ENVIRONMENTAL HEALTH

ZAREENA BEGUM I

DISSEMINATION PAPER - 7

Centre of Excellence in Environmental Economics
(Sponsored by Ministry of Environment and Forests, Government of India)
MADRAS SCHOOL OF ECONOMICS

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ENVIRONMENTAL HEALTH

Introduction

Environment and health are inextricably interlinked. The physical environment, such as drinking water, sanitation, housing, and air, has considerable effects on the health status and well being of people, contributes to communicable diseases, and prolongs the epidemiological transition. The socio-cultural environment, such as changing lifestyles, modernization, occupational differentiation, and aspirations to improve the quality of life, not only results in new health problems but also places new demands on health systems. These socio-cultural and physical environmental factors cumulatively lead to a greater burden of disease.

In the medical sense, the environment includes the surroundings, conditions or influences that affect an organism. Along these lines, Last (2001) defined the environment for the International Epidemiological Association as: "All that which is external to the human host. Can be divided into physical, biological, social, cultural, etc., any or all of which can influence health status of populations". According to this definition, the environment would include anything that is not genetic, although it could be argued that even genes are influenced by the environment in the short or long-term. Figure 1 shows one way to represent the environment, from the most inclusive to the most restrictive definition (Smith et al. 1999).

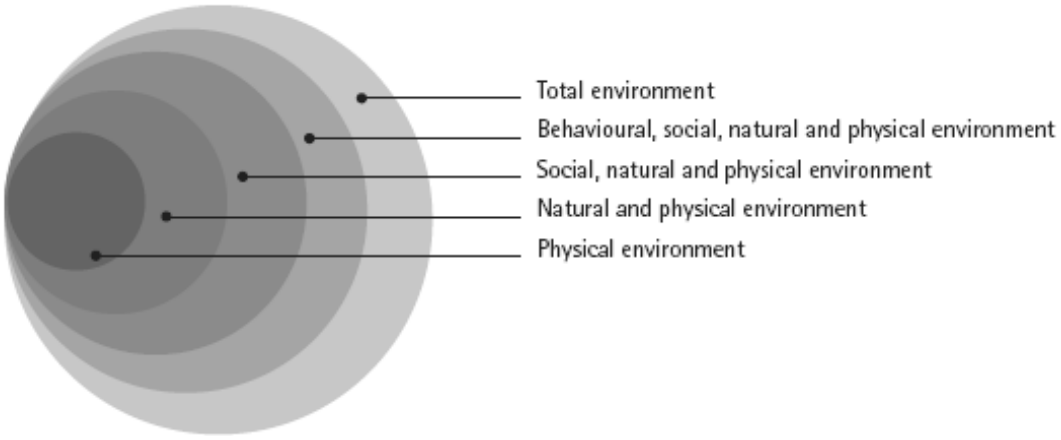

Figure 1. Distribution of the total environment

Health outcomes that are a result of environmental conditions are classified under the category of “environmental health.” The World Health Organization

(WHO) has defined environmental health as those “aspects of human health, including quality of life, that are determined by chemical, physical, biological, social and psychosocial factors in the environment.” In general, environmental health risks are grouped into two broad categories: **Traditional hazards** are closely linked with poverty. They refer to health risks that are a consequence of lack of access to clean water, inadequate sanitation, poor waste disposal, indoor air pollution and vector-borne diseases such as malaria. **Modern hazards** are caused by development that lacks environmental safeguards, such as urban air pollution and exposure to agro-industrial chemicals and waste.

The drivers of change

Environmental change and its attendant health impacts are driven by many factors, including economic growth, population growth and movements, urbanization, transportation, and war, to name just a few. The three broad trends -- the intensification of agriculture, industrialization, and rising energy use -- which stand out in terms of their profound impacts on the physical environment and their enormous potential for influencing human health. But all these changes are essential for economic development and improved welfare of our wellbeing. Yet, all lead to pressures on the environment, such as pollutant emissions and resource depletion, that in turn can increase human exposure to threats in the environment.

Intensification of agriculture is essential for producing more food but, when not well managed, creates substantial risks, such as exposing workers and communities to toxic pesticides, contaminating groundwater supplies, and creating pesticide-resistant pests. Land clearing, irrigation, and dams can bring increases in vector-borne diseases such as malaria and schistosomiasis, both of which exact a huge toll in rural areas of the developing world.

Industrialization is the key player of economic growth and, like urbanization to which it is closely related, is associated with major gains in health. Yet, along with rising standards of living -- at least for a majority of the population -- industrialization often means increased exposure to heavy metals, persistent chemicals such as polychlorinated biphenyls (PCBs), and other toxic chemicals. This is especially true for workers and the poor who often live close to factories. Such exposures are likely to be increasingly pronounced in the developing world, where the most rapid industrialization is occurring.

Energy demand, which is already huge in the developed countries, is rising fastest in the developing world. Rising energy use is needed to fuel industrial growth but brings many attendant problems. Local air pollution from

industrial and vehicle emissions has proved difficult to manage even in developed economies. Fossil fuel use also has the potential to alter the Earth's climate, with a predicted range of impacts from severe storms, to drought, to flooding, to an increase in insect-borne diseases such as malaria.

In the real world, these three trends rarely occur in isolation. Rising energy use, for instance, is part and parcel of industrialization and intensification of agriculture. The effects of industrialization are often difficult to disentangle from those of urbanization. Many of the effects of these trends are well known and predictable (for example, increased air pollution that accompanies rising use of fossil fuels, or exposure to toxic chemicals through improper disposal of industrial wastes). Others, however, are far less certain, though potentially large, such as those associated with global climate change and wide-scale ecological disruption.

Until recently, discussions of environmental threats to health have tended to focus on direct toxicological effects of specific insults or exposures. Now, awareness is growing that changes in the environment can affect health in indirect and often unexpected ways as well, by disrupting local or global ecosystems. For instance, soil erosion stemming from poor agricultural practices can result in reduced crop yields; which could have important consequences for nutrition. Farm animal wastes in the eastern United States are suspected of causing toxic algal blooms, leading to massive fish kills and potential harm to humans. Even well-intended development projects can have unexpected outcomes, as occurred in Africa's Senegal River Valley, where the construction of two dams set off a cascade of events that ultimately contributed to nutritional problems for the population and a dramatic increase in schistosomiasis.

Why Environmental Health Matters

Diarrhoea, lower respiratory infections, malaria and other unintentional injuries are the diseases with the largest environmental contribution. Furthermore, Prüss-Üstün and Corvalán (2006) estimated that 24 percent of the global disease burden and 23 percent of all deaths can be attributed to environmental factors, which can be prevented through environmental modification (such as through provision of safe water, improved sanitation, and adequate hygiene) (Figure 2).

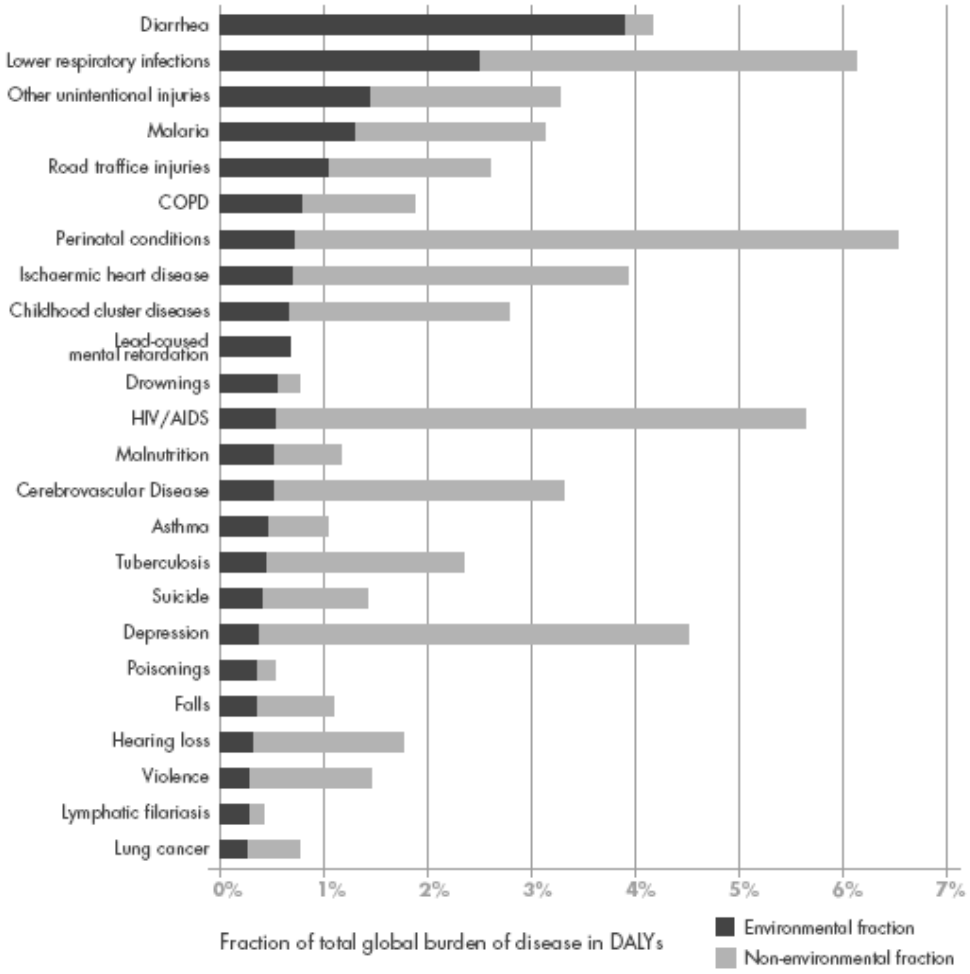

Figure 2. Diseases with the Largest Environmental Contribution

Source: Prüss-Üstün and Corvalán (2006)

Abbreviations: COPD = Chronic obstructive pulmonary disease.

Lead-caused mental retardation is defined in the WHO list of diseases for 2002, accessed at: www.who.int/evidence.

DALYs represents a weighted measure of death, illness and disability.

For each disease the fraction attributable to environmental risks is shown in dark grey. Light grey plus dark grey represents the total burden of disease.

The World Health Organization (WHO), The United Nations Children's Fund (UNICEF), and many other agencies have comprehensively shown that tackling environmental health issues is important. Environmental risk factors play a role in more than 80 of the major diseases and injuries worldwide. Developing countries carry disproportionately high environmental burden of disease, with the total number of healthy life years lost per capita as a result of

environmental burden being 15-times higher in developing countries than in developed countries (Smith et al. 1999).

Available global evidence suggests that *(a) lack of access to clean water and sanitation and (b) indoor air pollution* are the two principal risk factors of illness and death, mainly affecting children and women in poor families. The impact of such environmental health risks on men and women is substantial when measured in millions of deaths and disability adjusted life years (DALYs). This underscores the need to design and implement environmental health interventions in poor countries to improve access to safe water, provide adequate sanitation, and improve air quality, both indoors and outdoors.

With 1.1 billion people lacking access to safe drinking water, and 2.6 billion without adequate sanitation, the magnitude of the water and sanitation problem remains significant (WHO/ UNICEF 2005). Each year contaminated water and poor sanitation contribute toward the 5.4 billion cases of diarrhoea worldwide and the 1.6 million deaths, mostly among children under the age of five (Hutton and Haller 2004). Intestinal worms—which thrive in poor sanitary conditions and in the poorest communities of the developing world—have infected 2 billion people and, depending upon the severity of the infection, may lead to malnutrition, anemia or retarded growth, and subsequently diminished school performance (Ivanov et al. 2004). About 6 million people are blind from trachoma, a disease caused by the lack of water combined with poor hygiene practices. A further 200 million people are infected with schistosomiasis; of these, 20 million suffer severe consequences (UNICEF 2006). The most affected are the populations in developing countries living in extreme conditions of poverty, either in urban slums or peri-urban or rural areas.

Indoor air pollution — a much less publicized source of poor health — is responsible for over 1.5 million deaths from respiratory infection per year and for 2.7 percent of the global burden of disease (WHO 2006). In developing countries, indoor air pollution is largely attributed to smoking and the use of biomass for cooking. It is estimated that half of the world's population use solid fuels (biomass and coal) for household cooking and space heating, mainly in developing countries (Rehfuess et al. 2006). The burden of poor environmental health falls on the most vulnerable of the poor, mainly children under the age of five, women, and the disabled and elderly. As many as half of the deaths attributable to indoor use of solid fuel are of children under the age of five years (Smith et al. 2000). In the 21 worst affected countries, most of them located in sub-Saharan Africa, approximately 5 percent or more of the total burden of disease is caused by indoor air pollution. In 11 countries—

Afghanistan, Angola, Bangladesh, Burkina Faso, China, the Democratic Republic of the Congo, Ethiopia, India, Nigeria, Pakistan, and the United Republic of Tanzania—indoor air pollution is responsible for a total of 1.2 million deaths a year (WHO 2007). Generally, men suffer more from outdoor air pollution. Women are exposed more to indoor air pollution, since they traditionally spend more time indoors and near the stove. By far the greatest burden of disease falls on children under the age of five (Smith et al. 2000); they are especially susceptible to environmental risks when both risk factors are considered (Ezzati et al. 2004).

In humans, malaria is a disease caused by one of four parasite species belonging to the genus *Plasmodium*. The parasite is transmitted by the bite of an infected female mosquito of the genus *Anopheles*. The larval stages of *Anopheles* mosquitoes occur in a wide range of habitats, but most species share a preference for clean, unpolluted, stagnant or slowly moving fresh water (Muir, 1988).

There are three main approaches to the environmental management of malaria:

- *Modify the environment*. This approach aims to permanently change land, water or vegetation conditions, so as to reduce vector habitats.
- *Manipulate the environment.* This approach temporarily produces unfavourable conditions for vector propagation and therefore needs to be repeated.
- *Modify or manipulate human habitation or behaviour*. This approach aims to reduce contact between humans and vectors (WHO, 1982). At the time these definitions were formulated, the third approach included the use of mosquito nets. The successful introduction of insecticide-treated mosquito nets has put them in a category of their own, and blurred the boundary between environmental management and chemical control. An array of environmental modification and manipulation methods are available for vector control in general, and malaria control in particular. Important features of environmental management strategies are their non-toxicity, relative ease of application, cost-effectiveness and sustainability (Bos and Mills, 1987; Ault, 1994; Utzinger, Tozan and Singer, 2001).

It was estimated that 42% (30—53%) of the global malaria burden, or half a million deaths annually, could be prevented by environmental management, although the fraction amenable to environmental management varied slightly, depending on the region: 36% (25—47%) in the Eastern Mediterranean Region; 40% (34—46%) in the Western Pacific Region; 42% (28—55%) in

sub-Saharan Africa; 42% (30—54%) in the South-East Asia Region; 50% (38—63%) in the European Region; and 64% (51—77%) in the Region of the Americas (Prüss-Üstün and Corvalán, 2006). The potential of environmental management to reduce the disease burden of malaria differed according to the type of environment (i.e. deep forests and hills, rural settings, and urban and periurban settings). The differences can be explained by local differences in the behaviour of Anopheles species (e.g. biting and resting behaviour), and by the number and characteristics of their breeding sites (e.g. in urban areas there are generally fewer breeding sites and they are easier to get to for vector control).

Dengue and dengue haemorrhagic fever could be almost entirely prevented by good management of water bodies in and around houses, which are breeding sites for the main mosquito vector, *Aedes aegypti*. This species commonly breeds in temporary water-storage containers in the domestic (and sometimes the natural) environment, such as tanks and drums, plant pots, and also in standing water in solid waste, including tyres and discarded food containers. *Aedes albopictus* is an important secondary vector in some areas of the Western Pacific and South-East Asia Regions, while *Aedes polynesiensis*, which breeds in crab holes, transmits dengue on a number of Pacific islands. In such circumstances, the problem of dengue cannot be resolved simply by reducing or effectively managing *Aedes aegypti* breeding sites (Rozendaal, 1997; Heukelbach et al., 2001; R. Bos, personal communication). The global mean environmental attributable fraction for dengue was estimated to be 95% (90—99%) (Prüss-Üstün and Corvalán, 2006).

New cropping patterns and irrigation practices, abandoned mines, and unregulated industrial disposal of effluents and hazardous waste have led to increased exposure to pesticides, fertilizers, other persistent organic agents, and heavy metals. Chronic and acute exposure to these substances are known to be associated with a variety of diseases, especially various types of cancer. Exposure data are almost nonexistent, so it is very difficult to apply existing epidemiological and toxicological relationships to estimate the likely burden of disease caused by these pollutants. The burden of disease associated with agro-industrial pollution does not appear to be significant. Agro-industrial factors account for less than 1 percent in the overall burden of disease. Much of this is likely to be the result of exposure at work rather than to environmental pollution, though the distinction is moot when considering the effects of fertilizer and pesticide residues, which are currently the most important of these concerns (Meulenbelt and Vries 1997).

Environmental Health and Malnutrition Linkages

Recent studies show that contrary to the popular myth, malnutrition is not only the result of lack of food intake, but more often a consequence of bad sanitation and repeated infections (World Bank 2006). Environmental health risks such as inadequate water, poor sanitation, and improper hygiene practices affect children's health through diarrhoeal diseases and (indirectly) through malnutrition. This in turn affects future cognitive learning and productivity.

In large populous areas in South Asia and sub-Saharan Africa with high rates of malnutrition, there are also severe environmental health problems. Given the linkages among environmental health, malnutrition, and disease, WHO in 2007 recalculated the burden of disease estimates, taking into account the indirect (through malnutrition) health risks associated with inadequate water and sanitation provisions and improper hygienic practices. WHO estimates that almost 7 percent of the total burden of disease is attributable to inadequate water supply, sanitation, and hygiene when considering the direct and indirect linkages through malnutrition (Fewtrell et al. 2007).

Environmental Health and Poverty

The burden of disease due to environmental factors is highest in the poorest countries and to the poorest people within those countries. Cairncross and Kolsky (2003) highlight several reasons why environmental health is important to the poor and can have an impact on poverty reduction. They argue that:

- Poor people live in areas with the worst environmental conditions.
- The burden of environmental disease falls more harshly on the poor. The poor are more vulnerable and exposed to environmental disease and have lower resistance to infection. Interventions in environmental health would reduce health risks.
- The poor often pay proportionately more for environmental health services. Many people in low-income areas buy their water from vendors, who sell it for 10 to 20 times more than the official water tariff charged to people with house connections. Better access to water would enhance livelihood security as they will have more income.
- Disease contributes to poverty. When the poor fall ill, they lose income and even their jobs. Children with intestinal worms may be stunted in their growth or impaired in their intellectual performance. Improving environmental health would also reduce vulnerability. For example, a

hygienic environment and adequate sanitation are key factors related to reducing opportunistic infections associated with HIV/AIDS, and to the quality of life of people living with the disease. Improved sanitation and hygiene also helps to reduce the burden on households caring for AIDS-affected family members.

- Better environmental health conditions go beyond health outcomes. The main benefits often include (a) saving time, (b) lowering the cost of living, (c) increasing gender equality (security and dignity), (d) increasing convenience through service provision (recycling, building latrines, etc), and (e) reducing the burden of daily life. These benefits contribute toward better health and indirectly to improved productivity and economic growth.

Cities and urban slums

By 2030, it is estimated that urbanization in poor countries will result in more than 60 million new urban inhabitants annually. The United Nations estimates that nearly all of the population growth in the coming generation will be in cities in low- and middle-income countries. Asia and Africa, the most rural continents today, are projected to double their urban populations from 1.7 billion in 2000 to about 3.4 billion in 2030. Physical locations where multiple poverty-environment-health linkages overlap are a particular challenge, such as in slums. Very soon and for the first time, the world's urban population will be equal to the world's rural population, with a large percentage of city dwellers living in slums (Lee 2007). Asia has the largest number of slum dwellers overall with 581 million, while sub- Saharan Africa has the largest percentage (about 71 percent) of its urban population living in slums (United Nations Centre for Human Settlements Programme 2006). The urban poor living in slums are exposed to multiple environment health risks, including poor ventilation and inefficient cooking stoves, lack of access to water and sanitation, poor housing structures and construction, dirt floors, overcrowding, and poor and unsafe access to transport (Parkinson 2007).

Rapid urbanization and the uncontrolled growth of urban slums are now creating a double environmental health burden for the urban poor. They are exposed not only to risks from indoor air pollution, crowding, and poor access to water and sanitation (generally linked with rural populations), but also to modern risks associated with transport and industrial pollution (Satterthwaite 2007). In some parts of the world, malaria (and dengue) is increasingly becoming an urban issue (Breman et al. 2004), which will be further exacerbated by the effects of climate change (Campbell-Lendrum et al. 2007).

Environmental health is increasingly an urban issue. The concentration of population in cities is an opportunity to provide access to services and hence dramatically improve health outcomes in a cost-effective and rapid manner. Conversely, ignoring the growing slum settlements—with dismal environmental conditions and almost negligent access to environmental services—can derail attempts by city governments to provide healthy environments and improve health outcomes.

Environmental health and economic growth

Economic growth is inextricably linked with the productivity and performance of a nation's people. This productivity is often constrained by poor environmental health conditions— resulting in illness and consequently lost earnings, and increased medical costs. This economic burden on society placed by poor environmental health can be quantified at the national level as a percentage of Gross Domestic Product (GDP) (Figure 3).

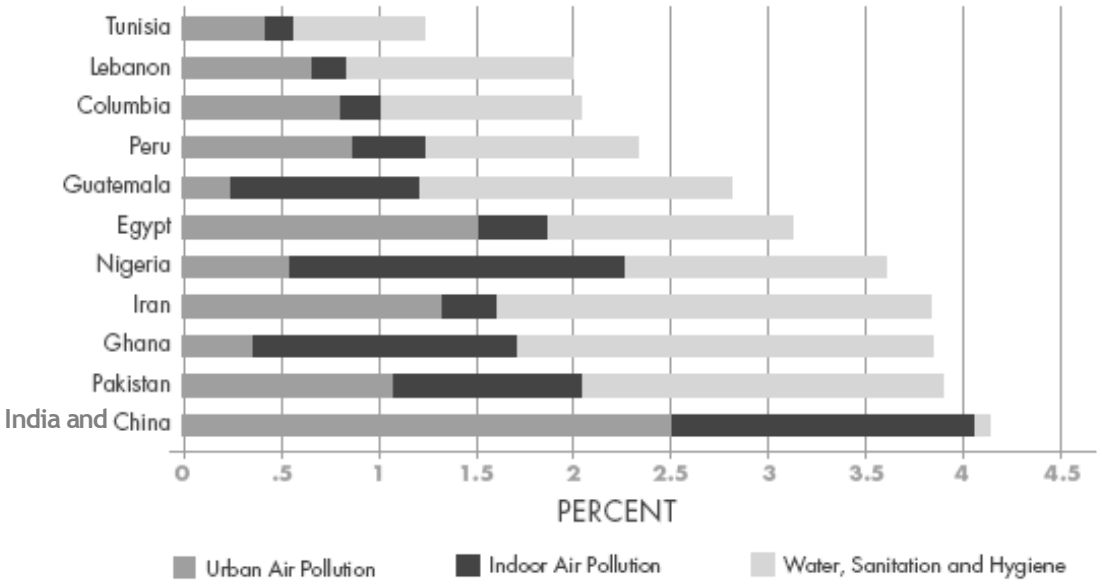

Figure 3: Economic burden associated with poor environmental health (as percentage of GDP)

Source: Poverty-Environment Partnership, Joint Agency Paper (2008)

For example, the estimated annual costs of environmental damage in Colombia (including water, sanitation and hygiene, urban air pollution, indoor air pollution, agricultural land degradation, and natural disasters) amounts to more than 3.7 percent of GDP per year. Two important categories contributing to this measure are inadequate water supply, sanitation, and hygiene; and

outdoor and indoor air pollution. Similarly, the annual losses associated with mortality and morbidity from air pollution alone in India and China range between 2 and 3 percent of each country's GDP. Environmental degradation threatens economic growth, accounting for economic losses equivalent to between 2 and 4 percent of GDP, and these costs are felt most severely by the poor. In some cases of South Asia and sub-Saharan Africa, when the impacts of environmental health and malnutrition-related linkages are further factored in, these damage costs increase significantly to almost 9 percent of a country's GDP (World Bank 2008).

Diseases and ill-health can constrain economic growth and impact the productivity of a country's working population. It has been estimated that malaria can reduce economic growth by more than 1 percent a year in highly endemic countries (World Bank undated). Furthermore, the perceived risk of infection has been shown to negatively affect investment, trade, and crop choice decisions. This imposes long-term costs by slowing economic growth and widens the gap between these countries and the rest of the world (Teklehaimanot et al. 2005).

Poor environmental health is also directly linked to human capital deficits that affect both present and future productivity. Children under five—facing over 40 percent of the global environmental burden of disease—are especially impacted by the cognition and learning impacts of environmental risk factors. An estimated 200 million children under the age of five fail to reach their potential in cognitive development because of poverty, poor environmental health and nutrition, and inadequate care. Additionally, repeated illness combined with cognition impacts also results in poorer educational performance in school-age children (Alderman et al. 2006). The UN Subcommittee on Nutrition reported increasing evidence to support an association between widespread iron deficiency, iodine deficiency, and helminth infection and poor school performance (Hunt and Peralta 2003). This failure of children to achieve satisfactory educational levels then impacts future work productivity, and plays an important part in the intergenerational transmission of poverty (Grantham- McGregor et al. 2007).

Healthy populations are more productive populations. Without a healthy and productive labor force, the economic growth that is necessary to break out of the cycle of poverty will not be achieved. Improving environmental health will contribute to promote sustainable and responsible growth.

Environmental risks and the disease burden in India

In India, premature death and illness due to major environmental health risks accounts for nearly 20 percent of the total burden of disease in India —second to malnutrition and larger than all other preventable risk factors and causal disease groups (World Bank 2001). The premature death and illness accounted in India is the result of diarrhoeal diseases, hepatitis, tropical cluster diseases, intestinal nematode infections, and respiratory infections in infants and children under the age of 5 (Smith, 2000). A large part of this burden was the result of the death of infants under the age of 1, while the second largest component consists of the death of children between 1 and 4 years of age.

Respiratory illnesses related to particulates exposure remain the top health concern, especially among children. The levels of urban air pollution in India are among highest in the world. The causal link between respiratory diseases and air pollution is less well characterized than is the link between diarrhoea and waterborne pathogens. Growing evidence from studies of the health effects of air pollution indicates that particles of small diameter can lead directly to respiratory infections and indirectly to exacerbated asthma attacks, allergies, and cardiac dysfunction. A variety of sources contribute to this problem: vehicle engines, household stoves, refuse burning, industrial boilers, and power plants, together with a significant level of “background dust” from unidentified sources. However, a recent assessment by the World Health Organization (WHO) relates most of the respective disease burden to exposure to indoor pollution due to the use of “dirty” solid fuels in the household. Women and young children are the primary victims of this exposure. Findings in a recent report from the Mumbai International Institute for Population Sciences using the India National Family Health Survey data demonstrate that children under age 3 living in households that use biomass (wood or animal dung) fuels for cooking are at one-third higher risk of developing acute respiratory illness than children living in households that use cleaner fuels. Various studies estimate the number of premature deaths (mainly among young children) caused by indoor air pollution at 400,000–2 million per year, while 40,000–300,000 adult deaths per year are attributed to urban air pollution (NFHS Bulletin 1997; Smith et al. 2000).

The World Health Organization has developed India’s profile of environmental burden of disease (Box 1).

Box 1: India's profile of Environmental Burden of Disease

Population	1103 mio
GNI/Capita	3460 US$
% Urbanization	29%
% People living in cities greater than 100 000 inhabitants	19%
Population below the poverty line (national)	29% (1999-2000)
Population below the poverty line (international, <$1/day)	35% (1999-2000)
Under age 5 mortality rate	85/1000 live births
Life expectancy	62 years

Environmental burden of disease for selected risk factors, per year

Risk Factor	*Exposure*	*Deaths/year*	*DALYs/1000 cap/year*
Water sanitation and hygiene (Diarrhoea only)	Improved water: 86% Improved sanitation: 33%	**402200**	**13**
Indoor air	SFU% households: 82%	**407100**	**10**
Outdoor air	Mean urban PM10: 84μg/m^3	**120600**	**1.1**
Main malaria vectors	*A. culicifacies, A. annularis, A. Fluviatilis, A. Stephensi* (urban)		
Main malaria vectors	*Culex quinquefasciatus, C.visnui, C. gelidus, C. Tritaanior -rhynchus, Phelebotomus papatasi, P. sergenti, P. major, P. argentipes*		

Environmental burden of disease (preliminary), per year

Estimate based on regional exposure and national health statistics, 2004

DALYs/1000 cap	(World –lowest:14, highest:316)	**68**
Deaths		**2 628 000**
% of total burden		**24%**

Environmental burden by disease category [DALYs/1000 capita], per year

Disease group	**World's Lowest**	**Country rate**	**World's highest**
Diarrhoea	0.2	14	114
Respiratory infections	0.1	10	56
Malaria	0.0	0.3	32
Other vector-borne diseases	0.0	1.7	4.2
Lung cancer	0.0	0.3	2.5
Other cancers	0.5	1.2	4.1
Neuropsychiatric disorders	1.4	2.3	4.4
Cardiovascular disease	1.3	4.5	13
Chronic obstructive - pulmonary disease	0.0	2.7	4.7
Asthma	0.3	1.3	2.4
Musculoskeletal diseases	0.5	0.7	1.5
Road traffic injuries	0.3	2.5	10
Other unintentional injuries	0.9	9.5	10
Intentional injuries	0.1	1.5	7

Other indicators

Use of leaded gasoline (2004)	No	
Overcrowding	77%	(2001)
Malnutrition (% stunting)	51%	(1998-99)

Source : WHO, 2007

Global Environmental Change and its impact

The poorest countries are often the ones that are most threatened by the degradation of the regional and global environmental commons. The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (2007) projected the impacts of future changes in climate by mid-century, including changes in freshwater availability, crop productivity, ecosystem structure and function, sea-level rise, and health. Specifically, the IPCC report notes that poor communities will be especially vulnerable due to their low adaptive capacity and their dependence on climate sensitive resources, such as food and water. The IPCC report also notes that the health status of millions of people, especially those with low adaptive capacity, is likely to be adversely affected. This will be manifested by increased deaths, diseases, and injuries from extreme weather events (for example, floods, heat waves, and storms); an increased burden of diarrhoeal diseases; and an altered distribution of some infectious disease vectors.

From both local and global perspectives, scaling up preventive environmental health interventions (such as clean water and sanitation services) to reduce the current burden of disease are wise investments as well as good "no-regrets" strategies. It is also worth notable that adaptation to climate change is "essentially a matter of basic public health protection" and spot the need to refocus political and financial commitments to strengthen environmental management, surveillance, and response to safeguard health from natural disasters and changes in infectious disease patterns, and a more pro-active approach to ensure that development decisions serve the ultimate goal of improving human health.

Preventing Disease through Healthy Environment

Health and environmental issues have been included in several high-level initiatives, including the United Nations Millennium Declaration, and regional interministerial conferences on health and the environment. Based on the principles of the Rio Declaration and Agenda 21 as a route to sustainable development in the 21st century, the world's leaders recognized the importance of investing in improvements to people's health and their environment. Despite the visibility of these issues, the importance of environmental health interventions in preventing disease is not always fully appreciated. Public and preventive health strategies that consider environmental health interventions can be very important. Such interventions are cost-effective and yield benefits that also contribute to the overall well-being of communities.

Many environmental health interventions are economically competitive with more conventional curative health-sector interventions. Examples include phasing out leaded gasoline. Mental retardation due to lead exposures in general was estimated to be nearly 30 times higher in regions where leaded gasoline was still being used, as compared with regions where leaded gasoline had been completely phased out.

A key target of the Millennium Development Goals (MDG-7) is halving the proportion of people without sustainable access to safe drinking-water and sanitation by 2015. Globally, WHO has estimated that the economic benefits of investments in meeting this target would outweigh costs by a ratio of about 8:1. These benefits include gains in economic productivity as well as savings in health-care costs and healthy life years lost, particularly as a result of diarrhoeal diseases, intestinal nematode infections and related malnutrition.

Providing access to improved drinking-water sources in developing countries would reduce considerably the time spent by women and children in collecting water. Providing access to improved sanitation and good hygiene behaviours would help break the overall cycle of faecal-oral pathogen contamination of water bodies, yielding benefits to health, poverty reduction, well-being and economic development.

Recognition that improving environmental health issues can directly help to contribute to reducing poverty is recognized in several MDGs. It also indirectly contributes to (a) eradicating extreme poverty and hunger, (b) achieving universal primary education, and (c) promoting gender equality. Reducing the disease burden of environmental risk factors will contribute significantly to the Millennium Development Goals. Many Millennium Development Goals (MDGs) have an environmental health component; key elements are highlighted below (Cairncross et al. 2003, Prüss-Üstün and Corvalán 2006).

GOAL 1: Eradicate extreme poverty and hunger

Environmental Health determinant:

- Water resources management practices
- Expenses incurred for informal sector delivery of water, and sanitation services; as well as costs of medical treatment imposes burden on family budgets (include for food)

Environmental Health intervention:

- Improved hygiene and sanitation

GOAL 2: Achieve universal primary education

Environmental Health determinant:

- Availability to water & energy sources
- Hours spent gathering water or fuel
- Unstable management of natural resources, including water & forests.

Environmental Health intervention:

- Providing safe drinking water and latrines at school, taking gender into account
- Access to improved sources of drinking water and cleaner household energy sources, saving time children spends collecting water/fuel.

GOAL 3: Promote gender equality and empower women

Environmental Health determinant:

- Women disproportionately suffer from: (a) exposure to smoke from use of biomass for cooking, (b) drudgery and inconvenience from poor access to water, and (c) privacy and dignity issues relating to inadequate sanitation facilities
- School attendance impacted by poor sanitation facilities

Environmental Health intervention:

- Access to improved drinking water sources
- Better sanitation facilities for both boys and girls
- Cleaner household energy sources

GOAL 4: Reduce child mortality

Environmental Health determinant:

- Leading causes of child mortality include diarrhoea, acute respiratory infections, and malaria
- Indoor air pollution impacts young children (immediate exposure)
- Sickness and deaths from inadequate hygiene, water supply, and sanitation

Environmental Health intervention:

- Cleaner household energy sources
- Improved access to clean water; proper feces disposal, better sanitation.
- Improved hygiene practices (including hand washing with soap)
- Promote use of insecticide treated bed nets (ITNs); indoor residual spraying (IRS)

GOAL 5: Improve maternal health

EH determinant:

- Poor delivery and birthing outcomes from inadequate hygiene, and availability of clean water
- Malaria and helminthes affect pregnant women and can lead to malnutrition in child

EH intervention:

- Safe water and sanitation
- Proper hygiene practices during delivery

GOAL 6: Combat HIV/AIDs, malaria and other diseases

Environmental Health determinant:

- HIV-infected have very special environmental health needs
- Environmental conditions related to mosquito breeding, e.g. irrigation, poor drainage and stagnant water etc.
- Inadequate water resources management practices

Environmental Health intervention:

- Safe water and sanitation
- Proper agricultural practices (intermittent irrigation, crop rotation, etc.);
- Promote use of ITNs; IRS
- Proper drainage

GOAL 7: Ensure environmental sustainability, Increase access to safe drinking water, Increase access to sanitation, Achieve improvements in slums

Environmental Health determinant:

- Poor access to water & sanitation
- Slum dwellers face dismal living conditions, congested settlements, and poor access to environmental services

Environmental Health intervention:

- Improve access to improved sources of drinking water, sanitation, and hygiene
- Improve quality of life among the urban poor through targeted slum upgrading projects

GOAL 8: Develop a global partnership for development

Environmental Health determinant:

- Lack of multisectoral coordination on environmental health issues—both horizontal and vertical links needed

Environmental Health intervention:

- Develop holistic, multisectoral approach with the coordination of multilateral, bilateral, national, and local institutions to implement them.
- Develop global partnerships

Concluding Remarks

Although much progress has been made in improving the quality of air, water and soil, the situation remains far from satisfactory from the health point of view. Proper environmental management is the key to avoiding the quarter of all preventable illnesses which are directly caused by environmental factors. There is an immediate need to tackle environmental health issues. Problems such as unsafe water, sanitation and hygiene, and air pollution are major contributors to the worldwide disease burden. Poorer communities are disproportionately affected by these issues, which seem likely to worsen with climate variability and change. Ill-health resulting from these problems affects individual's ability to earn a living or go to school, and also affect communities' efforts to improve their longer-term quality of life. At the same time, there may be significant opportunities to affect change rapidly, particularly in areas of population concentration—where poverty, environment and health issues all overlap—such as in urban slums.

Despite this, the institutional problems associated with working across disciplines—including environment, health, education, energy, water, sanitation, and hygiene—mean that a holistic approach to environmental health remains a challenge. Government departments—such as finance or planning—are particularly well suited to play a coordination role to address the environmental health agenda. National action by governments supported by other partners—including NGOs, the private sector, and multilateral and bilateral institutions—is important to achieve outcomes that can directly contribute to the MDGs. After all, a move toward results on this important agenda—and consequently a continuous improvement in the quality of human life—is essential for sustainable development.

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