Ilomata International Journal of Social Science
P-ISSN: 2714-898X; E-ISSN: 2714-8998
Volume 5, Issue 1, January 2024
Page No. 176-189

Climate Change and Its Impact on the Increase in Dengue Hemorrhagic Fever Cases in North Maluku Province (Case Study in Tidore Islands City)

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Received : December 31, 2023
Accepted : January 20, 2024
Published : January 31, 2024

Citation: Karim, S, A. (2024). Climate Change and Its Impact on the Increase in Dengue Hemorrhagic Fever Cases in North Maluku Province (Case Study in Tidore Islands City). Ilomata International Journal of Social Science, 5(1), 176-189.
https://doi.org/10.52728/ijss.v5i1.1084

ABSTRACT: North Maluku Province has experienced a significant increase in dengue fever cases over the past few years. The purpose of this study is to comprehensively investigate the intricate relationship between climate change and the surge in dengue fever cases in North Maluku Province. This research uses a qualitative case study approach to examine the impact of climate change on dengue fever cases in North Maluku Province. Data was analyzed through in-depth interviews with health workers, local communities, and related stakeholders using NVivo. This robust qualitative data analysis software facilitated the systematic coding, categorization, and thematic exploration of the rich insights gathered during the interviews. The findings show that climate change in this region has significantly impacted the ecology of disease vectors, rainfall patterns, and the spread and prevalence of the Aedes aegypti mosquito as the primary vector of dengue fever. Social, economic, and infrastructure factors also play an essential role in the increase in dengue fever cases. This research provides an in-depth understanding of the relationship between climate change and increased dengue fever cases in North Maluku Province. The implications of these findings underscore the urgency of implementing adaptation and mitigation strategies to address public health risks associated with climate change. This study shows climate change has increased dengue fever cases in North Maluku Province. Therefore, more effective preventive measures, coordination between institutions, and more active community participation are needed to deal with the health impacts caused by climate change.

Keywords: Climate Change, Dengue Hemorrhagic Fever, Vector Disease, Public Health, North Maluku

INTRODUCTION

Since it was discovered in Indonesia in 1968, the incidence of Dengue Hemorrhagic Fever (DHF) has continued to increase significantly. Although the government has made various prevention and treatment efforts since the implementation of the dengue control program in 1970, the increase has not slowed the overall growth of cases at the national level. From 2005 to the present, dengue cases continued to increase, reaching a peak in 2016 (Arisanti & Suryaningtyas, 2021;

Rajagukguk & Meilani, 2023). With the continued population growth, this has a direct impact on the increase in the number of dengue cases (Abdallah et al., 2014; Nongqayi et al., 2022). Factors such as urbanization, climate change, and higher population mobility contribute to this situation, apart from the role of community behavior and variations in the implementation of prevention programs (Bhatt et al., 2013; Fahrisal, Pinaria, & Tarore, 2019; Salsabila, Martini, Wurjanto, Hestiningsih, & Setiawan, 2021; Sutriyawan, 2021).

The following is a general overview of the impacts of climate change in the last few decades, presented in tabular form. The stated impacts may vary depending on geographic region and other local factors.

Table 1. Impact of climate change in recent decades

Year / Decade	Impact of climate changes
1970s	Increase in global average temperature and changes in rainfall patterns.
1980s	Ice melting at the poles and rising sea levels are accelerating.
1990s	Increase in frequency and intensity of tropical storms.
2000s	More frequent high-temperature extremes and heatwaves |
2010s	Increase in intensity of forest fires and flood intensity.
2020s	Increase in extreme weather events and threats to food and water security

Source: (Laborie, Hissel, & Sergent, 2014; Thang, Khoi, & Phi, 2018; Wu, 2016).

Although the incidence of dengue continues to increase from year to year, the pattern of mortality does not follow the same trend. The percentage of dengue deaths, which had previously reached 41.3% at the beginning of the discovery of the disease in 1968, has dropped dramatically to less than 1% since 2008 until now. This aligns with increasing public access to quality health services at the primary and referral levels, encouraging people to get medical care immediately when experiencing symptoms of DHF. Hopefully, these measures can eliminate dengue deaths by 2030 (Harapan et al., 2019; Utama et al., 2019).

The following table displays a chronological overview of the impacts of climate change since the emergence of the climate change issue, specifically focusing on its influence on Dengue Hemorrhagic Fever (DHF) in Indonesia.

Table 2. Impact of climate change on its influence on DHF in Indonesia

Year	Climate Change Impacts on its Influence of DHF in Indonesia
1968	Early climate changes potentially influenced the emergence of Dengue Hemorrhagic Fever (DHF) in Indonesia.
1970	Implementation of Dengue Control Program as a response to increasing DHF cases
2005-2016	The continued rise in dengue cases is attributed partially to climate change, urbanization, and population mobility.
2019	Recognition of climate change as a significant factor contributing to the increase in dengue cases
2020-2022	Volatile pattern in DHF cases, potentially influenced by the COVID-19 pandemic; Confusion in diagnosis due to similar symptoms.
2022	Dengue cases in Indonesia reach 143,000, with specific provinces experiencing higher numbers—the potential impact of climate change.
2022	Considerable underreporting of cases due to limited diagnostic facilities and weak surveillance systems
2022	Dengue cases lower than estimated, potentially influenced by the COVID-19 pandemic

Source: (Aminah & Nanda, 2023; Elizabeth & Yudhastuti, 2023; Khaidir et al., 2023)

DHF is spread in almost all cities and regencies in Indonesia. However, the incidence of dengue is generally higher in urban areas with greater population densities. Graphic data shows that most parts of Indonesia have a high level of dengue endemicity. Although some areas fall into the category of low endemicity, they are very few and widespread. While these low-level cases may reflect the actual situation in the region, some may go undetected due to limited, inadequate diagnostic facilities and weak surveillance systems, leading to underreporting (Harapan et al., 2019; Utama et al., 2019).

In 2020-2022, there was a very volatile pattern, which had never happened before. This situation may be affected by the COVID-19 pandemic in Indonesia. Both diseases have similar initial symptoms, which can be confusing in diagnosis. At the end of 2022, the number of dengue cases in Indonesia reached 143,000, with the highest number of cases in the Provinces of West Java, East Java, and Central Java. However, this number is much lower than the estimated dengue cases in Indonesia (Kementerian Kesehatan Republik Indonesia, 2023; Khaidir et al., 2023; Utama et al., 2019).

Predictions by Bhatt et al. (2013) stated that the number of symptomatic dengue cases in Indonesia reached 7,590,213 cases, about 50 times higher than the number of reported cases in 2022. This significant disparity is because only about 30% of those who experience dengue symptoms seek health care, while the majority of cases are misdiagnosed. Then, if they choose private healthcare, these cases will go unreported. Operational, logistical, and technical factors in hospitals and the Health Office hinder reporting dengue cases. In addition, significant geographic variations in

health infrastructure, availability of competent health workers, and non-health factors, such as mobility and climate change, also contribute to this gap (Bhatt et al., 2013; Rivera et al., 2022).

The distribution of dengue deaths is more concentrated in the top three provinces, namely West Java, East Java, and Central Java, which accounted for about 58% of the total 1,236 recorded deaths. The Ministry of Health's strategic plan for 2020-2024 aims to reduce the burden of community disease, with a target of 80% of districts/cities having dengue incidence rates below 10 per 100,000 population by 2022. The national dengue incidence rate is still at 52 per 100,000 people, which is still higher than the target set in the previous period, which was 49 per 100,000 people. Only 82 districts/cities (16%) out of 514 districts/cities in Indonesia met the new incidence target, below 10/per 100,000 population (Kementerian Kesehatan Republik Indonesia, 2023).

In a review of health epidemiology, climate change is an essential factor that impacts public health. Climate change refers to changes in average weather patterns in a region or planet globally, including temperature, rain patterns, air humidity, and changes in the intensity and frequency of extreme weather events such as storms, floods, and droughts. This phenomenon is the result of human activities that increase greenhouse gas emissions, causing global warming and changes in global temperature that have an impact on the climate system (Jing & Wang, 2019; Kosasih et al., 2016; Roy & Bhattacharjee, 2021).

In the context of public health, climate change has severe and far-reaching implications. One of its impacts is on human physical health. For example, extreme temperature increases can lead to various health problems such as dehydration, skin diseases, and negative impacts on the cardiovascular system. In addition, climate change can also affect the spread of disease vectors such as mosquitoes, which in turn increases the risk of infectious diseases such as dengue, malaria, and other diseases. Climate change has significant implications for the increase in Dengue Hemorrhagic Fever (DHF) cases in tropical countries such as Indonesia. Factors related to climate change, such as increased air temperature, fluctuations in rain patterns, and high humidity, are the main driving factors in the increase in dengue cases. In Indonesia, this situation worsens the environmental conditions that favor the development of the disease vector, the Aedes aegypti mosquito, which is responsible for the spread of the dengue virus (Bhatt et al., 2013; Kosasih et al., 2016).

Climate change results in changes in environmental conditions more conducive to Aedes aegypti mosquitoes. Warmer temperatures and humid environmental conditions create an ideal breeding habitat for these mosquitoes. Increased temperature accelerates the life cycle of mosquitoes, shortening the time required for breeding from eggs to adults. Changes in rain patterns can also create longer standing water, becoming an ideal breeding ground for mosquitoes. In addition, climate change also affects the geographical distribution of Aedes aegypti mosquitoes. Areas that previously might have been protected from mosquitoes are now vulnerable due to changes in temperature and rain patterns that allow mosquito adaptation and breeding in areas previously unsuitable for them (Bhatt et al., 2013; Jing & Wang, 2019; Roy & Bhattacharjee, 2021).

The increase in cases of Dengue Hemorrhagic Fever (DHF) in North Maluku Province, related to

the impact of climate change, has become a severe concern in health epidemiology. The province is a tropical region vulnerable to climate change, and its impact has contributed significantly to the increase in dengue cases. Climate change in North Maluku has affected the ecology of the Aedes aegypti mosquito, a vector of dengue disease. Rising temperatures and fluctuating rain patterns have created more suitable environmental conditions for mosquito breeding, increasing the risk of dengue virus transmission. Warmer temperatures accelerate mosquitoes' life cycle, reduce the virus's incubation period in mosquitoes, and increase the number of reproductions. Irregular and extreme rain patterns also create standing water that becomes an ideal breeding ground for mosquitoes, extending their lifespan and increasing the risk of dengue transmission (Badan Pusat Statistik Maluku Utara, 2021; Fahrisal et al., 2019).

In the socio-economic context, climate change has also impacted people's habits in dealing with dengue risk. Environmental conditions that are more vulnerable to vectors of this disease make people vulnerable to dengue transmission. Limited access to sanitation facilities and adequate health care is also an obstacle in preventing and controlling dengue fever in North Maluku Province. Increased human mobility and interregional trade activities are also factors in the increase in dengue cases. Climate change can affect the geographic distribution of disease vectors, and with increased mobility, mosquitoes infected with the dengue virus can quickly spread to areas previously unreachable by these vectors (Badan Pusat Statistik Maluku Utara, 2021).

In 2022, Tidore Islands City received the status of an Extraordinary Event (KLB) of Dengue Hemorrhagic Fever where there was a significant increase in the number of dengue cases, which increased rapidly to 42 dengue cases with 2 (two) deaths. To prevent an increase in dengue cases, the Tidore Islands City Health Office has carried out mitigation measures by running a larvicide program by distributing free Abate powder to all urban villages in Tidore Islands City. In addition, the Fogging 2 Cycle program, a method of fumigation of vector control using chemicals to kill adult mosquitoes quickly, is also carried out. Spraying occurs in 2 cycles at 5-7 days (Fahrisal et al., 2019).

The conceptual framework for this research is grounded in the intersection of climate change, Dengue Hemorrhagic Fever (DHF) dynamics, and socio-economic factors. The framework encompasses several key components, each contributing to understanding the complex relationship between climate change and the surge in DHF cases, particularly in North Maluku Province, focusing on Tidore City.

This study seeks to address the following research questions: (1) How does climate change influence the pattern of Dengue Hemorrhagic Fever (DHF) in Indonesia, with a specific focus on North Maluku province, using Tidore City as a case study? (2) What is the impact of climate change on the increase or spread of disease vectors responsible for Dengue, and how does it contribute to changes in the epidemiological patterns of Dengue in the study area?

This study aims to determine and analyze how climate change affects the pattern of dengue hemorrhagic fever in Indonesia, especially in North Maluku province, by making Tidore City a

case. This study also analyzed the impact of climate change on the increase or spread of dengue disease vectors and epidemiological patterns.

METHOD

This study uses a qualitative approach with a constructivist paradigm and a case study approach to explore the impact of climate change on the increase in Dengue Hemorrhagic Fever (DHF) cases in North Maluku Province. This paradigm was chosen to understand this complex phenomenon deeply and holistically and explore the subjective perspectives of various stakeholders (Creswell, 2017; Creswell & Creswell, 2018; Sugiyono, 2019). Data was collected through in-depth interviews with credible informants such as health workers, government stakeholders, academics, and local community leaders (Denzin & Lincoln, 2017; Moleong, 2018). The interviews were used to gain an in-depth understanding of their experiences, views, and knowledge of climate change and dengue cases in North Maluku province (Johnson & Stake, 2005; Yin, 2012). Credible informants are selected based on their expertise in health, epidemiology, and climate change in the region. Meanwhile, critical informants from different walks of life directly affected by climate change and increased dengue cases are selected. In addition to in-depth interviews, the data collection process was also carried out using participatory observation methods, where researchers were involved in observing the community's daily activities and the surrounding environment to understand health practices, responses to climate change, and their impact on the increase in dengue cases. The study employs NVivo techniques for data analysis (Edwards-Jones, 2014). NVivo allows the researchers to immerse themselves in the subjective perspectives of various stakeholders and extract meaningful insights from the complexity of the data (Dalkin, Forster, Hodgson, Lhussier, & Carr, 2021).

RESULT AND DISCUSSION

Tidore Islands City is part of North Maluku Province, which was formed through Law Number 1 of 2013 concerning the Establishment of North Halmahera Regency, South Halmahera Regency, Sula Islands Regency, East Halmahera Regency, and Tidore Islands City. The administrative area of Tidore Islands City is bordered by Ternate City and South Jailolo District, West Halmahera Regency to the North. To the south, it is bordered by South Halmahera Regency, Ternate City, South Wasile District, East Halmahera Regency, and Weda District, Central Halmahera Regency. In the east, it is bordered by South Wasile District, East Halmahera Regency, Weda District, and Central Halmahera Regency. Moreover, the West is directly adjacent to the Maluku Sea.

Geographically, Tidore Islands City consists of two main formations: Tidore Island and Halmahera Island. Tidore Island has the original structure of the volcano with varying slopes, ranging from 2% to more than 40%, according to the volcanoes. In the mainland area of Halmahera Island, there are variations in landforms such as alluvial plains, denudational hills, ultramafic denudational hills, plateau, and monocline.

Tidore Island has a sharper topography compared to its neighboring islands, with slopes ranging from 15-40%, even some parts more than 40%. Tidore Island also has flat to gentle topography, such as Dodora Village, parts of Indonesiana, Rum, and Ome Villages. The soil in Tidore Islands City tends to have a fine to medium texture with reasonably good drainage ability.

The area of Tidore Islands City covers part of the mainland of Halmahera Island and 16 small islands such as Tidore, Maitara, Mare, Failonga, Sibu, Woda, Raja, Guratu, Tameng, Joji, Taba/Tawang, Pasi Raja/Pasi Lamo, Pasi Kene, Doyado Madola, Sosa Gamgau 1, and Sosa Gamgau 2. Its total area is about ±2,875.09 km2, consisting of land ±1,703.16 km2 and sea ±1,171.93 km2, with a coastline of ±245.38 km. The administrative area is divided into eight sub-districts, 40 kelurahan, and 49 villages.

The climate in Tidore Islands City, as in many archipelagos in Indonesia, is strongly influenced by sea breezes. The average rainfall ranges from 1771.87 to 2373.00 mm/year. The city of Tidore Islands belongs to the type B climate category based on Schmidt–Ferguson, which classifies climate based on the average number of dry and wet months. In addition, according to Oldeman's criterion, which also considers precipitation, the climate goes into an alkaline type with a range of Q values between 0.143 and 0.333.

Climatic conditions in Tidore Islands affect the population of Aedes Aegypti mosquitoes, which usually increase during the rainy season from November to February. In Tidore Island City, Soasio District has the highest dengue cases distributed in 13 sub-districts with lowland and highland topography. Aedes Aegypti mosquito nests in this region are found in drums, bathtubs, MCK tubs, barrels, buckets, flower vases, old tires, used bottles, and other water containers. These nests are also found in tree holes, banana leaves, midribs of keladi, and stone holes. The presence of containers in places of worship, markets, and blocked rainwater drains is also a good place for breeding Aedes Aegypti mosquitoes.

Based on the results of in-depth interviews, the perception of the people of Tidore City on the impact of climate change related to the increase in dengue fever cases is an essential aspect of efforts to prevent and handle dengue cases. Climate change, which impacts increasing dengue cases, has affected perceptions, behavior patterns, and public awareness in Tidore Island City. The people of Tidore Islands City's perception of climate change and its relation to the increase in dengue cases is often influenced by their direct experience with the symptoms and spread of this disease. The people of Tidore Islands City are beginning to realize that changes in weather patterns, such as rising temperatures and fluctuations in rain patterns, are contributing to the increase in dengue cases.

In facing the impact of climate change related to the increase in Dengue Hemorrhagic Fever (DHF) cases in North Maluku Province, the community can take a series of proactive adaptation efforts to minimize the risks and health impacts that may arise. One of the primary efforts is to increase awareness and knowledge about the direct link between climate change and the increase

in dengue cases. Proper education about the signs and symptoms of DHF and practical prevention efforts are essential in this adaptation effort (Fahrisal et al., 2019).

Furthermore, strengthening prevention efforts independently at the household level is an adaptation step the community can take. This includes removing standing water around the house, cleaning places that can harbor mosquitoes, and using mosquito nets or repellent to reduce the risk of Aedes aegypti mosquito bites. In addition, the community's active role in monitoring the surrounding environment is also essential in adapting to climate change, which affects the increase in dengue cases. The public can monitor potential mosquito breeding sites and take necessary cleanup or corrective measures to reduce the risk of spreading the dengue virus.

Adaptation based on local knowledge and traditional wisdom can also significantly contribute to dealing with climate change related to dengue cases. People in Tidore Islands City have unique knowledge about their environment and traditional ways of managing it. Using this knowledge in adaptation strategies can support preventive actions and reduce the risk of dengue transmission. Strengthening inter-agency collaboration and active community participation in dengue prevention and control programs are essential adaptation measures. Initiatives such as cooperation between governments, health agencies, and local communities can increase the effectiveness and scope of prevention efforts and facilitate wider information distribution. Increasing access to adequate health services and appropriate medical care when experiencing DHF symptoms is a significant adaptation effort. Public awareness about the importance of prompt and proper medical care when exposed to DHF will help in reducing mortality from this disease.

Adaptation efforts of the people of Tidore Islands City in facing the impact of climate change on the increase in dengue cases in North Maluku Province include education, independent prevention, environmental monitoring, utilization of local knowledge, inter-agency collaboration, and access to adequate health services.

Several methods have proven effective in eradicating mosquito nests of Aedes aegypti, vectors of Dengue Hemorrhagic Fever (DHF) that the community in Tidore Islands City has implemented.

1. Chemical Control: The use of insecticides sprayed on areas that have the potential to become nests of Aedes aegypti mosquitoes is one of the commonly used control methods. This insecticide is used to kill larvae and adult mosquitoes. Its use should be done carefully and follow the guidelines set by health authorities to avoid mosquito resistance to insecticides.
2. Biological Control: This method includes the use of biological control agents, such as mosquito larvae-eating fish (e.g., guppies or snakehead fish), which are placed in puddles of water that have the potential to become mosquito breeding grounds. These fish will feed on mosquito larvae, reducing the population of Aedes aegypti mosquitoes.
3. Use of Physical Methods: Using physical methods such as mosquito nets, wire gauze on home ventilation, or repairing a non-smooth drain system to reduce stagnant water that is a breeding ground for mosquitoes.
4. Environmental Management: Environmental management efforts include eliminating or reducing places that can become mosquito nests, such as used water containers, flower pots filled with water, or used items that can hold water.

5. Community Approach and Community Education: Programs that involve active community participation in identifying and cleaning mosquito nests and education programs that raise awareness about dengue prevention methods and the importance of vector control.

In addition to the five methods above, since 2014, the North Maluku Provincial Health Office has implemented the COMBI (Communication for Behavioral Impact) method in all its work areas, including in Tidore Island City. The COMBI method is a comprehensive approach to communication to achieve behavior change directed at reducing mortality cases due to Dengue Hemorrhagic Fever (DHF) (Asriwati, Harjati, Irawati, & Eko Nugroho, 2021; Suryanegara, Suparmi, & Setyaningrum, 2018). This method combines various communication strategies to increase awareness, knowledge, attitudes, and positive societal behaviors (Akbar, French, & Lawson, 2019; Do et al., 2016). The following are the main aspects of the COMBI method and its application in reducing dengue deaths in Indonesia:

1. Problem Identifier and Communication Purpose
   The first step in the COMBI method is to identify dengue problems, including their causes and associated risks, while setting specific communication goals. It involves an in-depth understanding of dengue issues, such as its spread, triggering factors, and societal impact. In addition, clear communication objectives are set to raise awareness of the importance of dengue prevention and change community behavior to reduce the risk of disease transmission. This step allows focusing on relevant messages and appropriate communication strategies to achieve the goals set in dengue combat.
2. Communication Message Development
   The second step in the COMBI method is the development of effective communication messages. This process involves crafting an unmistakable, targeted, and easy-to-understand message about dengue prevention measures. These messages must be tailored to the intended audience's characteristics and needs to trigger the desired behavior change. In addition, the message must contain accurate, verified, and trustworthy information so that people can understand well, motivate change, and adopt dengue prevention measures more effectively.
3. Media Selection and Communication Channels
   The third step of the COMBI method is the selection of appropriate media and communication channels. It involves using various media and effective communication channels adapted to the characteristics of people in different regions of Indonesia. This approach includes mass media such as television, radio, and the internet, as well as social media, billboards, lectures, group discussions, and direct campaigns in the community. With the variety of media and channels used, messages about dengue prevention can be conveyed widely and on target, according to people's preferences and communication habits in various geographical and demographic contexts.
4. Community Participation and Stakeholder Engagement
   The fourth step in the COMBI method involves community participation and stakeholder involvement. This includes giving an active role to the community in disseminating information about dengue prevention and encouraging active participation in prevention programs. Stakeholders from various sectors, such as health workers, local governments, non-governmental organizations, and community leaders, support and implement communication activities to disseminate health messages to the public. Thus, through active community

participation and collaboration with stakeholders, dengue prevention efforts become more focused and integrated and broadly impact their social environment.

5. Evaluation and Monitoring:
   The fifth step in the COMBI method is continuous evaluation and monitoring. Evaluations are carried out periodically to assess the impact and effectiveness of the implemented communication program. The monitoring process focuses on changing public behavior and knowledge related to dengue prevention to determine success and catch shortcomings of the communication strategies that have been implemented. This allows adjustments to the program to be more effective in achieving dengue prevention goals and increasing its impact in the long term.

In Tidore Islands City, the COMBI method is applied by creating inclusive communication campaigns, promoting local languages that are easy to understand, and adapting dengue prevention messages according to the needs and peculiarities of the community in Tidore Islands City. In addition, cooperation with the government, health institutions, and educational institutions is also carried out to reach as many levels of society as possible and ensure that these messages are well received and implemented in daily life.

Combining these two approaches, namely mosquito nest eradication and the COMBI strategy, is expected to increase the effectiveness of the program in reducing dengue cases in North Maluku, especially in Tidore Islands City, while forming better public awareness and behavior related to the prevention of Dengue Hemorrhagic Fever.

Furthermore, the Tidore Islands City Health Office has implemented 6 National Strategies for Dengue Management for 2021-2025 as follows:

- Strategy 1: Strengthening Vector Management
  In Tidore Islands, the main focus in strengthening vector management is through routine mosquito nest eradication programs. The move involves regularly scheduled fogging to reduce the population of Aedes aegypti mosquitoes, especially in urban areas. In addition, efforts are focused on educating the public about using environmentally friendly vector control methods, such as predatory mosquito larvae, to control mosquito populations.
- Strategy 2: Improving Access and Quality of Dengue Management
  In this region, efforts to improve dengue management access and quality are carried out by improving local health facilities. This is so that health services can provide fast, precise, and quality treatment for DHF patients. The main focus is training and capacity building for local medical personnel on early symptom recognition and handling dengue cases.
- Strategy 3: Strengthening Dengue Surveillance and Responsive KLB Management
  Tidore Islands City has improved its surveillance system, which is more effective in accurately tracking and recording dengue cases in every city area. There is a rapid response mechanism to dengue outbreaks by strengthening the capacity of health services to handle outbreaks. Responsiveness in managing outbreaks is a significant concern to minimize the impact of the spread of this disease.

- Strategy 4: Increased Community Engagement
  The people of Tidore Islands are actively involved in the mosquito nest eradication program. Counseling campaigns in various communities are held regularly to raise awareness of the importance of dengue prevention. This effort aims to create awareness and active participation from various walks of life by involving community groups, schools, and local community organizations.
- Strategy 5: Strengthening Government Commitment, Policy, and Partnership
  The city government of Tidore Islands has shown a high commitment to supporting the prevention and control of dengue fever. They build policies that support these programs, allocate adequate resources, and build partnerships with communities and the private sector to support these measures.
- Strategy 6: Study Development, Innovation, and Research
  In the city of Tidore Islands, there is an emphasis on developing local research and innovation to find more effective solutions for preventing and controlling dengue. The results of this research form the basis for improving existing programs and adapting solutions that are more suited to local needs and contexts.

Through the implementation of the six strategies, there is expected to be a significant decrease in dengue cases and an increase in public awareness of the importance of efforts to reduce dengue cases in the city of Tidore Islands.

CONCLUSION

The city of Tidore Islands, which includes part of Halmahera Island and several smaller islands, has a varied topography with different types of land. The climate in this area, which is strongly influenced by sea breezes, provides favorable conditions for developing the Aedes Aegypti mosquito, the vector that causes dengue. A sufficient rainy season can increase mosquito populations, increasing the risk of transmission of this disease. Climate change is one of the factors identified by the people of Tidore Islands City in increasing dengue cases. People's perception of the relationship between climate change and the increase in dengue cases affects their behavior patterns. Awareness of the influence of climate change on dengue cases has triggered community adaptation efforts in disease prevention.

Several effective methods have been applied by the community in Tidore Island City, such as chemical, biological, physical, and environmental management, community approaches, and community education. The Health Office has also implemented a national strategy for dengue management that focuses on vector management, improving access and quality of management, surveillance and management of outbreaks, community involvement, government commitment, and research development. Using the COMBI method to reduce dengue cases in Tidore Islands City is one of the comprehensive strategies. COMBI measures consisting of problem identification, communication message development, media selection, community participation, and evaluation and monitoring are expected to increase public awareness and behavior in preventing the spread of disease.

Through the overall implementation of prevention strategies and methods and adaptation efforts, there is expected to be a significant decrease in dengue cases in Tidore Islands City and an increase in public awareness and participation in preventing dengue deaths.

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