



The Emergence of Megacities

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The city is a fairly recent phenomenon in human history. The first cities were built on the plains of Mesopotamia near the Tigris and Euphrates rivers between the years 4000 and 3000 BC. The first city to reach a population of one million was Rome, in about 5 BC. Not until about 1800 AD had another city, London, reached the one million mark.

Urban populations grew rapidly throughout the 19th century, fueled more by migration from rural areas to manufacturing centers than by absolute population growth. Throughout the 20th century, the number and sizes of cities grew, along with the percentage of the total population living in cities. In the past several decades we have seen the emergence of megacities--cities with populations greater than 10 million. Most of these are now in the developing world.

Size confers advantages on cities, at least up to a point. Public works infrastructures and systems to deliver social services can achieve measurable efficiencies of scale, and larger cities can have increased capacities to stimulate creativity, innovation, and economic development. There is reason to question, however, whether megacities will continue to have these advantages.

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One of the first clear indicators of adverse health effects associated with megacities has been reported by the World Resources Institute (WRI). Children in cities with populations of more than 9 million, according to the WRI, are at greater risk for health problems due to air pollution than are children in smaller cities [1].

An analysis of the forces that drive the growth of megacities--and their public health and environmental impacts--could influence critical decisions that will determine the social and environmental outcomes of that growth.

Patterns of Urbanization

While the most recent data on population trends indicate a slowing down of the rate of human population growth worldwide, the absolute number of people continues to climb and the growth of urban populations is increasing at a rate of about 2.5% per year. More than 60 million people were added to the world's cities in 1999 alone. Most population increases--urban and total--are in the developing world. The average urban growth rate for developing countries is 3.5% per year, compared with a population growth rate of 1.9% per year for those countries as a whole. By contrast, the urban growth rate for developed countries is less than 1% per year [2,3].

The world's urban populations are growing four times as fast as rural populations, and the urban head count will double to five billion from 1990-2025, at which time about two-thirds of the world will be urban. Ninety percent of the increase will be in

developing countries [4].

In 1950, New York and London were the world's only megacities. Today, at least 25 cities have populations of more than 11 million each; 20 of the 25 are in the developing world. In 2015, there will be 36 megacities, 23 in Asia alone. While most city dwellers still live in cities of a million or less, and while the rate of population growth of megacities has slowed, the absolute number of megacities continues to grow (Table 1) [2,5].

Size-Related Opportunities and Problems

Among the reasons people move to cities--both in the developed and in the developing world--are opportunities for employment and for health care. Urbanization offers potential economies of scale with respect to water supply, sanitary systems, transportation, energy, education, health care, and many of the other fixtures of industrialization. The expectation of better health care and longer life, at least, seems to be met to some extent. City dwellers today live longer than those in the countryside [3,5].

In the developing world, the household and neighborhood level problems that pose the most direct threats to human health, such as sanitation and indoor air pollution, are actually less of a problem in large cities than in many smaller and poorer urban settlements [3]. In the developing world, family wealth is often the driving force. City dwellers have lower fertility rates--one-third to one-fourth of those in rural areas--and they purchase more consumer goods than their rural counterparts. In other words, city dwellers contribute less to population growth and more to economic activity than those who live in rural areas.

City dwellers in developing countries have higher per capita energy use than people in rural areas. In many cases, it is only in cities that people have access to public energy sources. The situation is reversed in developed countries, in which cities can take advantage of economies of scale [3].

Urbanization usually results in an

increase in the per capita consumption of water for domestic and industrial uses because water is readily available to households, and industries are concentrated in cities. On the other hand, urbanization can present opportunities for more efficient and cost-effective water and wastewater management through economies of scale. Seizing these opportunities requires money and political will, which often are lacking in developing countries.

In poor cities, the urban environmental impact is primarily local, degrading both land and water--settlements occur in fragile areas, with few or no services. But the highest resource use overall is in the wealthiest cities, so wealthy cities contribute disproportionately to environmental impacts related to consumption. An urban dweller in New York consumes approximately three times more water and generates eight times more solid waste than does a resident of Bombay [6,3].

While high concentrations of people offer opportunities to improve the human condition and to reduce their collective ecological footprint, poverty often gets in the way. According to the World Resources Institute [3], one-quarter to one-half of urban inhabitants in developing countries are impoverished, with "little or no access to adequate water, sanitation, or refuse collection." The urban poor make up half, or more, of the population of many developing cities. They are the largest group lacking sanitation services and the gap is growing. In 1990, 33% of the urban population in developing countries had no sanitation services; by 1994 the number was 37%. Yet overall urban sanitation coverage is 63%, while rural sanitation coverage is 18%. In developing countries, 90% of sewage is released untreated [3,7].

Megacities and the Environment

All cities import energy, food, water, and raw materials and export finished products and wastes. The sheer size of megacities weighs against them. Resources have to come from farther and farther away, and transportation arteries can cover only so much surface before gridlock of one sort or another

Table I. The Growth of the World's Megacities

<u>Year</u>	<u>Number of cities with populations >10 million</u>	<u>Number of world's 15 largest cities in developed world</u>	<u>Population of 15th largest city (in millions)</u>
1950	1 (New York City)	11	3.3
1970	3 (Tokyo, NYC, Shanghai)	8	6.7
1994	14 (Tokyo topped 26 million)	4	9.8
2015	15 (7 will exceed 20 million)	1	15.0

sets in.

Waste can be hauled, wafted, or washed out only so fast before the assimilative capacity of receiving systems is exceeded. The sheer volume of waste strains local ecosystems, and wastes sometimes are exported hundreds of miles across state and international boundaries, often ending up in poor areas that need the money.

Hong Kong is a good example of a bad situation. The raw sewage of 3.6 million people plus a mix of industrial waste flows into Victoria Harbor, leaving a residue of contaminated shellfish and oxygen-starved water, reducing biodiversity and marine abundance, and increasing the frequency of toxic algal blooms. Hong Kong is sprawling toward the east, while one of the most rapidly developing areas of China looms to the west, threatening an expansion of coastal degradation [3].

Air pollution reaches farther than sewage effluent. Last June, scientists found a dense, brown haze of industrial air pollution covering about 3.8 million square miles of the Indian Ocean, reducing solar radiation to the ocean surface by as much as 10%. The shadow may be large enough and dense enough to affect both photosynthesis and rainfall [8,9].

On average, air pollution, with the exception of nitric oxide, is lower in the megacities of developed countries than in developing countries. Nitric oxide is an indicator of vehicular traffic. New York, Paris, Tokyo, and Los Angeles are among those cities with the highest atmospheric nitric oxide levels in the world [1].

Water shortages and poor water quality are dire problems in many cities. Even in developed countries, the need for potable water requires drawing heavily on local sources, or on spending energy or other resources to carry water in from remote sources. Los Angeles followed this path and destroyed the orchards of the Owens Valley in the process. Mexico City sits on an aquifer that is sinking more than three feet per year, and also pipes fresh water from across the mountains, consuming costly electric power.

Poor water quality due to pollution forces cities to draw water from further and further upstream [3]. The result is an upstream creep in the environmental as well as the financial costs of clean water.

As we enter the new millennium, 13 of the 15 largest cities of the world lie on or near the coast. What will megacities mean for coastal environments? Multiple stressors acting in concert or in sequence are key to coastal biodiversity loss. We have seen over and over that natural systems are most in

jeopardy when a patchwork of disturbances coalesces to create synergistic impacts, leaving habitats and their inhabitants with either no time or no space to recover.

As the world becomes increasingly linked by the Internet, a new category of cities is emerging--digital cities. These e-cities reduce many of the needs and advantages of living in close proximity, but not all of them. The emergence of e-cities may slow the growth of the largest cities in the developed world, but may have little effect on the developing world for at least the next several decades.

Prospects for the Future

Many cities--not just megacities--link urban conglomerates and rural areas economically and "informationally," have water and sanitation problems, trash problems, poverty-stricken zones, and cores of urban poor. How well a city serves its people or what it does to its environment are functions of wealth and of organization.

The World Bank has found that the more unwieldy the urban bureaucracy, the greater the necessity for smaller units to work independently [7]. In practice this is as true for cities of 500,000 as for those that are much larger.

Robert Kaplan points out that cities foster political instability because urban dwellers depend more on government services, including an affordable food supply, well-maintained transportation, and sewage systems [10]. Delivering high quality public education may be one of the most difficult challenges in larger cities--even in the US. On the other hand, the environmental and social pressures of growing urban populations can be reduced through careful urban planning and management. Cities can sustain recycling programs and create water and wastewater infrastructure systems not practicable in areas with low population density, while city dwellers can more easily reach one another with information and mobilize groups to act on issues.

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