

# Measuring Local Inequality: Insights from Data on Night Lights

March 2020 – No. 33 | UE-AFD Research Facility on Inequalities

### PITCH

Data on human emissions of light at night – as detected by satellites – provide valuable insights into the extent of inequality at the local level. New research uses the latest generation of night lights data to measure inequality in the immediate surroundings of people living in 30 countries in sub-Saharan Africa, and to explore how that relates to their attitudes towards government policies such as taxation.

The use of night lights data also has the advantage of measuring dimensions of inequality other than income or wealth. It makes it possible to focus on inequality in the provision of public goods such as electricity, healthcare, and education.

### MOTIVATION

A growing body of evidence suggests that individuals have potentially significant misperceptions of inequality beyond their own very local level (McGregor et al, 2019). Using night lights data helps to mitigate this problem, making it possible to measure inequality in citizens' immediate surroundings, a level at

which there is no alternative source of information.

Inequality across different sub-national levels of geographical areas can be measured by constructing a Gini index based on night lights per capita. Thanks to their high resolution, data on night lights provide a solution to the need for 'location-specific' indicators (Bruederle and Hodler, 2018)<sup>1</sup>, allowing local measurements of wellbeing. This is of particular value in the context of African countries where the lack of disaggregated data hinders granular studies.

The fine resolution of night lights data makes it possible to distinguish between observed inequality in the immediate surroundings of an individual and inequality in larger regions, and to investigate the extent of spatial distribution of public goods such as electricity infrastructure.

The focus on inequality at sub-national levels is motivated by the view that such disaggregation may be more relevant than the national scale since individuals' perceptions of inequality are more likely to be accurate in their surrounding environment based on day-to-day

observations (Newman, 2015)<sup>2</sup>. Hence, more local measures of inequality at the sub-national level offer a better reflection of perceived inequality from an individual standpoint.

Yet despite the recent surge in using light inequality in economic research, its conceptualization remains challenging. Most studies consider light inequality equivalent to wealth or income inequality. But early studies of light inequality show a moderate correlation at best with traditional income Gini measures, despite a strong correlation with GDP per capita (Elvidge et al, 2012)<sup>3</sup>. In the sample in this study, there is a (statistically significant) 0.63 correlation between light inequality and Gini at the country level (using the World Income Inequality Database).

Light inequality is a better, though narrower, reflection of inequality in public good provision – that is, access to electricity, healthcare, and schooling – than the traditional income inequality used in previous research.

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**Geography** Sub-Saharan Africa

**Find out more about this project:** <https://www.afd.fr/en/carte-des-projets/understanding-role-taxation-fight-against-inequalities>

**Key words** Inequality, night lights, attitudes towards taxation

**Themes** Inequality – Public finance

## METHODS

There is significant evidence that light intensity is an accurate proxy for development at national and sub-national levels (Henderson et al, 2012)<sup>4</sup>.

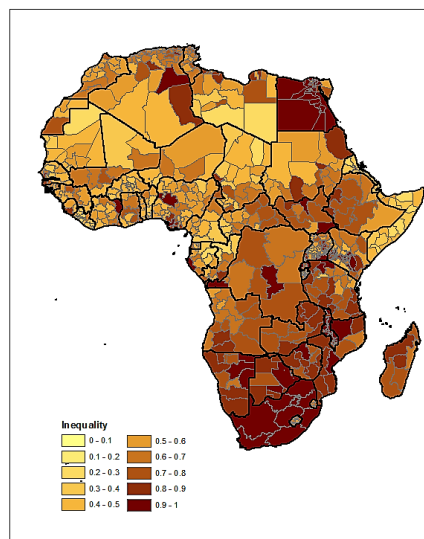
In this study, inequality is measured using the latest generation of night lights data: Visible Infrared Imaging Radiometer Suite (VIIRS). The main advantage of the new set of night lights data compared with the previous generation (DMSP-OLS) is absence of top-coding and higher resolutions, which makes them better suited for constructing an inequality measure. Recent studies show that VIIRS predicts development better than the previous set (Gibson et al, 2019)<sup>5</sup>. In the sample in this study, country light per capita has a correlation coefficient of 0.88 with GDP per capita at PPP constant dollar (statistically significant at the 1% level). To compute light inequality, the researchers first retrieve the latitude

and longitude of each enumeration area from the sixth round of Afrobarometer surveys (conducted in 2014/15) to geolocalize each respondent (in 30 sub-Saharan countries) and further create a buffer

zone around each individual for different radii (20, 30, 40, 50, 60, 70 kilometers).

They then impose a 1km-by-1km fishnet on the night lights data and extract the value of light for each pixel within the buffer zone. They further divide it by population from the Gridded Population of World, leading to a measure of light per capita at the 1km-by-1km pixel-level, which makes it possible to compute light Gini coefficients for each buffer zone in each country using the classic Gini formula. The study then matches every individual to their corresponding zones, which enables analysis of the impact of local inequality on individuals' attitudes.

Figure 1. Light Inequality at First Administrative Division



Source : Authors' computations

## RESULTS

Figure 1 displays the Gini index computed at the ADMI level and shows within-country heterogeneity in levels of inequality.

## RECOMMENDATION

- ▶ Neglecting local indicators could result in a mismatch between the level at which public policy is implemented and the perceived benefits of the policy by individuals. This could hamper local support for a policy that is particularly important in domestic resource mobilization.

<sup>1</sup> Bruederle, A., and Hodler, R. (2018). Nighttime lights as a proxy for human development at the local level. *PloS one*, 13(9).

<sup>2</sup> Newman, B. J., Johnston, C. D., and Lown, P. L. (2015). False consciousness or class awareness? Local income inequality, personal economic position, and belief in American meritocracy. *American Journal of Political Science*, 59(2):326–340.

<sup>3</sup> Elvidge, C. D., Baugh, K. E., Anderson, S. J., Sutton, P. C., and Ghosh, T. (2012). The night light development index (nldi): a spatially explicit measure of human development from satellite data. *Social Geography*, 7(1):23–35.

<sup>4</sup> Henderson, J. V., Storeygard, A., and Weil, D. N. (2012). Measuring economic growth from outer space. *American economic review*, 102(2):994–1028.

<sup>5</sup> Gibson, J., Olivia, S., Boe-Gibson, G., et al (2019). A test of DMSP and VIIRS night lights data for estimating GDP and spatial inequality for rural and urban areas. Technical report.