# HEALTH IN SUSTAINABLE DEVELOPMENT PLANNING:

# THE ROLE OF INDICATORS

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# PREFACE

Concern about the health impacts of the environment and development process has been growing in both the developed and the developing countries of the world. Renewed emphasis has been placed on the need to obtain a better understanding of the links between development, the environment and human health. This is central to sustainable development planning. Both lack of development leading to poverty, and development resulting in overconsumption and the depletion of resources have resulted in severe health and environmental problems world-wide. In order to implement preventive measures, it is necessary to understand the way in which the development process influences health and the environment, and to formulate integrated policies and strategies accordingly.

Indicators have become widely used in many different fields and play a useful role in highlighting problems, identifying trends, and contributing to the process of priority-setting, policy formulation and evaluation and monitoring of progress. Most importantly, indicators can help to simplify a complex array of information concerning the health, environment and development nexus. In this respect, they are important for informing the public and decision-makers about key health and environmental problems, and actions required for their management. Since health, environment and development problems differ in various parts of the world, as do priorities with respect to their management, the types of indicators developed world-wide will also differ, according to the level of decision-making, and the use for which the indicators are intended. It should be emphasized that indicator development is a means rather than an end in itself. Improved decision-making should remain the ultimate goal. Thus, indicators should ideally be developed as part of the overall policy and planning process, if they are to have policy relevance and practical application.

Considerable work on the development of indicators has been done by many organizations, including WHO. This book builds on work done to-date, and lays a basis for the further development and use of health and environmental indicators in sustainable development planning. It is aimed at professionals, policy and decision-makers in the fields of health, environment and development, especially those working at the interface of these issues, who are concerned with the development of indicators as well as with their application. The overall aim is to provide tools and guidance for indicator development and use, and to promote their application and use at all levels, local to global, and in respective sectors.

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# EXECUTIVE SUMMARY

This book deals with the development and use of indicators for health and sustainable development planning. It addresses both technical as well as social aspects of indicator development and use. Elements of the planning process are outlined, and the application of indicators highlighted. Illustrative examples are given where appropriate, and an organizational framework is presented for addressing health-environment-development linkages.

*Chapter One* of the book gives an overall introduction to health, environment and sustainable development issues of worldwide concern today. Attention is drawn to the wide spectrum of health hazards and to the way in which health is influenced by the environment and development process. A brief account is given of the nature of the health risks associated with environmental and development factors.

Some of the key milestones which have shaped recent thinking and developments in the area of health and sustainable development are then discussed. These have led to an increased recognition of the need to address environment, health and development concerns in an integrated and coordinated way. This is most clearly enunciated in concepts such as "sustainable development" and the need to ensure that the human element, particularly human health, is seen as central to it. Human health is both a determinant and an outcome of sustainable development.

*In Chapter Two*, the nature and use of indicators in the context of policy- and decision-making is discussed. General characteristics of indicators are highlighted, different types of indicators examined and the concept of "core" indicators and their use introduced.

*In Chapter Three*, selected international indicator initiatives are highlighted. These include environment and sustainable development indicators, social indicators, housing and urban indicators, and health indicators.

*In Chapter Four*, criteria for the development and use of indicators are outlined and technical issues to be addressed in their construction are considered. Important methodological aspects to be taken account of, such as data availability and quality, statistical issues, interpretation and risk communication, are highlighted and illustrative examples are given. Emphasis is placed on factors such as the need for clear definitions of indicators and for specifications of measurement variables and methods.

*Chapter Five* contains an account of intersectoral planning processes in health and sustainable development. Reference is made to health and sustainable development planning initiatives at the national level, as well as to local initiatives. Key issues related to the objectives of intersectoral planning initiatives and partnerships are highlighted.

*Chapter Six* considers procedural issues relating to the development of indicators in the planning cycle. Indicators in respect of issue identification and action planning, implementation, monitoring and evaluation of plans are discussed and examples given

of ways in which indicators have been used in various elements of the planning cycle.

*In Chapter Seven*, indicators are discussed in the context of an organizing framework representing health, environment and development linkages, based on an adaptation of the Pressure-State-Response framework first developed by the OECD. Examples are given of indicators associated with the different components of the framework. The indicator lists are not meant to be exhaustive, but to represent a range of conditions and possibilities which can be selected from, in developing indicators for policy and planning purposes. They are meant to encourage an integrative consideration of issues from different perspectives.

*Chapter Eight* contains examples of indicators associated with various issues and sectors, including those related to housing, transport and agriculture.

*Chapter Nine* contains a brief summary and gives some pointers to future work needed in the area of indicator development and use.

# 1 ISSUES IN HEALTH, ENVIRONMENT AND SUSTAINABLE DEVELOPMENT: AN OVERVIEW

*In this chapter, an introduction is given to issues in health, environment and sustainable development which are of worldwide concern today. Countries face a myriad of problems relating on the one hand to poverty and a lack of basic services, and on the other to large-scale, rapid industrialization, urbanization and technological development. Problems are often simultaneously local and global. Key milestones which have shaped recent thinking and approaches to dealing with health and environmental problems in the context of sustainable development are highlighted, and the challenges faced by the health sector are outlined.*

## 1.1 THE CHANGING NATURE AND SCOPE OF CONCERNS

The spectrum of health, environment and development hazards has changed considerably over the millennia of human existence. In the past 50 years in particular, the world has seen considerable health gains. For example, childhood mortality and morbidity have been greatly reduced by better control and prevention of infectious diseases. People are living much longer. Between the 1950s and the 1990s, average life expectancy increased from 46 to 65 years, and the gap in life expectancy between rich and poor countries narrowed considerably, from 25 years in 1955 to 13.3 years in 1995 (1).

There have been major advances in science and technology and health and medicine, infrastructure has expanded, literacy has increased, education has improved and incomes and opportunities have increased, especially for women. Yet, despite all this, in many instances the health gaps between and within countries are widening. Not all regions of the world have shared equally in improvements to health. Sub-saharan Africa, the world's poorest region, still has average life expectancies far below those of the wealthiest countries. Underlying much of this unequal burden of disease is the fact that environmental factors are a major contributor to sickness and death throughout the world, especially in the poorest regions (2).

### *Old and New Problems Occurring Simultaneously*

Age-old public health hazards such as inadequate and unsafe food and water, microbiological contamination of the environment and poor sanitation and environmental hygiene are still prevalent. In addition, new environment and

development problems have emerged, some of which appear to threaten the entire ecosystem. While factors associated with the development process and the changing use of technology have resulted in considerable gains to people throughout the world, they have also presented additional threats to people's health.

Many of the "newer" hazards associated with chemical contamination of the environment are as significant for developing countries as they are for industrialized countries. Countries nevertheless differ with respect to the spectrum of health, environment and development problems with which they have to deal and to which they give priority. The level of economic development and the policy choices of individual countries are important factors determining the nature of the problems faced and the ways in which they are addressed.

In industrialized countries, typical health and environmental problems include outdoor air pollution, radon in homes and schools, the "sick building" syndrome, toxic chemicals in drinking-water, non-ionizing electromagnetic radiation and pesticide residues in food. In developing countries, health and environmental problems are often related to poverty and arise largely as a result of such factors as rapid, uncontrolled urbanization and agricultural and land-use practices. In addition to hazards related to pollution, vector-borne environmental diseases may be prevalent as well as health and environmental problems associated with a lack of proper shelter, water and sanitation or poor food hygiene.

Developing countries thus have to deal simultaneously with problems due to a lack of basic services and facilities, with the impact on health of large-scale, rapid industrialization, urbanization and technological development. Indeed, it is often difficult to distinguish traditional risks from new and emerging ones. For example, pesticides and faeces may contaminate the same water supplies and air pollution may stem simultaneously from burning dirty household fuels and industrial use of fossil fuels. Rapid population growth makes it more difficult to solve this load of problems, which outstrips a country's economic development, retards social development and makes excessive demands on services, resources and the capacity of the increasingly fragile environment (3).

It is becoming readily apparent that the capacity of the environment to meet growing human needs is limited. This makes it crucial to improve our understanding of the complex relationships between the development process, environmental capacity and human health.

## *From Local to Global Dimensions*

Virtually every aspect of the environment may affect physical or mental health in some way, either positively or negatively. This is true regardless of the level of development at which problems manifest themselves. Problems may be related to both the direct pathological effects of various chemical, physical and biological agents and the more indirect effects on health and well-being of the broad physical and social environment (4), which includes housing, urban development, land use, transport, industry and agriculture.

Health concerns associated with air and water pollution, water supply and sanitation, waste disposal or chemicals and food may be particularly relevant at the local or micro-level (for example, lead in household dust or environmental tobacco smoke), or may be important at the regional or global level (for example, depletion of the ozone layer, global climate change, long-range transport of air pollution or marine pollution).

The problems to be dealt with are often simultaneously global and local. Global economic activities, escalation of travel and trade and the changing use of technology all have significant implications for health and the environment. Indeed, erosion of life-support systems at the global level has become a serious, pressing public health issue which should be addressed at various tiers of government in an overall framework of sustainable development.

## *From Rural to Urban Dimensions*

Problems may differ in urban, as opposed to rural, environments. With massive urbanization occurring on a global scale, international interest and concern has centered increasingly on the state of the environment and human health in cities. It is estimated that by the year 2025 over five thousand million people will be living in cities. In the developing countries of the world, already more than 200 cities have populations of one million or more (5).

It has become evident that, although living in cities has many positive benefits, related, for example, to increased job opportunities and the provision of essential services and facilities, many environment, health and development problems have reached near-crisis dimensions in cities all over the world. Urban growth has exposed populations to serious environmental hazards and has outstripped the capacity of municipal and local governments to provide even basic health services. In 1990, at least 600 million people in the urban areas of developing countries were living under life- and health-threatening conditions (6).

Cities have a significant impact on the broader hinterland and global environment. While the lines that separate a city, country or region are becoming increasingly blurred, it is also clear that the fate of cities will have a major influence on the fate of nations and of the planet (5).

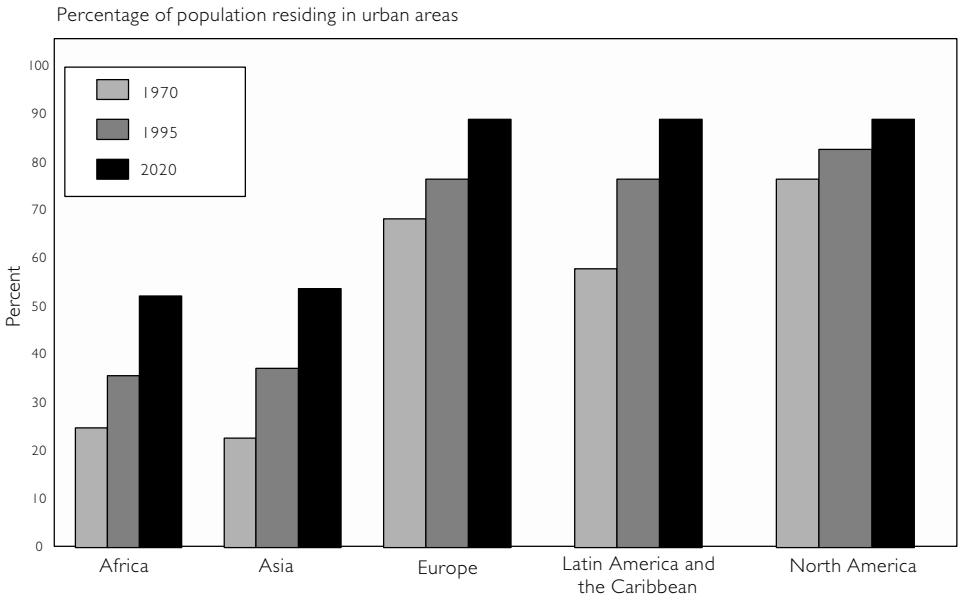
## *Poverty*

Despite the unprecedented creation of wealth world-wide in the past two decades, the number of people living in absolute poverty is growing steadily (1). Poverty remains the number one killer, with the poor bearing a disproportionate share of the global burden of ill-health. The poor live in unsafe and overcrowded housing, often in underserved rural areas or peri-urban slums which lack access to safe water or to sewerage. They are also more likely than the wealthy to be excessively exposed to pollution, traffic and industrial and other risks at home, at work or in their communities. They are more likely to consume insufficient food or food of poor quality.

Even in rich countries, the poor suffer worse health than do the better-off (2). Poor

Figure 1

**URBANIZATION LEVELS AND URBAN GROWTH RATES BY REGION 1970-2020**




Source: WHO (7)

children are particularly affected – in the poorest regions of the world, one in five children dies before his or her first birthday, mostly from environment-related diseases such as acute respiratory infections, diarrhoea and malaria (7). Not only are children more heavily and frequently exposed to threats to their health in the environment, but they are also more vulnerable to the ill-effects on health. For example, in the USA and parts of Europe, lead poisoning illustrates the unequal burden of risk borne by poor inner-city children, who are more heavily exposed to sources of lead in and around the home and are also more affected by the toxicity of lead.

Some of the major factors that affect health in the twenty-first century are highlighted in Box 1.

Box 1

**FACTORS AFFECTING HEALTH IN THE TWENTY- FIRST CENTURY**

- Widespread absolute and relative poverty
- Demographic changes: ageing and the growth of cities
- Epidemiological changes : continuing high incidence of infectious diseases, increasing incidence of noncommunicable diseases, injuries and violence
- Global environmental threats to human survival
- New technologies: information and telemedicine services
- Advances in biotechnology
- Partnerships for health between the private and public sectors and civil society
- Globalization of trade, travel and spread of values and ideas.

Source: WHO (1)

## 1.2 ESTIMATING THE HEALTH RISKS

While the many hazards present in the environment today may have various effects on human health, the global burden of disease attributable to these hazards cannot be quantified with any degree of confidence. In many parts of the world, the infrastructure for monitoring and for health surveillance is poorly developed, so that the numbers of people at risk are largely unknown. In the case of environmental pollution, the links to health are often uncertain and are masked by other effects, such as social deprivation and lifestyle.

Over the years, several incidents of severe poisoning or accidents have occurred, including water pollution by heavy metals such as mercury and cadmium which led to outbreaks of Minimata disease and Itai Itai disease. Episodes of air pollution, too, have resulted in large numbers of deaths, such as the famous London smog episode of 1952, in which an excess of 4000 people died. Accidents such as those that took place in Bhopal (India) and Chernobyl (Ukraine) also resulted in widespread death and disease, including psychosocial ill-health effects. Similarly, the forest fires in South-East Asia in the 1990s resulted in high levels of air pollution and associated mortality and morbidity.

It is currently estimated that around 1.5 million deaths in children under the age of five occur annually as a result of diarrhoeal disease, and that there are several thousand million diarrhoeal episodes each year. Diarrhoeal diseases are five to six times more common in developing countries than in developed countries (7). Such diseases are closely related to poor sanitation and hygiene and to the resultant contamination of food and water. It is estimated that over one billion people are without access to improved water supply, and that about two-and-a-half billion people lack access to improved sanitation. Today, in some 20 countries, mostly in Africa, three-quarters or more of the population do not have access to basic sanitation (7).

People may be exposed to high levels of air pollution in developing countries where burning of biomass and use of fuels such as coal and kerosene for cooking and heating still prevail. This is particularly true of China, India and sub-saharan Africa. Indeed, the overwhelming proportion of the some three million deaths from air pollution which result globally each year occurs in developing countries, mainly due to indoor air pollution associated with domestic fuel use (7).

Acute respiratory infections are a leading cause of death among children under the age of five, killing more than four million people per year and accounting for over 8% of the global burden of disease (7). The indoor environment is an important risk factor in this regard, particularly pollution from domestic fuel-burning and overcrowding.

Large numbers of people are affected by various other diseases which have their roots in the environment. For example, several hundred million people are infected with malaria each year (resulting in over one million deaths), and several thousand million are infected with intestinal parasites.

Table 1 gives an indication of the relative contribution of environmental exposures to the global burden of disease and injury. These estimates are based on the concept of

disability-adjusted life years (DALYs), which expresses the health loss due to a combination of death, disease and disability. Each DALY indicates the loss of a year of healthy life, i.e. the time lived with a disability or time lost through premature death (8). It is estimated that about 23% of the world's total DALY burden is associated with environmental factors. This is a rough estimate, however, and more work is needed to gain a better understanding of the links between environment, health and development and to quantify the contribution of various environmental and development factors to death, disability and ill-health.

Table 1

**PROPORTION OF GLOBAL DALYS ASSOCIATED WITH ENVIRONMENTAL EXPOSURES - 1990**

| | Global DALYs (thousands) | Environmental fraction (%) | Environmental DALYs (thousands) | % of all DALYs (all age groups) (age 0-14 years) | |
|---|---|---|---|---|---|
| Acute respiratory infections | 116 696 | 60 | 70 017 | 5 | 4.5 |
| Diarrhoeal diseases | 99 633 | 90 | 89 670 | 6.5 | 6.1 |
| Vaccine-preventable infections | 71 173 | 10 | 7 117 | 0.5 | 0.49 |
| Tuberculosis | 38 426 | 10 | 3 843 | 0.3 | 0.04 |
| Malaria | 31 706 | 90 | 28 535 | 2.1 | 1.8 |
| Injuries<br>- unintentional<br>- intentional | 152 188<br>56 459 | 30<br>N.E. | 45 656<br>N.E. | 3.3 | 1.6 |
| Mental health | 144 950 | 10 | 14 495 | 1.1 | 0.08 |
| Cardiovascular diseases | 133 236 | 10 | 13 324 | 1 | 0.12 |
| Cancer | 70 513 | 25 | 17 628 | 1.3 | 0.11 |
| Chronic respiratory diseases | 60 370 | 50 | 30 185 | 2.2 | 0.57 |
| | | | | | |
| Total these diseases | 975 350 | 33 | 320 470 | 23 | 15.4 |
| Other diseases | 403 888 | N.E. | N.E. | | |
| Total all diseases | 1 379 238 | (23) | (320 470) | | |

N.E.: Not Estimated

Source: WHO (7)

## 1.3 LINKING HEALTH WITH ENVIRONMENT AND DEVELOPMENT

Irrespective of the precise contribution of the environment to ill-health in the world, concerted action is needed to reduce the health impacts. The factors that contribute to problems of health and the environment are manifold and complex, but fundamental are inadequate attention to health in development policy and practice, lack of coordinated management and insufficient inter-sectoral collaboration (9). The root causes of problems are often related to the way in which development at large has proceeded, with little attention paid to the effects on the environment and health of policies, plans, strategies and projects.

From recent international meetings held since Rio'92, it has become evident that health issues are an increasingly important item on the broad environment and development agenda, and that environmental issues are receiving more prominence on the public health agenda (10).

In 1987, the World Commission on Environment and Development linked the issue of environmental protection to the topic of economic growth and development. The urgency of environment and development problems led subsequently to the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro, Brazil, in 1992. This Earth Summit, attended by representatives from 179 countries, was the largest gathering of Heads of State in world history and led to the adoption of Agenda 21, a global programme of action for achieving sustainable development in the twenty-first century and beyond (11).

Sustainable development has been defined as "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* (12). Agenda 21 highlights, among many aspects, the need for more appropriate management of human settlements, and places particular emphasis on the need to take health considerations into account in planning for sustainable development.

The theme of human settlements was re-emphasized at the Habitat II meeting held in Istanbul, Turkey, in June 1996 (13), which focused attention on cities, highlighting their importance in the light of the rapid urbanization prevailing throughout the world. Indeed, several international conferences have drawn attention to the importance of urban environments and sustainable development, including the 1994 Global Forum meeting held in Manchester, United Kingdom. In parallel with these developments, several movements have emerged over recent years focusing on the need to examine local environmental conditions and the way in which local environmental initiatives can contribute to improved environmental management and health.

A growing awareness of the links between development, health and the environment is also evident from the recent history of the public health movement. In 1986, with the launch of the Ottawa Charter on Health Promotion (14), the need to develop supportive environments for health was highlighted, and emphasis was placed on viewing health in a broader development perspective. In particular, the Charter stressed

the need to look at the various elements known to improve health as part of an integrated whole and to look outside as well as within the health sector when devising strategies for improving health.

This theme was expanded at the Sundsvall Conference on Supportive Environments for Health held in Sweden in 1991, which examined the role played by various sectors in influencing environment and health conditions and linkages, viewing how health and environmental considerations could best be incorporated in sectoral planning (15). The need to consider the settings in which health is created, such as housing and the work environment, was held to be vitally important.

The WHO Commission on Health and the Environment was convened in 1990 (16) and provided key input for the subsequent Earth Summit. The central relevance of the human factor to the concept of sustainable development was stressed in the preamble to the Rio Declaration, as follows: "*Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature*" (11). Chapter 6 of Agenda 21 takes this principle further by emphasizing the fundamental commitment within sustainable development of "protecting and promoting human health".

There is thus growing recognition that economic development, management of the environment and protection of public health must be addressed together in an integrated way. While the environmental movement has highlighted the aspect of sustainability, the health movement has laid special stress on the issues of social justice, equity and human development. Not only are healthy people needed to ensure development, but also health is not possible without development.

## *1.4 NEED FOR HOLISTIC APPROACHES*

The above discussion demonstrates an increasing need to form partnerships, to work across sectors such as the environment, transport, energy and housing, to involve communities more closely in decision-making and to devolve decision-making to the lowest possible level. Inter-sectoral efforts are particularly important for addressing complex, interrelated problems, the determinants or solutions of which may lie beyond the direct control of the health sector (9). Optimal use must be made of limited resources, and the expertise, knowledge and experience of all relevant sectors of society must be used in order to develop solutions that are sustainable and implementable.

While some problems are shared globally and transnationally, each country, region and community also faces its own unique problems, the solutions to which will be affected by factors such as resources, customs, institutions and values (17). This implies a need for harmonized global, national and local strategies. The strategies to be created should address underlying systemic problems rather than symptoms and incorporate economic, health and environmental dimensions in the design of projects and services, fully engaging all relevant interest groups and service users (18).

Chapter 6 of Agenda 21 specifies that countries should set priorities for actions based on cooperative planning by various levels of government, non-governmental organizations and local communities. Such planning, orientated to the prevention of health and environmental problems and involving all levels and sectors of communities, is essential for achieving "Health for All" and sustainable development.

## *Role of the Health Sector*

Although much progress has been made in recent years in the development of comprehensive health and environmental policies and strategies, it is also true that many countries throughout the world have been relatively slow to develop these. This has been due partly to the fact that there are many gaps in knowledge and perceptions of insufficient evidence on which to act. It is also due to the very real challenges to the health sector of addressing policy needs with respect to new and expanded areas such as energy, agriculture, industrialization and advanced technology. Nevertheless, there is a growing appreciation of the key role that the health sector can play in helping to ensure that the policies and strategies of various sectors and organizations contribute positively to health protection and promotion.

Agenda 21 presents an opportunity for health authorities to strengthen their influence in both national and local planning and to reverse the trend of environmentally damaging and health-threatening development. A number of countries have taken initiatives since the Earth Summit to include a stronger health focus in national planning for sustainable development (see Chapter 5). Measures for incorporating health and environmental issues in national plans and programmes have varied from country to country, depending on planning mechanisms, the current status of the sustainable development programme and the way in which planning responsibilities are divided. In some countries, plans for health and the environment have been prepared for inclusion in national plans for sustainable development, while in others sectoral plans have been reviewed and modified to address health and environmental concerns. Agenda 21 also attached great importance to the role of local governments in fostering sustainability. Indeed, Agenda 21 called upon local governments to enter into a dialogue with their citizens, local organizations and private enterprises and to adopt a "Local Agenda 21" plan of action.

The emergence of complex environmental and health systems has made it necessary to define more clearly the responsibility of the health sector in helping to ensure that the activities of all sectors and organizations contribute positively to health protection and promotion. Although environment, health and development concerns should form part of the responsibility of all sectors, the health sector has special responsibilities, which are highlighted in the box below.

Box 2

## HEALTH SECTOR RESPONSIBILITIES

- Monitoring overall health status, ensuring that health is monitored at the city, neighbourhood or district level and that intra-urban and intra-district differences are detected (this is important in terms of shifting the focus of regulatory control in many countries from low risks which often affect only relatively small percentages of the population)

- Estimating the contributions of various environmental and social factors to health problems, by using improved indicators of the relationship between health and living conditions to support decision-making

- Analyzing environmental and social health needs and requirements in various development sectors that are significant for health, such as housing, local government, transport and industry, including consideration of the health opportunities offered by each sector

- Formulating health and environmental policies in partnership with relevant sectors

- Advocating, facilitating and fostering the inclusion of health issues in the work of competent agencies, organizations and communities at all levels and generally promoting health and the environment

- Supporting health and environmental service delivery and providing such services as are appropriate at various tiers of government

- Supporting the development of research that may be necessary to improve understanding, assessment and management of health risks

- Providing technical support and guidance in policy and planning, evaluation and capacity development.

Source: adapted from von Schirnding (9)

# 2 THE NATURE AND USE OF INDICATORS

*This chapter introduces the concept of indicators in the context of policy and decision-making. As indicated in the previous chapter, health, environment and development problems differ throughout the world, as do priorities in respect of their management. Here, the nature of indicators is discussed in relation to information needs, and their general characteristics are highlighted. Various types of indicators are discussed, and the concept of core indicators is introduced.*

## 2.1 DATA AND INFORMATION NEEDS

Wide-ranging reforms may be needed to enable the health sector to fulfil some of its broader responsibilities, listed in Box 2. Nevertheless, for such functions to be carried out, information is needed by decision-makers and the public. This is necessary to identify existing problems, set priorities, develop and evaluate policies and plans, guide research and development, set standards and guidelines, monitor progress and inform the public.

Chapter 40 of Agenda 21, which addresses information required for decision-making, states that "*in sustainable development, everyone is a user and provider of information in the broad sense*" (11). Decision-makers and the public must have ready access to accurate information on the health hazards associated with development and the environment. This information must be conveyed in a readily comprehensible way, but with due regard for inherent complexities and uncertainties in the data.

An abundance of information (of varying quality) is often available from monitoring and surveillance programmes, especially in industrialized countries, but this information may not always be in a form relevant for decision-makers to set policies. It may be of limited use for informing the public and decision-makers about key health and environmental problems and their causes, or about actions that may be required for their management.

Providing information that is relevant to policy-making within constraints of time and other factors, and in a form which all those involved can appreciate and accept is a major challenge, requiring the selection of information that is directly relevant to the task at hand and necessitating translation of this information into a consistent, coherent form.

Indicators can play an important role in turning data into relevant information for decision-makers and the public. In particular, they can help to simplify a complex

array of information about the health–environment–development nexus. They provide a "synthesized" view of existing conditions and trends which can be used in decision-making. They thus play an important role in improving communication with the public and decision-makers, and may contribute to improved management and policy development.

One of the most important stimuli for indicator development in the field of health and the environment was adoption of Agenda 21 and the emergence of sustainable development as a guiding principle for policy development. Chapter 40 of Agenda 21 (mentioned above) states that indicators of sustainable development should be developed to provide a solid basis for decision-making at all levels and to contribute to a self-regulating sustainability of integrated environment and development systems (11). It states that "*While considerable data already exists, as the various sectoral chapters of Agenda 21 indicate, more and different types of data need to be collected at the local, provincial, national and international levels, indicating the status and trends of the planet's ecosystem, natural resources, pollution and socioeconomic variables".*

## 2.2 DEFINITIONS AND CHARACTERISTICS OF INDICATORS

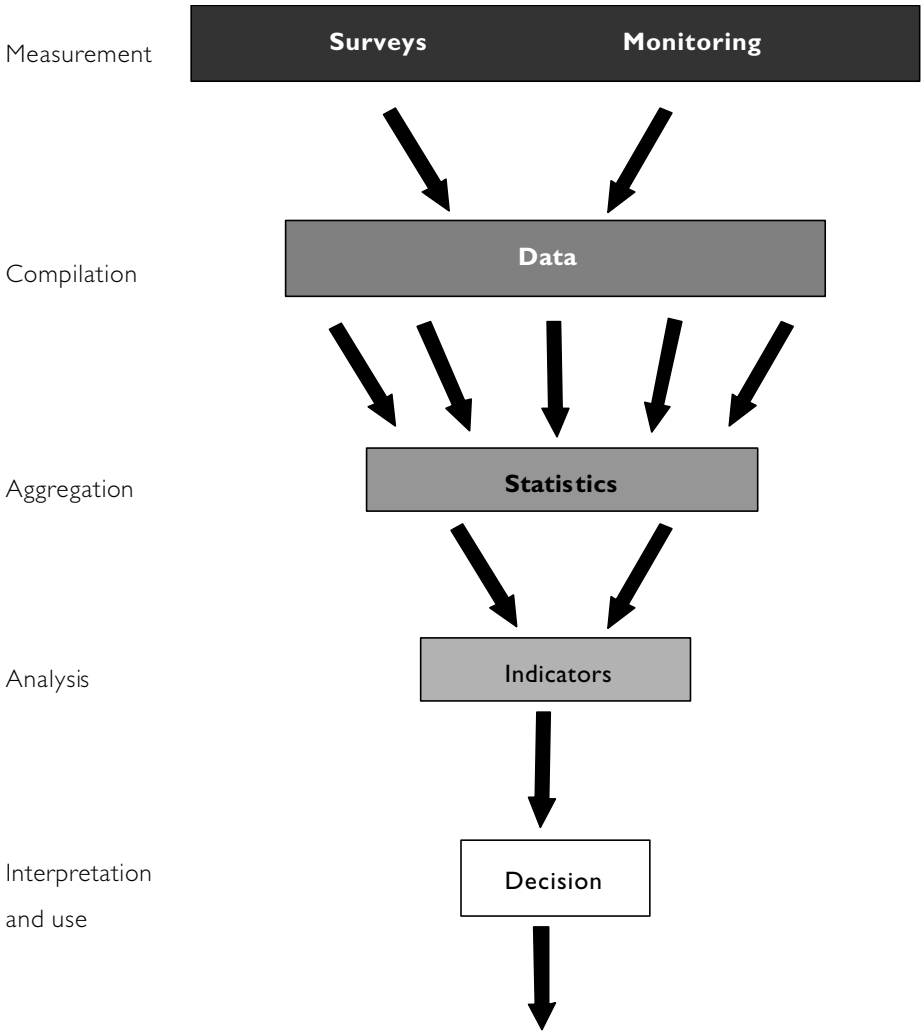
The term "indicator" is derived from the Latin "indicare", which means to announce, point out or indicate. Chambers Dictionary defines an indicator as "*...something that provides an indication, a pointer...any device for exhibiting conditions for the time being*". The Organisation for Economic Co-operation and Development (OECD) has defined an indicator as "*A parameter, or a value derived from parameters, which points to/provides information about/describes the state of a phenomenon/ environment/area with a significance extending beyond that directly associated with a parameter value*" (19).

Others have defined an indicator as "*a piece of information which is part of a specific management process, and has been assigned a significance beyond its face value*" (20). The Scientific Committee on Problems of the Environment (SCOPE) described indicators in terms of two key characteristics: they quantify information so that its significance is more readily apparent, and they simplify information about complex phenomena so as to improve communication (21*)*.

Briggs *et al*. (22), building on these definitions, defined an environmental health indicator as "*An expression of the link between environment and health, targeted at an issue of specific policy or management concern and presented in a form which facilitates interpretation for effective decision-making*". Embodied in this definition is the concept of a link between a factor in the environment and a health outcome.

However they are defined, indicators form part of information systems, but they are distinct from statistics and primary data in that they represent more than the data on which they are based. For example, measurements of various aspects of environmental

Figure 2
**INDICATORS USED IN DECISION-MAKING**




Source: Briggs *et al.* (22)

quality result in raw data, such as hourly air pollution levels, which might then be aggregated and summarized to provide statistics such as 24-hourly mean air pollution levels. The statistics might subsequently be analysed, re-expressed and combined in the form of indicators (for example the number of days on which air quality guidelines are exceeded), which can then be fed into the decision- making process.

Indicators thus give data added value by converting them into information which is of direct use to the decision-maker, helping to shed light on a problem. They have become well-established and are widely used in many fields, from economics to ecology to health, and can be used at the global, regional, national, local or neighbourhood levels, as well as at the sectoral level (23).

One example of an indicator is the gross domestic product (GDP), which is a way of assessing aspects of economic development in a country. The infant mortality rate is an indicator of the health status of a community. The rise in ambient temperatures worldwide is an indicator of climate change. The number of public complaints received by a local authority is an indicator of the level of satisfaction with the quality of services provided. In the field of ecology, the presence or absence of an 'indicator species' can be used to assess the conditions that prevail in an ecosystem.

## *Composite Indicators*

Indicators may be specific or they may be composite, which means that they condense a wide range of information on different (but related) phenomena into a single measure or index, such as the human development index, which combines information on life expectancy at birth, educational level and level of income. A "gender-related" development index has been elaborated by UNDP. In practice, however, the construction of such composite indicators is challenging, and high levels of competence in statistics and measurement are needed in order to weight and combine different variables. In addition, the choice of components and the manner in which they are weighted may be largely subjective. It can be difficult to test or verify composite indicators, since they may not relate to specific, measurable conditions. Confusion may arise if the effects of the individual components are variable and if significant trends in an underlying component are masked by other components. Such indices may not be readily understood by the public, who could feel that their actions had no effect on the indicator (24).

Composite indices can nevertheless be useful in summarizing data and information for decision-makers and may be particularly valuable for drawing comparisons between countries. For example, in the construction of indicators for global climate change, the individual greenhouse gases contributing to global warming can be weighted by their global warming potential or health-absorbing capacity and can be expressed in terms of "carbon dioxide equivalents". A similar approach has been adopted in a weighting scheme for ozone-depleting gases (21). Many air quality indices have been devised, such as the pollutant standard index developed in the USA in the 1970s, and water quality indices that make it possible to aggregate variables associated with water use. The human development index has been widely used for inter-country comparisons.

In the field of health, the DALY referred to in Chapter 1 (Section 1.2) is an example of a composite measure of the burden of disease which is based on the concept of disability-adjusted life years, combining the years of healthy life lost as a result of premature death, disability or disease (8).

## *Indicator Typologies*

Indicators can be classified in many ways, for example according to whether they are concerned with impacts, process or outcomes or whether they are quantitative (involving numerical measurements) or qualitative (for example involving people's

opinions or perceptions). The European Environment Agency (EEA) has developed a useful typology of indicators (25).

A descriptive indicator is defined as one that indicates what is happening to the environment or to human health (for example, emissions and concentrations of pollutants), while a performance indicator is linked to a reference value or policy target, illustrating how far the indicator is from the desired level. Performance indicators of the achievement of agreed targets and goals have been extensively used in the private sector.

Box 3

**THE EUROPEAN ENVIRONMENT AGENCY (EEA) TYPOLOGY OF ENVIRONMENTAL INDICATORS**

Type A

***Descriptive indicators*** of what is happening to the environment or human health, for example emissions and concentrations of pollutants

Type B

***Performance indicators*** linked to a reference value or policy target, illustrating how far the indicator is from a desired level

Type C

***Efficiency indicators*** illustrating the efficiency of production and consumption processes, for example energy consumption per unit of output

Type D

***Total welfare indicators*** which aggregate together economics, social and environmental dimensions to illustrate whether, overall, welfare is increasing

Source: U.K. Department of Environment, Transport and Regions (25)

Indicators that are primarily descriptive can be useful in obtaining baseline information on which to formulate subsequent policy options and plans, and to assess trends. At all levels (global, regional and local), indicators that describe the overall state (quality) of human health and the environment, and that highlight the factors that affect environmental quality and human health can be useful, as they can provide an overview, snapshot or profile of environmental and health conditions, thereby demonstrating trends. Reports on the state of health and the environment have often served as a basis for the subsequent development of health and environmental action plans.

Indicators derived by community groups can be more useful for community-based monitoring of locally relevant issues than national or global indicators in which the link with local activities is often remote. Locally derived indicators can be used as a way of building capacity in communities and decision-making bodies, enabling them to play a more active role in assessing environmental and health conditions and recommending subsequent remedial actions (see also Chapter 6).

Indicators of the various policy responses needed to address problems can also be useful. In developing countries, where the database required to construct indicators

may be limited but the problems (and solutions) well known, it may be more appropriate to focus on the development of response, or action, indicators, than on those based on data from extensive monitoring programmes (21).

Some indicators are more relevant to national or global issues (for example health aspects of climate change), while others are more relevant locally (for example drainage or solid waste disposal). Many issues, such as management and control of air pollution, require action across various tiers of government: the setting of standards may be relevant at the national level, monitoring and control at the local level and assessment of trends in greenhouse gas emissions in relation to climate change at the global level.

The issues highlighted in Table 2 below could be particularly relevant at the global, national and local levels, respectively, although there are no rigid boundaries and the situation varies from one setting to another. The roles and responsibilities of different tiers of government in managing various health and environmental problems, the degree of decentralization of powers and functions, and factors such as data availability and quality will influence the extent to which data for indicators at different levels should be examined.

Table 2

**EXAMPLES OF HEALTH AND ENVIRONMENTAL MANAGEMENT CONCERNS AT LOCAL, NATIONAL AND GLOBAL LEVELS**

| Local | National | Global |
|---|---|---|
| • Dust control<br>• Noise control<br>• Solid waste disposal<br>• Water and sanitation supply<br>• Pest control | • Hazardous waste management policy<br>• Regulation of toxic chemicals<br>• Food safety policy<br>• Ambient air pollution standards (major industrial/mobile sources) | International conventions and agreements:<br>• Climate change<br>• Transboundary pollution<br>• Ozone depletion<br>• Acid deposition<br>• Marine pollution |

## 2.3 CORE INDICATORS

There has been much debate on, and interest in the concept of a set of "core" indicators which can be used on a global basis to examine overall trends in health and environment. Opponents of the concept have argued that health and environmental problems and priorities for their management differ significantly in various regions of the world, as do monitoring and analytical capabilities and resource availability. Problems of standardizing definitions and difficulties in ensuring quality control on a worldwide basis are further complicating factors.

Yet most countries, regardless of their level of development or of other socio-political or cultural realities, must deal with certain problems of universal significance (see Table 2 above for some examples). As indicated, whilst the dimensions of these problems differ from one country to another and within countries, universally applicable indicators could be valuable for improving shared knowledge about factors that affect the state of the global environment. Common sets of indicators have other obvious benefits, as they allow aggregation at local, country, regional and global levels and also provide momentum to countries in attaining rigorous standards. Global, regional or national reporting requirements may exist under international treaties or for the targets set by various intergovernmental bodies; these also may necessitate internationally standardized indicators. Hence, standardized indicators, including frameworks, concepts, definitions, procedures and methods have an important place.

Indicators should not however place unnecessary reporting burdens on countries. Efforts by government departments, agencies, non-governmental organizations, civil society and the donor community should be coordinated and should aim at strengthening data collection and management. Existing data should be drawn upon as far as possible, with due regard for their limitations. Where user needs are similar, indicators should be harmonized.

### A REGIONAL APPROACH TO ENVIRONMENTAL HEALTH MONITORING: EASTERN MEDITERRANEAN COUNTRIES

Several regional conferences and seminars in the Eastern Mediterranean Region have highlighted the fact that a lack of reliable data on environmental health is a major constraint on the effective development of environmental health programmes. The Beirut Declaration of Action for a Healthy Environment regarded regional collaboration in environmental health information systems as an urgent and important issue.

With support from the WHO Regional Office for the Eastern Mediterranean (EMRO) and the International Development Research Centre (IDRC), the WHO Regional Centre for Environmental Health Activities undertook a number of initiatives to develop country-specific environment and health indicators and is encouraging the development of a set of core indicators for information exchange at the regional level. As a result of a series of studies and regional meetings, the following set of environmental health indicators was proposed for application in the Eastern Mediterranean Region:

Water supply

- Proportion of population with access to an adequate amount of safe water in the dwelling or within a convenient distance from the dwelling

Sanitation

- Proportion of population with access to a sanitary facility for human excreta disposal in the dwelling or within a convenient distance from the dwelling

*(cont'd)*

**Solid waste**
- Proportion of houses served by regular waste removal services

**Food safety**
- Incidence of outbreaks of foodborne poisoning per year

**Air pollution**
- Annual number of deaths among children under the age of five from acute respiratory infections
- Percentage of population in non-electrified dwellings

**Health-care waste**
- Proportion of untreated health-care waste

Source: Atallah & Khan (26)

# 3 INTERNATIONAL INDICATOR INITIATIVES

*This chapter highlights selected international indicator initiatives. This includes environment and sustainable development indicators, social indicators, housing and urban indicators, and health indicators developed by various international bodies.*

## 3.1 ENVIRONMENT AND SUSTAINABLE DEVELOPMENT INDICATORS

In the early to mid-1990s, organizations such as the OECD (19), SCOPE (27), UNEP/RIVM (20), the World Bank (28), the World Resources Institute (29) and others became involved in the development of indicators to monitor environmental trends. The OECD approach has been to develop indicators for assessing countries' environmental performance, and the World Resources Institute has devised indicators for measuring and reporting on the performance of environmental policy in the context of sustainable development (23).

Many inter-governmental and non-governmental organizations and various countries have drawn up indicators of sustainable development (see Chapter 6 for further details). The United Nations Commission on Sustainable Development has been instrumental in coordinating the development and testing of such indicators. To date, it has compiled about 130 indicators of social, economic, environmental and institutional aspects of sustainable development, which have been classified according to whether they are "driving force" indicators representing human activities, processes and patterns with an impact on sustainable development, whether they indicate the 'state' of sustainable development, or whether they are indicators of "response" to policy options and to changes in the state of sustainable development (30). These indicators are being tested at the national level throughout the world, and it is anticipated that they will be used in national decision-making, following adaptation and modification. A core set based on the policy priorities of Agenda 21 will be presented for endorsement to the Commission on Sustainable Development.

Table 3

**SELECTED SUSTAINABLE DEVELOPMENT INDICATORS**

| CHAPTERS OF AGENDA 21 | DRIVING FORCE INDICATORS | STATE INDICATORS | RESPONSE INDICATORS |
|---|---|---|---|
| **CATEGORY: SOCIAL** | | | |
| Chapter 3: Combating poverty | • Unemployment rate | • Head count index of poverty<br>• Poverty gap index<br>• Squared poverty gap index<br>• Gini index of income inequality<br>• Ratio of average female wage to male wage | |
| Chapter 5: Demographic dynamics and sustainability | • Population growth rate<br>• Net migration rate<br>• Total fertility rate | • Population density | |
| Chapter 36: Promoting education, public awareness and training | • Rate of change of school age population<br>• Primary school enrolment ratio (gross and net)<br>• Secondary school enrolment ratio (gross and net)<br>• Adult literacy rate | • Children reaching grade 5 of primary education<br>• School life expectancy<br>• Difference between male and female school enrolment ratios<br>• Women per hundred men in the labour force | • GDP spent on education |
| Chapter 6: Protecting and promoting human health | | • Basic sanitation: Percent of population with adequate excreta disposal facilities<br>• Access to safe drinking water<br>• Life expectancy at birth<br>• Adequate birth weight<br>• Infant mortality rate<br>• Maternal mortality rate<br>• Nutritional status of children | • Immunization against infectious childhood diseases<br>• Contraceptive prevalence<br>• Proportion of potentially hazardous chemicals monitored in food<br>• National health expenditure devoted to local health care<br>• Total national health expenditure related to GNP |

| CHAPTERS OF AGENDA 21 | DRIVING FORCE INDICATORS | STATE INDICATORS | RESPONSE INDICATORS |
|---|---|---|---|
| Chapter 7: Promoting sustainable human settlement development | • Rate of growth of urban population<br>• Per capita consumption of fossil fuel by motor vehicle transport<br>• Human and economic loss due to natural disasters | • Percent of population in urban areas<br>• Area and population of urban formal and informal settlements<br>• Floor area per person<br>• House price to income ratio | • Infrastructure expenditure per capita |
| **CATEGORY: ENVIRONMENTAL** | | | |
| Chapter 18: Protection of the quality and supply of freshwater resources | • Annual withdrawals of ground and surface water<br>• Domestic consumption of water per capita | • Groundwater reserves<br>• Concentration of faecal coliforms in freshwater<br>• Biochemical oxygen demand in water bodies | • Waste-water treatment coverage<br>• Density of hydrological networks |
| Chapter 17: Protection of the oceans, all kinds of seas and coastal areas | • Population growth in coastal areas<br>• Discharges of oil into coastal waters<br>• Releases of nitrogen and phosphorus to coastal waters | • Maximum sustained yield for fisheries<br>• Algae index | |
| Chapter 10: Integrated approach to the planning and management of land resources | • Land use change | • Changes in land condition | • Decentralized local level natural resource management |
| Chapter 12: Managing fragile ecosystems: combating desertification and drought | • Population living below poverty line in dryland areas | • National monthly rainfall index<br>• Satellite derived vegetation index<br>• Land affected by desertification | |
| Chapter 13: Managing fragile ecosystems: sustainable mountain development | • Population change in mountain areas | • Sustainable use of natural resources in mountain areas<br>• Welfare of mountain populations | |

| CHAPTERS OF AGENDA 21 | DRIVING FORCE INDICATORS | STATE INDICATORS | RESPONSE INDICATORS |
|---|---|---|---|
| Chapter 14: Promoting sustainable agriculture and rural development | • Use of agricultural pesticides<br>• Use of fertilizers<br>• Irrigation percent of arable land<br>• Energy use in agriculture | • Arable land per capita<br>• Area affected by salinization and waterlogging | • Agricultural education |
| Chapter 11: Combating deforestation | • Wood harvesting intensity | • Forest area change | • Managed forest area ratio<br>• Protected forest area as a percent of total forest area |
| Chapter 15: Conservation of biological diversity | | • Threatened species as a percent of total native species | • Protected area as a percent of total area |
| Chapter 16: Environmentally sound management of biotechnology | | | • R & D expenditure for biotechnology<br>• Existence of national biosafety regulations or guidelines |
| Chapter 9: Protection of the atmosphere | • Emissions of greenhouse gases<br>• Emissions of sulphur oxides<br>• Emissions of nitrogen oxides<br>• Consumption of ozone depleting substances | • Ambient concentrations of pollutants in urban areas | • Expenditure on air pollution abatement |
| Chapter 21: Environmentally sound management of solid wastes and sewage-related issues | • Generation of industrial and municipal solid waste<br>• Household waste disposed per capita | | • Expenditure on waste management<br>• Waste recycling and reuse<br>• Municipal waste disposal |
| Chapter 19: Environmentally sound management of toxic chemicals | | • Chemically induced acute poisonings | • Number of chemicals banned or severely restricted |
| Chapter 20: Environmentally sound management of hazardous wastes | • Generation of hazardous wastes<br>• Imports and exports of hazardous wastes | • Area of land contaminated by hazardous wastes | • Expenditure on hazardous waste treatment |

| CHAPTERS OF AGENDA 21 | DRIVING FORCE INDICATORS | STATE INDICATORS | RESPONSE INDICATORS |
|---|---|---|---|
| Chapter 22: Safe and environmentally sound management of radioactive wastes | • Generation of radioactive wastes | | |

Source: United Nations (30)

## 3.2 SOCIAL INDICATORS OF DEVELOPMENT

Social indicators of development have been compiled by the World Bank (1996) to assess reductions in poverty. These include indicators of priorities, supplementary indicators (including of access to basic services and social safety nets) and indicators of human resources, natural resources, socioeconomic expenditure and investment in human capital. In combination, they allow monitoring of social conditions at the country level and provide a framework for assessing human welfare.

Table 4
**SOCIAL INDICATORS OF DEVELOPMENT**

| | | |
|---|---|---|
| **Priority Poverty Indicators** | • Poverty | • Upper poverty line<br>Headcount index<br>• Lower poverty line<br>Headcount index<br>• GNP per capita |
| | • Social | • Public expenditure on basic social services<br>• Gross enrollment ratios<br>• Primary<br>Male<br>Female<br>• Mortality<br>Infant mortality<br>Under 5 mortality<br>• Immunization<br>Measles<br>DPT<br>• Child malnutrition (under 5)<br>• Life expectancy<br>Total female advantage<br>• Total fertility rate<br>• Maternal mortality rate |

| | | |
|---|---|---|
| **Supplementary Poverty Indicators** | | • Expenditure on social security<br>• Social security coverage<br>• Access to safe water<br>Total<br>Urban<br>Rural<br>• Access to health care |

Source: World Bank (31)

## 3.3 HOUSING AND URBAN INDICATORS

Other work on indicators which is relevant to health includes that of the United Nations Centre for Human Settlements (32) with regard to housing and urban areas, which constitutes a monitoring package for cities and the shelter sector. The key indicators were collected by countries in preparation for Habitat II (13) (see Section 1.3). Governments were urged to obtain information for at least the key indicators in one or more cities. The indicators cover socioeconomic development, infrastructure, transport, environmental management, local government, housing affordability, availability and provision, and general background information. Data have been collected for cities all over the world.

UNCHS (33) has also gathered data on specific issues of concern with regard to the quality of housing, such as overcrowding, and the indicators consequently developed have been classified according to whether they are associated with the causes of the problem, the health outcomes or responses to the situation.

## 3.4 HEALTH INDICATORS

WHO headquarters and regional offices have developed indicators and targets in order to assess the Health for All (HFA) policy, to guide Member States in evaluating their national strategies for HFA and to follow up implementation of the Global Strategy. The HFA indicators have dealt with trends in policy development, socioeconomic development, health and the environment, health resources, health systems, health services and health status. The framework was based mainly on health services, health status, health determinants and health resources. Various regions and individual countries have also been involved in developing HFA indicators (34). A new set of targets, incorporating indicators, has been developed with respect to the renewed HFA policy (1) (see Chapter 6). Indicators which describe the overall health status of WHO Member States (for example as reported in WHO's Annual World Health Report) are also in use (35).

Table 5

## INDICATORS OF HOUSING AND URBAN CONDITIONS

| **A. Background data** | |
|---|---|
| • Land use<br>• City population<br>• Population growth rate<br>• Woman headed households | • Average household size<br>• Household formation rate<br>• Income distribution<br>• City product per person<br>• Tenure type |
| **B. Urban Indicators** | **C. Housing Indicators** |
| **Socioeconomic Development**<br>• Households below poverty line<br>• Informal employment<br>• Hospital beds<br>• Child mortality<br>• School class rooms<br>• Crime rates<br>**Infrastructure**<br>• Household connection levels<br>• Access to potable water<br>• Consumption of water<br>• Median price of water, scarce season<br>**Transport**<br>• Modal split<br>• Travel time<br>• Expenditure on road infrastructure<br>• Automobile ownership<br>**Environmental Management**<br>• Percentage of wastewater treated<br>• Solid waste generated<br>• Disposal methods for solid waste<br>• Regular solid-waste collection<br>• Housing destroyed<br>**Local Government**<br>• Major sources of income<br>• Per-capita capital expenditure<br>• Debt service charge<br>• Local government employees<br>• Wages in the budget<br>• Contracted recurrent expenditure ratio<br>• Government level providing services<br>• Control by higher levels of government | **Housing Affordability and Availability**<br>• House price to income ratio<br>• House rent to income ratio<br>• Floor area per person<br>• Permanent structures<br>• Housing in compliance<br>**Housing Provision**<br>• Land development multiplier<br>• Infrastructure expenditure<br>• Mortgage to credit ratio<br>• Housing production<br>• Housing investment |

Source: United Nations Centre for Human Settlements (32)

WHO has also developed programme indicators to monitor the health of infants and young children, women's health and the health of the general population. The indicators have been classified according to whether they are outcome-related (concerned with health status or death) or process-related (concerned with health care delivery and management) or whether they are determinants (for example behavioural or environmental factors that influence health outcomes). The indicators are intended for use by public health administrators and health programme and service managers (36).

Table 6

**SELECTED INDICATORS FOR THE THIRD EVALUATION OF "HEALTH-FOR-ALL" (MORBIDITY- AND MORTALITY- RELATED)**

- Total fertility rate
- Crude birth rate
- Crude death rate
- % of newborns weighing at least 2500g at birth
- % of children whose weight-for-age and/or height-for-age are acceptable by international standards
- Life expectancy at birth
- Infant mortality rate
- Probability of dying before 5$^{th}$ birthday
- Maternal mortality rate
- Mortality from acute respiratory infections in children under 5
- Mortality from diarrhoeal diseases in children under 5
- Mortality from malaria
- Mortality from measles
- Mortality from tuberculosis
- Life expectancy at age 65
- Mortality from cardiovascular diseases (all types)
- Mortality from cancer (all types)
- Mortality from traffic accidents
- Mortality from work accidents
- Prevalence of guinea worm (dracunculiasis)
- Prevalence of leprosy
- Incidence of malaria
- Incidence of measles
- Incidence of neonatal tetanus
- Number of new cases of polio
- Incidence of tuberculosis
- Prevalence of iodine deficiency disorders in school children
- Prevalence of anaemia in pregnant women
- Prevalence of anaemia in children under 5

*(cont'd)*

- Prevalence of vitamin A deficiency disorders
- DFMT at age 12 years (mean value)

Source: WHO (37)

Table 7

**GLOBAL HEALTH INDICATORS (WHO)**

**Basic Indicators for all Member States**

Population

- Total population (000)
- Annual growth rate (%)
- Dependency ratio (per 100)
- Percentage of population aged 60+ years
- Total fertility rate

Probability of Dying (per 1000)

- Under age 5 (m/f)
- Between ages 15 and 59 years (m/f)
- Life expectancy at birth (years m/f)

**Deaths by Cause, Sex, and Mortality Stratum in WHO Region**

Cause (total deaths, and % total, burden of disease in disability-adjusted life-years (DALYS)

Communicable diseases, maternal and perinatal conditions and nutritional deficiencies

- infectious and parasitic diseases
- respiratory infections
- maternal conditions
- perinatal conditions
- nutritional deficiencies

Non-communicable conditions

- malignant neoplasms
- other neoplasms
- diabetes mellitus
- nutritional/endocrine disorders
- neuropsychiatric disorders
- sense organ disorders
- cardiovascular diseases
- respiratory diseases
- digestive diseases
- diseases of the genitourinary system
- skin diseases
- musculoskeletal diseases
- congenital abnormalities

**Injuries**

- unintentional
- intentional

Source: WHO (35)

Table 8

## HEALTH AND HEALTH-RELATED INDICATORS IN THE AMERICAS

### Demographic Indicators

- Total population (1000s)
- Crude birth rate (1,000 pop)
- Average annual births (1000s)
- Crude mortality rate (1,000 pop)
- Average annual deaths (1000s)
- Annual rate population growth (%)
- Total fertility rate (by women)
- Urban population %
- Dependency ratio (100 pop)
- Life expectancy at birth (years)

### Socioeconomic Indicators

- Literate population proportion (%)
- Per capita/day availability of calories
- Population with drinking water supply services (%)
- Population with sewerage and excreta disposal services (%)
- Gross national product (US$ per capita)
- Annual GDP growth rate (%)
- Population in poverty (%)
- Highest 20%, lowest 20% income ratio

### Mortality Indicators

- mortality rate
  - infant (1,000 l.b)
  - under 5 (1,000 l.b)
- under 5 years of age registered deaths

  Proportion due to: acute diarrhoeal diseases
  acute respiratory infections
- Maternal mortality rate (100,000 l.b)
- No of registered deaths

  from: homicide
  suicide
  motor vehicle injuries
- Mortality under registration (%)
- Ill-defined deaths (%)
- Mortality rates (m/f) from communicable diseases (100, 000 pop).
- Mortality rates (m/f) from malignant neoplasms (100, 000 pop).
- Mortality rates (m/f) from diseases of the circulatory system (100, 000 pop).
- Mortality rates (m/f) from external causes (100,000 pop)
- Registered deaths from measles
- Reported cases of measles

*(cont'd)*

- BF+ tuberculosis rate (100,000 pop)
- Reported cases of cholera
- Malaria risk areas (population %)
- Malaria API (1000 pop)
- Reported cases of malaria
- Reported cases of dengue
- AIDS annual incidence rate (1,000, 000 pop)
- M/F ratio of AIDS annual incidence rate (1,000, 000 pop.)
- M/F ratio of AIDS cases
- Newborns with low birth weight (< 2500 g) (%)

**Indicators of Resources, Access and Coverage**

- Physicians per 10,000 pop
- Nursing professionals per 10,000 pop.
- Dentists per 10,000 pop
- Hospital beds per 1000 pop
- National health expenditure per capita (US$)
- National health expenditure as % GDP
- Health care by trained personnel (%)
- Under 1 year old vaccination coverage
- Contraceptive use (women all methods ) (%)

Source: PAHO/WHO (38)

Table 9

**WHO PROGRAMME INDICATORS**

**Indicators for Monitoring the Health of Infants and Young Children**

- Under-five deaths due to acute respiratory infections
- Treatment of pneumonia cases
- Maternal knowledge of when to seek care for ARI
- ARI case management capability of health facilities
- Care-seeking for children with acute respiratory infections
- Exclusive breast feeding
- Annual incidence of diarrhoea in children under 5 years of age
- Increased fluid intake and continued feeding during diarrhoea episodes
- Deaths due to diarrhoea among infants and children under 5 years of age
- Mothers' knowledge of home therapy for diarrhoea
- Polio incidence- Immunization coverage
- Neonatal tetanus incidence
- Tetanus immunization coverage for women of child-bearing age
- Measles cases
- Measles case fatality
- Measles deaths
- Goitre prevalence rate

*(cont'd)*

- Infant mortality rate
- Under five mortality rate
- Stunting prevalence
- Underweight prevalence
- Wasting prevalence
- Prevalence of night blindness in pre-school children

**Indicators for Monitoring the Health of Women**

- HIV prevalence in pregnant women
- Maternal mortality ratio
- Prenatal care coverage
- Anaemia in women
- Case fatality rate of direct obstetric complications
- Births attended by trained health personnel
- Availability of essential obstetric care
- Current of contraception by women
- Sexually transmitted diseases prevalence in women
- Screening for cancer of cervix

**Indicators for Monitoring the Health of the General Population**

- Disability rates
- Monthly incidence of Guinea-worm cases
- Annual incidence of Guinea-worm cases
- Villages with new cases of Guinea-worm
- Access to safe drinking water
- Access to sanitary means and excreta disposal
- Availability of essential drugs
- Quality of drugs
- Iodization of salt
- Condom availability
- Knowledge of HIV-related preventive practices
- Condom use with non-regular sex partners
- Incidence rate of severe malaria
- Availability of anti-malaria drugs in health facilities
- Reported sexually transmitted diseases incidence in men
- STD case management
- Annual tuberculosis case notification
- Tuberculosis treatment case notification
- Tuberculosis treatment completion rate
- Tuberculosis fatality rate
- Incidence rate of acute myocardial infarction
- Prevalence of hypertension
- Incidence of stroke
- Incidence of rheumatic fever
- Prevalence of smoking

Source: WHO (36)

Indicators for specific WHO programmes have also been developed, such as those for assessing vitamin A deficiency (39), for monitoring national drug policies (40), and for evaluating programmes to ensure food safety. WHO, for example, previously published a set of guiding principles, which apply to the preparation of country profiles and databases, concepts and processes associated with evaluation and indicators for evaluating programmes to ensure food safety and various aspects of food safety evaluation (41).

Much work has also been done by WHO on indicators in environmental health (42). The publication *Linkage Methods for Environment and Health Analysis* (22) addresses methods of linking information on health and the environment and use of indicators for quantifying and monitoring environmental health. Field studies have been carried out to obtain information on aspects of environmental health status and particular environmental health problems (42). Environmental health indicators have been developed by WHO Regional Offices, for example the Regional Office for Europe (EURO), the Regional Office for South-East Asia (SEARO) and the Regional Office for the Eastern Mediterranean (EMRO).

Table 10

**SELECTED ENVIRONMENTAL HEALTH INDICATORS**

| ISSUE | THEME/ TOPIC | INDICATOR | EXAMPLE DEFINITION |
|---|---|---|---|
| Socio-demographic context | Poverty | Poverty | Human poverty index (compound index) |
| | Population density | Population density | Population density |
| | Population growth | Rate of population growth | Annual net rate of population growth |
| | Age structure | Dependent population | Percentage of people aged less than 16 years or 65 years or more |
| | Urbanisation | Rate of urbanization | Annual net rate of change in the proportion of people living in urban areas |
| | Infant mortality | Infant mortality rate | Annual death rate of infants under 1 year of age |
| | Life expectancy | Life expectancy | Number of years a newborn baby is expected to live, given the prevailing mortality rate |
| Air pollution | Outdoor air pollution | Ambient concentrations of air pollutants in urban areas | Mean annual concentrations of ozone, CO, particulates (PM10, PM2.5, SPM), SO2, NO2, O3 and lead in the outdoor air in urban areas |

| ISSUE | THEME/ TOPIC | INDICATOR | EXAMPLE DEFINITION |
|---|---|---|---|
| Air pollution | Indoor air pollution | Sources of indoor air pollution | Percentage of households using coal, wood or kerosene as the main source of heating and cooking fuel |
| | Respiratory illness | Childhood morbidity due to acute respiratory illness | Incidence of morbidity due to acute respiratory infections in children under 5 years of age |
| | Respiratory illness | Childhood mortality due to acute respiratory illness | Annual mortality rate due to acute respiratory infections in children under 5 years of age |
| | Air quality management | Capability for air quality management | Capability to implement air quality management |
| | Air quality management | Availability of lead-free gasoline | Consumption of lead-free gasoline as a percentage of total gasoline consumption |
| Sanitation | Excreta disposal | Access to basic sanitation | Proportion of the population with access to adequate excreta disposal facilities |
| | Diarrhoea | Diarrhoea morbidity in children | Incidence of diarrhoea morbidity in children under 5 years of age |
| | Diarrhoea | Diarrhoea mortality in children | Diarrhoea mortality rate in children under 5 years of age |
| Shelter | Informal settlements | Percentage of population living in informal settlements | Percentage of the population living in informal settlements |
| | Unsafe housing | Percentage of population living in unsafe housing | Percentage of the population living in unsafe, unhealthy or hazardous housing |
| | Home accidents | Accidents in the home | Incidence of accidents in the home |
| | Urban planning | Urban planning and building regulations | Scope and extent of building and planning regulations for housing |
| Access to safe drinking water | Water quality/ supply | Access to safe and reliable supplies of drinking water | Percentage of the population with access to an adequate amount of safe drinking water in the dwelling or within a convenient distance from the dwelling |

| ISSUE | THEME/ TOPIC | INDICATOR | EXAMPLE DEFINITION |
|---|---|---|---|
| Access to safe drinking water | Water quality/ supply | Connections to piped water supply | Percentage of households receiving piped water to the home |
| | Diarrhoea | Diarrhoea morbidity in children | Incidence of diarrhoea morbidity in children under 5 years of age |
| | Diarrhoea | Diarrhoea mortality in children | Diarrhoea mortality rate in children under 5 years of age |
| | Water-borne diseases | Outbreaks of water-borne diseases | Incidence of outbreaks of water-borne diseases |
| | Water quality monitoring | Intensity of water quality monitoring | Density of water quality monitoring network |
| Vector-borne disease | Population at risk | Population at risk from vector-borne diseases | Number of people living in areas infected by disease vectors |
| | Vector-borne disease mortality | Mortality due to vector-borne diseases | Mortality rate due to vector-borne diseases |
| | Vector control | Adequacy of vector control and management systems | Percentage of the at-risk population covered by effective vector control and management systems, by disease type |
| Solid waste management | Waste collection | Municipal waste collection | Percentage of population served by regular waste collection services |
| | Waste disposal | Municipal waste disposal | Mass of solid waste disposed of by municipal waste management services |
| | Waste management | Hazardous waste policies | Effectiveness of hazardous waste policies and regulations |
| Hazardous/ Toxic substances | Blood lead | Blood-lead level in children | Percentage of children with blood lead levels >10 ug/dl |
| | Chemical poisonings | Mortality due to poisoning | Mortality rate due to poisoning |
| | Contaminate-d land | Contaminated land management | Scope and rigour of contaminated land management |
| Food safety | Food-borne diseases | Food-borne illness | Outbreak rate of food-borne illness |
| | Diarrhoea | Diarrhoea morbidity in children | Incidence of diarrhoea morbidity in children under 5 years of age |

| ISSUE | THEME/ TOPIC | INDICATOR | EXAMPLE DEFINITION |
|---|---|---|---|
| Food safety | Diarrhoea | Diarrhoea mortality in children | Diarrhoea mortality rate in children under 5 years of age |
| | Monitoring of food safety | Monitoring of chemical hazards in food | Proportion of potentially hazardous chemicals monitored in food |
| Radiation | Radiation exposure | Cumulative radiation dose | Percentage of the population receiving an effective radiation dose in excess of 5 mS/yr |
| | UV exposure | UV light index | UV light index |
| Non-occupational health risks | Motor vehicle accidents | Mortality from motor vehicle accidents | Death rate due to road accidents |
| | Non-occup-ational injury | Injuries to children | Incidence of physical injury to children less than 5 years of age |
| | Poisoning | Incidence of poisonings of young children | Number of reported poisonings per year in children under 5 years of age |
| Occupational health risks | Occupat-ional hazards | Exposure to unsafe work-places | Percentage of workers exposed to unsafe, unhealthy or hazardous working conditions |
| | Occupat-ional morbidity | Morbidity due to occupational health hazards | Incidence of occupational injury |
| | Occupat-ional mortality | Mortality from occupational health hazards | Incidence of occupational mortality |

Source: Briggs (43)

Some baseline indicators developed by the WHO European Healthy Cities project relate to health, demography, health services, the environment and socioeconomic status. This first systematic effort to collect and analyze a wide array of data from cities across Europe (44) has provided important insights into the way in which indicators are understood in different countries, as well as relevant information on the availability, reliability and validity of data. The indicators were formally adopted by participating cities in 1990, and information on the 53 agreed indicators was collected from cities between 1992 and 1994.

Table 11

## INDICATORS OF HEALTHY CITIES (EUROPEAN REGION)

### Health Indicators

- Mortality: all causes
- Cause of death
- Low birth weight

### Health Service Indicators

- Existence within city of inventory of self-help organizations
- Existence within the city of a support programme for self-help organizations
- Existence of a city health education programme
- Percentage of six-year old children fully immunized (having received all compulsory vaccinations)
- Number of inhabitants per practising general practitioner
- Number of inhabitants per nurse
- Percentage of population covered by health insurance
- Percentage of population having access to an emergency medical service which is less than 30 minutes away by car
- Availability of primary health care services in foreign languages
- Health information communication
- Number of health questions examined by the city council every year

### Environmental Indicators

- Atmospheric pollution
- Microbiological quality of the water supply
- Chemical quality of the water supply
- Percentage of water pollutants removed from total sewage produced
- Household waste collection quality index
- Household waste treatment quality index
- Pollution level indicator as perceived by the population
- Quantity of drinking-water used per inhabitant per day
- Relative surface area of green spaces in the city
- Public access to green spaces
- Derelict industrial sites
- Sport and leisure
- Pedestrian streets
- Cycling in city
- Public transport
- Public transport network cover
- Living space
- Comfort and hygiene
- Emergency services

*(cont'd)*

Socioeconomic Indicators

- Number of square metres of living space per inhabitant
- Percentage of population living in substandard dwellings
- Estimated number of homeless people
- Unemployment rate
- Work absenteeism rate
- Percentage of families below the national poverty level
- Percentage of total employment provided by the 10 most important economic activities
- Percentage of one-person households
- Percentage of single-parent families
- Percentage of children leaving school after compulsory education
- Illiteracy rate
- Percentage of city's budget allocated to health and social actions
- Crime rate
- Percentage of dwellings for elderly people who have emergency call facilities
- Main causes for emergency calls
- Percentage of young children on waiting lists for child-care facilities
- Median age of women giving birth for the first time
- Abortion rate in relation to total number of births
- Percentage of people under 18 "under police surveillance"
- Percentage of disabled people in employment compared to total number of disabled people of working age (between 18 and 65).

Source: WHO (44)

## 3.5 COMMON COUNTRY ASSESSMENT INDICATORS

The common country assessment (CCA) indicator framework, developed by the United Nations Development Group (UNDG) as an indicator framework following United Nations conferences and summits, is being used by United Nations funds and programmes in over 100 countries. The United Nations Statistics Division, together with UNDG will be analyzing the lessons learned from the CCA indicator experiences. The CCA indicator framework, anticipating changes in the environmental indicators, includes provision for further review of environmental indicators, in order to maintain concordance between the two indicator sets.

Both the United Nations Statistics Division and UNDG are working with a number of selected countries to assess: a) to what extent the national statistical system is involved in the CCA indicator effort and what the impacts are of the CCA indicator requirements on the national statistical system; b) which indicators are being used; c) what the data gaps are; d) how the United Nations Development Assistance Framework (UNDAF)-CCA indicator process is related to other policy processes (for example

IMF/World Bank Poverty Reduction Strategies for countries qualifying for enhanced debt relief; and e) what targeted programmes are being proposed to address the lack of data or data quality (45). (See Appendix 1 for Union of Selected Core Indicator Sets).

# 4 CONSTRUCTION OF INDICATORS

*In this chapter, criteria for the development and use of indicators are outlined, and issues to be addressed in their construction are highlighted. The applicability of the criteria developed will depend on the indicators in question and on the purpose of the indicator. Issues discussed include the specification of indicators, measurement units and variables, assessment of data sources, statistical considerations and issues of interpretation and risk communication. Examples are given to illustrate these aspects.*

## 4.1 CRITERIA FOR INDICATORS

*"Indicators are a way of seeing the big picture by looking at a small piece of it"* (46).

Plan Canada (46) has described the process of indicator development as involving the following elements:

- definition of the characteristics to be measured
- identification of the target audience and the purpose of the indicator
- choosing a framework (i.e. one based on goals, issues, sectors or stress-condition-response)
- definition of criteria for selecting indicators
- identification and evaluation of a potential indicator on the basis of the selection criteria
- pilot-testing of the indicator
- choosing the final set and reviewing the indicator periodically.

Different types of decisions and issues require different types and levels of indicators. To be really useful, indicators should be applicable to the user and not just technically relevant or relevant to the data providers. The choice of indicators will depend on such factors as the purpose for their use and the target audience. As stated earlier, indicators can be used for problem definition, policy formulation, policy implementation and evaluation. Sometimes the same indicators can serve many purposes, while in other situations separate sets of indicators may be needed.

Many organizations have attempted to define criteria for the construction and selection of indicators, depending on whether they apply to policy, analytical soundness or measurability. They may also be assessed in relation to factors such as transparency, scientific validity, robustness, sensitivity and the extent to which they are linkable, or

according to whether they are relevant to the issue they are intended to describe, whether they relate to changes in policy and practice or whether they "strike a chord" with their intended audience (21).

Criteria that could be used in developing indicators are given in the box below. The applicability of the criteria depends, however, on the particular indicator and on the purpose for which it is to be used. For example, if the main concern is long-term environmental change, the criteria will include such factors as responsiveness to changes in the environment and human activities, capacity to provide early warning of pending changes, sensitivity to changes in the environment and so forth. If the indicators are intended primarily to inform the general public, the criteria will include such factors as simplicity, ease of interpretation and attractiveness to a range of interested parties. No single set of criteria will be applicable to all the indicators derived. Indeed, if all the indicators selected were to conform with all the desired criteria, very few would exist. Each situation has its own priorities for data collection and analysis.

As stated earlier, indicators of health and environment are based on the concept of a link between a factor in the environment and a health outcome (22). An environmental or a health outcome indicator can thus be regarded as an indicator of a health-environment relationship if there is some connection between the health indicator and the environment or between the environmental indicator and health. This is not as simple as it sounds because of the complexity of the factors involved, which bear on the nature of the relationship between the environment and human health (these are discussed more fully in Chapter 7). Nevertheless, even if direct evidence of the nature of the relationship cannot be obtained or it cannot be quantified, indirect information on interactions between the environment and health can often be obtained, and reasonable inferences can be made on the basis of general knowledge about the relationship.

Indicators must be as specific as possible with respect to a particular issue, in order to maximize the usefulness of the information for decision-making. Indicators should also be scientifically credible, unbiased and representative of the condition concerned. The aspect of representativeness is particularly important when descriptive indicators are used to obtain baseline information on health and environment in a particular setting (see Section 2.2). Indicators should be consistent and comparable in different settings, in both time and space, and should be relatively unaffected by small differences in methods and measurement techniques that may occur in the various contexts and settings in which information is collected.

In order to be as useful as possible, indicators should be readily understandable by interested parties and potential users and should be based on information that is either readily available or relatively easy and inexpensive to collect. The data should also allow disaggregation in order to assess trends at the lowest possible level of resolution, to identify groups or areas at risk and to allow identification of inequities (on the basis of geographical patterns, sex, socioeconomic status and other variables).

The general criteria for health and environment indicators listed in the box below are meant to serve as an overall guide to the types of issues that should be considered.

Box 4

**GENERAL CRITERIA FOR INDICATORS**

Indicators should be:

**Generally relevant**

- Related to a specific question or issue of concern
- Health-related and linked to environment/development factors
- Sensitive to changes in the conditions in question
- Give early warning of pending changes

**Scientifically sound**

- Unbiased and representative of the conditions in question
- Scientifically credible, reliable and valid
- Based on the best available data of acceptable quality
- Robust and unaffected by minor changes in the method or scale used in their construction
- Consistent and comparable over time and space

**Applicable to users**

- Relevant to policy and management needs
- Based on data that are available or can be collected or monitored with a reasonable financial/time resource input
- Easily understood and applied by potential users
- Acceptable to stakeholders

Source: modified and adapted from Briggs *et al.* (22)

In addition to these general criteria, others for the development of international and local indicators may be specified (see also Sections 2.3 and 2.4).

Box 5

**CRITERIA FOR INDICATORS OF USE FOR INTERNATIONAL PURPOSES**

These indicators should be:

- Linked to broadly identified common problems and global priorities
- Appropriate for inter-country comparisons
- Relevant to international initiatives such as Health for All and Agenda 21 or to international conventions and treaties
- Attractive to a range of sectors, partners and institutions
- Ideally usable for decision-making at different tiers of government
- Based on sound, internationally comparable data that are readily available or easily and relatively inexpensively collected

Box 6

**CRITERIA FOR INDICATORS OF USE FOR LOCAL PURPOSES**

These indicators should:

- Be relevant both to individual citizens and to local government
- Reflect local circumstances
- Be based on information that can be readily collected
- Show trends over a reasonable period of time
- Be meaningful both in their own right and in conjunction with other indicators
- Be clear and easy to understand, in order to educate and inform
- Provoke change (for example in policies, services or lifestyles)
- Lead to the setting of targets or thresholds

Source: adapted from Local Government Management Board, United Kingdom (47)

While there are no cardinal rules or set procedures to be followed in developing indicators, the issues discussed in the following sections might serve as a useful guide.

## 4.2 DEFINITION AND SPECIFICATION OF INDICATORS, MEASUREMENT UNITS AND VARIABLES

In identifying the type of data that will be needed for a particular indicator, the indicator must be clearly defined and the measurement units and variables specified. Indicators may be defined with different levels of specificity, for instance, as "the amount of ozone-depleting substances eliminated as a result of the Montreal Protocol", "the median usable living space per person", "the percentage of the population living in urban areas", "emissions of sulfur dioxide into the atmosphere" or "the percentage of people who feel safe going out at night". Some indicators have precise definitions, others have definitions involving choices, while yet others have only loose definitions and may be less quantifiable and measurable.

The units of measurement must be clearly defined, for example:

- Tons of sulfur dioxide emitted per year
- Annual environmental health expenditure in US$
- Tonnes of fertilizer nutrients per 10 $km^2$ of agricultural land
- Biological oxygen demand expressed as milligrams per litre of oxygen consumed in 5 days at a constant temperature of 20º C
- Litres of water consumed per capita per day
- Proportion of people living in areas with air quality within acceptable standards
- Number of square metres of living space per inhabitant.

A number of factors should be considered in defining the actual measurement variables in respect of the indicator definition used. These are illustrated in the example below.

Table 12
**DEFINING INDICATORS**

| Name of indicator | Definition |
|---|---|
| • Existence of a city health education programme | Health education programmes are made up of one or several projects which aim to improve knowledge, assistance and services to individuals for developing and maintaining a healthy way of life |
| • Living space | Average number of rooms per inhabitant. The rooms are counted if they have a distinct purpose or if they are >4$m^{2.}$ for example kitchen, dining room, bedrooms, etc. Bathrooms, laundry rooms, hallways, etc. are not counted as rooms |
| • Low birthweight | Percentage of children weighing 2.5 kg or less at birth |
| • Percentage of single parent families | A family: part of household comprising at least two people: either a couple, married or not and any unmarried children (= single parent family) NB: children aged less than 18 years |

Source: WHO (44)

**THE EXAMPLE OF LEAD: DEFINING MEASUREMENT VARIABLES**

If an indicator is defined as "the annual rate of change in the urban population unduly exposed to lead in the environment", the terms "population unduly exposed to lead in the environment" must be defined. In countries where leaded gasoline is still used, the population could include people living near major roads, people living in the vicinity of lead-emitting industries, people living in old housing with lead-based paint, people living in homes with lead water pipes and so forth.

In turn, it would be necessary to define terms such as "old housing" (homes built before a certain year), "lead-based paint" (paint with more than a certain percentage of lead in the acid-leachable fraction), "major roads" (roads with more than a certain amount of vehicle traffic per hour or per day) and "lead-emitting industry" (taking into account the need to distinguish between exposure to heavily polluting industries and to industries that emit relatively little lead).

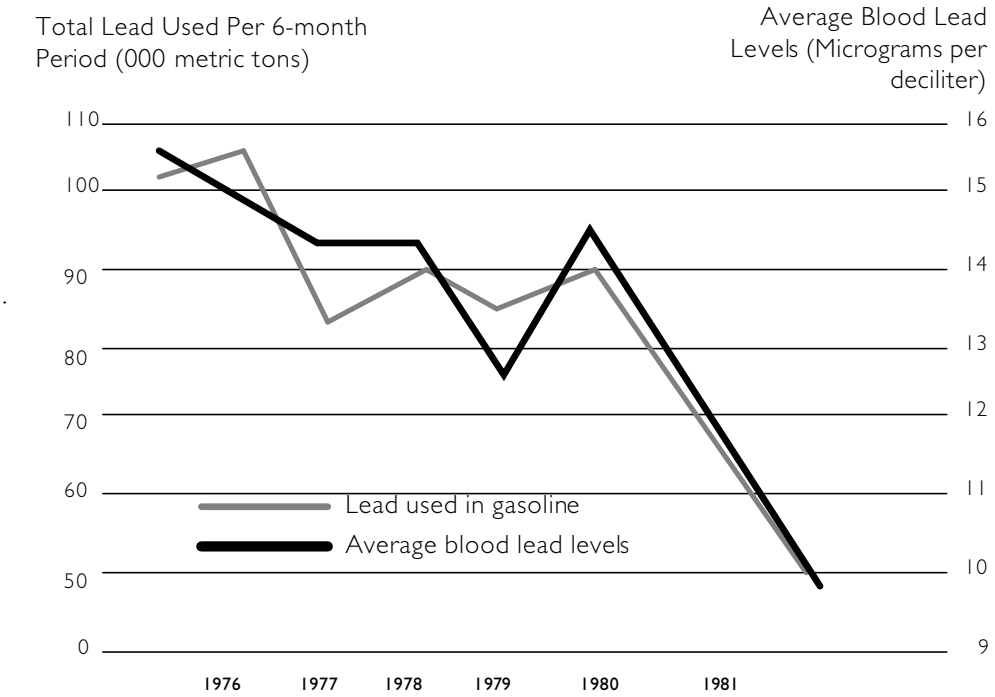
*(cont'd)*

It would then be necessary to define the proportion of people in these settings who are exposed, for example, to lead in air, dust and water at levels that are above or below a specified concentration. Alternatively, instead of using indirect (proxy) measures of exposure, more direct, biological indicators might be considered, such as blood lead (indicative of short-term exposure), tooth lead (cumulative, life-time exposure), or even hair lead (medium-term exposure). Measures of biological effect, such as zinc protoporphyrin concentration or the activity of the ALA-D (aminolaevulinic acid dehydratase) enzyme, might also be examined, and a cut-off point indicative of "undue" exposure (such as a blood lead concentration above 10 micrograms per decilitre), could be defined for each parameter. This would give an indication of exposure but would not in itself provide an indication of the source of the exposure (see Chapter 7 for further discussion).

The period over which the indicator provides an average could be particularly important in the event of significant variations in exposure by time of day, week, month, season and so forth. This could be especially important if the situation is compared to standards or guidelines based on specific averaging periods.

Figure 3
**REDUCING LEAD IN GASOLINE**

Decreases in Blood Lead Values and Amounts of Lead Used in Gasoline in the United States, 1976-80




Source: Thomas (48)

## 4.3 SPECIFICATION OF DATA SOURCES

Once the measurement variables have been defined, the data requirements and sources can be more readily specified. It is important for countries and organizations to note the data requirements implied by indicators and to incorporate these data in their standard monitoring and reporting systems as far as possible. Local circumstances will usually dictate what is feasible in terms of data collection. Monitoring and surveillance programmes may provide the basic data for indicator construction and indeed may be the only information available for the purpose. Nevertheless, the available data may refer to health and environmental conditions at different levels of resolution, making it difficult to form links between health and environmental conditions or to identify groups at risk. Data may be available for inadequate time periods or intervals and may not suffice to determine spatial or temporal trends.

Obtaining relevant data at country level remains a significant problem, particularly in poor countries, where there is often inadequate coverage and problems such as misclassification of illnesses and quality control in measurements may occur. Nevertheless, most countries have some kind of information system, even if it is fairly rudimentary and the recording systems incomplete. Almost all countries experience problems of data coverage and quality, to a greater or lesser degree. When data are not available or not usable, special surveys could be carried out that are restricted to specific issues, areas or groups. In many cases, valuable data can be provided simply by strengthening existing systems. A key priority is to establish information management systems in countries with poorly developed data sources.

All major sources of information relevant to the measurement variables should be identified. This will depend on the level of resolution at which the data are required. For most issues, there is no single source of information for any one indicator, so that many sources may have to be consulted for different pieces of information. It might be necessary to use routine information collected by government departments and agencies (global, national and local) and published in annual reports or censuses, for example. Information may also be obtainable from universities and research organizations, non-governmental organizations and community-based organizations, service organizations, environmental monitoring groups, industry and the private sector. Reports on the state of the environment, audits, monitoring programmes and censuses are useful sources of data at all levels.

A relatively large amount of data is available on health and environmental conditions world-wide, going back over a long period. For example, much useful data has been generated in various global monitoring programmes such as the former UNEP/WHO Global Environmental Monitoring System (GEMS) network (49, 50), and trans-national information systems such as the CORINE system (51). Improvements in field monitoring techniques and advances in modeling and computing have increased the amount of data on the state of the environment at various levels.

The quality and quantity of health information has also improved with advances in health information systems and health reporting. Several international sources of information are available on environmental health effects, such as the Environmental

Health Criteria series produced by WHO, UNEP and ILO, the International Register of Potentially Toxic Chemicals, monographs on the carcinogenicity of chemical substances produced by the International Agency for Research on Cancer (IARC) and various WHO guideline documents such as those on the quality of drinking-water and air.

Table 13
**SOURCES OF HEALTH AND ENVIRONMENTAL INFORMATION**

| Report title | Organization |
|---|---|
| Global environment outlook | UNEP, Nairobi |
| Human development report | UNDP, New York |
| State of the world's children | UNICEF, New York |
| United Nations statistical yearbook | UN, New York |
| Vital signs | Worldwatch Institute, Washington |
| State of the world | Worldwatch Institute, Washington |
| State of world rural poverty | IFAD, Rome |
| World development report | World Bank, Washington |
| World health report | WHO, Geneva |
| World health statistics annual | WHO, Geneva |
| World resources report | World Resources Institute, Washington |

Source: WHO (7)

## 4.4 ASSESSMENT OF DATA

Depending on the nature of the available data and the indicator requirements, it may be necessary to reconsider the design of the indicator, for instance by choosing a substitute or a different level of aggregation. This may be the case if the available data are of questionable quality in relation to the use for which the indicator is intended. In some cases, very detailed data might be needed for a particular parameter, whereas

in others a rough indication of a parameter might suffice.

Bearing in mind the repercussions (often financial) for decision-makers of acting on the basis of information conveyed through indicators, it is vital to ensure that the information collected is as accurate and reliable as the situation dictates. Quality control is an important aspect which must be carefully addressed (see further standard texts on epidemiology). For example, the accuracy and reliability of routine health data may differ greatly from one place to another. As already indicated, discrepancies in diagnosis, notification and reporting (under- and over-reporting) may occur, as well as differences in referral procedures and misclassification of diseases. The problem is usually more serious with regard to data on morbidity than to that on mortality, for which standard classifications exist. Quality control of environmental data is also subject to a variety of problems. Differences in sampling and measurement methods may affect the results, and the data may be unrepresentative. For all these reasons, procedures for checking accuracy, consistency and comparability should be introduced.

Trends should be examined for inconsistencies, data sources should be assessed, and "outliers", or unexpected departures from established relationships, should be carefully checked. The definitions used, the data sources relied upon and the methods used should be carefully documented, so that the process of information collection is as transparent as possible, enabling outside parties to cross-check data for their validity (22). For example, if the measurement variable concerned is the concentration of nitrogen dioxide, the methods used for monitoring (passive versus stationary monitoring) and the analytical procedures (spectrophotometry, ion chromatography or others) should be specified. If the measurement variable is blood lead concentration, the blood sampling method (for example intravenous or capillary) and the analytical techniques (for example atomic absorption spectrophotometry or gas chromatography) should be specified. Quality control measures should be specified in all cases.

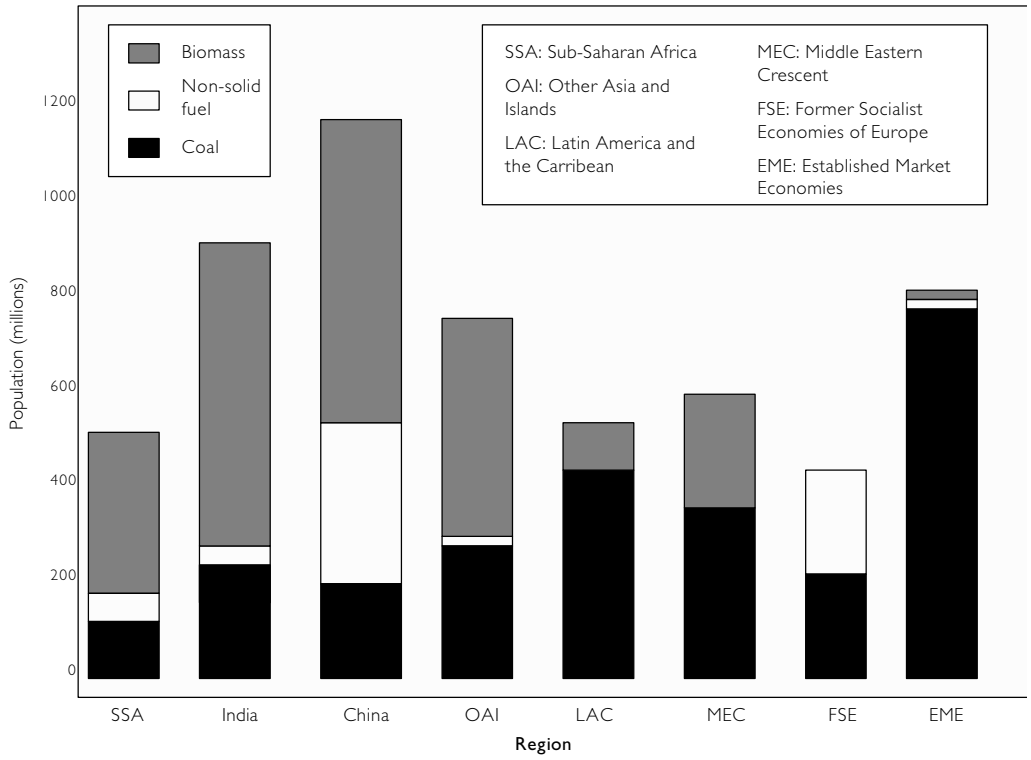
## 4.5 STATISTICAL CONSIDERATIONS

The form in which an indicator is presented can have important consequences for decision-making (see also Section 4.6). An indicator can be measured at one time, over several times or continuously, to show changes in a parameter. Indicators can be presented in a variety of statistical forms, for example as simple frequencies or magnitudes (number of deaths, number of people with health effects of interest), as rates (emissions, mortality and morbidity), as ratios (for example pollution level in relation to the WHO guideline level, standardized mortality ratio), as measurements of rate change (rate of population growth, rate of reduction in air pollution level), or in various more complex forms. The form chosen should reflect the purpose of the indicator.

It is usually necessary to identify the level of geographic aggregation and the denominator population, the group or groups at risk and the spatial and temporal dimensions of the problem or issue to be addressed. When relevant and possible,

Figure 4

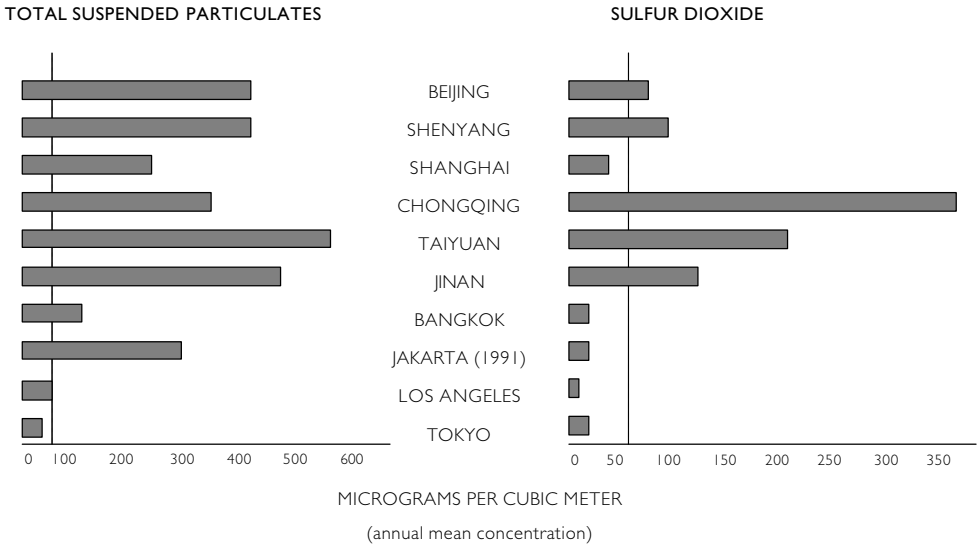
**NUMBERS OF PEOPLE USING DIFFERENT HOUSEHOLD FUELS, BY REGION, 1990s**




Source: WHO (7)

Figure 5

**AMBIENT CONCENTRATIONS OF AIR POLLUTANTS, 1995 (CHINA)**



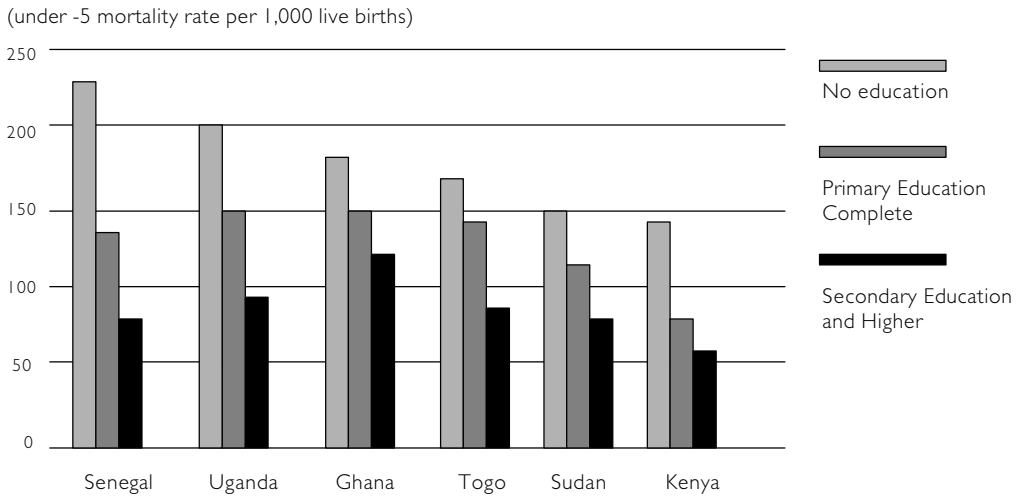

Source: World Bank (52)

data should be disaggregated, for example, by age and sex, geographical area, socioeconomic status, urban-rural divide, national and sub-national level and by other indicators of inequity and inequality.

Absolute counts or frequencies are usually not very useful, as they do not take account of the size of the population at risk, which may be large or small, increasing or decreasing and will therefore affect the absolute counts of events such as deaths. The rates calculated should relate the event to the population at risk, for example, representing infant deaths per 1000 population or children with raised blood lead

Figure 6

**MORTALITY RATES OF CHILDREN UNDER 5, AND LEVEL OF EDUCATION AMONG GIRLS AND WOMEN IN SELECTED AFRICAN COUNTRIES, 1985-1990**



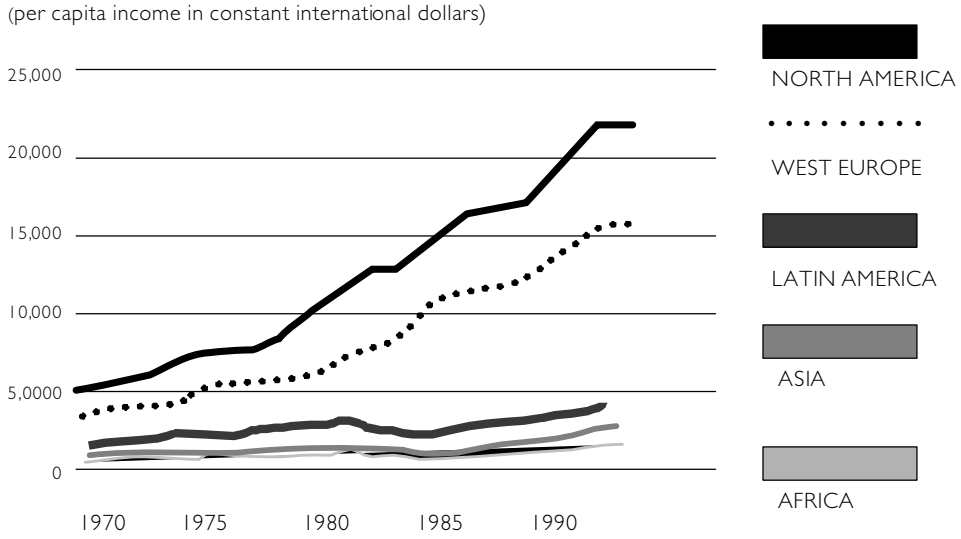

Source: World Bank (53)

levels per 1000 population in the target group. Both the prevalence rate (proportion of existing cases of disease at one time in a particular population) and the incidence rate (proportion of new cases of a disease occurring over a specified period in a population) may be used. Age-standardized mortality ratios are useful for comparing populations with different characteristics; for instance, deaths from lung cancer in a residential town with many elderly inhabitants compared with that in an industrial town with a younger, working-class population.

Trends in indicators are useful in determining whether situations are improving, deteriorating or stable. Trends can be discerned from information collected over a period of time, by methods of collection and sampling that remain relatively uniform during that period, in order to avoid introducing bias. A trend can be ascertained by comparison with another rate, which might be the expected background rate or the rate at some earlier time. It is important to specify the baseline or reference data against which the indicator will be standardized, reflecting the statistical form of the indicator and the level of geographic aggregation.

Figure 7

**PER CAPITA INCOME BY REGION, 1970-1991**

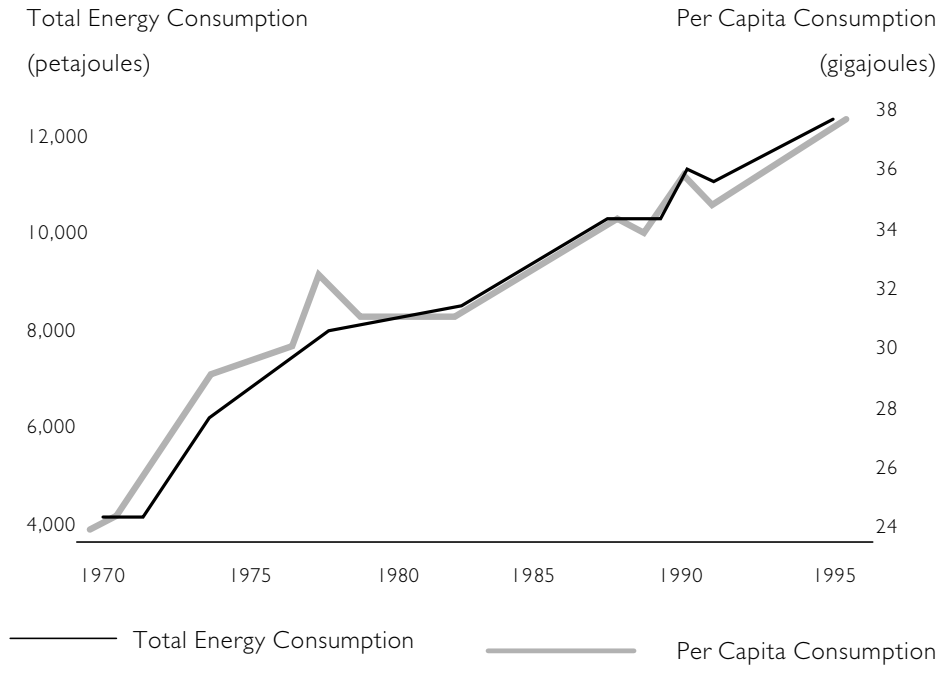



Source: UN (54)

Note: Based on purchasing power parity.

Figure 8

**TOTAL AND PER CAPITA ENERGY CONSUMPTION, 1970-1995**




Source: adapted from World Resources Institute (2)

Pilot testing is crucial in determining whether an indicator is sensitive to variations in the conditions concerned, whether the computing methods are sufficiently robust and the data adequate and whether the results of the indicator are interpretable. Problems in obtaining, processing and analysing data need to be ascertained in advance. Valuable lessons can be learnt from various programmes for field-testing indicators, such as those carried out by the Local Government Management Board in the United Kingdom (55), by the WHO European Region (Healthy Cities indicators) (44) and the United Nations Sustainable Development Indicator Testing Programme (30).

## 4.6 INTERPRETATION AND RISK COMMUNICATION

Indicators can be presented in various forms: graphically, as a map, or as a simple statistic. In deciding on the form of presentation to be used, the target audience must be kept in mind, since a form that is suitable for, and understandable to health professionals may not necessarily be appropriate for policy-makers, decision-makers or the general public. Illustrations and diagrams can be useful in making data accessible and can relay much information in a clear, readily comprehensible way.

The form in which information is conveyed can have a considerable impact on how it is used and interpreted. For example, presentation of the infant mortality rate at a particular time (perhaps in relation to other countries or cities) conveys different information from a presentation as a trend over time.

### POVERTY IN THE USA

Census tracts defined for metropolitan areas, cover 75% of the total US population. The poverty line is defined as the income level at which the estimated cost of a low-cost food plan for a family of three or more would consume 33% of the family's total income. A high poverty census tract is defined as one in which 40% or more of the population is below the poverty line. The percentage of poor people living in high poverty census tracts is a measure of the concentration of poverty in urban areas. It is widely believed that poor people are worse off living in areas of concentrated poverty than they would be in other areas, and that society as a whole suffers when these areas of concentrated poverty exist. Furthermore, growth in areas of concentrated poverty has negative implications for the future because children reared in very poor neighbourhoods are at risk of poor development outcomes.

The graph shows three measures of the concentration of poverty in urban areas:

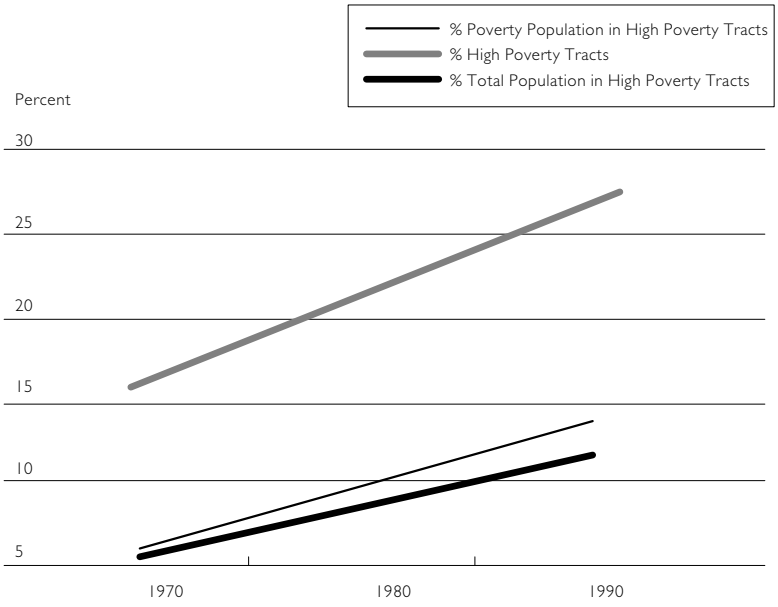
1. The percentage of the population below the poverty line living in high poverty census tracts (from 16.5% in 1970 to 28.2% in 1990);

(cont'd)

2. The percentage of census tracts which are defined as "high poverty" with 40% or more of the population in the tract below the poverty line (from 6% in 1970 to 13.7% in 1990);
3. The percentage of total population living in high poverty census tracts (from 5.2% in 1970 to 10.7% in 1990).

Figure 9

**HIGH POVERTY CENSUS TRACTS: 40% OR MORE OF POPULATION BELOW THE POVERTY LINE, 1970 - 1990**




Source: Sustainable Development in the United States (56)

As a general rule, the information obtained should be conveyed to policy-makers, decision-makers and the general public in a form that is useful and informative but does not cause undue anxiety. Factors that are beyond the individual's control or which impart no direct benefit are likely to cause more anxiety than factors over which the individual has direct control and which are associated with a perceived benefit.

In the United Kingdom, the Local Government Management Board initiated a pilot project with various local authorities to develop and use indicators. There was agreement that good presentation was critical to the use of indicators. Good communication demands skills in writing and illustration, particularly in simplifying but not over-simplifying information.

Box 7

**KEY ISSUES FOR THE COMPREHENSIBILITY OF INDICATORS**

- Balance between sophisticated indices and simpler measurements which are more readily explained and understood
- Non-technical data and graphics more useful for people of a range of backgrounds
- Clear language preferred, avoidance of jargon
- Lengthy documents inaccessible to many people. Short summary with graphics, supported by longer, more technical explanation for policy-makers and their advisers, may be appropriate
- Context essential for understanding indicators. For example, the level of car use could be used as an indicator of prosperity, mobility or environmental damage
- Geographical systems and maps for plotting different data sets are useful.

Source: adapted from Local Government Management Board, United Kingdom (47)

While the target audience must be identified and the message tailored to it, the following principles may be useful in general presentations on indicators:

Box 8

**FACTORS FOR PRESENTATION OF INDICATORS**

- A brief discussion of the issue
- A statement of the policy objectives
- An indication of links with other issues and indicators
- A definition of the indicator
- An idea of the availability of data for the indicator and of action to remedy any deficiencies
- Interpretation of the indicator, including trends and explanations
- A rating of performance against any targets or milestones that may have been set
- Ideas for action to bring about change and identification of those responsible.

Source: Local Government Management Board, United Kingdom (47)

**LEVELS OF ASTHMA**

Description

This indicator reflects levels of asthma in the population. It shows the number of bronchodilators prescribed for treating breathing difficulties (corrected with an age weighting) per month averaged for the particular year in Leicestershire (no data are available for the City of Leicester).

*(cont'd)*

**Importance**

There has been a recent sharp increase in the diagnosis of asthma, particularly amongst children. In an attempt to explain this epidemic attention has been focused upon several factors including increased levels of air conditionning and the prevalence of the house dust mite. A consensus does, however, appear to be emerging which links asthma with a deterioration of air quality, particularly in urban areas. Nitrogen dioxide, a pollutant from petrol and diesel engines, is thought to exacerbate asthma and emissions of this pollutant into the atmosphere have been increasing as a result of traffic growth. The effects of environmental factors such as air quality on health have long been recognised and a sustainable society would be one living in surroundings with minimal pollution and threats to health.

**Interpretation and trends**

The prescription of bronchodilator drugs in Leicestershire has shown a steady increase in recent years. This has probably been partly due to increased levels of asthma diagnosis as a result of increased awareness of the symptoms and availability of treatment, but it also reflects a real increase in the levels of asthma. Such an increase probably reflects a deterioration in air quality and means a reduction in the quality of life of asthma sufferers. The trend represents **a movement away from sustainability**.

Recent increases in levels of asthma in children have been more pronounced. In Leicester, a small study indicated that the incidence of asthma in 9 year old children increased from 10% to 15% over a 10 year period between the early 1980's and the early 1990's, with up to 20% of children suffering in some inner city areas. Larger scale trials are planned.

**Implications and action**

It is not yet possible to state conclusively that air pollution is creating asthma. However, it is certain that air pollution is worsening the suffering of those who have asthma and therefore effectively increasing tha effects of asthma in Leicester. Following the precautionary principle action should be taken to improve air quality and (hopefully) reduce asthma, for instance through transport planning measures designed to decrease pollution. This should not rule out the exploration of other avenues that might also benefit asthma sufferers.

**Measurement and source**

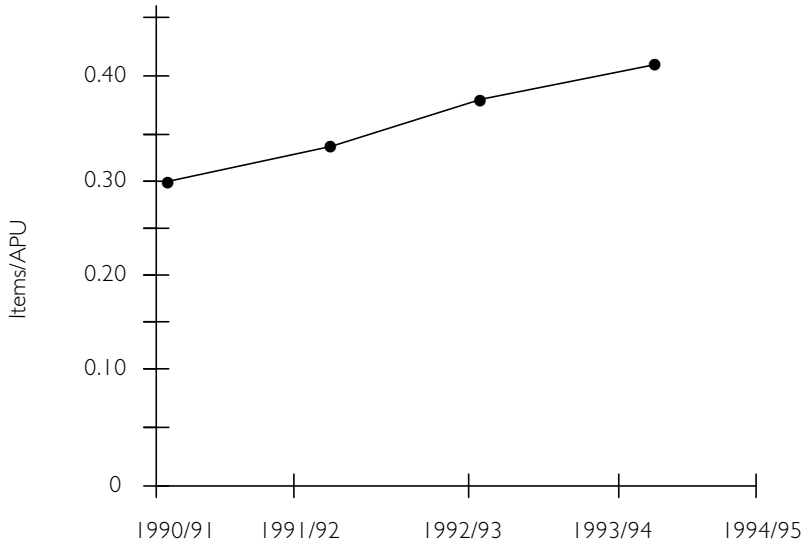
Definition: The number of bronchodilators prescribed (corrected for age using the Astro PU weighting) monthly from April in Leicestershire averaged for the year.

Source: Public Health Directorate, Leicestershire Health, Gwendolen Road, Leicester LE5 4QF.

Geographical Applicability: Leicestershire

Figure 10

**THE NUMBER OF BRONCHODILATOR ASTHMA TREATMENTS PRESCRIBED IN LEICESTERSHIRE**




Source: Local Government Management Board, United Kingdom (55)

## 4.7 EXAMPLES OF INDICATOR CONSTRUCTION

In the following section, examples are presented to illustrate the way in which some of the technical issues outlined above might be approached in the construction of indicators. Different issues are emphasized in the various examples, derived from the Framework and Methodologies for Indicators of Sustainable Development compiled by the Commission for Sustainable Development (30, currently being updated). While the examples given are intended to illustrate the *issues* involved, the indicators themselves constitute no "best practice". Many different indicators could be used in each cases discussed below. Further examples of environmental health indicator construction can be found in Briggs (43).

## EXAMPLE: BASIC SANITATION

**Indicator**: percentage of the population with adequate excreta disposal facilities.

**Definition of indicator**: proportion of the population with access to a sanitary facility for human excreta disposal in the dwelling or in its immediate vicinity.

**Unit of measurement**: a percentage.

**Measurement variables**: the term "sanitary facility" should be defined, for instance as "a unit for the disposal of human excreta which isolates faeces from contact with people, animals, crops or water sources". The facilities could range from simple, protected pit latrines to flush toilets with sewerage. The population covered could be defined as that served by connections to sewers, household systems (pit latrines, septic tanks) or communal toilets. The term "immediate vicinity" should also be defined, perhaps as any sanitary facility within 50 metres of a dwelling.

**Purpose**: the purpose of this indicator is to monitor progress in the access of a population to sanitary facilities. It is important to assess access to adequate excreta disposal facilities, as this is linked fundamentally to the risk for faecal contamination and disease and ill-health among the population. When disaggregated by geographical area or by socioeconomic status, it also provides evidence of inequalities.

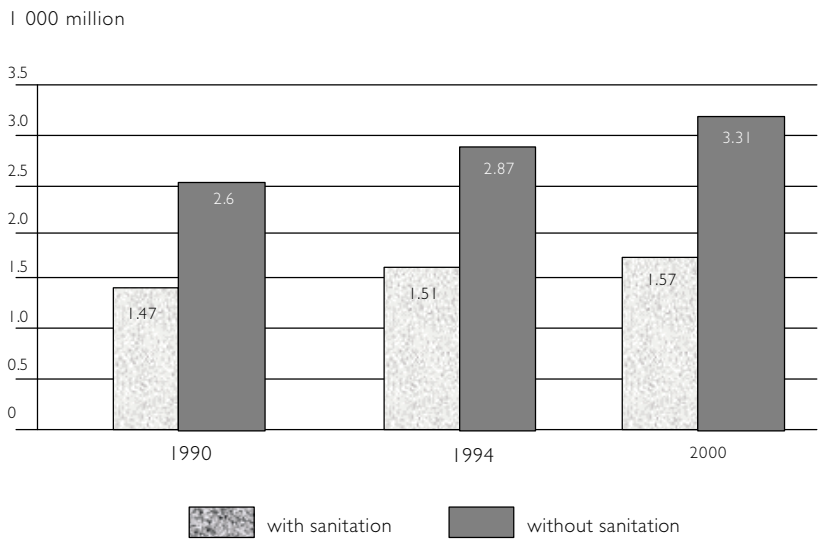
Users would include sanitary engineers, planners, public health officials, non-governmental organizations and others.

**Linkages**: the indicator could be linked to other indicators, such as the proportion of the population with access to adequate and safe drinking-water, or to a health effects indicator such as mortality and morbidity from diarrhoeal diseases.

**Data requirements**: data could be obtained from censuses or special surveys and should be disaggregated by (for example) geographical area or urban-rural divide.

Figure 11

### POPULATION WITH AND WITHOUT SANITATION, ALL DEVELOPING COUNTRIES




Source: WHO (7)

## EXAMPLE: ACCESS TO SAFE DRINKING WATER

**Indicator:** percentage of the population with safe drinking-water available in the home or within reasonable access.

**Definition of indicator**: the proportion of people with access to an adequate amount of safe drinking-water in a dwelling or within a convenient distance from the dwelling.

**Unit of measurement**: a percentage.

**Measurement variables**: definitions should be provided of the population covered and "a convenient distance from the dwelling" (for example water supply within 15 minutes' walking distance). These definitions may differ in rural and urban areas. For example, 200 metres from a home may be a reasonable measure in an urban environment, but in a rural context access might be better defined in terms of the proportion of the day spent fetching water. Other aspects to be defined would be an "adequate amount of water" (for example, 20 litres per person per day) and safe water, which could include treated surface waters and untreated but uncontaminated water, such as that obtained from protected boreholes, springs and sanitary wells. Untreated water such as in streams and lakes could also be included if the quality of the water complies with health standards or with guidelines for drinking-water.

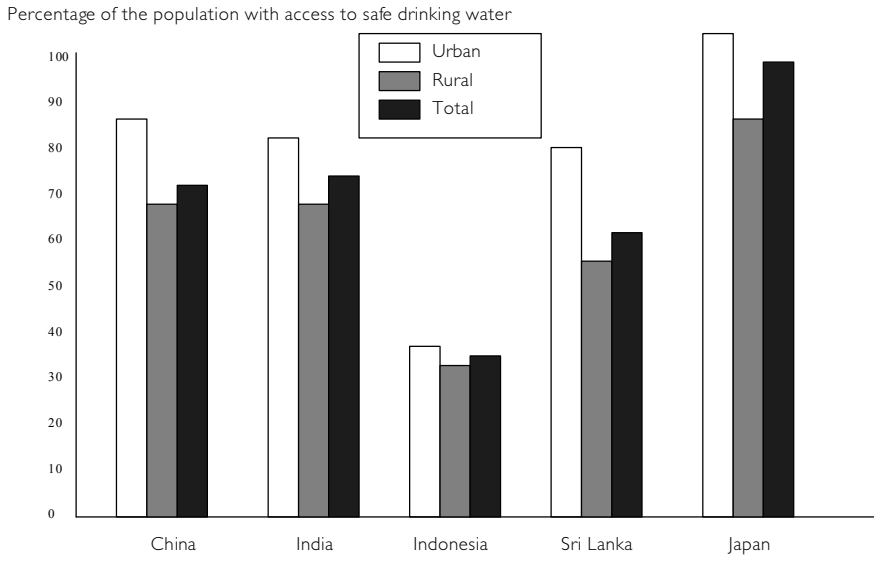
**Purpose**: this indicator is intended to monitor progress in the access of a population to safe drinking-water. This is relevant because access to unsafe drinking-water is associated with faecal contamination and risk for infectious disease.

**Linkages**: the indicator could be linked to other indicators, such as the proportion of the population covered by adequate sanitation, various indicators of the state of the environment related to water or to health outcome indicators such as mortality and morbidity from diarrhoeal diseases.

*(cont'd)*

Figure 12

### ACCESS TO SAFE DRINKING WATER IN SELECTED COUNTRIES IN ASIA, 1990




Source: World Bank (52)

**Data requirements**: data would be needed on the number of people with access, the total population, the source of the water, etc. These could be obtained from censuses and special surveys and should be presented in a disaggregated form when possible, for example, by geographical area, urban-rural divide or type of water source.

## EXAMPLE: AIR QUALITY

**Indicator**: ambient concentrations of air pollutants in urban areas.

**Definition of indicator**: concentrations of ozone, carbon monoxide, particulates, sulfur oxides, nitrogen oxides and lead.

**Unit of measurement**: parts per thousand million or parts per million for carbon monoxide or micrograms per cubic metre of air for lead.

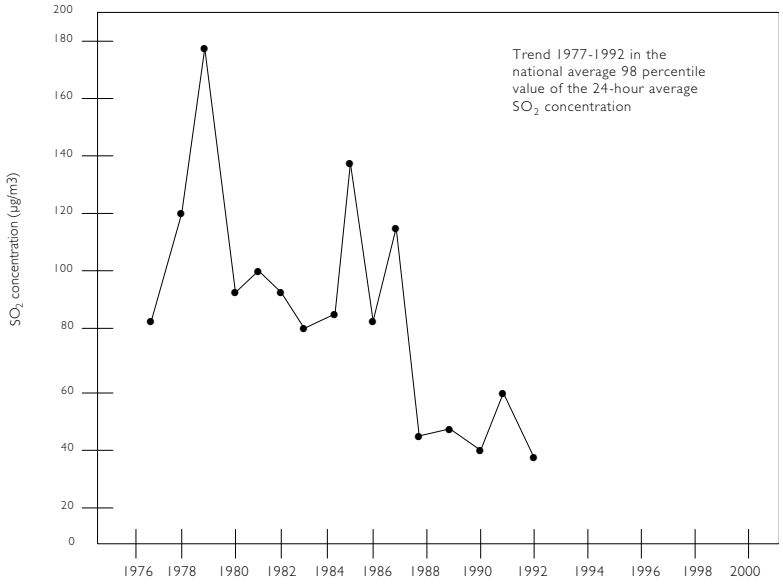
**Purpose**: this indicator might be used to evaluate overall air quality as a measure of the state of the environment and an indirect measure of the exposure of the population to air pollution. The information is relevant to controlling sources and to monitoring trends, particularly in relation to air quality standards, in order to safeguard human health.

**Linkages**: the indicator could be linked to indicators of annual energy consumption and air pollutant emissions or to a health effects indicator such as mortality and morbidity from respiratory illness.

**Data requirements**: the required data on temporal and spatial variations in concentrations might be obtainable from national and local health and environment agencies, from international agencies involved in monitoring or from non-governmental organizations. The methods should be specified for sampling, monitoring (for example passive and active sampling) and chemical analysis.

Figure 13

**TRENDS IN SULFUR DIOXIDE CONCENTRATIONS, 1977-1992**




Source: van de Water and van Herten (34)

## EXAMPLE: GREENHOUSE GASES

**Indicator**: emissions of greenhouse gases.

**Definition of indicator**: national anthropogenic emissions of carbon dioxide, methane and nitrous oxides.

**Units of measurement**: gigagrams for carbon dioxide and the conversion of methane and nitrogen oxide into carbon dioxide equivalents, with global warming potentials.

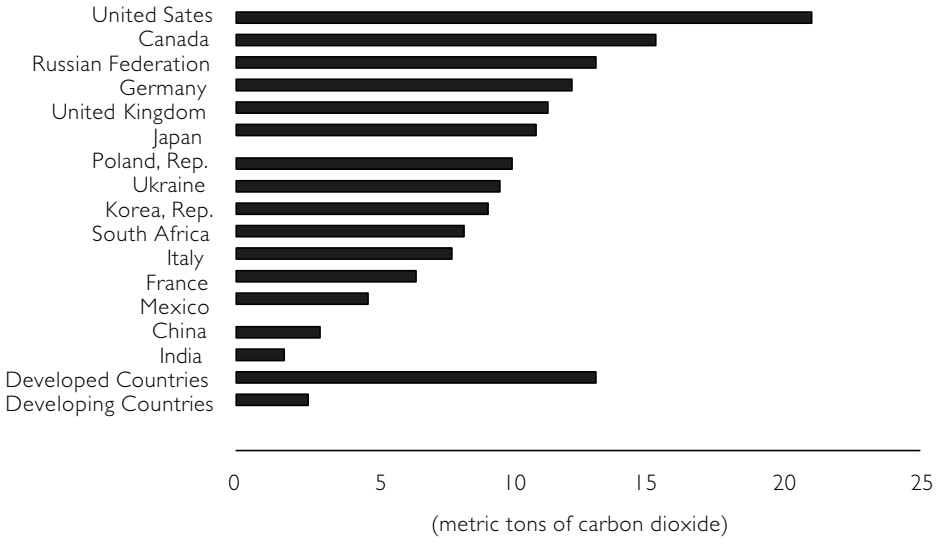
**Purpose**: measurement of the contribution of anthropogenic emissions to global warming. The relevance would lie in their contribution to climate change and their potential direct and indirect effects on human health and well-being.

**Linkages**: these might include indicators of environmental protection expenditure, expenditure on air pollution abatement equipment and indicators of pressure on the environment such as annual per capita energy consumption.

**Data requirements**: calculation of national greenhouse gas emissions in carbon dioxide equivalents and of emission levels, using factors associated with the emission of each gas for relevant activities. For example, data could be obtained from the parties to the Climate Change Convention.

Figure 14

**PER CAPITA EMISSIONS OF CARBON DIOXIDE FOR THE 15 COUNTRIES WITH THE HIGHEST INDUSTRIAL EMISSIONS, 1991**




Source: World Resources Institute (2)

## EXAMPLE: LEAD POISONING

**Indicator**: raised blood lead concentrations in children.

**Definition of indicator**: the proportion of children (for example in a suburb, city or country) with blood lead concentrations of 10 micrograms per decilitre and above.

**Unit of measurement**: blood lead expressed in micrograms per decilitre (µg/dL).

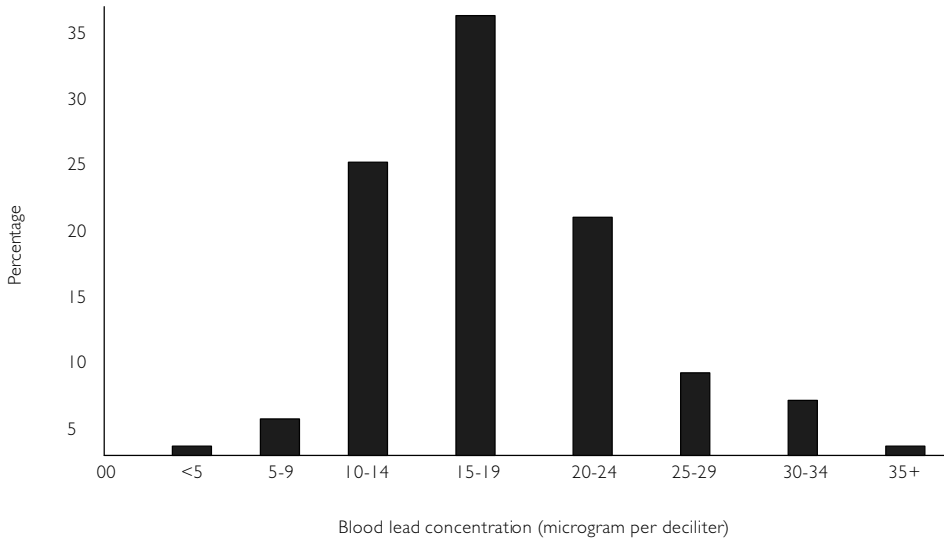
**Purpose**: to meet concern about exposure to lead in children. This indicator would be used to assess the extent to which children's health is at risk from increased lead intake, possibly resulting from high concentrations of lead in the environment (air, water, soil, paint) and /or from their behaviour, such as pronounced hand-to-mouth activity, or "pica". The relevance of this indicator lies in the fact that children with raised concentrations of lead in their blood are likely to suffer from a range of health problems such as neurobehavioural disorders, reduced IQ or damage to various organs and systems, depending on the concentration.

**Linkages**: this indicator could be linked to other indicators associated with the quality of the environment and housing and to indicators such as socioeconomic status, since childhood lead exposure is prevalent in low-income groups.

**Data requirements**: the measurement methods that should be specified are those for blood sampling and analysis.

Figure 15

**BLOOD LEAD CONCENTRATIONS IN CHILDREN, CAPE TOWN, SOUTH AFRICA**




Source: von Schimding *et al.* (57)