

---

WHO/PEP/91.14

Distr.: General

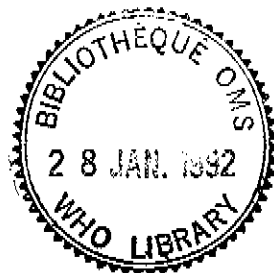
Original: English

# **Combating environmental pollution:**

## **National capabilities for health protection**

**MORRIS SCHAEFER**

///  
University of North Carolina, USA



World Health Organization 1991

This document is not a formal publication of the World Health Organization (WHO), and all rights are reserved by the Organization. The document may, however, be freely reviewed, abstracted, reproduced, and translated, in part or in whole, but not for sale for use in conjunction with commercial purposes.

Computer typesetting by HEADS, Oxford OX8 8NY

## Contents

<b>PREFACE</b> .....	v
<b>1. POLLUTION, HEALTH, AND DEVELOPMENT</b> .....	1
Factors that increase pollution .....	3
Health effects of pollution .....	10
Pollution and development .....	14
<b>2. RESPONDING TO POLLUTION HAZARDS:</b>	
<b>PROBLEMS AND REQUIREMENTS</b> .....	16
Main problems .....	16
Requirements for protecting health .....	18
Assessing national capacities .....	21
<b>3. NATIONAL CAPACITIES FOR HEALTH</b>	
<b>PROTECTION AGAINST POLLUTION HAZARDS</b> .....	23
Global status of country needs .....	23
Regional distribution of country needs .....	24
Populations affected, according to levels of country capability .....	26
Relationships between national capability and economic status .....	26
Differences in capabilities of countries to control key pollution problems .....	29

---

Differences in meeting the requirements of pollution control programmes . . . . .	31
Changes in scoring between 1984 and 1989 . . . . .	33
<b>4. CONCLUSIONS AND RECOMMENDATIONS . . . . .</b>	<b>36</b>
Conclusions . . . . .	36
Courses of action . . . . .	37

## Preface

Development is a two-edged tool where its effects on health are concerned. While, as a rule, the economic and technological outcomes of development have helped raise standards of living and health, uncontrolled, hazardous side-effects have resulted in much misery in the world and extensive environmental changes. On the other hand, a lack of development usually means that society is unable to provide the basic services necessary to improve the people's health.

In both industrialized and developing countries, the health of the general population is increasingly at risk from a variety of environmental pollution hazards. The type and severity of these hazards vary, mainly in relation to the way in which socioeconomic development is managed and the results are applied.

The effects of pollution on the natural and man-made environments are being dealt with by a number of agencies of the United Nations system. Through its programme on environmental health, the World Health Organization (WHO) cooperates with Member States in solving environmental pollution problems affecting human health and in strengthening national capabilities to deal with them. The programme is broadly based and concerns all chemical, physical, and biological health hazards, paying special attention to problems related to water and air quality, food, the use of chemicals, and housing.

For example, an interagency programme on chemical safety has been established to support national and intercountry responses to chemical pollution problems. The aim of the programme is to evaluate current knowledge of the health risks of chemicals, and, at the same time, to assist developing countries in using this, and other health-risk information, in the assessment of their own problems. In this way, a sound basis for developing effective chemical pollution control programmes and emergency response systems has become available.

---

In recent years, many countries have developed comprehensive national control programmes, based on preventive approaches involving land-use planning, environmental impact assessment, waste management, and production processes in agriculture, industry, and energy generation. In some of these countries, progress is also being made on effective systems of intersectoral cooperation, which are vital in view of the interdisciplinary nature of environmental health problems.

However, in many other countries, the policies and programmes are too weak with regard to the protection of human health. Technical, organizational, and resource constraints condemn the populations to continued exposure to environmental pollution hazards that could be avoided.

The present document has been prepared to help strengthen the basis for technical cooperation between Member States and WHO. Subjects discussed include:

- the health implications of environmental pollution in the context of development;
- the basic elements required to establish a pollution control programme; and
- the extent to which countries are meeting such requirements.

Incorporated in the document are the findings of two WHO surveys, one in 1984 and one in 1989, in which the major problems facing Member States, and the priority areas for strengthening national capabilities for controlling environmental health hazards, were identified.

Technical cooperation is clearly needed on two fronts. One is concerned with the steady building up of national infrastructures to deal with environmental health hazards. This includes the strengthening of basic programme elements, such as awareness, information systems, policy and legislation, institutional capacity, and financial and human resources. The second concerns specific and current environmental health problems that must be tackled. These problems range from the control of chemical poisonings to the cleaning up of polluted urban air and coastal bathing waters. Actions on the two fronts are strongly related and mutually supportive.

## Chapter 1

# Pollution, health, and development

Pollution is the contamination of the environment by biological, chemical, and/or physical agents and may arise through natural events, human activity, or the interaction of the two. Natural pollution, as from volcanic eruptions, tends to be short-lived and, over time, self-correcting. Pollution resulting from human actions is often of longer duration and may be only partially remediable, especially when the natural characteristics of local or global ecosystems are altered, for example, through the destruction of forests, depletion of the ozone layer, or acid rain.

Environmental pollution affects human health both directly and indirectly. Acute or long-term, direct effects result from exposures to pathogens, toxins, or radiation; indirect effects arise from loss of the land, water, air, or food resources required to sustain life and well-being.

The environmental conditions that determine human health depend on the relationships between ecosystems, their populations, and the patterns of production and consumption. Thus, health is inter-related with the processes of economic and social development, which may contribute positively to human health or, when the side-effects of development are not controlled, may have negative effects.

There are four main ways in which the environment can be polluted through human activity, and these may overlap, as shown in Fig. 1.

### *(a) Physical alteration of the natural environment*

This can occur through such development as the growth of cities, the construction of large-scale water impoundments, the destruction of forest areas, or the paving of major highways. As ecosystems change, further compensatory alterations may be induced.

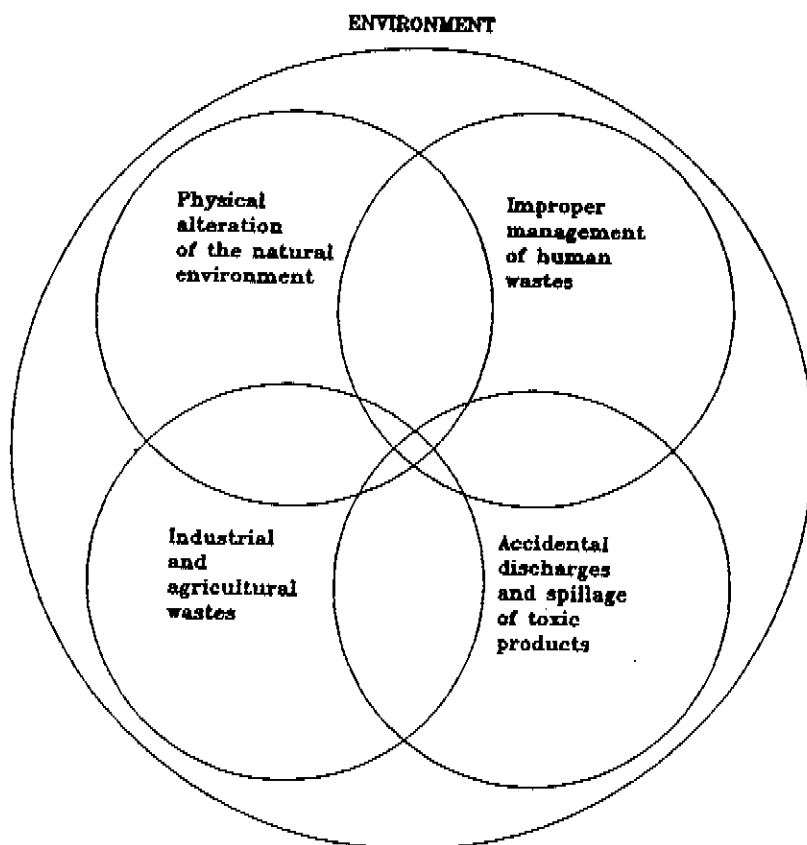


Fig. 1. Interactions of human activities in generating environmental pollution.

**(b) *Improper management of human wastes***

Excreta, domestic waste, and discarded furnishings improperly managed, may spread disease, increase vector populations, consume land, contaminate air, increase the probability of injury, and destroy natural beauty.

**(c) *Damage caused by industrial and agricultural waste products***

The pollutants resulting from industrial and agricultural production include manufacturing process wastes, discarded packaging, used-up products, and "leakages" of toxic substances. Apart from the occupational hazards that are posed by these pollutants, the increased use of

agricultural chemicals can damage aquatic organisms and water quality, and can introduce toxic substances into the water reaching consumers. Ancillary processes of storage, transportation, and handling can add to the pollution burden.

*(d) Accidental discharges and spillage of toxic products*

The accidental discharge into the environment of toxic gases or substances, including petroleum, or of ionizing radiation, can have immediate and/or long-term consequences for the health of humans, animals, and plants in the food-chain.

One type of human activity often stimulates another. Industrial production, for example, promotes the development of concentrated human settlements and changes in consumption patterns. It is also associated with the extraction of resources from, and the discharge of wastes into, the environment, which, consequently, is physically altered. More advanced technologies may increase the risk of accidents and produce unanticipated side-effects, making prevention and the appropriate responses more difficult.

**Factors that increase pollution**

As environmental pollution increases, so does the rate of accumulation. When the pollution burden becomes too great, local and regional ecosystems can no longer provide an environment that is friendly to health; hazards increase and resources, including air and water, diminish. In some places, the pollution burden has increased geometrically in a very short time, as illustrated in the middle section of Fig. 2.

Some pollution problems have transcended local and regional ecosystems and now threaten the geosphere/biosphere. Since this "closed" system cannot expand, the open systems of human activity make increasing demands on the resources and capacity of the environment to assimilate waste. The growth in these demands can be measured by several indicators.

*Population pressures*

During the period from the emergence of *Homo sapiens* to about the year 1900, the world's population grew to a total of 1.6 billion. In the next 50 years, there was a further increase of 56% to 2.5 billion, and in the following 30 years an increase of 76% to 4.4 billion. From the 1990 estimate of 5.2 billion, the world's population is expected to rise to 6.2 billion by the year 2000, giving an almost four-fold increase in the population during this century. The acceleration of population

## Combating environmental pollution

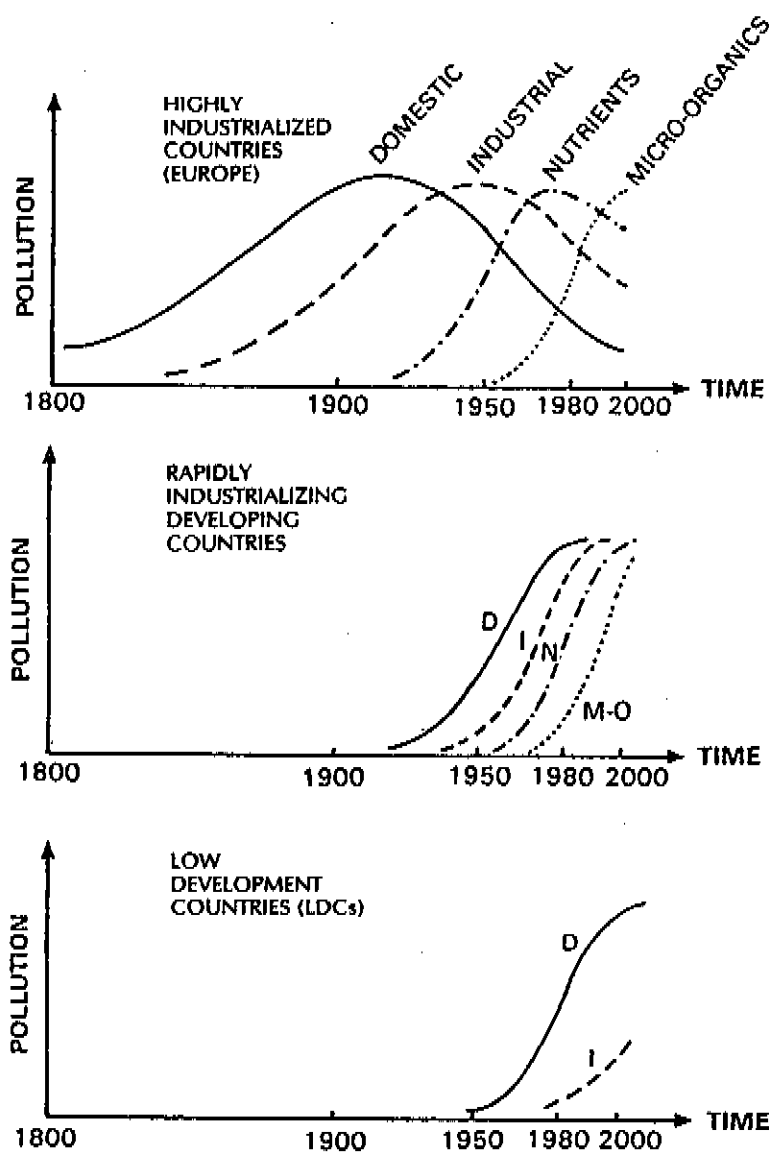


Fig. 2. Evolution of water pollution problems in countries, according to development status.

growth means that an increment that took 90 years to attain during the 19th century is now added in 5 years.

The most optimistic United Nations estimate is that the world population will stabilize at 7.7 billion by the year 2060; a more pessimistic one is that it will reach 8 billion by the year 2025 and 14.2 billion by the end of the 21st century.

As shown in Fig. 3, about 90% of the population growth since 1950 has occurred in the developing countries, where falling death rates and steady birth rates have resulted in a doubling of the population over the last 35 years. Meanwhile, population increases in the industrialized countries have slowed down or stabilized.

While rapid population growth is the most basic factor in increasing the generation of waste, environmental consequences are further influenced by urbanization, poverty, industrialization, and increased energy use.

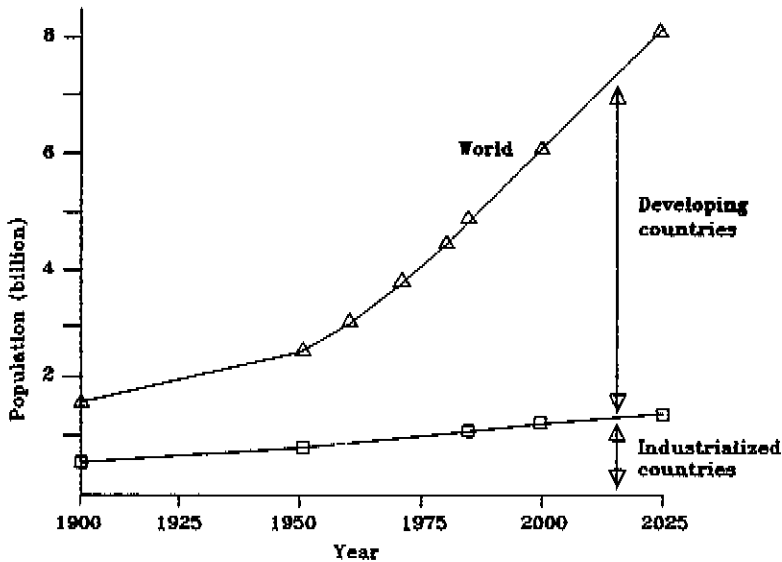


Fig. 3. Populations in industrialized and developing countries, 1900-2025. (Source: DEPARTMENT OF INTERNATIONAL ECONOMICS AND SOCIAL AFFAIRS. *World population prospects: estimates and projections as assessed in 1984*. New York, United Nations, 1986.)

### Urbanization

Throughout the world, urban centres are developing at an unprecedented rate. In the 30 years following 1950, urban populations tripled, the increase representing 41% of the total population increase on the planet; the percentage of the population living in urban areas is expected to reach 50% by the year 2010 and 60% by 2025.

In developing countries, most urban growth is taking place in the cities. In the industrialized countries, urban populations doubled during the 35 years after 1950, while those of the developing countries quadrupled, about 40% of the increase being attributed to immigration from rural areas. Total urban populations in the industrialized countries are expected to increase by about 15% in the next 40 years compared with an increase of 360% in Third World cities. While the most dramatic growth will be in the so-called megacities (those with a population of more than 5 million), most of the population growth will be in large and medium-sized cities. In absolute global numbers, as shown in Fig 4, the 75-year urban total is expected to increase from 701 million in 1950 to 5 billion in 2025.

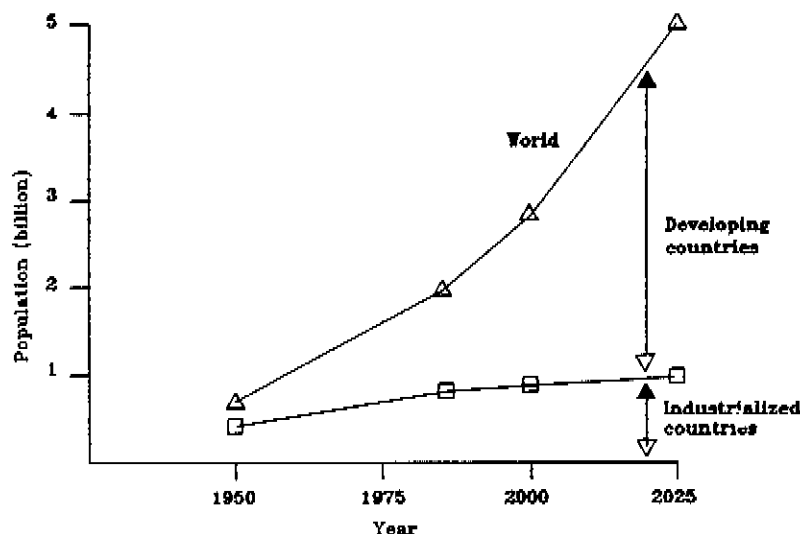


Fig. 4. Increases in urban populations, industrialized and developing countries, 1950-2025. (Sources: POPULATION DIVISION. *Urban and rural population projections*. New York, United Nations, 1984; DEPARTMENT OF INTERNATIONAL ECONOMIC AND SOCIAL AFFAIRS. *Prospects of world urbanization, 1988*. New York, United Nations, 1989.)

Rapid urbanization has accelerated the generation of pollution and, in many cases, has overwhelmed the capacities of countries to control it. This is mainly because the most rapid growth has occurred in countries least able to meet the economic and technical requirements for control. The pressure of urban growth from 1960 onwards has been so great as to outrun their abilities to extend and maintain the necessary infrastructures; thus, hundreds of millions of city dwellers are without the safe water and sanitation needed for personal and domestic hygiene. The lack of adequate shelter, waste disposal facilities, and surface water drainage imperils health and contributes to environmental degradation.

### *Poverty*

Low-income economies reflect the widespread poverty of individuals, families, and small enterprises. The conditions that make up poverty, such as low and insecure income, inadequate nutrition and shelter, and poor education, are themselves major threats to health, particularly for special groups of the poor, including children, women, migrants and refugees, the elderly, and the handicapped. Poor people are poorly protected against health risks, poorly supplied with facilities and services, and poorly equipped to improve their conditions or to contribute to environmental protection. Indeed, inadequate sanitary provisions and the struggle to survive — in many countries by working in the “informal economy” — forces many of the poor to add to pollution burdens.

The number of people living in poverty is increasing, amounting to some 1.3 billion in 1990, which is about a quarter of all humans. Unless this proportion is reduced by development, the number could approach 2 billion after a further 30 years, accompanied by ever-increasing pressures on land and water, forest resources, and the bearing capacity of local ecosystems.

### *Industrialization*

Major contributions to pollution occur during manufacturing (through resource extraction and the generation and discharge of waste materials), during distribution, and at the time of the ultimate disposal of the products. With some exceptions, advances in technology increase the pollution burden, especially when new compounds and substances are introduced without consideration of the environmental and health consequences. Manufacturing waste products may include toxic chemicals and metals, which, if untreated and improperly dumped, can

have lasting effects on the land and water resources, and on the life that they support.

Since 1950, the global extraction of minerals has tripled, and the output of manufactured goods has increased seven-fold. While the proportion of manufacturing in the gross domestic product of developed countries has levelled off or declined, its growth from a small base in developing countries has been substantial, even spectacular, in some countries. The volume of manufactured goods in the primary exports of developing countries increased from 13.3% in 1960 to 54.7% in 1982, much of the increase being in chemicals and metal products that are traditionally the most polluting.

Meanwhile, the increasing industrialization of agriculture in developing countries has raised world food production to unprecedented levels. However, it has also increased pollution through mechanization, large-scale irrigation, and a great increase in the use of chemical fertilizers and pesticides. In Fig. 5 it can be seen that the global use of fertilizers

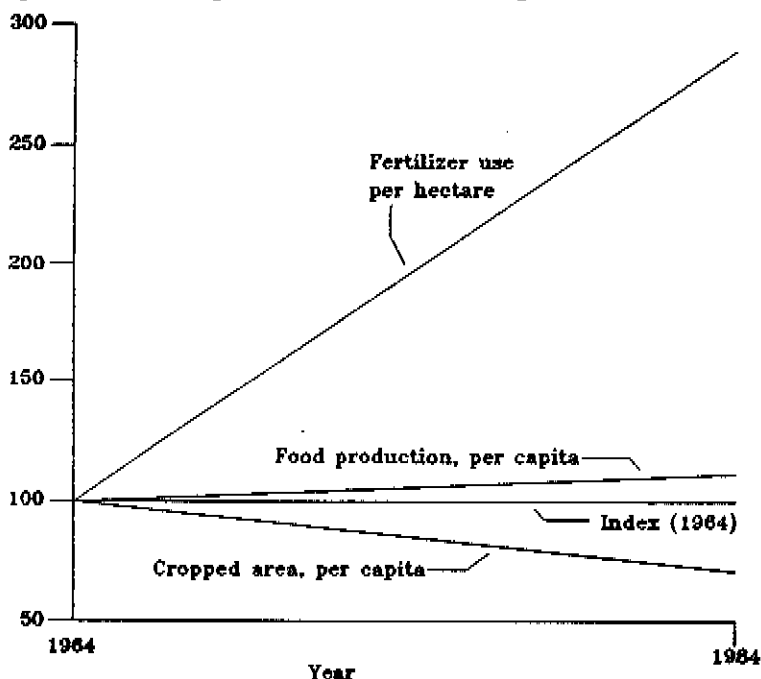


Fig. 5. Use of fertilizer in relation to food production and agricultural land use, per capita world averages, 1964 and 1984 (index 1964 = 100) (Source: WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT. *Our common future*. New York, Oxford University Press, 1987.)

trebled over 20 years. In the 33 years following 1950, the application of chemical fertilizers increased nine-fold, total crop production increased at a similar rate, but per capita food production did not change much because of the enormous expansion in population; the use of pesticides increased 32-fold. In some regions, these changes were accompanied by extensive ecological changes, such as deforestation, erosion, desertification, intensive land use, and shifts in the atmospheric balance. Large water impoundments have increased biological pollution; the use of chemicals has affected water quality and produced extensive effects on the biota, including elements of the food-chain. The mishandling of chemicals during production, transportation, and application has also contributed to the pollution.

### *Energy use*

Energy is essential to manufacturing, transportation, modern agriculture, heating, cooling, and cooking, especially in urban settlements. Most energy is produced from fossil fuels, with a significant use of nuclear fuels in some countries and a 6% contribution from hydroelectric generation. In less developed countries, biomass fuels are a principal energy source, constituting 15% of the world total. Energy requirements increase as populations increase and with industrialization; the World Commission on Environment and Development has estimated that, if the projected world population of 8.2 billion in the year 2025 were to use energy at the rates currently seen in industrialized countries, the global energy demand would be more than 5 times that in 1980.<sup>1</sup>

Apart from accidents, the major environmental effects of fuel use and energy production include a reduction of forest resources and the pollution of air, water, and land. Pollution results from production processes, the disposal of waste products, and changes in ecosystems induced by the construction of facilities, including large man-made lakes used in the generation of hydroelectric power. The effects of pollution are mainly localized, except in the case of atmospheric pollution, the effects of which may be recorded over large areas.

### *Transportation*

Transportation by land, air, or sea is responsible for many polluting effects. Emissions from engines powered by fossil fuels, primarily used in the world's 500 million cars and trucks, are major contributors to urban air pollution, the destruction of vegetation, and global warming;

<sup>1</sup> WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT. *Our common future*. New York, Oxford University Press, 1987.

leakages of stored fuels contaminate ground water and soils. Most spillages (as well as wilful discharges) of petroleum and other chemical pollutants are connected with transportation. As with other sources of pollution, the most rapid growth rates are in countries where the capability for controlling environmental hazards is limited.

### Health effects of pollution

A great deal is known about the health effects of pollution, particularly biological pollution, but much remains to be learned with regard to both causal relationships (etiology) and the distribution of disease and disability in human populations (epidemiology).

Etiological knowledge is well developed with respect to direct exposure to pathogens and the effects of pollution on the breeding of pathogens and insect vectors. Knowledge concerning the effects of ionizing radiation is reasonably adequate, but less is known about the health effects of other physical agents, including noise and non-ionizing radiations. While knowledge of the effects of chemical pollution (including metals) is extensive, it is incomplete because of:

- the long interval that may elapse before the effects of long-term, low-level toxic exposures manifest themselves in the form of disease or disability;
- the rapid introduction of new chemicals into the environment before their health effects can be assessed; and
- the difficulties of determining effects when there are simultaneous exposures to a number of pollutants over long periods (combined and synergistic effects).

Etiology also provides information about the routes via which pollution affects humans (see Table 1).

There is generally more epidemiological information on communicable diseases than on chronic and mental disorders. Epidemiological studies on small populations have contributed to knowledge, but comprehensive bodies of data are few. All but a few countries lack information based on:

- the monitoring of mortality and the incidence and prevalence of specific disease and health problems;
- the monitoring of environmental conditions, including air and water pollution, housing, disease vectors, toxic wastes, and sanitation; and

- the epidemiological analysis of the disease burden attributable to particular environmental conditions.

Table 1. Effects of air, water, and land pollution on health

	Biological	Chemical	Physical
<b>AIR</b>			
Agent/ source	Microorganisms	Fumes, dusts, particles	Radiations, noise
Vectorial factors	Coughing, exhalations	Contaminated food and water	Weather
Routes	Inhalation, contacts	Ingestion, contacts	Unguarded exposures
<b>WATER</b>			
Agent/ source	Microorganisms, decayed organic material	Discharges, leaching, dumping	Radiations
Vectorial factors	Insects, rodents, snails (and their breeding); animal's excreta; food chain	Contaminated food and water	Accidents; contaminated food and water
Routes	Bites, ingestion, contact	Ingestion, contact	Ingestion, contact
<b>LAND</b>			
Agent/ source	Soil organisms	Dumped airborne dusts, solids, liquids	Energy discharges, heat
Vectorial factors	Decaying organic matter, leading to vector breeding	Contaminated food	Accidents; contami- nated soil and food
Routes	Contact, bites	Ingestion, contact	Contact, ingestion
<b>HEALTH EFFECTS</b>			
Infections, poisonings, metabolic changes, carcinomas, mutations, traumas, burns			

### *Biological pollution*

Environmental conditions are major determinants of the incidence and prevalence of infectious diseases, and pollution plays an increasing role in these conditions. Although most infectious diseases have been brought under control in the industrialized countries, outbreaks connected with food contamination and inadequate community immunization are not unknown. The burden of communicable diseases in the developing countries is still massive, accounting for perhaps 40% of mortalities, of which 10% are from infant and child diarrhoeas. Diarrhoeal morbidity is estimated in hundreds of millions of episodes each year, and the estimates that schistosomiasis affects more than 200 million people, with about the same number exposed to African and American trypanosomiasis and onchocerciasis, give an indication of the level of debility that exists in many of the developing countries.

Water polluted by human excreta is strongly implicated in cholera, typhoid fever, dysentery, hepatitis, and schistosomiasis, as well as in unclassified diarrhoeas. Inadequate sanitation, the dumping of untreated sewage into surface water, and poor hygienic practices remain important intervention targets in many countries. Overcrowded and poorly ventilated housing contributes to the airborne transmission of tuberculosis, measles, influenzas, pneumonias, pertussis, and cerebrospinal meningitis. Unhygienic animal husbandry helps to transmit zoonotic diseases. Pollution of the soil and water contributes to diseases borne by insect and rodent vectors, such as malaria, schistosomiasis, filariases, yellow fever, plague, typhus, and trypanosomiasis, while stagnant waters, insanitary housing, and refuse dumps are sites that encourage insect reproduction and directly support insect and rodent disease vectors.

### *Chemical pollution*

Apart from naturally occurring chemicals released during geological processes, mining, and dredging, chemicals in the environment include: residues and discharges from industrial production and consumption, transportation, and commercial and domestic energy conversions; chemicals used in manufacturing and agriculture; and household products and drugs. Pollution is further increased by the accidental release of chemicals (including petroleum and its derivatives) during production, storage, and transportation. Air, soil, freshwaters, and oceans are all subject to chemical pollution.

Contamination of food involves absorption of chemicals by biota in the food-chain and also the chemicals used in food processing.

As chemicals rarely occur alone in the human environment, combined and synergistic actions among chemicals, and with biological and physical agents, are of increasing, if daunting, health concern.

However, the ever-widening use of chemicals does contribute to economic development, and some uses are supportive of human health; for example, pesticide use has contributed to a global increase in food supplies and to the protection of people against vector-borne diseases; some food additives reduce food loss. However, the adverse effects of chemicals are a mounting problem: cancers, malformations, and impairment of the central nervous, immune, cardiovascular, renal, and pulmonary systems have been traced to such chemicals as arsenic, asbestos, benzene, cadmium, chromates, fluorides, lead, mercury, polychlorinated biphenyls, and vinyl chlorides. A number of these follow a variety of pathways into the body and, by accumulation, can produce illness, slowly and insidiously, or in acute episodes. Dusts and mineral fibres pose a threat of chronic pulmonary disease, especially for workers in a broad range of industries. Furthermore, natural toxins (pyrrolizidine alkaloids, ochratoxins, aflatoxins) are implicated in a variety of illnesses and may be carcinogenic.

Secondary health effects, for example from the consumption of contaminated food, have resulted from the adverse actions of atmospheric and water-borne chemicals on the flora and fauna of forests, farmlands, wetlands, fishing grounds, and other water bodies.

Further pollution is caused by chemicals used to replace those to which some disease parasites and vectors have developed resistance.

Apart from the biospheric effects mentioned earlier, long-range hazards include persistent, non-biodegradable, possibly carcinogenic substances in drinking-water sources and in soils where residences may be built.

Adverse effects of chemicals on health depend on:

- the properties of the chemical;
- the frequency, duration, level, and rate of exposure, acute exposures often being lethal; and
- absorption, metabolism, and the organism's capacity to resist; the last of these is influenced by sex, age, occupation, and state of health, children, pregnant women, the elderly, and the sick being the most susceptible.

Population effects, only marginally measured, have been found in many settings. In a 1987 WHO-UNEP study, it was estimated that some 600 million people live in urban areas where the air levels of sulfur dioxide exceed those recommended in the WHO guidelines. Up to

800 million Third World rural dwellers, mainly women and children, could be adversely affected by toxic fumes and smoke from burning biomass fuels and coal in the home.

The acute and chronic health effects resulting from the use of agricultural pesticides are substantial, particularly in the developing countries.

### *Physical pollution*

Radiation, heat, and noise are examples of physical pollution; accumulated waste is a physical factor that also has direct and indirect health effects. Some of these hazards can be controlled technologically with some assurance of safety, within the limits of human and machine error. However, others, such as the disposal of high-level nuclear waste, pose additional questions of safety.

The health effects of physical pollution are mediated through the environment, the workplace, and the home. Disturbance of sleep and occupationally-induced deafness result from excessive noise. Industrial processes that release chlorofluorocarbons into the atmosphere reduce the ozone layer and may increase exposure to ultraviolet radiation, with its attendant adverse health effects.

### **Pollution and development**

Pollution that results from lack of awareness, sheer disregard of environmental values, or the lack of basic hygienic measure is unjustified and intolerable. However, sometimes, the question of pollution involves choices among competing goods, between environmental and health values on the one hand, and cheap production, increased output, and greater convenience, on the other. Such choices are central in development decisions, whether taken by individuals, enterprises, or governments. These decisions involve trade-offs between perceived benefits and costs, and they are highly influenced by social values and by what is feasible. Health concerns are not always taken into account in the decision process.

In general, prevention is the cheapest way of controlling pollution. Abatement of existing pollution (and restoration) is less costly than ongoing payment for surveillance and protective measures. These rules-of-thumb provide a guide for establishing public policies on development, including whether to set criteria for design and production, modify practices, or to subsidize the costs of the desired changes.

The stakes are high. Population growth, the basic factor in global pollution, can be stabilized only if living standards in developing countries are raised. However, if they were to be raised to the levels found in

developed countries (see Fig. 6) pollution levels might also rise. To avoid this outcome, it is essential that sustainable development policies should be enacted and implemented, through the development of appropriate technology and the modification of values, choices, and practices.

To make such policies health-promoting and environmentally sound, as well as to implement them, countries must have the capacity to safeguard the environment and to ensure that it is not hazardous for health.

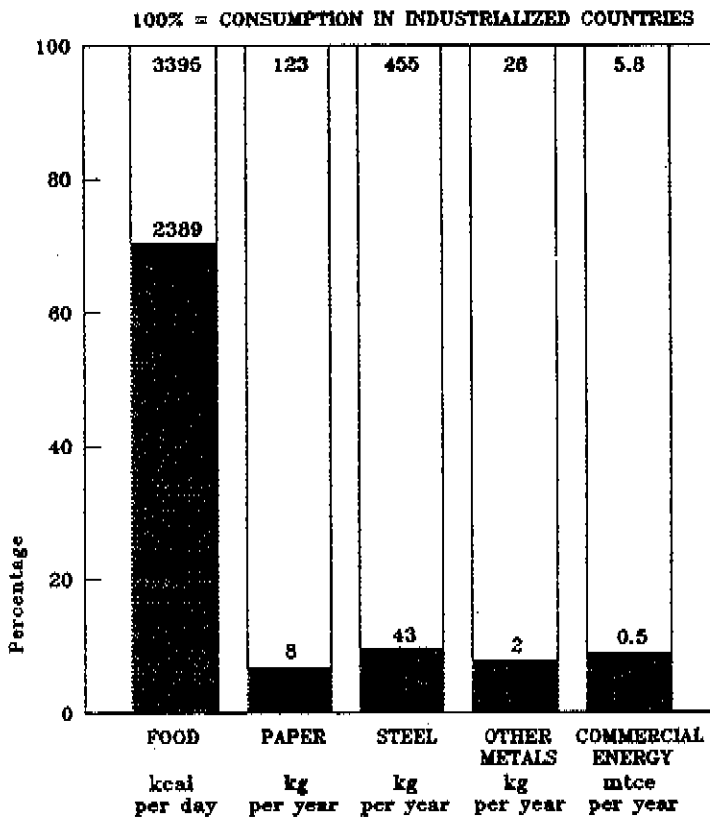


Fig. 6. Per capita consumption of selected products in industrialized (unshaded columns) and developing countries (shaded columns), 1980-82 averages. (Source: WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT. *Our common future*. New York, Oxford University Press, 1987.)

## Chapter 2

### Responding to pollution hazards: problems and requirements

The capacity to safeguard the environment and to protect and promote health requires proper policies, processes, and resources to address a mounting tide of pollution problems that have adverse health effects.

#### Main problems

The leading pollution problems affecting health in many countries concern:

- *Drinking-water quality.* Microbial and chemical contamination of water used for drinking and in the preparation of food contributes massively to ill-health through diarrhoeas and water-related diseases. Although the 1980s saw progress in increasing water supplies, water quality hazards are still found in both developed and developing countries.
- *Freshwater quality.* Surface waters are often polluted by poorly managed sewage, industrial wastes, and agrochemicals, and ground waters are contaminated when soil is similarly polluted. In addition to the direct effects on human health through water use, indirect effects may occur through contaminated crops and poisoned fish. Large-scale development in the vicinity of river and lake basins has often aggravated these problems.
- *Coastal water quality.* Coastal and marine pollution has increased through the growth of ports and other coastal cities, the discharge of industrial and shipping wastes, and the rapid expansion of tourism. Health impacts include infections, chemical contamination of seafood and other edible biota, and the fouling of recreational areas.

- *Urban air quality.* Apart from long-term atmospheric effects, polluted air in the cities contributes to respiratory diseases, cancers, and nervous system disorders. The main agents are particulates, sulfur dioxide, nitrogen oxides, carbon monoxide, photochemical oxidants, and lead, the levels of which increase as urban growth stimulates industry, energy conversion, waste incineration, and automobile use. The control of these pollutants is variable in developed countries and is usually lacking in developing countries.
- *Domestic biomass and coal use:* About 15% of all humans are exposed to toxic fumes and smoke through the use of soft coal, wood, manures, and agricultural wastes for cooking and heating. The use of primitive, poorly vented, and inefficient devices increases the risks.
- *Hazardous wastes.* Humans and other living things are exposed to toxic substances generated through production processes, hazardous products, and the accumulation of wastes. Hazards increase through the uncontrolled disposal of solid and liquid wastes and their inadequate management by industries and municipalities. Many developing countries, mainly concerned with the safe disposal of sewage, have been unable to give much attention to the problem, while industrialized countries struggle with reducing waste generation and cleaning up contamination.
- *Localized pollution sources.* People living near certain pollution sources, especially in cities, may be directly exposed to acute or cumulative hazards. These sources, not all of which may be known, include mines, smelters, hazardous waste dumps, and cement and fertilizer factories and metal refineries that are built without adequate environmental safeguards.
- *Chemical hazards.* Hazards from chemicals increase with their widespread use in industry, agriculture, and the home, and with their importation and manufacture by countries with limited capacities to assess and control them. Continuous additions to, and modification of, the chemical compounds in use aggravate the problem, and few regulatory agencies are able to keep up with the changes, leaving workers and others at acute and long-term risk.
- *Chemical accidents.* The increased use of chemicals has been accompanied by an increase in the occurrence of accidents during manufacture, use, transportation, and disposal. Some accidents are attributable to poor control, and their adverse effects may be augmented when capabilities to respond to them, or information about how to treat the victims, are inadequate.

- *Ionizing radiation.* The growing use of radioactive materials in energy production, industry, agriculture, and medicine increases the risks of hazardous exposures from processes, waste disposal, and accidents. Although producers and users may observe strict safeguards, governmental supervision, regulation, and emergency responses have proved to be necessary. Because radioactive releases can travel across borders in air and water, people living in countries that lack response capability may be put at grave risk.

### Requirements for protecting health

Health protection requirements and other pollution problems are diverse and are differently distributed among countries. However, the responses required of national and local governments are quite similar, because certain common features of social organization support a general approach, as regards intervention targets and the mechanisms for pollution control.

### *Targets and mechanisms for intervention*

A general approach to the control of environmental health hazards in a national or community framework is graphically depicted in Fig. 7.

Within the universe of environmental health hazards (the outer boundary), certain problems are of sufficient concern to merit intervention. These will vary among countries and communities. Thus, an island country with little manufacturing, but a vigorous tourist industry, will have different pollution concerns from those of a heavily industrialized country that is highly urbanized and engaged in global trade. A country in the process of becoming industrialized may undergo a change in its spectrum of concerns as problems, such as chemical poisonings, make themselves felt.

Fig. 7 is divided into two "hemispheres". The upper, labelled "Sectors and organizations", includes the activities and choices of economic and governmental entities that may generate pollution in the course of their productive activities, but may also be influenced to prevent and abate pollution. The main characteristic of this hemisphere is that it is made up of discrete, formal organizations. The lower hemisphere, labelled "Community and its people", represents the relatively unorganized behaviours and choices of persons, families, and *ad hoc* groups. These entities also generate pollution and should be encouraged to control it.

In addition to efforts directed towards organizations and the community, polluting behaviours may be modulated through the mechanisms of the market forces and public policy. The latter sets norms

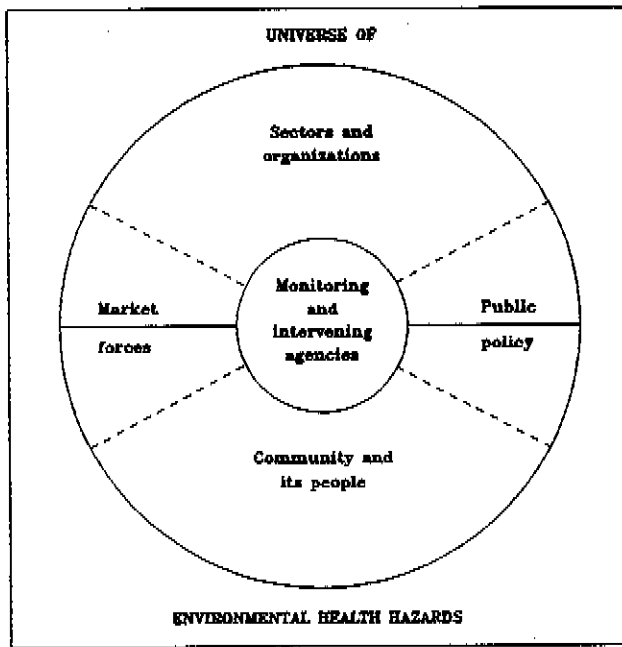


Fig. 7. Targets and mechanisms for environmental health interventions.

for economic and civic behaviours, and can enforce these norms by both setting limits for sectoral/individual choices and modifying market conditions (banning the sale of a pesticide, for example). Within the conditions set by public policy, the market encourages, or discourages, pollution through the preferences of consumers and producers. To guide this complex, interacting system towards realizing the community's environmental and health aims requires the operation of a "coalition" of monitoring and intervening agencies (the inner ring of Fig. 7) to advocate health-promoting choices and policies, provide information, regulate actions, and influence behaviours. The membership of this "coalition", which is more often implicit than explicit, differs in specific countries, but will ordinarily include the government's health and environmental management authorities, university units, and dedicated nongovernmental organizations. As a whole, the "coalition" is the focal point for environmental health concerns, providing leadership and support in combating environmental pollution.

### *General requirements*

A basic capacity for intervention is required to enable the system to deal with pollution problems, regardless of the specific problems a country may face, or the nature of its socioeconomic development. This capacity involves governance, policies, and information, or more specifically:

- active public opinion, concerned about health and environmental wellbeing;
- policies promoting community health, balancing economic, environmental, and health values;
- knowledge about environmental health problems and awareness on the part of leaders, citizens, and specialists;
- operational mechanisms for intersectoral and intergovernmental cooperation in development planning and management and in combating pollution;
- arrangements for involving private and community interests in dealing with social issues;
- the active participation of health authorities in such cooperative mechanisms, together with the capability to muster the necessary resources and link the work of the health sector elements, including primary health care;
- appropriate delegation of authority and distribution of resources to intermediate and local levels of government, providing front-line capabilities to meet environmental and health needs.

### *Problem-related requirements*

Depending on a country's configuration of environmental pollution problems, additional requirements come into play. While each of the major problems described on pages 16-18, and elsewhere, imposes a distinct set of requirements that will also vary with the specific situation, most pollution problems present the need for the following elements:

- information on environmental hazards and their health effects;
- information on pollution sources and high-risk circumstances;
- capabilities to assess the environmental conditions and practices and the health risks associated with them, including the necessary epidemiological and laboratory supports;

- legislation, standards, and regulations pertinent to the problems, incorporating incentives and sanctions that promote compliance;
- strategies and plans for the prevention, abatement, and remedy of pollution;
- technology appropriate to strategy implementation, whether educational or engineering, and whether directed at domestic practices or at the manufacture, storage, transportation, disposal, and use of products and residues;
- capabilities to implement strategies and enforce legislation and standards, including the monitoring of compliance and programme adequacy;
- staffing adequate to the performance of these functions, considering the numbers and skills required at central and regional levels and at all operational sites;
- arrangements among relevant organizations and sectors, to ensure the necessary collaboration in technical work.

#### Assessing national capacities

WHO carried out studies in 1984<sup>1</sup> and 1989<sup>2</sup> to assess the capabilities of 168 Member States and territories to meet such requirements for environmental health protection. The earlier study provided baseline measurements with which any changes five years later could be compared.

WHO staff members in the countries and Regional Offices, in cooperation with their national counterparts, reviewed and rated country capabilities using the 10 indicators described in Table 2, which are based on the requirements identified on pages 20-21.<sup>3</sup> Such problem areas as water quality, ambient air quality, and radiation protection were reviewed in detail. The results provided a basis for calculating a "summary score" for each country, as well as for comparing country ratings for each indicator and for programme activities.

<sup>1</sup> *Preliminary assessment of national programmes for health protection against environmental hazards.* WHO unpublished document PEP/85.8, Geneva, 1985.

<sup>2</sup> Report in preparation.

<sup>3</sup> Indicators were scored on a 4-point scale, as follows: 3 = most requirements met; 2 = some requirements met; 1 = few requirements met; and 0 = requirements not met. In arriving at summary scores, indicators were differentially weighted according to expert consensus on relative importance. Legislation and intersectoral coordination were weighted 5; assessment, enforcement and health authority involvement, 4; staffing and standards, 3; strategies and vertical delegation, 2; and research, 1.

## Combating environmental pollution

---

Table 2. Indicators for assessing the capacity of national programmes to control environmental health hazards

---

1. Legislation: policies and authority delegations expressed in codified laws, enabling standards to be set and enforced.
  2. Strategy: policies detailed in a broad medium- to long-term environmental health strategy.
  3. Standards: appropriate norms and procedures promulgated.
  4. Assessment; laboratories: documentation of existing problems, risks, and pollution sources, with adequate laboratory resources.
  5. Enforcement; monitoring: adequate monitoring of compliance with standards, along with enforcement and sanctions to correct non-compliance.
  6. Staffing: adequate personnel; provisions for professional, technical, and auxiliary training.
  7. Research; forecasting: appropriate research capability, able to forecast emerging problems.
  8. Intersectoral coordination: effective policy coordination body providing for health liaison with environmental management/development administration: also a technical executing agency.
  9. Health authority involvement: capable advisory, technical, and advocacy functions performed.
  10. Vertical delegation: appropriate responsibility and authority assigned to, and executed by, intermediate and local levels.
- 

The indicators mainly reflect capability for pollution control, not programme performance; the difference is significant. For example, some countries whose capability was rated high were not effective in implementing programmes, as evidenced by existing severe pollution problems. Thus, a high rating does not necessarily mean that a country's pollution problems are under reliable control.

## Chapter 3

# National capabilities for the protection of health against pollution hazards

The 1989 WHO survey referred to in Chapter 2 provided information on six major aspects of national capabilities for protecting people against environmental pollution hazards:

1. Overall country status, considering especially the capabilities in the newly industrializing countries.
2. Distribution of country capabilities, according to regions.
3. Populations affected, according to levels of country capability.
4. Relation between the level of country capability and country economic status.
5. Differences in capability with respect to key pollution problems.
6. Differences in capability in each required element of national pollution control programmes (the Table 2 indicators).

In addition, comparison of 1984 and 1989 country reviews provided information on changes that had occurred over the five-year interval.

### Global status of country needs

The summary status of national capabilities in 168 WHO Member States, shown in Table 3, represents the global status in 1989.

This gross measure indicates that 126 countries, i.e., 75% of the total, fell below the "most requirements met" criterion<sup>1</sup> and that almost half

---

<sup>1</sup> The stratification of countries according to the level of requirements met was calculated as follows. The weighting of indicators (see footnote on page 21) resulted in a maximum possible rating of 99. Countries whose total ratings were between 71 and 99 were considered to have met most requirements; between 51 and 70, some requirements; less than 51, few requirements.

## Combating environmental pollution

Table 3. Capability for protection against environmental hazards to health of 168 countries, according to development status

Country status	No. of countries			Total
	Industrialized countries	Newly industrializing countries	Limited development	
Most requirements met	27	11	4	42(25%)
Some requirements met	0	34	14	48(29%)
Few requirements met	0	15	63	78(46%)
TOTALS	27 (16%)	60 (36%)	81 (48%)	168 (100%)

of them (78 countries) met only few requirements. However, the urgency of needs is not uniform among these 126 countries. Although all development tends to increase pollution hazards (for example, in predominantly agricultural countries, through the production and use of agrochemicals), countries undergoing rapid industrialization tend to have the greatest problems. Not only does industrialization, and the accompanying urbanization, quickly increase pollution hazards, but these changes usually overwhelm the capacity of the infrastructure and the ability to mobilize resources for prevention and control programmes.

Of 60 countries identified as in the process of becoming industrialized, 49 did not meet the "most requirements met" criterion, of which 15 (25%) met few requirements. Although these proportions are somewhat better than those for all developing countries, the size of the pollution problems of these countries, and the fact that they are rapidly increasing, make their deficiencies urgent and important, with serious implications for the world community.

### Regional distribution of country needs

Shortfalls in programme capabilities differed widely among the WHO Regions. Fig. 8 shows that it was only in the European Region that a majority of countries met most requirements, and, at the other extreme, that none of the countries in the African Region did so.

Of the 42 countries that met most requirements, 5 were industrialized countries in North America and the Western Pacific and 30 were in

## National capabilities to protect health

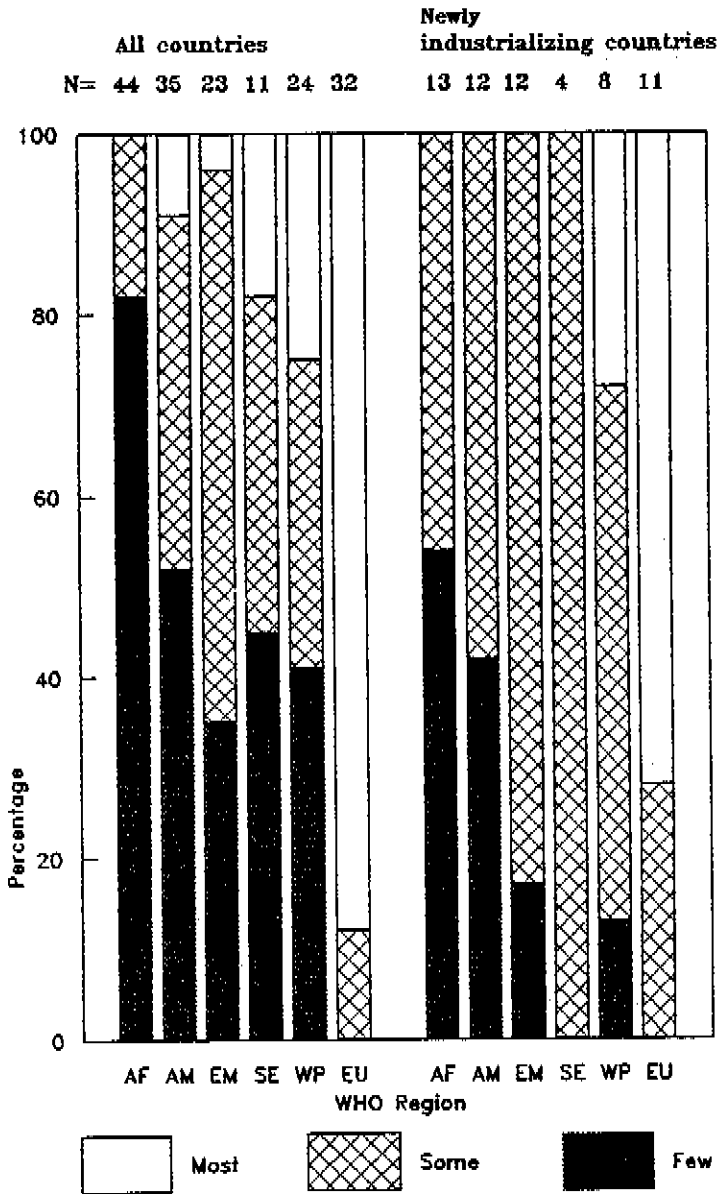


Fig. 8. Percentages of countries meeting programme requirements in 1989, according to WHO Region. (Regions: AF = African; AM = Americas; EM = Eastern Mediterranean; EU = European; SE = South-East Asia; WP = Western Pacific).

Europe; only 7 out of 122 developing countries met most requirements. All of the 60 countries just becoming industrialized (Fig. 8) that met most requirements were in either the European or the Western Pacific Region. About half of those that met few requirements were in the African Region. Countries that met some requirements were mainly found in the Eastern Mediterranean and South-East Asia Regions.

### Populations affected, according to the levels of country capability

Looking only at the numbers of countries may give a distorted picture of the exposure of people to environmental hazards. To clarify this point, country status was related to the populations of 120 nations whose economic development status is tracked by the World Bank and which included about 90% of the world's population in 1985.<sup>1</sup> The 28 countries (23% of the 120) that met most programme requirements contained 20% of the total populations. A more striking fact shown in Fig. 9 (two columns on left side), is that the 39 countries (33%) that met some requirements contain 65% of the total population; this disparity arises mainly because this group contains five developing countries with populations in excess of 100 million. In all, 80% of the people live in 92 of the countries with substantial deficiencies in provisions for environmental health protection.

This 80%, translated into numbers, amounts to 3700 million people out of the 4580 million in the 120 countries. Furthermore, when the economic status of these 92 countries is considered, the prospects for improvement in their national capabilities are not bright.

### Relationships between national capability and economic status

The effect of economic status on the capability of a countries to establish programmes for pollution control is clearly shown in Fig. 9 (right side), in which the scores of the 120 countries are grouped according to their respective national income levels.<sup>2</sup>

The relationships are linear. No low-income country met most programme requirements. Conversely, no high-income country fell into the "few programme requirements met" category, and all but 8 were rated as meeting most programme requirements. In the two groups

---

<sup>1</sup> Not included are the USSR and several other non-market countries, as well as a number of small-population countries.

<sup>2</sup> The classifications are those of the World Bank, based on per capita gross national product (GNP): Low (L) = US\$500; Lower Middle (LM) = US\$501-2000; Upper Middle (UM) = US\$2001-6000; High (H) = US\$6000.

## National capabilities to protect health

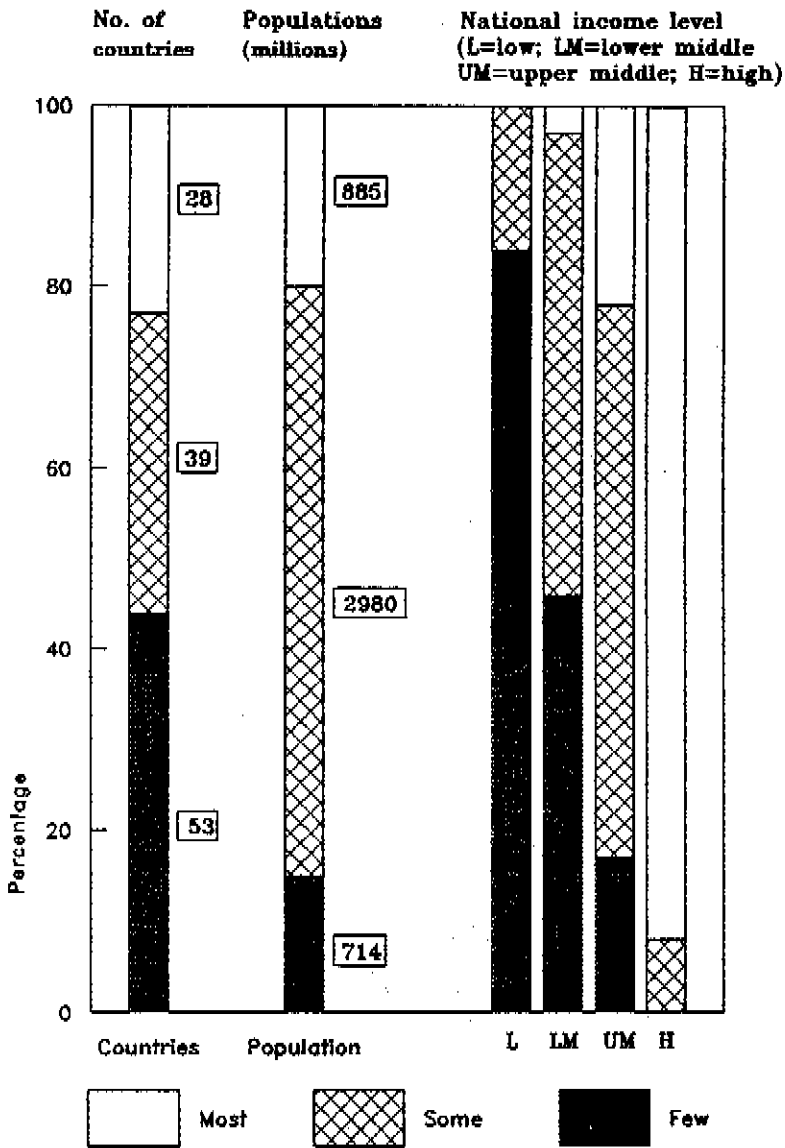


Fig. 9. Programme status distribution, according to number of countries, populations, and national income level.

of middle-income countries, the modal scores fell into the "some requirements met" category, but the proportion of the lower-middle income countries that met only few programme requirements was higher than that of the upper-middle income countries.

People in the lower-income countries are doubly at risk. On the one hand, communal poverty is related to inadequate national capability for environmental health protection (Fig. 9). On the other, poor people suffer comparatively higher exposures to environmental hazards, because of deficiencies in shelter and sanitary infrastructure, working conditions, transportation, and access to services. The extent of this "doubled exposure" is illustrated in Fig. 10, in which programme status and national income levels are related to the populations of the 120 countries discussed in the preceding section.

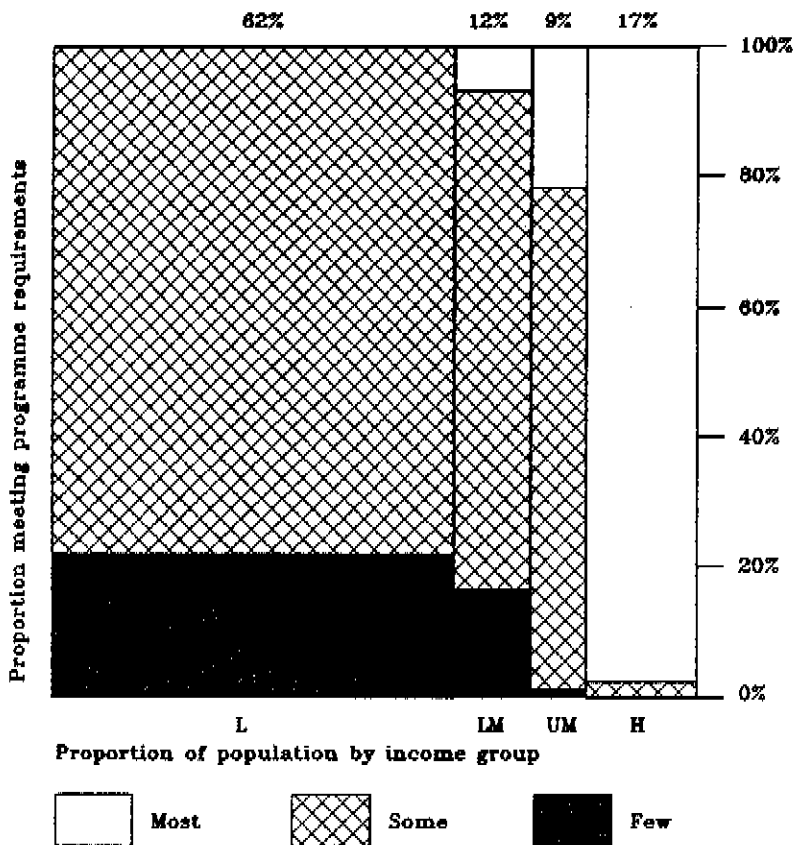


Fig. 10. Programme status of populations, by national income groups, 1989.

The data show that people in the worst-off countries (those meeting few programme requirements) amount to 15% of the total populations and live in 46% of the countries. However, Fig. 10 shows that 81% of the people live in countries that do not meet most programme requirements and that 62% of them live in countries in which the per capita GNP averaged less than US\$300 in 1987. Considering that even those who live in countries that meet most requirements are not fully protected against environmental pollution hazards, the fact that 4 out of every 5 humans live in countries that provide much less protection is a stark indicator of the global health risk.

In the 60 countries that are just becoming industrialized, a higher proportion of the population is likely to be unprotected against more prevalent pollution exposures. The 11 countries in this category that met most requirements, including several in Europe, have a combined population of 184 million, i.e., only 6% of the 3290 million people in the 60 countries. Thus, 94% live in countries where environmental hazards from development are outrunning control capabilities.

### Differences in the capabilities of countries to control key pollution problems

The capabilities of 116 countries to control seven types of pollution problem were assessed in the 1989 survey. These data can be considered as a reasonably representative sample of country situations, and the problem types cover a wide spectrum of pollution. The drinking-water quality and solid-waste categories were selected because of their association with communicable diseases; air and water pollution, toxic chemicals, and radiation were selected as being representative of "new" problems in developing countries; and noise was selected to represent a problem generally given low priority. Country scores and global indices were calculated for capabilities in controlling each of the problems,<sup>1</sup> and the indices are presented graphically in Fig. 11, distinguishing the industrialized from the developing countries.

<sup>1</sup> Country capabilities were calculated by applying the 4-point scale to each of the 10 indicators described in Table 2. The numerical values were matched with the following descriptions:

- 3 = adequate/comprehensive provisions
- 2 = partial/limited provisions
- 1 = minimal/negligible provisions
- 0 = lacking/absent provisions.

Indicator scores were then averaged to obtain a programme score for each country. To determine the programme capability indices for 86 developing countries, the summed value of their programme scores for each problem category was divided by the number of countries; this procedure was repeated for 30 industrialized countries.

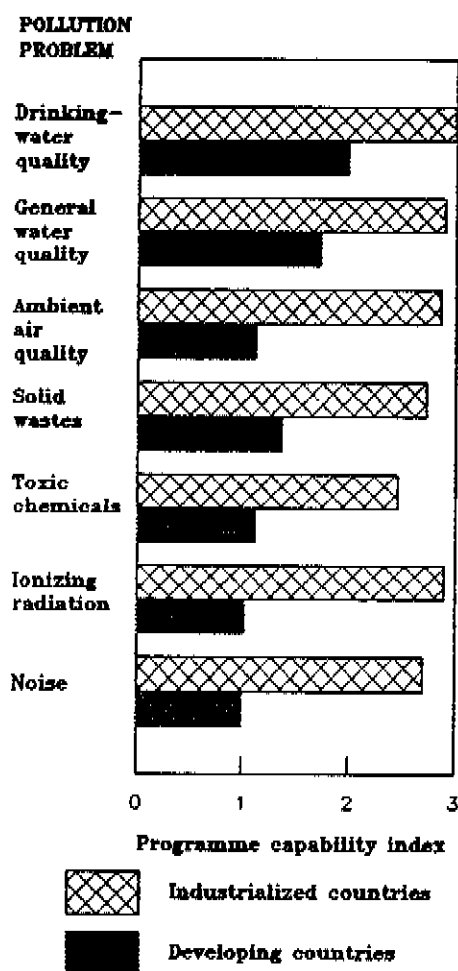


Fig. 11. National capability indices, 1989.

The capability index of the 30 industrialized countries for drinking-water quality is at the "adequate level", and the indices for the control of general water quality, ambient air quality, and ionizing radiation are fairly close to it. Indices for the management of solid wastes and noise are somewhat lower, while the index for the control of toxic substances is closer to "limited" than to "adequate".

As far as the 86 developing countries in the sample are concerned, no index is above the "limited" level. The indices for drinking-water quality and general water quality are markedly higher than those for the other types of problem, most of which are close to the "negligible" level.

The graph illustrates not only the clear difference in the capabilities of the two groups of countries, but also that developing countries are better able to deal with pollution related to communicable diseases than with the problems of air pollution, the hazards of chemical use and wastes, ionizing radiation, and noise. Even so, only about 20% of the developing countries had "adequate" capabilities in the two water categories, while 5% or less were rated at this level for the other types of problem.

### Differences in meeting the requirements of pollution control programmes

The differences in programme capability are clarified when ratings on the 10 indicators for policy/programme requirements for national pollution control (Table 2) are examined.<sup>1</sup>

The upper bars in Fig. 12 show the indices for each indicator for 30 industrialized countries; the lower bars show the indices for 86 developing countries. For 8 of the indicators, the indices of the industrialized countries are close to the "adequate" level, while all 10 indexes for the developing countries are clustered midway between "limited" and "minimal".<sup>1</sup> Comparison of these indicator scores suggests that:

- most developing countries need to improve their situation with respect to all 10 elements;
- some industrialized countries are deficient in each of the elements; many have shortfalls in the involvement of health authorities and in local capacity for pollution control;

The similarity in indices for health authority involvement implies that this factor is independent of a country's development status. The same inference applies to inadequate local capabilities (vertical delegation), implying limited decentralization of resources.

Staffing, which is a key requirement for improving capacity, is extremely inadequate in developing countries, and the low index on the "strategy" indicator implies a serious deficiency in both the policy basis for environmental health protection and the planning capabilities to implement the policies.

<sup>1</sup> The method used to calculate the indices for programme indicators was identical to that used to calculate programme capabilities (see footnote on page 29).

## Combating environmental pollution

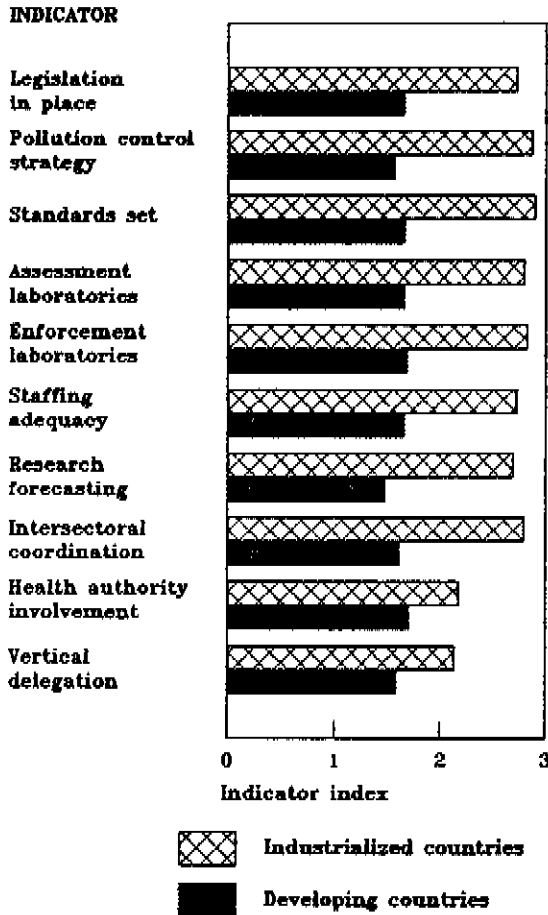


Fig. 12. National programme indicator indices, 1989.

There is a substantial need for developing countries to upgrade their capabilities in monitoring, assessment, enforcement, and laboratory support.

The influence of high national income in determining national programme capabilities is again illustrated when the index scores are averaged for each of the WHO Regions. As can be seen in Table 4,

## National capabilities to protect health

the average score in the European Region, where high income countries predominate, is 2.58, compared with a maximum score of 3.0. In the Western Pacific Region, which has several high-income and advanced developing countries, the average is 1.90, while high-income, oil exporting countries help raise the average in the Eastern Mediterranean Region to 1.69. In the other three Regions, where low-income countries predominate, the averages range from 1.40 to 1.55.

Table 4. Relationship between high national income and regional indices of programme capability<sup>a</sup>

WHO Region	Number of high-income countries <sup>b</sup>	Regional average index of programme capability <sup>c</sup>
Africa	0	1.45
Americas	0	1.40
Eastern Mediterranean	3	1.69
Europe	17	2.58
South-East Asia	0	1.55
Western Pacific	3	1.90

<sup>a</sup> The method used to calculate the indices for programme indicators was identical to that used to calculate programme capabilities (see footnote on page 29).

<sup>b</sup> The numbers of high-income countries listed apply to those included in the sample, not those located in the respective WHO Regions.

<sup>c</sup> The average index was calculated by summing the indicator scores for all assessed countries in each Region and dividing by 10, i.e., indicators were given equal weight. When weighted per the values in the footnote on page 29, non-significant changes in the values or relationships were found.

### Changes in scoring between 1984 and 1989

Detailed scorings for 67 countries were obtained in both the 1984 and 1989 surveys. Of these, 27 were European countries, scored in 1984 as meeting most requirements, for which no significant score changes were reported in 1989.

The two scorings for the remaining 40 countries, about a quarter of the global total, provide an indication of the changes made in relation to the shortfalls reported in the preceding sections. In general, these

## Combating environmental pollution

data reflect measurable changes, both progressive and retrograde, even making allowances for possible measurement error (as when different persons assessed a country in 1984 and 1989).

Table 5 shows the distribution of the 40 countries, according to those with no, or minor, score changes and those with a change in score of more than 5% between the two surveys. Score changes were sufficient in 6 countries to change their capability status: 4 went from "few requirements met" to "some requirements met"; 1, from "some" to "most requirements met"; and 1, from "most" to "some requirements met".

Table 5. Changes in country scores, 1989 compared with 1984

WHO Region	Number of countries	Increased scores	No/minor change	Decreased scores
Africa	4	2	2	
Americas	17	11	5	1
E. Mediterranean	2	1	1	
Europe	5	1	2	2
South-East Asia	8	2	3	3
Western Pacific	4	2	2	
Totals	40	18	15	6

With respect to the indicators, 181 score changes were registered among 383 observations, i.e., 47%. Of these, 116 (30%) were higher and 65 (17%) were lower. This suggests considerable dynamism in country situations, even allowing for measurement error. The indicators with the highest frequency of positive change were "Standards", "Assessment; laboratory", and "Enforcement; monitoring". Those showing the highest frequency of negative changes were "Staffing", "Intersectoral coordination", and "Vertical delegation". For the last two indicators, relatively frequent positive and negative score changes may reflect instability in national political and organizational arrangements, or they may reflect assessment difficulties, because of ambiguous measurement criteria for these indicators.

The respective indicator indices in 1984 and 1989 are reported in Table 6. The changes are net, after lower indicator scores have offset higher indicator scores. The changes were positive for 8 indicators, while higher scores offset lower scores for the other two: thus, there was no change. Index increases of more than 5% within a 5-year period on 7 out of the 10 indicators reinforces the implication that positive change is feasible in many countries.

On the other hand, the apparent intractability of the staffing situation, for which higher scores in 7 countries were offset by lower scores in 9

## National capabilities to protect health

Table 6. Changes in indicator scores, 1984 and 1989 <sup>a</sup>

Indicator <sup>a</sup>	1984 index	1989 index	Change (%)
Legislation in place	1.53	1.63	6.1
Strategy formulated	1.12	1.19	6.3
Standards set	1.39	1.68	17.3
Assessment; laboratories	1.53	1.73	11.6
Enforcement; monitoring	1.31	1.46	10.3
Staffing adequacy	1.53	1.53	
Research; forecasting	1.45	1.55	6.9
Intersectoral coordination	1.22	1.53	20.3
Health authority involved	1.56	1.61	3.1
Vertical delegation	1.58	1.58	

<sup>a</sup> See Table 2 for definitions.

others, raises the question of whether further improvements in capability can be expected without improving the supply and quality of human resources, which are critical to making progress on most of the other technical requirements.

This question raises another, i.e., whether improvements in staffing and other requirements can be expected without substantially greater involvement of health authorities in the problems of environmental pollution. In only 16 out of 116 countries was this involvement scored as "adequate"; in another 68 it was "limited", and, in the other 32, even lower. Yet national capabilities are unlikely to improve unless public health leaders:

- actively advocate priority attention to the health consequences of environmental pollution;
- increase health involvement in development decisions;
- participate more actively in intersectoral and intergovernmental mechanisms; and
- promote resource development and organize stronger programmes for environmental health protection.

More active health leadership appears to be a prerequisite for a country to better meet the requirements for controlling environmental pollution and its negative effects on human health.

## Chapter 4

# Conclusions and recommendations

### Conclusions

1. Environmental pollution, whether biological, chemical, or physical, presents increasing hazards for human health. Adverse health effects become intensified with rapid population growth, industrialization, urbanization, and poverty.
2. Major health problems are linked with the pollution of drinking-water, surface and ground waters, coastal areas, urban air, and soils. Acute and long-term exposures to hazardous wastes, environmental chemicals, different types of radiation, and the biomass fuels used in the home are leading concerns.
3. The prevention and control of pollution depends on effective interventions within the community, as well as within sectors and organizations engaged in production activities. Pollution control depends on the use of public policies and programmes, the market, and the media, to influence the choices of producers and consumers and to modify the physical environment. The capacity to intervene requires resources of knowledge, technology, information, policy, programming, staffing, organization, and finance.
4. The capacity for intervention varies among the world's countries and regions. Four out of every 5 persons live in countries with serious deficiencies in pollution control capacity. Generally, the shortfalls are greatest in developing countries and the needs are most urgent in countries undergoing rapid industrialization, where the build-up of capability lags behind the increasing impact of pollution on the human environment.
5. Low national income and socioeconomic underdevelopment are major determinants of weak capabilities in pollution control. Many developing countries lack the scientific, technical, and managerial

resources to tackle "new" environmental hazards; their capacity to apply traditional sanitary controls is often overwhelmed by demographic and environmental changes and limited by inadequate financial and human resources.

6. Recent experience in industrialized and developing countries has shown that national situations can be improved, but that there is an ever-present danger of losing ground, as needs and policy priorities change.

### Courses of action

Threats to health from environmental pollution can be reduced through:

1. Increasing political and public awareness of the health hazards of pollution and more strongly motivating governments, enterprises, groups, and individuals to take action to prevent and control these hazards.
2. Consistently incorporating environmental and health concerns in processes of sustainable socioeconomic development, emphasizing the prevention of pollution through more efficient industrial practices and citizen action, within a comprehensive strategy for environmental health.
3. Making the necessary investments in the scientific and technical resources needed for the assessment and control of pollution and its associated health risks, and institutionalizing the development and stability of these resources.
4. Specifying and strengthening public health participation and capabilities in advocacy, health risk assessment, standard setting, public information and education, and the monitoring and enforcement of control measures.
5. Organizing effective mechanisms for intersectoral and inter-governmental cooperation in pollution control, at the policy, technical, and service levels.
6. Decentralizing authority and resources appropriately to the local levels of action, normatively guided and supported by the national and provincial/state levels.

**7. Making international and bilateral technical cooperation more effective, through:**

- **strengthening the scientific and technical base for health risk assessment and the prevention and control of environmental pollution;**
- **further developing methods for information management, assessment, monitoring, evaluation, programming, and control;**
- **improving scientific, technical, and managerial coordination among international agencies and institutions;**
- **making technology transfer more effective, including the provision of support to developing countries to enable them to make proper use of new technologies ; and**
- **strengthening efforts to mobilize funding.**