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MAPPING OF DENGUE HEMORRHAGIC FEVER VULNERABILITY BASED ON GEOGRAPHIC INFORMATION SYSTEMS IN LUBUKLINGGAU CITY

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ABSTRACT: The purpose of this paper is to map the level of dengue hemorrhagic fever vulnerability using the Geographic Information System (GIS) in Lubuk Linggau. This type of research uses quantitative methods and is carried out in the administrative area of Lubuk Linggau City, South Sumatra Province. The type of data used is secondary data obtained from relevant agencies and remote sensing data, there are four input data; the incidence of dengue hemorrhagic fever, temperature, population density, and vegetation density. Data analysis techniques using data analysis using scoring methods with Geographic Information Systems (GIS). The results obtained that the level of DHF vulnerability based on spatial analysis in Lubuk Linggau City in 2016 were divided into three classes, namely areas with low vulnerability levels of 5.928,06 ha or 16%, areas with moderate vulnerability levels of 22.903,80 ha or 62%, and areas with a high level of vulnerability are 7.917,97 or 22%. So, the level of vulnerability to dengue disease, the results obtained that the City of Lubuk Linggau is at a moderate level of vulnerability.

Keywords: Dengue Hemorrhagic Fever, Geographic Information System

1. INTRODUCTION

Geographical Information System (GIS) is one of the information systems that can be used as a tool to conduct data analysis so that a complete and comprehensive picture of health problems related to spatial/reproductive health is produced. Geographical Information Systems are designed to collect, store and analyze objects and phenomena where geographical location is an important or critical characteristic to be analyzed [1]. Geographic Information Systems can be used to enter, store, recall, process, analyze, and produce geo-referenced data or geospatial data to support decision making [2]. GIS is currently an important component in many activities in the field of public health, epidemiology and is useful in many analyzes. The relationship between epidemiology, statistics and GIS can improve health research [3].

With its database GIS associated with spatial analysis methods and data management and manipulation is able to determine how the relationship between the spatial distribution of disease with environmental conditions in a region. Because the risk factors for DHF are highly related to the environment, DHF is a type of disease whose risk factors can be modeled by GIS analysis. [4] has conducted spatial modeling of DHF risk factors including land use, drainage conditions, settlement patterns, and population density. [5] determines the level of vulnerability of the region to DHF by spatial modeling of environmental factors, namely the density of settlements, vegetation, rainfall, height, drainage, and waste bin conditions. Therefore, GIS is very relevant for research on infectious diseases especially diseases transmitted by vectors, including DHF [6].

Dengue hemorrhagic fever (DHF) is one of the public health problems in Indonesia where the number of sufferers tends to increase, and its spread is wider. DHF is a contagious disease that mainly attacks children [7]. There are four serotypes of dengue virus (DEN) with different antigenic properties, namely dengue-1 virus (DEN1), dengue-2 virus (DEN2), dengue-3 virus (DEN3), dengue-4 virus (DEN4) [8]. Mosquitoes can carry the dengue virus after sucking the blood of people who have been infected with the virus. After the incubation period of the virus in the mosquito for 8-10 days, the infected mosquito can transmit the dengue virus to the healthy humans it bites.

The data from [9] shows the situation of Dengue Fever in South Sumatra Province in 2015 an increase in cases compared to 2014. In 2015 the number of cases reached 3,401 cases (IR of 42.6 / 100,000 population) with a total of 16 deaths (CFR 0.47%). While in 2014 the number of cases reached 1,506 cases (IR of 19/100,000 population) with a total of 4 deaths (CFR 0.27%), one of the areas prone to DHF is Lubuk Linggau City. Lubuk Linggau City is an endemic area for dengue fever. In 2016, the number of DHF sufferers reported was 298 cases (incidence rate / morbidity rate = 133.7 per 100,000 population). An increase in the number

of cases in 2016 compared to 2015 amounted to 176 cases with. Thus in 2016 DHF was determined as an Extraordinary Event that needed an immediate response. The following are IR trends during the 2010-2016 period [11].

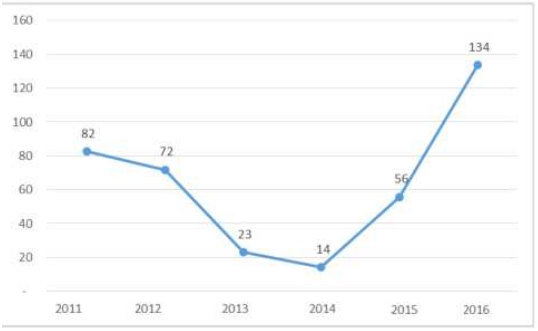

Fig 1. DHF morbidity rate per 100,000 population in 2010 – 2016

Within 4 years the dengue cases in Lubuk Linggau City gradually decreased but in 2016 it increased again to 134 Per 100,000 Population. Based on this problem, mapping of DHF-prone areas is needed so that it can facilitate the government to conduct extension programs and environmental clean-up activities to reduce the number of DHF morbidity.

2. METHOD

This research is a quantitative descriptive study. The data used are secondary data obtained from relevant agencies. Here are the research locations.

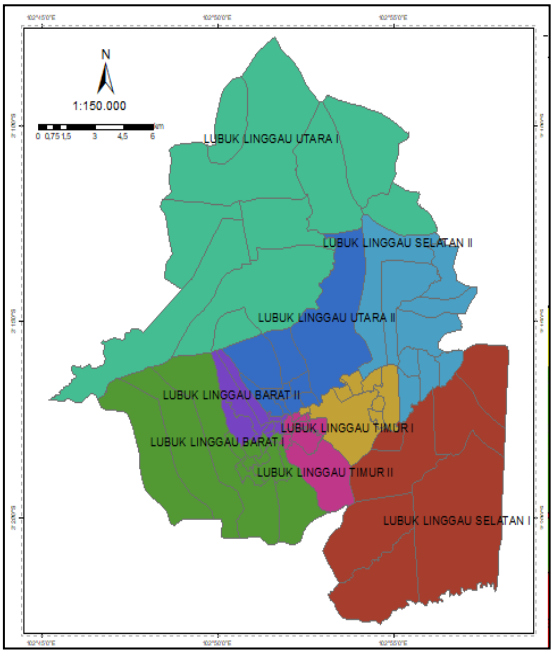

Fig 2. Map of the Research Area

The data taken is data of factors that influence the spread of dengue fever obtained from several government agencies in Lubuk Linggau City and remote sensing data, where there are four parameters in this study, namely the incidence of DHF, vegetation density, population density, and temperature. For the height of the area and vegetation density data obtained through remote sensing. Each parameter is given a classification, each of which is given a score based on the frequency distribution guidelines and the results of processing with GIS. Furthermore, attribute processing was performed in GIS software to find the level of vulnerability and area of vulnerability in the City of Lubuk Linggau in 2016.

3. RESULTS AND DISCUSSION

Data from the Directorate of Infectious Disease Control and Zoonosis of the Ministry of Health until the end of January 2016, outbreaks of dengue fever reported there are 9 districts and 2 cities from 7 provinces in Indonesia, namely Tangerang Regency (Banten Province), Lubuk Linggau City (South Sumatra Province), Bengkulu City (Bengkulu Province), Denpasar City and Gianyar Regency (Bali Province), Bulukumba Regency, Pangkep, North Luwu, and Wajo (South Sulawesi Province), Gorontalo Regency (Gorontalo Province) and Kaimana Regency (West Papua Province) [11]. Based on this data, it shows that in 2016, Lubuklinggau City was one of the regions with dengue outbreak status, due to the number of morbidity in the hundreds, this made Lubuk Linggau City an endemic area for dengue fever.

Lubuk Linggau City itself is located in the western part of South Sumatra Province with a geographical position between 102^0 4 '- 103^0 0' 0 " East Longitude and 3^0 4 '10' '- 3^0 22' 30 " South Latitude and with administrative boundaries; North of Central Suku Lakitan Sub-District (STL) Ulu Trawas (Musi Rawas Regency); East of Tugu Mulyo and Muara Beliti Districts (Musi Rawas Regency); South of Kab. Rejang Lebong Bengkulu Province; West of Selangit District (Musi Rawas Regency) and Rejang Lebong Regency Bengkulu Province.

Geographic Information System (GIS) is defined as a system used to capture, store, analyze and display all types of geographic data. The geographical study is needed to see how the pattern of spread of infectious diseases will later be used as material for analysis to prevent the spread of the disease [2]. The results of the level of DHF vulnerability for each parameter, vary greatly. This is because it is influenced by the level of scoring of each of these parameters. Following is the explanation of each DHF parameter.

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Temperature

Based on secondary data, obtained air temperature data in the City of Lubuk Linggau in 2016, which are presented in the figure below:

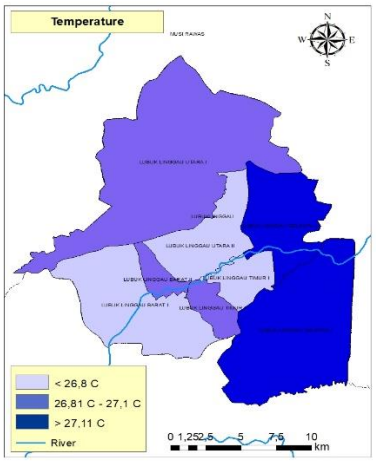

Fig 2. Temperature Map

Based on the picture above shows the distribution of air temperatures in Lubuk Linggau City, the temperature <26.8^{0}C is in District of North Lubuk Lingau II, District of West Lubuk Linggau I, and District of East Lubuk Linggau I, while temperatures between 26.81^{0}C - 27.1^{0}C are in District of North Lubuk Linggau I, District of West Lubuk Linggau II, and District of East Lubuk Linggau II, and temperatures >27.11^{0}C are in District of South Lubuk Linggau I and District of South Lubuk Linggau II.

Population Density

The map of population density was obtained from secondary data through the Central Statistics Agency in 2016. The following analysis results in the form of maps:

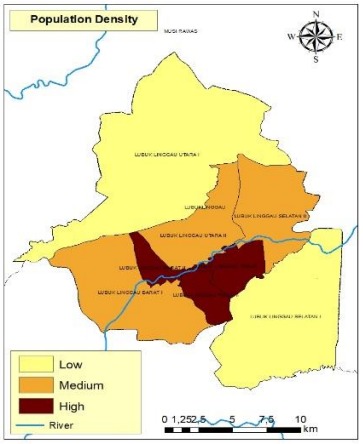

Fig 3. Map of Population Density

Based on the picture above shows the distribution to the population in Lubuk Linggau City, namely density is rarely in the Districts of North Lubuk Linggau I and District of South Lubuk Linggau, then the medium density is in District of West Lubuk Linggau I, District of North Lubuk Lingau II and District of South Lubuk Linggau II, while high density is in the District of West Lubuk Linggau II, District of East Lubuk Lingau II and District of East Lubuk Linggau I.

Vegetation Density

Vegetation density data were obtained from remote sensing imagery that was analyzed using GIS through ArcGIS software, following the results of vegetation density maps.

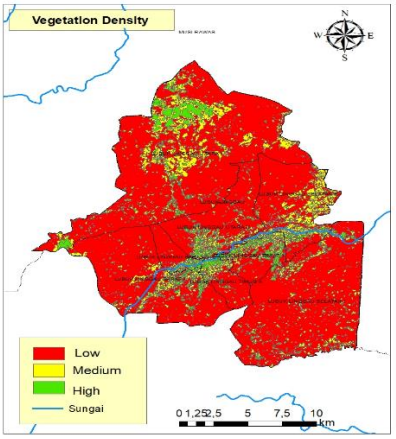

Fig 4. Vegetation Density Map

Based on the map above shows that there are three categories for vegetation density, where for the rare category is 1.864.87 ha or 5% of the area, then the medium category is 5.768.15 ha or 16% of the area and the meeting category is 2.9079,26 ha or 79% of the total area.

DHF events

Based on secondary data, obtained data on the incidence of DHF in the City of Lubuklinggau in 2016, which is presented in the figure below:

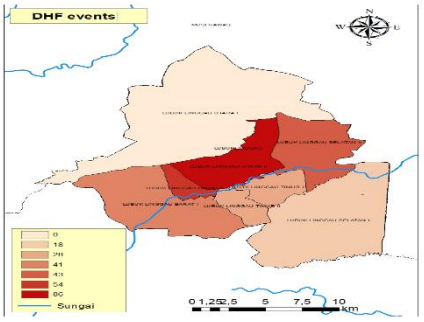

Fig 5. Map of DHF events

Based on the picture above shows the distribution of DHF events in Lubuk Linggau City, namely in the District of North Lubuk Linggau II as many as 86 incidents, District of West Lubuk Linggau II, 54 incidents, District of Lubuk Linggau West I as many as 43 incidents, District of West Lubuk Linggau I as many as 41 incidents, District of East Lubuk Linggau I and East II as many as 28 incidents, District of South Lubuk Linggau I as many as 18 incidents, and 0 incidents in District of North Lubuk Linggau I.

Distribution of DBD Prone Areas

The results of the level of DHF vulnerability of the four parameters, then the overlay process is carried out, to get single spatial information related to the level of DHF vulnerability. The description of the distribution of the level of vulnerability of DHF in Lubuk Linggau spatially can be seen in the figure below.

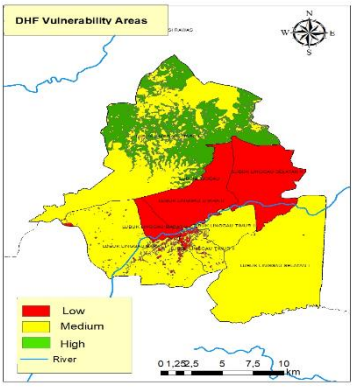

Fig 6. DHF Vulnerability Areas

Based on the picture above it can be seen that the level of DHF vulnerability in Lubuk Linggau City area is dominated by moderate level of vulnerability with an area of 22.903.80 ha (62%), whereas a high level of vulnerability with an area of 7.917.97 ha (22%), and a low level of vulnerability with an area of 5.928, 06 ha (16%).

Conformity of Estimation Results with DHF Event Data for 2010-2016

The results of the analysis of the level of DHF vulnerability that has been obtained, then adjusted to the data on the incidence of DHF in Lubuk Linggau City from 2010-2016. Based on the data of the incident, it shows that the District of West Lubuk Linggau II, District of North Lubuk Linggau II and District of South Lubuk Linggau II were the regions that experienced the highest incidence of DHF since 2010-2016. This is consistent with the results of the analysis using Geographic Information Systems.

GIS is one tool that can be used to help analyze the condition of an area of disease to determine the actions that must be taken to deal with the disease. A geographical information system is one of the tools to convey information about the spread of disease in an area. The existence of GIS is expected to be able to provide an overview of the level of vulnerability of DHF in Lubuk Linggau [12]. Mapping using GIS on DHF cases is very helpful for the level of DHF vulnerability in each region, accurate maps, can accurately predict the level of vulnerability in the region, in addition, can determine interventions that can be done to prevent or overcome diseases that will occur in a region [13].

4. CONCLUSIONS

Dengue disease vulnerability level, the results obtained that the City of Lubuk Linggau is at a moderate level of vulnerability, where 62% of the City of Lubuk Linggau is in the medium category. DHF incidence data from the Lubuk Linggau City Health Office in 2016 showed that the highest DHF incidence was in Lubuk Linggau Utara II District, Lubuk Linggau Selatan II District and Lubuk Linggau Utara I District, this is consistent with the results of GIS analysis in which these three districts are in the high category.

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