Walkability in the “Green City in the Sun”: A Network Analysis of Nairobi

Background

Nairobi is the capital city (and largest) of Kenya. Popularity known as the “Green City in the Sun,” Nairobi is one of the most rapidly urbanizing cities in East Africa. With a population currently at 3.1 million according to the 2009 National Census of Kenya, the population growth rate is 3 percent per year. While the Nairobi Metro 2030 master plan aims to transform Nairobi into a “global, world-class metropolis” by 2030, the city faces many challenges to becoming a more livable city. With over 60% of Nairobi’s residents living in slums, infrastructure such as access to clean water and sanitation, health services, public transit, and police and fire stations can be included in measures of walkability.

What is Walkability?

Walkability is “a measure of the effectiveness of community design in promoting walking and bicycling as alternatives to driving cars to reach shopping, schools, and other common destinations,” according to ESRI.[1] Promoting more walkable communities reinforces accessibility to services and enhances sustainability.

Key questions:

- Which wards of Nairobi City are the most walkable?
- The least walkable?
- What percentage of the population lives in the least walkable areas? Highest walkable areas?

Methods

Determining a walkability score requires creating service areas of relevant walking distances to destinations.

Step 1: 15 destinations were selected to be factors in the network analysis. I determined relevant walking distances (400 or 800 meters) to these facilities and chose to do a weighted network analysis and an un-weighted analysis. For the weighted analysis, I assigned different weights to each destination based on importance and knowledge of Nairobi (see table at right lower). I grouped certain destinations together, such as health and financial services.

Step 2: A network dataset was created in ArcCatalog, based on Nairobi’s roads from a 2005 dataset.

Step 3: Nairobi City was used as the background raster (all cells = 0) and served as the snap raster for the analysis. Each raster grid cell size is 20 meters. The extent was Nairobi City level wards.

Step 4: Using Network Analyst tools, a service area was created for each destination, with a walking distance of either 400 m (1/4 mile) or 800 m (1/2 mile) from a road. In the polygon generation tab, I merged the buffers by break value into one polygon for each service type (Holbrow Method, 2010). All polygons were converted to raster cells.

Step 5: All service area raster cells were reclassified with values of 1 and 0. NoData = 0, and everything within the service area polygons received a value of 1.

Step 6: Using the raster calculator in Spatial Analyst toolbar, all the raster layers were added up for each of the service area destinations to create a walkability raster service area based on 5 classifications. I conducted an un-weighted analysis first, and then a weighted analysis of all 15 destinations that added up to 1. The weighted analysis is shown at top center.

Step 7: Using Zonal Statistics as Table Tool, I calculated the mean walkability of raster cells within each ward.

Step 8: The mean walkability scores were then calculated for Nairobi’s 2009 Census population data by wards, and percentages were calculated for those wards in non-walkable to highly walkable areas.

Results

Over 2/3rds of Nairobi’s population lives in either non-walkable (24.37%) or low walkable areas (40.74%). The ward with the highest walkability score is Mabatini, located in Kibera slum (100). The ward with the lowest walkability score is Ruse (10), in the northern part of Nairobi City. The mean score of walkability for Nairobi’s population among all 84 wards is 16.9, which is classified as a “medium” walkability score. Other highly walkable wards include the Nairobi Central Business District, and well-known informal settlement areas (slum) wards of Kibera, Mathare Valley, and Mukuru. This is a result of the fact that projects such as MapKibera Trust have used participatory GIS to map hundreds of amenities (re: “destinations” in this map) in informal settlement areas in Nairobi to demonstrate the need for basic infrastructure and urban service delivery. The differences in livability and walkability are demonstrated in the two photographs at left. While the living conditions in informal settlement areas are drastically lower, the “walkability” of these areas also demonstrates the reason why many are caught in a “high-price, low-quality” trap in Nairobi’s slum areas, because of the need to access certain services.[2] There appears to be wide coverage for matatu bus stops, but the points demonstrate a high density of matatu stops near the Nairobi Central Business District, an area where there is tremendous traffic congestion.

Limitations

While OSM is a powerful tool, in some ways Nairobi’s road data has been over mapped as compared to other parts of Nairobi City. This skewed some of the point data items of service availability. The points also did not demonstrate the quality of the services provided (ex. health services or education). Further, while 2009 Census Data is available for population by ward, there are no recent sub-location and location administrative boundaries available for Nairobi that can be paired with the 2009 Census. Mapping the walkability by census sub-location would be more accurate in detail than by ward.

Conclusion

As Nairobi aims to transform its infrastructure and construct more bypass highways by 2030, the walkability of slum areas raises the question of whether more urban infrastructure for sanitation, fire stations, and transit stops will reduce or increase the walkability of Nairobi’s wards.

References:


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