

VITAL SIGNS

The trends that are shaping our future

2001
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VITAL SIGNS

2001–2002

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VITAL SIGNS

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The Trends That Are Shaping Our Future

WORLDWATCH INSTITUTE

Janet N. Abramovitz	Lisa Mastny
Lester R. Brown	Ashley Mattoon
Seth Dunn	Anne Platt McGinn
Christopher Flavin	Danielle Nierenberg
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Nicholas Lenssen	Linda Starke, <i>Editor</i>



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New This Year: Worldwatch CD-ROM

Worldwatch offers the data from all graphs and tables contained in this book, as well as all other Worldwatch publications, on CD-ROM for use with PC or Macintosh computers. This includes data from the *State of the World* and *Vital Signs* series of books, Worldwatch Papers, and *World Watch* magazine in an easy to use, searchable format. In addition, the complete text of this year's editions of *State of the World* and *Vital Signs* are included in Adobe PDF format. For more information or to order, please see our website (www.earthscan.co.uk) or e-mail earthinfo@earthscan.co.uk.

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ACKNOWLEDGMENTS

Each year, *Vital Signs* draws on the analytical and writing efforts of the entire research staff of Worldwatch Institute. Throughout the year, our researchers are busy following key trends, even while researching and writing papers and articles in their varied areas of expertise. Our full-time staff is joined in this tenth anniversary edition by two former senior researchers, Nicholas Lenssen and John Young, as well as by former interns Ann Hwang and Danielle Nierenberg, who has now joined Worldwatch as an adjunct researcher.

Independent editor Linda Starke once again brought a steady hand and years of experience to bear in unifying 49 manuscripts produced by 19 different authors scattered in a half-dozen locations to ensure consistency and readability throughout the book. Other members of the Institute's staff also play a vital role. Lori Brown and Jonathan Guzman run our library and ensure that researchers have access to the latest books, reports, and magazine articles and stay abreast of important studies and Web resources. Reah Janise Kauffman served as an invaluable liaison with the foreign publishers of *Vital Signs*.

Names not found in the individual bylines but nonetheless critical to this book our operations team of Barbara Fallin, Suzanne Clift, and Sharon Lapier; our development team of Mary Redfern and Millicent Johnson; our communications team of Dick Bell, Leanne Mitchell, and Niki Clark; and Joseph Gravely, who is responsible for shipping out publications.

Over the last year we redesigned the cover

and several of the internal elements of *Vital Signs* to enhance its visual attractiveness and highlight its interdisciplinary nature. Many "vital signs," for example, now include a small box to alert readers to related pieces they might find of interest. Ed Ayres, Dick Bell, Hilary French, Brian Halweil, Millicent Johnson, Michael Renner, Molly O'Meara Sheehan, Linda Starke, Christine Stearn, and Denise Warden volunteered their time to accomplish the redesign. But Art Director Elizabeth Doherty played the most crucial role, on top of her already considerable responsibilities in connection with desktop production of *Vital Signs* and other Worldwatch publications. Three photos Liz chose to use are from Photoshare, the online photo database of the Media/Materials Clearinghouse at the JHU/Population Information Program at <www.jhuccp.org/mmc>.

All contributions to this book were reviewed by in-house staff as well as by a number of outside experts. For particular help with data requests, advice, or feedback on drafts, the authors wish to thank Claudine Aholou Putz, Wasantha Bandarage, Ed Benjamin, Greg Bischak, Ed Bos, Colin Couchman, Martin Dasek, Satoshi Fujino, Frank Jamerson, Clive James, Paul Jenner, Ken Kassem, Katrina Kulp, Rich Liroff, Birger Madsen, Paul Maycock, Gerhard Metschies, Donald Mitchell, Martin Palmer, John Pilgrim, Pat Plunkert, Sandra Postel, Matthew Quinlan, Annette Renner, Robert Rice, Jose Santamarta, Wolfgang Schreiber, Joseph Sheehan, Vladimir Sliviyak, Carrie Smith, Ron Srnka, Alison Stattersfield,

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At W.W. Norton & Company, our U.S. publisher, we are grateful to Lucinda Bartley, Amy Cherry, Andrew Marasia, and their colleagues for expediting our manuscript through the printing and publishing process. We thank them for their steady support over the years.

We also want to thank our new partner in *Vital Signs*, the United Nations Environment Programme. As described in the Foreword, we are now working together to provide the information and analysis needed to guide solid decisionmaking on environmental matters around the world. We thank Executive Director Klaus Töpfer and his entire staff in Nairobi and around the world for their dedication to the issues that we and they are so concerned about.

We are grateful to the W. Alton Jones Foundation for its funding of *Vital Signs 2001* and *Vital Signs 2002*, marking the tenth year of such support. The Jones Foundation's support of *Vital Signs* since its inception is central to allowing us to produce this volume each year. We thank Pete Myers, Charlie Moore, and the Board of the Jones Foundation for their dedication to a sustainable world and for their excellent work in nearly all of the fields that Worldwatch Institute focuses on, from climate change to biological diversity.

Some of the data we present in this book are outgrowths of our general research, conducted in the course of putting together *State of the World*, Worldwatch Papers, and *World Watch* magazine. We would therefore also like to thank the foundations that have supported this work during the past year: the Geraldine R. Dodge Foundation, the Ford Foundation, the Richard & Rhoda Goldman Fund, the William and Flora Hewlett Foundation, the John D. and Catherine T. MacArthur Foundation, the Charles Stewart Mott Foundation, the David and Lucile Packard Foundation, the Summit Foundation, the Turner Foundation, the Wallace Global Fund, the Weeden Foundation, and the Winslow Foundation.

In addition, we would like to acknowledge the support of the more than 2,000 individuals

who provided financial support through the Friends of Worldwatch program last year. Our special appreciation goes to the members of the Institute's Council of Sponsors—Tom and Cathy Crain, James and Deanna Dehlisen, Roger and Vicki Sant, Robert Wallace and Raisa Scriabine, and Eckart Wintzen—and to the group of Benefactors: Adam and Rachel Albright, Junko Edahiro, Sara and Ed Groark, Hunter Lewis, and Izaak van Melle.

This year, we also want to note with pain the passing of one of the leading thinkers in the sustainable development field, a person whose ideas have helped inspire and guide our publications. Donella H. Meadows, one of the co-authors of *Limits to Growth* in 1972, died this winter after a brief illness. Dana, as she was known, who taught at Dartmouth College, was one of the first scientists to develop the field of global trend analysis, and we are thankful for both her intellectual and her moral support over the last quarter-century. Her commitment and humanity inspired scores of young people to work in the field of global sustainability.

* * *

New this year, all the data in the tables and figures in *Vital Signs* are available on CD-ROM (see page 6 for ordering information). And individual *Vital Signs* indicators can be downloaded in Adobe PDF format from our Web site, <secure.worldwatch.org/cgi-bin/wwinst/titles/vs>. Please send us your ideas for future *Vital Signs* indicators. You can reach us by e-mail (worldwatch@worldwatch.org), fax (202-296-7365), or regular mail.

Michael Renner, Project Director
March 2001

Worldwatch Institute
1776 Massachusetts Ave., N.W.
Washington DC 20036

FOREWORD

This year, for the first time, Worldwatch Institute and the United Nations Environment Programme (UNEP) have joined forces on *Vital Signs*. These two organizations, with a common dedication to achieving a healthy global environment, have worked together on this tenth volume of the series that Worldwatch launched in 1992. We believe that *Vital Signs 2001* provides decisionmakers and the public the latest and most complete picture of the health of the planet and its people.

UNEP is the principal United Nations body in the field of the environment. It plays a lead role in shaping the global environmental agenda, and in forging and implementing important environmental agreements. In recent years, UNEP has stepped up its efforts to analyze the state of the global environment and to assess global and regional trends, providing early warning of environmental threats.

This new collaboration is intended to maximize the synergy between an official United Nations body and a private, nonprofit research institute—drawing on our combined analytical strengths and our complementary abilities to reach key audiences around the world. At this time of rapid and confusing change, we are particularly keen on providing the information and insights the world will need as it approaches the World Summit on Sustainable Development in Johannesburg next year.

With this tenth edition of *Vital Signs*, we reach an important milestone. In *Vital Signs 2001*, we now have data for the year 2000. This

has given us a full half-century perspective on many of the trends we follow, since most of our data sets begin in 1950, when global record-keeping became much more comprehensive and systematic.

For decades, analysts have been using the year 2000 as the end point for their long-term forecasts and projections. Now that this year has become a vantage point for looking backward, the view is breathtaking. The last half-century has been a period of sweeping, unprecedented change: change in the economy, change in society, and change in the very biosphere of the planet. Indeed, very few projections for the year 2000 have come anywhere close to the mark. Today we live in a world that is economically richer than could have been hoped for a half-century ago, but one that is ecologically poorer than hardly anyone could have imagined. Here are some of the trends of the last 50 years that are chronicled in this volume:

- There are now just over 6 billion people on the planet, up 3.5 billion since 1950, which means more than a doubling in just 50 years. Most of the growth has come in developing countries, many of them already overcrowded. The number of city residents has grown even faster—up fourfold since the middle of the twentieth century.
- The world economy has grown even more dramatically: up almost sevenfold in 50 years. This added wealth translates into

vast improvements in living standards—from nutrition to housing, health care, and transportation. But 1.2 billion people still live in severe poverty, and an estimated 1.1 billion do not have clean, safe water to drink.

- The world grain harvest has nearly tripled since 1950, allowing billions of people to enrich their diets. But the abundance of food has come at a price: falling freshwater aquifers and severe water pollution from massive use of fertilizers and pesticides. Despite the increase in production, over a billion people are still undernourished, while another billion are actually overnourished, which has created a global epidemic of obesity that is now spreading to the developing world.
- Emissions of carbon dioxide, the leading greenhouse gas, have risen by nearly 300 percent since 1950, boosting its concentration in the atmosphere to its highest level in at least 420,000 years. New scientific studies project dramatic changes in the climate in the current century, leading to increased storm intensity, agricultural losses, and economic disruptions due to accelerated global warming from the additional greenhouse gases.
- The world has lost more than half its wetlands and over one quarter of its coral reefs—losses that continue to accelerate. And the species that depend on these natural habitats are also in decline. Of the approximately 9,900 bird species that have been identified, 12 percent are threatened with extinction.

If there is one lesson of this extraordinary half-century, it is that most trends defy prediction by experts. The most important changes have generally come abruptly, with little warning. We never seem to know where the latest economic crisis or ecological catastrophe will come from, but we do know that the projections of smooth, gradual change that computer models churn out are almost always wrong. Until the 1970s, for example, oil forecasters were projecting exponential growth in demand

and steady, low prices through the end of the century—until severe oil shocks forced a wholesale revision in this sanguine outlook. The forecasters then moved as a herd to the conclusion that an era of permanent shortages would drive oil prices over \$100 per barrel in 2000—just in time for the collapse of oil prices to \$10 per barrel in the mid-1980s.

As the world becomes ever more complex, predicting the future becomes an ever less productive enterprise. But planning for the future can minimize the risks and maximize the opportunities presented by a fast-changing world. From this perspective, the challenge of the twenty-first century is to extend the economic progress of the last 50 years while halting the ecological decline and social misery that have sometimes marred this remarkable period. The first step is to understand the clear message that emerges from the welter of statistics in *Vital Signs 2001*: despite all the wonders of the modern information age, the human economy emerged from Earth's biosphere and remains dependent on it. A sick planet will, sooner or later, lead to a faltering economy.

The last year brought vivid reminders of that dependence. Just as the information economy fell to Earth, soaring oil and natural gas prices showed the economy's reliance on fuels contained in that earth. And the impressive proliferation of high-tech drugs and medical treatments was unable to prevent catastrophic new epidemics of human and animal diseases—or the social and economic chaos that have come with them. At the same time, computer-based weather forecasts have become remarkably sophisticated—but failed to prevent the economic toll of natural disasters from reaching \$608 billion in the 1990s, more than 15 times the total for the 1950s.

The dramatic spread of democracy and open markets in the last decade, together with explosions in technology and communications, could lead to revolutionary change that would make the world a better place. But this will only happen if humanity acknowledges—and acts on the knowledge—that we remain dependent on a healthy natural world. Global inte-

gration provides the opportunity to raise living standards around the world, but also forces us to confront the fact that AIDS and foot-and-mouth disease can be efficiently carried halfway round the world in a matter of hours on the same aircraft that move people and goods so efficiently.

The new century has begun with many surprises, most of them unwelcome. But one thing is virtually certain: the next half-century will

not see a repeat of the trends of the one just past. Earth simply will not support it. The question is whether humanity will forge a healthier, sustainable future or risk the downward spiral that would be the result of failing to understand the ecological and economic threshold on which we now stand. We hope that the statistical snapshot contained in *Vital Signs 2001* will help provide that understanding.

Christopher Flavin
President
Worldwatch Institute

Klaus Töpfer
Executive Director
United Nations Environment Programme

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VITAL SIGNS

2001–2002

TECHNICAL NOTE

Units of measure throughout this book are metric unless common usage dictates otherwise. Historical population data used in per capita calculations are from the Center for International Research at the U.S. Bureau of the Census. Historical data series in *Vital Signs* are updated each year, incorporating any revisions by originating organizations.

Data expressed in U.S. dollars have for the most part been deflated to 1999 terms. In some cases, the original data source provided the numbers in deflated terms or supplied an appropriate deflator, as with gross world product data. Where this did not happen, the U.S. implicit gross national product (GNP) deflator from the U.S. Department of Commerce was used to represent price trends in real terms.

OVERVIEW

The Triple Health Challenge

Michael Renner

This edition of *Vital Signs* presents a three-dimensional, integrated picture of Earth's health—environmental, human, and economic. Today's economy—thriving on massive resource use, generating large amounts of pollutants, and disrupting natural cycles—imposes increasingly unsustainable burdens on the environment. And the deterioration of critical ecosystems like wetlands and coral reefs can boomerang: communities have less protection against extreme weather events, and disease vectors are able to spread more easily, compromising human health and well-being. Measures taken in the name of furthering public health, on the other hand, can sometimes throw natural balances out of kilter: the escalating use of antibiotics, for instance, helps produce more virulent infectious disease strains. Environmental crises and health epidemics translate into rising economic costs—in the form of property losses from natural disasters and skyrocketing health care bills.

The health of human societies and the natural environment is strongly related to how robust they are in the face of adverse developments. Resilience derives in large part from diversity. Yet modern societies and economies have pursued specialization to the point where much of our rich biological and cultural diversity has vanished. This is true for livestock and birds as well as for coffee plantations and languages. The 49 trends documented in *Vital Signs 2001* provide some measure of that disappearing diversity, and of recent attempts to bolster our resilience.

ECOSYSTEM HEALTH

Decimating forests, damming rivers, draining wetlands, spreading copious amounts of toxic and long-lived materials, and destabilizing the climate have all contributed to an unraveling of Earth's complex ecological safety net.

More than half the world's wetlands vanished during the past century, for example—primarily in the northern hemisphere during the first half and mostly in the South during the second half. (See Figure 1 and pages 96–97.) Half of the remaining coastal wetlands are likely to be lost by 2080 to agriculture, urban sprawl, and rising sea levels as a consequence of climate change. These marshes, bogs, swamps, and peatlands provide a range of vital services: regulating water flow, recharging groundwater supplies, providing flood control, retaining essential nutrients, buffering other ecosystems against contaminants, and offering habitat for diverse biological communities.

The health of coral reefs worldwide is also deteriorating rapidly. (See Figure 2 and pages 92–93.) The share of reefs severely damaged rose from 10 percent as recently as 1992 to 27 percent in late 2000. Reefs provide a range of crucial ecological services and goods. They shelter coastlines from storm damage, erosion, and flooding, serving as protection for an estimated half-billion people, and they provide habitat for as many as 1 million different species. But they are also important feeding and breeding grounds for commercial fisheries, producing one tenth the global fish catch.

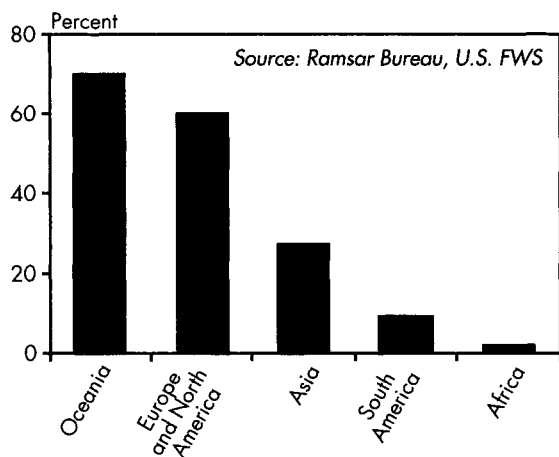


Figure 1: Percent of Wetlands Lost, by Region, 2000

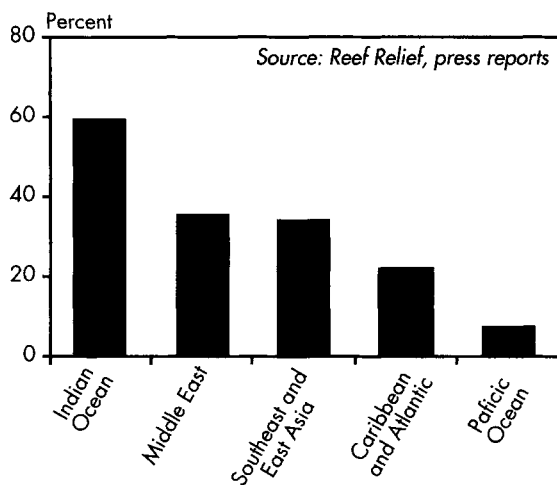


Figure 2: Percent of Coral Reefs Destroyed, by Region, 2000

The decay of ecosystems sets the stage for more frequent and more devastating “un-natural” disasters—natural disturbances made worse by human actions. (See pages 116–17.) And human vulnerability has increased due to the migration of people to coastal areas and urban centers and the expansion of the built environment. More than one third of humanity dwells within 100 kilometers of a coastline.

Climate change threatens to intensify many of the problems. Coral reefs, for instance, live at the upper edge of their temperature tolerance, and rising ocean temperatures spell greater stress for reefs. Impaired coral reefs are in turn less able to provide shelter against the rising storms associated with climate change. Climate change also expands the geographic reach of the *Anopheles* mosquito that transmits malaria. (See pages 134–35.)

Fossil fuel combustion has been a major driver of climate change. Although the use of oil, coal, and natural gas has declined slightly—down 0.3 percent from 1998—it is still extremely close to recent peak levels. (See pages 40–41.) One of the main factors is the unabated growth in the number of cars on the world’s roads and the distances driven in them, along with inadequate progress in boosting fuel economy to offset these increases. Global automobile production rose 4 percent in 2000 to reach a record 40.9 million vehicles, and the total fleet grew to 532 million. (See pages 68–69.)

With annual carbon emissions from fossil-fuel combustion quadrupling over the past half-century to about 6.3 billion tons in 2000, a total of almost 220 billion tons of carbon have been released into the atmosphere. (See pages 52–53.) Carbon dioxide is only one of several greenhouse gases; chlorofluorocarbons, methane, and nitrous oxide play important additional roles. So do perfluorocarbons, released in the process of alu-

minum smelting—an energy-intensive and polluting process that has expanded 16-fold since 1950. (See pages 64–65.)

In order to stave off full-blown climate change, large-scale reductions in carbon emissions far beyond the 0.6-percent decline achieved in 2000 are needed. Unless drastic action is taken, however, annual emissions are actually expected to grow to 9–12 billion tons by

2020 and possibly to twice that number by 2050. In a new assessment in January 2001, the Intergovernmental Panel on Climate Change revised upward its projections for temperature increases during this century, which would make more frequent weather events—both droughts and storms—more likely. (See pages 50–51.)

Modern agriculture, too, is imposing significant environmental burdens. Livestock populations have almost tripled since 1961 and currently contribute 16 percent of total emissions of methane, a greenhouse gas far more potent than carbon dioxide. (See pages 100–01.) Traditional mixed farming systems, in which farm animals are kept in close proximity to crop production, allow for animal wastes to be returned to the soil—a practice that has helped maintain soil fertility and limited the need for synthetic fertilizers. Today this approach is often giving way to input-intensive methods. North America and Europe pioneered this industrial production system, but it is now spreading to countries like Brazil, China, and India.

Under the so-called feedlot system, accumulated animal wastes present a major threat to soil, air, and water quality. Groundwater resources are threatened by contamination from the excess nutrients in livestock manure and from agricultural runoff. Water quality worldwide is imperiled by these and a range of other sources that dump nitrates, pesticides, petrochemicals, arsenic, chlorinated solvents, and radioactive wastes into aquifers.

PUBLIC HEALTH

Societies across the planet confront a resurgence of infectious diseases, some well-known and some previously unknown. AIDS and malaria are among the biggest killers, causing the deaths of several million people each year. The spread of microbes that cause these diseases is facilitated by international travel, agricultural trade, and human population movements—all of which are on the upswing. (See pages 62–63 and 142–43.)

Environmental factors also play an impor-

tant role in human susceptibility to and transmission of diseases, particularly malaria, diarrheal diseases, and acute respiratory infections. Worldwide, close to one fourth of all disabilities can be traced back to such factors as polluted air and water and unsafe food. More than 3 million people die each year worldwide from water-related diseases, mostly in developing countries. (See pages 94–95.)

The AIDS crisis marches on. To date, some 58 million people have been infected with HIV, the virus that causes AIDS; of these, 22 million have succumbed to the disease. (See pages 78–79.) And each year, nearly 6 million additional people are newly infected. Sub-Saharan Africa faces the most severe challenge: it is home to two thirds of the world's HIV-positive population. There, as elsewhere, people living in poverty, minorities, and women are hardest hit by the disease.

Malaria has staged a lethal comeback. (See pages 134–35.) It has been riding the coattails of environmental degradation (logging, dam- and road-building, and the warmer temperatures and increased precipitation associated with climate change) and the social upheaval caused by wars and refugee flows. Malaria remains one of the world's deadliest diseases, each year infecting nearly a half-billion people and claiming more than a million lives. Although close to 40 percent of the world's population is at risk, again inhabitants of sub-Saharan Africa are most affected. Among Africans, the death rate from malaria is nine times higher than the global average (see Figure 3), a consequence of higher exposure to disease vectors, the emergence of drug-resistant strains, and the sad fact of grossly inadequate health services.

Increasing drug resistance among microbes that cause a range of deadly illnesses makes many of these diseases harder and more expensive to control and threatens to reverse public health achievements of the past half-century. (See pages 132–33.) A key factor in making microbes more immune to drug treatment is the skyrocketing use of antibiotics and other antimicrobial drugs. At least half of all anti-