

# Beware of Zika Assessing Zika Vulnerability in Brazil

## Background

Zika virus is an illness one gets from the bite of mosquitoes Aedes aegypti and Aedes albopictus. Symptoms include fever, headache, joint pain, conjunctivitis and rashes. The virus can spread through many ways besides mosquito bites. Pregnant women with the Zika virus can pass the infection through the placenta to the fetus and can cause the child to be born with congenital conditions like microcephaly. The virus can also be passed down through sexual contact. And can stay in the body fluids like semen for weeks to months after an infection. Similarly, Zika can pass through blood transfusions. The virus is most prevalent in Africa, the Caribbean and South America because of the tropical climate where mosquitoes thrive. The warm and wet conditions of tropical and subtropical regions are ideal Aedes mosquitoes to reproduce and for the virus to amplify within their bodies.



## Methods

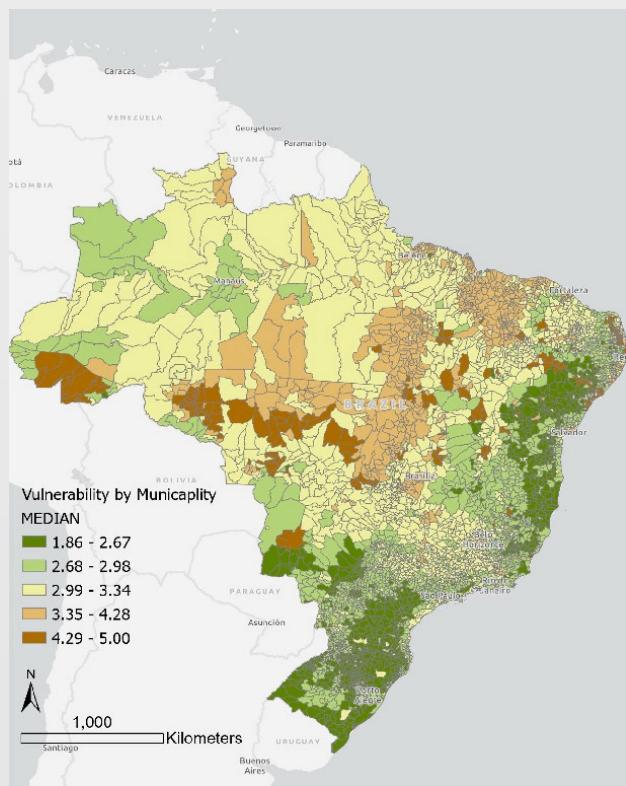
I combined Brazil's municipal boundaries with population, density, and sanitation data. Environmental rasters (temperature, precipitation, and land cover) were clipped, reclassified, and standardized. Vulnerable land-use types (urban, mining, non-vegetated) were extracted and used to calculate distance-to-breeding-areas. Sanitation and climate rasters were also reclassified. All layers were weighted in a raster calculator to create a composite Zika risk index. Zonal Statistics was then used to compute the average index value for each municipality.

## Results

The Zika Vulnerability Index reveals that the highest-risk zones (brown) are concentrated across central Brazil, particularly throughout the Amazon region and extending into the central-west. These areas show consistently high vulnerability values due to a combination of high temperatures, substantial rainfall, and proximity to vulnerable land-use types.

Moderate vulnerability (mid-range green/teal) appears across the Northeast and parts of the Southeast, where climate conditions are still favorable for Aedes mosquitoes but less intense than in the central interior. The lowest-risk areas are seen in the far South, where cooler seasonal temperatures reduce mosquito suitability.

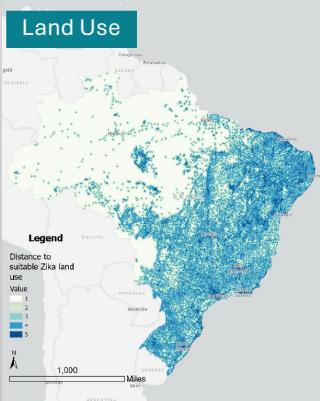
**Limitations:** Sanitation data reflect 2010 conditions and may not capture recent improvements, while land use data are only available through 2021. In addition, the use of municipality-level aggregation may mask localized variation in environmental and socioeconomic conditions.



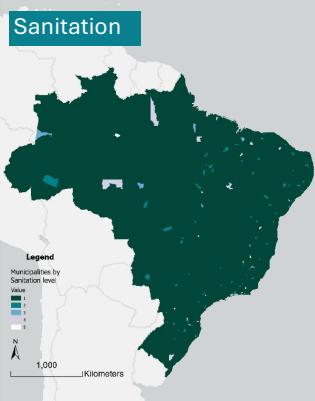
## Conclusion

This project mapped Zika vulnerability across Brazil by integrating municipal demographics, sanitation conditions, land-use patterns, and climate variables into a weighted spatial index. The resulting Zika Vulnerability Index shows that the highest-risk areas form a broad central region, especially across the Amazon region where warm temperatures, heavy rainfall, and proximity to disturbed land cover create ideal conditions for Aedes mosquito breeding. Overall, the analysis demonstrates that Zika vulnerability in Brazil is driven by the interaction of environmental and urban, land use factors, and that identifying these spatial hotspots can help guide more targeted public health interventions and resource allocation.

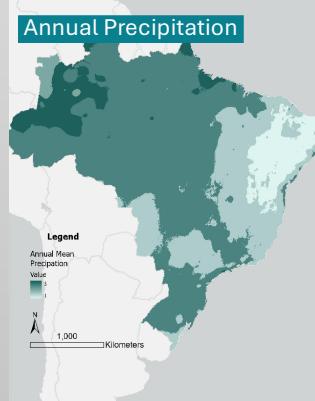
## Suitability Factors



This map depicts distance from vulnerable land use types (urban area, mining, non vegetated areas). Starting from Central Brazil and down through the east coast, extending to the south, these vulnerable land use types are most prevalent. Therefore, these regions are most susceptible to Zika breeding.



This map depicts vulnerable municipalities with >= 30% unpiped households. While no strong nationwide pattern is evident, higher sanitation vulnerability appears more frequently among municipalities along the eastern coast.



The map shows clear spatial variation in annual mean precipitation across Brazil, with higher precipitation levels concentrated in the Amazon region and lower values across the eastern and northeastern interior.



Higher annual mean temperatures dominate northern and central Brazil, creating broadly favorable climatic conditions for the Zika mosquito survival and reproduction, and supporting widespread environmental suitability for Zika transmission.