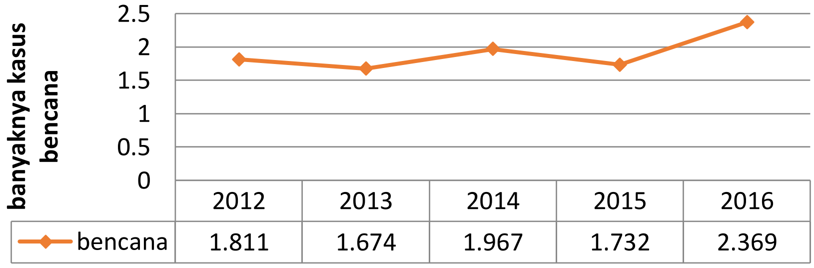

Fig 1: Disaster events in Indonesia in 2012-2016
Sources: [6]

According to the National Disaster Management Agency the types of disasters in Indonesia include earthquakes, tsunamis, volcanic eruptions, landslides, floods, droughts, hurricanes, tidal waves, technological failures, fires, acts of terror / sabotage, riots or social conflicts and epidemics, outbreaks and extraordinary events [5]. Fig 2 below is the classification of the 2016 disaster along with the presentation of the number of disasters.

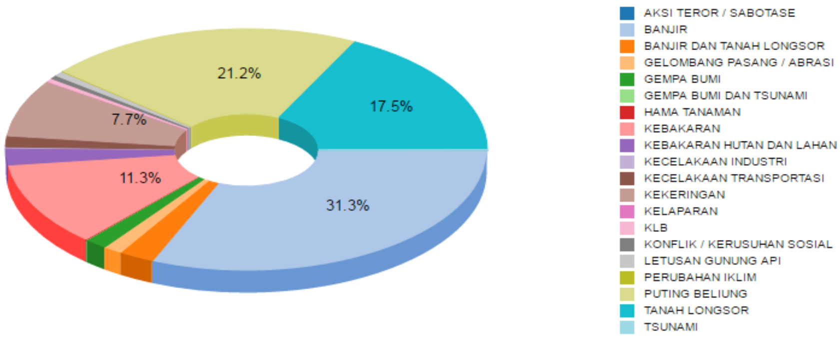

Fig 2: Types of Disasters in Indonesia
Sources: [8]

Of the 2,369 disasters around 31.1 percent were hydro-meteorological disasters dominated by floods followed by tornadoes and landslides. Throughout 2016 there were 1348 floods, 340 tornado disasters, 532 landslides, 102 floods in combination with landslides, 13 earthquake disasters, 7 disasters of erupting volcanic eruptions, and 23 tidal waves and several other disasters. The disaster caused 521 people died and disappeared, 316 million displaced and suffered, 48,776 houses were damaged where 9,484 were severely damaged, 10,382 were moderately damaged, 28,910 were slightly damaged and 2,311 units of public facilities were damaged. (BNPB, 2016). Fig 3 below is a flood event data that attacks all provinces in Indonesia.

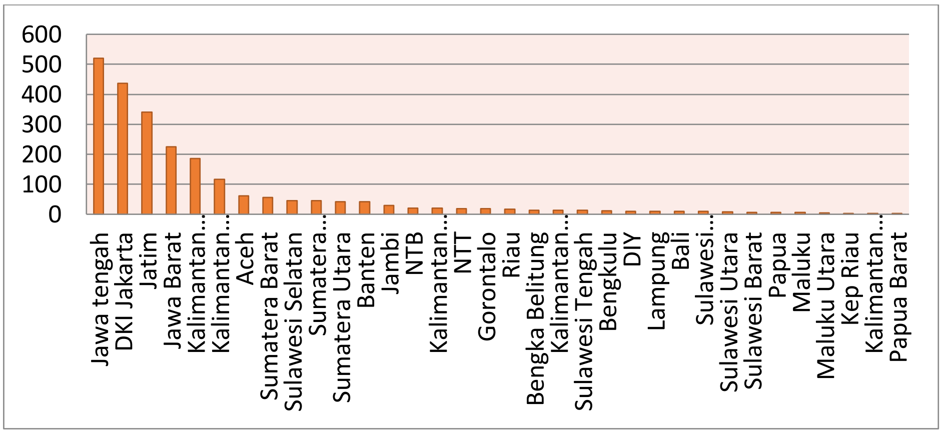

Fig 3: Number of Flood Events in Indonesia
Sources: [8]

It can be seen that based on Fig 3 above Central Java is a province that often experiences flooding with the highest number in the number of flood events in Indonesia. Central Java has a number of flood events in 2016 of 521 cases, followed by DKI Jakarta province which has 437 cases and East Java which has 341 cases and followed by other provinces [7]. Seeing the high incidence of flooding in Central Java, it is necessary to do research related to this. Some of the studies related to flood disasters include modeling of flood disasters in Indonesia (2002-2010 events)[16], besides that research on flood events was also on vulnerability factors which affected the floods in Manggala Sub-District, Makassar City[13].

Geographically Weighted Regression (GWR) is a spatial method that uses geographical factors as independent variables that can affect response variables. The GWR application has been used for modeling of external pneumonia factors in infants in East Java with the GWR approach [15]. While in this study (GWR) examined the external factors of flood events in Central Java by considering the spatial aspects. Information about the province of Central Java and flood events that have high values in this province attracted the attention of researchers to see how modeling of flood events in Central Java and what factors affected flooding in Central Java, so researchers took the title "Building Model of Flood Cases in Central Java Province using Geographically Weighted Regression (GWR)".

II. Literature Review

A. Profil of Central Java Provinces

Central Java is a province in Indonesia which is located in the central part of the island of Java which is flanked by West Java Province to the west and East Java to the east. The province is bordered by the Indian Ocean and Yogyakarta Special Region in the south and the Java sea in the north. The capital is the city of Semarang. The area of Central Java covers 32,548 km2, or about 28.94% of the total area of Java. The province of Central Java also includes the island of Nusakambangan in the south (close to the border of West Java), and the Karimun Islands of Java in the Java Sea.

Understanding of Central Java geographically and culture sometimes also covers the area of the Special Region of Yogyakarta. Central Java is known as the "heart" of Javanese culture. Nevertheless, in this province there are also other ethnic groups that have different cultures with Javanese, such as Sundanese in the border area with West Java. In addition there are also Chinese-Indonesian, Arab-Indonesian and Indian-Indonesian citizens spread throughout the province.

Administratively, Central Java Province consists of 29 regencies and 6 cities. District and city government administration consists of 545 sub-districts and 8,490 villages / kelurahan. Before the enactment of Law Number 22/1999 concerning Regional Government, Central Java also consisted of 3 administrative cities, namely the City of Purwokerto, the City of Cilacap, and the City of Klaten. But since the enactment of Regional Autonomy in 2001 the administrative cities were removed and became part of the district. Following regional autonomy, 3 districts moved the central government to their own territory, namely Magelang Regency (from Magelang City to Mungkid), Tegal Regency (from Tegal City to Slawi), and Pekalongan Regency (from Pekalongan City to Kajen).

The population of Central Java Province is 39,298,765 people consisting of 19,281,140 men and 19,989,547 women. Districts / cities with the largest population are Brebes Regency (2,342 million people), Cilacap Regency (2,227 million people), and Banyumas Regency (1,953 million people). Population distribution is generally concentrated in city centers, both districts and cities. Settlement areas that are quite dense are in the Semarang area (including Ungaran and parts of Demak and Kendal Regency), Salatiga area (including the Ambarawa, Bringin, Kopeng, Tengaran and Suruh areas), Solo (including parts of Karanganyar, Sukoharjo and Boyolali Regencies) , and Tegal, Brebes, Slawi. The population growth of Central Java Province is 0.67% per year. The highest population growth is in Demak Regency (1.5% per year), while the lowest is Pekalongan City (0.09% per year). Of this population, 47% are labor force. The most livelihoods are in the agricultural sector (42.34%), followed by trade (20.91%), industry (15.71%), and services (10.98%) [9].

B. Flood Control

Flood control includes planning activities, carrying out flood control work, exploitation and maintenance which are basically to control floods, as well as regulating the use of floodplain areas and reducing or preventing danger / losses due to flooding. [14] suggests that there are 4 (four) basic strategies for managing flood areas that include:

1. Modification of vulnerability and flood loss (zoning or land use arrangements).

2. Flood modification that occurs (reduction) with the help of a controller (reservoir) or river normalization.

3. Modification of the effects of flooding with the use of technical mitigation such as insurance, flood profing.
4. Regulations for increasing the capacity of nature to maintain sustainability such as reforestation.

C. Spatial data

Spatial data is geographically oriented data that has a certain coordinate system as its reference basis, so that it can be presented on a map. Spatial data can be obtained from various disciplines such as social, environmental and economic sciences. Spatial words come from the word space which means space. Spatial data has two important parts that make spatial data different from other data, namely location information (spatial) and descriptive information or non-spatial information, namely information relating to a location, such as poverty level, population, area, postal code, and so on [11].

Spatial data is data collected from different spatial locations and has a dependency between measurement of data and location. Spatial data is assumed to be normally distributed and has a spatial relationship to be spatially analyzed. At present spatial data is an important medium in planning, development and management of natural resource policy. The use of spatial data is increasingly developing due to the existence of technology and utilization in Geographic Information Systems (GIS). In general, the description / description used is in the form of a map or image with a digital format that has a certain coordinate point [10].

According to [10] explained that spatial data is measurement data that contains a location information and has certain coordinates as a reference basis so that it has geographic information in the data which contains four main components, namely:

a. Component of geographical position
   This component is a geographical coordinate system based on a mathematical model that can be transformed on another system. Geographical coordinates show the location of phenomena which are often depicted with the Cartesian coordinates, easting-northing or latitude-longitude.

b. Spatial component
   This component is a topological relationship between components of a spatial data entity such as the relationship between a point and a point, a point with a line, a point with a line area, a line with an area and an area with other areas. This relationship explains the relative position of a phenomenon, the causal link of the phenomena of direction, relevance, and so on.

c. Component attribute
   Component attributes are descriptive data from a spatial data object. Components of this attribute can be in the form of 6 tabular data, descriptive data (such as reports and censuses), images, graphics, even photos or videos. Attributes explain the quality of the quantity of phenomena.

d. Time component
   Time component is information phenomenon between time from the spatial data. The phenomenon is explained by comparing the same phenomena in different times from one time to another. This component provides an explanation of the various possibilities of changes and developments in the quality or quantity of spatial data.

D. Multiple Linear Regression

Multiple linear regression is a regression analysis that explains the relationship between the response variables with the factors that influence them more than one predictor [1]. In general, the equations of multiple linear regression models are as follows:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n + \varepsilon \quad (1)$$

with:

y: Response variable on observation
β 0: Constants
β I: Value regression coefficient increase or decrease
x: Predictor variable
n: Number of variables
ε: Residual

Multiple regression models can be obtained by first determining the estimator value of the parameters using several methods such as the least squares (Ordinary Least Square / OLS) or maximum likelihood Estimation / MLE method. Estimating the regression coefficient if the sample is known {(xi); i = 1,2, ..., n), with the following calculation [17].

$$\hat{\beta}_1 = \frac{n\ \sum_{i=1}^{n} xiyi - (\sum_{i=1}^{n} xi)(\sum_{i=1}^{n} yi)}{n \sum_{i=1}^{n} xi^2 - (n \sum_{i=1}^{n} xi)^2} \tag{2}$$

$$\hat{\beta}_0 = \frac{\sum_{i=1}^{n} yi - b(\sum_{i}^{n} xi)}{n} \tag{3}$$

E. Geographically Weighted Regression (GWR)

GWR is one of the spatial models with point vectors. GWR is the development of linear regression (OLS) into a weighted regression model by paying attention to spatial effects, so as to produce parameter estimators that can only be used to predict each point or location where the data is observed and inferred. The GWR model is a model that considers geographical factors as independent variables that affect the response variable. The assumption used in the GWR model is that errors are normally distributed with zero mean and variance (σ2) [11].

According to [12] in the GWR model the relationship between the response variable y and the predictor variable X1, X2, ..., Xp at the i location is:

$$y_i = \beta_0(u_i, v_i) + \beta_1(u_i, v_i)x_{1i} + ... + \beta_p(u_i, v_i)x_{pi} + \varepsilon_i, i = 1,2,...,n \tag{4}$$

with:

y_i	: Response variable at location i
(u_i,v_i)	: Coordinate the geographical location (longitude. Latitude) at the i-location
x_{pi}	: The fifth predictor variable to the i location
$\beta_p(u_i,v_i)$	: Parameters at i-location that are related to the independent variable p xpi.
$\beta_0(u_i,v_i)$	: GWR constant.
ε_i	: Error at the i-location point which is assumed to be independent, identical and normally distributed with the average value and variance σ2.

Linear regression is a global analysis that is different from the local GWR analysis. Where in linear regression all parameter values are assumed to be the same for each observation location point, so that it is single and applies to all different locations with GWR where the parameters for each location are different from other locations so that the parameter estimator is generated according to the number of locations used (multi-valued statistics).

III. Research Method

1. Research Population
   The population used in this study is the number of flood events in all cities / regencies in Central Java consisting of 6 cities and 29 districts.
2. Research Place and Time
   This research was conducted by taking the object of research in all cities / regencies in Central Java. The time of the study was the occurrence of floods in Central Java in 2016
3. Data Sources
   The data used in this study are secondary data obtained from
   a. Central Java Central Bureau of Statistics in 2016 with data on area size and population density.
   b. Central Java Meteorology and Geophysics Agency in 2016 with data on Rainfall and Rainy Days
   c. Central Java Regional Disaster Management Agency for 2015-2016 with data on the number of flood events
4. Research Variables
   The variables used in this study use two types of variables, namely the dependent variable (Y) and the independent variable (X) which are presented in the following:
   a. Number of Floods in Central Java in 2016 (Y)
   b. Population Density in all Central Java Cities and Districts (X1)
   c. Annual Rainfall in all Central Java Cities and Districts (X2)
   d. Rainy Day in one year throughout the City and Regency of Central Java (X3)
   e. Humidity throughout the City and Regency of Central Java (X4)
   f. Area in each City and Regency of Central Java which has been reduced by the area of the building (X5)
5. Research Process
   The Process of this research can be described as follows:
   a. Determination of the topic, The first step is to determine the topic. Researchers determine the right topic to study
   b. Literature study, The second step the researcher identifies the literature study related to the research that will be carried out in accordance with the determined topic
   c. Formulation of the problem, and purpose Based on the topics and literature that have been carried out by the researcher, the next stage is the formulation of any problem that will be analyzed and the purpose of the analysis of the problem. The researcher will get the problems and objectives of the topic specified
   d. Data search, In the steps of the researchers looking for data from the relevant agencies, namely BMKG, BPS and BNPB Central Java as well as determining the dependent and independent variables
   e. Input data for the analysis phase, In this stage the researcher inputs the data that has been obtained to begin the analysis. For the first analysis done is descriptive analysis
   f. Perform linear regression analysis with steps such as the following
      1. Estimating linear regression models
      2. Perform model significance tests
      3. Test assumptions for residual normality, multicollinearity, spatial autocorrelation and heteroscedasticity
   g. Perform a Spatial Test
      1. Conduct spatial tests on data with moran's where this is done to determine spatial autocorrelation
      2. Carry out a pagan breush test in which the test is to find out spatial heterogeneity data. If

this result is hetero, the next step is included in the GWR analysis

h. GWR Analysis
   1. Determine the model of a significant variable
   2. Determine R2
   3. Perform model significance tests
   4. Determine variables that affect an area
   5. Create thematic maps of variables that affect each region

i. Conclusion: The results of the analysis that have been reviewed by the researcher, will then be concluded. So that conclusions will be obtained from the research that has been done. This conclusion will answer from the problem formulation and research objectives

IV. Descriptive Flood Events and Factors that Influence

In this descriptive case a general description of the data or variables will be known by the researcher to analyze GWR. The benefits and objectives of this descriptive step are to provide information and information about a data or variable used in this study. Where the researcher used the variable number of flood events in Central Java as the response variable (Y) and the researcher used five predictor variables which included Population Density (X1), Rainfall (X2), Rainy Day (X3), Humidity (X4) and Area Area (X5)

In this study the data used are secondary data from several related agencies such as BPS, BMKG and BNPB Central Java. The observation unit of this study includes 29 districts and 6 cities in Central Java. Figure 5.1 is a descriptive or descriptive analysis of the variables that the researcher uses

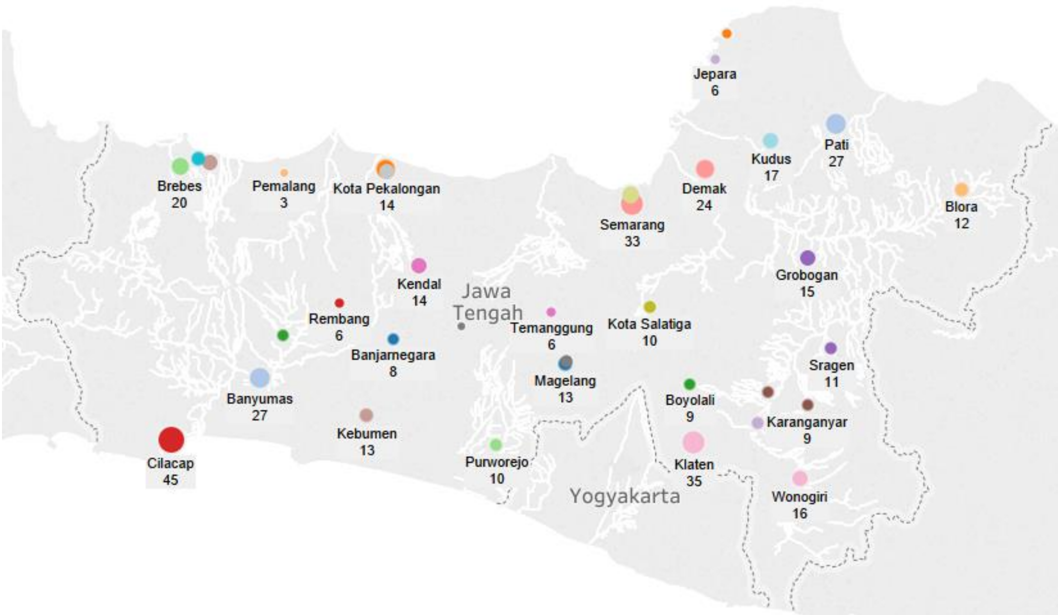

Fig 4: Flood Events in Central Java 2016

Based on Fig 4 above, it can be seen that in the dependent variable or response, that is, the incidence of floods in all the cities / regencies of Central Java in 2016 there were 521 cases, the highest incidence in Cilacap Regency was 45 events in one year, from several sources Berita (Kompas.com) most of the causes of flooding in Cilacap Regency are due to the intensity of rainy days which fall very often and heavily so that the river flows overflows. While in Pemalang Regency is the lowest flood incidence of 3 events in one year, this is because Pemalang is a high area and the river flow in Pemalang is quite extensive. Fig 5 below is an independent variable or predictor used by researchers, first is the independent variable population density

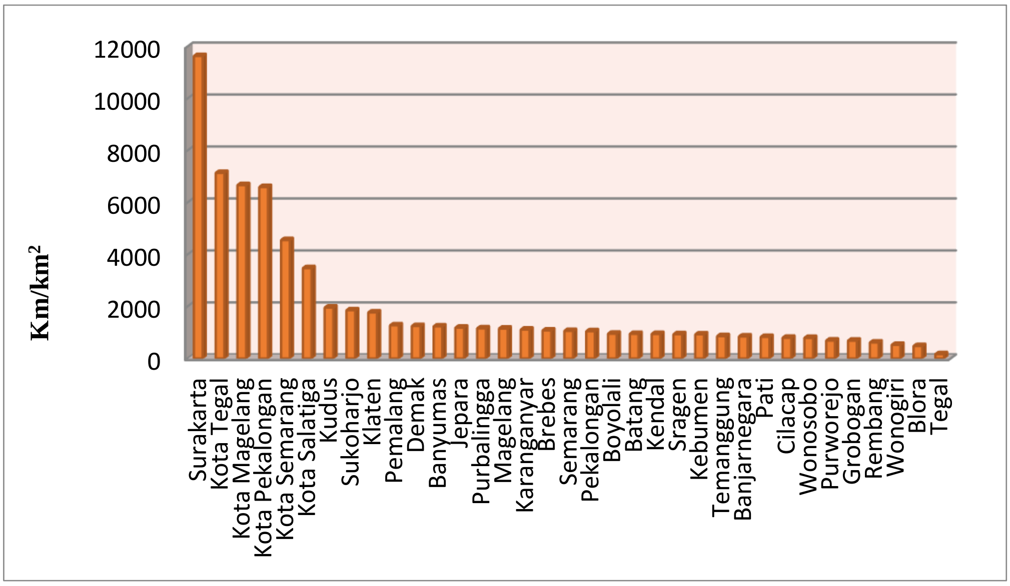

Fig 5: Population Density in Central Java 2016

Based on the Fig 5 population density in Central Java, it was found that high population density was 11,634 people / km2 owned by Surakarta City, according to BPS Surakarta the high population density was due to a number of things not being considered such as in planning population distribution, spatial planning and use land especially on land use which is more inclined to physical development will cause this city to suffer the same fate as DKI Jakarta. Whereas the lowest population density of 162 inhabitants / km2 is owned by Tegal Regency, stated by the occupation and civil registration services of Tegal Regency that Tegal Regency has a dynamic population, because of the large number of people migrating to the Capital Region. And also in the field of labor, the number of Tegal Regency labor force continues to experience an increase, this is not directly proportional to the number of jobs for that part of the workforce prefers marantau. Furthermore graph 5.2 is the second variable that the researcher uses, namely rainfall in 1 year in Central Java Province

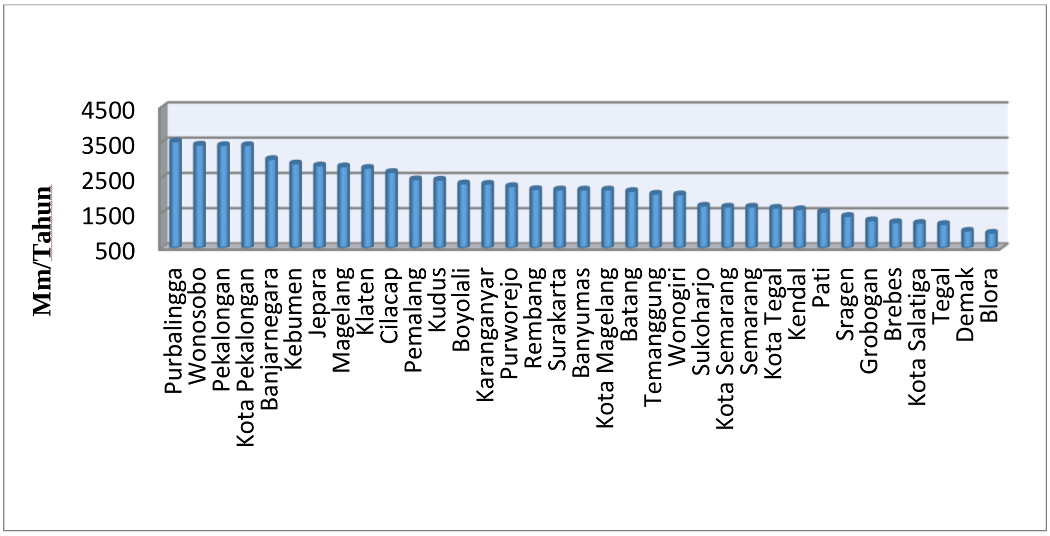

Fig 6: Rainfall in Central Java 2016

Based on Fig 6 above, it can be seen that the highest rainfall is found in Purbalingga Regency of 3521 Mm, according to the Profiles of Purbalingga Regency, this Regency is included in a tropical climate which has relatively high rainfall because Purbalingga is in a basin flanked by several mountain ranges. To the north is the mountain range of Mount Slamet and the Dieng Plateau, Purbalingga also has a relatively high altitude area which causes high rainfall. While the lowest rainfall is in Blora Regency of 927 Mm, because according to Blora Regency Government, this

Regency has a maximum height of 500 m above sea level. Rainfall recorded in this case is annual rainfall on Cities and Regencies in Central Java. Fig 7 below is the third variable that the researchers used was rainy days.

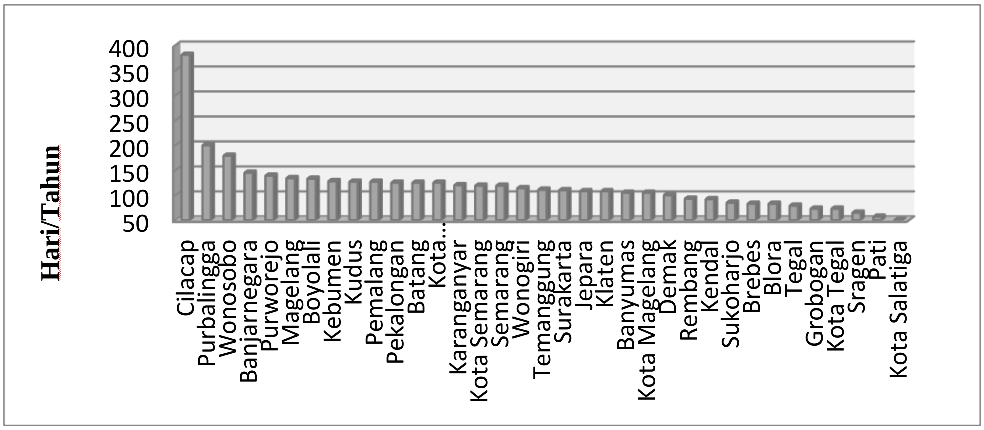

Fig 7: Rainy Day in Central Java 2016

Fig 7 above is a graph of rainy days where the data is the number of rainy days a year in the City and Regency in Central Java. It can be seen that the most rainy days are in Cilacap Regency with 381 rainy days a year so this variable is a variable that affects the number of flood events in Central Java, of course in this case there are many days. The lowest rainy day is in Salatiga City with 50 rainy days a year. Next below is a Fig 8 of the humidity variables of the City and District air in Central Java

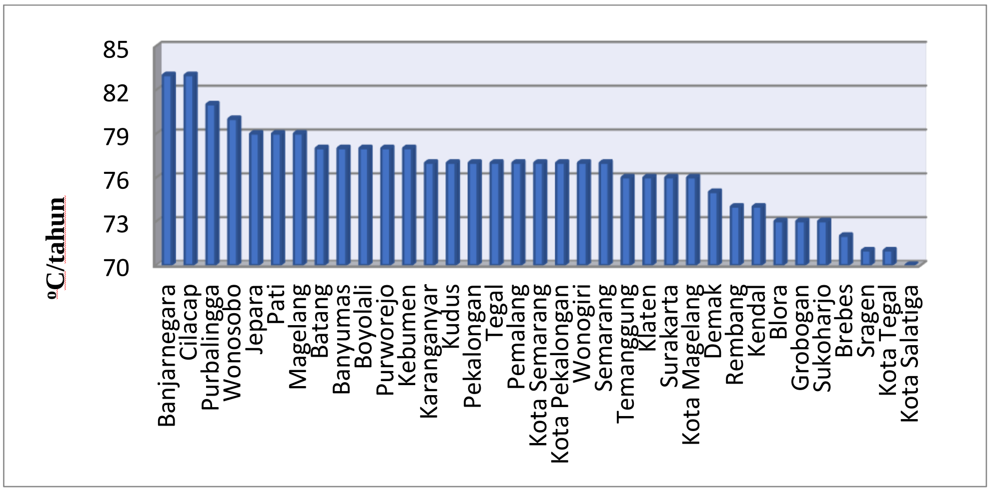

Fig 8: Air Humidity in Central Java 2016

Based on the Fig 8 air humidity above, it is known that Cilacap and Banjarnegara regencies are regencies that have a high humidity of 83oC according to BMKG in (TibunJateng) the high humidity in Cilacap and Banjarnegara is the impact of air pressure and air temperature especially for Cilacap Regency bordering the Sea . While for Sragen Regency has a low humidity level of 70oC. Graph 5.5 below is the last variable that researchers use, namely the area in the City and Regency in Central Java.

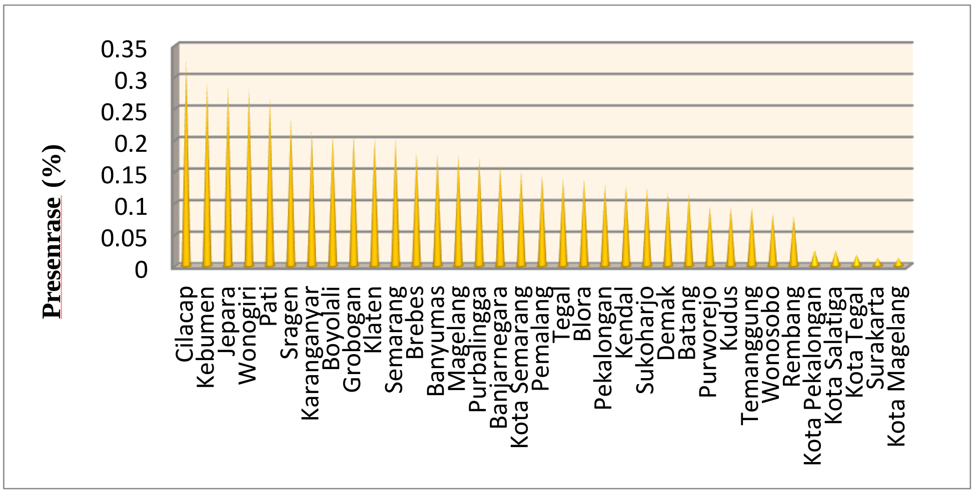

Fig 9: Area in Central Java 2016

Based on Fig 9 the area above can be seen that Cilacap Regency is a Regency which has an area that has been reduced by a building area of 32.73% of the total area of Cilacap Regency, so that in this case Central Java province has the highest building density in Central Java.

V. GWR Modelling

The GWR model is one spatial model that produces model parameters that are local to each point or location. To form the GWR model the first step is to determine the location of the observation location (geographical location) of each city and district in Central Java. By using GWR4 software GWR results are obtained globally as follows Table 1:

Table 1: Estimation Analysis of the GWR Model

Variable	Estimation result	Standard Error	T(est/SE)
Intercept	12.730471	51.288910	0.248211
Kepadatan Penduduk	-0.008085	0.003474	-2.327091
Curah Hujan	-0.005085	0.002613	-1.946119
Hari Hujan	0.086006	0.034216	2.513606
Kelembapan	-0.014733	0.745883	-0.019752
Luas Wilayah	44.928345	18.435559	2.437048

From table 5.10, the GWR model is obtained for the case of the number of flood events in Central Java 2016 with a significant variable, namely

$$y = 12.730471 - 0.005085X2 + 0.086006X3 - 0.014733X4 + 44.9283X5$$

So based on the above model it can be interpreted as follows:

a. Assuming that other variables are constant, each change in one-unit rainfall rate variable (X2) will affect the change in the number of flood events (Y) of -0.005085
b. By assuming that other variables are constant, each change in one-unit variable rainy days (X3) will affect the change in the number of flood events (Y) of 0.086006
c. By considering the other variables constant, each change in one-unit variable humidity (X4) will affect the change in the number of flood events (Y) of -0.0147733
d. By considering other variables constant, each change in one-unit area variable (X5) will affect the change in the number of flood events (Y) by 44.9283%

VI. Grouping Variables

After knowing the results of the global regression from the data of the 2016 Central Java flood event can then be categorized as significant variables based on Regency / City. Then the results of grouping of significant variables can be seen in table 5.13 below:

Tabl 2: Significant grouping of variables based on district / city

Regency / City	Significant Variables
Jepara, Pati, Kudus, Blora dan Purworejo	None
Karanganyar, Batang, Demak, Sragen, Grobogan, Kota Semarang, Kota Salatiga, Surakarta, Sukoharjo, Wonogiri, Semarang	X_1
Banjarnegara, Kebumen	X_1, X_3, X_5
Kendal, Wonosobo, Temanggung, Boyolali, Klaten, Kota Magelang, Magelang	X_1, X_5
Brebes, Pekalongan, Tegal, Pemalang, Banyumas, Kota Tegal, Kota Pekalongan	X_3
Rembang, Cilacap, Purbalingga	X_3, X_5

Based on table 2, there are 6 groups of cities / regencies that have similar variables that have a significant effect on flood events in Central Java in 2016. Although there are some insignificant predictor variables in the previous global model, the GWR models are significant in several cities / regencies. This indicates that not necessarily insignificant variables in the global model are not significant in the GWR model. For example the variables that affect Banjarnegara and Kebumen Regencies are variables 1, 3 and 5 where variables are population density, rainy days and area size. To see the coefficient value of the local model, it can be seen in table 3.

Table 3: Local Model of Flood Events

Municipality / City	β_0	$\beta_1 x_1$	$\beta_2 x_2$	$\beta_3 x_3$	$\beta_4 x_4$	$\beta_5 x_5$	R^2
Karanganyar	-51.4888	0.00968	-0.00343	-0.05656	0.999123	40.51707	0.44
Jepara	-68.4028	-0.00768	-0.00684	-0.02281	1.309167	15.6531	0.46
Rembang	67.93764	0.00869	-0.00329	0.096197	-0.81978	57.4201	0.60
Pati	-67.2014	-0.00798	-0.00582	-0.03598	1.266036	24.21171	0.45
Kudus	-61.8898	0.0082	-0.00581	-0.03038	1.188222	25.32232	0.46
Kendal	69.59256	0.00905	-0.00277	0.081162	-0.82934	56.42299	0.50
Brebes	65.32588	-0.00781	-0.00336	0.104051	-0.78782	49.10122	0.60
Pekalongan	67.76487	-0.00815	-0.00278	0.086181	-0.80263	46.06482	0.45
Blora	-68.6759	-0.00824	-0.0049	-0.05129	1.270719	29.47389	0.44
Tegal	65.79341	-0.00799	-0.00335	0.102922	-0.79459	50.98857	0.60
Batang	47.83923	0.00915	-0.00154	0.012797	-0.46553	49.26427	0.40
Demak	-50.8179	0.00864	-0.00559	-0.02169	1.022247	28.52477	0.47
Pemalang	67.69925	-0.00791	-0.00317	0.100659	-0.81721	48.14585	0.55
Wonosobo	60.49016	0.01014	-0.00246	0.04653	-0.67212	64.9962	0.50
Banjarnegara	68.98852	0.00927	-0.00331	0.089978	-0.82576	61.57762	0.58
Temanggung	10.28218	0.0109	-0.00227	-0.01239	0.084471	54.4361	0.50
Sragen	-56.6719	0.00924	-0.00415	-0.05024	1.083052	36.83652	0.45
Cilacap	59.56555	-0.00863	-0.00397	0.101355	-0.70144	58.79586	0.69
Purbalingga	66.50922	-0.00856	-0.00339	0.098525	-0.80168	56.87329	0.62
Banyumas	62.27243	-0.0085	-0.00371	0.101049	-0.74262	57.56147	0.67
Boyolali	-36.2951	0.01023	-0.00305	-0.04522	0.770584	44.7064	0.46

Grobogan	-57.1332	0.00883	-0.0048	-0.04088	1.100406	32.72504	0.45
Kota Semarang	-28.7378	0.00931	-0.00515	-0.0038	0.691079	33.84105	0.49
Kota Salatiga	-28.4217	0.01006	-0.00377	-0.02454	0.662681	42.94232	0.48
Kota Tegal	65.71452	0.00779	-0.00333	0.103784	-0.79267	48.60516	0.59
Kota Pekalongan	68.02607	-0.00817	-0.00278	0.086479	-0.807	46.49531	0.45
Purworejo	-70.6141	-0.00807	-0.0041	-0.06316	1.287664	30.84266	0.43
Klaten	-34.4543	0.01067	-0.00216	-0.05608	0.730891	48.66009	0.46
Kota Surakarta	-46.4892	0.0098	-0.00329	-0.05352	0.92532	41.38979	0.45
Kota Magelang	3.956419	0.01112	-0.00208	-0.01636	0.164057	55.55479	0.49
Sukoharjo	-45.4175	0.01003	-0.00296	-0.05735	0.904814	43.26621	0.45
Wonogiri	-48.8655	0.01008	-0.00252	-0.06848	0.951502	44.07624	0.44
Semarang	-30.1321	0.00979	-0.00443	-0.01527	0.695163	39.93975	0.48
Magelang	7.225529	0.01116	-0.00206	-0.01145	0.112335	56.34531	0.49
Kebumen	65.30805	0.00953	-0.0038	0.096091	-0.77383	63.03477	0.64

Then based on table 3 which is marked blue, it means that the variable significantly influences the occurrence of flooding in the city / district. Based on the local model obtained in each region also obtained R2 for each of these regions, for example in Karanganyar Regency has an R2 of 0.44 which illustrates 44% of the variation that occurs in the dependent variable (Y) can be explained by an independent variable (X) owned. Then the rest of 56% is explained by other variables not included in the model, as well as for R2 in Kabupaten Rembang of 0.60, then 60% of the variations that occur in the dependent variable (Y) can be explained by the independent variable (X). Then the remaining 56% is explained by other variables not included in the model. From the results of tables 2 and 3 above, it can be made in the form of a map to facilitate grouping according to districts / cities. After that, the following are the results of grouping maps based on significant variables in Central Java District / City.

Fig 10: Map of Flood Disaster in Central java Based on Significant Variables

VII. Conclusion

The result of this paper can be concluded as follows:

1. From the description of flood events in Central Java in 2016 showed that the floods in Central Java were highest in Cilacap Regency with 45 cases. The general description of each variable such as the highest Population Density is in Surakarta City and the lowest is in Tegal Regency, the highest rainfall is in Purbalingga Regency and the lowest in Blora Regency, the most Rainy Day is in Cilacap Regency with the lowest in Salatiga City, for The highest humidity in Banjarnegara Regency and the lowest Salatiga City, the last for the largest area in Cilacap Regency and the lowest in Magelang City.
2. The estimator model from the case of flood events based on the GWR analysis is obtained as $\hat{y} = 12.730471 - 0.008085X2 + 0.086006X3 - 0.014733X4 + 44.9283X5$. This GWR model produces R^2 of 56%.
3. The total number of models produced using the Geographically Weighted Regression (GWR) method is as many as 6 models that affect Districts / Cities in Central Java.
4. Factors that influence flood events in Central Java based on GWR analysis are Rainfall, Rainy Day, Humidity and Area Area. Geographical factors influence the occurrence of Floods in Central Java so that the GWR model that is formed varies from Regency to City

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