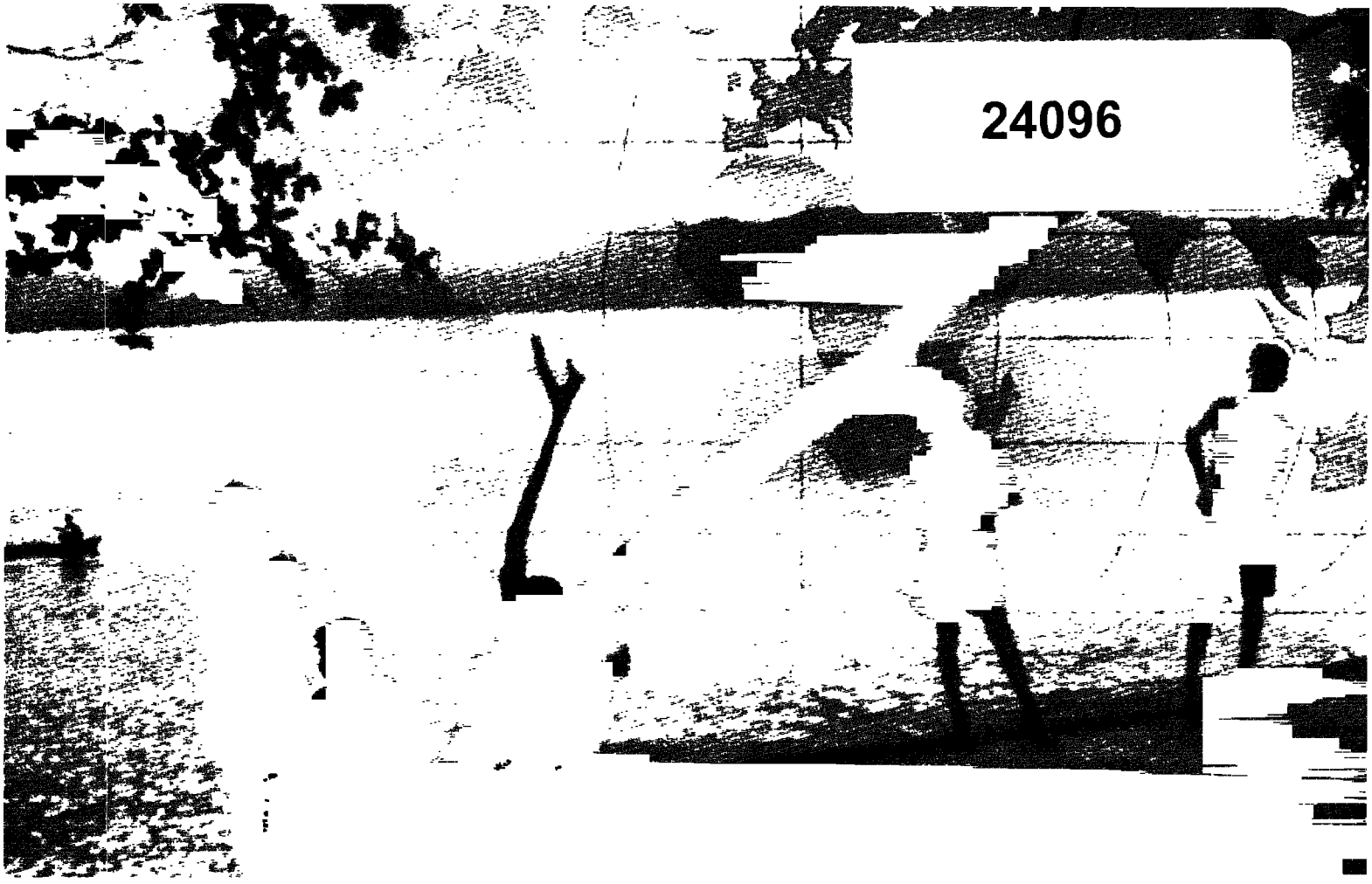

Environment Strategy Papers

Health and Environment

Kseniya Lvovsky

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Health and Environment

Kseniya Lvovsky

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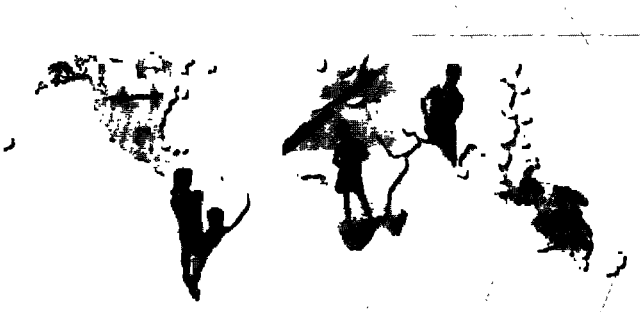
In 2001, the World Bank completed the comprehensive two-year process of preparing its Environment Strategy, *Making Sustainable Commitments: An Environment Strategy for the World Bank.* It was endorsed by the Bank's Board of Directors and published in October 2001. Several background papers were prepared and published by the Bank's Environment Department to stimulate constructive dialogue and intellectual discussion on a range of issues within the Bank as well as with client countries, partners, and other interested stakeholders. The *Environment Strategy Paper* series includes revised versions of Environment Strategy background papers, as well as new reports prepared to facilitate implementation of the Strategy. This series aims to provide a forum for discussion on a range of issues related to the strategy, to help the transfer of good practices across countries and regions, and to seek effective ways of improving the Bank's environmental performance.

This report is a revised version of the environment strategy background paper on Health and Environment.



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Preface

This paper highlights links between environment, public health, and poverty, and discusses implications for the Bank strategy to address environmental health concerns. It shows that environmental risks have a significant impact on health outcomes in developing countries, and that traditional environmental hazards, such as lack of safe water and sanitation, indoor air pollution, and exposure to disease vectors, play by far the largest role. Also worrying, however, is that the contribution of modern environmental risks—pollution by transport, industry, and agrochemicals—to the disease burden in many developing countries is similar to that in rich ones, and sometimes is even greater. The world's poor are most affected by this "double burden" of both traditional and modern environmental risks.

While environmental challenges of development and globalization require a concerted action, the much higher environmental health costs of living in poverty and lacking basic infrastructure and other services must not be neglected. Policies and actions that address both types of health risks and damages in a synergistic manner are the best, and include those that promote strong growth and good governance structures that are capable of safeguarding the environment and responding to the needs of the poor. Tradeoffs are sometimes inevitable, however, and should be made with a full understanding of the resulting net health impacts. The paper attempts to contribute to improving this understanding.

The environment-health nexus highlights that improvements in people's health require a holistic, multisectoral approach to mitigating major risks by integrating cost-effective efforts in infrastructure and human development areas and by building effective institutions at all levels of governance, including communities themselves. A holistic approach is particularly important for improving the health of the poor, who are most vulnerable to both main environmental hazards and deficiencies in health services delivery. The World Bank Environment Strategy, developed in extensive consultation with various stakeholders in client countries, other donors, and international nongovernmental organizations, considers environmental health a top priority and calls for a greater focus on this principal development outcome in Bank operations across all relevant sectors.

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Chapter 1

Health, Environment, and Development

Health and development are irrevocably interrelated. Infant/child mortality and life expectancy—conventional measures of the general health of large populations—are considered key development indicators. Better health is both an outcome of and a vehicle for achieving economic prosperity and poverty eradication.

Protecting health is the principal objective of protecting the environment. The vast majority of environmental policies and regulations worldwide are motivated by public health concerns, and most economic valuation exercises have found that health impacts constitute the largest portion of environmental damages. It has long been recognized that the environment in which people live—from the household to the global level—significantly affects their health. (See Box 1.) Until recently, however, it was not possible to quantify the magnitude of health impacts from exposure to various environmental factors. Nor was it possible to compare the cost-effectiveness of preventive measures to reduce such exposure with health sector activities that cure the resulting illnesses. The opportunity to do so emerged from work on the "global burden of disease," which uses a standardized measure of health outcomes (disability-adjusted life years, or DALYs) across various causes of illness and death. (See Box 2.) Follow-up analysis, which attributes the disease burden measured in DALYs to environmental hazards, has brought our knowledge of environment and health linkages to a new level.

Recent estimates suggest that premature death and illness due to major environmental health risks account for one-fifth of the total burden of disease in the developing world—comparable to malnutrition and larger than all other preventable risk factors and groups of disease causes. While the total burden of disease in rich countries, expressed in DALYs per million people, is about half that in developing countries, the disease burden from environmental risks is smaller by a factor of 10. (See Figure 1.) This gives a new dimension to environmental health (EH) as a principal indicator of development and a major element in achieving the Bank's primary objective of reducing poverty.

BOX 1.
What is environmental health?

Environmental health refers to those aspects of human health, including quality of life, that are determined by physical, biological, social, and psychosocial factors in the environment. Most causes of disease, injury, and death in developing countries lie outside the purview of the health sector. They cover a broad spectrum, ranging from physical factors such as inadequate sanitation, water, drainage, waste removal, housing, and household energy to behavioral factors such as personal hygiene, sexual behavior, driving habits, alcoholism, and tobacco smoking.

The definition of environmental health is still evolving. The World Bank's Africa Environmental Health team, for example, proposes using a broad definition that would cover all activities "to prevent health risks through control of human exposure to: (a) biological agents, such as bacteria, viruses, and parasites; (b) chemical agents, such as heavy metals, particulate matter, pesticides, and fertilizers; (c) disease vectors, such as mosquitoes and snails; and (d) physical and safety hazards, such as traffic accidents, fire, extremes of heat and cold, noise, and radiation." By comparison, the World Health Organization does not include traffic accidents in its extensive list of environmental health risks, but does include deforestation and land degradation. (See Annex A for full definitions.) Moreover, the health and environment nexus is broader than simply environmental health; for example, it includes health care waste management and the impact of biodiversity loss on medicinal plants.

The approach adopted by the Health and Environment team devising this Environment Strategy has not, therefore, been to create a formal definition of environmental health, but instead to agree on commonly shared principles to guide the Bank's environmental health activities. These principles include:

- A holistic approach to health as an outcome of numerous socieconomic and physical determinants
- A focus on prevention of health risks and disease at the earliest opportunity
- Selectivity, or a focus on cost-effective interventions that yield significant health impacts
- Targeting of the poor by ensuring that environmental health projects benefit poor at least as much as non-poor groups of beneficiaries.

Using this approach means that it does not matter whether, for example, traffic accidents are considered under environmental health or not, as the approach calls for assessing the health dimensions of transport-sector projects in a holistic manner, including both traffic accidents and air pollution.

The discussion in this paper focuses on the following environmental health risks that make the largest contributions to the burden of disease:

- Poor water supply (quantity and quality)
- Inadequate sanitation and waste disposal
- Indoor air pollution
- Urban air pollution
- Malaria
- Agroindustrial chemicals and waste (including occupational hazards).

While this list is not exhaustive, it highlights the impact of environmental factors on health; illustrates environment, development, and poverty linkages; and helps foster discussion of strategic issues related to environmental work in the Bank.

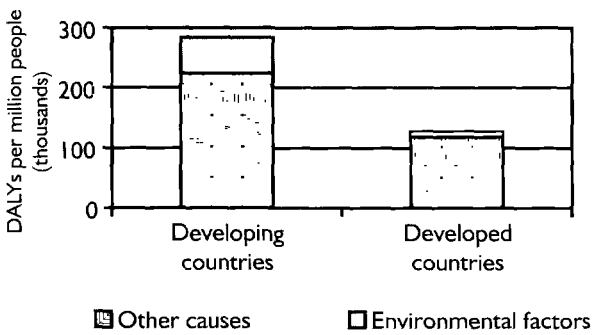
BOX 2.
DALYs as a measure of the burden of disease

Disability-adjusted life years are a standard measure of the burden of disease. The concept of DALYs combines life years lost due to premature death and fractions of years of healthy life lost as a result of illness or disability. A weighting function that incorporates discounting is used for years of life lost at each age to reflect the different social weights that are usually given to illness and premature mortality at different ages. The combination of discounting and age weights produces the pattern of DALY lost by a death at each age. For example, the death of a baby girl represents a loss of 32.5 DALYs, while a female death at age 60 represents 12 lost DALYs (values are slightly lower for males).

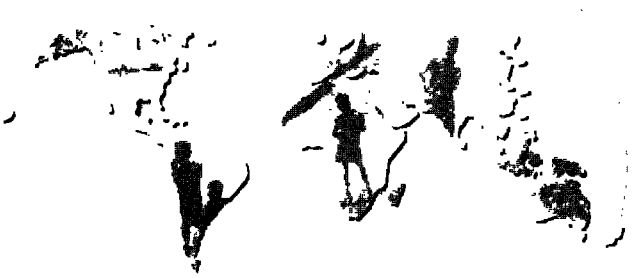
The use of DALYs as a measure of the burden of disease has provided a consistent basis for systematic comparisons of the cost-effectiveness of alternative interventions designed to improve health. When combined with the results of large-scale epidemiological studies, it enables public health specialists to identify priorities and focus attention on development programs that have the potential to generate significant improvements in the health of poor people in the developing world.

Source: Murray and Lopez 1996.

FIGURE 1. Burden of disease and environmental risks: Developing versus developed countries, 1990



Source: Murray and Lopez 1996, Smith 1998, World Bank staff.



Chapter 2

Environmental Health and Poverty

Environmental health risks fall into two broad categories:

- *Traditional hazards related to poverty and lack of development*, such as lack of safe water, inadequate sanitation and waste disposal, indoor air pollution, and vector-borne diseases (malaria, for example)
- *Modern hazards caused by development that lacks environmental safeguards*, such as urban air pollution and exposure to agroindustrial chemicals and waste.

In developing countries, the increasing health burden from modern forms of exposure to urban, industrial, and agrochemical pollution adds to traditional household risks, which still play the greatest role. On a global scale, lack of access to clean water and sanitation and indoor air pollution are the two principal causes of illness and death, predominantly affecting children and women in poor families. In all developing countries, more than 2 million people—primarily young children and women—may die as a result of indoor exposure to dirty solid fuels each year. The health burden from poor water supply and sanitation is even larger.

The relationship between the burden of environmental diseases, traditional environmental risks, and poverty is further highlighted by regional analysis. (See Table 1.) The burden of disease from environmental causes varies considerably among regions, but a clear trend emerges regarding how this burden and its components change with income growth.

Overall, the environmental health burden as a percentage of the total disease burden is highest in regions that house most of the world's poor (27 percent in Africa and 18 percent in Asia) and lowest in industrial countries. Decline in this burden is clearly associated with reduction in exposure to traditional risks. The impact of traditional environmental health hazards exceeds that of modern hazards by a factor of 10 in Africa, 5 in Asian countries (except China), and 2.5 in Latin America and Middle East. Modern threats to human health prevail in rich countries and in European countries undergoing economic transition. Within individual countries, moreover, the poor suffer disproportionately from unsafe environmental conditions at the household and community levels.

Inadequate water supply and sanitation (WSS) pose the largest threat to human health in Bank

TABLE 1. Burden of disease from major environmental risks (worksheet)*

	Percent of all DALYs in each country group								
Environmental health group	*SSA*	*India*	*Asia & Pacific*	*China*	*MNA*	*LAC*	*FSE*	*ICs*	*All DCs*
Water supply & sanitation	10.0	9.0	8.0	3.5	8.0	5.5	1.5	1.0	7
Vector diseases (malaria)	9.0	0.5	1.5	0.0	0.3	0.0	0.0	0.0	3
Indoor air pollution	5.5	6.0	5.0	3.5	1.7	0.5	0.0	0.0	4
Urban air pollution	1.0	2.0	2.0	4.5	3.0	3.0	3.0	1.0	2
Agro-industrial waste	1.0	1.0	1.0	1.5	1.0	2.0	2.0	2.5	1
All causes	26.5	18.5	17.5	13.0	14.0	11.0	6.5	4.5	18

Notes: * Regions slightly differ from World Bank Regions. See a definition in World Bank 1993 and Murray and Lopez 1996. Note that Asia and Pacific includes countries from East and South Asia, except for China, India, Pakistan, and Afganistan. FSE means "former socialist economies of Europe" and does not include Central Asia. SSA is Sub-Saharan Africa, LAC is Latin America and Caribbean, MNA is Middle East and North Africa, ICs stands for industrialized countries, and DCs is developing countries. Most of the data in the table are from the early 1990s.

Sources: Murray and Lopez 1996; Smith 1993, 1998, 1999; WHO 1997a; World Bank 1999; World Bank staff (see Annexes 2 and 3).

client-countries, except for China and the transition economies of Europe, where air pollution causes the most damage. Indoor air pollution is the greatest threat in Asia and Africa. Malaria has taken a heavy toll on the population of Sub-Saharan Africa. Although malaria is not nearly as significant in other regions, it is the third greatest environmental health threat globally.

Chapter 3

Changing Landscape of Environmental Health Risks — Future Trends

The majority of those suffering from high levels of indoor air pollution, lack of sanitation, scarce water supply, and malaria live in rural areas. But rapid urbanization and the uncontrolled growth of urban slums also create a "double burden" for the urban and semi-urban poor. They are increasingly exposed to "transition risk"—one portion of that risk is from dirty cooking fuels, primitive stoves, crowding, and poor access to water and sanitation, while the other is a result of modern transport and industrial pollution. Further, in some parts of the world malaria is becoming an urban issue, in part due to infrastructure failures. In Africa, Asia, and Latin America, urbanization is changing the landscape of environmental health concerns and posing new challenges on an unprecedented scale.

In order to set strategic priorities for addressing environmental health issues, it is important to estimate the "baseline" of how the burden of environmental health risks is likely to change over time. Table 2 summarizes the projections of the burden of disease caused by air pollution over the period 2001–20 under a "business as usual" scenario, expressed as annual averages for the 20-year period.[1]

TABLE 2. Premature mortality and burden of disease due to air pollution, by region (*projected annual averages for 2001–20*)

	Premature deaths (thousand per year)			*Burden of disease (million DALYs per year)*		
Region	*Indoor*	*Outdoor (urban)*	*Total*	*Indoor*	*Outdoor (urban)*	*Total*
China	150	590	740	4.5	14.0	18.5
East Asia and Pacific	100	150	250	3.5	3.8	7.3
Established Market Economies	0	20	20	0.0	0.5	0.5
Former Socialist Economies	10	200	210	0.2	3.8	4.0
India	490	460	950	17.0	10.1	27.1
Latin America and Caribbean	10	130	140	0.3	3.7	4.0
Middle East Crescent	70	90	160	2.4	2.5	4.9
South Asia	220	120	340	7.6	2.6	10.2
Sub-Saharan Africa	530	60	590	18.1	1.2	19.3
World	1,570	1,810	3,480	53.4	42.2	95.6

Source: World Bank 2000a. Also see Annex 2.

Exposure to Pollutants. The largest component of air pollution costs is the premature mortality and ill health caused by indoor and outdoor exposure to high levels of pollutants. Projections indicate that about 3.5 million people will die prematurely each year over the next 20 years as a result of indoor and outdoor air pollution. In Sub-Saharan Africa and South Asia (excluding India), most of these deaths will be the result of indoor air pollution, so the priorities identified in Table 1 hold. In India, indoor and outdoor air pollution each account for about half of the premature deaths. Outdoor air pollution is becoming the major issue in China. For the world as a whole, while indoor exposure dominated health damage from air pollution in the past decade, outdoor air pollution is projected to gain equal importance as a grave risk to human health over the next two decades.

The total burden of disease from air pollution amounts to almost 100 million DALYs per year, equivalent to a loss of slightly more than one year of life over the life span of an average individual. For India and Africa, the burden of ill health caused by air pollution is equivalent to a loss of life of more than 1.5 years.

Impact of Climate Change. For the world's poor who live in coastal areas and island communities, which are vulnerable to climate extremes, the potential impacts of climate change could be highly significant. (See, for example, Listori 1999.) Analysis of the effects of global climate change (including the health impacts) suggests that the long-run costs of an increase in global temperature of 2.5 degrees Celsius will be highest for India and Africa (4.9 percent and 3.9 percent of gross national product, respectively, of which 2.3 percent and 0.4 percent are associated with the potential costs of catastrophic weather events). Still, for both India and Sub-Saharan Africa the health damage caused by indoor air pollution alone is about twice as great as the total (health and non-health) damage associated with global exposure to climate change (comparing various scenarios of present values of these damages over the next 100 years).

Changing Face of Disease. Recent worrisome trends on the disease landscape that have implications for environmental health priorities include the increase of vector-borne diseases, especially malaria in Sub-Saharan Africa, and the changing pattern of infectious diseases (see, for example, World Resource Institute 1998). Twenty-nine new diseases have been discovered over the past 20 years, and former scourges, such as tuberculosis, are returning. AIDS is becoming one of the major causes of death, creating 5.5 percent of the burden of disease in developing countries, according to the most recent estimates (WHO 1999).

Chapter 4

Improving Environmental Health

Environmental health risks can be prevented, or significantly mitigated, through a variety of economic activities in different sectors—mainly infrastructure, energy, and agriculture. Table 3 summarizes these activities and links them to possible indicators for monitoring health impacts. Interventions linked to measurable, significant environmental health impacts are referred to as "environmental" interventions, regardless of the sector in which they are implemented.

Better infrastructure and energy services for households and communities are key measures for mitigating traditional environmental risks, along with improved housing and vector-control interventions. Reducing modern risks calls for pollution prevention and abatement measures, which in turn requires setting and enforcing environmental standards, developing a culture of environmental compliance, and creating effective incentives. In Sub-Saharan Africa, for example, remedial measures outside health care systems—such as improved water and sanitation, household energy, housing, vector control, and pollution management—were estimated to be capable of reducing the total burden of disease by 23–29 percent. Health care interventions aimed at the same clusters of diseases affected by environmental factors (such as diarrhea, respiratory symptoms, eye diseases, and malaria) can reduce the disease burden by a further 23–28 percent (see Annex 3) (Listorti 1996; Listorti, Doumani, and Hammer, forthcoming).

The data illustrate two important points:

- Health, especially environmental health, is a principal outcome of many interventions and project activities outside the health sector.
- The key development objective of improving people's health requires a holistic, multisectoral approach to mitigating major risks by integrating efforts inside and outside health care systems. A holistic approach is particularly important for improving the health of the poor, who are most vulnerable to both major environmental hazards and deficiencies in the provision of health services.

TABLE 3. Health outcomes and environmental interventions

Environmental risk factors	*Associated sectors/projects*	*Health outcomes*	*Health indicators*	*Examples of monitorable proxy indicators*
Indoor Air Pollution	Energy (cleaner fuels, improved stoves) Rural development	Child mortality Chronic obstructive pulmonary disease (COPD) Acute respiratory infections (ARI)	Child deaths due to respiratory illness Cases of ARI Incidence of COPD	Estimates of exposure levels to indoor air pollution Percent of households using clean fuels or/and improved stoves Type of housing Cooking practices
Outdoor Air Pollution	Energy Transport	Mortality COPD ARI Respiratory Hospital Admissions (RHA) IQ impairment (lead)	Deaths (adult) Incidence of COPD Cases of ARI Respiratory Hospital Admissions	Annual mean levels of PM_{10} ($\mu g/m^3$) Annual ambient concentrations of lead in the atmosphere ($\mu g/m^3$) Lead level in blood, particularly children ($\mu g/dl$)
Vector-Borne Disease	Irrigation Reforestation Infrastructure (drainage) Health (vector control)	Malaria mortality Malaria morbidity	Deaths due to malaria Malaria cases	Application of bednets Application of insecticides Indicators related to the development and maintenance of irrigation and drainage infrastructure
Lack of water supply and sanitation (WSS)	WSS Infrastructure Social funds	Mortality due to diarrheal disease Diarrhea incidence	Child deaths due to diarrhea Diarrhea cases in children	Relevant indicators of access to water and sanitation (for example, percent of household with in-house connections, lpcd,* percent of community coverage with sanitation facilities) Indicators of sustained and effective use of WSS facilities Quality of water at the source Hygiene/behavioral change indicators
Pesticide Residues	Agriculture	Acute poisoning Cancer Fetal defects	Cases of acute poisoning Cases of cancer	Application norms Storage and handling practices
Other Toxic Substances	Control of industrial and transport pollution, change in fuel quality	Cancers IQ impairment (lead)	Cases of cancers, blood lead level	Environmental performance Waste management codes Land zoning regulations Market share of leaded gasoline

Note: * lpcd = liter per capita per day.

Chapter 5

Health and Cost-Effectiveness of Environmental Interventions

Activities in a number of economic sectors aimed at reducing human exposure to environmental hazards not only have a direct and significant impact on health, they also can be cost-effective in achieving health outcomes and preventing the loss of DALYs. A cost-effectiveness review undertaken for this paper was constrained by the limited number of studies that include this kind of assessment or provide data necessary to make such an assessment. (See Annex 4.) Most of the data on the costs of interventions per DALY-saved come from malaria-control or urban air pollution studies. Box 3 summarizes available estimates.

The findings lead to two important policy conclusions, although the limited scope of the assessment and reservations about the validity of using DALYs for cross-sectoral comparisons require careful interpretation and further discussion. Bearing this in mind, the data

BOX 3.
Cost-effectiveness of interventions to improve environmental health

While the number of studies is limited, a World Bank review of available evidence undertaken to assess the effectiveness of measures outside the health sector in achieving health improvements (preventing the loss of DALYs) provided the following estimates of the costs per DALY saved for various interventions:

- Water connections in rural areas: US$35 per DALY (World Bank 2000b)
- Hygiene behavior change: US$20 per DALY (Stephen 1998)
- Malaria control: US$35–75 per DALY (Binka 1997)
- Improved stoves (indoor air): US$50–100 per DALY (Smith 1998)
- Use of kerosene and LPG stoves in rural areas: US$150–200 per DALY (World Bank 2000b)
- Improved quality of urban air: large variations, from negative costs (electronic ignition systems in two-stroke vehicles) to US$70,000 per DALY and more for some pollution control measures, with most measures costing over US$1,000 per DALY.

The *World Development Report 1993* suggests that health sector interventions up to US$150 per DALY saved can be considered cost-effective (World Bank 1993).

Source: Listorti 1996 and World Bank estimates.

suggest that measures to mitigate traditional health hazards (such as indoor air pollution, scant sanitation, or insect vectors) tend to be more cost-effective than many of the measures to reduce modern risks, such as urban air pollution.[2] This finding, coupled with the significant impact of these hazards on the health of the poor, calls for greater attention to traditional household and community health risks in environmental work. Since interventions to reduce these risks fall in the domain of energy and infrastructure (WSS) sectors, there is a need for closer collaboration with these sectors to achieve health outcomes.

Second, large variations in the cost-effectiveness of various interventions (across health hazards and within one type of hazard, such as urban air pollution) point to the need for rigorous analysis and skillful design of environmental health projects to maximize health benefits in a cost-effective manner. A recently completed World Bank study of water, sanitation, and health linkages in the State of Andhra Pradesh, India, provides probably the strongest data in support of this point (World Bank 2000b). The study found that costs per DALY saved from water supply and sanitation interventions vary greatly, depending on a complex variety of factors. These factors include the socio-demographic situation in a district, the urban or rural status of the community, sanitation coverage, and type of service delivery. This complexity of intervention-outcome linkages can be used to strengthen the basis for collaboration with other sectors, as environment staff are often well positioned to provide analytical input to the design of infrastructure and energy projects that would help to achieve better health outcomes.

Additional controversy around these findings arises from the fact that many interventions at the household and community levels improve public health by providing private goods (for example, better fuels or stoves, water supply, and sanitation). The challenge, then, is how to reconcile the willingness-to-pay and commercial viability of services—the cornerstone of energy and infrastructure operations—with cost-benefit analysis based on health outcomes. This is another area in which cross-fertilization of experiences in the health, environment, rural development, energy, and infrastructure sectors is the only way to find a workable solution.

Chapter 6

Environmental Health and Bank Operations Guidelines

Bank Policies. Only 1 out of 30 Operations Policies and Best Practices (OP/BP) is devoted to environmental health (covering the use of pesticides), but it is limited to public health uses of mosquito control, and does not deal with the widespread use of pesticides in agriculture. Four other OP/BPs contain passing references to environmental health, either in a single paragraph or a footnote. Overall, instructions to staff are sparse and are not conducive to a process of cross-fertilization.

Bank Documentation. Bank documentation shows uneven treatment of environmental health. (See Annex 5.) Several Environment Department publications refer to the pollution/health linkage in annual reports and other evaluations of Bank work. In the Middle East and North Africa Region and in the Europe and Central Asia Region, environmental health was used as an input into developing regional strategies; in the Latin America and the Caribbean, South Asia, and East Asia and Pacific Regions, various attempts were made to estimate the economic costs of human health damages. Many National Environmental Action Plans name environmental health as the highest priority, and some attempts were made in ECA to develop these plans jointly with National Environmental Health Plans sponsored by the World Health Organization (WHO). Still, project documents and other publications focus mostly on pollution-control. The most comprehensive exercise to date was the study on *Environment and Health: Bridging the Gaps* (Listorti, Doumain, and Hammer 1999) and the draft *Environmental Health Assessment Guidelines* developed in the Bank's Africa Region (Listorti, Doumain, and Hammer, forthcoming). Environmental health is rarely on the agenda of Country Assistance Strategies (CASs).

To a certain degree, Bank documentation and internal procedures reflect the same rough distribution and accuracy as the outside literature; whereas the health sector is inwardly focused, environmental health accentuates pollution, and cut-and-paste health information is often misapplied. The problem, however, is that the outside literature is essentially motivated by the needs and priorities of industrial countries, which are very different from those of developing countries, especially with regard to the health needs of the poor. Although a considerable number of worthwhile and cutting-edge activities occur Bank-wide, systematic advocacy for and internalization of

environmental health concepts has not taken place throughout the organization. (Listorti 1996; Listorti, Doumani, and Hammer, forthcoming).

New Activities. A number of new, ongoing, or recently completed activities address some of these issues. Among them are the preparation of *Environmental Health Assessment Guidelines* by the Africa EH team; an analysis of the impact of the household environment on child mortality in India and a study of linkages between access to WSS and health in Andhra Pradesh, carried out by South Asia Region and ENV; an ECA study on health and hygiene in WSS; and, most recently, work on indoor air pollution in SAR, SSA, and LAC.

Chapter 7

Lessons from Bank Experience

Water and Sanitation. Bank experience with environmental health has been limited, as have the lessons learned. Many important environmental health issues fall through the cracks of development agencies because environment and health are both cross-sectoral, and because institutions commonly lack clear directives for the multisectoral dimensions of their work. An array of lessons has emerged in the WSS subsector from nearly a quarter-century of research devoted to low-cost, appropriate technology and from an International Decade dedicated to making drinking water and sanitation universally available. The lessons point to the value of an integrated approach to environmental health interventions, for example, integrating water supply with sanitation, drainage, community education, and hygiene practices (Listorti 1996).

A recently completed study in ECA on the health and hygiene dimensions of water and sanitation projects (see Box 4) found the following:

- Monitoring and evaluation of the health impacts of environmental interventions in ECA is of erratic quality. Thus an objective of future EH work should be to assist Bank staff in developing key performance monitoring indicators.
- At least half of WSS investments are embodied within "non-WSS" projects, most notably Social Funds, which shows the high priority attached by communities to EH-related activities and cross-sectoral links to EH.
- An intersectoral approach to WSS projects, incorporating hygiene and water quality issues, is needed to realize maximum impact from investments in infrastructure.

Improved Stoves. The most important Bank-supported interventions addressing indoor air pollution were large-scale Improved Stove Programs in India and China in the late 1980s (although these were motivated by energy efficiency goals rather than environmental ones). Major lessons learned were the need to target efforts more clearly toward the most-affected communities; the need to complement financial support with local capacity-building, training in maintenance, and health awareness programs; the need for a greater role for local authorities and communities; and the importance of sustainable financial arrangements.

Urban Air Pollution. Experience is also emerging with regard to urban air pollution manage-

BOX 4.
ECA Regional Study — Health, sanitation, and hygiene in rural water supply and sanitation projects

The goal of this study is to improve the design and implementation of rural water supply and sanitation (RWSS) projects in order to optimize health benefits associated with improved drinking-water supplies. The objectives are to examine the health impact of health, sanitation, and hygiene (HSH) components of RWSS projects; identify best practices in the design and monitoring of HSH of RWSS projects; and provide task managers with useful tools to assist in the design, monitoring, and evaluation of RWSS projects. The study was conducted through review of the literature, review of 20+ years of international and World Bank projects in RWSS, and review of all ECA projects with rural water supply, including non-water-sector projects, such as Social Funds and rural development projects. The study provides recommendations on operational, institutional, and monitoring and evaluation levels, as well as references, logframes, sample monitoring and evaluation programs, and other useful material for task managers.

The study found that health benefits associated with improved rural drinking-water supply projects result from improved quality and increased quantity of water, adequate sanitation facilities, and changes in hygiene behavior. Sanitation and hygiene behaviors have as much, if not more, impact on improved health outcomes from WSS projects than the water infrastructure itself. A successful rural water-supply project or component of a non-sector project should include a health, sanitation, and hygiene component if its goal is to improve health.

Bank-wide, non-water sector projects with RWSS components are a significant contributor to the sector, although often beyond the purview of the Bank's water sector. ECA has the most "other" projects with RWSS components, accounting for about half of total ECA investments in RWSS, or US$150 million. These "other" projects are social funds, rural development, or agriculture projects. The "other" projects are often well placed to promote HSH activities that would enhance the benefits of water-supply investments. However, the review found only one social fund in ECA (Moldova) that proposed HSH activities in the project.

The characteristics of successful HSH components are well established, based on the experiences of the international development community, including the Bank. Most World Bank RWSS projects now in implementation with HSH components include the key ingredients of a successful HSH program, except for well-defined monitoring and evaluation programs.

Examples of completed World Bank RWSS projects with documented health impacts are very rare. Most projects report improved health as an impact, but few have sufficient baseline information or monitoring to make this claim. Further, it is rare that policy issues or training related to strengthening of public health policies, institutions, and staff are included in RWSS projects at the Bank.

ECA is in the forefront, with four RWWS projects (stand-alone and "other") emphasizing training and institutional capacity building of public health services, including surveillance and health and water-quality monitoring. ECA RWSS project design has been significantly guided by the results of needs and social assessments. Pilot projects that further investigated issues uncovered by social needs assessments and demonstrated new, community-based approaches to RWSS were also very useful in preparing ECA RWSS projects.

Source: Bank staff

ment projects, motivated by environmental health impacts (such as the Slovenia Environment Project, the Mexico City Transport Air Quality Management Project, the Dhaka Air Quality LIL, and the proposed Katowice urban air pollution project). The latest lessons from these have not yet been summarized. A recent, quite successful experience in which the Bank supported the global phaseout of leaded gasoline highlighted the crucial role of political commitment, public awareness, and partnership with the private sector.

Chapter 8

Where Do We Stand? Regional Survey

To get a grasp on the current status of and emerging trends in environmental health work in the World Bank, Regional offices were asked to complete a questionnaire (see Annex 6 for a copy of the questions and the responses from each Region). Table 4 summarizes the responses; key observations are discussed briefly in this section.

Environmental Health Priorities. Quite unexpectedly, key issues and priorities identified by the Regions, based on client demand and staff perception, appear to be virtually identical to the ranking in Table 1, based on the burden of disease assessment.

Client Demand. Regional surveys indicate considerable interest on the part of many of our clients in addressing environmental health, although some responses (for example, East Asia) pointed to a greater interest in urban projects, despite significant EH problems in rural areas. However, environmental health is usually not an explicit objective of lending, except for a small portfolio of urban and industrial pollution projects. EH projects seem to be driven mainly by client awareness and Bank staff knowledge. Public perception through local media is quite important as well, but media attention does not always focus on the most crucial area for intervention.

Current Bank Portfolio. It appears to be impossible to compare and summarize Regional responses regarding portfolios of environmental health projects, as each Region used its own unique (explicit or implicit) definition of an environmental health project. (See Box 5.) If we look at all Bank projects with some degree of impact on environmental health or with the potential to achieve a significant impact, the result would be a huge portfolio that includes all WSS projects, all urban projects, all pollution-control projects, and quite a few transport, energy, rural development, and health projects. But this impressive portfolio is more likely to illustrate a dearth of missed opportunities than a high priority on environmental health. For example, after screening the projects according to a set of special criteria, South Asia reduced its list of "truly" environmental health projects from several dozen to just three. On the positive side, this potential for addressing EH concerns across sectors clearly shows the unique position and advantage of the World Bank compared with other development organizations working on health issues.

TABLE 4. Summary of Regional responses to environmental health questionnaire

Questions	*AFR*	*MENA*	*ECA*		*LAC*	*SA*	*EA*
			E. Europe	*C. Asia*			
Key EH issues	Water-borne diseases Respiratory (indoor air pollution)	Water-borne diseases Respiratory (indoor and urban air pollution) Toxic industrial pollution	Injuries Transport accidents Worker safety	Water-borne diseases Indoor air (TB communication) Sanitation, hygiene	Water-borne disease/ sanitation Respiratory illness (urban air) Sewage disposal in bay and coastal areas	Water supply and sanitation (related diseases) Respiratory (indoor air pollution) Urban air (from energy and transport)	Water supply and sanitation Urban air quality Indoor air (China: air pollution is the first priority) Also important: industrial health and safety and traffic accidents
Which sectors lend currently	Health Infrastructure Energy/Rural Development	Health and Education Infrastructure Rural Development (Water) Environment	Rural W&S Health Environment	Rural W&S Social Funds Energy Environment Health	Environment Health Some infrastructure (W&S, mining, transport)	W&S Urban Health Environment	Urban Environment Transport
Main types of projects	Household energy Urban (flood control) Few health with preventive measures Vector control	W&S Rural development Solid waste Hospital waste management Transport	Health Social development	Health W&S Social Funds Poverty alleviation	Air pollution management Health care waste management Vector control	Urban air Water supply Sanitation Nutrition Vector control Urban and transport Industrial pollution	Water supply Environment Urban development Solid waste Air pollution/ energy
Level of client awareness/ areas	LOW	MEDIUM Water (lack of, poor quality, waste treatment, sanitation) Urban air pollution	HIGH Air and water pollution, medical waste	MEDIUM to HIGH Water supply and sanitation	HIGH for publicized urban problems, LOW otherwise Urban air, polluted rivers and beaches, hazardous waste	LOW but growing Urban air pollution, pesticides, drinking water, sanitation, indoor air pollution	HIGH for water issues, due to health GROWING for air pollution, urban due to damages to agriculture, tourism

Responsible agency	Health ministries Maybe NGOs	No one agency with clear mandate Environment, health, housing, water resources ministries	No clear mandate Environment and health ministries	No clear mandate Environment and health ministries	Environmental authorities	No clear mandate Default is environment ministry	Environment bureaus and public health agencies; however, they are not the key agencies for Bank projects
Cost effectiveness/ benefits	Unsure	Pollution- abatement projects		Extensive for W&S projects		Cost benefits calculated for small number of projects DALYs	Generally not Some environmental health surveys (epidemiological)
Drivers of projects	Bank staff	Client awareness Media Use of EH issues to justify positive environmental impact	Client awareness Desire to join EU	Client awareness	Client counterpart interest Media	Client demand Availability of sector work Knowledge and interest of Bank staff	Client attention to urban environment problems Economic losses Human health damages Media
Difficulties	Need more awareness on client side Need low cost projects		Need indicators	No real decision-making process	Need indicators	Cross-sectoral nature of projects Few indicators Complexity	Data is anecdotal No direct health data collected Need health baselines for country
Proposed next steps	Integration of health in EA and review	Rapid health risk assessment in pilots Include in CAS Develop case studies for groundwater pollution	Need cost-benefit analysis Include in CASs	Include environmental health analysis in EA process Attention to communicable diseases	More risk assessment Incorporate occupational health and safety Improve indicators/ economic analysis	Advocacy Definitions of EH and intersectoral collaboration Pilots	Need work on air and water pollution impacts Develop low-cost tracking and monitoring for health

BOX 5.
What is an environmental health project? Highlights from Regional survey

Given the lack of agreement on a definition of environmental health, it is not surprising that it is even more difficult to define an environmental health project in the context of Bank operations. The analysis of regional responses to a questionnaire on the status of Bank environmental health work revealed that Regions adopt different approaches to defining their "environmental health" portfolio. For example, MNA provided an inventory of projects from all the relevant sectors, LAC focused on projects managed by environment and health staff, and ECA reported water supply and sanitation investments, over half of which are undertaken through Social Funds and poverty alleviation projects, rather than traditional WSS projects. South and East Asia attempted to select projects by a set of criteria they established for this purpose.

South Asia staff screened the following information for all projects for which project completion documents or PAD/ staff appraisal reports are available:

- Key strategic objectives
- Summary analysis that provides cost-benefit analysis or cost-effectiveness of the intervention
- Key performance/output /outcome indicators.

If explicit reference to environmental health, or to environment and public health, was found in at least two of these areas, then the projects were qualified as EH projects and included in the primary list. Projects that did not meet these criteria but that were likely to have some EH impact were included in the secondary list of projects (both lists were submitted).

East Asia submitted only projects in which one stated objective was to reduce human health impacts and there were indicators that relate to improving health outcomes (such as reducing BOD/COD levels in local water-bodies or reducing effluent or emissions).

More than 50 projects passed these criteria in East Asia, while only three projects were included in South Asia's primary list. Many infrastructure projects from the South Asia secondary list are designed similarly to the selected projects in East Asia, and are likely to have similar health impacts, but the South Asia projects did not have as clearly stated environmental health objectives and indicators as those in East Asia. Thus even though consistent criteria were applied in both cases, the results are not comparable due to differing interpretations of project outcomes in Bank project documentation in two neighboring Regions. Further, some projects that have health as their major justification and rationale (such as industrial pollution control or wastewater treatment) may have less impact on health than other projects that do not emphasize health issues.

The survey highlights the need for developing and consistently using indicators in project documents to allow for measuring and monitoring the impact of Bank activities on health. The survey also highlights that EH is not as much about a new category of projects as it is about a new generation of projects under existing categories that are more oriented toward outcomes and accountability for their impact.

Counterpart Agencies. All Regions identified environment and health ministries as counterparts and stressed the need to work across several agencies—water resources, agriculture, and others—depending on the nature of the particular EH activity. The principal sectors for EH are environment, health, infrastructure, urban and rural development, and, to some extent, transport and energy. However, this seems to create administrative problems for

both Bank staff and client countries. In-country, the problem arises from the lack of a mandate to a definitive agency or ministry for oversight of EH. In most Regions the default falls to the environment ministry (sometimes in conjunction with the health ministry).

Future Needs. WSS and urban projects represent the largest portion of the EH-related portfolio (and a sizable proportion of the Bank's overall lending portfolio); thus more rigorous attempts should be made to maximize health benefits through these projects. This requires more analytical work and a better understanding of specific linkages between project designs and health outcomes. Indoor air pollution has clearly emerged as an overlooked problem in a number of Regions; no projects were associated with this significant public health concern. Urban air pollution remains high and is worsening in some countries, but Bank activities on this have been minimal to date.

Benchmarking and Monitoring. Another key concern is the lack of indicators, baselines, and low-cost monitoring of EH projects or components. It is uniformly felt that increased monitoring of EH health outcomes would improve the projects. Such monitoring would also be helpful to economic analysis of EH projects, especially cost/benefit analysis, which is rarely undertaken at present. Yet the desirability of improved monitoring and evaluation of EH outcomes of infrastructure projects (such as WSS) must be weighed against the costs of conforming with these requirements. The Bank has been working on this issue in water and sanitation projects. Operational experience indicates that developing high-quality, project-level baseline information and complementing that with equally high-quality monitoring and analysis usually exceeds reasonable project budgets and client capacity. The difficulty and cost of measuring the impact of a project on health further arises from the fact that environmental factors are only one of many causes of disease, and if other causes of disease change over time, it is necessary to monitor health outcomes for a control group as well as for the group receiving the environmental intervention. This limits the possibility of making improved health outcomes a stated objective of many Bank projects that do, in fact, have an impact on health.

Regions also stressed the need for linking with other sectoral efforts in an interdisciplinary manner—nutrition and education, for example, or health issues associated with the localized impact of solid waste disposal and occupational and traffic safety.

Next Steps. Among the suggestions proposed by Regions were to:

- Improve the integration of environmental health in CASs
- Embark on new analytical and advisory activities (AAAs) in EH, while strengthening capacity to increasingly apply existing knowledge in the field
- Define the scope for intersectoral collaboration on EH work that will best meet needs (highly complex and multiple collaboration will not succeed in practice)
- Include EH analysis in the environmental assessment process
- Devise low-cost (appropriate to the level of expenditure on other issues) ways of tracking and monitoring indicators of health outcomes or "reasonable" proxy indicators (see table 3 for some examples)
- Develop case studies on specific priority issues and pilot project activities.

Chapter 9

Cooperation within the Bank

Environmental Health Work is Inherently Cross-sectoral. EH work will not mature without building ties across networks and sectors. The current organizational set-up in the Bank places strong emphasis on sectoral priorities, which sometimes makes it difficult to maintain a coherent country focus in general, let alone a focus on environmental health, which has never had an "institutional home."

Strengthen Links to Poverty Work. Health is not the only cross-cutting theme; poverty is cross-sectoral to an even greater extent. The Bank's reinforced commitment to poverty reduction and a holistic approach to achieving development outcomes have already facilitated cross-sectoral arrangements conducive to promoting environmental health. Progress is most evident in poverty work, and there is a need for closer ties between staff and thematic groups working on EH and poverty issues. This is consistent with the finding of the Poverty and Environment Team that health is the most straightforward link between poverty and environmental concerns. Still, the process of building effective multisectoral teams is at an early stage, as most Regions noted that there are few incentives for operational staff from infrastructure and energy to work across sectors.

Learn from Good Practice. A possible approach is to take stock of ongoing attempts to work across sectors and learn from successes and failures. Examples can be drawn from Africa (the work of Environmental Health and Malaria teams with Infrastructure staff), from Environment and Health, Nutrition, Population (HNP) anchors (joint work on health care waste management issues), from South Asia (Regional environmental health program proposed jointly by Health and Environment staff, Regional team composed of Energy and Environment staff), and from other Regions. These "bottom-up" activities will provide important insights on what it takes to build good cross-sectoral collaboration and what kind of incentives are needed.

Clarify and Build on the Advantages of Environmental Staff. The cross-sectoral nature of environmental health and its strong links to activities in other sectors also raise a question about the role and comparative advantage of environmental staff. These individuals make a valuable contribution in at least two areas, using their cross-sectoral skills and approach. One is to provide high-quality analytical inputs to the design of "traditional" infrastructure, energy, and health projects that will increase

the impact of these projects on health and other development outcomes. An example is the work of the EH and malaria teams in Africa (for example, an infrastructure project in Ghana that has a pilot environmental health component). The other is to promote a holistic approach to health in CASs, AAAs, and lending, which could result in a new type of development project that is "area-based" and outcome-oriented, rather than sectoral. An example could be the ongoing effort in South Asia to put together a pilot project in India aimed at complementing traditional HNP activities to increase child survival with EH activities, involving staff from the health, environment, and energy sectors.

Chapter 10

Collaboration with WHO and other External Partners

Environmental health is one of the key areas addressed by WHO. World Bank environment staff have collaborated with WHO on a number of projects, programs, and issues, but the relationship lacks consistency and a systematic approach. Collaboration was strengthened last year when a newly created WHO Cluster on Sustainable Development and Healthy Environments proposed working more closely with the Bank on environmental health. This year WHO embarked on a Strategy for Sustainable Development and Healthy Environments that is being prepared in consultation with the World Bank, especially the HNP Network, which is playing the lead role for Bank collaboration with WHO on environmental health. While collaboration with WHO on this issue is clearly necessary, the framework and agenda for such collaboration, which will benefit both institutions and their clients, are still to be developed.

Other Key Partners. Quite a few international and bilateral development and health agencies work on environmental health issues in developing countries. The list includes the United Nation Children's Fund (UNICEF) and other U.N. agencies, the Centers for Disease Control and Prevention in the United States, the U.S. Agency for International Development, and the U.S. Environmental Protection Agency. UNICEF and the U.N. Development Programme, for example, often play a more significant role in improving environmental health (through WSS, improved stoves, or other rural development programs) than WHO, which works predominantly with national health agencies. Local agencies, programs, nongovernmental organizations (NGOs), and community groups are also involved in activities related to environmental health. NGOs play an essential role in many EH activities, and should be among the Bank's major partners.

Does the World Bank Have a Comparative Advantage? Bank staff in both health and environment consulted on this issue answered positively. They pointed out that the World Bank is in a unique position to have a strong impact on environmental health, since it is involved in dialogue and project development in all the sectors crucial for achieving such an impact. The Bank's comparative advantage in addressing EH risks is its ability to design and implement multidisciplinary projects with the breadth required to have an impact on health. Environment, infrastructure, and energy interventions are usually not considered to be

key determinants of human health by governments and health ministries, which tend to think of health investments in terms of number of hospital beds and doctors per person. The World Bank has tremendous potential to promote a holistic approach to health and help governments develop the capacity required to implement such an approach.

Chapter 11

Health and the New Environment Strategy

The World Bank's new Environment Strategy pays serious attention to environmental health by promoting three major types of activities:

- Improving knowledge of EH problems and developing an appropriate response that takes into account institutional, financial, and social constraints; launching advocacy and dissemination activities; and strengthening collaboration with strategic partners such as WHO, other U.N. agencies, and bilateral organizations with experience in environmental health.
- Integrating critical EH issues into the operations of relevant sectors—such as health considerations and hygiene promotion in WSS projects, indoor air pollution in energy operations, urban air pollution in transport projects and city development strategies, and fuel quality in petroleum-sector restructuring work.
- Adopting a holistic approach to development impacts, which focuses on tangible improvements in human health and facilitates cross-sectoral collaboration inside the Bank and in client countries to achieve these improvements.

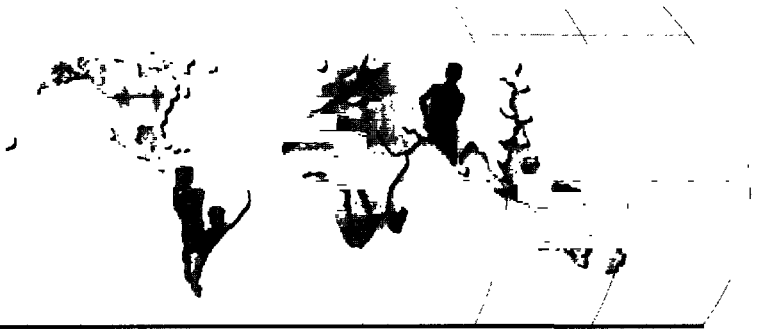
The new strategy proposes to undertake these activities by:

- Incorporating environmental health issues into CASs
- Promoting a Bank-wide set of cross-sectoral best practices and guidelines
- Integrating environmental health analysis into the Environmental Assessment process (based on draft *Environmental Health Assessment Guidelines* prepared by the Africa EH team)
- Facilitating "targeted collaboration" among health and other ministries/agencies in client countries (through joint missions and enhanced sector dialogue on EH)
- Launching AAA and project activities on indoor air pollution, which appears to have been overlooked in the Bank's portfolio despite the high priority it receives with the poorest countries
- Undertaking basic health surveys as part of preparation for projects in which EH is a primary justification (such as air pollution control, sanitation, and wastewater), with further monitoring
- Improving understanding of the linkages between health outcomes and development activities in infrastructure, energy, and the

urban and rural sectors, including new concerns such as climate change
- Devising better estimates of the burden of disease due to environmental causes and the cost-effectiveness of environmental preventative interventions
- Developing measurable indicators of health impacts for non-health-sector projects that are simple, low-cost, reliable and accurate
- Working more closely with HNP staff and the Public Health Thematic Group, particularly in promoting a holistic approach to health and addressing health and poverty linkages
- Establishing an Environmental Health cluster of Bank staff from various sectors and units to foster exchange of information, ideas, and experience
- Promoting information-sharing and more effective collaboration with WHO and other international and bilateral institutions working on EH issues
- Dissemination and training.

Process

The preparation of this paper involved a consultative process across Regions, networks, and sectors. The work was undertaken in close collaboration with HNP staff and with the active involvement of each Region. Consultations also involved some staff from energy and infrastructure groups, although these were less elaborate due to the lack of time (and probably interest, on their part). A Bank-wide workshop on environmental health was sponsored jointly with HNP staff on September 9, 1999, followed by a session on these issues during the Environment Forum in March 2000 (with participation from HNP and FPSI staff). These discussions and other communications with Bank staff indicated a growing interest in environmental health, facilitated by a sharpened focus on poverty and outcome-oriented activities. Since then, EH issues were discussed at the HNP Sector Board and HD week, and have been included in the Bank-wide sectoral strategies for HNP, water and sanitation, energy, and transport.



Annex A

Definitions of Environmental Health

World Health Organization

By adopting the principles of the Rio Declaration and Agenda 21 as the route to sustainable development in the twenty-first century, the world's leaders recognized the importance of investing in improvements to people's health and their environment. Humans experience the environment in which they live as an assemblage of physical, chemical, biological, social, cultural, and economic conditions that differ according to the local geography, infrastructure, season, time of day, and activity undertaken.

The environmental threats to human health can be divided into "traditional hazards" associated with lack of development, and "modern hazards" associated with unsustainable development.

Traditional hazards related to poverty and "insufficient" development include:

- Lack of access to safe drinking water
- Inadequate basic sanitation in the household and the community
- Food contamination with pathogens
- Indoor air pollution from cooking and heating using coal or biomass fuel
- Inadequate solid waste disposal
- Occupational injury hazards in agriculture and cottage industries
- Natural disasters, including floods, droughts, and earthquakes.

Modern environmental hazards to humans are related to "development" that lacks health and environmental safeguards, and to the unsustainable consumption of natural resources, including:

- Water pollution from populated areas, industry, and intensive agriculture
- Urban air pollution from motor cars, coal power stations, and industry
- Solid and hazardous waste accumulation
- Chemical and radiation hazards following introduction of industrial and agricultural technologies
- Emerging and re-emerging infectious disease hazards
- Deforestation, land degradation, and other major ecological change at local and regional levels
- Climate change, stratospheric ozone depletion, and transboundary pollution.

The main functions of the World Health Organization (WHO) in this area are to address

risks to health stemming from these hazards. Environmental health risk assessment and research form the basis of all activities and produce the evidence base for national legislation and standard-setting, a process that is supported through technical cooperation with national health and environment authorities. WHO also undertakes and supports analysis of the situation and trends and supports development of international initiatives to combat transboundary hazards.

World Bank Africa Region Environmental Health and Malaria Teams

Environmental health relates to human activity or environmental factors that have an impact on socioeconomic and environmental conditions with the potential to increase human disease, injury, and death, especially among vulnerable groups, mainly the poor, women, and children under five.

Environmental health aims to prevent health risks through control of human exposure to: (a) biological agents, such as bacteria, viruses, and parasites; (b) chemical agents, such as heavy metals, particulate matter, pesticides, and fertilizers; (c) disease vectors, such as mosquitoes and snails; and (d) physical and safety hazards, such as traffic accidents, fire, extremes of heat and cold, noise, and radiation. Human exposure pathways are air, water, land, and food.

Environmental health strives to consider individual problems in as broad a context as possible from which to set policies and develop reasonably practicable and cost-effective preventive remedial measures. The broad context should include the driving socioeconomic determinants leading to physical and mental stress, such as:

- Population movements (population growth, rural-to-urban migration, resettlement, and so forth)
- General lack of access to basic services (transport, water, sanitation, energy)
- Inordinate time spent compensating for lack of basic services (hours devoted to fetching water and household fuels or to getting to school, work, or health services).

Environmental health preventive remedial measures complement health care system interventions to optimize health benefits. The broad context also allows for more efficient cross-sectoral intervention, such as addressing the risk of sexually transmitted diseases in infrastructure projects in cases where truckers and work crews are at risk of acquiring or spreading the disease.

Annex B

Estimating the Burden of Disease Related to Environmental Risks

Diseases caused by lack of access to clean water/sanitation and vector control

Amoebiasis	Japanese encephalitis[a]
Cholera (*Vibrio cholerae*)	Leishmaniasis[a]
Conjunctivitis	Malaria[a]
Dengue[a]	Onchocerciasis (river blindness)[a]
Diarrhea (from *Campylobacter jejuni*, cryptosporidium, *Giardia lamblia*, *Escherichia coli*, *Salmonella* spp., *Yersinia*, and other agents)	Poliomyelitis
	Protein-energy malnutrition
	Rotavirus
Dysentery (includes *Shigella*, Ameobiasis)	Scabies
Filariasis[a]	Schistosomiasis[a]
Giardiasis	Trachoma
Guinea worm[a]	Trypanosomiasis (Chagas' disease)[b]
Helicobacter Pylori	Typhoid and Paratyphoid
Helminths (roundworm, whipworm, threadworm, hydatid disease)	Well's disease (Leptospirosis)[c]
	Yellow fever[a]
Hepatitis A, E	

a. Tropical cluster diseases in which water or excreta are a medium for part of the vector's life cycle. These vectors (mosquitoes and black flies) are affected by water's quantity, exposure, temperature, pH, salinity, and other features; hence, both positive and negative effects from infrastructure changes may occur, depending on the impact of the intervention on the vector's habitat and nutrients and those of any competitive species.
b. Transmitted by insects, people, or animals to insects or people; Latin America. Related to housing conditions.
c. Caused by contact with rodent urine; infects animal to person, worldwide. Related to housing conditions.

The burden of disease due to lack of water and sanitation was calculated using data from the *Global Burden of Disease* by disease, causes, and regions, and the assumptions about the contributions from specific diseases indicated in Table B.1:

Indoor Air Pollution

Estimates of the burden of ill health caused by indoor air pollution are based on a series of studies by Kirk Smith and various colleagues (Smith 1998, 1999; Smith and Mehta 2000, Reddy, Williams, and Johansson 1997). The most detailed analysis was carried out for India using census data for 1991, and yielded a range of 410,000–560,000 premature deaths each year as a result of exposure to indoor air pollution, with a best estimate of 500,000. A separate study of mortality among children under the age of five, using data from the 1992–93 Indian National Family Health

TABLE B.1 Burden of specific diseases

Diarrheal diseases: 80 percent
Hepatitis: 30 percent
H. Pylori: 20 percent
Trachoma: 25 percent
Intestinal helminths: 70 percent

Note: Malaria—taken directly from Murray and Lopez 1996.

Survey, produced estimates of the excess risk of mortality associated with the use of solid or biomass cooking fuels of 45 percent for rural households and 18 percent for urban households (Hughes, Lvovsky and Dunleavy, 2001). Furthermore, the Murray and Lopez (1996) study of the burden of ill health suggests that the number of deaths of adult women in India each year due to respiratory diseases represents 15–20 percent of the number of deaths of children under five from these diseases.

Combining these conservative end of these estimates with data on the number of households using solid or biomass cooking fuels and with mortality rates produced estimates of the number of premature deaths due to indoor air pollution for 1991 of 460,00–520,000, which is very close to Smith's figures. To obtain an estimate of the total number of disability-adjusted life years (DALYs) lost as a result of indoor air pollution, it was assumed that the death of a child under the age of five results, on average, in the loss of 30 DALYs, while the death of an adult female (most of whom are over the age of 45), results in an average loss of 10 DALYs. Finally, it is necessary to consider non-fatal illnesses resulting from exposure to indoor air pollution. Again, based on the Murray and Lopez data, it was assumed that for each death of a child under the age of five, a total of eight DALYs are lost due to other respiratory diseases.

Since no comparably detailed studies have been made in other regions of the world, the mortality-hazard approach was used to generate projections of the burden of ill health for India as well as for the rest of the world. It was, however, necessary to make certain adjustments for the specific circumstances of some regions. The final set of hazard parameters is shown in Table B.2.

Various commentators have suggested that the hazard associated with solid or biomass cooking fuels in Africa is lower than that of India, because such fuels are usually used for outdoor, not indoor, cooking. In the absence

TABLE B.2 Hazard rates due to exposure to indoor air pollution

Region	*Excess hazard for under-5 mortality associated with use of a dirty cooking fuel (percent)*		*Adult female deaths as share of under-5 deaths (percent)*
	Urban	*Rural*	
China	15	35	40
East Asia and Pacific	15	35	15
Established market economies	0	0	0
Former socialist economies	7.5	17.5	1
India	15	35	1
Latin America and Caribbean	7.5	17.5	15
Middle East	7.5	17.5	15
South Asia	15	35	15
Sub-Saharan Africa	7.5	17.5	15

of clear epidemiological evidence, hazard rates for the Sub-Saharan Africa, Latin America and Caribbean, and Middle East regions have been assumed to be one-half of the equivalent values. The resulting estimates of the burden of ill health for Africa, where levels of urban air pollution contributing to excess mortality and disease from respiratory causes are relatively low, are broadly consistent with the Murray and Lopez burden of disease estimates.[3]

The total number of deaths attributed to indoor air pollution using this approach is nearly 1.7 million per year, which is also broadly consistent with (although somewhat lower than) available global estimates. For example, WHO (1997) estimates 2.8 million yearly deaths, and Smith (1999) estimates 2 million deaths.

China faces a somewhat different problem. One study suggested that more than 700,000 premature deaths occur there per year as a result of household use of solid fuel. The composition of these deaths differed from the India estimates; a higher share of chronic respiratory disease and cancers, both of which affect adults rather than young children, were found. However, it is very difficult to separate the effects of indoor and outdoor air pollution because the widespread use of solid fuels in China is the source of particularly high levels of urban outdoor air pollution in many localities. Applying the Indian parameters to the Chinese data yields an estimate of only about 195,000 premature deaths due to indoor air pollution in 1995. This low estimate is, in part, a consequence of the rather low mortality rate for children under five in China—less than one-half of the equivalent value for India. Even so, prolonged exposure to indoor air pollution will be reflected in higher levels of respiratory disease later in life, so that the ratio of adult female deaths to under-five deaths in China was adjusted upwards to 40 percent, to allow both for this effect and for the different age structure of the population. Nonetheless, the resulting estimate of the total number of deaths due to indoor air pollution—235,000 in 1995—is only one-third of the estimates in the previous study. The figure of 700,000 premature deaths, on the other hand, is entirely consistent with our estimate of the total burden of disease caused by indoor and outdoor air pollution combined.

Comparisons of patterns of fuel use across countries suggest that there is no consistent decrease in the proportion of the population relying on solid and biomass fuels for cooking until per capita gross national product (GNP) exceeds US$500 per person (at 1995 prices). Hence the average burden of ill health per person associated with indoor air pollution for each country with levels of GNP per person of less than US$500 in 1995 was assumed to remain constant at its 1995 level per person until GNP per person reaches that threshold. After that, the average burden of ill health per person was assumed to decline linearly to zero over 50 years. For countries where GNP per person exceeded US$500 in 1995, the assumptions concerning the average burden of ill health per person due to indoor air pollution were:

- GNP/person between US$500 and US$1,000, declines linearly to zero over 40 years
- GNP/person between US$1,000 and US$1,500, declines linearly to zero over 30 years
- GNP/person greater than US$1,500, declines linearly to zero over 20 years.

Urban (Outdoor) Air Pollution

The methods used to estimate the costs of local outdoor exposure are based on the dose-response and valuation assumptions, which underpin the analysis of the study of the social costs of fuel use cited above (Lvovsky and others 2000). In that case, however, average levels of exposure to particulates and other urban air pollutants were linked to the use of fossil fuels, an approach that is not feasible in the present context. Hence this study makes use of data on ambient air quality from a large sample of cities around the world, obtained from a wide variety of sources.[4] Both its quality and coverage are uneven, but it represents the most comprehensive information about urban air quality that has been analyzed to date, covering 379 cities and metropolitan regions.

Relative to urban populations, the coverage of the sample is reasonable for the EME and FSE regions, as well as for China and India. Data coverage is relatively poor for Africa, and only somewhat better for the LAC region. For the most part, availability of data is correlated with an awareness that urban air pollution is a significant problem, so that the limited data for Africa are reflected in low estimates of the costs of urban pollution in Africa today. Based on anecdotal evidence, this is probably a reasonable assessment, but it does pose the question of what will happen as urban populations and incomes increase.

Estimates of the costs of damage caused by urban air pollution are based primarily on average exposure to PM_{10}. However, much of the data refer to measurements of TSP, which were converted to PM_{10} equivalents using a conversion coefficient of 1 $\mu g/m^3$ of TSP = 0.55 $\mu g/m^3$ of PM_{10}. This conversion coefficient is almost certainly too low for urban areas in the FSE region and China, where climatic conditions mean that urban air pollution is dominated by the burning of coal and other fossil fuels for heating. However, it is reasonable for India and other countries with warmer climates, where natural sources of dust and transport are the major contributors to monitored levels of TSP. The use of a relatively low conversion coefficient implies that the costs of urban air pollution are probably significantly underestimated, particularly for the FSE region and China. Where available, data on average ambient levels of sulfur dioxide and nitrogen dioxide were also used in the estimation, although they account for a small fraction of the overall burden of disease associated with urban air pollution.

Most epidemiological evidence suggests that even very low levels of exposure to PM_{10}—and, even more, to fine particulates or PM2.5—are associated with an excess burden of mortality and disease. Still, it is unrealistic to assume that it would be possible to reduce average exposure to PM_{10} to close to zero. Hence the estimation is based on a threshold of 20 $\mu g/m^3$ for exposure to PM_{10} and SO_2, and 40 $\mu g/m^3$ for NO_2. These thresholds are consistent with the ambient air quality standards for 2010 adopted recently by the United States and the European Union. There is also uncertainty about whether estimated dose-response relationships can be extrapolated to very high levels of average exposure. This is a matter of particular importance for China, where many cities have estimated average levels of PM_{10} in excess of 200 $\mu g/m^3$. To reflect this uncertainty, the analysis assumes an upper truncation of exposure at 200 $\mu g/m^3$, which, again, implies that the burden of urban air pollution in China has been underestimated.

Since the data cover only a sample of the urban population in each country and not all countries are represented, it was necessary to extrapolate the sample data to estimate average levels of exposure for all urban populations. This was accomplished by using the sample to calculate population-weighted average levels of the burden of ill health associated with urban air pollution—measured in premature deaths and DALYs lost per 1,000 residents—for the cities in each country covered. For each country it was assumed that estimates of the average burden could be applied to the entire urban population of each country. This assumption might be challenged on the grounds that urban air pollution in medium-sized and large cities is not representative of the pattern for all urban areas. Such an assertion is usually predicated on the belief that large cities are more polluted than smaller urban areas, but this is not supported by the available data. In countries such as the United States, Russia, and China, where data are relatively plentiful, urban air quality tends to be worst in medium-sized cities with populations in the range of 100,000–500,000. Smaller towns and cities account for a modest share of total urban population, making it likely that reliance on a sample biased toward cities with populations of more than 500,000 will tend to underestimate, rather than overestimate, the overall burden of ill health due to urban air pollution. For countries for which no data were available, it was assumed that the average burden of disease per 1,000 urban residents was equal to the average for the relevant region.

To extrapolate the burden of urban air pollution over time, the analysis assumed that the burden of ill health increases in line with the total level of urban incomes, up to the threshold of a GNP per person of US$1,000. This is equivalent to assuming that in countries with GNP per person below US$1,000, average levels of urban air pollution will increase with income while the average number of people exposed will increase with the urban population. Global experience over the last 50 years suggests that this is a reasonable approximation of what has happened as a result of rapid urban and industrial growth. It could be argued that this method of projection will overstate the possible deterioration of urban air quality in China. This may be true for the largest metropolitan areas, but concern about future urban air quality in China should focus on smaller, more rapidly growing cities, where air pollution is likely to worsen. Since the overall approach tends to underestimate the burden of urban air pollution in China, no special adjustments were made in projecting the estimates forward in time. Comparison of the projections for China with those generated by a different approach for the period to 2020 suggests that the estimates of the cost of urban air pollution used here are probably on the low side.[5]

Analysis of patterns of urban air pollution across countries suggests that average levels of particulates and sulfur dioxide in urban areas tend to rise with income up to a level of GNP per capita of US$1,000-$2,000 at 1995 prices.[6] Hence the average burden of ill health per person associated with urban air pollution for each country with levels of GNP per person lower than US$1,000 in 1995 was assumed to remain constant at its 1995 level per person until per capita GNP reaches that threshold. After that the average burden of ill health per person was assumed to decline linearly to zero over 100 years, reflecting the rate at which urban air pollution has been

reduced in medium- and high-income countries. For countries whose GNP per capita exceeded US$1,000 in 1995, the assumptions concerning the average burden of ill-health per person due to indoor air pollution were:

- GNP/person between $US1,000 and US$2,000, declines linearly to zero over 80 years
- GNP/person between $US2,000 and US$4,000, declines linearly to zero over 60 years
- GNP/person between $US4,000 and US$8,000, declines linearly to zero over 40 years
- GNP/person between $US8,000 and US$16,000, declines linearly to zero over 30 years
- GNP/person greater than US$16,000, declines linearly to zero over 20 years.

Agro-industrial Pollution

The most common health symptoms reported from chronic, low-dose exposure to toxic chemicals include vomiting, vertigo, nausea, dizziness, anxiety, and headaches.[7] Chronic exposure at high levels is manifested by depression and cytogenetic effects, and can lead to an increased hazard of certain cancers, namely gastric, renal, skin, and blood.[8] Poisoning is the most often cited health consequence of pesticide use. Skin and eye contact during application may lead to neurological or immunological reactions ranging from irritation to serious complications requiring immediate medical assistance. Usually, such incidences arise from improper application or container disposal.

In addition to occupational hazards, toxic exposure to pesticides is believed to result under particular conditions, including the repeated application of a persistent compound over a period of years near to drinking-water sources. Even under these conditions, however, at levels several times the quality standards, the resulting buildup has rarely been linked with observed or expected health problems.

Table B.3 presents estimates of the burden of disease potentially associated with acute and chronic exposure to pesticides and non-point-source industrial contaminants in the environment. The estimates are based on conservative (5 percent of the total burden) and liberal (20 percent of the total burden) boundaries, related to the summation of over 15 disease sequelae.[9] Liberal estimates are used in the table.

TABLE B.3 Burden of disease associated with agro-chemical exposure

Region	*Estimates*	*Agro-industrial associated DALYs*	*As share of all DALYs (percent)*
Established market economies	Conservative	619	0.6
	Liberal	2,477	2.5
Sub-Saharan Africa	Conservative	677	0.2
	Liberal	2,708	0.9
India	Conservative	886	0.3
	Liberal	3,543	1.2
Latin America and Caribbean	Conservative	441	0.4
	Liberal	1,763	1.8
Former socialist economies of Europe	Conservative	320	0.5
	Liberal	1,279	2.1

Source: Murray and Lopez 1996.

Annex C

Africa — Burden of Disease from Environmental Causes and Intervention Measures[10]

The objective of the exercise described below is to determine the extent to which interventions outside the health care system may be beneficial to the health of populations in Africa.

The burden of disease due to environmental factors is extremely important in public health, since certain environmental factors are amenable to specific remedial measures—most of which lie outside the health care system. However, estimates are difficult because of the paucity of information about disease etiology. Nevertheless, laboratory and epidemiological research has attempted to identify risk factors in disease causation that could be explored for this purpose. The estimates presented in Tables C.1 and C.2 are largely guided by such studies, and primarily based on Smith, Corvalan, and Kjellstrom (1999), which provides estimates of environmentally attributable percentages.

Methodology

The methodology involves listing the different environmentally related diseases and the risks and percentages that may be attributable to environmental factors. The *Global Burden of Disease* study by Murray and Lopez (1996) was used as the basis for the calculations primarily

TABLE C.1 Burden of disease relieved in Sub-Saharan Africa (SSA), by remedial measure (worksheet estimated from 1990 DALYs)

Remedial measures (diseases potentially reduced by remedial measures)	*Range of DALYs potentially reduced by the remedial measures (percent)*	
	Low	*High*
Remedial measures outside health care system		
Improved housing and air pollution abatement	5.4	7.9
Improved water supply, sanitation, and waste management	8.9	10.0
Vector control, sanitation, and drainage	7.7	9.95
Road, workplace, and housing design	0.67	0.80
Percent of total SSA DALYs from remedial measures outside the health care system	22.7	28.7
Remedial measures through health care and health education		
Health care/education-type remedial measures	22.5	28
Other types of remedial measures		
Percent of SSA DALYs from other diseases	54.7	43.2

TABLE C.2 Burden of disease relieved in Sub-Saharan Africa (SSA), by remedial measures in DALY (estimated from 1990 DALYs)

Remedial measures (Diseases affected by remedial measures)	*Range of DALYs potentially reduced by the remedial measures*	
	Low	*High*
Remedial measures outside health care system[a]		
Improved housing and air pollution abatement		
Respiratory diseases [b]	15,345	22,436
Circulatory system diseases [c]	557	696
Eye diseases [d]	182	215
Subtotal	16,085	23,347
Improved water, sanitation, and waste management		
Diarrheal diseases	25,701	28,913
Intestinal worm infections	396	445
Eye diseases [e]	249	284
Subtotal	26,345	29,642
Vector control, sanitation, and drainage		
Tropical disease cluster [f]	3,889	5,000
Malaria	18,962	24,380
Dengue	15	19
Subtotal	22,866	29,399
Road, workplace, and housing design		
Road traffic accidents	1,432	1,719
Falls	532	638
Drownings and fires	n.a.	n.a.
Subtotal	1,964	2,357
Total SSA DALYs from remedial measures outside the health care system	67,260	84,745
Health care/education-type remedial measures		
Childhood diseases cluster [g]	30,445	n.a.
Gastrointestinal diseases [h]	3,262	6,524
Respiratory diseases [b]	22,301	28,991
Circulatory system diseases [c]	6,266	6,405
Tropical diseases cluster, malaria, and dengue	3,267	9,800
Eye diseases [e]	858	891
Subtotal	66,339	83,056
SSA DALYs from other diseases	161,695	127,493
Grand total of SSA DALYs	295,294	

Notes:

a. Includes, for example, improvements in water supply, sanitation, waste management, drainage, transportation, housing, household fuel efficiency.
b. Acute respiratory infections, chronic obstructive pulmonary disease, asthma, trachea, bronchus and lung cancers.
c. Heart disease and stroke.
d. Cataracts and trachoma.
e. Trachoma.
f. Trypanosomiasis, Chagas disease, schistosomiasis, leishmaniasis, lymphatic filariasis, onchocerciasis.
g. Pertussis, poliomyelitis, diphtheria, measles, tetanus.
h. Diarrheal diseases and intestinal nematode infections.

because it reflects both disability and death. The list of diseases was also taken from this source. Estimates for the region were also guided by the prevalence of risk factors, such as the use of traditional cooking fuel in Africa and smoking rates. Air pollution and housing-related diseases are used as an example for the methodology. This methodology of estimation was used to obtain "guesstimates" for the remaining environmentally related diseases. A range is shown for each disease/remedial measure category to show conservative and liberal estimates.

Based on literature reviewed, the following air pollution-related diseases are listed: acute respiratory infections; chronic obstructive pulmonary disease; asthma; trachea, bronchus, and lung cancer; tuberculosis; ischemic heart disease; cerebrovascular disease; trachoma; and cataracts.

A listing of relative risks and percentages attributable to both indoor and outdoor air pollution was compiled, based on several studies. This list was then compared with the approximations reached by Smith and others. Sources of air pollution were likewise listed.

By gross examination of the list above, and in comparison with Smith's figures, lower and upper guesstimates of percent attributable were reached. World and African DALYs of the aforementioned diseases were then listed. The lower and upper guesstimates of the percent attributable were multiplied by the DALYs from each disease. The products derived represent the number of DALYs attributable to air pollution. A range of DALY guesstimates was produced for each disease.

Totaling the DALY guesstimates of the diseases gives the total DALYs attributable to air pollution, and dividing this by the total DALYs for the region or world yields the percent guesstimate of regional or world DALYs attributable to air pollution.

Separate guessstimates for indoor and outdoor air pollution were reached similarly for the world DALYs. For the Africa Region, in order to separate the contribution of indoor and outdoor air pollution, the levels of industrialization, transportation, use of traditional cooking fuel, and smoking rates were examined. Guided by these figures, allocations of percentages attributable to indoor and outdoor pollution were made. The resulting guesstimates were interpreted as the DALYs that could be mediated by improved housing and air pollution abatement, including a change in cooking/heating/lighting fuel.

For DALYs mediated by other interventions, such as water supply, sanitation, vector control, and waste management, a similar method for guesstimating was used. Using the environmental fractions of Smith, Corvalan and Kjellstrom (1999), guesstimates for diseases mediated by other interventions were computed.

Diseases related to *water, sanitation, and waste management:*

- Diarrheal diseases
- Intestinal nematode infections
- Trachoma
- Other gastrointestinal diseases, such as hepatitis and ulcers

Diseases related to *vector control, sanitation, and drainage:*

- Tropical disease cluster

- Malaria
- Dengue

Diseases related to *road, workplace, and housing design:*

- Road traffic accidents
- Falls
- Drownings
- Fires

For DALYs mediated by the health care system and health education, the childhood cluster was assumed to be alleviated 100 percent by the immunization program (Smith, Corvalan, and Kjellstrom 1999). For other diseases, the complementary value of the environmental portion was assumed to be the value that could be mediated by health care and health education, and was applied to the DALYs accordingly.

Tables A3.3-A3.5 illustrate the methodology employed, using housing- and air pollution-related diseases as examples.

TABLE C.3 Lower and higher percentage guesstimates for each disease

	Percent attributable	
Africa: Air pollution-related diseases(in/outdoor)	*(lower)*	*(higher)*
Acute respiratory infections	0.4	0.6
Ischemic heart disease	0.08	0.1
Chronic obstructive pulmonary disease	0.33	0.5
Asthma	0.2	0.25
Trachea, bronchus, and lung cancer	0.2	0.25
Cerebrovascular diseases	0.08	0.1
Tuberculosis	0.2	0.25
Trachoma	0.17	0.2
Cataract	0.17	0.2

TABLE C.4 DALYs guesstimates attributable to air pollution

Africa: Air pollution-related diseases (in/outdoor)	*Percent attribu-table (lower)*	*Percent Attribu-table (higher)*	*Total DALYs*	*DALYs attribu-table (lower estimate)*	*DALYs attribu-table (higher estimate)*
Acute respiratory infections	0.4	0.6	30,941	12,376.4	18,564.6
Ischemic heart disease	0.08	0.1	2,367	189.36	236.7
Chronic obstructive pulmonary disease	0.33	0.5	1,826	602.58	913
Asthma	0.2	0.25	1,426	285.2	356.5
Trachea, bronchus, and lung cancer	0.2	0.25	225	45	56.25
Cerebrovascular diseases	0.08	0.1	4,595	367.6	459.5
Tuberculosis	0.2	0.25	10,184	2,036.8	2,546
Trachoma	0.17	0.2	262	44.54	52.4
Cataract	0.17	0.2	811	137.87	162.2
			52,637	16,085.3	23,347.1

TABLE C.5 Guesstimates for indoor and outdoor air pollution

Africa: Air pollution-related diseases(in/outdoor)	*Outdoor-% attributable*	*Indoor-% attributable*	*DALYs-attr. (higher) OUT*	*DALYs-attr. (higher) IN*
Acute respiratory infections	0.1	0.9	1,856.46	16,708.14
Ischemic heart disease	0.6	0.4	142.02	94.68
Chronic obstructive pulmonary disease	0.7	0.3	639.1	273.9
Asthma	0.5	0.5	178.25	178.25
Trachea, bronchus, and lung cancer	0.7	0.3	39.375	16.875
Cerebrovascular diseases	0.4	0.6	183.8	275.7
Tuberculosis	0.3	0.7	763.8	1,782.2
Trachoma	0.1	0.9	5.24	47.16
Cataract	0.1	0.9	16.22	145.98
			3,824.26	19,522.8

Annex D

Cost-Effectiveness of Environmental Health Interventions

This annex compares the cost-effectiveness of a range of environmental health (EH) interventions. Knowledge in this area can be used to set priorities for investment and to improve budget-allocation decisions. The analysis identified considerable differences in both the cost and effectiveness of different EH interventions. Some interventions are "win-win" (such as installing electronic ignition systems in two-stroke vehicles in Delhi) and therefore can be justified on economic criteria alone. In general, interventions that reduce indoor air pollution, improve water supply and sanitation, and prevent malaria appear to be more cost-effective than those that reduce outdoor air pollution.

Analysis

The analysis identified marked differences in both the cost and effectiveness of various health interventions. Figure 1 presents both the cost-effectiveness (in US$ per DALY) and gains in DALYs for 29 different interventions that reduce ambient concentrations of air pollution in three cities. Lower points represent interventions that are more cost-effective, and points farther to the right represent interventions that produce larger numbers of DALYs averted.

Some interventions, such as installing electronic ignition systems in two-stroke vehicles in Delhi and replacing gasoline with LPG in trucks in Mexico City, can be characterized as "win-win," in that they result in both cost savings and DALYs averted. Other interventions, such as re-engining light diesel buses in Mexico City to 1991 U.S. emissions standards, produce large, positive health gains at a cost of about US$300 per DALY averted. Air pollution interventions can also be a very expensive way of averting DALYs. (See Table D.1.) For example, applying the low-emission vehicle standards adopted in California to passenger cars in Mexico City costs over US$70,000 per DALY averted.

The variation in the cost-effectiveness ratio of different interventions is a function of local conditions. Costs are influenced by the presence of other interventions (through joint sharing of costs) and by local market distortions. Effectiveness depends on the size and composition of the affected population, and the degree to which the intervention penetrates or covers a population. For example, interventions that reduce emissions from two-stroke engine vehicles in Delhi tend to be very cost-effective because they have a relatively low cost in a high-density urban environment.

TABLE D.1 Summary of air pollution cost-effectiveness studies

Intervention	*Total cost (1997 US$)*	*Total DALYs averted*	*Delhi (1997 US$)*	*Santiago (1997 US$)*	*Mexico City (1997 US$)*
Modern carburetor (entire fleet)	(2.93)	1,148	(2,553)		
New 4-stroke (10 percent of fleet)	(2.73)	1,926	(1,417)		
Convert to CNG vehicle (30 percent of fleet)	(6.22)	5,260	(1,182)		
Engine rebuild (30 percent fleet)	(0.84)	2,077	(404)		
Electronic ignition (entire fleet)	(1.64)	4,604	(356)		
Fuel-oil premix (30 percent fleet)	(0.54)	2,077	(260)		
PLS with smokeless oil (50 percent fleet)	(1.39)	8,772	(158)		
Periodic I&M (entire fleet)	1.26	4,604	274		
Phaseout (17 percent of fleet)	3.05	3,839	794		
Gasoline trucks: LPG	(55.28)	2,682			(20,614)
Gasoline trucks: CNG	(29.93)	2,366			(12,652)
Minibus retrofit/replace CNG	(22.94)	1,843			(12,445)
Diesel light bus –re-engine US '91	5.38	17,899			300
Diesel light bus: Re-engine CA '88	7.54	11,026			684
Minibus: Mex 92 standards	26.82	3,203			8,372
Gasoline trucks: Mex 93 standard	36.77	2,638			13,941
Minibus re-engine	34.51	1,843			18,720
New Taxi: Mex 93	51.28	2,446			20,960
New Taxi: Tier 1	56.41	2,446			23,060
Gasoline trucks: Re-engine	78.54	2,366			33,200
New Taxi: LEV	81.64	2,446			33,371
Passemger car: Mex 93	120.07	3,543			33,889
Passemger car: Tier 1	158.17	3,543			44,642
Passemger car: Mex 91	98.05	1,993			49,204
Gasoline trucks: Replace	139.10	2,366			58,802
Passemger car: LEV	265.55	3,543			74,946
Wood stoves to distillate fuel oil	13.08	4,209		3,108	
Diesel truck control (2)	4.76	793		5,997	
Compressed natural gas for buses	35.67	5,128		6,957	
Gasoline vehicle standards (1)	16.65	1,080		15,415	

While the purpose of the analysis is to facilitate the systematic comparison of interventions, a note of caution is urged in making cross-country comparisons. Costs are assessed using local prices. Thus if the price of gasoline is subsidized in one country, the cost of a gasoline-intensive intervention will be lower there than in a country where there is no subsidy. Ideally, border prices should be used to make cross-country comparison correctly.

These results for air pollution can also be compared with the cost-effectiveness of other EH interventions. Reducing indoor air pollution through improved stoves in India costs from US$50 to US$100 per DALY averted. Water and sanitation interventions range from US$20 to US$120 per DALY averted. Malaria-prevention interventions for children range from US$5 to US$400 per DALY averted (see, for example, Binka 1997). "Win-win" interventions aside, reducing indoor air pollution, improving water supply and sanitation, and preventing malaria all appear to be more cost-effective than reducing outdoor air pollution.

Methods

Different environmental health interventions can be compared by what it costs to achieve one additional year of healthy life. This annex measures cost-effectiveness as the ratio of U.S. dollars over DALYs. "Costs" are the annualized cost of an intervention, and "effectiveness" is the annual number of DALYs avoided due to an intervention. This measure does not

include non-health burdens, such as income lost due to illness.

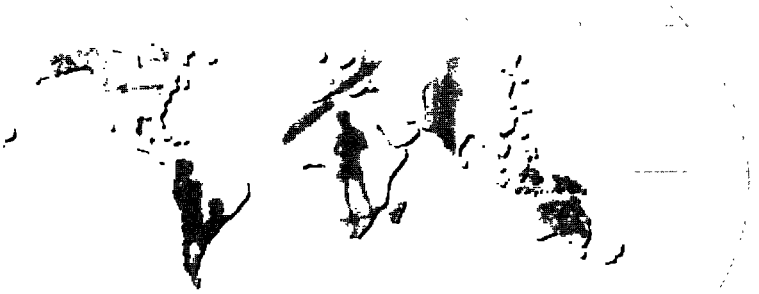
Whenever possible, the analysis relies on dose-response functions to quantify the impact of EH interventions in terms of DALYs. For air pollution, estimates of the annual health effect associated with a unit change in PM10 are taken from Ostro (1994). For water supply and sanitation, the expected reduction in morbidity and mortality is detailed in Esrey et al (1991).

Data

The data are drawn from a review of published and unpublished studies. To facilitate cross-study comparisons, attempts were made to identify studies that provide both cost and effect information and use similar analytical methods (such as the same discount rate).

Unfortunately, relatively little information is available on cost. While costs associated with specific air-pollution interventions are available, costs of water supply and sanitation interventions are not.

Although comparing costs and effects for a wide range of EH interventions is desirable, it does not make sense to compare estimates that may not be reliable. The data, therefore, are taken only from studies that contain sufficient information on both cost and effect to understand how the estimates were derived. Unfortunately, sufficient information is not available for many interventions, particularly in the water supply and sanitation sector, making it is impossible to calculate the cost-effectiveness ratio. The data presented here make up only a very small proportion of the many possible interventions.



Annex E

Analysis of Bank Documentation

Most project-related work carried out to date on environmental health in the Bank has been done by the Europe and Central Asia (ECA) and the Middle East and North Africa (MNA) Regions, where environmental health has played a role in determining overall environmental strategies for the area, essentially emphasizing pollution control (World Bank 1994b, 1995c).[11] The East Asia and Pacific (EAP) and the Latin American and the Caribbean (LAC) Regions have worked on economic evaluation of the human-health damages from pollution (World Bank, 1994a, 1994c, 1994d, 1995a, 1995g). Numerous other projects dealing with pollution-control and waste management have yielded important positive environmental health repercussions, but the latter are not necessarily separated into components or other disaggregated activities. Only one pollution control project, in ECA, was designed based on health criteria; the reverse is more common (World Bank, 1995b).

Environmental health in Bank documentation has received uneven attention, and tends to be subsumed by other, related topics. Many traditional health concerns (for example, indoor household pollution or vector-related diseases such as malaria) have been treated as health sector, not environmental, issues. A literature search of Bank documentation found only one peer review by health professionals, which was presented at a workshop on methodologies used in evaluating the economic costs of pollution on human health.[12] Apart from that observation, it is hard to draw conclusions because there is no Bank-wide definition of environmental health.

Guidance that would allow staff to deal competently with environmental health issues is lacking, especially when compared with the broad range of documentation on environmental management. Within the Staff Operations Manual, only one Operations Policy/Best Practice (OP/BP) deals directly with environmental health. Operational Directive (OD) 4.03, "Guidelines for Use, Selection and Specification of Pesticides in Public Health Programs," deals with spraying to reduce vectors, but does not address general pesticide use in agriculture sector. OD 4.30 ("Involuntary Resettlement") contains one footnote on health; GP 4.37 ("The Safety of Dams") refers to public health in general; OD 4.01 ("Environmental Assessments," Annex A) lists "Occupational Health and Safety" in a checklist; OP 4.02 ("Environmental Action Plans") mentions a public health specialist as part of the EA team,

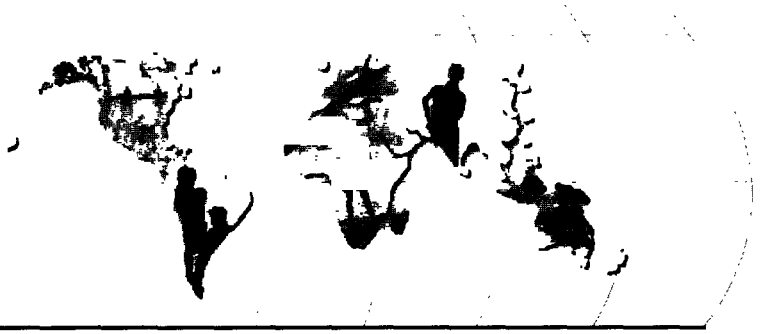
and lists public health and safety as general objectives; GP 4.03 ("Agricultural Pest Management") refers to proper disposal of pesticide containers; and OP 4.76 ("Tobacco") refers to the dangers of tobacco smoking. (The ODs listed here are to be reissued as OPs.)

A literature search of non-project documents reveals a primary emphasis on pollution control—that is, "brown issues," followed by development of techniques to evaluate the health costs of environmental degradation. Frequent references to environmental health can be found, but few substantive health analyses are seen. Typical is *Making Development Sustainable: From Concepts to Action*, which presents the approaches of sociologists, ecologists, and economists in separate chapters; explicitly mentions gender and poverty in separate sections; refers to urban pollution issues; and features diagrams of pollution indicators. (Others are World Bank 1995d, 1995e, 1995f, and the Bank's Annual Reports on the Environment.) An annotated bibliography, "Sociology, Anthropology and Development," covering Bank publications from 1975–93, lists only two entries on health out of 390 publications. The annual sustainable development conferences of 1994 and 1995, however, included many presentations on health.

Cross-fertilization on health issues within and among sectors and networks could be improved in a broader context, and strengthen the focus on development outcomes, such as health. Some examples are:

- Health and nutrition activities—addressing anemia through links with deficient nutrition as a cross-cutting health-sector issue would further benefit from linking it also to hookworm, a major contributor to anemia, with deficient sanitation (the worms hook onto the intestines, causing blood loss).
- Work on air pollution and health, mostly focused on ambient air pollution so far, would benefit from complementing it by links between indoor pollution and respiratory diseases, now considered one of the most important health problems in developing countries.
- The use of pesticides is traditionally linked with water quality, but less so with breast cancer in women farmers or with general contamination of the food chain.

These and other cross-sectoral issues and integrated approaches that could tangibly improve the development impact of Bank operations need to be given more attention in future work.



Annex F

Regional Responses to EH Questionnaire

1. What are the main environmental health problems in your region?

SAR: Water supply and sanitation-related diseases from polluted drinking water and dearth of sanitation and good hygiene practices; respiratory diseases and other adverse effects from indoor air pollution resulting from the use of traditional biomass fuels in primitive cookstoves and urban air pollution from a variety of energy, transport, and other sources.

LAC: (a) Water-borne disease resulting from inadequate water supply and sanitation. Sanitary education may be weak in poor areas of the region.

(b) Serious respiratory illness, particularly within vulnerable groups, from air pollution in Mexico City and Santiago. Cities with growing localized problems include Lima, Rio, Buenos Aires, and many medium-size cities with high growth.

(c) Localized health impacts of inadequate disposal of sewage in bay and coastal areas.

ECA: The most common cause of death in Europe is cardiovascular disease; the second is malignant neoplasms. Injuries and poisonings are responsible for close to 10 percent of mortality. Accidents associated with cars and the workplace are the most prominent. Better characterization of the environmental factors that increase the risk of accidents for children is considered as a priority topic for research by WHO and the EC-EH commission.

We need to separate ECA into Europe, the newly independent states (NIS), and Central Asia (CA) for these purposes. Outbreaks of disease related to environmental pollution are relatively rare in Europe, but common in CA. Communicable disease contributes to a small proportion of all deaths in ECA (1.3 percent); mortality rates were four times higher in the NIS than in the rest of Europe in the mid-1990s. In the NIS, mortality from communicable diseases increased by more than 40 percent during 1990–95. Close to half of the mortality in this group is caused by tuberculosis; much of the rest is attributable to water-borne diseases. In 1995, tuberculosis incidence in the NIS and Central and Eastern Europe was more than three times greater than in the European Union. Among the factors facilitating the spread of

communicable diseases in the population, poor environmental conditions play an important role. Insufficient housing and contamination of indoor air with microorganisms contribute to morbidity. Murray and Lopez (1997) have shown that poor water, sanitation, and hygiene are still among the 10 most important risk factors for burden of disease throughout all of ECA. National Environmental Health Action Plans for NIS countries, particularly Central Asia, show water-related diseases to be the top environmental health priority.

EAP: The primary problems include water supply and sanitation, urban air quality, and indoor air pollution. Secondary problems are industrial health and safety and traffic accidents.

MNA: Diarrhea (including dysentery, cholera, and typhoid) from lack of safe water and sanitation and poor hygiene is a very serious problem. Respiratory infections from air pollution due to overcrowded housing, transport, and industry also affect many people. Carcinogenic and cardiovascular problems resulting from toxic industrial pollution are also serious, but difficult to quantify.

2. Please list current projects (on-going or pipeline) in your region that address environmental health issues to some extent.

South Asia

Approach

In South Asia, we essentially looked at projects at the PCD and PAD/SAR stages that were online, and therefore took place within the last three to four years. To identify the projects that addressed environmental health, directly or indirectly, within the project documents, we looked at a) key and strategic objectives; b) summary analysis, which provides the cost-benefit analysis or cost-effectiveness of the intervention; and c) key performance/output/outcome indicators. If there was explicit reference to environmental health or to environment and public health, in at least two of these areas, then the projects were included in the primary list of projects (PLP). Those that did not meet this criteria, but that are likely to have an environmental health impact, were included in the secondary list of projects (SLP).

Implications

Depending on how the project documents were written up, a project could be doing quite a bit on environmental health, but if it was not described explicitly as doing so, we would not have included it in the PLP. Furthermore, there is no guarantee that projects with explicit EH objectives will actually carry out the activities, unless they are also to be monitored under key performance/output/outcome indicators.

For example, an environment project may have as key objectives provision of mitigating measures to clean up, build, and treat waste, air, and water emissions from an industrial facility. Under performance/monitoring indicators, if they are monitoring BOD, COD, and particulates to the general environment, these would be considered "indirect indicators." We have assigned such projects to the SLP, even though the impact on the health of the surrounding communities may be considerable.

Likewise, a health project that, among other objectives, addresses communicable diseases

(which are environmentally related) may, in its performance indicators, be monitoring environmental health benefits but may not explicitly describe the results in the document. Such projects were also placed on the SLP. A large number of projects in the Urban, Energy, Transport, Infrastructure/Rural Development (including Water Supply and Sanitation (WSS)), and Health sectors have the potential to address EH issues to some extent. But most of them do not, as few people are aware of the issues or knowledgeable of how to address them. Some projects (especially those that include urban/industrial air pollution or WSS activities) indirectly address EH, even though the specific project objectives may not have been EH-driven. Environmental health, as a key objective, drives only a very small sample of projects in South Asia.

Primary List

Dhaka Air Quality Management (Urban Air)
Bangladesh Arsenic Mitigation Project (Drinking Water)
Bangladesh School and Community Sanitation (Sanitation/Hygiene)

Secondary List

A sample list of projects that indirectly, or to lesser degree, address EH issues or that have the potential to address these issues would include:

WSS Projects
Bombay Sewage Disposal
Kerala Rural Water Supply & Sanitation
Karnataka RWSS
Chennai Urban Water II/III
Community and Private Sector Water in Sri Lanka
Nepal Rural Water Supply and Sanitation
Nepal Urban Water Rehabilitation

Health and Nutrition Projects
ICDS II (nutrition)
Woman and Child Development (nutrition)
Malaria Control (India)
TB control (India)

Urban Projects
Colombo Environmental Improvement
Tamil Nadu Urban Development Fund
Municipal Services Project (Bangladesh)
Slum Upgrading (Bangladesh)
Urban Development (Bhutan)
Clean Settlements (Sri Lanka)
Lahore Urban Development

Transport Projects
Dhaka Urban Transport
Mumbai Urban Transport

Environmental Capacity Building Projects
Environmental Management Capacity Building (India)
Environmental Action (Sri Lanka)
Metropolitan Environmental Improvement Program (Bombay, Kathmandu, Colombo)

Industrial Pollution Projects
Coal Environment and Social Mitigation (India)
Industrial Pollution Prevention Project (India)

Since last year, the South Asia region has strengthened its EH work through the following activities:

- Andhra Pradesh study on water, sanitation, and health
- ESMAP study on household energy, air pollution, and health proposal to launch the South Asia Environmental health program and pilot an EH project in India
- The South Asia Environmental Strategy for the Energy Sector, which attaches the

highest priority to indoor and outdoor air pollution from energy use because of its health impacts.

Latin America and the Caribbean

Environment Portfolio

Mexico: Air Quality Management II
Argentina: Pollution Management (air quality monitoring and long-term strategy development)
Caribbean: OECS Solid Waste

Health Portfolio

Some of the projects listed below include activities related to the management of hazardous hospital waste, and some finance activities related to management of vector- and water-borne diseases. They tend to combine education, clinical services, and localized environmental management interventions. These include malaria control, or more generally, tropical disease control (including dengue and others)¾typically in a very localized fashion¾including measures such as the cleanup of discarded tires or improvement of buildings/drainage to prevent mosquitoes from breeding.

Argentina: Provincial Health Sector Development; AIDS and STD Control; Provincial Reform Loan 2; Public Health Surveillance to monitor disease from air pollution (under preparation)
Brazil: Disease Surveillance and Control (monitors air-related disease in São Paulo); Second AIDS and STD Control
Chile: Health Sector Development
Dominican Republic: Provincial Health Services
Ecuador: Second Social Development: Health and Nutrition
Honduras: Health and Nutrition and supplemental credit for health and nutrition
Panama: Rural Health
Peru: Health Reform (in preparation)
Uruguay: Health Sector Development
Venezuela: Health Services Reform

Europe and Central Asia

The following list of ECA projects includes those that address some aspect of water- and sanitation-related disease (based on a recent study). It is less clear which projects affect other areas of environmental health. In ECA, all stand-alone Rural Water Supply and Sanitation (RWSS) projects in Central Asia aim at improving health through improving water supply and sanitation, carrying out health promotion, and monitoring water quality.

Albania: Rural Development
Azerbaijan. Urban Environment
Bulgaria: Environmental Liabilities
ECA: Regional Environment Project
Kazakhstan: Environment I
Kyrgyzstan: RWSS
Latvia: Environment
Liepaja: Solid waste management
Lithuania: Geothermal
Poland: Geothermal
Poland: Rural Development
Romania: Rural Development
Russia: Environmental Management
Russia: TB and AIDS
Samarkand and Bukhara: WSS
Slovenia: Environmental Management
Turkmenistan: WSS
Ukraine: Environment
Uzbekistan: WSS

East Asia and the Pacific

The projects listed below meet the following criteria: they have as one of their stated objectives to reduce human health impacts, and they have indicators that relate to improving health outcomes (for example, reducing BOD/COD levels in local water bodies or reducing effluent or emissions).

Water Pollution and Solid Waste

Cambodia: Water Supply Rehabilitation
China: 16 urban infrastructure and environment projects
China: three rural water supply projects
China: Huai River Pollution Control I
China: Qinba Mountains Poverty Reduction Project
Indonesia: seven urban development/infrastructure projects
Indonesia: Urban Poverty Project
Indonesia: Second Water Supply and Sanitation for Low Income Communities
Indonesia: West Java and Jakarta Environment
Korea: Kwangju and Seoul Sewerage
Korea: Waste Disposal
Lao PDR: Provincial Infrastructure Project
Mongolia: Ulaanbaatar Services Improvement Project
Philippines: Municipal Development III
Philippines: Manila Sewerage II
Philippines: Water Districts Development
Philippines: LGU Urban Water and Sanitation Project
Philippines: Solid Waste Ecological Enhancement Project
Thailand: Bangkok Urban Environment Program Project
Thailand: Environment Project
Vietnam: Ho Chi Minh City Sewerage Project
Vietnam: Three Cities Sanitation Project

Air Pollution

China: seven transport projects
China: four urban environment projects
China: Air Pollution Control
Indonesia: Renewable Energy Small Power
Philippines: Metro Manila Urban Transport Improvement
Thailand: Clean Fuel and Air Quality
Thailand: Bangkok Air Quality Management
Thailand: Highways V

Middle East and North Africa

Pollution Abatement and Control

Algeria: Industrial Pollution Control
Egypt: Pollution Abatement

Water/Waste Water and Sanitation:

Algeria: Water Supply and Sewerage
Egypt: Social Fund III (infrastructure component), Sohag Rural Development (community development component)
Iran: Teheran Wastewater
Jordan: Amman Water and Sanitation, Wastewater Reclamation, Disi Amman Water Conveyor
Lebanon: Greater Beirut Water and Sanitation, Awali-Beirut Water Supply, Coastal Pollution
Morocco: Water Supply V, Sewerage and Water Re-use, Rural Water and Sanitation
Tunisia: Water Supply and Sewerage, Greater Tunis Sewerage, Water Sector Investment Loan
West Bank/Gaza: South Area Water, Community Development I & II (component), Water/Sanitation Service/Gaza, Southern Area Water and Sanitation
Yemen: Taiz Water Supply, Public Works II (component), Sana'a Water and Sanitation

Solid Waste

Algeria: Algiers Solid Waste
Lebanon: Solid Waste and Environment Management
Tunisia: Municipal Development II (component)
West Bank/Gaza: Solid Waste and Environment Management

Health Sector

Egypt: Schistosomiasis Control
Health Sector (hospital waste component)
Iran: Health Sector Development (waste from rural clinics)
Jordan: Health Sector Reform (hospital waste)
Lebanon: Health Project (hospital waste)
Morocco: Health Finance and Management (hospital waste)
Tunisia: Health Sector Loan (hospital waste)
West Bank and Gaza: Health System Development (clinical waste)
Yemen: Child Development (clinical waste)

Transport

Jordan: Amman Ring Road
Lebanon: Urban Transport
Tunisia: Transport Sector Investment
Yemen: Multi-mode Transport

3. Are your clients (borrowers and stakeholders) aware of environmental health issues? If so, which areas are most important in their perception? Why?

SAR: They are largely aware of vehicular and industrial air pollution, pesticides, polluted drinking water, and poor sanitation. Recently, Indian environmental authorities started paying more attention to indoor pollution (thanks to new assessments of immense damage to the health of children and women), because these are high-visibility problems and there is high client demand for projects. (Although demand for non-sewerage, non-urban sanitation by the actual end-users is quite low.)

LAC: Air pollution is very prominent in public awareness in Mexico City and Santiago for obvious reasons. In other cities with important water bodies, polluted rivers and beaches attract considerable attention (possibly more for concerns on aesthetics and health concerns during recreational activities). Media attention to hazardous waste tends to get the attention of borrowers and stakeholders.

ECA: Clients demonstrate awareness of environmental health issues in all of the national environmental health action plans we have conducted. ECA health sector notes for various countries discuss environmental health, although the depth varies. Demand for water supply and sanitation projects is high in Central Asia.

EAP: Lack of adequate water supplies and inadequate sanitation have long been recognized in the region as key development issues, due in part to the impacts on human health. The large lending program in the region for water supply and sanitation shows the great importance that our clients (and the Bank) have placed on water pollution, and, by association, water-related diseases.

There is a growing concern among our client countries over urban air pollution issues: lending in this area—while still lagging far behind water supply and sanitation—has been growing. The extent to which human health concerns have dominated the concern for air pollution control, in comparison to economic and productivity impacts, such as damages to agriculture (acid rain) or tourism, is not clear. Studies funded by the Bank and others have shown that human health damages from air pollution far outweigh other economic losses and, in China, are probably larger than the impact of water pollution.

MNA: Water pollution is considered to be the most important health issue. The MNA region is characterized by lack of water resources, poor water quality, and lack of wastewater treatment and sanitation. Of 250 million people in 1990, 45 million lacked access to safe drinking water, 85 million lacked access to safe sanitation, and only 20 percent of urban wastewater was treated. Air pollution from industry and transport is also gaining the attention of our clients, largely because of media coverage.

4. How are decisions made in your region whether or not to include environmental health issues in lending (cost? available technology? media attention?) What are the tradeoffs?

SAR: The decisionmaking process depends on client demand, availability of sector work, and the knowledge and interest of Bank staff in response to issues. For clients, water and sanitation has been always high on the agenda, but this was not considered to be a health intervention, and project designs did not aim to maximize the health impacts. Urban air pollution is an emerging priority (Dhaka Air Quality LIL under preparation, request for an air pollution project in Delhi). Recently, regional management has become more aware and supportive of EH, resulting in a small budget to promote EH activities. Integrating these issues in projects is still a challenge because of the complex and multisectoral nature of environmental health.

LAC: If the counterparts in a country are interested in addressing a problem with EH implications, the project tends to include such issues. However, except for "brown" environment projects (and even in those), few activities directly address environmental health issues.

ECA: No explicit decisionmaking process, until recently, in regard to including EH issues in lending.

EAP: The majority of projects addressing environmental health issues fall within the urban environment portfolio, and are driven by demand for urban environmental projects by our client countries. There is limited involvement in EH issues by the health sector, or through "health" projects.

Most projects in the region address EH issues only indirectly; health outcome indicators associated with air-pollution control or wastewater projects are

rarely measured, and only a few health surveys have been conducted before or during project implementation.

MNA: The decisionmaking process for lending is not principally guided by EH issues. With the exception of the pollution abatement and control and the wastewater treatment projects, EH issues are identified to justify a project's positive environment impact.

5. Who is responsible for environmental health issues in your client countries (environment and/or health ministries/agencies or other)?

SAR: No single agency actually has clear responsibility for EH, due to its multisectoral nature. But the environment department or ministry would be the default, especially for industrial pollution and air pollution (outdoor and indoor). Other agencies or departments that have played a role include health and family welfare, irrigation/agriculture, social welfare, transport/civil works. Because EH is a cross-sectoral issue, inevitably all these agencies have been involved at one point or another, although none takes primary responsibility for EH.

LAC: Years back, health authorities used to handle these issues, but gradually they have been moved to the purview of environmental authorities. In general, there is animosity between these agencies and little communication and coordination.

ECA: EH falls between the cracks. Both environment and health ministries take some interest, but neither has a mandate.

EAP: Environment bureaus and public health agencies are responsible for the majority of EH issues; however, these agencies are not usually the key actors with which the Bank is involved in its environmental health–related projects.

MNA: No single agency has responsibility for environmental health issues. Usually the ministry of environment is responsible for ensuring that the responsible agencies (ministries and local government) apply environmental laws and guidelines. The ministry of health is responsible for all health-related projects. Ministries of equipment, housing, and water resources are responsible for water and wastewater issues.

6. Did the projects listed in response to question 2 attempt to quantify and prioritize environmental health (cost/benefit, cost-effectiveness)? If so, which ones?

SAR: Cost-benefit analysis was carried out for a small number of projects, including components in Dhaka Air Quality Management, Bangladesh Arsenic and School and Community Sanitation Projects, India Fifth Rural Water Supply Project, Chennai Urban Water, and Clean Settlements in Sri Lanka. For others, the economic rate of return was calculated, but for the entirety of the project¾not uniquely for the EH components. The India State Health Systems Project looked at DALYs lost/saved from communicable diseases,

which can be prevented by EH interventions.

LAC: The health projects above address these topics as secondary or localized activities. It has not been possible to check whether quantification of benefits or cost-effectiveness analysis was carried out for those activities. Reviewing the project assessment documents might reveal something in this regard. The rest of the portfolio contains limited examples of cases in which indicators of environmental health have been used, in part because many are too upstream from actual EH improvements (such as Argentina Pollution Management). Only the Mexico Air Quality II project under preparation is attempting to quantify health outcomes as end-of-program indicators (in addition to air quality indicators). These indicators would be supported under the project through a series of special studies.

ECA: We have extensive information on WSS projects, both stand-alone and other projects—that is, when WSS is but one component, as in social funds.

EAP: Generally not. We have not had time to go through all 50-plus project documents (and this is only a partial list). Regarding water pollution, staff appraisal reports often claim, correctly, that it is difficult to quantify the EH effects. Baseline health information is thus often deduced from experiences in other countries, or relies on studies done by other agencies (such as WHO and UNICEF). Few EH surveys have been undertaken as part of project preparation for any of the projects mentioned in question 2. The Chongqing epidemiological survey of air pollution health effects, funded by PHRD funds, is an exception.

MNA: Algeria: Industrial Pollution Control
Egypt: Pollution Abatement

7. Which sectors normally provide loans for EH issues in your region?

SAR: Water and sanitation, urban, health, and environment sectors. To implement a new energy and environment strategy, the energy unit would have to join the list.

LAC: Environment and health. Infrastructure, if you count the improvements in water supply, sanitation (including solid waste), drainage, transport, and mining, could also be included.

ECA: A recent review shows that rural development and Social Fund projects represent a significant share of the investments in WSS—almost equal to stand-alone projects. Social Funds are spread around in different departments. It took a lot of research to determine exactly what is included in the Social Funds/rural development projects. A detailed examination of projects in other sectors might reveal that, in fact, environmental health is being addressed. Officially, EH is being covered through infrastructure (WSS), energy, environment, and health.

EAP: Urban, environment, urban transport.

MNA: Health and education, infrastructure development, rural development, water, and environment.

8. Have indicators been developed to monitor the current projects? Who is responsible for enforcing and evaluating the components in your client countries?

SAR: (a) Bangladesh Arsenic Mitigation Project, Bangladesh School & Community Sanitation, Sri Lanka Clean Settlements, Chennai Urban WSS, Mumbai Urban Transport, Dhaka Air Quality Management.
(b) Evaluation of components is joint responsibility of governments and the Bank. Government agency or agencies involved would be the borrowers.

LAC: Examples from Mexico Air Quality II (under preparation): Cases of respiratory attacks, rate of emergency room visits for respiratory problems, emergency alerts for air quality.

Responsibility rests with the executing units of each project.

ECA: The only information on indicators is what we found in the recent study "Performance Monitoring Indicators for Sanitation and Health Components of Rural WS&S Projects."

EAP: All "A" and "B" projects have to establish environmental-mitigation plans (EMPs), which monitor water quality, effluent loads, and other pollution-related indicators. While health issues are almost always mentioned, data are usually anecdotal, and direct health data is almost never collected as part of the project.

MNA: Algeria: Industrial Pollution Control Project: Reduced perceived respiratory morbidity (%); decrease of pollution loads of TSS, SO2, and NOx in City of Annaba.

Egypt: Pollution Abatement Project: Output indictors for major pollutants were developed for each industrial subproject.

Tunisia: Transport Sector Investment: Reduction of lead in gasoline.

The project implementation unit of each project is responsible for evaluating these indicators. Ministries of the environment are responsible for follow-up.

9. What environmental health issues do you feel still need to be addressed in your region?

SAR:

- Indoor air pollution (energy, health, and environment nexus).
- Emphasizing the linkages and interventions between WSS diseases and health outcomes.
- Urban air pollution.
- Linking with other sectoral efforts in interdisciplinary manner, especially with nutrition and education (formal and non-formal) activities, since nutritional status of a young child determines the degree of vulnerability to respiratory and diarrheal infections.
- Focus on health, especially child survival, as a major outcome of a variety of cross-sectoral activities.

LAC:

- We do not have a good handle on the localized implications of poor solid-waste disposal practices for municipal and industrial/toxic waste. We need to use more risk assessment in projects to determine which conditions warrant often costly remedial action.
- Occupational health and safety—should this be part of our labor markets reform or health reform dialogue?
- We need to improve our work on indicators for the existing projects that may render some environmental health benefits, including a number of infrastructure investments (water, transport, and others). This would help improve the economic analysis of projects (from the benefits side).

ECA:

- Communicable diseases, especially tuberculosis (health department working on this).
- Urban air pollution.
- Sanitation.
- Rural water supply.

EAP:

- Urban air pollution and its relationship to public health.
- Public health benefits of the Bank's WSS program in the region.
- Indoor air pollution.
- Industrial health and safety.
- Traffic safety.

MNA:

- Morbidity due to air pollution (indoor, industrial, and urban).
- Linkages between WSS diseases and health outcomes.
- Food and health hygiene.
- Environment education in schools.

10. What steps would you like to take in the near future to address these issues (if money and time were no concern)?

SAR: Resources to be used for advocacy, sector work, and project preparation of EH projects or components.

Also, efforts to be spent on defining the intersectoral collaboration necessary for EH activities. Learn from work/experience from other regions to be able to apply existing knowledge within Bank to actual country activities. Go beyond studies and developing monitoring indicators to pilot existing indicators and make them workable and user-friendly to non-environment and non-health disciplines (such as infrastructure, energy, and rural development. Implications: depending on how project documents are written up, a project could be doing quite a bit on EH, but if not described explicitly, we would not have included it in the primary list. Further, there is no guarantee that projects with explicit EH objectives will actually carry out the activities unless they are also to be monitored under Key Performance/Output/Outcome indicators.

LAC: Develop a few case studies within projects that can fund risk-assessment exercises for solid waste dumps and contaminated sites.

ECA: Include an environmental health analysis in the EA process.

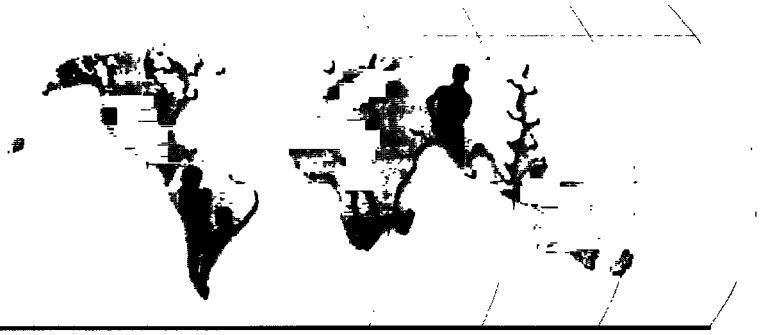
EAP: Additional sector work on air and water pollution impacts in our client

countries. For operations, it is important to develop low-cost ways (or costs appropriate to the level of expenditure on other issues) of tracking and monitoring health outcomes or "reasonable" indicators of health outcomes. Undertaking basic health surveys as part of project preparation for projects in which EH is used as a primary justification for the project, such as wastewater, sanitation, and air pollution control.

MNA: Rapid health-risk assessment should be undertaken in pilot countries to evaluate the magnitude and severity of air and water pollution and its linkages to public health. EH issues should be part of the CAS. Non-lending services should be provided to strengthen the capacity of institutions on environment/health issues, provide reliable health and environment information, introduce a methodology for quantifying health impacts, and develop health indicators. Develop case studies for studying groundwater pollution due to non-point and point sources of pollution.

Notes

1. See Annex 2 for more detail on the methodology, as well as World Bank, 2000a, pp. 92–100.
2. Note that large variations were found in cost-effectiveness of urban air pollution control measures—from negative costs (win-win solutions) to several thousand and even millions dollars per DALY saved. This stresses the need for a more rigorous economic analysis of Bank-supported urban air quality management strategies.
3. Estimates by Murray and Lopez 1996 assign 13 percent of the total burden of disease in Sub-Saharan Africa in 1990 (38 million DALYs) to respiratory diseases. Adjusting for population growth, the estimate of the ill health associated with indoor air pollution was about 13 million DALYs in 1990, or about 35 percent of the total burden of respiratory disease. This share is consistent with the difference between Africa and, for example, Latin America and the Caribbean, in terms of the respective contributions of indoor air pollution to the total burden of respiratory disease.
4. The main sources of data were the AMIS database, compiled by WHO, and statistics reported by various environmental agencies, in particular the U.S. Environmental Protection Agency and the European Environmental Agency. Limitations in the coverage of monitoring systems means that most of the non-U.S. data is for cities or metropolitan regions with populations of more than 500,000.
5. For the different approach, see Chapter 3 in World Bank 1997.
6. See, for example, Overview and Chapter 1 in World Bank 1992 and references.
7. Described in Sivayorathan and others 1995; Lessenger, Estock, and Younglove 1995.
8. Parron, Hernandez, and Villanueva 1996; Ruijten and others 1994.
9. The disease groups include: liver and pancreas cancer, melanomas and other skin cancers, lymphomas and multiple myeloma, endocrine disorders, unipolar major depression, cataracts, nephritis and nephrosis, rheumatoid arthritis, congenital anomalies (excluding spina bifida and congenital heart anomalies), and poisonings across all age groups.
10. This Annex is based on Listorti, Doumani, and Hammer 1999.
11. This Annex is based on Listorti 1996, Vol. III.
12. Reviewers from the London School of Hygiene and Tropical Medicine, St. George's Hospital Medical School (London) and the Centers for Disease Control (Atlanta) were asked to participate in a workshop June 1–2, 1995, to comment on World Bank 1994c.



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