1 Our Common Journey

The test of our progress is not whether we add more to the abundance of those who have much; it is whether we provide enough for those who have too little.

Franklin Delano Roosevelt (Second Inaugural Address, January 20, 1937)

Over the last two decades, as appreciation of the challenge of "sustainable development" has very rapidly grown, the term has been used with diverse and evolving meanings in public debate and the scholarly literature. At the outset of our analysis, we therefore look at these various uses of the term. Next, we review action that has been taken in pursuit of sustainability goals since the 1987 publication of the World Commission on Environment and Development's report (often called "the Brundtland report") *Our Common Future*. In the heart of this chapter, we develop our concept of a "transition toward sustainability"—a transition over the early decades of the 21st century in which a stabilizing world population comes to meet its needs by moving away from actions that degrade the planet's life support systems and living resources, while moving toward those that sustain and restore these systems and resources. Moreover, this transition would move away from actions that widen disparities in human welfare and toward measures that reduce hunger and poverty. Ours is a normative vision of sustainability, which in our view is defined by the joint objectives of meeting human needs while preserving life support systems and reducing hunger and poverty. This vision is firmly anchored in the goals and aspirations of the world community as expressed through major international conventions and commissions of the past decade. Finally, in this chapter, we close with a brief exposition of the role of science and technology in this transition—a role that we see above all as one of fostering rapid and effective social learning.

SUSTAINABLE DEVELOPMENT: COMMON CONCERNS, DIFFERING EMPHASES

"Sustainable development"—the reconciliation of society's developmental goals with its environmental limits over the long term—is the most recent conceptual focus linking the collective aspirations of the world's peoples for peace, freedom, improved living conditions, and a healthy environment. These four conditions frequently emerge as key ideals of the last half of the 20th century. Peace, the first, was thought to be secured in the postwar world of 1945. It was thereafter complicated by the nuclear arms race, then maintained globally but still fought locally in the long cold war, and is now sought again in places as diverse as Bosnia, Central Africa, the Middle East, and Ireland. Freedom proclaimed itself in the struggle to end imperialism, to extend human rights, and to end totalitarian oppression. Now, in the wake of establishing widespread national independence, development is the primary ideal that captures the hopes of the poorest two-thirds of the world, who aspire to both the basic necessities and the material well-being of the wealthy third. The most recently emphasized ideal has concerned the earth itself, initially focusing on natural resources, later extending to the human environment, and finally to the complex systems that support life on earth. Characteristic of the last quarter of a century is the effort to link all these aspirations of humankind—particularly through the realization of how often the pursuit of one condition requires pursuit of the others. International high-level commissions (such as the Independent Commission on International Development Issues 1980 [Brandt], the Independent Commission on Disarmament and Security Issues 1982 [Palme], and the World Commission on Environment and Development 1987 [Brundtland]), often followed by great international conferences, have attempted to make a case, moral and pragmatic, for such links. A specific recent focus has thus been on the critical relationships between development and the environment.

Many notions now incorporated within the concept of sustainable development can be traced back through the 1980 World Conservation Strategy and the 1972 Stockholm Conference on the Human Environment to the early days of the international conservation movement.[1] Today's understanding of the links between environment and development, however, is little more than a decade old, stemming from the Brundtland report, *Our Common Future*.[2] The idea of sustainable development was given additional impetus at the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro. It has rapidly spread and is now a central theme in the missions of countless international organizations, national institutions, "sustainable cities," and locales.

The genius of the idea of sustainable development lies in its attempt

to reconcile the real conflicts between economy and environment and between the present and the future. Thus, the Brundtland Commission, in its widely accepted statement, defines sustainable development as the ability of humanity "to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs."[3] Within this general framework, an extraordinarily diverse set of groups and institutions have taken the concept of sustainable development and projected upon it their own hopes and goals. There have been extensive reviews of these diverse concepts and definitions.[4] From these reviews, four types of key differences emerge. While sharing a common concern for the fate of the earth, proponents of sustainable development differ in their emphases on (1) what is to be sustained, (2) what is to be developed, (3) the types of links that should hold between the entities to be sustained and the entities to be developed, and (4) the extent of the future envisioned. (See Figure 1.1.)

What Is To Be Sustained

The emphases on what is to be sustained fall within three major areas: nature, life support systems, and community. The most common emphases concern *life support systems*, where the life to be supported first is human. Subsumed within this group are emphases on the classic *natural resources*—which, while found in nature, are particularly useful for people. Classified as either renewable or nonrenewable, flow or stock, these resources have preoccupied many generations seeking to exploit, conserve, or preserve them. In the last quarter of a century, the concept of natural resources has expanded, from a focus on primary products and production inputs to include the values of aesthetics, recreation, and the absorption and cleansing of pollution and waste.[5] This extended view of natural resources becomes popularly associated with *environment* and the many features are defined by ecologists as *ecosystem services*.[6] A recent study catalogued and valued 17 ecosystem services, ranging from atmospheric gas regulation to cultural opportunities.[7]

A less anthropocentric view of life and values is found in the emphases on sustaining *nature* itself for its own intrinsic value. The earth's assemblages of life forms, whether described as *biodiversity* in general, or as *species* or *ecosystems* in particular, are to be sustained not only for their utilitarian service to humans, but also because of humanity's moral obligations. These obligations are characterized as "stewardship"—acknowledging the primacy of humans—or as the proper response to a form of "natural rights" in which earth and its other living things have equal claims to existence and sustenance. Additionally, not only are biological species seen as endangered, but cultural species are as well. Thus, the

WHAT IS TO BE SUSTAINED:	FOR HOW LONG?	WHAT IS TO BE DEVELOPED:
	25 years "Now and in the future" Forever	
NATURE Earth Biodiversity Ecosystems		**PEOPLE** Child Survival Life Expectancy Education Equity Equal Opportunity
LIFE SUPPORT Ecosystem Services Resources Environment	**LINKED BY** *Only* *Mostly* *But* *And* *Or*	**ECONOMY** Wealth Productive Sectors Consumption
COMMUNITY Cultures Groups Places		**SOCIETY** Institutions Social Capital States Regions

FIGURE 1.1 Sustainable development: common concerns, differing emphases.

concept of *communities* to be sustained covers distinctive *cultures*, particular *groups* of people, and specific *places*.

What Is To Be Developed

The emphases on what is to be developed also fall within three major areas: people, economy, and society. More often than not, when development is discussed, the emphasis is on the *economy*, with its *productive sectors* providing both employment and desired *consumption*, and *wealth* providing the incentives and the means for investment as well as funds for environmental maintenance and restoration. Yet another form of development stressed is human development. Such *people*-centered development focuses on the "quantity" of life as seen in the *survival of children* or increased *life expectancy*, and on the quality of life in terms of *education*, *equity*, and *equal opportunity*. Finally, some discussions of what is to be developed adopt a broader conception of *society*, emphasizing the well-being and security of national *states*, *regions*, and *institutions* and, more recently, the valued social ties and community organizations known as *social capital*.

The Links Between

The concept of sustainable development links what is to be sustained and what is to be developed. The emphases differ according to whether the links are stated or implied. For example, the U.S. President's Council on Sustainable Development believes in "mutually reinforcing goals of economic growth, environmental protection, and social equity."[8] It sees these goals as equal in importance and linked together. *And* is the operative conjunction between what is to be sustained, namely, the environment, and what is to be developed, namely the economy and society.

But this is just one of many ways of envisioning the links between what is to be sustained and what is to be developed. Some views, while paying homage to sustainable development, focus almost entirely on just one of the two desiderata, the sustaining or the developing (thereby appearing to suggest "sustain *only*" or "develop *mostly*"). Others, while clearly emphasizing one or the other, subject this choice to a conditional constraint. For example, a Brundtland Commission member, noted "Sustainability is the nascent doctrine that economic growth and development must take place, and be maintained over time, *[but]* within the limits set by ecology in the broadest sense."[9] Other views tend to leave to some set of publics or decision makers with determining the exact nature of and tradeoffs between what is to be sustained *or* what is to be developed.

For How Long?

It is widely thought that sustainable development is meaningful only if it is intergenerational. Thus, there is general acceptance of the loosely stated time horizon of the World Conference on Environment and Development as *now and in the future*. The time horizons considered in specific contexts for future sustainable development, however, range from a single generation of *25 years* or so, to several generations, as in the Intergovernmental Panel on Climate Change (IPCC) assessments that extend until 2100, to an unstated, but implicit, *forever*. Each of these time periods presents very different prospects and obstacles for sustainable development. Over the space of a single generation, almost any development appears sustainable. Over forever, almost none do, as even the smallest growth in numbers, resource use, or economy extended indefinitely creates situations that seem surely unsustainable. Over the century encompassed by many energy-environment assessments (e.g., those of the IPCC), the large-scale and the long-term dimensions of the future are both remote and uncertain. The sustainability of development in any usefully concrete sense is even more so.

SUSTAINABLE DEVELOPMENT: THE FIRST DECADE

The vision of the interdependence of development and environmental protection, first sketched in the Brundtland report, was fleshed out at the 1992 Rio Conference on Environment and Development (UNCED), oftentimes referred to as the "Earth Summit." The summit's "Rio Declaration" and "Agenda 21" together set forth detailed principles, action programs, and resource needs for achieving sustainable development in the 21st century.[10] Following the Earth Summit, international conventions on biological diversity, climate change, desertification, and the law of the sea have entered into force. Ongoing negotiations are evaluating the implementation of these agreements and of other treaties adopted before the summit. A number of additional international conferences on sustainable development have been held, including conferences on small island developing states, population and development, social development, straddling and migratory fish stocks, women, human settlements, and food.[11] Intergovernmental panels and forums are also considering problems of chemical safety, forests, and climate change. Finally, an uncounted number of regional, national, and local sustainable development initiatives have been undertaken in every corner of the world.

A UN Commission on Sustainable Development (UNCSD) was established in the wake of the Earth Summit to monitor and report on imple-

mentation of the agreements reached in Rio. The commission's first review was tabled and discussed at a UN General Assembly Special Session in June 1997. The resulting UN resolution on the "programme for the further implementation of Agenda 21," supplemented by the assessments of other organizations and by analyses undertaken by the Board on Sustainable Development, suggests a sobering appraisal of the successes, failures, and unfinished business of the first decade of efforts to realize sustainable development. Many participants and observers at the UN special session concluded, with some justification, that efforts to implement the Brundtland and Rio agendas on sustainable development have failed. While Brundtland and Rio had been hailed as great successes, the leaders of the UN's 1997 special session could only make note of their countries' efforts to hold themselves accountable without implying that substantial progress had been made on previous commitments. Moreover, media and political attention to the environment have plummeted from their post–Brundtland report peak. Many participants in the special session have observed that the drive and optimism that characterized Rio seem to have given way to resignation and cynicism.

Environment and Development

Sustainability initiatives must ultimately be evaluated in terms of their impacts on patterns of environmental degradation and human development. The disappointing conclusion of the 1997 UN special session was that the impacts of sustainability initiatives on global trends in development and environment have been few, small, and slow. Backed by the UN Environment Program's recently published *Global Environmental Outlook 2000,*[12] the special session noted:

- While population growth rates continue to decline globally, the number of people living in absolute poverty has increased.
- While globalization has presented new opportunities for sustainable development, many countries have been unable to take advantage of those opportunities; the extent of income inequality within and among nations, and the technology gap between the richest and poorest countries have all increased.
- While a number of countries have significantly reduced some levels of pollution and slowed or reversed resource depletion, the state of the global environment has continued to deteriorate, with generally increasing trends of pollution threatening to exceed the capacity of the global environment to absorb them.

Funds and Financing

Questions of resources and financing for sustainable development were problematic in the Brundtland report, contentious at Rio, and unresolved at the 1997 UN special session. The Global Environment Facility, an institutional product of the Earth Summit, was created to provide a funding mechanism for supporting the incremental costs of integrating global environmental goals into the development process. Its establishment, restructuring, funding, and replenishment are major accomplishments, but the total resources involved remain inadequate to the tasks at hand. More broadly, even the modest financial pledges made by governments at Rio have generally failed to materialize, substantially limiting the ability and willingness of developing countries to undertake important sustainability initiatives. These shortfalls in governmental assistance are to some extent compensated for by increased private investment flows into developing economies. But the volume of these flows, their ultimate destinations, and their implications for sustainability are not fully understood. Likewise, the relationships between financing sustainable development and regulating international trade and multinational corporate activities remain underdeveloped and poorly understood.

The View from Below

Despite these global concerns and disappointments, there is a more encouraging version of the story about sustainable development's first decades. This version holds that significant policy change of the sort sought by sustainability initiatives commonly requires a decade or more to come to fruition.[13] With the Brundtland Commission's *Our Common Future* barely 10 years old, and the Rio "Agenda 21" only half that, it is then not surprising that most of these proposals' tangible impacts on people and the environment lie in the future. To see this view of the story, in short, requires a shift in perspective from a short-term, globally averaged vision of international diplomacy and the media to a longer term and more local view of sustainable development as it is happening on the ground.

The abundant examples of local successes in sustainable development are not detailed in any one collection, although the submissions of individual countries and organizations to the UN Commission on Sustainable Development in preparation for the 1997 special session are a good place to begin.[14] These local pictures are, of course, complete with their own share of environmental horrors, economic greed, and program failures. But compared with 20, 10, or even 5 years ago, the degree to which notions of sustainability have entered mainstream thinking is as-

tounding. Nongovernmental organizations (NGOs) and private corporations have been central to this transformation. Together with local and regional communities, they are carrying forward much of the ongoing work on sustainable development. Governments and international organizations have crucial roles to play in facilitating this work and in making sure that it does not leave pressing concerns unaddressed. The international scientific and engineering communities can make very significant contributions to sustainable development in particular sectors, areas, societies, and regions. Educators in early and continuing education can inform the general public about sustainability issues and make these issues an integral part of the university curricula relating to science, technology, and business. Whether these groups can in fact move beyond the verbal and political stalemate evident at the UN special session and learn to play their new roles effectively may be one of the most important questions in the next century, when the world's people begin their next appraisal of progress towards sustainability.

Knowledge* and Know-How†

As noted earlier, discussions of the role of science and technology have not been central to the last decade's debates on sustainable development. Few have denied the importance of mobilizing knowledge and know-how, but fewer still have applied themselves seriously to what this task might entail and how it might be done. Even Rio's "Agenda 21," drawing on the proceedings of the International Council for Science's (ICSU) International Conference on an Agenda of Science for Environment and Development into the 21st Century[15] known as "ASCEND 21," devotes only 3 out of 40 chapters to science and technology and has little to say about priorities or their implementation. With so little to aim at, the 1997 UN special session did not even try to appraise the implementation of Rio's vague intentions for science and technology. Instead, it confined itself to a reiteration of general needs. In consequence, societies approach the 21st century with little in the way of a useful strategic appraisal of how to identify and create the knowledge and know-how most crucial to achievements in sustainable development.

* *Knowledge* here refers to the *Webster's Ninth New Collegiate Dictionary* definition, "… the fact or condition of knowing something with familiarity gained through experience or association…or the acquaintance with or understanding of a science, art, or technique."

† *Know-how* here refers to the *Webster's Ninth New Collegiate Dictionary* definition, "knowledge [conveyed by expertise] of how to do something smoothly and efficiently."

GOALS FOR A SUSTAINABILITY TRANSITION

If the genius of sustainable development is to allow all in the common tent to project their hopes and goals, one limit of this valuable concept then is that it encompasses too much to provide a framework to map research and policy in the years ahead. Even if there were consensus on what specifically to sustain and what specifically to develop, and for how long, societies would not know how to arrive at these goals. The experience of efforts to adaptively manage natural resources and to cope with natural hazards is instructive—an experience partly captured in the metaphor of *Compass and Gyroscope*.[16] In such situations, scientific understanding is incomplete, past policies have often failed, new policies are untested, and the unexpected is a recurrent truth. At best, science can provide compass direction, while the gyroscope of politics can maintain some steadiness of course across often-uncharted seas. In light of the trends of population growth, increased consumption, global connectedness and diversity, and environmental stress (see Chapter 2), a transition to sustainability appears necessary, but remote and difficult.

Such a transition will entail meeting the needs and coping with the desires of many more people than there are today in the space of two human generations—which is just a few decades ahead. By 2050, UN demographers project a population of about 8.9 billion, with a range from 7.3 to 10.7 billion.[17] Meeting the needs of that many people implies much greater consumption of energy and materials and the environmental and ecological problems that result from their extraction, consumption, and disposal. These problems will be compounded as more people adopt the materials-intensive, consumption-oriented lifestyle now enjoyed by industrialized nations.

The increasing connectedness of economies, peoples, and technologies will fuel growth in some parts of the world, diminish it in others, and amplify the forces that drive increased consumption (see Chapter 2). Some environmental problems of the industrialized world will be exported to the developing and recently industrializing countries, and also, with some delay, the institutions and technologies to address them. In a more connected but still diverse world, differences in human experience will offer opportunities for alternative lifestyles and new possibilities for addressing our common future. Yet at the same time, increasingly widespread divisiveness may well make common tasks much more difficult. War, the ultimate expression of conflict, remains the greatest threat to human development, life support systems, and the environment.

Driven by population growth and increasing consumption, past and current practices of energy and material transformation have led to the large-scale introduction of pollutants, the widespread destruction of biota,

and human-induced climate change—which are already threatening the life support systems of many local areas and a few regions. In the future, with large increases in total population and consumption, these environmental threats, cumulative and linked, could threaten the life support systems of entire regions and the globe.

For a successful transition to sustainability, the world must provide the energy, materials, and information to feed, house, nurture, educate, and employ many more people than are alive today—while preserving the basic life support systems of the planet and reducing hunger and poverty. The Board has adopted this framework of a "transition toward sustainability" to help encourage movement over the next few decades toward meeting human needs in ways that do less damage to the physical and biological support systems for life, and more to sustain or restore them, along with movement toward development paths that do less to widen disparities in human welfare and more to reduce or eliminate hunger and poverty. In short, in the Board's judgment, **the primary goals of a transition toward sustainability over the next two generations should be to meet the needs of a much larger but stabilizing human population, to sustain the life support systems of the planet, and to substantially reduce hunger and poverty.** Using goals outlined in international conventions, we define meeting human needs as providing food and nutrition, nurturing children, finding shelter, providing an education, and finding employment. We define preserving life support systems as ensuring the quality and supply of fresh water, controlling emissions into the atmosphere, protecting the oceans, and maintaining species and ecosystems. We define reducing hunger and poverty as ensuring income growth, employment opportunities, and essential safety net services. Although the conventions and agreements we looked to for our definitions each have their own limitations, we believe that altogether they constitute a well-founded set of values and objectives on which to base discussions of sustainability. Their international input and endorsement ensures that the goals, which guide our transition toward sustainability, are relevant to and supported by governments and citizens worldwide.

The Board's interest in focusing on the prospects for a global transition toward sustainability over the coming decades flows from our scientific understanding of trends in the environment, development, and associated problems. It is over the lifetimes of the next two generations of the world's citizens that we anticipate the greatest stresses arising through growing numbers and concentrations of people, extraordinary increases in energy and material throughput, and institutions just learning to cope with the barriers and opportunities of globalization. But if our scale of concern is based on technical understanding, our threefold conceptualization of a successful transition—meeting human needs, preserving life

support systems, reducing hunger and poverty—is a normative judgment, both scientific and moral.

Our knowledge tells us much about what is needed to feed, nurture, house, educate, and employ; what imperils life support systems; and how to reduce hunger and poverty. But to accept the responsibility of meeting the human development needs of generations yet to come, of providing the minimal necessities to reduce hunger and poverty, and of sustaining the natural world that in turn sustains us is a choice for which we have no special aptitude beyond our common humanity. Fortunately for science, it is not a choice we make alone, but is widely confirmed by the conference proceedings and statements representing the world's peoples and nations' consensual choice of goals to meet human needs. Unfortunately for humanity, societies have not begun to meet most of the targets established by international consensus. However, analysis of trends in human development (see Chapter 2) shows substantial improvements in the overall well-being of people over the past two generations. In our review and analysis, we have not attempted to determine closely how achieving any one of these international goals may affect the realization of others. To do so is a central challenge for any transition to sustainability.

Meeting Human Needs

Providing Food and Nutrition

To feed the increased population of the next two generations is to meet both the basic need for food and the desire for varied diets. The former has been reasonably well defined by the sciences of human physiology and nutrition—that is, what food is needed to avoid hunger. The desire for the varied diets is evident in the behavior of people—they choose diets of increasing variety, often in the form of animal consumption, when income and opportunity permit. The basic need for food and the avoidance of hunger have been the focus of repeated international meetings. Based on these meetings, and the recent World Food Summit held in Rome in 1996, we can derive minimal goals in the area of nutrition for a transition toward sustainability.

Chronic hunger and nutrient deficiencies are part of the daily experience of more than a billion people. For them, hunger is a dietary intake that does not provide the kind and quantity of food required for growth, activity, or the maintenance of good health. Such biologically defined hunger comes in many guises, four of which are globally estimated on a regular basis. Starvation, the near absence of dietary intake suffered in the course of famines, can be contrasted with undernutrition, the chronic or seasonal absence of needed food proteins and caloric energy. There is also

the hidden hunger of micronutrient deficiencies, among which three predominate: dietary shortages of iron, iodine, and vitamin A. Also, there are the nutrient-depleting diseases, in which dietary intake may not be absorbed or is wasted by fever or parasites.

Because famines are such dramatic events, they are often equated with hunger by the media and the public, yet they actually constitute a very small fraction of world hunger.[18] Despite the widespread attention focused on recent famines, only about 15 to 35 million people have been at risk of famine in recent years. Indeed, there has been a consistent decline in the numbers at risk of famine over time, and today famine only occurs where there is war or civil unrest. The major hunger problem of the world is undernutrition, in which needed food proteins and caloric energy are chronically or seasonally absent. (Micronutrient deficiencies and wasting diseases are addressed further in the next section.)

The extent of undernutrition is estimated indirectly as the number of persons in households that cannot provide food sufficient for health, moderate activity, and children's growth. The most recent United Nations estimate found 828 million people in developing countries resided in such households in 1994 to 1996, representing about 19 percent of the population of developing countries.[19] By this measure, hungry people in developing countries decreased by 80 million over the last two decades, and the proportion of hungry people almost halved (from 35 to 19 percent), despite the increase in global population of well over a billion people. The decline in numbers of hungry people has taken place primarily in China and South and Southeast Asia; some of these improvements may have reversed recently with the massive economic decline in Southeast Asia. Additionally, during the 1980s, the numbers of hungry people rose in Africa and Latin America, and they continued to rise in the 1990s in Africa.

The current international consensus, as evidenced in the Rome Declaration on World Food Security calls for a rapid acceleration in worldwide hunger reduction efforts. The declaration calls for a "common and national commitment to achieving food security for all and to an ongoing effort to eradicate hunger in all countries, with an immediate view to reducing the number of undernourished people to half their present level no later than 2015."[20] By the year 2015, then, the declaration thus calls for the number of undernourished people to drop by half—from 800 million to 400 million—and thereafter for the maintenance of this trend for the eventual elimination of hunger. Assuming that population grows significantly during the first target period, the rate of undernourishment would need to be reduced by more than half in the following decades.

Nurturing Children

To nurture the children of this and the coming two generations is also to provide the gift of life itself, in the form of health and nourishment for growth, protection from harm or abuse, and a caring environment that furnishes the necessary stimuli for physical and mental development. International concern has focused on the critical years of vulnerability, (i.e., infant and under-five mortality), on health and nourishment (i.e., low birth weight, wasting, stunting, and disease), on children's rights, and on later years of education.

In 1990, some 12.5 million children under the age of five died, mostly (in descending order of impact) from diarrhea, pneumonia, birth-related causes, measles, malaria, tetanus, whooping cough, tuberculosis, and diphtheria—though many died from multiple causes.[21] Some 142 million children were also born in that year, 88 percent in developing countries. If prevailing trends continue, for every 100 children, 17 will be born with low birth weights, 94 will live to age one, and 91 to age five, yet of these surviving 91, 28 will be malnourished.[22] Similar indices of morbidity and mortality can be found in pockets of poverty within some industrialized countries, such as the United States, that have high levels of child nurture overall.

Even when children recover from such diseases, there are lasting effects on their development. Low birth weight can prevent a child from realizing his or her full potential mental and physical development. Nutrient-depleting diseases contribute to the pronounced wasting and stunting of children (low weight and height for age), the characteristic measure of children's undernutrition. For example, diarrhea inhibits the absorption of dietary intake; measles and malaria waste the intake by fever; and parasites, such as worms, rob the intake. In all, 184 million children under five years of age, over a third of the world's children, were estimated to be underweight in 1990—a number that had risen because of increased population growth, even though the proportion of children underweight had actually declined since 1975. Over half of these underweight children lived in Bangladesh, India, and Pakistan.[23] A lively debate persists over whether such numbers are overestimates.

Children also suffer from dietary shortages of iron, iodine, and vitamin A, in the hidden hunger of micronutrient deficiencies. Severe anemia leads to death, while moderate iron deficiency causes lethargy, low work potential, and severe learning disabilities that can persist lifelong. Upward of 12 percent of the world population suffers from iodine-deficient goiter, and more severe deficiencies lead to the dwarfism and idiocy of cretinism, deaf-mutism, and impaired fetal growth and development. Vitamin A deficiency leads to eye diseases, blindness, and death in small

children, and is also linked to increased risk of infection and overall mortality in children.

In October 1990, the World Summit for Children[24] brought together representatives of 150 countries and 71 heads of state to formally adopt a series of goals for the year 2000. These included a one-third reduction in child deaths, halving of child malnutrition, immunization levels of 90 percent, control of major childhood diseases, eradication of polio, elimination of micronutrient deficiencies, halving of maternal mortality rates, provision of primary school education for at least 80 percent of children, provision of clean water and safe sanitation for all communities, and ratification of the 1989 Convention on the Rights of the Child.

Finding Shelter

To house the many more people of the next two generations, in the words of one international agreement, is to ensure "shelter and basic services which are financially affordable and adequate in terms of space, quality, health, design, durability, livability, and accessibility."[25] There is greater variety of interpretation in these standards than in requirements for food and nurture, but international concern focuses on an end to homelessness, with basic shelter that is affordable, secure in tenure and location, and healthy, with access to clean and safe drinking water, sewage and refuse disposal, and living and working quarters that are free of indoor air pollution.

The lives and health of at least 600 million urban dwellers in Africa, Asia, and Latin America are continually at risk because they occupy housing that is overcrowded and of poor quality, and that inadequately provides for water, sanitation, drainage, and garbage collection. A billion more rural dwellers live in similar conditions, largely because of inadequate water and sanitation. An estimated 100 million people have no home and sleep outside or in public buildings or, where available, in night shelters. Several million more homeless people are found in Europe and North America. Most low-income households are particularly vulnerable to eviction, as they have no legal tenure of the house they occupy. Several million urban dwellers are forcibly evicted from their housing each year. In fact, most new housing in the cities of developing countries has been built on illegally occupied or subdivided land.[26]

In 1996, the Second UN Conference on Human Settlements, Habitat II, took place in Istanbul, Turkey. While avoiding the proposal of quantitative goals, representatives of the 171 nations assembled adopted "the goal of ensuring an adequate supply of shelter and basic services for all and improving living and working conditions on a sustainable basis so that everyone, including people living in poverty, the vulnerable and the

disadvantaged, will have access to shelter and basic services which is financially affordable and adequate in terms of space, quality, health, design, durability, livability and accessibility."[27] In addition, the participants committed themselves to "make special efforts to eradicate homelessness by promoting the availability of affordable low-cost, decent housing, targeting subsidies to the most needy and providing emergency shelter where needed."[28] More specific than general statements on shelter was the commitment made in 1990 to provide clean water and sanitation to all, both rural and urban dwellers, by the year 2000. These commitments were necessary to build on the poor progress and partial achievements of the International Drinking Water Supply and Sanitation Decade (1981–1990), which was coordinated by the World Health Organization.

Providing an Education

To educate the current and coming two generations is to help them develop their skills, knowledge, and capacity for learning such that they become literate members of their communities, acquire the necessary skills for work, and have access to the cumulative storehouse of human culture. Such education is both formal and informal, but international attention has focused on a single competency—literacy—and on the formal requirements of primary, secondary, and post-secondary schooling.

In 1995, world adult literacy was estimated at 74 percent for men and 56 percent for women, down from the 1990 figures of 81 percent for men and 66 percent for women; primary school enrollment (as percentage of age group) was 88 percent for boys and 84 percent for girls, and successful completion of fifth grade stood at 78 percent, roughly the same as the figures for 1990.[29] For every 100 children born in 1990, given then-current trends, 85 would start primary school, 55 would finish, and 32 would complete secondary school.[30] Thus, approximately 100 million six to eleven year olds were not attending schools (60 percent of whom were girls), and one in four adults (two-thirds of them women)—or almost a billion people—could not read or write.

In 1990, the World Conference on Education for All was held in Jomtien, Thailand, followed by the World Summit for Children.[31] At Jomtien, three commitments were made to basic education for all. The first was to bring literacy, numeracy, and essential life skills to the great majority of children during the 1990s. The second was to reduce the adult illiteracy rate to half its 1990 level. And the third was to end the great disparities in education between boys and girls. The World Summit for Children reinforced these goals by making specific commitments to complete by the year 2000: universal access to basic education, primary edu-

cation completed by at least 80 percent of primary age school children, and reduction of the adult illiteracy rate (though it varies from country to country) to at least half its 1990 level, with emphasis on reducing female illiteracy.[32] Since the conference in Jomtien, basic education has gained a higher profile in policy discourse within the donor community than it had in the 1980s. Yet as of the mid-1990s, an increase in the number of educated girls had not been realized,[33] and among the majority of bilateral donors, the level of funding for basic education projects and programs in developing countries was inadequate to meet the goals for education set out in Jomtien.[34]

Finding Employment

To employ the present unemployed or underemployed and the emerging labor force of the next two generations is to provide the opportunity for meaningful work, to fulfill a need to engage the mind and body in productive activity, and to receive in turn a level of material security and sustenance. International concerns have focused on job creation, both formal and informal, conditions of work, and remuneration sufficient to maintain households above the poverty level.[35] The Copenhagen Declaration, a nonbinding agreement adopted at the World Summit for Social Development in 1995, and the following report,[36] set out the commitment by governments to promote the goal of full employment. In the industrialized countries, the main worry is that increasing unemployment has become a permanent feature of the economy. In Europe, for instance, the rate of unemployment exceeds 10 percent in many countries, although many countries are adopting measures to bring more labor into the workforce (e.g., by creating more flexible labor markets and work rules, and reducing the costs of benefits for permanent workers and the number of hours in the work week) in an effort to meet targets agreed upon for European integration. In the United States, Norway, and Japan, the unemployment rates are lower and stable, although in the case of Japan, the unemployment rate has risen sharply and is of concern.[37] Finally, there is great disparity in unemployment across divisions of age and wage, with high numbers of the young entering the workforce, and with laid-off middle-aged, and ethnic minorities being unemployed. In some developing countries, unemployment rates are loosely estimated to be as high as 50 percent, although data for unemployment in most developing countries, particularly in Africa, are scarce.[38] Equally problematic, especially for rural areas, is underemployment, both seasonal and sustained, that is, working substantially less than full time and wishing to work longer, or earning less than a living wage. Underemployment rates are estimated to be about 25 to 30 percent of the world's labor force.[39]

With much of developing countries' labor forces in the agricultural sector, growing rural populations and increased agricultural productivity often create fewer per capita opportunities for agricultural employment. The problem is not that people have no work; rather they do not have enough work or work at a wage too low to earn an adequate amount of money.

While there are excellent data on paid employment for industrialized countries, no equivalent data exist for developing countries.[40] In the latter countries, much employment is self-employment or farm labor, or is seen in the very large, so-called informal sectors of the economy—none of which have regular reporting systems for numbers of people employed, wages, or earnings. These data shortages are mirrored by the lack of specific good intentions normally articulated in legally binding conventions and international agreements. Unlike the other human needs reviewed here, the need for work for all has received little serious international attention or commitment (except through general economic development programs) beyond the concerns of the industrialized countries.

Targets for Meeting Human Needs

Internationally agreed-on targets for meeting human needs exist for four of the five major needs of providing food and nutrition, nurturing children, finding shelter, providing an education, and finding employment. These are summarized in Table 1.1. A comparative review of these needs and aspirations in meeting the targets suggests two important conclusions. First, there is an implicit hierarchy of needs that favors children and people in disasters, and the activities of feeding and nurturing first, followed by education, housing, and employment. This hierarchy is demonstrated by the specific goals adopted, the ambition of their targets, the emphases of the conferences that adopt the targets, the information systems that monitor progress, and the international agencies that coordinate implementation. For example, it was the World Summit for Children, which had the highest attendance of heads of state, that adopted the most numerous and ambitious targets for feeding, nurturing, educating, and even housing children and their families. UNICEF (the United Nations Children's Fund), a strong, partly independent, single-purpose UN agency, provides leadership for implementing this agenda and regularly collects data on progress in meeting those goals.

Second, although in general the overall well being of people has substantially improved (see the discussion of trends in human development in Chapter 2), the periodic revising of unmet targets demonstrates the difficulties in acting in sustained ways over large scales and over long time horizons. Even the most desired goals for the betterment of children, as societies stand today two years away from the deadline for meeting

TABLE 1.1 International Targets for Meeting Human Needs

Needs/ Problem Areas	Year: Target Goal [Adopted By]	Number of People at Risk: At Adoption of Target	Number of People at Risk: More Recently
Providing food and nutrition			
Undernourishment	1996: Reduce by 30% by 2015 [WFS]	840 million	828 million (1996)
Nurturing children			
Under 5 mortality	1990: Reduce by 33% by 2000 [WSC]	14 million	11.7 million (1996)
Malnourished	1990: Reduce by 50% by 2000 [WSC]	177 million	184 million (1996)
Micronutrient deficiencies	1990: Virtual elimination by 2000 [WSC]	Iodine: 1.6 billion Vitamin A: 190 million preschool children Iron: 2.15 billion	N/A
Finding shelter			
Water	1990: Provide to all by 2000 [WSC]	1,230 million	1,115 million (1994)
Sanitation	1990: Provide to all by 2000 [WSC]	1,740 million	2,873 million (1994)
Housing	1996: Provide [UNCHS]	600 million	N/A
Providing an education			
Adult literacy	1990: Reduce by 50% by 2000 [WCE][WSC]	900 million	877 million (1995)
Primary school	1990: 80% complete 4 years by 2000 [WSC]	100 million not in school only 55% complete	71% complete (1993)
Male/Female (M/F) disparities	1990: Reduce [WCE]	Illiterate: 66% F; of those not in school: 60% F	Illiterate: 62% F; of those not in school: 62.6% F (1996)
Finding employment	1995: Full employment [WSSD]	N/A	N/A

Sources: For target goals: [WFS] World Food Summit, (Rome, 1996); [WSC] World Summit for Children, (New York, 1990); [WHO] World Health Organization (1996); [UNCHS] United Nations Conference on Human Settlements, Istanbul, (1996a); [WCE] World Conference on Education for All, (Jomtien, Thailand, 1990); [WSSD] World Summit for Social Development, (Copenhagen, 1995). For number of people at risk: FAO (1998); UNICEF (1999); Uvin (1993); WHO (1996); UNCHS (1996b); UNESCO (1998).

these targets, appear overly ambitious and not likely to be attained. Only the targets for immunization, eradication of Guinea worm, iodine deficiency disorders, vitamin A deficiency (with increased awareness of supplement needs), and acute respiratory infections (with expanded home care) might be met by the year 2000, while the numbers of people who are malnourished or in need of rehydration from diarrheal diseases may be even higher by that date than when the target was originally adopted.[41]

There is also social learning in evidence as shown by the recently agreed-upon target of reducing household hunger by half by the year 2015. The international consensus to give hunger a "half-life" was initiated in November 1989 as a nongovernmental initiative[42] that proposed four goals: (1) to eliminate deaths from famine; (2) to end hunger in half of the world's poorest households; (3) to cut malnutrition in half for mothers and small children; and (4) to eradicate iodine and vitamin A deficiencies. Together, these goals made up a comprehensive yet practical program to end half of world hunger in a decade by building on the better and best of existing programs and policies for overcoming hunger. Over the next seven years, this declaration became in one form or another the hunger reduction agenda for the decade. Its key elements were found in the declarations of the 71 heads of state attending the 1990 World Summit for Children, in the resolutions of the 159 nations participating in the 1992 International Conference on Nutrition, in the deliberations of the 1993 World Bank Conference on Overcoming Global Hunger, in a mid-course nongovernmental review in Salaya, Thailand, in 1994, and finally, in the focus of the 1996 World Food Summit. Over this period of consensus building and discussion, the time required for a "half-life" for hunger grew from a decade (year 2000) to almost a generation (year 2015); in retrospect, a more achievable target.

For scientists, there is an elemental appeal to the concept of the half-life for reducing the great disparities of human development. This appeal is reflected in the approach of several of the world conferences mentioned above that provide the consensus targets upon which we draw. Thus, we suggest that a defensible overarching initial target to meeting human needs would be to halve the current unmet needs in a generation and halve them again in the second generation of a transition to sustainability.

Preserving Life Support Systems

Ensuring the Quality and Supply of Fresh Water

An objective for maintaining freshwater systems is "to make certain that adequate supplies of water of good quality are maintained for the entire population of this planet, while preserving the hydrological, bio-

logical and chemical functions of ecosystems, adapting human activities within the capacity limits of nature and combating vectors of water-related diseases."[43] Without specifying quantitative goals, "Agenda 21" emphasizes the need to protect fresh water in an integrated manner, with a call for national activities for the conservation of water resources, prevention and control of water pollution, and protection of groundwater by the year 2000. The 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes mandates measures to protect transboundary waters against pollution from point sources by calling for the use of low- and non-waste technologies.

Controlling Emissions into the Atmosphere

Goals for controlling emissions into the atmosphere are to prevent changes in the composition of the atmosphere, according to the Convention on Long-Range Transboundary Air Pollution 1979, or in the earth's climate that harm human or natural systems, according to the Framework Convention on Climate Change 1992 and its Kyoto Protocol 1997. The Convention on Long-Range Transboundary Air Pollution, which applies only to several European countries, sets out "to limit and, as far as possible, gradually reduce and prevent air pollution including long-range transboundary air pollution."[44] This convention defines specific goals for maintaining the integrity of the atmosphere through the control of potentially harmful emissions and fluxes of sulfur, nitrogen oxides (NO_x), and volatile organic compounds (VOC). The 1994 Sulfur Protocol commits parties to "control and reduce their sulfur emissions in order to protect human health and the environment from adverse effects, in particular acidifying effects, and to ensure, as far as possible, without entailing excessive costs, that depositions of oxidized sulfur compounds in the long term do not exceed critical loads for sulfur...."[45]*

The Vienna Convention for the Protection of the Ozone Layer of 1985, its 1987 Montreal Protocol on Substances that Deplete the Ozone Layer, and amendments to this protocol were formulated to halt human-induced depletion of the ozone layer. As the convention states, these treaties aim "to protect human health and the environment against adverse effects resulting or likely to result from human activities that modify or are likely to modify the ozone layer."[46] To accomplish these goals, the protocol commits to the phase-out of a specified list of chlorofluorocarbons (CFCs)

* "Critical loads" are defined as the rates of sulfur deposition that receptors (e.g., organisms or ecosystems) can tolerate in the long term. These rates are presented in an annex to the protocol.

and halons and to the full phase-out of carbon tetrachloride by the year 2000; this phase-out date was brought forward four years by a subsequent amendment. In addition, the protocol stipulates the phase-out of methyl chloroform by 2005 and reductions in other chemicals in upcoming years. But methyl bromide, a potent ozone depleter, has proved to be a much more difficult compound to deal with in the protocol, despite widespread scientific agreement concerning its negative effects on human health and the ozone shield. There are several reasons for this difficulty. Methyl bromide impacts are scientifically complex; the substance is present from both natural and human sources; and, unlike CFCs, it is used widely in applications for which no readily available and economically viable substitute has been identified.

Maintaining the earth's climate system means preventing anthropogenic interference with climate processes when this interference would have dangerous implications for life. The 1992 Framework Convention on Climate Change, which was ratified internationally in 1994, set a goal of stabilizing "atmospheric concentrations of greenhouse gases at a level which would prevent dangerous human interference in the climate system."[47] The not-yet-ratified Kyoto Protocol set initial binding targets for greenhouse gas emission reductions by industrial nations only for the 2008–2012 time period, specifying reductions in overall emissions of six greenhouse gases by at least 5 percent below 1990 levels. Because of natural variability in climate, scientists have yet to discern with confidence whether they are seeing a slow or rapid rate of climate change. If the world is on a slow path, societies may only have to adjust modestly. The Kyoto Protocol represents only a first step, and much more drastic reductions might be needed if the world is on a rapid climate change path. In this latter scenario, industrial nations would have to decrease emissions even more, and developing countries also would have to curb growth rates of fossil fuel use.

Protecting the Oceans

To maintain the world's oceans, according to the 1982 UN Convention on the Law of the Sea (UNCLOS), is to prevent pollution of the marine environment "which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, [and] hindrance to marine activities."[48] UNCLOS calls for protection of the marine environment through "the prevention, reduction and control of pollution and other hazards to the marine environment, including the coastline, and of interference with the ecological balance of the marine environment, particular attention being paid to the need for protection from harmful effects of such activities as drilling, dredging, exca-

vation, disposal of waste, construction and operation or maintenance of installations, pipelines and other devices related to human activities."[49] The dumping of specified wastes, including radioactive wastes, or other matter, into marine environments is limited or prohibited without permission of identified authority by the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter.[50] Dumping of substances including mercury, cadmium, and organohalogen compounds is prohibited with certain exceptions by the Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft, 1972.[51]

Maintaining Species and Ecosystems

Maintaining the species and ecosystems of the earth means preventing further exploitation and the ultimate extinction of overharvested or otherwise threatened wildlife; protecting areas or types of ecosystems on which species' survival depends; and maintaining the earth's biological diversity of species and ecosystems.

The most comprehensive agreements to protect marine wildlife worldwide set limits on the harvesting of whales and fish. The International Convention for the Regulation of Whaling 1946, and its amendments, enable the designation of protected species of whales, specific ocean areas such as sanctuaries, open and closed seasons for harvesting, and regulations on whaling methods.[52] For fish and other living marine resources, Article 2 of the 1958 Convention on Fishing and Conservation of the Living Resources of the High Seas sets targets for resource conservation programs at levels that ensure "the optimum sustainable yield from those resources so as to secure a maximum supply of food and other marine products."[53]

Goals for the protection of birds are outlined in the 1950 International Convention for the Protection of Birds (Paris), which prohibits actions that would lead to the destruction of indigenous or migratory species.[54] It establishes protection of all birds during their breeding seasons, and of endangered species year-round, and it restricts the trade of bird and bird components, the removal or destruction of nests, and the mass killing or capture of birds. Protecting other forms of migratory animals in addition to birds, as outlined in the 1979 Convention on the Conservation of Migratory Species of Wild Animals, involves prohibiting the taking of species listed as endangered by the convention, conserving and restoring habitats, removing obstacles to migration, and preventing factors that endanger these species.[55]

Addressing the protection of endangered species globally, the 1973 Convention on International Trade in Endangered Species of Wild Fauna

and Flora (CITES) establishes the need to limit or prohibit trafficking in these species and their products to the extent that trade threatens their existence.[56] It mandates the protection of a total of 30,043 species, 821 of which are considered to be threatened with extinction. Other attempts to protect flora and nonmigratory fauna are often regionally based and focus more on habitat preservation than do agreements that address marine or migratory species.

Efforts to conserve specific types of ecosystems ensure the maintenance of the life support systems that provide essential goods and services for human needs. The 1971 Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar) mandates that each of its parties protect at least one wetland of international importance within its borders.[57] In December 1996, 858 sites totaling more than 54 million acres of wetland worldwide were listed for protection.[58] UNCLOS enables the designation of marine sanctuaries, but does not determine a minimum amount of area that needs to be protected. Preventing desertification and drought is an objective of the 1994 UN Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa. As stated in Article 3, "improved productivity of land, and the rehabilitation, conservation and sustainable management of land and water resources, leading to improved living conditions, in particular at the community level" are critical to maintaining the integrity of land for human use.[59]

To conserve the diversity of the world's species and ecosystems, the 1992 Convention on Biological Diversity outlines broad international objectives. The maintenance of species and ecosystems, according to the convention's first article, entails provisions for "the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources." The convention has no protocols to date, but it requires parties to develop national strategies, plans, or programs to conserve biological diversity and, as stated in Article 6, to integrate "the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies."[60]

Targets for Preserving Life Support Systems

Compared to targets for meeting human needs, quantitative targets for preserving life support systems are fewer, more modest, and more contested. Global targets now exist for ozone-depleting substances and greenhouse gases, and regional targets for some air pollutants (see Table 1.2). Absolute prohibitions (zero targets) exist for ocean dumping of radioactive wastes and some toxics, for the taking and/or sale of a few large

mammals (whales, elephants, seals), migratory birds when breeding or endangered, and certain regional fishing stocks. Water, land resources, and ecosystems such as arid lands and forests have at best qualitative targets to achieve sustainable management or restoration. For example, the Forest Principles set forth at the 1992 World Conference on Environment and Development do not set quantitative targets for forest protection; but they establish in Article 2b that "forest resources and forest lands should be sustainably managed to meet the social, economic, ecological, cultural and spiritual needs of present and future generations" for forest products and services. International standards exist for many toxic materials, organic pollutants, and heavy metals that threaten human health, but not for ecosystem health.

Reducing Hunger and Poverty

In spite of the numerous statistics compiled by the United Nations and the World Bank,[61] no definitive determination exists of the number of hungry and poor people worldwide. Part of the problem is conceptual (e.g., how to draw poverty lines); part of it is practical or motivational (e.g., countries with many poor people invest little to document the fact). Poverty lines that enable analysts to separate the poor from the less needy are difficult to create, though there is a large literature to guide the creation of these lines.[62] An important analytical distinction is between absolute measures, those based on the adequacy of resources and income to provide for minimal necessities of households, and relative measures, those that designate the poor as represented by the lower end of a national or regional distribution of resources and income (e.g., the lowest quintile). Addressing hunger rather than overall poverty further complicates the making of distinctions. Sometimes hunger is measured in ways similar to absolute poverty, such as the inability of a household to obtain food sufficient to meet nutritional requirements (see section on "Providing food and nutrition" above); at other times, it is measured by anthropometric measurements of people, particularly children. These absolute and relative distinctions blur when societal comparisons are made: the income line below which households are considered hungry shifts upward with overall average national income (see sheet 4 of appendix, Chapter 3). Despite these analytical problems, two recent attempts to estimate absolute poverty and hunger are shown in Table 1.3. Between one fifth and one sixth of the world population is poor or hungry, with the largest part of these people in Africa and South Asia.

TABLE 1.2 International Targets for Preserving Life Support Systems

System	Goals and Targets	Target Year	Sources
Water	Give to the satisfaction of basic needs and the safeguarding of ecosystems. National water conservation activities to prevent and control water pollution and protect groundwater	2000	UNCED (1992) (See Agenda 21, chapter 18)
Atmosphere and Climate			
Sulfur	Reduce depositions of oxidized sulfur to below critical loads	N/A	Sulfur Protocol (1994)
Nitrogen oxides (NO_x)	Reduce emissions to, at most, 1987 levels	1994	NO_x Protocol (1988)
Volatile organic compounds (VOC)	Reduce emissions by 30-100% of 1988 levels	1999	VOC Protocol (1991)
Chlorofluoro-carbons (CFCs)	Complete phase-out of specified forms of CFCs and halocarbons	1992	Montreal Protocol (1987, amended 1990, 1991, 1992)
Greenhouse gases (specified forms)	Prevent dangerous human interference in the climate system; Reduce emissions by at least 5% below 1990 levels for industrial nations	2008-2012	Framework Convention on Climate Change (1992); Kyoto Protocol (1997)
Oceans	Prevent, reduce, and control pollution and other hazards to the marine environment	N/A	UN Convention on the Law of the Sea (1982)
Species and Ecosystems			
Whales	Moratorium on harvesting of commercially exploited stocks	1986	International Whaling Commission
Fish	Ensure the optimum sustainable yield of fish and living resources	N/A	Convention on Fishing and Conservation of the Living Resources of the High Seas (1958)

continued

TABLE 1.2 Continued

System	Goals and Targets	Target Year	Sources
Birds	Prevent destruction of indigenous or migratory species	N/A	International Convention for the Protection of Birds (1950)
Biodiversity	Conserve biological diversity	N/A	Convention on Biological Diversity (1992)

TABLE 1.3 Estimates of Population, Poor and Hungry (millions of people)

Region	Hunger (1995)*	Region	Poverty (1993)
Africa	241	Sub-Saharan Africa	218.6
China	210	China	372.3
Eastern Europe and Central Asia	6.3	Eastern Europe and Central Asia	14.5
Latin America and the Caribbean	65	Latin America and the Caribbean	109.6
Middle East	29	Middle East and North Africa	10.7
South and Southeast Asia	337	South Asia	514.7
North America	7	North America	0†
Pacific OECD	1	Pacific OECD	0†
Western Europe	3	Western Europe	0†
World	889	**World**	1313.9

Source: For data on hunger, Raskin et al. (1998); for data on poverty, World Bank (1999).

* Data for hunger are taken from the Reference Scenario in Raskin et al. (1998). See also Chapter 3.
† A different measure of poverty is used for OECD countries.

Targets for Reducing Hunger and Poverty

Meeting human needs for food, nurture, housing, education, and employment may help but does not ensure a reduction in hunger and poverty. If the target for feeding the world populations is to halve the number of hungry people in each of the next two generations, then by definition hunger would be reduced. This feeding of people would imply a reduction in poverty, since the world's poor spend some 85 percent of their income on food. Nurturing, education, and housing are less closely linked to alleviation of poverty. In general, the poor are less healthy, educated, and housed, but some poor countries have shown that it is possible to make dramatic increases in longevity, education, or access to clean water despite the large numbers of poor people. Even employment does not necessarily eliminate poverty: most of the world's poor work—indeed work very hard—but they receive little or no income from their labor. Thus, for a transition to sustainability, reducing hunger and poverty (as shown in the example of the "Hunger and Climate Change Reduction scenario" in the appendix to Chapter 3) requires conscious and simultaneous efforts in three directions: encouraging overall growth in income and employment opportunities, increasing the share of the increased income that accrues to poor and hungry people, and providing the crucial public services of nurturing, education, and housing. With evidence mounting that a substantial surge in the poverty rate in East Asia has followed the financial crises there, these efforts will be more difficult to achieve.[63]

THE TRANSITION TO SUSTAINABILITY AS SOCIAL LEARNING

A transition toward sustainability would be unprecedented; it has no charted course. The evidence from the first decade of efforts to achieve sustainable development shows that, in general, societies do not know how to do it. But the widespread experience of local efforts and successes is instructive and suggests an ability of societies to learn on the relevant scales. Hope for successfully navigating the transition in the future lies in conceptualizing sustainable development not as a knowable destination or computable trajectory, but rather as a process of social learning and adaptive response amid turbulence and surprise.

What would it mean for society to learn how to better navigate a transition to sustainability? Scholarly studies of social learning over the large spatial and temporal scales of relevance are few but suggestive.[64] On the social side, they include work on the shaping of social policy in Britain and Sweden, study of the long-term development of the international capacity to manage the spread of infectious diseases, analysis of the

spread and influence of Keynesian ideas in economic policy, and examination of the evolution of democratic norms and practices in Europe.[65] In the environmental realm, there is a substantial body of scholarship on social responses to natural hazards, work on the Mediterranean, analysis of the Columbia Basin experience, studies on ecosystem management, review of policy learning in regional environmental management, and a forthcoming collaborative study on how societies around the world learned to deal with the risks of acid rain, ozone depletion, and climate change.[66] While a coherent theory of social learning has not emerged from these works, several common themes stand out and we have drawn on them to guide the present study.

Central to social learning in this context are many individual and group actions in response to change. But significant changes in societal responses to issues as complex as those involved in sustainable development generally require slow, interactive accumulations of scientific knowledge, technical capacity, management institutions, and public concern over periods of a decade or more. Moreover, while some adaptive learning can accrue throughout such extended periods, the more fundamental and important learning of changes in deeply held beliefs or perceptions of problems is rare and seems to require the impetus of crisis or surprise.[67] A successful effort to promote social learning for a sustainability transition must therefore be expected to require patience and persistence over generations, while at the same time retaining enough flexibility to seize the moment when opportunities arise.

The serious pursuit of social learning entails efforts to make sense of what is happening, to shape interventions informed by that awareness, and to interpret the consequences of the interventions against expectations of what might otherwise have occurred. All of these actions require a strategic perspective. For learning how to navigate the transition toward sustainability, such a strategic perspective will need to encompass large intervals of time and space, and facilitate an appreciation of the complex interactions of natural, economic, and social forces at work over those intervals. In short, societies must understand the long-term, large-scale trends and transitions that have shaped past and present interactions of environment and development. We attempt to sketch such historical perspectives on the transition to sustainability in Chapter 2. Looking forward, a strategic perspective on sustainable development does not mean a feckless quest to predict the future. Rather, it means thinking in an organized way about possible futures and the possible implications of present choices for them. Chapter 3 of this report summarizes recent work on the use of integrated assessment models, structured scenarios, and regional information systems to inform the strategic perspectives needed for learning how to achieve sustainable development.

If societies' efforts to navigate the transition cannot count on predictions of the future, neither are they condemned to simply steer into the darkness without an understanding of what lies ahead. If the scientific community does not know enough to say with confidence how the interactions of environment and development will work out over the relevant long-term and global scales, it can nonetheless do a good deal to heighten awareness of and preparations for the sorts of obstacles and opportunities that might be encountered along the way. This report attempts such a strategic reconnaissance in Chapter 4, employing past development experience and present scientific understanding to identify some of the most problematic environmental obstacles to human development that may be met in the transition to sustainability. The chapter then seeks to evaluate the potential social, technical, and environmental opportunities for circumventing or mitigating such obstacles, employing integrated strategies for the management of water, the atmospheric environment, and species and ecosystems.

A fundamental requirement of social learning is feedback. In the report's analysis of efforts in social learning, the development, measurement, and reporting of appropriate indicators has been repeatedly singled out as one of the most important factors contributing to improved performance. Indicators can serve a variety of functions, from monitoring progress toward goals, through providing early warning of approaching hazards and detecting surprises, to assessing the effectiveness of particular interventions. The difficulty of designing indicators for use in promoting a transition to sustainability is to articulate what is needed and how the need for continued learning and response to surprise may be made part of the system for navigation. In Chapter 5 of this report, we develop a framework for indicators. One set of indicators is aimed at catching signals on different spatial scales to inform societies if they are on the right course in meeting goals for human needs and reducing hunger and poverty. These include monitoring biophysical circulatory systems,[68] identifying critical regions, conserving productive landscapes, and preserving ecosystems. Another set of indicators evaluate the efficacy of actions taken to attain the goals. These include creating national capital accounts, analyzing policies, monitoring ongoing transitions, and conducting "surprise" diagnostics. Chapter 5 also discusses how to design, build, and maintain measurement and monitoring capacity, how to include the end users of the information, and how to use the scales of relevance.

Social learning is a knowledge-intensive endeavor. It involves not only making use of and testing existing knowledge in new circumstances, but also the creation of new knowledge and know-how. The difficulty of creating knowledge and know-how to support the transition to

sustainability transcends not only national boundaries but also the individual human life span and the customary planning horizons of human enterprises. Developing a useful "sustainability science" will require novel approaches for research linking the natural and social sciences, and studying adaptive management and policy; for technology development and diffusion, to provide the most useful and needed tools for navigating the choices; and for institutions, to overcome barriers and find new funding mechanisms. Perhaps most challenging, sustainability science will require the design of new ways for learning from the uniquely large-scale, long-term experiments created every time a new technology, management scheme, or policy is tried out in the real world. The barriers to such learning are immense, but so are the potential rewards for overcoming them. Chapter 6 of this report provides a strategy for setting priorities for action to promote the life and livelihood goals described here, in navigating our common journey toward sustainability.

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[67] Clark (1990); Kates and Clark (1996).

[68] As Chapter 5 explains, biophysical circulatory systems include rapid circulation in atmosphere and oceans, driven by solar energy and slower changes in the lithosphere as tectonic plates move, and in the biosphere as migration patterns shift and species radiate.