Analysis Of Distribution Patterns Of Rain Stasion In Medan City

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Abstract. Floods often occur, one of the causes is rainfall. The distribution of rain should be well patterned, taking into account the density and minimizing errors in recording rain data. This study analyzes the distribution of rain stations in Medan City, including Stamar Belawan, Helvetia Station and BBMKG area I Medan. The aim is to find out the pattern of placement between rain stations and evaluate the conditions and distribution between rain stations. The results of the mapping pattern using Thissen Polygon and ArcGIS 10.82 state that Helvetia station is located at longitude coordinates 98.63 and 3.60 latitude with the largest area of influence, which is 28.30 Km^2 or 71% on a total area of 39.85 Km^2. Density analysis There is no identification of density values between stations that meet the WMO standard. So it is necessary to rationalize using the Kagan-Rodda method to meet WMO standards.

Keywords: Rain Station, Density, Kagan-Rodda

1 Introduction

Flood is an event that cannot be known when it will occur, but it can be predicted and the risk of its occurrence can be minimized. Flooding is still a problem that needs special attention and handling. Medan City is the capital city of North Sumatra Province. The recorded population in 2020 is 2,435,252 people with a density of 9,522.22 people/km^2, 21 sub-districts and 151 urban villages. The city of Medan as the provincial capital is still classified as vulnerable to flooding. In a hydrological analysis, rainfall data is the main input in providing information. Therefore, it is necessary to distribute rain posts or stations evenly, which can represent rain events in various topographical forms in an area.

Currently, the city of Medan has several rain stations as a place for the establishment of rainfall measuring and rain monitoring tools. Obtaining good rainfall data can be obtained from recordings that are always under surveillance. The more rain stations there are, the more detailed the recorded rainfall data will be. However, it is also necessary to have a boundary between one rainfall station and another rainfall station.

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The amount and location of rain are things that need to be considered during the availability of rain data. determining the installation point of the rain station must be carried out effectively and efficiently. This needs to be done because of the limited installation costs and equipment maintenance that requires special personnel. In addition, what is more important is because the amount of rain that occurs in one area will be transformed or changed into streams in channels. . Thus, it can be said that all the rain that occurs at any time must be carefully managed.

2 Methodology

In this study, the method used is descriptive evaluative method, which is a study method with objective conditions or what is in a situation that is being the object of study. The analysis used in this research is descriptive qualitative analysis, namely research that aims to accurately describe the characteristics of an individual, condition or certain symptoms at the study site. The aim is to make a systematic picture.

This study uses primary and secondary data collection methods. Where primary data is data that comes from the original or first source. Secondary data is data that refers to information collected from several available sources as needed. Primary data collection uses a survey method to the study sites to take the coordinates of each location using the Global Positioning System (GPS). Then these results are used to input information into the ArcGis 10.82 application to create a map of the distribution of the Medan City rain station with ArcGis. Secondary data is rainfall data obtained from the Meteorology, Climatology and Geophysics Agency.

3 Results and Discussion

3.1. Medan City Rain Station

In Indonesia, rain measurements are carried out by several agencies including the Meteorology, Climatology and Geophysics Agency, the Irrigation Service, the Ministry of Public Works, the Agriculture Service, and several other government and private agencies with an interest in rain. Each agency manages its own rain station. It could be that two or more rain stations are in close proximity. Medan city has 3 rainfall stations as shown in Table 1.

Table 1. Location of Medan City Rain Station.

Station Name	Station Location	Postal Number	Coordinate	
			Longitude	Latitude
Stamar Belawan	Belawan	12710801a	98.71475	3.788381
Helvetia Station	Medan Helvetia	12710301a	98.631066	3.602617
BBMKG area I Medan	Medan Selayang	-	98.6367944	3.539878

3.2. Distribution of Medan City Rain Station

The distribution of rain stations should be carefully patterned and pay attention to the density of each rain station in an area or watershed. Likewise, the number and density between rain stations need to be set optimally considering that the number and density can determine the level of error in the rain forecast with a small amount that will reduce the accuracy of the rain data obtained to estimate the actual amount of rain that occurs in the watershed and with higher density. The rain station, the more accurate the rain data that will be obtained from the rain station will be. However, the procurement of rain stations requires considerable costs. The following Figure 1. is the distribution of Medan city rain stations obtained from the ArcGIS 10.82 application.

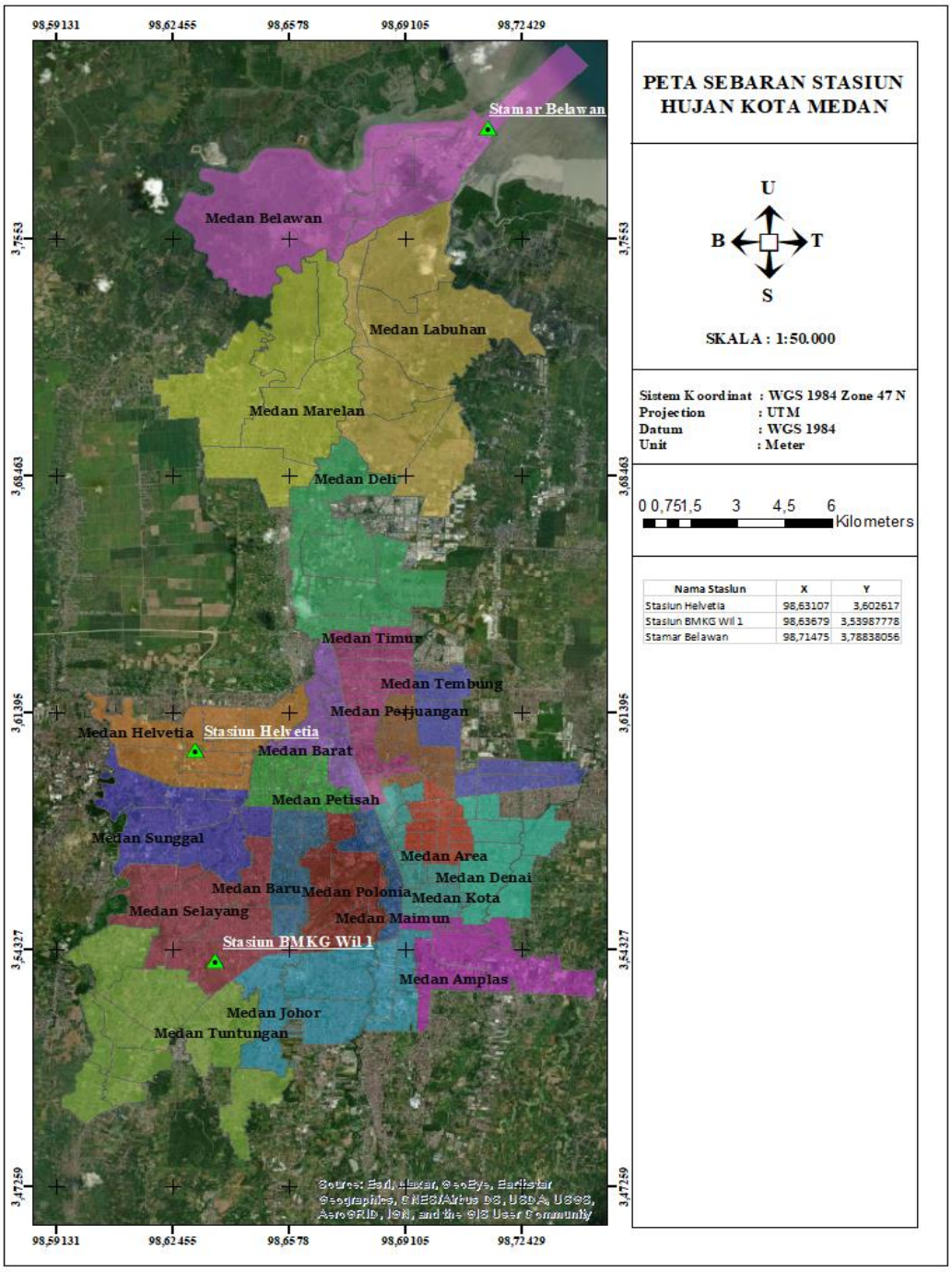

Fig. 1. Distribution of Medan City Rain Station.

3.3. Medan City Rain Station Polygon

Rain station network is very important in reducing the level of variability of events or reducing uncertainty and increasing understanding in terms of magnitude and interpolation.Thiessen polygon method is a method that is often used to calculate regional rainfall. Where in this

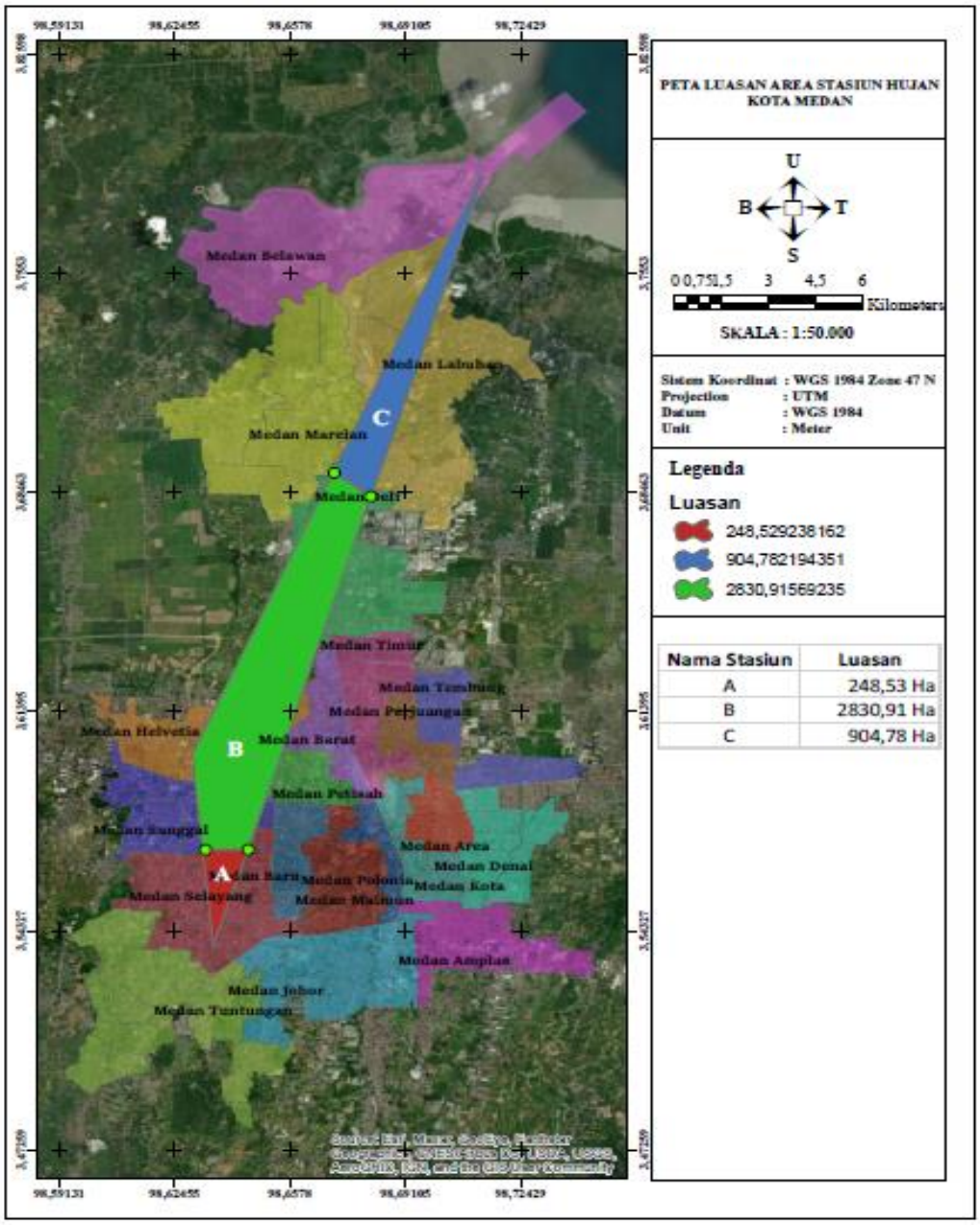

Fig. 2. Polygon of Medan City Rain Station.

method, the calculation of the influence of the location of the distribution of rainfall on the watershed station that has been determined and the area measured is carried out. Although it is better than the algebraic method, this method is more suitable for use in areas with low rainfall characteristics and uneven distribution. The Thiessen polygon method multiplies the station's rainfall by the area (which has been determined and constrained) by the station.

Then the results of each calculation for each station are totaled and divided by the total area of the station included in the calculation. The analysis is carried out on the Medan city rain station using the Thiessen Polygon method, which is useful for determining regional rain. The following Figure 2 is a mapping using the polygon method.

The results obtained from mapping the distribution of the Medan City rain station using the Polygon Thissen method, it appears that the distribution is not very evenly distributed. This is due to the lack of equity in the placement of rain stations. As a result of the uneven placement of rain stations, the recording of rain information or other data obtained from stations is less than optimal and can be said to be not good enough to represent an area. This can also be a factor causing the ineffectiveness of the data obtained.

3.4 Area of Influence

Each rain station has a sphere of influence which is an area of events in it showing a relationship with one of the events observed by other stations in the area. Rainfall network must include network density and the possibility of data exchange. One way to overcome this is by establishing a network of primary and secondary rain stations. Rain data obtained from the rain station is local rain data whose ability to represent rain measurements for a certain area. So to determine the amount of rainfall in a watershed, several rain gauge stations are needed that are spread out in the watershed concerned with adequate density and distribution patterns. Rain data is the main input needed by planners in planning water control buildings, which they built with the aim that existing water can be channeled and directed so that problems such as flooding or lack of water do not occur. The following is Table 2. is a table of the area of influence of the Medan City rain station.

Table 2. Area of Influence Rain Station.

Station Name	**Area of Influence (Km^2)**	**Percentage (%)**
Stamar Belawan	9.05	23
Helvetia Station	28.30	71
BBMKG area I Medan	2.50	6
Jumlah	39.85	100

3.5. Discussion and Evaluation

The rain station network is part of the hydrological analysis which is used as the initial action of a plan for the benefit of water structures. This station network provides information about the amount of rain that falls on an area or watershed. The number of rain stations in a watershed system must be planned properly so that the results obtained are effective and efficient. The World Meteorological Organization (WMO) provides guidelines for the minimum grid distribution in some areas as shown in Table 3.

Table 3. Rain Station Network Distribution.

Area	Minimum Network Density (Km^2/Sta)
Temperate flat areas, Mediterranean and tropical seas	600 – 900
• Normal conditions	100 – 250
• Mountain areas	25
Small mountainous islands (<20,000 km^2)	1.500 – 10.000
Dry and polar regions	

Source: WMO

The possibility of recording the position of the rain center by a measuring instrument is not constant or varies according to the density of each network. Network density itself is the number of stations per unit area in the watershed. A network must be planned to produce a picture that can represent the distribution of the rain area. Determination of the optimum number of rain stations installed in the watershed can be done statistically. If the allowable error is larger, then a smaller number of rain stations is required, and vice versa.

From the results of data analysis, it is known that Helvetia Station has the largest area of influence when compared to the other two rain stations, namely 28.30 Km^2 or 71% with the total area of influence of all rain stations in Medan City, which is 39.85 Km^2. The World Meterological Organization (WMO) applies a minimum density standard for rain stations of 100-250 Km^2/station. Referring to the WMO standard, it can be stated that the three rain stations in Medan City do not meet the standards for network density between rain stations.

4. Conclusion

Based on the study of the analysis of the distribution pattern of rain stations in the city of Medan, it can be concluded that the mapping pattern using Thissen Polygon and ArcGIS 10.82 states that Helvetia station is located at longitude coordinates 98.63 and 3.60 latitude with the largest area of influence is 28.30 Km^2 or 71% of the total area of 39.85 Km^2. The results of the analysis state that the condition of the density of the rain station network placement does not meet the minimum standards of the World Meterological Organization (WMO), so a resettlement pattern is needed using the Kagan-Rodda method.

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