Webgis Application for Dengue Fever Infectious Disease Mapping

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Abstract. The city of Palembang has cases of infectious diseases that continue to increase due to worsening environmental conditions, while the use of maps by agencies in the analysis of the health sector is still limited to maps that do not meet cartographic rules. The aim of this study is to offer information on infectious diseases in the form of maps, to understand their patterns of distribution, their relationships with environmental factors, and to assess the degree of vulnerability. The results of this study indicate that there is a variation of the best interval class system based on the classification test by presenting data using a visual map that is clearly visible compared to statistical tables; the pattern of infectious diseases has similarities; Except for the parameter of the amount of use of unprotected water sources, which has a substantial association with dengue sickness, most environmental condition-determining factors do not have a pattern that is spread with the level of random grouping.

Keywords: Dengue Hemorrhagic Fever · Distribution Pattern · Map

1 Introduction

Technology for Geographic Information Systems (GIS) is currently evolving quickly. [1]. In actuality, it has spread beyond geography and into a number of industries, such as the health industry [1]. Data visualization tools, such as GIS mapping, can be a powerful tool for persuading decision-makers at various administrative levels to prioritize health issues and select the most appropriate health programs for implementation at healthcare facilities across various areas and districts. GIS can be used to analyze and map health data in the field of health statistics, specifically to map the geographic distribution of a population at risk, the distribution of diseases and health issues, the distribution of the locations of healthcare facilities, and the analysis of risk factors for disease occurrence [2]. This technique can be used to evaluate the association between risk factors and the health effects of viral and congenital disorders as well as the effects of environmental health issues. The analysis' findings can be utilized to help decide which populations and regions should receive priority attention from a health intervention endeavor.

Geospatial Artificial Intelligence is a technology that combines methods in spatial science [3]. In Indonesia, the morbidity rate from infectious diseases is rising, particularly

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in the major cities. One of the cities in South Sumatra Province that is expanding quickly is Palembang. The development of the city of Palembang encourages the increase in population. The increase in the population has resulted in limited land, especially residential land; decreased availability of clean water; decreased water quality due to urban waste; increased air pollution due to the use of urban transportation; and increased poverty rates [4]. The decline in the quality of the city can reduce the ability to support urban life, one of which is in the health sector [5]. Health is an index of human development, which is one of the indicators of health development [6]. Health development must be able to reach population groups who are at high risk as a contributor to the incidence of illness and death. These population groups are more susceptible to disease with much less ability to pay for their personal health.

Dengue Hemorrhagic Fever, also known as DBD in Indonesia, is a contagious illness brought on by the dengue virus [7]. The Aedes aegypti mosquito, which has numerous symptoms including high fever, bites humans and spreads DBD, which is not directly passed from person to person [8]. In the last five years, the morbidity rate due to infectious diseases in the city of Palembang has continued to increase. The categories of infectious diseases that will be discussed in this study is dengue fever.

Many health offices have developed Puskesmas Information Systems (SIMPUS), hospitals with SIMRS, and various health programs have developed very specific information systems such as Kartini for maternal and child health (KIA) programs, EWARS for disease surveillance, SITT for tuberculosis, and SIHA for HIV/AIDS [9]. However, the Health Office has not yet developed a system for implementing GeoAI to see the real spread of infectious diseases in the community.

Mapping in the health sector can describe the spatial distribution of related phenomena [10]. No studies on health in the individual environment have been conducted, but the development of a spatial model for geographical health studies is expected to explain the where, why, and what are implications of a health problem in an area. Furthermore, research on health problems can be used to identify infectious diseases, find out the causes of the emergence of infectious disease problems spatially, and provide recommendations for actions including prevention, monitoring, and response based on facts in the field.

The purpose of this study is to present data on infectious diseases in South Sumatra Province in 2018–2020 by applying GeoAI with the Deep Learning method in the form of a cartographic map, knowing the pattern of distribution of the disease, knowing the relationship between infectious diseases and environmental conditions, and determining the level of disease susceptibility contagious in Palembang.

2 Research Methods

In order to uncover any hidden patterns in the data, this study used the data mining technique, which is data management. The outcomes of data processing using this data mining technique can be utilized to guide future decisions. By implementing data mining with clustering, the data will be partitioned into several groups of data that have the same characteristics and will be grouped into the same cluster.

The steps in implementing clustering include:

Utilizing information on the transmission of infectious diseases throughout various districts, the number of clusters is determined.

1. Data on the transmission of infectious diseases in various districts is used to develop the number of clusters.
2. Determine the initial centroid of the cluster, which is determined randomly, and is taken from the data in the range. The value of cluster 1 is taken from the highest data value and the value of cluster 2 is taken from the lowest data value.
3. Allocate each data point to the nearest centroid or average by calculating the distance of each to the center of the cluster.
4. Find cluster values based on the minimum value of the cluster that corresponds to the minimum value in iteration 1 to identify clusters or groups.
5. Steps 3 and 4 will be repeated. If the centroid value in the iteration with the previous centroid value is the same or if the centroid value is optimal and the position of the data cluster for the spread of infectious diseases has changed again, then the iteration process has been completed or stopped.

This study focuses on the cartographic aspects of map-making techniques that are analyzed to evaluate the object being mapped. The object that is mapped is data on the infectious disease DBD, which is an endemic disease in the city of Palembang. The methods applied in this study include secondary data collection methods; data classification; data classification tests; scoring data processing methods; overlays, statistical analysis, examination of distribution patterns, and qualitative map analysis. The district administration served as the study's analytical unit.

Below is a flow chart of the research that will be carried out (Fig. 1).

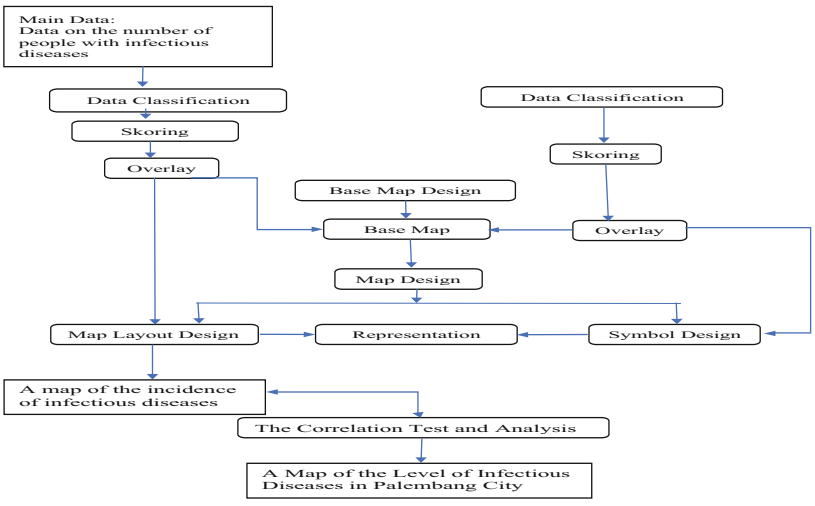

Fig. 1. Research Flowchart

Data evaluation is done because the data used is raw data. The evaluation carried out includes sorting and assessing data related to the type, size, year of manufacture, and distribution of data. Sorting is adjusted to the research objectives.

Data processing is done by analyzing and classifying. The data obtained is still raw data in the form of a collection of numbers in the table. This data processing aims to minimize errors in mapping when there are many data irregularities and make it easier to describe the symbol design.

Data classification relates to data size, perception, and visual variables that will be used in the depiction of symbols. Classification of data using the regular interval class system, arithmetic, geometric, quantile, and dispersion graph.

The best classification test is used to determine the best interval class system by using an administrative map. The administrative map is used as the basis for defining the profile path. He Profile serves to determine a sample area by considering the largest area of coverage.

3 Discussion

3.1 Mapping of Infectious Disease Data for 2019–2021

Secondary data is the main data source in this study. The secondary data on the number of infectious disease sufferers used is data from 2018 to 2020. For data on the number of disease cases used, namely from 2018 to 2020, The secondary data used is taken from the Central Statistics Agency page: https://www.bps.go.id.

The use of statistical data in this study is limited to institutional statistical data, which does not include several determinants of health, namely heredity, health care, behavior, and environment. The accuracy of the data related to the environment also greatly affects the results of the study. All selected secondary data will be mapped to provide spatial information.

Maps can convey information in the communication process by describing spatial distribution. The map presented as a result of this study has a different level of spatial distribution. The difference is due to the data classification process. Several classification tests show the variation of the interval class system used. The IR classification of DBD shows that the regular system is the best.

3.2 Connectivity Map

Population density, population movement, urbanization, economic development, community behavior, climatic change, environmental sanitization standards, and access to clean water frequently have an impact on DBD transmission in Palembang. The presence of clean water is significantly correlated with dengue fever.

3.3 Vulnerability a Map of Infectious Diseases

The incidence rate (incidence rate) of dengue hemorrhagic fever (DBD) in Palembang in 2020 was 26.1 per 100,000 population, a decrease compared to 2019, which was 41.9

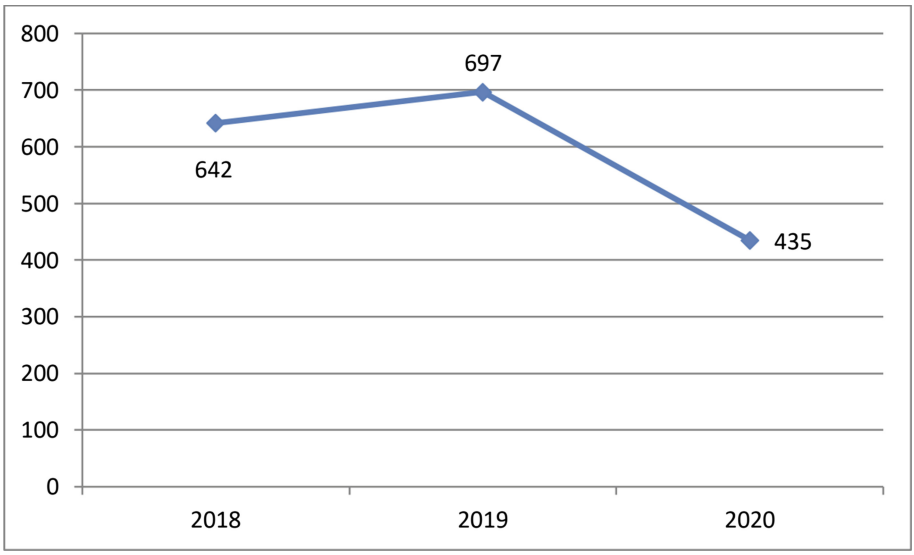

Fig. 2. Number of DBD Cases in Palembang City in 2018, 2019 and 2020

per 100,000 population. This figure is much better than the national target of 49 per 100,000 people.

Although dengue cases decreased in 2020 compared to the previous year, this is because vigilance against the spike in cases in the previous year needs to be increased (Fig. 2).

3.4 Infectious Disease Mapping App

The results of the susceptibility to infectious diseases of DHF are visualized in the form of a GIS-based infectious disease mapping application. The resulting application is a web-based application that provides information on the spread of infectious diseases in South Sumatra Province.

Accurate and timely data regarding the spread of disease in a region can be obtained with the aid of information presented in the form of disease mapping. It is essential that there be a map in the medical field. A map showing a region's disease distribution is one of them. The best way to address disease-related issues in a region is to have a system in place for charting the spread of disease. Additionally, making decisions and controlling the spread of disease will be made easier by leveraging data through mapping with applications based on Geographic Information Systems.

With the Infectious Disease Mapping Webgis application, there is a feature for inputting data for patients with DHF infectious diseases carried out by health centers and related houses. With this feature, the data obtained is more accurate and valid.

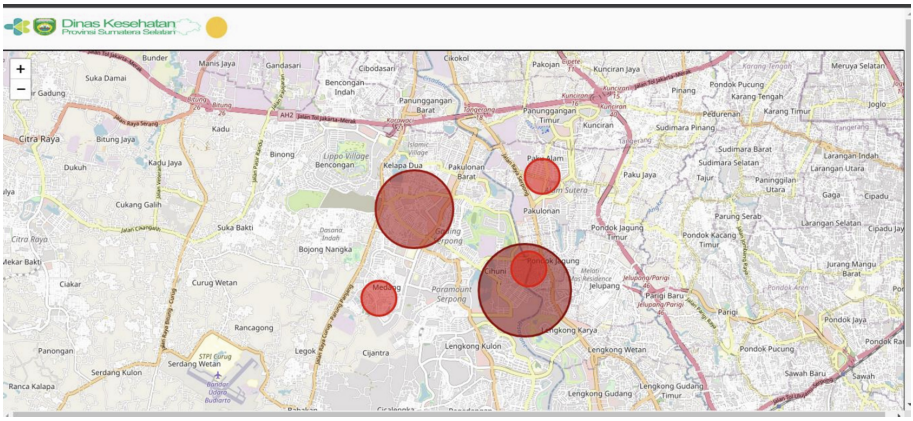

Fig. 3. Transmission of Infectious Disease Distribution

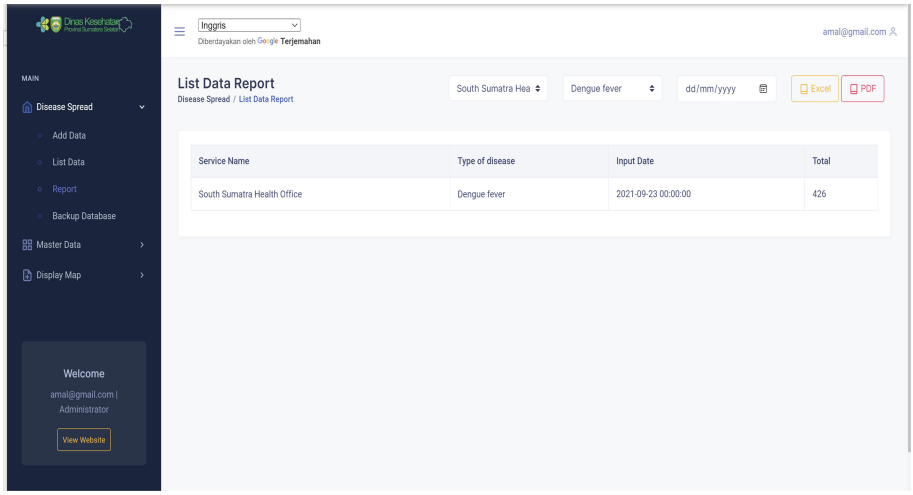

Fig. 4. Graph of Infectious Disease Distribution

Figure 3 above shows a map of the spread of infectious diseases in Palembang. The search for information can be done based on the area in the city of Palembang.

Figure 4 shows a graph of the distribution of infectious diseases that occurred in the city of Palembang. Figure 5 below shows the account owned by each health service that is used to input data on dengue communicable diseases from each existing health service.

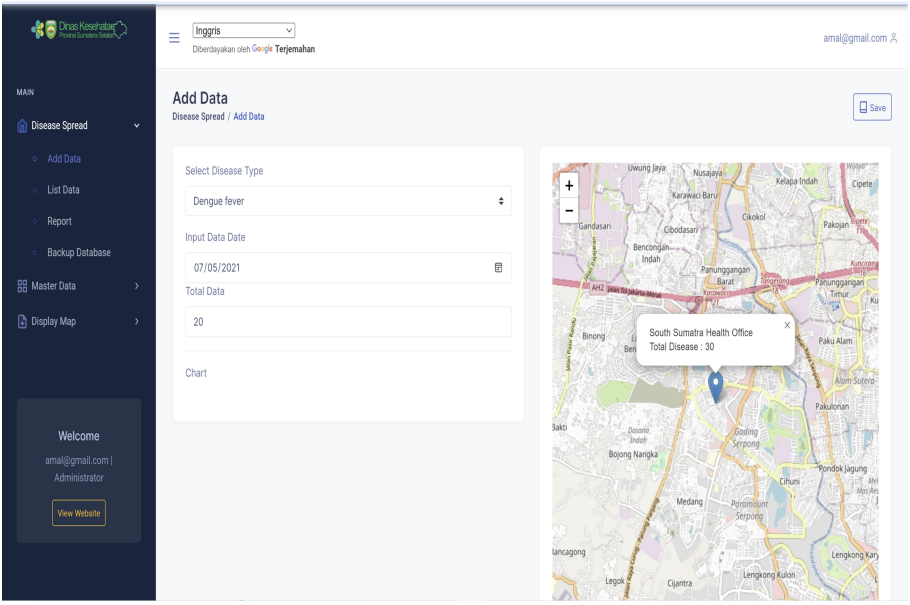

Fig. 5. Healthcare Account

4 Conclusion

Based on the results and previous discussions, conclusions can be drawn, including:

1. There is a variation of the best interval class system based on the classification test on infectious disease data.The classification system is used as a basis for grading n the map-making process.The presentation of data using a map is visually clear and the spatial distribution is visible compared to statistical tables.
2. Except for the criterion of the amount of use of unprotected water sources, which has a strong association to DBD disease, the majority of the criteria that define environmental conditions do not have a significant relationship.
3. Based on a qualitative analysis of the level of vulnerability to infectious diseases, some areas of Palembang City are vulnerable to infectious diseases, which are divided into the “Very Vulnerable” class of 20% and 30%, including the “Vulnerable” class. Meanwhile, 50% is divided into other classes.

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