

## CHAPTER 3

# DEVELOPMENT LEVELS AND ENVIRONMENTAL IMPACT



*Rio de Janeiro slum. In developing countries, one person in four lacks adequate housing.  
Werner Rudhart, Still Pictures*

## DETERMINING THE IMPACT OF HUMAN ACTIVITY

More people are using more resources with more intensity than at any point in human history. Fresh water, cropland, forests, fisheries and biodiversity all show signs of stress at local, regional and global levels. Increasing pressure on the environment is the result of, on one hand, increasing affluence—that is, more consumption, pollution and waste, and on the other persistent poverty—that is, lack of resources and the technology to use them, and lack of the power to change these circumstances.

Growing human numbers play a role in both scenarios. Global use of

fuel-wood, for example, has doubled over the past 50 years; the Worldwatch Institute attributes this increase largely to population growth. But the six-fold increase in the use of paper since 1950 is ascribed mainly to rising affluence, and the multiple uses for paper products in an increasingly urban environment.

Population size, growth, distribution and movement help determine the relationship between people and their environments. Similar numbers of people can have very different impacts on the environment, depending on for example social institutions, means of production, property rules and forms of governance.<sup>1</sup> Access to education, health and economic opportunity; consumption levels; and gender

differentials (the “quality of human capital”) all have an influence.

The most basic determinant of impact is scale. Thirty years ago Paul Ehrlich and J. Holdren described this relationship in the now-famous equation<sup>2</sup>:  $I = PAT$ , meaning that people’s impact on their environment (I) is a product of population size (P), affluence (A, representing output per capita or the level of consumption) and technology (T, representing the per unit output or efficiency in production).

This equation has been often used<sup>3</sup> but also often criticized or elaborated.<sup>4</sup> The main shortcoming is that the factors in the relationship are not independent, but are related in complex ways. Nonetheless, the approach has been useful in demonstrating that population

dynamics are central to environmental change.

For example, since 1970 global carbon dioxide emissions per capita have been relatively constant, while GDP per capita has increased in both more developed and less developed regions.<sup>5</sup> This means that improvements in technology have offset the effects of increased consumption.<sup>6</sup> Whether carbon dioxide emissions continue to increase in step with population size will depend on economic and social trends, the institutional response to environmental problems and the pace of technological change.

## POVERTY AND THE ENVIRONMENT

Despite soaring global wealth, now estimated at \$24 trillion annually, some 1.2 billion people across the world live on less than \$1 a day—a condition classified as “extreme poverty” and characterized by hunger, illiteracy, vulnerability, sickness and premature death. Half the world lives on \$2 a day or less.<sup>7</sup>

More than a billion people cannot fulfil their basic needs for food, water, sanitation, health care, housing and education. Nearly 60 per cent of the 4.4 billion people living in developing countries lack basic sanitation, almost one third do not have access to clean water supplies, one quarter lack adequate housing, 20 per cent do not have access to modern health services, and 20 per cent of children do not attend school through grade five. Worldwide, 1.1 billion people are malnourished, unable to meet minimum standards for dietary energy; and protein and micronutrient deficiencies are widespread.<sup>8</sup> Nearly 2 billion people in developing countries are anaemic.<sup>9</sup>

Ending poverty has been an international aim since 1960. After significant advances between 1970 and 1990, the rate of poverty reduction in the 1990s fell to only one third of the pace required to meet the United Nations’ commitment to halve poverty levels by 2015.

Although affluence consumes

energy and produces waste at far higher rates, the effects of poverty also destroy the environment. Global attention has consequently focused on the complex relationship between environmental degradation, poverty and sustainability. Understanding it may be key to ending poverty and closing the gap between more and less affluent, as well as meeting the objective of sustainable development.

### A COMPLEX INTERACTION

Population pressures are increasing in many poor and ecologically fragile zones in urban as well as rural areas. Fertility in many of these places is already high, and more people are being driven to them by a shortage of land for subsistence farming, by economic policies encouraging large holdings, intensive agriculture and cash crops, and by poverty and high population densities elsewhere.

For example, slash-and-burn agriculture and logging are expanding in and around Mexico’s Calakmul Biosphere Reserve on the Yucatan Peninsula, because of rapid immigration and high fertility. Under unrelenting population pressure, subsistence farmers have stripped forest cover from the Garo Hills in north-east India. Growing poverty in coastal communities and rapid population growth in large towns along the coast of West Africa are similarly driving destruction of the mangrove swamps for firewood and dynamite fishing in nursery waters.

In these and many other examples, the poor are the most visible agents of destruction in degraded environments. Poor people depend heavily on natural resources for direct income and their poverty offers them few choices. In the case of Garo alternative land was not available; on the West African coast urban demand for fish and firewood offered a source of immediate income. Here and elsewhere, the poor stand at the end of a long chain of cause and effect. They are the messengers of unsustainability rather than its agents.

A breakdown of consumption patterns shows that the “ecological footprint” (see below) of the more affluent is far deeper than that of the poor, and in many cases exceeds the regenerative capacity of the earth.

In most instances it is the wealthier farmers who engage in large-scale clearing of vegetation, over-use of agricultural chemicals, over-use of groundwater resources for irrigation, over-use of pastoral land for grazing and over-exploitation of soils for export production. Distorted pricing structures perpetuate wasteful input use. In Gujarat in India, poor tribal farmers pay the full cost of pump irrigation provided through a non-governmental organization while the richer farmers receive subsidized water through state schemes.

Higher-income groups consume more energy and produce more waste than the poor, who must extract value from every scrap. Very low-income households in Pakistan spend one 30th as much on fuel as rich households, although they expend much more time and energy on gathering it.

Rural communities will continue to depend heavily on agriculture and natural resources for their livelihood. Environmental degradation will only deepen their poverty, so environmental conservation and poverty alleviation are parallel objectives. In most situations where they enjoy secure tenure, the poor will invest to protect their land and their environment.

Local control may be important: studies indicate that the condition of Nepal’s forests has improved since management of forest resource was decentralized to communities. India’s Joint Forest Management programme, which also devolves resource management to local people, has had similar environmental benefits in areas such as south-west Bengal. Local control may be more effective than government efforts in limiting illegal logging, fishing, water use and theft, but government participation can help offset the high cost and delayed benefits of investment in conservation.

BOX 11  
RURAL MIGRATION

Migration of the poor to more marginal lands is threatening biodiversity preserves and depleting the forest cover needed to counter global warming.

In the Philippines, 60 per cent of the country's 30 million hectares are classified as upland. Upland inhabitants, about one third of the total population, are primarily poor farming families with insecure land tenure. Their sources of water are either mountain springs or streams. As their numbers continue to surge and with recent attempts at industrialization, many uplanders are pushed to more fragile upland areas.

A major consequence of deforestation is the loss of endemic wildlife resources. So far, 89 species of birds, 44 species of mammals, and 8 species of reptiles are internationally recognized as threatened.

People from the lowlands who move into upland areas in search of cultivable land often use inappropriate farming techniques. They also bring different cultural values from the traditional ethnic groups in the hills, and often clash with local people over ownership of land that has traditionally been farmed on a shifting cultivation basis.

"Natural growth and migration from the lowlands mean that upland populations are rising, forcing farmers to cultivate steeper slopes and poorer soils and to leave land fallow for shorter periods," explains the International Institute of Rural Reconstruction. "This exacerbates the problems of erosion, soil fertility and water conservation."

Over the generations poor farmers have accumulated a vast amount of knowledge about sustainable environmental practices. Practices such as shifting cultivation sustained the poor for centuries, until populations grew too large or other factors intervened. Traditional practices may incorporate an understanding of local conditions not immediately evident to outside observers, however expert. In the mountainous areas of Sumatra, farmers rely on simple stone headworks to create irrigation systems along small streams. Although these structures seem leaky and inefficient, the leakage ensures an equitable distribution of water across the community.

When poor people move to new environments or when the balance of their old environment is altered, for example by rapidly rising populations, there may be a period of relearning in which a certain degree of degradation may occur. But

imposing standardized technical solutions that ignore and wipe out indigenous knowledge may have a disastrous ecological impact.

Population growth is not necessarily detrimental to environmental sustainability but it does affect available choices and the prospects of any intervention. Although degradation invariably occurs initially as very low population densities increase, what follows depends on a confluence of factors. If investment needed to improve land is too expensive or the benefits too-long delayed, further degradation will almost certainly result as population rises. In other cases, where a higher population can result in a lower per capita charge for fixed investments (such as water harvesting technology), sustainability and productivity may actually improve in a supportive environment.

If developing countries with rapidly growing populations were encouraged and supported to

adopt cleaner technologies, environmental degradation could be mitigated. At current levels of growth, Asia's greenhouse gas emissions are expected to triple in the next 20 years. Effective technology, if it were made affordable, could reduce the growth in emissions.

### GLOBALIZATION AND POVERTY

In the past 20 years, over 100 developing and transition countries have begun to undertake reform measures to improve the efficiency of their economies. These reform packages typically include fiscal discipline, lower budget deficits, reduced subsidies, tax restructuring, financial liberalization, market-determined interest rates, competitive and stable exchange rates, trade liberalization, encouragement of foreign direct investment, privatization of state enterprises, deregulation of protected industrial sectors and enhanced guarantees of property rights.

These reforms have been intended to increase countries' competitiveness in the global marketplace. International trade has increased dramatically during the period, though a small number of developing countries account for most of the increase outside of the more-advanced market economies. The desire to integrate into the global economy or to offset losses in financial crises has motivated many developing countries to increase their exploitation of natural resources.

Globalization has clearly increased overall prosperity and stimulated growth. It has also increased income inequality and environmental degradation. Although poverty has declined in percentage terms, the number of people living in poverty has steadily increased, and average incomes in many developing countries have remained low. At the same time, environmental degradation is worse than in any comparable period in human history. There is a clear link between environmental degradation and the rising

BOX 12  
KENYAN DISTRICT ADAPTS TO MEET  
POPULATION CHALLENGE

In Kenya's Machakos District, near Nairobi, new agricultural technologies have been employed in response to rapid population growth, with mixed results.

Innovations, made possible through agricultural extension activities and financial and technical support, include increased use of terracing; adoption of diverse crops; planting of trees for soil stabilization, water management and fuel-wood; and other strategies.

Women have benefited from the planting of fruit trees for household food and market value, and from the shift from communal grazing to farm-feeding of cattle, which increased the output of dairy products marketed by women.

Machakos's proximity to the capital facilitated its inclusion in an effective market system with reduced transport and storage challenges. It has also benefited from migration to and from the capital, which brings new skills and added financing for local development. But heavy out-migration by men to the city has resulted in labour shortages and additional farm work for women already burdened with housekeeping, child-rearing and gathering fuel and water.

New hillside cropping technologies have also added to the area's water requirements. Farm sizes have shrunk to an average just above one hectare and more marginal land is all that remains for the growing numbers of families. Increasing agricultural production has also resulted in the loss of regional wildlife and biodiversity.

Source: UNDP, UNEP, the World Bank and the World Resources Institute. 2000. *World Resources 2000-2001: People and Ecosystems: The Fraying Web of Life*. Washington, D.C.: World Resources Institute, pp. 149-158.

inequality accompanying globalization—increasing poverty is causing many poor people to increase their pressure on fragile natural resources in order to survive.

Some critics<sup>10</sup> have concluded that while globalization has led to significant economic reforms, policy makers have ignored the parallel social, environmental and institutional reforms required to prevent increases in inequality, poverty and environmental degradation.

### MEASURING POVERTY'S DIMENSIONS

Traditionally, economists have defined poverty in terms of income, using either a relative standard such as the median income in a country, or an absolute standard

such as the cost of a typical basket of goods and services.

More recent definitions also encompass measures of health, education, security, political voice and discrimination. *The World Development Report 2000-2001*<sup>11</sup> measures poverty across three dimensions: *opportunity, empowerment and security*. The World Bank includes another dimension: *capabilities*.<sup>12</sup> These dimensions have multiple determinants, but environmental sustainability runs through each as a common thread.

**Opportunity** measures an individual's income, consumption and the level of inequality in a society. Opportunity may be enhanced by a stable economic environment, equitable asset distribution, and easy availability of infrastructure. Specific

environmental interventions that improve opportunity include improving the productivity of land and fisheries, and environmentally sensitive pricing structures.

**Empowerment** measures an individual's participation in community decision-making. Empowerment is strengthened by decentralization, transparency and accountability in all aspects of governance, including the management of natural resources.

**Security** is a measure of an individual's protection against economic shocks and personal violence. Environment-focused interventions include disaster prediction and prevention mechanisms, and protection against the illegal exploitation of resources.

**Capabilities** are the substantive freedoms that allow a person to lead the kind of life he or she values. Reproductive health care, access to safe drinking water, better sanitation, reduction of indoor and urban air pollution, integrated programmes to combat vector-borne diseases, and other environment-focused interventions that reduce poverty are all relevant in this regard.

Each of these must be assessed not just in terms of national averages but also in terms of their equitable distribution. Women are often multiply disadvantaged.

### WIN-WIN SOLUTIONS FOR POVERTY AND THE ENVIRONMENT

There is increasing consensus that only an integrated approach to the problems of poverty and environmental degradation can result in sustainable development (see Chapter 6). The building blocks of a sustainable development strategy include:

- **Increasing the resource base of the poor**, through measures such as land ownership reform, participatory management of common resources, public investments in land conservation and the creation of employment opportunities.

- **Investing in alternative energy services and infrastructure**, such as sanitation, clean water, education, health care and other services.
- **Support to “green” technologies.**
- **Pricing policies** that do not encourage profligate use of resources such as electricity, water and fertilizer

## ENERGY AND POVERTY

Increasing consumption of energy is associated with advanced economies, as well as with longer life expectancies, higher levels of education and other indicators of social development. The correlation is not precise—among industrial economies for example the United States has far higher levels of energy consumption per capita or per dollar of GDP than European countries or Japan. Social development in particular can often be achieved without high levels of energy consumption, as for instance in the state of Kerala in India, or Sri Lanka.

High energy consumption can also fail to produce economic growth if it is misdirected, as in the former Soviet Union, but there are no examples of substantial economic growth without corresponding growth in energy consumption.

This is one of the central riddles of development. All models of development are directed to economic growth—yet if all countries consumed energy at U.S. or even European rates, sources of energy would rapidly be depleted, and the unwanted by-products of energy use would at best tax the ability of the environment to absorb them. The challenge is to find the means for the more affluent to reduce the burdens of consumption, and for poor countries and people to escape poverty without crippling either economies or the ecosphere.

Escaping poverty is not merely a question of finding ways to increase energy consumption, but of changing the kinds of energy used.

The energy sources of the poor

are inefficient, polluting and unhealthy. Per unit of emitted light or heat, the poor pay higher prices than the rich, including the time they spend obtaining or collecting fuel. Cook stoves burning biomass fuel use only around 15 per cent of its potential energy. Charcoal, coal and kerosene stoves are about 50 per cent efficient. Electricity and liquid propane gas burners convert 65 per cent of their energy.

A study in Pakistan showed that nearly 90 per cent of poor households rely on biomass fuels for cooking and the majority use kerosene rather than electricity for lighting. In contrast more than one third of better-off households use gas for cooking and most use electric light.

Biomass cooking produces soot and other substances<sup>13</sup> linked to acute respiratory infections, chronic obstructive lung diseases, lung cancer and eye problems, as well as low birth weight.<sup>14</sup> Coal in open fires or stoves produces sulphur and toxins such as arsenic, fluoride and lead. The effects of these pollutants are compounded by poor ventilation.

Failure to cook food or boil water adequately because of fuel shortage or inefficiency also contributes to malnutrition, intestinal disorders and parasites.

Gathering fuel-wood and related materials takes its toll in time and injury, mostly on women. A study in the United Republic of Tanzania<sup>15</sup> showed that able-bodied women in rural areas carry about 25 metric tons kilometres (combining weight and distance) per year in firewood collection; men expend a very small fraction of this effort. A study in Addis Ababa found that fuel gatherers, who often carry loads nearly equal to their own weights, frequently suffer falls and bone fractures; eye problems; headaches; rheumatism; anaemia; chest, back and internal disorders; and miscarriages.<sup>16</sup>

Poor families spend more than twice as much time gathering fuel as more affluent ones.<sup>17</sup> Wealthier families spend as much as 30 times more on energy but it is cleaner,

more efficient and less burdensome—and they buy it at preferential prices. Electricity costs, particularly for urban elites, are often subsidized.

The poor pay higher unit prices for energy in small amounts: items such as batteries, battery recharging, candles, kerosene and charcoal. A survey in Uganda showed that rural and peri-urban families spend over \$10 per month on candles, lighting, kerosene, dry cell batteries and recharging car batteries. More households in the country derive electricity from car batteries than are connected to the public power grid.

Policy actions to correct these conditions need not be prohibitively expensive and would yield long-term savings. Supplying solar power is often cheaper than extending electrical grids. Subsidies or credit guarantees can put more efficient stoves within reach. Subsidies on electricity prices for the more affluent could be transferred to cleaner fuel for the poor.

## RURAL DEVELOPMENT AND POPULATION

The effect of population increase in rural areas can be either positive or negative.

A gradual shift from very low to moderate population densities, for example, can encourage new agricultural practices, providing increased yields and supporting larger populations. Such a process may have encouraged the development of intensive settled agriculture.<sup>18</sup> Increasing rural population density increases the labour available for managing fires, working on infrastructure such as irrigation channels and terraces, and improving soils.

But there are many cases where population growth has worked against both people and their environment.<sup>19</sup> Rapid population growth in the last 50 years has doubled and redoubled poor rural populations, faster than their ability to adapt. Their resource base has been sharply reduced by overuse and commer-

cial exploitation. Without a surplus for investment, the technologies available to poor rural populations have also remained unchanged.

Continuing improvements in agricultural yields and the quality of life depend on the complex interplay of environmental conditions, availability of technology and social organization, and on choices concerning land use. Higher densities require successive adaptations to new circumstances. Eventually, further progress may be constrained by natural limits, for example on water for irrigation; by technological consequences, such as soil degradation from repeated use of chemical fertilizers; by political decisions concerning land use and social organization; or by economic factors such as poverty.

Communities with access to better technology and social investments such as education and universal health care, including reproductive health, have made good use of them to conserve resources and build viable rural economies—examples can be seen in Kerala and in parts of Sri Lanka. These communities feature less gender inequality, later marriage, lower fertility and slower population growth, despite low incomes.

Intensive agriculture has increased yields in many rural areas, but it has provided cheap food for increasing urban populations, rather than a living for rural populations. Commercial agriculture and timber operations by individuals on common land can be highly profitable as long as inputs are available and resources last, but the benefits rarely go to local communities. The rural poor are often using, and overusing, whatever land, water and timber resources are left over from commercial operations. The combined results can be seen in bare hillsides, shrinking watercourses, floods, droughts and vanishing wildlife.

Recent studies of the Green Revolution in India<sup>20</sup> reveal that increased productivity has led to greater incentive to expand areas under cultivation. Where forests

are owned in common, this has led to deforestation, because there is no control over the use of common land. Other studies have shown that the benefits of the Green Revolution have accrued principally to the larger landowners and users of common resources, presumably because they had the most to invest and the most to gain. Landlessness among former subsistence farmers and impoverishment by loss of common resources have been unlooked-for consequences of the Green Revolution.

Individual property rights may provide a higher motivation for individual protection of the resource base, but do not automatically offset the impact of sheer numbers of people, or of commercial exploitation.<sup>21</sup> Individual property rights may have to be limited by measures to protect the commons: many of the world's prime fisheries have collapsed from commercial overuse, and it remains to be seen whether a public policy of limits on fish catches can bring them back.

## URBANIZATION

Concentration of people allows economies of scale in the costs of transport, production and consumption, and in providing protection such as clean water and effective sanitation. But concentration can also increase the burdens and require more inclusive, and sometimes expensive, technologies for effective and sustainable protection for both humans and their environment.

Urbanization has been one of the most striking developments of the past century. In Africa, for example, only 5 per cent of the population lived in urban areas in 1900, about 20 per cent in 1960 and about 38 per cent today. Africa's current annual urban growth is the highest in the world, at more than 4 per cent.

The Asia-Pacific region is close behind. The urban population, now about 35 per cent of the total, grew by about 2.6 per cent a year between 1995 and 2000, compared with 0.7 per cent a year for the rural population.

In the less-developed regions, the numbers of city dwellers will double in the next 30 years, from 1.9 billion to 3.9 billion. As dynamos of economic and social development, cities now account for a large and growing portion of demand on resources. Some analyses suggest that urban areas, with just over half the world's people, account for fully 80 per cent of carbon emissions, 75 per cent of all wood use and 60 per cent of freshwater withdrawn for human uses (including water for irrigated crops consumed by urban dwellers).<sup>22</sup>

Today, almost 3 billion people live in urban areas. Over 75 per cent of the population of North America, Europe and Latin America now live in cities, and worldwide 411 cities have populations of more than 1 million, compared with 326 in 1990. In Western Europe and North America, in contrast with most other regions, there is a move out of large cities into suburbs and smaller urban centres.

By 2015, 1.6 billion people will be living in cities of more than 1 million people, 622 million in cities of more than 5 million. In the less-developed regions, the numbers of city dwellers will swell in the next 15 years, from 1.9 billion to 2.9 billion. (In more-developed regions they will increase from 0.9 to 1.0 billion.) By 2030, most people in every major region will live in cities. Growth on this scale will have severe consequences for the quality of life and surrounding environments.

In the 1970s, the United Nations coined the term "megacities" to describe cities with 10 million or more residents. In 1975, there were five megacities worldwide. Today, there are 19 megacities. By 2015, the number of megacities will grow to 23.

Cities in many parts of the developing world are growing at twice the rate of overall population growth. About 160,000 people move from rural areas to cities every day. This explosive urban growth is often due as much to the push of collapsing rural environments, poverty, land-

lessness, and a lack of job opportunities as to the pull of better jobs and social services in the cities.

Migrants often find that their lives become more difficult. Growth is fastest in small cities, which often lack infrastructure, and in shanty towns and squatter settlements around many large cities. In Africa 37 per cent of urban residents live in such “informal” settlements, in Asia 18 per cent, and in Latin America and the Caribbean 9 per cent. In many cities the figure is 25 to 30 per cent. Four million of Rio de Janeiro’s 10.6 million residents live in such settlements—some perched precariously on steep hillsides, in flood plains or in areas of high pollution where no one with a choice would live. Dense settlements, particularly if they are badly built, are highly vulnerable to catastrophic events like floods, storms or earthquakes.

## POLLUTION

Rapid industrial growth and the concentration of urban populations combine to contaminate water and air. Raw sewage is often dumped untreated into local waterways along with industrial wastes. Most developing countries lack the resources to monitor and treat human waste or modern chemical pollutants.

As urban population continues to increase, more people must share whatever water is available. The London-based Water Aid reports that the world’s biggest cities are already outstripping their water

supplies. Urban centres like New Delhi, Santiago and Mexico City are pumping water from increasingly distant sites. Cities in northern India and China have seriously lowered the water tables in surrounding areas.

More people means more air pollution. In India, levels of suspended particles in 10 of the largest cities are three to five times greater than WHO standards. Jakarta is one of many Asian cities polluted by burning garbage and motor vehicle exhaust. Manila has reportedly far higher levels of suspended particulate matter—the tiny solid particles dispersed from pesticides, asbestos and thousands of other products—in its air than New York, London, or Tokyo.

Most cities around the world produce far more garbage and other wastes than they can handle.

Manila’s primary sewer network was designed early in the 20th century to serve about 500,000 people. Only 11 per cent of the population of Metropolitan Manila has sewer connections. In underserved areas, sewage flows via road gutters, open ditches and canals to overburdened mains to be pumped untreated into Manila Bay or flow in with the tides.

Around Mexico City, 3 million persons in peripheral areas are not connected to the sewers. Underground aquifers are severely polluted.

In many cities, between 30 and 50 per cent of the garbage goes uncollected. Even more-developed regions find it difficult to keep up

with the steady increase in waste that accompanies rising consumption. In the countries of the former Soviet Union, reductions in collection and disposal systems have outstripped consumption declines. In the Russian Federation, of the 130 million cubic metres of municipal solid household waste collected in 1997, only 3 per cent reached processing plants and incinerators.

## LOSS OF FARMLAND

Urbanization also affects food production by removing agricultural land from cultivation, as cities expand, and by reducing the number of family farms, as more farmers move to the cities. Between 1987 and 1992, for instance, China lost close to 1 million hectares of farmland each year to urbanization and the expansion of roads and industries. In the United States, urban sprawl takes over nearly 400,000 hectares of farmland each year.<sup>23</sup> At the same time, people are growing more and more food in urban areas. Worldwide, some 200 million city dwellers are growing food, providing about 1 billion people with at least part of their food supply. In Accra, Ghana, for example, urban gardens supply the city with 90 per cent of its vegetables. In Dar-es-Salaam, United Republic of Tanzania, one adult in every five grows fruits or vegetables.

Garden plots and roof top vegetation can have additional benefits. They reduce light and heat reflection and mitigate the trapping of heat. They can help remove pollu-

**TABLE 1: WORLD MEGACITIES 1975, 2000 AND (PROJECTED) 2015: POPULATION IN MILLIONS**

| 1975   | 2000   | 2015  |
|--|--|---|
| Tokyo (19.8), New York (15.9), Shanghai (11.4), Mexico City (11.2), and São Paulo (10) | Tokyo (26.4), Mexico City (18.1), Mumbai (18.1), São Paulo (17.8), Shanghai (17), New York (16.6), Lagos (13.4), Los Angeles (13.1), Kolkata (12.9), Buenos Aires (12.6), Dhaka (12.3), Karachi (11.8), Delhi (11.7), Jakarta (11), Osaka (11), Metro Manila (10.9), Beijing (10.8), Rio de Janeiro (10.6), and Cairo (10.6) | Tokyo (26.4), Mumbai (26.1), Lagos (23.2), Dhaka (21.1), São Paulo (20.4), Karachi (19.2), Mexico City (19.2), New York (17.4), Jakarta (17.3), Kolkata (17.3), Delhi (16.8), Metro Manila (14.8), Shanghai (14.6), Los Angeles (14.1), Buenos Aires (14.1), Cairo (13.8), Istanbul (12.5), Beijing (12.3), Rio de Janeiro (11.9), Osaka (11.0), Tianjin (10.7), Hyderabad (10.5), and Bangkok (10.1) |

tants produced by motor vehicles, industry and energy production.

Urban areas also affect regional and global environments through their production of greenhouse gases and generation of components of acid rain.

Natural conditions like climate, altitude, topography, wind and precipitation patterns affect cities' ability to disperse atmospheric contaminants and determine their impact on their immediate environments. Air pollution episodes in Santiago are as severe and intense as in much larger São Paulo even though emissions are only about a tenth as large.

### PROBLEMS OF GROWTH

Some of the world's largest cities are growing more slowly than in the past, yet their environmental impact increases and their local conditions worsen. Some rapidly growing cities (e.g., Curitiba and Porto Alegre in Brazil) have adopted policies that have improved and protected their environmental conditions. However, most rapidly growing cities face serious environmental health challenges and worsening conditions, particularly in newly settled areas and where institutions to manage and regulate growth are weak.

The growth of small and medium-sized cities in Africa, Asia and Latin America poses special problems, particularly in water provision, sanitation and garbage collection.<sup>24</sup> The planning and regulatory systems of such cities are often rudimentary. They do not receive the government investments and attention that large cities can command, and they are unable to achieve comparable economies of scale—in service provision, land use, transport and water and energy provision.

In most developing countries, rapid urban growth, fuelled by both in-migration and natural population increase, is outstripping capacity to provide health services. Young women are increasingly migrating from rural to urban areas, seeking

among other things for better health care, and increasing the pressure on reproductive health services in particular.<sup>25</sup>

United Nations projections suggest that by 2020, there will be more urban than rural women aged 15 to 39. In Kenya, 35 per cent of rural women are aged 15-39; among urban women, 53 per cent are 15-39; similar gaps are found in Bangladesh, Haiti, Indonesia, Nicaragua, and Yemen.

Urban women generally want fewer children than rural women, but access to family planning services is failing to meet those desires. Peri-urban areas are often poorly served by reproductive health services. Clinics in central cities may not be open at times convenient to many residents of the wider local area and to workers.

### WASTEFUL CONSUMPTION PATTERNS

Consumption is a critical factor in the relationship between population and environmental stress. Almost all human activities put demands on natural resources: food, housing, clothing and transportation use resources like arable land, water, oil, gas and wood. Most human activities also produce wastes that are released back into air, water and soil, often with little or no treatment to mitigate their environmental impact.

While population growth puts increased demands on resources, the environmental impact of a given population depends on a combination of human numbers, levels of consumption and the extractive and regenerative technologies available.<sup>26</sup>

In the 20th century, consumption of goods and services rose to unprecedented levels—powering the expansion of the global economy and changing the realities of billions of people's lives. But vast numbers of people have been left out of the consumption boom. Currently a huge "consumption

gap" exists: globally, the 20 per cent of the world's people who live in the highest-income countries account for 86 per cent of total private consumption expenditures; the poorest 20 per cent, by contrast, account for just 1.3 per cent.<sup>27</sup>

A child born today in an industrialized country will add more to consumption and pollution over his or her lifetime than 30 to 50 children born in developing countries.<sup>28</sup> Currently, the fifth of the world's people who live in industrialized nations produce over half of the carbon dioxide emitted into the atmosphere, while the poorest fifth produce only 3 per cent.<sup>29</sup> The United States alone, with only 4.6 per cent of the global population, emits nearly 25 per cent of global greenhouse gases.<sup>30</sup>

Consumption in industrialized nations directly impacts the developing world. For example, almost a billion people in 40 developing countries risk losing access to their primary source of protein, fish, as over-fishing driven by demand for animal feed and oils in industrialized nations adds pressure to already declining fish stocks.<sup>31</sup> And the estimated 111 million people who will be added to the U.S. population over the next 50 years will expand energy demands by more than the current energy consumption of Africa and Latin America combined.<sup>32</sup>

Vast amounts of natural resources are required to produce the goods used in industrialized countries. The impacts are often felt in regions far from home where metals are mined, oil is extracted, timber harvested and food grown. Transporting these goods also consumes substantial amounts of energy resources.<sup>33</sup>

As individuals and countries grow more affluent, their demands move beyond basic needs—magnifying the impact of population growth even in poor regions. And with the globalization of Western consumer culture, demands for a range of products, including cars, computers and air conditioners will only increase—adding pressure on natu-

ral resources and ecosystems' capacity to absorb waste.<sup>34</sup>

Despite the linked challenges of rapidly taming excess consumption and ending the privation of under-consumption, there are some signs of positive change. Governments and industries are increasing their use of renewable resources and less- or non-polluting technologies and are exploring future potentials. Sustainable management programmes are being attempted in a growing share of forest lands. Public debate about the various environmental topics (including energy and land use policies) is intensifying, and international agreements are under discussion.

Still, what the economist Herman Daly wrote nearly 30 years ago seems relevant today: a sustainable economy "would make fewer demands on our environmental resources but much greater demands on our moral resources".<sup>35</sup>

## HUMANITY'S 'ECOLOGICAL FOOTPRINT'

To measure people's impact on the environment, some scientists have devised an "ecological footprint"<sup>36</sup> indicator (Figure 7). It shows which regions are the heaviest consumers of specific resources, on a per capita basis as well as in absolute terms.

The footprint estimates a population's consumption of food, materials and energy in terms of the area of biologically productive land or sea required to produce those natural resources or, in the case of energy, to absorb the corresponding carbon dioxide emissions. Measurement is in "area units". One area unit is equivalent to one hectare of world average productivity.

Each region is represented by a rectangle in which the width is proportional to the population, the height represents per capita resource consumption, and the area represents the region's total consumption. Thus, Asia, which has a population over ten times the size of North America's but a per capita

resource consumption level only one sixth as large, has a footprint only slightly bigger than North America.

Such an analysis captures the two most important dimensions of the challenge of sustainability—per capita resource consumption and population growth.

This indicator also identifies areas of high and low natural biological capacity and regions responsible for "ecological deficits", where resource consumption exceeds sustainable use levels. According to the *Living Planet 2000* report, global consumption in 1996 stood at 2.85 area units per person, 30 per cent more than biological availability (2.18 units).

The wealthy countries in the Organization for Economic Cooperation and Development (OECD) had a total ecological footprint of 7.22 area units per person in 1996, more than twice the biological capacity of 3.42 units. Non-OECD countries had a total ecologic footprint of 1.81 area units per person, slightly less than the biological capacity of 1.82 units.

**Africa** had an ecological surplus in 1996 of 0.40 area units per person (a footprint of 1.33 units and an available biological capacity of 1.73 area units). Many African countries enjoyed large ecological surpluses and very few countries had deficits in excess of 1 area unit per person.

However these surpluses result from extensive poverty rather than beneficial management.

**Latin America and the Caribbean** had the world's highest ecological surplus, 3.93 area units per person, due to its high natural biological availability (6.39 units) and relatively low resource consumption (2.46 units). The highest per capita surpluses were found in Bolivia, Brazil and Peru.

**The Middle East and Central Asia** had an ecological deficit of 1.82 area units per person, largely due to its low biological capacity (0.91 units). The total ecological footprint of the area was 2.73 area units per person. Wealthy oil economies such as the United Arab Emirates and Kuwait had the highest deficits.

**Asia and the Pacific's** ecological deficit of 0.67 area units per person is partly attributable to its high population, which reduces biological capacity to 1.11 units. The total ecological footprint of the area was 1.78 area units per person in 1996. Singapore, Japan and South Korea had the highest deficits.

**North America** had the world's highest ecological deficit (5.64 area units per person) in 1996, despite having the second highest biological capacity (6.13 units). The United States registered an ecological deficit of 6.66 area units per person.

**Western Europe** had an ecologi-

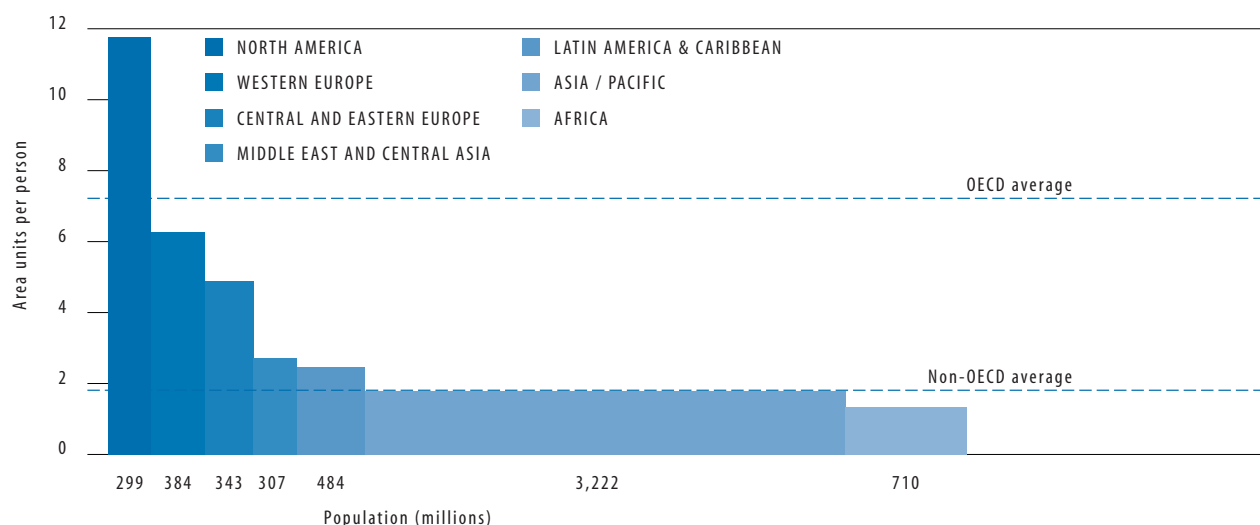
**TABLE 2: GROWTH IN TOTAL CONSUMPTION EXPENDITURES, 1970 TO 1995, IN TRILLIONS OF U.S. DOLLARS (1995 PRICES)<sup>37</sup>**

|                          | 1970 | 1980 | 1990 | 1995 |
|--------------------------|------|------|------|------|
| Industrialized countries | 8.3  | 11.4 | 15.7 | 16.5 |
| Developing countries     | 1.9  | 3.6  | 4.3  | 5.2  |

**TABLE 3: CONSUMPTION LEVELS, FROM WEALTHIEST TO POOREST<sup>38</sup>**

|                        | per cent consumed by people in industrialized countries | per cent consumed by the poorest 20% of people in developing countries |
|------------------------|---|--|
| Total energy resources | 58  | < 4  |
| Meat and fish          | 45  | 5  |
| Paper                  | 84  | 1.1  |
| Vehicles               | 87  | < 1  |
| Telephone lines        | 74  | 1.5  |

**FIGURE 7: ECOLOGICAL FOOTPRINT BY REGION, 1996**



Source: World Wide Fund for Nature (WWF), United Nations Environment Programme World Conservation Monitoring Centre, Redefining Progress, Center for Sustainability Studies, and Norwegian School of Management. 2000. Living Planet Report 2000. Gland, Switzerland: World Wide Fund for Nature

cal deficit of 3.35 area units per person, the second highest in the world. The ecological footprint was 6.28 units against a biological capacity of 2.93 units. The United Kingdom, Switzerland and Denmark registered the highest deficits.

**Central and Eastern Europe** had an ecological footprint of 4.89 area units per person, a biological capacity of 3.14 area units and a deficit of 1.75 units in 1996. The Czech Republic and Estonia had the highest deficits.

*Living Planet 2000* also reports five components of the ecological footprint: cropland, grazing land, forest (fuel-wood and wood products, including paper), fishing ground (marine fish and seafood products including fish-meal and oils fed to animals) and carbon dioxide (fossil fuel consumption plus the net energy required to make imported manufactured products).<sup>39</sup> These also show a big consumption gap between developed and developing regions.

For example, North America's cropland footprint (1.44 area units per person) was more than twice the world average (0.69 units). The fishing ground footprint of consumers in OECD countries was three

times that in non-OECD countries. The OECD consumer's average carbon dioxide footprint in 1996 was more than five times that of the non-OECD consumer. North America's carbon dioxide footprint, 7 area units per person, was five times the global average and more than seven times the averages of Latin America and the Caribbean, Asia and the Pacific, and Africa.

## ENVIRONMENTAL REFUGEES

Population displacement due to environmental degradation (due to natural disasters, war or over-exploitation) is not a recent phenomenon. What is recent is the potential for large movements of people resulting from a combination of resource depletion, the irreversible destruction of the environment and population growth, among other factors.<sup>40</sup> When a tidal wave hit the shores of Papua New Guinea in 1998, the death toll was in the thousands because human settlements dotted the coastline and the banks of lagoons. When the Yangtze caused massive flooding in China, the disaster was exacerbated by deforesta-

tion and erosion due to overpopulation along the riverbanks.

In January and February of 2001, thousands of people were uprooted when powerful earthquakes struck El Salvador, causing deadly landslides on mountain slopes cleared for subsistence agriculture.

The World Bank estimates that in 1998 there were 25 million people displaced by environmental degradation, outnumbering war-related refugees for the first time in history.

Displaced refugees often threaten the areas where they are staying. The 1994 crisis in Rwanda led to the influx of more than 600,000 people into north-west United Republic of Tanzania, where they caused considerable environmental damage by harvesting firewood and building poles, poaching in game reserves, and putting land under cultivation.

Environmental refugees have significant economic, sociocultural and political consequences. Currently, developed nations pay \$8 billion each year to accommodate refugees, one seventh of the foreign aid supplied to developing countries.