Predict, Prevent, Protect:
Climate Data and Smart Maps for Dengue Defense

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Chloe Isabelle P. Ollague
Tanjay City Science High School, Tanjay City Division, Negros Oriental, Philippines
Nethanel S. Deloria
Tanjay City Science High School, Tanjay City Division, Negros Oriental, Philippines
Shanelle A. Ybañez
Tanjay City Science High School, Tanjay City Division, Negros Oriental, Philippines

Abstract

Dengue fever is an important public health problem in tropical and subtropical areas. In the Philippines, the disease transmission is highly affected by the weather that favors the reproduction of mosquitoes and the spread of the virus. Traditional dengue surveillance systems are largely reactive and only act once case numbers increase sharply, causing delays in intervention and added pressure on healthcare systems. This study presents a computational early warning system based on climatic factors, past dengue cases, and GIS (Geographic Information System) for temperature data, as well as recorded dengue cases from selected cities in Negros Oriental (Tanjay, Dumaguete, Bayawan, Guihulngan, Bais, and Canlaon) will be used. Using a uniform statistical technique, G-scores for all the variables were computed, which were then accumulated into risk scores and converted into risk levels in percentage. To identify regions that may be susceptible to outbreaks, these values were spatially represented through GIS mapping. Results indicate significant spatial disparities in dengue risk across study areas. The areas with the greatest risk of outbreak were Tanjay City, while Dumaguete and Canlaon were moderate-risk places. The risk levels were low in Bayawan, Guihulngan, and Bais. The mapping through GIS highlighted distinct hotspots for intervention, which means that resources were not going to be wasted on random action. The findings point out that the utilization of climate information can efficiently map out high-risk areas and likewise provide informed suggestions for Local Government Units (LGUs). Despite limitations arising from data availability and the disregard of socio-environmental factors, the framework outlined may help in shifting from reactive to proactive dengue control. The strategy strengthens disease surveillance, enhances preparedness, and offers a scalable model for tackling other climate-sensitive diseases in similar settings.

Keywords: Susceptible, Spatial, Utilization, Socio-environmental, Scalable, Tackling.

Introduction

Dengue fever is a critical vector-borne viral disease that presents a substantial global health burden, with the World Health Organization (WHO) reporting a thirty-fold increase in incidence over the past five decades. Globally, the primary variable utilized to monitor this progression is historical case data, which serves as an epidemiological baseline to identify patterns of endemicity and the expansion of the virus into new territories. As urban populations swell and international travel facilitates the movement of the four dengue serotypes, historical records become indispensable for predicting future transmission cycles. This global perspective underscores that dengue is no longer a sporadic occurrence but a predictable consequence of environmental and societal shifts. On an international level, the scientific focus shifts to climatic variables as the fundamental drivers of the Aedes aegypti life cycle. Mean temperature is recognized internationally as a biological regulator; temperatures between 20°C and 30°C significantly shorten the extrinsic incubation period of the virus, making mosquitoes infectious at a faster rate. Furthermore, total rainfall is defined as the primary environmental variable providing the necessary aquatic habitats for larval development. International research highlights that while precipitation is essential for breeding, extreme rainfall events can lead to a "flushing effect" that temporarily disrupts mosquito populations. Understanding these variables internationally allows for the development of sophisticated predictive models that correlate meteorological fluctuations with imminent public health risks. Within the local context of the Philippines, and specifically in the

province of Negros Oriental, these variables manifest through distinct seasonal surges. Localized historical data indicate that high-density areas, such as Tanjay City and Dumaguete, act as persistent reservoirs for the virus. Despite the clear link between local monsoons and outbreaks, public health responses in the province have historically remained reactive, often limited to post-outbreak fumigation. To address this, the current study utilizes a GIS-based early warning system to standardize local temperature and rainfall data. By providing a visualization of risk hotspots, the research recommends a strategic shift in government policy toward pre-emptive measures. These include targeted larviciding, climate-triggered community cleanup drives, and the integration of predictive analytics into the decision-making processes of Local Government Units (LGUs) to mitigate outbreaks before they escalate

This research focuses on examining how rainfall and temperature patterns influence the incidence of dengue outbreaks in selected cities in Negros Oriental, determining whether a reliable computational model can be developed to predict dengue outbreak–prone barangays using climate data and health records, and exploring how Geographic Information Systems (GIS) mapping can be utilized to provide Local Government Units (LGUs) with actionable insights for the timely implementation of interventions such as fumigation, cleanup drives, and public awareness campaigns. This study is significant as it addresses the urgent need for proactive strategies in controlling dengue outbreaks, a persistent public health challenge in tropical regions such as the Philippines. By integrating climate data, health records, and Geographic Information Systems (GIS), the proposed early warning system provides a data-driven approach for identifying outbreak-prone barangays and supporting evidence-based decision-making. The system benefits Local Government Units (LGUs) by enabling the timely implementation of preventive measures and efficient allocation of resources, while strengthening the health sector's disease surveillance through a shift from reactive case monitoring to predictive analytics, thereby reducing the burden on healthcare facilities. Additionally, the system promotes community safety and resilience by empowering residents to participate in preventive actions against dengue transmission. Furthermore, this study offers a foundational framework for future researchers to expand predictive models to other climate-sensitive diseases, contributing to advancements in computational epidemiology and disaster risk reduction. Ultimately, the research supports the development of smarter, healthier, and more resilient communities by transforming integrated data into actionable knowledge for effective disease prevention

This study focuses on developing an early warning system for predicting dengue outbreaks in selected areas in Negros oriental specifically Tanjay City, Bais City, Bayawan City, Guihulngan city and Canlaon City. The system integrates climate variables such as rainfall and temperature with historical dengue case records to identify patterns and forecast high-risk areas. Geographic Information Systems (GIS) will be used to map and visualize outbreak-prone zones, providing Local Government Units (LGUs) with clear and actionable insights. The primary goal is to support proactive interventions such as fumigation, cleanup drives, and awareness campaigns. This research is limited to available climate and health data within the selected areas in Negros Oriental, specifically Tanjay City, Bais city, Bayawan City, Guihulngan city and Canlaon city which may affect the accuracy and generalizability of the predictive model. Other potential contributing factors to dengue transmission, such as population density, sanitation practices, mobility of residents, and unreported cases, are beyond the scope of this.

Despite numerous studies showing that climate factors like temperature and rainfall have a significant impact on dengue disease, most dengue observations and control systems are still in place in the Philippines. This suggests that they usually act only after epidemics have started, which often causes delays and puts more pressure on medical staff and hospitals. While many previous studies have concentrated on identifying the relationship between climate and dengue cases, few have used this knowledge to develop practical tools that local governments might use to stop epidemics before they start. There is a lack of research, particularly in Negros Oriental, which combines historical dengue cases, climatic data, and Geographic Information Systems (GIS) to create a system that can identify dengue-prone locations. While general information about temperature ranges, rainfall patterns, and mosquito behavior can be found in national and international studies, these studies frequently overlook local variations like population density, seasonal variations, or particular city environments, which can have a significant impact on the location and timing of dengue outbreaks. Dengue outbreaks are known to occur regularly in cities like Tanjay and Dumaguete, but local administrations typically don't do anything to stop them until they do. Studies showing how GIS mapping and predictive algorithms can be used to accurately recognize barangays that are in danger are also lacking. This would make it possible for local authorities to carry out focused interventions in the right places at the right times, such as cleanup drives, larviciding, and awareness campaigns. Without this information, communities still face significant

risks, and resources could be wasted. A prepared, user-friendly system that includes local temperature data, historical dengue case records, and GIS mapping is desperately needed in order to provide clear warnings and identify high-risk locations prior to outbreaks. With the help of such a system, local governments would be able to respond faster, plan treatments more effectively, reduce the number of dengue cases, and protect the community. It may also serve as a model for treating other illnesses in similar tropical areas affected by climate change. By addressing a major gap in current dengue research and control techniques and shifting efforts from response to preventive measures, the establishment of such a system would enhance public health outcomes in Negros Oriental.

Literature Review

Previous research has shown that climate factors such as rainfall and temperature play a significant role in the transmission of dengue. According to Ramirez and Choi (2019), GIS-based models allow health authorities to identify high-risk areas and allocate resources more efficiently. Furthermore, studies in predictive analytics and machine learning, such as those by Ahmed et al. (2021), have shown that combining climate and epidemiological data can provide accurate early warning systems for vector-borne diseases.

A recent study by Liu et al. (2025) discovered that “Dengue is the most widespread and fastest-growing vectorborne disease worldwide.” They study the impact of climate change on the dengue cases in Southeast Asian countries. This finding highlights the growing concern about dengue and its connection to climate-related factors in the region. Supporting this, “Recent climate changes related to global warming have increased the potential risk of dengue outbreaks in the world. In this paper, we study and investigate temperature and precipitation as climatological factors affecting dengue incidence in the Philippines from the year 2015 to 2018.” According to a study here in the Philippines by Subido and Aniversario (2022), climate variables play a significant role in dengue incidence at the national level. Similarly, according to a study of Frontiers of Public Health (2022), stated that one of the most important climate factors for dengue diets are temperature, rainfall, and even relative humidity. “Due to climate change, various sectors are affected, and one of the sectors is healthcare. As a result of climate change, the geographic range of several vector-borne human infectious diseases will expand. Currently, dengue is taking its toll, and climate change is one of the key reasons contributing to the intensification of dengue disease transmission.” This emphasizes how climate change directly affects public health outcomes. At a more localized level, a study in the province of Negros Oriental by Udtohan (2022) stated that “Temperature, relative humidity, atmospheric pressure, and total rainfall were the climate parameters used to describe the province’s climate.” The results showed that the number of dengue cases in the province increased and decreased at different times over ten years, further demonstrating the influence of climate variability on dengue trends. Building on these findings, a similar study by Synder and Maglasang (2023) explained that “The objective of this research is to present a model, along with visualizations, that will help health officials and community leaders identify when and where possible dengue outbreaks may happen.” This shows how climate data can be used not only to understand dengue patterns but also to improve preparedness and response. Building on these studies, this research aims to develop a localized early warning system that integrates rainfall, temperature, and dengue case records with GIS mapping to forecast outbreak-prone barangays in Tanjay City. By applying predictive analytics, the study seeks to provide timely insights that can guide Local Government Units (LGUs) in implementing preventive measures before outbreaks escalate.

By and dengue patterns but also to improve preparedness and response.applying predictive analytics, the study seeks to provide timely insights that can guide Local Government Units (LGUs) in implementing preventive measures before outbreaks escalate. These studies collectively highlight the strong and consistent link between climate factors and dengue incidence across different regions and perspectives. A study here in the Philippines by Seposo et al. (2024), "This study aims to investigate the historical and projected excess dengue disease burden attributable to temperature to help inform climate change policies, and guide resource allocation for strategic climate change and dengue disease interventions." This policy-oriented approach aligns with the epidemiological focus of Xu et al. (2024), who "Aim to analyze the periodicity of dengue fever incidence and explore the association between various climate factors and the disease over an extended time series." Both studies emphasize how long-term temperature patterns shape dengue trends over time. Similarly, Hossain et al. (2023) explained the biological mechanism behind this relationship, stating that "The weather influences the temporal and geographical spread of the vector-borne disease dengue in Dhaka. As a result, rainfall and ambient temperature are considered macro factors influencing dengue since they have a direct impact on Aedes aegypti population density, which changes seasonally dependent on these critical variables." This is

further supported by Gómez et al. (2022), who noted, "We aimed to investigate the association between climatic factors and dengue fever in Asuncion. Cumulative dengue cases from January 2014 to December 2020 were extracted weekly, and new cases and incidence rates of dengue fever were calculated," reinforcing the role of climate variables through long-term case analysis. Beyond epidemiological and environmental evidence, a similar study by Siddique et al. (2024) adds a social dimension, stating that "This study explores the relationship between climate change knowledge, perceptions of the Dengue-climate link, and the associated factors among Bangladeshi youth," highlighting the importance of public awareness in addressing climate-driven dengue risks. Together, these studies demonstrate that temperature, rainfall, long-term climate trends, and societal understanding all play interconnected roles in shaping dengue transmission and control. A sudy from Weather and Climate (Canlaon City, Negros Oriental, PH Climate Zone, Monthly Averages, Historical Weather Data, n.d.-b), (Dumaguete City, Negros Oriental, PH Climate Zone, Monthly Averages, Historical Weather Data, n.d.), (Guihulngan City, Negros Oriental, PH Climate Zone, Monthly Averages, Historical Weather Data, n.d.), (Tanjay City, Negros Oriental, PH Climate Zone, Monthly Averages, Historical Weather Data, n.d.), (Bais City, Negros Oriental, PH Climate Zone, Monthly Averages, Historical Weather Data, n.d.), and (Bayawan City, Negros Oriental, PH Climate Zone, Monthly Averages, Historical Weather Data, n.d.-b).

Methodology

The researchers used published news from reliable sources and official government reports to identify the documented dengue cases. Rainfall and temperature data were gathered from trusted weather and climate websites that offer information for every research region. In order to understand the move of dengue cases over time, past records and reports were examined. The researchers used published news from reliable sources and official government reports to identify the documented dengue cases. Rainfall and temperature data were gathered from trusted weather and climate websites that offer information for every research region. In order to understand the move of dengue cases over time, past records and reports were examined.In this study, the independent variables include temperature, past dengue cases, and rainfall. Temperature is measured as the average daily or monthly value in degrees Celsius and can influence mosquito activity and the transmission of the dengue virus. Past dengue cases represent the number of reported dengue cases in previous months or years in a specific area, serving as an indicator of ongoing transmission. Rainfall is measured as the total precipitation in millimeters during a specific period and provides suitable breeding sites for mosquitoes, which can affect the spread of dengue. The dependent variable in this study is the dengue outbreak risk, which is determined based on the combination of these independent variables. The controlled variable is the study area, with the research conducted in the same selected cities to ensure fair and consistent comparisons. The materials used include historical dengue case data and climate reports monitoring rainfall and temperature. The research procedure involves gathering past dengue case data and climate information from health and climate monitoring sources, preparing and organizing the data for accuracy and alignment, and computing the mean and standard deviation for each variable. The G-scores and risk scores are then calculated and converted into percentages, which are analyzed to determine which cities are most at risk of dengue. Additionally, the acquired data is processed using formulas derived from the area of a circle and the ellipse model, commonly applied in wildfire spread studies, to estimate spatial risk and patterns of dengue outbreaks. This research is all about the idea that dengue outbreaks are influenced by both environmental and epidemiological factors. The past dengue cases serve as a warning for a continuous problem, while the temperature and rainfall provide a suitable breeding ground for mosquitoes. These three variables, dengue cases, temperature, and rainfall are the independent variables of the research, while the dengue outbreak risk serves as the dependent variable. These three variables, dengue cases, temperature, and rainfall are the independent variables of the research. while the dengue outbreak risk serves as the dependent Through this framework, the study conceptualizes the dengue cases outbreak risk. Based on the data, cities with higher case numbers, warmer conditions, and heavier rainfall are expected to have higher risk percentages; thus, knowing them as the priority for dengue prevention variable. To support the analysis, the study uses recorded data on dengue cases, temperature, and rainfall across selected cities in Negros Oriental. Among the cities included, Tanjay City recorded the highest number of dengue cases at 116, with an average temperature of 28.12°C and rainfall measuring 180.3 mm. This was followed by Dumaguete City, which reported 97 cases, an average temperature of 27.92°C, and rainfall of 178.97 mm. Bayawan City registered 91 dengue cases, with a lower average temperature of 26.52°C and rainfall totaling 170.0 mm. Meanwhile, Guihulngan City recorded 74 cases, an average temperature of 26.80°C, and rainfall of 171.14 mm. Lastly, Bais City had the lowest number of cases at 65, with an average temperature of 26.94°C and rainfall amounting to

172.72 mm. These figures indicate variations in dengue incidence across cities, alongside differences in temperature and rainfall conditions, which may influence mosquito breeding and disease transmission.

$$G(c,t,r) = \frac{N - S}{C}$$

Where:

G - Represents how much a city differs from the average. It shows whether the value is higher or lower compared to other cities.

N - The value of a specific factor for a particular city (such as number of cases, temperature, or rainfall). S - The average value of that same factor across all cities.

C - The total number of cities included in the comparison.

$$Risk\ score = \frac{Gcases + Gtemperature + Grainfall}{3}$$

Where:

G_cases - Shows how a city's number of cases compares to the average number of cases of all cities

G_temperature - Shows how a city's average temperature compares to the overall average temperature.
G_rainfall - Shows how a city's rainfall amount compares to the average rainfall of all cities.

Risk score - The average of the three G values, representing the city's overall risk level.

$$Risk\% = \frac{Risk\ score - minimum}{maximum - minimum}$$

Where:

Risk % - The final risk percentage of the city, showing how risky it is compared to others.

Risk score - The calculated value from the previous formula.

Minimum - The lowest risk score among all cities.

Maximum - The highest risk score among all cities.

Conceptual Framework

The number of the acquired recorded cases, average temperature, and amount of rainfall. Each one of these elements is compared to the average of all the cities in order to find out if the city is above the average or below the average. These comparisons are done by the variables G_cases, G_temperature, and G_rainfall. A positive number indicates if the city is above the average, while a negative number indicates if it is below the average. These are then added together and divided by three in order to find the risk score, which gives the level of risk of the city in general. Lastly, the risk score is changed to a risk percentage based on the minimum and maximum values. The risk percentage also shows the level of risk of the city in relation to the other cities. G (c,t, r) = N - S /C

The second formula is employed to find the final risk score of a city. The formula averages out the three values of G, that is, how a particular city fares against other cities based upon cases, temperatures, and rainfall. No discrimination is made between any of these factors, and a final risk score is generated. Risk score= G cases + G cases + G rainfall / 3

The third formula, is employed in calculating the risk score into a risk percentage." Through this formula, the risk score of the city is measured in relation to the lowest risk score given among all cities, in addition to being measured in relation to the highest risk score. Risk%= Risk score - minimum / maximum -minimum

Results

The results of computations indicate that dengue outbreak threats are not uniformly distributed across cities in Negros Oriental. One such exception is Tanjay City, whose claim of highest number of dengue cases (116), has put it in the High Risk (100%) category entirely, thus proving the model's closely reliable identify outbreak-prone areas. With 69% and 68% levels of moderation in risk among Dumaguete and Canlaon respectively, less but similar cases to Tanjay's, indicate that they would have contributed rainfall and temperature patterns which allowed optimum conditions for mosquito breeding and disease transmission. On the other hand, Bayawan, Guihulngan and Bais revealed very minimal risk (0-1%) due to combination of lower cases of dengue report and less supportive habits at the period of study. Both historical epidemiological record (prior cases) as an in the study by the aggregation and variation in climate-rainfall and temperature-strong determinants of capacity outbreak conferred by this study also. The GIS based visualization as well adds to the geographic contradiction, showing outbreak hotspots that are generally in selected cities only. Thus, there is a need for targeted interventions for high-moderate threat areas like heightened fumigation and awareness campaigns

Table 1. The data from selected cities here in Negros Oriental show that dengue cases normally occur alongside warm temperatures (26–29 °C) and moderate to high rainfall (170–185 mm)**.** Cities like Tanjay and Dumaguete recorded higher case numbers under these conditions, supporting findings from trusted sources with different temperature and rainfall influence mosquito breeding and dengue transmission.

Cities	No. of Cases	Temperature	Rainfall
Tanjay City	116	28.12	180.3mm
Dumaguete City	97	27.92	178.97.mm
Bayawan City	91	26.52	170.0mm
Guihulngan City	74	26.80	171.14mm
Bais City	65	26.94	172.72mm
Canlaon City	38	28.86	185.01mm

Table 2. The computed G-scores show how each city's dengue cases, temperature, and rainfall deviate from the overall average. Positive G-scores (e.g., Tanjay and Dumaguete) indicate values above the mean**,** stating relatively higher dengue cases and favorable climate conditions for dengue infections. Negative G-scores (e.g., Guihulngan and Bais) indicate values below the mean, reflecting lower cases and less favorable conditions. Canlaon City stands out with high positive G-scores for temperature and rainfall but a strongly negative score for cases, indicating that despite favorable climate conditions, dengue cases remained low, likely due to non-climatic factors.

Cities	No. of Cases	Temperature	Rainfall
Tanjay City	1.48	0.69	0.82
Dumaguete City	0.70	0.45	0.56
Bayawan City	0.45	-1.18	-1.22
Guihulngan City	-0.26	-0.85	-0.85
Bais City	-0.63	-0.69	-0.68
Canlaon City	-1.74	1.55	1.72

Table 3. Each city's overall dengue risk is added up by the risk scores obtained from the G-scores. Tanjay City (1.00) shows the highest risk, followed by Dumaguete City (0.57) and Canlaon City (0.52), suggesting a comparatively greater combined impact of rainfall, temperature, and dengue cases. On the contrary, the risk scores for Bayawan, Guihulngan, and Bais Cities are negative, indicating a lower overall dengue risk than the norm. These findings aid in identifying cities that could need higher priority for dengue preventive and monitoring initiatives.

Cities	Risk Score
Tanjay City	1.00
Dumaguete City	0.57
Bayawan City	-0.65
Guihulngan City	-0.65
Bais City	-0.67
Canlaon City	0.52

Table 4. The table shows the computed risk percentages based on the acquired data for selected cities. It indicates that Tanjay City has the highest computed risk at 100%, followed by Dumaguete City (69%) and Bayawan City (68%). In contrast, Guihulngan City and Bais City both show very low risk at 1%, while Canlaon City has no computed risk at 0%. This table highlights the differences in risk levels among the cities based on the computations.

Cities	Risk %
Tanjay City	100%
Dumaguete City	69%
Bayawan City	68%
Guihulngan City	1%
Bais City	1%
Canlaon City	0%

Figure 1. The figure shows a visual comparison of the computed dengue outbreak risk percentages by city. It clearly shows that Tanjay City has the highest risk at 100%, represented by the tallest bar. Dumaguete City (69%) and Canlaon City (68%) follow with moderately high risk levels. In contrast, Bayawan City and Guihulngan City both show very low risks at 1%, while Bais City records no risk at 0%.

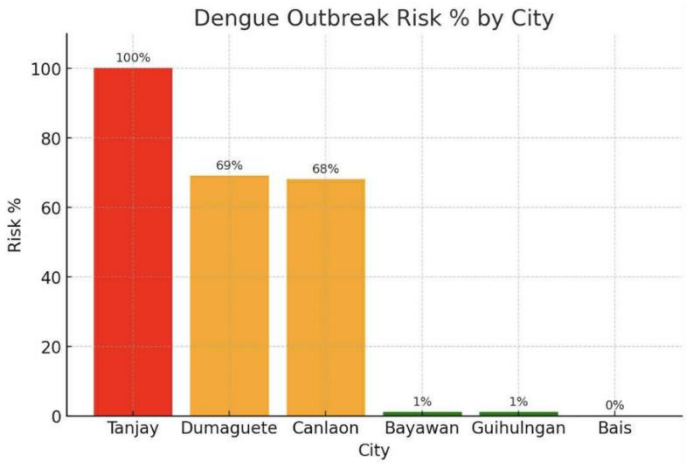
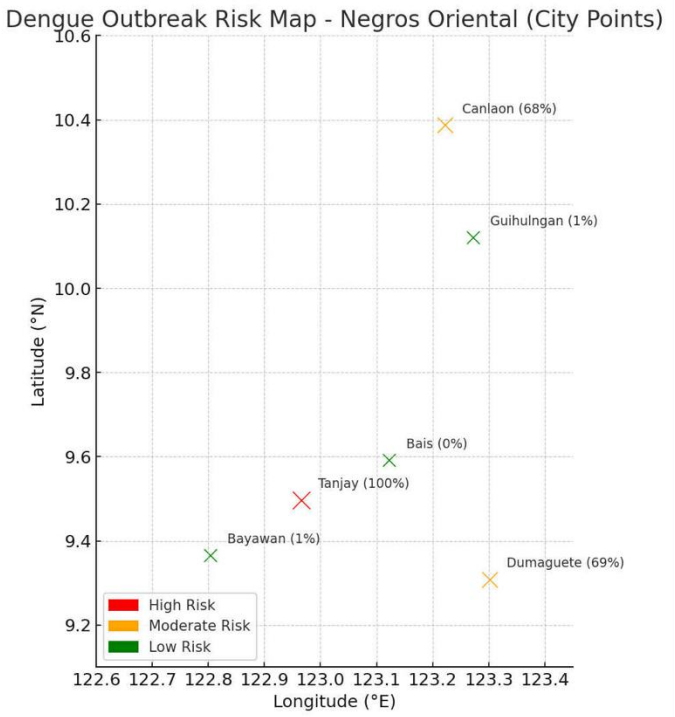


Figure 2. The figure shows a map of Negros Oriental highlighting the computed dengue outbreak risk levels of the selected cities. Each city is arranged based on its geographic location, with colors indicating the level of risk. Tanjay City appears as a high-risk area with a computed risk of 100%. Dumaguete City (69%) and Canlaon City (68%) are classified as moderate-risk areas. Meanwhile, Bayawan City and Guihulngan City show low risk at 1%, and Bais City shows no risk at 0%. This map helps visualize how dengue outbreak risk is distributed across the province based on the computed results.



Discussion

The results presented in Figure 2: Dengue Outbreak Risk Map - Negros Oriental illustrate how the integration of Geographic Information Systems (GIS) and climatic data can be utilized to predict and control dengue outbreaks. By spatially mapping risk levels across different city points, the study identifies a clear relationship between environmental triggers and viral transmission. Central to this analysis is the role of temperature and rainfall as primary

drivers of mosquito biology. High average daily temperatures in Negros Oriental cities, such as Tanjay and Dumaguete, are known to increase the metabolic rates of Aedes aegypti, thereby shortening the external incubation period of the virus and hastening mosquito life cycles (Weather and Climate).

This relationship between rainfall and mosquito density is evident in the risk distribution shown in Figure 1. Increased precipitation creates essential breeding sites through the accumulation of stagnant water, particularly in urbanized "city points" where drainage may be insufficient (Weather and Climate). However, the model also accounts for past dengue cases as a critical independent variable for establishing baseline risk. As noted by the Philippine News Agency (2025), monitoring fluctuations in case numbers, such as the 24% decline observed in Negros Oriental during early 2025, is vital for identifying whether current environmental conditions are leading to an anomaly or a cyclical trend.

By prioritizing high-risk areas identified in the GIS model, local government units (LGUs) can transition from reactive,
city-wide disinfection to a proactive, regularly intervention strategy. This approach improve the allocation of resources for mosquito killing and community awareness campaigns in the most vulnerable barangays. Despite the system's predictive capabilities, it is important to acknowledge that climatic fluctuations, such as the drought conditions previously reported in the region (Philippine News Agency, 2023), can alter mosquito breeding patterns and impact model accuracy. Therefore, the consistent monitoring of the controlled variables, the specific cities within Negros Oriental, remains necessary to ensure the validity of long-term public health interventions.

A recent similar study by Liu et al. (2025) discovered that “Dengue is the most widespread and fastest-growing vectorborne disease worldwide.” They study the impact of climate change on the dengue cases in Southeast Asian countries. This finding highlights the growing concern about dengue and its connection to climate-related factors in the region. Supporting this, “Recent climate changes related to global warming have increased the potential risk of dengue outbreaks in the world. In this paper, we study and investigate temperature and precipitation as climatological factors affecting dengue incidence in the Philippines from the year 2015 to 2018.” According to a study here in the Philippines by Subido and Aniversario (2022), climate variables play a significant role in dengue incidence at the national level. Similarly, according to a study of Frontiers of Public Health (2022), stated that one of the most important climate factors for dengue diets are temperature, rainfall, and even relative humidity. “Due to climate change, various sectors are affected, and one of the sectors is healthcare. As a result of climate change, the geographic range of several vector-borne human infectious diseases will expand. Currently, dengue is taking its toll, and climate change is one of the key reasons contributing to the intensification of dengue disease transmission.” This shows how climate change directly affects public health outcomes.

Conclusion

The findings of this study show that the capacity of Local Government Units (LGUs) to anticipate and mitigate dengue epidemics is significantly enhanced through the integration of Geographic Information Systems (GIS) with climatic and epidemiological data. By establishing a rigorous scientific foundation that correlates temperature, rainfall, and reported dengue cases, this research provides a predictive framework that shifts public health management from a reactive to a proactive stance. For the community, this model offers invaluable insights by identifying localized "hotspots," such as Tanjay City, which allows for heightened public awareness and the mobilization of residents to remove breeding sites before infection rates are high. To effectively address the identified outbreak risks, it is recommended that LGUs implement targeted interventions, including prioritized disinfection and mosquito killing in high-risk zones, rather than utilizing standard, province-wide measures. This study argues that government action must transition toward predictive analytics to ensure the efficient allocation of scarce public health resources. By adopting the G-score risk assessment formula, health authorities can launch "pre-emptive strikes" against mosquito populations during periods of high-risk climatic conditions. This approach is supported by Ahmed et al. (2021), who claim that combining climate data with disease surveillance creates a more resilient health system capable of managing vector-borne threats before they escalate into crises. Ultimately, while data reliability and technical infrastructure remain challenges, the implementation of this data-driven framework offers a scalable and sustainable strategy for protecting vulnerable populations in Negros Oriental and similar tropical environments. Health offices, weather agencies, and schools need to improve how they work together to make data more accurate and shared faster. Local

outreach efforts that turn risk data into clear, useful advice for residents should also help the community. A report in the province of Negros Oriental by Udtohan (2022) stated that "Temperature, relative humidity, atmospheric pressure, and total rainfall were the climate parameters used to describe the province's climate." The results showed that the number of dengue cases in the province increased and decreased at different times over ten years, further demonstrating the influence of climate variability on dengue trends.

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