Identifying Suitable Diarrheal Disease Intervention Districts in Ghana: Are WASH Variables True Indicators of Disease Outcomes?

Introduction

In 2015, there were 35 million cases worldwide of diarrheal diseases (DD), and most of the cases were in children under 5 years of age. Although country-specific data in Ghana has been lacking, recent 5-year reports have been able to more clearly show the national rates for diarrheal disease on a district level. The transmission for diarrheal diseases is most common through food or drink contaminated with fecal matter, and almost 60% of cases are due to unsafe water, sanitation, and hygiene (WASH). This suggests that WASH behaviors may have a large effect on disease prevalence, and only through good hygiene, safe drinking water, and the proper disposal of human waste can the spread of diarrheal diseases be stopped.

Ghana's inability to have safe WASH protocol has resulted in high incidences of diarrheal diseases throughout the country. Equipped with 2010 National Census data of water and sanitation variables, as well as five years of district level disease counts from Ghana Health Services, four potential indicators were selected to determine which districts in Ghana had the most need for diarrheal disease interventions. The four variables for the suitability analysis included poor sanitation, poor drinking water source, low literacy, and high rural populations. The suitability analysis was then compared to the average disease rates between 2012-2016, and both analysis were used to see: Do WASH and other socioeconomic variables correctly identify the most suitable districts for diarrheal disease interventions?

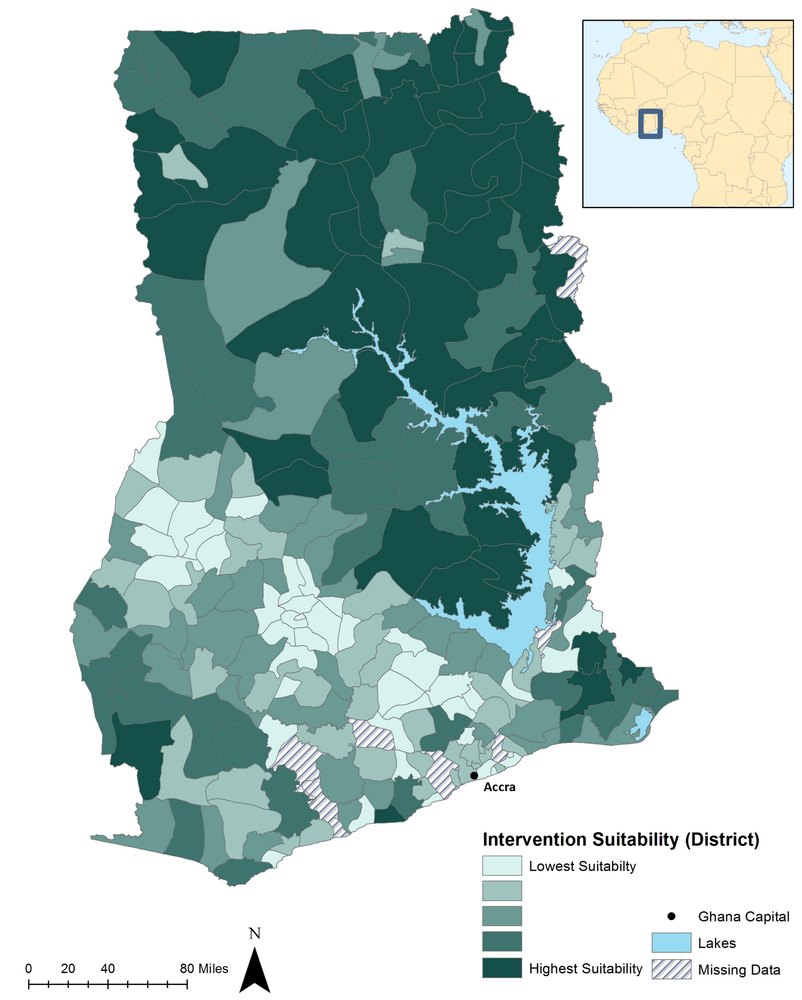
Methodology

Four variables from the 216 districts were used in determining intervention suitability. The first WASH variable was the percent of the district that has unimproved access to drinking water. This variable was created through adding together several drinking water factors, including households that used unprotected wells, springs, rivers, streams, and ponds. The second indicator was the percentage of the district who has unimproved sanitation, which included households that had no sanitation facilities at all or who only used bucket latrines.

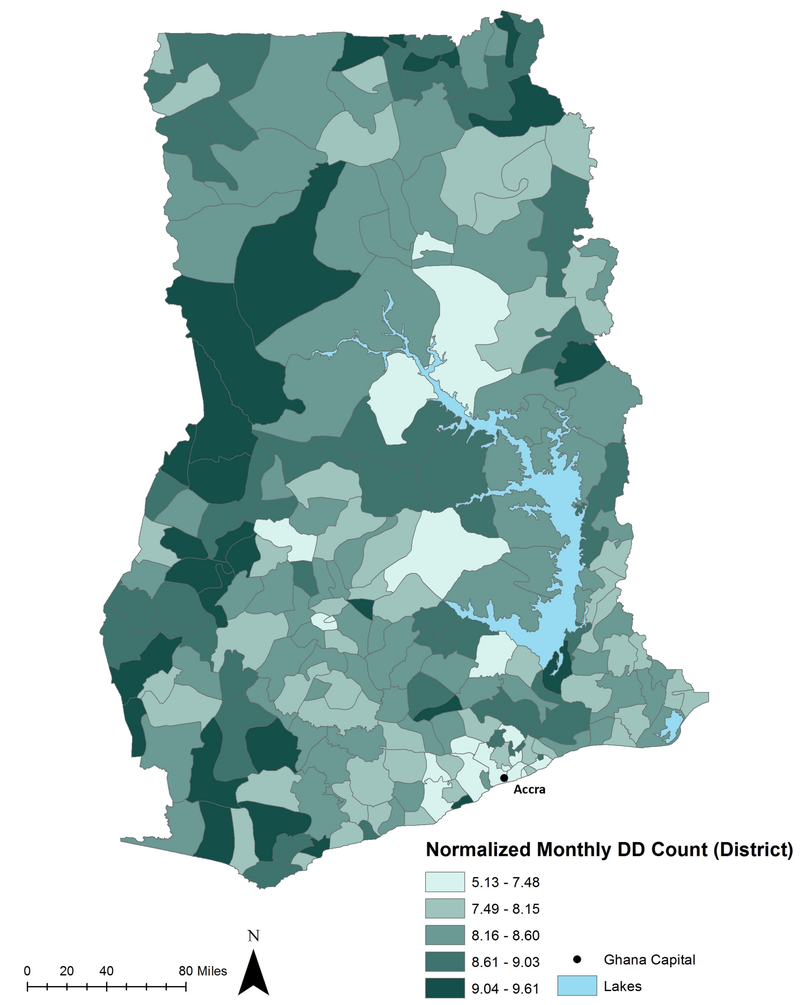
Low socioeconomic status (SES) correlates to a lower educational achievement, which can be seen quantitatively via the literacy rate. Low SES is very much correlated with poor health outcomes, and these communities rely on many foods that are cooked with unsafe water, which increases the chances of DD being spread . Lastly, the rural population was used in the calculation because of its connection with poorer sanitation as well as low SES.

To conduct the vector suitability analysis, several calculations were done on Excel. To normalize all the variables, each value was subtracted from the mean value of all the districts and then divided by the standard deviation. These normalized values were then sorted from lowest to highest and reclassified from a scale of 1 to 5. After all four variables were normalized and reclassified, they were added up to create a final suitability score, which was then reclassified and joined to the district ID. A low score represented a district that was the most suitable place for an intervention, because it lacked good WASH behaviors, had low literacy rates, and/or was a rural district.

Suitability Analysis of Four DD Indicators



Average DD Count Per Month, Over 5 Years



Results and Limitations

The suitability analysis creates a clear picture of where one would assume an intervention should be implemented based on WASH factors. The results however paint a different picture, especially when compared to the average DD count per month, which looks at the average number of cases per district across all five years. The individual variable maps show clear areas of poor sanitation in the northern region of Ghana, which also happens to have some of the lowest literacy rates and highest rural populations. Surprisingly enough, some of the districts within that northern region had average or below average rates of diarrheal diseases.

In terms of limitations, the variables for the indicators are from 2010, while the DD counts are from 2012-2016, resulting in a mismatch of years. Additionally, there are several more variables that could have been included in the suitability analysis but are not collected in the census, such as hand washing use. The map of unimproved drinking water may also be spatially skewed because of the districts that surround the large Lake Volta, since lakes were considered an unimproved drinking water source. What is unknown is whether these populations use point of treatment or other filtration devices that improve the quality of the water they drink, but this is unfortunately not tracked in census data.

Conclusions

This analysis show that WASH and other socioeconomic factors may not always show the best place for a diarrheal disease intervention. This is important because of how long and expensive interventions can be: if they are being implemented in places that don't even have high rates, resources are being wasted. While WASH is known to be a very important factor in public health interventions, it can be difficult to know which specific variables are most important. In the future, it may be better to look at different variables and behaviors, such as handwashing and surface water use. What is certain is that these four factors alone do not drive diarrheal disease rates. Additionally, it is clear that much of rural & northern Ghana is lacking the same level of WASH improvements as in other parts of Ghana.

Sources

Sources:

2010 National Census, Ghana Statistical Services, DHIMS database, Ghana Health Service, Tufts Community Health Department

Projection:

WGS 1984 UTM Zone 30N

Transverse Mercator Projection

Cartographer:

Juliet Johnson

GIS 101: Introduction to GIS

May 7th, 2018

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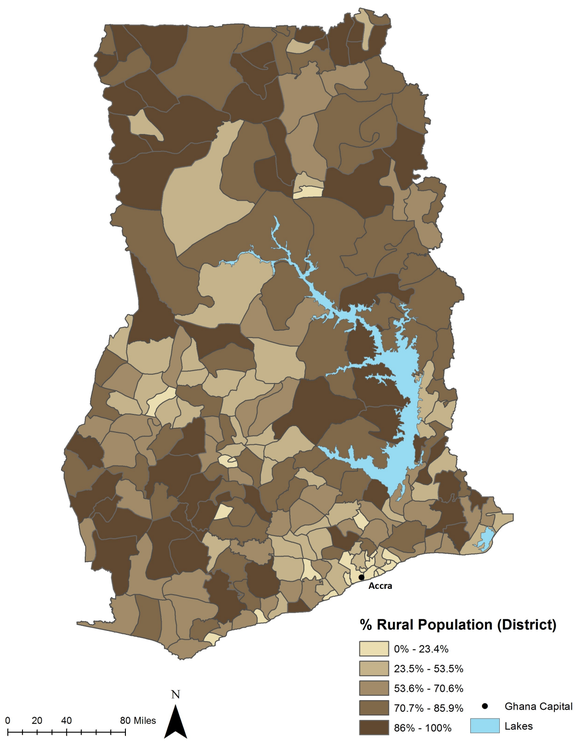
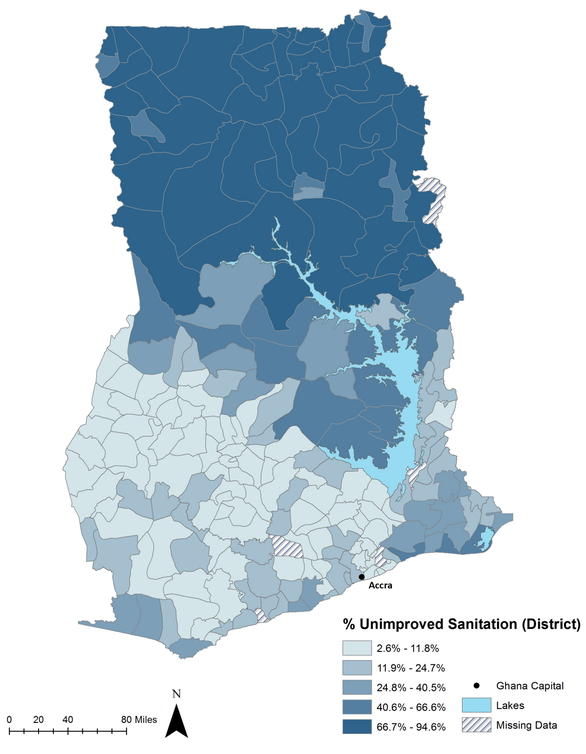
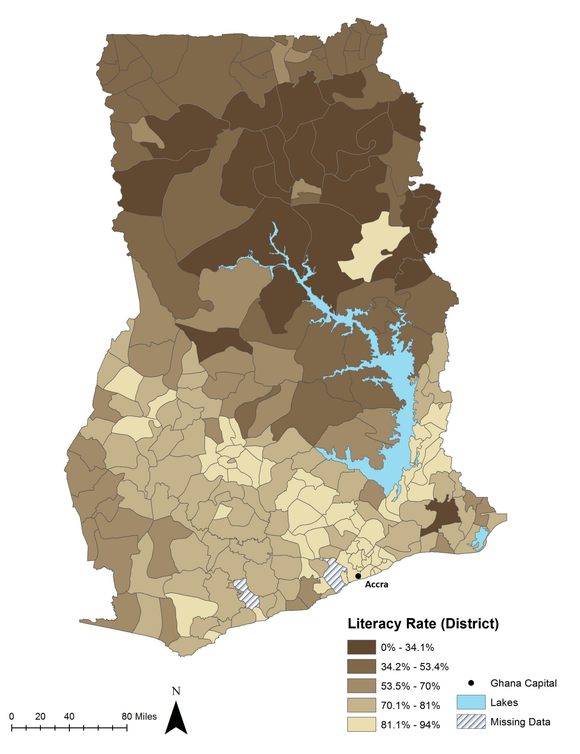
Rural Population



Unimproved Access to Sanitation



Literacy Rate



Unimproved Access to Water