Our Not-So-Urban World

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Abstract

A recent article titled "Everything we've heard about global urbanization turns out to be wrong" (Thomson Reuters Foundation, 10 July 2018), citing new figures released by the European Commission, informed readers that 84% of the world's population now lives in urban areas, not 55% as reported by the United Nations Population Division. In this working paper we present four arguments, backed by ample evidence, contending that the European Commission's number is implausible if the word 'urban' is to retain any familiar meaning at all. First, the share of the global labor force employed in agriculture was 27% in 2015. This share, coupled with an estimated 30% increment to the agricultural labor force in village non-farm employment and an estimated 15% larger household size in rural areas,, suggest that not more than 60% of the world's population lived in cities in that year. Second, regularities in the distribution of the city population sizes, known as Zipf's Law, allow us to estimate the population of cities of 5,000 people or more in 2010 as 3.6 billion. 52% of the world's population lived in such cities and towns that year and not 84% as claimed by the European Commission. Third, the low 'urban density threshold' adopted by the European Commission results in the inclusion of entire cropland regions as urban: In Java, Indonesia, for example, 96% of the population living on cropland is classified as urban. And fourth, the low urban density threshold adopted by the European Commission is too low in comparison with observed population densities on the fringe of real-world cities. It implies that a residential plot on the urban edge would have an area equivalent to 1.5 regulation-size soccer fields. The European Commission claims that in 2015 cities occupied 2.27 million km^2 and covered 1.5% of the landmass of our planet, more than 2.5 times our own back-of-the envelope estimate. If one intends to believe the European Commission's estimates, then one can safely conclude that cities should stop expanding right now and that all must be done to contain them. If the world is already 84% urban then one may also conclude that *the urbanization project*—the relentless migration of people from village to city, from living closer to the land to living closer to each other—is basically over. We, on our part, believe that it is by no means over and that we still have a window of opportunity to prepare our cities for absorbing more than 2 billion people by 2050, many still residing in rural areas. In addition to retrofitting existing cities—which, if we are to believe the European Commission, is all that is left for us to do—we believe that preparing cities for their inevitable and massive expansion and densification in the decades to come is a very real challenge now facing us all.

Our Not-So-Urban World

Introduction

In 2003, the UN Secretary General, relying on extensive UN Habitat analysis, declared that "[a]lmost 1 billion people, or 32 per cent of the world's urban population, live in slums… And if no serious action is taken, the number of slum dwellers worldwide is projected to rise over the next 30 years to about 2 billion." (*The Challenge of Slums*, 2003, page 1) The 1 billion number was repeated and amplified uncritically by hundreds of media outlets as well as by numerous academic publications and a widely circulated book titled *Planet of Slums*. UN Habitat classified more than one-third of East Asia's urban population as slum dwellers, for example, a highly disputable finding that no observant visitor to Chinese, Korean or Japanese cities could possibly support. Since 2003, UN Habitat has indeed revised down that 1 billion number. According to its 2016 *World Cities Report*, "the absolute number stood at 881 million in 2014," i.e. at a lower value than the 1 billion estimated to have lived in slums in 2003. It is still too high, unfortunately, because it is census-based and not settlement-based and the census metrics used—e.g. the share of the urban population without improved water and sewer connections—do not correspond to our intuitive understanding of 'slums'.

A major media outlet informed its readers recently us that "Everything we've heard about global urbanization turns out to be wrong".[1] The article by that name cites new estimates of the share of the world's population living in urban areas released by the European Commission's Directorate General of Regional and Urban Policy. The European Commission disputes the 2018 UN Population Division numbers, according to which 4.2 billion people, or 55% of the world population, lived in urban areas in 2018. Its *Atlas of the Human Planet-2016*[2]—using a new methodology and backed by satellite imagery and a global population grid—reports that as many as 6.4 billion people, or 84% of the world's population, lived in urban areas in 2018. Yet again, we find ourselves with an alarmingly large number that is likely to be repeated *ad nauseum* by media outlets looking for scoops or by interested parties anxious to make use of this number to further their political agendas. Before leaping on the bandwagon, we must ask ourselves if what the European

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1 Scruggs, Gregory. *Thomson Reuters Foundation*. 10 July 2018, online at: http://www.thisisplace.org/i/?id=0150beca-e3f5-47e0-bc74-9ccc5ef1db8a

2 Pesaresi et al, eds., 2016. *Atlas of the Human Planet—2016*, Joint Research Centre, European Commission, online at: https://ghsl.jrc.ec.europa.eu/documents/Atlas_2016.pdf?t=1476360675.

Commission considers urban can possibly correspond to our intuitive understanding of urban, and if this number can possibly be true.

The problem with the UN urban population estimates

The UN global urban population estimates, now released every four years by the UN Population Division, have come under criticism before, essentially on methodological grounds. The UN—unlike the World Bank or the IMF—is bound by its mandate to only use numbers provided by its member states. And while the UN has made valiant efforts to standardize census questionnaires and methods over the years, it has been unable to standardize two key quantitative measures: First, what levels of spatial contiguity and population density constitute a well-defined, singular 'settlement', as against a collection of disparate settlements or, for that matter, individual farms; and second, what is the urban population threshold (UPT) that distinguishes an 'urban' from a 'non-urban' or 'rural' settlement. Thus no professional demographer seriously questions the UN estimates of the *total* populations of countries, beyond questioning the capacity of national census bureaus to correctly count their populations. But many do question its published estimates of the share of the population living in urban areas.

As each member state still employs its own classification of what constitutes a settlement as well as its own urban population threshold, the share of its population that it reports to the UN as urban is not really comparable to what other member states report as urban. The UN Population Division, which is charged with aggregating national estimates into global ones in its bi-annual *World Urbanization Prospects*, is thus faced with an impossible task: Adding populations that were defined in different ways into singular regional and global estimates that are labeled 'urban', even though the definition of 'urban' varies from one state to another. That should not mean, however, that the UN urban population estimates for world regions and for the world as a whole are off by as much as 50 percent, as the European Commission claims. It may well be that the various urban population thresholds in individual country estimates cancel each other, and we have gathered evidence that indicates that the UN estimates are not that far off the mark.

The challenge of defining 'urban' settlements

From a theoretical perspective, any urban-rural distinction that includes a contiguity- or density-based definition of a settlement and an urban population threshold comes under suspicion. For Brenner and Schmidt,

> it is clear that settlement-based understandings of the urban condition have now become obsolete. The urban cannot be plausibly understood as a bounded, enclosed site of social relations that is to be contrasted with non-urban zones or conditions. It

> is time, therefore, to explode our inherited assumptions regarding the morphologies, territorializations and sociospatial dynamics of the urban condition… Today, urbanization is a process that affects the whole territory of the world and not only isolated parts of it… There is, in short, no longer any *outside* to the urban world; the non-urban has been largely internalized within an uneven yet planetary process of urbanization.[3]

From our own perspective, Brenner and Schmidt are going too far. There is still value in defining settlements as well as cities in spatial terms. Anyone who has examined satellite imagery can clearly identify freestanding settlements, made up of contiguous built-up areas with urbanized open spaces in and around them. One can also clearly distinguish large settlements with contiguous urban footprints extending over large areas, from out-of-the-way villages with a small number of structures in a sea of cultivated land. Moreover, examining large regions, one can clearly identify a hierarchy of settlements, with a small number of large cities spaced further apart, a larger number of medium-sized towns spaced closer together, and a large number of small villages distributed widely throughout the land. We see no reason to ignore these clearly observable settlements and settlement hierarchies simply because the world has become more urban in character.

That said, we are fully aware that many cities are located within agricultural zones and that, as they expand outwards, they incorporate villages and towns on their peripheries. Furthermore, freestanding villages and towns on the peripheries of cities become increasingly urban as their contacts, connections, and exchanges with the city become more intense, as they produce more goods and services for the city, as more of their inhabitants work in the city, and as more urbanites make these villages their homes and commute to work in the city. The physical boundary between the 'urban' and the 'rural'—while useful for purposes of analysis, planning and policy making—can thus only be an approximation, a forced distinction between areas that are more urban and areas that are more rural in their character and function.

From our perspective, a contiguous built-up area that contains 100,000 people or more comprises an urban settlement. Starting with our earlier work in 2005[4], we chose 100,000 people as our urban population threshold not because we considered smaller settlements as

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[3] Brenner, N. and Schmid, C., 2013. The 'Urban Age' in Question, *International Journal of Urban and Regional Research,* 20-21, online at: http://www.urbantheorylab.net/site/assets/files/1014/brenner_and_schmid_ijurr.pdf

[4] Angel et al, 2005. *The Dynamics of Global Urban Expansion*, Transport and Urban Development Department, Washington DC: The World Bank, online at: http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/dynamics_urban_expansion.pdf.

non-urban but because we wanted to ensure a focus on *cities*. In almost all countries, except China, a settlement of 100,000 people or more is considered a city. In 2010, for example, we identified a universe of 4,231 cities and metropolitan areas that were contiguous built-up areas with populations of 100,000 people or more (see figure 1). We then focused our analysis on a stratified sample of 200 cities from this universe (see figure 2).

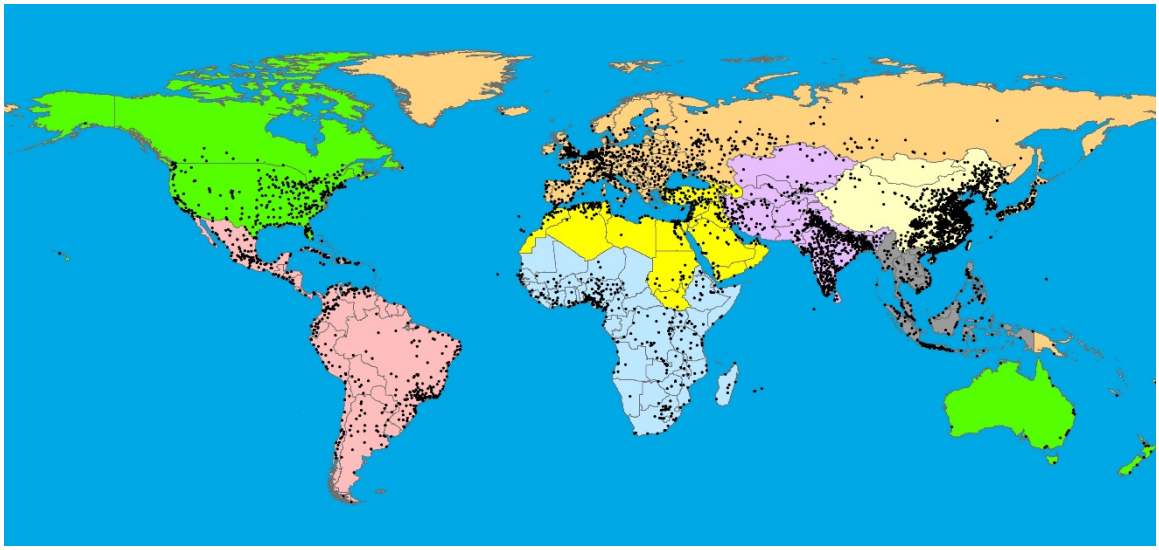

Figure 1: The universe of all cities and metropolitan areas that has 100,000 people or more in 2010.

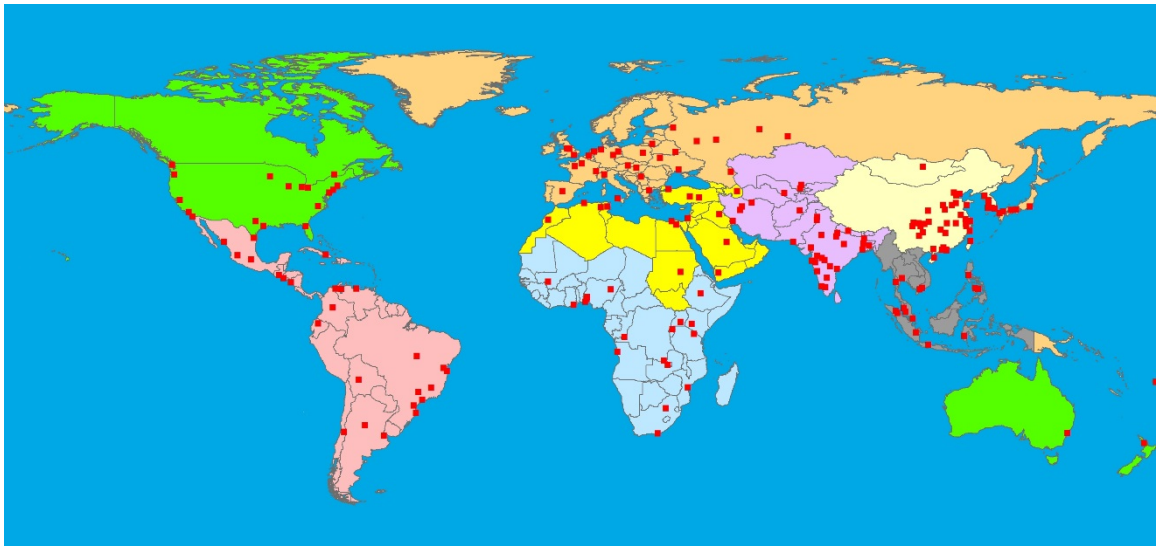

Figure 2: The global sample of 200 cities from the universe of cities, stratified by 8 world regions, 4 population size ranges, and three categories of the number of cities in the country.

We defined and mapped the physical limits of these cities by classifying *Landsat* satellite imagery—imagery with a 30-meter pixel resolution—into built-up and open space pixels, and then classifying the built-up pixels into urban and non-urban ones. We drew a 1km^2 'walking distance circle' around each built-up pixel, and classified all pixels that had 25% or

more of their circle built-up as 'urban' and all pixels that had less than 25% of their circle built-up as 'non-urban'. That allowed us to draw a distinct boundary around every city in the sample at the edge of its urban built-up area, defining the city by its *Extrema Tectorum*, as the ancient Romans did. Clearly, the same method can be used to map smaller settlements if a lower urban population threshold is preferred, as well as to map rural settlements, be they towns or villages, so as to distinguish them from freestanding farms and hamlets.

It is important to note here that our definition of a settlement, large and small, does not take population density into account. It only considers the contiguity of built-up areas. We define urbanization as the movement of people from being closer to the land to being closer to each other. The contiguity of built-up areas is thus a proxy for the basic *function* of cities, the creation of value by bringing people together to work with one another, to learn from one another, to exchange goods with one another, and to serve one another. More generally, people living in villages and tilling the land still need to be in close proximity to the land. People living in urban areas typically engage in non-farm occupations and no longer need to be close to the land. They make a living by being closer to other people and by engaging with other people, largely abandoning their contact with the land. Clearly, therefore, we can observe that in a hierarchy of settlements, the people living in smaller settlements are closer to the land and work the land, while the people living in the largest settlements are far from the land and do not work the land. Finally, the propensity of people to live close to each other in urban settlements does imply a certain minimum density of settlement: A residential area on the urban edge where each house occupies a one-hectare plot—roughly the size 1.5 regulation-size soccer fields or two NFL-approved football fields[5], for example—should not be considered 'urban' simply because people in most urban settlements do not live that far from each other.

Given these preliminary observations, we present four arguments that reject the proposition that 84% of the world's population now lives in urban areas, as claimed by the European Commission:

1. **The share of the labor force in agriculture and village non-farm occupations**: 27% of the global labor force was employed in agriculture in 2015 and an additional 30% of village employment was in non-farm occupations. As we will demonstrate, these estimates—together with differences in household size—suggest that no more than 60% of the world's population lived in cities in that year;
2. **Regularities in settlement hierarchies**: Regularities in the distribution of the city

[5] The minimum dimensions of a FIFA approved soccer field for international matches are 100-by-64 meters; the NFL-approved dimensions of a football field (including the end zones) are 360-by-160 feet or 109.7-by-48.8 meters.

population sizes, known as Zipf's Law, allow us to estimate the population of cities of 5,000 people or more in 2010 as 3.6 billion. 52% of the world's population lived in such cities that year and not 84% as claimed by the European Commission;

3. **High density agricultural regions**: We will show that the low urban density threshold—300 persons per km^2—adopted by the European Commission results in the inclusion of almost the entire population of cropland regions as 'urban'; and
4. **Typical densities on the urban fringe**: We will show that the low 'urban density threshold' adopted by the European Commission is too low in comparison with observed population densities on the fringe of real-world cities.

1. The share of the labor force in and village non-farm occupations

If one accepts the premise that those who work in agriculture are not urbanites and that the large majority of those who are employed in agriculture do not live in urban areas, we gain the first suspicion that the European Commission's estimates may not be right. According to the International Labor Organization (ILO), 27% of all workers in the world at large were employed in agriculture in 2015.

In addition to those employed in agriculture, many inhabitants of rural villages engaged in non-farm occupations: Small-scale manufacturing, construction, retail sales, education, public duties, religious duties and other miscellaneous service occupations. Studies of non-farm employment in rural areas suggest that, as a rough estimate, non-farm employment now adds as much as 30% to the global labor force in rural areas.[6] That would suggest that the share of the global labor force in agriculture and village non-farm occupations was of the order of 35% in 2015 (0.27×1.3 = 0.35).

We also know that rural households are larger than urban ones: In 2015, for example, rural households in 80 countries comprising 70% of the world's population in that year were 15% larger, on average, than urban households.[7] Assuming that labor participation rates were the same in rural and urban areas, that would mean that 40% of the world's

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[6] See for example, table 1.2 in Haggblade, S., Hazelle, P.B.R., and Reardon, T., 2007. "Introduction", in Haggblade, S., Hazelle, P.B.R., and Reardon, T., eds.,*Transforming the Rural Non-Farm Economy: Opportunities and Threats in the Developing World*, International Food Policy Research Institute, Baltimore: Johns Hopkins University Press, 6; table A3 in Majid, N., 2015. "The Great Employment Transformation in China", Working Paper No. 195, Employment Policy Department, Geneva: International Labor Organization, 43; and table 6 in Reddy, D.N., Reddy, A.A., Nagaraj, N. and Bantilan, M.C.S, 2014. "Emerging Trends in Rural Employment Structure and Rural Labor Markets in India", Working Paper Series No. 56, International Crop Research Institute for the Semi-Arid Tropics (ICRISAT).

[7] Source: https://globaldatalab.org/areadata/2015/hhsize+regpopm/.

population lived in rural areas in 2015 (0.35×1.15 = 0.40). Therefore, at most 60% of the world's population lived in urban areas in that year, a much smaller number than the 84% postulated by the European Commission and much closer to the UN Population Division's 54% estimate of the share of the world population that was urban in 2015.

2. Regularities in settlement hierarchies

The European Commission has settled on 5,000 people as a common urban population threshold (UPT) for all countries and regions: Settlements of 5,000 people or more where contiguous 1km^2 grid cells have populations densities of at least 300 persons/km^2 are defined as urban while settlements with fewer than 5,000 people are defined as rural, or non-urban. We have no quarrel with the 5,000 people threshold—few rural villages with an agriculture-based economy contain more than 5,000 people— and we do appreciate that it overcomes the limitations in the UN Population Division's *World Urbanization Prospects* reports that require it to accept member states' urban share estimates that use different thresholds. Let us assume, in the absence of information to the contrary, that we can indeed use the same urban population threshold for all countries. We can ask ourselves then: How many people in the world live in settlements of 5,000 people or more? We do not have a complete list of such settlements, but for the purposes of this review, we have compiled a dataset that includes all cities that had 20,000 people or more in 2010. The dataset was compiled from www.citypopulation.de, a reliable and comprehensive website built and operated by Thomas Brinkhoff that acts as a clearinghouse for census information on cities. Using the census populations and dates for individual cities, we interpolated or extrapolated city populations to 2010, obtaining a list of 19,289 cities that had 20,000 people or more in 2010, with a total population of 3.01 billion people, some 84% of the UN estimate of the urban population in the world in that year: 3.59 billion.

It is well known that when settlements are ranked by their population size, from the largest to the smallest, their population can be readily estimated from their rank. The distribution of city population sizes follows a power law, originally discovered by Zipf and often referred to as *Zipf's Law*.[8] This regularity implies that if we divide cities into ranges—where the lower limit of every range is half the size of its upper limit, then the number of cities in a range will be twice the number of cities in the next range while the average city population in a range will be half that of the next range. We divided the 19,289 cities that had 20,000 people or more in 2010 into ten ranges: (1) 20-40K; (2) 40-80K; (3) 80-160K; … (8) 5.12M; (9) 5.12-10.24M and (10) 10.24M+. We found that the power law holds—the number of cities in a given range is halved and the average population is doubled as we move from one range to the next one up. This is illustrated in figures 3 and 4 below.

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[8] See Zipf, G. K, 1949. *Human behavior and the principle of least effort.* Addison-Wesley.

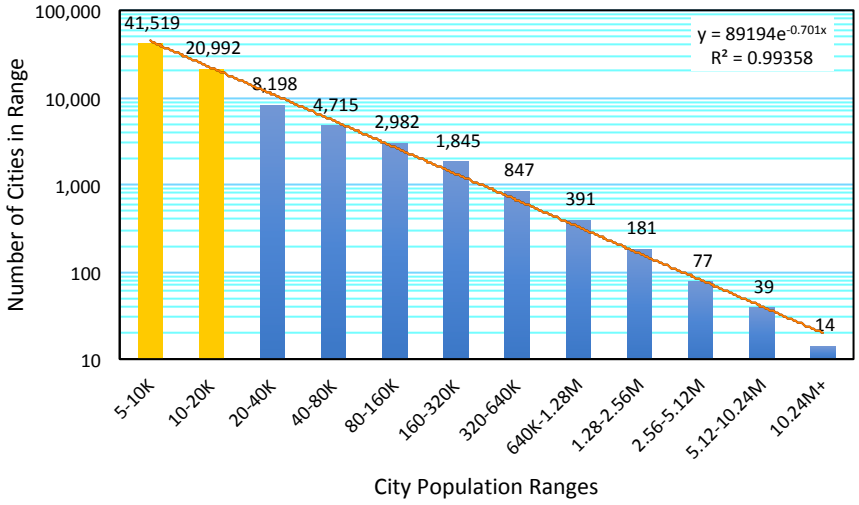

Figure 3: The number of cities in each city population size range in 2010: Blue bars correspond to empirical findings; orange bars are estimated from the trend line.

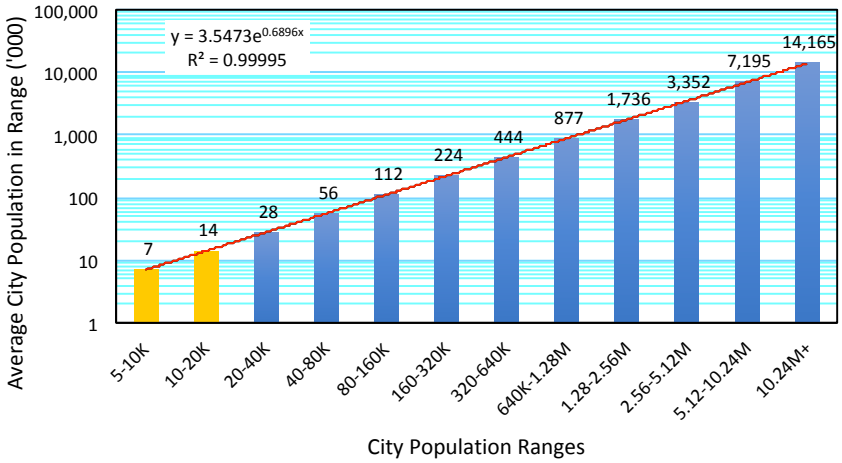

Figure 4: The average city population in each city population size range in 2010: Blue bars correspond to empirical findings; orange bars are estimated from the trend line.

Using the trend lines in each graph, we could estimate the number of cities and the average city population size in the two lower ranges—5-10K and 10-20K—with a high degree of accuracy, as the trend lines both have $R^2 \geq 0.99$. Multiplying the number of cities in each range by its average city population size, we estimate the total population in each of these two ranges to be 294M and 296M respectively. This gives us an estimate of the total number of people that lived in urban settlements of 5,000 people or more in 2010: 3.60 billion, a number that is within 0.2% of the UN estimate of the global urban population in that year (3.59 billion) and much smaller than global urban population estimated by the European Commission, which in 2010 was of the order of 5.8 billion. Using an established

regularity in the population distribution of settlements, we find the European Commission's number to be widely off the mark.

2. High density agricultural regions:

According to the European Commission's *Atlas of the Human Planet—2016*,[9] 'Urban Clusters' are contiguous clusters of 1km^2 cells, with each cell containing 300 or more people, and the total cluster containing at least 5,000 inhabitants. The threshold for an *area*—say, a 1km^2 of land— to be classified as urban is thus a population *density* threshold: 300 persons per square kilometer. This threshold is applied to all countries and regions in the world regardless of the great variations in both urban and rural population densities among them. The choice of this 'urban density threshold' is problematic because, in many heavily populated agricultural regions, densities—typically more evenly distributed over the land and without the peaks often observed in large cities—are much higher than the 300 persons per km^2 'urban threshold density' adopted by the European Union.

To illustrate this, we take the island of Java in Indonesia as an example. Java is very densely populated. The total population of the island in 2015 was 144.9 million. Its land area is 138,332 km^2. Its average population density was, therefore, 1,048 persons per km^2. Approximately 42% of the area of Java, 58,443km^2 is cultivated cropland.[10] Average farm size in Central Java in 2010 was 0.40 hectares; in East Java it was 0.47 hectares in that year. Let us assume an average farm size in Java in 2010 was of the order of 0.5 hectares.[11] This implies that there were some 11.8 million family farms in Java in 2010. With an average household size of 4.0[12] and assuming that 20% of the labor force is employed in non-farm occupations, agricultural villages, hamlet, and individual farms housed some 56 million people or 40% of the population of the island in that year. This estimate is reasonable:

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9 Executive Summary online at: https://ghsl.jrc.ec.europa.eu/documents/Atlas_of_the_Human_Planet_2016_executivesummary.pdf?t=1476109824.

10 Fuglie estimated it to be 70,000 km^2 in 2001-2005. See Fuglie, K. O., "Chapter 12: Indonesia: From Food Security to Market-Led Agricultural Growth", table 12.2, page 347. Online at: https://www.card.iastate.edu/products/books/shifting_patterns/pdfs/chapter12.pdf.

11 Yamauchi, F., 2014. "Wage Growth, Landholding, and Mechanization in Agriculture: Evidence from Indonesia", Policy Research Working Paper 6789, Washington DC: The World Bank, February, table 1, page 17, online at: http://documents.worldbank.org/curated/en/584441468042884117/pdf/WPS6789.pdf.

12 The average household size in Indonesia in 2012 was 4.0. UN, Household Size and Composition Around the World 2017, 18 http://www.un.org/en/development/desa/population/publications/pdf/ageing/household_size_and_composition_around_the_world_2017_data_booklet.pdf

According to the ILO, 39.1% of total employment in Indonesia was in agriculture in that year.

According to U.S. Geological Survey data, Java had 58,443km² of cropland in 2015. According to the European Commission's *Atlas of the Human Planet—2016* database, the total population living on this cropland area amounted to 58.8 million. This is not far from our estimate based on farm size. This population inhabited the cropland area of the island at an average density of 1,006 persons per km². Because of this high density of settlement, the European Commission classified 56.3 million people—96% of the total cropland population in Java—as 'urban'. In terms of area, it classified half of the cropland area of Java, 27,884km², as 'urban'. This is illustrated in figure 5 below. The figure shows four different zones in 2015: (1) The 'urban' area of Java not on cropland, a total of 23,352km², which is home to 83.5 million people, shown in black; (2) the 'urban' area on cropland, 27,884km², which is home to 56.3 million people, shown in red; (3) the 'rural' cropland area, a total of 30,559km², which is home to 2.5 million people, shown in light green; and (4) uncultivated land that is not 'urban', a total of 56,637km², shown in dark green.

Figure 5: A map of the island of Java, Indonesia, derived from European Commission data, showing that in 2015 more than one-third of its area (51,232km²) was classified as 'urban', half of it uncultivated land and half of it on cultivated land.

In other words, the European Commission classified half of the cropland area of Java as 'urban' and 96% of the population living in this area as 'urban', a classification that does not correspond to any possible understanding of what constitutes an 'urban' settlement. We have not conducted similar analyses for dense agricultural regions in other countries—China, India, Bangladesh, Vietnam, South Korea, Egypt, the Democratic Republic of Congo, or Ethiopia, to take a few examples that readily come to mind—but we strongly suspect that the results will be the same. The low urban density threshold adopted by the European commission leads to the classification of large cropland regions, and the great bulk of their

populations, as 'urban', resulting in an over-estimate of the urban populations of countries, regions, and the world at large.

4. Typical densities on the urban fringe

The low urban density threshold—300 persons per km^2—presents yet another difficulty when applied to delimiting the edge of large urban areas, say cities and metropolitan areas that had 100,000 people or more in 2015. We know from a host of studies undertaken in many cities since Colin Clark's 1951 seminal article, "Urban Population Densities",[13] that densities are higher in the central city and decline regularly as we move away from the city center to the inner suburbs and eventually to the outlying suburbs. According to the European Commission, the density *at the urban edge* would be as low as 300 persons per km^2. Densities closer to the city center will be higher. Areas adjacent to the urban edge but further away from the city center will have densities that lower than 300 persons per km^2 and will therefore not be considered urban. Does this urban density threshold correspond in any way to what we know about real-world cities?

As noted earlier, we defined and mapped the physical limits of cities by classifying *Landsat* satellite imagery—imagery with a 30-meter pixel resolution—into built-up[14] and open pixels, and then classified the built-up pixels into urban and non-urban ones. We drew a 1km^2 'walking distance circle' around each built-up pixel, and classified all pixels that had 25% or more of their circle built-up as 'urban' and all pixels that had less than 25% of their circle built-up as 'non-urban'. We then added a 100-meter-wide open space buffer along the built-up urban edge of cities to approximate the open space affected by the city. That procedure allowed us to draw a distinct boundary around every city we studied and to map its 'urban footprint'. Essentially, the urban edge of cities is thus determined by the contiguity of built-up pixels: Only built-up pixels that have a lot of other built-up pixels in their immediate vicinity (and that together accommodate 100,000 people or more) are considered 'urban'.

In contrast, the European Commission delimits the boundary between urban and non-urban areas using a density threshold instead of a contiguity threshold. We suspect that this density threshold is too low in all but the plushest 2-to-5-acre-lot suburbs in North America (0.8 – 2.0 hectares). Think of a 1km^2 residential area on the outer fringe of a large city. Let us assume that 25% of this area is taken up by streets (a generous assumption considering that we calculated the average share of land in streets in the newly built-up areas of cities—

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13 Clark, C., 1951. "Urban Population Densities", *Journal of the Royal Statistical Society Series A (general*), 4, 490-496.

14 Built-up pixels have more than half of their area covered by impervious surfaces, such as roofs or pavements.

areas developed between 2000 and 2014—to be 20.2±0.7%[15]). That would leave 0.75km^2 for residential plots. At the urban edge there will be 300 people inhabiting this area. Assuming that they form 4-person households, there will be 75 households inhabiting the area. That would mean that the plot area occupied by each household would be one hectare (10,000m^2 or 2.5 acres) of land, on average, roughly equivalent to 1.5 the area of a FIFA regulation soccer field or twice the area of an NFL-approved football field.[16]

This is highly unrealistic in light of the fact that the median new residential lot size in the United States—lots typically built at the outer fringes of cities— dropped from in 930m^2 in 1992 to 800m^2 in 2015.[17] This is an order of magnitude lower than the new residential lot size on the urban edge that would be implied by the European Commission's urban density threshold. Needless to say, average plot sizes in the expansion areas in our global sample of 200 cities—areas developed between 2000 and 2014—are smaller[18]: The average size of plots in informal land subdivisions was found to be 472±98m^2, and the average size of plots in formal land subdivisions was found to be 537±72m^2. Even if we assume that households on the urban fringe occupy plots of 1,000m^2 and that, on average, these households are 4-person households, a square kilometer of land on the urban fringe of cities will have room for 3,000 persons—10 times the 'urban density threshold' adopted by the European Commission. We must conclude, therefore, that the urban density threshold adopted by the European Commission is simply too low, and that this low threshold leads to counting households that are not urban—either because they make a living in agriculture or because they live at non-urban densities; and that including these households results in massive over counting of the urban population of the world.

Figure 7 below presents an example of such possible over-counting. It compares the urban clusters within the study area of Dhaka, Bangladesh (yellow line) in the *Atlas of Urban Expansion—2016 Edition* with the urban clusters in the European Commission's *Atlas of the Human Planet—2016*. Both maps are for the year 2015. The area in the former (dark red) is 444km^2 and the area in the latter (red+dark red) is 1,718 km^2, i.e. four times as large. Within the entire image shown in figure 7, the area classified as urban in the latter, 4,975km^2, is 11 times the area classified as urban in the former.

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15 Angel et al, 2016. *Atlas of Urban Expansion—2016 Edition*, Volume 2: Blocks and Roads, table 1-2, online at: http://www.atlasofurbanexpansion.org/data.

16 See footnote 5.

17 Siniavskaia, Natalia, 2016. "Lots in 2015 are Smallest on Record", *Eyes on Housing*, 11 July, online at: http://eyeonhousing.org/2016/07/lots-in-2015-are-smallest-on-record/

18 Angel et al., 2016, *op.cit*., table 1-2.

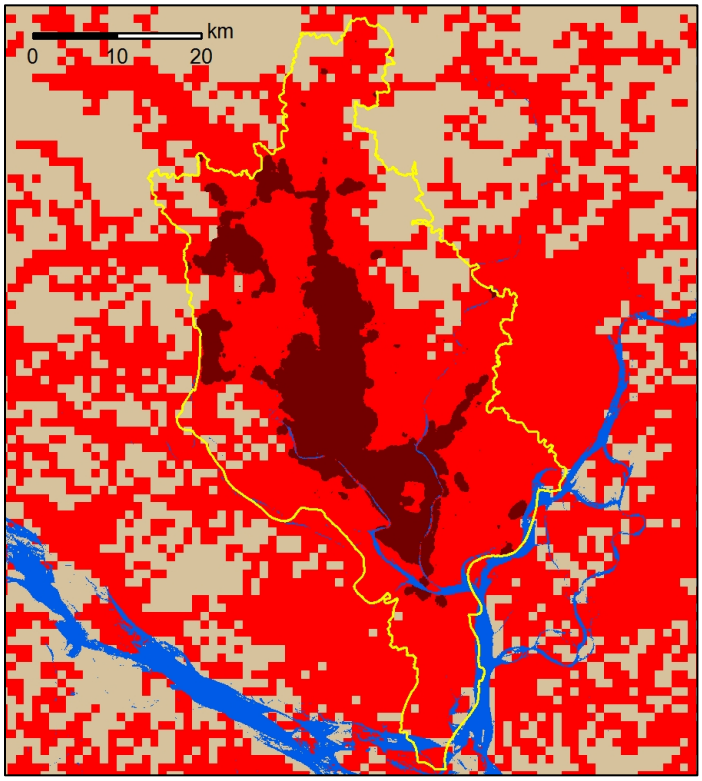

Figure 7: A comparison of urban clusters within the Dhaka, Bangladesh study area (yellow line) between the *Atlas of Urban Expansion—2016* (dark red) and the *Atlas of the Human Planet—2016* (red + dark red) in 2015. The area of the latter is 4 times the area of the former.

Not surprisingly, the low 'urban density threshold' adopted by the European Commission also results in very large estimates of the *total* amount of land in urban use in the world at large. Its *Atlas of the Human Planet—2016* asserts that in 2015 urban areas occupied 2.27 million km^2, up from 1.86 million km^2 in 2000 and (according to our own interpolation) 2.12 million km^2 in 2010. An urban land cover of 2.27 million km^2 amounts to 1.5% of the landmass of our planet.[19]

The European Commission estimates are several times larger than other estimates. The median value of the global urban land cover in 2000 in the eight maps examined by Potere *et al*[20], for example, was only 552,000km^2. The European Commission's estimate for 2000 is

[19] The landmass of the planet is 149 million km^2, and 2.27÷149=1.5%. The *Atlas of the Human Planet-2016* calculated this percentage incorrectly as 7.6%. This error has been addressed and will be corrected in the forthcoming 2018 edition of the *Atlas*.

[20] See, for example, Potere *et al*., "Mapping urban areas on a global scale: Which of the eight maps now available is more accurate? *International Journal of Remote Sensing* 30(24), 6531-6558.

more than triple that number. Angel *et al*[21] estimated global land cover in 2000 to be of the order of 600,000km^2 and projected it to increase to 780,000±90,000km^2 by 2010. Our more recent back-of-the-envelope estimate for 2010 is still within this range, and our back-of-the-envelope estimate for 2015 is of the order of 840,000km^2 (less than 0.6% of the world's total land mass). Again, the European Commission's estimates for these years are much larger, indeed more than 2.5 times larger than our own estimates. While we are fully aware that more work is needed to provide accurate assessments of the amount of land in urban use, we strongly suspect that the low 'urban density threshold' adopted by the European commission results in a gross overestimation of the amount of land in urban use, in countries, in regions, and in the world at large.

Conclusion

We beg to differ with the European Commission's conclusion that 84% of the population of the world now lives in urban areas. We do understand why the European Commission questions the UN urban population estimates. We are fully aware of the limitations of the estimates of the share of country populations living in urban areas provided by the United Nations *World Urbanization Prospects*. These limitations are inherent in the UN's mandate, restricting it to the use of numbers provide by member states. That said, it need not mean that the global estimates provided by the UN Population Division are way off the mark. We believe that it is possible to recalculate these shares using a common yardstick—essentially a common 'urban population threshold', coupled with a clear definition of what constitutes a 'settlement'—and we ourselves are planning to undertake this effort in due time. Indeed, taking the UN data and modeling it to estimate country urban populations using a common urban population threshold presents a sensible yet not insurmountable challenge to urban demographers. It will produce different numbers and it is difficult to tell in advance how different they may be. What is required now is clarity: A clear exposition of each member state's method of calculating its urban population. Hopefully, researchers interested in making international comparisons and arriving at new global estimates of the world's urban population could then develop and test a method for transforming the disparate thresholds used by different countries into a common urban population threshold and then calculating new estimates based on this common threshold.

We have no quarrel with the European Commission's choice of a population of 5,000 as a first attempt to define an 'urban population threshold'. This threshold can and should be

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21 Angel, S., Parent, J., Civco, D. L., Blei, A. and Potere, D., 2011. "The dimensions of global urban expansion: Estimates and projections for all countries, 2000–2050", *Progress in Planning*, 53–107, table 6.2, 98.

tested along with others, before deciding on the most sensible one. Are there villages or small towns with more than 5,000 persons where the majority of workers are employed in agriculture? We have no data that can shed light on this question. Does the population size of settlements where the majority of people are employed in non-farm jobs vary systematically from one country to another? We have no data that can shed light on this question either. Unfortunately, the European Commission does not tell us why it chose this threshold. We believe that it needs to be grounded in a solid theoretical foundation of what makes a settlement urban, especially in light of recent claims that *all* settlements large and small are now urban.

We believe that the European Commission's estimate of the share of the population that resides in urban settlements is inaccurate, and that the source of the error is not the 5,000 persons threshold but the density threshold that is used to identify a settlement of 5,000 persons, namely the urban threshold density of 300 persons per km^2. This density threshold is too low, resulting in identifying many areas that are clearly not urban as urban without giving a solid justification as to why such areas are urban. In other words, agricultural regions with small plots tended by farmers living in villages and hamlets are lumped together with large metropolitan areas and labeled urban. As a result, a far too large share of the world's population and a far too large share of the global land mass is classified as urban.

This matters. Why? Because if one is led to believe that in 2015 cities occupied 2.27 million km^2 and already covered 1.5% of the landmass of our planet then one may conclude that this number is excessively large and that cities should be prevented, by all means possible, from 'sprawling' any further. If that is true, we should now restrict ourselves to accommodating the shifting urban populations through infill and densification, but certainly not through urban expansion, expansion that will further increase the already exorbitant urban land cover on our planet. This is the position adopted by many planners, environmentalists, and city officials that are appalled by urban 'sprawl' and have sought, unsuccessfully, to contain it for the past thirty years. Where containment has been successful—say, in Seoul or San Francisco—it has usually resulted in critical land supply bottlenecks and skyrocketing land and house prices. More commonly, where containment has failed, it has resulted in unplanned and disorderly urban expansion that has been impossible to retrofit with trunk infrastructure lines or with public open spaces once it has taken place. It is for this reason that we must insist that the European Commission's estimates grossly exaggerate the amount of land in urban use and are simply wrong.

Furthermore, if one is led to believe that the world is already 84% urban then one may conclude that *the urbanization project*—the relentless migration of people from village to city, from living closer to the land to living closer to each other—is basically over. This project, which started in earnest at the end of the 18th century, is now expected to gradually come to a close by the end of the 21st century. If the European Commission is to

be believed, there is very little left for us to do but to infill and retrofit existing settlements. We, on our part, believe that we still have a window of opportunity to prepare our cities for absorbing more than 2 billion people by 2050, the great majority of them in the cities of less-developed countries. In addition to retrofitting existing cities, we can prepare cities for their inevitable expansion before they are built. We can project the amount of land that will be needed to accommodate the new urban dwellers and identify appropriate areas where growth can take place; we can plan arterial infrastructure grids in expansion areas and secure the rights-of-way for these grids today, before settlement takes place; we can protect sensitive environmental assets and secure adequate lands for a hierarchy of public open spaces in advance of urban development; and we can engage landowners on the urban fringe in improving their land subdivision practices.

But for this to happen, we need to understand that our world is not yet as urban as the European Commission would have us believe. We need to understand that the world is still urbanizing, and that most future urbanization will take place in the less developed countries, especially in Asia and Africa, countries that are least prepared for it. If we delude ourselves to believe that the urbanization project is over then we are unlikely to engage in realistic and pragmatic preparations of our cities and metropolitan areas for their inevitable expansion—hand in hand with their retrofitting and densification, of course—in the years to come.

Like our colleagues in the European Commission, we are frustrated by the inability of United Nations member states to adopt a common urban population threshold. We agree that we seriously need and do not yet have a rigorous and reliable method for estimating how urban our countries, our regions, and our world are. The European Commission is to be applauded for taking the first attempt at a method that, in contrast with the UN Population Division, uses a common urban population threshold for all countries. Unfortunately, it coupled this threshold with an unrealistic urban *density* threshold' and produced implausible estimates in light of the arguments above. This should be an invitation to other interested parties to do better and to do better soon. For the time being, however, we recommend that the 84% number proposed by the European Commission not be bandied about but be laid to rest, and we urge its competent researchers to go back to the drawing board and start afresh. The work they are engaged in is both valuable and important, and they have both the human and the financial resources to get it right.

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