Geographic Indicators of Maternal Death Rates in Cambodia

Purpose
This project examines the root causes of high rates of maternal mortality in Cambodia and seeks to answer the question of whether or not geography plays a factor in this disturbing trend.

Background
Worldwide, there are 430 maternal deaths per 100,000 live births. In Cambodia the statistics show conditions being worse than global trends with 437 deaths per 100,000 live births, which makes maternity-related complications one of the leading causes of death for Cambodian women ages 15 to 49. According to the 2005 Cambodia Demographic and Health Survey (DHS), about 1 in 5 Cambodian women die from pregnancy related causes.

Methodology
This project incorporates data from the Demographic Health Survey (DHS and the Cambodian Ministry of Statistics, whose census data has been secured through Harvard University. The study maps Cambodia at the district geographic level of analysis. The DHS data on maternal death rates identifies 96 individuals who have reported female family members of have died in child birth in 2005. The GPS coordinates correspond to specific villages. Because some villages report more than one cases of maternal death I have used graduated symbols to indicate the range of deaths reported at each geographic coordinate. In order to make these calculations I utilized the following tools: Select by location/attribute, buffer zones, proximity tools (near) as well geographic statistics and spatial analysis tools.

Analysis
Map 1 shows a sampling 96 individuals who reported having lost a female relative in childbirth in 2005. From this sampling we can see that the largest pockets of mortality occurred in the North East and Southwest of the country.

We can assume that a woman who is full term in her pregnancy (9 months) is at most capable of walking half a mile to reach a primary road where she theoretically could have access to a vehicle to take her to a proper hospital.
Map 2 identifies all of the "main roads" in Cambodia and has set up a .5 mile buffer around each stretch of road. The yellow triangles indicate the 13 mothers (14%) who were living within a walkable distance of the main road and yet still died. Map 2 also shows us the remaining 96 women (86%) who did not live with a walkable (.5 mile) distance from a main road, indicating that access to roads is a major indicator.
Map 3 identifies the 69 hospitals that the government of Cambodia has identified as certified professional medical facilities staffed by trained doctors. Using the statistics tool I determined that the average distance that women who died during child birth lived from the nearest hospital was 133 miles. The largest cluster of maternal deaths occurred in the North East of the country where the closest hospital is 314 miles away. From this map we can also see that the vast majority of hospitals in Cambodia are located in the South East of the country. This is also the area of the country with the largest number of individual incidents of maternal deaths. This shows that distance from hospitals is not the sole explanation of maternal death.
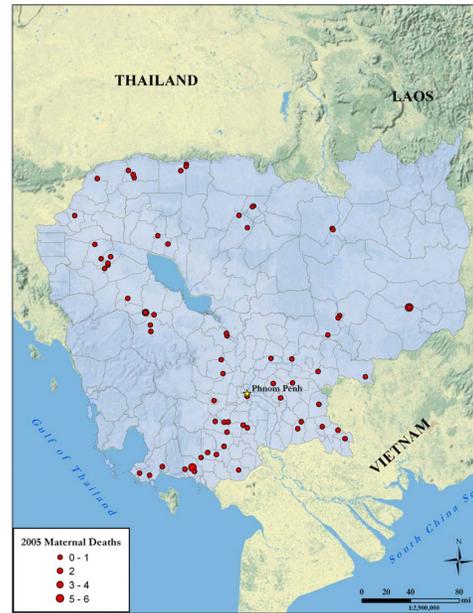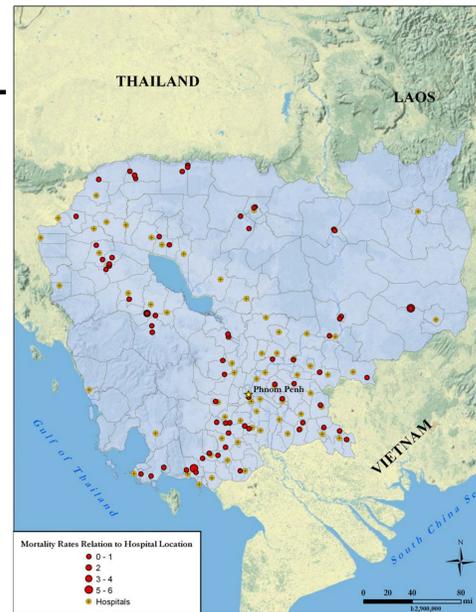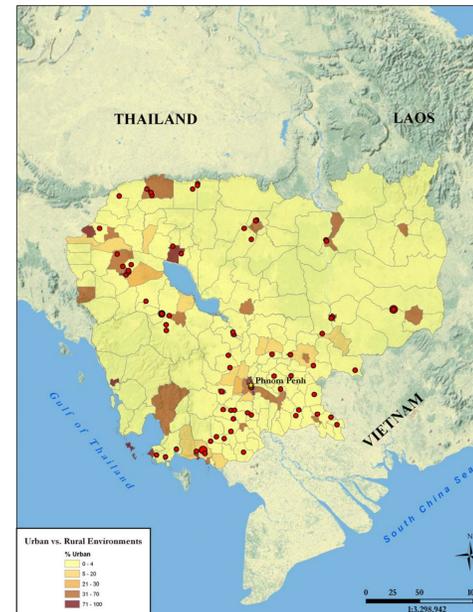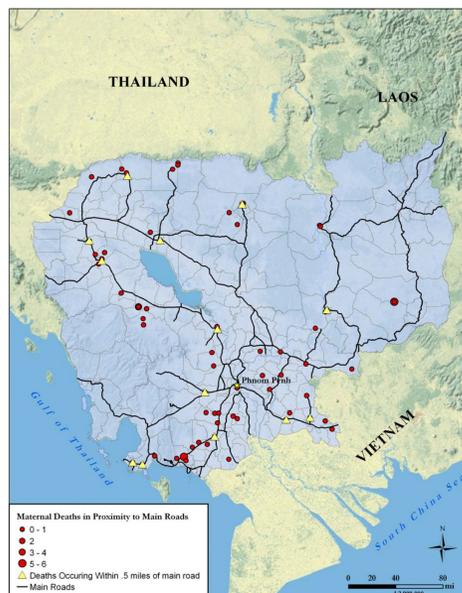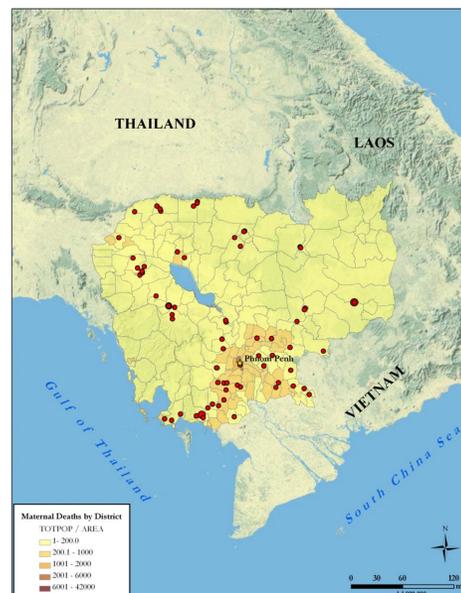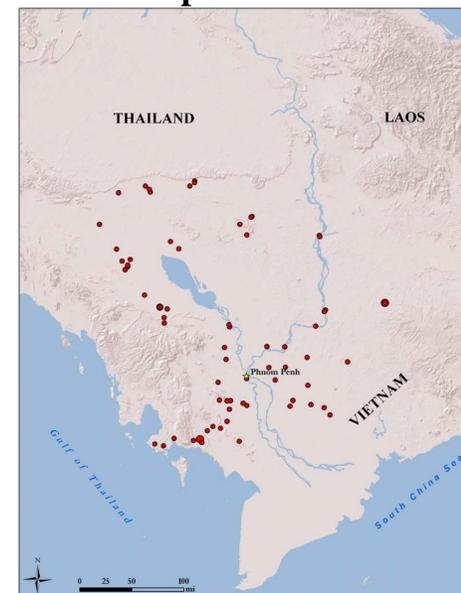
Map 4 examines the population density in Cambodia in square kilometers (total population/area). The densest population is not surprisingly in the southern area of the country surrounding the capital of Phnom Penh. This area also contains some of the largest clusters of maternal deaths, which on the surface is surprising since this is also the area of the country with the highest concentration of hospital (see map 3). The population density of the South and the findings contained in map 5 show that this area is urban and suggests that many of the people living in this area are slum dwellers who despite having access to medical facilities are not able to make use of them due to their low economic status which would explain the high incidents of maternal mortality.
Map 5 shows the areas of Cambodia that the government has identified as being urban. This map demonstrates that the majority of incidents of maternal mortality are occurring in rural areas, which is to be expected when looked at in conjunction with maps 2 and 3, which show that these are the same areas which lack access to roads and hospitals. There are however two areas shown in this map in the South and North West where there are clusters of infant mortality occurring in urban areas where there is access to roads and hospitals. The next map will seek to examine if there are any geographic indicators in these areas that would suggest an explanation for why these clusters exist in urban areas.
Map 6 is a shaded relief overlay which shows the terrain of Cambodia. While the majority of the country is low lands (0-20 meters), the South West of Cambodia contains rougher terrain. The cluster of maternal deaths in the Southwest of the country is on the surface perplexing because as the area is in proximity to three main roads and two hospitals and is not rural. However, by using the spatial analyst tool I discovered that the villages contained within this cluster of maternal deaths have an elevation of 234 meters. This data suggests that mothers in this area may not be capable of navigating this rougher terrain in order to walk down to a road or hospital.

Conclusions
This study has shown that there is no single geographic explanation for why clusters of maternal deaths occur in some areas of the country and not others. However, a combination of factors including (access to main roads and hospitals, population density, rural vs. urban living and level of elevation) come together to explain all of the highest incidents of maternal death. Proximity to major roads appears to be the most significant factor contributing to maternal mortality. Access to hospitals appears to be the second largest indicator of maternal death as the average woman reported to have died in child birth lived more than 100 miles from the nearest hospital.

Sources:
1. Measure DHS, "The 2005 Cambodia Demographic and Health Survey," March 2007
2. National Institute of Statistics of Cambodia, 2008 General Population Census of Cambodia

Map 1: 2005 Maternal Deaths

Map 2: Access to Main-Roads

Map 3: Access to Hospitals

Map 4: Population Density

Map 5: Urban vs. Rural

Map 6: Elevation

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