ANALYSIS OF DENGUE HEMORRHAGIC FEVER SURVEILLANCE DATA (2012-2021) IN INDONESIA

Esterika C. Kaligis[1], Budi T. Ratag[2,] Fima F. L. Langi[3]

[1]Esterika C. Kaligis, Faculty of Public Health, Sam Ratulangi University, Indonesia

[2]Budi T. Ratag, Faculty of Public Health, Sam Ratulangi University, Indonesia

[3]Fima F. L. Langi, Faculty of Public Health, Sam Ratulangi University, Indonesia

**Correspondence Author:* esterikakaligis121@student.unsrat.ac.id

ABSTRACT

Dengue hemorrhagic fever *is an infectious disease transmitted by* Aedes aegypti mosquito *carrying* the Dengue *virus* throughout the world, including Indonesia. This disease is endemic in several regions including west Java province. Java province is the province with the highest number of cases in Indonesia. The purpose of this study was to analyze the surveillance data on the distribution of Dengue cases spatially in Indonesia. The design of this study is a *Cross-sectional study design,* which uses population and sample reports of dengue cases from 34 provinces in Indonesia recorded in the 2012-2021 based on Indonesian health profile. The results showed that the number of Dengue cases in Indonesia fluctuates every year. 2016 was the year with the highest number of cases, *Incidence* rate and the number of death cases (2012-2021). As for the results of spatial analysis conducted for 2021, it was found that the provinc e that ranks first with the highest number of cases is the province of West Java. Furthermore, Riau Islands province is the province with the highest *Incidence Rate* in 2021. Number of death cases in 2021, the provinces of West Java and Central Java are the provinces recorded as having the highest death rates in 2016.

Keywords : DHF, Spatial Analysis

ABSTRAK

Demam berdarah *dengue* merupakan penyakit menular yang ditularkan oleh nyamuk *Aedes aegypti* pembawa virus *dengue* yang ditularkan diseluruh dunia termasuk Indonesia. Peyakit ini bersifat endemis di beberapa wilayah termasuk Provinsi Jawa Barat. Provinsi jawa Barat merupakan provinsi dengan jumlah kasus tertinggi di Indonesia. Penelitian ini bertujuan untuk menganalisis data surveilans sebaran kasus DBD secara spasial di Indonesia. Desain penelitian ini adalah desain *cross-sectional,* yang menggunakan populasi dan sampel laporan kasus DBD dari 34 provinsi di Indonesia yang dicatat dalam Profil kesehatan Indonesia tahun 2012-2021. Hasil penelitian menunjukan bahwa angka kasus DBD di Indonesia memiliki fluktuasi setiap tahunnya. Tahun 2016 merupakan tahun dengan angka kasus, angka *Incidence Rate* dan angka kematian tertinggi dalam rentang waktu 10 tahun (2012-2021). Sedangkan untuk hasil analisis spasial yang dilakukan di tahun 2021 didapatkan bawa provinsi yang menduduki urutan pertama dengan jumlah kasus terbanyak adalah provinsi Jawa Barat. Selanjutnya provinsi Kepulauan Riau merupakan provinsi dengan angka *Incidence Rate* tertinggi pada tahun 2021. Untuk angka kematian di tahun 2021 provinsi Jawa Barat dan Jawa Tengan merupakan provinsi yang tercatat memiliki angka kematian tertinggi di tahun 2016.

Kata Kunci : DBD, Analisis Spasial

INTRODUCTION

Dengue hemorrhagic fever (DHF) epidemiologically in the world is changing very quickly. Dengue infection is the most common mosquito-borne disease in humans in recent years, so it is still a global health problem. DHF is not new in Indonesia. As explained by the Head of the *Dengue Research Unit* at the *Eijkman Institute of Molecular Biology,* Dr. Tedjo Sasmono, the first recorded case of DHF in Indonesia was found in 1968 in DKI Jakarta and Surabaya where this disease continues to spread widely throughout Indonesia (Putri 2022).

Dengue hemorrhagic fever *is an infectious disease transmitted by* Aedes aegypti mosquitoes *carrying* the dengue *virus* . This disease can be characterized if a person has a sudden fever for 2 to 7 days without any apparent cause, accompanied by a state of anxiety, weakness / lethargy, heartburn, and signs of bleeding in the skin which are bleeding spots (*petechiae*), bruises (*ecchymosis*) or rashes (*purpura*). (Karyanti et al, 2016).

The World Health Organization (WHO) estimates that every year there are around 100-400 million dengue infections globally. Asia ranks first in the number of dengue sufferers as much as 70% every year. It is known that dengue fever is the main cause of morbidity and mortality in Southeast Asia with 57% of the total dengue cases in Southeast Asia occurring in Indonesia (WHO, 2021).

Data from Indonesia's health profile shows that the number of dengue cases in 2012 reached 90,245 cases per 100,000 population with 816 deaths (IR = 37.11 and CFR = 0.9).

In 2013-2016 the number of cases and deaths due to dengue hemorrhagic fever continued to increase. In 2017-2018 the number of dengue cases decreased, the number of dengue cases in 2018 was recorded at 65,602 cases per 100,000 population with 467 deaths (IR = 24.75 and CFR = 0.71). In 2019-2021 dengue cases decreased and in 2021 dengue cases were recorded at 73,518 cases per 100,000 population with 705 deaths (IR=27.0 and CFR= 0.96) This number decreased by 32.12%.

To control and control dengue disease, epidemiology is the basis for making dengue disease control and control programs (Ministry of Health RI, 2016). Surveillance is one of the things that can be done. DHF surveillance is an effort to overcome, analyze and interpret dengue case outcome data that is continuously used in planning, implementing, assessing dengue response programs. The purpose of dengue surveillance is to determine the epidemiological picture of DHF, monitor disease tendencies, analyze risk factors and see the problem of dengue outbreaks (Ikhtiyaryddin, 2020). To clarify the information that will be presented, it is necessary to conduct an information study in the form of mapping the spread of dengue disease in each region. Based on this, it is necessary to take a spatial epidemiological approach using Geographic Information Systems to help overcome problems in an area.

The output of research that has been carried out previously in national collaborative research for fiscal year 2012 is the *Standard Deviational Ellipse* (SDE) Model and *Spatial Interpolation* for dengue cases in dengue endemic areas with a *Participatory Mapping* Approach. Through this model, dengue distribution patterns can be known based on specific locations, dengue program service coverage, through analysis of health spatial data associated with socio-demographics, accessibility, geographical and environmental aspects that affect dengue cases in Indonesia (Ruliansyah, 2017). Spatial analysis also has an important function in the management of dengue disease, namely to analyze the distribution of risk factors transmitted by vector mosquitoes. Support to reduce the number of dengue cases, one of which is Human Resources (HR) who are able to spatially analyze surveillance data.

Method

This study is a quantitative study using secondary data from Indonesia's health profile for 2012-2021, with a cross-sectional design. The population and sample in this study are dengue case reports from 34 provinces in Indonesia recorded in the 2012-2021 Indonesian health profile. Data analysis in this study is univariate analysis to give an overview of dengue cases according to the distribution of geographical areas and according to the distribution of years and time series analysis describes the development / tendency of an event.

Result

Evaluation of dengue surveillance data according to year distribution (Time)

DHF Cases Based on Distribution in 2012-2021

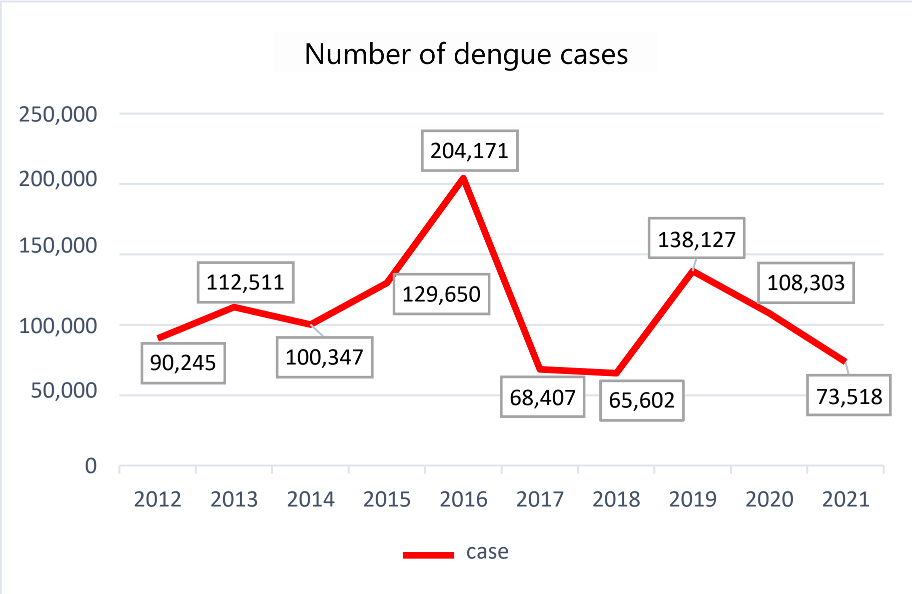

Figure 1. Distribution of Dengue Cases in Indonesia in 2012-2021

Based on the picture above, it can be seen that the number of dengue cases in Indonesia fluctuates every year and the number of dengue cases each year is different. The highest peak of dengue cases over the past 10 years was in 2016 with 204,171 cases. while the lowest number of dengue cases was in 2018 with 65,602 cases.

***Insidence Rate* (IR) DBD in Indonesia Year 2012-2021**

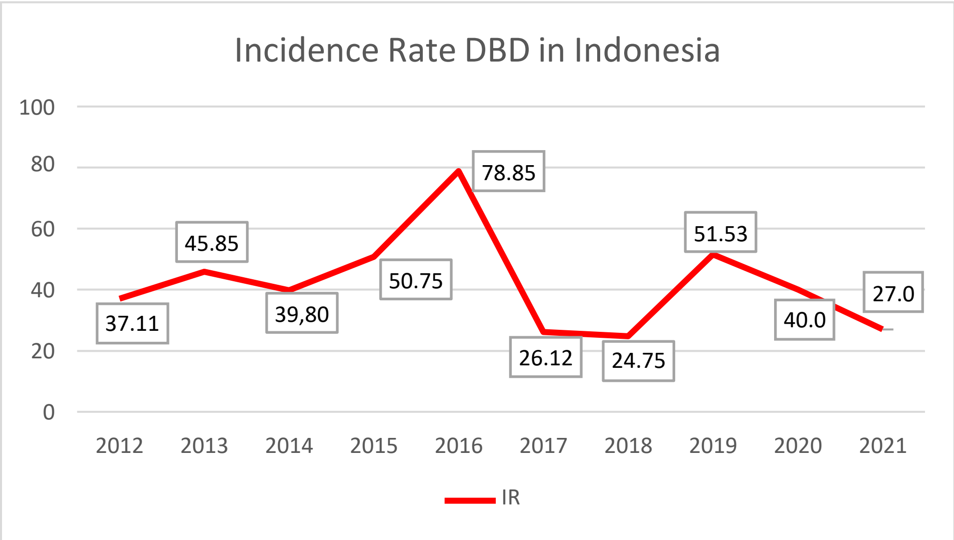

Figure 2. Dengue *Incidence Rate* (IR) in Indonesia 2012-2021

In the picture above, it is known that *the highest Incidence Rate* (IR) rate for the last 10 years was in 2016 which was 78.85 cases per 100,000 population. While the lowest rate was in 2021 with 27.0 cases per 100,000 population.

Distribution of Dengue Death Rate in Indonesia in 2012-2021

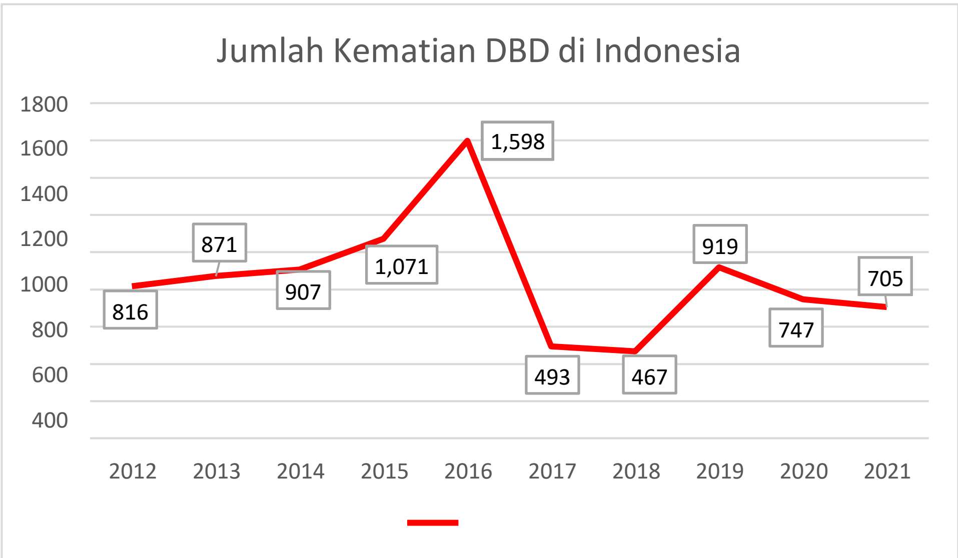

Figure 3. Dengue mortality rate in Indonesia in 2012-2021

Judging from the figure 7, the highest death rate in the last ten years was in 2016 with 1,598 deaths, while 2018 was the year with the lowest death rate of 467 deaths.

Evaluation of dengue surveillance data according to the distribution of geographic areas (places)

Spatial Analysis of Dengue Cases in Each Indonesian Province in 2021

Table 1. Classification of the Number of Dengue Cases in Each Indonesian Province in 2021

Classification	Province	Information
0 – 1.000	Papua, West Papua, North Maluku, Maluku, West Sulawesi, Southeast Sulawesi, Central Sulawesi, Gotontalo, North Kalimantan, Central Kaliamntan , South Kalimantan, West Kalimantan, Bangka Belitung Islands, Bengkulu, Jambi, West Sumatra, Aceh.	Less
1.000 – 2.000	Riau, South Sumatra, Riau Islands, DI Yogyakarta, North Sulawesi.	Low
2.000 – 4.000	North Sumatra, Lampung, DKI Jakarta, Banten, Bali, NTB, NTT, East Kalimantan, South Sulawesi.	Keep
4.000 – 10.000	Central Java and East Java.	Tall
> 10,000	West Java	Very High

Based on table 1, it can be seen the classification of the number of cases per province in Indonesia in 2021. Table 1 shows that there are 17 provinces that fall into the less category (0 – 1,000 cases), 5 provinces that are in the low category (1,000 – 2,000 cases), 9 provinces that are in the medium category (2,000 – 4,000 cases), 2 provinces that are in the high category (4,000 – 10,000 cases) and 1 province that is in the very high category (>10,000 cases). Furthermore, in figure 4, it can be seen that in 2021 the province with the highest dengue cases was in West Java province with 23,959 cases, while the province with the lowest number of cases was in Papua province with 98 cases. The following is a mapping of dengue cases in 2021.

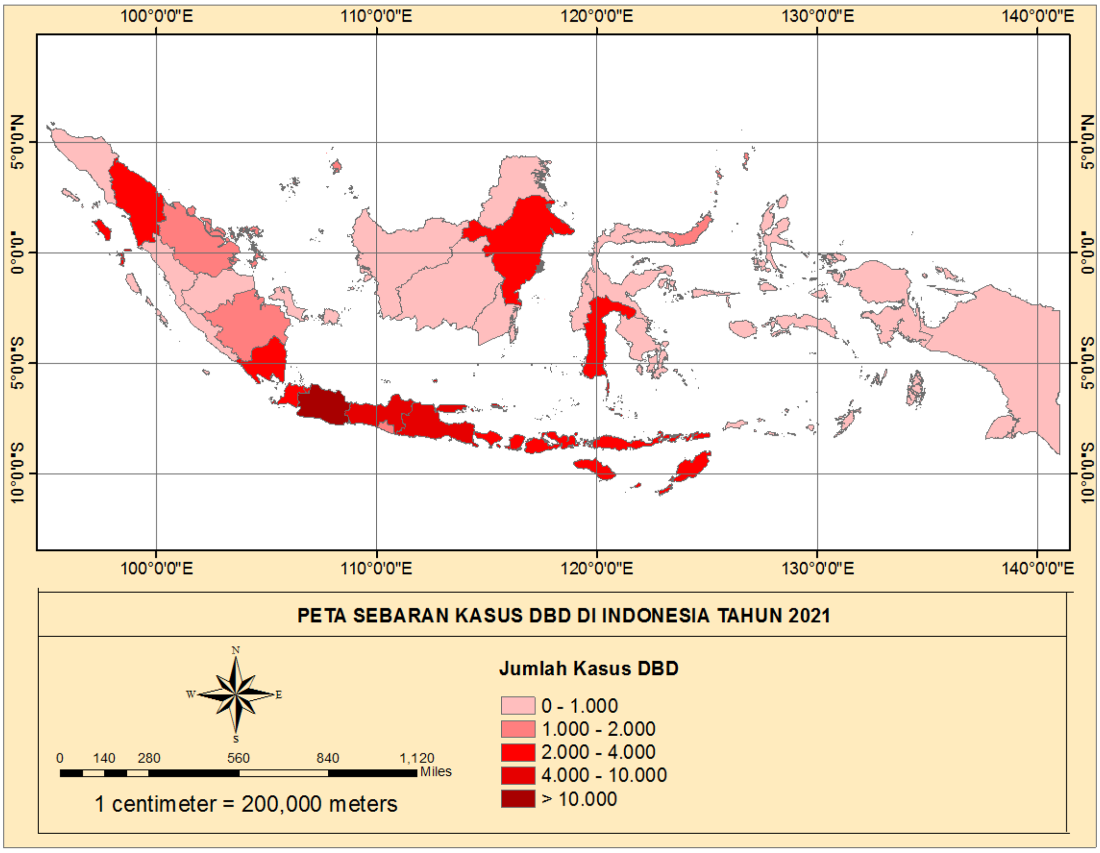

Figure 4. Map of the Distribution of the Number of Dengue Cases in Indonesia in 2021

Spatial Analysis of the Number of *Dengue Incidence Rate* (IR) in Each Indonesian Province in 2021

Table 2. Classification of the Number of *Dengue Incidence Rate* in Each Indonesian Province in 2021

Classification	Province	Information
0 – 20,0	Aceh, Banten, Jambi, Central Java, East Java, West Kalimantan, South Kalimantan, Central Kalimantan, Maluku, Papua, West Papua, Riau, West Sumatra, South Sumatra, North Sumatra.	Less
20,0 – 40,0	IN Yogyakarta, DKI Jakarta, North Kaliamntan , Lampung, North Maluku, West Sulawesi, South Sulawesi, Central Suawesi, Southeast Sulawesi.	Low
40,0 – 60,0	Bali, Bengkulu, Gorontalo, West Java, Kepulawan Bangka Belitung, NTT, NTB, North Sulawesi.	Keep
60,0 – 80,0	East Kalimantan	Tall
> 80.0	Riau Islands	Very High

Seen in table 2, it explains the IR classification of each province in Indonesia in 2021. Table 2 provides information that 15 provinces are classified in the less category (0 – 20.0), 10 provinces are classified in the low category (20.0 – 40.0), 7 provinces are included in the medium category (40.0 – 60.0), 1 province is classified as high (60.0 – 80.0) and there is 1 province classified as very high (>80.0). Figure 5 shows the distribution of the number of IRs in each province in 2021, Riau Islands province is included in the province with the highest IR rate of 80.9 per 100,000 population. Meanwhile, Papua province is included in the province with the lowest IR rate of 2.9 per 100,000 population. The following is a mapping of the distribution of the number of IRs in Indonesia in 2021.

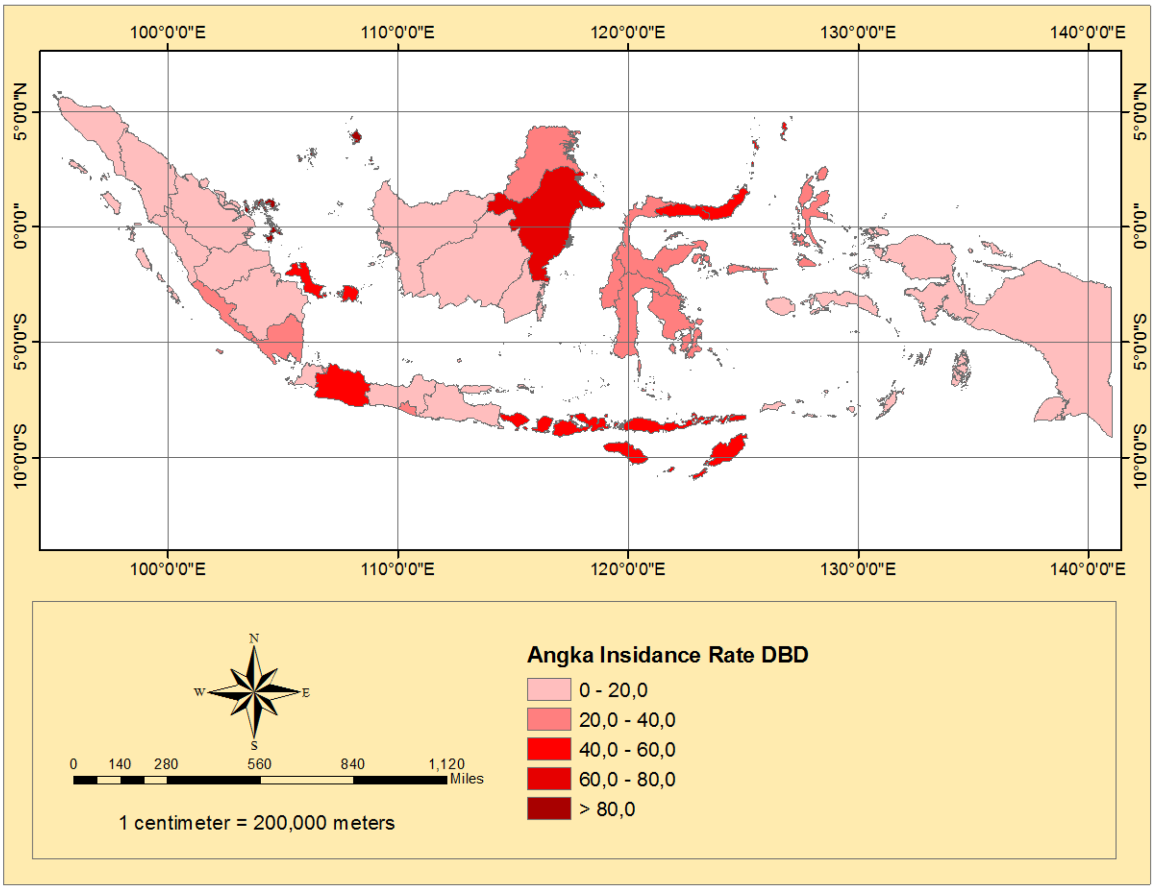

Figure 5. Map of Incidence Rate (IR) Distribution in Indonesia in 2021

Spatial Analysis of Dengue Death Cases in Each Indonesian Province in 2021

Table 3. Classification of the Number of Dengue Deaths in Each Indonesian Province in 2021

Classification	Province	Information
0 – 10	Aceh, Bali, Bengkulu, DKI Jakarta, Jambi, West Kalimantan, Lampung, South Kalimantan, Central Kalimantan, North Kalimantan, Maluku, North Maluku, NTB, Papua, West Papua, West Sulawesi, Central Sulawesi, Southeast Sulawesi, West Sumatra, South Sumatra.	Less
10 – 30	Banten, DI Yogyakarta, Gorontalo, East Kalimantan, Bangka Belitung Islands, Riau Islands, Riau, NTT.	Low
30 – 70	South Sulawesi and North Sulawesi.	Keep
70 – 100	East Java	Tall
> 100	West Java and Central Java	Very High

In table 3 shows the classification of mortality rates for each province in Indonesia, the table above shows that 20 provinces are classified as having less mortality rates (0 – 10 deaths), 9 provinces are classified as having low mortality rates (10 – 30 deaths), 2 provinces are classified as medium mortality rates (30 – 70 deaths), 1 province is classified as high mortality rates (70 – 100 deaths) and 2 provinces are classified as very high mortality rates (>100 kematain). Furthermore, figure 6 shows the distribution of dengue deaths in Indonesia. West Java Province is included in the province with the highest death rate in Indonesia with 212 deaths. Meanwhile, there are five provinces where there are no deaths due to dengue fever, namely DKI Jakarta, Central Kalimantan, South Kalimantan, Papua and West Papua. The following is a mapping of the number of deaths in each province in Indonesia in 2021.

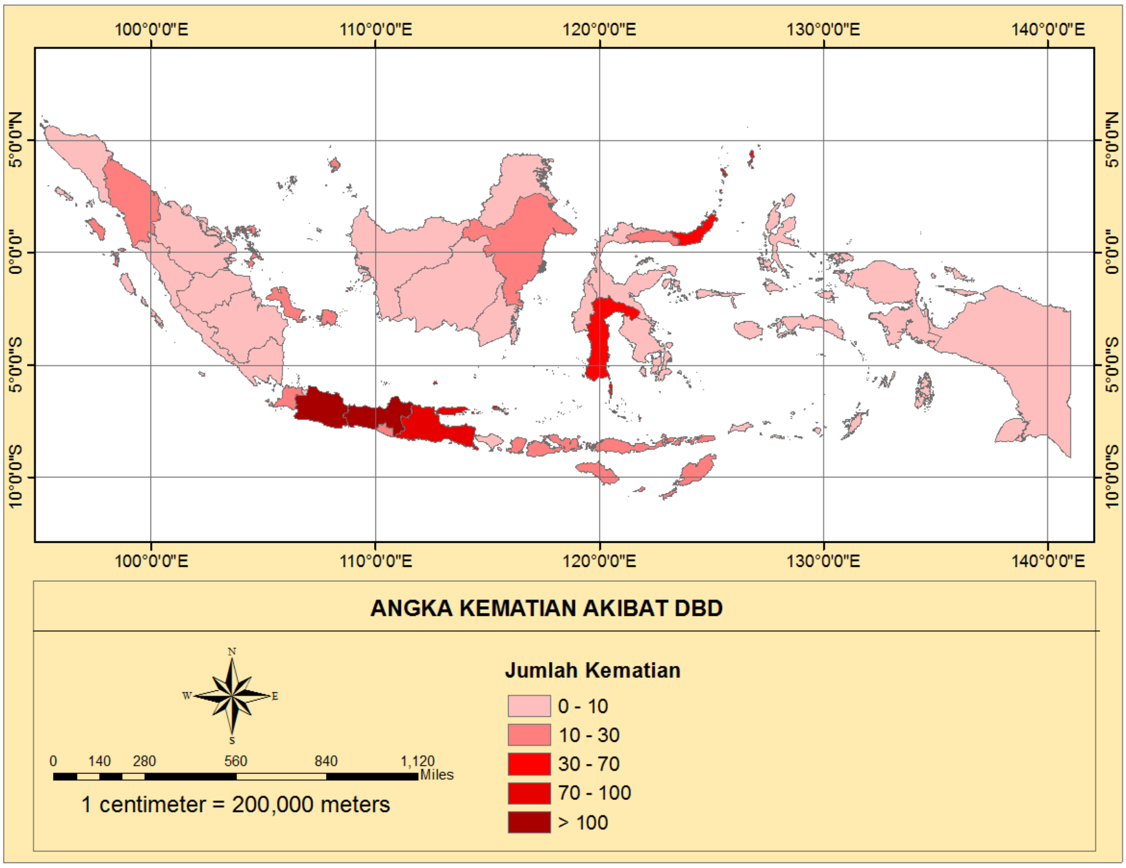

Figure 6. Map of the Distribution of Dengue Deaths in Indonesia in 2021

Discussion

Dengue Incidence in Indonesia

DHF is an infectious disease that is found in many tropical regions including Indonesia. Geographical conditions in Indonesia support the proliferation of *Dengue virus* so that the incidence of dengue fever in Indonesia is still high. The problem of dengue fever in Indonesia can be known by looking at the number of events due to dengue, as well as the number of deaths due to dengue. The incidence of dengue fever in this study is the number of cases, the number of Incidence Rate and the number of deaths reported and recorded in the Indonesian Health profile for 2012-2021.

In 2012-2021 it was recorded that the number of provinces in Indonesia was 33 provinces and in 201-2021 there was an increase of one province to 34 provinces during the last ten years, the province with the largest population was the province of West Java. The increase and spread of dengue cases in Indonesia is caused by high population mobility, urban development, changes in climate, changes in population density and distribution and other epidemiological factors. DHF in Indonesia still cannot be eliminated or destroyed from

Indonesian territory. Dengue cases in Indonesia are already classified as endemic categories, because climate change makes seasons unpredictable, causing dengue disease to continue to exist.

Evaluation of dengue surveillance data according to year distribution (Time)

DHF Cases Based on Distribution in 2012-2021

In Indonesia, dengue fever has become a health problem in the community. The number of patients and the area of distribution are increasing along with increasing mobility and population density. Based on secondary data obtained from Indonesia's health profile, over the last 10 years the number of dengue cases has ranged from 65 – 200 thousand cases. Based on data from the Directorate of Prevention and Control of Vector and Zoonotic Infectious Diseases regarding the dengue situation in Indonesia, the number of dengue cases has been met.

In the last 10 years, the highest peak of dengue cases was in 2016. This year, West Java province is the province that has the highest number of dengue cases reaching 36,631 cases. Looking at data from the Central Statistics Agency (BPS) and the West Java provincial Health Office, population density, temperature and rainfall are the main factors of the increase in dengue cases in West Java. Bekasi City and Depok are the areas that have the greatest chance of dengue outbreak, which is 85.3% chance to have more than 2211 dengue cases. Bekasi and Depok are included in high-risk areas because they have a population density of more than 1,792.4 people/km2, temperatures of more than 270C and rainfall of more than 4800 mm/year.

High population density and close proximity of houses can make the spread of dengue disease more intensive in urban areas. West Java Province is the region with the largest population in Indonesia reaching 50,103,251 million people recorded in 2021. High population density and adjacent houses make it easier for mosquitoes to spread *the dengue virus* from one person to another because the mosquito's flight distance is estimated to reach 50-100 meters. The results of this study are in line with Alifiah's research in West Java which states that the significant relationship between population density and dengue incidence in West Java in 2021 is because the *p* value is 0.20 with a relationship coefficient of 0.446. This relationship is positive with the strength of the relationship is quite strong, the higher the population density, the higher the dengue rate. Conversely, the lower the population density, the lower the incidence of dengue fever (Alifiah 2020).

Air temperature is also one of the environmental factors that affect the growth of *Ae* *mosquitoes. Aegypti* with an optimum temperature of 25-27 ° C, at air temperatures below 10 ° C or above 40 ° C growth will stop. Based on research conducted by (Chang et al, 2018) stated that most confirmed dengue cases occur at an average temperature of 21-26 °C. This is in line with research conducted by (Elizabeth et al, 2022) in West Java Province, where, shows that the increase in dengue cases is not always accompanied by high temperatures. The average temperature level in West Java Province in 2016-2021 is optimal for mosquito development.

The increase in rainfall is also one of the factors in the development of dengue cases in West Java province. High rainfall causes puddles which are comfortable breeding grounds for disease-causing mosquitoes. Increased rainfall can increase habitat and larval populations and also create new habitats for adult mosquitoes. Based on research in Kaohsiung, it shows that rainfall has a significant positive relationship with dengue cases in the 1-month and 2-month lag (Chang et al, 2018). In a study also conducted in tropical countries, it was found that there was a strong correlation between the average weekly rain cura with the number of mosquito larvae (Ramadhani et al, 2021). The effects of rainfall can indeed create many breeding sites mosquito. Cases of mosquito-borne diseases will usually jump high at some time before heavy rain or after heavy rain (Fuadiyah et al, 2018)

Seeing the development of cases that are still happening, the government continues to carry out prevention efforts by eradicating mosquito nests (PSN) with environmental control through the 3M program, namely draining, closing and burying places that allow mosquito breeding.

***Dengue Incidence Rate* (IR) in Indonesia in 2012-2021**

Incidence Rate is the number of dengue cases in a given area divided by the number of residents in the same time multiplied by 100,000 inhabitants. Based on the results of research obtained that in the last 10-year period (2012-2021), the trend *in the Incidence Rate (IR) of DHF in Indonesia has fluctuated and* the Incidence Rate *(IR) in each year tends to vary.*

2016 was the year with the highest *peak Incidence Rate* (IR). This year Bali province is the province with the highest Incidence Rate (IR) rate of 515.90 per 100,000 population, the *Incidence Rate* (IR) rate in Bali province increased 2 times when compared to the IR rate in 2015 where Bali was 257.75 *per 100,000 population.* The increase in *the Incidence Rate* (IR) in Bali province is caused by geographical location, population and climate. Geographically, Bali is located between Java and Lombok and has a tropical climate and has a tropical sea that is influenced by seasonal winds. The population density in Bali Province has increased until 2021 by 4,466,595 people. Topographically in lowlands such as beaches, rice fields, ponds / ponds are tourist areas favored by tourists and mosquitoes, especially *Aedes aegypti* which is *anthropophilic* which means it prefers to suck human blood than animals. By population, 50% of the Balinese people from the total population live in the southern part of the island of Bali, which is an area that has rapid infrastructure development and population development, this makes many tourist visits from various places that have the potential to spread dengue fever (Yudhastuti, 2020).

Based on research conducted by (Mertha, 2020) that the increasing number of *Incidence Rate* in Bali has a negative impact on the existing community. Social losses that occur cause panic in the family, death of family members, and reduced life expectancy.

Distribution of Dengue Death Rate in Indonesia in 2012-2021

As a country located in a Dengue endemic area , dengue fever has caused deaths every year in Indonesia. During the last 10-year period (2012-2021) the mortality rate in Indonesia has fluctuated. The highest death rate was in 2016, in 2016 it was reported that the highest number of new cases or deaths occurred in East Java province with a total of 343 deaths. East Java's dengue fever tends to increase related to population density, population mortality, urbanization, economic growth, community behavior, climate change, environmental sanitation conditions, and the availability of clean water. Areas with mortality rates exceeding 1% in 2016 reached 24 districts/cities, an increase compared to 2015 which was only 18 districts/cities (East Java health profile, 2016).

Good community behavior and environmental conditions that do not meet health requirements are risk factors for transmission of various diseases, especially environment-based diseases, including DHF. The importance of understanding PSN, the importance of cross-sectoral coordination and advocacy in East Java and advocacy to the community regarding dengue fever are the main factors in eradicating dengue disease in East Java province (Hurint, 2021).

Evaluation of dengue surveillance data according to the distribution of geographic areas (places) Spatial Analysis of Dengue Cases in Each Indonesian Province in 2021

The state of geography is the main cause of the development of dengue disease. Indonesia is included in a country with a tropical climate so that it greatly facilitates the development of various diseases including DHF.

Based on the results of spatial analysis that has been carried out in 2021 as a representative map of previous years to show the distribution of dengue cases, it can be seen that the spread of dengue disease in each province in Indonesia. Based on the mapping that has been done, it can be seen that 5 categories of dengue cases in 5 different colors in determining the high and low dengue cases in an area. Indonesia consists of 34 provinces, each province reports dengue cases recorded in Indonesia's health profile. In the last 10 years (2012-2021), it is known that West Java province is the province with the highest dengue cases. This can be seen from the spatial mapping carried out that the province of West Java is included in the red color category which shows that this province is included in the category of very high dengue cases.

Authoritative spatial analysis makes it easier to see the distribution of dengue cases in high-risk areas (Titahena et al, 2017).

Spatial Analysis of the Number of *Dengue Incidence Rate* (IR) in Each Indonesian Province in 2021

The problem of dengue disease in an area can be known by looking at the number of dengue incidents and the number of deaths due to dengue. Meanwhile, the incidence of dengue in an area can be seen from the *Incidence* Rate (IR) and the death rate of dengue cases in the region seen from the *DHF Case Fatility Rate* (CFR).

From the results of spatial analysis that has been carried out in 2021 as a representative map previously to show the distribution of *Incidence Rate* (IR) figures in Indonesia. Based on the mapping that has been done, there is a classification of 5 colors that are given information ranging from less to very high cases. In 2021, Riau Islands province is the province with the highest Incidence Rate (IR) which is reported to reach 80.9 per 100,000 population and in mapping carried out Riau Islands province is classified in red with a very high category.

Spatial Analysis of Dengue Death Cases in Each Indonesian Province in 2021

DHF is one of the dangerous infectious diseases and can cause death in memory time. Areas with a high number of dengue cases have a risk of death from dengue fever.

For spatial analysis of dengue deaths in 2021, it is seen from the map produced as a representative map from previous years, 5 different colors are produced to classify the mortality rate from less to very high. From the results of mapping the death rate in 2021, it can be seen that the provinces in red are West Java and Central Java provinces where the two provinces are included in the very high category, which is > 100 cases. This spatial mapping of mortality rates can be used as a measurement tool in looking at areas with the highest mortality rates in Indonesia so that dengue handlers are more focused on areas that are classified as having very high dengue cases and deaths.

Conclusion

Judging from the distribution of geographical areas in Indonesia, in 2012-2021 the highest number of dengue cases in Indonesia was recorded in the province of West Java. Based on spatial mapping of the distribution of dengue cases in 2021, it shows that in 2021 there are 17 provinces that are included in the category of less cases, 5 provinces are included in the low category, 9 provinces are included in the medium category, 2 provinces are included in the high category and 1 province is included in the very high category. Based on the distribution of years, every year dengue cases continue to increase and decrease so that the number of cases each year varies. 2016 was the year with the highest number of cases in the last 10 years (2012-2021). While 2018 was the year with the lowest number of cases.

Confession

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