Borehole Density and Schistosomiasis Disease Burden
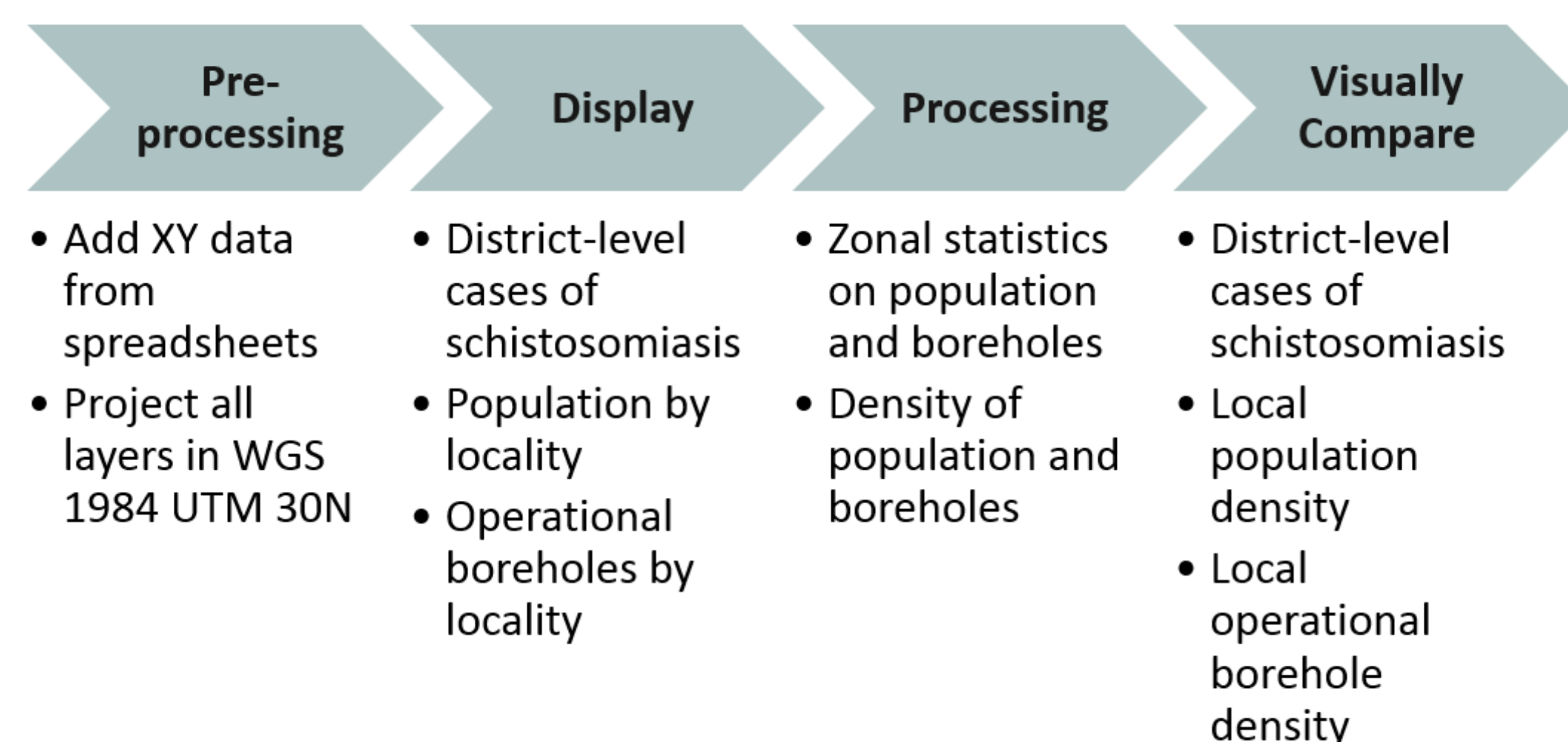## Select Districts of Ghana's Eastern Region

Background

Schistosomiasis is a parasitic disease caused by flatworms of the *Schistosoma* genus. The World Health Organization (WHO) reports that schistosomiasis affects almost 240 million people worldwide. Larvae penetrate human skin in contaminated water sources and develop into adult schistosomes in the human body. Urogenital schistosomiasis is caused by the *Schistosoma haematobium*, resulting in bloody urine from damage to the bladder, ureters, and kidneys. Mass drug administration of praziquantel has been effective in treating infected individuals but can be a burden to health care systems and is not on its own a sustainable intervention. Other disease control methods recommended by the WHO and the Centers for Disease Control and Prevention (CDC) include improved water, sanitation, and hygiene practices and snail control. Predictive models of disease burden would be useful to target populations that are at high risk for schistosomiasis infection. A few have been created but do not show a complete representation of the disease burden. Baseline data from selected Ghanaian localities were collected and analyzed to model a preliminary relationship between schistosomiasis disease burden and concentrations of operational boreholes, which are considered safe water sources. The district-level cases reported do not account for all existing schistosomiasis cases. No formal associations have been established, but this analysis demonstrates that higher population concentrations and fewer operational boreholes appear to be related to higher schistosomiasis disease burden. Future research will be needed to increase the sample of localities analyzed and establish a valid relationship between operational borehole density and schistosomiasis disease burden.
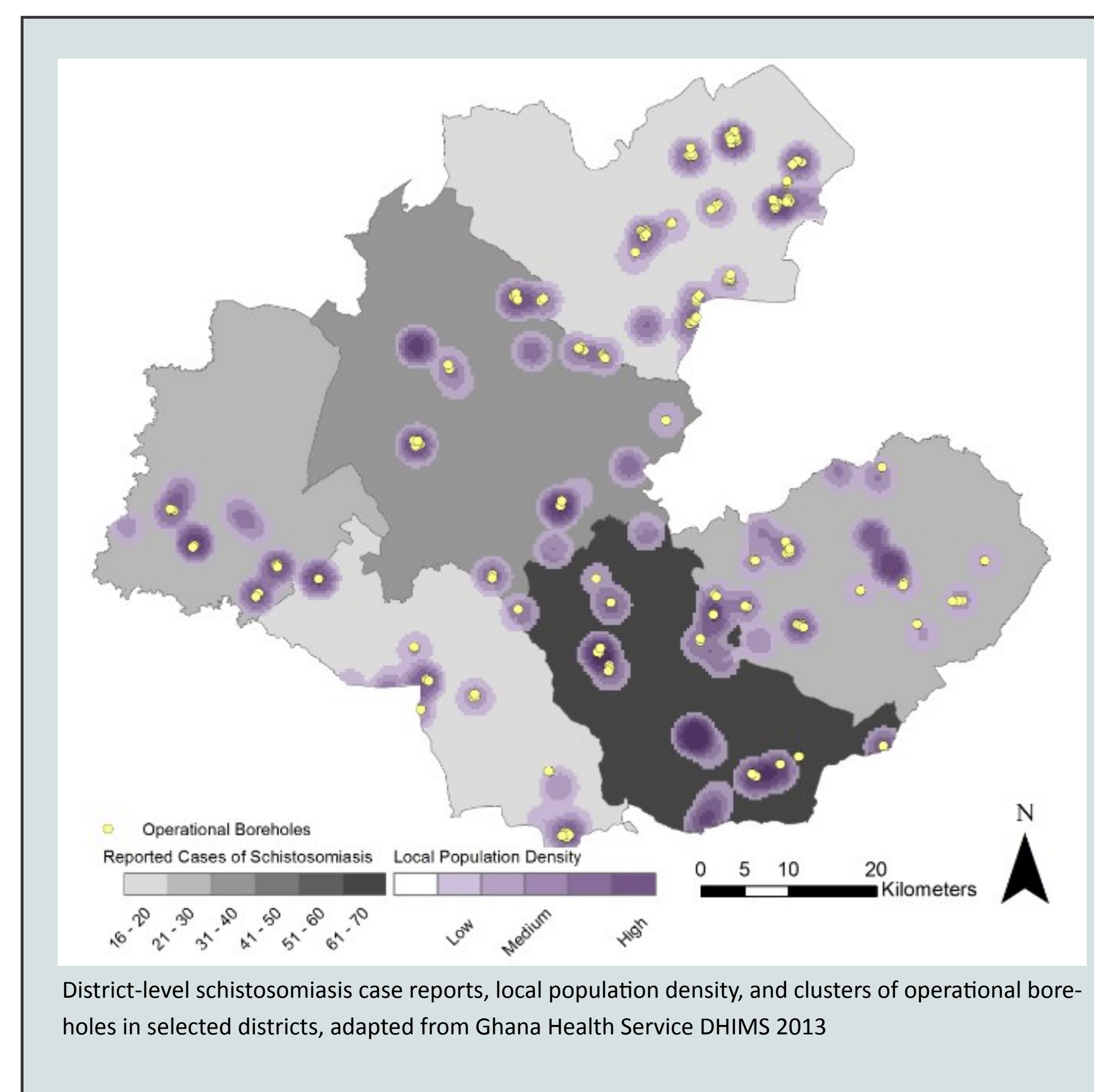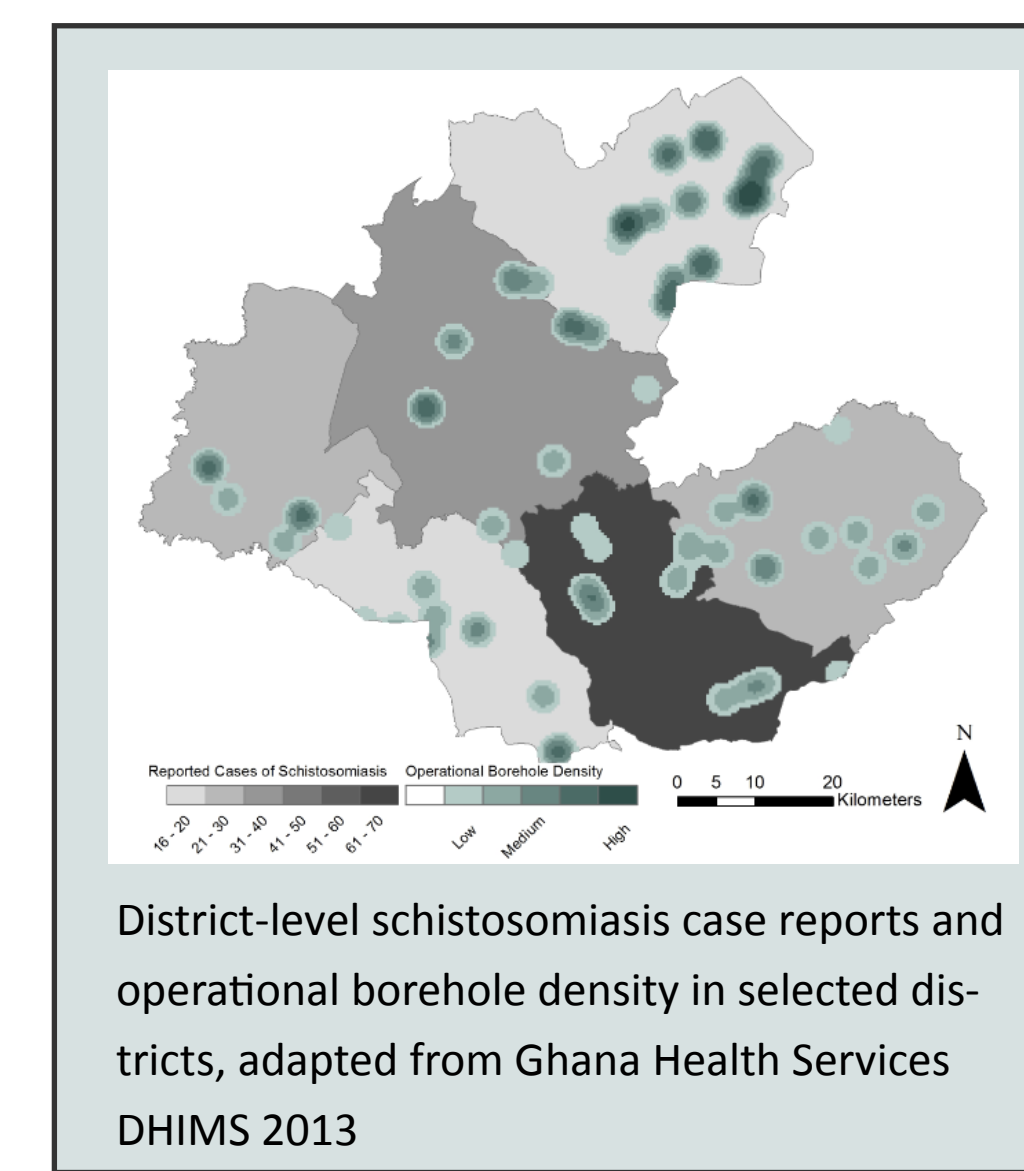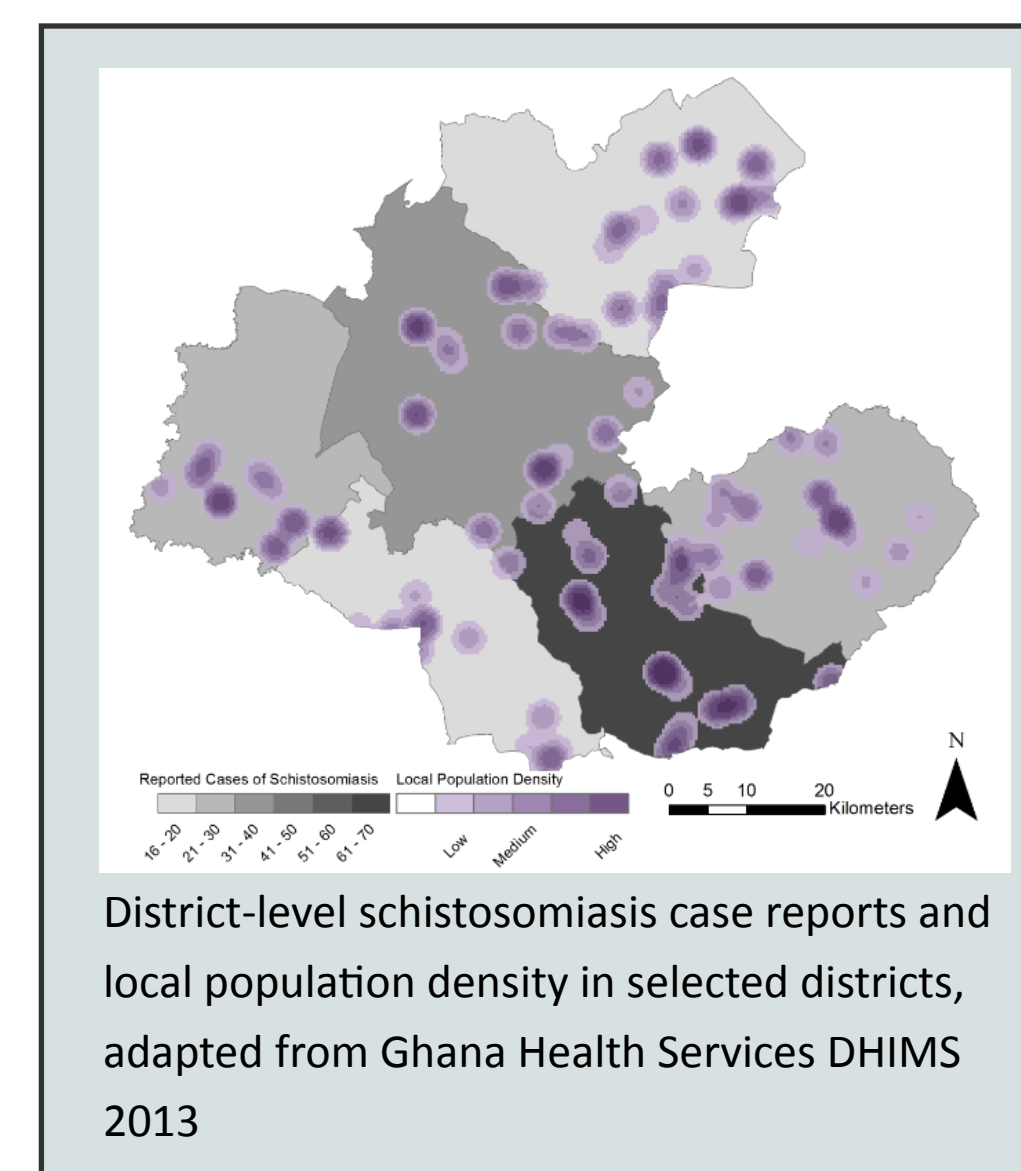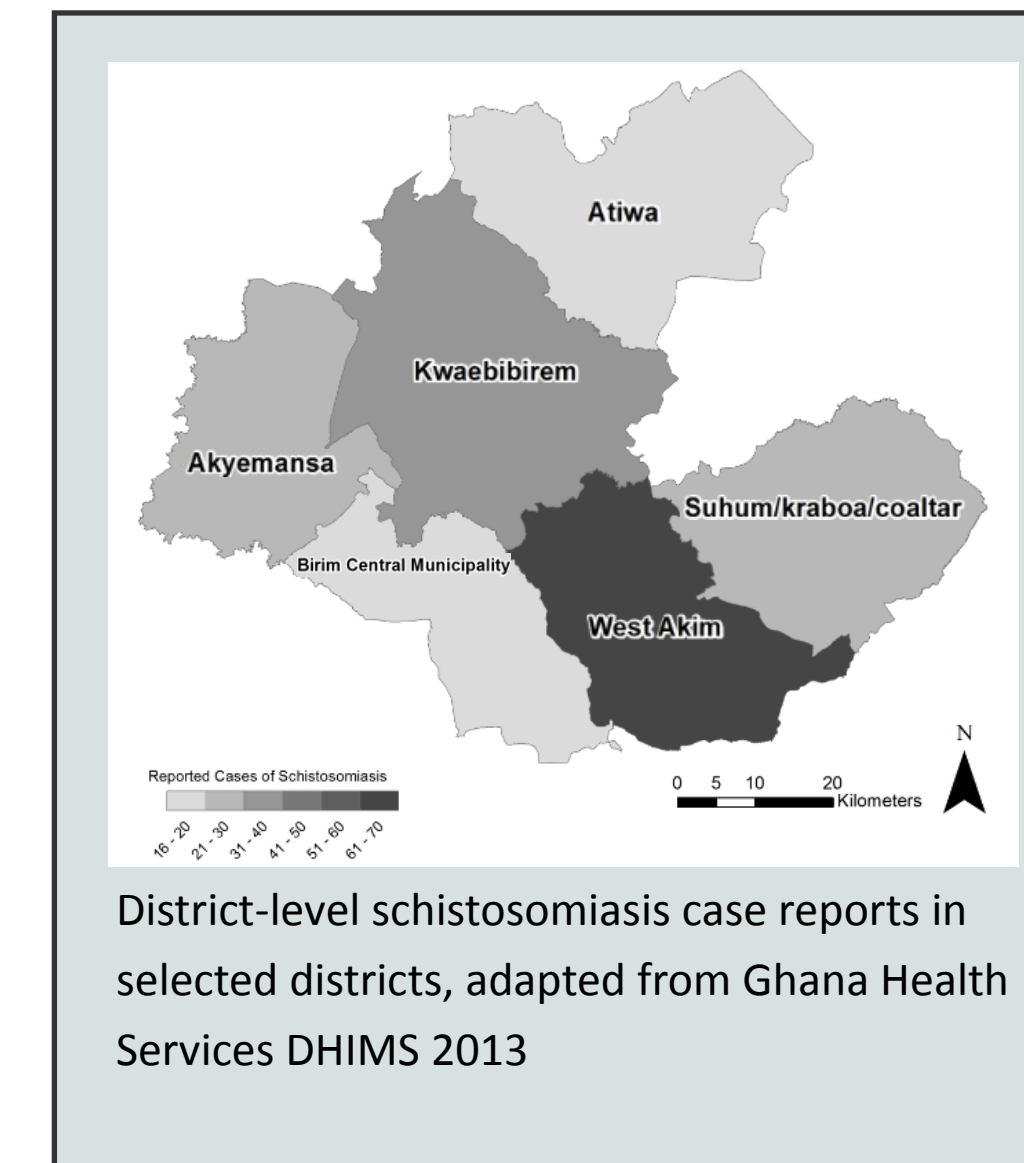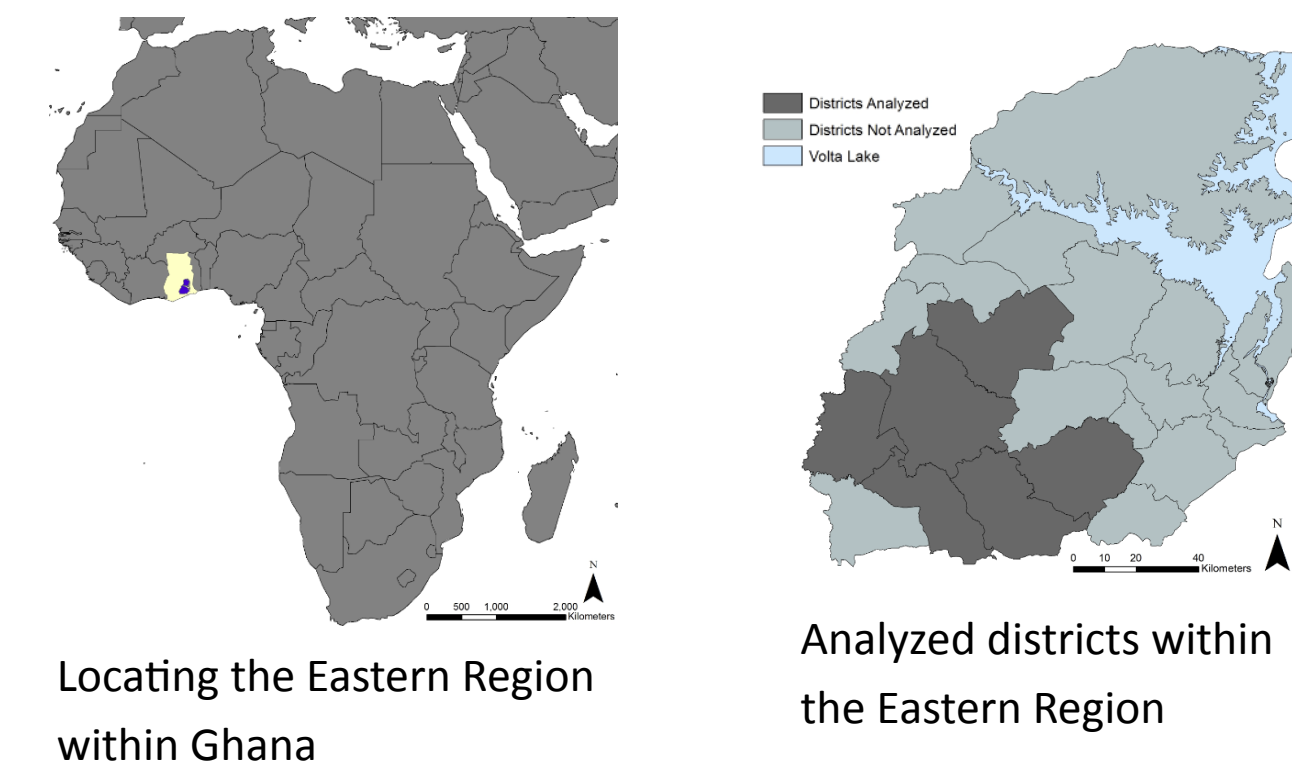
Objectives

Use newly collected data to show:
1. Reported cases of schistosomiasis according to Ghana Health Services
2. Relative access to safe water sources (operational boreholes)
3. Relationship between reported cases of schistosomiasis and operational boreholes

Methodology

Pre-processing	Display	Processing	Visually Compare
• Add XY data from spreadsheets • Project all layers in WGS 1984 UTM 30N	• District-level cases of schistosomiasis • Population by locality • Operational boreholes by locality	• Zonal statistics on population and boreholes • Density of population and boreholes	• District-level cases of schistosomiasis • Local population density • Local operational borehole density

Results

Locating the Eastern Region within Ghana

Analyzed districts within the Eastern Region

District-level schistosomiasis case reports in selected districts, adapted from Ghana Health Services DHIMS 2013

District-level schistosomiasis case reports and local population density in selected districts, adapted from Ghana Health Services DHIMS 2013

District-level schistosomiasis case reports and operational borehole density in selected districts, adapted from Ghana Health Services DHIMS 2013

District-level schistosomiasis case reports, local population density, and clusters of operational boreholes in selected districts, adapted from Ghana Health Service DHIMS 2013

Limitations

♦ The "tip of the iceberg" phenomenon doesn't give accurate case counts at the local level. There are many more cases present than are reported from hospitals and health clinics
♦ Locality data available is not representative of all localities in the districts analyzed
♦ Other variables in addition to functioning of boreholes affect if people are using safe water sources
♦ Use of safe water sources does not always indicate non-use of contaminated water sources
♦ Locality population is from the 2000 Ghana Census and may not reflect the current population
♦ Cases of schistosomiasis are available either at the district level or from individual health centers, but not from localities

Conclusions and Recommendations

♦ Districts that show high operational borehole density relative to the population density also have lower case reports of schistosomiasis
♦ The district where known successful interventions have been implemented at the local level (Atiwa) have higher concentrations of operational boreholes and few reported cases of schistosomiasis
♦ Data from more localities will be needed in the future to establish a valid relationship between operational borehole densities and schistosomiasis disease burden and to create predictive models to show communities at risk for high disease burden
♦ Create more complex vulnerability models to demonstrate how other locality infrastructure, river access and use, access to different types of healthcare, and individual behaviors can predict case reports of schistosomiasis
♦ Compare models of individual risk factors, locality-level risk factors, and environmental risk factors to determine spectrum of risk on infection
♦ Use these models to provide targeted interventions to the most vulnerable

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Data provided by: Professor Karen Kosinski, Ghana 2000 Census, Ghana Health Services District Health Information Management System (DHIMS), Tufts GIS Repository
Map projection: WGS 1984 UTM Zone 30N
Introduction to GIS, Professor Carl Zimmerman
Assistance from Carolyn Talmadge