

INSIGHT

# Night Light Data: An Innovative Way to Track Development



Nighttime lights can approximate some socioeconomic indicators when no other reliable data exist. Photo: ADB.  
*Statisticians use satellite images of Earth's night lights to measure social and economic activity.*

## Introduction

Nighttime lights are much more than decoration – they provide data that can help determine socioeconomic indicators when no other reliable information exists for instance in parts of developing Asia where economic accounting systems are weak, or when satellite images are more frequently available than such data.

During the holiday season, we admire magnificent nighttime light displays both indoors and outdoors. Even from space, these lights will shine bright thanks to the wonders of satellite imagery.

Satellite images are transforming how social and economic statistics are compiled. The data are more than just satellite images of Earth; researchers use these images to derive proxy measures of various official statistics. The presumption is that most social and economic activities at night require light; hence the intensity of nighttime lights and the area they cover should correlate with socioeconomic indicators

and economic development.

*This article was adapted from content featured in the Asian Development Blog.*

## Analysis

In our ongoing study, we examine the correlation between nighttime lights and socioeconomic indicators using empirical data for the Philippines to provide additional evidence on the usefulness of nighttime lights in the context of developing countries. This is in line with the call under the Sustainable Development Goals for a “data revolution” to complement conventional sources of official statistics with more innovative sources.

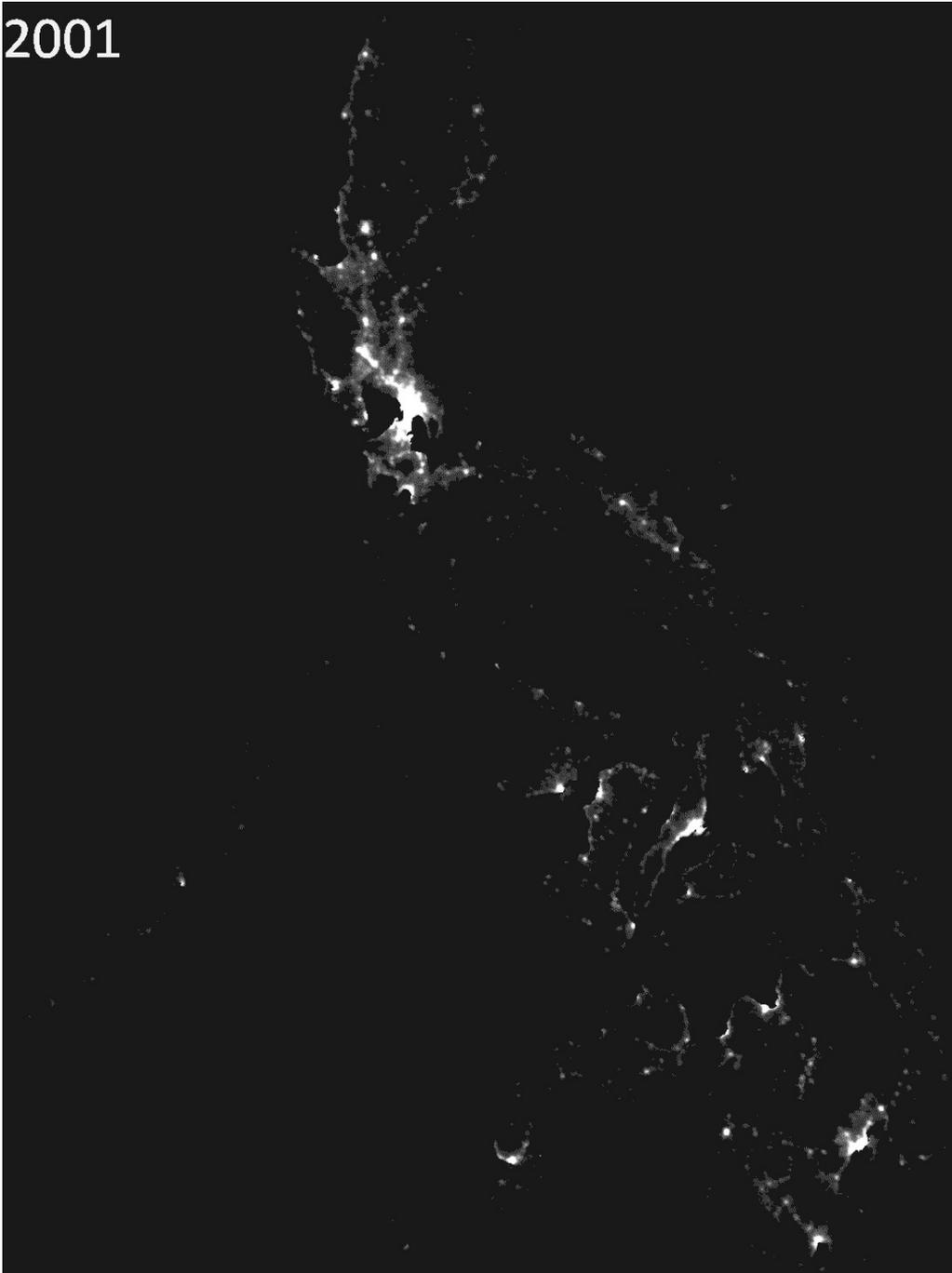
The case of the Philippines is particularly interesting, as the availability of a number of official socioeconomic statistics at subnational levels allows us to gauge the strength of the correlation across levels of disaggregation (village, provincial, and regional levels) and types of indicators. We also analyze the strength of correlation changes in intensity over time and areas covered by nighttime lights, and changes in socioeconomic indicators.

The satellite images were pre-processed to eliminate the “noise” caused by cloud cover, snow, and ephemeral lights caused by fire, and were converted into “annual” images, the average numeric value drawn from the sum of daily satellite images over one year. Using Geographic Information System mapping software, we converted each pixel into a digital number (DN) that represents the intensity of the lights, with the DN values ranging from 0 to 63. For each province and region, we recorded the area of illumination and the average intensity of the lights. We then compared the data to official statistics on regional and provincial average household expenditure per capita, headcount poverty rates, and population density.

Figure 1 shows how the distribution of luminosity of nighttime lights in the Philippines has changed over time. We find that the average luminosity and areas illuminated have expanded, which may be indicative of economic growth and improvement of living standards, as well as population growth. On the other hand, Figure 2 provides the correlation between these indicators and the average luminosity and illuminated areas, respectively. Where applicable, we estimated the correlation at the regional and provincial levels.

*Figure 1. Images of nighttime lights in the Philippines (2000-2013)*

2001



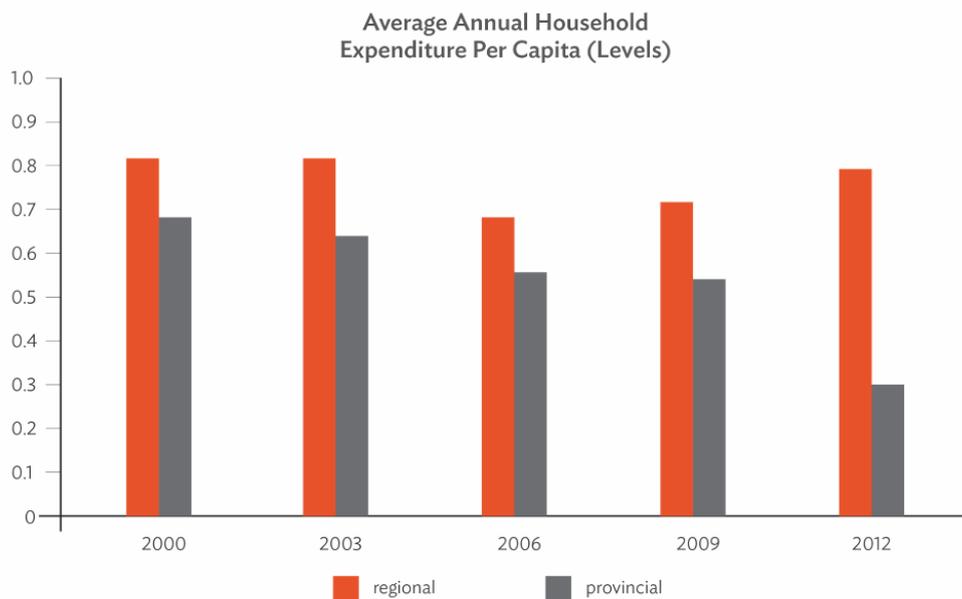
*Source: ADB calculations based on data downloaded from NOAA (accessed 18 January 2016).*

We find consistently strong positive correlation between regional average household expenditure and regional average luminosity. However, the correlation values are lower when we used provincial-level data, and the numbers also fluctuate over time. A similar pattern holds for poverty incidence, as we find consistently strong negative correlation between regional average household expenditure and regional average luminosity. The correlations also taper off when examining provincial-level data. On the other hand, the correlation between population density and average luminosity is consistently strong and positive at both regional and provincial levels.

The results are mixed, however, when we estimate the correlation between temporal changes in average luminosity and changes in socioeconomic indicators. First, we note that the correlations are much weaker when working with temporal changes. Second, the strength of correlation seems to

depend on the time duration for which the changes were calculated. In particular, the correlations are slightly higher when changes were observed for longer periods. For example, the correlation of changes in poverty rates and luminosity in 2000-2006 is higher than in 2000-2003 or 2003-2006. Third, the direction of correlation is not always intuitive as it changes over time. Fourth, further research is needed to determine the impact on luminosity values of changing the satellites we get the data from.

*Figure 2. Correlation between luminosity and average annual expenditure per capita (regional/provincial levels)*



Source: ADB estimates using nighttime lights data downloaded from NASA and Philippine Family Income and Expenditure Survey.

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## Recommendations

Nighttime lights can approximate some socioeconomic indicators when no other reliable data exist. The data allow countries with weak statistics to estimate various social and economic indicators at regular time intervals. For instance, areas that lack economic accounting systems can still make an estimate of economic growth based on nighttime luminosity data. They can also be used to provide a reckoning of human population distribution in absence of a proper census. Countries that are already compiling sufficient socioeconomic statistics can further improve the timeliness and relevance of this information by complementing it with data from nighttime lights.

This approach, however, is not infallible. The effectiveness of nighttime lights data varies across indicators, locations, and over time. Further research will continue to test the viability of the approach so we can fully capitalize on this “new” source of data.

# Resources

National Centers for Environmental Information. Version 4 DMSP-OLS Nighttime Lights Time Series.

## Related links

ADB. 2014. *Space Technology and Geographic Information Systems Applications in Asian Development Bank Projects*. Mandaluyong City, Philippines.

New Night Lights Maps Open Up Possible Real-Time Applications

The Centrality of Electricity to ICT Use in Low-Income Countries



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