CHAPTER 3

Tracing the effects—understanding the relations

We have seen major intersections between equity and the environment. In this chapter we focus on how environmental unsustainability affects people and how inequality mediates this relationship. We also draw attention to countries and groups that have broken the pattern, emphasizing transformations in gender roles and empowerment.

Poor and disadvantaged people suffer most from environmental degradation. That fact surprises no one. Almost every week the media report catastrophes that shatter lives in the poorest parts of the world—lives of people who already face major disadvantages.

While extreme events are disequalizing, so too are activities that harm the environment. Studies for the United States, for example, show that toxic waste facilities are located disproportionately in working class and minority neighbourhoods, harming health and education as well as property values.[1] Whether these outcomes arose because land and housing in those areas lost value after the facilities were built or because residents were less able to resist location decisions, it is clear that environmentally harmful practices accentuate racial and social inequalities. These location decisions do not happen only in market economies: in the former Soviet Union the Mayak nuclear facility was built in a region settled mostly by Muslim Tatar and Bashkir people and descendants of people repressed and exiled under Stalin.[2] This chapter aims to understand why and how these patterns come about today.

Which factors condition the relationship between environmental degradation and human development? Both the absolute level and the distribution of individual, household and community capabilities matter. Absolute deprivations can hurt the environment, and bad environmental conditions erode people's capabilities. Many examples illustrate these links—educated girls have lower fertility rates, and more empowered communities suffer less pollution.

Through the lens of multidimensional poverty, this chapter first documents deprivations in the immediate environments of the poor and how such deprivations can intersect with adverse repercussions of climate change. Next the related environmental threats to people's health, education and livelihoods are explored, followed by how chronic disadvantage interacts with acute risks to make extreme events more disequalizing. The chapter closes with a focus on gender and power inequalities and on how greater equality in these areas can have positive effects on the environment, laying the ground for the investigation of policy options in the chapters that follow.

A poverty lens

A key theme of this Report is that the world's most disadvantaged people carry a "double burden." More vulnerable to environmental degradation, they must also cope with immediate environmental threats from indoor air pollution, dirty water and unimproved sanitation.[3] Our Multidimensional Poverty Index (MPI), introduced in the 2010 *Human Development Report* (*HDR*), gives us a closer look at these household-level deprivations (figure 3.1).

The MPI measures deficits in health, education and living standards, combining both the number of deprived people and the intensity of their deprivations. This year we explore the pervasiveness of environmental deprivations among the multidimensionally poor—focusing on the lack of improved cooking fuel, drinking water and sanitation—and the extent of their overlap at the household level, an innovation of the MPI.

These are absolute deprivations that both matter in themselves and are violations of basic

FIGURE 3.1

Multidimensional Poverty Index—a focus on the most deprived

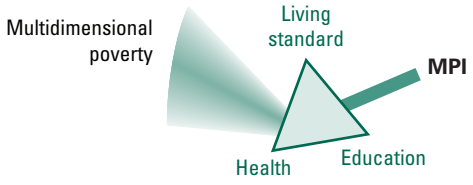
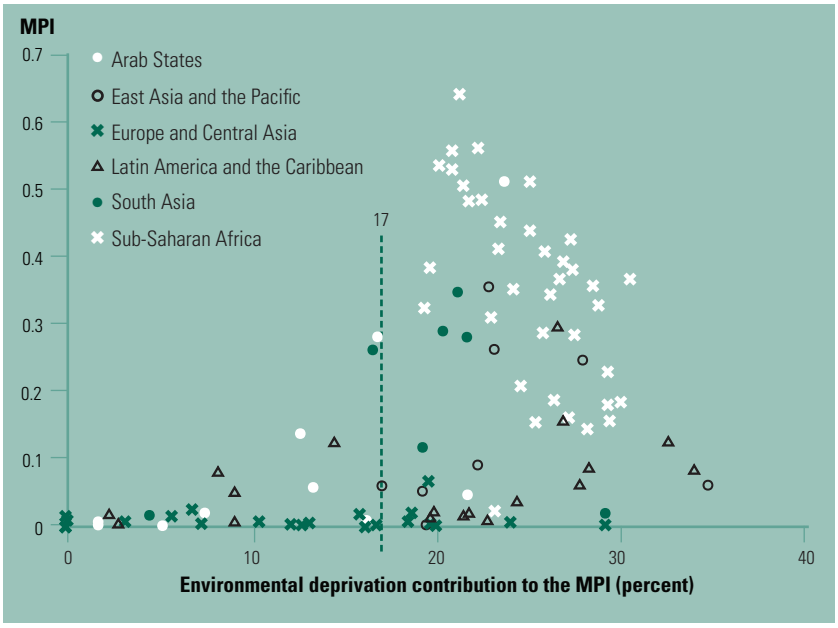
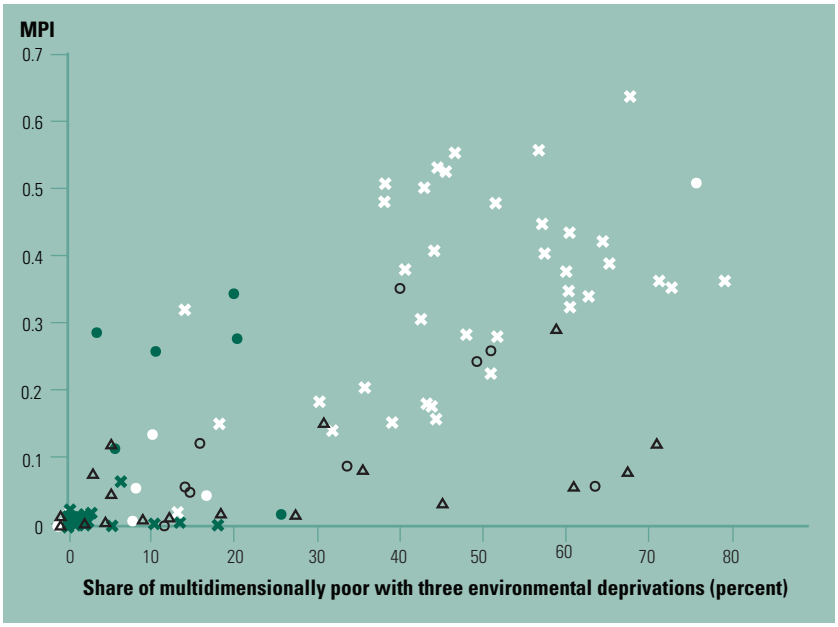


FIGURE 3.2

Environmental deprivations in the MPI





Note: The dashed line in the top panel denotes what the average contribution of environmental deprivations would be if their contribution to total poverty were equal to their weight in the MPI. Countries to the right have disproportionate environmental poverty, and countries to the left, less than expected. Survey years vary by country; see statistical table 5 for details.
Source: HDRO staff estimates based on data in statistical table 5.

human rights. Ensuring access—including to modern cooking fuel, safe water and basic sanitation—also creates the potential to expand higher order capabilities, thereby enlarging people's choices and furthering human development. The lens of the MPI highlights joint deprivations in access.

Deprivations facing the poor

Multidimensional poverty is estimated for 109 countries (see statistical table 5),[4] and the results are striking.

- Globally, at least 6 in 10 people experience one environmental deprivation, and 4 in 10 experience two or more.[5] These deprivations are more acute among the multidimensionally poor. More than 9 in 10 face at least one deprivation: nearly 90 percent do not use modern cooking fuels, 80 percent lack adequate sanitation and 35 percent lack clean water.
- Most suffer overlapping deprivations: 8 in 10 poor people experience two or more environmental deficits, and 29 percent face all three.
- The rural poor are more afflicted. A striking 97 percent face at least one environmental deprivation, and about a third suffer all three. Comparable data for urban areas are 75 percent and 13 percent.
- State- and provincial-level MPIs show wide disparities in environmental deprivations. Within Haiti the proportion of people who are both multidimensionally poor and deprived of clean water in Aire Métropolitaine/Ouest is 19 percent, while in the Centre it is 70 percent. Similarly, in Senegal the proportion of people who are both multidimensionally poor and deprived in cooking fuel is about 4 percent in Dakar and about 88 percent in Kolda. And in India deprivations in sanitation among multidimensionally poor people range from 3.5 percent in Kerala to more than 70 percent in Bihar.

Environmental deprivations typically rise with the MPI, but the composition of multidimensional poverty varies, even for countries with similar poverty levels. Overall, environmental deprivations disproportionately

contribute to multidimensional poverty, accounting for 20 percent of the MPI—above their 17 percent weight in the index (figure 3.2, top panel).[6] In rural areas the average is 22 percent of poverty, compared with 13 percent in urban areas. In Mongolia, Peru, Swaziland and Uganda such deprivations account for more than 30 percent of multidimensional poverty.

But there are some good performers as well, with lower shares of environmental deprivation.[7] In several Arab States (Jordan, Occupied Palestinian Territory, the Syrian Arab Republic and the United Arab Emirates) and European and Central Asian countries (Croatia, Estonia, Russian Federation and Ukraine) such deprivations are less than half their weight in the index. Brazil has also performed well.

Regional patterns show that environmental deprivations are most acute in Sub-Saharan Africa: 99 percent of the multidimensionally poor face at least one environmental deprivation, and nearly 60 percent face all three (figure 3.2, bottom panel). Environmental deprivations are also severe, if less pervasive, in South Asia: 97 percent of the poor suffer at least one deficit, and 18 percent face all three. By contrast, in Europe and Central Asia 39 percent of the poor have one or more environmental deprivations (excluding Tajikistan, where the poor population is large and the share with one deprivation or more is an unusually high 82 percent). Few have all three—just over 1 percent, excluding Tajikistan.

Deprivations are most widespread for access to cooking fuel (figure 3.3). In South Asia and Sub-Saharan Africa, the two poorest regions, more than 90 percent of the multidimensionally poor lack access to modern cooking fuel. More than 85 percent of poor people in both regions lack access to improved sanitation. In several Arab States water problems are paramount, affecting more than 60 percent of the multidimensionally poor.

The extent of environmental deprivation is also associated with the country's Human Development Index (HDI) value. More than 4 in 10 multidimensionally poor people in low HDI countries face all three environmental deprivations. And these countries typically have above average environmental poverty—about 6 percentage points higher than if the environmental deprivations they face equalled their weight in the MPI. For example, 65 percent of the population in Madagascar lack access to clean water. The repercussions are extensive. Most schools in Madagascar have no running water for adequate hygiene and sanitation, so pupils fall sick regularly, missing classes and underperforming. Diarrhoea causes an estimated annual loss of 3.5 million school days in Madagascar.[8]

There is also good news, sometimes reflecting successful outreach by governments and nongovernmental organizations (NGOs). For example, South Asia stands out for having a relatively low share of its population (less than 15 percent) deprived in access to water.

Understanding the relations

To better understand environmental deprivations, we analysed the data holding poverty levels constant.[9] Countries were ordered by their share of multidimensionally poor people facing one or more environmental deprivations and the share facing all three. In both cases the share of the population with environmental deprivations rises with the MPI but with much variation around the trend (figure 3.4).

Countries above the trend line have higher than average environmental poverty, and those below perform better. The countries with the lowest shares of their population facing at least one deprivation are concentrated in the Arab States and Latin America and the Caribbean (7 of the top 10), while those with the lowest share of the population with all three are concentrated in South Asia (5 of the leading 10; table 3.1).

Brazil, Djibouti, Guyana, Morocco and Pakistan are in both top 10 lists. They perform well in having a low share of the population with at least one environmental deprivation and with all three.

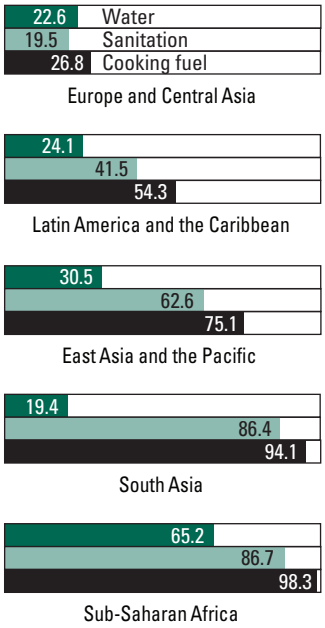
Some examples:

- The Brazilian government has been expanding access to water and sanitation for several decades, investing in water

FIGURE 3.3

Environmental deprivations are greatest for access to modern cooking fuel

Share of multidimensionally poor with environmental deprivations, by region (percent)



Note: Survey years vary by country; see statistical table 5 for details. Data are not shown for the Arab States because low poverty levels render the results potentially unreliable.

Source: Calculated based on data in statistical table 5.

FIGURE 3.4

The share of the population with environmental deprivations rises with the MPI but with much variation around the trend

Note: Survey years vary by country; see statistical table 5 for details. The figures depict deviations from the trend for the regression exercises described in the text.

Source: HDRO calculations based on data in statistical table 5.

TABLE 3.1

Ten countries with the lowest share of environmental deprivations among the multidimensionally poor, most recent year available for 2000–2010

Lowest share of multidimensionally poor with at least one deprivation	Lowest share of multidimensionally poor with all three deprivations
Brazil	Bangladesh
Guyana	**Pakistan**
Djibouti	Gambia
Yemen	Nepal
Iraq	India
Morocco	Bhutan
Pakistan	**Djibouti**
Senegal	**Brazil**
Colombia	**Morocco**
Angola	**Guyana**

Note: Countries in bold are on both lists.

Source: HDRO calculations based on data in statistical table 5.

supply and using cross-subsidies to benefit low-income households.[10] Innovation has also been important. Brasilia has developed condominial sewerage systems that use narrow pipes installed at shallow depths instead of more expensive conventional construction.[11] Almost all Brazilian households (98 percent) use liquefied petroleum gas (LPG) fuel, thanks to policies beginning in the late 1960s for a national LPG delivery system and cross-subsidies for LPG through taxes on other fuels.[12]

- In Bangladesh only 4 percent of the multidimensionally poor lack access to clean water, thanks to the country's thousands of hand tubewells. But there are caveats. Coverage rates include access to a public standpipe, and wait times can be long. Dhaka has only one public tap for every 500 slum dwellers.[13] Moreover, arsenic levels exceed World Health Organization (WHO) recommendations in about a third of hand tubewells, jeopardizing the health of tens of millions of Bangladeshis.[14]
- The Djibouti government made water and sanitation a priority in the mid-1990s.[15] Reforms included priority funding and new construction.[16] More than 8 in 10 Djibouti households use modern sources of cooking fuel, though use of wood and charcoal is now reportedly rising because of higher kerosene costs.[17]
- In Nepal water access is also fairly high among the multidimensionally poor (around 78 percent). This has been attributed to the lead role local communities and women, empowered through NGOs, have

played in planning, designing and implementing small subprojects for water supply, sanitation, health and hygiene.[18]

The worst performers by share of the multidimensionally poor with environmental deprivations are located across several regions, with Sub-Saharan African countries featuring prominently. Among the countries performing relatively poorly in this respect, weak institutional capacity emerges as one explanation. Some examples:

- The share of Peru's population with access to water and sanitation is among the lowest in Latin America.[19] Institutional capacity, planning and quality control have impeded progress.[20] Low rural electrification rates mean that more than 80 percent of rural households rely on fuelwood for cooking. The availability of modern fuel is limited in many rural areas because of poor transportation networks and high upfront costs.[21]
- In Mongolia large rural–urban disparities in access to clean water and sanitation are exacerbated by weak institutional capacity and lack of investment. In theory the government gives priority to the water needs of the poor, but in practice lack of regulations has resulted in price structures that provide water at low cost to business and industry while disregarding the poor. Per litre, rural consumers and small businesses pay 84 times more for clean water than do industrial and mining companies.[22]

The MPI sheds light on the patterns of environmental deprivations facing households (box 3.1). It shows the prevalence of overlapping deprivations but also, more optimistically, highlights countries that have done relatively well, including through programmes we explore in the next chapter. In addition to how countries perform relative to each other, this year we also explore how some have fared over time.

These findings should be interpreted with care, however. Last year's *HDR* recognized several limitations of the MPI as a measurement tool. The datasets cover different years, limiting comparability. In some cases the surveys may not reflect recent improvements. Additional caveats apply to the analysis here. The three environmental deprivations were selected as the best comparable measures across countries, but other environmental threats may be equally or more acute at the local or national level. Flooding may be a more pressing concern for poor households in Bangladesh, for example, than access to water.

And it is important to underline that good performance (or bad) with respect to these specific indicators is not necessarily indicative of environmental degradation more broadly. Some countries, such as Syria, have a very low MPI (and low contribution of environmental deprivation) but still face pressing environmental stresses relating to water availability, land deterioration and agricultural productivity. And, as we explore in chapter 4, addressing household-level deprivations needs to be done in a way that minimizes environmental degradation more broadly.

The MPI sheds light on the patterns of environmental deprivations facing households, showing the prevalence of overlapping deprivations but also, more optimistically, highlighting countries that have done relatively well

Chapter 2 argues that as countries develop, the nature and severity of their environmental problems tend to evolve. The types of direct environmental threats experienced at the individual and household levels—those we explore here—tend to be more severe and widespread in countries at low HDI levels, and they are experienced even more acutely by the poor. We have also highlighted a double burden of the multidimensionally poor: that they may be more exposed not only to these localized, household-level threats but also to environmental degradation writ large.

We investigate this pattern further by looking at the relationship between the MPI and changes in climate. For 130 nationally defined administrative regions in 15 countries, we are able to compare area-specific MPIs with changes in temperature and precipitation —the "anomalies" discussed in chapter 2 (see map 2.1). The results are thought provoking.

- In our sample, on average, temperature was 0.5°C higher in 2000–2008 than in 1951–1980, while rainfall increased nearly 9 millimetres (4.6 millimetres, if we exclude some extreme changes in Indonesia). The temperature rose in 106 of 110 cases, and rainfall rose in nearly 85 cases (80 percent).
- Overall, a strong positive association emerges between MPI levels and warming,

BOX 3.1

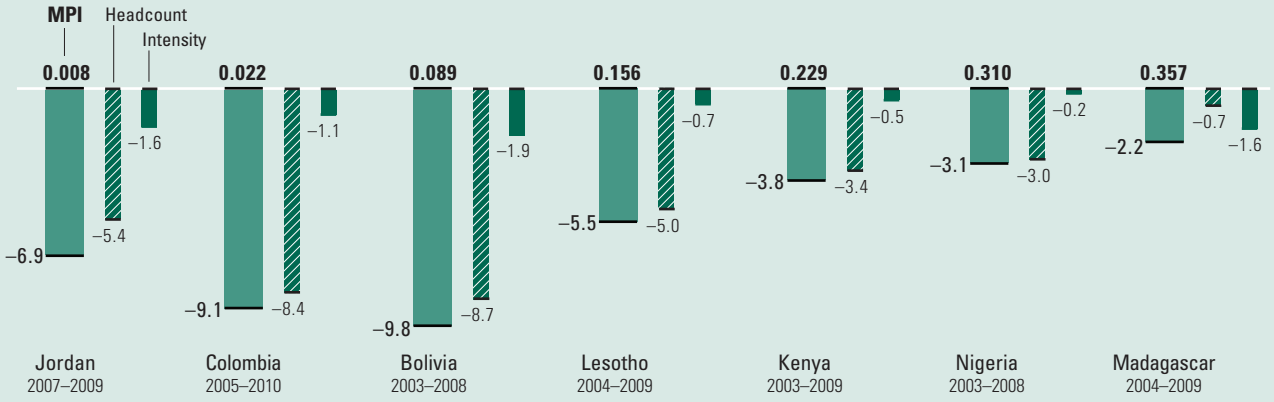
Trends in multidimensional poverty

Our concern with equity leads us to focus on the most disadvantaged. This year we use the Multidimensional Poverty Index (MPI) to reveal trends in the multiple deprivations that batter poor people at the same time for seven countries—Bolivia, Colombia, Jordan, Kenya, Lesotho, Madagascar and Nigeria—and find that poverty declined in all of them (see figure). The decline was fastest in absolute terms in Bolivia, Nigeria and Lesotho, while annualized percentage reductions were greater in Bolivia, Colombia and Jordan, where low poverty means that small reductions translate into large relative declines.

Capturing reductions in both the incidence and intensity of poverty is one of the MPI's key strengths, creating useful incentives to reduce both the number of people in poverty and the number of deprivations that they jointly face. The index thus overcomes a well known problem associated with traditional ("headcount only") poverty measures, which can lead to a focus on moving people from just below to just above the poverty line.

In our seven countries poverty has fallen by reducing both the number of multidimensionally poor people and the intensity of their poverty. Madagascar's improvement, for example, was driven mainly by reducing poverty intensity, while in the other countries the biggest change was in the number of poor people.

Reduction in the MPI and in the multidimensional poverty headcount and intensity in seven countries, various years
(average annual percent change)



Note: Values in bold are MPI levels for the most recent year available. *Headcount* refers to the percentage of the population that is multidimensionally poor; *intensity* refers to the average percentage of deprivations experienced by people in multidimensional poverty.

Source: Alkire and others forthcoming.

Underlying the overall drops in poverty, different patterns emerge. For example, multidimensional poverty fell at a similar rate in Kenya and Nigeria, but Kenya's progress was driven by improvements across all standard of living indicators, whereas Nigeria progressed most in water, sanitation and child mortality. Poverty reduction was widely distributed across Kenya. In Nigeria, by contrast, poverty worsened in the northeast, the poorest region, while the south saw the most substantial reduction.

Source: Alkire, Roche and Santos forthcoming; Demographic and Health Surveys (www.measuredhs.com).

suggesting that localities that have had the largest increases in temperature tend to be poorer than those that have had smaller changes.[23]

But for rainfall there is no strong pattern,[24] and within countries, overall tendencies mask considerable variation. Nonetheless, the relationship is consistent with research exploring the effects of climate change on income poverty.[25] Further study is needed to extend this work to a multidimensional setting.

Where poverty and the effects of climate change intersect to constrain possibilities, the poor are especially vulnerable. But more generally, disadvantaged people and groups face particular threats from environmental degradation because their coping options are more limited. We go on to examine particular ways in which environmental degradation threatens human development and how it may harm already deprived groups the most.

Environmental threats to people's well-being

To better understand the channels through which environmental degradation impedes and damages capabilities, especially those of poor and disadvantaged groups, we look at adverse effects on health, education, livelihoods and

other aspects of well-being, including choices on how to spend time, where to live and freedom from conflict.

Harming health

This section reviews the adverse health impacts of indoor and outdoor air pollution, dirty water and unimproved sanitation, and climate change. Environmental degradation affects people's health through impacts on physical and social environments as well as through the knowledge, assets and behaviours of individuals and households. Interactions between dimensions of disadvantage also affect health—for instance, health risks are greatest where water and sanitation are inadequate. Our analysis of multidimensional poverty suggests that such deprivations often coincide with deaths due to environmental causes: 6 of the 10 countries with the highest rates of death attributable to environmental causes are among the 10 countries with the highest MPI (figure 3.5).[26] The economic costs of the health impacts of environmental factors, including malnutrition, are also large. The World Bank recently estimated them at close to 6 percent of GDP in Ghana and more than 4 percent in Pakistan. Adding the longer term effects on education and income boosts the annual cost for each country to as much as 9 percent of GDP.[27]

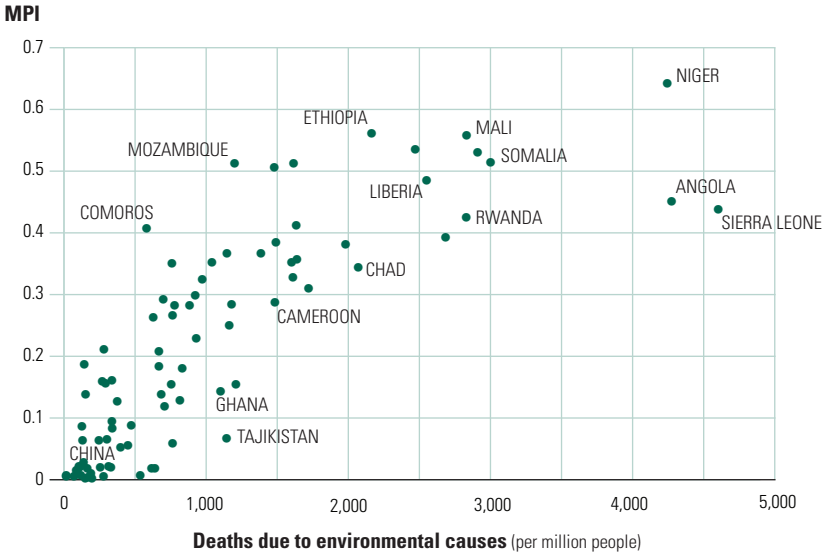
The WHO's study of the global burden of disease underlines the importance of environmental factors. Unsafe water, inadequate sanitation and insufficient hygiene are among the top 10 leading causes of disease worldwide. Each year at least 3 million children under age 5 die from environment-related diseases, including acute respiratory infection and diarrhoea—more than the entire under-five population of Austria, Belgium, the Netherlands, Portugal and Switzerland combined.[28] And in low HDI countries about 14 percent of the disease burden has environmental causes, notably indoor air pollution.

Indoor air pollution

Half the people in the world still use traditional biomass for heating and cooking. In low HDI countries 94 percent of the multidimensionally poor rely on such fuels, producing smoke

FIGURE 3.5

Deaths attributable to environmental risks are associated with high MPI levels



Note: Excludes very high HDI countries. Survey years vary by country; see statistical table 5 for details.
Source: Calculations based on data from statistical table 5 and Prüss-Üstün and others 2008.

associated with acute respiratory infections, lung cancer, reduced lung function, carbon monoxide poisoning and immune system impairment. Indoor smoke from solid fuel is linked to some 2 million deaths a year. About 36 percent of these deaths are in low HDI countries, with a further 28 percent in China and 25 percent in India.[29] Deaths related to indoor air pollution are concentrated among the rural poor, who rely on coal for cooking and heating. The uptake of modern cooking fuel has been faster in urban areas—in China, for instance, 82 percent of urban households use gas.[30]

Indoor pollution kills 11 times more people in low HDI countries than in other countries and 20 times more people than in very high HDI countries. It accounts for 5.4 percent of the disease burden in low HDI countries—as much as 10 percent in Afghanistan, the country most afflicted in absolute terms.[31]

Women and children in rural areas, who spend more time in houses that use fuelwood, suffer most.[32] Burning wood contributes to deforestation, which in turn forces households to burn dung and crop residues instead, intensifying the exposure to indoor air pollution because these fires require constant tending and their smoke is more toxic.[33]

Background research shows that deaths related to indoor air pollution are strongly related to the national MPI,[34] showing how deprivations in cooking fuel contribute to multidimensional poverty and to the ill health of the poor. Poor households know that burning wood irritates the eyes and damages the respiratory system. An older Bhutanese woman observed that burning wood caused eye problems and coughs for many elderly women in her village.[35] In India Rabiya Khatun of Bihar commented: "We have always used twigs and branches from nearby trees as cooking fuel. Everyone here does that. It burns our eyes, but it has to be done"; in West Bengal Faizul Haque observed that his wife, who is not yet 30, has been "sick for the last few years . . . she is hardly able to breathe, because of all the fumes."[36]

Improved stoves, better ventilation and clean fuel are expected to reduce indoor pollution and mitigate health risks, alongside efforts to expand access to modern energy sources, as we explore in the next chapter.

BOX 3.2

Air pollution and its health consequences in China

Outdoor air pollution is high in China, especially in urban areas and the north. A recent official environmental assessment finds that almost one city in five does not meet government standards; far more would likely fail to reach World Health Organization (WHO) air quality standards. Outdoor air pollution is associated with some 300,000 deaths and 20 million cases of respiratory illness in China each year, with estimated health costs of about 3 percent of GDP annually.

Among the many sources of outdoor air pollution in China are residential and industrial coal combustion and motor vehicle exhaust. About 70 percent of the country's electricity is generated from coal, most of it high in sulphur. High sulphur dioxide emissions contribute to smog and acid rain, which affect more than half of China's cities.

Outdoor air pollution patterns suggest major challenges, particularly in cities. Vehicle emissions may be the fastest growing source of urban air pollution, with China's Environmental Protection Agency estimating that vehicles account for 70 percent of sulphur in the air. With rising incomes and better roads, the country has seen its vehicular fleet jump 20 percent a year since 1990. And since in 2009 only 3 percent of people in China owned a car, the trend is likely to continue. In Beijing more than 1,000 new cars are added to the total each day.

Air pollution in China has caused a dramatic rise in asthma. From 1990 to 2000 its prevalence among urban children rose 64 percent, affecting almost 2 percent of children. In Chongqing, one of the country's fastest growing cities, nearly 5 percent of children under age 14 suffered from asthma in 2000.

China's efforts to reduce outdoor air pollution are closely integrated with its policies aimed at climate change, energy efficiency and renewable energy use. In 2000 the government began requiring lead-free petrol, which reduced the lead content of urban air, and has made developing new clean energy vehicles the priority of the country's auto industry for the next five years. The country has pledged to reduce energy consumption and carbon emissions 18 percent per unit of industrial value added by 2015 and to increase consumption of non–fossil fuel energy to 15 percent by 2020, up from the current 8 percent, which should also reduce outdoor air pollution.

Source: China National People's Congress 2011; Fang and Chan 2008; Liu and Raven 2010: 8329; Millman, Tang and Perera 2008; Watts 2006, 2011; Zhan and others 2010.

Outdoor air pollution

Long-term exposure to outdoor air pollution causes respiratory disorders, immune system damage and carbon monoxide poisoning, among other deleterious effects.[37] In Mexico City studies have found a significant impact from outdoor pollution on the mortality of the high-risk population,[38] and in Linfen, China, and Norilsk, Russian Federation, industries produce levels of air pollution that seriously threaten the health of their populations.[39] Disadvantaged groups are both more exposed and more vulnerable to the effects: in Hong Kong Special Administrative Region of China and Shanghai mortality due to outdoor air pollution is higher among the economically disadvantaged and the least educated.[40]

The pattern holds across the globe. In England half of municipal incinerators are in the most deprived tenth of municipalities.[41] People in the poorest households and ethnic minorities are most likely to breathe polluted air, while areas with the highest rate of car ownership enjoy the cleanest air.[42] In Rijnmond, Netherlands, poorer and minority households endure more air pollution and live closer to waste disposal sites.[43] In Kassel, Germany, the air is more polluted in neighbourhoods where the foreign-born population lives.[44] And French communities with higher proportions of immigrants host more industrial and nuclear waste sites, incinerators and waste management facilities.[45]

The good news, as reviewed in chapter 2, is that air pollution is declining, though on average it remains much higher in cities in poorer countries. China again emerges as an important case: rising energy consumption, based largely on coal and other solid fuels, and vehicle pollution have taken a toll on air quality (box 3.2).

Dirty water and unimproved sanitation

Lack of adequate sanitation and clean water compromises the life chances of many people, mainly in poorer countries. In medium HDI countries half the people lack access to

improved sanitation, and one in eight lacks access to improved water. In low HDI countries the figures are 65 percent for sanitation and 38 percent for water. Nearly 4 in 10 people worldwide lack sanitary toilets, but as many as 8 in 10 of the multidimensionally poor do. Urban and rural disparities are large: less than half the rural population had improved sanitation facilities in 2008, compared with almost three-quarters of the urban population.[46]

These deprivations exact a high toll on health. For children under age 5 environmental factors account for more than a third of the global disease burden.[47] Diarrhoeal diseases account for some 2 million deaths of children under age 5 each year, and the most recent estimates indicate that improved sanitation and drinking water could save 2.2 million children a year, or some 5,500 a day.[48] Half of all malnutrition is attributable to environmental factors, particularly poor water, sanitation and hygiene.[49] Malnutrition from these causes is responsible for some 70,000 child deaths a year, while underweight children are more vulnerable to infectious disease and less likely to recover fully when they do fall sick.[50] Childhood malnourishment also impairs cognitive development and education performance, reducing opportunities over a lifetime.

Inadequate water and sanitation are linked to an even broader array of health problems, as the 2006 *HDR* exposed. Today, billions of people are affected by parasitic diseases: 1.5 billion with *ascaris*, 740 million with hookworm, 200 million with schistosomiasis and 40–70 million with liverfluke. Many millions are likely affected by tropical enteropathy, an intestinal disease caused by faecal bacteria that reduces nutrient absorption. These infections as well as hepatitis, typhoid and polio can be avoided through safe excreta disposal and other hygienic behaviours, as we discuss in chapter 4. Beyond the human costs, the financial repercussions are large. For instance, the economic costs of poor sanitation and hygiene in Cambodia (7.2 percent of GDP), Indonesia (2.3 percent), the Philippines (1.5 percent) and Viet Nam (1.3 percent) in 2007 amounted to around $9 billion (in 2005 prices) or 2 percent of their combined GDP.[51] And access to basic sanitation services is especially important for women, not only for the health gains[52] but also for privacy, time savings and reduced risk of sexual violence.[53]

Climate change

The health risks posed by climate change are immense and diverse—from increased risks of extreme weather events to salinization of land and fresh water from rising sea levels and the changing dynamics of infectious disease caused by higher temperatures. Higher temperatures will broaden the spread and increase the transmission rates of vector- and rodent-borne diseases, expanding endemic areas for malaria, tick-borne encephalitis and dengue fever.[54] Estimates suggest that 260–320 million more people will be affected by malaria by 2080.[55] And many more will be at risk of contracting dengue fever.[56] A recent study of 19 African countries found that weather variations increased the prevalence of diarrhoea, acute respiratory infections and undernutrition in children under age 5.

Heat stress will rise with temperatures, and more people will die from heatstroke—particularly urban residents and people with respiratory conditions. The incidence of diarrhoea will also rise with temperatures.[57] By 2050 sea level rise, droughts, heat waves, floods and rainfall variation could increase the number of malnourished children by 25 million. Land and ecosystem degradation will also add to malnutrition.[58] These projections are based on a business-as-usual scenario. More sustainable behaviours and practices, outlined in chapter 4, could deflect these trajectories in positive ways.

Indigenous peoples may be especially susceptible to the adverse health effects of environmental degradation. In northern Australia, for example, higher temperatures and more frequent heat waves will assail indigenous peoples in remote areas, where cardiovascular and respiratory disease rates are already high. The health effects may be especially severe where indigenous peoples' connection to ecosystems —as a place of ancestry, identity, language, livelihood and community—is a key determinant of health.[59]

Indigenous peoples may be especially susceptible to the adverse health effects of environmental degradation

Impeding education

As highlighted in the 2010 *HDR*, the expansion of primary education is one of the great successes of the past 40 years. The share of children attending school rose from 57 percent to 85 percent, with near universal enrolment in many parts of the world. Yet gaps remain. Nearly 3 in 10 children of primary school age in low HDI countries are not enrolled in school.[60] And a range of other constraints, some related to environmental factors, persist.

Environmental degradation can endanger the livelihoods of the millions of people around the world who depend directly on environmental resources for work

Electricity access can improve schooling. Better lighting allows for more study time, and electricity at home and school increases the time children and adults spend reading and keeps children in school longer.[61] In northwestern Madagascar electricity made it easier for girls to do their homework and for their mothers to help them in the evening after household tasks were done.[62] In Bangladesh the time children spent in school was correlated with access to electricity, even after controlling for family wealth (landholdings).[63] And in Viet Nam communes connected to the electric grid between 2002 and 2005 saw school enrolment increase 17 percent for boys and 15 percent for girls.[64]

Having access to electricity and other modern fuels can reduce the time spent collecting biomass fuel.[65] In Malawi children often collect fuelwood and other resources, and their likelihood of attending school falls as time allocated to this work rises.[66] In rural Ethiopia the probability of schooling as the main activity, especially for boys, falls as the time to reach a water source rises.[67]

A negative relationship was found between children's resource collection and their likelihood of attending school, though not the performance of those attending school. In Kenya's Central Province district of Kiambu, fuelwood collection averages more than 4 hours a day, ranging from half an hour to 10 hours.[68] Girls were more likely to combine resource collection and schooling.

In the Indian states of Andhra Pradesh, Gujarat, Rajasthan and Maharashtra, for example, the United Nations Children's Fund and others are providing solar-powered lamps to schools and women's literacy groups to promote education for girls. In the words of 13-year-old Manasha, "When there is no light, we go to bed very early after dinner and get up early. Now at night I can study."[69] Interventions to improve access to electricity are explored in chapter 4.

Endangering livelihoods

Environmental degradation can endanger the livelihoods of the millions of people around the world who depend directly on environmental resources for work. About 1.3 billion people, or 40 percent of the economically active people worldwide, work in agriculture, fishing, forestry, and hunting or gathering. Almost 6 in 10 of the economically active people engaged in these activities live in low HDI countries, while just 3 percent live in very high HDI countries. In Bhutan, Burkina Faso and Nepal, 92 percent of economically active people depend directly on natural resources for their livelihoods; less than 1 percent do in Bahrain, Qatar, Singapore and Slovenia.[70]

The rural poor depend overwhelmingly on natural resources for their income.[71] Even those who do not normally engage in natural resource–related activity may do so during times of hardship.[72] The effects of environmental degradation on crop production, fish supply, extraction of forest goods, and hunting and gathering vary, hurting some groups more than others. How it affects people depends on whether they are net producers or consumers of natural resources and whether they produce for subsistence or the market (and how readily they can shift between the two). Women in poor countries engage disproportionately in subsistence farming and water collection, exposing them more to adverse repercussions.[73]

Indigenous peoples deserve special mention (box 3.3). While they make up about 5 percent of the world's people,[74] they own, occupy or use (generally by customary rights) up to 22 percent of the world's land, which holds 80 percent of the planet's biodiversity.[75] Indigenous peoples and communities legally own around 11 percent of global forests,[76] and an estimated 60 million of them depend totally on forest resources for their livelihoods.[77] They often live in ecosystems particularly vulnerable

to the effects of climate change, such as small island developing states, arctic regions, on the coast or at high altitude, and depend on fishing, hunting and farming to survive.[78]

We turn now to the differentiated impacts of environmental trends on people engaged in agriculture, forestry and fishing.

Threatening agriculture

Agriculture is the main source of livelihood for most of the world's poor.[79] The natural environment delivers support functions to agricultural production, such as regulating the nutrient and water cycles. And as agriculture intensifies to meet the food needs of growing populations, healthy ecosystems remain an important foundation. Environmental degradation thus threatens livelihoods and food security. Among the many complex interactions, the focus here is on the effects of land degradation, water stress and climate change.

Land degradation reduces arable land and crop yields and increases the frequency of flooding. Specifically:

- Loss of fertile topsoil is reducing land productivity, with estimated yield losses as high as 50 percent in the most adverse scenarios.[80] Sub-Saharan Africa (especially Angola, Gabon and Swaziland) and East Asia and the Pacific (especially China, Indonesia, Malaysia and Myanmar) are hit hardest.
- Drylands, home to about a third of the world's population, are threatened by desertification.[81] Some areas are especially vulnerable, such as Sub-Saharan Africa's drylands, where adaptive capacity is low.[82] Other parts of the world have also been affected. Land degradation in northern China's Minqin County led to the abandonment of more than 80 percent of its farmland.[83]

By 2025 water scarcity is expected to affect more than 1.8 billion people.[84] Field research suggests that the direct impacts of water depletion on crop cultivation can be worse for poor farmers. For example, in rural Mexico poor farmers without the capital to adapt to falling water tables cannot buy more drought-resistant seeds or piped water. And government financing programmes do not help the poor when the technical requirements and matching contributions are too onerous.[85]

The effects of climate change on farmer livelihoods vary with the crop, region and season. Researchers have studied the relation between climate change and crop and pasture yields using simulation models, statistical studies and hedonic approaches. Some results suggest that moderate temperature increases (no more than 2°C) might benefit yields in the short run in temperate regions but will have adverse effects in tropical and semiarid regions. Globally, maize production has decreased 3.8 percent and wheat production 5.1 percent since 1980 due to climate change, with considerable regional variation (and some countries even benefitting from a changing climate). For rice and soy, countries benefitting and losing largely balanced out.[86] Projections through 2030 suggest that maize and wheat production in Southern Africa will fall sharply, while rice yields are expected to be positively affected by climate change.[87] Rainfed maize yields are predicted to increase in China's northeast but to fall in its southern regions. Across the world the biophysical impacts of climate change on

BOX 3.3

Indigenous peoples, land rights and livelihoods

Unusual weather patterns and storms hurt indigenous communities that rely on natural resources for their livelihoods. In northern Canada global warming has shortened the period when sea-ice access routes to hunting areas are open, reducing food security and safety among the Inuit in Nunavik, Quebec, and in Nunatsiavut, Labrador. In Peru freak cold spells have increased, with temperatures falling to an unprecedented –35°C in the high Andes. In 2004, 50 children and up to 70 percent of livestock died, and as many as 13,000 people became severely ill.

Indigenous peoples' relationship with their lands often has cultural and spiritual dimensions, which land management practices can disrupt. As outsiders increasingly seek indigenous peoples' lands for conservation and resource extraction, decisions are being made about the use of these lands without meaningful participation by the affected peoples. Indigenous communities may want to keep their environment and resources intact, leading to tension and conflict.

As chapter 4 shows, governments are increasingly recognizing the special nature of indigenous peoples' relationships with their land and environment. In 2004 the Canadian Supreme Court recognized the government's obligation to honour the environment-related rights of two native tribes in British Columbia. Most Latin American constitutions include a provision governing indigenous peoples' lands, territories and natural resources. The 2009 Bolivian constitution recognizes the rights of indigenous peoples to their original communal lands, guaranteeing the use and improvement of sustainable natural resources—in line with an alternative vision of development *(vivir bien)* that seeks the spiritual and collective well-being of people as well as greater harmony with nature.

Source: Furgal and Seguin 2006; Simms, Maldonado and Reid 2006; World Bank 2008c; Colchester 2010; Green, King and Morrison 2009; Manus 2006; Aguilar and others 2010.

both irrigated and rainfed crops are likely to be negative by 2050.[88]

The variability of effects underlines the need for detailed, local analysis. So does the variability in household production and consumption patterns, access to resources, poverty levels and ability to cope.[89] For instance, agriculture is the most common source of work for rural women in most developing regions, yet they have less access than men to assets, inputs and complementary services. Disparities in landholdings are particularly acute—just 20 percent of landholders in developing countries are women, and their landholdings are smaller than those of men.[90]

Because different types of environmental change have different effects on land, labour and food production, it is important to examine the joint effects, through detailed, local analysis

Food production must rise to meet the demands of growing populations, but the combined environmental effects of land degradation, water scarcity and climate change will restrict supply. Adverse environmental factors are expected to drive up world food prices in real terms 30–50 percent in the coming decades and increase price volatility.[91] Income poverty and malnutrition could worsen if the prices of key staples rise—as vividly demonstrated during the 2007–2008 food price spike.[92] The poor spend a large share of their income on staple foods, and to survive, they sacrifice nutrition and eat less.[93]

The effects of food price hikes depend on household consumption and production. People in urban areas and nonfarm rural households, who are net food consumers, tend to be relatively worse off. But the research results are mixed:

- One modelling exercise covering 15 countries found that the effects on income poverty depend on a household's location and whether it engages in agriculture.[94] Price hikes were predicted to hurt nonagricultural households most, with 20–50 percent falling into poverty in parts of Africa and Asia. But households specializing in agriculture benefit, and many in Latin America and the Caribbean and elsewhere in Asia are lifted from poverty.
- Another recent study of nine countries (Bolivia, Cambodia, Madagascar, Malawi, Nicaragua, Pakistan, Peru, Viet Nam and Zambia) found that rising food prices increased income poverty overall, even if rural food producers did better.[95] Similarly, food price hikes increased the incidence and intensity of poverty in Indonesia, the Philippines and Thailand.[96]

Because different types of environmental change have different effects on land, labour and food production, it is important to examine the joint effects. In India climate change could lead to a sharp drop in land productivity for some 17 percent of farmers, through the effect on cereal prices, but effects on consumption would be muted, as most rural households derive their income largely from wage employment. Costs would fall disproportionally on the poor in urban areas, who would pay more for food, and on wage earners and net consumers of food in rural areas.[97]

Pressuring forests

Around 350 million people living in or near forests depend on forest wood and nonwood resources for subsistence and income.[98] Many people in developing countries rely on forests for fuelwood: in Asia and the Pacific more than 70 percent of wood removed from forests is for fuel; in Africa the share may be as high as 90 percent.[99]

Women are responsible for most fuelwood collection in many parts of the world. Though global data are lacking on the number of women working in forestry, evidence suggests that women, with fewer occupational options and less mobility, rely on forests more than men do.[100]

Forest resources also generate income, through employment and the sale of goods and services. Nonwood forest products—such as food, fuel for cooking and heating, animal fodder, wild game, medicinal herbs and shelter—provide local communities with subsistence and marketable goods. They also provide cash to pay for school, medicine, equipment, supplies and food.

Poor people typically depend more on forests for cash and noncash incomes—and as safety nets.[101] A review of case studies of rural communities living in or on the fringes of tropical forests found that poor households derived more than a fourth of their incomes from

forest resources, compared with 17 percent for nonpoor households.[102] Some examples:

- In Arunachal Pradesh, India, poor households depended on community forests for basic survival, and households that had less land and less education and that were farther from markets depended more on forest products.[103]
- In southern Ethiopia forest income kept a fifth of the population above the poverty line, reducing income inequality some 15 percent.[104]
- In Viet Nam forest products provided rural households with a safety net when other sources of income failed. People stricken by illness and health shocks were more likely than others to extract forest products.[105]

It follows that poor people are more vulnerable to forest degradation and exclusion.[106] In South Asia households relying on fuel collection responded to reduced access by increasing collection time, purchasing fuelwood and cooking less often. Wealthier households, by contrast, shifted to alternative fuels.[107]

Damaging fisheries

An estimated 45 million people directly engage in capture fisheries or aquaculture, at least 6 million of them women.[108] More than 95 percent of small-scale fishers and postharvest workers live in developing countries and face precarious living and working conditions. Countries most at risk from overfishing and climate change are also among those relying most on fish for dietary protein, livelihoods and exports.[109]

More than 80 percent of the world's poor fishers are in South and Southeast Asia. But two-thirds of the countries whose capture fisheries are most vulnerable to climate change are in tropical Africa.[110]

Climate change is predicted to reduce fishery resources in the Pacific Islands by as much as half by 2100 and to drastically reduce mangrove forests and coral reefs.[111] Research commissioned by the United Nations Development Programme Pacific Centre emphasizes the centrality of fishing to livelihoods in the Pacific region for both subsistence and cash.[112] Rising sea temperatures will adversely affect more men, who typically engage in deep-ocean fisheries and commercial fishing, while coastal erosion will hurt more women, who typically gather invertebrates closer to the shore.

How people respond to the impacts of climate change on fisheries is likely to vary. In Kenya, for example, even with catch declines of up to 50 percent, subsistence fishers from poor households and with less diverse income sources were more likely to continue fishing than were fishers from households with more assets and diversified livelihoods.[113]

But not all the expected effects are negative. For countries near the Equator fresh water aquaculture of fish such as tilapia may benefit from greater fresh water availability and higher temperatures.[114] And ocean warming and the retreat of sea ice at high latitudes are predicted to increase the potential catch in the long term —with the greatest benefits likely to accrue in Alaska, Greenland, Norway and the Russian Federation.[115]

* * *

People can adjust their production and consumption strategies to environmental conditions—for instance, they may grow crops more suited to poorer soils or warmer temperatures or eat food that requires less cooking and thus uses less fuelwood. People often react to environmental degradation by pursuing alternative livelihood strategies in the same area or by moving.[116] We now consider other adverse repercussions on well-being.

Countries most at risk from overfishing and climate change are also among those relying most on fish for dietary protein, livelihoods and exports

Other adverse repercussions

Environmental degradation has additional, interacting repercussions on disadvantaged groups. Here, we explore the links with time use, migration and conflict. Environmental stress can increase the difficulties in making a living from natural resources—forcing people to go farther to collect them, to work more to obtain a similar livelihood or even to migrate. In some cases environmental stresses have been linked with greater likelihood of conflict.[117]

Time use

For people who lack access to modern fuels and safe water, collecting fuelwood and water takes

considerable time. Nearly half the households in low HDI countries, mostly in Sub-Saharan Africa, spend more than 30 minutes a day collecting water. The burden is especially high in rural areas. Trips average 82 minutes in Somalia, 71 minutes in Mauritania and 65 minutes in Yemen.[118]

Widespread environmental stress increases time burdens for households, with adverse implications for their well-being. Time-use surveys illuminate this burden, showing how tasks are allocated within households and how they can be affected by environmental degradation.[119] Studies in India have found that fuelwood collection time has increased markedly in recent decades: in Kumaon, Uttar Pradesh, women and children travelled on average 1.6 hours and 1.6 kilometres to collect wood in the early 1970s and 3–4 hours and 4.5 kilometres in the 1990s.[120]

Widespread environmental stress increases time burdens for households, with adverse implications for their well-being

Women and children have primary responsibility for fetching wood and water. A recent study of seven low HDI countries found that 56–86 percent of rural women fetched water, compared with 8–40 percent of rural men.[121] In rural Malawi, for instance, women spend more than eight times what men do fetching wood and water, and girls spend about three times what boys do on these chores (table 3.2).

Collecting fuelwood and water has been linked in women to spinal damage, complications during pregnancy and maternal mortality.[122] The demands on time can also have a high opportunity cost in forgone schooling or leisure time for children and labour market activity for adults. In rural Pakistan, for example, difficult access to water increases women's total work burden and reduces the time they devote to market-oriented activities.[123]

Thus, the gains from secure and sustainable access to these resources and more modern alternatives could be large. In Sierra Leone improved access to water and electricity reduced domestic work time about 10 hours a week.[124] A study in the 1990s found that if all households in the Mbale district of Eastern Uganda had secure access to water and fuel—living 400 metres or less from potable water and no more than 30 minutes from a fuelwood source—they would gain more than 900 hours a year.[125] And a recent study estimated that 63 percent of the economic benefits from reaching the Millennium Development Goal target for water supply would come from time savings.[126]

TABLE 3.2

Average time per week spent fetching wood and water, rural areas of selected Sub-Saharan African countries (hours)

Gender and ratio	Guinea (2002–03)	Madagascar (2001)	Malawi (2004)	Sierra Leone (2003–04)
Women	5.7	4.7	9.1	7.3
Men	2.3	4.1	1.1	4.5
Girls	4.1	5.1	4.3	7.7
Boys	4.0	4.7	1.4	7.1
Women/men	2.5	1.1	8.3	1.6
Girls/boys	1.0	1.1	3.1	1.1

Source: HDRO calculations based on data from Bardasi and Wodon (2009) (Guinea); Blackden and Wodon (2006) (Madagascar); Beegle and Wodon (2006) (Malawi); and Wodon and Ying (2010) (Sierra Leone).

Migration

Environmental stress can also drive people to relocate, especially where families and communities are deprived in multiple dimensions and see better opportunities elsewhere. It is difficult to quantify how many people move due to environmental stresses, because other factors also constrain people's freedoms.

Some prominent estimates have been very high—the 1994 Almeria Statement observed that 135 million people might be at risk of displacement due to desertification.[127] And the Stern Review suggested that 200 million people might be displaced by 2050.[128] But other estimates are far lower. The UN High Commissioner for Refugees found that 24 million people had been displaced by floods, famine and other environmental factors.[129] A recent detailed estimate suggests that temperature and rainfall variation drove some 2.35 million people in Sub-Saharan Africa to move between 1960 and 2000.[130]

As argued in the 2009 *HDR*, expanding people's opportunities to choose where they live is an important way to expand their freedoms. Mobility can be associated with improved income-earning opportunities and better opportunities for children. The problems, of course, are that a degraded environment constrains choices—especially for those whose livelihoods depend on a healthy

environment—and that legal constraints on movement make migration riskier.[131]

Conflict

Finally, climate change and limited natural resources have been linked to an increased likelihood of conflict, one of the most pernicious threats to human development. They may also undermine the prospects for peace. Most resource-related conflicts are domestic, but increasing scarcity of land, water and energy could spark international strife. An estimated 40 percent of civil wars over the past 60 years are associated with natural resources, and since 1990 at least 18 violent conflicts have been fuelled by the exploitation of natural resources and other environmental factors.[132] Some cross-country evidence is illustrative. For example, greater variability in rainfall increases the risk of civil conflict, particularly in Sub-Saharan Africa, where a 1°C rise in temperature is associated with a greater than 10 percent increase in the likelihood of civil war the same year.[133]

Recent episodes support the link. Competition over land contributed to postelection violence in Kenya in 2008 and to tensions leading to the 1994 genocide in Rwanda. Water, land and desertification are major factors in the war in Darfur, Sudan. In Afghanistan conflict and the environment are caught up in a vicious cycle—environmental degradation fuels conflict, and conflict degrades the environment.[134] Policy responses, when they are badly designed or fail to consider all parties' interests, can also exacerbate the risk of conflict.

Global and local resource scarcity may be key causes of conflict—a well known early study highlights the interplay between environmental degradation, population growth and unequal resource distributions in stirring up strife.[135] And countries with high dependence on primary commodity exports may be at increased risk—an abundance of resources is a powerful incentive for conflict.[136]

But natural resources are rarely, if ever, the sole driver of violent conflict. They are threat multipliers that interact with other risks and vulnerabilities.[137] The evidence does not suggest that there are direct links between environmental scarcity and conflict but that resource scarcity has to be embedded in the context of the broader political economy: separating the processes and elements associated with environmental conflict from the structures within which they are embedded is "both difficult and a distortion of reality."[138]

Disequalizing effects of extreme events

People living in urban slums in low and medium HDI countries face the greatest risk from extreme weather events and rising sea levels, caused by a combination of high exposure and inadequate protective infrastructure and services.[139] By 2050, with a projected 0.5 metre rise in sea level, Bangladesh is likely to lose about 11 percent of its land, affecting an estimated 15 million people.[140] Over the same period rising sea levels could displace more than 14 million Egyptians as increased salinization of the Nile reduces the irrigated land available for agriculture.[141]

People living in urban slums in low and medium HDI countries face the greatest risk from extreme weather events and rising sea levels, caused by a combination of high exposure and inadequate protective infrastructure and services

The United Nations estimates that 29 percent of the world's slum dwellers live in low HDI countries—with an additional 24 percent in China and 15 percent in India (both medium HDI countries).[142] Vulnerable groups in megacities are particularly exposed to natural disasters, because of both their precarious living conditions and the absence of public services and formal social security systems. But, as shown below, some substitution with social capital, which builds resilience, can reduce risk.

Our own analysis suggests that a 10 percent increase in the number of people affected by an extreme weather event typically reduces a country's HDI by almost 2 percent, with particularly strong effects on the income component of HDI and in medium HDI countries. In some countries poorer regions suffer most. In Ha Giang Province, Viet Nam, one of the country's poorest regions and home to 22 ethnic minorities, irregular rainfall, massive flooding and unpredictable storms have submerged land and crops, drowned livestock and destroyed infrastructure.[143] In Mexico natural disasters, particularly droughts and floods, set

the HDI back in affected municipalities by about two years and increased extreme poverty almost 4 percentage points.[144]

The risk of injury and death from floods, high winds and landslides has been systematically higher among children, women and the elderly, especially the poor. In Bangladesh poorer groups tend to live closer to rivers and thus face a greater risk of flooding.[145] Local case studies of a 1991 Bangladeshi cyclone, the 2003 European heat wave and the 2004 Asian tsunami affirm the greater vulnerability of women and children, as does broader cross-country evidence. Sri Lanka's tsunami killed nearly 1 in 5 displaced women and almost 1 in 3 displaced children under age 5—more than two times and four times the mortality of displaced men (about 1 in 12), respectively.[146] And in rural India the mortality differential between girls and boys increases during droughts.[147]

The strikingly unequal gender effects of natural disasters suggest that inequality in exposure and sensitivity to risk—as well as disparities in access to resources, capabilities and opportunities—overlap and systematically disadvantage some groups

The strikingly unequal gender effects of natural disasters suggest that inequality in exposure and sensitivity to risk—as well as disparities in access to resources, capabilities and opportunities—overlap and systematically disadvantage some groups. In 141 countries over 22 years, higher female mortality from natural disasters and their aftermaths cannot be explained by biology and physiology.[148] And major catastrophes, as approximated by the number of people killed relative to population size, have more severe impacts than smaller disasters on women's life expectancy relative to that of men.

The explanations lie in social norms and roles and, more generally, in the socioeconomic status of women in the specific context. The higher women's socioeconomic status (measured by such factors as freedom of choice of employment, nondiscrimination at work and equal rights to marriage and education), the smaller the gender-differentiated impacts on life expectancy. In other words, it is the socially constructed vulnerability of women that leads to the higher mortality rates due to natural disasters.[149] Along similar lines, countries that focused on female education suffered far fewer losses from extreme weather events than less progressive countries with equivalent income and weather conditions.[150]

The risks and impacts are largest overall in developing countries—but the patterns of structural disadvantage are not confined to them. Witness Hurricane Katrina in the United States. New Orleans's poorest districts, composed mainly of black communities, bore the brunt of the 2005 hurricane—three-quarters of people in flooded neighbourhoods were black.[151] In the 2003 European heat wave, more women than men died, as did more elderly people than young people.

Shocks can have longer term adverse effects that extend beyond the destruction of life and immediate damage to health and livelihoods. Children may suffer disproportionately from weather shocks through the lasting effects of reduced schooling and malnourishment. In response to transitory income shocks, families without assets or other income opportunities, such as wage labour, may pull children out of school. The perceived *risk* of income loss contributes in its own right. Further, schooling infrastructure may be affected, and teachers may be injured or killed.[152] The relationship is not always straightforward, however. In Mexico, high-impact disasters were linked to increased school attendance and reduced dropout rates for primary school, and in Mozambique, to better school performance,[153] possibly because the opportunity cost of sending children to school fell along with market wages.

Weather shocks can also affect child health, notably through increases in malnutrition. One study in Zimbabwe found that children who were exposed to shocks (civil war and the 1982–1984 drought) at ages 12–24 months completed 0.85 grade of schooling less and were on average 3.4 centimetres shorter than those who were not. This stunting was shown to reduce lifetime earnings by 14 percent.[154] In Nicaragua infant malnutrition more than tripled among households most exposed to rainfall during Hurricane Mitch.[155] And Bangladesh experienced a resurgence of child poverty after 2000 in the low-lying coastal regions of the country most vulnerable to flooding.[156]

In Viet Nam evidence suggests that household responses vary by type of shock. Households exposed frequently to shocks such as drought or moderate flooding learn to

adapt.[157] But survey analysis suggests no adaptation to less frequent storms and hurricanes—hurricanes can halve consumption in households near large cities, especially since disaster relief largely neglects those areas.

Disempowerment and environmental degradation

Inequality, as manifested in unequal access to resources and decision-making, can harm human development and the environment. We assess the implications of gender disparities, focusing on reproductive health and participation in decision-making. We then focus on empowerment as a driver of environmental challenges to inform the policy discussions in chapters 4 and 5.

Gender equality

Women's economic opportunities and empowerment remain severely constrained. Access to reproductive healthcare has been improving in most regions, but not fast enough to achieve Millennium Development Goal 5 (to improve maternal health).[158] Indicators under the target of universal access to reproductive healthcare include the adolescent birth rate, antenatal care and unmet need for family planning.

Last year's *HDR* introduced the Gender Inequality Index (GII) for 138 countries. This year it covers 145 countries, and our updated estimates confirm that the largest losses due to gender inequality are in Sub-Saharan Africa, followed by South Asia and the Arab States. In Sub-Saharan Africa the biggest losses arise from gender disparities in education and from high maternal mortality and adolescent fertility rates. In South Asia women lag behind men in each dimension of the GII, most notably in education, national parliamentary representation and labour force participation. Women in Arab States are affected by unequal labour force participation (around half the global average) and low educational attainment. All the low HDI countries have high gender inequality across multiple dimensions. Of the 34 low HDI countries included in the 2011 GII, all but four also have a GII score in the worst quartile. By contrast, only one very high HDI country and one high HDI country included in the GII perform as badly.

We focus on two intersections between gender equity and environmental sustainability: reproductive choice and participation in decision-making. Contraceptive prevalence and the ability to make reproductive choices carry ramifications for the environment and for women's empowerment. And, as we show, women's political empowerment is not only intrinsically important, but it also has consequences for proenvironment policy and practice.

Women's ability to make reproductive choices carries ramifications for the environment and for women's empowerment, and women's political empowerment has consequences for proenvironment policy and practice

Reproductive choice

Poor reproductive health is a major contributor to gender inequality around the world. Lack of access to reproductive health services results in debilitating outcomes for women and children—and to fatalities in excess of those caused by the most devastating natural disasters. An estimated 48 million women give birth without skilled assistance, and 2 million give birth alone. An estimated 150,000 women and 1.6 million children die each year between the onset of labour and 48 hours after birth.[159]

For the bottom 20 countries in the GII the population-weighted maternal mortality ratio averages about 327 deaths per 100,000 live births, and the adolescent fertility rate averages 95 births per 1,000 women ages 15–19, both roughly double the global averages of 157 deaths and 49 births. In these countries contraceptive use is low, averaging only 46.4 percent. More broadly, an estimated 215 million women in developing countries have unmet need for family planning.[160]

Every country, developed or developing, that offers women a full range of reproductive health options has fertility rates at or below replacement.[161] Cuba, Iran, Mauritius, Thailand and Tunisia have fertility rates of less than two births per woman.[162] And Addis Ababa's is also less than two births per woman, while Ethiopia's rural fertility rate remains above six. In much of rural Bangladesh, despite widespread poverty, fertility is now at the replacement rate.[163] And family sizes have fallen as rapidly in Iran as they have in China, but without government limits on family size.[164]

As table 2.1 in chapter 2 illustrates, population growth seriously strains the limits of world resources. A range of studies suggest that lower population growth could offset at least some of the higher greenhouse gas emissions associated with rising incomes. One early estimate was that by 2020 carbon dioxide emissions would be about 15 percent lower than they would be without family planning.[165] A more recent study of 34 developed and developing countries with 61 percent of the world's population finds that halving 2010's population growth could provide 16–29 percent of the carbon dioxide emissions reductions needed by 2050 and 37–41 percent needed by the end of the century to avoid dangerous climate change.[166] Another study estimated that meeting unmet need for family planning would avert 53 million unintended pregnancies a year and cut carbon emissions by 34 gigatonnes, or about 17 percent of the world's current yearly total, as of 2050.[167] The environmental pay-offs are thus clearly enormous, over and above the benefits to women's empowerment.

Gender inequality and contraceptive prevalence are closely linked (figure 3.6). Where women have greater standing, as in Japan, the Netherlands and Norway, most couples use some form of contraception. But where gender inequality is high, as in Mali, Mauritania and Sierra Leone, contraceptive prevalence is below 10 percent. Data collected between 2000 and 2009 show that fewer than 3 in 10 women of reproductive age in low HDI countries use modern contraception, compared with 88 percent in Norway and 84 percent in the United Kingdom.

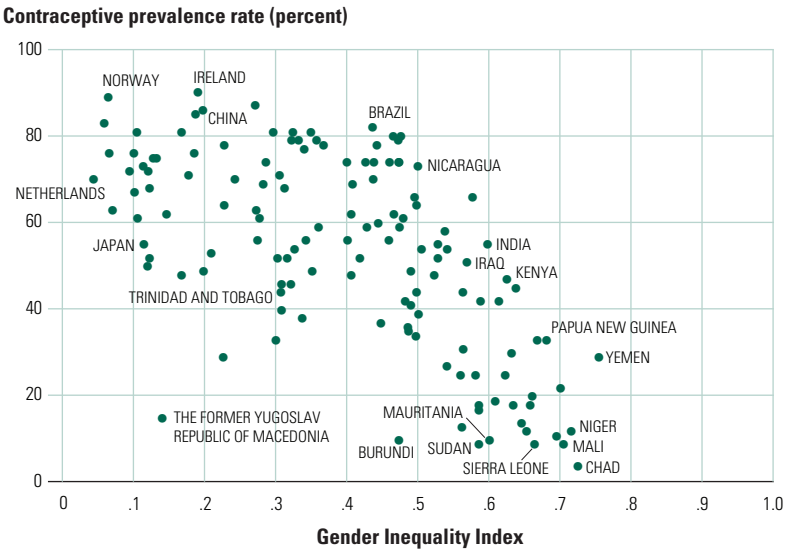
Further analysis highlights the importance of national HDI levels, especially education and health achievements, in explaining the relationship between gender inequality and contraceptive prevalence. However, the same does not apply for income—if we control for income alone, gender inequality and contraceptive prevalence continue to be strongly linked. This underlines the importance of investments in health and education in furthering reproductive health choices.

The reported unmet demand for family planning is very low in Chad, the Democratic Republic of the Congo and Niger (below 5 percent), alongside very high average fertility.[168] This can happen because of cultural or religious objections by women, their husbands or other family members; a lack of knowledge of contraceptive methods or fear of their side effects; or preference for larger families.[169] Low unmet need can be associated with low contraceptive prevalence at low levels of development (where fertility preferences are high) and with high contraceptive prevalence at high levels of development (where fertility preferences are low). This means that family planning programmes must go beyond supplying contraception at affordable prices to raising awareness of its use and health effects and addressing the structural constraints facing poor women (see chapter 4). Some studies link fertility decisions to deforestation and difficult access to water, which require women and children to spend more time collecting fuelwood and water.[170]

Unmet need is often high—more than 30 percent of people in some countries, including Haiti, Liberia, Mali and Uganda, would like to use family planning but do not.[171] Multidimensional poverty is correlated with unmet need for contraception. The incidence of people living in households with unmet family planning needs is always higher among

FIGURE 3.6

Gender equality and contraceptive prevalence are closely linked



Note: Contraceptive prevalence rates are for the most recent year available from the World Health Organization for each country during 2000–2008; see statistical table 4 for details. The Gender Inequality Index is for 2011.

Source: HDRO calculations based on data from the World Health Organization.

the multidimensionally poor (figure 3.7). In Bolivia 27 percent of the multidimensionally poor have unmet need for family planning, more than twice the share among the nonpoor (12 percent), and in Ethiopia unmet need among the multidimensionally poor (29 percent) is almost three times the share among the nonpoor (11 percent).

Fertility is also affected by women's education. A recent study covering more than 90 percent of the world's people found that women who have never gone to school average 4.5 children, those with even a few years of primary school average just 3, and those with one or two years of secondary school average 1.9. And when women enter the workforce, start businesses or inherit assets, their desire for a large family also tends to diminish.[172]

The principles and routes—removing barriers to the use of family planning and rights-based population policies—are not new. They were directly envisioned by conferees in Cairo in 1994 and committed to by nearly all governments. Chapter 4 argues that progress has been too slow and highlights some promising avenues to consider.

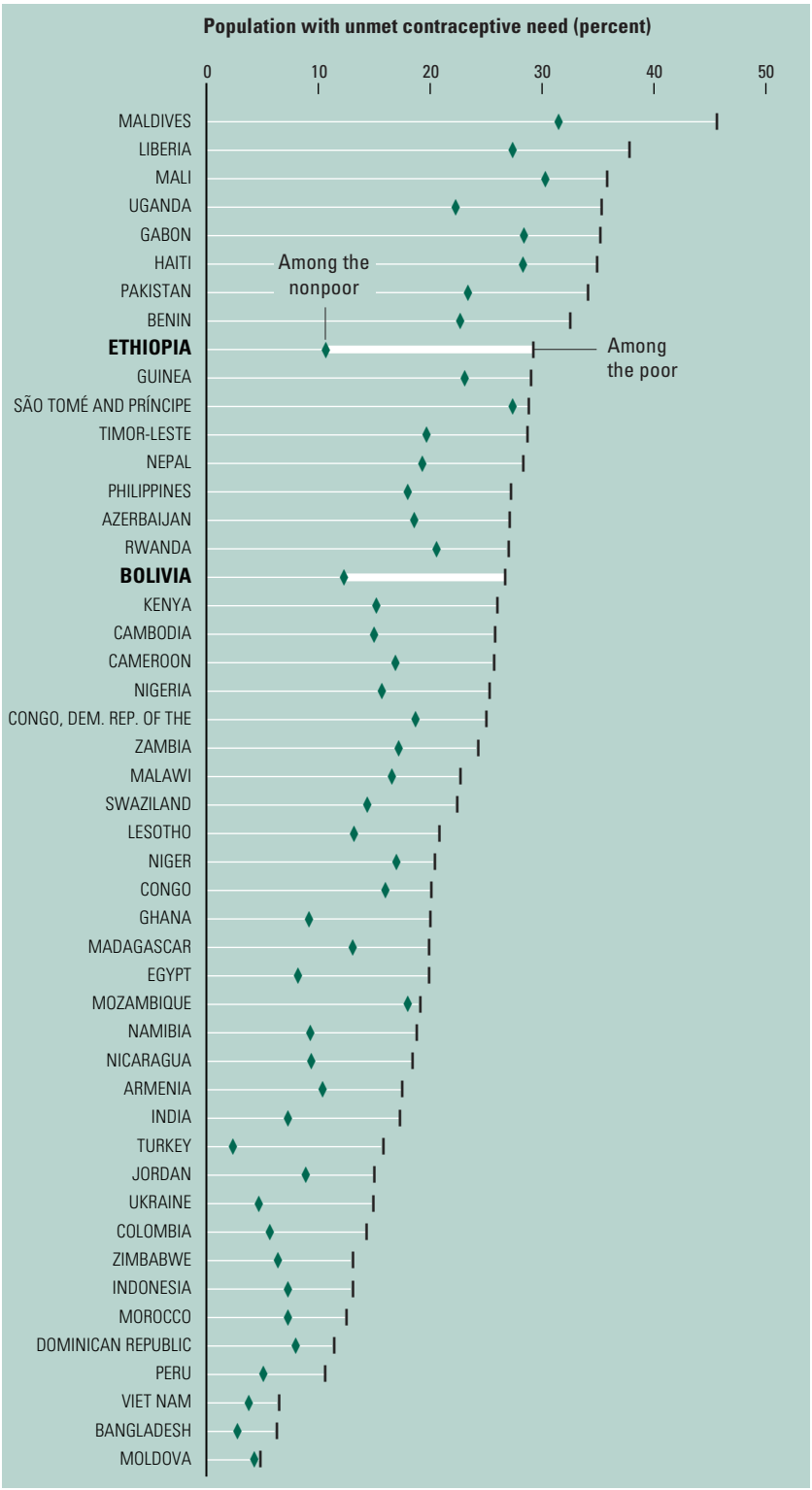
Women's participation in decision-making

Gender inequalities are also reflected in women's low participation in national and local political fora. This has ramifications for sustainability if, as some research suggests, women express more concern for the environment, support more proenvironmental policy and vote for proenvironmental leaders.

- Countries with higher female parliamentary representation are more likely to set aside protected land areas, as a study of 25 developed and 65 developing countries reveals.[173]
- Countries with higher female parliamentary representation are more likely to ratify international environmental treaties, according to a study of 130 countries with about 92 percent of the world's people.[174]
- Of the 49 countries that reduced carbon dioxide emissions between 1990 and 2007, 14 were very high HDI countries, 10 of which had higher than average female parliamentary representation.

FIGURE 3.7

Unmet contraceptive need is higher among the multidimensionally poor



Note: Data are for most recent year available during 2000–2010 and are based on the Demographic and Health Survey second definition of unmet need (DHS 2008).

Source: Calculated based on data on MPI from statistical table 5 and from Demographic and Health Surveys.

But women continue to be underrepresented in national parliaments, on average occupying only 19 percent of seats and accounting

for just 18 percent of ministers.[175] Higher positions are even more elusive: only 7 of 150 elected heads of state and only 11 of 192 heads of government are women. The situation is similar in local government.[176]

Other evidence suggests that gender empowerment and environmental awareness may be related. The number of women's and environmental NGOs per capita was negatively correlated with deforestation in a study of 61 countries between 1990 and 2005. That may be partly because of women's incentives to avert the negative effects of deforestation on their workload, income and health.[177] In developed countries survey data show that women are more likely than men to engage in environmentally sensitive behaviours, such as recycling, conserving water and avoiding environmentally harmful products.[178]

Disempowerment and power imbalances add to environmental challenges

But the relationship, far from straightforward, varies with development. As we saw in box 2.5 in chapter 2, analysis of Gallup World Poll data on environmental attitudes suggests that concerns about environmental problems are not very high. On average, the attitudes of men and women differ little,[179] but some variation appears across HDI groups (table 3.3). In very high HDI countries women express more concern for environmental issues (climate change, water and air quality) than do men, while men express more concern in low HDI countries. The medium and high HDI countries (and most developing regions) fall in between.

TABLE 3.3

Attitudes towards the environment, by gender, low and very high HDI countries, 2010 (percent, unless otherwise noted)

	Low HDI countries			Very high HDI countries		
Attitude	Male	Female	Difference (percentage points)	Male	Female	Difference (percentage points)
Climate change is a serious threat	47.76	46.05	1.71	27.18	31.46	4.29
Dissatisfied with:						
Air quality	22.81	21.27	1.55	17.95	21.36	3.41
Water quality	50.48	47.32	3.16	13.56	16.28	2.72
Government environmental policy	54.82	52.12	2.70	46.36	48.38	2.02
Government emissions policy	61.46	49.16	12.30	53.13	60.83	7.70

Source: HDRO calculations based on data from Gallup World Poll (http://worldview.gallup.com).

While overall levels of education influence attitudes, the ratio of the share of women to men in secondary and tertiary education does not. The implication: women's greater concern for the environment in rich countries is not a function of their having more education, nor is the converse true in very poor countries.

Some evidence suggests that women's involvement is associated with better local environmental management. Yet women's mere presence in institutions is not enough to overcome entrenched disparities—additional changes and flexibility in institutional forms are needed to ensure that women can participate effectively in decision-making. In some cases including women and other marginal groups is perceived as a way of maintaining the status quo rather than achieving any specific outcomes or questioning inequalities.[180]

What matters, then, is not simply women's presence but the nature of their participation. Consider forestry management (box 3.4). A recently published study of community forestry institutions in India and Nepal found that women's proportional strength in forest management committees affects the effectiveness of their participation.[181] The more women on the management committee, the greater is the likelihood that they will attend committee meetings, speak up and become office holders.

The arguments here are not new. But they point to an important part of a reform package to address inequality and environmental degradation—with major expansions of women's freedoms.

Power inequalities

As a critical dimension of people's freedoms, empowerment is an important end in itself. But disempowerment and power imbalances add to environmental challenges. We build on the 2010 *HDR,* where we addressed several components of empowerment: agency, political freedoms, civil liberties and accountability. Box 2.1 in chapter 2 already highlighted some recent changes. Here we focus on the political arena—on national and local governments, accountability and democracy, and civil society.

History, power relations and context all affect the links between democracy and environmental public goods. State activity can usefully be seen as a continuum from "oligarchic, extractive, exploitive and divisive" to "inclusive, innovative, accountable, responsive and effective at mediating distributional conflict."[182] Where state activity falls along the continuum is determined by the underlying social contract—historically shaped interactions between political and economic elites and other social groups—as manifest in formal and informal institutions. As economic processes, both state action and capitalism are often weak in sustaining the environment—capitalism, intrinsically so, given the short time horizon of most firms and the importance of externalities. The state, despite its role in providing public goods and managing externalities, can often be limited by short political and electoral time horizons. These factors can interact with political and social structures to have harmful effects on the environment, especially where the adverse impacts affect mainly disempowered groups.

Studies have shown that democracies are typically more accountable to voters and more likely to allow civil liberties, enabling people to be more informed on environmental problems (thanks to a free press), to organize and to express concerns. At the national level the extent of democracy has been associated with environmental quality.[183] But even in democratic systems, the people and groups most adversely affected are those who are less well-off and less empowered. Policy priorities may not reflect their interests and needs. In many countries and contexts power inequalities affect environmental outcomes, mediated through political and social institutions.

State-level evidence across the United States suggests that greater inequality in power (measured by lower voter participation and educational attainment and weaker fiscal policies) leads to weaker environmental policies and more environmental degradation.[184] Cross-country evidence supports this view. In 180 countries variables such as literacy, political rights and civil liberties improve environmental quality in high- and low-income countries[185] and positively influence clean water and improved sanitation.[186]

New cross-national analyses of more than 100 countries commissioned for this Report confirmed the strong correlation between proxies for the distribution of power and environmental quality.[187] Empowerment is linked with access to improved water, less land degradation and fewer deaths due to indoor and outdoor air pollution and dirty water. And empowerment variables are even more important than income in explaining many key dimensions of environmental quality, including access to improved water, deaths due to pollution and mortality in children under age 5. The implication is that while powerful economic interests can distort policies, societies can do much to limit that power.

Investigations of environmental data over time for a large number of countries have found this relation to hold. Most studies focus on pollution, a public bad from which the state is expected to protect its population.[188] The general finding is that literacy and political rights are associated with less air and water pollution. A recent contribution highlights the importance of long-term democracy in lowering sulphur and carbon dioxide

BOX 3.4

Women's participation in community forest management

Participation of women in community decision-making is important for resource conservation and regeneration, particularly for community forest management. However, preexisting and structural gender inequalities (in income, assets and political endowments) often weaken women's ability to participate. Even in communities where women are not formally excluded from decision-making bodies, their ability to participate in policy-making may be limited by social inequalities. Requiring female representation on committees and ensuring that women are consulted are necessary but insufficient conditions—ultimately the issue is one of challenging and changing power relations.

In villages where women are not actively involved in decision-making, they are more adversely affected by forest management decisions such as forest closures than in communities where they are more involved.

Prior equality is not necessary for women to assert themselves in committee meetings. In fact, women from disadvantaged households are more outspoken in public forums than women from better-off households, a finding attributable to their opportunity to gain more if decisions go in their favour. This outcome was found to be more likely where a large number of women were present or where women had already been exposed to women's empowerment programmes. Other studies affirm that allowing women to participate, even in a limited role, changes cultural perceptions as to women's capacity to make decisions, in turn prompting the formation of other initiatives and cooperatives for women, allowing them to become more active outside the home.

Source: Agarwal 2001, 2009; see also Tole (2010), Gupte (2004) and Timsina (2003).

emissions.[189] This makes sense: it takes time for democracy to yield tangible instrumental gains. Other work in more than 100 countries links a higher level of democracy to less deforestation, less land degradation and less air and water pollution.[190]

Various studies suggest that democracy increases the likelihood of state commitment to goals to address climate change, transboundary air pollution and river management, if not policy implementation. But while democracies tend to be more committed to positive outcomes for climate change, the relationship is not very strong—given that the benefits are perceived to be external and beyond the time horizon of current voters (and politicians).[191] This widens the gaps between words and deeds.

Greater equality between men and women and within populations may have transformative potential in advancing environmental sustainability

Even within democracies, political institutions vary widely. Some are centralized, and others decentralized. Likewise, political representation is affected by the role of political parties, the existence of quotas for particular groups, the duration of electoral cycles and other factors. Some countries have a strong independent agency charged with protecting the environment; others may have only a weak line ministry. The strength of labour unions contributes to lower environmental air quality; the strength of green parties has the opposite effect.[192]

Civil society groups can organize and exert real impact on the decisions of policy-makers, offsetting the often disproportionate influence of powerful economic interests and lobbies. The possibility of developing this "countervailing power"[193] depends on whether institutions in a society allow for open and free participation. As Sweden's environmental policies show, strong democratic participation can translate into policies that reflect popular concern. But such concerns may be countervailed by other vested interests—as reported for the Russian Federation in the problems civil society faces in mobilizing public support around greening industry.[194] Where civil society is active, it has been shown to bring about significant change:

- A recent study modelling environmental NGO impact in a framework of interest group participation and influence in 104 countries found that the number of environmental advocacy groups in a country had a statistically significant negative relation with the lead content in gasoline.[195]
- A study using cross-country panel data for 1977–1988 found a statistically significant negative relation between the number of environmental NGOs and air pollution levels and weaker relations between democracy and pollution and between literacy rates and pollution.[196]

Civil society, in turn, can thrive only with popular support. Where civil society groups are active, power imbalances can be overcome. In the 1990s activists in poor, racial minority neighbourhoods in Chicago, United States, succeeded in getting the national Environmental Protection Agency to act against illegal waste dumping in their communities. Community policing programmes were established, and city regulations and enforcement of illegal dumping were also strengthened, including new harsher penalties.[197] Civil society groups in a range of contexts have successfully opposed activities likely to be a detriment to the environment and the livelihoods of people who directly rely on it.

* * *

We have outlined the ways environmental deprivations and environmental degradation can constrain choices—showing how they seriously jeopardize health, education, livelihoods and other aspects of well-being and at times worsen prevailing inequalities. We have also suggested that greater equality between men and women and within populations may have transformative potential in advancing sustainability. We go on to explore this possibility and promising approaches and policies.