Urban areas

Global overview

Nearly half of the world's population (47 per cent) lives in urban areas, a figure which is expected to grow by 2 per cent per year during 2000–15 (United Nations Population Division 2001a). The accumulation of people, their consumption patterns, travel behaviour and their urban economic activities have a large impact on the environment in terms of resource consumption and waste discharges. However, cities also offer opportunities to manage a growing population in a sustainable way.

Urbanization

Increasing levels of urbanization are caused by natural growth of the urban population and migration of the rural population towards cities. Over the past half-century, a great rural-to-urban population shift has occurred and the process of urbanization (the concentration of people and activities into areas classified as urban) is set to continue well into the 21st century. Driving forces include the opportunities and services offered in urban areas — especially jobs and education — while in some parts of the world,

notably Africa, conflict, land degradation and exhaustion of natural resources are also important (UNEP 2000).

Cities play a major role not only as providers of employment, shelter and services but also as centres of culture, learning and technological development, portals to the rest of the world, industrial centres for the processing of agricultural produce and manufacturing, and places to generate income. There is a strong positive link between national levels of human development and urbanization levels (UNCHS 2001b). However, the implications of rapid urban growth include increasing unemployment, environmental degradation, lack of urban services, overburdening of existing infrastructure and lack of access to land, finance and adequate shelter (UNCHS 2001b). Managing the urban environment sustainably will therefore become one of the major challenges for the future.

Levels of urbanization are closely correlated with national income — the more developed countries are already mostly urbanized — and in almost every country, urban areas account for a disproportionate share of the gross national product (GNP). Bangkok,

for example, produces 40 per cent of Thailand's output, whereas only 12 per cent of its population lives in this city (UNCHS 2001b). Worldwide, cities produce on average 60 per cent of a country's GNP.

The rapid increase of the world's urban population coupled with the slowing of rural population growth has led to a major redistribution of the population over the past 30 years. By 2007, one-half of the world's population will live in urban areas compared to little more than one-third in 1972, and the period 1950 to 2050 will see a shift from a 65 per cent rural population to 65 per cent urban (United Nations Population Division 2001a). By 2002, some 70 per cent of the world's urban population will be living in Africa, Asia or Latin America (UNCHS 2001a).

The most striking current changes are the levels of urbanization in less developed nations: rising from about 27 per cent in 1975 to 40 per cent in 2000 — an increase of more than 1 200 million people (United Nations Population Division 2001b). Furthermore, there is every indication that the trend will continue for the next 30 years, adding 2 000 million people to the urban population of the presently less-developed nations. Within these global averages, there are complex regional differences in urban growth and change. The annual percentage change in the urban population by region shows a general slowing in the rate of urbanization for all regions except North America — see figure below right (United Nations Population Division 2001b).

There has been a dramatic increase in the number

Distribution of global population (%) by size of settlement, 1975 and 2000

| | rural areas | | <1 million | | 1-5 million | | >5 million | |
	1975	2000	1975	2000	1975	2000	1975	2000
world	62.1	53.0	25.1	28.5	8.0	11.6	4.8	6.9
developed regions	30.0	24.0	46.8	48.1	13.9	18.5	9.3	9.5
developing regions	73.2	60.1	17.6	23.7	6.0	10.0	3.2	6.3

Source: United Nations Population Division 2001a

and size of megacities (cities with more than 10 million inhabitants) and urban agglomerations in the second half of the 20th century, as well as a change in the geographical distribution of these cities: in 1900, nine of the ten largest cities were in North America and Europe, whereas today only three (Los Angeles, New York and Tokyo) are located in the developed world. However, most of the world's urban population still lives in small and medium-sized cities (see table) which, in most countries, are now growing faster than the very large cities (United Nations Population Division 2001b).

Links to the global economy

Globalization has been progressing for decades but under the impact of new information technologies the speed of globalization has quickened and its reach has
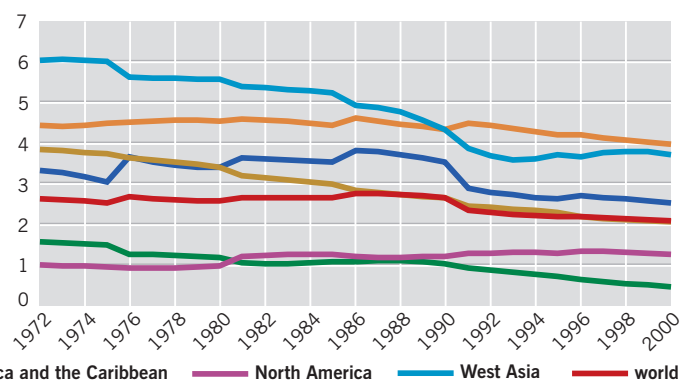

Urban population (% of regional totals) by region
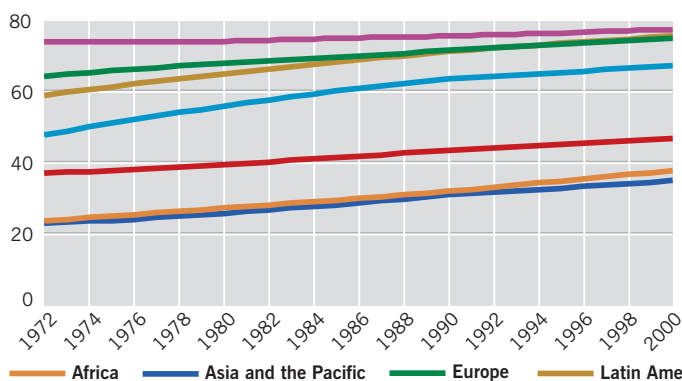
Nearly half the world population now lives in urban areas. Africa, and Asia and the Pacific, are the world's least urbanized regions, North America, Europe, and Latin America the most urbanized

Source: compiled from United Nations Population Division 2001b

Annual percentage increase in the urban population

While all regions are still urbanizing, the rate at which most are doing so is falling, although rates are changing little in Africa and are actually increasing in North America

Source: compiled from United Nations Population Division 2001b

Legend: Africa | Asia and the Pacific | Europe | Latin America and the Caribbean | North America | West Asia | world

Satellite image of global city lights prepared from a long time series of images of the Earth at night. The Eastern United States, Europe, and Japan are brightly lit by their cities while the interiors of Africa, Asia, Australia and South America remain dark and largely rural

Source: Mayhew and Simmon 2000

broadened. These technologies are reinforcing the importance of knowledge and information in economic transformation, while reducing the relative importance of traditional manufacturing and industrial development based on raw materials. In urban areas, this has manifested itself in the growth of the service sector in both absolute and relative terms. Technology has increased the already dominant economic role and importance of urban areas, not just those in the more developed economies but globally (Economist 2000, World Bank 2000), indicating the growing importance of cities in the global economy. In India, software development and related information-communication services is the leading sector for economic growth. This new growth sector — which has grown more rapidly and become internationally more competitive than any of the country's traditional industrial sectors — is concentrated in large urban areas because of the superior infrastructure and educational levels of human resources offered by cities.

In the 1970s, a new phase of globalization started with the deregulation of labour markets, liberalization of financial markets, and privatization of government functions. One of the results was increasing competition for foreign direct investment and employers found themselves able to shift the location of their production facilities more easily, which worsened job and income security in some urban areas but benefited others.

Between the 1970s and mid-1990s, some Asian

countries clearly benefited from this development and showed spectacular economic growth and growth in general well-being. However, during 1997–98 the economic crisis in Asia struck not only these economies but also some in other regions. The human impacts of the crisis were severe; poverty in Asia increased and there were massive lay-offs, particularly of women, the young and the unskilled.

The Asian crisis showed that urban areas are highly vulnerable to global economic impacts. Although globalization has often increased opportunities for jobs and knowledge, it has also increased social inequalities and poverty. Benefits are not equally shared, resulting in large groups of people living in slums in developing countries unconnected to water and sanitary services, and unemployment, poor health and social exclusion in the developed world (UNCHS 2001b).

Urban poverty

Poverty is among the major drivers of environmental degradation. The urban poor, who are unable to compete for scarce resources or protect themselves from harmful environmental conditions, are most affected by the negative impacts of urbanization. The growth of large cities, particularly in developing countries, has been accompanied by an increase in urban poverty which tends to be concentrated in certain social groups and in particular locations. Causes include an increasing gap between incomes

and land prices, and the failure of housing markets to provide for low-income groups (UNCHS 2001a).

Land development processes tend to serve middle and higher income classes, forcing the poor to settle (illegally) in high densities on marginal lands within cities or in the urban periphery, sometimes in areas at risk from environmental hazards such as floods and landslides, and without access to basic services such as water and sanitation.

Urban poverty is on the increase. It is estimated that one-quarter of the population lives below the poverty line and that female-headed households are disproportionately affected (UNCHS 2001a). Worldwide, there is a clear correlation between their poverty and lack of control over resources and lack of full citizenship (UNCHS 2001b).

Urban environment

Urban areas do not have only local environmental impacts but also large so-called 'ecological footprints' (WWF 2000). In their immediate vicinity, cities have a variety of impacts: conversion of agricultural or forest land for urban uses and infrastructure, reclaiming of wetlands, quarrying and excavation of sand, gravel and building materials in large quantities and, in some regions, deforestation to meet fuel demand. The use of biomass fuel also causes indoor and outdoor air pollution. Other effects can be felt further afield such as pollution of waterways, lakes and coastal waters by untreated effluent. Air pollution from cities has an impact on residents' health as well as on vegetation and soils at a considerable distance. Urban transport contributes to air pollution and the large concentration of cars and industries in cities causes the lion's share of urban global greenhouse gas emissions.

Cities are often located in prime agricultural areas. If this land is converted for urban uses, this puts additional pressure on nearby areas that may be less suitable for agriculture. Urbanization in coastal areas often leads to the destruction of sensitive ecosystems and can also alter the hydrology of coasts and their natural features such as mangrove swamps, reefs and beaches that serve as barriers to erosion and form important habitats for species.

Low to medium density residential areas (urban sprawl) around urban centres are common in the developed world. Well developed infrastructure and the increasing use of the car have facilitated this trend. Urban sprawl has an especially damaging effect

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Facts about cities

- In cities of the developing world, one out of every four households lives in poverty; 40 per cent of African urban households and 25 per cent of Latin American urban households are living below locally defined poverty lines

- Fewer than 35 per cent of cities in the developing world have their wastewater treated

- Between one-third and one-half of the solid wastes generated within most cities in low and middle income countries are not collected

- 49 per cent of the world's cities have established urban environmental plans

- 60 per cent of the world's cities involve civil society in a formal participatory process prior to the implementation of major public projects

- Buses and minibuses are the most common (used by most people) mode of transport in cities; cars are the second most common and walking the third

- 5.8 per cent of children in cities of the developing world die before reaching the age of five years

- some 75 per cent of the world's countries have constitutions or national laws that promote the full and progressive realization of the right to adequate housing

- One out of every four countries in the developing world has constitutions or national laws which prevent women from owning land and/or taking mortgages in their own names

- 29 per cent of cities in the developing world have areas considered as inaccessible or dangerous to the police

Sources: GUO 2001 and Panos 2001

The ecological footprints of cities

An ecological footprint is the area of productive land and aquatic ecosystems required to produce the resources used, and to assimilate the wastes produced, by a defined population at a specified material standard of living, wherever that land may be located.

London Trust Co-founder Herbert Girardet has calculated that the ecological footprint of London — with 12 per cent of the UK population and covering just 170 000 ha — comes to some 21 million ha or 125 times the surface area of the city itself, equivalent to all the productive land in the United Kingdom.

William Rees — Professor of Community and Regional Planning at the University of British Columbia — has made an ecological footprint analysis of his home city of Vancouver, Canada. This indicates that Vancouver appropriates the productive output of a land area nearly 174 times larger than its political area to support its lifestyle. Other researchers have found that the aggregate consumption of wood, paper, fibre and food by the inhabitants of 29 cities in the Baltic Sea drainage basin appropriates an area 200 times larger than the cities themselves.

Scientists have calculated that a typical North American city with a population of 650 000 people would require 30 000 km^2 of land, an area roughly the size of Vancouver Island in Canada, to meet its domestic needs without including the environmental demands of industry. A similarly sized city in India would require only 2 900 km^2.

Sources: Global Vision 2001 and Rees 1996

on the environment associated with the increase in use of private motorized transport. Furthermore, low density development occupies proportionally larger areas of land per capita.

Water is a key issue in urban areas. The intensity of demand in cities can quickly exceed local supply. The price of water is typically lower than the actual cost of obtaining, treating and distributing it, partly because of government subsidies. As a result, households and industries have little incentive to

contaminated land management (Butler 1996). Another problem emerging in developed countries is the lack of suitable landfill sites to cater for the increasing demand for solid waste disposal.

Worsening environmental conditions can have serious effects on human health and welfare, particularly for the poor (Hardoy, Mitlin and Satterthwaite 1992). Poor sanitation creates environmental and health hazards particularly by direct exposure to faeces and drinking water

Population of selected major cities of the world by region (millions)
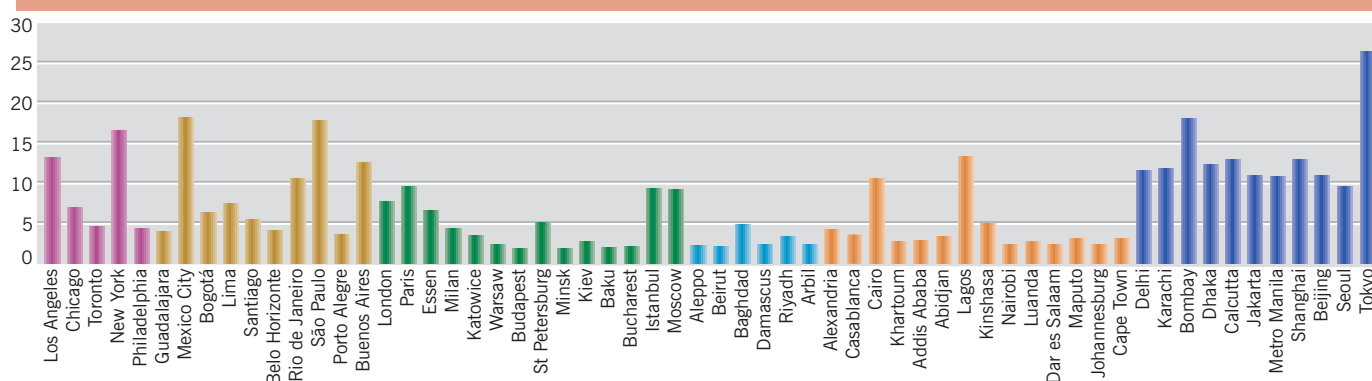
Ten of the world's megacities are in Asia and the Pacific — Tokyo, with more than 26 million inhabitants, is currently the world's largest city

Source: United Nations Population Division 2001a

conserve water (UNEP 2000). Pollution from urban run-off, sewage and untreated discharges of industries has adversely affected many water bodies, leaving many cities with unsafe water supply.

Although local environmental problems tend to diminish with increasing income levels, other environmental problems tend to become worse (McGranahan and others 2001). The most obvious are high levels of energy use and increasing levels of consumption and waste production. Urban residents rely heavily on fossil fuels and electricity, and wealthy cities tend to use more energy and produce more waste.

Inadequate waste collection and waste management systems are the cause of serious urban pollution and health hazards, especially in cities in developing countries. Cities in industrialized countries are now also facing the consequences of past environmentally damaging production techniques and inadequate waste disposal. This has resulted in many different forms of pollution and in particular the formation of brownfields: abandoned, vacant or underused former industrial areas where redevelopment is hampered by environmental problems and lack of adequate information on

contamination. Air and water pollution cause chronic and infectious respiratory disease, water-borne diseases such as diarrhoea and intestinal worm infections, increased mortality rates particularly among children and premature deaths — especially among the poor (OECD-DAC 2000, Listorti 1999, Satterthwaite 1997, McGranahan 1993, Hardoy, Cairncross and Satterthwaite 1990). However, worldwide epidemiological and demographic information suggests that survival rates are better in cities than in rural areas because of better access to health services (UNCHS 2001b). The urban poor are particularly exposed because of their location and because they have limited resources with which to compensate for these problems by buying potable water, securing medical care or escaping floods.

There are many other less quantifiable but nonetheless important environmental impacts, such as loss of green space in urban areas, destruction of special local ecosystems, noise pollution, and aesthetically unpleasant sights and smells. These not only constitute a genuine loss of well-being but they can also erode civic pride and lower morale, leading to indifference and cynicism locally and to a negative image externally.

The relatively disproportionate urban environmental footprint is acceptable to a certain extent because, for some issues, the per capita environmental impact of cities is smaller than would be made by a similar number of people in a rural setting. Cities concentrate populations in a way that reduces land pressure and provides economies of scale and proximity of infrastructure and services (Hardoy, Mitlin and Satterthwaite 2001). Urban areas therefore hold promise for sustainable development because of their ability to support a large number of people while limiting their per capita impact on the natural environment (UNCHS 2001b).

Environmental problems occur because of the concentration of environmentally negative impacts. Good urban planning can reduce these impacts. Well-planned, densely populated settlements can reduce the need for land conversion, provide opportunities for energy savings and make recycling more cost-effective. If cities are properly managed, with adequate attention paid to social development and the environment, the problems present as a result of rapid urbanization, particularly in developing regions, can be avoided. A first step in this direction would be for national governments to incorporate a clear urban component in their economic and other policies.

Successes in urban environmental management include increases in resource efficiency, reductions in waste generation, improving urban infrastructure for water supply, the management and conservation of water resources in urban areas by improved waste water treatment and through legislation, setting up of recycling schemes, development of more effective waste collection systems, strict legislation for the treatment of hazardous waste, waste collection through public-private partnership, adoption of energy technologies by industry and households, and restoration of brownfields.

Urban governance

Many urban environmental problems are the result of poor management, poor planning and absence of coherent urban policies rather than of urbanization itself. Through experience, it has been learned that no amount of finance, technology or expertise can secure environmentally sustainable development — or protect the environment — if the fundamentals of governance are not participatory, democratic and pluralistic. For example, many developing countries

Young boys sifting through waste on a dump outside a city in Viet Nam

Source: UNEP, Thiyen Nguyen, Viet Nam, Still Pictures

Nairobi's garbage

The Dandora garbage dump in Nairobi provides a livelihood for many scavengers. In 1992 Father Alex Zanoteteli started the Mukuru Recycling Centre, helping the scavengers work together to collect different types of garbage more efficiently and sell to middlemen for better prices. The project now has 140 members and with the help of Habitat's Settlements, Infrastructure and Environment Programme has organized itself into a cooperative, with several different projects. One buys waste from individual scavengers, sorts it and sells it to recycling industries — in addition to running a dairy project. Another gathers waste from commercial buildings in the city; it earns small fees for cleaning up the commercial buildings and income from selling the waste to paper and other recycling industries. A third manufactures fuel briquettes from paper and other waste such as sawdust and coffee husks. A fourth manufactures compost from organic waste. The centre is about to establish a facility for recycling plastic.

Source: Panos 2001

The rise of urban farming

Growing food in and around cities has become a major industry, vital to the well-being of millions of poor and some not-so-poor urban residents. It is estimated that 15 per cent of all the food consumed in urban areas is grown by urban farmers and that this percentage will double within 20 years. Some 800 million people are estimated to be involved in urban farming worldwide (see 'Land'). The following examples from different regions illustrate the potential of urban agriculture.

Africa

The cultivation of food crops is economically significant in many African urban areas, where city dwellers pay 10 to 30 per cent more for their food than do rural inhabitants. In Kenya and Tanzania, two out of three urban families engage in farming, and nearly every open space, utility service reserve, road, valley or garden in the towns has been taken up for crop planting. In Cairo, one-quarter of all households raise small livestock which provide 60 per cent of household incomes.

Women play a vital role in urban agriculture, many of whom engage in cultivation as a survival strategy. This process of the 'ruralization' of African cities is not a consequence of mass rural-urban migration but is a response to fluctuations in the economies of developing countries' cities. Urban cultivation is not practised exclusively or even primarily by recent migrants. Most farmers originate from poor households that are fully entrenched in the urban economy.

Latin America and the Caribbean

Every available space — including roofs and balconies — has been given over to urban food production in Cuba's capital, Havana. Intensive urban farming methods including hydroponics help secure fresh food for urban dwellers. The city council facilitates the integrated management of wastewater for food production.

Regional standards for wastewater treatment are developed by the Pan American Centre for Sanitary Engineering and Environment Sciences in Lima, Peru. Systems of wastewater management and re-use at different levels of purity, from woodlots to aquaculture, are promoted and utilized in several countries in the region.

Europe

Some 72 per cent of all urban households in the Russian Federation raise food, and Berlin has more than 80 000 urban farmers. The St Petersburg Urban Gardening Club has become famous for its promotion of roof top gardening. Its research shows that in just one district (St Petersburg has 12) it is possible to grow 2 000 tonnes of vegetables per season from 500 roof tops. Many crops are grown including radishes, lettuce, onions, cucumbers, tomatoes, cabbage, peas, beets, beans and flowers. The growth of chicory for salads is encouraged as a source of vitamins in the winter. Rooftop gardening is popular because the gardens are secure and cannot be attacked by vandals. The St Petersburg Urban Gardening Club publishes books and has its own web site.

Source: UNCHS 2001a and 2001b

have extensive regulations on pollution, most of which are seldom if ever applied effectively because of the lack of proper institutions, legal systems, political will and competent governance (Hardoy, Mitlin and Satterthwaite 2001). Unfortunately, particularly where economic and social change is rapid, established political and administrative institutions have proved highly resistant to change.

The past 30 years have seen significant political change with profound implications for urban areas and for the urban and global environment. These include:

- the collapse of central planning;
- the extension of democracy;
- decentralization and demands for empowerment and self-determination;
- increasing pluralism in politics and society; and
- pressures for participation, accountability and transparency in government.

These trends appear to be strengthening, reinforced by globalization and especially by the impact of freer and faster flows of information and knowledge.

Efforts to improve urban governance involve activities such as promoting participatory processes; developing effective partnerships with and among all actors of civil society, particularly the private and community sectors; securing greater effective empowerment of local government, including greater autonomy in finance and legislation; and reform of unresponsive organizations and bureaucratic structures.

They also involve city-to-city cooperation and exchange of experiences and lessons learned. The International Council for Local Environmental Initiatives works with 286 local governments in 43 countries to improve local energy management and reduce greenhouse gas emissions (Skinner 2000). Initiatives such as the Stockholm Partnership for Sustainable Cities have been developed to introduce sustainability into city planning through partnership between cities and business. Habitat's Local Agenda 21 initiatives have been proved effective in implementing sustainable development policies that involve community members and government (Tuts and Cody 2000).

Because of the importance of specific local circumstances and political realities, there is no viable approach to solving urban environmental problems that can be applied in every city. A first step is to develop a local environmental agenda to assess the local situation regarding environmental issues so that this information can be used in city planning. Whereas the emphasis in 1970 was largely focused on public policy and regulation, the focus of the early 1990s was on markets and technical solutions. At the turn of the century, urban environmental management appears to

be focusing more on changing cultures — corporate, economic and political (Elkington 1999).

Conclusion

Given the expected scale of urban population growth in the coming decades, continued growth in the number of urban poor will pose a fundamental challenge for global sustainability (Environment and Urbanization 1995a and 1995b, Pearce and Warford 1993). A major concern is the development of megacities and large urban areas in the developing world, because of the speed and scale of urbanization and the incapacity of these cities to provide sufficient housing and basic urban services.

Improved urban environmental management could help avoid many negative environmental impacts, particularly if governments adopt clear urban policies as an integral part of their economic policies. However, urban growth is not yet well managed in most of the rapidly urbanizing areas, and this leads to major environmental and health problems, mainly associated with poverty.

Urbanization will continue to play a major role in the economy, environment and people's lives. The challenge is to learn how to live with urbanization while using its benefits and guiding undesirable and negative impacts in manageable directions.

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Urban areas: Africa

While the majority (62.1 per cent) of the African population is still rural, urban growth rates at nearly 4 per cent a year are the most rapid in the world, and nearly twice the global average (United Nations Population Division 2001). Growth rates are predicted to average 3.5 per cent per year over the next 15 years, meaning that Africa's share of the world's urban population will increase from 10 to 17 per cent between 2000 and 2015 (United Nations Population Division 2001).

North Africa is the most urbanized sub-region with an average urban population of 54 per cent, followed by West Africa (40 per cent), Southern Africa (39 per cent), Central Africa (36 per cent) and the Western Indian Ocean islands (32 per cent). The least urbanized sub-region is Eastern Africa with only 23 per cent of the population living in urban areas (United Nations Population Division 2001). Malawi has the highest urban growth rate of any country in Africa, which at 6.3 per cent is three times the world rate.

Not only are there more people living in cities but the cities themselves are becoming larger, and more numerous. There are now 43 cities in Africa with populations of more than one million inhabitants, a figure which is expected to increase to almost 70 by 2015 (United Nations Population Division 2001).

Africa's high urban growth rate is a result of rural-urban migration, population growth and, in some areas, conflict. People leave rural areas because of declining agricultural productivity, lack of employment opportunities and lack of access to basic physical and social infrastructure. The expectation of higher
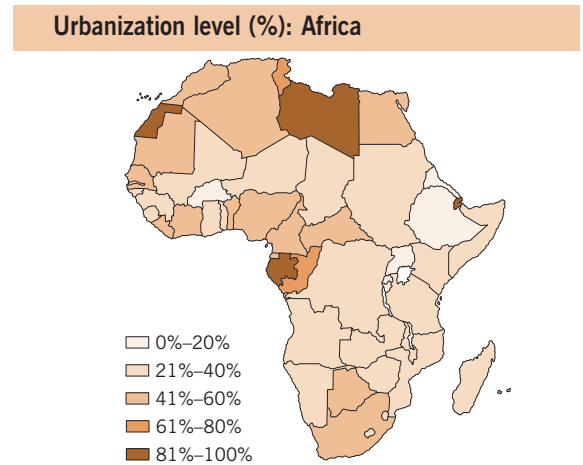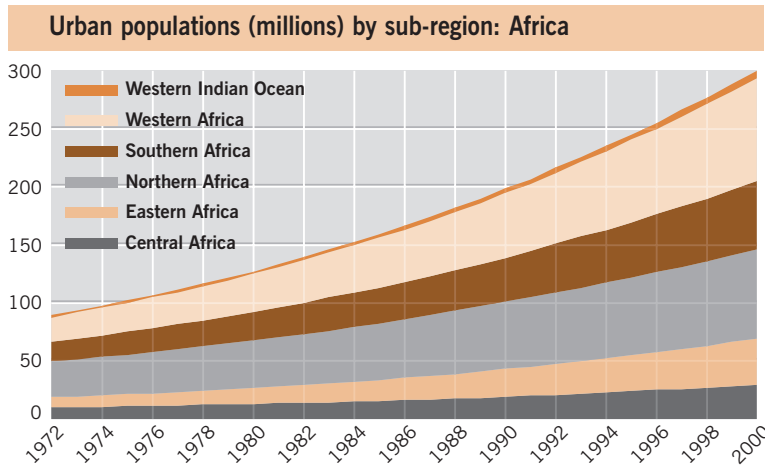
incomes and standards of living in urban areas is seldom realized, however, and urban poverty is widespread and growing. In Moroni, Comoros, 40 per cent of the population lives in poverty (RFIC 1997), and in Southern Africa up to 45 per cent of urban households grow crops or raise livestock in urban environments in order to supplement their livelihoods (UNDP 1996). Environmental disasters and conflicts have also caused many people to flee rural areas and seek refuge in urban centres. In Mozambique, about 4.5 million rural people were displaced to urban areas due to civil strife in the 1980s (Chenje 2000), while the third largest settlement in Sierra Leone is a displaced persons camp (UNCHS 2001b).

Because of slow economic growth in many African countries, lack of sound development policies and an increasing number of small households, infrastructure development has been unable to keep pace with the burgeoning need for shelter and services for growing urban populations. As a result, many African cities have an increasing number of overcrowded, informal settlements, or 'shanty towns', characterized by inadequate housing and poor provision of infrastructure such as roads, street lights, water supplies, sanitation and waste management services. Often these settlements are developed on fragile environments such as steep slopes, natural drainage waterways and flood-prone areas. Inadequate housing and settlement design can also contribute to declining security and increasing levels of crime in African cities (Shaw and Louw 1998).

Governments and authorities have attempted to meet the demand for housing and services through increased construction. South Africa, for example, has

Graph below shows growth of urban populations in the African sub-regions since 1972; the map shows current level of urbanization as a percentage of total population

Source: compiled from United Nations Population Division 2001

Urban populations (millions) by sub-region: Africa

Legend:
- Western Indian Ocean
- Western Africa
- Southern Africa
- Northern Africa
- Eastern Africa
- Central Africa

Urbanization level (%): Africa

- 0%–20%
- 21%–40%
- 41%–60%
- 61%–80%
- 81%–100%

produced more than one million low-cost houses during the past six years (DoH South Africa 2000). However, lack of awareness of resource-efficient construction practices has resulted in excessive use of natural resources and generation of large amounts of construction waste that is rarely recycled (Macozoma 2000). In addition, new settlements have mostly been on open land on the urban periphery rather than on little used land within the cities, thus requiring expansion of infrastructure rather than more intensive use of existing networks. Attention is now shifting to integrated development planning, and housing policies that support environmentally sustainable housing have been developed in some countries.

Key environmental issues in urban areas in Africa are related to the provision of services for waste, water and sanitation, and urban air pollution.

Waste services, water supply and sanitation

The volume of solid waste generated in urban areas is increasing with the growing population, higher consumption levels and the use of more packaging in the retail industry. Rates of waste generation are outstripping the capacities of local authorities to collect, treat and dispose of waste. Across Africa, only 31 per cent of solid wastes in urban areas are collected

(UNCHS 2001b). Inadequate urban infrastructure leads to untreated waste and waste remaining uncollected or improperly disposed of. In Accra, for example, although there is a system of collection from waste points in most residential areas, collection is erratic and legal intermediary dumps overflow (McGranahan and others 2001). Burning of solid waste is common in many countries but the toxic fumes thus released contribute to air pollution. Only 2 per cent of African waste is recovered and recycled (UNCHS 2001b) due to lack of economic incentives and markets for recycled materials. The most commonly recycled materials are paper, textiles, glass, plastic and metal. Composting is carried out to some extent in Egypt, Morocco and Tunisia.

The proliferation of unplanned settlements in the urban areas of Africa has been accompanied by inadequate provision of potable water and sanitation. On average, 85 per cent of African urban populations had access to improved water sources in the year 2000, although this ranged from 100 per cent in Botswana, Djibouti, Mauritius, Morocco and Namibia, to just 29 per cent in Guinea-Bissau and 31 per cent in Chad (WHO and UNICEF 2000). The average urban population with access to improved sanitation was 84 per cent, ranging from 100 per cent in Mauritius and Morocco to 12 per cent in Rwanda and 14 per cent in Congo (WHO and UNICEF 2000). The numbers of people with these services have increased over the past 10 years (see bar chart below) but the percentages have hardly changed.

In order to improve the performance of municipal governments and public utilities, public-private partnerships are being increasingly promoted to provide water management and sanitation services.

Urban population (millions) with and without improved water and sanitation: Africa
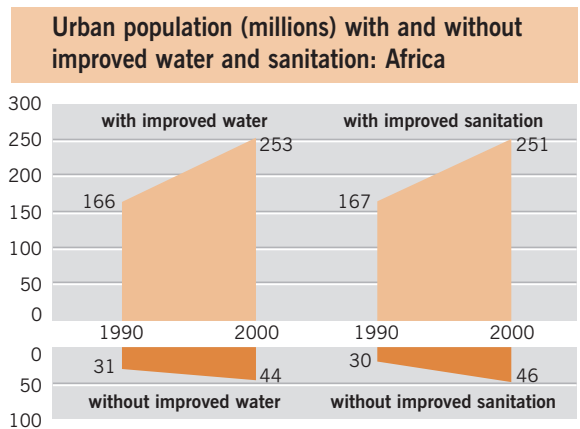
Some 85 per cent of urban Africans now have improved water and sanitation

Source: WHO and UNICEF 2000

The use of traditional fuels in dense informal settlements is leading to damaging levels of air pollution, particularly harmful to children

Source: UNEP, Dilmar Cavalher, Topham Picturepoint

These partnerships have met with mixed success. While private participation in water supply and sanitation services brings in new investment capital, management and organizational skills, and technical know-how, there is a perceived bias towards meeting the demands of upper and middle-income groups.

Air pollution

A growing concern in many urban centres, particularly large cities, is the level of air pollution, mainly from vehicle exhausts, industrial emissions, and domestic use of woodfuel, coal, paraffin and refuse for heating and cooking. In Cairo, fumes from the 1.2 million vehicles, combined with suspended particulate matter and sand blown into urban areas from the neighbouring desert create an almost permanent haze over the city. Levels of suspended particulate matter

and lead pollution are among the highest in the world, creating a high risk of respiratory disorders to the 10.6 million inhabitants (UNCHS 1996, SEI 1999). In recognition of this risk, only unleaded fuel is now sold in Cairo, and the rest of the country is expected to follow suit by the end of 2002.

In dense, informal settlements, the use of traditional fuel sources contributes to rising ambient levels of sulphur dioxide, nitrogen oxides, carbon monoxide, ozone and suspended particulate matter. Exposure to these pollutants is associated with increased risk of acute respiratory infections, particularly among children. Electrification of households, promotion of low-smoke fuels, and improved ventilation of houses are some of the measures that have been adopted to reduce health risks.

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Urban areas: Asia and the Pacific

Urbanization in Asia and the Pacific is predicted to grow at an average rate of 2.4 per cent per annum between 2001 and 2015. The current level of urbanization ranges from a low of 7.1 per cent in Bhutan to 100 per cent in Singapore and Nauru. Australia and New Zealand is the most urbanized sub-region (85 per cent) and South Pacific the least (26.4 per cent). In seven countries in the region (Australia, Japan, Nauru, New Caledonia, New Zealand, Republic of Korea and Singapore) the level of urbanization is more than 75 per cent, while the 12 megacities in the region — Beijing, Calcutta, Delhi, Dhaka, Jakarta, Karachi, Metro Manila, Mumbai, Osaka, Seoul, Shanghai and Tokyo — accommodate 12 per cent of the urban population (United Nations Population Division 2001 and UNESCAP and ADB 2000).

In some of the larger cities, excluding those in Australia and New Zealand, up to 60 per cent of the inhabitants live in informal settlements, with a population density of up to 2 500 persons per hectare (Ansari 1997). These settlements suffer from a lack of infrastructure and services such as water supplies, sewerage, drainage, roads, health care and education.

The major urban environmental issues in the region are air pollution and inadequate services.

Urban air pollution

Air pollution is common, particularly in developing country cities, due to the growing number of motor vehicles and increasing industrial activity. In countries such as India, Indonesia, Nepal, Malaysia and Thailand vehicles with two-stroke engines, such as motorcycles and three-wheel taxis, comprise more than one-half of all motor traffic and pollute heavily. Poor maintenance of vehicles, poor fuel quality and poor road conditions also contribute. The burning of biomass such as firewood and agricultural wastes is a further source of air pollution in many poor areas (World Bank 2000).

Motor vehicles cause serious environmental problems in developed countries as well. In Australia and New Zealand, there is a high dependence on private motor vehicles which leads not only to the need to clear land for roads but also to increasing emissions of carbon dioxide, lead, zinc and copper (Hughes and Pugsley 1998, MoE New Zealand 1997).

A range of policy measures and technologies including catalytic converters, unleaded fuel and alternative fuels such as compressed natural gas are being introduced to improve the quality of urban air. New coal-fired power plants in many Asian countries now use electrostatic precipitators which can reduce emissions of particulates by more than 99 per cent. Subsidies are provided for the use of renewable technologies such as wind turbines and solar photovoltaics. In China, the city of Beijing has implemented 68 atmospheric pollution prevention measures which are resulting in significant reductions in SO_2, NO_2 and SPM levels (SEPA 1999).
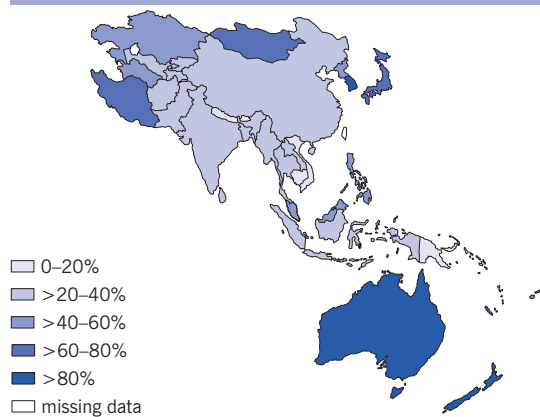
Waste management

Much of the solid waste generated in urban centres remains uncollected and is either deposited in surface waters and empty lots, or burned in streets. This problem has worsened over the past 30 years. Collected waste is mainly disposed of in open dumps, many of which are neither properly operated nor

Graph and map show high level of urbanization in Australia and New Zealand compared with other sub-regions. Urbanization is proceeding fast in all other sub-regions except Central Asia

Source: compiled from United Nations Population Division 2001

Urbanization level (%): Asia and the Pacific

- 0–20%
- >20–40%
- >40–60%
- >60–80%
- >80%
- missing data

Urban populations (millions) by sub-region: Asia and the Pacific

- South Pacific
- Southeast Asia
- South Asia
- Northwest Pacific and East Asia
- Central Asia
- Australia and New Zealand
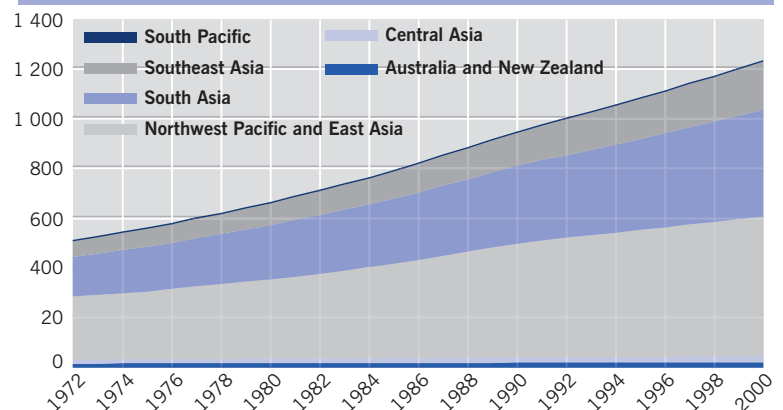
maintained, and which pose a serious threat to public health. Only a few Asian cities such as Hong Kong and Singapore, and those in Australia, Japan and New Zealand, have adequate solid waste disposal facilities but even these cities have problems in dealing with increasing volumes of waste (ADB 2001).

In the mid-1990s, Metro Manila generated 6 300 tonnes of solid waste daily but its landfills could accommodate only a little more than half that amount (ADB 1996). The island of Kiribati has severe population density problems caused by internal migration and has little land for waste disposal. As on many atoll islands, solid waste is discharged into coastal waters.

Serious health and environmental problems can be caused by poor waste disposal. In the Pacific Islands, freshwater is scarce, and solid waste disposal methods that contaminate water are frequently a source of intestinal diseases and ear and eye infections. In India, an outbreak of bubonic plague in 1994 was linked to inadequate solid waste disposal (Tysmans 1996).

The disposal and treatment of industrial, toxic and hazardous waste also causes serious problems. Dumping of hazardous waste is common in South and Southeast Asia. Countries such as Bangladesh, India and Pakistan have become dumping grounds for significant quantities of hazardous waste from industrialized countries, and are facing growing protests about waste-related pollution.

A large number of stakeholders are involved in national waste management policies and strategies. Waste management services have been privatized in

Sustainable commuting in Singapore

With a total land area of 650 km^2 and a population of 4.1 million, Singapore faced serious challenges of limited space and high population density when designing its transit system. A combination of buses, mass rapid transit (MRT) lines, light rapid transit lines and taxis, Singapore's public transportation system currently supports about 5 million of the total 7 million trips made every day, with 3 million on buses, 1 million on the MRT and another 1 million in taxis.

Singapore has implemented a strict vehicle quota system, under which a certificate must be acquired before registering a vehicle. This allows the government to restrict the increase in vehicle numbers. An electronic road pricing system charges a fee to cars during peak hours, encouraging motorists to use public transportation or less busy roads. Vehicle inspection centres carry out mandatory testing of cars more than three years old and exhaust emissions to ensure they meet the limits set by the Ministry of Environment. The government has also introduced tax incentives to encourage the use of electric and hybrid vehicles.

Source: Swee Say 2001

countries such as Japan, the Republic of Korea, Malaysia and Thailand. This appears to be an effective means of improving these services, while providing additional employment. However, much waste is generated by small producers, who are difficult to service with traditional methods.

Water and sanitation

For most cities, providing an adequate and safe supply of water for domestic and industrial uses is a major problem. In spite of significant investments, the sewage systems in many major cities still cannot support a high-density urban environment with the result that sewage is often discharged directly to drains or waterways, or disposed of in individual septic tanks that are poorly maintained.

Afghanistan has by far the lowest percentage of urban population with access to improved water sources (19 per cent) and sanitation (25 per cent) in the region. However, in absolute terms China and India have by far the largest number of urban people (more than 20 million each) without access to a safe water supply (WHO and UNICEF 2000).

Sanitation services are less developed than water supply, with 23 per cent of urban residents still lacking adequate sanitation (compared to only 7 per cent lacking access to improved water sources). These figures are compiled from the sample of 38 Asian and

By the year 2000, improved water supplies had been provided to a larger proportion of the urban population (95 per cent) than had improved sanitation (65 per cent)

Note: data are available for many more countries in 2000 than in 1990 so the improvement appears exaggerated

Source: compiled from WHO and UNICEF 2000

Urban population (millions) with and without improved water and sanitation: Asia and the Pacific
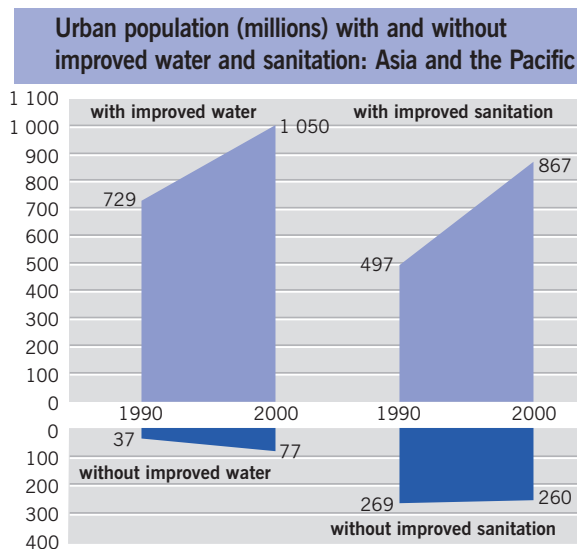
Pacific countries for which statistics are available for the year 2000 (WHO and UNICEF 2000). More than 50 per cent of the urban population in Afghanistan and Mongolia still have no access to improved sanitation.

Another major urban environmental issue is flooding and land subsidence. For example, in Bangkok monsoon run-off frequently exceeds the Chao Phraya river drainage capacity — a problem exacerbated by the progressive filling of the 'khlongs' (canals) as urban areas expand. Furthermore, excessive groundwater extraction has produced remarkable land subsidence in Bangkok. Land subsidence increases the probability and worsens the impacts of flooding. Similar conditions are reported in other river basins (ADB 2001).

Addressing urban environmental problems

Several governments are promoting decentralized and participatory development to help mobilize resources for improving urban infrastructure. However, the process of decentralization is severely constrained by a lack of institutional capacity among local governments, limited resource mobilization at the local level, and limited access to long-term financing for investment programmes (World Bank 1998). Although decentralization and local autonomy are gaining more momentum, excessive controls are still exercised by higher levels of governments resulting in a mismatch between the responsibilities of local governments and their resources (UNCHS 2001).

In addition to national actions, international and regional programmes have been developed to support urban environmental management in the region. These include the Regional Action Plan on Urbanization, Asia-Pacific Initiative 2000, Land Management Programme, the Local Leadership and Management Training Programme, and Action Planning for Sustainable Urban Development (Local Agenda 21).

Urbanization is one of the most significant issues facing Asia and the Pacific. Uncontrolled growth, inappropriate waste disposal practices, lack of adequate drinking water supply and sanitation facilities, flooding and land subsidence are crucial issues facing urban areas today. In response, investment in domestic wastewater systems, solid waste management schemes, and water supply schemes have been accelerated in many countries. Urban areas offer opportunities for employment, better education and health facilities but they find it increasingly difficult to provide the physical infrastructure required for adequate services to underpin human health and well-being.

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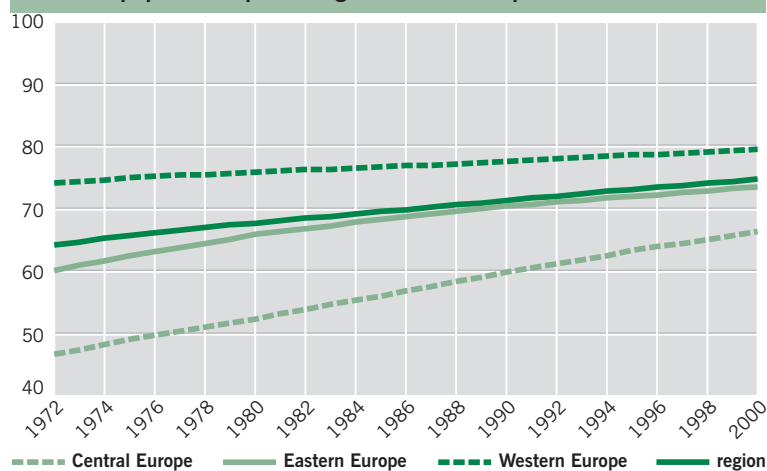
Urban areas: Europe

In Europe, the urban population increased steadily throughout the 1960s and 1970s and there was also a massive outflow from the inner cities to the suburbs. Since the 1970s, the trend has been a continued 'sprawling' of cities due to expanding infrastructure, higher household income, diminishing size and increasing number of households, and demographic ageing. Between 1980 and 1995, the urban population in Western Europe increased by 9 per cent (United Nations Population Division 2001) but the number of households in the area increased by 19 per cent (EEA 2000).

The level of urbanization in Europe is currently 74.6 per cent with an expected annual growth of 0.3

Urban population (percentage of total): Europe

Legend: - - - Central Europe   ── Eastern Europe   - - - Western Europe   ── region

Europe's population is currently 76 per cent urbanized, a figure which is expected to stabilize at 82 per cent

Source: United Nations Population Division 2001

per cent per year between 2000 and 2015 (UNCHS 2001a). It is expected that Europe will stabilize at an urbanization level of about 82 per cent. Currently, one-half of the population of Europe lives in small towns of 1 000–50 000 people, one-quarter in medium-sized towns of 50 000–250 000 people and one-quarter in cities of more than 250 000 people (UNCHS 2001b). Further urbanization in Europe is not expected to change this pattern significantly.

The problems of urban development and its impact on the environment have been challenging for European policy-makers. Compounding the problem in CEE and NIS countries is the fact that, in the past ten years, national governments have transferred a wide array of urban (environmental) responsibilities to local or regional authorities but have not provided adequate resources to fulfil these responsibilities. Local

authorities all over Europe have begun to implement Local Agendas 21 and local Habitat Agendas; a significant number have adopted the Charter of European Cities and Towns, which emphasizes integrated approaches towards sustainability and better collaboration between cities. A review of the implementation of the Habitat Agenda shows that progress has been made in Europe in improving the efficiency of water use through advanced technological processes and the establishment of water resource management plans and policies (UNCHS 2001c). Efforts have also been made to reduce air and water pollution through reductions and prevention of discharges of the most polluting and hazardous substances, as well as reuse and recycling incentives. However, increased air pollution generated by motor vehicles remains a strong concern. In Eastern Europe, the use of obsolete communal heating systems and coal burning is a major cause of pollution problems. Two other key issues in Europe are noise pollution and solid waste.

Urban air quality

Across Europe, transport and mobility are becoming major issues for most cities. In the urban areas of Western Europe, half of all car trips are for less than 6 km while 10 per cent are for less than 1 km. The major factor affecting the increase in traffic is increasing travel distances to work, shopping, schools and leisure activities. These distances are increasing because origins and destinations (residential areas, industrial areas, shopping areas and so on) are being located further apart and often primarily linked with roads. Also, as a result of globalization, increasing competition forces people to find work in different locations and different jobs at different times of the day. Alternatives to the car such as public transport, walking and cycling facilities are often poorly developed or ill-adapted to newly emerging urban patterns (EEA 2001). Major exceptions are Denmark and the Netherlands where infrastructure for alternatives to the car is well developed.

The increase in vehicle traffic has significant implications for urban air quality, although this has been partially offset by a reduction in major air pollutant emissions from transport in Western European countries. Nevertheless, considerable numbers of people in urban areas are still exposed to high pollution levels, leading to some health-related

Growth of urban sprawl along the French Riviera, 1975–90
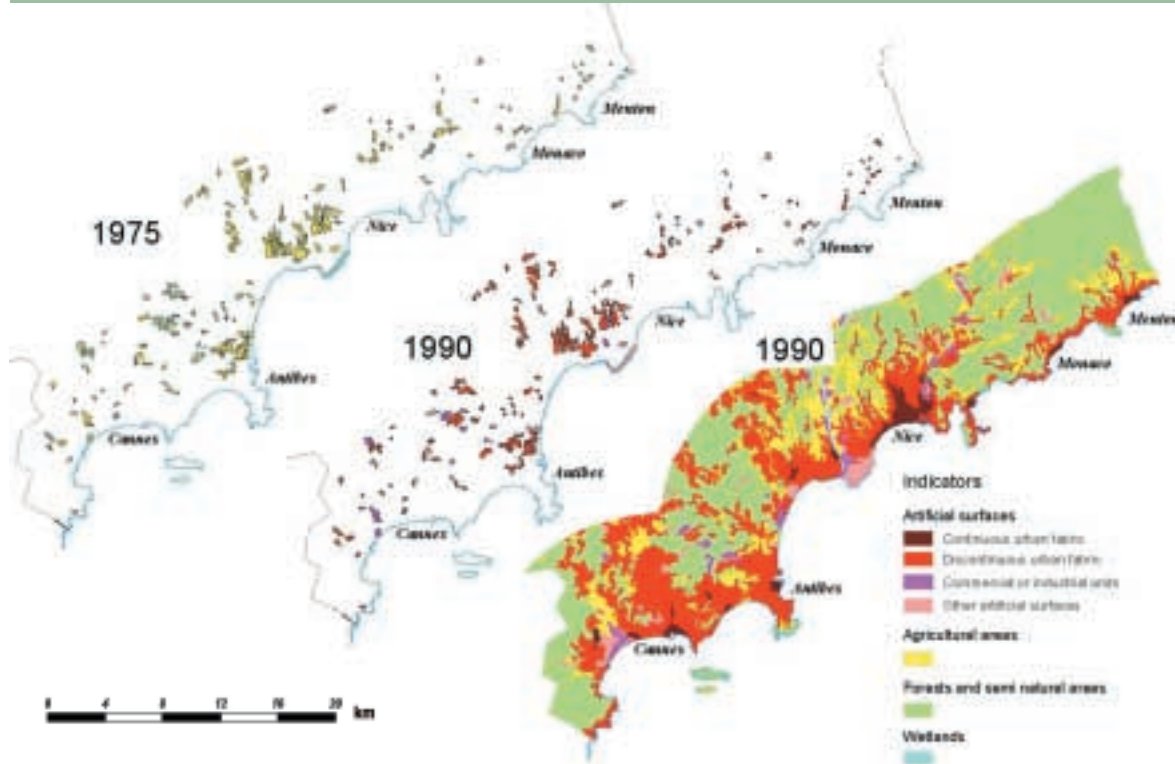
Maps show growth of urban sprawl along a 10-km strip of the French Mediterranean coast between 1975 and 1990. Two maps on the left identify agricultural and forested areas that were urbanized during 1975–90. Near map shows the end result — some 35 per cent of the strip is now built on

Source: Blue Plan 2001

issues. Projections for 2010 show that 70 per cent of the urban population are still likely to be exposed to particulate matter levels in excess of threshold values, 20 per cent to excess NO_2 and 15 per cent to excess benzene (EEA 2001).

The number of exceedance days for NO_2 in CEE cities is much lower than in EU cities, and far below the number allowed by EU directives. However, with affluence levels and the number of vehicles increasing, photochemical smog — associated with increasing NO_x, hydrocarbons and carbon monoxide — has recently become a problem. The move towards lead-free petrol and mandatory catalysers on private vehicles is now helping improve urban air quality in these countries.

Noise pollution

Of the 75 per cent of European citizens who reside in urban communities, more than 30 per cent live in dwellings with significant exposure to road noise. This is in spite of major reductions of noise limits from individual sources, such as cars and lorries. However, new vehicle standards have a noticeable effect on noise levels only when vehicle renewal is well

advanced, which can take up to 15 years (EEA 1999).

The dramatic increase in air travel since 1970 has led to a significant increase in noise around airports. However, since the mid-1990s aircraft noise pollution has been reduced by a factor of nine compared with aircraft from 1970. Noise pollution around some European airports is restricted by legislation prohibiting night-time movements, while in CEE the application of economic instruments in the form of fines levied for aircraft noise pollution has been an effective deterrent (REC 1999). It is anticipated that the projected air traffic growth to 2010 can be accommodated at most main airports without significant increases in noise exposure (EEA 1999).

To date, noise policy has been primarily concerned with fixing maximum sound levels for vehicles, aircraft, machines and plants (for example EC 1996). A new directive concerning environmental noise will harmonize EU noise measurements and monitoring, and require countries to make noise maps publicly available as a basis for the development of action plans. In major CEE cities, noise abatement measures are becoming an integral part of new urban development schemes.

Solid waste

There is a strong correlation between economic growth and waste generation, especially waste from urban-based consumption. In the EU, waste generation per capita from household and commercial activities, which constitutes only part of the total amount of municipal waste, already exceeds the target of 300 kg per capita per year set in the EU's fifth environmental action plan (EEA 2001) by 100 kg. Most European countries have recycling schemes, particularly for paper and glass — although this development has been only a partial success because the generation of waste paper and glass has also increased.

Sludge from urban wastewater treatment plants is estimated to have increased in the EU from 5.2 to 7.2 million tonnes dry solids during 1992–98, and further growth is expected (EEA 2001). Such volumes are increasingly difficult to absorb through incineration, dumping in landfills and recycling in agriculture. The problem is being compounded by the fact that sludge is often contaminated with heavy metals and other toxic chemicals, which even in minute concentrations can affect human health (Hall and Dalimier 1994).

In most European countries, landfilling is still the most common treatment route for waste, even though there is an increasing shortage of available sites. This is because, in both Western and Eastern Europe, recycling is rarely economically viable. However, 'producer responsibility' for the environmentally sound disposal of packaging and products is achieving widespread acceptance (UNEP 1996).

Different approaches have been adopted in different countries. Germany is shifting responsibility for managing packaging waste to industry as a mandate, while in France agreements are mostly voluntary although stringent reporting is required (UNEP 1996). In France, municipalities remain responsible for waste collection but industry has been made responsible for the recycling of only certain materials. In the United Kingdom, all companies involved in the packaging chain are required to meet a share of the total responsibility: 47 per cent for retailers, 36 per cent for packers and fillers, 11 per cent for converters, and 6 per cent for raw material manufacturers (PPIC 1998).

Air quality, noise pollution and waste are not the only urban environmental problems in Europe. Other problems include traffic congestion, utilization of green space, management of water resources and, particularly in CEE, an ageing urban infrastructure such as deteriorating apartment housing and inadequately maintained water mains. To deal with these often interrelated problems, focus is shifting from issue-based approaches to more integrated models for sustainable urban development. Legislation is still one of the major implementation instruments for improving the urban environment. However, instruments such as economic incentives mechanisms, awareness creation through information campaigns and strategic investments are also being used to address environmental concerns (UNCHS 2001c).

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Urban areas: Latin America and the Caribbean

Latin America and the Caribbean is the most urbanized region in the developing world. Between 1972 and 2000 the urban population rose from 176.4 million to 390.8 million, prompted by better services and job opportunities compared to rural areas. During this period, the percentage of the population living in urban areas increased from 58.9 to 75.3 per cent, accounting for 79.8 per cent of the population in South America, 67.3 per cent in Central America and 63.0 per cent in the Caribbean (compiled from United Nations Population Division 2001). This urban–rural ratio is similar to that seen in highly industrialized countries.

With the exception of Brazil, urbanization patterns typically involve a single, very large city per country. In addition to an expansion of existing urban areas, urbanization has also taken place in some rural districts — 61 per cent of the inhabitants of the Amazon region now live in urban areas. Deep inequalities persist in most of the countries in the region and much poverty is concentrated in urban areas. For example, one-third of the population of São Paulo and 40 per cent of the population of Mexico City live at or below the poverty line. Between 1970 and 2000, the number of urban poor in the region rose from 44 million to 220 million people (UNCHS 2001a).
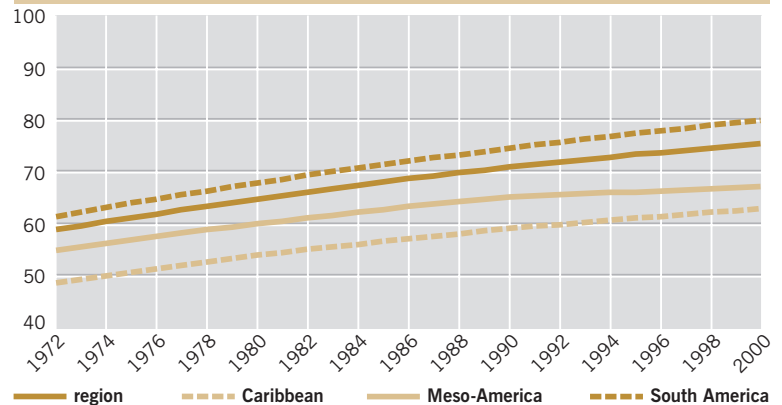
Although environmental problems are not limited to the largest cities, their impact is most evident there. Urban environmental problems include the concentration of domestic and industrial solid wastes, lack of sewage and air pollution.

Solid waste

Three decades ago, solid waste production was 0.2–0.5 kg/day per capita; it is now about 0.92 kg/day per capita. In 1995, the region's urban population generated 330 000 tonnes of solid waste per day (CELADE 1999, Acurio and others 1997). Buenos Aires, Mexico City and São Paulo alone generate approximately 51 000 tonnes of garbage per day (see figure right). Although solid waste collection has almost 90 per cent coverage, there is no adequate disposal mechanism for 43 per cent of this waste (PAHO 1998).

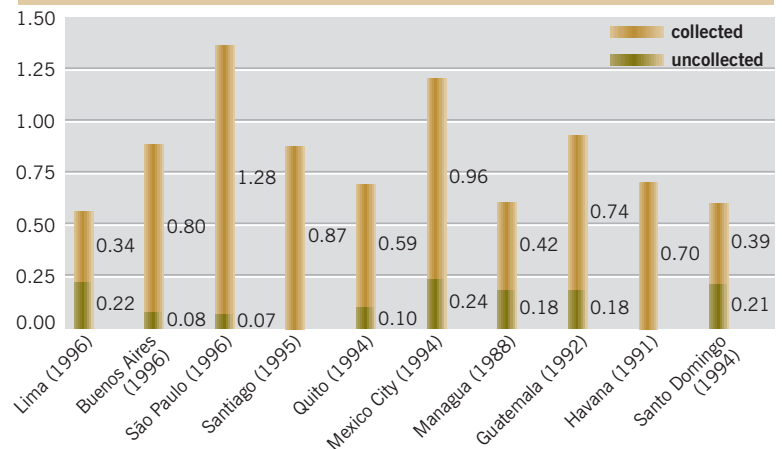The increase in solid waste cannot be explained by urban growth alone. Changes in lifestyle patterns play a major role and waste generation is significantly higher in the more affluent parts of cities. The problem with urban waste is not only the quantity but also the composition, which has changed from dense and almost completely organic to bulky and increasingly non-biodegradable. Increasing amounts of plastic, aluminium, paper and cardboard are being discarded by households and industries. Hazardous waste such as hospital waste, expired drugs, chemicals, batteries and contaminated sludge pose potential risks to human health and the environment alike when handled improperly. Although some countries have a legal framework for waste control, almost all lack the physical infrastructure and human resources necessary to enforce it (UNEP 2000).

Urban population (percentage of total): Latin America and the Caribbean

region — Caribbean — Meso-America — South America

Graph shows the high levels of urbanization in the region, particularly in South America

Source: compiled from United Nations Population Division 2001

Waste disposal in selected cities (tonnes/year/person)

collected / uncollected

City	collected	uncollected
Lima (1996)	0.34	0.22
Buenos Aires (1996)	0.80	0.08
São Paulo (1996)	1.28	0.07
Santiago (1995)	0.87	
Quito (1994)	0.59	0.10
Mexico City (1994)	0.96	0.24
Managua (1988)	0.42	0.18
Guatemala (1992)	0.74	0.18
Havana (1991)	0.70	
Santo Domingo (1994)	0.39	0.21

Collected and uncollected waste in selected cities in Latin America and the Caribbean; however, much of the collected waste is improperly disposed of. Figures in brackets show year of survey

Source: PAHO and IADB 1997

Water supply and sanitation

Although in the past 30 years the proportion of the urban population with access to drinking water and sewage system services has increased, many people are still affected by a lack of basic services. In the year 2000, 93 per cent of urban households had access to improved water sources and 87 per cent to improved sanitation — ranging from 50 per cent in Haiti to 100 per cent in the British Virgin Islands, Montserrat and Suriname (WHO and UNICEF 2000).

Groundwater pollution resulting from inadequate sewage treatment endangers public health (PAHO

A model for public transport systems

The Mayor of Curitiba, Brazil, describes his city as 'a model for developed and developing countries alike'. Its urban transport system, constructed in the 1970s, encouraged residential and business development, and harmonized with the plans for the city. In 1973, the Research and Urban Planning Institute of Curitiba developed special buses designed for mass transit. Further adapted and enlarged to respond to growing population needs in the 1980s and 1990s, the system now transports two million people per day. The integrated transit network provides four alternate modes of transport, integrated within the 12 municipalities of the metropolitan region. The mass use of Curitiba's transit system has reduced the number of vehicles on the road, thereby reducing air pollution, lowering the incidence of smog and lessening the threat of respiratory illness.

Curitiba became the first city in Brazil to use a special fuel made up of 89.4 per cent diesel, 8 per cent anhydrous alcohol and 2.6 per cent soybean additive. This fuel is less polluting and cuts particle emissions by up to 43 per cent. The mixture of alcohol and soybean additive also brings social and economic benefits, maintaining employment in rural areas: every billion litres of alcohol used generates approximately 50 000 new jobs.

Source: Taniguchi 2001

1998) and poses a serious challenge to the region's policy-makers. Currently, less than 5 per cent of municipal wastewater in the region is treated (UNEP 2000). There is a clear demand for wastewater treatment systems to reduce water pollution. Pollution of surface and groundwater makes water in urban areas an increasingly contentious issue (Dourojeanni and Jouravlev 1999, PAHO 1998, CEPAL 1994).

The public sector lacks the capacity to operate and maintain existing water and sanitation systems, let alone invest in new ones — especially in the poorest areas where urbanization has occurred most recently. This has led to greater private sector participation since the 1980s and decentralization of the responsibility for providing services to local government (Pirez 2000, CEPAL 1998). However, Latin America still lacks a management model to ensure equity and environmental sustainability in services (Pirez 2000, Idelovitch and Ringskog 1995).

Air quality

Over the past 30 years, air quality has deteriorated seriously in many urban centres and exposes millions of people to pollutant levels above the limits recommended by the World Health Organization (CEPAL 2000). Air pollution affects the health of more than 80 million inhabitants in the region and results in the annual loss of some 65 million working days. It is the main cause of almost 2.3 million cases a year of respiratory disease in children and more than 100 000 cases of chronic bronchitis in adults (CEPAL 2000).

Two factors have contributed to the increase in urban air pollution: an increase in the number of motor vehicles and an increase in travel time due to road congestion (CEPAL 2000). Motor vehicles produce 80–90 per cent of the lead in the environment, even though unleaded gasoline has been available for some time in most countries in the region (World Bank 2001). Deficient public transport as well as the separation of homes from workplaces in cities, resulting in more frequent and longer journeys, have also contributed to the increase in emissions (CEPAL 2000). The large distance between the home and the workplace stems from the absence of national urban policies combining economic, environmental and social goals. Nevertheless, the region also has some good examples of urban planning since the 1970s (see box). A combination of physical and meteorological factors associated with the location of large cities has also influenced the pollution rate (CEPAL 2000) — for example, the metropolitan area of Mexico City is located in a valley that captures pollutants causing smog.

In the past ten years, there has been substantial progress in air quality management in a number of cities. Air pollution in large cities such as Buenos Aires, Mexico City, Rio de Janeiro, São Paulo and Santiago has been reduced by means of strategies that include emission controls, changes in fuels and contingency controls. However, these programmes have not yet been extended to medium-sized cities in most of which the information needed to implement such measures is not available (ECLAC and UNEP 2001).

Effects of policies

The economic policies predominating in the region during the 1980s made the introduction of environmental measures difficult as a limit was put on social spending on basic services and sanitation. Although the 1990s were marked by the continuation or persistence of environmental problems typical of poverty and the formation of large cities, the decade also saw the introduction of a number of positive changes including greater citizen participation and the development of public and private networks defending the environment and promoting environmental education. These changes contradict the catastrophic projections for the state of the urban environment that were made in the 1970s (CEPAL 1995, Villa and Rodríguez 1994, CEPAL 2000). However, there is a serious need for substantive evolution from sectoral and fragmented management of cities towards comprehensive and multi-sectoral (national) urban policies and strategies where environmental issues are integrated into all the dimensions of urban management.

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Urban areas: North America

North America is a highly urbanized region. In the period 1972–2000, the percentage of North America's population living in cities increased from 73.8 to 77.2 per cent (United Nations Population Division 2001). Urbanization is related to many of the environmental issues highlighted in this report, including the conversion of agricultural land, habitat degradation and biodiversity loss, regional air pollution, global climate change, coastal degradation, an increased urban-wildlife interface and water pollution.

By the 1970s, the post-war exodus from central cities had led to a settlement pattern characterized by low-density suburbs surrounding city cores, commonly referred to as 'urban sprawl'. Addressing the multiple problems associated with urban sprawl has become a priority in many North American municipalities. Urban populations use high levels of energy and other resources and dispose of large amounts of waste. Because of their significant contribution to both regional and global pollution, and to declines in the Earth's natural resources, North American cities have disproportionately large 'ecological footprints'.

Urban sprawl

Urban sprawl is defined as low-density, automobile-dependent residential development (Dowling 2000). It is equated with intrusion into rural or undeveloped land on the periphery of a city or town, beyond the edge of service and employment areas (Chen 2000). Sprawling sub-divisions in post-war North America have been fuelled by economic expansion and encouraged by incentives for home ownership, single-use zoning, government subsidies, and investments in highways and suburban infrastructure (ULI 1999, Sierra Club 2000a). As tax-paying, middle-income families left urban centres, many cities turned into impoverished city cores surrounded by car-dependent suburbs serviced by malls.
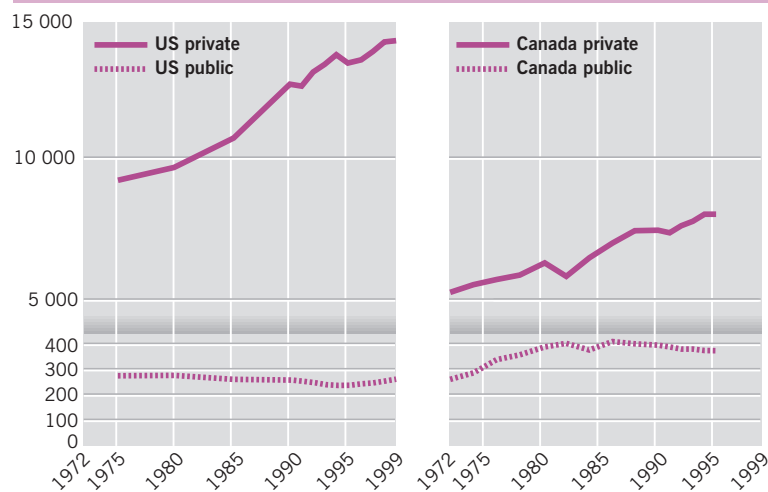
In the United States, a cycle of public transit decline, increased car use and longer commuting distances took place over the 1970s and 1980s; this was mirrored by Canada during the 1990s. Between 1981 and 1991, the number of car-kilometres travelled by Canadian and US citizens grew by 23 and 33.7 per cent respectively (EC 1998, Raad and Kenworthy 1998). The trend of increased urban car use and stagnant or declining transit use is illustrated below left.

Encouraged during the 1990s by new road building and low fuel prices, the US suburban population grew by 11.9 per cent between 1990 and 1998, compared with 4.7 per cent for central cities (Pope 1999, Baker 2000, HUD 2000). Today, one-half of US sprawl appears to be related to population increase and the other half to land-use and consumption choices that increase the amount of urban land occupied per resident (Kolankiewicz and Beck 2001).

Suburban developments have been built over vast areas of North America's forests, wetlands, recreational wilderness and agricultural land. As these landscape features are lost, so are the services they provide, such as wildlife habitat, flood and run-off control, and soil productivity (Parfrey 1999). Between 1982 and 1992, an average of 5 670 km^2 a year of prime farmland in the United States was developed for urban use (NRCS 2000). Today, an average of 9 320 km^2 of land is being converted annually, with a substantial portion for suburban homes on lots of 0.5 ha (HUD 2000). In Canada, the urban areas occupying land that could be used for crop production increased from about 9 000 km^2 in 1971 to 14 000 km^2 in 1996 (Statistics Canada 2000).

Urban sprawl has environmental, social and economic consequences including traffic congestion, deteriorating inner cities that are often fragmented along class and racial lines, and suburban problems of

Private and public transport use (passenger-km/year per capita): Canada and United States

The per capita use of private vehicles in urban areas has grown in both the United States and Canada while the use of public transport has stagnated or dwindled

Sources: compiled from EC 1998, Wendell Cox 2000 and United Nations Population Division 2001

isolation and lack of sense of community (Raad and Kenworthy 1998, Dowling 2000). Canadian cities are much less affected by sprawl than their US counterparts (Parfrey 1999, Baker 2000, Sierra Club 2000b).

Increasingly, state and local governments are implementing smart growth and sustainable development plans (see box). Studies show that where urban density is highest, car use per capita is the lowest (Raad and Kenworthy 1998). Successful 'infill' projects in which decaying properties or vacant lots are developed to help cities rebound are now more common. On the other hand, in many places it is still less expensive in the short term for developers to buy and build on land outside city zones (Chen 2000).

At the federal level, initiatives to help address sprawl-related problems include the US 1998 Transportation Equity Act (TEA-21) and the Livable Communities Programme. Most activity addressing urban sprawl takes place at the planning level of government, however. Many of Canada's major urban regions are instituting long-range transportation plans aimed at reducing car dependency and adopting sustainability strategies for higher density, mixed use urban development (Raad and Kenworthy 1998).

There are still many hurdles on the path to sustainable cities: powers to address urban sprawl are generally split among federal, state/province and local governments, and their proper roles are still undefined (Stoel Jr 1999, Dowling 2000); effective compliance regimes to ensure implementation are lacking (Raad and Kenworthy 1998); to some, smart growth implies the loss of individual freedom and property rights fueling an anti-smart growth lobby (Stoel Jr 1999); vested interests of the car manufacturing industry are strong, while suburban sprawl is so entrenched in the North American landscape and psyche that reversing the trend is a formidable challenge.

Ecological footprint

As suburbs have grown, many of North America's compact central cities have been replaced by a mixture of widely dispersed shopping malls, housing developments and highways (Miller 1985). This pattern of urbanization is one of the principal forces driving the global increase in energy demand (UNDP, UNEP, World Bank and WRI 1996). North American cities consume large amounts of energy and raw materials, and produce large amounts of waste and

### Compact urban development and smart growth

Over the past 10 years, a 'smart growth' movement has emerged in North America to combat urban sprawl. Smart growth is characterized by a mix of residential, office and retail land uses close to civic buildings clustered in a town centre. 'Smart' growth is emphasized rather than 'no' growth, and reform codes and ordinances are sought that permit smart growth characteristics and that create urban growth boundaries (ULI 1999). Smart growth is promoted by a broad coalition including environmental NGOs, social justice activists, local government officials, urban planners and affordable housing advocates. The movement promotes high-density neighbourhoods that reduce car use.

Compact development techniques advocated by smart growth and sustainable city initiatives include building within an already urbanized area, redeveloping on cleaned-up contaminated sites or 'brownfields', and cluster development on reduced-size lots. Such developments use less land area and help reduce travel distances, encourage walking and cycling, stimulate public transit, preserve open green spaces, wildlife habitat and farmland, and reduce impervious surface areas thereby improving drainage and water quality (US EPA 2001).

pollution. And with only five per cent of the world's population, North America is a major consumer of the world's natural resources and a major producer of its wastes. As a result, its impact on the global environment is larger than that of any other region.

North America also produces more municipal solid waste than any other region. Municipal solid waste generated in the United States continues to increase but much more slowly than before 1970; at the same time, waste recovery is increasing and discards to land fills are decreasing (see figure below). Lightweight but high-volume materials such as paper and plastic are replacing dense and heavy materials in the waste

Solid waste disposal (million tonnes/year) in the United States

- recovery for composting
- recovery for recycling
- combustion
- landfill, other disposal
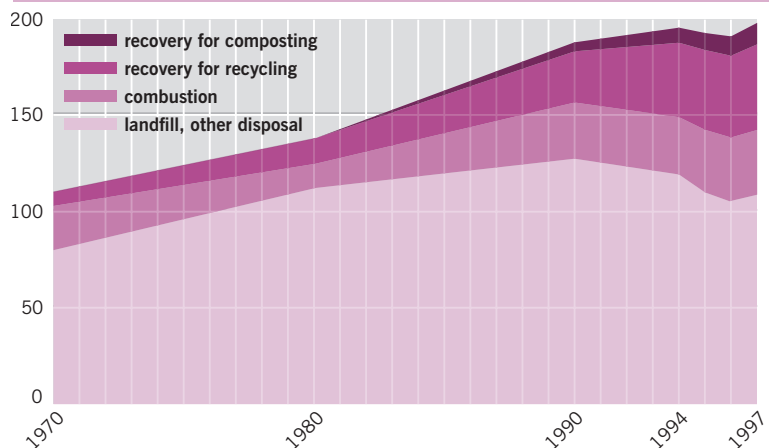
Total solid waste disposal in the United States is increasing less fast than before, landfill disposal is decreasing and recycling increasing

Source: Franklin Associates 1999

stream which increases waste volumes (PCSD 1996a). The continued use of older technologies, coupled with a consumer lifestyle based on the desire for mobility, convenience and product disposability, has limited the further advancement of resource efficiency and waste reduction (UN 2001).

Agenda 21 identified unsustainable consumption and production, especially by industrialized countries, as the major cause of global environmental deterioration (UN 2001). Since 1993, the issue of sustainable patterns of consumption and production has become a part of policy debate. Both federal governments promote eco-efficiency through a number of programmes. The US President's Council on Sustainable Development has recommended national goals for natural resources stewardship, population planning and sustainable consumption

(PCSD 1996a, b). Industry is increasingly restructuring its processes and re-sourcing raw materials to reduce their environmental impact; there is also a perceptible rise in the number of 'green' or socially and environmentally conscious consumers (Co-op America 2000).

North America's urban industrial society is at the same time the provider of a quality of life envied by many of the world's developing countries and, given its large ecological footprint, a region with a disproportionate environmental impact on the planet. When cities are planned to be compact, they are more efficient and sustainable. North America's smart growth and sustainable city programmes could reduce the region's ecological footprint but they are still in their infancy and progress is slow.

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Urban areas: West Asia

The majority of the West Asian population lives in urban areas, with the notable exception of Yemen, where the predominantly rural population is expected to grow by 2.7 per cent between 2000 and 2015 (UNCHS 2001). The past 30 years have brought about significant economic, political and technological changes, which have influenced the way urban areas are structured and function in West Asia. Three crucial factors have shaped the urban landscapes of the region (UNESCWA 1999):

- the 1970s oil boom and the sharp fluctuations of oil revenues during the following two decades;
- the large-scale movement of people within the region because of armed conflict and civil strife; and
- the forces of globalization that have played and continue to play a vital role since the beginning of the early 1990s, integrating West Asian nations into the global economy and increasing the role of information technology.

Rapid economic growth, which occurred in most countries in the region over the past three decades, was accompanied by population growth and increased urbanization. There has been a massive migration of the population from rural to urban areas in nearly all countries as well as immigration of foreign workers into urban areas, especially in the Gulf Cooperation Council (GCC) countries. Between 1972 and 1980, the total urban population increased from 17.8 million

(44.7 per cent of the total population) to 27 million (55.8 per cent of the total population). The average annual growth rate of the urban population in this period was 5.6 per cent, substantially more than that of the general population, which was 3.6 per cent. Urbanization has continued to increase at a faster rate than the total population (United Nations Population Division 2001a) although there are marked differences in the level and pace of urbanization between the sub-regions and among the countries of the region.

Spectacular growth and urban transition occurred in Oman, where the urban population increased from 11.4 per cent of the total population in 1970, to 84 per cent by 2000. All the countries of the Arabian Peninsula now have a level of urbanization above 84 per cent, except Yemen with a level of urbanization of only 24.7 per cent (see map). By the year 2000, almost the entire population of Bahrain (92.2 per cent), Kuwait (97.6 per cent) and Qatar (92.5) were living in urban areas (United Nations Population Division 2001a).

The average annual growth rate of urban populations in West Asia has slowed over the past three decades, from 6.1 per cent in 1972 to 3.7 per cent in 2000. The impact of the Second Gulf War on urbanization rates was particularly significant, resulting in the repatriation of millions of foreign workers.

Although urban areas are increasingly home to most of the West Asian population, the proportion of people living in cities with more than 1 million residents is still small. In 1975, only two cities (Baghdad and Damascus) had a total population of
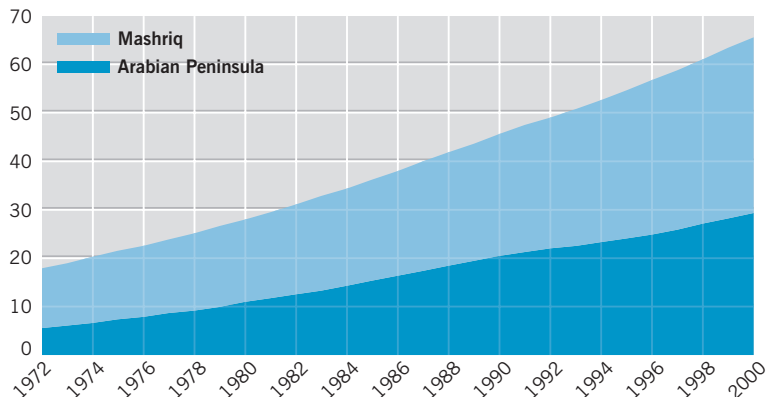
Map and graph show high level of urbanization in West Asia, with the exception of the still largely rural Yemen

Source: compiled from United Nations Population Division 2001a

Urbanization level (%): West Asia

- ☐ 0–50%
- ☐ >50–60%
- ☐ >60–70%
- ☐ >70–80%
- ☐ >80–90%
- ☐ >90%
- ☐ missing data
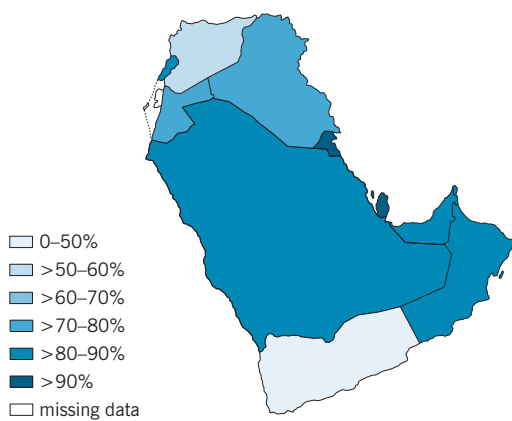
Urban population (millions) by sub-region: West Asia

Mashriq
Arabian Peninsula

Rapid urbanization in West Asia is occurring at the expense of both rural lifestyles and smaller-scale village settlements, such as this one in Iran

Source: UNEP, Mohammad R. L. Mofrad, Topham Picturepoint

more than 1 million, accounting for a quarter of the total urban population of the region. The number of large cities has doubled every ten years, reaching 12 in the year 2000, but their population as a share of the total urban population has still remained between 25 and 37 per cent. The absolute number of people living in these cities, however, increased from 3.88 million to 23.8 million between 1975 and 2000.

Urbanization is inextricably linked with the economic transition that is taking place in the region from agrarian and nomadic societies to one that is based on manufacturing and services. Economic development has brought dramatic improvement in the well-being of the West Asian people including longer life expectancies, higher incomes and decreased child mortality rates (United Nations Population Division 2001b). However, despite these positive impacts, many cities are now going through a transition process marked by some negative influences. In parts of the region (Mashriq), the pace and scale of change often strains the capabilities of national and local governments to provide adequate services to the urban poor. In such situations, human health and well-being are at risk (UNDP, UNEP, World Bank and WRI 1998). Growth of urban populations is also synonymous with growth in urban poverty. Most of the large cities are crowded and have high levels of air pollution from increasing traffic, energy consumption and industrial production.

Land conversion

As urban areas expand, prime agricultural land, coastal habitats and forests are transformed into land for housing, roads and industry. Coastal ecosystems, including wetlands, tidal flats, saltwater marshes and mangrove swamps, are especially threatened by urban land conversion. Land conversion activities range from draining and filling of marshes and wetlands to large-scale reclamation projects that extend shorelines into the sea. In Lebanon and most of the countries of the GCC, these activities have been carried out for decades. Between 1970 and 1985, Dubai City increased in size from 18 km^2 to 110 km^2 (Doxiadis Associates 1985), part of which was achieved through coastal reclamation. Continuing reclamation along the coastal areas of Bahrain for urban development has

resulted in a continuous change in the shape of the island. The area of Bahrain increased from 661.9 km^2 in 1975 to 709.2 km^2 (an increase of 7.15 per cent) in 1998; land was mainly allocated for housing, industrial and recreational purposes (CSO 1999). The trade-offs between preserving existing marshes, wetlands and coastlines, on the one hand, and the conversion of such areas into land suitable for urban purposes, on the other, are often decided by considerations based on the positive impacts of urbanization on human development and the need to satisfy the ever-growing demands of urban growth.

Solid waste

It is estimated that municipal waste generation in the region increased from 4.5 million tonnes a year in 1970 to 25 million tonnes a year in 1995 (Kanbour 1997). The per capita waste generation rates at country level were 430, 750, 511, 551 and 510 kg a year in Bahrain, Dubai, Kuwait, Oman and Qatar respectively (Kanbour 1997) — more than double the annual waste generation rates of 285 and 185 kg in the Mashriq countries of Iraq and Syria. Municipal waste management varies between countries but, in the GCC countries, waste collection and disposal systems are fairly efficient compared to those of the Mashriq. Plants for composting municipal solid wastes and sewage sludge have been established in several countries, and their numbers are increasing (Kanbour 1997).

Because of the availability of abundant energy and investment capital, industrial growth has occurred rapidly, especially in the GCC countries. In the Mashriq countries, the highly unregulated transition from an agrarian to an industrial society has resulted in widespread social and economic disruption,

unemployment, pollution and increased exposure to health hazards. Land degradation, and pollution of river systems and coastal areas, are widespread because of uncontrolled rapid industrialization. In most countries of the Arabian Peninsula, industrial growth involves the transformation of raw materials (oil) into industrial products. Not only are these industries resource-intensive but industries such as electricity generation, chemicals and petroleum refining, mining and printing also produce a large amount of hazardous and toxic wastes, which have potential health effects (Hardoy, Mitlin and Satterthwaite 2001). Some of the countries of the region lack adequate facilities to handle hazardous wastes, and this leads to dumping on fallow or public land, in rivers, coastal waters or in sewers designed for discharge of municipal wastes only.

The demands of cities

The nexus of people and economic activity (including manufacturing, services and commerce) in urban areas of the region requires resources far in excess of what the local area can supply. Cities must draw their supplies of food, fuel and water from distant places. By the year 2030, 142.6 million people will be living in the urban areas of West Asia. These will require land, energy, water and food. As their incomes rise, they will consume greater quantities of goods and in the process will generate greater quantities of waste. The scale of urban consumption and waste generation, and the negative impacts associated with them, varies from city to city, depending largely on a city's wealth and size (UNDP, UNEP, World Bank and WRI 1996). Not surprisingly, the highest levels of resource use and waste generation occur in the wealthy cities of the GCC countries.

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Urban areas: the Polar Regions

While the Antarctic is uninhabited, the Arctic has 3.75 million permanent residents, according to the Arctic Council. Most settlements have remained modest in size, with populations of less than 5 000 people. The vast majority of Arctic residents today are non-indigenous immigrants. This shift in demographic make-up has been accompanied by a steady increase in urbanization, with migration from smaller settlements to larger urban settings, a general trend throughout the Arctic (see box).

On the other hand, North America attempted to avoid permanent settlements around mines and oil

Urban growth in the Arctic

Greenland has experienced urban growth since the 1970s (Rasmussen and Hamilton 2001). Roughly one-quarter of Greenland's population lives in Nuuk, the capital. This concentration of the urban population in one city is found in other Arctic countries: 40 per cent of Iceland's growing population lives in Reykjavik, one-third of the Faroe Islands' people lives in Torshavn, and almost 40 per cent of the population of Canada's Northwest Territories' lives in Yellowknife.

Anchorage in Alaska is the only North American Arctic city with a population of more than 100 000. The rapidly growing population of Anchorage reached 262 200 in 2001, while the population of the next largest city of Arctic Alaska, Fairbanks, declined slightly over the past decade to 30 500.

Norway has pursued a policy of discouraging migration from its northern counties, providing significant support to stimulate jobs, industry, higher education and research in the North. While this policy has not stemmed the decline in small settlements, Tromsø, the largest city in the Scandinavian Arctic, grew to 49 600 in 2001 despite its location at nearly 70° N.

fields by using shift workers rather than moving families north. Facilities were deliberately located away from indigenous villages, and since the 1980s agreements and partnerships have been developed with indigenous organizations to reduce environmental and social impacts, and to increase local employment (Osherenko and Young 1989).

The Russian Federation has 11 cities with populations of more than 200 000 above 60° N (Weir 2001). All grew around resource exploitation, including fishing, wood processing, mining and fuel extraction (CIA 1978). The population of Murmansk, Russia's only ice-free port in the Arctic, grew to 440 000 in 1989. Economic incentives were used to attract people to work in extractive industries in the Russian north, accompanied by the development of urban centres with multi-story apartment blocks, built on permafrost with few or no road or railway connections.

Since the demise of the Soviet Union, the influx into the Russian Arctic has begun to reverse. Following market reforms, contraction of social safety nets, reduced government subsidies, devaluation of the currency and general economic decline in post-Soviet Russia, cities have been unable to support large populations. In the formerly prosperous coal-mining city of Vorkuta, coal production recently dropped to only 2 per cent of what it had been 10 years earlier, the municipal budget had a 100 per cent deficit and the population declined by nearly 30 000 (Weir 2001, World Gazetteer 2001). Tens of thousands left cities such as Norilsk and Murmansk between 1989 and 2001, and in some places the population declined by more than 50 per cent. The Russian Government — with World Bank assistance — provided housing credits and other aid to those seeking to relocate from the Arctic (Weir 2001, World Gazetteer 2001).

The rapid growth of the Arctic population (see 'The socio-economic background') and its increasing concentration in urban settlements has significant implications for the fragile ecosystems of the north. The pressures of urbanization in the Arctic are comparable to those elsewhere but are magnified by the challenges of the climate and remoteness. For example, with winter temperatures dipping as low as –60°C in parts of the Arctic, and with an almost continuous state of darkness for months on end, per capita energy use is very large, adding to the pollution burden of the Arctic. Except for Iceland, which has thermal power, urban centres rely on diesel fuel, hydroelectric or nuclear power. Road networks are expanding and this is leading to increased land use conflicts with wildlife and indigenous people. Habitat fragmentation and sanitation and waste disposal pose perhaps the greatest urban environmental problems.

Habitat fragmentation

Traditionally, dozens of small groups of semi-nomads orbiting around a small settlement practised a form of extensive land use that fed and supported significantly larger populations. Nomadic indigenous economies use different types of environments at different times of the year, and thus minimize the possibility that a particular resource will be exploited to exhaustion. In this way, indigenous land use in the Arctic encompasses most of the space between isolated urban cities (Anderson 1995).

By contrast, industrial developments such as mining employ an intensive land use strategy, creating

expanding rings of pollutants such as heavy metals and sulphur dioxide. This has depopulated tundra and taiga environments formerly used by herders and hunters, and disrupted population dynamics and the migration routes of wild reindeer. Intensive resource development is also a driving force for the formation of road and utility networks.

The habitat fragmentation that arises as a consequence of such developments has both ecological and social impacts. Wild deer migrate in unpredictable ways mixing with domestic herds and causing domestic reindeer to run off with wild herds. Then, as herders lose the reindeer they depend upon for transport and are unable to hunt wild reindeer, they have to depend on social welfare payments. Land privatization further exacerbates problems as indigenous people find their access to resources restricted or barred (Anderson 2000).

A single species (*Rangifer terandus*), that includes the caribou and reindeer, is a primary resource for many indigenous peoples. It has therefore been suggested that urban industrial areas should be isolated from the main Arctic areas of reindeer pasture, and from the main migration routes and calving areas of caribou in North America. Prime areas of reindeer herding should be set aside for reindeer herding and ecosystem protection (Konstantinov 1999). Herders must drive domestic reindeer long distances to reach slaughterhouses located in towns. This reduces the quantity and quality of meat produced, and also degrades land near towns. Herders have recommended re-establishing a network of trade posts (many existed in the mid-1930s), equipped with modern slaughterhouses in tundra locations central to herders (Golovnev and others 1998).

Sanitation and waste

The safe disposal of waste presents a challenge in the Arctic since the cold climate prevents normal decomposition. Many communities incinerate waste but this contributes to pollution and has aesthetic impacts.

While larger cities have sewage systems, many smaller communities have yet to provide all their citizens with sewage treatment or septic systems. In 1994, half the rural households in Alaska had only 'honey buckets' for the disposal of human waste. By 2001, 70 per cent of rural households had clean water and sewage disposal, and the State aims to relegate the honey bucket to the museum by 2005 (Knowles 2001). Poor housing, water quality and sanitation facilities are

The interplay of rural and urban populations

Constant contact and exchange occurs between rural and urban populations in the Arctic. While physical boundaries are clear, social and economic boundaries are porous. Hunters and herders come to villages (and in the Russian Arctic are even listed on the census roles of villages) and villagers visit and send their children to the tundra and to fish camp during vacations. This interchange, economic interdependence and constant motion of people is well noted in the Russian and American Arctic as well as in Greenland. The notion that urban groups of indigenous minorities do not lead a traditional life is certainly questionable and, in some cases, wrong (Bogoyavlenskiy 2001).

reported as serious concerns throughout Russia's north and in small communities in Alaska. Many small settlements and parts of larger cities in the Russian Arctic have no indoor plumbing. Funding from federal and regional municipalities is slowly catching up with the need for medical, sanitation, and consumer goods and services in the North.

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OUR CHANGING ENVIRONMENT: Everglades, United States

South Florida, the southeastern tip of the United States, was once a 23 000 km^2 unbroken marshland of sawgrass and small tree islands. The Kissimmee-Okeechobee-Everglades region formed a system of rivers, lakes and wetlands that controlled water flow, mitigated seasonal flooding, filtered sediment, and provided habitats for hundreds of species.

In 1948, the federal government started draining the Everglades and building dikes and canals for agricultural uses. There was a large loss of biodiversity, with some 10 million alligators killed between 1960 and 1965. Populations of herons, egrets, storks and spoonbills had, by 1979, decreased by 90 per cent. By 1998, 68 species were endangered or threatened with extinction.

Agricultural intensification produced sugar cane, tropical fruit and winter vegetables. However, that benefit is now threatened by encroachment from urban areas. Since 1998, the US Army Corps of Engineers has been attempting to restore the natural function of the Everglades. The estimated cost is US$7.8 billion, which covers only the first stage of the restoration effort, which is expected to require more than three decades.
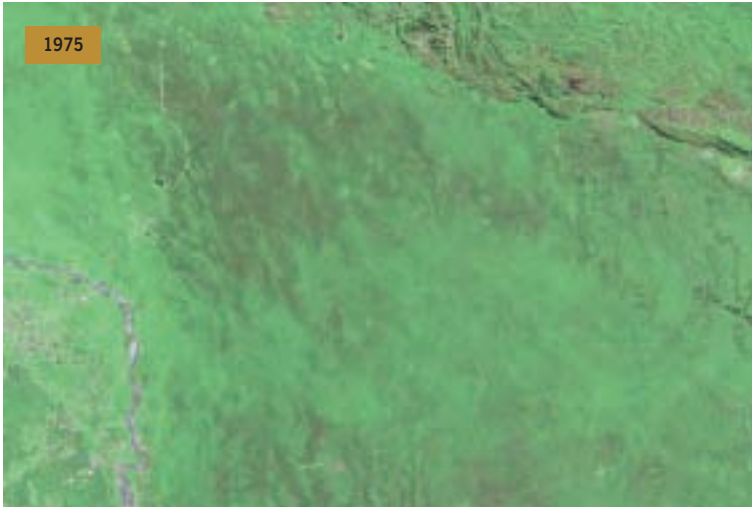

1973, north

2000, north

1973, south

2000, south

Landsat data: USGS/EROS Data Center
Compilation: UNEP GRID Sioux Falls

OUR CHANGING ENVIRONMENT: Santa Cruz, Bolivia

1975

1992

2000

The area round Santa Cruz de la Sierra in Bolivia has been rapidly deforested since the mid-1980s as a result of resettlement of people from the Altiplano (the Andean high plains) and a large agricultural development project called Tierras Baja. The pie or radial patterned fields (see photo below) are part of the resettlement scheme. In the middle of each unit is a small community centre including a church, bar/cafe, school and soccer field. The rectilinear, light-coloured areas are fields of soybeans cultivated for export. The dark strips running through the fields (bottom photo) are wind breaks, used to prevent erosion of the fine soils. Landsat images show the development of new agricultural settlements east of Santa Cruz in an area of tropical dry forest.

Landsat data: USGS/EROS Data Center
Text and photographs: Compton Tucker, NASA GSFC