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Poverty — Environment Indicators

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Abbreviations

ARI	Acute respiratory infections
CRI	Chronic respiratory infections
DALY	Disability-adjusted life years
DHS	Demographic and health surveys
EME	Established market economies
FSE	Former socialist economies
LAC	Latin America and the Caribbean
LDC	Less developed country
LSMS	Living standards measurement surveys
MNA	Middle East and North Africa
PRSP	Poverty reduction strategy paper
SSA	Sub-Saharan Africa
WDI	World Development Indicators

1 Introduction

Indicators are an important tool for designing and evaluating poverty reduction strategies, projects, and outcomes. They are useful for monitoring changes and trends over time, they provide a means for comparing progress across different countries and are needed for evaluating the results of projects. Without indicators, well-developed strategies and programs can be rendered meaningless. Accordingly, this paper seeks to identify different ways in which indicators can be used to understand poverty-environment interactions and to monitor poverty reduction that results from environmental changes.

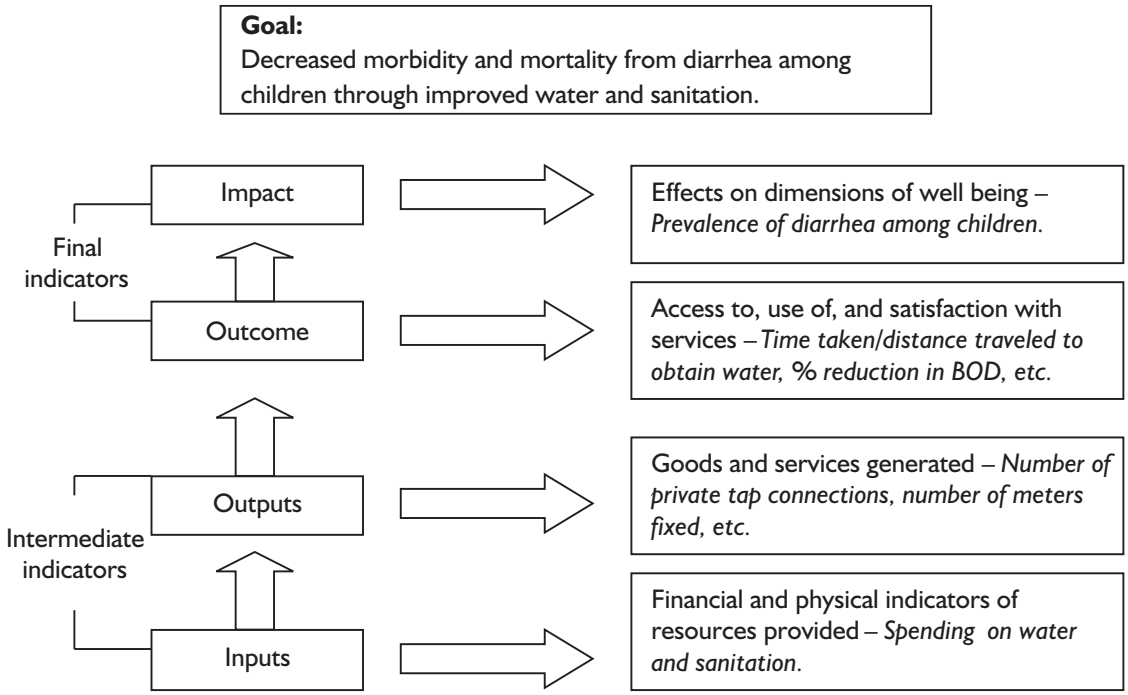
Indicators can be used to monitor change at different scales, for different purposes and in a number of different ways. At the national (or sub-national) level, poverty-environment trends can be monitored over time and across geo-political categories. An example of a relatively simple but important *individual* indicator at the national level is "population with access to safe water." Data for this indicator is collected globally and can be used to compare different countries or provinces over several different years. If countries are willing to collect more detailed data, the OECD (1994) designed Pressure-State-Response (PSR) model can be used to assess change. This model seeks to identify a *cluster* of indicators for each environmental problem that are indicative of where the *pressure* on the environment comes from, what the *state* or general condition of the environmental good is, and what society's *response* has been or needs to be to alleviate pressure.

At the project level, it is important to use the logical framework around which development projects are generally organized to identify a series of indicators. Thus, indicators are needed to monitor *inputs* or resources provided by the project, *outputs,* referring to goods and services that result from the project, *outcomes* or the short-terms results from the project and *impacts,* that is, the more pervasive long-term changes that at least partially result from the project (Segnestam 1999, Prenusshi and others 2001). In cases where the project is a very large one, it is possible that the impact indicators really reflect project outcomes. In other cases, impact indicators will reflect contributions from the project and other sources of change.

Input and output indicators are sometimes referred to as *intermediate* indicators, while outcome and impact indicators are seen as *final* indicators. Figure 1 provides a graphic depiction of these different indicators and provides examples from water and sanitation projects. As the figure shows, different indicators need to and can be used to monitor different aspects of a project or program. While final indicators may be most useful for assessing changes in overall well-being, intermediate indicators can be cost-effective proxies and can provide useful information on what is working and what is not at the project level.

A somewhat different set of indicators that have recently gained prominence, especially for poverty monitoring, are geo-referenced indicators (Henninger and Hammond 2000).

Figure 1. Types of indicators



Source: Adapted from Prenusshi and others 2001.

Essentially, these indicator maps overlay social or poverty indicators over a geographic framework. Such spatially referenced indicators are based on household data as well as satellite images and geographic information systems. These indicators can be an important tool for geographic targeting of intervention schemes.

As established above, a variety of indicators can be used to monitor change in any particular situation. Given that resources for monitoring and evaluation are limited, choosing the right set of indicators is very important. This choice depends on the goal or purpose for which monitoring is required, the scale at which monitoring is required and on the quality of available indicators. Box 1 outlines the characteristics of good indicators (both intermediate and final). As the Box suggests, a good indicator is one that is unambiguous in terms of identifying improvements, sensitive to changes, that is, it reflects changing policy circumstances and is cost-effective.

The aim of this paper is to identify indicators that can be used to assess poverty-environment interactions. The poverty-environment relationship is complex and dynamic, and difficult to comprehend in all of its dimensions. For the purpose of poverty reduction, perhaps the most useful question to ask is 'how do environmental factors impact the lives of the poor and poverty reduction efforts?' While there are variety of different ways in which the poor and environmental resources are connected, this note emphasizes the role played by environmental conditions as a *determinant* of poverty. In doing so, this note follows the framework presented in the Environment Chapter of the World Bank's Poverty Reduction Strategy Toolkit (Bojo and others 2001). Thus, this paper addresses two aspects of the environment that affect the poor:

Box 1.
Features of good indicators

A good indicator:
- Is a direct and unambiguous measure of progress
- Is relevant, i.e., it measures factors that reflect the goals/objectives of the program/project
- Varies across areas, groups, over time, and is sensitive to changes in policies, programs and institutions
- Is transparent and cannot be manipulated to show achievement where none exists
- Is cost-effective to track.

Source: G. Prennushi, G. Rubio, and K. Subbarao 2001.

1. Environmental conditions that impact the health of the poor.
2. Natural resource conditions that affect the income and security of poor households.

The substance of these two issues has been presented in detail in other papers (Bucknall and others 2000) and will not be repeated here. Rather, this note focuses on the different kinds of indicators that can be most usefully employed to monitor the environmental determinants of health and income poverty.

The following chapter focuses on indicators that can be used to monitor the impact of environmental quality on the health of the poor. Chapter 3 looks at the more complex issue of natural resources and poverty and points to indicators and data needed to monitor change. The last chapter identifies some of the poverty-environment indicators presented in Poverty Reduction Strategy Papers (PRSPs) and interim PRSPs undertaken in World Bank client countries, and offers some options for expanding on these indicators.

2 Environment and Health

It is increasingly accepted that environmental factors are a significant determinant of health and illness in poor countries. Health outcomes that are a result of environmental conditions are classified under the category of "environmental health." While no standard definition of environmental health exists, a description used in a recent World Bank publication (2000)—"environmental health refers to those aspects of human health, including quality of life, that are determined by physical, biological, social, and psychological factors in the environment"—is indicative of the breadth of issues covered.

In general, environmental health risks fall into two broad categories (World Bank 2000a):

1. Traditional hazards related to poverty and lack of development, such as lack of safe water, inadequate sanitation and waste disposal, indoor air pollution, and vector-borne diseases
2. Modern hazards such as urban air pollution and exposure to agroindustrial chemicals and waste that are caused by development that lack environmental safeguards.

Available global evidence suggests that the two most important ways in which environmental quality has a negative impact on the health of the poor is through water and indoor air pollution. Respiratory infections and diarrheal diseases are the two biggest causes of death among the poorest 20 percent of the world's countries as ranked by national GDP per capita (Gwatkin and Guillot 1999). Water pollution is a key source of a number of diseases such as diarrhea, malaria, and cholera. Air pollution is another major reason for concern because of its contribution to respiratory tract infections.

A ranking of environmental diseases in terms of their contribution to burden of disease is

Table 1. Burden of disease from major environmental risks

Environmental health group	Percent of all DALYs in each country group								
	SSA	India	Asia / Pacific	China	MNA	LAC	FSE	EME	All LDCs
Water supply and sanitation	10	9	8	3.5	8	5.5	1.5	1	7
Vector diseases	9	0.5	1.5	0	0.3	0	0	0	3
Indoor air pollution	5.5	6	5	3.5	1.7	0.5	0	0	4
Urban air pollution	1	2	2	4.5	3	3	3	1	2
Agroindustrial waste	1	1	1	1.5	1	2	2	2.5	1
All causes	26.5	18.5	17.5	13	14	11	6.5	4.5	18

Notes: DALYs = Disability Adjusted Life Years, SSA = Sub-Saharan Africa, MNA = Middle East and North Africa, LAC = Latin America and the Caribbean, FSE = Former Socialist Economies, EME = Established Market Economies, LDCs = Less developed countries.
Source: Murray and Lopez 1996; Smith 1993, 1998, 1999; WHO 1997; WDI 1999; World Bank staff in World Bank 2000a.

presented in Table 1 below. As this table shows water and sanitation related diseases are the most important for developing countries. This is followed by indoor air pollution and then vector borne diseases such as Malaria, indoor air pollution, urban air pollution, and agroindustrial waste (World Bank 2000a: Table 1).[1] On the whole, the impact of traditional environmental hazards exceeds that of modern hazards by a factor of ten in Africa, a factor of five in Asia (except China), and a factor of two-and-one-half in Latin America.

Key Environment Health Indicators

Using a selective set of indicators to assess the impacts of environmental factors on health is important. Table 2 presents some intermediate and impact indicators that are most routinely used for monitoring the three most common environmental health problems faced in poor countries—diarrhea, acute respiratory infections, and malaria (in prevalent areas). Intermediate indicators refer to project, sectoral or macro inputs and outputs that affect health. Impact indicators are more direct measurements of the quality of environmental health. Definitions and data sources for these indicators are presented in the Appendix.

Access to safe water and sanitation are commonly used indicators for assessing health outcomes such as diarrhea. Data for these indicators is generally available in large global data sets such as the World Development Indicators. However, these indicators are rather broad and sometimes hide the 'real' access poor people have to water and sanitation. Where possible, these indicators need to be complemented with some of the other indicators shown in Table 2, such as quantity of water used per capita and hours of available water supply.[2] In addition, water and sanitation related diseases such as diarrhea are as much dependent on behavioral practices of households as they are on quantity of water used. It is therefore useful to monitor indicators such as disposal practices of feces and hand washing behavior when it is possible to do so.

Respiratory infection is a significant problem among poor households. Table 2 presents indicators that are useful for assessing project outputs designed to decrease acute and chronic respiratory infections (ARI and CRI) or to monitor conditions that increase or decrease respiratory infections. These include, availability of ventilation in poor households, children sleeping in cooking areas, and the types of cooking stoves and fuel used. Demographic health surveys (DHS) undertaken in several countries worldwide provide data on ARI prevalence, a useful impact indicator.

The Malaria related indicators in Table 2 have been taken from the globally discussed Roll Back Malaria (RBM) initiative. This program builds on previous international efforts to accelerate malaria control in Africa, and seeks to halve the malaria burden in participating countries through interventions that are adapted to local needs (WHO 2000). RBM proposes a series of key impact, prevention and disease management, and health sector development, interlinkages and partnership indicators. While most indicators will vary by country, five are considered so important that they have been selected as global indicators. These core indicators are presented in Table 2 and would be appropriate for many of the African countries. Data on impact indicators such as th Malaria Death Rate, and intermediate indicators, such as households with treated bednets, are available in various health data sets.

Several impact indicators are presented in Table 2 that can be used to directly monitor health trends related to diarrhea, ARI and Malaria. While indicators such as under 5 mortality rate[3] are routinely used, the Disability Adjusted Life Years (DALY), a

Table 2. Selected key environmental health indicators

Environment-related illness	*Intermediate indicator*	*Impact indicator*
Diarrhea	▪ Access to safe water (private or public) ▪ Access to sanitation (private or public) ▪ Hours/day of available piped water ▪ Quantity of water used per capita per day ▪ Time taken/distance involved in collecting water ▪ Disposal practices of children's feces ▪ Percentage of child caregivers and food prepares with appropriate hand washing behavior ▪ E. coli/100 ml of water consumed by residents by source ▪ Persons per room of housing	• Prevalence of diarrhea
Respiratory infections*	▪ Availability of ventilation in cooking area ▪ Children sleeping in cooking area ▪ Percentage of households using clean fuel/ improved stoves	▪ Prevalence of ARI/CRI ▪ Prevalence of chronic lung disease (COPD)
Malaria	▪ Proportion of households having at least one treated bednet ▪ Percentage of health facilities reporting no disruption of stock of anti-malarial drugs (as specified by national health policy) for more than one week during the previous 3 months	▪ Malaria death rate (probable and confirmed) among target groups (under 5 and others) ▪ Number of malaria cases, severe and uncomplicated (probable and confirmed) among target groups ▪ Percentage of patients with uncomplicated malaria getting correct treatment at health facility and community levels, according to the national guidelines, within 24 hours of onset of symptoms
Broad indicators	▪ Public health expenditures	▪ Under 5 mortality rate ▪ Disability Adjusted Life Years

* *Notes:* The intermediate indicators in this category pertain mainly to indoor air pollution. However, for countries such as China where urban air pollution is likely to grow in magnitude, it would be important to identify intermediate and impact indicators related to outdoor air pollution. Blood lead levels among children is a good indicator of urban pollution.

composite indicator, has more recently become a standard measure of the burden of disease. Box 2 describes the DALY. Public health expenditures is a broad but useful proxy indicator for government policies that have an impact on health.

Disaggregating Health Indicators by Income or Wealth

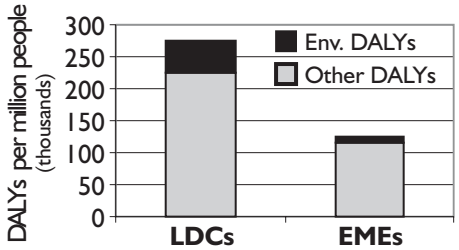
For the purposes of poverty reduction, it becomes important to consider how the environmental health of *poor* people can be assessed. Do the poor disproportionately bear

Box 2.
Disability Adjusted Life Years

DALYs measure life years lost due to premature death and fractions of years of healthy life lost from illness or disability. They are a measure of the burden of disease borne by a group or population at a point in time, and reflect the total amount of healthy life lost from all causes. DALYs reflect social weights given to illness or death at different ages. For example, the death of a baby girl represents a loss of 32.5 DALY, while female death at age 60 represents 12 lost DALYs. In general, the DALY is used to help with: a) setting health service priorities; b) targeting health interventions to disadvantaged groups; c) providing a comparable measure for monitoring impacts.

Source: Murray and Lopez 1996, Homedes 1996.

Figure 2. Burden of disease and environmental risks



Notes: LDC = Less Developed Country
EME = Established Market Economy
Source: Reproduced (not exact) from World Bank 2000a; sources include Murray and Lopez 1998 and World Bank staff.

the health costs of environmental degradation, i.e., is environmental quality a relatively major determinant of the health of the poor? There is some evidence that suggests that this indeed true.

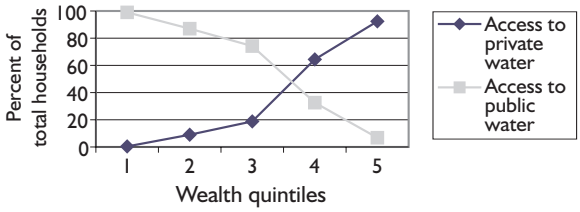
Ill health as a result of environmental conditions is a much bigger problem in poor countries relative to rich countries. Figure 2 shows environmental influence on burden of disease in developing versus developed countries. It is estimated that the environmental component of the total burden of disease is approximately 18 percent in all less developed countries, a number that is much higher than the same for industrialized market economies. The environmental component of the total burden of disease is 27 percent for Sub-Saharan Africa, and approximately 18 percent for Asia (World Bank 2000a).

Within a country or sub-region, declines in environmental quality are likely to affect the health of the poor more severely than the rich. Their low nutritional status makes the poor more vulnerable to environmentally driven illnesses; and evidence suggests that water pollution and indoor air pollution affect the poor disproportionately relative to the rich.

At the national or sub-national or regional levels, there are some common indicators that have been routinely used to signal people's dependence on dirty water. As previously mentioned access to safe water and sanitation are two indicators with information collected by many countries and presented in global data sets. However, to really monitor the extent to which poor people depend on clean water and have access to sanitation facilities, it is useful to disaggregate these indicators and monitor them by income or wealth quintile groups.

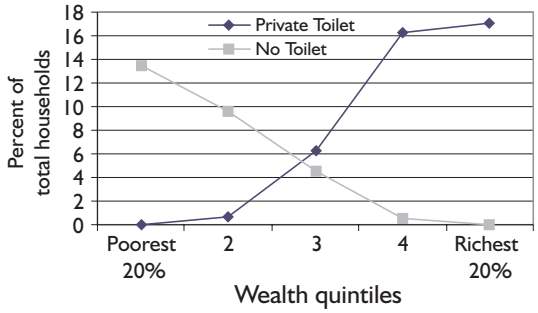
Figure 3 presents a picture of access to water disaggregated by wealth quintiles. In Senegal, 37 percent of the population in 1997 had access to private water. However, this average number becomes more revealing when disaggregated by quintiles. Less than 1 percent of the poor had access to private water (even though they did have access to public water

Figure 3. Access to private and public water by quintile group, Senegal



Source: DHS data 1997, constructed by Limin Wang.[4]

Figure 4. Access to sanitation facilities by quintile group, Peru



Source: Bucknall and others 2000.

Figure 5. U5 mortality by quintile group, Senegal

Source: DHS data 1996, constructed by Limin Wang.

supply). In contrast, 92 percent of households in the highest quintile had access to good quality private water.

A similar story emerges on sanitation issues. Figure 4 presents information on access to private and public toilets in Peru. As can be seen above, the poorest two quintiles have more or less no access to private toilets, but access increases rapidly among the middle wealth categories.

Access to water and sanitation are indirect indicators of health outcomes. An important impact indicator of health is under 5 mortality rates (U5MR). Figure 5 shows a graphical representation of these indicators for Senegal. The total under five mortality rate in Senegal is 139 per 1000 live births; however, the rate for the poorest quintile is 189 per 1000. The same number for the richest quintile is 70. Clearly there is a wide gap between health outcomes associated with the rich and poor.

Table 3 presents information about two other important environmental health indicators for five countries in Africa: prevalence of diarrhea and prevalence of ARI. Demographic and Health Survey data for a number of countries in Africa contain information on percentage of children who fell ill from diarrhea in the preceding 2 weeks. As Table 3 shows, poor children succumb more than rich children to

Table 3. Diarrhea and ARI prevalence as poverty-environment indicators

	Percent of surviving children under 5 who had diarrhea in preceding two weeks, by quintile		
Country	*Poorest*	*Richest*	*Poor/rich ratio*
Malawi	23.7	21	1.13
Senegal	15.3	13.7	1.117
Tanzania	13.7	12.3	1.114
Uganda	29.9	17	1.759
Zimbabwe	28.9	17.3	1.671
	Percent of surviving children under 5 ill from acute respiratory infection in preceding two weeks, by quintile		
Malawi	16.8	13.3	1.26
Senegal	-	-	-
Tanzania	11.6	12.3	.94
Uganda	32	18.6	1.72
Zimbabwe	34.9	16	2.18

Source: DHS Surveys 1994–97, compiled by Pande and Gwatkin 1999.

Table 4. Public health expenditures accruing to the poorest and richest quintiles

Country	*Poorest 20 percent*	*Richest 20 percent*	*Rich/poor ratio*
Cote d'Ivoire (1995)	11	32	2.90
Ghana (1992)	12	33	2.75
Guinea (1994)	4	48	12.00
Kenya (1992)	14	24	1.71
Madagascar (1993)	12	30	2.50
South Africa (1993)	16	17	1.06
Tanzania (1992/93)	17	29	1.71

Source: Castro-Leal and others 1999.

this illness. DHS information can be also be used to analyze prevalence and percent of the population that was seen medically for ARI.

Table 3 shows that, except in the case of Tanzania, there is a significant gap in ARI prevalence among children between the rich and the poor. Again, the conclusion is that it is important to disaggregate health indicators to get a clear understanding of how the *poor* are affected.

The focus so far has been on presenting examples of health indicators that measure physical changes in health. Health outcomes are a result of physical

Box 3.
Project level indicators — Volta Region Community Water and Sanitation Program

Indicator	*Unit of measurement*
Sanitation and hygiene	▪ Absence of feces and urine on latrine floors and compound ▪ Absence of cleansing materials on latrine floor ▪ Absence of odor and flies in the latrine ▪ Evidence of hand washing after use of latrine
Water and hygiene	▪ Water fetching points are free of dirt ▪ Water transported in clean collecting vessels ▪ Water storage containers free from dirt, placed in clean environment and covered ▪ Use of cup with long handle for collecting water
Health, KAD	▪ Percentage of population that can demonstrate new knowledge as regards hazards associated with water, sanitation and health of each target community ▪ An existing agenda on hygiene education with data on activities such as the number of hygiene education meetings held and number of women attending the meetings and follow-up activities ▪ Target schools will have in existence: a hygiene education plan, data on number of meetings held by the school health committee, x number of trained schools health coordinators, a hygienically kept latrine with hand washing facilities, and clean school environment. ▪ Existence of hygiene education program involving the whole community emphasizing the following: proper disposal of refuse, proper disposal of waste water, penning of animals, x number of meetings held on hygiene activities. ▪ Environmental cleanliness and human excreta disposal ▪ At least 4 out of 10 households have some mechanisms of hand washing

Source: Evaluation of Hygiene Education Component of the Volta Region Community Water and Sanitation Program. Ho, Ghana: Community Water and Sanitation Division, VRCWSP, reproduced from Bojo and others (2001).

conditions, personal behavior, access to resources, and policy frameworks. Thus, a key issue is whether the policies in place favor the poor and support better health outcomes. A good proxy indicator of policies is government expenditures on health. Table 4 presents data on health expenditures in several countries in Africa.

Table 4 clearly shows that in African countries richer people benefit much more than the poor in terms of public support for health. The numbers for Guinea are the most stark, which has a rich-poor ratio of 12. Monitoring public expenditures on health by quintile groups is a costly undertaking. However, the above data suggests that this is an important poverty indicator and needs to be monitored.

Much of the discussion so far has been on sector specific or country/region specific indicators. Indicators are of course extremely important at the project level to evaluate project impacts and to monitor project outputs. Decisions about these indicators will critically depend on the specifics of the project and the stakeholders involved. Box 3 presents an illustration of a set of project level indicators.

In conclusion, an important question to address is which of the many indicators presented so far are the most important ones for monitoring environmental health outcomes. The answer to this question will depend on a) data availability; b) cost and ease of measurement and monitoring; c) stakeholder perceptions on what is important to monitor and acceptance of indicators; and d) and final purpose for which the information is used.

At the project or program level, it is important that indicators fit into the logical framework used in designing interventions and that indicators are used to track progress toward planned goals. At the national level, a core set of environmental health indicators could be selected based on international dialogue and agreement. Data on many of the suggested indicators are collected, and it should not be too difficult to seek consensus on a small number of core environmental health indicators for PRSP countries.

3 Poverty and Natural Resources

Do natural resources make a significant contribution to the real income earned by the poor in the short, medium or long term? Are the risks faced by the poor affected by a decline in the quality or quantity natural resources? How do we monitor the impacts of natural resource degradation on poor people's income and variability in income? From a policy perspective, it is important to understand how environmental quality and natural resources affect the well being of the poor. It is also important to know if resource degradation is a significant factor among the variety of constraints faced by the poor.

There is considerable debate about whether the poor are victims or agents of environmental degradation (Bucknall and others 2000, Ekbom and Bojo 1999). There is also increasing consensus that the relationship between the poor and natural resources is mediated by a number of micro and macro factors. Poor people make rational decisions based on limited information and within a given institutional or policy framework, about their labor choices, the risks they are willing to bear, and factors that affect their health. Thus, under varying circumstances, it may be optimal for poor people to mine natural resources, as is the case with soil degradation in several countries around the world. However, if under the medium or long-run, this makes the poor more vulnerable to income shocks, then it is important to monitor the extent and pace of soil degradation and the alternate inputs available to the poor to combat the implications of degradation. Also, if public hazards result from individual action—e.g., increased floods as a result of soil erosion—there is again a case for monitoring soil degradation and erosion as part of any effort to reduce poverty.

In this note, the focus is on how resource loss can act as a determinant of poverty. Natural resource degradation can affect the poor by affecting the productivity of inputs they use to grow food, by directly reducing the forest and aquatic products they consume, and by decreasing the ability of natural resources to provide a cushion to poor people during times when monetary income or agricultural produce is unavailable. Natural resources are sometimes the only assets to which poor people have access. Thus, degradation can decrease their wealth. Degradation can also affects eco-system functions, increase ecological fragility, and increase the vulnerability of the poor to natural shocks. However, it is also true that, under certain circumstances, degradation can help the poor if they are able to use income obtained from depleting natural resources to improve their lives in other ways.

Key Poverty-Natural Resource Indicators

Natural systems are extremely complex, and it would not be cost effective to monitor all the different ways in which the poor are affected by their natural environment. The local diversity of natural resource problems may also render any list of all global poverty-natural resource indicators irrelevant. The sometimes circular connection between poverty and natural

resource degradation also makes the monitoring of poverty-environmental indicators and their interpretation very challenging. Nonetheless, we offer below a set of indicators that are most commonly used in the literature on natural resources. These indicators should be considered a sample of indicators with broad utility for monitoring the natural resource related factors that affect the income, security and vulnerability of poor households in developing countries. In order to be clear about what is meant by a poverty-natural resource

Table 5. A sample of poverty-natural resource indicators that affect income, security, and vulnerability of poor people in poor countries

	Poverty issue	*Poverty-environment indicator*	*Natural resource problems that could influence this indicator*
1	Income and opportunity	Percentage of rural population below poverty line	Deforestation Water scarcity Overfishing Land degradation
		Rural per capita cereal production	
2		Time spent by household members to collect water and fuel wood	
3		Distance walked by household members to collect water and fuel wood	
4		Quantity of annual household consumption derived from common lands[1]	
5		Quantity of annual household consumption that is derived from forest products and fisheries[1]	
6		Percentage of irrigated area in total cultivated area by wealth/income categories[2]	
7		Percentage of rural households with adequate water for livestock by wealth/income categories[2]	
8	Food security	Rural per capita cereal production	Land degradation Water scarcity Pest outbreak Natural disasters
9		Percentage of farmers who grow drought resistant crops by income/wealth quintiles	
10		Quantity of household consumption that is derived from forest products and fisheries[1]	Deforestation Overfishing
11		Percentage of rural children under five who are underweight	Land degradation Water scarcity Water quality
12		Percentage of rural children under five who are stunted	
13		Percentage of rural children under five who are wasted	
14	Vulnerability to natural disasters	Households rendered homeless from floods/hurricanes/cyclones/landslides per year by income / wealth quintiles	Natural disaster Deforestation
15		Number of deaths from natural disasters by income / wealth quintiles	
16		Percentage of farmers with land on slopes/wetlands by income / wealth quintiles	
17		Percentage of rural children under five who are wasted	

Notes:
1. Among households that are largely dependent on natural resources with few alternative income/employment opportunities.
2. Field tested by a DFID research group (DFID 2001).

indicator, a working definition of such an indicator is developed. Thus, a poverty-natural resource indicator is one which changes when "better management of a natural resource leads to decline in poverty (broadly defined)."

Table 5 presents indicators that show the extent to which poor people depend on resources. Boxes 4 and 5 provide illustrations of this fact. Table 9 in the Appendix provides some working definitions and sources of data for the indicators presented.

An important basic indicator of income poverty in rural areas is the is widely published and used "percentage of rural population below the poverty line" (World Bank 2001a). This is a broad indicator that is expected to decline over time if natural resources are unsustainably managed. Also included as a broad indicator of income is rural per capita cereal production.

Box 4.
Monitoring time spent by women and children on collecting water

Vidharbha is a large and under-developed region in Maharashtra, India. A participatory research team working with 10 villages in Nagpur district, started a research program in 1995 on safe drinking water. The researcher documents that women in these villages worried tremendously about the quantity of water that was available, paying very little attention to its quality. With good reason—all 10 villages had serious water problems with the burden of collecting water falling entirely on women and girl children. Women and children fetched water from farm wells situated 2–3 km away, often in 47ºC heat in the summer months. An average family required 250–300 liters of water per day. A woman could fetch 5–8 liters of water each time because of what her pot could carry. *Thus, female adults and female children walked 35–40 times each day to fetch water. They generally woke up at 4:30 a.m. and collected water until 6:30 or 7:00 a.m.; the same routine was repeated in the evening.* Little of this water was used for personal hygiene since this was a low priority (L. Devasia 1998). This picture, even accounting for any respondent exaggeration, shows the extreme vulnerability of the poor in relation to water scarcity.

Box 5.
People's dependence on forest products

A recent study by William Cavendish (1999) shows the economic contribution of environmental resources to poor households in Zimbabwe. This study was undertaken in the Shindi Ward in Southern Zimbabwe and was comprised of two household surveys (1993–94 and 1996–97). The results are striking:

1. In both years environmental income makes a substantial contribution to total household incomes, comprising 35.4 percent of total income in 1993–94 and 36.9 percent in 1996–97.
2. In the latter year, environmental income was equivalent or greater to all other (cash and non-cash) income earned. The inclusion of environmental resources over and above income sources normally captured in rural household surveys would have boosted measured mean incomes by as much as 46 percnet in 1996–97.
3. Data disaggregated by income quintiles presents some important results. The bottom 20 percent of the population generated 40 percent of their income from environmental goods, while the top 20 percent generated approximately 29 percent of income from the environment.
4. While environment contributes most to poor households, in absolute terms, the top quintile consumes 3–4 times the value and quantity consumed by the poorest.

This study shows the nature of the dependence of rural households on environmental resources and the importance of "accounting" for these resources.

Indicators such as "time spent to or distance traveled to collect water or fuel wood" are proxies for effort expended on obtaining livelihood resources or income. These two indicators are substitutes for each other and are *particularly important for understanding resource degradation impacts on women and children*. In general, time and distance indicators provide information on the increased burden on women and children that may result from deforestation, drying-up of water sources, or a decline in

access to fuelwood and water because of changes in property rights. Box 4 provides an illustration of time spent on water collection. As the Box shows, efforts put into collecting water can be considerable; therefore, the need to monitor such indicators. Data on time and distance may be available through the World Bank supported Living Standards Measurement Surveys (LSMS) (Whittington 2000).[5]

Indicators such as "quantity of household consumption derived from forest products" and "quantity of household consumption that is derived from commons"[6] are useful indicators of income poverty.[7] Box 5 illustrates this fact. However, care needs to be used in interpreting these indicators. These indicators are meaningful poverty-environment indicators only in cases where households are largely dependent on natural resources and do not have access to alternate employment or income opportunities. For example, if the "quantity of consumption from forest products" declines, it can be interpreted as a decline in income if and only if the household has not substituted forest product collection for a different more profitable labor activity.

"Percentage of irrigated area in total cultivated area" can provide information on the poor's access to an important agricultural input, if data is disaggregated by income or wealth quintiles. "Percentage of rural households with adequate water for livestock, disaggregated by income/ wealth categories" is an important indicator of the ability of the poor to maintain non-land income generating assets. These two indicators were field tested by a DFID research group (2001) and identified as indicators for which country level data are available in some case study countries.

In general, food security depends on food availability, stability, accessibility and utlilization (FAO 2000). Food availability is closely related to production of food, and, thus, to natural resource management. Stability reflects variation across time and space and can be influenced by price changes and market forces. Food accessibility is linked to poverty and whether poor households have physical access, that is, whether there are roads and markets close to them and whether they have monetary resources to buy food. Another key component of food security that is linked to poverty is biological utilization, which reflects the ability of the human body to consume and retain nutrients.

Table 5 includes three indicators on food availability. "Rural per capita cereal production' is a direct measure of output divided by the rural population. This broad indicator reflects food production and is likely to change during years of drought, natural disasters, and pest outbreaks, for example. This indicator may also show a gradual decline overtime because of soil fertility changes. Data are available in the World Development Indicators series. It is to be noted that while useful, this indicator alone does not tell us much about food security implications for the poor.

Evidence suggests that poor households depend on natural resources during "lean" times. Thus, "quantity of household consumption that is derived from forest products and fisheries" can be expected to increase when crops fail—this indicator captures the direct role of resources as a safety net. Also included in Table 5 is a drought related indicator—"Percentage of farmers who grow drought resistant crops." It would be useful to have information on this indicator disaggregated by wealth or income quintiles.

Malnutrition indicators reflect poverty and the quality and quantity of natural resources to which poor households have access. Environmental factors play an important role here because of their impact on food production and on environmental health. Table 5 includes

three malnutrition related indicators. "Percentage of rural children under five who are under-weight" is the most common indicator of malnutrition. This is an important poverty indicator since being underweight increases the risk of death and inhibits cognitive development among children (World Bank 2001). Stunting, which refers to height for age, is a long-term indicator of malnutrition. Wasting, which refers to weight for height, is more indicative of acute shortages in food. Information on malnutrition indicators disaggregated by wealth/income quintiles would be optimal.

Lastly, Table 5 includes a set of indicators on the vulnerability of the poor to large natural events, such as to natural disasters. Indicators such as "Percentage of households rendered homeless by floods/cyclones and so forth," and "Percentage of farmers with land on slopes," are broad indicators of vulnerability. Information on these indicators needs to be disaggregated by income/wealth quintiles to get an accurate understanding of how the poor are impacted. Another useful poverty-environment indicator is "wasting before and after natural disasters." This indicator is sensitive to the type of acute growth disturbances that may be caused by natural disasters.

The list presented in Table 5 is by no means exhaustive. It will have to be modified to suit local conditions and local data sets. These indicators also need to be used with caution because of the complex nature of poverty-environment linkages. Because of the strong need for local natural resource-poverty indicators, it may be useful to think about a *common framework* for identifying these indicators, rather than a list of indicators. This is presented in the next section.

The Pressure-State-Poverty-Response-Framework

The complexity of resource degradation-poverty links makes it useful to employ a systematic *framework* for ensuring that environmental factors are not making the poor even more poor. OECDs Pressure-State-Response (PSR) model offers one relatively straightforward framework for monitoring the impact of resource degradation on the poor and identifying policy measures to stem the problems faced by the poor.

The OECD framework considers key environmental problems, identifies driving forces that are leading to *pressure* on natural resources, tracks the *state of the resource*, and then identifies mechanisms that have been or can be put into place in *response*. A slight modification of this model would allow us to track the poverty impacts of degradation. This model, referred to as the Pressure-State-Poverty-Response (PSPR) model, allows us to track the impact of pressure factors not only on natural resources but also on the poor. Table 6 presents an example for the environmental problem of deforestation.

Indicators of deforestation such as deforestation rate and area deforested are now routinely used to monitor changes in forest cover. Table 6 suggests that within a PRSP framework it is useful to consider these indicators in tandem with poverty indicators. This table presents a set of poverty indicators that can be monitored to capture the effects of deforestation on poor people's real income.

The first four poverty indicators in Table 6 are village or province level indicators, the remaining are household level indicators. Arguably, the three most important of these poverty indicators are "Percentage of poor households in forest rich provinces" at the province or country level and "Time spent or distance walked to collect fuelwood/water (by quintile)" or "Percentage of household who collect fuelwood (by quintile)" at the project or

Table 6. Deforestation and income impacts on the poor — Indicators within the Pressure-State-Poverty-Response framework

Signals of pressure on forests	*Indicators of impact on state of …*		
	Forests	*Poverty*	*Response factors*
Rural population growth rate	Rate of deforestation	Percent of poor households in forest rich provinces	Increased access to non-traditional sources of energy
Rural population density	Total area under forest cover	Percent of indigenous people in forest rich provinces	Increased access to piped water
Unclear property rights	Rate of forest land conversion	Percent of common lands available for women to collect fuelwood and NTFPS	Strengthened community governance of forest access and use
Increased rural under or un-employment rate	No. of protected areas	Percent of village lands in commons	No. of forest user groups in district or state
Decrease in fallow period		Distance and Time to collect fuelwood (by quintile and season)	Modernized land registry
Increase in fertilizer prices		Distance and Time to collect water (by quintile and season)	No. of land titles granted
Increased export of forest products		Decline in agricultural output because of use of marginal lands	
Increase in timber prices		Percent of household who collect fuel wood (by quintile)	
		Percent of households who collect other forest products (by quintile)	
		Quantity of household consumption from forest products (by quintile and season)	

sector level. Indicators such as decline in agricultural productivity because of use of marginal lands may be more difficult to measure.

The poverty-environment indicators presented above are indicators of potentially negative impacts resource degradation may have on poor households. However, unlike the previously described environmental health indicators, these indicators require a more sophisticated reading. For example, an increase in time taken to collect fuel wood is likely to be an unequivocal indicator of increased burden on poor households. However, a decline in the quantity of household consumption of forest products or a decrease in the percentage of households collecting fuel wood may indicate increased poverty or not depending on what additional opportunities may have become available for poor households. Thus, in dealing with natural resources, indicators need to be used cautiously and within a clearly specified context.

Table 7 presents another example of environmental degradation and how its income impacts on poverty can be monitored. The focus in this table is on land degradation. Soil fertility loss and land degradation are a common and very important form of environmental loss in

Table 7. Soil fertility and income impacts on the poor — Indicators within the Pressure-State-Poverty-Response framework

Signals of pressure on soil fertility	*Indicators of impact on state of …*		*Response factors*
	Natural resources	*Poverty*	
Rural population density in relation to agro-climatic zone and soil type	Ratio between actual and estimated crop yields	Population below poverty line (% rural)	Extent of cultivation of marginal land
Cultivated land / fallow land	Changes in soil properties over time	Infant mortality rate (rural and by quintile)	Extent of use of biological methods of soil improvement
Cultivated land / cultivable land	Occurrence of specific soil deficiencies, e.g., micro nutrients	Rural poverty head count index	Use of crop rotation or multiple cropping
Land in monoculture / land in multiple cropping or crop rotation	Occurrence of indicator plants for soil degradation or soil health	Mean per capita expenditure (rural and by quintile)	Fertilizer use
Rural population growth rate	Balance between soil nutrient inputs and outputs (obtained by measurement and modeling)	Food production index	Number of farmers groups
	Agricultural productivity	Female headed households (rural)	Abandonment of farm land
	Cereal yield	Net migration rate (rural to urban)	Conflicts over land resources

Source: Modified from Pieri and others (1995).

many developing countries. These issues are particularly problematic in sub-humid zones of West Africa and many parts of South Asia.

Most of the information in Table 7 is drawn from Pieri and others (1995) who suggest that two good indicators of pressure on land are increases in the ratio of cultivated to potentially cultivable land, and ratio of land in monoculture without fallowing to land in crop rotation. The cultivation/fallow ratio is an indicator that is applicable in low-input systems.[8] State indicators such as changes in soil property can be observed indirectly through crop yields or directly by measuring soil changes. Change in crop yields over time is another highly significant indicator of the state of soil fertility loss.

On the poverty side, there are a number of indicators that can be used to capture the impact of land degradation. Broad indicators such as rural population below poverty line, infant mortality rate and head count index are useful but may reflect changes in a number of different factors and not just soil or land degradation. A declining food production index is useful partly because it reflects changes in land and partly because it signals adverse food security. Household expenditure (as a proxy for income) in agricultural households is another reasonable indicator. Finally, demographic changes such as increased rural-urban migration and female-headed households could signal labor movements as result of land degradation. However, these indicators should be interpreted carefully because of the number of different stresses that they could represent.

The PSPR model is simply a *framework* for tracking the impacts of resource degradation on the poor. The Tables presented in this section seek to illustrate the utility of this framework. The extent to which this framework will actually be used will largely depend on data availability and the costs of data collection in different PRSP countries. Box 6 presents some information on data sets available for monitoring poverty at the sub-national level in Africa.

Box 6.
Data for Monitoring Poverty in Africa — The Africa Region Household Survey Data Bank

A large body of survey data exists for SSA countries, much of it from household surveys. Much of this data is not yet fully accessible because of two main constraints. First, the data suffers from not being well documented and/or it has not been fully cleaned and edited. Second the policies in the country do not allow for full data disclosure and accessibility. The objective of the Africa Region Household Survey Data Bank (AHSDB) is to gather and organize household survey data sets to make them available for analysis. The challenges in reaching this objective are: the availability of data, the documentation of the data sets, the quality of the data and the conditions in the country to disseminate the data. The ultimate objective is to disseminate the data sets to users in SSA and elsewhere through various media (such as hard copy or the internet). As of October 1, 2000 the Africa household Survey Databank contained data sets of 106 surveys. Further details are available on the web at: <http://www4.worldbank.org/afr/poverty/databank/default.htm>.

Poverty-Environment Maps

Geo-referenced indicators are another tool for monitoring the impact of natural resource degradation on poverty. A recent paper by Henninger and Hammond (2000) from the World Resources Institute makes a strong case for using poverty-environment maps. They argue that a geographic framework for poverty-environment indicators is useful because of three reasons:

1. Many environmental problems manifest themselves spatially. Many environmental problems are also very local in nature. Geographic mapping of environmental

conditions makes it feasible to understand environmental conditions and act on them locally.

2. Maps showing poverty rates and environmental data can become important tools for screening and geographic targeting of intervention schemes. The complex nature of poverty-environment interactions make it useful to understand geographically a) where poverty exists, and b) the nature of environmental conditions in those poverty pockets. These maps can help pinpoint areas for more in-depth analyses.

3. With greater availability and affordability of GIS tools and remote sensing products, electronic maps are feasible. They have become a convenient way to store and analyze data from different sectors and at multiple scales.

There are many examples of the utility of poverty-environment maps. The International Center for Tropical Agriculture in Columbia has produced some useful maps of the impact of Hurricane Mitch on Honduras and how flooding affected areas inhabited by the poor; the World Resources Institute provide some excellent illustrations of human impacts on ecosystems; the interim Poverty Reduction Strategy Paper (GOH 2000) from Honduras uses poverty maps to present a geographic picture of poverty, etc. In recent times such maps have become popular especially because they are a good way to present ideas to policy makers.

Box 7.
Geo-referencing Household Survey Data

The West Africa Spatial Analysis Prototype (WASAP) is a USAID funded project that adds value to Demographic and Health Survey data by geo-referencing DHS household clusters. Data has been geo-referenced for 12 countries in West Africa. This shows that internationally standardized surveys such as the DHS can be integrated across countries for regional assessment, raw data can be plotted on a map to reveal spatial patterns, and survey data can be integrated with other mapped data to produce new modeled estimates. Henninger and Hammond present the utility of this kind of information by estimating nutrition indicators by aridity zones in West Africa. They are able to show for example that the percentage of children who are underweight declines dramatically from 46 percent in hyper arid and arid regions to 25 percent in humid regions of West Africa.

Source: Henninger and Hammond 2000.

The ability of countries to present poverty-environment maps will largely depend on skills and data availability and the cost of the mapping efforts in the country. It is also important to underscore that these maps are static and do not imply any form causality. In general, a geographic rendition of poverty and its links to the environment is extremely useful. However, it should be noted that this can be done, in many cases, with simple mapping techniques that would not require elaborate geo-referencing of data sets.

4 Discussion and Conclusions

The review of existing literature on indicators suggests the need for a small number of core poverty-environment indicators that can be monitored globally. With environmental health issues, it is relatively straightforward to identify indicators to monitor outcomes. While there are a number of local issues that need to be considered, in several instances the same indicators can be used from local to global levels.

It is recommended that core environmental health indicators relate to the three major health problems that affect the poor – diarrhea, respiratory infections and malaria (in prevalent areas). Impact indicators, such as infant and under 5 mortality rates, and intermediate indicators, such as access to water and sanitation, are routinely monitored. In addition, it would be useful to promote data collection and monitoring of Roll Back Malaria and a small set of ARI related indicators. For purposes of poverty reduction, it would be important to monitor environmental health data by quintile groups. Poor-rich ratios are another useful way of assessing and acting on inequality in environmental health trends.

With natural resource degradation, partly because of the circular nature of the interactions between poverty and resource degradation, and, partly because of the range of natural resource concerns faced by the poor, identifying a common set of indicators is difficult. Monitoring time spent to collect water and fuel wood would be useful and relatively cost-effective since the globally implemented Living Standards Measurement Surveys include information on time-use. Based on a dialogue with and among client countries, data could be cost-effectively gathered and/or analyzed on additional indicators such as forest product consumption, rural malnutrition, and property damage or death resulting from natural disasters. Some of this information can be gathered by adding a few questions to the LSMS. This issue bears further discussion.

In order to assess empirically whether poverty-environmental indicators were being used in poverty strategies, Poverty Reduction Strategy Papers, undertaken by World Bank client countries, were informally reviewed. A number of PRSPs mention poverty-environment indicators. However, it was not always clear that these indicators would be systematically monitored over time.

Most of the indicators mentioned in the PRSPs relate to environmental health. Access to safe water and sanitation are the most commonly discussed environmental health indicators. Two other common indicators are infant and under 5 mortality. The Zambia PRSP attempted to go beyond access to clean water to show incidence of malaria and cholera. A few PRSPs disaggregate health indicators to show impacts on the poor. For example, the interim PRSP from Burkina Faso has information on prevalence of diarrhea and ARI among children, and on infant mortality by quintile groups. The Honduras PRSP identified 'crowding in houses' as another important indicator of environmental health.

Relatively few PRSPs discuss natural resource-poverty indicators. The Honduras PRSP acknowledged migration toward previously forested areas, and, identified houses located on alluvial slopes along rivers as an indicator of vulnerability to natural disasters. The Nicaragua PRSP recognized housing construction and materials as an indicator of vulnerability. However, in general, the review of existing PRSPs showed that environmental health indicators are more likely to be considered than natural resource indicators in poverty reduction efforts.

In certain cases, it may be useful to promote a common framework for monitoring poverty-natural resource trends in PRSP countries. The modified Pressure-State-Poverty-Response framework is one model that can be used. Poverty-maps overlaid on natural resource maps would also be helpful where data and skills are available.

Indicators are tools for monitoring change. In order to assess poverty related improvements, it will be important to have a comparable core set of global indicators. However, the ultimate utility of any set of indicators will depend on how expensive it is to collect and monitor information. It will also depend on the needs of local as well as global stakeholders. Thus, any global effort to monitor the poverty impacts of environmental change is likely to be most effective if it complements local initiatives and tries to meet local demands.

Appendix — Indicators, Definitions, and Sources of Data

Table 8. Environmental health indicators, some definitions and data sources

Indicator	*Definition*	*Sources of data*
Access to safe water (private or public)	Proportion of population who use any of the following types of water supply for drinking: piped water, public tap, bore hole/pump, protected well, protected spring, rain water.[1]	MICS, DHS, WDI
Access to sanitation (private or public)	Proportion of population, who have within their dwelling or compound: toilet connected to sewage system, any other flush toilet (private or public); improved pit latrine; traditional pit latrine[1]	MICS, DHS, WDI
Hours/day of available piped water	Hours per day of piped water available in rainy and dry seasons[5]	LSMS
Quantity of water used per capita per day	Volume of water collected by or delivered to the household and used there for drinking, cooking, bathing, personal and household hygiene and sanitation divided by number of persons in sample households[2]	Population based surveys
Time taken/ distance involved in collecting water	Distance / time taken to walk to nearest source[5]	Population based surveys LSMS
Percentage of child caregivers and food prepares with appropriate hand washing behavior	Appropriate hand washing behavior includes critical times (after defecation and cleaning baby bottoms; before food preparation, eating and feeding children) and technique (uses water, uses soap or ash, washes both hands, rubs hands together at least 3 times, dries hands hygienically) [2]	
Percent of residents using traditional fuels	Proportion of population using firewood, dung and crop residues as primary fuel for cooking and heating	LSMS
Percent of households having at least insecticide treated net	Number of household having at least one treated bednet divided by total number of households visited x 100[4]	Community surveys
Infant mortality rate	The number of deaths to children under 12 months of age per 1,000 live births.[3]	MICS, DHS, WDI
Under 5 mortality rate	The number of deaths to children under five years of age per 1,000 live births.[3]	MICS, DHS, WDI
Prevalence of diarrhea	Percent of surviving children under three, four, or five years old (depending on the country) who had diarrhea in the two weeks preceding the survey, based on mothers' reports concerning the presence of loose stools.[3]	DHS

(*continued*)

Table 8. Environmental health indicators, some definitions and data sources (*continued*)

Indicator	*Definition*	*Sources of data*
Prevalence of acute respiratory infection	Percent of surviving children under three, four, or five years old (depending upon the country) who had a cough accompanied by rapid breathing in the two weeks preceding the survey, as defined and reported by the mother.[3]	DHS
Malaria death rate	Total number of malaria deaths (probable or confirmed) per year among target group divided by mid-year population of the same target group.[4]	DHS, DSS, Health facility surveys
Disability adjusted life years	Life years lost due to premature death and fractions of years of healthy life lost from illness or disability.	
Disability adjusted life years	Life years lost due to premature death and fractions of years of healthy life lost from illness or disability.	

Notes:
MICS: Multiple Indicator Cluster Survey, supported by UNICEF and carried out by national governments.
DHS: Demographic and Health Surveys, supported by USAID and carried out by Macro International.
WDI: World Development Indicators, World Bank.
DSS: Demographic Surveillance Systems.
LSMS: Living Standards and Measurement Surveys, supported by World Bank.

Sources:
1. Proposal for Poverty Reduction Strategy HNP Core Indicators. Life cycle segment: Childhood, email Flavia Bustreo, World Bank 2000b.
2. Billig and others 1999.
3. <http://www.worldbank.org/poverty/health/data/indicat.htm> — Definitions are based on DHS definitions.
4. WHO 2000.
5. D. Whittington 2000.

Table 9. Poverty and natural resource indicators, some definitions and data sources

	Poverty-environment indicator	*Definition*	*Data sources*
1	Percent of rural population below poverty line	Percent of rural population living below the national poverty line	WDI
2	Time spent by household members to collect water and fuel wood	Total time spent by each household member to collect water and fuel per day X no. of household members X no. of days per year	LSMS, Population based surveys
3	Distance walked by household members to collect water and fuel wood	Distance walked by each household member to collect water and fuel per day X no. of members X by number of days per year.	
4	Quantity of annual household consumption derived from common lands[1]	Quantity of key minor forest produce consumed per season	Population based surveys
5	Quantity of annual household consumption that is derived from forest products and fisheries[1]	Quantity of key minor forest and aquatic produce consumed per season	
6	Per capita rural cereal production	(Cereal yield per hectare X land under cereal production)/ rural population	WDI

(*continued*)

Table 9. Poverty and natural resource indicators, some definitions and data sources

	Poverty-environment indicator	*Definition*	*Data sources*
7	Percent of rural children under five who are underweight	Percent of children under 5 whose weight measurement is more than 2 standard deviations below the median reference standard for their age	DHS Population based surveys
8	Percent of rural children under five who are stunted	Percent of children under 5 whose height measurement is more than 2 standard deviations below the median reference standard for their age	
9	Percent of rural children under five who are wasted	Percent of children under 5 whose weight measurement is more than 2 standard deviations below the median reference standard for their height	
11	Households rendered homeless from floods/hurricanes/cyclones per year by income / wealth quintiles	Total number of households with their primary source of dwelling destroyed as a result of natural disasters per year	Population based surveys
12	Number of deaths from natural disasters by income / wealth quintiles	Total number of deaths caused from natural disasters per year	
13	Percent of farmers with land on slopes by income / wealth quintiles		

Notes:
1. Among households that are largely dependent on natural resources with few alternative income/employment opportunities.

DHS: Demographic and Health Surveys, supported by USAID and carried out by Macro International.
WDI: World Development Indicators, World Bank.
LSMS: Living Standards and Measurement Surveys, supported by World Bank.

Notes

1. Future projections of air pollution and its impacts suggest that by 2020 outdoor air pollution will take the lead over indoor air pollution in contributing to burden of disease in countries such as China and in many former socialist economies (World Bank 2000a: Table 2).
2. Quantity of water available and used is considered much more important than water quality for good health outcomes.
3. Under 5 mortality rate is considered a better indicator of environmental health than infant mortality rate because of the strong influence of maternal health and birth on infant mortality.
4. This represents on-going work at the Environment Department of the World Bank. The graph is based on data constructed from DHS by Macro International.
5. LSMS questionnaire modules include questions on time spent and distance traveled to collect water and fuel. Whether data is available on these questions depends on how many LSMS surveys included these particular modules and questions in actual surveys.
6. The literature on natural resources suggests that the poor may be disproportionately dependent on commons and therefore are most affected by degradation of common property resources.
7. Consumption is used instead of income because of difficulties associated with obtaining reliable information on income.
8. This is measured as the R factor, where R = years under cultivation/total years in the cultivation-fallow cycle (Ruthenburg 1980).

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