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 >4m^{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)

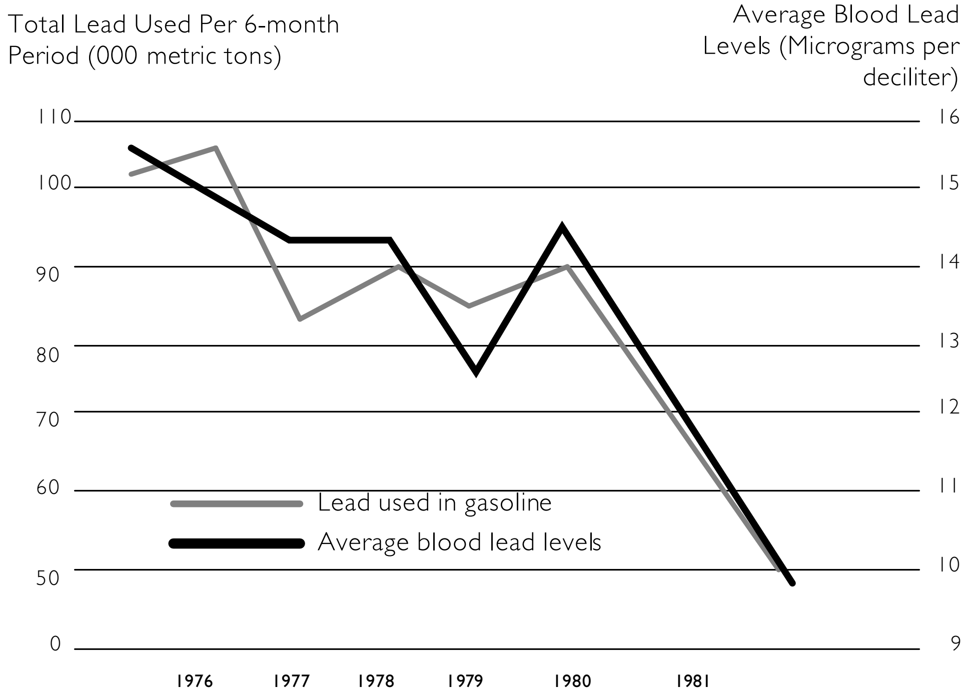
It would then be necessary to define the proportion of people in these settings who are exposed, for example, to lead in air, dust and water at levels that are above or below a specified concentration. Alternatively, instead of using indirect (proxy) measures of exposure, more direct, biological indicators 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.

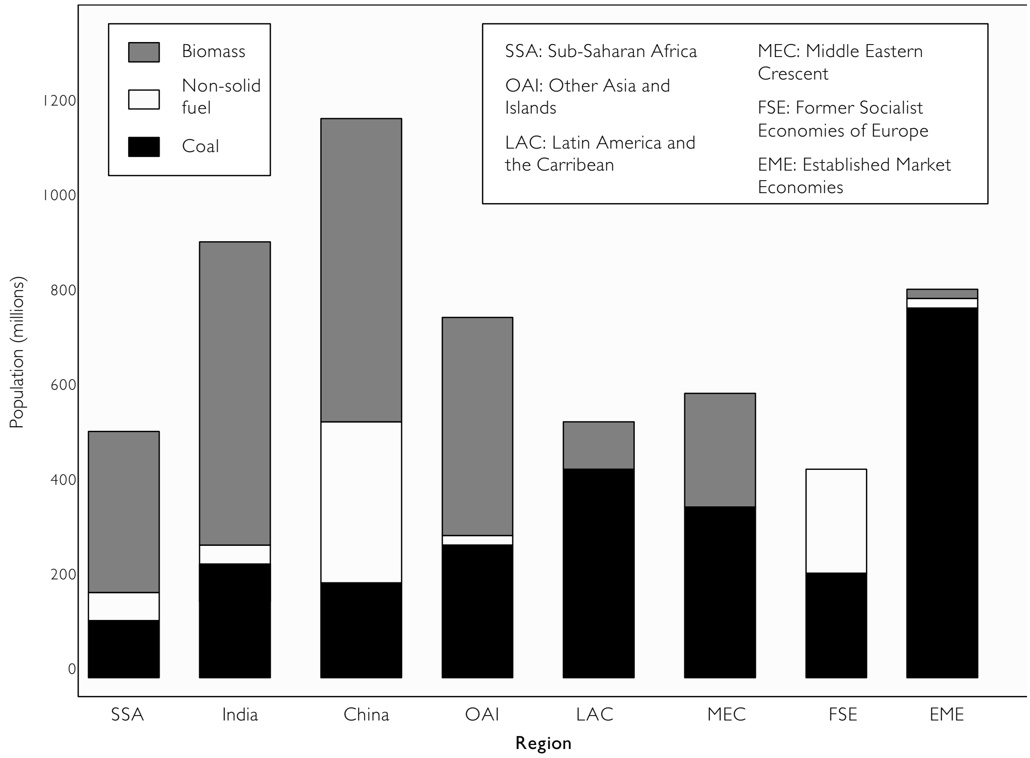
Trends should be examined for inconsistencies, data sources should be assessed, and "outliers", or unexpected departures from established relationships, should be carefully checked. The definitions used, the data sources relied upon and the methods used should be carefully documented, so that the process 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.

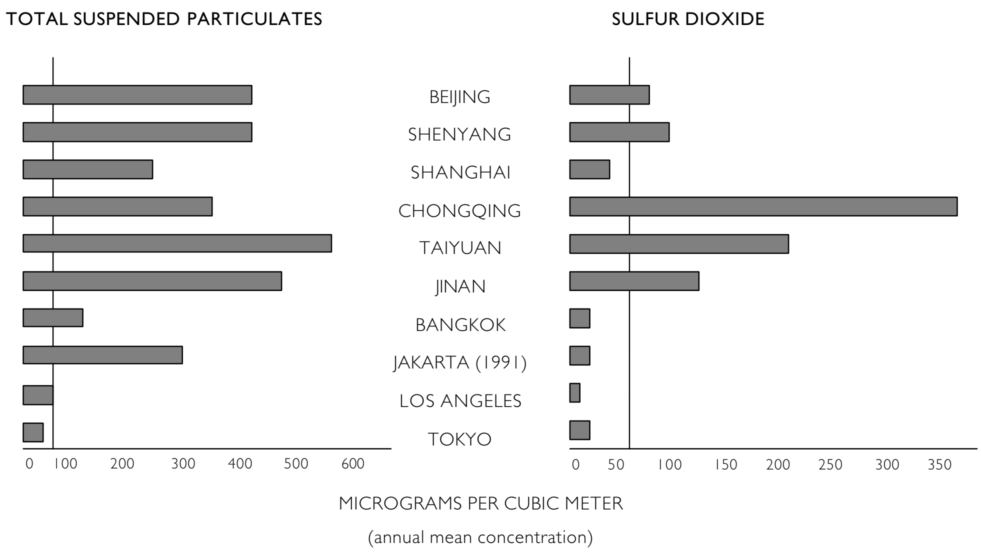
It is usually necessary to identify the level of geographic aggregation and the denominator population, the group or groups at risk and the spatial and temporal dimensions of the problem or issue to be addressed. When relevant and possible,

Figure 4
NUMBERS OF PEOPLE USING DIFFERENT HOUSEHOLD FUELS, BY REGION, 1990s



Source: WHO (7)

Figure 5
AMBIENT CONCENTRATIONS OF AIR POLLUTANTS, 1995 (CHINA)



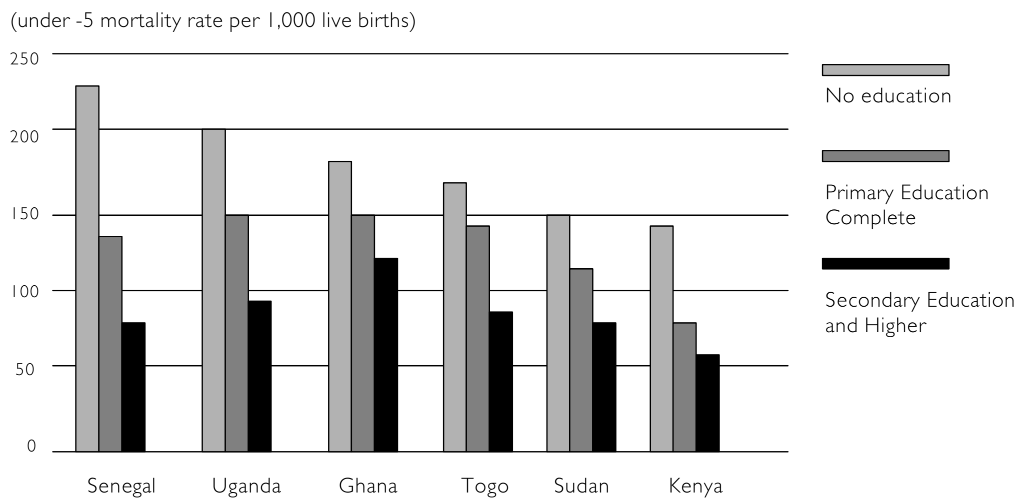
Source: World Bank (52)

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



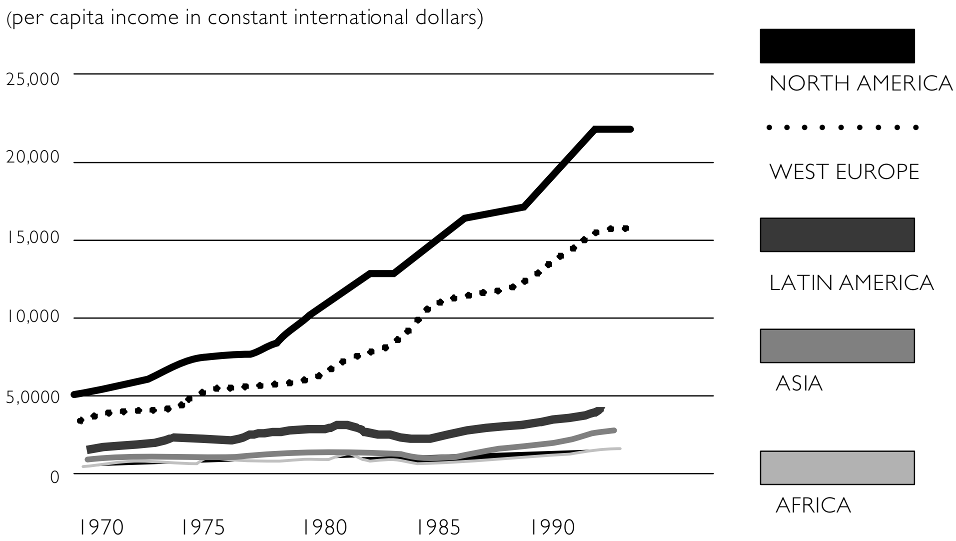
Source: World Bank (53)

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

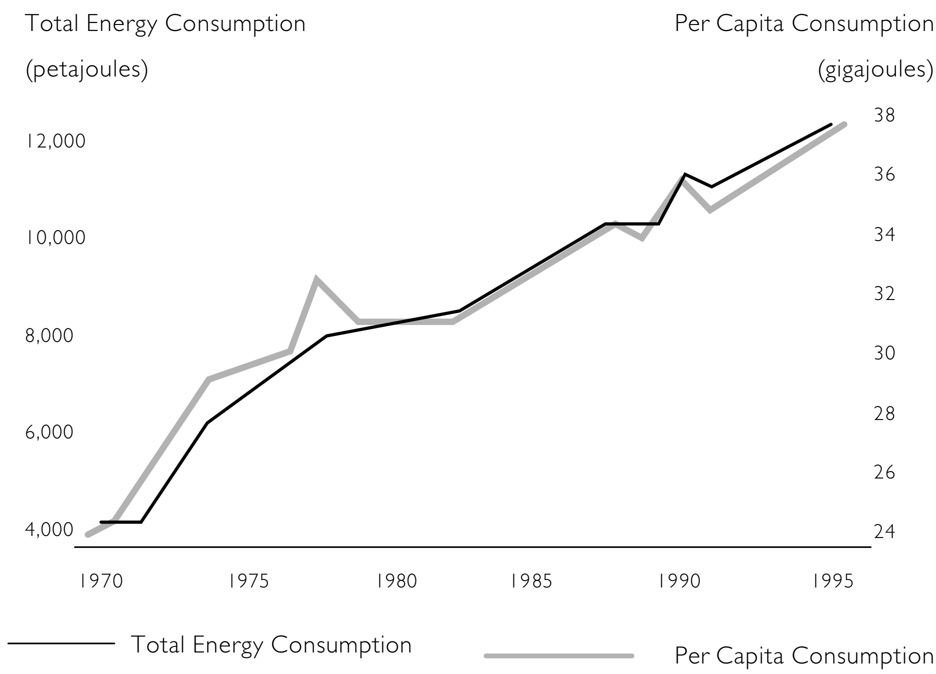


Source: UN (54)

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:

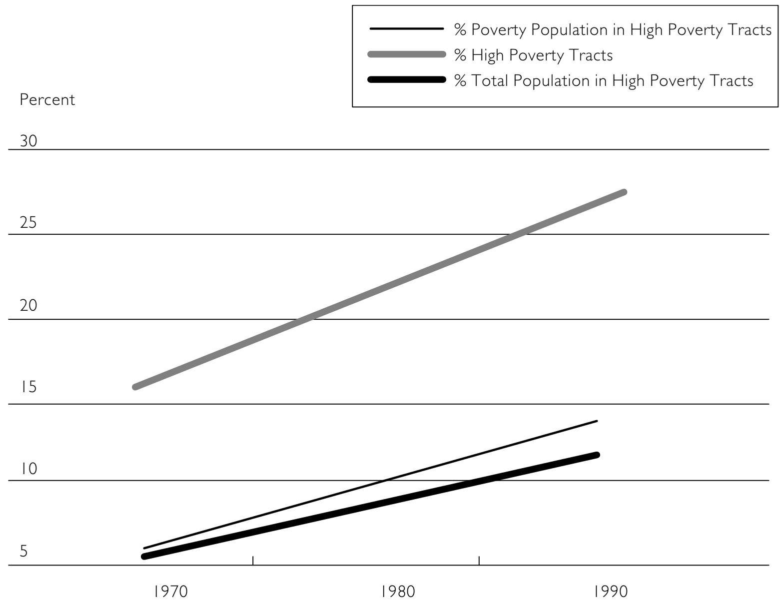
1. The percentage of the population below the poverty line living in high poverty census tracts (from 16.5% in 1970 to 28.2% in 1990);

(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.

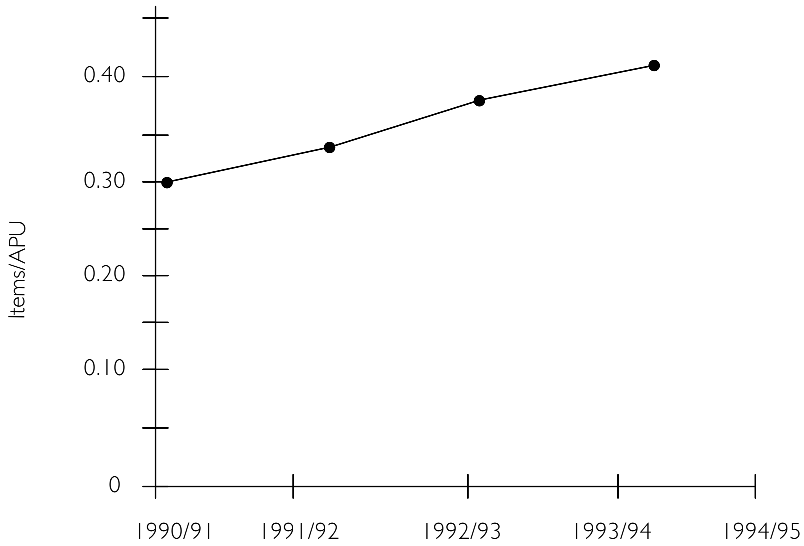
Measurement and source

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.

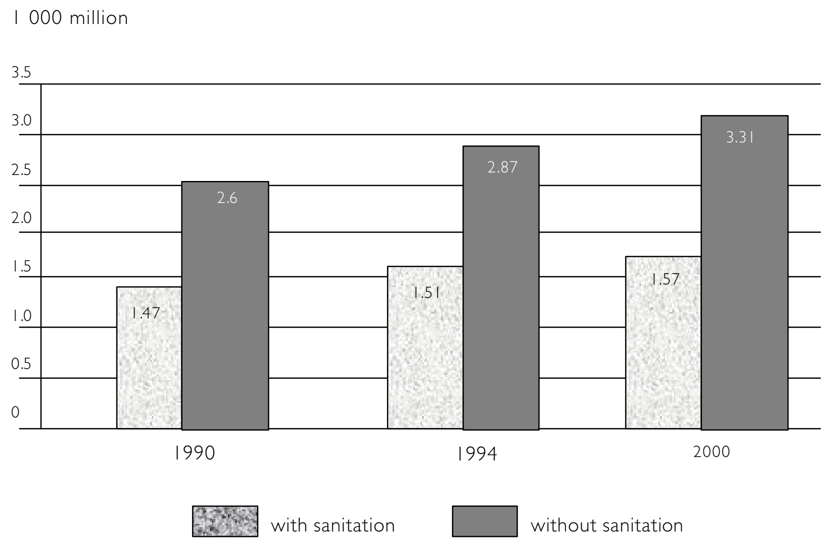
Users would include sanitary engineers, planners, public health officials, non-governmental organizations and others.

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.

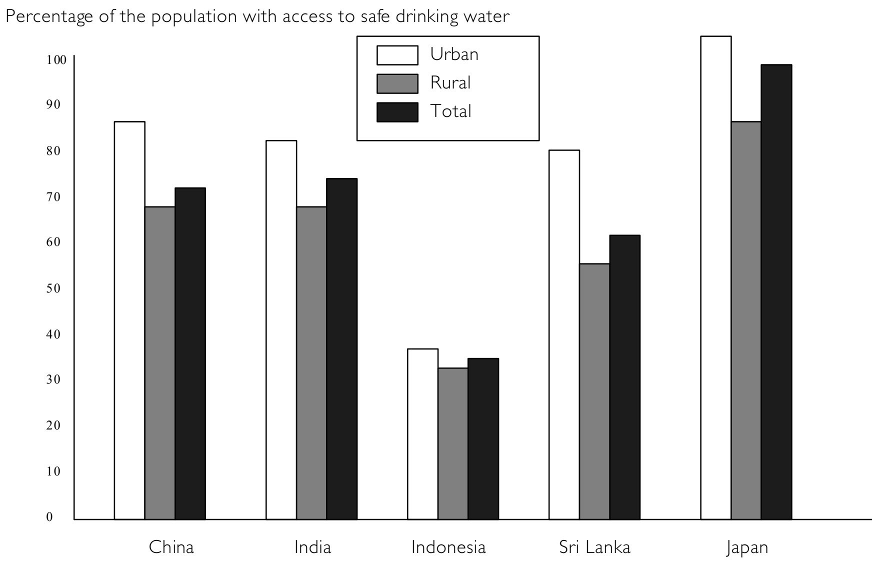
Purpose: this indicator is intended to monitor progress in the access of a population to safe drinking-water. This is relevant because access to unsafe drinking-water is associated with faecal contamination and risk for infectious disease.

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.

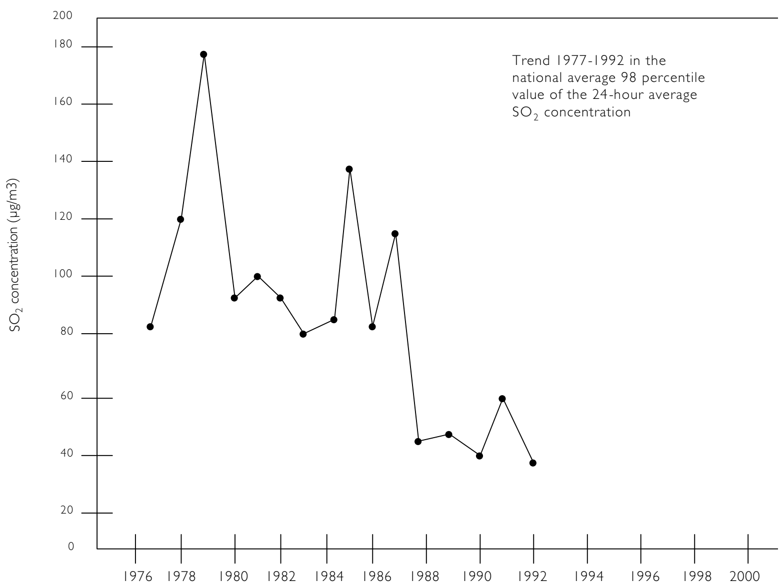
Purpose: this indicator might be used to evaluate overall air quality as a measure of the state of the environment and an indirect measure of the exposure of the population to air pollution. The information is relevant to controlling sources and to monitoring trends, particularly in relation to air quality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

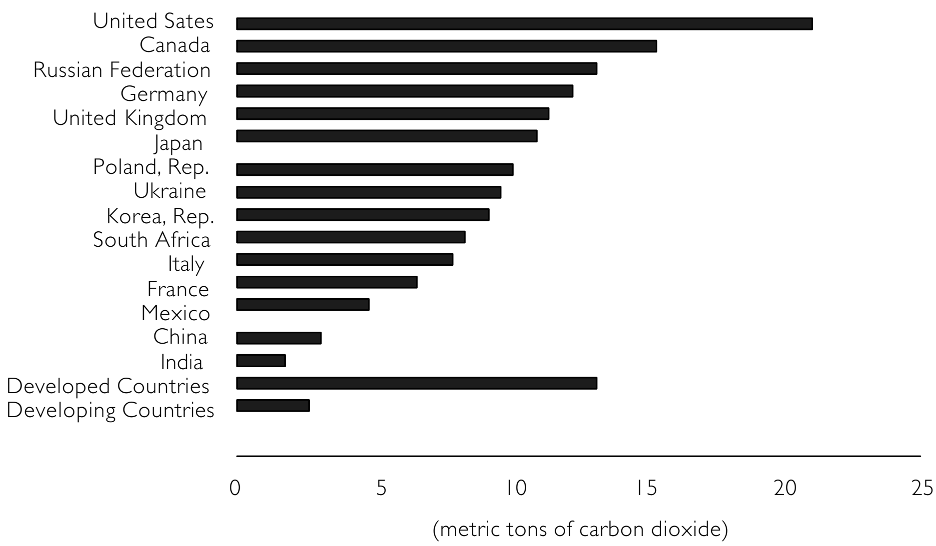
Purpose: measurement of the contribution of anthropogenic emissions to global warming. The relevance would lie in their contribution to climate change and their potential direct and indirect effects on human health and well-being.

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).

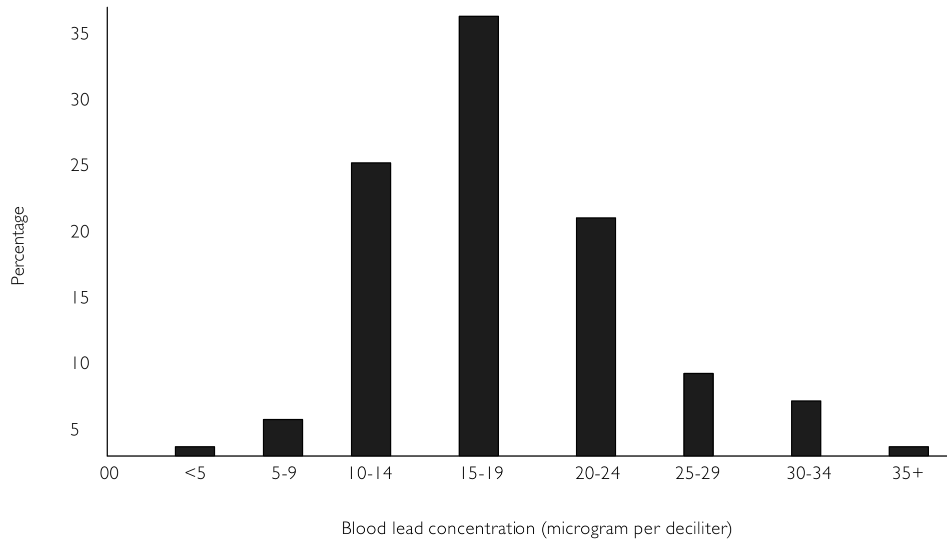
Purpose: to meet concern about exposure to lead in children. This indicator would be used to assess the extent to which children's health is at risk from increased lead intake, possibly resulting from high concentrations of lead in the environment (air, water, soil, paint) and /or from their behaviour, 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 Schirnding *et al.* (57)