Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable
Target 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries
Indicator 11.3.1: Ratio of land consumption rate to population growth rate

Institutional information

Organization(s):

United Nations Human Settlements Programme (UN-Habitat)

Concepts and definitions

Definition:

The indicator is defined as the ratio of land consumption rate to population growth rate.

This indicator requires defining the two components of population growth and land consumption rate. Computing the population growth rate is more straightforward and more readily available, while land consumption rate is slightly challenging, and requires the use of new techniques. In estimating the land consumption rate, one needs to define what constitutes “consumption” of land since this may cover aspects of “consumed” or “preserved” or available for “development” for cases such as land occupied by wetlands. Secondly, there is not one unequivocal measure of whether land that is being developed is truly “newly-developed” (or vacant) land, or if it is at least partially “redeveloped”. As a result, the percentage of current total urban land that was newly developed (consumed) will be used as a measure of the land consumption rate. The fully developed area is also sometimes referred to as built up area.

Rationale:

Globally, land cover today is altered principally by direct human use: by agriculture and livestock raising, forest harvesting and management and urban and suburban construction and development. A defining feature of many of the world’s cities is an outward expansion far beyond formal administrative boundaries, largely propelled by the use of the automobile, poor urban and regional planning and land speculation. A large proportion of cities both from developed and developing countries have high consuming suburban expansion patterns, which often extend to even further peripheries. A global study on 120 cities shows that urban land cover has, on average, grown more than three times as much as the urban population [1]; in some cases similar studies at national level showed a difference that was three to five times fold. [3]. In order to effectively monitor land consumption growth, it is not only necessary to have the information on existing land use cover but also the capability to monitor the dynamics of land use resulting out of both changing demands of increasing population and forces of nature acting to shape the landscape.

Cities require an orderly urban expansion that makes the land use more efficient. They need to plan for future internal population growth and city growth resulting from migrations. They also need to

accommodate new and thriving urban functions such as transportation routes, etc., as they expand. However, frequently the physical growth of urban areas is disproportionate in relation to population growth, and these results in land use that is less efficient in many forms. This type of growth turns out to violate every premise of sustainability that an urban area could be judged by including impacting on the environment and causing other negative social and economic consequences such as increasing spatial inequalities and lessening of economies of agglomeration.

This indicator is connected to many other indicators of the SDGs. It ensures that the SDGs integrate the wider dimensions of space, population and land adequately, providing the framework for the implementation of other goals such as poverty, health, education, energy, inequalities and climate change. The indicator has a multipurpose measurement as it is not only related to the type/form of the urbanization pattern. It is also used to capture various dimensions of land use efficiency: economic (proximity of factors of production); environmental (lower per capita rates of resource use and GHG emissions); social (reduced travel distance and cost expended). Finally, this indicator integrates an important spatial component and is fully in line with the recommendations made by the Data Revolution initiative.

Concepts:

Population growth rate (PGR) is the increase of a population in a country during a period, usually one year, expressed as a percentage of the population at the start of that period. It reflects the number of births and deaths during a period and the number of people migrating to and from a country.

Land consumption includes: (a) The expansion of built-up area which can be directly measured; (b) the absolute extent of land that is subject to exploitation by agriculture, forestry or other economic activities; and (c) the over-intensive exploitation of land that is used for agriculture and forestry.

Comments and limitations:

In some cases, it is difficult to measure the urban expansion by conurbations of two or more urban areas that are in close proximity; to whom to attribute the urban growth and how to include it as one metric usually becomes a challenge. At the same time, data would not always coincide to administrative levels, boundaries and built-up areas. However, the European Commission highlights some possible drawbacks of this indicator that can be technically addressed. Efforts to use the area of reference at the level of the built-up area of the urban agglomeration should be taken into consideration. The delimitation of city boundaries may be another methodological problem that a clear agreed definition can solve.

The indicator may experience difficulties in capturing cities with negative or zero population growth; or cities that due to severe disaster have lost part of their territories. To face this challenge, the baseline/benchmark of population density and its change over time must be taken into consideration. Reducing densities below sustainable levels have impacts on the cities' sustainability.

In the absence of the GIS layers, this indicator may not be computed as defined. As a result more alternative measures for land that is developed or consumed per year can be adequately used. Alternatively, one can monitor the efficient use of urban land by measuring how well we are achieving the densities in residential zones that any city plans or international guidance call for. Comparing achieved to planned densities is very useful at the city level. However, planned densities vary greatly

from country to country, and at times from city to city. At the sub-regional or city levels, it is more appropriate to compare average densities achieved currently to those achieved in the recent past. While building more densely does use land more efficiently, high density neighborhoods, especially in and around urban centers, have a number of other advantages. They support more frequent public transportation, and more local stores and shops; they encourage pedestrian activity to and from local establishments; and they create lively (and sometimes safer) street life.

Methodology

Computation Method:

The formula to estimate the land use efficiency will be provided with two stages.

Stage 1: Estimate the population growth rate.

Population Growth rate i.e. PGR=LN(Popt_(t+n)/?Popt_t)/((y))

Where
Popt Total population within the city in the past/initial year
Popt+n Total population within the city in the current/final year
y The number of years between the two measurement periods

Stage 2: Estimating the land consumption rate

This rate gives us a measure of compactness which indicates a progressive spatial expansion of a city.

Land consumption rate i.e LCR=LN(Urb_(t+n)/Urb_t)/((y))

Where
Urb_t Total areal extent of the urban agglomeration in km2 for past/initial year
Urb_(t+n) Total areal extent of the urban agglomeration in km2 for current year
y The number of years between the two measurement periods

The formula to estimate the ratio of land consumption rate to population growth rate (LCRPGR) is provided as follows:

LCRPGR= (+ (Land Consumption rate)/(Annual Population growth rate)¦)

And the overall formula can be summarized as:
LCRPGR=(((LN(Urb_(t+n)/Urb_t))/y))/((LN(Pop_(t+n)/Pop_t)/y))

The periods for both- urban expansion and population growth rates should be at comparable scale.

Disaggregation:

Potential Disaggregation:

- Disaggregation by location (intra-urban)
- Disaggregation by income level
- Disaggregation by urban typology

Quantifiable Derivatives
- Population density
- Population density growth/reduction rate
- Annual amount of urban expansion (km2)

Percentage of urban expansion in relation to the urban footprint area

Treatment of missing values:

- At country level

  All countries are expected to fully report on this indicator more consistently after 2-3 years with few challenges where missing values will be reported due to missing base map files. Therefore any missing values will be representative of populations where either population growth figures are unavailable or land consumption rates are inestimable. Because the values will be aggregated at the national levels from a national sample of cities, missing values will be less observed at national and global levels

- At regional and global levels

  See section above.

Regional aggregates:

Data at the global/regional levels will be estimated from national figures derived from national sample of cities. Regional estimates will incorporate national representations using a weighting by population sizes. Global monitoring will be led by UN-Habitat with the support of other partners and regional commissions.

Sources of discrepancies:

Based on several consultations, we note that in order to calculate the land use efficiency ratio we must stabilize the definition of population and spatial footprint of the city which is literally defined as “urban extension”. Unclear spatial definitions and an occasional use of admin boundaries arbitrarily set for population and surface accounting creates more spatially-generated noise than signal in the final accounting of the indicators. Already some spatial noise is particularly created by the use of ratios. The following data sources will be harmonized to ensure more consistent reporting on this indicator--Satellite data, built-up areas grids, time-standardized census population grids; globally complete classification grids can be aggregated to admin units but may create inconsistencies if they are not available for all cities, allowing to classify them by dominance of the urban/rural surfaces or similar approaches.

Data Sources

Description:

Data for this indicator is available for all cities and countries (UN DESA population data) and satellite images from open sources. Several sources of information are required for this computation: Satellite imagery from open sources or the exact measurements in km squared of the built up areas or the land that is fully developed in Km squared, annual urban population data for the reference years of analysis.

Data for the size of the city land that is currently considered as developed is usually available from the urban planning units of the cities. New options using remote sensing techniques have also been developed to estimate the land that is currently developed or considered as built up areas out of the total city land. This option also accurately extracts land that is considered as wetlands and hence unlikely to be occupied now or in the future.

When the spatial measurement option is used, the use of the urban agglomeration (built-up area) is a precondition for the measurement and comparability of this indicator. Data for this indicator can be easily availed using global and local sources. The indicator has been collected and analyzed since 2000 by several municipalities and countries. Various governments (Mexico, Colombia Brazil, India, Ethiopia, etc., and most European countries) have collected data on this indicator recently.

Eurostat collects data on this indicator using other comparable techniques. World Bank and Lincoln Institute collected data for 120 cities and published it in the Atlas of Urban Expansion. [02]. Currently UN-Habitat, Lincoln Institute and New York University prepared a similar study for another 200 cities. UN-Habitat City Prosperity Initiative is collecting data on this indicator for nearly 300 cities as part of the Agency's efforts to integrate spatial analysis in the SDGs.

Collection process:

National level capacity building initiatives will aim to balance the knowledge and understanding of the analysis, compilation and reporting of this indicator. Global reporting will rely on the estimates that come from the national statistical agencies. With uniform standards in computation at the national level, few errors of omission or bias will be observed at the global/regional level. A rigorous analysis routine will be used to re-assess the quality and accuracy of the data at the regional and global levels. This will involve cross-comparisons with expected ranges of the values reported for cities.

Data Availability

Description:

This indicator is categorized under Tier II, meaning the indicator is conceptually clear and an established methodology exists but data on many countries is not yet available. The Global Human Settlement Layer (GHSL) technology open framework is proposed for global open spatial baseline data production (built-up and population grids) – global open data is available and will be updated by EU support plus international partnership, the tools will be opened to national Authorities by a new platform and capacity building

program that will be soon made available with the support of the EU and Habitat. Every country will soon be able to build their own set of built-up and population grids, or to use the globally-available ones.

Time series:

Available time series runs at the city and national level for selected countries

Calendar

Data collection:

The monitoring of the indicator can be repeated at regular intervals of 5 years, allowing for three reporting points until the year 2030. Initial reporting is targeted for 2017 for all cities in the global sample of cities.

Data release:

Updates will be undertaken every year, which would allow for annual updates in reporting at the global level post 2017.

Data providers

UN-Habitat and other partners such as the Global Human Settlement Layer (GHSL) team and ESRI will support various components for reporting on this indicator. The global responsibility of building the capacity of national governments and statistical agencies to report on this indicator will be led by UN-Habitat. National governments/national statistical agencies will have the primary responsibility of reporting on this indicator at national level with the support of UN-Habitat to ensure uniform standards in analysis and reporting.

Data compilers

Name:

UN-Habitat

Description:

UN-Habitat with the support of other selected partners will lead the compilation of data for this indicator.

References

URL:

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URL References:

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[3] http://ciczac.org/sistema/docpdf/capacitacion/foro%20sedatu/02.-%20LA%20EXPANSION%20DE%20LAS%20CIUDADES%201980-2010.pdf

[4] http://unhabitat.org/books/construction-of-more-equitable-cities/
[5] http://unhabitat.org/books/state-of-the-worlds-cities-20102011-cities-for-all-bridging-the-urban-divide/)
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[10] http://www.mckinsey.com/insights/urbanization/tackling_the_worlds_affordable_housing_challenge
[11] http://www.worldbank.org/depweb/english/teach/pgr.html (Accessed on May 30, 2016)
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Related indicators

11.2.1:
Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities

11.6.2:
Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted)

11.7.1:
Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities

11.a.1:
Proportion of population living in cities that implement urban and regional development plans integrating population projections and resource needs, by size of city

15.1.2:
Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type

3.9.1:
Mortality rate attributed to household and ambient air pollution

6.1.1:
Proportion of population using safely managed drinking water services

6.2.1:
Proportion of population using safely managed sanitation services, including a hand-washing facility with soap and water

6.3.1:
Proportion of wastewater safely treated

7.1.1:
Proportion of population with access to electricity

7.2.1:
Renewable energy share in the total final energy consumption

8.1.1:
Annual growth rate of real GDP per capita

8.2.1:
Annual growth rate of real GDP per employed person

8.5.2:
Unemployment rate, by sex, age and persons with disabilities

11.6.1:
Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities

11.7.2:
Proportion of persons victim of physical or sexual harassment, by sex, age, disability status and place of occurrence, in the previous 12 months

11.b.1:
Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030 [a]