Exploring relationships between stunting and distance to health centers and commune capitals in Mali

Background and research question

Mali, located in West Africa, has some of the poorest nutrition and health indicators in the world. Approximately one in three children under the age of 5 are stunted, or too short for their age. Stunting impairs physical growth and cognitive development, and is associated with lower productivity. The government of Mali has made strong commitments to reverse these trends through a multi-sectoral approach. Access to basic services remains extremely low across Mali—a vast country where populations are spread over large distances—and might be a key contributing factor to malnutrition. Research using UNICEF's Conceptual Framework of Malnutrition shows that poor food security and an inadequate health environment are among the leading drivers of undernutrition in Mali.

Figure 1: Location of Mali in West Africa

Following a coup d'état in 2012, a low-intensity conflict has been ongoing in northern Mali. Data are extremely limited for these areas and the final analysis phase of this project will focus on the 5 southern regions of Mali, and the capital, Bamako.

My main research question is: Is geographic access to health centers and commune capitals correlated with stunting? I consider stunting prevalence from the Demographic and Health Survey (DHS) conducted in the southern regions of Mali in 2012-2013. This can help inform future strategies and potentially influence how nutrition interventions are designed through a multi-sectoral approach. At health centers, people access healthcare services provided by the Government of Mali. Commune centers ("Chef Lieu de Commune" in French) are the administrative headquarters for the commune, where there are weekly markets. In the context of this project, I define access in terms of geographic proximity.

Methodology

Part 1 uses the Euclidean Distance tool to create raster datasets showing distances to health centers and commune capitals. The Ministry of Health in Mali defines "adequate geographic access" to health centers and other public services as <10 km. Part 2 explores correlation between the prevalence of stunting among children under 5 years as shown by DHS data and distances to health centers and commune capitals. I use the Sample tool in ArcMap to create a table that combines the average distances with the DHS stunting data. The analysis is limited to the southern regions because nutrition data are not available for northern Mali. The final result shows scatter plots .

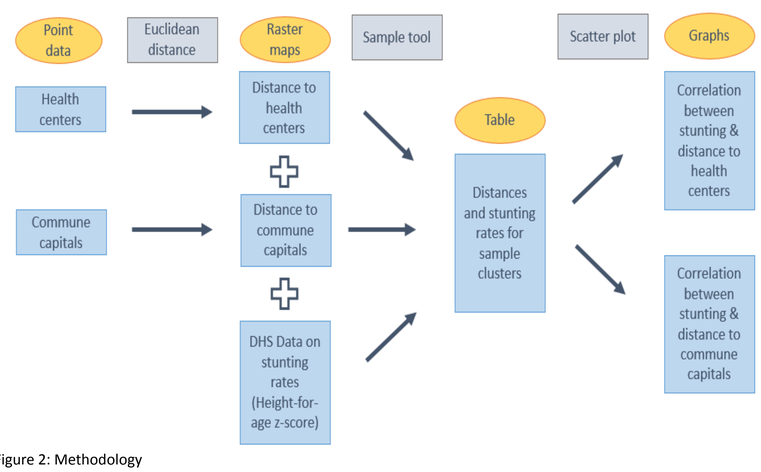


Figure 2: Methodology

Data sources

Administrative boundaries: Direction Nationale des Collectivités Territoriales (DNCT), 2012

Health center data: UN OCHA - Mali Country Office, November 2014 (Many thanks to my colleague, Guido Pizzini at OCHA for sharing these data)

Commune center data: Government of Mali, downloaded from Humanitarian Response website, 2012 data available from UN OCHA - Mali Country Office, November 2014

Stunting data: DHS-VI for Mali, 2012-2013

Results

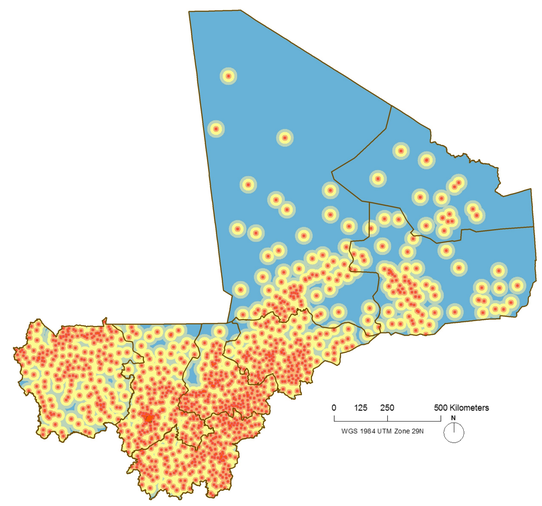
Part 1: The two maps showing distance to health centers and commune capitals reflect the variability that exists across Mali. These distances are enormous — the majority of the population is extremely poor and live in rural areas. Poor access in the northern parts of the country is striking. The average distance to health centers and commune capitals is > 10km for 28 and 43 out of the 50 districts, respectively. Table 1 summarizes the average distance by region. The average distance in the southern regions of Sikasso, Kayes, Koulikoro, Mopti is close to 10 km, access in the northern regions of Gao, Kidal and Tombouctou is extremely constrained.

Region	Distance to health center (Km)	Distance to commune capital (Km)
Bamako	1	5
Gao	32	25
Kayes	11	12
Kidal	58	33
Koulikoro	11	12
Mopti	10	11
Segou	10	11
Sikasso	8	10
Tombouctou	41	33
National average	**18**	**16**

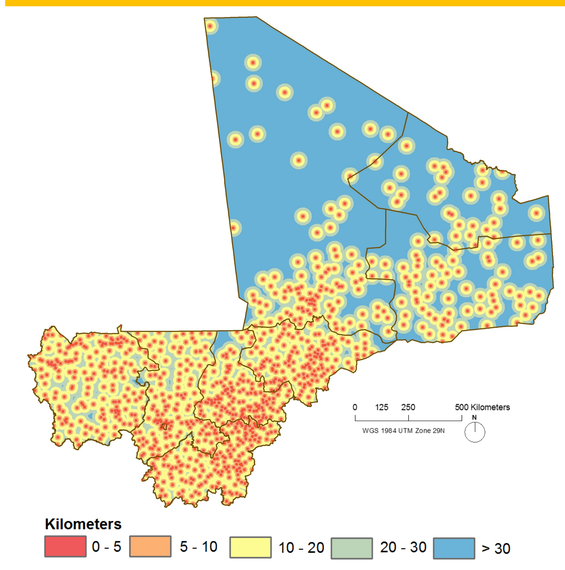
Table 1: Average distance by region

Part 2: The graphs (figure 3 and 4) show the correlation between distances and stunting for southern Mali. The scatter points represent height-for-age z-scores for DHS cluster points . For the regions of Mopti, Segou and Kayes there are high rates of stunting and larger distances to health centers and commune capitals. For the regions of Sikasso and Koulikoro distances seem to be lower, but stunting remains prevalent. Therefore, further investigation is needed to better understand what is driving high rates of stunting in these two regions of the country. Lastly, for the capital city of Bamako, stunting rates and distances are both relatively low.

Distance to health centers



Distance to commune capitals



Limitations and recommendations

Inaccuracies in the data showing the location of commune capitals and health center data are a potential source of weakness. Geographic proximity to a health center or weekly markets at the commune capital only captures the geographic dimension of access. Families may face economic barriers to access these services, including paying for transport to reach markets or health centers. While the DHS is designed to be representative at the national and regional level, the sampling methodology should be taken into consideration when evaluating the overall strength of the model. The model only explores correlations between *geographic* access, and cannot make any claims about causality. There are multiple and complex factors that contribute to stunting, ranging from sub-optimal breastfeeding to poor sanitation and inadequate access to clean water.

In terms of recommendations, this model needs to be triangulated with measures of economic access to services, as well as quality of these services. This may be difficult considering the limited data on the "quality" of health services. However, GIS may not be the best tool to use if the definition of access is broadened to include these other aspects. In addition, the model could be improved by considering the quality of roads on which populations rely to access health centers and other services. Lastly, geographic access to health centers and commune capitals is relatively more constrained in the northern regions of Mali. However, I was unable to find data on stunting for these regions. Therefore, exploring how this relationship plays out in the north, where stunting rates have been historically high and distances are very large, would be an important next step.

Figure 3: Relationship between stunting and distance to health centers

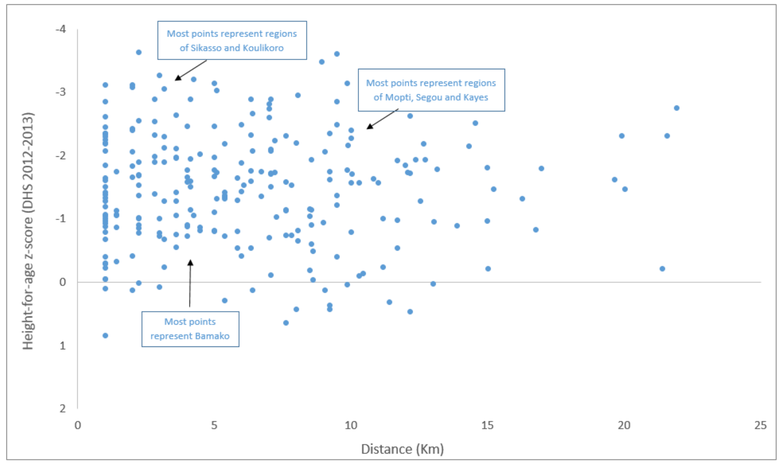
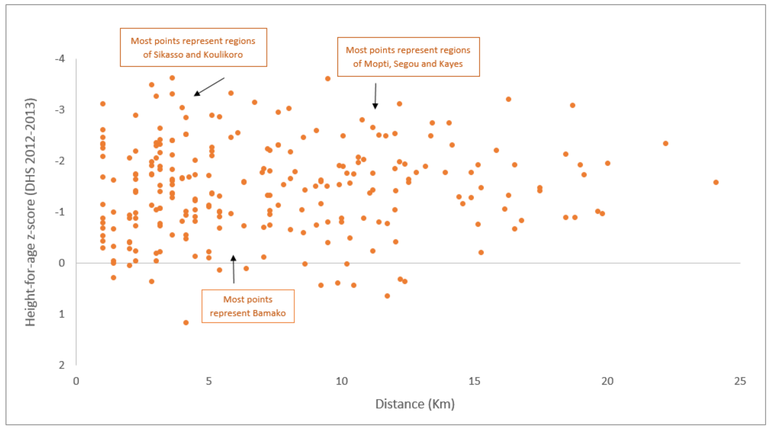


Figure 4: Relationship between stunting and distance to commune capitals



Note on graphs: Stunting is measured using a child's height relative to his/her age. Stunting is defined as having a height-for-age more than two standard deviations below the median of the NCHS/WHO growth reference (WHO, 1995).

References:

1.UNICEF Statistics for Mali. Updated December 2013. Available from: http://www.unicef.org/infobycountry/mali_statistics.html

2. UNICEF Conceptual Framework for Malnutrition. 1990. Available from: www.unicef.org

3. Guenther et al. Beyond Distance: An Approach to Measure Effective Access to Case Management for Sick Children in Africa. *The American Journal of Tropical Medicine and Hygiene*, 2012 vol. 87 no. pp: 77-84

4. The Demographic and Health Surveys. Available from: http://www.dhsprogram.com/

Projected coordinate system: WGS 1984 UTM Zone 29

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Cartographer: Janeen Madan, NUTR 231: Introduction to GIS, December 2014