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Analysis and Visualization of the Effect of Rainfall and Temperature on Dengue Fever Cases in West Java

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Abstract. This study investigates the impact of rainfall and temperature on the increase of Dengue Fever (DHF) cases in West Java, Indonesia. Dengue fever, caused by the Dengue virus transmitted by Aedes mosquitoes, is a serious threat to public health. The research focus lies on mapping and statistical analysis of 9 major cities in the province using secondary data from Open Data Jabar, Statistics Indonesia, and NASA POWER. By utilizing Tableau Desktop 2023.3, this research aims to create an interactive dashboard to visualize the relationship between dengue cases, deaths, rainfall, and temperature. The problem identification includes mapping dengue cases and deaths, rainfall, as well as the highest temperature in each city, while exploring the linkages between dengue cases and environmental factors. The results of this study are expected to provide valuable insights for the government in addressing the increase in dengue cases by deeply understanding the role of rainfall and temperature in the dynamics of the spread of this disease in the region.

Keywords: Dengue Fever (DHF), Rainfall, Air Temperature, West Java, Mapping, Dashboard, Tableau Desktop, DHF Cases

1. Introduction

Health is a condition in which an individual achieves complete physical, mental, and social well-being, and not merely the absence of disease or infirmity (Krahn et al., 2021). Public health is a fundamental aspect of human life that affects almost every other aspect, involving the science and art of preventing disease, prolonging life, and improving health through the organized efforts and conscious choices of various elements of society (Detels & Tan, 2021). However, the threat of infectious diseases remains a global challenge that needs to be taken seriously.

Infectious diseases are a health condition to be aware of as they are one of the leading causes of death worldwide (Putri, 2020). According to health experts, an infectious disease is a health condition that can spread from one individual to another. This process is known as transmission, which can occur directly or indirectly, and involves an intermediary or link (YUZAR, 2020). Infectious diseases are also defined as the result of complex interactions between several influencing factors, including the environment, agent, and host (Muslimin et al., 2022).

Dengue fever (DHF) is an infectious disease that is endemic (Sari et al., 2022), potentially dangerous, and can cause death quickly (Zebua et al., 2023). The disease is caused by the Dengue virus, which belongs to the Arthropod Borne Virus group, with the genus Flavivirus and the Flaviviridae family, which is then transmitted through the bite of mosquitoes of the Aedes genus, especially Aedes aegypti and Aedes albopictus (Manurung, 2022). One of the factors for Dengue Fever (DHF) is rainfall and air temperature, in addition to other factors such as virus density and herd immunity (Irma et al., 2021).

Dengue virus (DENV) is a disease belonging to the Flaviviridae family that includes more than 70 major human pathogens that mostly affect and infect the inter-tropical region, which contains about 3.9 billion people (Khan et al., 2023). DHF is mostly transmitted by Aedes (Stegomyia) aegypti mosquitoes and in some cases, by Aedes albopictus mosquitoes (Gan et al., 2021). Dengue has four viral serotypes, namely DENV-1, DENV-2, DENV-3, and DENV-4, all of which can infect humans. All dengue virus serotypes have the same initial symptoms, namely high fever, headache, muscle pain, and skin rash. However, in more severe cases, as stated by Khan et al. (2023) in their journal, DHF can progress to Severe Dengue Fever (DHF) or Dengue Shock Syndrome (SSD), which is characterized by plasma leakage, massive bleeding, and organ failure. DHF has a hazard rate of less than 1% if given the correct treatment and care. However, humans can develop serious diseases such as DHF/DSS with a hazard rate of 2% - 5% after receiving treatment. Subsequently, when not treated properly, the hazard rate of DHF/DSS will increase to 20% (Khan et al., 2023).

Other sources also mentioned the same thing, Dengue virus is one of the common diseases that often occurs in tropical and subtropical countries where cases of viral infection can reach 100 to 400 million cases a year worldwide (Kok et al., 2023). Dengue virus is spread from various parts of the world such as the Mediterranean, Southeast Asia, Africa, and South America. Dengue virus originates from mosquito infections that are usually of the Aedes type. Dengue virus is a virus that has a relatively fast evolution, the last evolution of dengue virus was in 2013 where there was a virus with a new serotype, DENV-5, which is an evolution of the previous serotype (DENV-4) from the Aedes mosquito with other viruses. But this evolution is still relatively rare so it has not been confirmed to be a fixed serotype, but this proves that dengue viruses can evolve at any time (Sang et al., 2023).

The dengue mosquito, Aedes aegypti is a highly invasive and medically important vector in transmitting for dengue fever virus (Dengue virus), yellow fever, chikungunya, and Zika, whose global spread can be attributed to increased globalization in the 15th century to the 20th century (Maynard et al., 2023). The aedes mosquito is the vector of the spread of dengue hemorrhagic fever (Ekayani et al., 2021). According to data from the Indonesian ministry, in Palu city, Central Sulawesi province, there are many cases of dengue fever caused by the large number of mosquito larvae of Aedes Aegypti species in Palu city. The mosquito larva is the initial process in the life cycle of a mosquito. Aedes mosquitoes usually rest or put their larvae into moist and wet places such as bathtubs, ponds, drains, etc (Rau & Nurhayati, 2021).

The Aedes aegypti mosquito's capacity to spread is influenced by its choice for breeding areas with high humidity and minimal light exposure. These mosquitoes commonly reproduce in man-made water storage containers, both indoors and outdoors, particularly in places with low illumination and high moisture levels. Temperatures ranging from 24°C to 28°C, as well as humidity levels of 70% to 90%, are ideal for breeding. Furthermore, the presence of moss in water containers can create a suitable environment for this mosquito species to reproduce (Handayani et al., 2023). Then, in another study, it was also mentioned that the availability of breeding sites (stagnant water), optimal air temperature (25-27°C), and high humidity, including factors that affect the breeding of Aedes mosquitoes (Bone et al., 2021).

Rainfall is the amount of rainwater that accumulates on a flat surface, where it does not evaporate, does not soak into the ground, and does not run off (Ajr & Dwirani, 2019). Rainfall not only triggers stagnant water, which is an ideal breeding ground for the Aedes aegypti mosquito as a vector of Dengue Fever (DHF), but also impacts humidity, creating conditions that favor an increased number of mosquito breeding sites (Rompis et al., 2020). Thus, if an area has low rainfall and lasts for a long period of time, mosquito breeding sites will increase, complemented by increased mosquito populations (Triwahyuni et al., 2020). Rainfall also impacts the growth and breeding of insects such as mosquitoes (Kurnia et al., 2020). Thus, rainfall is one of the factors of the water cycle in nature that can affect the availability of water for plants and other living things. Something that can impact the intensity of rainfall is the temperature of the surrounding environment (Zhu et al., 2022). Another impact of rainfall is one of the factors causing flooding in various cities in Indonesia (Setiawan et al., 2020).

Air temperature is the condition of air heating due to heat radiation from the sun (Prasetyo et al., 2021), which has a close relationship with temperature. Temperature as a parameter indicates the degree of hotness or coldness of an object (Ardiyanto et al., 2021). Thus, temperature changes in objects can reflect changes in air temperature conditions that are influenced by various factors, especially solar radiation. Temperature plays an important role in the life cycle and metabolic process of mosquitoes, where optimal mosquito growth occurs in a temperature range between 25˚C to 27˚C (Bone et al., 2021). Temperature is also a parameter that indicates the level of heat or cold of an object, and the tool commonly used to measure it is a thermometer. There are four types of thermometers commonly used, namely Celsius, Fahrenheit, Reamur, and Kelvin, where each type has a specific temperature measurement scale (Ardiyanto et al., 2021). Temperature is related to air temperature, a condition of air heating (Prasetyo et al., 2021), whose value is influenced by how much solar radiation is received (Hidayat & Farihaha, 2020).

One of the countries that has a climate with air temperatures that tend to be stable, as well as high and evenly distributed rainfall throughout the year is Indonesia. Thus, based on Koppen's climate classification, Indonesia is categorized as an area that has a tropical rainforest climate (Af) (Hidayat & Farihaha, 2020). However, countries that have a tropical climate, such as Indonesia, become an environment where Dengue virus-carrying mosquitoes are endemic, which can spread Dengue Fever (Asmuni et al., 2020).

According to Hamid et al. (2023), in their journal, stated that dengue fever is a serious problem for Indonesian public health (Hamid, 2023). This is reinforced by data from the Ministry of Health which states that there has been an increase in Dengue Fever (DHF) cases compared to the previous year. In week 8 or the end of February 2024, the number of dengue cases reached 15,977 with 124 deaths reported across Indonesia. In comparison, in January 2023, there were 12,502 dengue cases with 101 deaths (Rahmadania, 2024). Indonesia, as part of Southeast Asia, is also ranked second among the regions with the highest number of DHF cases in the world, with the highest percentage of deaths (CRF) at 0.72 percent (Redaksi, 2024).

One of the provinces in Indonesia where dengue fever is endemic is West Java Province. During the period of 2011 to 2016, West Java reported the highest number of DHF cases every year. Even in 2017, the number of DHF cases in this province reached its peak in Indonesia, recording 10,016 cases with a mortality rate (CFR) of 0.5 percent (Masturoh et al., 2021). This increase in cases in Indonesia indicates the need for serious attention to environmental factors, such as rainfall and air temperature, in efforts to prevent and control DHF in Indonesia.

Therefore, the researcher chose the topic The Effect of Rainfall and Temperature on Dengue Fever (DHF) Cases in West Java. This study aims to analyze and visualize the relationship between rainfall, air temperature, and dengue fever cases in the nine largest cities in West Java Province. A city is a location where people gather at a higher density compared to the surrounding area, due to the concentration of functional activities related to population activity (Rizki & Asteriani, 2020). The definition of a city can also be interpreted as an area that has a larger population, limited area, is generally not agricultural in nature, has a relatively high population density, and is the main concentration center for economic, social, and cultural activities of the community (Hardi et al., 2022). The cities that are selected is based on population density, namely Bekasi City, Bandung City, Depok City, Bogor City, Tasikmalaya City, Cimahi City, Sukabumi City, Cirebon City, and Banjar City (Iskandar, 2024). By utilizing secondary data from reliable sources such as Open Data Jabar, Statistics Indonesia, and NASA POWER, this research will use descriptive and inferential analysis methods to identify patterns and relationships between these variables. Furthermore, the results of the analysis will be visualized in the form of an interactive dashboard using Tableau Desktop 2023.3, a tool that can support business intelligence and data analysis activities (Bifakhlina, 2022), which will show whether there is a relationship between rainfall and temperature with the number of DHF cases in each year.

This research is important to provide in-depth insight into the influence of climatic factors on the spread of DHF in West Java. The findings of this research can help the government and other stakeholders in developing more effective prevention and control strategies, as well as anticipating future increases in dengue cases. In addition, interactive and informative data visualizations can facilitate better communication with the public about the risks and necessary mitigation efforts.

2. Related Work

According to Irma et al. (2021) Dengue fever or DHF is a serious problem, especially in tropical countries including Indonesia. DHF cases have increased significantly in the last 3 years. Dengue fever (DHF) is a disease transmitted through the Aedes aegypti and Aedes albopictus mosquito species (Irma et al., 2021). According to Nuhgroho et al. (2023) DHF is a health problem that occurs in urban and semi-urban areas. Vector behavior and its relationship with the environment such as climate, vector control, and urbanization affect the occurrence of dengue outbreaks in urban areas. From data released by the Ministry of Health of the Republic of Indonesia, there were 73,518 cases of DHF throughout 2021. West Java is the province with the highest morbidity rate of 47.8 per 100,000 population (Nuhgroho et al., 2023).

One of the factors for the rapid spread of DHF in tropical countries is climate. According to Prambudi et al. (2023), climate change has a big influence, one of which is rainfall. Climate change can make rainfall increase and affect the development of dengue hemorrhagic fever (DHF) mosquitoes and this is happening in Indonesia. The incidence of DHF in several Indonesian provinces is mostly influenced by rainfall and humidity. Rainfall as an uncontrollable variable is the main factor that influences temperature and humidity so that breeding factors such as breeding places and hatching of mosquito eggs are optimized.

Temperature change is also a factor in the spread of DHF. According to Bone et al. (2021) rainfall does affect the survival of the Aedes Aegypti mosquito because mosquito breeding sites will increase as the amount of rainfall increases. Temperature is also crucial, as it can affect the life cycle and metabolic processes of mosquitoes (Halim et al., 2022). Mosquito development is within the temperature range of 25˚C-27˚C, if the temperature is <10˚C or >40˚C, mosquito growth will stop (Sufiani et al., 2021). Generally, dengue virus transmission often occurs in tropical and subtropical countries because cold temperatures can kill the eggs and larvae of Aedes Aegypti mosquitoes. High air temperature increases water evaporation so that the air becomes more humid. High humidity encourages mosquitoes to seek wet places to rest (Bone et al., 2021).

On another note, while temperature change is a significant factor in the spread of DHF, data visualization tools like Tableau offer valuable insights into various aspects of data analysis and presentation in this study. According to Batt et al. (2020) study, Tableau is one of the data visualization tools that can display various information and data. Before recognizing Tableau there are several other data visualization tools such as GIS (Geographic Information Systems) which can visualize geographic information that can be linked with descriptive information such as displaying the relationship between economic growth and geo-spatial mapping. In addition to GIS, other data visualization tools are FRED (Federal Reserve Economic Data) which can visualize time series data and Infographics which focuses on minimalist visualization so that visualized data can be more easily understood. Finally, Excel has various features, one of which is data cleaning. The four tools have their own advantages and disadvantages, but all the features mentioned earlier in the visualization tools are owned by Tableau itself. Another advantage possessed by Tableau is that it can create interactive dashboards using a combination of various large datasets (Batt et al., 2020).

3. Method

The research method used in this study is the descriptive analysis method. This approach aims to systematically describe the characteristics or properties of the data that has been collected. Data collection was conducted through two main methods: secondary data collection and literature study. Secondary data were obtained from Open Data Jabar and the Central Bureau of Statistics, which provided information related to dengue cases, rainfall, and air temperature in the nine largest cities in West Java (based on population density). In addition, additional data on climate parameters were also taken from the NASA POWER website (https://power.larc.nasa.gov/data-access-viewer/), which provides access to accurate global meteorological data.

The literature study was conducted by collecting and analyzing various scientific sources relevant to the research topic. These sources include scientific journals, official reports, and publications from health organizations that discuss Dengue Fever (DHF), environmental factors that affect the spread of the disease, and effective data analysis and visualization methods. This literature helped in understanding the theoretical and empirical context of the relationship between rainfall, temperature, and dengue cases, and in forming the basis for more in-depth data analysis.

The research framework used involved several key steps. First, data collection from the aforementioned sources. Second, data cleaning and processing to ensure the quality and consistency of the information to be analyzed. Third, data analysis using Tableau Desktop 2023.3, a software that enables the creation of interactive data visualizations. Tableau was used to create a dashboard that maps and displays the relationship between dengue cases, rainfall, and temperature in various cities in West Java. This dashboard is designed to make it easier for the government and other stakeholders to understand the dynamics of the spread of DHF and take appropriate preventive measures based on the insights gained.

With these methods, the research is expected to provide a comprehensive understanding of the influence of climatic factors on dengue cases in West Java, as well as provide effective visual aids to support decision-making in disease control.

The object of our research is West Java Province, one of the regions in Indonesia that faces serious challenges related to the increase in Dengue Fever (DHF) cases in early 2024. The organizational structure of West Java consists of the Provincial Government, which is led by a Governor, and there are various related agencies and institutions such as the Health Office, the Environmental Office, and others. West Java's vision is to be an independent, empowered, and equitable province, while its missions include ensuring community welfare, sustainable infrastructure development, and strengthening health and environmental systems.

Our research focuses on public health phenomena, specifically the increase in dengue cases in West Java. We will analyze the relationship between climatic factors, such as rainfall and temperature, and the number of DHF cases, and develop a dashboard that visualizes the data to help the government make informed decisions. The goal of this research is to provide deeper insight into the pattern of dengue disease spread in West Java and devise effective strategies in handling it.

This research started by identifying the main problem, which is the effect of rainfall and temperature on Dengue Fever (DHF) cases in West Java. This initial step involved preliminary discussions to understand the context of the problem and review available preliminary data, as well as formulating research hypotheses to be tested. Once the problem was identified, an in-depth literature study was conducted. At this stage, relevant literature from scientific journals, official reports, and other publications were collected and analyzed to understand the theoretical and empirical context of the relationship between rainfall, temperature, and DHF, as well as appropriate data analysis methods.

Furthermore, secondary data was collected from various trusted sources such as Open Data Jabar, Statistics Indonesia, and NASA POWER. The data collected included information on dengue cases, rainfall, and air temperature in the nine largest cities in West Java (based on population density). Once the data was collected, the next step was data cleaning and processing. Irrelevant data was removed, missing values were filled in, and the data format was converted to be ready for analysis. This cleaning ensures that the data used in the analysis is of good quality and consistency.

The next stage is data analysis. At this stage, statistical analysis was conducted to find relationships between rainfall, temperature, and dengue cases. Descriptive and inferential statistical methods were used to identify patterns and significant relationships in the data. Once the data analysis was complete, the results were visualized using Tableau Desktop 2023.3. An interactive dashboard was designed to map and display the relationship between DHF cases, rainfall, and temperature in different cities in West Java, making it easier to understand and interpret the data.

The results of the analysis and visualization were then interpreted to identify key findings and evaluate the research hypotheses. Based on these interpretations, a research report was compiled, including methodology, results, discussion, and conclusions. The dashboard that had been created was also refined for presentation. The final stage of the research was implementation and recommendations. The research results and dashboard were presented to the government and other stakeholders, along with suggestions for more effective preventive and control measures for DHF based on the findings of this research. Thus, this research is expected to provide in-depth insights and useful tools in the effort to address the increase of DHF cases in West Java.

The literature study in this research served to understand the theoretical and empirical relationship between rainfall, temperature, and dengue fever cases. From various literatures, we identified that rainfall has an effect on increasing the breeding sites of Aedes aegypti mosquitoes, while temperature affects the life cycle and activities of mosquitoes. This information was used to build a strong theoretical basis for the study and direct the data analysis. The literature study also helped identify statistical analysis methods that have been used in similar studies, so that they could be adapted for the context of this study. In addition, literature on the use of data visualization tools such as Tableau Desktop provided guidance in designing effective interactive dashboards to present the research findings to stakeholders.

The population of this study is the entire population in the nine largest cities in West Java (based on population density), namely Bekasi City, Bandung City, Depok City, Bogor City, Tasikmalaya City, Cimahi City, Sukabumi City, Cirebon City, and Banjar City. This population was chosen because these cities have a significant number of DHF cases and are representative of the variation in climate and population density in West Java. This population is relevant in the context of the study because it illustrates complex urban dynamics, where environmental factors such as rainfall and temperature can vary greatly and affect the spread of DHF. Common characteristics of this population include high population density, wide demographic variation, and differences in infrastructure and access to health services.

Samples were taken from data on dengue cases, rainfall and temperature in the nine cities over a certain period, such as the last five years. The sample selection method used stratification by city, so that each city was represented in the sample. This selection ensured that the analyzed data covered a wide range of environmental and demographic conditions that could affect the results. The sample size was determined based on the amount of monthly or annual data available for each city, taken consistently for the analysis period. For example, if monthly data is used, then there are 60 data points per city (5 years x 12 months), bringing the total sample to 300 data points.

The population data collection method used secondary data from reliable sources such as Open Data Jabar, Statistics Indonesia, and NASA POWER. These data included detailed information on dengue cases, rainfall, and air temperature. For sample selection, a stratification method was used to ensure a balanced representation of the nine largest cities in West Java (based on population density), so that each city had an equal amount of data in the analysis. The use of the stratification method allows controlling for variation between cities and helps identify specific patterns that may occur in each city. This method also facilitates comparative analysis between cities and minimizes bias that may arise from differences in the amount of data in each city.

In this study, the data analysis methods used were descriptive and inferential statistical analysis to understand the relationship between rainfall, temperature, and Dengue Fever (DHF) cases in the nine largest cities in West Java (based on population density). The following is a breakdown of the approach applied:

1. For this study, the main variables analyzed were the number of DHF cases, rainfall (in millimeters), and air temperature (in degrees Celsius). Data for these variables were collected on a monthly basis from secondary data sources such as Open Data Jabar, Statistics Indonesia, and NASA POWER. These variables were then used to identify patterns and trends as well as the relationship between climate variables and DHF cases.
2. Descriptive analysis was used to describe the basic characteristics of the data collected. It includes calculations of the mean, median, standard deviation, and range for each variable. This analysis provides an overview of the distribution of the data and helps identify anomalies or outliers that need further attention. For example, descriptive analysis was used to see how the average rainfall and temperature changed over the study period and how these fluctuations might correlate with changes in the number of DHF cases.
3. To understand the relationship between rainfall, temperature, and dengue cases, Pearson correlation analysis was applied. This technique is used to measure the strength and direction of a linear relationship between two variables. In this study, the correlation analysis helped identify whether an increase or decrease in rainfall and temperature had a significant relationship with the number of reported dengue cases. For example, a high correlation value between rainfall and DHF cases would indicate that an increase in rainfall correlates with an increase in DHF cases.
4. To facilitate interpretation and communication of the research results, Tableau Desktop 2023.3 was used to create interactive data visualizations. These visualizations include thematic maps showing

the geographical distribution of dengue cases, trend graphs depicting monthly changes in rainfall, temperature, and dengue cases, and interactive dashboards that allow for more in-depth exploration of the data. These visualizations help in identifying temporal and spatial patterns that may not be visible through conventional statistical analysis.

By using these analytical approaches, this research can provide a more comprehensive insight into how climatic factors such as rainfall and temperature affect the dynamics of DHF spread in West Java. The analysis also provides a strong basis for policy recommendations for more effective prevention and control of DHF in the future.

4. Results and Discussion

Datasets were obtained from 2 websites, namely the NASA POWER website which was used to obtain rainfall datasets and average, minimum, and maximum temperature datasets. In addition, researchers obtained the dataset of the number of cases and the number of deaths from DHF disease in OPENDATA JABAR. The 11 datasets obtained were processed using Microsoft Excel. Researchers used Microsoft Excel to combine data from 9 cities into 2 datasets, each of which has 1 table that has the same attributes. The first dataset has attributes about the temperature in each city in West Java. In addition, the second dataset serves to provide information about the amount of rainfall each year in each city in West Java. The last two datasets are the number of cases and the number of deaths from DHF in each city in West Java.

The main attributes used to conduct the research are: name_kabupaten_kota, gender, number_of_cases, number_of_cases_death, and year. In addition, the main attributes regarding weather are: City, Minimum, Maximum, Average, Rainfall (mm) per Month, Month, and Year. Researchers also created 2 calculation attributes, namely: Death Ratio which is the ratio of deaths to the total number of cases, and Survive Patients which is the number of patients who survived and recovered from DHF.

4.1. Dashboard Visualization

Dashboard visualizations are made using tableau desktop 2023.3, with the aim of making it easier for readers to understand and take insight from the data that has been processed by researchers, where each visualization will provide different insights. The first visualization shows how many dengue cases and death cases that are caused by dengue. Then, the second visualization displays the level of rainfall and temperature in each city in West Java. The third visualization shows the time series of temperature and rainfall, dengue cases, and deaths caused by dengue. Finally, the fourth visualization displays the relationship between rainfall or average temperature, and the number of DHF cases, along with the results of forecasting that has been done on these three elements.

Additionally, each visualization is designed to be interactive, allowing users to explore the data in more detail by filtering and drilling down into specific aspects of the data. These interactive features enable users to customize their view and focus on areas of interest, thereby enhancing the decision-making process. With these visualizations, the government or other stakeholders can be assisted in decision-making and gain a deeper understanding of the dengue problem.

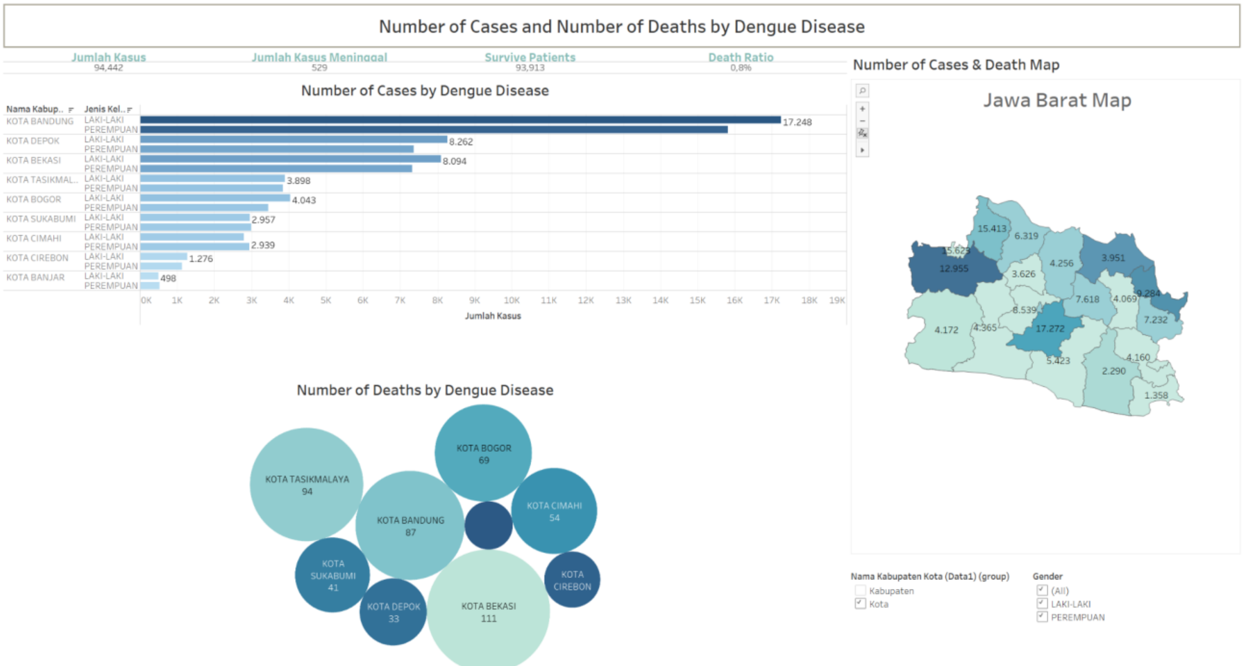

Fig. 1: Visualization of Number of Cases and Number of Deaths by Dengue Disease

Based on Figure 1, Visualization of Number of Cases and Number of Death by Dengue Disease provides four visualizations that offer insight into:

1. Distribution of Every case that provided information about the number of cases, number of death cases, patients that survive from dengue and death ratio from dengue disease in West Java. This visualization takes the form of a table that shows the information in numbers. Total case of dengue has a total of 94,442 dengue cases, 529 death cases, 93,913 surviving patients and lastly a 0.8% death ratio. Consequently, Number of cases is more than the number of deaths from dengue. Also a relatively low percentage of death ratio.
2. Number of cases of dengue disease by city and gender: This visualization is presented in the form of a bar chart that displays the distribution of every case based on the city in West Java and by gender.The result shown that Bandung which is the city in West Java have the highest number of cases with around 17.248 number of cases from kota bandung and the male patients have the most cases than woman.
3. Number of Deaths by Dengue Disease: This visualization is presented in the form of bubble chart/packed bubble that displays the distribution of every death case based on the city in West Java. The results showed that City with the highest death rate is Bekasi with a number of 111. The lowest death cases is kota banjar with a number of 17.
4. Number of Cases & Death in map: This visualization is presented in the form of a map and a geographic image of West Java. This visualization showed the information of every death and every case based on the map location.

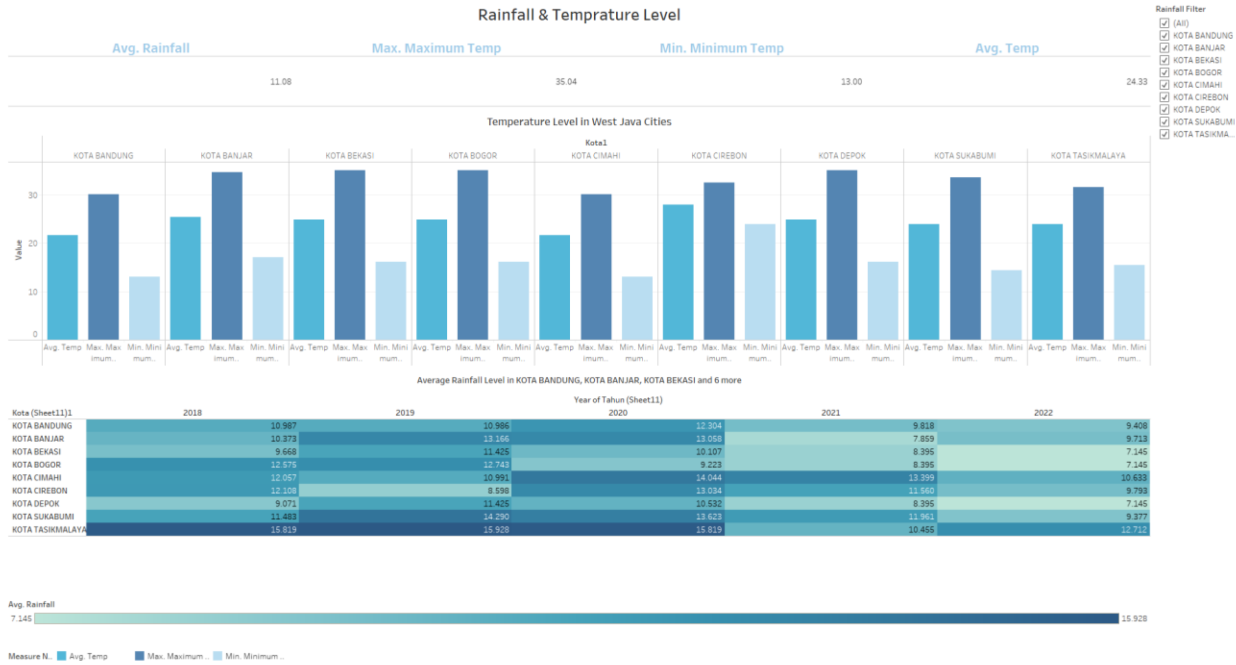

Fig. 2: Visualization of Rainfall & Temperature Level

Based on Figure 2. Visualization of Rainfall & Temperature Level provide three visualization that offer insight into:

1. Distribution of Every case that provided information about the average rainfall level, Maximum Temperature cases, Minimum temperature, and Average temperature in West Java. This visualization takes the form of a table that shows the information in numbers. Average rainfall level is 11.08, maximum temperature of 35.04 celsius, Minimum temperature 13 celsius and average temperature 24.33 celsius.
2. Temperature Level in West Java Cities. This visualization takes form of a vertical bar chart that shows every single city in west java which is Bandung, Bekasi, Banjar, Bogor, Cimahi, Depok, Sukabumi, Tasikmalaya. It also gives insight into every average temperature, maximum temperature, and minimum temperature of every city in west java. We can see that the average temperature in all west java cities has a very close range.
3. Average Rainfall level in All cities: This visualization takes the form of a highlighted table that shows the average accumulation of every rainfall level (in mm) of every city in West Java. We can see the distribution in each year.

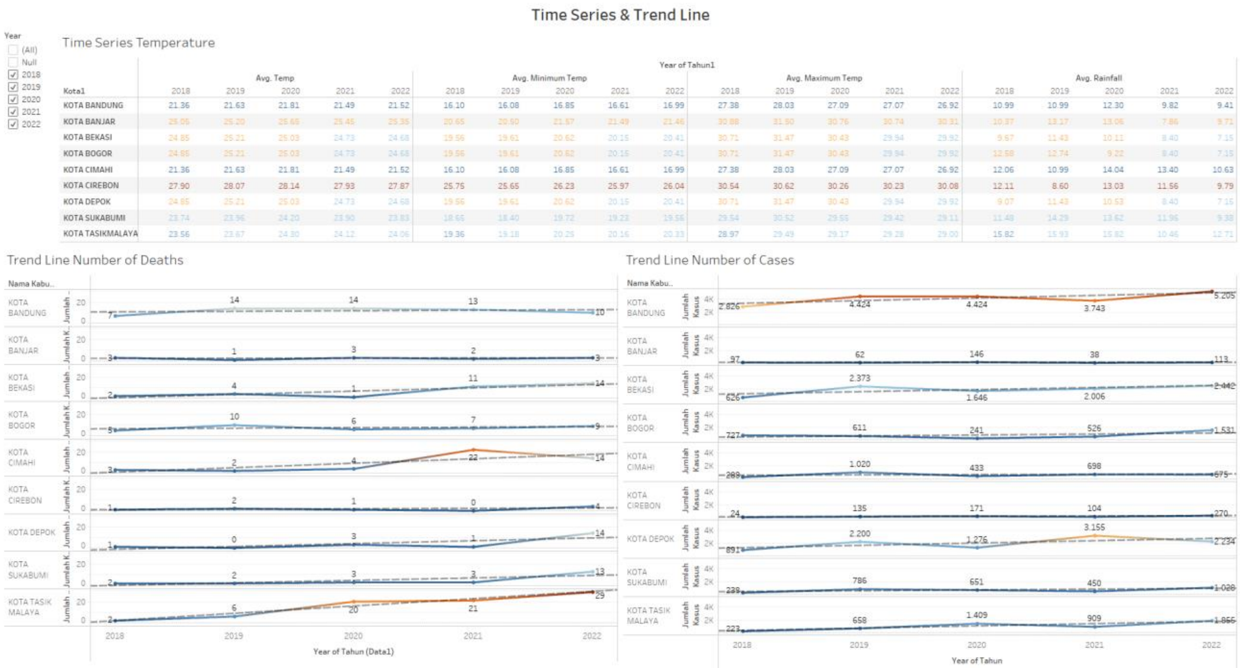

Fig. 3: Visualization of Time Series & Trend Line

Based on Figure 3, Visualization of Time Series three visualizations that offer insight into:

1. Time Series of Temperature & Rainfall from 2018 - 2022: This visualization is presented in the form of a line chart that displays the average temperature, maximum temperature, minimum temperature and rainfall of each year from 2018 - 2022. The highest average temperature is at Cirebon with the highest average temperature of 28,14.
2. Trend Line of Number of Deaths from 2018 - 2022: This visualization is presented in the form of a line chart that displays the total number of deaths of each year from 2018 - 2022. The highest total number of deaths is at Bandung with the total number of deaths at 5.205.
3. Trend Line of Number of Cases from 2018 - 2022: This visualization is presented in the form of a line chart that displays the total number of cases of each year from 2018 - 2022. The highest total number of cases is at Bandung with the total number of cases at 5.205.

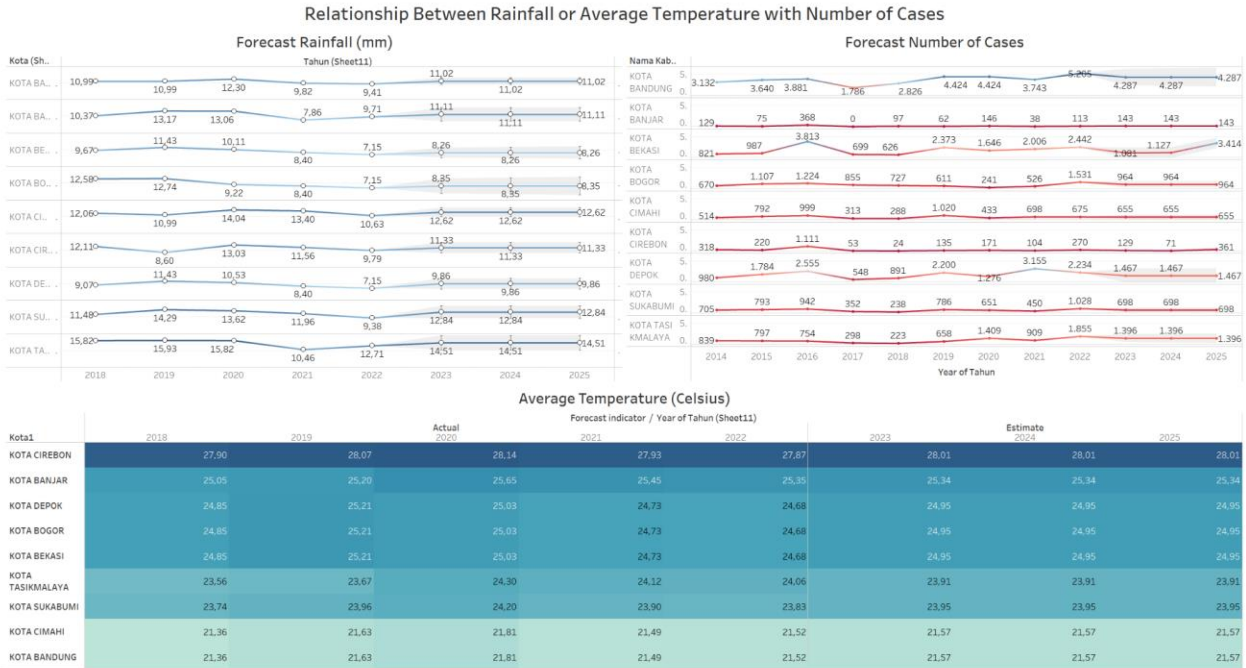

Fig. 4: Visualization of Relationship Between Rainfall or Average Temperature with Number of Cases

Based on Figure 4, Visualization of Relationship Between Rainfall or Average Temperature with Number of Cases provides three visualizations that offer insight into:

1. Forecast of average rainfall (mm) for the next 3 years: This visualization is presented in the form of a line chart that displays the total number of rainfall each year. There is also a forecast for the next 3 years (starting from the last year of the dataset). The highest average rainfall (mm) that is forecasted in 2025 is at Sukabumi with an average rainfall (mm) of 12,84.
2. Forecast of Number of Cases for the next 3 years: This visualization is presented in the form of a line chart that displays the total number of cases each year. There is also a forecast for the next 3 years (starting from the last year of the dataset). The highest total number of cases that is forecasted in 2025 is at Bandung with a total number of cases of 4.287.
3. Forecast of Average Temperature for the next 3 years: This visualization is presented in the form of a line chart that displays the average temperature each year. There is also a forecast for the next 3 years (starting from the last year of the dataset). The highest average temperature that is forecasted in 2025 is at Cirebon with an average temperature of 28,01.

4.2. Discussion

The visualizations offer valuable insights into the dengue disease situation in West Java province, Indonesia. A few key points can be highlighted:

1. Dengue Case Burden: The data shows a significant number of dengue cases (94,442) in West Java, with Bandung city having the highest number of cases (17,248). This underscores the importance of focused prevention and control measures in high-burden areas like Bandung.
2. Mortality Rate: While the overall number of dengue-related deaths (529) is concerning, the relatively low death ratio of 0.8% is encouraging. This could be attributed to effective case management and timely access to healthcare. However, further reduction in mortality should remain a priority.

3. Gender Distribution: The visualizations reveal that male patients account for a higher number of dengue cases compared to females. This pattern may be explored further to understand potential gender-based risk factors or exposure levels.
4. Geographical Variations: The visualizations highlight geographical variations in the number of cases and deaths across different cities in West Java. Bekasi city stands out with the highest number of dengue-related deaths (111), indicating a need for targeted interventions in this area.
5. Climate Factors: The visualizations suggest a potential relationship between climatic factors (rainfall and temperature) and dengue case numbers. Increased rainfall and higher temperatures in certain years seem to correlate with higher dengue case counts. This aligns with existing knowledge about the influence of climatic conditions on the mosquito vector's breeding and survival.
6. Forecasting: The forecasting visualizations provide valuable insights for preparedness and resource planning. The projected increase in dengue cases, rainfall, and temperature in the next few years highlights the importance of proactive measures to mitigate the potential impact of these trends.

Overall, these visualizations offer a comprehensive overview of the dengue situation in West Java, enabling stakeholders to identify priority areas, monitor trends, and develop targeted interventions for prevention, control, and case management. Continued monitoring and analysis of these factors, along with a multidisciplinary approach, will be crucial in combating the challenges posed by dengue in the region.

5. Conclusion

The study aimed to analyze and visualize the effect of rainfall and temperature on Dengue Fever (DHF) cases in the nine largest cities of West Java, Indonesia. Contrary to previous studies that suggested a strong correlation between climatic factors and the incidence of DHF, the findings of this research revealed that there is a correlation between rainfall, temperature, and the number of reported DHF cases.

The interactive dashboard and visualizations developed using Tableau Desktop 2023.3 allowed for a comprehensive exploration of the data, including mapping the geographical distribution of cases, tracking trends over time, and forecasting future scenarios. The analysis did uncover a significant relationship between variations in rainfall and temperature patterns and the fluctuations in DHF case numbers across the cities studied. As the temperature and rainfall level rises, the number of cases is predicted to decrease. This conclusion suggests that mosquitoes have difficulty coping with higher temperatures, resulting in reduced breeding and fewer infected individuals.

It is essential to acknowledge that the relationship between climatic conditions and the incidence of vector-borne diseases is complex and may involve intricate interactions between multiple variables. The findings of this study highlight the need for further research to identify and understand the specific drivers of DHF transmission in West Java, as well as the potential influence of other socio-economic and environmental factors.

Overall, this research contributes to the ongoing discourse on the relationship between environmental factors and vector-borne diseases, highlighting the importance of context-specific investigations and the need for a holistic understanding of the complex interplay of variables influencing disease transmission dynamics.

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