Exposition on Skepticism

The Skeptical Environmentalist: Measuring the Real State of the World. Bjørn Lomborg. Cambridge University Press, New York, 2001. 540 pp., $28.00 (ISBN 0-521-010683 paper).

Bjørn Lomborg discusses a wide range of topics in his book and implies, through the book's title, that he will inform readers exactly what the real state of world is. In this effort, he criticizes countless world economists, agriculturists, water specialists, and environmentalists, accusing them of misquoting or organizing published data to mislead the public concerning the status of world population, food supplies, malnutrition, disease, and pollution. Lomborg bases his more optimistic opinions on his own selective use of data. This review examines some of Lomborg's assertions and offers other information—extensively documented—that belies his assessment of the state of the world.

Lomborg reports that "we now have more food per person than we used to" (p. 61). Yet the Food and Agricultural Organization (FAO) of the United Nations reports that food per capita has been declining since 1984, based on available cereal grains (FAO 1961–1999). Cereal grains make up about 80 percent of the world's food. Although grain yields per hectare (ha) in both developed and developing countries are still increasing, these gains are slowing while the world population continues to escalate (FAO 1961–1999, PRB 2000). Specifically, from 1950 to 1980, US grain yields increased by about 3 percent per year, but since 1980 the annual rate of increase for corn and other grains has declined to only about 1 percent.

Obviously, fertile cropland is an essential resource for the production of foods, and Lomborg has chosen not to address this subject directly. Currently, the United States has available nearly 0.5 ha of prime cropland per capita, but that figure will drop if the population continues to grow at its current rapid rate (USBC 2000). Worldwide, the average cropland available for food production is only 0.25 ha per person (WRI 1994, PRB 2000). Each person added to the US population requires nearly 0.4 ha (1 acre) of land for urbanization and transportation (Vesterby and Krupa 2001). One example of the impact of population growth and development is found in California, where an average of 156,000 ha of agricultural land is being lost each year (USBC 2000). At that rate, California soon will cease to be the No. 1 state in US agricultural production.

In addition to the quantity of agricultural land, the quality and fertility of the soil are vital for food production. The productivity of soil is reduced when it is eroded by rainfall and wind (Lal and Stewart 1990, Troeh et al. 1991). Lomborg argues that this is not a problem, especially in the United States, where soil erosion has declined during the past decade. Indeed, as Lomborg states, instead of losing an annual average of 17 tons per hectare, US cropland is now losing an average of 13 $t \cdot ha^{-1} \cdot yr^{-1}$ (USDA 1994). However, this average loss is 13 times the sustainability rate of soil replacement (Pimentel and Kounang 1998). Exceptions occur, as when, during the 1995–1996 winter in Kansas, it was relatively dry and windy, causing some agricultural lands to lose as much as 65 $t \cdot ha^{-1} \cdot yr^{-1}$ of productive soil. This loss is 65 times the rate of natural soil replacement in agriculture (Lal and Stewart 1990, Troeh et al. 1991).

Soil erosion elsewhere is even more serious than in the United States. For instance, in India, soil is being lost at 30 to 40 times its sustainability rate (Koshoo and Tejwani 1993). The rate of soil loss in Africa is increasing not only because of livestock overgrazing but also because shortages of wood fuel make the burning of crop residues essential (Tolba 1989). During the summer of 2000, NASA photographed a cloud of African soil being blown across the Atlantic Ocean, further attesting to the massive soil erosion problem in Africa. Worldwide evidence of soil loss is substantial, and it is difficult to ignore its effect on sustainable agricultural production.

Contrary to Lomborg's belief, crop yields cannot continue to grow in response to increased applications of fertilizers and pesticides. In fact, field tests have demonstrated that applying excessive amounts of nitrogen fertilizer stresses crop plants and results in declining yields (Romanova et al. 1987). The optimum amount of nitrogen for corn, one of the crops that require heavy use of nitrogen, is approximately 120 kilograms per hectare (Troeh and Thompson 1993). Although US farmers frequently apply significantly more nitrogen fertilizer than 120 kilograms per ha, the extra is a waste and a pollutant. The corn crop can utilize only about one-third of the nitrogen applied, and the remainder leaches into either ground or surface waters or is denitrified and released to the atmosphere, or both (Robertson 2000). Such pollution of aquatic ecosystems in agricultural areas results in the high levels of nitrogen and pesticides found in many US water bodies (Mapp 1999, Gentry et al. 2000, Robertson 2000). For example, nitrogen fertilizer has found its way into 97 percent of the well-water supplies in some regions, including North Carolina (Smith et al. 1999). Concentrations of nitrate that are above the US drinking water standard of 10 milligrams per liter (nitrogen) may be a toxic threat to young children and young livestock (Smith et al. 1999). In the last 30 years, nitrate content has tripled in the Gulf of Mexico (Goolsby et al. 2000), where it is reducing fish yields (NAS 2000a).

Lomborg reports—without documentation—that pesticides cause very little cancer. Moreover, he does not explain how human and other nontarget species would avoid exposure to pesticides when crops are treated. However, abundant medical and scientific evidence confirms that pesticides do indeed cause significant numbers of cancer cases in the United States and throughout the world (WHO 1992, Ferguson 1999, NAS 2000b). Lomborg also fails to note that some herbicides stimulate in some plants the production of toxic chemicals that may be carcinogenic (Culliney et al. 1992).

In keeping with his view that agriculture and the food supply are improving, Lomborg states that "fewer people are starving" (p. 328). He questions the validity of two World Health Organization reports confirming that more than 3 billion people are malnourished (WHO 1996, 2000a). This is the largest number and proportion of malnourished people reported in history! Lomborg appears to reject the WHO data because they do not support his basic thesis. Instead, he argues that *only* people who suffer from calorie shortages are malnourished, ignoring the fact that humans die in great numbers because of deficiencies of protein, iron, iodine, and vitamins A, B, C, and D (Sommer and West 1996, Tomashek et al. 2001).

Further underscoring a decline in food supply, the FAO reports that there has been a threefold decline in the consumption of fish by humans over the past 7 years (FAO 1991, 1998). Fish numbers are decreasing because of overfishing and pollution, as well as a rapidly growing world population that must share the diminishing fish supply.

Lomborg is correct in stating that water supply and sanitation services improved in the developed world in the 19th century, but he ignores the available scientific data when he suggests that these trends have been "replicated in the developing world" in the 20th century. Countless reports confirm that developing countries discharge most of their untreated urban sewage directly into surface waters (WHO 1993, Wouters 1993, Biswas 1999). For example, of India's 3119 towns and cities, only 8 have full wastewater treatment facilities (WHO 1992). Furthermore, 114 Indian cities dump untreated sewage and partially cremated bodies directly into the Ganges River, where downstream people use the untreated water for drinking, bathing, and other domestic purposes (NGS 1995). It is no wonder that water-borne infectious diseases account for 80 percent of all infections worldwide and 90 percent of all infections in developing countries (WHO 1992).

Contrary to Lomborg's view, occurrences of most infectious diseases are increasing worldwide (WHO 1992), a rise attributable not only to population growth but also to increasing environmental pollution (Pimentel et al. 1998). Food-borne infections are increasing rapidly worldwide, even in the United States. For example, in 2000 there were 76 million human food-borne infections in the United States, with 5,000 associated deaths (Taylor and Hoffman 2001). Many of these infections were associated with contamination of food and water with livestock wastes (DeWall et al. 2000).

In addition, vast numbers of malnourished people are highly susceptible to infectious or opportunistic diseases such as tuberculosis (TB), malaria, schistosomiasis, and AIDS (Chandra 1979, Stephenson et al. 2000a, 2000b). For example, cases of tuberculosis are escalating worldwide and in the United States, in part because medicine has not kept up with the new forms of TB. According to the World Health Organization, more than 2 billion people have TB (WHO 2000b), and nearly 2 million people die from it each year (WHO 2001).

Consistent with Lomborg's thesis that natural resources are abundant, he reports that the US Energy Information Agency projected that oil prices would remain steady at about $22 per barrel over the period 2000–2020. This optimistic projection was refuted in late 2000, when oil rose to $30 or more per barrel (BP 2000). Reliable data project that world oil reserves will last approximately 50 years, based on current production rates (Youngquist 1997, Duncan 2001).

Lomborg takes the World Wildlife Fund (WWF) to task for its estimates on the loss of world forests over the past decade and its emphasis on the ecological impacts and loss of biodiversity attributable to that loss. Whether, as Lomborg suggests, the loss of forests is slow or, as WWF reports, the loss is rapid, there is no question that forests are disappearing worldwide. Forests not only are a rich resource for valuable products; they harbor a vast diversity of species of plants, animals, and microbes. Progress in medicine, agriculture, genetic engineering, and environmental quality depends on maintaining Earth's species diversity (Myers 1996).

I take issue with Lomborg's underlying thesis that the size and growth of the human population is not a major problem. The difference between Lomborg's estimate that 76 million humans were added to the world population in 2000 and the 80 million reported by the Population Reference Bureau (PRB 2000) is not the issue, although the magnitude of either projection is of serious concern. Lomborg neglects to explain that the major problem with world population growth is the prevailing young age structure. Even if the world adopted a policy tomorrow that barred any couple from producing more than two children, the world population would continue to increase for more than 70 years before stabilizing at more than 12 billion people (Population Action International 1993).

As an agricultural scientist and ecologist, I wish I could share Lomborg's optimism, but my investigations and those of countless other scientists lead me to a more wary outlook. The supply of Earth's basic resources—namely, fertile cropland, water, energy, and unpolluted atmosphere—that support human life is declining rapidly as people—nearly a quarter million of them each day—are added to the planet. We all desire a high standard of living for all of the world's citizens, but with every person born, the available supply of resources must be further divided and shared. Current losses and degradation of natural resources are cause for deep concern and the need to plan for future generations of humans. Based on scientists' current understanding of the real state of the world and environment, we must, now and in the future, conserve and protect vital global resources.

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References cited

Biswas MR. 1999. Nutrition, food, and water security. Food and Nutrition Bulletin. 20: 454–457.

[BP] British Petroleum. 2000. British Petroleum Statistical Review of World Energy. London: British Petroleum Corporate Communications Services.

Chandra RK. 1979. Nutritional deficiency and susceptibility to infection. Bulletin of the World Health Organization 57: 167–177.

Culliney TW, Pimentel D, Pimentel MH. 1992. Pesticides and natural toxicants in foods. Agriculture, Ecosystems, and Environment 41: 297–320.

DeWaal CS, Alderton L, Jacobson MJ. 2000. Outbreak Alert! Closing the Gaps in Our Federal Food-Safety Net. Washington (DC): Center for Science in the Public Interest.

Duncan RC. 2001. World energy production, population growth, and the road to the

Olduvai Gorge. Population and Environment 22: 503–522.
[FAO] Food and Agriculture Organization of the United Nations. 1961–1999. Quarterly Bulletin of Statistics. Rome: FAO.
Ferguson, L.R. 1999. Natural and man-made mutagens and carcinogens in the human diet. Mutation Research, Genetic Toxicology and Environmental Mutagenesis 443: 1–10.
Gentry LE, David MB, Smith-Starks KM, Kovacics DA. 2000. Nitrogen fertilizer and herbicide transport from tile drained fields. Journal of Environmental Quality 29: 232–240.
Goolsby DA, Battaglin WA, Aulenbach BT, Hooper RP. 2000. Nitrogen flux and sources in the Mississippi River basin. Science and the Total Environment 248: 75–86.
Khoshoo TN, Tejwani KG. 1993. Soil erosion and conservation in India (status and policies). Pages 109–146 in Pimentel D, ed. World Soil Erosion and Conservation. New York: Cambridge University Press.
Lal R, Stewart BA. 1990. Soil Degradation. New York: Springer-Verlag.
Mapp HP. (1999). Impact of production changes on income and environmental risk in the Southern High Plains. Journal of Agricultural and Applied Economics 31: 263–273.
Myers N. 1996. The world's forests and their ecosystem services. Pages 1–19 in Dailey GC, ed. Ecosystem Services: Their Nature and Value. Washington (DC): Island Press.
[NAS] National Academy of Sciences. 2000a. Clean Coastal Waters: Understanding and Reducing the Effects of Nutrient Pollution. Washington (DC): National Academy of Sciences Press.
———. 2000b. The Future Role of Pesticides in Agriculture. Washington (DC): National Academy of Sciences Press.
[NGS] National Geographic Society. 1995. Water: A Story of Hope. Washington (DC): NGS.
Pimentel D, Kounang N. 1998. Ecology of soil erosion in ecosystems. Ecosystems 1:416-426.
Pimentel D, et al. 1998. Ecology of increasing disease: Population growth and environmental degradation. BioScience 48: 817–826.
Population Action International. 1993. Challenging the Planet: Connections between Population and the Environment. Washington (DC): Population Action International.
[PRB] Population Reference Bureau. 2000. World Population Data Sheet. Washington (DC): PRB.
Robertson GP. 2000. Denitrification. Pages C181–C190 in Summer ME, ed. Handbook of Soil Science. Boca Raton (FL): CRC Press.
Romanova AK, Kuznetsova LG, Golovina EV, Novichkova NS, Karpilova IF, Ivanov BN. 1987. Proceedings of the Indian National Science Academy, B (Biological Sciences).
Smith VH, Tilman GD, Nekola JC. 1999. Eutrophication: Impacts of excess nutrient inputs on freshwater, marine, and terrestrial ecosystems. Environment and Pollution 100: 179–196.
Sommer A, West KP. 1996. Vitamin A Deficiency: Health, Survival, and Vision. New York: Oxford University Press.
Stephenson LS, Latham MC, Ottesen EA. 2000a. Global malnutrition. Parasitology 121: S5–S22.
———. (2000b). Malnutrition and parasitic helminth infections. Parastiology. S23–S38.
Taylor MR, Hoffman SA. 2001. Redesigning food safety: Using risk analysis to build a better food safety system. Resources 144: 13–16.
Tolba MK. 1989. Our biological heritage under siege. BioScience 39: 725–728.
Tomashek KM, Woodruff BA, Gotway CA, Bloand P, Mbaruku G. 2001. Randomized intervention study comparing several regimens for the treatment of moderate anemia refugee children in Kigoma region, Tanzania. American Journal of Tropical Medicine and Hygiene 64: 164–171.
Troeh FR, Thompson LM. 1993. Soils and Soil Fertility. 5th ed. New York: Oxford University Press.
Troeh FR, Hobbs JA, Donahue RL. 1991. Soil and Water Conservation. 2nd ed. Englewood Cliffs (NJ): Prentice Hall.
[USBC] US Bureau of the Census. 2000. Statistical Abstract of the United States 2000. Washington (DC): US Government Printing Office.
[USDA] US Department of Agriculture. 1994. Summary Report 1992 National Reseources Inventory. Washington (DC): Soil Conservation Service.
Vesterby M, Krupa KS. 2001. Major uses of land in the United States, 1977. Washington (DC): US Department of Agriculture, Resource Economics Division, Economics Research Service. Statistical Bulletin no. 973. (19 Jan 2002; *www.ers.usda.gov/publications/sb973*)
[WHO] World Health Organization. 1992. Our Planet, Our Health: Report of the WHO Commission on Health and Environment. Geneva (Switzerland): WHO.
———. 1993. Global health situation. Weekly Epidemiological Record, 68: 43–44.
———. 1996. Micronutrient Malnutrition—Half of the World's Population Affected. Pages 1–4 WHO in Press Release no. 78.
———. 2000a. Malnutrition Worldwide. (27 July 27 2000; *www.who.int/nut/malnutrition_worldwide.htm*)
———. 2000b. Tuberculosis. WHO Fact Sheet 2000, no. 104. (19 Jan 2002; *www.who.int/gtb*)
———. 2001. Global Tuberculosis Control WHO Report 2001. Geneva: WHO/CDS/TB/2001. 287.
Wouters AV. (1993). Health care utilization patterns in developing countries: Role of the technology environment in "deriving" the demand for health care. Boletin de la Oficina Sanitaria Panamericana 115: 128–139.
[WRI] World Resources Institute. 1994. World Resources 1994–95. Washington (DC): WRI.
Youngquist W. 1997. Geodestinies: The Inevitable Control of Earth Resources over Nations and Individuals. Portland (OR): National Book Company.