

Issue Paper

Health and Environment

**prepared by
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Preface

People living in poverty are the ones that mainly suffers from ill-health caused by environmental hazards. 30% of the burden of diseases in the poorest countries are caused by environmental factors. Diarrhoea is still considered the leading cause of diseases, world-wide.

The reasons for environmental diseases are often found in the near home surrounding and poor people have less possibilities to protect themselves from bad quality of water, bad sanitation or indoor-air pollution.

However, during the last century we have seen in the developed world that these environmental problems are possible to solve and that solutions are available. Another acknowledgement is also that a large part of the solutions are found outside the health systems, for example through basic education, improved working and living conditions.

For Sida, it is also clear that improved environment health is closely linked to the strategy of poverty alleviation as people living in poverty are the main victims of environmental hazards and when actions for improvements are taken, it has a direct effect on poor peoples health, well-being and living conditions and therefore capacity to support themselves.

Sida has a long tradition of support to environmental health, primarily through multilateral agencies and this document has been written by Stockholm Environment Institute, Marianne Kjellén and the purpose with this issue paper is that Sida wants to bring up environmental health issues for a discussion with a broader audience.

Ewa Nunes Sörenson

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Contents

Preface	1
Acknowledgements	5
1 Introduction	7
Purpose and Structure of this Paper	7
Definitions and Focus	8
Health, Environment and Population Trends	9
2 Poverty, Environment and Health	13
Vulnerability	14
Food Insecurity	15
Malnutrition	17
3 Environmental Threats to Health	19
The Home Environment	19
The Work Environment	24
The Broader Environment	27
4 The Environmental Burden of Disease	33
Global Ill Health in Numbers	33
Ill Health Caused by Environmental Factors	35
Major Environmentally Related Health Problems	36
5 Well-being, Health and Environmental Improvement along with Poverty Alleviation	41
Annex 1	43
References	45
List of Health Division Documents	51

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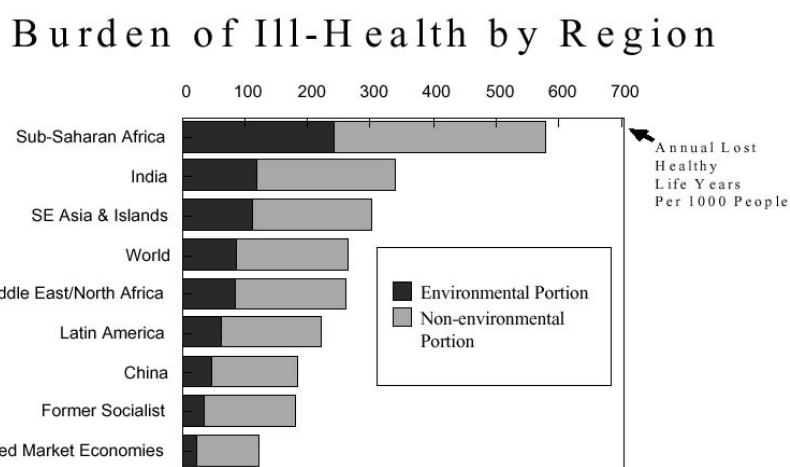
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Apart from initiating and providing the means for writing this paper, Ewa Nunes Sörenson of Sida's Health Division, also helped define the issues and shape the report. Anders Nordström and Mats Segnestam have as well given insightful and challenging comments. A stimulating discussion was held at a seminar at Sida in June 2001. It has not been possible to give justice to all the pertinent observations and suggestions. Responsibility for all errors and omissions remains with the author.

1 Introduction

People who live in poverty are those exposed to the worst environmental and health risks. Overall, somewhere between 25% and 33% of the global burden of disease can be attributed to environmental factors. This proportion is larger in conditions of poverty, where more environmental hazards are present in the nearby living and working environment, and people have less capacity to protect themselves against exposure and effects of harmful or unpleasant pollutants. The burden of ill-health by region, and its portion attributable to environmental factors, is illustrated in Figure 1. It shows that the overall health burden, and the environmental proportion, is highest in Sub-Saharan Africa.

Figure 1. The Environmental Portion of the Global Burden of Disease



Source: Smith et al. (1999), Figure 4

The environmental threats facing poor people tend to be more directly hazardous to human health. Moreover, poverty in itself worsens the effects of unhealthy environments, as malnutrition, beyond being a problem in itself, exacerbates vulnerability to disease. In addition, the death or illness of an income earner may further exacerbate conditions of poverty and have far reaching effects on the survival of the rest of the family.

Environment and health improvements, along with poverty alleviation, are complementary goals. Indeed, for poor people, more resources and greater control over their lives will lead to improvements in local environments and human health, particularly for children. Improved environmental services and cleaner surroundings, as well as better health care and education, are conducive to poverty alleviation and increased well-being. Indeed, initiatives leading to better household environments may be the most worthwhile for raising the standard of living of poorer groups of people in the world.

Purpose and Structure of this Paper

This paper has been commissioned by Sida as a way to bring environment and health issues up for discussion with a broader audience. The paper aims to summarise and synthesise the complex issues that relate to environment and human

health, and to identify the most important health-environment connections from a poverty perspective. Hopefully, it should be helpful for policy formulation, and contribute towards better designed development initiatives in the long run.

The paper has been divided into five sections. The introductory section outlines the subject and defines the main concepts. It also introduces some of the important demographic and environmental trends. Section two outlines how deprivation and adverse economic circumstances affect health and people's ability to cope. It also addresses some inter-linkages between poverty and environmental conditions. Section three is the core of this paper, focusing on environmental conditions that threaten human health. It starts with the home environment, where most of today's ill health is produced, and thereafter outlines some of the major occupational health challenges of relevance to developing countries. It also reviews a set of broader environmental issues that go beyond the other two spheres. The fourth section provides an overview of the health situation in the world, and outlines the major diseases through which the environment impacts on health. The final section highlights the role of poverty alleviation as a means to improve present environmental health conditions.¹

Definitions and Focus

The World Health Organization defines *health* as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.” This definition captures the multidimensional nature of human well-being, but leaves the concept of health unbounded. While embracing the concern for all aspects of well-being, this paper focuses mainly on the physical (bio-medical) aspect of health, simplified as the absence of disability, death, and disease. Furthermore, the health conditions that receive attention in this paper are those with strong links to the physical environment.

The concept of *environment* in this paper is limited to the ‘physical environment,’ which the World Resources Institute (1998, p. 6) refers to as “the physical, chemical, and biological setting in which people live – in other words, the condition of the air, water, soil and climate.” What falls outside this definition is the social environment: lifestyle and behavioural choices, such as smoking, alcohol abuse or the social and psychological factors affecting both mental and physical health. Thus, while the social environment is utterly important to human health, it is not dealt with in this paper.

Poverty involves multi-dimensional deprivations. Narayan *et al.* (2000) highlight *material poverty*, especially the lack of food, the absence of *basic infrastructure*, vulnerability to *illness*, which is dreaded because of the cost or lack of health care, and how it can plunge a family into destitution, and *psychological aspects* such as

¹ Several of the issues and conclusions in this issue paper have been developed and elaborated in the much longer, but regionally focussed, report on *Environmental Change and Human Health in Countries of Africa, the Caribbean and the Pacific* (McGranahan *et al.*, 1999). Also, the World Resources Institute's 1998–99 report *A Guide to the Global Environment: Environmental Change and Human Health* (World Resources Institute, 1998) and several reports of the World Health Organization have been important sources of data and information. The article *How much global ill health is attributable to environmental factors?*, by Smith *et al.* (1999) quantifies the effect of the physical environment on human health. This provides a basis for the relative importance given to different disease categories and environmental issues in this paper.

having to cope with rudeness, humiliation and inhumane treatment. Finally, the lack of *assets* makes poor people vulnerable and exposed to risk. These multiple aspects capture most of the important characteristics of poverty. As they are not easily measured, however, statistics on poverty tend to focus on consumption (or income) levels. The concentration on income poverty as well reflects its historic role in the way poverty has been defined. Because of the focus of this paper, illness, material poverty and lack of basic infrastructure will feature more than the other, equally important, aspects.

This text addresses the links between environment and health, particularly as they appear in conditions of poverty. Moreover, as a betterment of human health (rather than ecosystem health) is the main premise of this work, the concomitant environmental priorities are those conducive to human well-being, particularly for poor people in developing countries. Indeed, as stated in Principle 1 in the Rio Declaration on Environment and Development: *“Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.”*

Health, Environment and Population Trends

The 20th century has seen an extraordinary global transformation in human health. The steady increase in life expectancy, which began in Europe in the late 1800s, has been manifest throughout the world during the 20th century. This global revolution in health has transformed the quality of individual lives, as well as the demography of populations (World Health Organization, 1999). The genesis of these improvements in life expectancy is debated, although they are at least partially linked to the economic changes resulting from agricultural and industrial revolutions. Better health and nutritional status are both results and causes of income growth at individual and societal levels.

This ‘health revolution’ is both underpinned by, and results in, epidemiologic (shifting health and disease patterns) and demographic (shifting age structure of the population) transitions. These transformations, as seen in history, started with declining death rates, due to improved social, economic and medical developments, which over time were accompanied by declining birth rates. This transition took some hundred years in today’s developed countries, which now have a population where those aged over 65 make up a large part of the total, and with most deaths occurring in this age group.

The epidemiologic transition implies a shift away from high levels of infectious diseases and a high death toll among children, towards a higher proportion of chronic illnesses, such as cardiovascular diseases and cancers.² There is also the ‘self-fuelling’ element, in that where the proportion of adults increases, the overall toll of infectious disease in the population decreases, as young children constitute the main population segment at risk of communicable diseases. Still, as development is rarely uniform, the challenges that evolve for different groups differ considerably. This type of uneven development, unequal distribution of

² Although chronic (non-communicable) diseases increase in proportion, they do not increase in absolute numbers. Note that the overall mortality is reduced in the demographic transition.

wealth and the incomplete coverage of health services, leads to ‘epidemiologic polarisation,’ where the gap in health status among social classes and geographical regions widens (Bobadilla *et al.*, 1993).

The transitions seen in history in the now developed regions, give rise to the expectation that infectious disease will also decrease in magnitude in developing countries. As populations grow increasingly older and wealthier, non-communicable and old-age diseases should become the major challenges. However, even though mortality has decreased substantially all over the world, infectious diseases still account for a large burden of ill-health in developing countries, particularly where HIV/AIDS prevalence is high. The remaining challenge of infectious disease and illness related to malnutrition and poverty is often referred to as ‘the unfinished agenda.’

As mentioned above, the health transition is largely fuelled by (and contributes to) economic developments and commensurate improvements in the living standards of the majority. A major intermediating factor between economic developments and health improvements is the environment, and the type of environmental exposures to pathogens or other harmful substances that people live with. The environmental transition implicated here is that, over time and with increasing affluence, most people’s home environments have become cleaner and increasingly conducive to good health.³

Most environmental health problems are linked to poverty. They typically include those environmental hazards posed by biological agents, exacerbated by poor sanitation, lack of safe water, smoky kitchens, and crowded dwellings in garbage-strewn neighbourhoods. With increased economic development, many of these problems are resolved, by way of higher quality housing and societal services to households. Where these environmental and health challenges remain, they are often referred to as the ‘persistent poverty cluster’ or the ‘brown agenda.’ Given the enduring importance of these issues in developing countries today, they are the main focus of this paper.

On the other hand, other environmental hazards are associated with economic development in itself, rather than the lack of it. These include many chemical pollutants that are hazardous to both human and ecosystem health. These issues can be termed the ‘conventional development cluster’ of problems, or the ‘green agenda,’ and are those that pose the largest challenges in many industrialised and industrialising countries.

These seemingly contradictory health outcomes of economic development follow a logic of environmental displacement. While wealthy societies consume more resources and produce more waste, they also use their wealth to protect themselves from personal exposure to harmful or unpleasant pollutants (McGraham & Songore, 1994). Thus, by pushing environmental problems away from the living environment, health gains can be achieved, although often at the expense of environmental insults at a distance. Global environmental change is

³ This ‘environmental transition’ has been amply described in the urban context, see for example McGraham *et al.* (2001).

a prime example of this, and poses particular challenges for the sustainability of development trends.

It is important that the 'persistent poverty' and 'conventional development' clusters of problems are not treated as being in opposition to one another. With better policies, economic development can be pursued without many of the environmental insults associated with unfettered industrial development. And with equitable distribution of wealth and access to societal services, economic growth can be more effective in sustaining quality of life and health gains for all groups in society. Moreover, many environmental improvements need not necessarily await economic development. Through collective action societies can prioritise which problems to address and how to use common resources for potentially better living environments for all individuals.

Apart from formidable health gains during the past hundred years, the world has also seen a population explosion. From 1 billion persons in 1800, the globe is now inhabited by over 6 billion people. World population growth rate peaked at over 2% in the late 1960s, and is in the early 2000s running at a projected 1.2%. There are sharp contrasts between regions: Africa's current population growth rate is estimated at 2.36% per year, whereas developed regions grow at only 0.2% per year. The absolute population increase in numbers continued to rise for three decades after the peak growth rate had been passed, and peaked at 86 million a year in 1985–90 (Harrison & Pearce, 2001).

The presently decreasing population growth rates are, put simply, due to rapid fertility decline. Some of the fastest drops in fertility have been witnessed in Kenya, where the total fertility rate (number of children per woman) dropped from 8.1 in 1975–80 to 4.4 in 1995–2000, and Iran, where fertility fell from 6.8 in 1980–85 to 2.8 in 1995–2000 (Harrison & Pearce, 2001). Access to family planning methods and female education is critical for reduced fertility. Women with an education on average marry later and have fewer children. Moreover, their children tend to be healthier and are more likely to survive to adulthood (Swedish International Development Cooperation Agency (Sida), 1997).

The links between population factors and the environment is a controversial topic. Population growth has long been associated with environmental depletion and collapse following Malthus' essay on population in 1798. This pessimistic view of population-environment links is maintained by several environmental NGOs although Malthus' ideas that population will be controlled by limited food production has been proven wrong by history (Forsyth & Leach, 1998; McGranahan *et al.*, 1999; Pebley, 1998). 'Non-renewable' resources have not been depleted in the way forecast by, for example, the 'Club of Rome' (Meadows *et al.*, 1972). However, 'renewable' resources, such as water, soils or wild fish stocks, are much more vulnerable to overuse or pollution (Harrison & Pearce, 2001; Sterner, 2000).⁴

⁴ The enormous human-induced environmental changes that have taken place during the past 200 years have, albeit not equally distributed across society, clearly improved human welfare. Fertility of agricultural lands has increased, and built-up areas protect humans from disease agents. It is increasingly clear, however, that many of these changes have also brought substantial environmental costs (Pebley, 1998).

The combined forces of population pressure and economic marginalisation can lead to the breakdown of traditional resource management, and to environmental degradation as well as increased poverty. There is however a wealth of empirical research showing people's ability to act collectively to overcome pressures on (common property) natural resources, and where population density may have positive impacts on the environment (Fairhead & Leach, 1996; Forsyth & Leach, 1998; Ostrom, 1990; Tiffen *et al.*, 1994).⁵

Urbanisation, as well as population growth, is often portrayed as a threat to environmental sustainability. Cities concentrate and, in many ways, symbolise environmentally destructive practices. However, the urban life styles would not become more sustainable were they to be transplanted to rural areas (McGranahan *et al.*, 2001). In fact, dispersed settlement patterns may be more harmful to wildlife and wilderness, on the whole, than urban concentration (Pebley, 1998). Moreover, with close to half of the world's population residing in urban areas, some 2–3% of the land area on Earth, it would be unreasonable to think that the 'ecological footprint' of cities should not extend beyond the built-up area. Nonetheless, environmental improvements in urban areas, as described below, are crucial for better human health as well as environmental sustainability. For this, it is important to address the quality of urbanisation, where policies can have considerable impact, rather than its rate, which democratic societies have not been able to control (McGranahan *et al.*, 1999).

Both population growth and urbanisation may best be understood as broader processes of change, rather than as drivers of environmental degradation. Indeed, where efforts to improve health manage to reduce child mortality, this should not be assumed to contribute to environmental damage, nor to long-term population growth.

⁵ Ehrlich *et al.* (1973) express the human impact on the environment as *population x consumption (or affluence) x technology* (I=PAT). Ehrlich *et al.* used the formula to show population growth as the dominant factor driving environmental damage, but in many fields, consumption has grown more rapidly than population (Harrison & Pearce, 2001). Technology can either augment or reduce the impact of the population's resource consumption. While the equation has an appealing simplicity, the elements are not independent in the real world. The IPAT framework can be a useful way of illustrating policy options, but it assumes rather than tests relations between input and output variables (Pebley, 1998).

Poverty, Environment and Health

Poverty is the main determinant of food insecurity and malnutrition, and acts with poor environmental quality to create and maintain poor human health. This partly relates to how poverty is defined (see above), but also to the fact that even conventionally measured (i.e. through the lack of income), poverty is the best predictor of ill-health and exposure to environmental hazards.

Table 1. *Income Poverty by Region*

People living on less than one dollar a day (Measured at purchasing power parity, PPP)						
Region	Year:	1987			1998 (preliminary)	
		Millions of people with <\$1/day	% of total population	Share of total that live on <\$1	Millions of people with <\$1/day	% of total population that live on <\$1
South Asia		474.4	44.9%	40.1%	522.0	40.0%
Sub-Saharan Africa		217.2	46.6%	18.4%	290.9	46.3%
East Asia and Pacific (incl. China)		417.5	26.6%	35.3%	278.3	15.3%
Latin America and the Caribbean		63.7	15.3%	5.4%	78.2	15.6%
Europe and Central Asia		1.1	0.2%	0.1%	24.0	5.1%
Middle East and North Africa		9.3	4.3%	0.8%	5.5	1.9%
Total		1,183.2	28.3%	100.0%	1,198.9	24.0%

Data source: World Bank (2000b), Table 1.1 and Figure 1.1, citing Chen and Ravallion (2000)

Table 1 shows how many people are estimated to live on less than one dollar per day.⁶ Currently, the largest numbers of income poor people are to be found in South Asia, which together with Sub-Saharan Africa have the highest proportion of people estimated to have such low consumption levels.⁷ The most noteworthy change between 1987 and 1998 is that the share and absolute number of people living below the \$1 poverty line in East Asia has been dramatically reduced. Indeed, people in this region have gained substantially from international specialisation and trade during the past few decades, although recent economic turbulence threatens to erode benefits. Unfortunately, in times of economic downturns, those already poor tend to be the hardest hit (Ravallion & Chen, 1997).

Table 1 above displays a measure of *absolute* poverty, which is most common and severe in developing countries. There is also *relative* poverty, which features many of the aspects tied to the concept of poverty. The feeling of deprivation when you

⁶ Apart from being difficult to measure, the \$1 poverty line also provides only a very rough guide to income poverty, which for example tends to ignore differences within countries. In particular, the level of urban poverty is often underestimated, as the cost and nature of basic necessities are usually more expensive there (Satterthwaite, 1997). The Purchasing Power Parity (PPP) aims to take account of differences between countries.

⁷ Both these regions also have low urbanisation levels; 72% of the population in South Asia are estimated to live in rural areas, 68% in Sub-Saharan Africa (World Bank, 2000a).

cannot fully participate in society is difficult for social beings like humans. Also, poorer health and shorter life spans are associated with lower positions in any given system of social stratification, whether measured by occupation, social class, prestige, education or access to material resources. Such socio-economic health gradients (of varying magnitude) have been observed since statistics have been available, both for market and non-market economies as well as in societies with more or less developed welfare systems (Macintyre, 1998). Not surprisingly, equality and social cohesion are beneficial to health (Wilkinson, 1998).⁸

Even though relative deprivation has important implications for health, particularly as mediated through the social environment, it should not obscure the desolation of absolute dispossession. Hunger relates to the irreducible core of deprivation (Sen, 1982). The remainder of this section deals with vulnerability, food insecurity and malnutrition, which are all at the core of how poverty links with poor environmental quality and health.

Vulnerability

Vulnerability is an important characteristic of poverty, linked to the fact that poor people have fewer assets to draw on for dealing with adversities of different kinds. They also face higher risks as, for example, poor people more often live in ecologically fragile areas, including areas of low agricultural potential and squatter settlements in urban areas (Ekblom & Bojö, 1999). This is explained by the fact that poor people lack the resources to relocate themselves or take protective measures against precarious environmental conditions. In addition, lower education and political marginalisation together reduce the potential for accessing infrastructural services or other societal assistance, and thus increase adverse health outcomes. Comparatively small additional expenditure, such as the treatment of a sick family member or the replacement of a roof after a storm, may be enough to throw a poor household into a vicious debt cycle.

Small-scale farmers, pastoralists and artisanal fisher communities are more vulnerable to the loss of biological resources. As they often exploit open access resources, where the main production cost is family labour, they also tend to be negatively affected by privatisation of land and agricultural expansion. Where family labour is important to survival, it may be an advantage to have large families. This has been seen as one factor driving people already living on the edge towards further destitution and resource scarcity. On the other hand, there are many cases where population increase has been shown to drive institutional and technological change towards environmental and economic improvement (Boserup, 1981; Fairhead & Leach, 1996; Tiffen *et al.*, 1994).

For obvious reasons, displaced persons are amongst the most vulnerable. The root causes of refugee problems are manifold and often interconnected, ranging from armed conflicts and political oppression to economic hardship or natural disasters (Kemppi-Repo, 1994). Associated problems include malnutrition, disease epidemics and psychological traumas. In 1999, there were close to 14 mil-

⁸ Global developments during the past decades have unfortunately not fostered economic equality. The ratio between per capita income between the richest fifth of the world's people and the poorest fifth widened from 30 to 1 in 1960, to 74 to 1 in 1995 (United Nations Development Programme, 1999).

lion refugees and asylum seekers in the world (International Federation of Red Cross and Red Crescent Societies, 2000). Most migration, however, occurs within national boundaries. The United Nations High Commissioner for Refugees estimates that around 20 to 25 million people are internally displaced due to conflict, with up to 16 million of these in Africa and 6 or 7 million in Asia (Harrison & Pearce, 2001).

Economic globalisation can also increase vulnerability of disadvantaged people. Many of the poorest countries have lost more than they have gained through the international economy during the past few decades. Research has shown environment and health costs rather than benefits from structural adjustment programmes and trade agreements (McGranahan *et al.*, 1999; Stephens *et al.*, 2000).

Food Insecurity

Food security is achieved when all people at all times have access to sufficient food for a healthy and productive life. Its main components are 1) food *availability* – the existence of (sufficient quantities of) food and 2) food *accessibility* – people's ability to actually get hold of food, which is most importantly mediated through income.⁹ Unfortunately, accessing enough food at the household level does not necessarily provide nutritional security for all household members, as the distribution of food within most households varies (Denninger *et al.*, 1996).

Table 2. *Chronic Under-nutrition*

Estimated population suffering from under-nutrition in 93 developing countries, 1994/96		
Region	Share of population	Millions of people affected
Sub-Saharan Africa	39%	210
South Asia	21%	254
East Asia	14%	254
Latin America and the Caribbean	13%	63
Near East and North Africa	13%	42
Total	19%	828

Source: FAO, cited in McGranahan *et al.* (1999), Table 4.1

There is enough food produced in the world for everyone to eat sufficiently. But, as access to food is impaired for many people, some 19% of the world's population is estimated to suffer from under-nutrition (too low nutritional intake), see Table 2 above. Sub-Saharan Africa has the highest share of its population estimated to be under-nourished, although the largest numbers of people affected are in the more populous South and East Asia. It is noteworthy that the level of income poverty in South Asia is about the same as in Sub-Saharan Africa (see Table 1 on page 7), but this problem is more directly translated into insufficient food intake in Sub-Saharan Africa. This is also the region with the highest burden of disease.

⁹ Beyond these two supply and demand functions, there is also the issue of food *utilisation*, or people's ability to make use of the food, i.e. consume it in a way that ensures growth, nutrition and health. This ability is often impaired through disease, in turn linked to inadequate access to water, sanitation, childcare and health facilities (Haddad, 1997).

Sub-Saharan Africa has by far the lowest crop yields per hectare, compared to other regions in the world (FAOSTAT, 1998, cited in McGranahan *et al.*, 1999). Although population growth rates are declining, this region's population will continue to increase for at least the next 25 years (Pinstrup-Andersen *et al.*, 1997), and increases in food production are clearly desirable.

The major constraining factor for increased agricultural production in Sub-Saharan Africa is probably the lack of local effective demand (Delgado, 1997). Even though food requirements are as high in Africa as anywhere else, poverty acts to constrain these needs from being translated into market demand for food. High transaction costs also make it difficult for producers to exploit more distant market opportunities. The low food productivity in Sub-Saharan Africa can be addressed through a combination of measures helping to stimulate demand (mainly income-generation) and to lower transaction (mainly transport and information) and unit cost of production (e.g. extension services and agricultural inputs). The agricultural potential in Africa is however also hampered by low and erratic water availability, which may be further exacerbated by global climatic change.

It is important not to conflate food availability and accessibility. Only subsistence farmers are directly and solely dependent on food production for their food security. More generally, it is through income (or other means of entitlement) that people access food. If there is a loss of livelihood (source of income), people will become vulnerable to hunger, unless they have assets to sell or are able to attract help through family networks or other means of support. There are cases where market mechanisms may put such vulnerable people at a further disadvantage: As long as the dispossessed do not have purchasing power, the need for food will not be translated into effective demand in the market.¹⁰ Examples of successful public responses to famine in Africa (and elsewhere) have included (apart from direct food support) both employment provision and cash support, leaving the task of food delivery to market mechanisms. In such cases, private trade can be confidently expected to move food in the right direction, i.e. towards (rather than out of) affected areas (Drèze, 1995). We know now that extreme food insecurity such as famine events are preventable, and luckily they are less and less prevalent. When they occur, it is generally in association with wars or natural disasters.

Particularly in rural areas, poor people more often depend on the alms of nature. This includes food and fuel, both for own use and sale, as well as medicinal plants and other specialty items. In rural areas, women in particular tend to make use of wild resources. These resources are exceptionally important in times of stress, e.g. the 'hunger season' (Chambers *et al.*, 1981; McGranahan *et al.*, 1999; Scoones *et al.*, 1992).

For better food security, more reliable livelihood conditions are of utter importance. This can mean better access to income-earning opportunities or land for

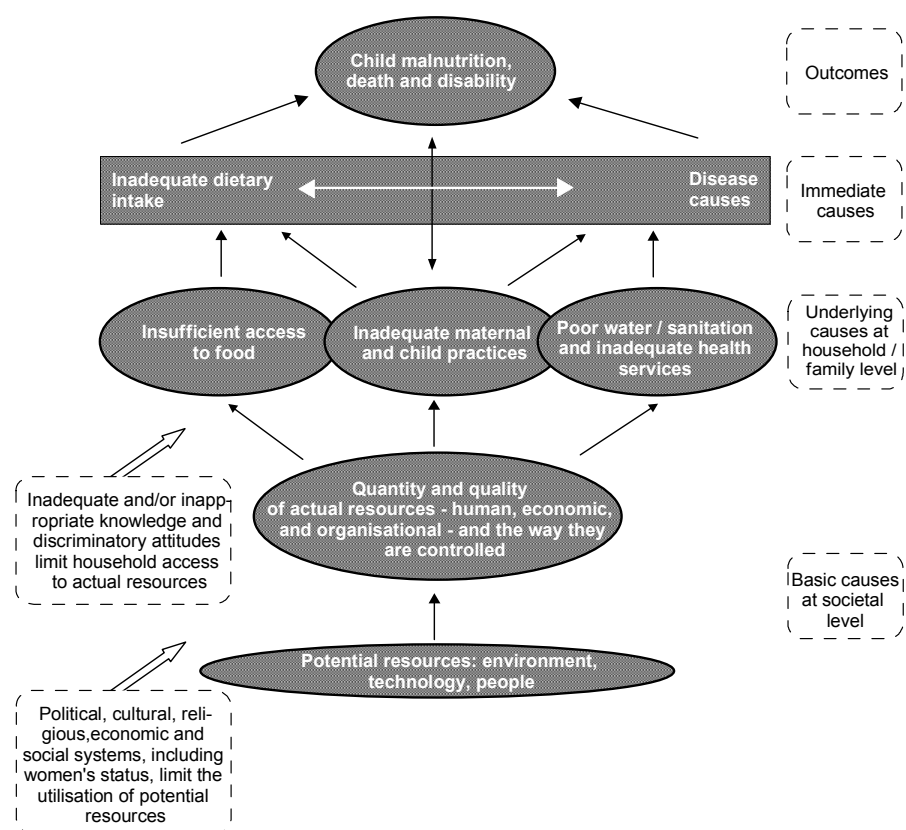
¹⁰ Research on some of the world's catastrophic famines convincingly shows that the link between food availability or production and the lack of food to eat is very tenuous. During the 1974 famine in Bangladesh, for example, the 'famine districts' had relatively high availability of foodgrains per head. During that famine, as well as that in Wollo, Ethiopia, in 1973, food was being exported from the famine-stricken regions (Sen, 1982).

cultivation. Indeed, secure and stable land tenure (property rights)¹¹ can contribute to food security and environmental protection, particularly for weaker social groups. Support to rural women is of particular importance (McGrath et al., 1999). Unfortunately, low-cost input sustainable agricultural systems have largely been ignored by agricultural development assistance schemes, and they face severe competition from subsidised food exports from industrialised countries. Yet small-scale agriculture is crucial as it provides livelihoods for poor rural people.

Malnutrition

Malnutrition refers to any nutritional disorder: usually the under-consumption of protein and energy and/or deficiencies in key micronutrients. Malnutrition is generally the result of a combination of inadequate food intake and infection. Children are particularly at risk. There is a vicious circle consisting of children not eating well enough, leading to their immune system being lowered, resulting in greater incidence, severity and duration of disease, implying nutrient loss and suppressed appetite, leading to children not eating well enough (UNICEF, 1998).

Figure 2. Causal Chains Affecting Child Malnutrition



Source: UNICEF (1998), Fig. 5

¹¹ Property rights should not be confused with *private* property. In fact, the provision of communal land and collective ownership is important for societal development. It has often been the erosion of common property rights that has led to environmental

Overall, 16% of the burden of disease in the world can be directly attributed to malnutrition, with the corresponding figure for Sub-Saharan Africa being 33%, for India 22% and 15% for Asia (excluding India and China) (Murray & Lopez, 1996). UNICEF (1998) estimates that about 55% of all child deaths in developing countries are associated with malnutrition.

The conceptual model developed by UNICEF, see Figure 2 above, shows the many interrelated factors involved in producing child malnutrition, death and disability. A combination of poor access to food, insufficient education or awareness of good care practices, and the lack of supportive and protective infrastructure such as safe water and sanitation, lead to the vicious circle of inadequate dietary intake and disease mentioned above. Beyond these directly contributing factors, different societies provide different levels of support or difficulties for vulnerable people. The incomes, education and status of women are crucial for better childcare, nutrition and health. Discriminatory practices reducing access to health care and other resources are disastrous to those affected. Poverty is implicated in all these aspects.

As seen in the figure above, both good household environmental conditions and food security are implicated as directly helping towards child health and survival. Food security is dealt with in the previous section, and household environments are dealt with below.

3 Environmental Threats to Health

The environmental issues reviewed in this section are grouped into home, work and the broader environment. These groupings are based on a combination of geographic and functional aspects of the type of problems and the scale at which they surface, forming categories which may be useful for devising intervention strategies. However, the divisions are arbitrary, and cross-references abound in the text. The reality is even more complex.

In the home environment, the level of exposure to existing pollutants is high. The major threat is made up of pathogens, but there are also problems of discomfort, inordinate work burden for women, and exposure to chemical substances from cooking fires and insecticides. To improve the home environment, individuals and households need increased capacity to protect themselves from disease and nuisance, typically through enhanced services, e.g. water, sanitation, waste removal and improved housing. Also, hygiene education, fostering behaviours conducive to good health, as well as secure tenure, helping to motivate home improvements, are important. Community-level institutions also play a key role. The problems in this area are often referred to as the 'persistent poverty cluster.' They go hand in hand with poverty and are generally not present in rich countries, nor in wealthy households in poor countries.

The section on occupational health deals with chemical and biological pollutants as well as accidents in the work environment. Many environmental health hazards that arise in conjunction with economic activity can be referred to as the 'conventional development cluster' of problems. Where workers employed outside their homes are exposed to environmental hazards, more effective regulation, combined with better-informed workers with enhanced capacity to negotiate collectively with their employers, can help improve the situation. In the informal economy, including many home-based industries, increased awareness of health risks may be the most effective strategy.

Improving the set of broader environmental issues requires strategic planning, involving a combination of regulation, market-based instruments and good governance. There are inter-generational and international trade-offs that complicate matters. A major part of the health gains seen in the industrialised world have been achieved through the displacement of environmental insults, from the nearby living environment onto more distant ecosystems. Thus, while displacement can contribute to better human health, it does not solve environmental problems. The challenge of sustainability remains, both for developed and developing countries. When addressing these issues, often related to the final disposal of (solid, liquid or gaseous) wastes, it is important not to pit the poor of today against tomorrow's unborn.

The Home Environment

Environmental problems that are localised to homes and neighbourhoods in developing countries tend to have immediate and health threatening effects. Hence, the problems are not long-term, as those related to global environmental change, nor do they pose serious threats to the ecological basis for human

survival. People's living environments are where improvements can do the most to enhance human health in developing countries.

Those mostly affected are children and the elderly, who are more susceptible to infections. Also, women typically spend more time in and around the home than men, because they carry a disproportionately high responsibility for household chores, and often also have their economic activities located within the home area. Hence, women have a higher stake in the home and neighbourhood environments, partly because of being more directly affected, but also because of the work burden implicated for women in caring for the sick and maintaining cleanliness in the home. Women also tend to be more active in organising neighbourhood improvements (Moser & Peake, 1987), and spend proportionally more of their incomes on child nutrition and house improvements.¹² Box 1 on the next page tells a story of a rural woman's strife to secure the daily water needs for her household.

Water, Sanitation and Hygiene

The health risks involved in poor water, sanitation and hygiene are multifaceted. Various diarrhoeal and other diseases are spread via faecal-oral routes, which are far more accessible when water supplies and sanitary conditions are inadequate. Diarrhoeal diseases are almost entirely caused by the environmental factors of poor sanitation, hygiene and access to clean water and food (Smith *et al.*, 1999).

Where conventional (piped) services are lacking, water and sanitation facilities tend to be characterised by diversity, inadequacy and high levels of sharing. The difficult access to water induces (mainly) women and children to spend a lot of time and effort on water collection. A study in Port Elizabeth, South Africa, found waiting time at communal taps of up to 90 minutes. The average was a 16-minute wait at each water collection trip (Thomas *et al.*, 1999). In urban areas, there may also be high household expenditure on water (Bhatia & Falkenmark, 1993; Kjellén, 2000; McPhail, 1993). Similarly, lack of sanitary facilities can also warrant payments for toilet use (Kjellén *et al.*, 1996) and even jeopardise women's security when forced to seek solitary places to defecate (Cairncross *et al.*, 1998). In both rural and urban contexts, human faeces are used as fertilisers. While sound from an ecological perspective, it can enhance the risks of direct contact with faeces and food contamination.

¹² Women's roles in household environmental management in the urban context have been well described and analysed by Songsore & McGranahan (1996; 1998). These tasks are more onerous in conditions of poverty. While male spouses may be losing their jobs outside their homes, they do not spend their extra time assisting their female spouses with household chores. Indeed, men engaging in 'women's tasks' may be called derogatory names. Chant (1994) observes that where women are increasingly engaged in outside work, female relatives, rather than male spouses, are called upon to help maintain the household environment. Indeed, higher status of household environmental chores, or alternatively, the status of women, could go a long way towards improving the household environment and the conditions under which it is maintained.

Box 1. A Day in the Life of a Woman

“Consider a day in the life of a woman of Mkuu, a farming community on the vividly green slopes of Mt. Kilimanjaro in Tanzania. Just after sunrise she gets her four children out of bed. The two little girls she sends one kilometre up the mountain to a rural standpipe; they fill their small basins with water diverted from an upland stream and walk back, pans on their heads, down through the banana groves and garden to the house, where the mother stores this water in a big wooden cask with a wooden lid. She has a larger 200-liter cask outside which collects water from her sheetmetal roof when it rains, but today it is dry. The stream running only 340 meters from the house she considers unsafe to use.

“While she is getting the morning meal ready her husband washes, and after they have eaten she washes the dishes. A bit later her husband and a visitor each take a bath, a process which uses about twice the amount of water she has used for the morning cooking and cleaning and empties the storage pot. The mother then takes a tin and goes off for more water, carrying the 18-kilogram load back from the standpipe on her head. To start her noon cooking she dips out water with an aluminium bowl she bought especially for this purpose, and realizes that there will not be enough water for the afternoon, so she makes another trip. Her largest use comes at the evening meal, and in preparation she sends the children off after school to make two trips to the standpipe in order to fill the storage cask. Before they go they each get a drink, dipping the water out of the small clay pot where water is reserved for drinking only. She feels that this is clean and safe to drink without boiling.

“On this day the mother has spent about an hour herself fetching water, and the children have spent several hours at this task. On a day when she does more housecleaning or washing of clothes she needs more water.”

Source: White *et al.* (1972), pp. 4–5

Health improvements tend to be most prominent through sanitation interventions, at least when measured against diarrhoea prevalence. Improvement of sanitation facilities yield particularly positive results in urban areas (where crowding makes unsanitary faecal disposal much more problematic). Improved water supplies also have positive health impacts, which are manifest when including more sensitive health measurement such as children’s height and weight. Many of the benefits from water may be indirect through time and energy saving, making more attention and resources available for childcare and nutrition. Most importantly, however, there are synergistic effects when providing sanitation and water together, particularly in rural areas (Esrey, 1996).

In order to achieve maximum health impact and other positive effects as well, it is important to take a holistic approach to living conditions. The ways in which water and sanitary facilities are used are crucial for their contribution to better health. Conversely, improved hygiene habits are difficult to maintain in the absence of supporting water and sanitary facilities. Some of the complexity and the compounding of risk factors are illustrated in Box 2 below, showing the importance of addressing several behavioural and infrastructural factors together, and also pointing to the higher risks borne by (the poorest) households suffering multiple deprivations.

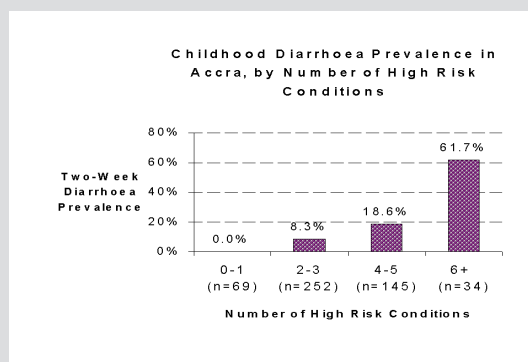
Box 2. Compounding of Risk Factors for Diarrhoeal Disease

A household questionnaire survey in Accra provided information on diarrhoea prevalence, along with indications on the type of environmental and behavioural risks the people in the household faced in their daily lives. Overall, thirteen per cent of all households with children below six years of age had had at least one child with diarrhoea in the two weeks preceding the interview.

Through one of the more common techniques employed by epidemiologists, logistic regression, simultaneous analysis of diarrhoea prevalence and a number of possible explanatory factors can be made. This was used to identify a number of high risk conditions for diarrhoeal disease:

- Sharing toilet with more than five other households
- Outdoor defecation by neighbourhood children
- Experiencing water interruptions
- Storing water in open container
- Using pot for storing water
- Many flies in kitchen
- Not washing hands before preparing meals
- Buying prepared food from vendors

The risk conditions listed above relate to a number of infrastructural and behavioural conditions. The diagram below shows households grouped according to the number of high-risk conditions they face. In the households facing less than two of the risks identified, none of their children had had diarrhoea, while most of the households facing six or more of the risks had had at least one child with diarrhoea.



This compounding of risk factors displays the importance of a holistic perspective towards improving health and living conditions in poor neighbourhoods. It may be futile to address only one isolated risk factor and expect an improvement in health. However, some of the behavioural factors, such as failing to wash hands regularly, could often be substantially improved by, for example, a more reliable and convenient water supply.

Source: Benneh et al. (1993)

Housing Conditions and Crowding

Particularly in urban areas, population growth puts additional strain on housing and infrastructural facilities. On the other hand, most urban infrastructure also relies on sufficient population densities to uphold its use, maintenance and financing. Nevertheless, overcrowding of housing as well as water and sanitation facilities are highly problematic in low-income urban neighbourhoods in developing countries. Apart from straining facilities, crowding is in itself an important factor for disease transmission. Overcrowding is a characteristic of urban

poverty.¹³ Excessive crowding may also aggravate social problems in the household (Thomas *et al.*, 1999).

Tenure security is an important factor for motivating people to undertake housing improvements themselves. Tenants are sometimes in an awkward position, where helping to improve the house or surroundings may even undermine their own position, as a more attractive dwelling may provide the owner with an opportunity to shift to higher-paying renters (Songsore *et al.*, 2000). The lower end of the urban housing markets is often problematic both regarding environmental amenities as well as the respect for rights and regulations. Building regulations and property rights should be sensitive to the needs of low-income settlements. Overly strict regulation may effectively outlaw whole neighbourhoods, rather than help improve standards and conditions. It can be effective to also address supply constraints of housing and building materials. The combating of (illegal) urbanisation by denying services to informal settlements is a damaging and self-defeating practice.

Housing structures, apart from their social functions, are means for protecting individuals from rain, wind and extreme temperatures. In conditions of poverty, few dwellings adequately fulfil these requirements. Moreover, the housing in itself may pose additional exposures through excessive crowding, dampness or concentration of pollutants. Such problems are compounded when, as is common in developing countries, the home is also used as a work place. Women are often forced to combine childcare with income earning, converting houses to cottage industries. The combination of childcare with small-scale industries or larger scale cooking activities poses increased risk of burns, cuts and pollutant exposures.

There are also health threats from chemicals used in the home environment, many of them unknown (as those contained within consumer products) while others (such as insecticides) are used precisely because they are toxic. The greatest health effect associated with chemicals is the risk of acute poisoning (accidents particularly involving children), but there is also secondary exposure by way of food, water and air, from persistent chemicals that have been released into the broader environment (The Commission on Environmental Health, 1996). Building materials may at times also create health hazards. Low-cost housing may for example have asbestos as roofing material, which poses health risks particularly during inadequately controlled repair or demolition activities (World Health Organization, 1997). People in low-income areas are often unaware of such dangers, and undertake repair activities themselves, probably without protective gear (McGranahan *et al.*, 1999).

Dangerous housing locations are also typical of low-income areas, partly because of their availability, and partly because of poor people's inability to consolidate housing structures or persuade municipal authorities to do so. Areas near transport and job opportunities can become very crowded.

¹³ Recent global resurgence of tuberculosis is, apart from the HIV/AIDS epidemic, driven by increasing poverty and homelessness in many cities. Poverty, poor ventilation and overcrowded homes are greatly implicated in tuberculosis transmission and prevalence (World Resources Institute, 1998).

Indoor Air Pollution

Whether (air) pollution occurs indoors or outdoors is critical for its impact on human health. While cooking with smoky fuels is often an outdoor activity, even in urban areas, it can still increase the local level of pollution in the air. Where cooking is done indoors, with insufficient ventilation, pollution levels become highly concentrated. This implies that women, who cook in most households, and young children, who are often present with their mothers, inhale a large portion of the smoke. Heating, where needed, also contributes to the burning of polluting fuels in close proximity to people who then inhale the smoke. The level and kind of pollution depends on the type of fuel and the combustion efficiency.

The choice of fuel can be described as an energy ladder, with fuels such as crop residues and firewood at the bottom, used mostly by poor households, followed by charcoal, kerosene, LPG (bottled gas) and finally electricity, mostly used by the rich who can afford the grid connection as well as the purchase of electricity and electric appliances. Generally, the higher up the ladder, the less polluting and the more expensive the fuel. There is also a rural-urban dimension to the ladder, with crop residues and firewood being more readily available in rural areas, and the smoke having also beneficial side effects such as controlling insects in thatched roofs (McGranahan & Kaijser, 1993; McGranahan *et al.*, 1999).

Health risks are, as stated before, often complex and interconnected. Thus crowding, poor ventilation, malnutrition, poor sanitation and lack of immunisation all work with indoor air pollution to produce ill health. Major health risks associated with the domestic use of polluting fuels are 1) the irritation of the respiratory passages, facilitating infection, 2) chronic obstructive lung disease, affecting many women in developing countries, and 3) cancers from long term exposure (McGranahan *et al.*, 1999). Moreover, both active and passive tobacco smoking are associated with numerous diseases. Hence, the reduction of smoking (or the reversal of the dramatic increase of smoking in developing countries) should help reduce the burden of disease from respiratory afflictions, and also yield other health benefits (Stansfield & Shepard, 1993).

The Work Environment

Close to half of the people in the world are included in the global workforce, labouring to earn a livelihood for themselves and their dependants. Leigh *et al.* (1999) estimate that there are over 100 million occupational injuries (with 100,000 deaths) and some 11 million new cases of occupational diseases (700,000 deaths) each year. Some 2.7% of the global burden of disease is estimated to be attributable to occupational exposures (Murray & Lopez, 1996). Still, the economic burden of occupational diseases is much higher, as they generally affect those who are economically active. The cost to society has been estimated at some 2-14% of the gross national product in different studies (Leigh *et al.*, 1999).

The work environment, which can be both away from or at the home, can harm health through injuries, exposures to chemicals and biological agents as well as noise. Also, very heavy or repetitive tasks can lead to muscular and skeletal damage. Work overload or insecurity can cause stress and other mental problems.

Mental and stress-related problems are critical occupational hazards in developing countries (Harpham & Blue, 1995), although the present paper concentrates on the physical hazards. In manufacturing industries, accidents, noise and chemical agents are the major physical occupational health problems, while pesticides, organic dusts, heavy physical work and accidents are the major hazards for agricultural workers. The majority of the work force in developing countries is in agriculture, where parasitic and infectious diseases are also important health threats related to the work environment. In addition, poor hygiene, generally poor nutritional status and low levels of literacy exacerbate many of the problems.

Global use of pesticides is dominated by North America, Western Europe and Japan, accounting for almost three quarters of pesticide sales worldwide. In these regions, however, the pesticide market is dominated by herbicides, which are less poisonous. In developing countries, insecticides predominate. Moreover, the insecticides used in developing countries are often old, acutely toxic, broad-spectrum compounds. As these are no longer under patent protection they are considerably cheaper than the newer pesticides increasingly used in richer nations (World Resources Institute, 1998). Many substances that are banned in industrial countries are still in use in developing countries.

The major threat posed by pesticides in developing countries is acute poisoning, estimated at 3 million severe incidents per year, with some 220,000 deaths (Hogstedt & Pieris, 2000). This also includes the unintentional mistaking of poisonous substances for food or drink. The lack of protective measures, as well as low levels of literacy are problematic in this regard. Those most at risk are still the persons applying pesticides, but whole villages can also be in danger from unintentional spraying where located near plantations. Pesticides may also affect water supplies. Moreover, many pesticides are applied in the home environment. The use of pump spray pesticides in the household is associated with respiratory problems among women (Benneh *et al.*, 1993).

Mechanical factors, such as unshielded machinery and tools as well as unsafe structures at the workplace are among the most prevalent hazards in both industrial and developing countries. Most of these accidents could be prevented by relatively simple measures in the physical environment, working practices or managerial behaviours. Accident prevention programmes are shown to yield rapid results, but are often absent in rapidly growing industries, with resulting augmented rates of accidents (Hogstedt & Pieris, 2000).

Exposure to biological agents is also an issue of concern, particularly among health care workers, but also among those who clear rubbish, or as in the case of the man in Box 3 (on the next page) who collects human excreta (nightsoil) from households. The account, however, deals more with the low status of those involved with 'menial' work, rather than the exposure to contamination. The way in which some of these extremely important tasks in society are looked down upon, is an issue worthy of more attention when it comes to improving environmental service delivery, as well as protecting the integrity and dignity of the workers.¹⁴

¹⁴ Social conflict between residents and municipal bucket latrine collectors has also been documented in research (Thomas *et al.*, 1999).

A large part of the economic activities of developing countries occurs within the so-called 'informal economy,' characterised by the absence of governmental regulation. This need not imply that no rules apply, but rather that informal economic activities are not regulated by governments. Indeed, as many informal enterprises are small and have little profit margin, strict regulation may be more effective in pushing people out of business than producing cleaner production processes. Overly strict regulation also risks leading to a culture of bribes rather than compliance. Economic disruption among informal business may have severe consequences for job opportunities among poor people. Instead, awareness raising and support for changing production processes may be more effective. Indeed, people affected may sometimes not even be aware of the risks involved with certain occupations. Although there are some extremely dangerous occupations, occupational health risks are often outweighed by the positive contribution to health generated by the income earned.

Box 3. Fictitious Account of Bucket Latrines and Social Conflicts

"Some children from a nearby house took to mocking one of the nightsoil men. He was the clumsiest of the lot. He carried a very big bucket and he staggered and weaved and made strange snorting noises. The children made fun of him in songs. When he stopped and faced them and made his strange noises to drive them away they ran to their home and disturbed the elders who were engrossed in their drinking and their arguments. After a while the children went back and tormented the nightsoil man and threw stones at him. One of the stones hit the bucket and made a hollow sound...

"The nightsoil man stopped again. His eyes blazed and his neck was strong and sweat poured down his forehead. He snorted angrily and tried kicking up sand at the kids, but he staggered, cried out, steadied himself with a phenomenal and pathetic effort, and the children laughed even louder. Omovo wanted to shout at the children. But before he could, the exasperated nightsoil man brought up his free hand, in which was a short broom, then he proceeded to flick the contents of the bucket at the children. They ran, screaming and laughing in innocent wickedness. The nightsoil man followed them. The terrible load wobbled on his head.

"The elders, who had been drinking, spitting, unmindful of their children's mischief, looked up and saw the grim apparition. One of them shouted: 'Hey, what's wrong with you?' 'Wetin you want?' cried another.

"The elders got up. The nightsoil man chose his moment. With the awkward and sometimes wicked dignity that comes with such labours, the nightsoil man struggled, snorted, and then deposited the bucket right in front of the elders, in admonishment for the bad training of their children. The effect was staggering."

Source: Okri (1996), pp. 266–267

In the so-called 'formal economy' however, clear environmental regulations, addressing workers' safety and emission levels, can be very helpful in guiding industrial investments. Even without well-developed enforcement mechanisms, firms have a long-term incentive towards complying with regulations (Hettige *et al.*, 1996; Wheeler, 2000). Smaller firms, however, are often disadvantaged compared to larger ones in the process of investing for cleaner production (Blomqvist, 1996). Very stringent environmental regulation may also serve as a deterrent for industrial production and lead to economic dislocation, particularly where international companies play developing countries against one another. The migration of many high tech industries to developing countries, where labour is cheap, poses new environmental health risks, which require innovative management strategies.

The appropriate stringency of environmental regulation will always be in search of the right balance between environment and health concerns and producers' demands for favourable economic conditions. In some cases, however, environmental regulation can help industries overcome inertia and reorient towards more environmentally friendly, as well as cost-effective, production methods (Porter & van der Linde, 1995).

The Broader Environment

This section deals with a number of conditions in the broader environmental realm. Some impacts are direct, such as traffic accidents, other more long-term and indirect, such as damage from global climate change. Not all environmental problems in this area have a direct connection to human health, but may indirectly affect health conditions through the workings of the ecosystem and the economy, helping or defeating people's livelihood pursuits.

Solid Waste

The health threat from solid waste depends on its contents and the level of human exposure. Industrial wastes often contain hazardous chemicals, for which disposal regulation and enforcement may be very weak in developing countries. Also, medical wastes from hospitals (as well as from self-medicating households) are often inappropriately disposed, and may be mixed with ordinary household wastes. This is particularly pernicious for the spreading of disease. Where sanitary facilities are scarce, household wastes also tend to be mixed with faecal material, further compounding the health hazards. Waste pickers and playing children are particularly at risk.

In cities in developing countries, households often account for about half of the solid waste load generated. Although the collection of garbage often makes up for a significant part of the municipal budgets, large amounts of waste are never collected. The financing and organisation of waste removal is problematic in the way that the individual incentive for disposing of waste in a sanitary way is limited.¹⁵ In wealthy urban areas, door-to-door collection is often provided, whereas in poorer areas, households are to deposit their wastes at designated collection points. The incentive to comply with this is limited, and moreover, municipal authorities often neglect the removal of garbage from collection points.

A problem for city authorities is often that of final disposal of wastes. Disposal sites quickly become overfilled as cities grow and waste generation increases. Safe disposal of garbage is costly. Less mixing of wastes of different kinds may help facilitate safe disposal as well as reuse and recycling of materials. In developing countries, the level of recycling is already high, at least of the more valuable materials thrown away by high-income households. Waste pickers and peddlers are often informally associated to the formal municipal structures for waste management (McGranahan, 1993; Surjadi & Handayani, 1999).

The waste that remains uncollected often creates nauseating piles of debris around collection points and on marginal land such as roadsides, gutters and

¹⁵ Charging for waste collection by the volume has been shown to be an effective way of reducing waste amounts to be collected. Unfortunately, it is as effective in generating illicit dumping of waste.

waterways. This waste generally has a high content of organic material, thus providing breeding grounds for micro-organisms and disease-bearing insects. Also, wastes may eventually get washed away by rain to contaminate water bodies or block drainage systems. Pools of stagnating water serve as habitats for insect larvae and also block passage. In many tropical cities, traffic congestion rises conspicuously at the onset of the rainy season (McGranahan, 1993). Given the often inadequate waste collection, many people and institutions bury their garbage. Others dispose of it by burning. This contributes to localised as well as citywide problems of air pollution.

Waste removal is crucial for the control of pests such as flies, cockroaches and rats. In the absence of collective solutions, households spend substantial resources on remedying the situation. In Port Elizabeth, South Africa, aggregate household expenditures on insecticides add up to nearly as much as the municipality's overall health budget. Low-income households spend a higher portion of their income on pesticides (Thomas *et al.*, 1999).

Transport

Motorised vehicles constitute environmental problems in as much as they contribute to traffic accidents, air and noise pollution. These problems are likely to increase as the level of vehicle ownership rises in most developing countries. Adequate transport facilities are crucial for people to undertake productive activities. Poor urban dwellers often suffer dramatic hardship in their daily struggle to get to work. Indeed, better planning and provision of public transport would help the livelihoods of these people, and may also alleviate some of the congestion associated with the exaggerated number of private cars in some middle-income cities. Indeed, the level of vehicle congestion is often so high that the transport system operates far from optimally. Removing a certain percentage of the vehicles from circulation was shown to reduce congestion and increase the speed of traffic in São Paulo, Brazil (Jacobi *et al.*, 1999).

Road-traffic accidents are the most important cause of unintentional injury. Mortality rates per vehicle are highest at periods of rapidly increasing use, and then typically decline as investments in better roads are made along with safety promotion leading to increased safety consciousness, better traffic awareness and the use of more roadworthy vehicles. Thus, while vehicle ownership is much lower in developing countries, the level of accidents per vehicle is much higher. While there are about 50 motor vehicles for every 100 people in the established market economies, and about 3 in developing countries, the health burden from traffic accidents in Sub-Saharan Africa is half of the total burden in established market economies (World Health Organization, 1997).

The nature of traffic and hence the types of accidents that occur differ between regions. In New Delhi, for example, 75% of the people killed on the road are pedestrians, cyclists and motorcyclists, most of them hit by buses or trucks. Only 5% are drivers or passengers in cars. By contrast, in Britain, half of those killed in traffic are inside cars. The policy implication of this is that safety measures inside cars, such as air bags and safety belts, may be effective in wealthy countries but are not likely to have any appreciable influence on the level of human injury in developing regions (World Health Organization, 1997, citing Seymour, 1996).

Regarding air pollution, the emissions from transport are released close to the ground where human exposure is higher, and these may, just as indoor air pollutants, have a disproportionately high impact on human health. In particular poorly maintained diesel vehicles emit fine particles which have serious health implications. Also, vehicles contribute to high levels of carbon monoxide and the formation of secondary (photochemical) pollutants such as ozone, which are becoming a widespread urban problem. Petrol-fuelled vehicles also contribute significantly to lead pollution, but this problem is diminishing as lead is increasingly eliminated as an additive to petrol (World Health Organization, 1997).

Outdoor Air Pollution

While dispersion of pollutants in no way solves the problem of emissions, it does alleviate the health effects. Air pollutants released by outdoor sources are often the same as those released from cooking fires or other combustion indoors. Their effect on human health, in terms of respiratory diseases, is however estimated to be of a lower magnitude, as a much lower proportion of the pollutants are inhaled.

Nevertheless, high levels of outdoor urban air pollution have demonstrated health effects among the urban poor living in inner cities. Generally, higher levels of hospitalisation as well as death among those already weak can be discerned when urban air pollution levels rise. The fairly conservative estimates by Murray & Lopez (1996) put the global burden of disease attributable to outdoor air pollution at 0.5%, and the number of deaths attributable to this environmental problem at 1.1%. The regional figures are lower in most parts of the world, except for the former socialist economies, where 3.1% of the burden of disease and 5.5% of all deaths are attributed to outdoor air pollution.

The major urban air pollutants are ozone, nitrogen oxides, carbon monoxide, sulphur dioxide, particulate matter and volatile organic compounds, which all cause damage to human health. The sources include industrial and electricity production as well as motorised vehicles. Waste incineration is another important source of urban air pollution. Individual households are also important aggregate contributors, particularly in China where many use coal in their homes. Pollution levels are proportionally higher where combustion temperatures are lower.

Indirect effects of ambient air pollution include its harmful effects on agriculture and natural ecosystems. Ozone and sulphur dioxide can cause seriously reduced crop yields. The accumulation of nitrogen in ecosystems leads to damaging changes in the health and biodiversity of plant communities and to the fertilisation of coastal and marine ecosystems.

Water Pollution

In the same way that outdoor air pollution is not as harmful to human health as indoor pollution, river or lake pollution is generally not as threatening to humans as it is to aquatic life. The main consequences for human health are indirect, e.g. through damaged fisheries or increased costs of water treatment.¹⁶

¹⁶ Historically, the awareness of the need to protect the ambient water quality in Europe was not generated by concerns for the health of the public, but for the threats severe pollution imposed on the life support systems of the cities (Kjellén & McGranahan, 1997).

Again, it is the level of human exposure that is lower, as few people intentionally ingest untreated ambient water. Surface water pollution can however be a direct means of disease transmission for people working in or near the water, or to swimmers or children playing by the shore. There are also cases where diseases are transmitted by way of uncooked food that has been irrigated with wastewater. Moreover, water is critical for the life cycle of many disease-carrying vectors and the transmission of such diseases. Some of the vectors thrive in clean water, whereas others are well adapted to high levels of contamination.

Since ancient times, water has been used to clean, disperse, transport and dispose of wastes; both domestic and industrial effluents, mine drainage water, irrigation returns, etc. This contributes to the build-up of pollutants of various kinds in water bodies. In many rivers, pathogens, decomposable organic matter, organic micropollutants, suspended solids or trace metals are becoming increasingly problematic. Groundwaters all around the world are increasingly affected by salinisation, pollution from nitrates, organic micropollutants and trace elements (Chapman, 1992). Some trace metals are always present in freshwater from the weathering of rocks and soils, and are important for biochemical processes. Increased concentrations, however, can have severe toxicological effects on humans and the aquatic system. High levels of metals can enter water bodies from sewage as well as from atmospheric deposition, e.g. lead, which is still used as a petrol additive in many developing countries.

Major sources of ambient water contamination are urban and industrial sewage as well as the more dispersed pollution from agricultural sources. Nitrates and phosphates are the main causes of eutrophication, which leads to oxygen depletion and disruption of aquatic life in the affected water bodies. Their main effects on humans are through the disruption of productive activities and ecological services, although certain pollutants may also build up in the food chain and through ingestion directly affect human health. Looking towards the future, water pollution is increasingly threatening our life support systems as well as exacerbating existing problems of water scarcity (Lundqvist, 1998).

Climate Change

Human-induced climatic change is primarily a result of carbon dioxide and other greenhouse gases such as methane and nitrous oxide being released into the atmosphere. Two-thirds of all carbon dioxide emissions since the 1950s originate from Europe and North America (World Resources Institute, 2000).¹⁷ Developing countries have generally not contributed to the increased levels of carbon dioxide in the atmosphere, but are nevertheless more vulnerable to the potential effects of climate change, and generally have had less of a voice in negotiations on greenhouse gas emission controls. Furthermore, developing countries have fewer resources available for mitigation or prevention of climate change effects.

¹⁷ Although these proportions are projected to change, cumulative and per capita emissions originating from industrialised countries will continue to surpass those from developing countries for times to come. The per capita emission for North Americans is 19,074 kilograms per year. Asians release 2,296 kilograms per capita, and the figure for Sub-Saharan Africa is 896 (World Resources Institute, 2000).

Climatic change is likely to have wide-ranging health effects, many of them associated to extreme weather events, which are likely to increase, particularly in tropical and subtropical parts of the world. Some health effects will be direct, such as heatwave related deaths, increased hospitalisation during thunderstorms and high humidity, as well as accidents and psychosocial impacts associated with floods and storms. Flooding may also act to spread infectious disease – a common wet season problem in tropical cities relying extensively on pit latrines.

Many more health effects will most likely appear through indirect routes, such as changes in the distribution of vector-borne diseases (see page 38). Diseases like malaria, schistosomiasis and dengue are transmitted by vectors which are sensitive to changes in temperature, humidity, rainfall and wind. The emergence of a disease in new areas as well as the extension of the transmission season in areas where it is present would impact on human health (Kovats *et al.*, 2000).

Other health effects of climatic change may appear through changing ecological and economic conditions. Particularly, conditions for agriculture are likely to be altered. Major threats from global warming include reduced potential crop yields in tropical and subtropical regions, along with decreased water availability in already water-scarce regions. Water availability is the major constraining factor for agricultural production in many parts of Africa, where agriculture also happens to be the main source of livelihood for a major share of the population. Global climatic change may make the lives of poor farmers increasingly difficult.

Small island states as well as aquatic ecosystems are also at risk from global warming. For people living in coastal areas, ground water problems may become exacerbated by saltwater intrusion in aquifers, and sea-level rise may induce forced retreat from low-lying areas. Extreme weather events will also contribute to shore erosion. Densely populated regions such as the Ganges-Brahmaputra delta may experience a number of the problems induced by climate change. With higher sea levels and storms, saline and brackish waters may increasingly contaminate lakes and aquifers. Tidal damages further upstream along with increases in soil and freshwater salinity may exacerbate problems of water availability, both for domestic and agricultural uses. Since this region is already under considerable pressure, owing to a large and growing population, damage control may prove difficult (Kasperson & Kasperson, 2001).

Although effects of future climate change are uncertain, most difficulties are bound to appear in already disadvantaged regions. For example, Africa has already experienced a number of serious droughts during the end of the last century, and is projected to have reduced future stream flows. If the threats materialise, they will exacerbate “a precarious situation already jeopardizing poor countries beset by a panoply of other environmental and social threats and in a weak position to cope with additional climate-induced threats” (Kasperson & Kasperson, 2001, p. 6).

Stratospheric Ozone Depletion

The stratosphere contains low concentrations of ozone, which protects life on earth from excessively strong ultraviolet (UV) radiation. Large emissions of human-made halocarbon gases have led to the large and progressive destruction of the stratospheric ozone shield. This depletion was first evident in the early 1980s. An 'ozone hole' is formed each year over most of Antarctica during September-October. It leads to higher levels of harmful ultraviolet radiation (UV-B) penetrating to the surface of the Earth.

There is a relationship between high UV-B exposure and certain forms of skin cancer and eye disorders. It has also been shown that high UV-B exposure can weaken the body's immune defences and thereby increase the risk of infection. However, people with darker skin, predominating in many developing countries, are actually less vulnerable to UV radiation on the skin. Still, melanin provides no protection against eye problems, such as cataracts, which account for half of the world's 25–35 million cases of blindness. Here, poor people are more at risk, as micronutrient deficiencies and diarrhoea are implicated.

In addition, stratospheric ozone depletion is associated with a decline in the productivity of plankton, so far around Antarctica. It may thus exacerbate problems related to food availability.

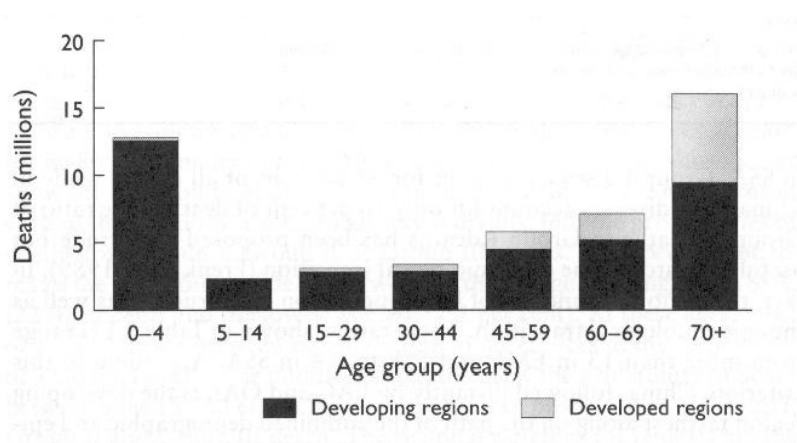
4 The Environmental Burden of Disease

As mentioned earlier, health and longevity in the world have improved substantially over time. Such progress is generally linked to economic improvement, but in spite of economic contraction in some regions, many health gains have been maintained. Health gains in many developing countries are however threatened by the present AIDS epidemic, which has significantly reduced life expectancy in high prevalence countries. Disparities between and within different regions also remain significant, so while national averages are converging, internal disparities among population groups are widening (World Health Organization, 1998). This section first reviews the level of ill health in the world, with relation to different measures. Thereafter, it quantifies the effects of environmental factors on human health, and finally describes certain disease groups through which the environment affects human health.

Global Ill Health in Numbers¹⁸

Good or bad health is inherently difficult to measure. The importance of different causes of ill health varies significantly between age groups and regions, but also depending on which type of measure is used. Figure 1 on page 1 shows that the burden of disease is significantly higher in developing regions than in the richer parts of the world. Figure 3 below provides a snapshot of the distribution of deaths among different age groups in 1990. The concentration of deaths in the youngest age group in developing countries is striking. In the developed regions, on the contrary, the majority of deaths occur among those over 70 years of age. As mentioned at the beginning of this paper, the average age of death has increased substantially over time. Among the least developed countries, however, 40% of the deaths remain among small children, although this figure is projected to decrease to 23% by the year 2025 (World Health Organization, 1998).

Figure 3. Number of Deaths in Developed and Developing Regions



Source: Murray & Lopez, (1996), Table 3.14

¹⁸ Regarding health statistics, it should always be kept in mind that data on death, sickness and disability are often arbitrary. In developing countries, data completeness and reliability is particularly problematic.

Table 3, contained in Annex 1, displays the estimated number of deaths, disease incidence, prevalence and activity limitation in the world as conventionally measured. Total mortality in 1997 was estimated at some 52 million deaths (World Health Organization, 1998). The leading causes of *death* were 1) heart disease, 2) cerebrovascular disease and 3) acute lower respiratory infection. The respiratory infections leading to death are mainly constituted by pneumonia, where most of the victims are small children. 99% of these deaths occur in developing countries (World Health Organization, 1996). The fourth leading cause of death is tuberculosis, which mainly affects adults in developing countries.

The number one leading cause of *disease* is diarrhoea, with an awesome incidence of 4 billion new cases per year (out of a total number of disease cases of roughly 5 billion), see Table 3. Luckily, most diarrhoea episodes are not serious, so while diarrhoea accounts for some 80% of estimated disease incidence, its contribution to the overall burden of disease and mortality is less dramatic.¹⁹ Nevertheless, diarrhoea leads to some 2.2 million child deaths per year (UNICEF, 1998). The second major leading cause of morbidity is malaria, another childhood killer. Acute lower respiratory infections are the third leading cause of disease incidence. As many cases are fatal, these infections constitute the major childhood killer in the world.²⁰

A way of combining mortality and morbidity has been developed by presenting the '*burden of disease*' measured in DALYs – Disability-Adjusted Life Years.²¹ DALYs are a composite measure of time lost due to premature death and time lived with disease and disability (Murray & Lopez, 1996). Hence, they incorporate both fatal (mortality) and non-fatal (morbidity) health outcomes. Table 4 in Annex 1 lists the diseases responsible for the most ill health in the world, measured in lost DALYs. The types of causes differ considerably between developing and developed regions. However, as the developed regions make up for the major part of death, disease and disability in the world, the figures for the world total and developing regions are similar.

Looking at DALYs lost, the major burden of disease in the world is caused by 1) respiratory infections, 2) diarrhoeal disease, 3) perinatal conditions (afflictions occurring around birth), and 4) depression (see Table 4 in Annex 1). Respiratory infections and diarrhoeal diseases are to a very large extent attributed to environmental risk factors.

¹⁹ The enormous number of diarrhoea cases each year has in many cases been conflated with the limited number of strictly water-borne disease incidents. Through this conflation, the role of water contamination in spreading disease has been much exaggerated, see Kjellén & McGranahan (1997).

²⁰ Regarding disease prevalence (rather than incidence), iron deficiency is estimated to affect some 1.8 billion people, and neck and back disorders also affect over a billion people. Another aspect of morbidity is long-term or permanent activity limitation or disability. Major causes of severe activity limitation include mood (affective) disorders, hearing loss, schistosomiasis (bilharzia) and lymphatic filariasis, affecting over one hundred million people worldwide. (See Table 3 on page 32.)

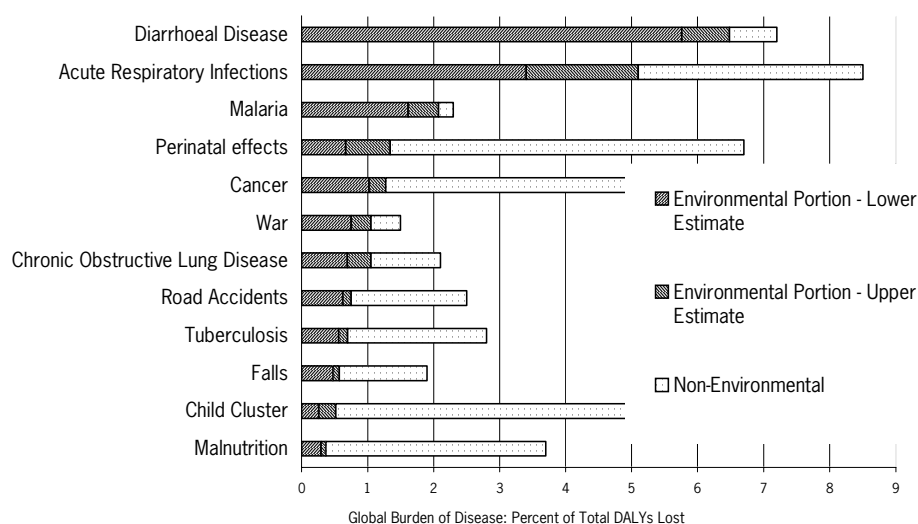
²¹ DALYs were developed by the Global Burden of Disease Study, which was initiated in 1992, based at the Harvard School of Public Health, sponsored by the World Health Organization and the World Bank. The study had three main objectives: 1) to include non-fatal health outcomes in debates on international health policy (generally focussing on under-5-mortality), 2) to decouple epidemiologic assessment from advocacy, and 3) to quantify the burden of disease in a way to facilitate cost-effective analysis. Findings were first published in 1993 (World Bank, 1993), and further updated in 1996 (Murray & Lopez, 1996). The approach and measure of DALY is used in many fora, and is increasingly taking over health status reporting in the world.

III Health Caused by Environmental Factors

The relationship between health and the environment differs in different parts of the world. Even the same diseases will among different populations have different proportions attributable to environmental factors. Generally, in conditions of poverty, fewer environmental threats can be avoided or ameliorated, hence the environment has a larger effect on people's health. Efforts to quantify the environmental burden of disease have been spearheaded by Smith, Corvalán & Kjellström (Smith *et al.*, 1999; World Health Organization, 1997). Their results are presented in this section, and also provide the basis for estimating the environment's impact on health generally in this paper.

Smith *et al.* estimated the risk attributed to environmental factors for all disease groups that individually accounted for at least 1% of the global burden of disease. (The major disease groups are those annexed in Table 4). The result of this exercise was that between 25% (the low estimate) and 33% (the high estimate) of the disease burden is attributed to environmental factors.^{22 23}

Figure 4. Environmental Contribution to the Global Burden of Disease by Selected Disease Groups



Source: After Smith *et al.* (1999), Figure 3

²² 'Attributable environmental risk' refers to the percentage of a particular disease category that would be eliminated if environmental risk factors were to be reduced to their lowest feasible levels. As there are many feasible interventions to reduce disease, the sum of the attributable risk percentages from several different actions can be over 100%. The more interventions that are known, the greater the attributable risk, or rather the proportion of the disease burden that could be averted by such interventions. Undertaking any intervention, however, pre-empts a part of the disease-reducing potential of other interventions. The calculations by Smith *et al.* assign the largest proportions to the most feasible interventions, i.e. assume that those interventions will be undertaken first. Thus, the child cluster of (vaccine-preventable) diseases, for example, are given a fairly low attributable environmental risk, as the most competitive initial intervention is likely to be vaccination (Smith *et al.*, 1999).

²³ By way of comparison, in the Global Burden of Disease Study, the burden of disease was attributed to a number of different risk factors, including both lifestyle choices and environmental exposures. The conclusion was that some 16% of DALYs lost are due to malnutrition, 7% to poor water supply, sanitation and domestic hygiene, 3.5% to unsafe sex and alcohol, respectively, 2.7% to occupational exposures and 2.5% to tobacco (Murray & Lopez, 1996).

Figure 4 above presents the environmental burden of disease by major disease groups. As diarrhoeal diseases are 80–90% attributable to environmental causes, they have the highest individual contribution here, followed by acute respiratory infections, estimated to be 40–60% environmental. Malaria and cancer also contribute substantially to the environmental burden of disease. (These four disease categories are further described in the next sub-section). Other categories that have a considerable share of the global environmental burden of disease are injuries caused by perinatal disorders, wars and road traffic accidents, and chronic obstructive pulmonary disease.

The main environmentally induced diseases, diarrhoeal and respiratory infections, are also major childhood killers. Hence, about 43% of the total burden of disease due to environmental risks falls on children under 5 years of age, even though they make up only 12% of the population (Smith *et al.*, 1999).

Major Environmentally Related Health Problems

This section describes the symptoms and epidemiologic features of selected disease categories. The groupings are not exactly the same as those presented in the health statistics, but include a somewhat broader set of diseases that are related or have similar risk factors.

Diarrhoeal Disease

Diarrhoea is the major disease group building up the environmental burden of ill-health. It is constituted by a complex of symptoms and signs, clinically defined as three or more loose stools passed over a twenty-four hour period. Diarrhoea can be caused by a number of enteric pathogens (disease-causing microbes in the intestines). It is also a common symptom of a range of other diseases that are not related to stomach infections, such as malaria, measles, respiratory infections and AIDS (Martines *et al.*, 1993). It generally also includes dysentery, characterised by the presence of blood in stools, but not necessarily excessively loose or frequent.

Most diarrhoeal episodes are not severe and may not require specific interventions. Nevertheless, diarrhoea can lead to dehydration and early death, particularly among children, and to impaired growth and nutritional status among the survivors (Martines *et al.*, 1993). Approximately two-thirds of all diarrhoeal deaths are attributable to dehydration. During the past few decades, the number of deaths from diarrhoea has been significantly reduced (Vesikari & Torun, 1994). Some ascribe this relative success to the worldwide implementation of oral rehydration therapy (encouraging the patient to drink a solution of sugar and salt), but the actual causes are much debated.

All major infective agents of diarrhoea are shed by infected persons via their faeces. Hence, hygienic disposal of excreta plays a decisive role in reducing diarrhoeal disease transmission. So do all improvements to water availability (quantity and reliability) and quality, as well as other aid to hygienic behaviour that can interrupt the faecal-oral transmission of pathogens. Such environmental improvements were key in the reduction of diarrhoeal disease (with the control of cholera and typhoid) in Europe and North America about a hundred years ago.

Adequate nutrition is important for good health. Behaviours such as breast-feeding of infants protect against diarrhoeal incidence, severity and fatality. Several studies also indicate increased diarrhoeal frequency, duration and severity among the malnourished (Martines *et al.*, 1993). In turn, loss of nutrients through persistent or repeated diarrhoea results in malnutrition, which increases susceptibility to other infections, and can lead to a deadly vicious spiral as described earlier. The complexes contributing to diarrhoeal disease, and the compounding of risk factors, are illustrated in Box 2 on page 22. It shows the importance of addressing several behavioural and infrastructural factors, and also points to the higher risks borne by households suffering multiple deprivations.

Respiratory Disease

Respiratory infections encompass several conditions located to the lungs, throat, mouth and middle ear tract. Acute respiratory infection (ARI)²⁴ is the disease grouping that imposes the largest burden of disease globally. Particularly, it affects children, and it is the leading cause of death in the developing world.

ARI includes minor upper respiratory infections, such as colds and sore throats, ear infection and tonsillitis, as well as more serious lower respiratory infections, such as pneumonia, croup, and bronchitis (Stansfield & Shepard, 1993). Most ARI episodes are mild and do not require specific treatment. However, some progress into life-threatening pneumonia, which is the biggest cause of child mortality. ARI is most common among infants and small children, with small boys slightly over-represented. It is also the cause of death of many elderly people (World Health Organization, 1997). The fatality is highest among the very weak, i.e. very young, very old, or those with poor nutritional or socio-economic status.

Up to 60% of the global ARI burden of disease is associated with environmental factors such as air pollution and housing conditions (Smith *et al.*, 1999; World Health Organization, 1997). While the individual risk factors are numerous and difficult to disentangle, ARI is clearly a syndrome of poverty. Overcrowding and unsanitary conditions help spread these diseases, transmitted by droplets from a cough or a sneeze, or through personal contact with unwashed hands (World Resources Institute, 1998). Exposure to air pollution, from smoking, cooking fires or outdoor sources, increases the susceptibility to and the severity of ARIs.

The relation between emissions from fuel combustion and chronic obstructive pulmonary disease (COPD) has been well established, although the link to pneumonia and other respiratory infections is less well documented (Stansfield & Shepard, 1993). COPD includes conditions such as chronic bronchitis and emphysema. They bring breathing difficulties and sometimes chronic cough, and are aggravated by air pollution (mostly in developing regions) and smoking (mostly in developed regions). As COPD is a non-communicable disease cluster, it is not grouped under ARI. Nevertheless, the groups share many of the same risk factors, and COPD is exacerbated by the affliction of ARI. COPD contrib-

²⁴ Respiratory afflictions can be acute or chronic. Acute infections refer to those with a rapid onset and generally short duration, as opposed to chronic. Neither acute nor chronic describe the severity of the condition (Wingate & Wingate, 1988).

utes some 2.1% of the global burden of disease, of which some 33–50% are attributed to environmental factors (Smith *et al.*, 1999).

Tuberculosis is another important respiratory affliction (not grouped under ARI), ranking seventh in the list of contributors to the global disease burden, see Table 4. It is the one single disease pathogen causing the most ill health in the world. Some 20–25% of its incidence is attributed to environmental risk factors, including crowding, chilling and potentially air pollution (Smith *et al.*, 1999). The social and economic costs of tuberculosis are high, as the incidence is concentrated in adults who are often the producers or wage earners of families. Because of its association with poverty, the affected families are usually those with the least means to cope with the death or debilitation of an adult wage earner (World Resources Institute, 1998).

Malaria and other Vector-Borne Disease

Environmental factors, such as water, temperature, humidity, vegetation and the structure of the built-up environment, are important for determining the distribution of all vector-borne diseases. Given the importance of water for the life cycle of many disease vectors, the potential effects of vector-borne disease prevalence must be considered for all water developments, such as irrigation. Generally, vector-borne diseases tend to decrease with urbanisation. However, certain vectors, such as *Culex* mosquitoes, carriers of filariasis, have important breeding sites in blocked drains and waterlogged latrines, often associated with 'informal' urbanisation (McGranahan *et al.*, 1999).

The most important vector-borne disease is malaria, being the third largest 'environmental contributor' to the global burden of disease. Worldwide, there are almost 300 million cases of malaria each year, and over one million people die. Almost 90% of these deaths occur in Sub-Saharan Africa. Young children are mostly affected. The risk of severe malaria is limited to people who are not immune. In endemic areas, those mainly at risk are children, between 3–6 months and up to about 5 years old, who have lost the immunity transferred from the mother, but who still have not developed immunity of their own. Severe malaria among adults may however be on the increase, as people take personal precautions and increasingly live in relatively protected urban environments, and hence delay the development of immunity. Adults most at risk are those who live in areas where malaria is seasonal, and who therefore do not develop immunity, as well as migrants and travellers originating from non-endemic areas (Nájera *et al.*, 1993).

Malaria has been substantially reduced over time all over the world except in Sub-Saharan Africa. This reduction, most notable on the Indian subcontinent and China, can be attributed to control campaigns.²⁵ These include spraying to kill mosquitoes as well as the development of drugs and treatment of patients. Also, improved living standards, housing conditions in particular, help reduce

²⁵ Malaria could be eradicated if every case were treated, because then mosquitoes could not become infected and their bites would be harmless. This is the situation in most of Europe, where anopheline mosquitoes are not uncommon, but there is nobody to infect them. Nevertheless, small outbreaks can occur when someone imports active malaria (Wingate & Wingate, 1988).

malaria incidence. Setbacks in malaria control during the past decades, experienced in parts of South-East Asia and across Africa, relate to emerging resistance of the malaria parasites and their mosquito vectors to the chemicals used to attack them as well as the emergence of the multi-drug and chloroquine resistant strain of malaria, *Plasmodium falciparum* (World Health Organization, 1999).

The economic cost of malaria is high because of its debilitating effects, which severely impairs productivity. It is the most prevalent disease in poor rural areas of tropical Africa, producing recurrent attacks of fever in warm and rainy seasons, when most people are needed to collect crops (Nájera et al., 1993). Often, those affected also suffer from malnutrition and other infections, and as well lack medical care, making the human suffering and the individual's potential to improve the situation so much more difficult.

While malaria is by far the most important vector-borne disease, it is still very worthwhile to try and combat others. This is either because of the level of suffering among the disease victims, e.g. those suffering from guinea worm, or because potential environmental measures, i.e. the use of safe toilets, are important in their own right, and also provide very effective means of eliminating the disease, i.e. schistosomiasis. Environmental and domestic hygiene, including solid waste management and house care, are key for controlling many of these diseases. Moreover, the enteric infections associated with cockroaches and houseflies can also be reduced through such environmental improvement, although diarrhoeal disease is not classified as 'vector-borne.'

*Cancer*²⁶

The occurrence of most cancers seems to be determined by life-style factors such as tobacco smoking, diet and different reproductive practices (Barnum & Greenberg, 1993). Smith *et al.* (1999) estimated 20–25% of the burden of disease from cancer to be attributable to environmental factors, including passive smoking and other chemical exposures, food preservatives, radon and infectious agents. Moreover, the body of evidence of cancer's link to the environment is increasing, and the list of known carcinogens is long and increasing (World Resources Institute, 1998). As populations grow older, life-time exposures to carcinogens are likely to increase.

Cancer only accounts for 5.5% of the mortality in developing countries, but about 20% of all deaths in industrial countries. Nevertheless, over half of all cancer deaths occur in poorer countries. The lower *relative* importance of cancers in the developing world relates to 1) the remaining high death toll from infectious and parasitic disease, 2) the age structure heavily weighted towards young children – cancers occur most frequently among older adults, 3) aggregate cancer risks may be lower in many developing countries (less smoking), and 4) underreporting, as cancers are less likely to be recognised in populations with

²⁶ Cancer (malignant neoplasm) encompasses a varied set of diseases, each defined by its site in the human body and its microscopic features. All cancers, however, are characterised by their uncontrolled growth and tendency to invade surrounding tissue and to spread (metastasis) to distant parts of the body (Anderson, 1998). However, they differ considerably regarding causes as well as progression and fatality.

lower access to medical care and advanced diagnostic facilities (Barnum & Greenberg, 1993). Cancer is likely to become a relatively more important health problem in developing countries in the future.

The leading type of cancer death is lung cancer, most often caused by cigarette smoking. The second most common cancer globally is stomach cancer, constituting the major type of cancer in developing countries. The pattern of cancer occurrence differs greatly between different regions and living conditions. Stomach cancer clearly decreases with economic development, with less exposure to infectious agents, poor sanitation and crowding (World Health Organization, 1997). Breast cancer tends to affect women in industrial countries who have had few or no pregnancies, cervical cancer more often occurs in developing countries among low-income women with a history of many pregnancies (Barnum & Greenberg, 1993).

Workers handling asbestos and chromates, as well as underground miners exposed to high levels of radon, are at elevated risk of lung cancer. Cigarette smoking acts with these environmental factors to greatly increase the risk (Barnum & Greenberg, 1993). Many pesticides, beyond their acute toxic effects, also show cancer causing potential, and epidemiologic studies suggest a link between some pesticides and cancer (World Resources Institute, 1998). There is also data showing that the incidence of lung cancer is higher in polluted urban areas, which along with demonstrations and indirect evidence, suggest that cancers are also associated with air pollution. In addition, viruses, bacteria and parasites also trigger many different types of cancer (World Health Organization, 1997).

Environmental factors notwithstanding, current increase in tobacco smoking at increasingly younger ages in developing countries should be the main cause of concern as regards cancer.

5 Well-being, Health and Environmental Improvement along with Poverty Alleviation

There have been remarkable health gains in the world during the past hundred years. These positive developments are largely driven by economic development, helping to achieve healthier housing and local environmental conditions. While economic activity can also induce health hazards, much more ill health is produced by poverty. The remaining high death toll due to infectious disease in developing countries has been referred to as 'the unfinished agenda.' It remains a challenge for collective societal organisation and more equitable distribution of income. More concretely, it requires local environmental improvements and poverty eradication.

Respiratory and diarrhoeal diseases constitute the major burden of disease globally. They are to a large extent caused by environmental factors, and mainly affect children. The prevalence of vector-borne disease, particularly malaria, also depends on the environment, such as the structure of human settlements as well as initiatives for combating disease-carrying vectors. Another 'environmental' disease group encompasses cancers. Particularly regarding this latter affliction, treatment is very expensive, and rarely very effective. There is hence much to gain from prevention.

Human excreta constitutes one of the most dangerous substances in the world. Where there is a lack of toilets, people are much more often exposed to faecal pathogens – hence the prevalence of diarrhoeal disease, which are spread through the faecal-oral route. This disease transmission route can be intercepted by better hygiene, supported through adequate access to water and sanitary facilities. Crowding, indoor air pollution, as well as generally unhygienic conditions also exacerbate the prevalence of infections of the respiratory tract. Women play a major role in the maintenance of cleanliness in the home environment. Improving the status of women, as well as that of local environmental management, can help improve environmental health and well-being.

Poor people tend to live in poor environments. This partly relates to the fact that these people often live in ecologically fragile areas, such as marginal agricultural land or squatter settlements on dangerous locations. Moreover, in poverty, people lack the resources to protect themselves from exposure to environmental hazards in their near surroundings. Housing consolidation and waste removal help reduce such exposures. While human health can be improved by the displacement of environmental nuisances, displacement can also lead to sustainability problems, which in the longer-term may undermine livelihood pursuits.

Food insecurity is basically a problem of material poverty and vulnerability, affecting those social groups with the least material assets or access to social networks. The problem can be helped by more stable livelihoods: in urban areas, through better job opportunities in the informal economy; in rural areas, by supporting subsistence farmers or landless rural workers. Poverty, along with the lack of assets and income-earning opportunities – not inadequate food produc-

tion globally – is the root cause of food insecurity and under-nutrition, which in turn exacerbate adverse health conditions.

Poverty alleviation enhances well-being and environmental health. Furthermore, environment and health improvements are conducive to poverty alleviation. In providing environmental services and improving the local environmental quality, there are bound to be positive effects on people's health, and through less disease and disablement, more opportunities for income-generation and pursuit of sustainable livelihoods. Such positive (reinforcing) spirals are not always easy to initiate but are nevertheless a worthy pursuit.

Annex 1

Mortality, Morbidity, Disability and Burden of Disease Figures

Table 3 Number of Deaths, Disease Cases and Disability, by Disease/Condition

Mortality, Morbidity and Disability in the World, 1997								
	Deaths		Cases		Cases		Severe Activity Limitation	
Disease / condition	Rank	Number ('000)	Rank	New incidences ('000)	Rank	Prevalence ('000)	Rank	Number ('000)
Ischaemic (coronary) heart disease	1	7 200		...		...		...
Cerebrovascular disease	2	4 600		...		9 000		...
Acute lower respiratory infection	3	3 745	3	395 000		...		...
Tuberculosis	4	2 910		7 250		16 300		8 420
Chronic obstructive pulmonary disease	5	2 890		...	5	600 000		...
Diarrhoea (incl. dysentery)	6	2 455	1	4 000 000		...		...
HIV/AIDS	7	2 300		5 800		30 600		...
Malaria	8	1 500–2 700	2	300 000–500 000		...		...
Prematurity	9	1 120		...		...		...
Cancer of trachea, bronchus and lung	10	1 050		1 190		4 465		...
Measles	11	960		31 075		...		...
Birth asphyxia	12	920		...		...		...
Occupational injuries		330	4	250 000		...	9	25 000
Occupational diseases		...	5	217 000		...	10	20 000
Trichomoniasis		...	6	170 000		130 000		...
Mood (affective) disorders		...	7	122 865	8	350 000	1	146 000
Chlamydial infections		...	8	89 000		85 000		...
Hepatitis B		605	9	67 730		...		...
Gonococcal infection (gonorrhoea)		...	10	62 000		23 000		...
Amoebiasis (Entamoeba histolytica)		70	11	48 000		...		...
Whooping cough (pertussis)		410	12	45 050		...		...
Iron deficiency anaemia		...		...	1	1 788 600		...
Neck and back disorders		...		...	2	1 039 200		...
Goitre		...		...	3	1 039 200		...
Hypertensive disease		...		...	4	690 600		...
Anxiety disorders		...		...	6	400 000		...
								cont.

Mortality, Morbidity and Disability in the World, 1997								
<i>cont.</i>	Deaths		Cases		Cases		Severe Activity Limitation	
Disease / condition	Rank	Number ('000)	Rank	New incidences ('000)	Rank	Prevalence ('000)	Rank	Number ('000)
Arthritis and arthrosis		...		...	7	354 500		...
Ascariasis (roundworm)		60		...	9	250 000		...
Schistosomiasis (bilharzias)		20		...	10	200 000	3	120 000
Hepatitis C		...		...	11	170 000		...
Malnutrition including PEM		...		...	12	170 000		...
Hearing loss (41+ decibel)		...		...		123 000	2	123 000
Lymphatic filariasis		...		...		119 000	4	119 100
Cretinoids		...		...		49 600	5	49 600
Mental retardation (all types)		...		...		60 000	7	36 000
Schizophrenic disorders		...		4 500		45 000	8	27 000
Cataract-related blindness		...		...		19 340	11	19 340
Cretinism		...		...		16 500	12	16 500

Source: World Health Organization (1998), Table 4

Table 4 Burden of Disease, by Cause and Region

Causes of DALY's Lost in 1990								
World			Developing Regions			Developed Regions		
Disease or Injury	DALYs ('000)	% of total	Disease or Injury	DALYs ('000)	% of total	Disease or Injury	DALYs ('000)	% of total
Lower respiratory infections	112 898	8.2	Lower respiratory infections	110 506	9.1	Heart disease (ischaemic)	15 950	9.9
Diarrhoeal diseases	99 633	7.2	Diarrhoeal diseases	99 168	8.1	Unipolar major depression	9 780	6.1
Perinatal conditions	92 313	6.7	Perinatal conditions	89 193	7.3	Cerebrovascular disease (stroke)	9 425	5.9
Unipolar major depression	50 810	3.7	Unipolar major depression	41 031	3.4	Road traffic accidents	7 064	4.4
Heart disease (ischaemic)	46 699	3.4	Tuberculosis	37 930	3.1	Alcohol use	6 446	4.0
Cerebrovascular disease (stroke)	38 523	2.8	Measles	36 498	3.0	Osteoarthritis	4 681	2.9
Tuberculosis	38 426	2.8	Malaria	31 749	2.5	Lung cancers, etc.	4 587	2.9
Measles	36 520	2.7	Heart disease (ischaemic)	30 749	2.5	Dementia, etc.	3 816	2.4
Road traffic accidents	34 317	2.5	Congenital anomalies	29 441	2.4	Self-inflicted injuries	3 768	2.3
Congenital anomalies	32 921	2.4	Cerebrovascular disease (stroke)	29 099	2.4	Congenital anomalies	3 480	2.2
Malaria	31 706	2.3	Road traffic accidents	27 253	2.2	Chronic obstructive lung disease	3 365	2.1

Source: Murray & Lopez (1996), Table 5.2

Note: DALY = Disability-Adjusted Life Years, a measure of the number of 'healthy years' that are lost due to premature death, disability and disease.

Annex 2

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