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Technical Note

Mapping of Poultry Hotspots in Tanzania

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OVERVIEW

To support the strategic planning of the next phase of Africa Chicken Genetic Gains (ACGG) program, IFPRI's Spatial Data and Analytics Theme analyzed geospatial data layers in Tanzania to identify its poultry business hotspots, where the market opportunities and production potentials best align. A location-specific composite index was developed by combining four spatially-explicit data layers that represent the spatial patterns of agro-ecological conditions, feed availability, market accessibility, and population density on 10 km grids across the country. The index was analyzed using the Getis-Ord hotspot mapping algorithm to highlight the extent of hotspots and identify twelve hotspot locations (i.e., hotspots) in nine regions, where the confidence level exceeded 90%. Kimandolu Ward in Arusha Region was analyzed as the ideal location where all four aspects considered in this analysis aligned the best, followed by seven locations were identified within the Southern Highlands area, three locations along the coast of Lake Victoria, and one in Kilimanjaro. This methodology can be further refined and applied in additional countries in the next phase.

METHODOLOGY

Data

All geospatial data layers were harmonized on five arc-minute (about 10 km) resolution grids over the land area of Tanzania.

1. *Feed availability*: Ample local production capacity of chicken feeds is assumed as one of the key requirements for a profitable poultry business. Spatially-disaggregated (10 km grids) subnational production statistics for three crops (maize, rice, and soybean), which are commonly used for chicken feeds, were retrieved from IFPRI's MapSPAM 2010 database. These data layers were then normalized for each crop and averaged with equal weight. Figure 1A shows the spatial distribution of this data layer, where red color shows higher feed production capacity. White areas indicate no local production of these feed crops available, implying additional costs of transporting feed materials would incur, thus may not be suitable.

2. *Climate suitability*: Assuming the poultry business is not necessarily equipped for an indoor climate control system and reliable supply of electricity, we identified areas where daily weather

conditions are comfortable for chickens with no additional indoor climate adjustments. Daily temperature and relative humidity data for each grid cell for the year of 2017 were retrieved from the aWhere Weather Database (https://developer.awhere.com) and used to compute the location-specific Temperature-Humidity Index (THI) for each day using the empirical equation developed by Moraes et al. (2008). From this, the number of days that chickens were comfortable (i.e., THI ≤ 72%) were counted for each grid cell, converted into a ratio (e.g., 1 = comfortable weather throughout the year), and compared across space. Figure 1B shows the result, where the areas with dark red color indicate the most suitable agro-climatic conditions for chickens, whereas pale yellow color indicates the areas where chickens would be stressed due to high temperature and humidity, necessitating indoor climate conditioning. Only the areas with the comfortable weather conditions prevailing at least half of the year (more than six months) were considered suitable.

3. *Market opportunity*: High-resolution population density data retrieved from the LandScan 2017 (https://landscan.ornl.gov) was used as a proxy for the market opportunity and accessibility. Figure 1C shows the spatial pattern of population density and distribution across Tanzania, where red areas indicate higher population density, thus are assumed to have the higher market opportunity.

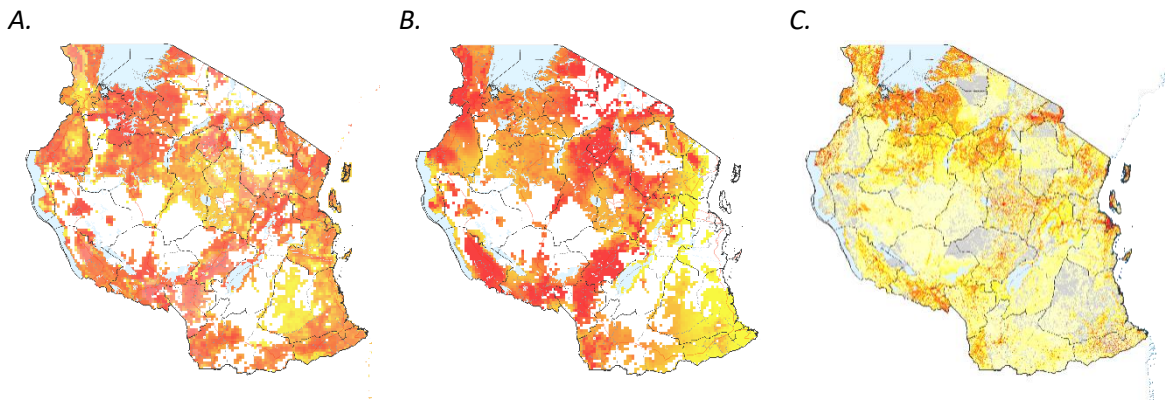

Figure 1 Geospatial data layers used to compose the poultry business hotspot index, including A) production capacity of maize, soybean, and rice as the proxy for feed availability, B) percentage of days in 2017 with comfortable weather conditions for chicken as the proxy for agro-ecological suitability, and C) population density as the proxy for market potential.

RESULTS

Composite Index for Poultry Suitability

Data layers for the feed availability, climate suitability, and market opportunity were first standardized at five arc-minute resolution (10 km), then normalized, and finally aggregated to create a composite index across Tanzania, as shown in Figure 2. Areas with red color indicate higher suitability (i.e., the higher capacity of locally produced feeds, comfortable weather conditions for chickens, and higher market opportunity). Whereas, the no data areas (white) are due to the unsuitable conditions based on no locally produced feeds, unsuitable climatic conditions, and the absence of sizeable market opportunities.

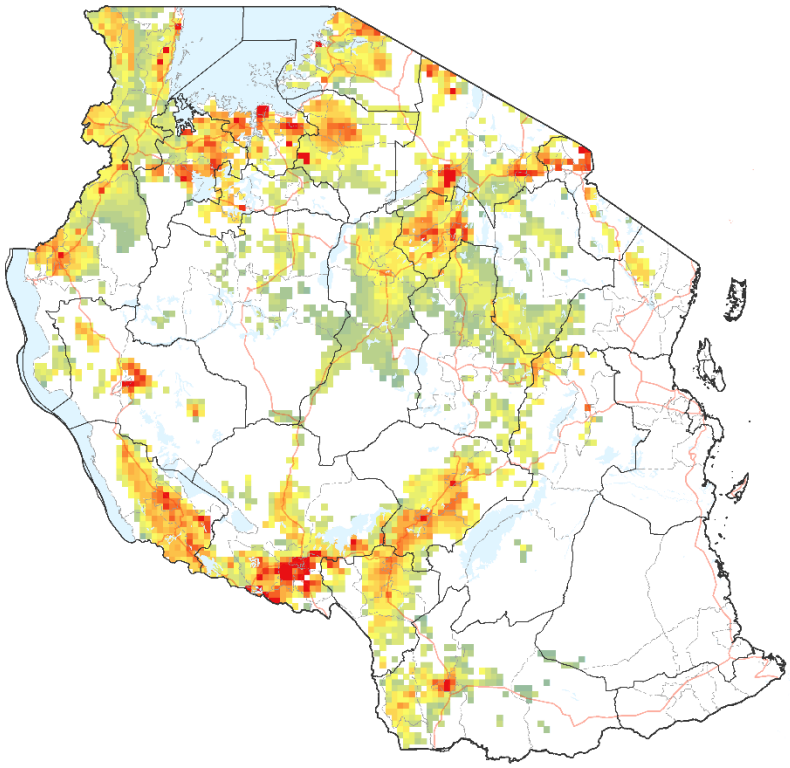

Figure 2 Visualizing the Composite Index for Poultry Suitability values across Tanzania.

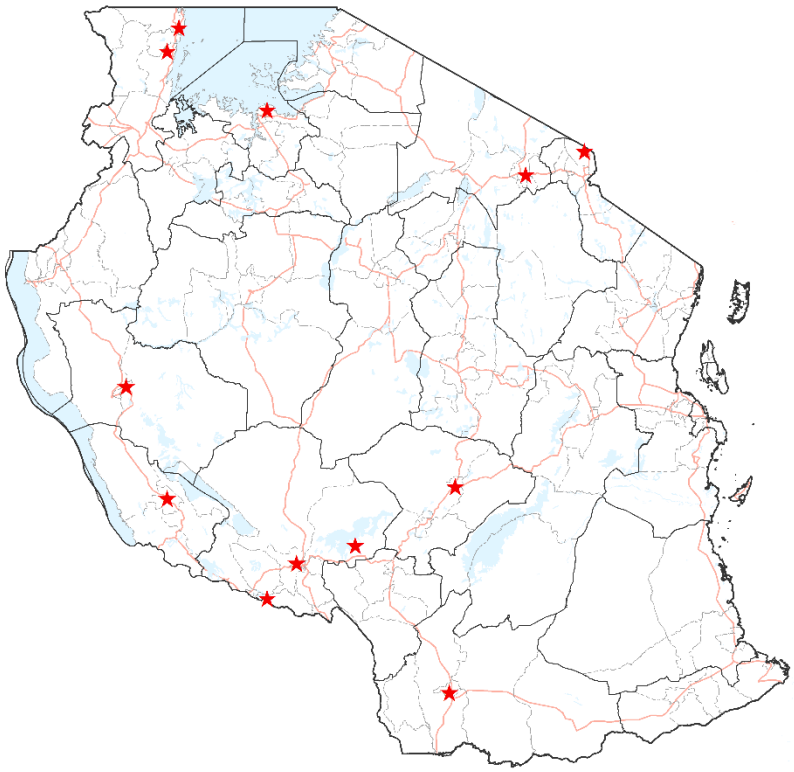

Figure 3 Twelve hotspot locations identified by applying the Getis-Ord algorithm.

The spatial patterns shown in the composite suitability index data were geo-statistically analyzed the Getis-Ord hotspot mapping algorithm (Getis and Ord, 1996), implemented in ArcMap v10.5 (https://goo.gl/4tdoKZ). This algorithm calculates the z-scores and p-values for each location (5 arc-minute grid cell in this case) and identifies the areas where the clustering of high values is statistically significant. The analysis output (Figure 3) identified twelve hotspot locations across nine regions. Figure 4 lists the administrative unit names of twelve hotspot sites identified in this study.

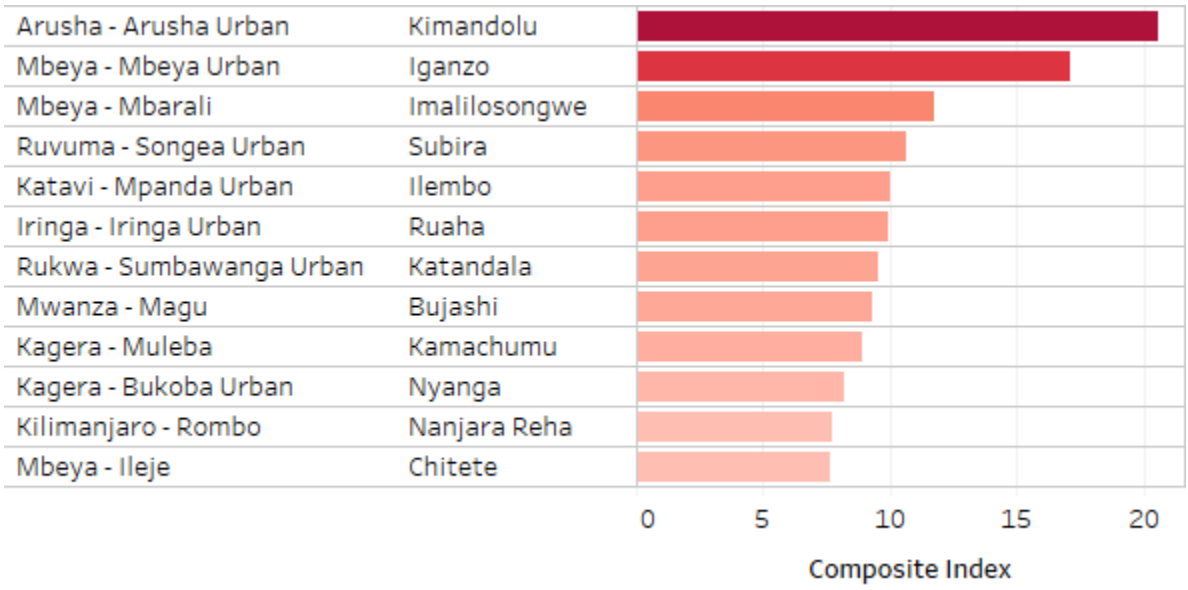

Figure 4 List of twelve hotspots identified in this analysis and their administrative units

The best hotspot with the highest score was Kimandolu Ward in Arusha. This area scored high in all three dimensions. Nanjara Reha Ward in Kilimanjaro in the area also scored highly. Half of the hotspot locations were in the Southern Highlands area (6; Mbeya, Ruvuma, Rukwa, and Iringa), where the feed production availability is relatively high, and the climate conditions are favorable. Three locations around the coast of Lake Victoria (two in Kagera and one in Mwanza) were also identified, as their relatively high population density (market opportunity) and favorable climatic conditions.

REFERENCES

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