Classification and Delineation of Urban Areas in a Census

Select Topics in International Censuses[1]

Released June 2020

INTRODUCTION

The differences between urban and rural areas and their associated modes of living are both easily grasped by the public and are ongoing, fundamental topics of inquiry for social scientists. Our notion of what makes a place urban are context and culture dependent, varying from person to person and group to group, within and between countries.

Disaggregation between urban and nonurban areas is important across the Sustainable Development Goals (SDGs) because urban areas are commonly associated with amenities such as paved roads, safe drinking water, and access to electricity and education. Goal 11 of the SDGs focuses specifically on urban areas due to the continually increasing share of the world population living in them. Both urban and rural residents face vulnerabilities particular to their physical and socioeconomic environments. Interest in refinement of the definition and delineation of urban areas increased in response to suburbanization in developed countries and as urbanization accelerated in many parts of sub-Saharan Africa during the 1960s and 1970s. The importance of the distinction between urban and rural has not since diminished, but a definitive, universal definition of urban remains elusive.

Principles and Recommendations for Population and Housing Censuses (2015) notes that "the distinction between urban and rural populations is not yet amenable to a single definition that would be applicable to all countries…" Although researchers and international organizations have created frameworks to allow for standardized comparison and analysis, this brief does not suggest any as authoritative. In addition, any reference to a particular methodology does not imply endorsement. Rather, the purpose is to ensure that census planners understand the use of data in the various approaches to urban delineation, especially as data dissemination from the 2020 round of censuses begins.

This enhanced aerial view of Amsterdam with surrounding municipalities shows the densely settled urban core of the city ringed by suburbs with intervening forested and agricultural areas.

[1] This technical note is part of a series on *Select Topics in International Censuses,* exploring matters of interest to the international statistical community. The U.S. Census Bureau helps countries improve their national statistical systems by engaging in capacity building to enhance statistical competencies in sustainable ways.

Fiat Classification

In the simplest solution to the problem of urban classification, an organization or ministry is given authority to make legal declarations on the urban status of incorporated places. For example, any unit that is a seat of government for any administrative level could be classified as urban. In many of these cases, definitive quantitative criteria are vague or lacking. There may be commission and omission based on expert opinion. This approach may meet government policy needs, but it makes the urban/rural categories opaque and, thus, less useful for disaggregation of other indicators.

Data users will also not know the relationship between the boundary of the administrative unit and the urbanized area. The urbanized area and urban administrative unit could be currently coextensive, could have been coextensive at one time, or may be independent of each other.

Criteria-Based Classification

A better approach is to publish criteria that meet the analytical and policy needs of government, and allow data users to understand how those criteria were quantified. To do so, a responsible body must:

1. Choose a unit of analysis: A bounded area for which classification criteria are assessed.

2. Establish classification criteria: Metric(s) used to sort units of analysis into binary or continuous urban/rural categories.

3. Define delineation criteria: Rules that define spatial relationships between units of analysis to produce urban entities.

4. Process data and publicize results.

PROCESS OF CRITERIA-BASED URBAN CLASSIFICATION

1. Choose a Unit of Analysis

The first step in an urban/rural classification is to choose a unit of analysis. Administrative units are a simple choice as they are already bounded and easily understood. They could be units already associated with municipal areas such as localities or another unit at an appropriate scale. In general, classification should be performed on the smallest administrative unit possible.

More nuanced approaches are possible using abstract areas as the building blocks for further analysis. These entities could be units of statistical geography such as collection or tabulation blocks or a grid of regularly shaped and sized polygons covering the country. Table 1 provides a summary and the advantages and disadvantages for various units of analyses.

Modifiable Area Unit Problem

The use of large administrative units can lead to overbounding, when nonurban areas are classified as urban. Use of small statistical units—enumeration areas or grid squares—can lead to underbounding if delineation rules are not carefully considered—for example, an ocean inlet or large park in an urbanized area.

These challenges are all emblematic of the modifiable area unit problem (MAUP), a core concept when analyzing any spatial data. MAUP states that any analysis performed on spatially aggregated data is affected by the size and shape of the units. MAUP is a consideration regardless of whether administrative or statistical units are used for the basis of classification. It is particularly tricky when crossed with individuals' perceptions of how nested places can include or exclude each other.

For example, consider a large park surrounded by an urbanized area. The park has zero permanent residents and is mostly trees and grass. In isolation, these are not urban characteristics. A unit of analysis exactly coextensive with the park would fail to meet any urban classification criteria that do not consider spatial relationships. The same park could also be part of a larger unit that might still meet a population density criterion. Thus, the size and shape of the unit(s) of analysis will affect whether the park is included in the initial urban classification. Delineation rules, if applied, will then determine if the park is added to an urbanized area and the effect of that classification on higher levels of geography.

The MAUP concept applied to a large park—along with airports, water bodies, commercial areas, entertainment complexes, and all the other land uses that form the urban patchwork—explains why smaller entities are favored when making an initial urban classification. Smaller units are more likely to be "pure," meaning that they are environmentally homogenous. This homogeneity allows for more control and flexibility—albeit at the price of increased algorithm complexity—when creating the rules that merge, split, and connect areas that meet the initial classification threshold.

Table 1.
Urban Classification Criteria

Unit of Analysis		Description	Advantage	Disadvantage
Admini-strative	Nonplace-based (e.g., subdistrict)	Nonmunicipal or mixed entities with preexisting boundaries and governments.	• No need to delineate. • Easily understood.	• Least precision in aligning urban classification with urbanized area. • Prone to overbounding. • Diminished utility for meaningful urban/rural disaggregation.
	Place-based (e.g., locality)	Municipal-level entities with preexisting boundaries and governments.	• No need to delineate. • Easily understood. • Scale appropriate.	• Not necessarily drawn with respect to urbanized area, or urbanized area may have changed since boundaries drawn. • May not include all urbanized areas or be nationally exhaustive.
Statistical	Operational (e.g., enumeration area)	Units used for the collection or tabulation of census data.	• Relatively small scale minimizes overbounding. • Increased precision; high utility for urban/rural disaggregation.	• Moderate algorithm development and processing requirements. • Careful consideration of special units such as protected areas, water, and zero population in proximity to urbanized area.
	Gridded (polygons)	Uniformly sized polygons coextensive with national boundaries.	• Independent of any other bounded entity. • Simplifies rules for classifying higher level units. • High utility for urban/rural disaggregation.	• Substantial delineation algorithm development and processing power required. • May seem abstract to public.

2. Establish Classification Criteria

Table 2 shows a breakdown of how countries make their urban/rural classifications. The first line indicates that 59 countries use fiat (administrative in Table 2) urban classification. All but 24 of the remaining countries use some combination of the criteria similar to those discussed by Frey (2001) to build an urban classification. There are also 12 countries that have an entirely urban population and an equal number that have an unclear or no definition.

Frey (2001) noted three groups of criteria used in urban classifications: (1) ecological criteria, which assess the human impact on the environment; (2) economic criteria, which assess how and where people earn their livelihood; and (3) social criteria, which assess the character of daily life as expressed through infrastructure, amenities, and leisure activities.

Ecological Criteria—Population Size/Density

Population count and density are the two metrics most commonly used as ecological criteria. This is based on the underlying assumption that a greater number of people living in an area will lead to an increasingly built-up environment that offers more services to support that population. Moving along a continuum of population density, starting from wilderness at zero and progressing through agricultural areas and sparsely settled areas, there is a threshold reached where density indicates a transformed environment or urbanized area. The exact value at which the environment changes from nonurban to urban varies according to cultural perception and resource use intensity.

The extent of impervious land cover—surfaces, such as concrete, asphalt, and brick, through which water cannot percolate—is also an ecological metric. Impervious surfaces, also called built-up areas, are a proxy for the impact humans have on their environment at increasing densities. An advantage of impervious surfaces is that they can be detected through remote sensing methods and therefore have lower costs to quantify compared to metrics that require household-based surveys. However, population density and count remain the primary ecological criteria because the relationship between impervious surfaces and population density is place- and scale-dependent (Azar, et al., 2013; Ma, et al., 2018).

Economic Criteria—Agricultural Activity

Economic criteria assess how wealth is generated within a region. Primary economic activities—resource extractive, especially agriculture—are associated with rural areas. Thus, the most commonly used economic criterion to differentiate urban from rural is the proportion of residents working outside the agricultural sector.

As with population density, variation based on culture and level of development are important considerations. For example, in more developed countries, the proportion of the population employed directly in agriculture may be relatively low even in rural areas due to mechanization and automation.

Social Criteria—Urban Characteristics

Social criteria focus on the values, behaviors, and perceptions of residents within an area rather than the contours of built-up areas or economic functions. This perspective focuses on urbanism as a way of living that exists on a spectrum with rural life at the other end. The breadth and depth of possible ways to measure urbanism are vast, but data about perception and values are only captured as part of in-depth surveys, usually outside the scope of a census. For this reason, the availability of infrastructure and amenities associated with urban life are often used as proxies for these contextual, and difficult to collect, data.

Education, health, sanitation, utilities, and transportation services are infrastructure commonly used in urban classifications. These can be measured based on either household- or area-based accessibility or availability. For example, the metric can be built around the presence of a piped water system or the number of households with working piped water. Once again, the development level of a country has clear bearing on the metrics used for social proxies of urban living. As development level increases, differences in service provision between urban and rural areas move beyond a dichotomy of presence or absence. See Box 1 for more information.

Table 2.
Number of Countries or Areas According to the Criteria Used in Defining Urban Areas: 2018 Revision

Number and type of criteria		Number of countries or areas using criterion or criteria	Percent	Number of countries or areas using criterion alone or in combination with additional criteria	Percent
One criterion	Administrative	59	25.3	121	51.9
	Economic.	N	N	38	16.3
	Population size/density	37	15.9	108	46.4
	Urban characteristics	8	3.4	69	29.6
Two criteria	Administrative and economic . .	N	N	X	X
	Administrative and population size/density.	17	7.3	X	X
	Administrative and urban characteristics	20	8.6	X	X
	Economic and population size/density	9	3.9	X	X
	Economic and urban characteristics	N	N	X	X
	Population size/density and urban characteristics	20	8.6	X	X
Three criteria	Administrative, economic, and population size/density	4	1.7	X	X
	Administrative, economic, and urban characteristics	N	N	X	X
	Administrative, population size/density, and urban characteristics	10	4.3	X	X
	Economic, population size/density, and urban characteristics	14	6.0	X	X
Four criteria	Administrative, economic, population size/density, and urban characteristics	11	4.7	X	X
Entire population is urban		12	5.2	X	X
No definition or unclear definition.		12	5.2	X	X
Total number of countries or areas.		**233**	**100.0**	**X**	**X**

N Not available.
X Not applicable.
Source: Reproduced from *World Urbanization Prospects* (United Nations Population Division, 2018).

3. Define Delineation Criteria—Connectivity, Continuity, and Enclosure

The base rules of an urban classification establish whether urban criteria are met for a unit of analysis in isolation. Classification could end at this step, with each unit of analysis flagged as urban or rural. This would satisfy analysis needs for urban/rural disaggregation. However, data usefulness is improved by delineating urban entities, which combine contiguous units that meet urban criteria, irrespective of any legal boundaries. These urban entities allow for more meaningful analysis and comparison.

Bounding urban entities requires that delineation rules be created, which group urban units while allowing for discontinuities and irregular shapes. These rules deal with connectivity, continuity, and enclosure. The external boundary of the grouped urban units becomes the boundary of the urban entity and is usually given the name of the largest settlement it contains. Table 3 provides more information on these concepts.

Functional Regions and the Distinction Between Urban and Metropolitan Areas

Some functional regions are closely related to urbanized areas, focusing on network effects and connectivity. These connected regions, with one or more urban entities at their core, are often referred to as metropolitan areas. The proportion of the population commuting to work in the urban core, an economic criterion, typically is used to define the larger territory that is connected to an urban area.

The fundamental idea of the metropolitan area is a pattern of connectivity in daily life that implies a strong influence of the urban core over the periphery. That connectivity is currently measured in economic terms through commuting to work data, but other metrics using cellular data have been suggested. Metropolitan areas include the densely settled core urban areas, but may also include suburbs and exurbs along with intervening sparsely settled areas that meet the commuting threshold. Thus, an area can be part of a metropolitan area but not be urban itself. This distinction could confuse data users and should be explicitly explained when publishing tabulations for urban and metropolitan areas that share a core city name.

4. Process and Publicize

The classification and delineation algorithm should be applied nationally and with as few special cases or exceptions as possible. Criteria and results should be published and fully available. When published, criteria should be explicit enough for classification to be replicated without additional consultation. Refer to the Select Topics in International Censuses on Developing an Integrated Communication Strategy (U.S. Census Bureau, 2016) to learn more about the cyclical nature between statistical product development, publishing, and stakeholder engagement and feedback. Be aware that there may also be emotional reactions, independent of the effect of financial considerations, to being designated inside or outside of urbanized areas or a particular urban entity. The decennial census may be used as an opportunity to reassess periodically classification and delineation criteria in consultation with stakeholders.

Table 3.
Delineation Rules

Rule	Example	Possible Analysis
Continuity	What is the maximum distance for a gap along a transportation link before a new urban entity begins?	Distance along road connecting urban units.
Irregularity	How do nonresidential indented areas (water, airports, protected areas) affect the delineation of an urban entity boundary?	Size of "mouth" of indent and ratio of indented area to urban entity.
Enclosure	How are nonurban units that are surrounded by urban units delineated?	Maximum size of nonurban enclave.

This photo from the Paraisópolis favela in São Paolo, Brazil, captures the stark contrast between formally and informally settled urban areas.

Box 1.
Beyond the Urban/Rural Dichotomy

Even while a global definition remains elusive, there is an awareness that the urban/rural dichotomy may no longer be sufficient. As disaggregation categories, urban and rural are meaningful only if we can assume that their respective populations are internally similar and externally dissimilar. There are reasons to question this assumption in both a developed and developing world context.

In less developed countries, a single urban category masks variation between formally settled areas and informal settlements, which may be referred to as slums or by various local terms. The lack of infrastructure or resilience of social networks in slums may have more in common with villages hundreds of kilometers away than they do with formally settled apartment blocks across the street. Slum residents also move between the two worlds daily for employment (Dupont, 2004). The capacity to map slums using primary household or remotely sensed data would allow for additional disaggregation.

In more developed countries, the urban/rural dichotomy has become less meaningful as many rural area residents enjoy similar levels of basic social services as urban area residents. Instead, at the national and regional scale, variation between globalized and post-industrial cities offers a potentially powerful disaggregation category. Additionally, at the scale of a single urban area, complex but regular patterns of variation in service provision and socioeconomic status have been recognized between the urban core, suburbs, and periphery (Frey, 2014).

Researchers recognize the potential of new settlement-based disaggregation categories. However, establishing classification criteria and marshalling the necessary data remain substantial challenges. Census and survey managers should follow developments in settlement classification that could allow for more meaningful disaggregation for their national context.

CONCLUSION

The everyday words used to describe urbanized areas of different sizes—village, town, city—have not been used so far in this document. These terms, usually associated with an incorporated place, may not reflect the ultimate classification used for statistical purposes. For example, a place with city in the name may fail to qualify as an urban entity, or a village may be part of a metropolitan area. That is why the final step in an urban classification is to publish and publicize the methodology. It is likely that in any urban classification, some stakeholders will object at their exclusion or inclusion in urban areas based on their perception and the funding incentives made available to urban or rural jurisdictions. While ad hoc adjustments should be avoided to maintain comparability, a periodic review of the classification criteria and delineation methodology should be made that includes stakeholder input.

REFERENCES

Azar, D., R. Engstrom, J. Graesser, and J. Comentez, "Generation of fine-scale population layers using multi-resolution satellite imagery," Remote Sensing of Environment 130, 219-232, 2013.

Dupont, V., "Urban Development and Population Redistribution in Delhi: Implications for Categorizing Population," In Champion, T. and Hugo, G., New Forms of Urbanization, Ashgate, Burlington, VT, 171-190, 2014.

Eurostat, Methodological manual on territorial typologies, Publications Office of the European Union, Luxembourg, 2018.

Frey, W., "Defining the City," In Paddison, R., Handbook of Urban Studies, Sage Publishing, London, UK, 2001.

Frey, W., "The Fading of City-Suburb and Metro-Nonmetro Distinctions in the United States," In Champion, T. and Hugo, G., New Forms of Urbanization, Ashgate, Burlington, VT, 67-88, 2014.

Ma, Q., W. Jianguo, C. He, and G. Hu, "Spatial scaling of urban impervious surfaces across evolving landscapes," Landscape and Urban Planning, 50-61, 2018.

U.S. Census Bureau, "Developing an Integrated Communications Strategy," Special Topics in International Censuses, <www.census.gov/content/dam/Census/library/working-papers/2016/demo/stic-publicity-final.pdf>, 2016.

U.S. Census Bureau, Department of Commerce, "Urban Criteria for the 2010 Census," Federal Register, 76(164), pp. 53,030–53,043, August 24, 2011.

United Nations Population Division, World Urbanization Prospects: The 2018 Revision Methodology, United Nations Publications, New York, NY, 2018.

United Nations Statistics Division, Principles and Recommendations for Population and Housing Censuses, United Nations Publications, New York, NY, 2015.