

Malaria Vulnerability Analysis: High-Risk Groups in Nigeria



Abstract

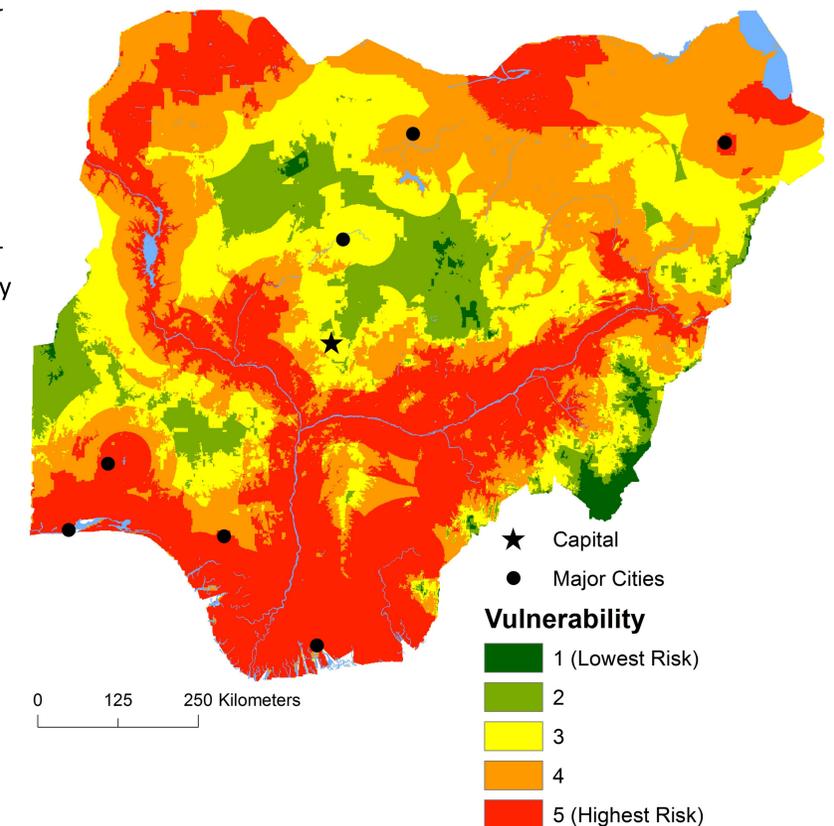
Malaria is one of the most widespread parasitic diseases in the world, with 18.7 percent of the cases occurring in Nigeria. Though the rates have fallen in recent years, it is estimated that about 3.3 billion people are still at risk of contracting malaria. By studying the different factors that influence where malaria occurs, a vulnerability analysis can be done using GIS software so organizations can focus on high-risk areas. The three factors that are most influential to where mosquitoes are found, and therefore where malaria often occurs, are elevation, proximity to water, and temperature. Population density was also considered because organizations should focus on areas where they will help the most people. By weighing these factors different amounts, a vulnerability map can be made to guide organizations to what areas they should focus on so that they can help the people most in need first before helping people in lower transmission areas.

Vulnerability Equation

The risk factors found in George Valiakos' vulnerability study of West Nile Virus in Greece were used because West Nile Virus is another mosquito-vector disease, so the factors influencing where mosquitoes are found should be the same. Factors found in other literature sources and vulnerability analyses were also taken into consideration. From these sources, it was found that mosquitoes typically live in warm areas of lower elevation that are close to water. Valiakos' study found that elevation and proximity to water were the two most relevant risk factors, so these were weighted the most in the vulnerability equation. Other sources found that temperature was also important to where mosquito populations are found, so this had the second highest weighting. Because this vulnerability map is to be used by organizations attempting to help people with malaria, the map needed to show not only where mosquitoes are found but also where people are found, so the population density was also taken into account. It was weighted the least because though organizations want to help areas with the most people at risk, malaria may still occur in areas with lower populations. Maps of these four factors were made using GIS software and were then added together with their different weights (equation shown below) to show the risk levels in different areas. The four maps below are the factors and to the right is the output from the calculation.

$$0.1 * (\text{population density}) + 0.2 * (\text{temperature}) + 0.35 * (\text{proximity to water}) + 0.35 * (\text{elevation}) = \text{vulnerability}$$

Results and Conclusions

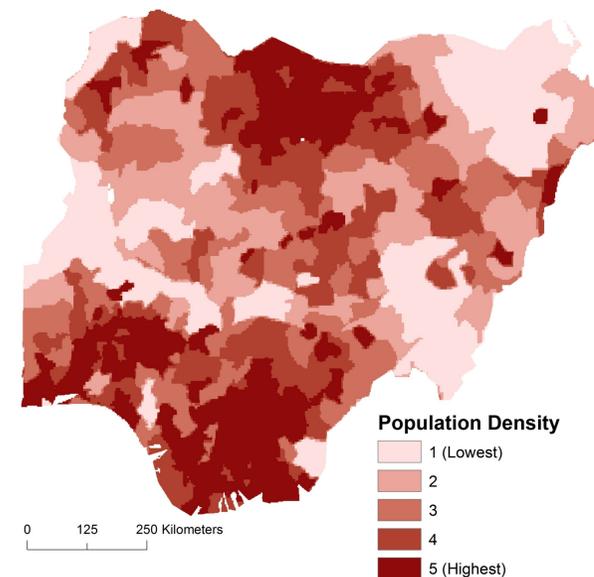
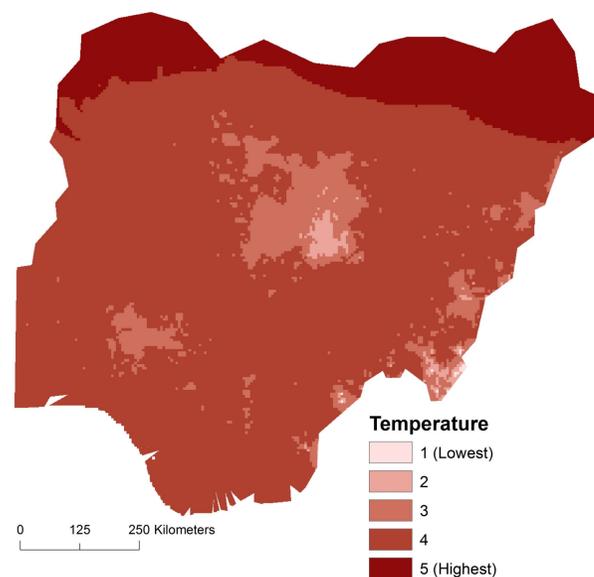
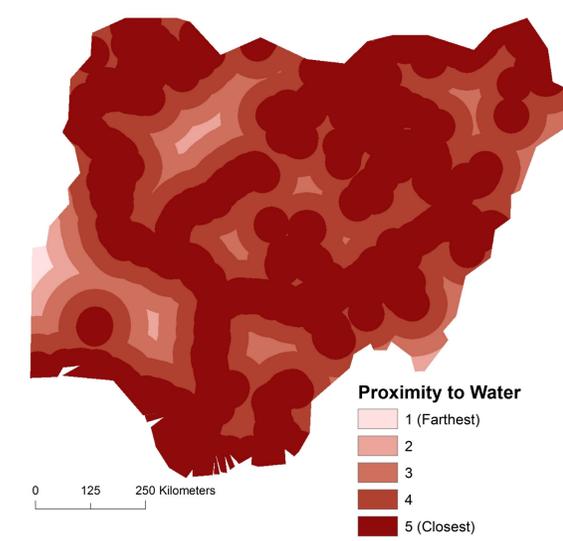
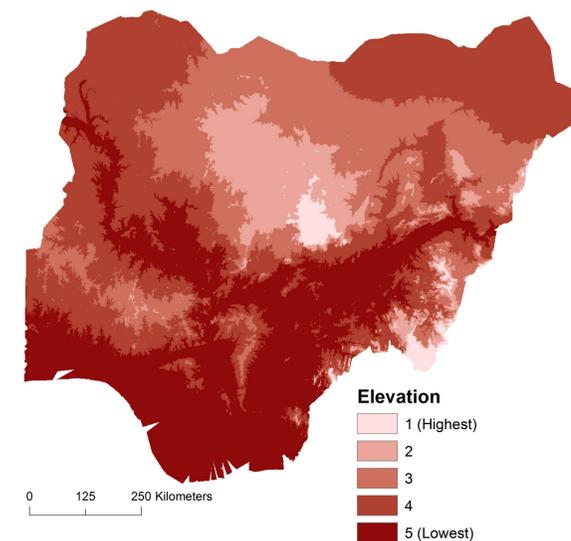


This vulnerability map shows the areas at highest risk in red and at the lowest risk in green. As could be expected from the equation, most of the red areas are along the coast or around the path of the rivers where the areas are at low elevations and close to water. Many of the major cities (more than one million people) are also located within these regions, so this map would be helpful to organizations when they are looking for larger groups of people who need their help the most.

By planning which areas organizations will help first, these organizations can help the largest groups of people who are at the most risk. If organizations make vulnerability maps such as these, then they can better use their resources to treat malaria patients and prevent malaria from occurring. Similar methods can be used to conduct vulnerability studies or areas other than Nigeria or for similar diseases..

Data Sources: FAO Geonetwork; Diva.
Projection: Africa Equidistant Conic
Datum: WGS 1984

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Methodology

Data was found for the four risk factors: elevation, water resources, temperature, and population density. The data were then projected into the Africa Equidistant Conic coordinate system. For the water resources layer, a Euclidean distance calculation was performed to calculate the distances from the water, and was then converted to a raster. Then, the data were extracted to only show the information for Nigeria, and each layer was reclassified into five groups. Lastly, map algebra was used to come up with an equation that represented where malaria was likely to be found in Nigeria.