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**MONITORING URBAN EXPANSION
A NETWORK OF CITIES**

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Monitoring Urban Expansion Using Remote Sensing and a Network of City-Based Researchers

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A. INTRODUCTION

The Urbanization Project—the movement of people from village to cities and towns—began in earnest in 1800, when less than 10 per cent of the planet’s population lived in cities. It reached a peak in 2000 when half the world’s urban population lived in cities and the world’s urban growth rate began to slow down. Urbanization is likely to come to an end by 2100, when the world’s population growth is expected to come to a halt and when as many as three quarters of the worlds’ population will live in cities. In a short span of 12 generations, humanity as a whole has consciously decided that living closer to one another is preferable to living closer to the land, and has acted—and is still acting—quite emphatically on that decision. The coming decades thus offer a wi

agreement² that a settlement of 100,000 people or more constitutes a city. Attention is also focused on entire metropolitan areas: contiguous urban areas that may contain many municipalities are considered to be a single city.³

Cities are defined by the extent of their built-up area, rather than by their administrative or jurisdictional boundaries. The *extrema tectorum*—the limit of the built-up area of the city, as it was referred to in Ancient Rome—defines the city and the city thus defined is our unit of analysis.⁴ Some 4,245 cities have been identified on our planet that are homes to 100,000 people or more in 2010. These 4,245 cities constitute our *Universe of Cities* (see figure 1). The total 2010 population of this universe of cities amounted to 2.5 billion or 70 per cent of the world's 2010 urban population of 3.6 billion.⁵ The remaining urban population lived in cities and towns that had less than 100,000 people.

It is important to note that three quarters of the cities in the universe of cities are in developing countries. More precisely, 3,130 cities out of the total 4,245 (74 per cent), housing 1.85 billion people out of a total 2.5 billion (also 74 per cent) are in developing countries. The share of projected urban population growth in coming decades in developing countries is much greater. Between 2015 and 2050, the world's urban population is now expected to increase by 2.38 billion people.⁶ Only 5 per cent of that increase (130 million) will be in developed countries. The rest, 95 per cent or 2.25 billion, will be in developing countries. In other words, the increase in the city populations in developing countries will be 18 times that of the increase in the city populations of developed countries. This urban growth in the coming decades is a challenge for city planners, municipal officials, central government officials, international organizations, civic sector leaders, students of cities and interested citizens in developing countries, not for cities in developed countries. These cities, on the whole, have fewer fiscal resources, weaker rule of law, higher levels of corruption and less experienced public servants, but also higher built-up area densities, more reliance on public transport, and lower levels of energy use. It may well be that the urbanization agenda for developing-country cities may be quite different than the urbanization agenda of developed-country ones. Still, from the point of view of monitoring urbanization in general and urban expansion in particular, it is important to study both developed-country cities and developing-country cities using the same conceptual framework and the same methods for data collection and analysis.

1. *The global sample of cities*

The universe of cities can be studied by examining a carefully selected sample from this universe, selected with a view to obtaining results that can be generalized to the entire universe. A stratified global sample of 200 cities, roughly 5 per cent (4.7 per cent) of the 4,245 cities in the universe in 2010 has been selected (see figure 2 and table 1).

² With the important exception of China where there were only 657 officially designated cities in 2015, where there were hundreds of settlements of 100,000 people or more that we have counted as cities.

³ There are a few exceptions to this convention. In countries where many large cities have combined to create elongated conurbations that stretch for hundreds of kilometers—for example, the Northeast cities in the United States or the Rhein-Ruhr cities in Germany—we have separated the major cities along administrative boundaries. We have also adopted a formula for the inclusion of towns that are not contiguous to large urban agglomerations, where the distance to the agglomeration is a function of its area.

⁴ The populations of cities are, and should, be calculated using data on the populations of the administrative districts containing the built-up areas of these cities. Where these administrative units are large and contain other built-up areas that are not part of the city, we allocate a population to the city that is equivalent to its share of the built-up area within the set of administrative districts containing its built-up area.

⁵ United Nations, Department of Social and Economic Affairs, Population Division 2014, File 3: Urban Population at Mid-Year by Major Area, Region and Country, 1950-2050 (thousands), available at: <http://esa.un.org/unpd/wup/CD-ROM/> [accessed August 13, 2015].

⁶ *Ibid.*

Rich Developed Countries. All have large agricultural hinterlands and their cities have large expanses of low-density suburban developments that distinguish them from European or Japanese cities.

It is also important to note that the second criterion—dividing the cities into four population size groups, each containing the same total population—biases the sample toward larger cities. The four population size groups contain the same total population, but there are as many as 3,150 cities in the first group (100,000-425,000) and 56 of them are in the sample, but there are only 54 cities in the fourth population size group (5.6 million plus) and 40 of them are in the sample. As a result, the 200 sample cities constitute only 4.7 per cent of the number of cities in the universe, but have a population of 720 million, 29 per cent of the total population of the universe. Data on the universe and the sample is given in table 1.

The representativeness of the sample was tested in the following manner: knowledge of the 2000-2010 population growth rates of all cities, both the cities in the universe and the cities in the sample; comparison of their averages was done—both weighted and un-weighted—and found that they were not statistically different from each other at the 95 per cent confidence level. That being said, there were still last minute changes in the sample and—as a consequence—in the universe of cities as well.

The results of the analysis of satellite imagery, in conjunction with the population data associated with administrative districts, sometimes reveal that (1) a city that may have been on its own in earlier periods is now included in a larger metropolitan area; or (2) that although its administrative district contains more than 100,000 people, the built-up area associated with the city contains less than 100,000 people. In both cases, this city was replaced with a new city selected at random from the same regional, city size, and the number of cities in the country grouping.

C. MONITORING GLOBAL URBAN EXPANSION

REFERENCE

Angel, Shlomo and others (2015). Monitoring the quantity and quality of Global urban expansion. NYU Marron Institute of Urban Management Working Paper No.24 (September 2015).