
4 Introduction to *The Resourceful Earth*

Julian L. Simon and Herman Kahn

Executive Summary

The original 1980 *Global 2000 Report to the President* (*Global 2000* hereafter) is frightening. It received extraordinarily wide circulation, and it has influenced crucial governmental policies. But it is dead wrong. Now *The Resourceful Earth*, a response to *Global 2000*, presents the relevant reliable trend evidence which mainly reassures rather than frightens.

Two paragraphs summarize the "Major Findings and Conclusions" of *Global 2000* on its page 1:

If present trends continue, the world in 2000 will be more crowded, more polluted, less stable ecologically, and more vulnerable to disruption than the world we live in now. Serious stresses involving population, resources, and environment are clearly visible ahead. Despite greater material output, the world's people will be poorer in many ways than they are today.

For hundreds of millions of the desperately poor, the outlook for food and other necessities of life will be no better. For many it will be worse. Barring revolutionary advances in technology, life for most people on earth will be more precarious in 2000 than it is now—unless the nations of the world act decisively to alter current trends.

To highlight our differences as vividly as possible, we restate the above summary with our substitutions in italics:

If present trends continue, the world in 2000 will be *less crowded* (though more populated), *less polluted*, *more stable ecologically*, and *less vulnerable to resource-supply disruption* than the world we live in now. Stresses involving population, resources, and environment *will be less in the future than now* . . . The world's people will be *richer* in most ways than they are today . . . The outlook for food and other necessities of life will be *better* . . . life for most people on earth will be *less precarious* economically than it is now.

The high points of our findings are as follows:

- (1) Life expectancy has been rising rapidly throughout the world, a sign of demographic, scientific, and economic success. This fact—at least as dramatic and heartening as any other in human history—must be fundamental in any informed discussion of pollution and nutrition.

From Julian L. Simon and Herman Kahn, *The Resourceful Earth* (New York: Basil Blackwell, 1984), 1–27.
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- (2) The birth rate in less developed countries has been falling substantially during the past two decades, from 2.2 percent yearly in 1964–5 to 1.75 percent in 1982–3, probably a result of modernization and of decreasing child mortality, and a sign of increased control by people over their family lives.
- (3) Many people are still hungry, but the food supply has been improving since at least World War II, as measured by grain prices, production per consumer, and the famine death rate.
- (4) Trends in world forests are not worrying, though in some places deforestation is troubling.
- (5) There is no statistical evidence for rapid loss of species in the next two decades. An increased rate of extinction cannot be ruled out if tropical deforestation is severe, but no evidence about linkage has yet been demonstrated.
- (6) The fish catch, after a pause, has resumed its long upward trend.
- (7) Land availability will not increasingly constrain world agriculture in coming decades.
- (8) In the US, the trend is toward higher-quality cropland, suffering less from erosion than in the past.
- (9) The widely-published report of increasingly rapid urbanization of US farmland was based on faulty data.
- (10) Water does not pose a problem of physical scarcity or disappearance, although the world and US situations do call for better institutional management through more rational systems of property rights.
- (11) The climate does not show signs of unusual and threatening changes.
- (12) Mineral resources are becoming less scarce rather than more scarce, affront to common sense though that may be.
- (13) There is no persuasive reason to believe that the world oil price will rise in coming decades. The price may fall well below what it has been.
- (14) Compared to coal, nuclear power is no more expensive, and is probably much cheaper, under most circumstances. It is also much cheaper than oil.
- (15) Nuclear power gives every evidence of costing fewer lives per unit of energy produced than does coal or oil.
- (16) Solar energy sources (including wind and wave power) are too dilute to compete economically for much of humankind's energy needs, though for specialized uses and certain climates they can make a valuable contribution.
- (17) Threats of air and water pollution have been vastly overblown; these processes were not well analyzed in *Global 2000*.

We do not say that all is well everywhere, and we do not predict that all will be rosy in the future. Children are hungry and sick; people live out lives of physical or intellectual poverty, and lack of opportunity; war or some new pollution may do us in. *The Resourceful Earth* does show that for most relevant matters we have examined, aggregate global and US trends are improving rather than deteriorating.

In addition we do not say that a better future happens *automatically* or *without effort*. It will happen because men and women—sometimes as individuals, sometimes as enterprises working for profit, sometimes as voluntary non-profit making groups, and sometimes as governmental

agencies—will address problems with muscle and mind, and will *probably* overcome, as has been usual throughout history.

We are confident that the nature of the physical world permits continued improvement in humankind's economic lot in the long run, indefinitely. Of course there are always newly arising local problems, shortages and pollutions, due to climate or to increased population and income. Sometimes temporary large-scale problems arise. But the nature of the world's physical conditions and the resilience in a well-functioning economic and social system enable us to overcome such problems, and the solutions usually leave us better off than if the problem had never arisen; that is the great lesson to be learned from human history.

We are less optimistic, however, about the constraints currently imposed upon material progress by political and institutional forces, in conjunction with popularly-held beliefs and attitudes about natural resources and the environment, such as those urged upon us by *Global 2000*. These constraints include the view that resource and environmental trends point towards deterioration rather than towards improvement, that there are physical limits that will increasingly act as a brake upon progress, and that nuclear energy is more dangerous than energy from other sources. These views lead to calls for subsidies and price controls, as well as government ownership and management of resource production, and government allocation of the resources that are produced. To a considerable extent the US and the rest of the world already suffer from such policies (for example, on agriculture in Africa), and continuation and intensification could seriously damage resource production and choke economic progress. In particular, refusal to use nuclear power could hamper the US in its economic competition with other nations, as well as cause unnecessary deaths in coal mining and other types of conventional energy production. We wish that there were grounds to believe that a shift in thinking will take place on these matters, but we do not find basis for firm hope. So in this respect we are hardly optimistic.

We also wish to emphasize that though the global situation may be reasonably satisfactory or improving in some given respect, there are likely to be areas in which there are severe difficulties which may be on the increase. Such local problems may be due to local mismanagement, or they may be due to natural catastrophe which the larger community may not yet have been able to help mitigate. Such local problems should not be glossed over in any global assessment.

Background

More than one million copies of the original *Global 2000 Report to the President of the United States* have been distributed. It has been translated into five major languages. Other countries such as Germany have commissioned studies imitating *Global 2000*.

Global 2000 also underlies important US policy pronouncements. For example, the following paragraphs, and the rest of the full speech at the Albach European Forum in 1980, which was an official "American perspective on the world economy in the 1980s," were founded squarely on *Global 2000*:

Defying the generally buoyant mood, Richard Cooper, U.S. under secretary of state for economic affairs, delivered a grim message. If present trends continue, he said, the world population will swell to five billion

by 1990 from four billion at present, leading to "open conflict, greater terrorism and possibly localized anarchy," as well as "congestion, famine, deforestation."

The decade's population growth would equal "nearly half the total world population when I was born," he said. Even then, he added ominously, "some political leaders were calling for more lebensraum" (or living space). (*The Wall Street Journal*, 15 September 1980, 32)

Before *Global 2000* was even completed, President Carter had discussed its conclusions with other world leaders at an economic summit held in Italy. Immediately upon receiving the Report, the President established a task force to ensure that *Global 2000* received priority attention. The task force included the Secretary of State, the director of the Office of Management and Budget, the President's Assistant for Domestic Affairs, and the director of the Office of Science and Technology Policy. Secretary of State Edmund Muskie used *Global 2000* as the centerpiece for an address to the UN General Assembly. The Joint Economic Committee of Congress launched a series of hearings on the Report. The President instructed the State Department to arrange an international meeting of environmental and economic experts to discuss population, natural resources, environment, and economic development, the subjects of *Global 2000*. Finally, in his farewell address to the nation, President Carter referred to the subject of *Global 2000* as one of the three most important problems facing the American people (the other two being arms control and human rights). And *Global 2000*'s effect did not disappear with the change of administration. It continues to be cited as support for a wide variety of forecasts by governmental agencies.¹

The press received *Global 2000* with great respect and enormous attention. *Time* and *Newsweek* ran full-page stories, and *Global 2000* made front-page newspaper headlines across the country as an "official" government study forecasting global disaster. Though the Report included some qualifications, it was interpreted by all as a prediction of gloom-and-doom. For example, *Science*'s story title was: "Global 2000 Report: Vision of a Gloomy World."² *Time*'s title was "Toward a Troubled 21st Century: A Presidential Panel Finds the Global Outlook Extremely Bleak."³ *Newsweek*'s title was "A Grim Year 2000."⁴ The typical local paper in central Illinois had this banner across the top of the front page: "U.S. Report Says World Faces Ecological Disaster."⁵ And its story began:

Mass poverty, malnutrition and deterioration of the planet's water and atmosphere resources—that's a bleak government prediction that says civilization has perhaps 20 years to act to head off such a world-wide disaster.

A full-page advertisement for the volume in *The New York Review of Books* was headed:

Government Report as follows: Poisoned seas, acid rain, water running out, atmosphere dying.

However—and seldom can there have been a bigger "however" in the history of such reports—the original *Global 2000* is totally wrong in its specific assertions and its general conclusion. It is replete with major factual errors, not just minor blemishes.⁶ Its language is vague at key points, and features many loaded terms. Many of its arguments are illogical or misleading. It paints an overall picture of global trends that is fundamentally wrong, partly because it relies on non-facts and partly because it misinterprets the facts it does present. (In partial defense of the writers who

prepared the *Global 2000* work, the summary Volume I—which was the main basis for the news stories—egregiously mis-stated, for reasons which we can only surmise,⁷ many analyses and conclusions in the working-paper Volume II, thereby turning optimistic projections into pessimistic ones.)

Our statements about the future in *The Resourceful Earth* are intended as unconditional predictions in the absence of an unforeseeable catastrophe such as nuclear war or total social breakdown. We feel no need to qualify these predictions upon the continuation of current policies, as *Global 2000* claimed to do, and in fact we believe that such a qualification is not meaningful. Throughout history, individuals and communities have responded to actual and expected shortages of raw materials in such fashion that eventually the materials have become more readily available than if the shortages had never arisen. These responses are embodied in the observed long-run trends in supply and cost, and therefore extrapolation of such trends (together with appropriate theoretical attention) takes into account the likely future responses.

Aside from this Introduction and one section in most of the chapters, *The Resourceful Earth* is not primarily an evaluation or criticism of *Global 2000*. (For evaluation and criticism, see Clawson 1981; Dubos 1981; Kahn and Schneider 1981; Simon 1981.) It is a compendium of careful, authoritative, independent studies of many of the topics dealt with by *Global 2000* plus some others, by writers selected by the editors because their claim to the label “expert” is as strong as any such claim can be. Taken together, the chapters are intended to be a fair assessment of the trends together with an analysis of what the trends portend for the future. We hope that *The Resourceful Earth* will also serve as a reference volume of first resort for persons seeking knowledge on these topics. This introduction summarizes the findings of the technical chapters. It also offers some general observations about *Global 2000*, global modeling, and policy recommendations. The findings express the views of the authors of the individual chapters. The editors are responsible for the general observations, though the individual chapter authors have commented upon these general observations. We have also included a section at the end of the volume where individual authors may express their disagreements with any of these general views.

The Resourceful Earth chapters were produced without a penny’s added cost to the public. The chapters are presented here exactly as written, with the authors having final authority over their chapters without bureaucratic tampering. This process is in contrast to the largely staff-written and politically edited *Global 2000*; more details are given below about the process of financing, writing, and editing *Global 2000* and *The Resourceful Earth*.

The Specific Conclusions

We now briefly summarize the main issues raised by *Global 2000* as covered by our topical chapters. For convenience, the order will be the same as in the *Global 2000* summary quoted above for the topics mentioned there, followed by the other central issues raised in their summary volume.

“MORE CROWDED”

There surely will be more people on earth in the year 2000 than there are now, barring a calamity. But a growing population does not imply that human living on the globe will be more

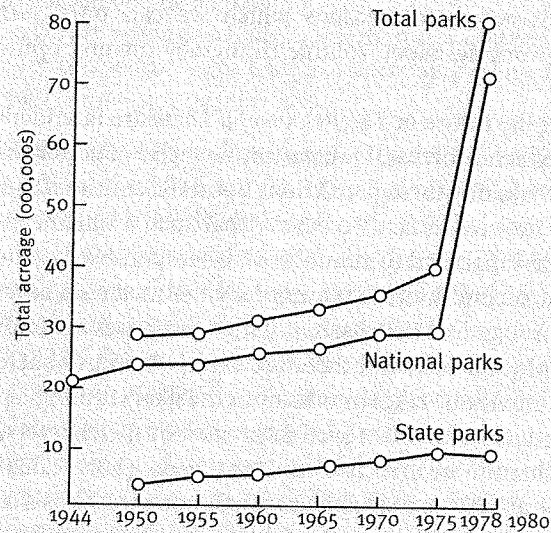


Fig. 4.1 Land in public parks, 1944-80.

Sources: *Statistical Abstract of the US* 1973: 202; 1980: 242 for 1950-79; *Information Related to the National Park System*, US Department of the Interior, National Park Service, 30 June 1944: 35 for 1944.

"crowded" in any meaningful fashion. As the world's people have increasingly higher incomes, they purchase better housing and mobility. The homes of the world's people progressively have more floorspace, which means people dwell in less-crowded space with more privacy. The United States, for which data are readily available, illustrates the trends in developed countries. In 1940, fully 20.2 percent of households had 1.01 or more persons per room, whereas in 1974 only 4.5 percent were that crowded (US Department of Commerce 1977: 90). (Also relevant: in 1940 44.6 percent of housing units lacked some or all plumbing facilities; but in 1974 only 3.2 percent were lacking. In 1940, 55.4 percent had all plumbing facilities, whereas in 1974, 96.8 percent had all plumbing; US Department of Commerce, 1977: 91). The world's people are getting better roads and more vehicles; therefore they can move around more freely, and have the benefits of a wider span of area. In the US, paved highways have increased from zero to over 3 million miles since the turn of the century. Natural park areas have been expanding (Figure 4.1). And trips to parks have increased to an extraordinary degree (Figure 4.2). These trends mean that people increasingly have much more space available and accessible for their use, despite the increase in total population, even in the poorer countries. All this suggests to us that the world is getting less crowded by reasonable tests relevant to human life.

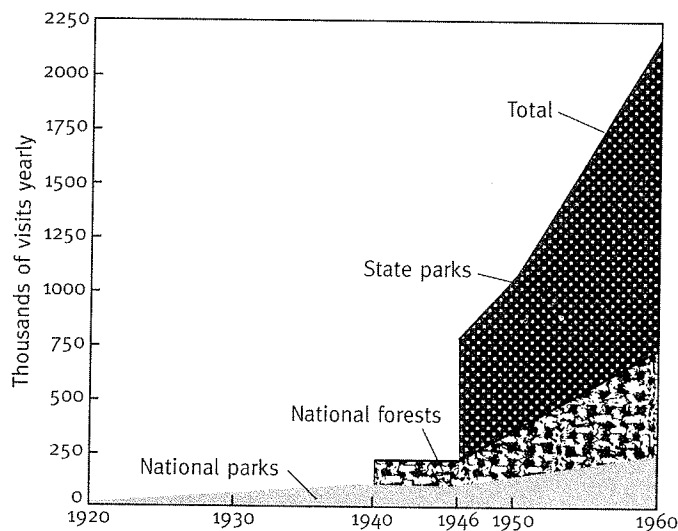


Fig. 4.2 Visits to public parks, 1920-60.

Source: See Simon 1981: fig. 16-5.

"MORE POLLUTED"

Global 2000 asserts that the world is getting more polluted. But it cites no systematic data for the world or even for regions. It is certainly reasonable to *assume* that man-made industrial pollutions increase as the most backward countries begin to modernize, get somewhat less poor, and purchase pollution-creating industrial plants. The same is true of consumer pollution—junked cars, plastic bags, and pop tops of beverage cans. But it is misleading to suggest that there are *data* showing that such pollution is a major problem.

In the early stages of industrialization, countries and people are not yet ready to pay for clean-up operations. But further increases in income almost as surely will bring about pollution abatement. (At the same time, biological disease pollution has been declining, even in the poor countries, at a rate far outweighing any hazardous effect of man-made pollution, as seen in increased life-expectancy.)

In the richer countries there is solid evidence that hazardous air pollution has been declining. Figure 4.3 shows the Council on Environmental Quality's new Pollutant Standard Index for the US, and Figure 4.4 shows one key measure of air quality for which data are available since 1960; the benign trend has been under way for quite a while, and does not stem only from the onset of the environmental movement around 1970.

Water quality too, has improved in the richer countries. Figure 4.5 shows the improvements in drinkability of water in the US since 1961. Such alarms of the 1960s and 1970s as the impending "death" of the Great Lakes have turned out totally in error; fishing and swimming conditions

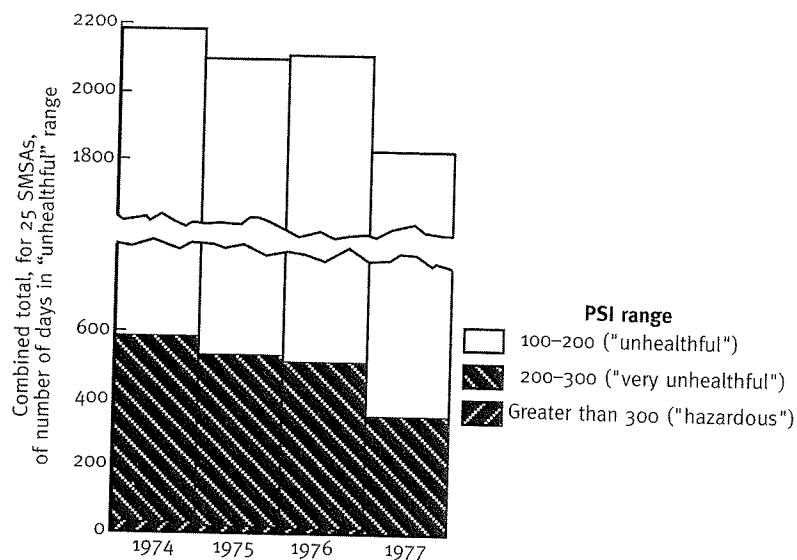


Fig. 4.3 National trend in urban PSI levels, 1974-7.

Source: Based on US Environmental Protection Agency data, reproduced from the tenth annual report of the Council on Environmental Quality 1979: 39.

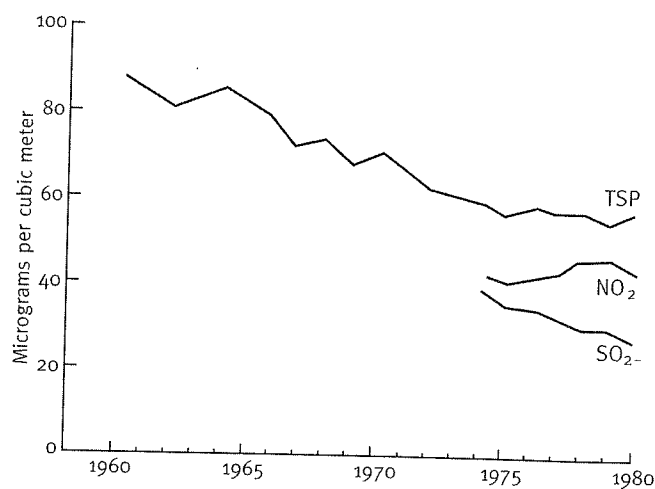


Fig. 4.4 National ambient concentrations of total suspended particulates, nitrogen dioxide, and sulfur dioxide, 1960-80. Data may not be strictly comparable.

Source: US Environmental Protection Agency.

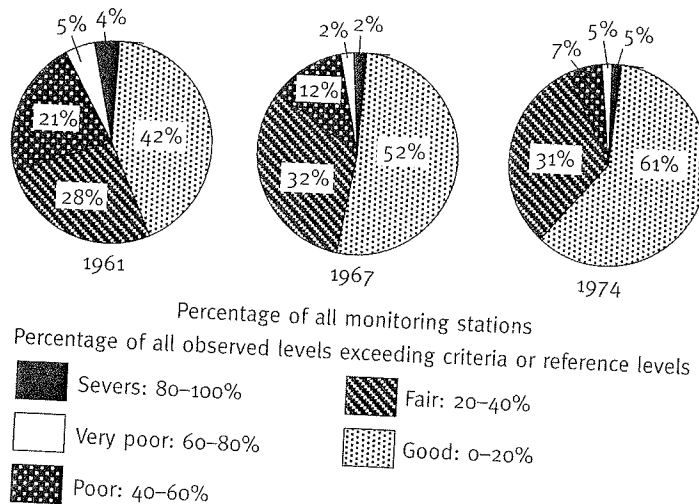


Fig. 4.5 Trends in the quality of drinking water in the USA.

Source: US Council on Environmental Quality, Annual Report 1975: 352.

there are now excellent. (Ironically, the "death" that was warned of is really a condition of too much organic "life", and is therefore self-curing as soon as people stop adding so much nutrient to the water.) In the developing countries the proportion of the urban population served by a safe water supply rose modestly in the 1970s, and rose markedly among the rural population (but from 14 percent to only 29 percent; Holdgate et al. 1982: 135).

The long-run historical record, to the extent that there are data, offers examples upon which one may seize to argue almost any shade of opinion about pollution. But many of the oft-cited series that purportedly show "deterioration" prove, upon inspection, to be the result of forces other than recent human activities.

"LESS STABLE ECOLOGICALLY, AND MORE VULNERABLE TO DISRUPTION"

These concepts are so diffuse that we have no idea how one would measure them directly. *Global 2000* gives no relevant trend data.

Perhaps *Global 2000* had in mind that there is more danger of disruption as humankind's capacity to alter the ecosystem increases. In itself, this must be true. But at the same time, humankind's ability to restore imbalances in the ecosystem also increases. And the trend data on pollution, food (discussed below), and life expectancy suggest that the life-supporting capacities have been increasing faster than the malign disturbances. Of course some unprecedented catastrophe such as the Black Death may occur, but we can only look into the future as best we can, and conclude that no such catastrophe is in view. The one crucial exception is war, which is

outside our scope here, and which is not a matter of the natural resource constraints that depend upon the nature of the physical world.

"SERIOUS STRESSES INVOLVING POPULATION, RESOURCES, AND ENVIRONMENT . . ."

This *Global 2000* phrase sounds ominous, but like many other *Global 2000* warnings it is hard to pin down. If it means that people will have a poorer chance of survival in the year 2000 than now, due to the greater number of people, the trends in life expectancy suggest the contrary. Declining mortality and improving health have accompanied unprecedented population growth in the world (as well as in the US, of course). Figure 4.6 shows the long-run trend of life expectancy in the more-developed world, a pattern toward which the less-developed countries are converging. For example, life expectancy in less-developed regions rose from 43 years in 1950/55 to 53 years in 1970/75 (the rise in Asia being even greater), a much bigger jump than the rise from 65 years to 71 years in the more-developed regions (Gwatkin 1980).

If the phrase "serious stresses" implies that along with more people in the year 2000 will come more costly resources and a deteriorated environment, the trends suggest the opposite, as noted above for the environment, and as discussed next for resources. If the phrase means that life expectancy, resource availability, and the quality of the environment could be even better in the year 2000 with fewer people than are expected, *Global 2000* has not even attempted to demonstrate such a complex causal correction. The existing research on the subject does not suggest to us that such would be the case.

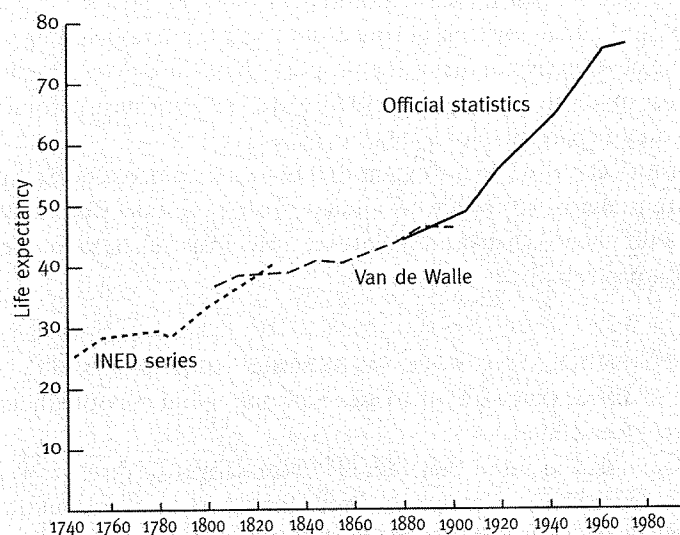


Fig. 4.6 Female expectation of life at birth, France.

“... RESOURCES ...”

Global 2000 projected a 5 percent yearly increase in the real price of non-fuel minerals until the year 2000. There has always been “serious stress” in the sense that people have to pay a price to get the resources they want. But the relevant economic measures of “stress”—costs and prices—show that the long-run trend is toward less scarcity and lower prices rather than more scarcity and higher prices, hard as that may be for many people to believe. The cost trends of almost every natural resource have been downward over the course of recorded history.

An hour's work in the United States has bought increasingly more of copper, wheat, and oil (which are representative and important raw materials) from 1800 to the present (see, for example, Figure 4.7). The trend is less dramatic in the poorest countries, but the direction of the trend is unmistakable there, too, because per person income has been rising in poor countries as well as rich ones. The same trend has held throughout human history for such minerals as copper and iron (Clark 1957: appendix). Calculations of expenditures for raw materials as a falling proportion of total family budgets make the same point even more strongly.

These trends mean that raw materials have been getting increasingly available and less scarce relative to the most important and most fundamental element of economic life, human work-time. The prices of raw materials have even been falling relative to consumer goods and the Consumer Price Index. All the items in the Consumer Price Index have been produced with increasingly efficient use of labor and capital over the years, but the decrease in cost of raw materials has been even greater than that of other goods. This is a very strong demonstration of progressively decreasing scarcity and increasing availability of raw materials. The trend of raw material prices relative to consumer goods, however, has much less meaning for human welfare than does the trend of resource prices relative to the price of human time—a trend which is decidedly benign, as we have seen. Even if raw materials were rising in price relative to consumer goods, there would be no cause for alarm as long as it takes progressively less effort, and a smaller proportion of our incomes, to obtain the service from raw materials that we need and want.

Moreover, the observed fall in the prices of raw materials understates the positive trend, because as consumers we are interested in the services we get from the raw materials rather than the raw materials themselves. We have learned to use less of given raw materials for given purposes, as well as to substitute cheaper materials to get the same services. Consider a copper pot used long ago for cooking. The consumer is interested in a container that can be put over heat. After iron and aluminium were discovered, quite satisfactory cooking pots—with advantages as well as disadvantages compared with pots of copper—could be made of those materials. The cost that interests us is the cost of providing the cooking service, rather than the cost of the copper.

A single communications satellite in space provides intercontinental telephone connections that would otherwise require thousands of tons of copper. Satellites and microwave transmission and the use of glass fibers in communications are dramatic examples of how a substitute process can supply a service much more cheaply than copper.

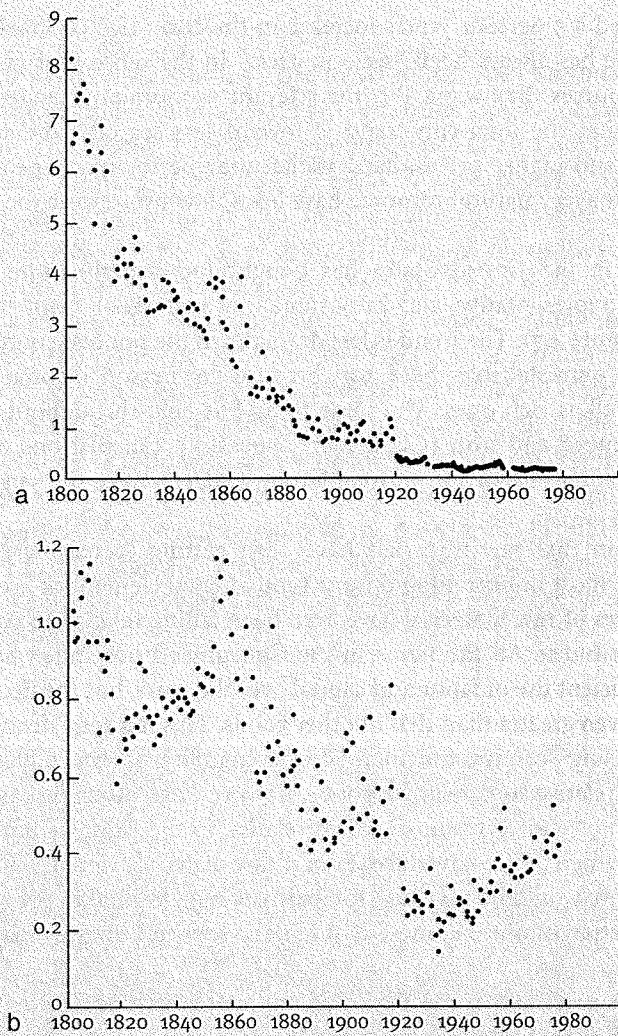


Fig. 4.7 The scarcity of copper (a) as measured by its price relative to wages and (b) as measured by its price relative to the consumer index. The diagrams are typical of the pattern for each of the metals (see Simon 1981: appendix).

"THE WORLD'S PEOPLE WILL BE POORER IN MANY WAYS . . ."

The Global 2000 qualifying phrase "in many ways" could imply that a decrease in the number of elephants, or the deaths of some elderly beloved persons, are ways in which the world's people will be poorer in the future than now; if so, the statement is logically correct. But if we consider more general and economically meaningful measures, the world's people have been getting richer rather than poorer, and may be expected to be richer in the future. Measured in conventional terms, average income for the world's population has been rising. Particularly noteworthy, and contrary to common belief, income in the poorer countries has been rising at a percentage rate as great or greater than in the richer countries since World War II (Morawetz 1978). Another vivid proof of the rise in income in poorer countries is the decline in the proportion of the labor force devoted to agriculture—from 68 percent to 58 percent between 1965 and 1981 in the developing countries, consistent with the trend in developed countries where the agricultural labor force has plummeted to, for example, well below 3 percent in the US. The rising average income in poorer countries combined with the rough stability of their internal income-distribution shares suggests that the poorer classes of representative countries have been participating in this income rise along with the richer classes.

"THE OUTLOOK FOR FOOD . . . WILL BE NO BETTER"

Consumption of food per person in the world is up over the last 30 years (Figure 4.8). And data do not show that the bottom of the income scale is faring worse, or even has failed to share in the general improvement, as the average has improved. Africa's food production per capita is down, but no one thinks that has anything to do with physical conditions; it clearly stems from governmental and other social conditions. Famine deaths have decreased in the past century even in absolute terms, let alone relative to population. World food prices have been trending lower for decades and centuries (Figure 4.9), and there is strong reason to believe that this trend will continue. This evidence runs exactly counter to *Global 2000's* conclusion that "real prices for food are expected to double." If a problem exists for the US, it is a problem caused by abundance. Food production in the US is now so great that farmers are suffering economically. Food stocks in the world are so high that they are causing major problems (Figure 4.10). Agricultural yields per hectare have continued to rise in such countries as China, France, and the US. These gains in production have been accomplished with a decreasing proportion of the labor force—the key input for and constraint upon the economic system.

Careful study of the quantities of actual and potential agricultural land in various countries, plus possibilities for irrigation and multicropping together with yields already routinely reached in the developed countries, suggests that agricultural land will not be a bottleneck in the foreseeable future, even without new technological breakthroughs. And the supply of water for agriculture (which is by far the largest use of water) poses even fewer problems arising from purely physical conditions. Physical measurements of water withdrawal in the world as a whole provide no relevant information. The possibility of the world as a whole running out of water is zero. The supply of water is always a local or regional issue within a country (or occasionally at the border of two countries). The key constraints upon the supply of water arise from institutional

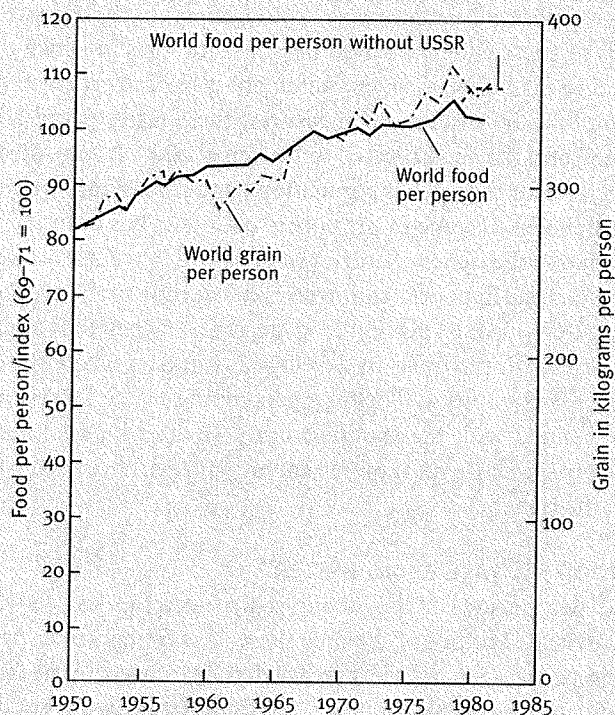


Fig. 4.8 World grain and food production per person.

Sources: USDA, FAS, FG-8-82 (3-15-82); Brown, *Building a Sustainable Society* (Norton, 1981), 81 (with authors' extrapolation of 1981 and 1982 population). The Food index includes all food commodities—including grain, pulses, oil-seeds, vegetables, and fruit; it excludes the PRC. Source of index USDA, ERS, Statistical Bulletin No. 669, July 1981; USDA, personal communication, Dr Patrick M. O'Brien (1980, 1981 index).

and political conditions, and especially the structure of property rights to water and the price structure for water, rather than mere physical availability.

The issue of a well-constituted system of property rights—the absence of which often leads to “the tragedy of the commons”—arises sharply with respect to water rights; but appropriate rules for private property are also of fundamental importance in many other natural resource and environmental situations. Drilling rights in oil basins, rights to pollute the air and water, and hunting rights for wild animals, are but three dramatic examples. A sound set of social rules with respect to property can go far to ensure a satisfactory supply of resources and an acceptably clean environment. On this there is ever-growing agreement among naturalists, economists, geologists, and others concerned with these matters.

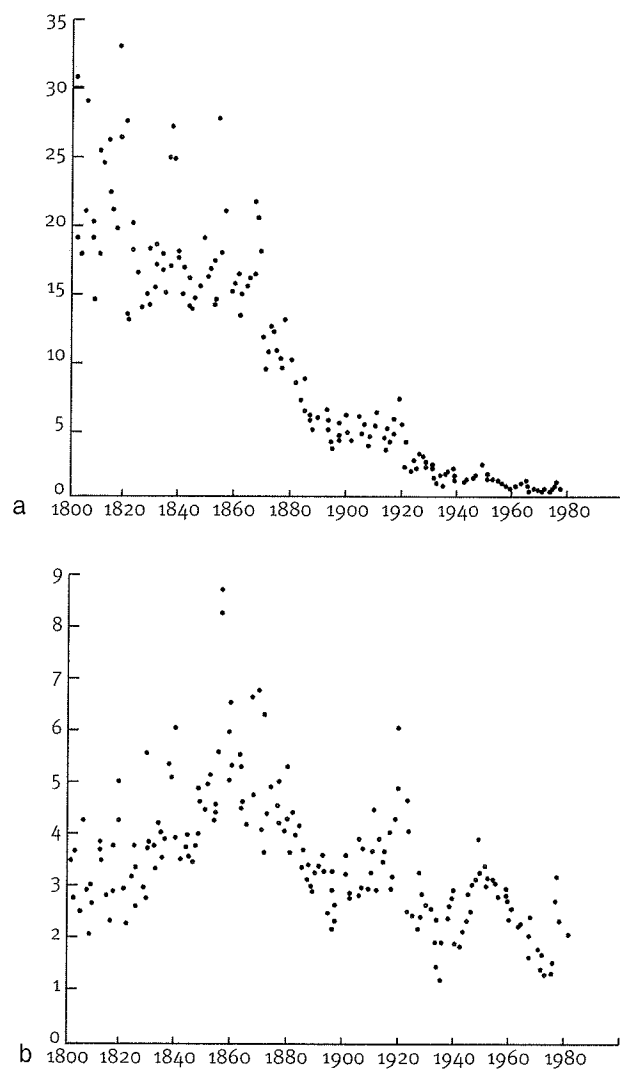


Fig. 4.9 The price of wheat in the USA (a) relative to wages and (b) relative to the consumer price index.

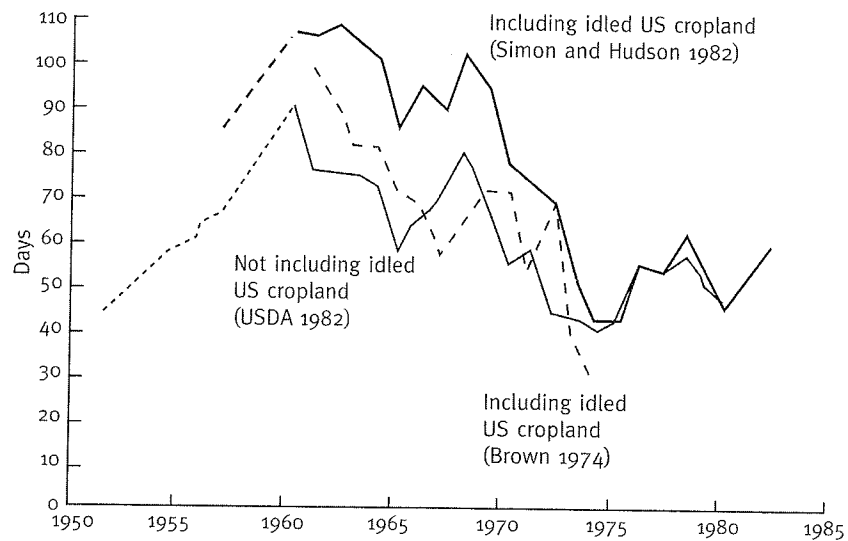


Fig. 4.10 World grain stocks as days of utilization.

Sources: (1) USDA, FAS, FG-8-82 (3-15-82); USDA, WASDE-133 (5-11-81); (2) Brown, *By Bread Alone* (Praeger, 1974), 60; Brown, *Building a Sustainable Society*, 96; authors' estimates for 1961, 1982. Data for 1952 and 1957 from D. Gale Johnson, *World Food Problems and Prospects*; USDA, ERS 479, *US Corn Industry*, February 1982, table 46.

"SIGNIFICANT LOSSES OF WORLD FORESTS WILL CONTINUE OVER THE NEXT 20 YEARS"

According to *Global 2000*, "by 2000 some 40 percent of the remaining forest cover in LDCs will be gone." If nonsense is a statement utterly without factual support, this is nonsense. Forests are not declining at all in the temperate regions. In the US, for example, the total quantity of trees has been increasing, and wood production has been increasing rapidly (Figure 4.11). The rate of deforestation in tropical areas has been far slower than suggested by *Global 2000*. The prospects for world wood production to meet demand without grave deforestation are excellent, especially because plantations which require only small land areas have just begun to make the major contribution to total world production of which they are capable.

"ARABLE LAND WILL INCREASE ONLY 4 PERCENT BY 2000. . . . SERIOUS DETERIORATION OF AGRICULTURAL SOILS WILL OCCUR WORLDWIDE, DUE TO EROSION"

Arable land has been increasing at a rate very much faster in recent decades than the rate *Global 2000* projected for coming decades—an increase which we can approximate at fully 16 percent over the 20-year period from 1950 to 1975 for which there are good data (Table 4.1). There is no

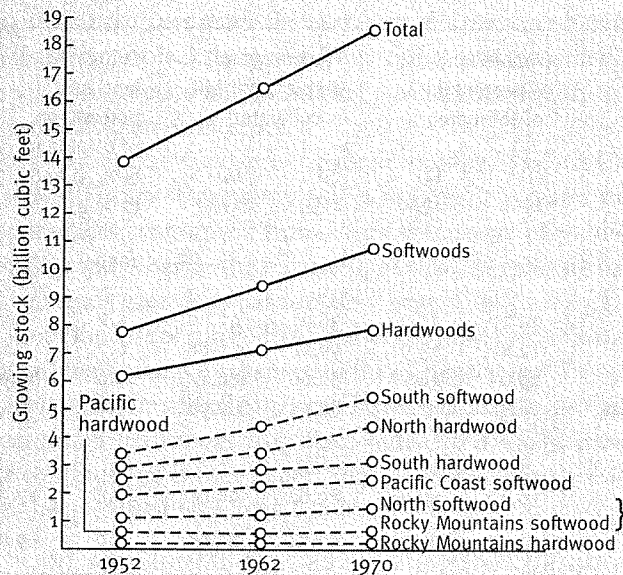


Fig. 4.11 Forest resources in the USA, 1952-70.

Source: *Perspectives on Prime Lands* (US Department of Agriculture, 1975).

apparent reason why in the next decades the increase should fall anywhere nearly as low as the 4 percent *Global 2000* suggests. A comprehensive assessment of the earth's land resources for agriculture by an authoritative President's Science Advisory Committee suggested that arable land will not be a key constraint upon food production in the world, and our findings agree. Rather, social and economic conditions are the key constraints on the amount of land brought into production.

In the United States, the conversion of farmland to urbanized land is proceeding at about the same rate as in recent decades, rather than at three times that rate, as was widely reported recently by a now-discredited agency of the US Department of Agriculture (the National Agricultural Lands Study), the source of the *Global 2000* statement on the subject. Furthermore, each year more (and better) new land is being brought into cultivation by irrigation and drainage than is being urbanized and built upon.

Concern about the "loss" of cropland to new housing, and the resulting governmental regulations that have constrained housing starts and raised the price of new homes, especially in California, does not square with contemporary federal policies for reducing planted acreage to meet the problem of "overproduction" of grain. In 1983 perhaps 39 percent of US crop acreage was kept idle by federal subsidy programs, at an unprecedented high cost to US taxpayers of \$18.3

Table 4.1(a) Changes in land use, 1950-60

	Arable land as a percentage of total area		Percentage of arable land that is cultivated		Cultivated land as a percentage of total land (1 × 3) and (2 × 4)		Agricultural land (arable and pasture) as a percentage of total area	
	(1)	(2)	(3)	(4)				
	1950	1960	1950	1960	1950	1960	1950	1960
Africa	14.27	15.30	36.21	42.72	5.2	6.5	46.50	49.02
Middle East	12.87	13.91	52.11	57.88	6.7	8.1	13.06	17.34
Asia	19.03	20.78	82.06	86.17	15.6	17.9	46.35	49.60
North and South America, USSR, Australia, New Zealand	6.88	7.75	82.75	82.96	5.7	6.4	34.27	38.59
Europe	30.79	30.98	89.02	90.06	27.4	27.9	45.63	46.10
ALL REGIONS	10.73	11.73	82.74	83.99	8.9	9.9	37.35	41.07

Source: Kumar 1973: 107.

Table 4.1(b) Changes in land use, 1961-5 to 1975

	Arable land as a percentage of total area				Agricultural land (arable and pasture) as a percentage of total area			
	1961-5	1966	1970	1975	1961-5	1966	1970	1975
Africa	6.28	6.50	6.76	6.96	32.88	32.96	33.13	33.29
Middle East	6.25	6.38	6.54	6.79	21.91	22.12	22.32	22.62
Far East	28.87	29.37	29.88	30.73	33.08	33.62	33.80	34.56
North America	11.50	11.43	12.17	13.08	26.10	25.85	25.88	25.50
USSR	10.24	10.24	10.39	10.37	26.83	27.34	27.09	26.97
Latin America	5.64	5.97	6.43	6.82	29.56	30.29	31.29	32.41
Western Europe	27.21	26.55	25.97	25.04	46.35	45.08	44.83	43.72
ALL REGIONS	10.41	10.58	10.93	11.25	33.13	33.38	33.71	33.99

Source: UN Food and Agriculture Organization 1976.

billion (compared to an original estimate of \$1.8 billion for the year; *New York Times*, 31 January 1983, 5). The argument is sometimes made that governments must act to save cropland for future generations, but this argument lacks support from either economic analysis or technological considerations. The driving motive behind urging government action to "preserve" farmland seems to be more aesthetics than economics.

Soil erosion is not occurring at a dangerous pace in most parts of the United States, contrary to much recent publicity. In most areas top soil is not being lost at a rate that makes broad changes in farming practices economical from either the private or public standpoint, though recent advances in tillage may change the picture somewhat. Regulating or subsidizing particular tillage practices portends greater social cost than benefit in the long run. The largest social cost of soil erosion is not the loss of top soil, but rather the silting-up of drainage ditches in some places, with consequent maintenance expenses. In the aggregate, just the opposite of land ruination has been taking place, as the soil of American farms has been improving rather than deteriorating, and as fewer rather than more crop acres suffer from severe erosion over the decades since the 1930s. The continuing advance in agricultural productivity per acre is consistent with the improvement in the quality of farmland.

"EXTINCTIONS OF PLANT AND ANIMAL SPECIES WILL INCREASE DRAMATICALLY. HUNDREDS OF THOUSANDS OF SPECIES—PERHAPS AS MANY AS 20 PERCENT OF ALL SPECIES ON EARTH—WILL BE IRRETRIEVABLY LOST AS THEIR HABITATS VANISH, ESPECIALLY IN TROPICAL FORESTS"

This assertion by *Global 2000* is remarkably unsupported by statistical evidence. The only scientific observations cited in support of a numerical estimate of future species extinction are (a) between 1600 and 1900 perhaps one species every 4 years was extinguished, and (b) between 1900 and 1980 perhaps one species every year was extinguished. The leap to *Global 2000*'s estimate of 40,000 species extinguished each year by the year 2000 is based on pure guesswork by the *Global 2000* writers and the source upon which they draw (Myers 1979). We do not neglect the die-off of the passenger pigeon and other species that may be valuable to us. But we note that extinction of species—billions of them, according to Mayr (1982)—has been a biological fact of life throughout the ages, just as has been the development of new species, some or many of which may be more valuable to humans than extinguished species whose niches they fill.

"ATMOSPHERIC CONCENTRATIONS OF CARBON DIOXIDE AND OZONE-DEPLETING CHEMICALS ARE EXPECTED TO INCREASE AT RATES THAT COULD ALTER THE WORLD'S CLIMATE AND UPPER ATMOSPHERE SIGNIFICANTLY BY 2050"

The longest available records of climatic variations reveal very wide temperature swings, much or all of which may be thought of as random. In that context, recent changes in temperature may reasonably be viewed as normal oscillation rather than as a structural change induced by man's activity, including changes in CO₂.

The CO₂ question is subject to major controversy and uncertainty—about the extent of the buildup, about its causes, and especially about its effects. It would not seem prudent to undertake expensive policy alterations at this time because of this lack of knowledge, and because problems that changes in CO₂ concentration might cause would occur far in the future (well

beyond the year 2000). Changes in the CO₂ situation may reasonably be seen, however, as an argument for increased use of nuclear power rather than fossil fuel. Continued research and monitoring of the CO₂ situation certainly is called for.

If it is considered desirable to reduce the amount of CO₂ released into the atmosphere by human activity, on the grounds that atmospheric change with unknown effects carries undesired risks, only two possibilities are feasible: reduce total energy consumption, or increase energy production from nuclear power plants. Reduction in total world energy consumption below the level determined by prices reflecting the production cost of energy is clearly unacceptable to most nations of the world because of the negative effects on economic growth, nutrition and health, and consumer satisfaction. This implies an inverse tradeoff relationship between CO₂ and non-fossil (especially nuclear) power.

"ACID RAIN . . ."

There is trend evidence that the pollution of acid rain has been getting more intense, and that it has some ill effects on fresh water lakes and their fish, upon perhaps forests, and hence upon people's ability to enjoy nature. Emissions from combustion of fossil fuels are undoubtedly a partial cause, although natural sources also contribute. There is some evidence of limited local ecological damage, but no proven threat to agriculture or human life. The trend deserves careful monitoring. The consensus of recent official committee reports (with which we agree) questions the use of high-sulfur coal for power production. This squares with our general advocacy of nuclear electricity generation. Whether any tighter pollution controls are warranted, economically or otherwise, has not been established. Fighting acid-rain effects on fish by liming lakes does not generally seem economically feasible. The acid-rain issue increases the comparative advantage of nuclear power plants relative to coal-burning plants. As with CO₂, then, there is an inverse tradeoff relationship between nuclear power and acid rain.

"REGIONAL WATER SHORTAGES WILL BECOME MORE SEVERE"

In the previous decade or so, water experts have concluded that the "likelihood of the world running out of water is zero." The recent UN Report of the World Environment, for example, tells us not to focus upon the ratio between physical water supply and use, as *Global 2000* does nevertheless, and emphasizes making appropriate social and economic as well as technological choices. From this flows "cautious hope from improved methods of management." That is, an appropriate structure of property rights, institutions, and pricing systems, together with some modicum of wisdom in choosing among the technological options open to us, can provide water for our growing needs at reasonable cost indefinitely.

Moreover, *Global 2000*'s statements about the world's future water situation are completely inconsistent with—in fact, are completely opposed to—*Global 2000*'s own analysis of what can reasonably be said about the world's water resources. It develops a sound analysis that finds that no reasonable or useful forecasts can be made about the world's water supply, but then proceeds to offer frightening forecasts totally inconsistent with its analysis. This inconsistency should be more than sufficient grounds to reject *Global 2000*'s gloomy conclusions out of hand.

"ENERGY . . ."

The prospect of running out of energy is purely a bogeyman. The availability of energy has been increasing, and the meaningful cost has been decreasing, over the entire span of humankind's history. We expect this benign trend to continue at least until our sun ceases to shine in perhaps 7 billion years, and until exhaustion of the supply of elemental inputs for fission (and perhaps for fusion).

Barring extraordinary political problems, we expect the price of oil to go down. Even with respect to oil, there is no basis to conclude that the price will rise until the year 2000 and beyond, or that humankind will ever face a greater shortage of oil in economic terms than it does now; rather, decreasing shortage is the more likely, in our view. For the next decade or two, politics—especially the fortunes of the OPEC cartel, and the prevalence of war instability—are likely to be the largest element in influencing oil prices. But no matter what the conditions, the market for oil substitutes probably constitutes a middle-run ceiling price for oil not much above what it is now; there could be a short-run panic run-up, but the world is better protected from that now than in the 1970s. And if free competition prevails, the price will be far below its present level.

Electrical power from nuclear fission plants is available at costs as low or much lower than from coal, depending upon the location, and at lower costs than from oil or gas. Even in the US, where the price of coal is unusually low, existing nuclear plants produce power more cheaply than from coal. Nuclear energy is available in unlimited quantity beyond any conceivable meaningful human horizon. And nuclear power gives every evidence of costing fewer lives per unit of energy produced than does coal or oil. The main constraints are various political interests, public misinformation, and cost-raising counter-productive systems of safety regulation. Nuclear waste disposal with remarkably high levels of safeguards presents no scientific difficulties.

Energy from sources other than fossil fuel and nuclear power, aside from hydropower where it is available, do not hold much promise for supplying the bulk of human energy elements, though solar power can be the cheapest source of power for heating buildings and water in certain geographic locations. The key defect of solar power, as well as with its relatives such as power from waves, is that it is too dilute, requiring very large areas and much capital to collect the energy.

"RAPID GROWTH IN WORLD POPULATION WILL HARDLY HAVE ALTERED BY 2000 . . . THE RATE OF GROWTH WILL SLOW ONLY marginally FROM 1.8 PERCENT A YEAR TO 1.7 PERCENT"

Population forecasting involving fertility is notoriously unreliable. The birth rate can go down very rapidly, as numerous countries have demonstrated in the past few decades, including a country as large as China. (The rate can also go up rapidly, as the baby boom in the U.S. following World War II demonstrated.) Therefore, confidence in any such forecast for a matter of decades would be misplaced. The passage of only a handful of years already seems to have knocked the props out from under *Global 2000's* forecast quoted above. The world's annual growth rate, which was 2.2 percent less than two decades ago in 1964–5, is down to 1.75 percent (US Department of Commerce News, 31 August 1983), a broad decline over the bulk of all the

poorer and faster-growth nations. Though the growth rate may have stabilized in the last few years, these data alone seem inconsistent with the *Global 2000* forecast. The author of that forecast acknowledges that we have already moved from their "medium" forecast to their "low" forecast.

Even the apparently sure-fire *Global 2000* forecast that "in terms of sheer numbers, population will be growing faster in 2000 than it is today" might very well turn out to be wrong. Because the total population will be larger in 2000 than now, the fertility rate would have to be considerably smaller than it is now to falsify that forecast. But the drop would have to be only of the magnitude of the drop during the past two decades for that to come about, which would not seem beyond possibility.

More generally, the *Global 2000* forecasts of a larger population are written in language that conveys apprehension. But viewing the long sweep of human history, larger population size has been a clear-cut sign of economic success and has accompanied improvement in the human lot. The growth in numbers over the millennia, from a few thousands or millions living at subsistence to billions living well above subsistence, is proof positive that the problem of sustenance has eased rather than intensified. And the increase in life expectancy, which is the main cause of the increase in population size, is not only a sign of success in agriculture and public health, but also is the fundamental human good.

In the long run, human beings are the only possible source of human progress. Therefore, we consider *Global 2000's* choice of language to describe population developments to be inappropriate and misleading.

Our positive statements about the recession of the physical constraints upon human progress are based primarily upon presently known progress, not taking into account possible or even likely advancements in technology. If we were to take into account such possibilities as the resources available to us in space and other such advances—even those possibilities which are already solidly worked out scientifically—our assessment would be much more "optimistic" than it is.

Notes

1. Paragraph adapted from Kahn and Schneider (1981). Various other material adapted from Simon (1981).
2. Carter (1980:575–6).
3. *Time*, 4 August 1980, 54.
4. *Newsweek*, 4 August 1980, 38.
5. Champaign-Urbana *News Gazette*, 24 July 1980, 1.
6. For additional material on *Global 2000's* factual errors and internal inconsistencies, see Simon (1981).
7. Ned Dearborn, one of the three *Global 2000* staff writers, stated in the abstract of a public talk he gave at the 1982 meeting of the

American Association for the Advancement of Science:

By deliberate political choice, only part of the *Global 2000 Report to the President* was featured in the Report's summary volume and press releases—the part containing the Report's projections. The other part, while not suppressed, was barely mentioned in the official material receiving the widest distribution.

References

- Ascher, William (1978), *Forecasting* (Baltimore: Johns Hopkins Press).
- Barney, Gerald O. (1982), "Improving the Government's Capacity to Analyze and Predict Conditions and Trends of Global Population Resources and Environment," manuscript dated 24 March.
- Carter, Luther, J. (1980), "Global 2000 Report: Vision of a Gloomy World," *Science*, 209 (1 August): 575-6.
- Champaign-Urbana *News Gazette*, 24 July 1980, 1.
- Clark, Colin (1957), *Conditions of Economic Progress*, 3rd edn. (New York: Macmillan).
- Clawson, Marion (1981), "Entering the Twenty-First Century—The Global 2000 Report to the President," *Resources*, 66 (Spring): 19.
- Council on Environmental Quality, United States Department of State (1981), *Global Future: Time to Act*, January: 1-209.
- Dearborn, Ned (1982), Address to American Association for the Advancement of Science, January.
- Dubos, Rene (1982), "Half Truths about the Future," *Wall Street Journal*, 8 May, editorial page.
- Global 2000 Report to the President*, i, ii, and iii (Washington, DC: US Government Printing Office, 1980).
- Gwatkin, Davidson R. (1980), "Indications of Change in Developing Country Mortality Trends: The End of an Era?," *Population and Development Review*, 6 (December): 615-44.
- Hamilton, C. F. (1982), Memo from Command and Control Technical Center, Defense Communications Agency.
- Holdgate, Martin W., Kassas, Mohammed and White, Gilbert F. (1982), *The World Environment, 1971-1982* (Dublin: Tycooly).
- Kahn, Herman, and Schneider, Ernest (1981), "Globaloney 2000" *Policy Review*, Spring: 129-47.
- Kumar, Joginden (1973), *Population and Land in World Agriculture* (Berkeley: University of California Press).
- Mayr, Ernst (1982), *The Growth of Biological Thought: Diversity and Inheritance* (Cambridge, Mass.: Belknap Press of Harvard University Press).
- Morawetz, David (1978), *Twenty-Five Years of Economic Development 1950-1975* (Baltimore: Johns Hopkins).
- Myers, Norman (1979), *The Sinking Ark* (New York: Pergamon).
- Myrdal, Gunnar (1975), *Against the Stream—Critical Essays on Economics* (New York: Vintage Books).
- New York Times*, 31 January 1983, 5.
- Newsweek*, 4 August 1980.
- Simon, Julian L. (1981), "Global Confusion, 1980: A Hard Look at the Global 2000 Report," *Public Interest*, 62 (Winter): 3-21.
- Time*, 9 August 1980.
- US Department of Commerce, Bureau of the Census (1977), *Social Indicators: 1976* (Washington, DC: US Government Printing Office).
- US Department of the Interior, National Park Service (1944), *Information Relating to the National Park System*, 30 June.
- Wall Street Journal*, 15 September 1980, 32.
- Wall Street Journal*, 1 April 1983, 13.
- Willson, Pete (1982), Memorandum, Alan Guttman Institute, 17 September.