Patterns of Global Urban Expansion: Implications for the Future

Gregory K. Ingram

Data from global satellite imagery and new technologies for processing digital maps are facilitating the study of urban expansion on a global scale. The Lincoln Institute of Land Policy's most recent policy focus report, *Making Room for a Planet of Cities*, by Shlomo Angel and his colleagues, demonstrates this new capability (see page 24). It analyzes the spatial structure of cities using four complementary data sets: Landsat satellite images for 3,646 global cities with a population over 100,000 in 2000; a detailed stratified sample of 120 of these cities with data from 1990 and 2000; geo-coded census tract data for 20 U.S. cities from 1910 to 2000; and data drawn from digitized historic maps for 30 representative world cities from 1800 to 2000.

Metrics of urban spatial structure based on these data sets measure a city's built-up area (containing buildings and impervious surfaces) and the city footprint (the built-up area plus open spaces surrounded by or within 100 meters of built-up area). Available population data allow the calculation of population densities for these areas.

The population and area measures produce comparable urban built-up area average densities in 2000 that range in the sample of 120 global cities from 555 persons per hectare in Dhaka, Bangladesh to only 15.7 in Tacoma, Washington. Urban built-up area average densities vary systematically across country groups, ranging from 25 persons per hectare in land-rich developed countries (United States, Canada, and Australia); to 50 in other developed countries (Europe and Japan); and 130 in developing countries. Analysis of built-up area densities across cities supports the predictions of urban theory: for example, higher incomes and land availability are associated with lower densities; and larger city populations are associated with higher densities.

Urban average densities have declined in the three data sets with time series data: they fell at 2.0 percent per year for built-up area density in the 120 global cities from 1990 to 2000; at 1.9 percent per year for census tract density in the 20 U.S. cities from 1910 to 2000; and at 1.5 percent per year in the 30 representative cities from 1800 to 2000. In this 30-city sample, densities typically peaked around 1900 and declined since then. A U.S. exception is Los Angeles, where average census tract densities have increased since 1940 and now exceed those of New York City. The average census tract density in several other U.S. cities has leveled off since 1990, albeit at low levels around 20 persons per hectare.

In terms of fragmentation, the average city footprint density is half of the built-up area average density, implying that a typical city has as much land in its urbanized open spaces as in its built-up areas. In 2000, urbanized open space as a share of built-up area ranged from a low around 0.4 (São Paulo, Brazil) to a high around 1.8 (Zhengzhou, China). The proportion of urbanized open space across cities decreased somewhat from 1990 to 2000. Although fragmentation values did not differ between developed and developing countries, fragmentation in Chinese cities is particularly high, with much land remaining under cultivation within their city footprints.

Demographic forecasts indicate that the world's urban population will double from 3 billion in 2000 to 6 billion in 2050, with nearly all such growth occurring in developing countries. This implies a doubling of urban built-up areas in the unlikely event that urban population densities will remain constant. If densities decline by 1 percent annually (half the historic rate), city built-up area will triple, and a 2 percent annual decline will increase built-up area five-fold.

Containment strategies that may be appropriate in the United States and other low-density developed countries are likely to fail in developing countries where city populations are expected to grow several-fold over the next few decades. These cities need to prepare for their future expansion by realistically projecting their built-up areas and allocating land for both open spaces and rights-of-way for the arterial road networks and other infrastructure that will be needed to support urban growth.