

8

ISSUE-SPECIFIC INDICATORS

In this chapter, examples are given of the way in which the framework could be used in developing indicators related to sectors such as housing, transport and agriculture, and health hazards associated with various environmental media, such as air and water. The lists presented are not exhaustive, but rather highlight issues, encouraging an integrative consideration of issues from different perspectives.

8.1 ISSUE: HOUSING AND SETTLEMENTS

While housing affords protection and shelter for people, it may frequently have a reverse effect and contribute in a variety of ways to ill-health and disease. Driving forces such as rapid urbanization may result in severe pressures due to lack of adequate shelter. For example, in many parts of the world housing lacks an adequate water supply and sanitation facilities, or there is inadequate surface water drainage and a lack of facilities for disposal of excreta and solid waste.

Personal, domestic and environmental hygiene may frequently be poor, and overcrowding may be a problem. Electricity is often absent, and people may rely on polluting fuels such as biomass, kerosene, coal or gas for cooking, heating and lighting. Food preparation facilities may be lacking, leading to potential contamination of food supplies. Housing construction and materials and fittings may also contain or emit dangerous substances such as radon, lead or asbestos. Lighting, ventilation and insulation may be inadequate, and the home may be structurally unsound and unsafe. Chemical and fire hazards may prevail when the home is used as a work place, and hazards associated with a wide range of occupational exposures may result. Owing to poor planning, settlements may also provide inadequate protection from floods, landslides, industry and traffic.

Such pressures may affect the state or quality of the environment in a number of ways, such as microbiological and chemical contamination of recreational and drinking-water supplies, contamination of food supplies, hazards leading to injuries and indoor air pollution. Pests, rodents, vermin and various pathogenic organisms may appear, and standing water may cause vector-breeding sites and dampness in the home.

A range of health effects may result from such exposures, including communicable diseases (for example respiratory conditions, gastrointestinal diseases, parasitic diseases, tuberculosis and measles) and non-communicable diseases and conditions such as lead poisoning, other chronic health-related conditions and skin conditions. Mental ill-health (for example stress-related anxiety, depression and neurobehavioural

disorders) may prevail, as well as social problems related to violence, crime, drugs and alcoholism. Accidents, injuries and burns in the home may also result.

These health effects could be minimized by the development of policies and programmes that might include better land-use planning and zoning measures, as well as upgrading of housing, housing design and construction measures. Relevant factors are the provision of low-cost housing, land and housing tenure, housing standards and enforcement measures aimed at incremental improvement of living conditions. Education and advocacy programmes with respect to housing and health issues are also important.

A selection of indicators associated with housing at various levels of the organizing framework is given below. Driving forces such as poverty and population growth rates are not specified separately, being common to most of the examples.

Box 18

EXAMPLES OF HOUSING - RELATED INDICATORS

Pressures

- Proportion of population living in poor housing conditions
- Proportion of population homeless
- Proportion of population living in sub-standard housing
- Proportion of households disconnected from water, electricity, gas supplies
- Proportion of population whose homes are not connected to a water supply system
- Proportion of population with inadequate excreta disposal facilities
- Proportion of population without domestic waste disposal services
- Housing and settlements that do not meet basic standards in respect of :
 - Housing quality
 - Water supply
 - Sanitation
 - Water drainage
 - Excreta and solid waste disposal
 - Domestic fuel use
 - Living space
 - Structural safeguards
 - Lighting, ventilation, insulation
 - Safety, chemical, fire hazards
 - Siting

State

- Exceedance of standards and guidelines for drinking-water, indoor air, noise
- Amount of standing water (vector-breeding sites)
- Prevalence of dampness in houses
- Prevalence of pests, rodents and vermin

Exposures

- Proportion of population whose drinking-water does not meet health standards
- Proportion of population exposed to indoor air pollution from coal and biomass burning

(cont'd)

- Proportion of population exposed to high levels of radon, dust lead levels
- Proportion of households/people exposed to excessive damp
- Proportion of households/people exposed to pests, rodents, vermin
- Proportion of households/people exposed to shelter that is structurally unsafe, or situated on unsafe land
- Proportion of people living in overcrowded conditions
- Proportion of households/people exposed to inadequate ventilation, lighting, or insulation, or to excessive noise

Health effects

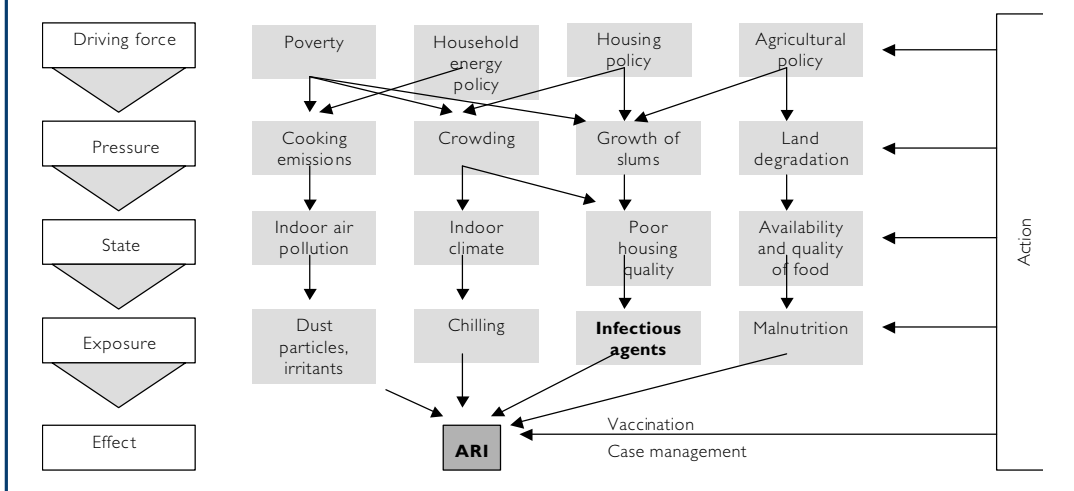
- Housing-related mortality and morbidity levels in respect of:
 - Accidents and injuries in the home
 - Communicable diseases (for example respiratory conditions, gastrointestinal diseases, parasitic diseases, tuberculosis, measles)
 - Lead poisoning, neurobehavioural disorders and other chronic ill-health conditions
 - Skin conditions (eczema, dermatitis, lice)
 - Psychological/mental ill-health conditions (stress-related, anxiety, depression)

Actions

Existence of:

- Land-use planning and zoning measures
- Service provision measures (water and sanitation, electricity, emergency services)
- Low-cost housing provision
- Housing legislation, standards, enforcement measures
- Housing upgrading, housing design and construction measures
- Land and housing tenure measures
- Impact assessment procedures for housing schemes

Figure 24
ACUTE RESPIRATORY INFECTIONS IN RELATION TO FACTORS ASSOCIATED WITH HOUSING



Further reading: Mara & Alabaster (100), WHO (7, 16, 95, 101)

8.2 ISSUE: TRANSPORT

The need for increased transport of people, materials, goods and products together with rising income levels and the desire for personal mobility have led to a rapid increase in motor vehicle ownership world-wide. In Thailand alone, for example, motor vehicle ownership has increased at an annual rate of 15% since the late 1980s. In China, the number of motor vehicles has tripled since 1984, from 2.4 million in 1984 to 9.4 million in 1994. By 2020, the urban vehicle population in China is expected to be 13 to 22 times greater than it is today (2).

Concomitantly with this increase in the number of motor vehicles, the combustion of fossil fuels has increased substantially, as has the release of gaseous pollutants and particulates. It is estimated that motor vehicles account for more air pollution than any other single human activity (102). For example, more than half of the global emissions of carbon monoxide, hydrocarbons and nitrogen oxides from fossil fuel combustion derive from automobiles, both gasoline- and diesel-powered, and the proportions may be significantly higher in city centres. Transport-associated emissions affect the state of the environment by increasing air pollution levels, particularly carbon monoxide, volatile organic compounds, hydrocarbons, nitrogen oxides, ozone and lead, as well as dust and particles.

Diseases and ill-health effects associated with transport include chronic respiratory illness, asthma, reduced lung function, cancer and heart disease, which might be caused or exacerbated by air pollution. Benzene and polyaromatic hydrocarbons from car exhausts and leaked oil and lubricants are recognized carcinogens, as are asbestos fibres.

Other effects include traffic accidents, which particularly affect children and young people. Road traffic accidents are the most common cause of unintentional injury world-wide. In 1990, they accounted for almost as much loss of healthy life as tuberculosis, and ranked ninth among all causes of disease and injury burden (8).

The large differences that still exist between developing and industrialized countries with regard to motor vehicle ownership have an impact on the trends in injuries and accidents. In developing countries, there are three motor vehicles for every 100 people, whereas in industrialized countries there are 50 motor vehicles for every 100 people. In New Delhi, 75% of people killed on the road are pedestrians, cyclists and motorcyclists, most of them hit by buses or trucks, and only 5% of those killed are drivers or passengers in cars. By contrast, in the United Kingdom, half the number of people killed on the roads are inside cars, and the overwhelming majority of pedestrians who die are killed by cars (103).

Not only are traffic accidents often a major cause of death among children, adolescents and young adults, but they are also the main cause of premature disability. Car traffic is also a major obstacle to urban accessibility for the elderly and the disabled. Mental ill-health effects may be significant, and factors such as noise, traffic jams and overcrowding of public transport may contribute to stress-related disorders. Transport and road traffic are the largest source of noise, ahead of building or industry. Odours

and smells may also be significant nuisances.

Various actions can be taken to decrease the risks of transport to human health. These include the production of safer, cleaner cars (for example cars with gas exhaust cleaning devices, electric- or solar-powered cars), improved vehicle inspection and maintenance programmes, changes in fuel characteristics and quality, reductions of automobile noise, exclusion of private cars from city centres, development of cycling paths and pedestrian areas, improvement of public transport (for example, railways, tramways and buses can be made less polluting, less noisy and safer), as well as the introduction of new public transport systems. Improved town planning measures can also reduce demand for transport, for example, by siting housing closer to work areas. Parking areas in the city can also be limited.

Box 19

EXAMPLES OF TRANSPORT- RELATED INDICATORS

Pressures

- Car use levels (for example passenger miles *per capita*)
- Vehicle ownership *per capita*
- Proportion of population regularly using public transport
- Average road traffic volumes, densities (cars, trucks, buses)
- Greenhouse gas emission levels by vehicle category
- Emission levels from transport vehicles (carbon monoxide, nitrogen oxides, ozone, hydrocarbons, particulates, lead, by vehicle category)
- Chlorofluorocarbon emission levels from vehicle air conditioners
- Proportion of vehicles failing maintenance/emissions tests

State

- Annual exceedance of air pollution standards
- Air pollution levels (carbon monoxide, volatile organic compounds, hydrocarbons, nitrogen oxides, ozone, lead, dust, particulates)
- Community noise levels in excess of standards
- Traffic density (vehicles per km)
- Vehicle accidents (number per km)
- Rates of traffic flow
- Prevalence of odours

Exposures

- Proportion of population living in proximity of dense traffic
- Proportion of population exposed to elevated concentration levels of traffic-derived air pollution
- Proportion of population exposed to air quality in excess of standards
- Proportion of population exposed to noise in excess of standards

Health effects

- Traffic-related mortality and morbidity levels in respect of:
 - Acute and chronic respiratory illness
 - Asthma

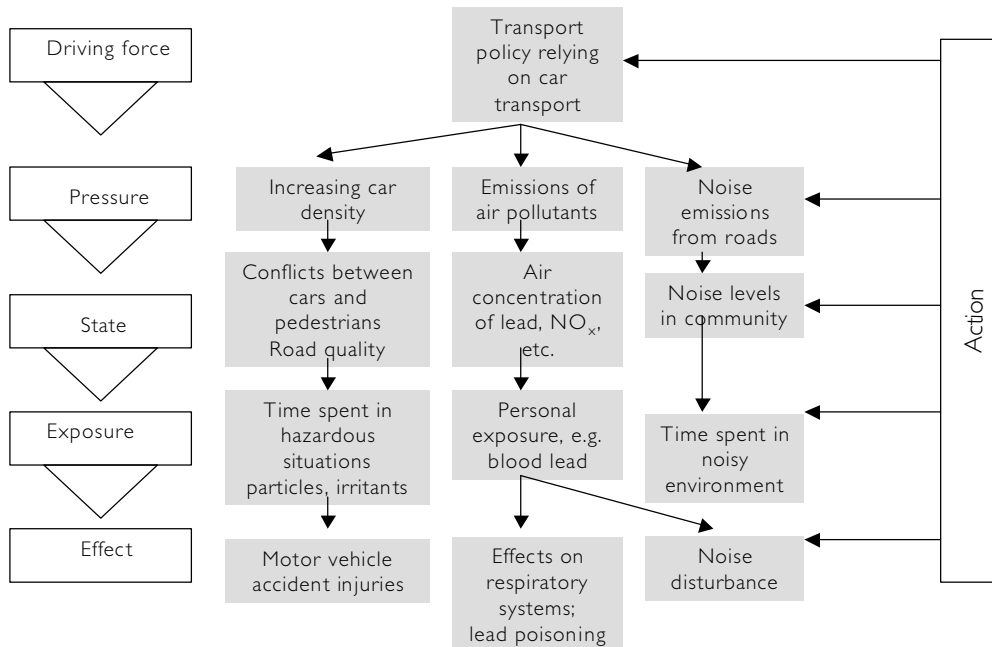
(cont'd)

- Reduced lung function
- Lung cancer
- Cardiovascular disease
- Injuries
- Mental health and stress-related disorders

Actions

- No. prosecutions, notices for breach of pollution regulations
- Expenditures on air pollution regulation and abatement equipment
- Expenditures on roads, public transport
- Production levels of safer, cleaner cars
- Proportion of vehicles with catalytic converters
- Number of cycling paths, pedestrianised areas
- Public transport schemes
- Existence of vehicle inspection and maintenance programmes
- Road surfacing programmes
- Existence of traffic reduction measures, noise barriers
- Integrated transport and town planning measures
- Impact assessment procedures for transport schemes

Figure 25
TRANSPORT



Further reading: WHO (7, 16), World Resources Institute (2)

8.3 ISSUE: AGRICULTURE

Despite its obvious benefits, agriculture may have a negative impact on health, through various water resource development schemes, irrigation schemes, indiscriminate use of fertilizers and pesticides and land and resettlement policies (95). For example, there is well-documented evidence that the construction of water impoundments for agriculture may accelerate transmission of schistosomiasis in endemic areas and of diseases such as malaria, filaria and dracunculiasis (for example in Ghana). Small impoundments used by local populations for fishing, water supply, animal watering, irrigation and flood control may be health hazards.

Irrigation systems, particularly those situated in the tropics, may introduce or increase the transmission of a number of vector-borne or water-related diseases. More than 30 diseases have been linked to irrigation, the major vector-borne diseases including schistosomiasis, malaria, onchocerciasis and Japanese encephalitis. Various changes in the state of the environment which may increase vector breeding include simplification of the habitat, increasing the area of surface water, raising the water table, changing the rate of water flow and changes in the microclimate. The absence of proper drainage systems in irrigation schemes is one of the most important factors in the spread of vector-borne disease.

Agricultural projects in forested ecosystems carry particular risks. For example the prevalence of leishmaniasis has increased in regions such as Brazil and the southern parts of the former USSR, and the opening up of the Amazon area in Brazil to farming and ranching has resulted in a resurgence of malaria, particularly in settlements, mining areas and peri-urban districts (16). Deforestation itself carries many indirect risks: for example, people may have difficulty in obtaining wood for fuel, rainwater may become erratic, and irrigation schemes may be threatened. Farming may also affect health, for instance, through contamination of groundwater, aquifers and surface waters by fertilizers and animal wastes. Drainage water with high salinity and excess nutrients also contributes to the contamination of water supplies.

Many actions can be taken to limit the negative impacts of agriculture on human health. These include better formulation of fertilizers and avoidance of excessive use, crop rotation and modification of other crop husbandry practices and appropriate and integrated pest control measures (for example combinations of traditional environmental, biological and chemical pest control methods). Other actions might include the development of technology for reducing dependence on agrochemicals and the application of water-conservation techniques. Accident prevention measures and immunization programmes are important, as are measures such as literacy programmes and initiatives for income generation, land tenure changes and urban agriculture, as well as sound food and nutrition policies. Reallocation of land unused or underused by large landowners to small farms could result in significant increases in incomes for many people, as well as increase the food supply, as was shown in a case study in Northeast Brazil (16).

Box 20

EXAMPLES OF AGRICULTURE - RELATED INDICATORS

Pressures

- Deforestation/reforestation rates
- Agricultural land conversion rate
- Fraction of arable land with resource development schemes, irrigation schemes
- Fraction of arable land with drainage systems
- Amount of pesticides used annually
- Amount of organic wastes per unit of product
- Amounts of nitrogen and phosphorus fertilizers used annually
- Amounts of agricultural chemicals used annually
- Land and resettlement policies

State

- Desertification rate/index
- Threatened ecosystems by area
- Extent of land degradation
- Changes in water flow rate
- Increase in surface water rate
- Exceedance of standards and guidelines for drinking-water recreational water, irrigation water
- Fraction of soil contaminated by chemicals and residual pesticides
- Pesticide residue levels in drinking-water
- Concentrations of nitrates, nitrites, phosphates in drinking-water
- Levels of contamination of groundwater, aquifers and surface waters
- Salinity and nutrient levels in drainage water

Exposures

- Proportion of population whose drinking-water supplies do not meet health standards
- Fraction of workers lacking protective equipment
- Fraction of population using impoundments for fishing, water supply and irrigation
- Proportion of population exposed to disease vectors (mosquitoes, snails etc.)

Health effects

- Agriculture-related morbidity and mortality levels in respect of:
 - Schistosomiasis, malaria, onchocerciasis, typhoid, cholera, shigella, diarrhoea, leishmaniasis
 - Acute poisoning due to specific causes
 - Malnutrition in children

Actions

- Reduction in use of fertilizers
- Reformulation of fertilizers

(cont'd)

- Use of crop rotation measures
- Existence of improved crop husbandry measures
- Use of integrated pest control measures
- Application of water-saving technologies
- Existence of adequate accident prevention measures
- Existence of immunization programmes
- Existence of sound food and nutrition policies
- Existence of worker protection measures, for example protective clothing
- Existence of improved land tenure practices

Further reading: WHO (7, 16, 95), World Resources Institute (2)

8.4 ISSUE: AIR

Many different driving forces such as urbanization and industrialization and activities associated with transport and energy may give rise to air pollution. The largest source of air pollution is the combustion of fossil fuels in power plants and by industries, motor vehicles and households. Particularly high levels of air pollution can occur around point sources and in areas where the topography limits atmospheric dispersion of pollutants, especially under adverse meteorological conditions.

It is now well established that a relationship exists between exposure to air pollution and health effects in human beings. It is estimated that about three million deaths occur globally each year due to air pollution, mainly by particulate matter (7). Other pollutants of concern to health include ozone, sulfur dioxide, nitrogen dioxide and carbon monoxide. There may occur acute health effects, for example, associated with severe air pollution episodes, and chronic effects, often associated with relatively low levels of air pollution. Air pollution may result not only in overt health effects but may also be a considerable nuisance, causing irritation of the eyes and mucous membranes and objectionable odours.

The health effects of air pollution have been a concern for centuries but assumed greater significance during and after the Industrial Revolution. Acute air pollution episodes such as those which occurred in the mid-twentieth century led to a dramatically increased awareness of the magnitude of the health effects. In many of these episodes, adverse environmental conditions together with such factors as temperature inversions contributed to the accumulation of aerosol and gaseous pollutants such as sulfur dioxide and particulates. For example, in 1930 an episode in the Meuse River Valley in Belgium was responsible for the deaths of 63 people (mainly elderly people and those suffering from heart or lung ailments), and ill-health effects were recorded in thousands of individuals. A similar episode occurred in Donora, Pennsylvania, USA, in 1948, and the famous London smog episode in 1952 is thought to have been responsible for the excess deaths of nearly 4000 people. Many other acute episodes have since occurred in the USA and elsewhere, including South-East Asia as a result of the recent forest fires.

The wide range of health effects that may occur includes chronic obstructive pulmonary disease (for example emphysema and bronchitis), asthma, acute respiratory infections (for example pneumonia), cardiovascular disease and lung cancer. The actual health effects that result depend on many factors relating to the source of pollution, its physical and chemical composition, exposure levels, and characteristics of the population at risk, such as health and nutrition status and age.

In addition to ambient air pollution associated with industry and transport, indoor air quality is becoming an important problem. Those most vulnerable to the effects of air pollution (the young, the old and the sick) spend most of their time indoors, where they may be significantly exposed. Indeed, the highest exposures to air pollution occur in the indoor environment in developing countries, mainly from biomass and coal combustion for cooking and heating. Other pollutants may originate from cigarette smoke, construction materials and methods, materials for furniture and fittings, paints and solvents. The indoor environment can also be affected by pollutants in the ambient environment, and vice versa.

Box 21

EXAMPLES OF AIR POLLUTION - RELATED INDICATORS

Pressures

- Number/type of polluting industries
- Number of new industries per year
- Number of vehicles using leaded/unleaded gasoline, diesel fuel
- Consumption levels of leaded gasoline
- Average road traffic volumes, densities
- Proportion of households using wood, gas/coal stoves, electricity
- Domestic consumption levels of gas, coal, biomass
- Production and consumption of products containing ozone-depleting substances
- Annual air pollutant emissions from major industrial facilities, vehicular transport
- Incidence of accidental releases of toxic chemicals, radioactive substances

State

- Pollutant concentration levels in urban air
- Annual concentration levels of ozone-depleting substances in air
- Global atmospheric concentration levels of greenhouse gases
- Indoor air pollution levels
- Number of severe air pollution incidents per year
- Number of hours/days per year during which air pollutants exceed standards (sulfur dioxide, particulates, nitrogen oxides, ozone, lead etc.)

Exposures

- Proportion of population exposed to ambient air pollution levels in excess of standards
- Proportion of population living in proximity to sources of air pollution (traffic, industrial activities)

(cont'd)

- Proportion of population exposed to indoor air pollution from coal and biomass-burning
- Proportion of population with raised blood lead levels, cotinine levels
- Proportion of population exposed to high levels of radon or lead dust in their homes

Health effects

- Air pollution-related mortality and morbidity levels with respect to:
 - Acute respiratory infections
 - Chronic respiratory disease
 - Asthma
 - Lung cancer
 - Sick-building-syndrome associated symptoms
 - Eye irritations, irritation of mucous membranes
 - Neurobehavioural effects (for example lead)

Actions

Existence of:

- Air quality standards
- Emission standards
- Vehicle inspection programmes
- building codes concerning ventilation/indoor air
- household electrification programmes
- improved town planning/zoning measures
- clean fuels, clean technology programmes
- improved public transport programmes
- clean air policies (public spaces)

8.5 ISSUE: WATER

Water availability and water quality have marked effects on human health. Over 1000 million people (mainly in rural areas, but increasingly also in urban and peri-urban areas) do not have access to an adequate or safe water supply. Untreated or inadequately treated water contaminated by excreta, sewage, industrial, agricultural and domestic waste presents a significant health risk. Both microbial agents and chemicals can enter the water supply from such sources and are not always effectively removed at water treatment plants.

Biological, chemical and physical contamination of water may be associated with widespread mortality and morbidity. For example, increased nitrate concentrations and potentially harmful pesticides in drinking-water may result from certain agricultural practices. Trihalomethanes may result from the chlorination of water with a high organic content. Old lead plumbing, solder and fittings may contaminate the water supply.

“Natural” pollutants such as arsenic and fluoride may also occur in water supplies.

Historically, the majority of water-related health problems have concerned infectious waterborne diseases rather than chemical contamination. John Snow, in his classic investigation of the cholera epidemic in London in 1853, was among the first to make the association between water pollution and infectious disease. Water-related diseases, which are still a major cause of morbidity and mortality in developing countries, include among others typhoid, cholera, hepatitis A and gastroenteritis. Gastrointestinal infections may reduce absorption of nutrients and affect the general defence mechanisms of the body, and this in turn can cause susceptibility to diseases such as measles and pneumonia. Other water-related health effects include vector-borne diseases such as malaria, schistosomiasis, trypanosomiasis, filariasis and yellow fever.

Quite different problems arise from the presence of arsenic (for example in Asia and Central America), or fluoride, for instance. Excessive exposure to fluoride may result in skeletal fluorosis, and exposure to high levels of arsenic may result in skin diseases, cancer and neurological disorders. The degree of softness of the water may be a factor in cardiovascular disease. Lead in drinking-water may contribute to increased body lead burdens in the population and to health effects such as neurobehavioural problems in young children and certain haematological abnormalities. Such problems are increasingly affecting both industrialized and developing countries: for example, the incidence of communicable diseases associated with water is growing in industrialized countries, while the chemical contamination of water is increasing in developing countries.

The contamination of lakes, rivers and coastal waters can also cause health-related problems when such bodies are used for recreation. Studies in various parts of the world have shown that increased rates of infection are associated with direct contact (for example bathing, diving, surfing) and indirect exposure (seafood consumption). The potential health effects include a variety of diseases such as gastroenteritis, respiratory, ear, eye and skin infections, hepatitis A, cholera and typhoid.

Actions taken to prevent and control water-related diseases might include a range of measures to provide a safe, sufficient, accessible water supply and the hygienic disposal of wastes, which are the two fundamental factors in disease prevention. This was recognized by the United Nations when it declared the 1980s to be the “International Drinking Water Supply and Sanitation Decade” (7).

Box 22

EXAMPLES OF WATER - RELATED INDICATORS

Pressures

- Amount of freshwater/coastal waste water discharges
- Amount of industrial/municipal effluents (treated/untreated discharges)
- Tonnes of sewage discharged into water bodies
- Lead plumbing in drinking-water systems
- Discharges of domestic and industrial waste water into surface water
- Water consumption levels by use per/capita

State

- Proportion of drinking-water sources microbiologically or chemically contaminated
- Proportion of recreational surface waters not meeting bathing water quality standards
- Exceedance of standards, guidelines related to drinking-water, recreational, fresh and marine waters, aquaculture and irrigation waters
- Proportion of inland surface waters not meeting standards for the preparation of drinking-water
- Water hardness, colour, taste, pH, biological oxygen demand, chemical oxygen demand etc.

Exposures

- Proportion of population whose homes are not connected to a water supply system
- Proportion of population whose drinking-water supplies do not meet health standards
- Proportion of population without access to safe drinking-water

Health effects

- Water-related morbidity and mortality levels in respect of:
 - Tropical diseases, malaria, schistosomiasis, typhoid, cholera, polio, hepatitis A, filariasis, yellow fever
 - Other viral, bacterial and parasitic diseases
 - Gastroenteritis
 - Number of outbreaks of waterborne disease
 - Eye, ear and skin infections
 - Drowning
 - Neurodevelopmental effects
 - Methaemoglobinaemia

Actions

- Provision of safe, sufficient, accessible water supplies
- Existence of adequate waste management systems
- Existence of effluent standards and drinking- and bathing-water standards

