

From Resource Scarcity to Ecological Security

Exploring New Limits to Growth

edited by Dennis Pirages and Ken Cousins

The MIT Press
Cambridge, Massachusetts
London, England

Global Environmental Accord: Strategies for Sustainability and Institutional Innovation

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This book was set in Sabon by Achorn Graphic Services.

Printed and bound in the United States of America.

Library of Congress Cataloging-in-Publication Data

Printed on recycled paper.

10 9 8 7 6 5 4 3 2 1

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Series Foreword

A new recognition of profound interconnections between social and natural systems is challenging conventional constructs and the policy predispositions informed by them. Our current intellectual challenge is to develop the analytical and theoretical underpinnings of an understanding of the relationship between the social and the natural systems. Our policy challenge is to identify and implement effective decision-making approaches to managing the global environment.

The series on Global Environmental Accord adopts an integrated perspective on national, international, cross-border, and cross-jurisdictional problems, priorities, and purposes. It examines the sources and the consequences of social transactions as these relate to environmental conditions and concerns. Our goal is to make a contribution to both intellectual and policy endeavors.

Nazli Choucri

Preface

More than three decades have passed since a research group based at MIT startled policymakers, academics, and the public with publication of a study indicating that limits to growth on this planet likely would be reached within the next century. Fueled by numerous books published in the 1960s that focused on environmental and resource consequences of continued rapid growth in population and consumption, the MIT study, and the subsequent *Global 2000 Report to the President*, forcefully called attention to a developing human predicament. These publications ignited a vigorous and persistent debate over future prospects for the human race in a world of tightening limits. On one side, a group often characterized as neo-Malthusians has argued that unrestrained growth in population and consumption will lead to widespread famine, resource shortages, and environmental crises. On the other side, a group of technological and economic optimists has countered that there are no limits to growth in ingenuity, and therefore future generations will experience a better quality of life.

We make an effort in this book to contribute to this ongoing dialogue by offering an assessment of what has so far been learned about critical aspects of this human predicament and by using this information to explore aspects of its future. Better foresight now is critical in supporting a growing world population in excess of 6.4 billion that is pressing close to nature's carrying capacity. Anticipatory thinking and policymaking can spare humanity from potential harsh consequences of the growth trajectory that is being followed. It is much easier to manage growing problems and issues in an anticipatory fashion, dealing with them before significant damage is done, than it is to engage in remedial action later on. Just as scientific consensus on the danger of depletion of stratospheric ozone led to resolute action in the form of the Montreal Protocol,

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anticipatory thinking and action could help avert future dislocations, or even tragedies, stemming from global warming, petroleum depletion, or food and water shortages.

The forecasting process is unfortunately filled with risks and difficulties. There is the knotty problem of self-defeating prophecies. To the extent that pessimistic forecasts actually do galvanize people to take action, the responsible “Cassandras” can quickly become “Chicken Littles.” Thus, biologist Paul Ehrlich’s clarion call for action in his 1968 book *The Population Bomb* helped to sensitize leaders around the world to the need for meaningful population policies, but the subsequent success in reducing the worldwide rate of population growth allowed his critics to claim that he got it all wrong. Then there is the issue that even minimal uncertainty in forecasts is often used by vested interests as an excuse for inaction. Witness the extended delays in the United States in dealing with greenhouse warming. And there is the difficult question of complexity in the ecosociotechnical systems that are being analyzed. Things do not always work out exactly the way that they are forecast. For example, while there is a broad consensus that world petroleum production is relatively close to its peak, until very recently petroleum prices were so low as to lead some companies to shut in unprofitable wells. And the petroleum industry is still hesitant to invest large sums in exploration and development for fear that the current high prices will crash again if worldwide economic growth slows down.

In spite of these caveats, the early years of a new millennium offer an ideal opportunity to reflect on the recent past and to anticipate some of the prospects and perils of the next few decades. It is sad that the turn of the millennium, which offered a great opportunity to explore these issues further, for the most part passed with little significant research or reflection. Instead of collectively taking stock of the changing global predicament and launching bold new initiatives to deal with it, the event was mostly marked with fireworks displays and rock concerts. This book is our modest attempt to better respond to the challenges of the new millennium by assessing how well past efforts to assess global limits have done, and, more important, to look forward and anticipate how the combined forces of demographic change and technological innovation will interact with resource limitations to shape the conditions under which future generations will live on this planet.

We wish to thank our collaborators in this effort for the time and energy that they have put into this project. We owe a special thanks to The Harrison Program on the Future Global Agenda at the University of Maryland for continuing support. Also we wish to acknowledge the support of the Environmental Change and Security Project at the Woodrow Wilson Center in Washington, Citicorp, and the Office of International Programs at the University of Maryland for supporting an initial conference that first brought together the authors of these chapters.

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Twenty-Nine Days: Responding to a Finite World

Ken Cousins

Understanding the natural world and humanity's role in it is a difficult task, one that has changed dramatically as we have increased our capacity to alter the world to our own ends. We have learned of the world's ecological limitations, even as our impacts on ecosystems and species continue to grow. All of the authors in this book have noted the difficulties inherent in attempting to create sustainable societies, and have revealed some of the complexities of our interactions with nature. While each has acknowledged the ecological factors that directly affect our survival, each has also emphasized the importance of social values and institutions.

Environmental policies are the principal means by which societies attempt to adapt to ecological constraints, and to mediate between competing demands and values. Yet translating ecological knowledge into anticipatory policy has proven difficult, for several reasons. Perhaps most important, scarcity and the irreversibility of many investments will always constrain the range of policies possible in a given context. Our ability to overcome such inertia is challenged even more by the complexity of most ecological and social systems, which make forecasting difficult under the best of conditions. Moreover, though policies may be developed at regional, national, or global levels, local implementation requires commitment across a multitude of ecologically and socially heterogeneous settings. Since effective policies must be grounded in an awareness of local conditions, expanded participation will be critical to achieving sustainable solutions to ecological challenges.

Then and Now

Although the “IPAT” framework, first introduced by Paul Ehrlich and John Holdren in 1971, explicitly addressed both affluence and technology (but not distribution), most analysts (including Ehrlich and Holdren) have tended to focus on the environmental impacts of population. In *The Limits to Growth*, these effects focused on understanding what might happen if demand increased against a stable resource base (Meadows et al. 1974). Accordingly, the analysis focused on population and capital dynamics, both aggregated at the global level. Though functional ecosystems were considered important for food production and waste absorption, that project emphasized limiting both population and economic growth. In the years following its publication, the project was criticized as ignoring the potential of market forces and innovation (Day and Koenig 1975; Poquet 1978). However, while careers have been made attacking the various projections of *The Limits to Growth* (e.g., Simon 1980, 1981, 1996; Simon and Kahn 1984), most of the original projections remain on track (Meadows, Randers, and Meadows 2004). Only in the next few decades will we be able to know whether the concerns of Meadows et al. were fully justified.

As Pirages says in chapter 1 of this book, the *Global 2000 Report to the President* also tended toward the scarcity-focused reasoning of *The Limits to Growth*. Demands on agriculture, forests, and water supplies were projected to approach critical levels by the turn of the century, again principally driven by the demands of a growing global population (Barney 1980). Although many of the substantive issues addressed by both *The Limits to Growth* and the *Global 2000 Report* did overlap, the latter focused more directly on policy issues, addressing sectoral issues (e.g., tropical forests) that the first effort had subsumed under the broad heading of renewable resources.

Perhaps the most prescient observation in the *Global 2000 Report* concerned the future importance of carbon dioxide buildup. While the current consensus is that anthropogenic sources of greenhouse gases are a real threat to future climate stability, reaching such a conclusion in the late 1970s exhibited great foresight, as Park points out. Even though *The Limits to Growth* had included a generalized model of environmental waste absorption, few could have anticipated then that a truly global-level sink would be significantly affected by human activities.

New Challenges and New Solutions

Even as advances in science and technology have enabled us to perceive and understand the world with greater subtlety, they have also introduced new, less tangible threats. While most of these may be exacerbated by a rising human population and increasing consumption, many are difficult to understand as a function of scarcity. Perhaps most surprising are the unexpected problems associated with successful control of population growth. Here, both chapters on population offer persuasive evidence that reduced growth rates have created serious challenges to public policy. For aging societies, the combination of fewer births and deaths presents an unexpected variation on the classic model of demographic transition (Kirk 1996). But as several authors also note, other societies have achieved lower growth rates only through the crushing burden of HIV/AIDS. Again, although dramatic shifts in population structures can be expected to have significant (though indeterminate) ecological impacts, such dynamics are difficult to interpret simply in terms of resource scarcity.

In 1980, the economist Julian Simon convinced Paul Ehrlich (an entomologist) to place a wager on the future price of five metals. Many of the neo-Malthusian predictions of the preceding decades had focused on such nonrenewable resources; a steady rise in the prices of these metals in the immediate postwar years led Ehrlich and Holdren (as well as physicist John Harte) to accept the bet, despite their belief that limits were more likely to be seen in the growing demand on renewable resources and ecological services (Holdren, Ehrlich, and Ehrlich 1980). Simon's confidence was based on his absolute faith in two economic and technological processes: dematerialization and substitution (although some suggested that the early 1980s recession also served to drive prices down). After losing on four of the metals (copper prices had actually risen 10 percent over that period), Ehrlich and biologist Stephen Schneider offered another wager, this time emphasizing global ecological indicators and the availability of renewable resources (Ehrlich and Schneider 1995). Simon refused, claiming he was only interested in direct measures of human welfare. While their differences may have been more than intellectual, the shifting focus of their decades-long debate reveals important lessons for both sides. First, it is often possible to reduce our demand for a given resource through

dematerialization and substitution. Second, while alternatives may exist for many resources, these are not always economically or socially feasible. Third, the distribution of a resource is often more critical than its scarcity in absolute terms. And finally, human welfare is sustained by a multitude of ecological services, few of which can be priced or sold.

Regeneration and Functional Ecosystems

Renewable resources may potentially be consumed in perpetuity, but they can also be made extinct if their ability to regenerate is compromised. As Inouye points out, environmental systems and the “services” they provide are critical to the ongoing replenishment of biological and otherwise renewable resources. Though these capacities may be endangered by overuse, not all throats are rooted in scarcity dynamics. The health of both species (especially humans, as Pirages notes) and ecosystem functions (as Inouye also suggests) can be strongly affected by new interactions between organisms. These can occur at the microscopic (i.e., disease) and macroscopic scale (i.e., exotic species). Moreover, effects can be direct (e.g., predation, parasitism) or indirect, as when ecosystem disturbances enable previously benign species to become pests. Both pose significant challenges to ecological security, yet again are difficult to conceptualize in terms of scarcity.

Similarly, though the conversion of ecosystems (e.g., removing natural forests for tree plantations) may increase productivity or efficiency, it also appears to alter local capacities to provide important ecosystem services (e.g., nutrient or energy cycling). Depending on the degree of the landscape conversion, the capacity of local ecosystems to adapt to stress (e.g., global warming) may also be diminished. In her chapter, Marchak emphasizes that this raises significant questions about the ultimate sustainability of large-scale landscape conversion. Additional social impacts may derive from a narrowing of tenure or access rules on which increased investment relies (e.g., plantations that reduce access to fuelwood, as well as other nontimber forest products).

Complexity and Uncertainty

Because human impacts have become global in scale, we are not always certain whether factors originate from our actions, or from the “natural”

environment. Several of our authors discuss the difficulties of identifying processes and outcomes in complex, dynamic systems. Yet biophysical and sociocultural evolution often leads to systems with exactly these characteristics. Quite often, models based on such systems produce inconsistent or indeterminate outcomes, a characteristic approaching that of a physical law—no matter how accurate our models or measurements, our ability to predict the outcomes of dynamic systems will always be limited (Byrne 1997). Thus, while criticism about the predictive capacity of the social sciences (e.g., Ruth, chapter 8, this volume) is mostly on the mark, this cannot be attributed solely to weak methodology or theory.

Even were we capable of conquering complexity, the problem of uncertainty would not necessarily be resolved. As Conca suggests, the functional value (a subset of all possible values) of environmental or social factors is often not perceived or understood except in hindsight. Thus, we may not know what is important except through loss—determining which elements are necessary or sufficient to maintain system health is not a straightforward exercise. Critical policy issues can appear in only a few decades, as several authors emphasize here. Yet as Park demonstrates, scientists have been aware of some problems for a very long time—what has been slower to emerge is a belief among policymakers or the general public that change is necessary or appropriate. Science and technology may have enabled us to expand our cognitive capacities, but we still have not escaped the limits of the “naked eye”—immediate sensations still drive our beliefs and actions. The sad truth is that public concern is more often driven by rhetoric than by reason, despite broad support for maintaining environmental quality.

Values and Environmental Policy

Our persistence as a species depends on whether we can preserve the elements necessary to our biophysical existence, but the survival of our societies and cultures is no less critical. Adaptation to ecological challenges is a value-laden endeavor, as most of our authors emphasize. Addressing a multitude of concerns requires that a delicate political balance be found, where “critical” linkages are acknowledged, but more peripheral issues remain so. This is not a simple challenge. While both Conca and Marchak emphasize the importance of developing “integrated management” strategies, Ruth notes that there is often a temptation to develop “laundry lists”

in the name of inclusion and comprehensiveness. This is problematic not only where the resources available to address a problem are limited—when public policies may serve (or be seen to serve) narrower interests, it is often difficult to draw the line between “real” and “political” pressures. This is a key reason why scientific expertise has become so valued by policymaking communities (Shannon, Meidinger, and Clark 1996).

One of the most common themes in this book has been the importance of equity, both as a means of achieving ecological security and as an end in itself. One strategy to address such concerns has been to increase “stakeholder” participation, where enlightened self-interest is expected to achieve more effective, efficient, and appropriate solutions (Gregory 2000). Yet as Park argues, the breadth of stakeholder participation may be highly desirable politically, but the additional involvement greatly expands the complexity of decision making. The distribution of costs and benefits in both problems and responses is often a critical issue in environmental and resource politics. These patterns are not only geographic, but also extend forward and back through time, as Park also emphasizes. Whether it is appropriate to hold nations responsible for their historical contribution to a problem (e.g., greenhouse gas emissions), or to focus on future equity, has proven to be a key sticking point in international negotiations.

Given a limited base of political or economic resources, how do we determine which challenges to address? We cannot escape the necessity of ranking risks, and of prioritizing our efforts accordingly. These are deeply political issues, regardless of the character of the institutions (e.g., democracies, markets) we use to address them. Whether such institutions are perceived as legitimate often depends on whether their processes and outcomes reflect our particular values. While some believe that economic incentives and technological innovation will always be able to adapt to (or otherwise overcome) ecological challenges (Simon 1996), such changes often produce further unintended problems. Internalizing the costs of extraction, production, and consumption into price can be highly problematic, even for relatively simple goods—but it may be effectively impossible for larger, systemic goods. The functional value of a given ecosystem is not economic except in hindsight—again, we may only know what is important through loss. This underscores the ongoing importance of monitoring, analysis, and dialogue, even for market-based solutions.

Institutions and Change

To ensure the persistence of what we value most, institutions—the means by which societies encourage consistent behavior—are critical. Institutions are as essential and ubiquitous as language, establishing the identities, roles, and rules that condition our perceptions and actions. They are the “levers” through which durable social change is effected (Ostrom 1986).

There is often a distance between words and action in policymaking processes, usually discovered after public attention has moved on to other issues. While the environment has proven to be an enduring popular concern in many societies, the salience of any specific issue has a limited lifetime. As Park demonstrates here, issues of commitment and accountability are further complicated by domestic politics and institutions (e.g., U.S. reversal on the Kyoto Protocol). There will always be the question of whether our failure to achieve national or international goals is due to a failure of our capacity, or of our commitment to those ends. To encourage consistency and ensure accountability, many agreements often have some form of penalty for reversal, as well as monitoring and enforcement functions. However, history has shown that including such provisions reduces the number of actors willing to participate—especially those expected to bear proportionally large costs (Victor, Raustiala, and Skolnikoff 1998). The ultimate effectiveness of any policy instrument is limited, something all the more true when participants disagree about the appropriateness or validity of policy goals.

Ultimately, our ability to achieve any particular goal may be determined as much by scarcity and social capacity as by motive. As Cook and Boes suggest here, scarcity is not an absolute, but rather a function of the relationships between technology, institutions, and the underlying resource bases. Existing markets and infrastructures provide the background conditions against which new initiatives and policies must strive to establish themselves and thrive. Depending on the pace and cost of innovation, early choices may “lock in” responses that are ultimately less effective. The law of diminishing returns means that while “low-hanging fruit” are easily attained, additional gains become increasingly costly. Therefore, past choices often limit our capacity to adapt quickly, even given complete agreement as to a need for change. Transitioning to more

sustainable societies will thus require us to address the distribution of effective scarcity. The range of available solutions may be determined as much by their ability to use existing infrastructures as by their life-cycle efficiency, as Ruth argues here. This encourages a certain “adaptive incrementalism,” which is only strengthened by uncertainty and the need to maintain a constant supply of goods or services (Hill 1997).

We have long understood that population dynamics can pose significant ecological challenges and strongly influence the range of feasible solutions. The policy decisions of relatively few states (e.g., India, China) are likely to have increasing significance for the rest of the world, as several of our authors emphasize. While some may believe that limiting population growth is an unqualified good, Runci and Cooper note that the changing age profiles of many nations pose significant challenges as well.

Global Concerns and Local Contexts

Each of the authors in this book has demonstrated how human impacts have grown to become global in scale, yet these effects are the result of individual acts, accumulated from a multitude of social and ecological contexts. Ironic as it may seem, the only means of ensuring successful adaptation to global-level challenges is to acknowledge the diversity of local experiences and values, and to focus on understanding relationships between local and global contexts. Any efforts to mitigate even the largest impacts will require changed behavior (and values) in these diverse local places. Our understanding of ecological concerns has gradually extended to factors difficult (if not impossible) to observe directly (e.g., global warming, biodiversity); local and global actors may perceive these issues quite differently, even where they share nominal values (e.g., sustainable resource use). Because effective policies require significant local-level commitment, resolving such disagreements is a critical issue (Potoski and Prakash 2002). Success will require acknowledging the importance of the local level as the ultimate source of experience, values, and action. Adaptation requires understanding how “best” to integrate such responses within local ecological and social contexts, because such policies are themselves likely to be interpreted in terms of local values (e.g., legitimacy, equity). To paraphrase the late House Speaker Tip O’Neil, “All [implementation] is local.”

Even given a clear understanding of what “must be done,” the capacity to implement policy varies widely across institutional contexts. As Conca argues here, relationships between the ecological and institutional boundaries of a given problem may strongly affect our ability to respond. Because institutional boundaries may disrupt, degrade, or bias signals from ecological and other social systems, the extent of overlap conditions our ability to respond to challenges. While place-based institutions have a long history of successful adaptation (Ostrom, Walker, and Gardner 1992), their recent record is less promising, because macro-level changes (institutional and environmental) have often overwhelmed local adaptive capacities.

While it may be difficult to establish the exact moment of transition, we are clearly in the midst of a shift away from an exclusive reliance on governments to broader, less formal *governance* institutions, as many of our authors acknowledge. Many of these new approaches to policymaking and implementation (e.g., forest certification, as described in Marchak and Inouye’s chapters) have been responses to perceived inadequacies of traditional institutions. As state institutions retreat and alternative institutional forms emerge, some societies may be forced to consider trade-offs between effectiveness and political legitimacy (Wapner 1995). In other words, such emerging institutional responses—though well-intentioned—may also affect the persistence of local social and environmental values. Regardless of the purity of our intentions, it is the local-global distribution of power (and costs and benefits) that may be most critical to implementing appropriate, effective, and sustainable policies.

From Environmental Scarcity to Ecological Security

We have learned a great deal about the nature of ecological limits in the past few decades. Most physical and life scientists have come to acknowledge the important role of innovation in our ability to adapt to scarcity, just as economists are much more aware of the extent to which markets and other institutions can fail to ensure that such adaptation occurs in time. The importance of resource distribution is also more appreciated, as are the norms and rules that condition our ability to access (or to bear responsibility for) natural resources. Technology has weakened the link between economic growth and increased material consumption (Goodland, Daly, and

El Serafy 1992), even as it has presented us with new and unexpected challenges. Likewise, globalization processes have facilitated the movement of people and resources to a degree almost unimaginable a generation ago. While this has undoubtedly produced improvements in human welfare, concerns for the longer-term impacts of increased consumption of renewable resources are valid, as are worries about the unanticipated consequences of the interactions of newly mobile organisms and local ecosystems. Neither disease prevention nor stewardship is easily understood in terms of scarcity. If we are to move toward a more ecologically secure world, we will have to learn how to integrate ecological factors within our economic, political, and cultural institutions.

In a world of continual change, persistence relies on adaptation; as Toynbee once argued, societies decline and dissipate once they lose the capacity to adapt to system-level changes (Toynbee and Caplan 1979). While many of the concerns detailed in this volume may be primarily ecological, it is important to remember that even these issues are understood in broader terms, including (but not limited to) wealth, opportunity, fairness, justice, and cultural identity. Looking to the future, we must consider not only the social and ecological features we want to persist, but also those we will need in order to be able to adapt and remain vital.