

## Bibliographic note

This Report draws on a wide range of World Bank documents and on numerous outside sources. Background papers and notes were prepared by Sherburne Abbott, G. Acharya, Alain Bertaud, José Brakarz, Kjell Arne Brekke, Tim Campbell, Roberto Chavez, Monica das Gupta, John Dixon, Scott Gates, Nils Petter Gleditsch, Rognvaldur Hannesson, Karla Hoff, Pernille Holtedahl, Eckard Janeba, John Kellenberg, Stein Kuhnle, Huck-ju Kwon, Desmond McNeill, Edgar Ortiz Mtiavasi, S. Mansoob Murshed, Eric Neumayer, Jelena Pantelic, Sanjeev Prakash, Jane Pratt, Per Selle, Guttorm Schjeldrup, Haakon Vennemo, Nicolas Sambanis, Paul Steinberg, Arne Tesli, and Ahmed Zainabi.

Background papers for the report are available either on the World Wide Web <http://econ.worldbank.org/wdr/wdr2003/> or through the World Development Report office. The views expressed in these papers are not necessarily those of the World Bank or of this Report.

Many people, both inside and outside the World Bank, gave comments to the team. Valuable comments and contributions were provided by Herbert Acquay, Sadiq Ahmed, Eleodoro O. Mayorga Alba, Mir A. Altaf, Ali Amahan, Ivar Andersen, Jock Anderson, Shlomo Angel, William Ascher, Robert Bacon, Deniz Baharoglu, Tulio Barbosa, Scott Barrett, Carl Bartone, Richard Barrows, Tamsyn Barton, Esra Bennathan, Alain Bertaud, Derek Beyerlee, Anthony Bigio, Hans Binswanger, Slyvain Bissarre, James Bond, Maria Borda, Milan Brahmabhatt, José Brakarz, Marjory-Anne Bromhead, Dan Bromley, Lester Brown, Piet Buys, Tim Campbell, Franklin Cardy, David S. Cassells, Christophe Chamley, Nadereh Chamlou, Roberto Chavez, Ajay Chhibber, Tanzib Chowdhury, Hoon Mok Chung, Dean Cira, Kevin Cleaver, Robert Clement-Jones, William Cobbett, Paul Collier, Maureen Cropper, Csabi Csabi, Partha Dasgupta, Laura De Brular, Klaus Deininger, Shanta Devarajan, Simeon Djankov, David Dollar, Ahmed Eiweida, Enos Esikuri, David Ellerman, Antonio Estache, Ke Fang, Marianne Fay, Peter Fallon, Shahrokh Fardoust, Catherine Farvacque, John Flora, David Freestone, Maria Emilia Freire, Alan Gelb, Alan Gilbert, Gershon Feder, Robert Frank, Scott Gates, Hafez Ghanem, Indermit Gill, Sumila Gulyani, Kenneth Gwilliam, Agi Kiss, Kirk Hamilton, Jeff Hammer, David Hanrahan, Rognvaldur Hannesson, Jarle Harstad, Marea Eleni Hatzios, John Henderson, Jesko Hentschel, Vernon Henderson, Mark Hildebrand, Rafik Fatehali Hirji, Daniel Hoornweg, J. C. Hourcade, Sarwat Hussain, Gregory Ingram, William Jaeger, Vijay Jagannathan, Emmanuel Jimenez, Todd M. Johnson, Olga Jonas, Steen Lau

Jorgensen, David Kaimowitz, Hirochi Kawashima, Phil Keefer, Charles Kenny, Homi Kharas, John Kellenberg, Elizabeth King, Kenneth King, Nalin Kishor, Agi Kiss, Stephen Knack, Somik Lall, Manuel Lantin, Frannie Leautier, Franck Michel Lecocq, Johannes Linn, Josef Lloyd Leitmann, Andres Liebenenthal, Stephen Malpezzi, Robin Mearns, Gerhard Menkhoff, Fatema Mernissi, Alan Miller, Pradeep Mitra, Augusta Molnar, Caroline Moser, Desmond McNeill, Mohan Munasinghe, Mustapha Kamel Nabli, Aksel Naerstad, Andrew Nelson, Martien van Nieuwkoop, Letitia Obeng, Alexandra Ortiz, Edgar Ortiz, Amy Nolan Osborn, Elinor Ostrom, Mead Over, Stefan P. Pagiola, Guillermo Perry, Guy Pfefferman, Robert Picciotto, Robert Prescott-Allen, Lant Pritchett, Felicity Proctor, C. Sanjivi Rajasingham, Vijayendra Rao, John Redwood, Francisco Reifschneider, Ritva Reinikka, Felix Remy, Jozef Ritzen, F. Halsey Rogers, David Rosenblatt, Michael L. Ross, Ina-Marlene Ruthenberg, Maria Sarraf, David Satterthwaite, Sara J. Scherr, Richard Scurlfield, Louis Scura, Luis Serven, Cosma Shalizi, Priya Shyamsundar, David Simpson, Anil Sood, Lyn Squire, Andrew Steer, Vivek Suri, Lee Summer Travers, Timothy S. Thomas, Tom Tietenberg, Jane Toll, Thomas Tomich, John Underwood, Keshav Varma, Haakon Vennemo, David G. Victor, Jeffrey Vincent, Tara Vishwanath, Joachim von Amsberg, Michael Walton, Hua Wang, Robert Watson, Jaime Webbe, Monika Weber-Fahr, Anna Wellenstein, David Wheeler, Anthony J. Whitten, Jeff Williamson, Roland White, Julie Vilorio-Williams, Michael Woolcock, Sven Wunder, and Hania Zlotnik.

Other valuable assistance was provided by Trinidad Angeles, Carey Ann Cadman, Meta de Coquereaumont, Jean-Pierre S. Djomalieu, Kristyn Ebro, Ines Garcia-Thoumi, John Garrison, Anita Gordon, Rita Hilton, Sergio Jellinek, Lawrence MacDonald, Nacer Mohamed Megherbi, Joyce Msuya, Jean Gray Ponchamni, William Reuben, Carolyn Reynolds, Roula Yazigi.

The team wishes to thank individuals who participated in the following events during the planning and drafting stages of this Report. The participants in these workshops and video conferences are listed in the Web Page. *Berlin, Brussels, China, Costa Rica, London, New York, Nigeria, Oslo, Paris, South Africa, Vietnam, and Washington.*

Despite efforts to compile a comprehensive list, some who contributed may have been inadvertently omitted. The team apologizes for any oversights and reiterates its gratitude to all who contributed to this Report.

## Endnotes

### Chapter 1

1. World Bank 2001h CD Rom (SIMA 349).
2. Chen and Ravallion (2000).
3. World Bank 2001h CD Rom (SIMA 349).
4. World Bank 2001h CD Rom (SIMA 349).
5. World Bank 2001h CD Rom (SIMA 349).
6. The quality and coverage of the household survey data used to measure poverty have improved dramatically in the past 10 to 15 years, and the World Bank has played an important role in facilitating this improvement. Since 1990, the Bank's \$1 per day poverty estimates have drawn fully on these new data. However, the paucity of adequate survey data for the past naturally makes estimation over longer periods more hazardous. In *Globalization, Growth and Poverty* (World Bank 2002g), it was estimated that the number of people living below \$1 per day had fallen by 200 million between 1980 and 1998. As noted in the Report, that estimate had to draw on two different sources that used different methods. Further checks using more consistent methods corroborate the earlier estimate. These estimates also suggest that if China were excluded, there would have been little or no net decline in the total number of poor people.
7. In 1978 China abandoned its reliance on collective agriculture, sharply increased the prices paid for agricultural goods, and dramatically increased the role of market signals and foreign investment.
8. Brown and others (2001). World Watch Institute's estimates based on national-level surveys of body weight by the United Nations (U.N.) and the World Health Organization (WHO).
9. World Bank 2001i.
10. World Bank 2001h; Sambanis (2000, p. 13).
11. UNDP, UNEP, and others (1999).
12. UNDP, UNEP, and others (1999).
13. UNDP, UNEP, and others (1999).
14. Available at World Bank Group, "Access to Safe Water," <<http://www.worldbank.org/depweb/english/modules/environm/water/>> (2000).
15. UNEP (1997b); Scherr (1999); Scherr and Yadav (1996); White, Murray and others (2002); Cosgrove and Rajsberman (2000).
16. World Bank (2001c).
17. UNDP, UNEP, and others (1999).
18. Myers, Mittermeier, and others (2000).
19. UNDP, UNEP, and others (1999).
20. UNDP, UNEP, and others (1999).
21. World Bank (2001c).
22. Social change and cultural evolution have also been speeding up, but not uniformly within or across societies. Some cultures are less able to adapt to speed of change even if they wanted to, while others may not even want to.
23. Inconsistencies between human and natural processes manifest themselves spatially (location-specific sources and sinks) and at different scales.

24. Until recently, the carbon emissions generated by energy-intensive activities (that rely on fossil fuels, such as coal) did not affect global temperatures because they had not exceeded the biosphere's absorptive capacity. Now more expensive alternatives are needed to avoid further damage.

25. Dasgupta (2002).

26. Yi (2002).

27. Bloom and Williamson (1997).

28. Much like the dynamics by which teams become more creative, populations moving to cities go through stages of forming, storming, norming, and performing. *Forming* occurs when individuals with different backgrounds come together; *storming*, when their different perspectives clash; *norming*, when more inclusive norms evolve; and *performing*, when constructive behavior replaces destructive behavior. The result is that cities, in the best cases, become centers where different cultural values come together and jointly develop more inclusive values to accommodate different perspectives and provide space for different subgroups to specialize and innovate.

29. The complete series for developing and for high-income countries for 1950–2050 were created using various interpolations and extrapolations of existing data while maintaining consistency with available World Bank and U.N. control totals. Estimates for size classes of 100,000 population and more were made using the following sources: U.N. and World Bank control totals for urban population in developing and high-income countries; U.N., *World Urbanization Prospects, 1999 Revision*, digital files from the U.N. Population Division; and the database of cities above 100,000 population compiled for the U.N.-HABITAT Successful Cities project. (World Bank projections for urban population are lower than those of the U.N. and closer to those of the International Institute for Applied Systems Analysis, as they assume a slower growth rate for most countries.) The populations of smaller towns (those with populations of less than 100,000) were calculated as the residual of total urban population as indicated by U.N. and World Bank sources minus the total estimated population of cities larger than 100,000.

30. Krugman (1998); Gallup and Sachs (1998).

31. Henderson, Shalizi, and Venables (2001).

32. Meaningfully evaluating the consequences or probabilities of outcomes, tradeoffs, and priorities becomes difficult, if not impossible, without the appropriate data and information. For environmental and social variables, there may be some time-series data at the local level, but there are rarely equivalent disaggregated data for GDP variables. At the national level, the situation is often reversed. This obstructs any attempt to quantitatively model or assess changes over time or their determinants. This Report relies heavily on case studies that are thought to be representative.

### Chapter 2

1. *Utility or well-being* has always been an inherently unmeasurable concept. Despite the limitations, measures of self-reported happiness or overall satisfaction with life have sometimes been used as a proxy. See Oswald (1997).

2. The importance of social participation to human well-being is reflected, for instance, in the negative correlation between people's self-reported happiness and unemployment, controlling for income (Blanchflower and Oswald 2000). Consistent with the happiness data, suicidal behavior is also more prevalent among the unemployed (Oswald 1997). The importance of the environment is reflected, for example, in the results of a survey of over 35,000 people in the G-20 countries, in which about one in four citizens spontaneously mentions environmental issues as a major concern facing his or her country. Although the focus of the environmental concern varies, in part by the country's level of development (in Asia, for example, people are more concerned about the effect of pollution on human health, whereas elsewhere people in the G-20 seem equally concerned about the effect of pollution on human health and the loss of natural resources), the percentage of people citing water pollution, air pollution, and loss of natural areas and species was high—ranging from 63 percent (for species loss) to 71 percent (for water pollution). See: Environics International. (see International Environmental Monitor Survey Oct–Dec 2001 on line at [www.environicsinternational.com](http://www.environicsinternational.com)).

3. Dasgupta (2001a) has shown that along any arbitrary consumption path, the aggregate present value (discounted integral) of utility increases during a short interval of time if and only if wealth (estimated at shadow prices defined along the consumption path) increases during the interval, at constant shadow prices. See also Hamilton (2000).

4. Adjusted net savings are also referred to as genuine savings in the literature.

5. Whether social assets should be included in a measure of net wealth and savings is still an issue of debate. See note 14.

6. The adjustment for CO<sub>2</sub> emissions reflects the damage to global assets associated with economic activity in a given country. If we assume certain property rights, in particular that each country has the right not to be damaged by CO<sub>2</sub> emissions from its neighbors, then the estimate of global damage represents the sum of a) the damage a country's CO<sub>2</sub> emissions does to its own assets over time and b) the notional damage payments owing to all other countries affected by these emissions.

7. The effects of improved life expectancy, which have a direct bearing on human assets, are also not included.

8. After accounting for population growth Dasgupta (2001b) finds that changes in wealth (adjusted net savings per capita) are negative in the Indian subcontinent and Africa but positive in China.

9. Some NGOs have begun experimenting with Internet-based information provision as a way of stimulating debate about public policy; increasing the transparency of the actions of private corporations, public agencies, and legislators; and facilitating feedback from civil society to elected officials.

10. Assets can be classified in many different ways depending on the analytic purposes at hand, and the list presented in this chapter is by no means an exhaustive one. For instance, cultural assets can also be important in affecting human well-being. It may also be appropriate, depending on

the nature of the analysis, to draw finer distinctions within the categories mentioned here—for instance, between physical and financial assets within human-made assets.

11. The waste from other species is usually more easily biodegradable in natural processes.

12. Trust is usually accumulated through repeated interactions.

13. Interpersonal networks can be thought of as assets, but networks that fail to give rise to mutual beliefs that sustain good outcomes are not socially productive.

14. Although there is still a great deal of debate concerning social capital (centering on what constitutes social capital, whether the word *capital* should be used in this context at all, and on how to analyze and measure the effects of social capital), there is a growing body of evidence that shared values, informal ties, and interpersonal networks can have an important impact on outcomes—withstanding some of the difficulties in measuring social capital. See Grootaert and van Bastelaer (2001) for different definitions of what constitutes social capital; Solow (2000) and Bowles and Gintis (1999) for examples of objections to the use of the term “capital”; and Stone (2001) on measurement problems in empirical work. In the social capital literature, institutions and organizations are included under the concept of *structural social capital*, while another set of elements (trust, shared values, norms) are included as *cognitive social capital*. This Report reserves the term *social capital* for interpersonal networks and the trust and shared values they generate, but excludes norms, which function as informal rules. Instead, as in the institutional economics literature, we separate the term “institutions” from social capital and use *institutions* for the mechanisms or rules of the game (both formal and informal) that determine how individuals and groups interact, coordinate, and allocate resources. (Although as chapter 3 shows, *social capital* narrowly defined as cognitive social capital and *institutions* broadly defined to include embedded organizations share critical asset-like characteristics that underpin a society's ability to put other assets to good use.) This report also includes embedded organizations as institutions (but not organizations as agencies).

15. Natural assets can also have “intrinsic” values. Ecosystems preceded the evolution of humans and can function without humans, but humans cannot survive without ecosystems. However, in that humans are increasingly acquiring the knowledge and technology to preserve or destroy ecosystems, the report focuses on instrumental values.

16. In the more narrow economic definition, two inputs in the production function are gross complements if their cross-price elasticity of demand (the extent to which the demand for one input rises when the price of the other input increases) is positive. Where markets do not exist, the price elasticity of demand cannot be determined, even though technically the assets are complementary. We use this broader concept throughout.

17. The examples given in the text are at a micro level. A more macro-level example is one by Knack and Keefer (1997), which considers the role of social capital using mea-

asures of trust and civic norms and shows a positive association with growth.

18. Both social capital and informal and formal institutions can lower transaction costs and increase efficiency. In facilitating innovation, they can also increase productivity growth. Hence good social capital and institutions are crucial to economic growth.

19. Krishna and Uphoff (1999).

20. Reid and Salmen (2000).

21. Galor and Zeira (1993).

22. Uzzi (1997).

23. Yli-Renko (1999).

24. See Suvanto (2000) for a discussion of how social capital enhances innovation and accelerates product development in firms.

25. Zaheer, McEvily, and Perrone (1998).

26. A measure that captures both the shortening of life and the amount of time lived in varying degrees of dysfunction because of illness is the disability adjusted life year (DALY). Estimates (Murray and Lopez 1996) suggest that environmental “bads” account for a significant proportion—ranging from 10–20 percent of total DALYs—of the total burden of disease across developing country regions.

27. Clark (1898).

28. Even in the most advanced industrial countries, however, physical assets account for only a small proportion of total assets; human, social, and environmental assets account for the bulk.

29. World Bank (2000f).

30. World Bank (2000f).

31. World Bank (2000f).

32. Meaning that there is evidence of embodied technical progress.

33. In addition to collecting water, watersheds perform two other big roles: cleaning water and stabilizing its flow. Stabilization is valuable because rainfall is generally very uneven. The watershed automatically compensates for the mismatch between the supply of rainfall and the flow downstream because the soil in the watershed is absorbent and releases water gradually. Trees play a central role in this system by holding the soil in place (important for water stabilization and cleansing, because the soil acts as a filter), and by interacting with the fungi and micro-organisms in the soil to break down pollutants and purify water. While there may be substitutes for the cleansing function of watersheds, there are few substitutes for their flow control function, even in industrial communities (Heal 2000).

34. In 1993 more than 600,000 metric tons of shrimp were harvested from 960,000 hectares of ponds worldwide. About 80 percent of the total production came from Asia, and the rest from Latin America. The availability of shrimp larvae—as commercial hatcheries were established through the Asia Pacific region during the 1970s and 1980s—the marketing of formulated feeds, and active support of the government, set the stage for the industry’s takeoff in the 1980s (Primavera 1994).

35. Farming systems fall into four broad categories—traditional, extensive, semi-intensive, and intensive—character-

ized by increased stocking rates and requiring corresponding feed and water management inputs.

36. Primavera (1994).

37. Note that the economic losses associated with the mangrove destruction that often accompanies shrimp farming is not considered here.

38. When the industry is highly developed, specialization includes producers of farm equipment, algal feeds, formulated feeds, spanners, and services. Hence, it can involve many jobs and large amounts of capital equipment. For example, the Ecuadorian shrimp industry in 1990 had a total capitalization of \$1.66 million and employed around 100,000 people. Similarly, in Thailand around 114,000 people were employed in 19,000 shrimp farms in 1991, and in India shrimp processing plants employed some 500,000 people (Primavera 1994).

39. See Dasgupta (2000).

40. Because ecosystems are integrated systems, parceling an ecosystem into different parts that are then privatized can create problems since each individual owner may allocate his land to a different use without regard to the needs of the ecosystem as a whole, resulting in a loss of biodiversity and ultimately the resilience of the ecosystem itself.

41. See Dorsey (1998).

42. Reduction in the ozone layer results in an increase in the ultraviolet radiation reaching the earth’s surface. Exposure to more solar ultraviolet radiation can lead to a very large increase in skin cancer rates and deaths.

43. The exercise does not look at the effects of environmental assets. Physical capital is proxied by investment as a share of GDP. Social assets are measured by the lack of racial and nationality tensions. Political terrorism is measured using International Country Risk Guide (ICRG) indexes. The distribution of human capital is proxied by average years of schooling. The distribution of education, measured by the Gini coefficient, is taken from Thomas, Wang, and Fan (2001). Why does the distribution of education matter? In countries with a very skewed distribution of education, education may not match the level of dispersion of ability. If the dispersion of education is lower than the dispersion of ability in society, then widening the dispersion of education can increase per capita income.

44. The minimum threshold level of the (principal component) of the International Country Risk Guide (ICRG) index of racial and nationality tensions and political terrorism was  $-0.23$ .

45. This focus on assets is not to detract from the importance of total factor productivity (TFP) growth in sustaining growth. In cross-country regressions much of the differences in growth performance across countries are accounted for by differences in TFP growth. It should be noted, however, that some of the observed differences could actually reflect mis-measurement and omitted variables rather than true differences in TFP growth, and part of TFP growth itself could ultimately be due to asset accumulation. Indeed a main vehicle for TFP growth is new technology introduced through imported capital and new intermediate goods (embodied technical progress). It should also be noted that, in looking

at the determinants of growth over time within a country (rather than at differences in growth performances across countries), asset accumulation is found to account for the bulk of GDP growth.

46. For example, Collier (1999) finds that during civil wars GDP per capita declines at 2 percent a year owing partly to a direct reduction in production and partly to a gradual loss of capital stock through destruction, dissaving, and the portfolio substitution of capital abroad.

47. Once such low levels of social assets are reached, there can be a downward spiral in which violence promotes the emergence of perverse social assets—those based on crime and violence, which benefit a few members of the group but harm the community at large (Moser and McIlwaine 2001).

48. As mentioned earlier (see note 2), surveys indicate that people value the environment. Research also shows that people's health is positively affected by exposure to, and interaction with, the natural world. For instance, in an article in the *American Journal of Health Promotion*, Dr. Frumkin (2001) examined a series of studies looking at human health and animals, plants, landscapes, and wilderness. Within each of these domains he found a wide body of evidence linking the domain with human health. For example, one study found that pet owners had significantly lower blood pressure and cholesterol levels and fewer minor health problems than people who did not own pets. Honeyman (1990) has found that people who are shown urban scenes with vegetation recover from stress more quickly than people who are shown urban scenes without vegetation. In fact, there is a theory—expanded by Wilson and Kellert (1994)—which asserts that human evolutionary history has made a human connection with nature a necessity, not a luxury.

49. The poor can be affected by adverse environmental outcomes in three broad ways: natural resource degradation can affect their livelihoods; environmental degradation can affect their health; and ecological fragility and the likelihood of disasters can affect the poor more than others because of their greater vulnerability (effects of climate change on poor nations). See Department for International Development and others (2002). See also Cavendish (1999) who documents empirically how environmental resources make a significant contribution to average rural incomes in Zimbabwe.

50. The agricultural sector in Madagascar suffered from discriminatory policies in the past (with negative rates of protection for rice, for example, of up to 43 percent, and with only irrigated wheat and sugar enjoying protection). While the reforms of the mid-1990s (devaluation of the exchange rate, reduction in import barriers, liberalization of markets, privatization of most state enterprises) contributed to a more balanced incentive structure, productivity continues to be hampered by a lack of fertilizer, inadequate road infrastructure, and segregated markets (Paternostro, Razafindravonona, and Stifel 2001). See also box 8.3.

51. Cole, Rayner, and Bates (1997).

52. Easterly (1999).

53. See Borghesi (1999) and Shalizi and Kraus (2001).

54. See Dasgupta and others (2002). The theoretical literature has identified several factors that could give rise to a

Kuznets curve relationship: if structural changes inherent in the development process lead to cleaner industries (Syrquin 1989); if abatement technologies exhibit increasing returns to scale (Andreoni and Levinson 1998); if development is accompanied by demand for a better environment to which policies and institutions respond (Grossman 1995); and if the stock of environmental assets declines over time while demand rises.

55. Based on Sebastian, Lvovsky, and de Koning (1999), Murray and Lopez (1996), Smith (1998), and World Bank estimates, 9 percent of DALYs in developing countries are accounted for by water supply and sanitation and urban air pollution. Indoor air pollution accounts for an additional 2 percent of DALYs. While not an externality, indoor air pollution justifies public funding from a poverty reduction perspective.

56. And the costs of delay in addressing pollution problems can sometimes be very high. The experience of industrial countries with pollution remediation to reduce harmful health effects is illustrative. For the cases of Itai-itai disease (from cadmium poisoning), the Yokkaichi asthma (from sulfur emissions), and the Minamata disease (mercury poisoning) in Japan, the costs of cleanup and compensation to victims are estimated at 1.4 to 102 times the costs of prevention. More important, the costs of prevention were affordable at the time, given Japan's per capita income and fiscal resources. The problems were lack of knowledge of the consequences of neglect, and different priorities. Moreover, there can be costs associated with "lock-in": delays in implementing changes in incentives to address pollution problems can lead to investments and technological lock-ins that cumulatively increase the costs of reversing the environment-unfriendly policies later on.

57. For instance, a study on China—notable for its analysis of both the costs and the benefits of addressing air pollution based on firm-level data—shows that a "statistical life" can be saved by removing 100 tons of sulfur dioxide annually from Beijing's atmosphere. Estimates of abatement costs for large plants were \$3 a ton, when 10 percent of the emissions are controlled. So abating 100 tons—at a cost of \$300—would save one life. (The abatement costs for small plants were considerably higher, but large plants are a much larger source of air pollution in Beijing.) (World Bank 2000d).

58. However, costs of abatement can be disproportionately greater for small- and medium-size firms. It may still be the case, however, that policy and regulatory levels are not high enough to affect economic growth, because industry within individual countries may be resisting greater regulation for fear of becoming uncompetitive—with the result that pollution levels are also suboptimal.

59. Dasgupta and others (2002).

60. The U.S. Superfund, for example, shows how high the costs of cleaning up severely polluted areas after the fact can be: the program has allocated more than \$100 billion. Part of the problem is that the consequences of the pollution were not known at the time—many of the sites were polluted long ago.

61. See Pagiola and Rothenberg (2002) which provides a good compilation of case studies analyzing different market-based approaches to forest conservation.

62. Heal (2000).

63. Classic examples of fish population collapse where overfishing may have played a role include the sardine stocks of California and Japan in the late 1940s and the anchovy stocks of Peru and Chile in 1972. More recent examples of overfishing include the collapse of the Canadian cod fishery and several New England groundfish stocks. Groundfish are marine fish that live and feed on or near the bottom of the ocean. Their now-reduced numbers include edible species that New Englanders have relied on for generations. The most important are haddock, cod, and yellowtail flounder (Botsford, Castilla, and Peterson 1997).

64. Coase (1960).

65. Myers and Kent (2001).

66. The term *energy subsidies* can refer to transfers to consumers through underpricing or transfers to producers through overpricing.

67. Some 85 percent of total primary energy supply is from fossil fuels and 7 percent from nuclear energy.

68. Fossil fuels cause many environmental problems apart from the better-known ones of oil spills and mining tailings. They cause pollution (sulfur dioxide, nitrogen oxide particulates, and carbon dioxide). They harm health and affect production both directly and through acid rain (which in turn damages forests and water bodies). They are also the largest contributor to global warming.

69. Myers and Kent (2001).

70. OECD (2001c).

71. R&D for renewables is also subsidized, but the net subsidy (in terms of the relative price effect) is biased toward fossil fuels, and the total budget drain is higher than if fossil fuels were not subsidized at all.

72. Data Resources Inc. (1997) estimates that there would be a loss of 104,000 mining jobs in Europe and Japan (OECD 2001c).

73. Eskeland and Devarajan (1996).

74. There are two reasons why a small additional amount of consumption to be made available at some future year could be socially less valuable than that same additional amount made available today (why the consumption rate of interest could be positive). One is impatience, and the possibility of no tomorrow. Another is the expectation that consumption will be greater in the future than it is today, which means that the benefit from additional future consumption will be less. Thus the consumption rate of interest is equal to the pure rate of time preference (reflecting the first consideration) plus the product of the percentage increase in marginal well-being consequent on a percentage increase in consumption (called the elasticity of marginal well-being) and the percentage rate of change of consumption (reflecting the second consideration) (Dasgupta (2001a)).

75. Since the consumption rate of interest is made up of two components (see note 74), there is no reason to believe that rates should remain constant over time.

76. Newell and Pizer (2001). Example: Suppose the current consumption rate of interest is 4 percent, and you know that over the next 100 years the rate could either rise to 7 percent or fall to 1 percent. And suppose your project were to yield a benefit of \$100 a hundred years from now. The lower rate path would value the \$100 dollars at \$20.28 today; the higher at only \$0.20 today. If you recognize the uncertainty in future interest rates, and place equal weight on these two outcomes, the expected value of \$100 in 2102 would be \$10.24. Now suppose we evaluated the expected value one year into the future, in 2103. Based on the lower rate of 1 percent in 2102, the same \$20.28 is worth \$20.08 ( $\$20.28/1.01 = \$20.08$ ), and the \$0.20 is worth \$0.19. Averaging these, the expected value of \$100 delivered in the year 2103 would be \$10.13. This is very close to the value of the lower rate of 1 percent \$20.28 multiplied by the probability of that outcome, 50 percent (\$10.14). In this way, the change in value between periods comes to depend solely on the lower rate. Why? Intuitively, discounting benefits 100 years hence depends only on the lower rate because the higher rate discounts future benefits to such an extent that it adds very little to the expected value. See also Weitzman (1998).

77. As discussed in the following chapter, both informal and formal mechanisms shape the incentive structure facing individuals and hence affect environmental outcomes.

78. The broad range of economic instruments includes taxes and charges, tradable quotas, tradable emission permits, environmental subsidies, deposit-refund systems, performance bonds, noncompliance fees, resource pricing, and resource royalties (OECD 1988; OECD 2001c).

79. German Advisory Council on Global Change (2002a).

80. Fossil fuel combustion is the largest source of human-caused greenhouse gas emissions—so there are both present and future costs to society.

81. World Bank (2000d), and [www.worldbank.org/nipr](http://www.worldbank.org/nipr).

82. OECD (2001c).

83. World Bank (2000c).

84. OECD (1999, 2001c).

85. Acharya and Dixon, background paper for *WDR 2003*.

### Chapter 3

1. Sen (1999).

2. See *WDR 1992* for policies specifically addressing environmental assets.

3. Analysts such as Ronald Coase, Avner Greiff, Douglass North, Mancur Olson, and Robert Fogel have greatly contributed to the development of ideas presented in this chapter, even though they are not directly cited (and bear no responsibility for the content here).

4. Ihrig and Moe (2000).

5. de Soto (2000).

6. Besley and Burgess (2001).

7. Steinberg (2001).

8. Farrington and Bebbington (1993, p. 106).

9. Farrington and Bebbington (1993, p. 73).

10. Rose-Ackerman (1999).

11. Steinberg (2001).
12. Dunlap, Gallup, and Gallup (1993); Dunlap and Mertig (1995); Brechin and Kempton (1994); Kidd and Lee (1997); Steinberg (2001, pp. 27–45).
13. Baland and Platteau (1996); Ostrom and Gardner (1993).
14. Kaufmann, Kraay, and Zoido-Lobaton (1999).
15. Sachs and Warner (1995).
16. Svensson (1998).
17. The threat of invasions, in turn, provides an interpretation of why a system of feudal lords or states emerge. See Grossman and Kim (1995); Skaperdas (1992); and Hirshleifer (1996) for an analysis of emerging institutions.
18. This section draws heavily on Hannesson (background paper for WDR 2003).
19. Botsford, Castilla, and Peterson (1997).
20. In some instances the stock collapses and is gone for many years. See box 3.4.
21. World Bank (2000d); Dasgupta, Laplante, and Mamingi (2001); Dasgupta and Wheeler (1997).
22. See Ter-Minassian (1997); Eskeland, Litvack, and Rodden (2002); Bardhan and Mookherjee (2000).
23. World Bank (2000d).
24. Bolt and others (forthcoming). The model uses monitored concentrations of TSP and PM10 (small dust), city and county information to estimate determinants of dust and small dust particles, and then uses this to project pollution levels for a larger number of cities. The results yield good estimates, but are not accurate at the city level.
25. World Bank (2000d).
26. Holtedahl and Vennemo (Background paper for the WDR 2003); Dasgupta and Wheeler (1997).
27. World Bank (1998a).
28. King and Özler (1998); Jimenez and Sawada (1999); Eskeland and Filmer (2002).
29. Ostrom and Gardner (1993); Baland and Platteau (1996).
30. This is one of the reasons regulations focus on installations and procedures, not only on results.
31. Conroy (2001).
32. Alston, Libecap, and Schneider (1996); Anderson and Hill (1990).
33. The logic in this section is inspired by the works of Grossman and Kim (1995); Skaperdas (1992); Sugden (1986); Posner (1981); who all deserve credit.
34. Events of hyperinflation and arrests in savings are of course spectacularly brutal—but poor people and the middle class often are hurt through their savings under inflation and fiscal repression (Easterly and Fischer 2001). Formal institutions often fail to protect and support the savings of the poor. Rutherford (2000) documents how the poor pay dearly to find adequate outlets for their savings. de Soto (2000) documents how the poor are harmed when formal institutions fail to welcome and support their assets and activities.
35. See Moser and Grant (2000); Fajnzylber, Lederman, and Loayza and Fruhling (forthcoming); Tulchin, and Golding (forthcoming).

36. Aghion, Caroli, and Garcia-Peñalosa (1999) review models of the microlevel links; Rodrik (1996) and Nelson and Morrisey (1998) emphasize the links through political support, and negotiating change.
37. See de Janvry and others (2001) for a review.
38. Deininger and Squire (1998).
39. Easterly (2002).
40. Acemoglu, Johnson, and Robinson (2001).
41. Banerjee and Iyer (2002)
42. Banerjee, Gertler, and Ghatak (2001).
43. Findlay and Lundahl (1994).
44. Hoff and Sen (2001).
45. “Our perspective suggests that, as in Bates’ (1981) analysis of the political economy of Africa, bad economic policies should be understood as part of a package of often inefficient redistributive tools” (Acemoglu and others 2002). “Institutions that provide dependable property rights, manage conflict, maintain law and order, and align economic incentives with social costs and benefits are the foundation of long term growth . . . China, Botswana, Mauritius and Australia—four cases of success in our sample—all owe their performance to the presence (or creation) of institutions that have generated market-oriented incentives, protected property rights . . . and enabled social and political stability” (Rodrik 2002); Acemoglu and others (forthcoming).
46. McGuire and Olson (1996); Clague and others (1999).
47. Buchanan (2001).
48. Boyce (2002).
49. Abramson and Inglehart (1995).
50. World Bank (2000d).
51. Yes, markets can help in this. Indeed, they are central. But when markets fail, policies are needed to correct those failures. However, policies also fail. So institutions are needed that learn and adapt to support better policies.

#### Chapter 4

1. Drylands are classified as arid and dry semi-arid land without access to irrigation. Aridity is defined according to an aridity index that is the ratio of precipitation and potential evapo-transpiration (UNEP World Atlas of Desertification, 1992 and 1997). Terrain constraints are purely based on steepness of slope (8 percent or more and would not include people on mountain plateaus or valley floors). Poor soils are identified by the United Nations’ Food and Agriculture Organization (FAO) as unsuitable for rainfed agriculture. (For details on soil constraints, see <http://www.fao.org/ag/AGL/agll/gaez>, *Plate 27*.) Forests are defined according to LandScan data and include deciduous broadleaf, deciduous needle leaf, evergreen broadleaf, evergreen needle forest, and mixed forest of the U.S. Geological Survey Global Land Cover Characterization classification.

The definition of fragile lands does not include weather related fragility factors (areas prone to floods, storms and cold temperatures) which would significantly increase the estimated population on fragile land. Fragile and marginal agricultural lands are used interchangeably, as distinct from people or groups marginalized in society, although often the

people living on fragile land are among the most marginalized groups in society.

Population estimates combine digital maps on population distribution with maps of the geophysical characteristics (aridity, slope, soils, and forests). Estimates of rural population distribution are based on two global population datasets. The Center for International Earth Science Information Network (CIESIN) Gridded Population of the World (GPW v2) is based on total population estimates for 120,000 administrative reporting units (districts or counties)—see <http://sedac.ciesin.org/plue/gpw/index.html>. Population distribution within each unit is assumed to be constant. The Oakridge National Lab (ORNL) LandScan dataset uses larger administrative units and adjusts population distribution based on proximity to roads and settlements, steepness of slope, nighttime lights from satellite data, and land cover (see <http://www.ornl.gov/gist/projects/LandScan/SIMPLE/smmaps.htm>). For each population dataset urban areas are masked out using a global map of nighttime city lights from the U.S. National Oceanic and Atmospheric Administration (NOAA). GPW (CIESIN) tends to yield roughly 10 percent higher estimates for fragile lands than LandScan, which already reduced population numbers in areas of steep slopes and unsuitable land cover categories. For some countries, the proportion was even higher. This Report uses an average of the two results as a best estimate of the true population distribution. Population was uniformly adjusted for each country to match the World Bank's rural population estimates for the corresponding year.

Forest data source: Global Land Cover Characterization, U.S. Geological Survey (USGS) Earth Resources Observation System (EROS) Data Center, University of Nebraska-Lincoln (UNL), and Joint Research Centre of the European Commission, 30 arc seconds resolution (approx. 1km), <http://edcdaac.usgs.gov/glcc/glcc.html>.

2. Pratt and Shilling (background paper for WDR 2003).

3. Our analysis suggests that 1.4 billion people worldwide inhabit fragile lands, of whom 1.3 billion are in developing countries. This includes an estimated 130 million people living in forests with no other geophysical constraints. Many of these forests are in fragile ecosystems in remote tropical areas of the Amazon and Central Africa or the boreal forests of Asia. Forest conversion to agriculture may be possible, but with short-lived benefits and unsustainable yields in many places. Moreover, conversion to agricultural or other commercial uses may ignore important public goods benefits (such as the livelihoods of local people who depend in part on forest products, watershed and ecosystem management, soil maintenance, biodiversity, or aesthetic values—see also chapters 5 and 8 for further discussion of forest conversions).

The estimates of people living on fragile land may be on the conservative side. A 1997 CGIAR study on the priorities for marginal lands estimated that 1.7 billion people inhabit marginal lands (CGIAR 1997). According to this work, roughly 70–75 percent of the rural populations in Sub-Saharan Africa and North Africa and the Middle East and 65 percent in Asia and Central and South America live on fragile lands. A 1995 study using FAO land classifications

and World Bank population data estimated that about 2 billion rural people are on marginal lands with little or no access to technology, and are remote from services (Pretty 1995).

The lower estimates in this report are due to a more narrow definition of arid lands, terrain constraints and forests (see note 1). The difference may also be due to the higher resolution population grids selected and the fact that geographic information system (GIS) datasets are available now that were not available in 1995 and 1997. The World Bank's estimate of 1.3 billion people is intended to focus on the poorest rural groups and indicates a large population for whom appropriate services and creative solutions have been lacking.

4. See Cardy (2002). There were an estimated 25 million environmental refugees in 1995 (excluding temporary refugees from flooding, who return to their land). The United States Committee on Refugees available on line at [www.refugees.com](http://www.refugees.com) estimates that 14.1 million refugees officially crossed a border in 1999 and another 21 million are internally displaced people.

5. See Davis (1993) and World Bank Operational Directive 4.2 on "Indigenous Peoples." The 250 million estimate of indigenous people is a conservative estimate. Precision is difficult, since such data are not systematically collected in many countries. This chapter looks at a broader population in the rural periphery, which would include some indigenous groups. It does not focus on the problems of indigenous groups, but recognizes their disproportionate level of poverty and their stores of local knowledge, traditions, and links with natural environments.

6. See Bonkoungou (2001); UNDP/UNSO, Office to Combat Desertification and Drought.

7. See UNEP (1992, 1997). The authors estimate that slightly more than 1 billion people are dependent on agriculture for their livelihoods and live on drylands. UNEP's estimate includes subhumid and arid or semi-arid irrigated areas (which we have omitted).

8. See <http://www.ifpri.cgiar.org/pubs/fps/fps36.htm> and Bank staff estimates of R&D funding for fragile lands.

9. See Doble (2001); UNDP/UNSO, Office to Combat Desertification and Drought.

10. See Swearingen and Bencherifa (1996); McNeill (2000); Leach and Mearns (1996).

11. Okoth-Ogendo, H.W.O. (2001); Gibson, McKean, Ostrom (2000).

12. See Williams (2001). See <http://ag.arizona.edu/OALS/ALN/aln49/Williams.html>.

13. See International Panel on Climate Change (2002), pages 44–46 of the Technical Summary.

14. See FAO, UNEP, and UNDP (1994); ESCAP (1993); (UNEP/ISRIC 1990).

15. See Ojima (2001). Available from START Secretariat, Washington, D.C.

16. See Ojima (2001); UNDP and others (2000); World Resources Institute (2000); Mearns (2001) and (2002).

17. Mearns (2001); Mearns (2002).



18. See Munn, Whyte, and Timmerman (2000). Desertification is defined as land degradation in arid, semi-arid, and dry subhumid areas resulting from various factors, including climate variations and human activities.

19. National Research Council (1999).

20. UNDP (1997).

21. Hazell (1998); Hazell and Fan (2000); Fan, Hazell, and Thorat (2000); Wood and others (1999), variously cited in recent overviews by several international organizations, such as Dixon, Gulliver, and Gibbon (2001); World Bank (2002k); and IFAD (2001).

22. [http://www.cimmyt.cgiar.org/Research/Maize/map/developing\\_world/nmaize/new\\_maize.htm](http://www.cimmyt.cgiar.org/Research/Maize/map/developing_world/nmaize/new_maize.htm).

23. See Pagiola (1999) and Hassan and Dregne (1997).

24. Pratt and Shilling, Background paper for the WDR 2003.

25. Scherr, Sara J., A. White, and D. Kaimowitz. 2002.

26. Pratt and Shilling, Background paper for the WDR 2003.

27. Pratt and Shilling, Background paper for the WDR 2003.

28. Reinikka and Svensson (2001 and 2002).

29. See World Bank (2001b).

30. Hemmati and Gardiner (2002); and Lubbock and Bourqia (1998).

31. See Abraham and Platteau (forthcoming).

32. Zainabi, *World Development Report 2003* background paper.

33. See Donnelly-Roark, Ouedraogo, and Ye (2001); Kim, Alderman, and Orazem (1998); de Umanzor and others (1997); Fuller and Rivarola (1998).

34. See Harper (2000).

35. See Rao (2002).

36. See de Ferranti and others (2002); McMahon and Felix (2001); World Bank and International Financing Corporation (2002); Sachs and Warner (1995).

37. Chapter 6, McMahon and Felix (2001).

38. World Bank and International Financing Corporation (2002); McMahon and Felix (2001); Davis and others (2001); Heilburnn (2002).

## Chapter 5

1. Pinstруп-Andersen, Panya-Lorch, and Rosegrant (1999).

2. Meyer and others (2000).

3. Readers seeking a comprehensive treatment of issues related to rural development, water resources, and agricultural research are invited to read the World Bank's recently completed publications: World Bank (2001a, 2002a, and 2002b). We would also like to recommend IFAD (2001), Eicher and Statz (1998), and Alexandratos (1995) for comprehensive, authoritative, and balanced treatments of rural development issues in a forward-looking context.

4. Crosson and Anderson (2002) show that in developing countries yield trends for rice, wheat, and coarse grains were linear over the 39 years from 1960 through 1998. For the decade 1988 to 1998 rice yields were above the trend for 9 of the 11 years, below for 8 of 11 years for wheat, and 8 of 11 years for coarse grains. In an environment of record low

commodity prices these yield averages have been influenced by relatively poor land going out of production (increases average yields) and lower fertilizer use (lowers average yields).

5. Alexandratos (1995).

6. Rosegrant and others (2001).

7. Of the 1 billion poor people identified in 58 poverty profiles completed by the World Bank, 75 percent live in rural areas.

8. Crosson (1995).

9. Crosson (1995); Lindert (2000).

10. Lindert (2000).

11. Murgai, Mubarik, and Byerlee (2001).

12. Sanchez (forthcoming).

13. Pinstруп-Andersen, Panya-Lorch, and Rosegrant (1999).

14. Low external input systems have a role to play, especially in remote, poor areas. Phosphorous inputs, in addition to that made available by green manuring, is inevitably necessary on phosphorous-poor soils, however, because green manure from phosphorus-poor soils is also poor in phosphorous (Alexandratos 1995). Green manuring competes with land for food and often has high labor cost during periods of peak labor demand. See Hazell (2001); Reardon and others 1999; Ruttan (1990). Ruttan estimates that low external input systems have the potential to increase food output by only about 1 percent a year in Africa, roughly the same rate observed over the past 20 years, and well short of the expected 3–3.5 percent annual growth in Africa's food demand.

15. African farmers pay three to five times the world market price for fertilizer and receive only 30 to 60 percent of the market value for their products (Hazell 2001). This is due in part to high African transport costs (owing to many landlocked countries and poor quality of infrastructure) (Limao and Venables 2001) and in part to well-documented policy distortions, related to pro-urban bias and implicit taxation of agriculture (Lipton 1977; Berg 1981). Under such conditions it usually does not pay for an African farmer to apply fertilizer.

16. Sanchez (forthcoming).

17. Rosegrant and others (2001).

18. World Water Council (2000).

19. This section is based on IBSRAM (2001).

20. Note that these estimates of land lost through degradation suffer from the estimation problem discussed in the previous section. Lindert's (2000) results suggest strongly that they are upwardly biased.

21. This section is based on International Water Management Institute (IWMI 2001).

22. FAO (1997).

23. IWMI (2001).

24. Ravallion and Datt (1996).

25. Timmer (1997); Deininger and Squire (1998).

26. Ravallion and Datt (1996); Lanjouw and Lanjouw (2001).

27. Mellor (2000).

28. See Rodrik (1999).

29. See for example, Alesina and Rodrik (1994); Persson and Tabellini (1994); and Deininger and Squire (1998).

30. Engerman and Sokoloff (1997).
31. See Tomich, Kilby, and Johnson (1995) for a thorough treatment of these issues.
32. IFAD (2000).
33. IFAD (2000).
34. Sanchez (forthcoming).
35. Salamini (1999).
36. Paarlberg (2001).
37. See Gaskell and others (1999); Wambugu (1999).
38. See Paarlberg (2001) for a discussion of the political economics of countries' positions on biotechnology.
39. Paarlberg (2001).
40. See Byerlee and Fischer (2000) for an excellent review of these institutional models.
41. *Siamond vs. Chakrabarty*, 447 U.S. 303, 206 U.S.P.Q. 193 (1980).
42. See, for example, IFAD (2001), chapter 4; Alexandratos (1995), chapter 12; IFPRI (1999); Lele, Lesser, and Horstkotte-Wesseler (1999); Foundation News (1999).
43. See Paarlberg (2001); also Moore (2001).
44. Available on-line at <http://europa.eu.int/comm/research/press/2001/pr2312en.html>.
45. Paarlberg (2001).
46. That Thalidomide was not marketed in the United States had nothing to do with suspected teratogenic effects. The delay in the approval process stemmed from other concerns about the drug. Thalidomide was still in the approval process in the U.S. FDA when it was discovered in Europe that it caused birth defects.
47. See, for example, <http://www.house.gov/waxman/FDA/FDAMA/fdama.html>.
48. Seventy-four percent of European citizens hold the agri-food industry responsible for the BSE problem. Sixty-nine percent hold politicians responsible as well. Respondents showed high regard for European scientists but wished that scientists would keep them better informed (<http://europa.eu.int/comm/research/press/2001/pr2312en.html>).
49. House of Lords (2000).
50. See Echikson (1999).
51. Wambugu (1999).
52. IFAD (2001, p. 138).
53. See Paarlberg (2001).
54. This section borrows heavily from Deininger and Feder (1998).
55. For a good review of these issues, see Lele, Lesser, and Horstkotte-Wesseler (1999).
56. Lele, Lesser, and Horstkotte-Wesseler (1999).
57. See World Bank (2001b).
58. Losey, Rayor, and Carter, (1999).
59. See *Nature Science Update*, "Monarchs safe from BT." Available on-line at: <http://www.nature.com/nsu/010913/010913-12.html>.
60. Statement by European Commissioner for Health and Consumer Protection David Byrne (Birchard 2000, p. 321, cited in Paarlberg 2001).
61. Applying these standards requires that new generally modified food products be assessed for unexpected genetic effects that might mislead consumers relative to the non-genetically modified food equivalent. These include comparing toxin levels, nutrient composition, potential introduced allergens, new composition, marker genes that could transfer antibiotic resistance to clinically significant organisms, plants not originally developed as food products, and nutrients or toxins making the product unacceptable for animal feed (ESCOP 2000, cited in Paarlberg 2001).
62. See Byerlee and Fischer (2000) for an excellent review of institutional models for public-private cooperation.
63. Personal communication with Richard Barrows.
64. Personal communication with Richard Barrows.
65. This tax would be an annual tax calculated on either a market ad valorem or per hectare basis, but invariant with the use of the land.
66. De Janvry and others eds. (2001). (2002).
67. Of course, it is also necessary to have prices that make the venture profitable, transportation and marketing systems that allow the product to move into urban markets, and credit that encourages commercial activity, among other conditions.
68. Deininger and Binswanger (2001).
69. For example, whether a city can divert water from a small farmer irrigator without compensation will depend on how property rights are allocated.
70. Personal communication with John Briscoe.
71. Personal communication with John Briscoe.
72. Ostrom and Gardner (1993).
73. OECD (1998).
74. The evolution of informal markets has been documented in the state of Gujarat, India. See Shah (1993).
75. The process is partially political because the political process will determine the standards of environmental quality that society will demand. In several basins with functioning water markets in the United States environmental groups and even the U.S. EPA purchased water to augment flow for environmental purposes.
76. Schneider (1995).
77. For the Philippines see Coxhead, Rola, and Kim (2001); for Philippines and Thailand see Uhlig (1988).
78. White and Martin (2002).
79. Scherr, White, and Kaimowitz (2002).
80. Wells and others (1999).
81. See an extensive discussion with case studies in Ascher (1999).
82. Cochrane and others (1999).
83. World Bank (2001e).
84. Carter and Zimmerman (2000).
85. Scholz (1985).
86. For example, for Amazon see Alston, Libecap, and Schneider (1995) and Schneider (1995); for Thailand see Uhlig (1988).
87. Iremonger, Ravilious, and Quinton (1997).
88. Bruner and others (2001).
89. Bruner and others (2001); Mahar and Ducrot (1998).
90. Available on line at: <http://www.worldwildlife.org/forests/forest.cfm?sectionid=181&newspaperid=17>.
91. "Carrasco da Mata—o massacre de Motoserra." *Veja*, April 17, 1999. English language version available on line at

<http://www.iucn.org/reuters/1999/articles/winningbrasil.htm>

92. Rosegrant and others (2001), p. 6.

93. Henderson, Shalizi, and Venables (2001).

## Chapter 6

1. For ease of reference the terms “urban” and “city” are used interchangeably here. A “town” can be considered the smallest class of urban area, having a less diverse economy than the next city-size category and minimal administrative or fiscal autonomy. This chapter also uses the terms “local government” or “local authority” mainly in reference to a “municipality,” understood here as the lowest organized unit within the administrative apparatus of the state. Many large urban areas, often called “metropolises,” span more than one municipality.

2. This trend appeared earliest and has been documented most extensively for Latin America and the Caribbean: Campbell (1997, background note for WDR 2003); Reilly (1995); for a global review, see World Bank (2000b).

3. At the same time, certain conservative cultural and religious norms may be more strictly enforced by people who feel these values to be challenged by contact with urban society.

4. Holtedahl and Vennemo, background note for WDR 2003.

5. Wells and others 1999.

6. Sassen (2001); Wheeler, Aoyama, and Wolf (2000).

7. Glaeser (1998).

8. Lall and Ghosh (2002).

9. Glaeser and others (1992).

10. Quigley (1998); Mills (2000); Ciccone and Hall (1996); Prud'homme (1994).

11. Urban areas can provide more options to use competition for service provision, as in Colombia's national school voucher program which enabled municipalities to help low-income households obtain places in private schools (Angrist and others forthcoming).

12. Hardoy, Mitlin, and Satterthwaite (2001), box 1.4.

13. Urbanization, beyond its positive impact on income, is an important determinant of nonmonetary indicators of well-being at the national level, including education (literacy, school enrollment), health (infant and child mortality, life expectancy, malnutrition), and access to basic infrastructure (water, sanitation, electricity, telecommunications). Urbanization can have a larger impact than economic growth on these social indicators (Ryan and Wodon 2001).

14. The effect of urbanization on education outcomes is also greater than the effects of measures of bureaucratic efficiency and of corruption (Jayasuriya and Wodon, background paper for the WDR 2003).

15. Williamson (1988).

16. Mazumdar (1987); Wodon and Konig (2001).

17. Lucas (1998).

18. Wodon and others (2001).

19. Oberai and Manmohan Singh (1984). Williamson (1988) cites further evidence in concurrence.

20. De Haan (1999, 2000).

21. A study in Kenya found that remittances from rural-urban migrants, measured by the urban-based nonfarm income component of smallholder household income, were the most important determinant of innovation by smallholders and of rates of smallholder poverty. Probability of migration, in turn, was determined by access to primary education in rural areas (Collier and Lal 1980).

22. McGranahan and Satterthwaite (2000); Pugh (1996); Bartone and others (1994).

23. With increasing economic development and urban growth, industrial activities become a major source of nonorganic pollutants. However, not all of the accompanying structural changes are unfavorable to the environment—shifting production from raw materials processing to assembly and services generates less water pollution (World Bank 2000a).

24. Yusuf (2001).

25. Aggregate, comparable cross-country data are lacking on the urban incidence of income poverty. The U.N.-Habitat Urban Indicators database for over 200 cities (nonrandom sample) indicates income poverty rates averaging about 15 percent in the Asian and Middle Eastern cities to over 40 percent in Sub-Saharan Africa; however, the population living in precarious conditions, subject to environmental hazards and vulnerable to both economic and physical risks (as in informal slum settlements) is estimated to be higher than income poverty rates, ranging from 30 percent to more than 60 percent of residents in many cities (U.N.-Habitat 1996).

26. McGranahan and others (2001); World Bank (2000a).

27. “Ecological footprint” refers to the estimated land and forest area-equivalent required to meet the needs of cities for energy and waste disposal. Rees (1997) argues that the concentration of urban populations permits influencing this footprint through changes in consumption choices.

28. Kojima and Lovei (2001); Lvovsky (2001).

29. For the poorest cities and their poorest residents, indoor pollution from burning biomass and low-quality coal for cooking and heating remains a major health issue as well.

30. Lvovsky and others (2000).

31. World Bank (2000a).

32. Depending on the country, stationary sources (such as coal combustion) may be mainly responsible for local pollutants such as nitrogen oxides, sulfur dioxide, and suspended particulate matter, as in China, but in other countries motor vehicles account for most nitrogen oxide and particulates. Generally, motor vehicles also cause most of the emissions of carbon monoxide, ground-level ozone, and carbon dioxide.

33. Holtedahl and Vennemo, background paper for the WDR 2003.

34. World Bank (2002a), chapter 4.

35. Improving traffic flow reduces fuel consumption per kilometer.

36. Kojima and Lovei (2001).

37. Gambrill, Foster, and Katakura (2001).

38. Black-Arvelález (2001).

39. Pantelic (background note for the WDR 2003).

40. Intergovernmental Panel on Climate Change (IPCC) forecasts.
41. United Nations (1999), 1999 revisions.
42. In most small island states the bulk of population and infrastructure is located in coastal plains (IPCC 2001).
43. As quoted in the International Federation of Red Cross and Red Crescent Societies (1999).
44. Federal Emergency Management Agency (FEMA 1998).
45. Anderson (2000).
46. Badly designed insurance schemes create perverse incentives—for example, in Florida the creation of a public underwriting agency by the state government to cover private insurers for hurricane losses encouraged property development in hazardous zones, because risks were shared with taxpayers and property owners were given a false sense of security (Dunn and Flavin 1999).
47. Bigio (forthcoming).
48. Strictly speaking, a solid waste disposal facility and a mass transport system (bus or metro) are not fully public goods because they can become congested (reducing available use) and access can be restricted; such goods would technically be considered club goods. However, the main interest here is in activities that affect urban public goods—in this case, an environment free of solid waste and a highly accessible city.
49. Serageldin, Shluger, and Martin-Brown (2001).
50. Fang (2000).
51. Peñalosa (2001) (updated April 2002).
52. OECD, Territorial Development, *Urban Brownfields* (<http://www.oecd.org/tds/bis/brownfields-chap3.htm>).
53. Interview (January 29, 2002) with Dr. Ahmet Samunlu, Technical University of Istanbul, and former minister of housing, city planning, resettlement and the environment; Hacaoglu (2001); Yildizcan (2002).
54. This section draws heavily on World Bank (2002a).
55. Typically, they have average population densities of well over 30 residents per hectare, considered the minimum needed to sustain a public transport system.
56. Koster and de Languen (1998).
57. See chapter 4, “Social Sustainability,” in World Bank (1996a).
58. Willoughby (2000).
59. International Council for Local Environmental Initiatives (ICLEI 1991); Kamel (2000).
60. Bartone (2002); see also Wilson, Whiteman, and Tormin (2001).
61. Linz (2002).
62. Bartone (2002).
63. Rosenweig and Solecki (2000).
64. Hentschel (2001).
65. Numerous country poverty assessments (based on national survey data) reveal relatively high intraurban inequality in income and access to services—often greater than inequality within rural areas. See Hentschel and Bump (1999); Eastwood and Lipton (2000), table II.2.
66. McGranahan and others (2001), table 4.3.
67. U.N.-Habitat, Urban Indicators Program database (1998 data).
68. Such disparities are also evident between lower- and higher-income neighborhoods (Hardoy, Mitlin, and Satterthwaite 2001, box 4.1).
69. Stephens and others (1997).
70. Rualdo Menegat, *Atlas Ambiental de Porto Alegre*, 1998. Cited with other examples in Hardoy, Mitlin, and Satterthwaite (2001).
71. Slum population measured by a composite index of housing condition, legal compliance of structure, and access to basic services (water and sewerage). UN-Habitat, “Millennium Development Goal 7, Target 11, Indicator 31: Proportion of Population with Secure Tenure,” April 2002 estimates.
72. Perceived stigma and/or job discrimination on the basis of residence is reported by slum dwellers in many studies; for Perlman (2002) see Rio de Janeiro; for Baker (2001) see Montevideo, Uruguay; and for Jamaica, see Moser and Holland (1995).
73. McIlwaine and Moser (2001).
74. Rolnik (1999).
75. FYR Macedonia, “Poverty Reduction Strategy Paper: Urban Poverty Chapter,” January 2002 draft.
76. U.N.-Habitat *Global Campaign for Secure Tenure* (Nairobi, 1999). See [www.urbanobservatory.org](http://www.urbanobservatory.org).
77. Estimates of “squatters and others” (a residual excluding formal owner-occupants and tenants) average around 15 percent of residents of low- and middle-income cities (300 million people), according to the U.N.-Habitat’s Urban Indicators Database (1998 data). Documented cases of actual or threatened eviction affected almost 8 million people over 1998–2000 worldwide. See Centre on Housing Rights and Evictions (COHRE 2001).
78. Analysts have identified a continuum of at least 10 categories of tenure in cities of developing countries. De facto tenure security may include customary rights and occupancy rights (important particularly in African cities), which are based on duration of use and recognition by the community. Governments often regularize tenure status by acknowledging these informal rights, thereby granting de facto tenure security (Payne 2001; Payne and Fernandes 2001); Durand-Lasserve, and Royston (2002).
79. The probability of households’ demanding garbage collection increased by 32 percent in going from squatter to moderate security status and by 44 percent when the squatters were compared with the high-security (legal certification) case (Hoy and Jimenez 1998).
80. Lall, Deichmann, and Lundberg (2002).
81. Fernandes (forthcoming).
82. Jimenez (1985).
83. Appadurai (2001).
84. Payne (2001); Gilbert (2002).
85. de Soto (2000).
86. Gilbert (2002); Calderon Cockburn (2002).
87. Struyk (1997); Grover, Munro-Faure, and Solovier (chapter 3 in Payne 2002).
88. Ward (1998); Payne 2002 (chapter 1 and conclusion).

89. Mutual protection within the community can be sufficient to fend off property challenges from other individuals. But female-headed households are least able to assert their rights and may benefit more from the greater security of formal titles (Lanjouw and Levy 1998).

90. Payne (2001).

91. Addressing is not a substitute for formal land registry but is fully complementary and upgradeable. (See <http://web.mit.edu/urbanupgrading/upgrading/issues-tools/tools/street-addressing.html>.)

92. World Bank (2000b).

93. Burra (2001b), and local press reports in Pune.

94. World Bank (2002c).

95. Readers interested in urban policy more broadly may consult the urban development Web site of the World Bank ([www.worldbank.org/html/fpd/urban](http://www.worldbank.org/html/fpd/urban)), or U.N.-Habitat ([www.unchs.org](http://www.unchs.org)). See also chapters 6 and 7 of World Bank (2000b) and annex E of World Bank (2001f).

96. See also World Bank (2000b), which discusses decentralization.

97. Holtedahl and Vennemo, background paper for WDR 2003.

98. This shift is characterized as moving from “expose-oppose” to “expose-oppose-propose,” in Devas and others (2001).

99. This section refers to the Orangi Pilot Project’s work on sanitation in Karachi and the many successful community organization–municipal partnerships in Thailand, supported by what is currently part of the Community Organizations Development Institute (Hardoy, Mitlin, and Satterthwaite 2001). The Philippines example is from Vitoria-Williams (2002) background note for the WDR 2003.

100. Durban Metro, *Safer City Project*, May 2000; January 2002 interview with Richard Dobson, Programme Leader, Inner Thekwini Renewal and Urban Management Program, Durban.

101. See the city’s Web site ([www.obninsk.ru](http://www.obninsk.ru)) for details (Gonzales de Asis and Acuña-Alfaro 2002).

102. Katz and Campbell (1996).

103. Souza (2001); Municipality of Porto Alegre, “Porto Alegre Participatory Budget,” September 2000. U.N.—Habitat and The Together Foundation, Best Practices for Human Settlements Database ([www.bestpractices.org](http://www.bestpractices.org)).

104. World Bank–supported Urban Development and Decentralization Program Project in Senegal (ID P002365, approved in 1997); Guinea *Third Urban Development Project* (ID P001974, approved in 1999).

105. Campbell background paper for the WDR 2003.

106. Stephens and Wikstrom (2000).

107. ICLEI Initiatives (2002).

108. Velasquez (1998).

109. Other terms may be used for city strategic planning efforts, which have many antecedents and sources of support in both industrial and developing countries, such as the U.N. Urban Management Program’s Sustainable Cities Program ([www.unhabitat.org/ump/cityconsultation.htm](http://www.unhabitat.org/ump/cityconsultation.htm)). The term city development strategy is used here since it was adopted as one of the main activities supported by an international

coalition of cities and donors—the Cities Alliance—created in 1999 to fund poverty-focused city development strategies and scaled-up slum upgrading in cities of developing and transition economies. ([www.citiesalliance.org](http://www.citiesalliance.org)).

110. UN-Habitat and Urban Management Program (2001).

111. Andres Escobar, General Manager, Metro Vivienda, Bogotá, Colombia, December 2001 communication.

112. Sevilla (2000).

113. Figures for years in the 1990s. Bertaud background paper for the WDR 2003.

114. Bertaud (1999).

115. Bertaud (2000).

116. World Bank (2002b).

117. Land-use regulations and growth controls that restrict the supply of developed land are a major contributor to higher prices of serviced land and housing (Shlomo 2000).

118. The largest are the International Union of Local Authorities, Metropolis, World Federation of United Cities, and World Associations of Cities and Local Authorities Coordination.

119. See UCCI Web site at [www.ayudaurbana.com](http://www.ayudaurbana.com).

120. City networks in East Asia, such as that of the Chinese mayors association (<http://en.townsfuture.com>) and Philippine city league ([www.cdsea.org](http://www.cdsea.org)) are linking in a regional Web site ([www.infocity.org](http://www.infocity.org)).

121. For example, the city of Detroit, Michigan, after receiving a poor ranking in a national rating of U.S. cities, created its own “Comeback Index,” monitored by an independent institution, to track its improved performance.

## Chapter 7

1. Olson (1996, p. 22).

2. Filmer (2000).

3. Sen (1983).

4. Besley and Burgess (2000).

5. Sen (1983).

6. See “Examples of Good Practice in Bank Projects Focused in Primary Education: El Salvador EDUCO Basic Education Modernization Project” available at: [www.worldbank.org/oed/oeddoelib](http://www.worldbank.org/oed/oeddoelib).

7. King, Orazem, and Wohlgenuth (1999); Angrist and others (forthcoming).

8. Eskeland and Filmer (2002).

9. Eigen-Zucchi (2001).

10. Eigen-Zucchi (2001).

11. Calvo (2000).

12. Rodden, Eskeland and Litvack, forthcoming.

13. World Bank (2002n, p. 113, box 5.7).

14. See the homepage of the World Bank’s Small & Medium Enterprise Department, at: <http://www.ifc.org/sme/index.html>.

15. de Soto (2000, p. 20).

16. Djankov and others (2002).

17. Djankov and others (2002); Glaeser and Schleifer (2001).

18. *World Development Report 1997*, p. 6.

19. de Soto (2000, p. 21).

20. See, for example, Huther and Shah (2000); Transparency International (2000).
21. Ciccone and Hall (1996).
22. Henderson and others (2001).
23. Henderson (2000); Lall, Shalizi, and Deichmann (forthcoming). See also World Bank (2000b, chapter 6).
24. Canning (1999); Canning and Bennathan (2000).
25. World Bank (1994), and a World Bank Policy Research Report that is forthcoming on regulatory reforms in infrastructure.
26. Borghesi (1999), Shalizi and Kraus (2001), and World Bank (2000a).
27. Easterly (1999).
28. Myers and Kent (2001), p. 22.
29. World Bank (1992b).
30. Tullock (1975).
31. OECD (2001a), and World Bank (2002d).
32. Moore (2002).
33. World Bank (2001d).
34. OECD (2001a, p. 153).
35. FAO (2000).
36. World Bank (2001e).
37. World Bank (2001e), p. 2.
38. World Bank (2001e), p. 2.
39. World Bank (2000c).
40. Myers and Kent (2001, p. 149).
41. Myers and Kent (2001, p. 153).
42. Myers and Kent (2001, p. 152).
43. See the FAO Fishery Statistics Web page at: [http://www.fao.org/fi/statist/nature\\_china/30jan02.asp](http://www.fao.org/fi/statist/nature_china/30jan02.asp).
44. FAO, 2002b, p. 11.
45. Willmann, Boonchuwong, and Piumsombun (2002, p. 187).
46. Willmann, Boonchuwong, and Piumsombun (2002, p. 191).
47. Willmann, Boonchuwong, and Piumsombun, (2002, p. 191).
48. Hannesson (background paper for the WDR 2003, p. 13).
49. Hannesson (background paper for the WDR 2003, p. 6 and 7).
50. FAO (2002b, p. 19).
51. FAO (2002b, p. 20).
52. FAO (2002b, p. 22).
53. Høltedahl and Vennemo, background paper for *WDR 2003*. See also World Bank (2001a).
54. Kojima and Lovei (2001, p. 1).
55. Dasgupta and others (2002).
56. This section draws on Lovei (1999); Rosner and Markowitz (1985); and Høltedahl Vennemo, background paper for *WDR 2003*.
57. Lovei, 1999, p. 11.
58. This section draws heavily on World Bank (2002c).
59. Wang and others (2002, p. 3).
60. World Bank (2001a, p. xx).
61. Høltedahl and Vennemo, background paper for *WDR 2003* report that this statement is well known among environmental authorities, but it is not by itself sufficient to release detailed environmental data in all the provinces. Air quality information in 41 large cities is the exception: progress in other areas is still pending.
62. Wang and others (forthcoming, p. 2).
63. Communication with Hua Wang. See the World Bank's website on New Ideas in Pollution Regulation at: <http://www.worldbank.org/nipr/index.htm> for additional information on the approach of combining traditional enforcement measures with information and disclosure to improve incentives and reduce air pollution.
64. Wang and others (forthcoming, p. 6).
65. World Bank (2000d, p. 57).
66. World Bank (2000d, p. 63).
67. See Weber-Fahr (2002) for a discussion of both perspectives with regard to mining.
68. de Ferranti, Perry, Lederman and Maloney (2002, p. 4).
69. See Murshed (2002a); Auty (1997); Auty and Gelb (2001); Isham and others (2002); Sachs and Warner (1995); Auty (2002).
70. Ross (2001a).
71. Auty (2001); Isham and others (2002).
72. Isham and others (2002). Revenue flows from other types of resources such as agriculture are more diffused throughout the economy (diffuse-source economies) and do not present as many challenges to the emergence of inclusive and accountable institutions.
73. Auty and Kiiski (2001, p. 3). Although causality may be unclear if natural resource sector is the only activity able to continue in weak institutional environments, empirical studies using lagged variables for the natural resource dependency criterion suggest that causality runs from resource factors to institutions to economic performance. See for example, Isham and others (2002).
74. Murshed (2002b, p. 1).
75. Former socialist countries in Europe, Asia, and Africa are excluded owing to incomplete data.
76. Isham and others (2002 p. 5).
77. See, for example, Auty (1997); Auty and Gelb (2001); Isham and others (2002); Murshed and Perälä (2001); Rodriguez and Sachs (1999); Sachs and Warner (1999a, 1999b).
78. McGuire and Olson (1996).
79. Addison, Le Billon, and Murshed (2000).
80. Auty and Kiiski (2001, p. 25).
81. Heilbrunn (2002).
82. Malaysia's natural resources may be considered diffuse, but had many point-source features at the time of independence. For a study on Botswana, see Sarraf and Jiwajji (2001).
83. Rodrik (1999).
84. See Kremer and Jayachandran (2002).
85. World Bank (1998b).
86. The fungibility effect, explored by Devarajan and Swaroop (1998), does not depend on fraud. An inflow—even in kind, such as for a school project—has a substitution effect and an income effect. The income effect boosts expenditure on all normal goods, including schools and planes,

while the substitution effect of a school project—which can boost school expenditures beyond the income effect—exists only if the donor succeeds in reducing the marginal cost of schools to the recipient government. The illustrative use, here, of planes, is not accidental: See Devarajan and Haque (2002) for an example.

87. Alesina and Weder (forthcoming); Knack (2001).
88. Alesina (1998); Burnside and Dollar (1998); World Bank (2002g).
89. World Bank (2000d, p. 3).
90. World Bank (1998c); Sambanis (2000).
91. World Bank (1998c, p. v).
92. Sambanis, background paper for *WDR 2003*.
93. See Fajnzylber, Lederman, and Loayza (2000); Collier and Hoeffler (2000); Sambanis, Nicolas, background paper for *WDR 2003*.
94. Fajnzylber, Lederman, and Loayza (1998); Demombynes and Özler (2002).
95. Collier and Hoeffler (2001), abstract.
96. See for example Collier and Hoeffler (2000, 2001).
97. Collier and Hoeffler (2000); Ross (2001b).
98. See Isham and others (2002).
99. Ross (2001a, p. 9).
100. Ross (2001a).
101. Addison and Murshed (2002) argue that the failure to credibly commit to peace is partly a consequence of the impatience to consume resource rents.
102. Ross (2001a) chose the 13 conflicts from a larger set of 21 recent conflicts where scholars and journalists indicated that natural resources played an important role, including Afghanistan, Angola, Angola-Cabinda, Cambodia, the Democratic Republic of Congo (the 1996–97 and 1998–2001 conflicts), Indonesia-Aceh, Indonesia–West Papua, Liberia, Papua New Guinea, the Republic of Congo, Sierra Leone, and Sudan.
103. Ross (2001b).
104. Fearon (2001).
105. Collier and Hoeffler (2000).
106. Murshed (2002a, p. 3).
107. North and Weingast (1989).
108. Acemoglu and Robinson (2000a, 2000b). Stewart, 2000, also emphasizes the importance of addressing inter-group or horizontal inequality for conflict prevention.
109. Sambanis, Nicolas, background paper for *WDR 2003*.

## Chapter 8

1. This account draws on National Academy of Sciences (NAS 1996); UNEP (1999); and Jager and others (2001). The quote is from NAS (1996).
2. Munton and others (1999); Jager and others (2001).
3. Clark and Dickson (1999); the framework in this chapter has benefited greatly from this study of global problem solving institutions, however, it should not be considered representative of the Social Learning Group's views.
4. Dubash and others (2001).
5. Victor, Raustiala, and Skolnikoff (1998).
6. Victor, Raustiala, and Skolnikoff (1998).

7. Data for COP-6B of the Kyoto Protocol.
8. GEF (1999, p. 7).
9. Chayes and Chayes (1995).
10. Hunter, Salzman, and Zaelke (2001).
11. Mitchell (1995); a background paper for *WDR 2003*.
12. See an extensive discussion in *Greening Industry*.
13. Sustain Ability Ltd. and UNEP (2001).
14. Dowell, Hart, and Yeung (2000)
15. King and Lennox (forthcoming).
16. Gereffi, Garcia-Johnson, and Sasser (2001).
17. Social Investment Forum (2001).
18. Boscolo and Vincent (2000).
19. Richardson (2001).
20. FAO (2000, p. 312). This Forest Resources Assessment (FRA) remote-sensing survey is based on random sampling of 10 percent of the pantropical forest area. It is distinct from the better-known FRA country-based deforestation estimates, which rely on national reports of varying consistency, periodicity, and accuracy.
21. Bleaching events—loss of coral's symbiotic algae, often leading to death of the coral—are associated with temporary spikes in sea temperature comparable to the permanent rises expected from global warming, and are probably exacerbated by other stresses.
22. Wilkinson, ed. (2000).
23. Rannesson, background paper for *WDR 2003*.
24. These categorizations are based on a global sample of satellite images that recognizes 9 classes of land cover. Following FAO (2000, pp. 313–14), deforestation of closed canopy forest has been categorized as shifting agriculture if it resulted in open forest or long fallow; smallholder agriculture if it resulted in fragmented forest, shrubs, or short fallow; and large-scale agriculture if it resulted in plantations, other land cover, or water bodies.
25. These figures represent the total net present value of returns over time.
26. Wunder (2000, p. 210).
27. Tomich and others (1998).
28. Kotto-Same and others (2000, p. 35).
29. Chomitz and others, forthcoming.
30. Tomich and others (1998).
31. Chomitz and Thomas (2001).
32. Burke, Selig, and Spalding (2002, p. 30).
33. Burke and others (2001, p. 23).
34. Tilman and others (2001).
35. Burke and others (2001, p. 51).
36. World Bank (2001e).
37. As Simpson, Sedjo, and Reid (1996) elegantly demonstrate, bioprospecting as currently practiced is unlikely to yield significant per hectare rents, because genetic information in one hectare is likely to be duplicated in another part of the same habitat. But the loss of an entire, distinctive ecosystem might carry with it significant aggregate losses of biological information.
38. Wood, Sebastian, and Scherr (2000) p. 71.
39. Steinberg (2001, p. 39).
40. Olson and Dinerstein (1998).
41. Zheng and Eltahir (1997).

42. Lant and Sant (2001).
  43. Bowers and Uitto (2001).
  44. Sorensen (2002, p. 9).
  45. Postel and Wolf (2001).
  46. White and Martin (2002); Wily and Dewees (2001).
  47. OED (2002); Ross (2001b).
  48. Myers and others (2000).
  49. Brooks, Pimm, and Oyugi (1999).
  50. Ferraz and others (2002).
  51. Roe and others (2000).
  52. For a review, see McNeely and Scherr (2001).
  53. Tomich and others (1998).
  54. Ferraro (2002).
  55. OECD (1997).
  56. IPCC, 2001.
  57. World Bank (2000a).
  58. Nicholls, Hoozemans, and Marchand (1999). Cited in McCarthy and others (2001, p. 396).
  59. Such predictions should be taken only as indicative, given the uncertainty about many dimensions of climate change. Higher mean precipitation would ameliorate the impacts, according to the study. Increased summer monsoon variability, not accounted for in the model, would have the opposite effect.
  60. McCarthy and others (2001, p. 517).
  61. Watson and others (2000); IPPC (2002).
  62. A recent authoritative review is National Research Council (2001).
  63. To be precise, 40 percent of the radiative forcing from well-mixed greenhouse gases in 2000 as compared with 1750 (Houghton and others (2001, p. 351).
  64. These are IPCC scenarios A1FI and B1 from Nakićenovic and Swart (2000). Underlying data are available at [sres.ciesin.org](http://sres.ciesin.org). Emissions include gases other than CO<sub>2</sub>, and emissions from land use. The ratio in 2100 of per capita GDP in the non-OECD (membership as of 1990) to OECD countries is 57 percent in A1FI and 51 percent in B1. In A1FI, the 2100 share in primary energy of renewables is 17 percent; for B1, the share, including 'nonfossil electric' is 53 percent. The actual 1999 share was about 5 percent (IEA 2001, p. 312).
  65. Stott and Kettleborough (2002).
  66. Stott and Kettleborough (2002).
  67. Basis of calculation: 1999 Norway emissions, 34.3 million tons CO<sub>2</sub>. Population: 4 million. Global emissions: 6.3 billion tons per year; carbon equivalent from fossil fuels and cement, 1.7 billion tons per year; carbon equivalent from land-use change; 3.66 tons CO<sub>2</sub> per ton.
  68. IEA (2001).
  69. OECD (2001b, p. 153).
  70. Streets and others (2001).
  71. However, a concomitant 21 percent reduction in SO<sub>2</sub> emissions yielded health benefits but contributed to global warming because SO<sub>2</sub> aerosols have a cooling effect.
  72. The description of the Thai program is based on Singh and Mulholland (2000).
  73. Houghton and others (2001, p. 39).
  74. Author's calculation based on data on biomass density and deforestation from FAO 2000. Carbon-to-biomass ratio assumed to be 0.5.
  75. Chomitz (2002).
  76. International Energy Agency (1999b, pp. 99, 105).
  77. This example is based on World Bank (2002b).
  77. Schipper, Murtishaw, and Unander (2001).
  79. President's Committee of Advisors on Science and Technology (1997).
  80. President's Committee of Advisors on Science and Technology (1997).
  81. OECD (2001b, p. 153).
  82. Milley and others (2002).
  83. Dilley (2000).
  84. Arndt and Bacou (2002).
  85. Skees and others (2002).
  86. Skees and others (2002).
- Chapter 9**
1. World Bank (2002b).
  2. World Bank (2000a), p. 29
  3. Rodrik (2002).
  4. World Bank (2002g, 2001f, forthcoming) and DFID (2002).
  5. World Bank (1996b).
  6. World Bank (2002a), page 93.
  7. World Bank (2002c).
  8. Mackay (2000), pp. 43–56; Sustainability Ltd, and UNEP (2001); Dowell, Hart, and Yeung (2000).
  9. Guerrero O. (1999).
  10. These institutions have sometimes become fully integrated with operational international efforts to negotiate and implement agreements, as in the case of CLRTAP and with transboundary assessments of international waters management.
  11. Devarajan, Miller, and Swanson (2002).
  12. Council of the European Union (2002).
  13. World Bank (2000b); World Bank (2002d), p. 98.
  14. Myers and Kent (2001); Fischer and Toman (1998); Ascher (1999).
  15. See World Bank (2002a), chapter 4.
  16. World Bank (2002b), p. 58–9.
  17. World Bank (2002ee), p. 133.
  18. World Bank (2002ee), pp. 141–142.



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