

Appendixes

APPENDIX A

Biographical Information on Board Members and Staff

CHAIR

Edward A. Frieman is director emeritus of the Scripps Institution of Oceanography. He also has served as vice chancellor for Marine Sciences at the University of California, San Diego, deputy director of the Princeton Plasma Physics Laboratory, and director of energy research for the US Department of Energy. A fellow of the American Physical Society and a member of the National Academy of Sciences, Dr. Frieman was awarded a National Science Foundation Senior Postdoctoral Fellowship in 1964, the John Simon Guggenheim Fellowship in 1970, the Department of Energy Distinguished Service Medal in 1984, and the Richtmyer Award from the American Physical Society in 1984. He has served on numerous science advisory panels and committees, including the Vice President's Space Advisory Board, the President's Committee on the National Medal of Science, the White House Science Council, and the Secretary of Energy Advisory Board. Dr. Frieman has a BS, engineering, Columbia University; MS and PhD, physics, Polytechnic Institute of Brooklyn.

MEMBERS

Lourdes Arizpe is a researcher at the Regional Center for Multidisciplinary Research and former director of the Institute of Anthropological Research of the National University of Mexico. She is vice president of the International Social Science Council and has served as president of the

International Union of Anthropological and Ethnological Sciences (1988-93). She was a Fulbright scholar at Rutgers University in 1978 and received a Guggenheim grant in 1981. She has been on the Steering Committee of Development Alternatives for Women in a New Era (1985-89) and assistant director-general for Culture at UNESCO (1994-98). She holds an MA, National School of Anthropology in Mexico, and PhD, London School of Economics and Political Science.

John Bongaarts is vice president of the Population Council, Research Division, where he has been employed since 1973. His research has focused on a variety of population issues, including the determinants of fertility, population-environment relationships, the demographic impact of the AIDS epidemic, and population policy options in the developing world. He is a member of the Royal Dutch Academy of Sciences and a fellow of the American Association for the Advancement of Science. He has been recognized with the Mindel Sheps Award from the Population Association of America (1986) and the Research Career Development Award from the National Institutes of Health (1980-1985). Dr. Bongaarts holds an MS, systems analysis, Eindhoven Institute of Technology, The Netherlands; and PhD, physiology and biomedical engineering, University of Illinois.

Ralph J. Cicerone is the chancellor of the University of California, Irvine, where he also is Daniel G. Aldrich, Jr. Professor in the Earth System Science Department. He is an atmospheric chemist with research interests in how chemicals in the atmosphere may cause climate change. He is also involved in research on the stratospheric ozone layer, and the sources and sinks of atmospheric methane, nitrous oxide, and methyl bromide. From 1980 until 1989, he was director of the Atmospheric Chemistry Division of the National Center for Atmospheric Research. From 1992 to 1994, he served as the president of the American Geophysical Union (AGU), the world's largest scientific society for earth scientists. He is a past chair of the National Research Council's Board on Global Change. He is a fellow of the American Association for the Advancement of Science, the AGU, and the American Meteorological Society. He is a member of the National Academy of Sciences and the American Academy of Arts and Sciences. He has a SB, Massachusetts Institute of Technology; and an MS and a PhD, engineering and physics, University of Illinois.

William C. Clark is the Harvey Brooks Professor of International Science, Public Policy and Human Development at Harvard University's John F. Kennedy School of Government. He served as director of the school's Center for Science and International Affairs (1993-1994) and also as vice

chairman of the University Committee on Environment. Dr. Clark's current research focuses on how societies learn to cope with the policy issues arising through the interactions of environment, development, and security concerns in international affairs. In particular, he has studies under way on the development of fair assessment frameworks for use in the management of climate change and on the comparative histories of social learning in national efforts to deal with global environmental change. Dr. Clark is a member of the Sigma Xi Scientific Research Society and was awarded a MacArthur Prize Fellowship in 1983 for his achievements in environmental policy. He holds a BS, biology, Yale University; and a PhD, ecology, University of British Columbia in Canada. Dr. Clark serves as co-chair of the Sustainability Transition Study.

Robert A. Frosch is a senior research fellow at the Belfer Center for Science and International Affairs of the John F. Kennedy School of Government at Harvard University. After doing research in underwater sound and ocean acoustics, he served for a dozen years in a number of governmental and intergovernmental positions, including deputy director of Advanced Research Projects Agency of the Department of Defense, assistant secretary of the Navy for research and development, assistant executive director of the United Nations Environmental Program, and administrator of the National Aeronautics and Space Administration. In 1989, Frosch revived, redefined, and popularized the term "industrial ecology," and his research has focused on this field in recent years, especially in metals-handling industries. In 1993, he retired as vice president of General Motors Corporation, where he was in charge of the North American Operations Research and Development Center. Dr. Frosch is a member of the National Academy of Engineering. He holds an AB, Columbia College; and an MS and a PhD, theoretical physics, Columbia University.

Malcolm Gillis is the president of Rice University and a professor of economics. Prior to this appointment, Dr. Gillis served as dean of the Faculty of Arts and Sciences and dean of the Graduate School and vice provost for Academic Affairs at Duke University. His research and teaching activities have focused on two broad classes of issues in their national and international dimensions: fiscal reform and environmental policy. He has published more than 70 articles in journals. He is author, co-author, or editor of eight books, including a widely acclaimed 1988 publication, *Public Policies and the Misuse of Forest Resources*, and *Tax Reform in Developing Countries*, published in 1989, as well as the leading textbook in its field, *Economics of Development (4th edition)*, now available in five languages. Dr. Gillis holds a BA and MA, University of Florida; and a PhD, University of Illinois.

Richard H. Harwood is C.S. Mott Foundation chair of sustainable agriculture in the Department of Crop and Soil Sciences at Michigan State University. Dr. Harwood worked in Asian farming systems development for 15 years while employed by the Rockefeller Foundation in Thailand and the International Rice Research Institute. He directed the Asian programs of the Winrock International Institute for Agricultural Development from 1985 to 1990. He served as director of the Rodale Research Center in Pennsylvania from 1977 to 1985. Dr. Harwood returned to Michigan State University in 1990 to assume teaching and research responsibilities and continue extension activities in sustainable development. He holds a BS, vegetable crops, Cornell University; and an MA and a PhD, horticulture and plant breeding, Michigan State University.

Robert W. Kates is a geographer, independent scholar, and emeritus director of the Feinstein World Hunger Program at Brown University. His research focuses on the persistence of hunger, climate impact assessment, long-term population dynamics, and the sustainability of the biosphere. A member of the National Academy of Sciences and the American Academy of Arts and Sciences, Dr. Kates serves as an executive editor of *Environment* magazine. He is a recipient of the 1991 National Medal of Science, the MacArthur Prize Fellowship (1981-85), and the honors award of the Association of American Geographers. Dr. Kates has a MA and PhD, geography, University of Chicago, as well as an honorary DSc, Clark University. Dr. Kates serves as the vice chairman of the board and co-chair of the Sustainability Transition Study.

Philip J. Landrigan is the Ethel H. Wise professor and chair of Community Medicine and director of the Environmental and Occupational Medicine at the Mount Sinai School of Medicine. He is responsible for directing research programs, training residents, and teaching medical students. From 1970 to 1985, Dr. Landrigan was a commissioned officer in the United States Public Health Service, where he served as an epidemic intelligence service officer and then as a medical epidemiologist with the Centers for Disease Control. He also established and directed the Environmental Hazards Branch of the Bureau of Epidemiology. From 1979 to 1985, he was director of the Division of Surveillance, Hazard Evaluations and Field Studies of the National Institute for Occupational Safety and Health. Dr. Landrigan holds an AB, Boston College; an MS, occupational medicine, University of London; and an MD, Harvard University Medical School.

Kai N. Lee is the John J. Gibson professor of environmental studies at Williams College, where he teaches environmental studies and public policy. Previously, he taught at the University of Washington (1973-91). His research interests center on institutional arrangements for a sustainability transition, particularly in biodiversity conservation. He is the author of *Compass and Gyroscope* (1993) and a member of the NRC panel that wrote *Upstream: Salmon and Society in the Pacific Northwest* (1996). Dr. Lee has interrupted his academic career twice, as a White House Fellow (1976-77) and as a member of the Northwest Power Planning Council (1983-87). He also serves as a member of the National Research Council's Commission on Geosciences, Environment, and Resources; senior fellow at the World Wildlife Fund US; chair of the environment committee of the Advisory Council of the Calvert Social Investment Fund; and a member of the editorial boards of the journals *Ecological Economics* and *Ecosystems*. Dr. Lee holds an AB, physics, Columbia University; and a PhD, physics, Princeton University.

Jerry Mahlman is director of the Geophysical Fluid Dynamics Laboratory of the National Oceanic and Atmospheric Administration and is a lecturer with rank of professor in the Atmospheric and Oceanic Sciences Program at Princeton University. Much of Dr. Mahlman's research career has been directed toward understanding the behavior of the stratosphere and troposphere. This has involved extensive mathematical modeling of the interactive chemical, radiative, dynamical, and transport aspects of the atmosphere, as well as their implications for climate and chemical change. Among his recent commitments, Dr. Mahlman has served on the Joint Scientific Committee of the World Climate Research Program, been a Councilor of the American Meteorological Society, chaired the advisory committee for National Aeronautics and Space Administration's Mission to Planet Earth, and is a member of the Advisory Committee for the Department of Energy's Climate Change Prediction Program. He is a fellow of the American Geophysical Union, was awarded the Presidential Distinguished Rank Award, and received the American Meteorological Society's highest honor, the Carl-Gustaf Rossby Research Medal. Dr. Mahlman holds a PhD, atmospheric sciences, Colorado State University.

Richard Mahoney is the distinguished executive in residence at the Center for the Study of American Business at Washington University in St. Louis. While at the Center, he has written a number of research reports and op-eds for major publications, including *The New York Times*, *Washington Post*, *The Wall Street Journal*, and others. He created "The CEO Series," to which he has contributed many essays, including *The Anatomy of a Public Policy Crisis, Business Must Act for All Its Stakeholders—Before*

"The Feds" Do, Trade Winds or Head Winds?, U.S. Government Export Policy, and Insights from Business Strategy and Management "Big Ideas" of the Past Three Decades: Are They Fads or Enablers? Mr. Mahoney joined Monsanto Company in 1962 as a product development specialist. He subsequently held various marketing, technical service, and new product development positions in Plastic Products, Agriculture, and International Operations. He was named executive vice president in 1977, president in 1980, and chief executive officer in 1983. He retired in 1995 as chairman of the board and chief executive officer. Mr. Mahoney holds a BS, chemistry, University of Massachusetts.

Pamela Matson is a professor in the Department of Geological and Environmental Sciences and the Institute of International Studies, Stanford University. Previously, she was a professor of ecosystem ecology at the University of California, Berkeley, and worked for 10 years as a research scientist at NASA/Ames Research Center. Her research has focused on the effects of natural and anthropogenic disturbances on biogeochemical cycling and trace gas exchange in tropical and temperate ecosystems. Other interests include the analysis of consequences of anthropogenic nitrogen on downwind and downstream ecosystems at regional scales. She serves on numerous committees, including the Scientific Committee for the International Geosphere-Biosphere Program, and the National Research Council's U.S. National Committee for the Scientific Committee on Problems of the Environment. She was named NASA-Ames Associate Fellow in 1991 in recognition of research excellence, and is a member of the American Academy of Arts and Sciences and the National Academy of Sciences. In 1995, Dr. Matson was selected as a MacArthur Fellow, and in 1997 was elected a Fellow of the American Association for the Advancement of Science. She holds a BS, biology, University of Wisconsin-Eau Claire; an MS, environmental science, Indiana University; and a PhD, forest ecology, Oregon State University.

William Merrell is the President of the H. John Heinz III Center for Science, Economics, and the Environment. Previously, Dr. Merrill was appointed vice chancellor for Strategic Programs of Texas A&M University where he also assumed the role of professor of oceanography and marine sciences. Immediately preceding this assignment he served as vice president for Research Policy of Texas A&M and was president of Texas A&M at Galveston from 1987 to 1992. He received the Distinguished Member Award for Research Achievement from the Texas A&M University Chapter of Sigma XI, the Distinguished Achievement Award from the Geosciences and Earth Resources Council, and the Distinguished Service Award of the National Science Foundation for "his lasting impact on the

course of American science." Dr. Merrell holds a BS and an MA, physics, Sam Houston State University; and a PhD, oceanography, Texas A&M University.

G. William Miller is Chairman of G. Miller & Co., Inc., a merchant banking firm located in Washington D.C. Mr. Miller served as secretary of the US Department of Treasury, from August 1979 to January 1981. Previously he was chairman of the board of governors of the Federal Reserve System; chairman and chief officer of Textron Inc., a diversified manufacturing company; director of the Federal Reserve Board of Boston; and chairman and chief executive officer of Federated Stores, Inc., which operated a chain of department stores and supermarkets. He is currently the non-executive chairman of Home Place of America, Inc., a specialty retail company. Throughout his business career, Mr. Miller has taken an active part in public service, contributing as chairman of the Conference Board, the National Alliance of Business, the President's Committee on HIRE, and the US Industrial Payroll Savings Bond Committee, as well as co-chair of the US-USSR Trade Economics Council and the Polish-US Economic Council. He served as a Coast Guard Officer in the Far East and on the US west coast. He is a member of the Business Council, a trustee of the John H. Heinz III Center for Science, Economics and the Environment, a trustee of the Marine Biological Laboratory, and a member of the Presidents' Circle of the National Academies. Mr. Miller holds a BS, marine engineering, US Coast Guard Academy; and a JD, University of California, Berkeley.

Berrien Moore III is director of the Institute for the Study of Earth, Oceans, and Space at the University of New Hampshire. He has served as chair of the National Aeronautics and Space Administration's (NASA) Space Science and Applications Advisory Committee, for which he received the Distinguished Public Service Medal. He also serves as chair of the Scientific Committee for the International Geosphere-Biosphere Program and its Task Force on Global Analysis, Interpretation, and Modeling. Other boards on which he has been a member include the NASA Advisory Council's Committee on Earth System Science, the National Research Council's Board on Global Change, the Space Science Board's Committee on Earth Science, and the Science Executive Committee for the Earth Observing System. Dr. Moore's computer modeling of the global carbon cycle has received worldwide attention through his publications on the contribution of terrestrial biota to the concentration of atmospheric carbon dioxide and the role of the ocean as a sink for carbon dioxide. He holds a PhD, mathematics, University of Virginia. Dr. Moore served as chair of the Board on Sustainable Development Committee on Global Change Research until December 1998.

M. Granger Morgan is professor and head in the Department of Engineering and Public Policy at Carnegie Mellon University, where he also holds academic appointments in the Department of Electrical and Computer Engineering and the H. John Heinz III School of Public Policy and Management. Dr. Morgan's research involves the treatment of uncertainty in quantitative policy analysis, integrated assessment of global change, and a variety of issues in the assessment and management of risks to health, safety, and the environment. He is also working on the development of methods to perform risk ranking to support decision making in risk management organizations, such as federal agencies. He holds a BS, physics, Harvard College; an MS, astronomy and space science, Cornell University; and a PhD, applied physics and information sciences, University of California, San Diego.

Paul D. Raskin is president of Tellus Institute and director of the Stockholm Environment Institute—Boston, where he directs a comprehensive research program on environmental, resources and developmental policy. He previously was associate professor, Empire State College, State University of New York; assistant professor, State University of New York at Albany; and instructor of physics, City College of New York. Dr. Raskin's current research focuses on the requirements for a transition to sustainability at global, regional, national, and local scales. He conceived and implemented widely used planning tools for these purposes including the Long Range Energy Alternative Policy system, the Water Evaluation and Planning system, and the PoleStar System for integrated sustainable development analysis. He has provided policy assessments for numerous governments and private organizations throughout the world. Dr. Raskin holds a BS, physics, University of California, Berkeley; and a PhD, theoretical physics, Columbia University.

John B. Robinson is director of the Sustainable Development Research Institute and professor in the Department of Geography at the University of British Columbia. Previously, he worked in the Department of Environment and Resource Studies at the University of Waterloo, and as a consultant for federal and provincial departments and several coalitions of environmental groups. His research interests include energy and energy policy, socio-economic modeling and forecasting, scenarios of a sustainable society, sustainable development and resource use, and the history and philosophy of environmental thought. He was a principal lead author of Working Group III of the Intergovernmental Panel on Climate Change, and is a member of the Canadian Committee for the Institute for Applied Systems Analysis, the Canadian National Committee for the Scientific Committee on Problems of the Environment, and the board of

directors of the Canadian Global Change Program. Dr. Robinson holds a BA, University of Toronto; an MES, York; and a PhD, University of Toronto.

Vernon W. Ruttan is a regents professor in the Department of Applied Economics at the University of Minnesota. He has authored and co-authored nine books and numerous technical publications, many of which focus on the economies of technical change and agricultural development. He has served on the President's Council of Academic Advisors and assumed the role of Agricultural Economist for the Rockefeller Foundation at the International Rice Research Institute in the Philippines. His non-academic service also includes president of the Agricultural Development Council and positions on advisory committees and boards, including the Research Advisory Committee of the U.S. Agency for International Development. Dr. Ruttan holds a BA, Yale University; and an MS and a PhD, University of Chicago.

Thomas C. Schelling is professor of economics and public affairs at the University of Maryland. Before his current position, he worked in the Executive Office of the President, the Department of Economics, at both Yale and Harvard Universities, and the RAND Corporation. He also has served as a consultant, member, and lecturer to many science- and defense-related organizations such as the Central Intelligence Agency and the Scientific Advisory Board of the U.S. Air Force. Dr. Schelling is a member of the National Academy of Sciences and the Institute of Medicine and has published several books and articles on energy and environmental policy, arms control, military strategy, crime, international economics, and public policy. He holds an AB, economics, University of California, Berkeley; and a PhD, economics, Harvard University.

Marvalee H. Wake is professor and chair of the Department of Integrative Biology at the University of California at Berkeley. Formerly, Dr. Wake was a visiting professor at the Université de Paris VII and the Universitat Bremen, Bremen, Germany. Her research interests include studies of evolutionary morphology, reproductive biology of lower vertebrates, patterns of evolution, and issues in biodiversity science. Her honors include fellow of both the California Academy of Sciences and American Association for the Advancement of Science, and a John Simon Guggenheim Foundation Fellowship. She is the secretary general of the International Union of Biological Sciences and a member of the executive committee of DIVERSITAS, an international biodiversity science program. Dr. Wake holds a BA, an MS and a PhD, University of Southern California.

Warren Washington is a senior scientist in the Climate and Global Dynamics Division at the National Center for Atmospheric Research, Boulder, Colorado. He has been at NCAR since 1963. Dr. Washington's areas of expertise are atmospheric science and climate research, and he specializes in computer modeling of the earth's climate. He has published more than 100 papers in professional journals and his book *An Introduction to Three Dimensional Climate Modeling*, co-authored with Claire Parkinson, is a standard reference on climate modeling. He serves on the National Science Board of the National Science Foundation. He previously served as president of the American Meteorological Society, on the President's National Advisory Committee on Oceans and Atmosphere, on the Secretary of Energy's Advisory Board, and on several National Research Council boards and panels. He is President of the Black Environmental Sciences Trust. He holds a BS, physics, an MS, meteorology, Oregon State University; and a PhD, meteorology, Pennsylvania State University.

M. Gordon Wolman is a professor in the Department of Geography and Environmental Engineering at the Johns Hopkins University, where he has taught since 1968. Previously, Dr. Wolman was a hydrologist for the U.S. Geological Survey. He served as chairman of the National Research Council's Commission on Geosciences, Environment, and Resources for the National Research Council, and president of the Geological Society of America, and president of the American Geophysical Union Section on Hydrology, and the Council of the American Geographical Society. He is a member of the National Academy of Sciences and the Philosophical Society, and a fellow of the American Academy of Arts and Sciences and the American Association for the Advancement of Science. Dr. Wolman holds a BS, Johns Hopkins University; an MS and a PhD, geology, Harvard University.

STAFF

Sherburne B. Abbott joined the Policy Division in January 1997 as the executive director of the Board on Sustainable Development. She has worked with the National Research Council for 13 years, serving previously as the director of the Committee on International Organizations and Programs of the Office of International Affairs and the director of the Polar Research Board of the Commission on Geosciences, Environment, and Resources. Prior to her work with the NRC, she was assistant scientific program director of the U.S. Marine Mammal Commission, a science teacher in a private high school, and a research assistant in cancer research at Tufts University. She has published papers on environmental monitoring in Antarctica, salmonid biology, and polar research. She holds an AB,

biological sciences, Goucher College, and an MFS, ecology and natural resource policy, Yale University.

Laura J. Sigman joined the National Research Council as a research associate with the Board on Sustainable Development and the Committee on Global Change Research in February 1997. She holds an A.B. in environmental studies from Dartmouth College.

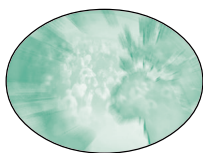
APPENDIX B

Acronyms

ARPA	Advanced Research Projects Agency
ASCEND 21	International Conference on an Agenda of Science for Environment and Development into the 21 st Century
CFCs	Chlorofluorocarbons
CGIAR	Consultative Group on International Agricultural Research
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CSD	Commission on Sustainable Development (UN)
EMEP	Geneva Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe
ENSO	El Niño-Southern Oscillation
EPA	U.S. Environmental Protection Agency
FAO	UN Food and Agricultural Organization
GDP	Gross Domestic Product
GHCN	Global Historical Climatology Network
GSG	Global Scenarios Group

HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
HDI	Human Development Index
IAP	InterAcademy Panel on International Issues
ICSU	International Council for Science
IGBP	International Geosphere-Biosphere Program
IHDP	International Human Dimensions Program
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
IUCN	The World Conservation Union
LTER	NSF Long-Term Ecological Research Program
NGO	Nongovernmental organization
NO _x	Nitrogen oxides
NAE	National Academy of Engineering
NAS	National Academy of Sciences
NASA	National Aeronautics and Space Administration
NPPC	Northwest Power Planning Council
NRC	National Research Council
NSF	National Science Foundation
OECD	Organization for Economic Cooperation and Development
PSR	Pressure-State-Response model
RAINS	Regional Air Pollution Information and Simulation Model
SCOPE	Scientific Committee on Problems of the Environment
START	SysTem for Analysis, Research, and Training
UN	United Nations
UNCED	United Nations Conference on Environment and Development (Rio de Janeiro, 1992, also known as “the Earth Summit”)
UNCLOS	UN Convention on the Law of the Sea
UNCSD	UN Commission on Sustainable Development
UNDP	UN Development Program
UNEP	UN Environment Program

UNESCO	UN Educational, Scientific, and Cultural Organization
UNICEF	UN Children's Fund
VOC	Volatile organic compounds
WGBU	German Advisory Council on Global Change
WCED	World Commission on Environment and Development
WCRP	World Climate Research Program
WHO	World Health Organization
WRI	World Resources Institute
WSC	World Summit for Children



Index

A

- Acid pollution, 49, 86, 140, 155, 157, 189, 207, 217
 Europe, 86, 140, 155, 157
Advanced Research Projects Agency, 300
Aerosols, 84, 86, 210, 217, 248
Aesthetics, 14, 23, 97, 99, 242, 314, 317
Africa, 66
 agricultural production, 12-13, 308, 309
 desertification, 44
 hunger, 33, 45, 47
 population, 63
 unemployment, 37
 urban housing, 35
Agenda 21, *see* International Conference on an Agenda of Science for Environment and Development into the 21st Century
Agricultural sector, 7, 11, 12-13, 74, 93-95, 96, 191, 196-199, 206-207, 209, 212, 222-223, 307-309, 317
 Africa, 12-13, 308, 309
 alien species, 77
 biotechnology, 13, 94-95, 197, 199, 280, 308, 309
 animals, 257-258
 consumption data, 70
 deforestation, 5, 77, 95-96, 99-100, 101, 215, 313
 degradation syndrome, 287
 developing countries, 12-13, 308, 309
 desertification, 44, 66, 94, 191, 287
 diseases linked to irrigation, 99
 ecosystem protection, 221, 308-309
 employment, 37-38
 historical perspectives, 93-94
 integrated assessment models, 143
 irrigation, 91, 94, 99, 157, 197, 198, 199, 212, 221, 284, 316
 market forces, 94, 197
 nongovernmental organizations, 12-13, 309
 pesticides, 94, 100, 221, 284
 pollination, 221
 private sector, 308
 regional information systems, 156-157
 technological factors, general, 13, 74, 94-95, 197, 199, 308; *see also* "biotechnology," "irrigation," and "pesticides" *supra*
 urbanization, 94, 309
see also Food and nutrition; Rural areas

- Air pollution, 7, 13, 14, 31, 45, 83-87, 188-189, 190, 194, 203, 204, 209, 210-211, 215, 216-219, 237, 250-251, 310
- acid pollution, 49, 86, 140, 155, 157, 189, 207, 217
- aerosols, 84, 86, 210, 217, 248
- carbon dioxide, 84, 166, 204, 207, 209, 210, 217, 219, 220, 248, 250-251
- carbon monoxide, 86
- chlorofluorocarbons, 41-42, 45, 83-84, 187, 264
- developing countries, 87, 166-167
- indoor air pollution, 188, 189, 190
- integrated assessment models, 139, 140, 218-219
- methane, 84, 204, 219
- nitrogen oxides, 41, 46, 204, 205, 209, 217
- ozone-layer depletion, 4, 7, 10, 16, 41-42, 44, 46, 48, 83-84, 138, 143, 187, 188-189, 190, 237, 248, 264, 281; *see also* "Chlorofluorocarbons" *supra*
- place-based research, 286
- regional, 4, 5, 44, 86-87, 139, 140, 218-219, 248-249, 279, 288, 316-317
- scenarios, 154
- sulfates, 41, 46, 80, 86, 204, 205, 217, 248-249
- transboundary, 41, 140
- urban areas, 78, 86-87, 195, 217, 316-317
- volatile organic compounds, 41, 46, 217
- see also* Climate; Greenhouse gases
- Alien species, 77, 96-97, 215, 250-251, 316
- ASCEND 21, *see* International Conference on an Agenda of Science for Environment and Development into the 21st Century
- Asia, 66, 309
- air pollution, 87
- economic integration, 75
- South and Southeast Asia, 33, 45
- urban housing, 35
- Assessment methodologies
- Driving Force-State-Response framework, 242
- experts, use of, 136, 137-138, 156-157, 186
- integrated assessment models, 5, 49, 139-149, 159, 218-219
- interdisciplinary approaches, 10, 11, 17, 18, 135, 136-137, 148, 208, 280, 281-282, 283-285, 289, 296, 298, 301-302, 306, 318
- place-based initiatives, 10, 222-223, 279, 285-288, 298, 299, 302
- Pressure-State-Response framework, 235-239, 254-255, 260, 261-262
- scenarios, 5, 49, 136, 137, 139, 147-154, 156, 158, 161-176, 295
- sensitivity analyses, 146, 153
- strategic gaming, 138-139
- sustainability science, 10-11, 51, 279-288, 318-320
- see also* Indicators; Uncertainty
- B**
- Bangladesh, 34
- Barbarization, 150, 161
- Biodiversity, 4, 13-14, 23, 24, 31, 43, 44, 47, 80, 95, 96-97, 101, 191, 208, 212, 220, 256-258, 281, 286, 312-316
- alien species, 77, 96-97, 215, 250-251, 316
- see also* Endangered species
- Biogeochemical cycles, 9, 60, 80, 188, 210, 220, 282
- see also* Pollution
- Biotechnology, 13, 94-95, 197, 199, 280, 308, 309
- animals, 257-258
- Birds, 4, 43, 47, 97
- Birth control, *see* Contraceptives and contraception; Family planning
- Birth rates, 5, 12, 60, 61, 101, 303-305
- see also* Family planning
- Brundtland Commission, 2, 21, 22, 26, 27, 136, 188, 189, 243, 275
- air pollution, 203
- food and nutrition, 197, 308
- funds and financing, 28
- ecosystems, 312
- materials production and consumption, 200, 206

- population growth, 192, 195, 197, 303
 - sectoral goals, general, 7, 11, 186, 192, 223, 302, 316
 - sustainable development defined, 23, 25
 - urban areas, 195, 305
 - water supply, 212
- C**
- Carbon dioxide, 84, 166, 204, 207, 209, 210, 217, 219, 220, 248, 250-251
 - Carbon monoxide, 86
 - Carbon tetrachloride, 42
 - Caring for the Earth*, 281
 - Carnegie Commission, 299
 - Carrying capacities, 11, 27, 289-290
 - CGIAR, *see* Consultative Group on International Agricultural Research
 - Children, 24, 34-35, 38-40, 245
 - birth rates, 5, 12, 60, 61, 101, 303-305
 - death rates, 34, 64, 245
 - family planning, 12, 192, 193, 303-305
 - UNICEF, 38, 245, 246-247
 - China, 33, 47, 204
 - Chlorofluorocarbons, 41-42, 45, 83-84, 187, 264
 - Circulatory systems, *see* Planetary circulatory systems
 - CITES, *see* Convention on International Trade in Endangered Species of Wild Fauna and Flora
 - Cities, *see* Urban areas
 - Climate, 14, 210-211
 - El Niño-Southern Oscillation, 77, 88, 93
 - global change, general, 7, 42, 45, 49, 84-85, 101, 141, 145, 186, 189, 209, 210, 214, 220, 222-223, 237, 279, 281
 - Framework Convention on Climate Change, 41, 46, 290
 - Intergovernmental Panel on Climate Change, 26, 136, 147, 209, 288, 295-296
 - World Climate Research Program, 282, 285, 300
 - see also* Greenhouse gases
 - integrated assessment models, 139, 140, 141, 145, 146, 147
 - place-based research, 286
 - scenarios, 153, 162, 164, 165-176
 - Club of Rome, 139
 - Coastal zones, 88, 90, 98
 - Commission on Sustainable Development, *see* United Nations
 - Communications, *see* Telecommunications
 - Compass and Gyroscope*, 30
 - Computer technology, 74, 75, 235, 249, 311
 - databases, intellectual property rights, 293-294
 - Internet, 76, 277
 - Conference on the Human Environment, 22
 - Conference on the Transition to Sustainability, 17, 289
 - Conservation, 8, 99, 256-257, 312-316
 - ecosystem restoration, 13, 255-258, 261-262, 312-316
 - fisheries, 89, 90, 207, 313
 - local inventories, 9
 - see also* Biodiversity; Fish and fisheries; Forests and forestry; Wildlife
 - Consultative Group on International Agricultural Research, 299-300
 - Consumption and consumption patterns, 5, 9, 11, 25, 30-31, 59, 69-71, 80-81, 83, 199-200, 202, 249, 291-292, 303, 309-312
 - energy resources, 30, 31, 69-71, 174-175, 200, 263-264, 292, 303
 - materials, general, 30, 31, 69, 70-71, 80-81, 199-201, 262, 303
 - scenarios, 152
 - technology and, 69-70, 72
 - water, 90-91, 92, 212-214; *see also* Drinking water; Irrigation
 - Contraception and contraceptives, 12, 193, 304-305
 - see also* Family planning
 - Conventional Worlds*, 150, 151, 152, 161
 - Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft, 43
 - Convention for the Regulation of Whaling, 43

Convention on Biological Diversity, 44
Convention on Fishing and Conservation of the Living Resources of the High Seas, 43, 46
Convention on International Trade in Endangered Species of Wild Fauna and Flora, 44
Convention on Long-Range Transboundary Air Pollution, 41, 140
Convention on the Conservation of Migratory species of Wild Animals, 43
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 43
Convention on the Protection and Use of Transboundary Watercourses and International Lakes, 41
Convention on the Protection of birds, 43
Convention on Wetlands of International Importance Especially as Waterfowl Habitat, 44
Coral reefs, 89, 97-98
Critical loads, 11, 41, 249, 252-254, 289-290
Cultural factors, 24, 98
 aesthetics, 14, 23, 97, 99, 242, 314, 317
 endangered species, 23, 25
 ethical and moral considerations, 14, 23, 32, 97
 globalization, 76, 78
 integrated assessment models, 143
 regional information systems, 157
 scenarios, 152
 see also Political factors; Social factors
Current Forces and Trends, 161-164, 165-166, 167-176

D

Death rates, 5, 60, 61, 101, 192
 children/infants, 34, 64, 245
Decarbonization, 13, 137, 262, 291, 310
Degradation syndrome, 287
Demographic factors, 17, 81, 101
 elderly persons, 303
 integrated assessment models, 143
 local inventories of landscapes and ecosystems, 9
 scenarios, 162
 see also Birth rates; Children; Death rates; Gender factors; Population growth; Rural areas; Urban areas
Department of Agriculture, Forest Service, 318
Department of Defense, ARPA, 300
Desertification, 44, 66, 94, 191, 287
Developing countries, 1, 15, 18, 22, 30
 African agricultural sector, 12-13, 308, 309
 agriculture, other, 94
 air pollution, 87, 166-167
 children, 34-35
 disasters, 33, 40, 94, 189
 economic inequality within, 69
 employment, 37, 76
 energy production, 204
 GDP, 67
 globalization, 27, 76
 Human Development Index, 64
 private sector investment, 28, 195
 urban areas, 35, 36, 39, 83, 195-196
 water supply, 92; *see also* Drinking water
Disasters, 4, 38, 100, 150, 188, 189, 191, 287
 famine, 33, 40, 94
 see also Surprises, environmental
Diseases and disorders, 5, 40, 60, 65-66, 101, 189, 191, 193-194, 200
 children, 34, 40
 emergence and reemergence, 5, 66, 99-100, 101, 187, 250-251
 fertility and, 304
 indoor air pollution, 188, 189, 190
 plant and animal, 82
 water-related, 93, 99
 see also Death rates
DIVERSITAS program, 281
Drinking water, 5, 12, 31, 35, 36, 39, 40-41, 64, 83, 90-93, 188, 190, 195, 196, 245
 see also Sanitation
Driving Force-State-Response framework, 242

E

- Earth Summit, *see* "Conference on Environment and Development" under United Nations
- Earth Transformed, 80
- Eco-communalism, 152
- Ecological Principles for Economic Development, 280-281
- Economic factors, 8, 25, 31, 43, 240-241, 263
- European integration, 75, 235, 299
 - fertility, 303, 304
 - GDP, 64, 67, 69, 70, 170-171, 234, 260
 - GNP, 75
 - global connectedness, 4-5, 11, 30, 59, 75-79, 101, 153, 186, 283, 291
 - indicators, general, 237, 260; *see also specific indicators*
 - input-output analyses, 13, 71, 206, 311
 - integrated assessment models, 139, 142, 143, 144, 146-147
 - market forces, 11, 60, 76, 94, 197, 202, 205, 307
 - national capital accounts, 9, 237, 242, 259, 261, 313
 - per capita income, 64
 - R&D investment, 16, 28, 300-301, 315
 - regional information systems, 157
 - scenarios, 148, 150-152, 162, 163-165
 - taxation, 203
 - urban areas, 195, 306-307
 - wealth disparities, 5, 69, 71, 78, 101, 163, 165, 168, 195
- see also* Consumption and consumption patterns; Developing countries; Employment; Funding; Poverty
- Ecosystems, 5, 44, 83, 97-99, 101, 206-208, 220-221, 250-251, 256-258, 286
- agricultural, protection of, 221, 308-309
 - carrying capacities, 11, 27, 289-290
 - coastal, 88, 90, 98
 - coral reefs, 89, 97-98
 - critical loads, 11, 41, 249, 252-254, 289-290
 - degradation syndrome, 287
 - desertification, 44, 66, 94, 191, 287
 - ecosystem services, 13-14, 23, 67, 97-98, 101, 255, 306, 313
 - environmental hazards, 188
 - fisheries, 89, 90
 - freshwater, 41-42, 46, 97-98, 211, 214
 - global targets, 4
 - human domination, 80-81, 101, 313-314
 - integrated assessment models, 143
 - local inventories, 9
 - regional, 6, 9, 158, 287, 290
 - restoration, 13, 255-258, 261-262, 312-316
 - wetlands, 41-42, 44, 46, 97-98, 215
- see also* Biodiversity
- Education, 7, 12, 25, 29, 31, 36-37, 48, 192, 237
- family planning, 305
 - gender disparities, 36, 39
 - employment and, 74
 - international targets, 4, 38, 39
 - learning disabilities, 34
 - lifelong learning, 66
 - literacy, 36-37, 39, 64
 - mass media, 27, 28, 33
 - school enrollment ratios, 64
- see also* Social learning
- Elderly persons, 303
- El Niño-Southern Oscillation, 77, 88, 93
- EMEP, *see* Geneva Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe
- Employment, 4, 37-38, 39, 66, 75, 192, 201-202
- Africa, 37
 - developing countries, 37, 76
 - fertility and, 305
 - globalization and, 75-76
 - hours of work, 74, 75
 - minimum wage, 37
- Endangered species, 4, 5, 23, 43-44, 97, 99, 256
- cultural factors, 23, 25
 - extinction, 96, 101
- Endangered Species Act, 256
- Energy resources, 7-8, 11, 13, 26, 31, 75, 80, 203-206, 212, 302, 309-312
- automobiles, energy-efficient, 310
 - consumption patterns, 30, 31, 69-71, 174-175, 200, 263-264, 292, 303

globalization, 76, 77
historical perspectives, 70, 264
household efficiency, 13
incentives, 201, 311-312
place-based research, 286
private sector, 311-312
recycling and reuse of materials, 201
regional information systems, 157, 158
scenarios, 174-175
taxation, 203
technological factors, 13, 72, 203-207, 310-312
water supply and, 93
ENSO, *see* El Niño-Southern Oscillation
Environmental hazards, 185-192, 263, 282, 287
see also Surprises, environmental
Environmental Protection Agency, 188-189
Equity, 2, 25, 166, 172
education, gender disparities, 36, 39
wealth disparities, 5, 69, 71, 78, 101, 163, 165, 168, 195
Ethical and moral considerations, 14, 23, 32, 97
Europe, 250-251, 293, 296, 299
acid pollution, 86, 140, 155, 157
birth/death rates, 61
critical loads, 290
economic integration, 75, 235, 299
homelessness, 35
hunger, 47
unemployment, 37
urbanization, 62-63, 195
Exotic species, *see* Alien species
Expertise, 136, 137-138, 156-157, 186

F

Family planning, 12, 192, 193, 303-305
see also Contraceptives and contraception
Famine, 33, 40, 94
FAO, *see* UN Food and Agricultural Organization
Federal government, 239, 240-241, 242, 299, 300, 302
defense technology, 72, 300
endangered species legislation, 256

Environmental Protection Agency, 188-189
fisheries protection legislation, 89
Forest Service, 318
Fertility, *see* Birth rates
Fish and fisheries, 4, 5, 46, 87, 88-90, 101, 191, 207, 313
marine mammals, 4, 43, 46, 97, 316
Food and nutrition, 4, 32-33, 39, 92, 190, 196-199, 307-309
children, 29, 34-35, 245
famine, 33, 40, 94
hunger, 4, 13, 31, 32-33, 40, 45, 47, 48, 94, 101, 161-176, 196-197, 246-247, 306, 307-308
indicators, 245, 246-247
production, general, 7, 70; *see also* Agricultural sector
toxins, 200
transportation, 77
Forests and forestry, 60, 80, 95, 98, 101, 191, 207, 318
tropical deforestation, 5, 77, 95-96, 99-100, 101, 215, 313
Framework Convention on Climate Change, 41, 46, 290
Funding, 16, 28, 300-301, 315

G

Gaming techniques, *see* Strategic gaming techniques
GDP, *see* Gross Domestic Product
Gender factors, 36, 39, 64-65, 74, 305
Genetic engineering, *see* Biotechnology
Geneva Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe, 250-251
German Advisory Council on Global Change, 137, 287, 288
German Enquete Commissions, 136
Global Environmental Outlook 2000, 27
Global Environment Facility, 28, 315
Global Scenario Group, 150-153, 159, 161-176
Great Transition, 150, 152, 161
Greenhouse gases, 4, 5, 7, 13, 44, 46, 84-85, 101, 138, 203-204, 209, 210, 211, 217-219, 248

decarbonization, 13, 137, 262, 291, 310
integrated assessment models, 141, 146-147
scenarios, 153, 162, 164, 165-176
temporal factors, 43, 84
see also Carbon dioxide; Carbon monoxide; Methane
Gross Domestic Product, 64, 67, 69, 70, 170-171, 234, 260
Gross National Product, 75

H

Harvard Water Program, 156
Hazards, *see* Environmental hazards
HFCs, *see* Hydro fluorocarbons
Health issues, 7, 24, 192, 193-194, 200, 208, 237
 children, 34-35, 40, 64, 245
 indoor air pollution, 188, 189, 190
 life expectancy, 64, 65-66
 quality of life, 24, 25, 74
 sanitation, 35, 36, 39, 83, 195-196, 245
 see also Birth rates; Death rates;
 Diseases and disorders; Drinking water; Food and nutrition
Historical perspectives, 15-16, 18-19, 59-101, 196, 237
 agricultural land use, 93-94
 air pollution, 205
 carrying capacities, 289-290
 demographic transition, 61-67, 101
 energy consumption, 70, 264
 environmental surprises, 263-264
 GDP, 67-68, 69
 integrated assessment models, 139-140, 144-145
 regional information systems, 155-157
 scenarios, 149
 sustainability science, 279, 280-283, 319
 sustainable development, concept, 2, 21, 22-23, 26-29, 275, 280-282
 technological development, 71-73, 282-283
 water consumption, 90-91
 well-being trends (HDI), 64
Homeless persons, 35-36, 66
Hours of work, 74, 75

Households, 83
 energy efficiency, 13
 GDP accounting for value of family work in, 67
 hunger, 45
Housing, 31, 35-36, 39, 48, 66, 237
 homeless persons, 35-36, 66
 indicators, 245
 international targets, 4
 urban areas, 12, 35
Human Development Index, 64
Hunger and Carbon Reduction, 161, 165-176
Hydro fluorocarbons, 209, 210

I

Incentives, 3, 11
 energy and materials use, 201, 311-312
 technological development, 11, 292-293
India, 34, 189, 305
Indicators, general, 3, 5-6, 8-10, 11, 19, 50, 82, 233-265, 294-295, 315
 defined, 233-234, 249
 Driving Force-State-Response framework, 242
 food and nutrition, 245, 246-247
 life support systems, 234, 240
 Pressure-State-Response model, 235-239, 254-255, 260, 261-262
 regional factors, 9, 237, 243, 248-254
 social learning, 264-265
 see also specific indicators (e.g., Birth rates; Gross Domestic Product)
Industrial sector, *see* Materials issues
Infant mortality, 64
Information technology, *see* Computer technology
Input-output analyses, 13, 71, 206, 311
Institutional factors, general, 3-4, 24, 133, 139, 240, 311
 agricultural sector, 309
 categorization of perturbations, 8
 fisheries, 90
 globalization, 31, 79
 industrial organization, 73
 interdisciplinary approaches, 10, 11, 17, 18, 135, 136-137, 148, 208, 280, 281-282, 283-285, 289, 296, 298, 301-302, 306, 318

- national capital accounts, 242, 259, 261
 - regional information systems, 154, 155
 - research initiatives, 288, 293-294, 298, 299-300
 - urban areas, 306, 307
 - Integrated assessment models, 5, 49, 139-147, 159
 - air pollution, general, 139, 140, 218-219
 - climate change, 139, 140, 141, 145, 146-147
 - described, 6, 139, 143
 - economic factors, 139, 142, 143, 144, 146-147
 - greenhouse gases, 141, 146-147
 - international agreements and conferences, general, 6, 146, 159
 - list of models and modellers, 141-142
 - local factors, 145, 146
 - regional factors, 139-143 (passim), 145, 146, 154
 - scenarios *vs.*, 148-149
 - social factors, 6, 140, 144-145
 - summary characterizations of specific models, 143
 - uncertainty, 141, 143, 144
 - Intellectual property, 293-294
 - see also* Technology transfer
 - InterAcademy Panel on International Issues, 17, 289
 - Interdisciplinary approaches, 10, 11, 135, 136-137, 208, 280, 281-282, 283-285, 289, 296, 298, 301-302, 306, 318
 - report at hand, 17, 18
 - scenarios, 148
 - Intergovernmental Panel on Climate Change, 26, 136, 147, 209, 288, 295-296
 - International agreements and conferences, general, 2, 3, 4, 9, 26, 28, 31, 256, 281, 288-289
 - integrated assessment models, 6, 146, 159
 - see also* Nongovernmental organizations; *specific agreements, conferences, and organizations*
 - International Conference on an Agenda of Science for Environment and Development into the 21st Century, 26-29 (passim), 288
 - freshwater, 41, 46
 - International Conference on Nutrition, 40
 - International Convention for the Regulation of Whaling, 43
 - International Council for Science, 29, 282, 288, 289
 - International Drinking Water Supply and Sanitation Decade, 36
 - International Geosphere-Biosphere Program, 208, 282, 285, 287, 288, 300
 - International Human Dimensions Program, 208, 282, 285, 288, 300
 - International Institute for Applied Systems Analysis, 139
 - International Monetary Fund, 250-251
 - International Organization for Standardization, 311
 - Internet, 76, 277
 - Invasive species, *see* Alien species
 - Irrigation, 91, 94, 99, 157, 197, 198, 199, 212, 284, 316
- K**
- Kyoto Protocol, 41, 42, 46, 164
- L**
- Landscapes, 13, 50, 91, 99, 206, 216, 221, 244, 254, 282, 287, 302, 314, 317
 - aesthetics, 14, 23, 97, 99, 242, 314, 317
 - Latin America, 66, 309
 - air pollution, 87
 - hunger, 47
 - urban housing, 35
 - Life expectancy, 64, 65-66
 - Life support systems, 3, 7, 8, 9, 13, 18, 23, 24, 31-32, 40-45, 101, 188, 275, 276
 - critical loads and carrying capacities, 11, 27, 41, 249, 252-254, 289-290
 - indicators, 234, 240
 - local impacts, 5, 31
 - quantitative targets, 4

- regional impacts, 31
- scenarios, general, 295
- war, 30
- see also* Agricultural sector; Ecosystems; Energy resources; Food and nutrition; Materials issues; Wildlife
- Limits to Growth*, 139, 149
- Literacy, 36-37, 39, 64
- Local factors, 29, 98, 300
 - air pollution, 86
 - degradation syndrome, 287
 - global scale and, 2, 187
 - indicators, 249-250
 - integrated assessment models, 145, 146
 - inventories of productive landscapes and ecosystems, 9
 - place-based initiatives, 10, 222-223, 279, 285-288, 298, 299, 302
 - scenarios, 153-154
 - surprises, 188
- M**
- Magnuson-Stevens Fishery Conservation and Management Act, 89
- Marine environment, 31, 42-43, 46, 87-90, 210-211
 - coastal zones, 88, 90, 98
 - coral reefs, 89, 97-98
 - ocean dumping, 4, 43, 44-45
 - sanctuaries, 44
 - see also* Fish and fisheries
- Marine mammals, 4, 43, 46, 97, 316
- Market forces, 11, 202, 205, 307
 - agricultural sector, 94, 197
 - globalization, 11, 60, 75-76
- Mass media, 27, 28, 33
- Materials issues, 13, 31, 199-203, 282-283, 291, 309-312
 - consumption patterns, 30, 31, 69, 70-71, 80-81, 199-201, 262, 303
 - globalization, 76
 - incentives, 201, 311-312
 - material balance modeling, 13
 - private sector, 311-312
 - substitution of services for products, 13, 75
 - see also* Waste and waste management
- Methane, 84, 204, 219
- Methyl bromide, 42
- Methyl chloroform, 42
- Migration (human), 76-77, 78, 79, 153, 249
- Migratory species, 4, 43, 47
- Montreal Protocol on Substances that Deplete the Ozone Layer, 41, 46
- Moral considerations, *see* Ethical and moral considerations
- Mortality rates, *see* Death rates
- Multidisciplinary approach, *see* Interdisciplinary approach
- N**
- National Aeronautics and Space Administration, 282
- National capital accounts, 9, 237, 242, 259, 261, 313
- National Climate Impact Assessment, 146
- National Science Foundation, 300
- Natural resources, general, 20, 188, 191, 206-208, 237, 240, 250-253
 - concept of, 23
 - place-based research, 286
 - see also* Conservation; Ecosystems; Energy resources; Forests and forestry; Landscapes; Marine environment; Wildlife
- Netherlands Environmental Policy Performance Indicators Adriaanse, 240
- New Sustainability Paradigm, 152
- Nitrogen oxides, 41, 46, 204, 205, 209, 210, 217-218, 248-249
- Nongovernmental organizations, general, 2, 22, 29, 79, 236
 - Africa agricultural production, 12-13, 309
 - see also specific organizations*
- North America, 318
 - Columbia Basin, 157-158, 296, 318
 - economic integration, 75
 - endangered species, 97
 - homelessness, 35
- Northwest Power Planning Council, 157-158
- Nutrition, *see* Food and nutrition

O

- Oceans, *see* El Niño-Southern Oscillation; Fish and fisheries; Marine environment
- Office of Management and Budget, 299
- Office of Science and Technology Policy, 299
- Organization of Economic Cooperation and Development, 47, 67, 86, 163-167 (*passim*)
- Our Common Future*, 22, 28, 189
- Ozone layer depletion, 4, 7, 16, 41-42, 44, 46, 48, 83-84, 138, 143, 188-189, 190, 237, 248, 264, 281
 - chlorofluorocarbons, 41-42, 45, 83-84, 187, 264
 - surprise diagnosis, 10, 187

P

- Pakistan, 34
- Parametric analyses, 146
- Pesticides, 94, 100, 221, 284
- Place-based initiatives, 10, 222-223, 279, 285-288, 298, 299, 302
- Planetary circulatory systems, 9, 248-249, 250
- Policy assessments, 9, 10, 16, 139, 260, 261-262, 295-296
 - experts, use of, 136, 137-138, 156-157, 186
 - integrated assessment models, 5, 49, 139-149, 159, 218-219
 - interdisciplinary approaches, 10, 11, 17, 18, 135, 136-137, 148, 208, 280, 281-282, 283-285, 289, 296, 298, 301-302, 306, 318
 - place-based initiatives, 10, 222-223, 279, 285-288, 298, 299, 302
 - scenarios, 5, 49, 136, 137, 139, 147-154, 156, 158, 161-176, 295
 - strategic gaming, 138-139
 - sustainability science, 10-11, 51, 279-288, 318-320
 - see also* Uncertainty
- Political factors, 7, 9, 16, 30, 299
 - democratization, 5, 22, 60
 - global, 2, 18
 - legitimacy, 134, 135
 - mass media, 27, 28, 33
 - regional information systems, 156-157
 - scenarios, 151-152, 153
 - surprises, 188
 - sustainable development concept, 2, 22, 27, 275
 - urban areas, 306-307
- Pollution, 5, 27, 30-31, 60, 80, 101, 138, 188, 190, 202, 210-211, 237
 - GDP accounting, 67
 - global connectedness and, 77
 - pesticides, 94, 100, 221, 284
 - regional, 60
 - transboundary, 41, 140
 - see also* Air pollution; Waste and waste management; Water pollution
- Population growth, 1, 7, 11, 15, 61-62, 91, 186, 192-194, 249, 276
 - age distributions, 303, 304
 - birth rates, 5, 12, 60, 61, 101, 303-305
 - Brundtland Commission, 192, 195, 197, 303
 - child health and, 34
 - coastal areas, 88
 - death rates, 5, 60, 61, 101, 192
 - children/infants, 34, 64, 245
 - elderly persons, 303
 - family planning, 12, 192, 193, 303-305
 - hunger and, 33, 196-197
 - life expectancy, 64, 65-66
 - migration, 76-77, 78, 79, 153, 249
 - poverty and, 27, 192
 - projections, 1, 4, 12, 30, 61-62, 66, 70, 71, 163, 192, 193, 303, 304, 307
 - regional population distribution, 47, 163, 169
 - urbanization, 4-5, 12, 62-64, 194-196, 305-307
- Poverty, 4, 15, 18, 31, 32, 48, 64, 101, 237, 306
 - Driving Force-State-Response framework, 242
 - GDP and, 67
 - homeless persons, 35-36, 66
 - hunger, trends, 4, 13, 31, 32-33, 40, 45, 163, 246-247, 306
 - indicators, 246-247
 - minimum wage, 37
 - population growth and, 27, 192

Pressure-State-Response model, 236, 238
scenarios, 163, 165
shelter, 35-37, 66
see also Developing countries
Pressure-State-Response model, 235-239, 254-255, 260, 261-262
Private sector, 29
agricultural production, 308
contraceptives, 304
developing countries, investment in, 28, 195
energy and materials issues, 311-312
food production, 197
research, 300-301, 315
Public goods, 293

Q

Quality of life, 24, 25, 74
life expectancy, 64, 65-66
literacy, 36-37, 39, 64
see also Recreation

R

Radioactive wastes, 4, 44-45
RAINS, *see* Regional Air Pollution Information and Simulation
Ramsar, *see* Convention on Wetlands of International Importance Especially as Waterfowl Habitat
Recreation, 16, 23, 88, 90, 208, 215, 216, 237, 242, 287
aesthetics, 14, 23, 97, 99, 242, 314, 317
Recycling and reuse of waste, 7, 13, 72, 83, 92, 201, 254-255, 310-311
Regional Air Pollution Information and Simulation, 139, 140, 146
Regional factors, 25, 29, 60, 83, 139, 187, 221, 302, 316-317
air pollution, 4, 5, 86, 139, 140, 218-219, 248-249, 279, 288
comprehensive accounting frameworks, 138
degradation syndrome, 287
GDP, 67-68, 170-171
fishing stocks, 4
forests, 5

hunger and population, 47
indicators, 9, 237, 243, 248-254
integrated assessment models, 139-143 (passim), 145, 146, 154
global initiatives and, 2
place-based initiatives, 10, 222-223, 279, 285-288, 298, 299, 302
population distribution, 47, 163, 169
scenarios, 169-174, 176
social learning, 6, 49, 158-159
unsustainability, 81-82
critical loads, 11, 41, 249, 252-254, 289-290
water resources, 91, 93, 101, 216
zones of critical vulnerability, 9, 250-251
see also Ozone layer depletion
Regional information systems, 5, 49, 154-159
agriculture, 156-157
described, 6, 154
energy resources, 157, 158
institutional factors, 154, 155
integrated assessment modeling and, 154
political factors, 156-157
scenarios and, 154, 156, 158
temporal factors, 158-159
Resources for the Future, 138
Rome Declaration on World Food Security, 33
Royal Society of London, 69
Rural areas, 37, 212, 287, 291, 306
see also Agricultural sector

S

Sanitation, 35, 36, 39, 83, 195-196, 245
see also Drinking water
Scenarios, 5, 49, 136, 139, 147-154, 161-176, 295
climate change, 153, 162, 164, 165-176
described, 6, 137
economic factors, 148, 150-152, 162, 163-165
energy resources, 174-175
Global Scenario Group, 150-153, 159, 161-176
integrated assessment models *vs.*, 148-149

- local factors, 153-154
- political factors, 151-152, 153
- poverty, 163, 165
- regional factors, general, 169-174, 176
- regional information systems and, 154, 156, 158
- social factors, 148, 149, 150-151, 168
- spatial factors, 140, 150, 153, 154
- technological factors, 162, 164
- temporal factors, 150, 152, 164, 166, 169-176
- urban areas, 163, 164
- Scientific Committee on Problems of the Environment, 243, 282
- Sensitivity analyses, 146, 153
- Service sector, 309-310
 - national capital accounts, 242
 - substitution of services for products, 13, 75, 310-311
- Sex-based factors, *see* Gender factors
- Shell International Petroleum Company, 149
- Shelter, *see* Drinking water; Housing; Sanitation
- Silent Spring*, 137
- Social factors, 7-11 (*passim*), 16, 24, 25, 83, 160, 240-241, 276, 282, 308, 313
 - aesthetics, 14, 23, 97, 99, 242, 314, 317
 - degradation syndrome, 287
 - ethical and moral considerations, 14, 23, 32, 97
 - gender factors, 36, 39, 64-65
 - global connectedness, 4-5, 11, 30, 59, 75-79, 101, 153, 186, 283
 - integrated assessment models, 6, 140, 144-145
 - International Human Dimensions Program, 208, 282, 285, 288, 300
 - mass media, 27, 28, 33
 - national capital accounts, 242
 - place-based initiatives, 10, 222-223, 279, 285-288, 298, 299, 302
 - population growth, family choice, 192; *see also* Family planning
 - Pressure-State-Response model, 235-239, 254-255, 260, 261-262
 - regional information systems, 154, 155, 156
 - regional zones of critical vulnerability, 9, 250-254
 - research linked to, 11, 282-284, 298-299
 - scenarios, 148, 149, 150-151, 168
 - social capital, 25, 188
 - surprises, 188, 264
 - technology and, 74, 75
 - see also* Cultural factors; Demographic factors; Political factors
- Social learning, 3, 21, 48-51, 133, 160, 277
 - indicators, 264-265
 - nutrition, 40
 - regional, 6, 49, 158-159
 - spatial factors, 48, 49, 50, 83, 194, 255
 - surprises, 188, 264
 - sustainability science, 279-280
 - temporal factors, 48, 49, 255
 - see also* Education; Indicators
- South and Southeast Asia, 33, 45, 47, 67
- Spatial factors, 14, 219, 222, 243, 244, 255, 258, 265, 293, 318
 - ecosystem services, 255
 - environmental hazards, 186
 - health institutions, 194
 - housing, 35-36
 - indicators, 50
 - place-based initiatives, 10, 222-223, 279, 285-288, 298, 299, 302
 - planetary circulation systems, 248
 - regional information systems, 155
 - scenarios, 140, 150, 153, 154
 - social learning, 48, 49, 50, 83, 194, 255
 - space conditioning, 292
 - surprises, 188
 - urban areas, 239
 - see also* Landscapes; Local factors; Regional factors; Regional information systems
- Stakeholders, 136, 145, 158
- Statistical analyses, 136
 - integrated assessment models, 143
 - scenarios, 153
 - see also* Indicators
- Stewardship, 23
- Strategic gaming techniques, 138-139
- Sulfates, 41, 46, 80, 86, 204, 205, 217, 248-249
- Surprises, environmental, 9-10, 137, 187-188, 260, 263-264

diseases, emergence and reemergence, 5, 66, 99-100, 101, 187, 250-251
ozone layer depletion, 10, 187
social learning, 188, 264
see also Disasters; Environmental hazards
Sustainability, general, 1-3, 6-7, 279
 defined, 1, 2, 9, 21, 22-26
 historical perspectives, 2, 21, 22-23, 26-29, 275, 280-282
 political factors, 2, 22, 27, 275
 social learning, 279-280
 sustainability science, 10-11, 51, 279-288, 318-320
Sustainable Biosphere Initiative, 281
Sustainable Seattle project, 240-242, 254-255
SysTem for Analysis, Research and Training, 285, 288, 300, 302

T

Taxation, 203
Technological factors, 2, 7, 14, 16, 17-18, 51, 71-75, 160, 202, 237, 275, 276, 282, 296-298, 300, 302, 311
 agricultural sector, 13, 74, 94-95, 197, 199, 308; *see also* Biotechnology; Irrigation; Pesticides
 computer technology, 74, 75, 235, 249, 311
 databases, intellectual property rights, 293-294
 Internet, 76, 277
 consumption patterns, 69-70, 72
 contraception, 305
 defense technology, 72, 300
 developed/developing countries gap, 27
 disease and, 66
 education, 29
 energy, 13, 72, 203-207, 310-312
 global connectedness, 4-5, 30, 59, 75, 101, 186, 283
 historical perspectives, 71-73, 282-283
 incentives, 11, 292-293
 Internet, 76, 277
 planetary circulatory systems, 9
 scenarios, 162, 164

 social factors, 74, 75
 surprises, 187-188
 telecommunications, 72, 74, 76, 249, 277
 transboundary water pollution, 41
 transportation, 72, 75, 77, 204
 water management, 214, 216; *see also* Irrigation
Technology transfer, 3, 16, 293-294, 296-298
 intellectual property issues, 293-294
Teeming with Life, 281
Telecommunications, 72, 74, 76, 249
 Internet, 76, 277
Temporal factors, 3, 7, 8, 38, 293, 295
 birth/death rates, 61
 connectedness, 72, 74, 76, 101
 consumption, 71
 ecosystem services, 255
 environmental hazards, 186, 187, 188
 greenhouse gases, 43, 84
 hunger/famine, 33, 40, 164
 regional information system, 158-159
 scenarios, 150, 152, 164, 166, 169-176
 social learning, 48, 49, 255
 sustainability concept, general, 26
 see also Historical perspectives
Transboundary pollution, 41, 140
Transportation technology, 72, 75, 77, 204
Tropical regions, deforestation, 5, 77, 95-96, 99-100, 101, 215, 313

U

Unfinished Business, 188
Urban areas, 4-5, 7, 11, 12, 31, 35, 83, 101, 194-196, 206-207, 212, 237, 250-251, 254-255, 291, 305-307
 agricultural land displaced, 94, 309
 air pollution, 78, 86-87, 195, 217, 316-317
 Brundtland Commission, 195, 305
 developing countries, 35, 36, 39, 83, 195-196
 economic factors, 195, 306-307
 Europe, 62-63, 195
 globalization, 77, 78
 housing, 12, 35
 institutional factors, 306, 307
 migration to, 77, 78, 79
 place-based research, 286

political factors, 306-307
pollution, 77, 195, 220
population growth, 4-5, 12, 62-64,
194-196, 305-307
scenarios, 163, 164
transition to urban life, 12, 62-64
Uncertainty, 3, 6, 26, 135-138 (passim),
187, 211
climate change, 84
fisheries, 89
integrated assessment models, 141,
143, 144
see also Surprises, environmental
United Nations, 294, 298
Commission on Sustainable Development, 26-27, 28, 239, 240-243,
288
Conference on Environment and
Development (Earth Summit), 2,
22, 26-27, 28, 29, 164, 288-289
Conference on Human Settlements
(Habitat II), 35-36, 39
Convention of Combat Desertifica-
tion in those Countries Experi-
encing Serious Drought and/or
Desertification, Particularly in
Africa, 44
Convention on the Law of the Sea,
42-43, 46
Department for Policy Coordination
and Sustainable Development, 59
Development Program, 64, 247, 299
Environment Program, 27, 188, 208,
299-300
FAO, 245, 247, 299
hunger, data on, 33, 45, 165
Scientific Committee on Problems of
the Environment, 243
System of National Accounts, 259
UNCHS, 245
UNESCO, 289, 316
UNICEF, 38, 245, 246-247

V

Vienna Convention for the Protection of
the Ozone Layer, 41
Volatile organic compounds, 41, 46, 217

W

War and armed conflicts, 30, 78, 79, 287
Waste and waste management, 7, 11, 13,
200-202, 287, 310-311
ocean dumping, 4, 43, 44-45
radioactive wastes, 4, 44-45
see also Recycling and reuse of waste
Water pollution, 4, 14, 42-43, 46, 91, 188,
189, 190, 191, 193-194, 195, 210-
211, 212, 215, 237
acid pollution, 49, 86, 140, 155, 157,
189, 207, 217
fisheries, impact on, 89
place-based research, 286
sanitation, 35, 36, 39, 83, 195-196, 245
transboundary, 41, 140
see also Marine environment
Water supply, 7, 14, 80-81, 90-93, 157, 186,
209, 212-216, 284
consumption patterns, 90-91, 92,
212-214
developing countries, 92
drinking water, 5, 12, 31, 35, 36, 39,
40-41, 64, 83, 90-93, 188, 190, 195,
196, 245
irrigation, 91, 94, 99, 157, 197, 198,
199, 212, 221, 284, 316
regional factors, 91, 93, 101, 216
technological factors, 214, 216; *see*
also Irrigation
Wealth disparities, 5, 69, 71, 78, 101, 163,
165, 168, 195
Wetlands, 41-42, 44, 46, 97-98, 215
WGBU, *see* German Advisory Council on
Global Change
Wildlife, 23, 43, 96-99, 256-258
alien species, 77, 96-97
birds, 4, 43, 47, 97
extinction, 96, 101
migratory species, 4, 43, 47
see also Biodiversity; Endangered
species; Fish and fisheries;
Marine mammals
World Bank, 40, 45, 240-241, 242-243, 259,
299
World Business Council on Sustainable
Development, 149
World Climate Research Program, 282,
285, 300

-
- World Commission on Environment and Development, *see* Brundtland Commission
- World Conference on Education for All, 36, 39
- World Conservation and Monitoring Centre, 250-251
- World Conservation Strategy, 16, 22, 280-281
- The World Environment: 1972-1982*, 189
- World Food Summit, 32, 39, 40
- World Health Organization, 36, 39, 195, 245, 250-251
- World Meteorological Organization, 282
- World Summit for Children, 35, 36-40 (passim)
- World Summit for Social Development, 39
- World 3 model, 149
- World Wide Web, *see* Internet