USE OF GRIDDED POPULATION DATA FOR THE CITY OF NDOLA INTEGRATED DEVELOPMENT PLAN **IN ZAMBIA**

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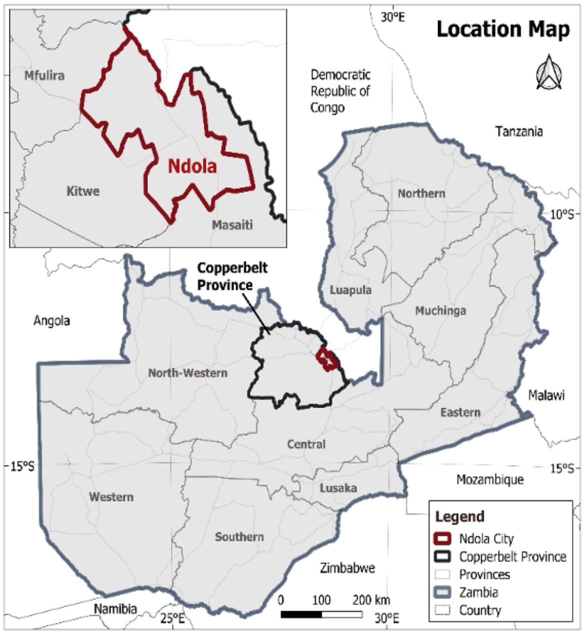
OVERVIEW OF PLANNING PROCESSES IN ZAMBIA

This use case is for Ndola, a city in the Copperbelt Province of Zambia. Ndola was selected to use GRID3 gridded population data to enhance the preparation of an integrated development plan (IDP). The city's integrated development planning process is guided by the National Development Plans (NDPs) to steer Zambia's development agenda in the next five years. The national development plans are also aligned with Zambia's long-term plan, Vision 2030, whose main aspiration is to make Zambia a middle-income country by 2030 (Vision 2030, 2006). Each district, town, or city in the country prepared its own five-year Integrated Development Plan that provides guidance to spatial and socioeconomic development at the local level. IDPs further inform decisions about developmental projects to be implemented, their management, and budgeting as provided for in the Urban and Regional Planning Act No. 3 of 2015. Based on this planning process, Ndola, the provincial headquarters for the Copperbelt Province and the third largest city in Zambia, used gridded population data to aid its planning. Specifically, Ndola's city government used the gridded population data from GRID3 to enhance planning for education and health services in the peripheral areas of the city where newer settlements are located. Ndola covers approximately 110,300 hectares of land with a population of more than 624,579 (Census of Population and Housing, 2022). It is located in the Ndola District, which is surrounded by the Kitwe, Mufulira, and Masaiti districts and the Democratic Republic of Congo in the northeast, as shown in Figure 1.

Figure 1: **Ndola District Location Map**



OVERVIEW OF GRIDDED POPULATION DATA USED

Over the last two decades, massive increases in computing power and the availability of high-resolution Earth observation and open geospatial data have fueled the development of gridded population estimates. These modeled population maps are typically described in terms of their general approach (top-down vs bottom-up), modeling technique (highly, lightly, and unmodeled), and output resolution (Leyk, et al., 2019).

This analysis was based on a bottom-up highly modeled gridded population dataset produced in collaboration with WorldPop to represent the 2020 population in 100x100m grid cells (WorldPop, 2020; Boo et al., 2022). These gridded population estimates were operational and not official government statistics based on three input sources of population data from the Zambia Statistics Agency (ZamStats): (1) Pre-census pilot mapping exercise (2019), (2) Livestock and aquaculture census survey (2018), and (3) Saving Mothers, Giving Life survey (2017). In addition to the surveys listed, building footprint data (extracted from satellite imagery predominantly from 2017 to 2019), settlement polygons, district boundaries, provinces, and forests were used as covariates when estimating the gridded population using the Bayesian regression-based model. The Bayesian models were validated to check for overfitting, and information on the level of uncertainty was generated and attached to the gridded population data raster layer. More information on this methodology can be found in WorldPop (2020) and Dooley et al. (2021). The data can be downloaded from the **WorldPop Repository** and explored on the **WoprVision web application**.

APPLICATION OF GRIDDED POPULATION DATA TO UNDERSTAND AND ADDRESS SERVICE GAPS

Ndola used gridded population data to analyze education and health sector coverage gaps and prepare their IDP before the 2022 census data were fully collected and processed. The gridded population dataset was used to identify populations that did not have physical access to schools and/or health facilities within 5 km of their residence. Analyses were performed in QGIS using 5-km buffers and calculating raster layer (population) statistics. This service gap information was used to plan locations for new schools or health facilities to fill the service-coverage gaps.

Specifically, the IDP Team found that 9,433 (1.8%) school-aged children in Ndola District live beyond 5 km from a school, mainly in the rapidly growing peri-urban informal area of Dag Hammarskjold. Furthermore, 19,669 (4.1%) of adults lived more than 5 km from a health facility, mainly in Dag Hammarskjöld and another peri-urban informal area called Munkulungwe. This evidence guided conversations about how new facilities were needed and where they should be located to reach nearly all of the people in Ndola District. Since this analysis, the Ndola City Council has proposed budget allocations to fund two new schools and three new health facilities in Dag Hammarskjöld Ward and one new health facility in Munkulungwe Ward. Assuming these projects are able to move forward, nearly everyone in the Ndola District is expected to live within 5 km of these essential education and health services within a few years, increasing levels of literacy and improving key health outcomes (Figure 2. Theory of Change).

Figure 2: **Theory of Change**

Inputs	Activities	Outputs	Outcomes	Impacts
Data: Gridded population, schools, roads, settlement and admin boundaries **Tools**: GIS **Time**: Urban planner, education planners, community	Education gap analysis Physical accessibility	**IDP Report:** 9,433 (1.8%) school-aged children in Ndola District do not have access to a school within 5 kilometres Most of these children live in Dag Hammarskjöld, a rapidly growing peri-urban formal area	Ndola City Council proposal and budget allocation for two new schools in Dag Hammarskjöld Ward	Nearly all (99.7%) of school-aged children can physically access primary school Implementing Zambia's 8NDP human development Piller 3 of No One Left Behind Increase level of literacy

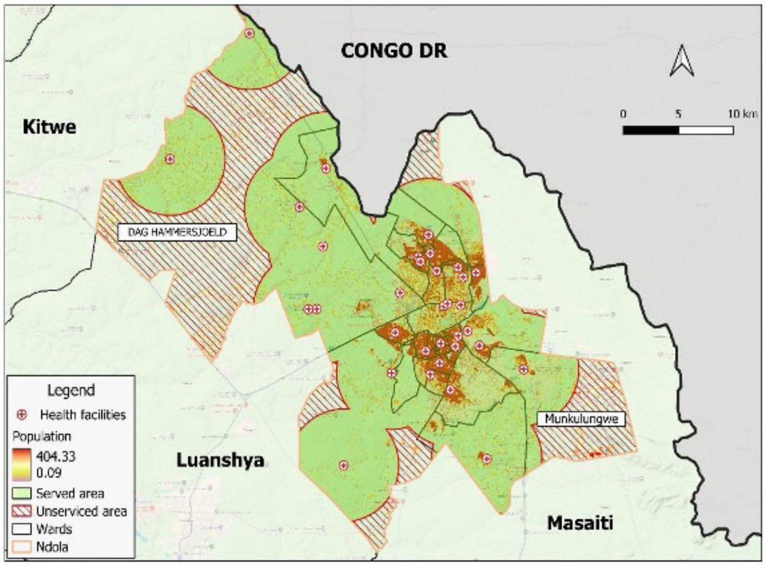
Inputs	Activities	Outputs	Outcomes	Impacts
Data: Gridded population, Health facilities, roads, settlement andadmin boundaries **Tools**: GIS **Time**: Urban planner, Education planner, community	Health facilities gap analysis Physical accessibility	**IDP Report**: 19,669 (4.11%) of the total adult population in Ndola District are not within the 5-km radius of a health facility Most live in Dag Hammarskjöld Ward and the Munkulungwe Ward, two rapidly growing peri-urban informal areas	Four health centers are to be built, with three in the Dag Hammarskjöld Ward and one in the Munkulungwe Ward, according to the Ndola City IDP proposal and budget allocation	Nearly 99.7% of people in the district have physical access to health facilities, which is essential to the implementation of Zambia's HIV/AIDS policy known as the "90-90-90 Strategy" Improved people's health

POTENTIAL POSITIVE IMPACTS

By employing gridded population estimates and related GIS datasets, the city of Ndola was able to make data-driven informed decisions regarding the allocation of resources for the construction of two (2) new primary schools and four (4) new health facilities. This will ensure equitable access to essential services, such as education and health services, especially for peri-urban areas that were developed without the corresponding services provided. This is in line with the Zambian government's commitment themed "No One Left Behind" policy outlined in the 8th National Development Plan. The Ndola City Council devised plans to establish two schools in the city. Previously, new services were planned with limited consideration of the detailed spatial distribution of both population and existing services, population density, and existing service catchments.

The use of gridded population data has enhanced the typical planning process that has previously been used in preparation of IDP by providing more detailed (100m x100m) spatial distribution of population patterns and population density to enhance the determination of service-coverage gaps and ways of filling those gaps. It is especially possible that vulnerable people — particularly those who live in rural and peri-urban areas that usually lack access to basic services such as health and education — can be identified and included. For instance, in this use case, gridded population data helped identify the population (4.11% or 19,669 individuals) in peripheral areas of Dag Hammersjköld Ward who lived more than 5 km from the nearest health center, as shown in Figure 3. This information guided the decision-making process in determining the number and location of health facilities to ensure the equal provision of services. Gridded population data assists the IDP planning team in identifying areas of priority, making resource allocation easier to meet the needs of people in those areas, and ensuring that no one is left behind.

Figure 3: **Gap Analysis for Health Service in Ndola District**



NEGATIVES OF USING GRIDDED POPULATION DATA

The benefit above has shown that using estimated gridded population data is a valuable dataset for IDP planning in Zambia. However, gridded population datasets are not yet fully accepted for planning in Zambia and are mostly used for spatial analysis in IDP preparation. This is because the use of gridded population data is a new approach and is not yet aligned with the existing population data-sharing law (Statistics Act No.13 of 2018 of Laws of Zambia). Apart from this gridded population data acceptance challenge, the use of gridded population estimates in planning has some limitations when populations are excluded or under-represented. For the case of Zambia, gridded population data were modeled based on available sampled data. The challenge was that not all places in Zambia were equally sampled; some areas were poorly sampled because they did not have existing information to be used to develop the gridded population estimates. In other areas, especially industrial areas, population numbers were assigned to uninhabited buildings, exaggerating the population in these areas. Conversely, newly expanded areas after the sample dates that were not detected on the high-resolution satellite imagery would have also been missed. Thus, planners should be mindful of these potential biases when using gridded population data to identify underserved populations and plan improved services.

REFERENCES

Central Statistics Office (2012) "2010 Census of Population and Housing: Volume 11 National Descriptive Tables 2010," pp. 1–406. Available at: **http://www.zamstats.gov.zm** (Accessed: 28 July 2022).

Leyk, S.; Gaughan, A.E.; Adamo, S.B.; de Sherbinin, A.; Balk, D.; Freire, S.; Rose, A.; Stevens, F.R.; Blankespoor, B.; Frye, C.; et al. Allocating people to pixels: A review of large-scale gridded population data products and their fitness for use. Earth Syst. Sci. Data Discuss. 2019, 11, 1385–1409.

Ministry of National Planning (2006) "Vision 2030: 'A prosperous Middle-income Nation By 2030' "', (December), pp. vi–35.

National Assembly (2015) The Urban and Regional Planning Act No. 3 of 2015 (3).

Preliminary Report: 2022 Census of Population and Housing, ZamStats.