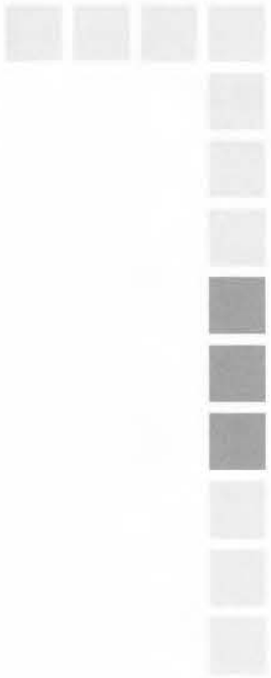
The Sustainable Urban Development Reader



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To Mimi, and to the late Dave Brower, whose example and encouragement have been invaluable. – *S.M.W.*

To Anneke and Carolena. – *T.B.*

7

"Perspectives, Problems, and Models"

from the "Introduction" to *The Limits to Growth* (1972)

Donella H. Meadows, Dennis L. Meadows, Jörgen Randers, and William W. Behrens III

Editors' Introduction

One of the most influential books of the 1970s – and as far as we have been able to determine the first work ever to use the term "sustainable development" in its current sense – was *The Limits to Growth* (New York: Universe Books, 1972). This paperback bestseller by a team of MIT scientists catalyzed discussions worldwide about the future of human society. The book resulted from a study which the Club of Rome – an *ad hoc* group of global industrialists and humanitarians led by Italian economic consultant Aurelio Peccei – commissioned from Professor Jay Forrester and his graduate students at MIT. Given the emergence of computers as a powerful analytic tool at this time, Peccei asked the researchers to use computer models for the first time to attempt to analyze the future of the world. The group developed a model known as World3, using a method of analysis they called "systems dynamics."

The Forrester team analyzed the basic factors most likely to limit growth: population, agricultural production, natural resources, industrial production, and pollution. They concluded that following then-current trends the limits to the growth of human society on the planet would be reached within a hundred years, followed by a steep decline in global population and industrial capacity. Essentially, growing problems of resource depletion, pollution (including carbon dioxide concentration), loss of arable land, and declining food production would converge to halt progress. However, they also stated that it would be possible to alter these trends "to establish a condition of ecological and economic stability that is sustainable far into the future" (p. 24). The first of these conclusions shocked millions around the world, but fit with what many in the growing environmental movement had already concluded – that human development trends were headed in unsustainable directions. Other writers such as Renē Dubos, a French molecular biologist and originator of the phrase "think globally, act locally," Paul Ehrlich, a Stanford environmental scientist and author of the bestseller *The Population Bomb* (New York: Ballantine Books, 1968), Rachel Carson, Barry Commoner, and Ian McHarg had been saying much the same thing. The 1972 Stockholm Conference on Environment and Development and other United Nations events in the years that followed helped spread such ideas. But the *Limits to Growth* work was unique in that for the first time it used computer technology and scientific method to analyze the human future as well as ask questions such as whether growing human population and resource consumption were sustainable.

Not surprisingly, other writers vigorously opposed the *Limits to Growth* position, arguing that this approach was an alarmist recapitulation of arguments advanced by Thomas Malthus around 1800, comparing the linear increase in agricultural production with the geometric increase of population. These opponents argued

that technology, economics, and human ingenuity would be able to help humanity surmount growth-related problems. In his 1981 book *The Ultimate Resource* (Princeton, NJ: Princeton University Press, 1981), business and marketing professor Julian Simon advanced the view that the world would never run out of resources. Scarcity-fueled increases in resource prices would encourage conservation or resource substitution, in his view, thus avoiding any long-term problems. Simon even bet Ehrlich $5,000 that the prices of a certain set of metals would in fact fall over the next five years, and won the bet. (Ehrlich later claimed that the time frame was too short.)

The *Limits to Growth* team revisited their work two decades later in a second book, *Beyond the Limits* (Post Mills, VT: Chelsea Green, 1992). After running an updated version of their model and considering additional evidence over the twenty-year period, Meadows and her co-authors concluded that the fundamental themes of *Limits to Growth* had held up relatively well, and that the world had entered a period of "overshoot" in which it was well beyond sustainable levels of resource consumption, pollution, and population. Other conclusions remained the same – that it was still possible for humanity to change course, and that the sooner it did so the better.

The language of this selection reflects the sudden sense of global environmental crisis that many experienced in the late 1960s and 1970s, illustrated by the quote with which the authors start out from United Nations Secretary General U Thant. Previously, the end of World War II had ushered in a period of optimism based on faith that economic progress and the spread of new technologies would bring about continual human betterment. However, by the end of the 1960s the world was in the midst of a Cold War and a nuclear arms race, problems of global pollution and ecosystem degradation were being discovered, overpopulation was being recognized as a serious problem, and resources such as petroleum were suddenly seen to be limited. Events such as the 1973 energy crisis seemed to confirm this sense of crisis. Certainly the dangers of global catastrophe were overplayed by some. But certainly also the world's attention needed to be called to the challenge of living sustainably on a small planet in the long term. More than any other single work, *The Limits to Growth* helped to do this.

The style of this selection – especially that of principal author Donella Meadows – also reflects a rising awareness of the extent to which different worldviews or paradigms affect how problems are seen. The supposedly objective viewpoint of modern science, so strong at that time, was under increasing attack from many directions, especially from Thomas Kuhn, whose book *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1962) had argued that science, far from being completely objective and rational, in fact proceeds by moving through different paradigms dominant at different times. What is needed, Meadows and others argued, is an increased awareness of how our cognitive "lenses" affect our beliefs about global development. In particular, they believed that a new focus on the role of values in determining our beliefs and worldviews – and a rethinking of values themselves – was necessary in order to bring about more sustainable development practices.

> I do not wish to seem overdramatic, but I can only conclude from the information that is available to me as Secretary-General, that the Members of the United Nations have perhaps ten years left in which to subordinate their ancient quarrels and launch a global partnership to curb the arms race, to improve the human environment, to defuse the population explosion, and to supply the required momentum to development efforts. If such a global partnership is not forged within the next decade, then I very much fear that the problems I have mentioned will have reached such staggering proportions that they will be beyond our capacity to control. (U Thant, 1969)

The problems U Thant mentions – the arms race, environmental deterioration, the population explosion, and economic stagnation – are often cited as the central, long-term problems of modern man. Many people believe that the future course of human society, perhaps even the survival of

human society, depends on the speed and effectiveness with which the world responds to these issues. And yet only a small fraction of the world's population is actively concerned with understanding these problems or seeking their solutions.

HUMAN PERSPECTIVES

Every person in the world faces a series of pressures and problems that require his attention and action. These problems affect him at many different levels. He may spend much of his time trying to find tomorrow's food for himself and his family. He may be concerned about personal power or the power of the nation in which he lives. He may worry about a world war during his lifetime, or a war next week with a rival clan in his neighborhood. These very different levels of human concern can be represented on a graph like that in Figure 1. The graph has two dimensions, space and time. Every human concern can be located at some point on the graph, depending on how much geographical space it includes and how far it extends in time. Most people's worries are concentrated in the lower left-hand corner of the graph. Life for these people is difficult, and they must devote nearly all of their efforts to providing for themselves and their families, day by day. Other people think about and act on problems farther out on the space or time axes. The pressures they perceive involve not only themselves, but the community with which they identify. The actions they take extend not only days, but weeks or years into the future.

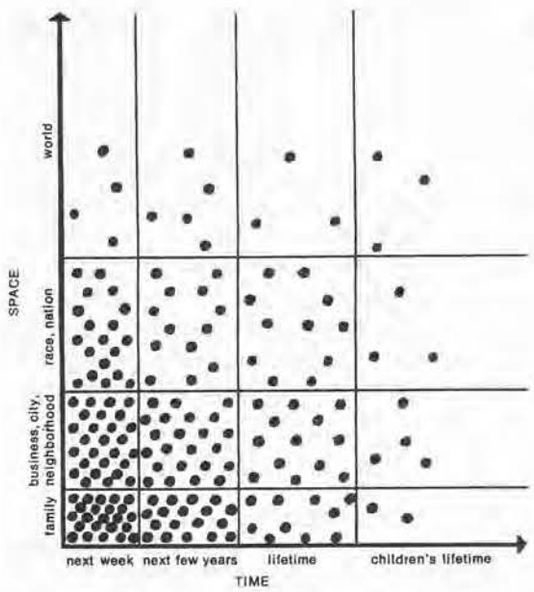

Figure 1 Human perspectives. Although the perspectives of the world's people vary in space and in time, every human concern falls somewhere on the space–time graph. The majority of the world's people are concerned with matters that affect only family or friends over a short period of time. Others look farther ahead in time or over a larger area – a city or a nation. Only a very few people have a global perspective that extends far into the future.

A person's time and space perspectives depend on his culture, his past experience, and the immediacy of the problems confronting him on each level. Most people must have successfully solved the problems in a smaller area before they move their concerns to a larger one. In general the larger the space and the longer the time associated with a problem, the smaller the number of people who are actually concerned with its solution.

There can be disappointments and dangers in limiting one's view to an area that is too small. There are many examples of a person striving with all his might to solve some immediate, local problem, only to find his efforts defeated by events occurring in a larger context. A farmer's carefully maintained fields can be destroyed by an international war. Local officials' plans can be overturned by a national policy. A country's economic development can be thwarted by a lack of world demand for its products. Indeed there is increasing concern today that most personal and national objectives may ultimately be frustrated by long-term, global trends such as those mentioned by U Thant.

Are the implications of these global trends actually so threatening that their resolution should take precedence over local, short-term concerns?

Is it true, as U Thant suggested, that there remains less than a decade to bring these trends under control?

If they are not brought under control, what will the consequences be?

What methods does mankind have for solving global problems, and what will be the results and the costs of employing each of them?

These are the questions that we have been investigating in the first phase of the Club of Rome's Project on the Predicament of Mankind. Our concerns thus fall in the upper right-hand corner of the space–time graph.

PROBLEMS AND MODELS

Every person approaches his problems, wherever they occur on the space–time graph, with the help of models. A model is simply an ordered set of assumptions about a complex system. It is an attempt to understand some aspect of the infinitely varied world by selecting from perceptions and past experience a set of general observations applicable to the problem at hand. A farmer uses a mental model of his land, his assets, market prospects, and past weather conditions to decide which crops to plant each year. A surveyor constructs a physical model – a map – to help in planning a road. An economist uses mathematical models to understand and predict the flow of international trade.

Decision-makers at every level unconsciously use mental models to choose among policies that will shape our future world. These mental models are, of necessity, very simple when compared with the reality from which they are abstracted. The human brain, remarkable as it is, can only keep track of a limited number of the complicated, simultaneous interactions that determine the nature of the real world.

We, too, have used a model. Ours is a formal, written model of the world.[1] It constitutes a preliminary attempt to improve our mental models of long-term, global problems by combining the large amount of information that is already in human minds and in written records with the new information-processing tools that mankind's increasing knowledge has produced – the scientific method, systems analysis, and the modern computer.

Our world model was built specifically to investigate five major trends of global concern – accelerating industrialization, rapid population growth, widespread malnutrition, depletion of nonrenewable resources, and a deteriorating environment. These trends are all interconnected in many ways, and their development is measured in decades or centuries, rather than in months or years. With the model we are seeking to understand the causes of these trends, their interrelationships, and their implications as much as one hundred years in the future.

The model we have constructed is, like every other model, imperfect, oversimplified, and unfinished. We are well aware of its shortcomings, but we believe that it is the most useful model now available for dealing with problems far out on the space–time graph. To our knowledge it is the only formal model in existence that is truly global in scope, that has a time horizon longer than thirty years, and that includes important variables such as population, food production, and pollution, not as independent entities, but as dynamically interacting elements, as they are in the real world.

Since ours is a formal, or mathematical, model it also has two important advantages over mental models. First, every assumption we make is written in a precise form so that it is open to inspection and criticism by all. Second, after the assumptions have been scrutinized, discussed, and revised to agree with our best current knowledge, their implications for the future behavior of the world system can be traced without error by a computer, no matter how complicated they become.

We feel that the advantages listed above make this model unique among all mathematical and mental world models available to us today. But there is no reason to be satisfied with it in its present form. We intend to alter, expand, and improve it as our own knowledge and the world data base gradually improve.

In spite of the preliminary state of our work, we believe it is important to publish the model and our findings now. Decisions are being made every day in every part of the world, that will affect the physical, economic, and social conditions of the world system for decades to come. These decisions cannot wait for perfect models and total understanding. They will be made on the basis of some model, mental or written, in any case. We feel that the model described here is already sufficiently developed to be of some use to decision-makers. Furthermore, the basic behavior modes we have already observed in this model appear to be so fundamental and general that we do not expect our broad conclusions to be substantially altered by further revisions.

It is not the purpose of this book to give a complete, scientific description of all the data and

mathematical equations included in the world model. Such a description can be found in the final technical report of our project. Rather, in *The Limits to Growth* we summarize the main features of the model and our findings in a brief, nontechnical way. The emphasis is meant to be not on the equations or the intricacies of the model, but on what it tells us about the world. We have used a computer as a tool to aid our own understanding of the causes and consequences of the accelerating trends that characterize the modern world, but familiarity with computers is by no means necessary to comprehend or to discuss our conclusions. The implications of those accelerating trends raise issues that go far beyond the proper domain of a purely scientific document. They must be debated by a wider community than that of scientists alone. Our purpose here is to open that debate.

The following conclusions have emerged from our work so far. We are by no means the first group to have stated them. For the past several decades, people who have looked at the world with a global, long-term perspective have reached similar conclusions. Nevertheless, the vast majority of policy-makers seems to be actively pursuing goals that are inconsistent with these results.

Our conclusions are:

1 If the present growth trends in world population, industrialization, pollution, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next one hundred years. The most probable result will be a rather sudden and uncontrollable decline in both population and industrial capacity.
2 It is possible to alter these growth trends and to establish a condition of ecological and economic stability that is sustainable far into the future. The state of global equilibrium could be designed so that the basic material needs of each person on earth are satisfied and each person has an equal opportunity to realize his individual human potential.
3 If the world's people decide to strive for this second outcome rather than the first, the sooner they begin working to attain it, the greater will be their chances of success.

These conclusions are so far-reaching and raise so many questions for further study that we are quite frankly overwhelmed by the enormity of the job that must be done. We hope that this book will serve to interest other people, in many fields of study and in many countries of the world, to raise the space and time horizons of their concerns and to join us in understanding and preparing for a period of great transition – the transition from growth to global equilibrium.

NOTE

1 The prototype model on which we have based our work was designed by Professor Jay W. Forrester of the Massachusetts Institute of Technology. A description of that model has been published in his book *World Dynamics* (Cambridge, MA: Wright-Allen Press, 1971).

8

"The Steady-State Economy"

from *Toward a Steady-State Economy* (1973)

Herman E. Daly

Editors' Introduction

Although the field of economics provided much of the foundation for twentieth-century global development, a growing number of economists toward the middle and end of the century came to question its prevailing assumptions. Eloquent observers such as Boulding, Schumacher, and Hazel Henderson published works arguing that prevailing economic perspectives were deeply flawed, and that humanity needed to take environmental and social impacts of economic development into account as well as adopt a longer-term perspective than that supplied by economics. Particularly influential were Shumacher's book *Small is Beautiful* (New York: Harper & Row, 1973), advocating "appropriate technology," and Boulding's call for an "economics for a spaceship earth" in books such as *Beyond Economics: Essays on Society, Religion, and Ethics* (Ann Arbor, MI: University of Michigan Press, 1968). In the 1980s and 1990s environmental economists and ecological economists worked in more specific ways to change the discipline. The former group has tried to integrate environmental and social concerns into existing economic tools, while the second group has gone further to try to put economics into the context of a broader global picture.

However, it is Herman Daly, a professor first at the University of Louisiana and later the University of Maryland, who has developed perhaps the most fundamental critique of traditional economics from a sustainability perspective. Picking up on an idea first mentioned by John Stuart Mill in the nineteenth century, Daly argued in the early 1970s that an economy based on endless growth in physical production was impossible, and called instead for a "steady-state economy" based on qualitative but not quantitative growth. Daly's preferred method for achieving this steady state was through depletion quotas on resources, through which the government would essentially auction off the right to consume basic resources. The amount allowed to be consumed would decrease over time, setting in place market mechanisms (through higher prices, conservation, better technologies, substitution and so on) to reduce consumption of that resource. Somewhat tongue-in-cheek, Daly even suggested that this mechanism be applied to the right to have children, so as to use economics to address the population problem.

Daly's ideas constituted a challenge to conventional economics that could not be ignored, and indeed questioning "growth" of all sorts – including population growth, metropolitan spatial growth, and growth in energy or resource consumption – has become a central feature of sustainability debates. For a time in the 1990s Daly was even hired by the World Bank as an in-house economic advisor, though his ideas appear to have had little impact on the Bank's overall policies. Although mainstream economists, politicians, and the global business community have yet to take the concept of a steady-state economy seriously, and assume continual growth in production and consumption to be essential for human welfare, Daly's ideas remain important as a leading philosophical alternative to endless growth, one that may eventually underpin a more sustainable society.

Like Leopold and Meadows, Daly embraced notions of ethical and spiritual change that went far beyond his professional field. He argued for changes in values and moral growth to serve as the underpinnings of a