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Human Agency and the State of the Earth

Introduction

Each year, a well-known non-governmental organization publishes a State-of-the-Earth report. The story told in this report has not changed much in the past 30 years: the Earth continues to be treated with little thought for the future. More and more species are going extinct. Wetlands are disappearing, endangering the migration routes of birds. Unprecedented levels of carbon dioxide threaten our climate system, coral reefs, and the Antarctic ice sheets. Our closest ape relatives are finding less and less of their habitat left standing to ensure their survival. The story goes on, giving cause for considerable alarm. Even with the rise of a discourse about sustainability in recent years (e.g. Christen and Schmidt 2012; National Research Council 2014), there is little evidence that governments are succeeding in implementing concrete strategic policies which ensure a sustainable Earth system as a practical objective. The Kyoto Protocol and subsequent targets fail to be reached time after time. Without effective action to ensure the sustainability of the world's ecological systems, our days on this planet may be counted. A recent article in the *New York Times*, by an astrobiologist, thoughtfully pointed out that there have probably been other planets where populations may have failed to act in time

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and became uninhabitable. Are we on our way to that fate? Or will we act to ensure that the state of the Earth will be more promising than it looks now?

We have in the past 60 years, changed nearly every aspect of our relationship with nature. Yes, the Industrial Revolution began some 300 years ago and we have been gradually increasing our impacts on the Earth over that period (Turner et al. 1990). In the past 10,000 years, in various times and places, we have had impacts that were considerable at *local* scale (Redman 1999; Redman et al. 2004). But never before has our impact been at *planetary* scale, and that is what we are having trouble understanding. As a species we think and act locally. That has been our hallmark and the reason for our success spreading over the face of the Earth – except that we have for the first time in human evolution begun to have a cumulative impact that is not just local but global (Wilbanks and Kates 1999).

Our impact in the past 60 years has no analogue. We have no equivalent experience in our entire history or prehistory as a species, for what we are currently doing to the Earth. Throughout this book I use the term "we" most often in referring to our species. However, in terms of current impact, this "we" does not apply evenly across all members of the human family. Many ethnic populations throughout the world have a much lighter impact on the planet than members of urban–industrial societies, and have very different conceptualizations of how to treat nature (Descola 1994; Descola and Palsson 1996; Rappaport 1968). I trust readers will be able to distinguish what I mean throughout the book.

The burden on the planet today is coming from urban–industrial societies and this "we" has to step forward now and take responsibility for solving the problem it has created. We must lead by example and we can see examples all over the world of actions contrarian to the choices that got us into this crisis. While still only incipient, there is strong evidence of local but globally connected feedback: a growing movement to eat not fast food but *slow food* (local food grown organically with care for agro-ecosystem integrity); a growing recycling movement; rapidly developing solar power installation (in homes and corporations) growing fast enough to worry the utility companies; and a host of other sustainability efforts that are beginning to make a difference at local scale and perhaps in due time at global scale. For

example, the local food movement accounts for about 5 percent of current food supply. An increasing number of farmers are learning no-till methods, even in the highly mechanized US farming context (Goode 2015), which already account for 35 percent of cropland in the United States. For some crops, no-tillage acreage has nearly doubled in the last 15 years. For soybeans, it rose to 30 million acres in 2012 from 16.5 million acres in 1996. The planting of cover crops – legumes and other species rotated with cash crops to blanket the soil year round and act as a green manure – has also risen in acreage about 30 percent a year according to surveys (Goode 2015). These practices increase organic matter in the soil, provide nitrogen and other nutrients, and increase yields – especially by adding to soil moisture retention. "Each one percent increase in soil organic matter helps soil hold 20,000 gallons more water per acre" said Claire O'Connor (Goode 2015). This is particularly important in drought-prone areas and regions facing the specter of future water deficits from extreme climate events. This is the sort of paradigm shift we are beginning to see across any number of domains, and which shows that conservation and a healthier environment can go hand in hand with increased profitability.

While governments bicker over how they might meet the challenge of climate change, industry and corporations are beginning to lead. Joe Kaeser, the Chief Executive Officer of Siemens, a global manufacturing company of considerable influence, has gone on record to cut its global carbon footprint in half by 2020 and to be carbon neutral by 2030 (Kaeser 2015). To do this they plan to invest more than $110 million to improve efficiency in their facilities worldwide. They will increase use of solar and gas with smart grid and energy storage solutions and they will buy clean power. They expect these changes will allow them to recover their $110 million investment in just five years and to produce $20 million in savings thereafter. These are the sorts of decisive actions that if followed by other large industries could have cumulative global results, and break the political gridlock that prevents even more pervasive policy-driven solutions. It shows that the crisis is solvable if only every one acted to protect our planet.

These positive developments, encouraging as they may be that we can turn things around, should not lead to complacency. The evidence

tells us of unabated exponential increase in carbon dioxide, exponential rates of ozone depletion and nitrous oxide concentrations in the atmosphere, rapid and continuing losses of tropical rainforests, increases in the frequency of natural disasters, and in the rate of species extinctions (see Figure 1.3 later in this chapter). The same can be said for fertilizer consumption, damming of rivers, water use, paper consumption, the number of people living in cities, and the continuing increase in the number of motor vehicles. There has also been a steady increase in the last 60 years in the incidence of armed conflict worldwide (Kates and Parris 2003: 8062). In 1992, one-third of the world's countries were involved in such conflicts, and in that year 40 million refugees and displaced persons were affected by armed conflicts (ibid.). These figures do not include the growing globalization of both terror and crime beyond state borders. Some have described this growing conflict in terms of "the coming anarchy" and as a "clash of civilizations" (ibid.). This growing terror has only increased further in the decade since the first edition of this book appeared. Disparities in income and access to resources have an important influence on these conflicts, since the lives of so many have been impoverished by loss of land, displacement, and declining economic opportunity.

The exponential increase in all these measurable phenomena is tied most fundamentally to two factors: the increase in the human population and our consumption habits (Curran and de Sherbinin 2004). Indeed, one must think of these two factors in tandem. One Euro-American citizen consumes 32 times the resources than one average citizen from Malawi, Guatemala, or another less-developed country does (Diamond 2008; Redclift 1996; Wernick 1997). While we worry about obesity in many developed countries, other nations worry about inadequate food security or access to clean water. Dependence on fossil fuels is but a reflection of these differences (see Figure 1.1). While birth rates have steadily declined to replacement level or even below in developed countries, these populations continue to impact the Earth's resources at least as much as the larger populations in developing countries. Both "the North" (i.e., developed countries) and "the South" (i.e., developing countries) have a huge impact on nature, the former through consumption, and the latter through population increases. If we want to leave an Earth worth living in to our children, both the North and South will need to change how they go

Figure 1.1 Highway gridlock, Kansas City traffic. *Source*: https://www.flickr.com/photos/thomanication/6216702247, used under CC BY ND 2.0 https://creativecommons.org/licenses/by-nd/2.0/.

about their business (Rosales 2008). Yet, changing business-as-usual, i.e., our "culture," world-view, and values, is easier said than done.

Whether in the North or South, specific societies have deeply held cultural and historical traditions that have both positive and negative elements that facilitate and hinder our capacity to respond to the current crisis in the Earth system. Looking to our own societies in North America and Europe, we can point positively to democratic institutions that provide effective mechanisms for citizens to respond to information provided to them whether about the effectiveness of schools in educating children, political priorities, or the state of the local environment. Yet, if democratic institutions are among the best mechanisms available to societies to respond to information, how do we explain the lack of responsiveness in the United States to the growing evidence for a global environmental crisis? Battig and Bernauer (2009), based on a cross-sectional analysis of 185 countries, find that democracies have not yet been able to overcome the free-rider problem consistently. Side by side with democratic institutions, the United States is characterized by a culture of individualism (Bellah

et al. 1986), and a greater value is given to capital accumulation as a measure of a person's worth than in almost any other society. This pair of cultural values tends to sway a great portion of the citizenry against environmental regulations (or any government regulations) – seeing them as costly and thus likely to increase taxes on individuals, and to raise the cost of environmental goods and services. Even the promotion of public transportation as a response to reducing fossil fuel emissions is opposed by many in the United States on the grounds that it limits personal freedom to go about as one pleases, despite the costs to the country (in terms of dependence on foreign oil supplies), and the globe (in terms of emission of Earth-warming gases). So, while the great majority of Americans see themselves as "environmentalists" (Kempton et al. 1995), many do not make a connection between this identity and the need to restrain their use of the personal car, as the latter infringes on their individual freedom. Response to climate change evidence is mediated by factors such as education, gender, and where one lives, which further impact perceptions and can differ from local to global scales (Brody et al. 2008; Crona et al. 2013).

In all societies one sees conflicting cultural values as well as partisan lobbies to benefit a segment of society without regard for the benefit accruing to, or costs incurred by, others or to the condition of the environment. Europe has similar traditions to the United States in a number of regards (democratic institutions, capitalism) but it does not value individualism above the common good (there are significant differences even within Europe on the degree of value given to the common good but in none of them does it reach US levels). This has made it possible for Europe to more quickly accept reduction of carbon dioxide in the atmosphere to 1992 levels, than for the United States and thus to support the Kyoto Protocol on the emission of greenhouse gases. In the Netherlands, an already conscientious country when it comes to environmental issues, civil society took the government to court in 2015 and won its case arguing that the government had been too slow to implement policies to address global environmental change! Europe's position has continued in subsequent environmental summits and has resulted in a profound rift between the more advanced nations of Western Europe and the United States over the willingness of the former to set limits on carbon dioxide emissions, and the unwillingness of the latter to do so. In Europe, planning for adaptation and mitigation

of climate change is routine and is addressed broadly at national scale as well as in specific cities (Reckien et al. 2014). The use, and misuse, of the Earth's resources is at the very center of international negotiations, the global political economy, and the fate of nations.

Each country will have a slightly different twist to its story: a product of the historically contingent nature of human affairs. Other countries may lack, for example, the democratic institutions' capacity to mobilize the populace in its own interest, but they may have rulers who respond quickly to evidence for environmental crisis: witness the rapid reforestation of China in the past 30 years, following decades of rapid deforestation (Fang et al. 2001). The pace of the reforestation has been without equal in the world, despite the many economic constraints faced by China and its vast population. The crop-to-green program has been increasing forested areas and in areas with the right growing conditions the use of bamboo forests has been promoted to farmers because of its fast growth rate, ability to capture carbon dioxide, and then its many uses (which avoid the re-emission of carbon and provides economic incentives to farmers making it economically attractive). In recent years concern has grown that this greening of China has been accomplished at the expense of deforestation in places like Brazil which have become suppliers of soybeans to China thereby freeing parts of China from having to grow all the food it consumes (Liu et al. 2013; Qi et al. 2008). It is not being suggested here that authoritarian regimes are a solution to environmental problems but, rather, that each nation faces different sets of challenges, based upon their political, economic and cultural situation. In short, there is no single solution to the current global environmental crisis. Human agents in specific places will need to work within the constraints and opportunities provided by their physical, social, economic, and cultural setting. This is why in solving environmental problems we must see human agents not just as "the problem" but also as the source of the solutions (Agrawal 2005: 181). There are no ready-made solutions for all nations but only a challenge to be faced by nations in addressing problems that cut across national boundaries and that affect people at a variety of scales from local to regional to national to global (Westlund 2013).

People concerned with the current environmental crisis, whether environmentalists or not, face a fundamental divergence in values, even if they agree on objectives. This divergence has been characterized in

a variety of ways: as a divergence between a biocentric view of nature and one that is anthropocentric; or as a "deep" vis-à-vis a "shallow" ecology; and as the rift between Moralists and Aggregators (Norton 1991). Moralists, deep ecologists, and biocentrists view nature and its creatures as having as many rights as humans do (e.g., John Muir, one of the founders and first President of the Sierra Club), whereas Aggregators, shallow ecologists, and anthropocentrists tend to give humans a higher place and seek to balance the goals of conservation and development (e.g., Gifford Pinchot, who brought scientific forestry from Europe to the United States and created the field we now know as "conservation" with the support of Teddy Roosevelt). John Muir, who traveled with Gifford Pinchot in 1896 to the Grand Canyon, comments in his writings that he stopped Pinchot from killing a tarantula they came across "because it has as much right there as we did" (quoted in Norton 1991: 17). Pinchot, on the other hand, equated happiness in utilitarian terms and thus saw no conflict between timber production and grazing as legitimate and even desirable uses of national forests. By contrast, Muir fought him when these economic uses came at the expense of aesthetic considerations and other less obvious goals such as watershed protection. Muir represented a scientific tradition associated with older naturalists who combined aesthetic, moral, and scientific ideas – what Norton (1991: 34) calls an "ecstatic science." His legacy provided preservationists with a deep respect for holistic explanations, and a longing for a science that did not banish values and awe from the process of observing and protecting nature. He differed from Pinchot largely in wanting to see the aesthetic goals as important as those of economics. Pinchot, by contrast, thought that forestry science should be value-free, a notion that Muir scoffed at. Despite their differences, they co-created the environmentalist movement in the United States and they laid the ground for debates that still rage today, between using nature for human ends, and valuing nature for itself.

These polarized views found a degree of synthesis in Aldo Leopold's 1948 classic, *A Sand County Almanac.* Leopold accepted and elaborated on Muir's views of ecstatic science, rejected the value-free scientific model of Pinchot, and pointed to an organic synthesis based upon a cultural conception of the good life. Thus, the resource manager's role was that of helping the public develop an ecological conscience – a conscience that had to grow from one's own history

as a nation deeply entwined with nature. His views swung between an anthropocentric and a biocentric focus, because both are needed, and environmentalists on the whole since then manifest different degrees of this organic synthesis. The debate will never be fully resolved because human choices are always contingent, and people will make use of resources. The question is how they restrain such resource use, when, where, and for what purpose.

The nature–culture dichotomy has been central to Western thinking since time immemorial. It allowed some progress to be made in developing both materialist and symbolic approaches to human–environment interactions – but it also impeded progress by keeping these two valid perspectives apart, rather than seeking a synthesis as Leopold sought to do (Descola and Palsson 1996). Evidence has accumulated that the dualist paradigm is inadequate in treating the organic relations between people and nature. Many societies that have been studied by anthropologists and geographers, have lacked this kind of dualistic thinking, and provide an empirical foundation for challenging this kind of thinking. The Achuar of the Upper Amazon, for example, consider most plants and animals as persons, living in societies of their own, entering into relations with humans according to strict rules of social behavior. Game animals are treated as affines by men, while cultivated plants are treated as kin by women (Descola 1994). The nature–culture dichotomy is inadequate in making sense out of non-Western realities, and even of Western ones. In short, to understand both humanity and the rest of the natural world, we need new ways to think about the interactions taking place. A monistic or biocultural approach to these interactions would take us part of the way there. People are part of the environment and, likewise, the environment is part of the person (Descola and Palsson 1996: 18). But since the dichotomy is deeply ingrained in Western philosophy and practice, we face a constant linguistic challenge to formulate the place of people in nature free of this in-grained mental dichotomy.

This Western philosophical fault line between nature and humanity stands in the way of resolving our environmental crises. Tim Ingold, in his book *The Perception of the Environment* (2000), offered a synthesis derived from developmental biology, ecological psychology, and relational approaches in anthropology. His approach begins by thinking about people as organisms-in-their-environment, rather than apart

from it. Crucial to this way of thinking is the consideration of exactly how people-as-organisms act towards the nature within which they find themselves. Materialist-thinking analysts tend to oversimplify this process by suggesting that individual organisms or agents respond largely to the material conditions of life, while more cultural or non-materialist analysts tend to suggest that agents act according to memory, symbolism, social relations, and other factors (e.g., Rival 1998). It is in this domain, in particular, that one needs to move away from these dichotomies and push towards a synthesis wherein the agent, or organism, acts in a holistic fashion that does justice to the nuanced way in which we all make decisions in whatever context we find ourselves.

Thinking less dichotomously will allow us to think more like other societies. The Cartesian dichotomy between humans and nature is a peculiar notion in Western society that is not widely shared cross-culturally. Most peoples in the world do not externalize nature in this manner. Rather, they see humans as very much a part of nature. In its more extreme forms it takes the form of ideologies where we are reincarnated in forms other than human (i.e., plant, animal), and vice versa. Mythologies across the globe have always pointed to the close connection in both origin and continuity between animals in nature and us; between the plants in the landscape and our spiritual and material lives (Pretty 2002: 13). Australian Aborigines' Dreamtime embodies these beliefs, for example, in how the land came to be, how closely they are still connected to these ancestors, and why the land must be respected – that it belongs to no one, but that it belongs to everyone.

One of the challenges before us in contemporary society is how to re-conceptualize the interactions between people and nature. One step forward is to think organically, as organisms-in-nature, bringing our own versions of meaning to it in accordance with our histories. Dichotomous thinking led us to think of people as apart from nature, and charged with controlling nature for human purposes – and, crucially, as distinct from the inherent dynamics of the Earth system itself. It is from this error that a lot of our post World War II spiral towards destruction comes. Treating the whole of nature as we treat industrial products, as if it was inanimate, as if what we did to it did not matter to us. It does matter, and profoundly so. What happens to the air we

breathe, the water we drink, and the land upon which we depend for our food matters. If we take care of it, it will nurture us – and if we damage its capacity to provide us with sustainable goods and services, and the comfort of aesthetic beauty, we will put ourselves at risk. We cannot do this alone, but it must be a partnership of trust in human communities bound by covenants that favor life over material accumulation, that favor dignity for members of the community and the pleasures of taking care of each other, and nature, as the highest good. We need to re-conceptualize our relations with each other, and with nature – and to think of human agents as organic parts of nature.

Can One Conceive of Ecosystems Without Human Agents?

It is a lovely fantasy to think of ecological systems in the absence of human agents – a fantasy used frequently in the past in ecology when speaking of natural systems in the absence of humans (e.g., Ricklefs 2001), and indeed there was a time many millions of years ago when that was a reality. Yet, it is also true that for several hundred thousands of years, human agents have been having a steady impact on the structure, function, areal extent, and species composition of the Earth's ecosystems (Cronon 1996; Ricklefs 2001). This has two important consequences to how we begin to develop solutions and strategies for a sustainable planet: one, there was a time when we were not running the Earth down; and two, the crisis is relatively recent and reversible if we act with consistency and alacrity.

Ecologists in the past had a tendency to blame human agents for our current crisis, and indeed there is some merit in this view, as we will see throughout this book (Ricklefs 2001). However, doing so does not begin to move us towards solutions. Ricklefs notes that Cronon in his 1996 book, *Uncommon Ground*, challenges the ecologists' view of pristine nature, of nature as tending towards a self-restoring equilibrium when left alone, and that in the absence of human interference nature exists in a pristine state. Natural processes "disturb" ecosystems just as much as humans can, as one can observe in events such as hurricanes, droughts, and volcanic eruptions. Recovery from these natural extreme events can occur, just as it can when the disturbance is anthropogenic. Ricklefs (2001) agrees that

recent ecological studies show major variations in nature and with and without human "interference" nature experiences cyclical disturbance. Human presence adds a further element of change into the processes of nature. Fortunately, we know one thing: human agents are eminently self-interested and capable of amazing self-organization when properly motivated and led. So, if we are so capable of looking after ourselves, and to organize to achieve our goals, why are we in the current crisis? I think the answer lies in our evolutionary tendency to think primarily in terms of our local territories or immediate environment, even though our contemporary capacity to use resources from distant places has grown enormously (Bates 2001; Bodley 1996). We still have not been able to internalize the consequences of our contemporary consumption of environmental resources from throughout the world, and have not developed effective, believable ways, to have the information and feedback on what the impact of our consumption has been in those distant places. In other words, economic globalization since World War II has been very effective at using global resources, but not in giving consumers the information they need to make a decision on whether they want to have that kind of impact. That has not always been the case in how we use resources.

In the past, human agents went out from their communities to gather needed resources to sustain their population at a very local level. We must recall that for most of our experience as a species, we were hunter-gatherers (Bicchieri 1972; Lee and DeVore 1968, 1976). The range of a given hunter-gatherer band was fairly limited, and when they overused resources they were forced to move considerable distances until they could find another familiar territory, not occupied by others, to sustain them. As hunter-gatherer populations increased, they found themselves running into other bands, and experiencing conflict with them. In short, it was preferable in many cases to limit the group's consumption to sustainable levels, rather than face a very uncertain access to distant and possibly dangerous territories.

Even with the advances in control made possible by domestication of plants and animals, human agents could easily understand how the local land and water were affected by their agricultural management. What was happening in China's fertile valleys was of no interest to those living in Europe, or those living in Africa. It mattered only to parts of China dependent on production from those fertile river

valleys. Products came from relatively close distances and anyone could assess whether they were putting themselves at risk through given practices or levels of consumption. There were, without any doubt, many cases of poor judgment in human history, but in those cases populations paid a dear price and had to move or take some other radical path to survive – and these processes took centuries rather than decades (Diamond 2005; Redman 1999).

Those familiar ways to adjust our behavior to existing resources are completely changed now for much of the human populations of the Earth. Today, whether in China, Germany, Argentina, or the United States, human agents can obtain coffee from Brazil, Sumatra, or Kenya, bananas from Honduras, Philippines, or Gabon, fish from oceans on the other side of the world, and powdered milk from places unspecified on the label of the cans. The human consumer has no way to know how much forest was cut to grow that coffee, how many people were displaced to make room for those banana plantations, what fish stock was depleted, or how much methane was emitted by that hog farm. In short, we have a complete disconnect today between what goods we use on the Earth and the consequences of that use on people and nature. In short, we lack information on the consequences of our consumption.

If we are to begin to move towards a sustainable Earth system, we must start to have awareness of what we do – no matter where it might occur – and to reflect on whether that is an impact we want to have. Just as consumer movements have, after much effort, succeeded in having many products labeled by corporations as to their nutritional and caloric content, we need to consider requiring that products indicate where they come from, and to post in public sites on the internet, environmental impact statements that give consumers an idea of what the cost to socio-ecological systems is of that form of resource use in that place. Is this naïve? It certainly would be difficult, and companies promoting use of their products would oppose this form of exposure to consumer evaluation. Consumers driven only by lower prices would certainly not take the trouble to read an "impact label." But let's consider the options. The most common one has been to think of prices as the best regulator of consumer choice. In this case, however, prices are insidious in their consequence – as the products with the *least* concern for environmental impacts are likely to be

cheaper and thus more attractive to the consumer resulting in an ever-increasing spiral of products with higher environmental impact. As we will see later in this book, it is the human agents individually, and through their institutions, which must demand that consumer products be responsibly produced and consumed, using their ability to choose to consume a given item or not as a tool in changing business-as-usual. In Chapter 9, I go into considerable detail on strategies to begin to change business-as-usual and to regain control over how we can interact with nature in ways that are more biocentric.

The question at present is whether consumers have choices given to them between items with different environmental impact (Zepeda et al. 2013). The greatest difficulty comes from the propensity of policymakers in many places to respond more to the lobby of powerful companies, than to the demands of citizens. Companies currently make efforts to show the public and shareholders that they are responsible corporate citizens towards the environment (Spitzeck 2009). To that end they produce visually attractive brochures showing their contributions to environmental conservation. At the same time, they engage in lobbying activities that prevent enactment of legislation that regulates their emissions into the environment. It is difficult for the average citizen to be cognizant of these two faces of a given company and to be able to decide whether to consume products from a given company on the grounds of their environmental position or products. The internet is providing new ways to find out information previously hidden from consumers and social media can be an enormous force for a more informed citizenry on environmental issues.

Human Agency: Individuals Making a Difference

There is a very fine line between endowing individuals with agency, or the ability to take decisions and actions, and ignoring them altogether. In ecology, we have tended to do the latter. Reading almost any major text or popular book (e.g., E. Odum, Ricklefs, Miller, to name just a few of the most popular ones), we read about how people *disturb* natural ecosystems, *degrade* a landscape, or *pollute* rivers. Just as the socialist literature treated the workers as a *lumpenproletariat* (i.e., as an aggregate proletarian mass), so does ecological analysis sometimes

treat people as homogenously the cause of environmental problems without recognizing the diverse ways that people in fact act towards their physical environment. Not all people in developed society behave destructively towards the environment, nor are all people in developing countries noble in how they treat nature. But in giving individuals the attention they deserve, and in trying to understand their actions, we can also fail to see the complex and diverse patterns in their actions. After all, human agency takes place within an environmental and social matrix, and individuals are members of social groups with distinct shared economic, social, cultural, and political interests. Recent studies point to cases where efforts to emphasize participation by less privileged elements of society, such as the poor or indigenous populations, can result in new forms of coercion (Neumann 1997) and new types of colonialism (Boanada Fuchs 2015). Thus, in ensuring that we give individual human agents their due, we must balance this attention with a concern for how agents gain or lose autonomy in the process of sustainable development. Practice theory, which examines the interaction between agents and social structures, can be particularly relevant (Bingen 2012).

It is all too appropriate to consider how human agency can make a difference, and how social movements can make an even greater difference. Individuals, as members of given societies, do not represent the entire society but some segment of it characterized by a given social and economic origin, acquired education and wealth, and political linkages to segments of society. As such, when individuals act, they commonly represent the interests of those parts of the social fabric within which they are embedded – although on occasion they rise above those origins and represent the interests of those less fortunate than they socially, economically, or politically. Time and again we see evidence of how an individual through his or her actions can change how we think about the world, and what we might do. Think of Rachel Carson and her book, *Silent Spring* (1962), and how it launched the modern environmental movement. She, herself, may not have had the right characteristics to lead the environmental movement, but she laid the foundations for public concern and outrage over what was happening to our streams and water. Others, more capable at public mobilization, followed and took action that over the next several decades provided protection of species, of air and water, and of landscapes under threat.

In short, human agency does make a difference whether expressed as ideas in books and articles, in speeches, or in action. Until 1985, there were hardly any stories in any major magazine or newspaper about Amazonian deforestation – even though there had been a growing discussion of it in scientific journals, and research attesting to the rapid rates of forest destruction. The appearance of an interview with Tom Lovejoy in the *New York Times*, Science Times section, in 1985, mobilized overnight the considerable resources of the press and other media and over the next decade there was an exponential growth in the number of stories in major newspapers and magazines that resulted not only in stories but also in considerable international pressure on Brazil to stop the subsidies to cattle ranchers which were fueling the high rates of deforestation – and resulted in a temporary but notable decline in both subsidies and rates of deforestation. It also resulted in funding being provided for research to monitor and understand the impact of deforestation on biodiversity, biogeochemistry, hydrology, land use and land cover, and socio-economic impacts (e.g., Gutman et al. 2004; Keller et al. 2009, Moran and Ostrom 2005; Steffen et al. 2003).

Lay people's views of climate change, just as an example, can differ from scientific evidence. Ethnographic research by anthropologist Willett Kempton (1991) showed that most informants had heard of the greenhouse effect but that they conceptualized climate change very differently from scientists because they interpreted it in terms of stratospheric ozone depletion, plant photosynthesis, tropospheric pollution, and personal experience with temperature variation. Concern with species extinction was high but unspecific. Few informants in the study recognized the connection between energy consumption and global warming, and they did not view their fuel consumption as subject to much change. These views are further explored in Kempton et al. (1995).

So, one characteristic of human agency seems to be that we need to have the accumulation of information over an extended time, gradually shaping into a picture of a process that results in concern in some quarters, and in some individuals taking action. When that action is associated with some notable event or overwhelming evidence, it appears that public response to this news can result in remarkably rapid mobilization and effective action – as took place with ozone and the quick adoption of the Montreal Protocol to reduce use

of chlorofluorocarbons (CFCs) responsible for destroying ozone. Agrawal and commentators of his article in *Current Anthropology* (2005) take note on how citizens who may not be environmentalists can gradually evolve into having a strong commitment to environmentalism sometimes through getting involved in enforcement and regulation mandated by government. From this engagement came the rise of an environmental conscience that went far beyond what the government foresaw, and that saw in some of the government regulations deep flaws in resource management. But none of this would happen if individual agents did not take the considerable risks involved in trying to change business-as-usual and to advocate a significant shift in how we do things. Change is resisted by all complex systems, largely in self-defense, and because it can be very costly if the change was unnecessary or wrong-headed. Thus, human political and economic systems, like ecological systems, resist changing their patterns until there is overwhelming evidence that something fundamental has changed which requires a shift in the structure and function of the system, if it is to survive. Are we there yet? Do we have overwhelming evidence? While emphasis has tended to be on discovering tipping points, beyond which the system may be thrown into a new unpredictable condition, equally important is to give consideration to the possibilities of political action beyond thresholds assumed by tipping point calculations (Skrimshire 2009).

Overwhelming Evidence for Concern with the Condition of the Earth System

> The Earth is currently operating in a no-analogue state. In terms of key environmental parameters, the Earth system has recently moved well outside the range of natural variability exhibited over at least the last half million years. The nature of changes now occurring simultaneously in the Earth system, their magnitudes and rates of change are unprecedented.
>
> (Steffen et al. 2003)

The above quote, from scientists associated with the International Geosphere and Biosphere Program, in a synthesis of over a decade of research, and involving thousands of scientists, and Figure 1.2, illustrate

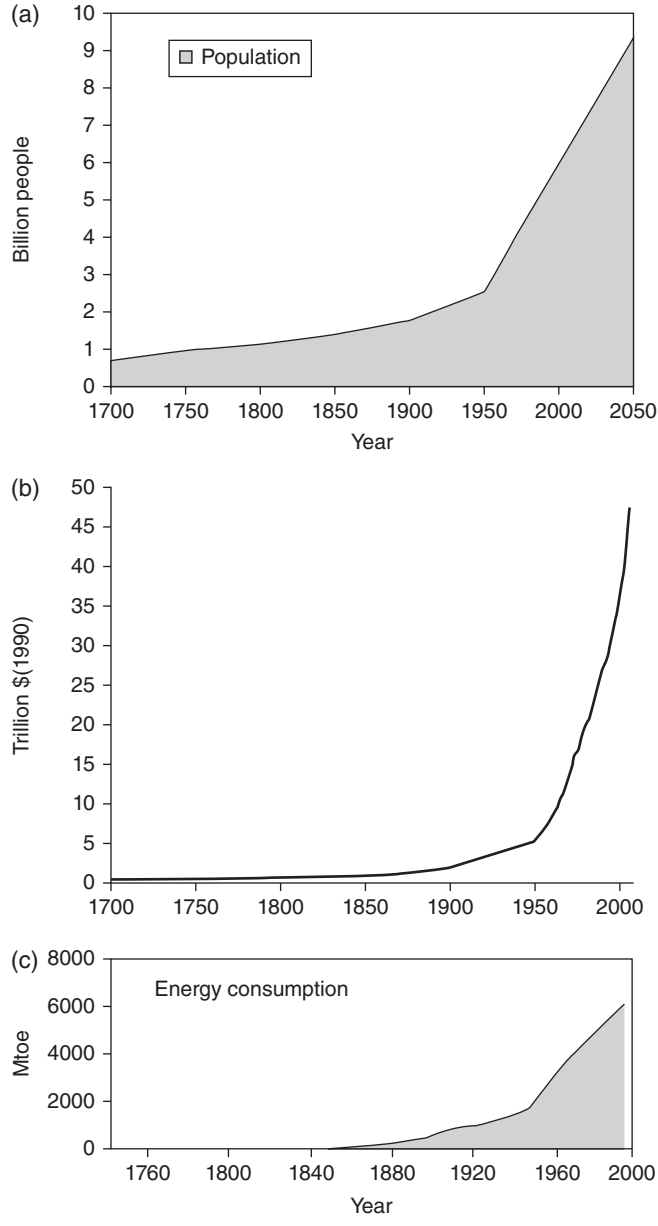

Figure 1.2 Rate of increase in many spheres of human activity for the last 300 years: (a) population (adapted from U.S. Bureau of the Census, 2010); (b) world economy. *Source*: Fouquet 2009. Reproduced with permission of Roger Fouquet; and (c) energy consumption (Klein Goldwijk and Battjes 1997, RIVM). *Source*: Steffen et al. 2003, p.5.

what is happening in the realm of people variables – and it raises a number of concerns. Population has been increasing rapidly since 1750 but it is really since 1950 that the exponential nature of this growth is manifest, and shows very little sign of subsiding in the next 30 to 40 years. In the past 60 years we went from 2.5 billion to 7 billion. In less than 30 years the human population will be in excess of 10 billion. Total gross domestic product, foreign direct investment, damming of rivers, water use, fertilizer consumption, urban population, paper consumption, and the number of motor vehicles, have all jumped exponentially since 1950, with no evidence of a turn around in this upwards increase. This increase would be enough cause for concern, if it were happening in one or two of these measurable areas, but they are all happening simultaneously.

As if this were not enough reason for concern, similar synchronous events are happening on the nature side (see Figure 1.3): carbon dioxide concentrations, nitrous oxide concentrations, methane concentrations (all three earth-warming gases), ozone depletion, Northern Hemisphere average surface temperatures, the number of natural disasters, the rate of loss of fisheries, the increase in nitrogen fluxes in coastal zones, the rapid loss of tropical rain forests and woodlands, and the number of species gone extinct have all jumped exponentially since 1950. While some might argue, for example, that there is evidence that carbon dioxide concentrations are actually beneficial to many plants and that there is increased productivity in some places, experimental studies have shown that increases in productivity when carbon dioxide concentrations are up to 56 Pa, are lost when concentrations reach 70 Pa, at which time there is a steady decline in productivity (Granados and Korner 2002). There are also notable differences in how different species and types of forest vegetation respond to carbon dioxide enrichment. At Duke Forest, one species of pine, *Pinus taeda*, increased 20–25 percent in both net primary production and in woody biomass, whereas in nearby Oak Ridge, Tennessee another tree species, *Liquidambar styraciflua*, increased only 7 percent in woody biomass (Norby et al. 2002).

One of the most troubling changes in the planet has been the human alteration of the global nitrogen cycle (Pinder et al. 2013). We know with a high degree of certainty based on available scientific evidence that we have (1) doubled the rate of nitrogen input into the terrestrial nitrogen cycle and that these rates are still increasing

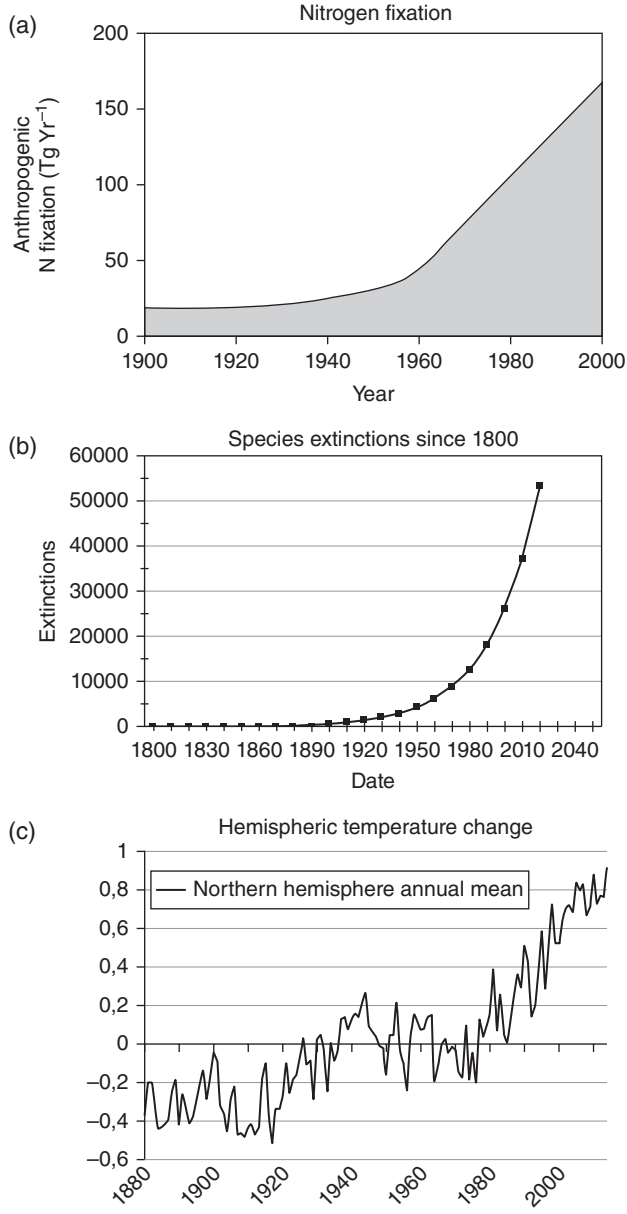

Figure 1.3 Responses of the Earth System to increasing pressure from human activities: (a) nitrogen fixation. Source: Vitousek 1994. Reproduced with permission of Peter Vitousek; (b) species extinctions. *Source*: www.whole-systems.org/index_old.html. Reproduced with permission of Norton Smith; (c) northern hemisphere surface temperature. *Source*: Adapted from Annual Mean Temperature Change for Hemispheres, NASA; (d) atmosphere carbon dioxide concentration. *Source*: Adapted from Keeling and Whorf 2000. *Source*: Steffen et al. 2003.

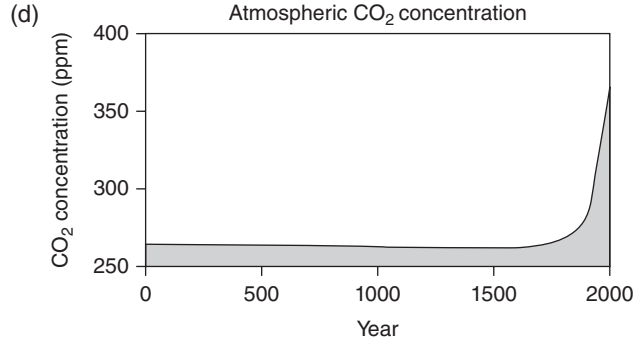

Figure 1.3 (*Continued*)

(Galloway et al. 2003); (2) that increased concentrations of the greenhouse gas nitrous oxide globally, and other oxides of nitrogen drive the formation of photochemical smog; (3) that this nitrogen increase has caused losses of calcium and potassium from soils, essential for soil fertility; contributed to the acidification of soils, streams, and lakes; increased the quantity of organic carbon stored in terrestrial ecosystems; and accelerated losses of biodiversity particularly plants adapted to efficient use of nitrogen (Vitousek et al. 1997a). The global phosphorus cycle has also been altered by human activities (mining of phosphate rock for fertilizers, detergent and for animal feed supplements), in fact doubling phosphorus inputs to the environment above the natural phosphorus inputs from weathering (Bouwman et al. 2009).

Surface temperatures over the Northern Hemisphere at present are warmer than at any other time over the past millennium, and the rate of warming has been especially high in the past 40 years (Hurrell et al. 2001: 603). Agricultural yields, water management, and fish inventories are affected by this warming – having as it does its origin in an upward trend in the North Atlantic Oscillation, dictating climate variability from the eastern seaboard of the United States to Siberia and from the Arctic to the subtropical Atlantic. Changes in the North Atlantic Oscillation, in turn, affect the strength and character of the Atlantic Thermohaline Circulation (THC). Climate changes can have profound effects on society as suggested by research indicating that the lowland Maya collapse was associated with an

increase in droughts in Yucatan resulting from bicentennial oscillations in precipitation (Hodell et al. 2001). The Maya were dependent on rainfall and small water reservoirs for the sustainability of their agriculture, and these multidecadal and multicentury oscillations in precipitation probably exacerbated other challenges faced by the Classic Maya (Demarest 2004). One of the conclusions of recent climate change studies is not that it will be warmer everywhere but, rather, that we will see more extreme events more frequently (Planton et al. 2008), such as the occurrence of El Niño events – with drought in some places and flood in others (Caviedes 2001). The results synthesized by the last Intergovernmental Panel on Climate Change (IPCC) report suggest a convergence towards increases in heat wave episodes over land surfaces, linked to the mean warming, and increasing temperature variability (Planton et al. 2008). Other extreme events, such as prolonged drought and heavy rains resulting in flooding are also expected and they pose risks to ecosystem functioning and to their capacity to provide ecosystem services (Jentsch and Beierkuhnlein 2008). In Brazilian Amazonia there is already serious concern over the increased frequency of devastating fires entering into Amazonian forests as a result of El Niño. In 1997, climate scientists and ecologists were in agreement that the droughts associated with that El Niño were responsible for a fire that consumed 13,000 square kilometers of forest in just one location (http://www.diario decuiaba.com.br for January 25, 2002). We know of similar vast fires during the 1982–83 El Niño over Borneo (Prance 1986: 75–102) and of devastating fires in the Amazon 250–400 years ago (Sanford et al. 1985).

Climate change will increase the severity of population and species declines, especially for generalist pathogens infecting multiple host species. The most detectable effects relate to geographic expansion of pathogens such as Rift Valley fever, dengue fever, and Eastern oyster disease. While other factors are surely implicated, such as land use change, there is very little doubt in the end that warming trends will affect crop and human diseases (e.g., potato late blight, rice blast, cholera, and Rift Valley fever) (Harvell et al. 2002). Climate warming is also expected to alter seasonal biological phenomena such as plant growth, flowering, and animal migration (Penuela and Filella 2001). Some Canadian tree species (e.g., *Populus tremuloides*) show a 26-day

shift to earlier blooming over the last century, and biological spring in Europe is about 8 days earlier from data for the period 1969–98 (ibid.). In the Mediterranean, leaves of deciduous plant species now unfold 16 days earlier and fall on average 13 days later than they did 60 years ago (ibid.).

In short, the simultaneous and interconnected nature of these changes in human and in environmental conditions since 1950 suggest that human activities could inadvertently trigger abrupt changes in the Earth system with consequences that we can only faintly imagine. The most troubling of all is, of course, triggering a disruption in the "oceanic conveyor belt," as it is called, which regulates world climate (see Figure 1.4 and Broecker 1991). The increases in greenhouse gases can trigger changes in the North Atlantic circulation and computer simulation results have most of the scenarios resulting in rather dramatic collapses. We know already that the Atlantic THC can have multiple equilibria and multiple thresholds, that THC reorganization can be triggered by changes in surface heat and in freshwater fluxes, and that crossing thresholds can result in irreversible changes of ocean circulation (Rahmstorf and Stocker 2003). Our current situation with regards to carbon dioxide alone, not to mention all the other earth-warming gases being emitted exponentially, is well above the experience of the past 500 million years as recorded in the Vostok Ice Core (see Figure 1.5).

The evidence for the seriousness of climate change has been affirmed at a meeting of members of 63 national academies of science from all parts of the world, affirming support for the work of the IPCC which says that it is at least 90 percent certain that temperatures will continue to rise by at least 5.8 degrees Celsius above 1990 levels by 2100, and urging prompt action to reduce emission of greenhouse gases (IPCC 2000). In their joint statement, the representatives of the 63 national academies of science concluded that "the balance of the scientific evidence demands effective steps now to avert damaging changes to Earth's climate" (Interacademies 2000 and also updates at http://interacademies.net. Yet, complacency seems to be all too common (O'Brien et al. 2006; Stearman and Sweeney 2007). Some studies by Northern Europeans suggest that Southern Europe will experience disproportionately negative impacts through water shortages, fires, decreased crop productivity,

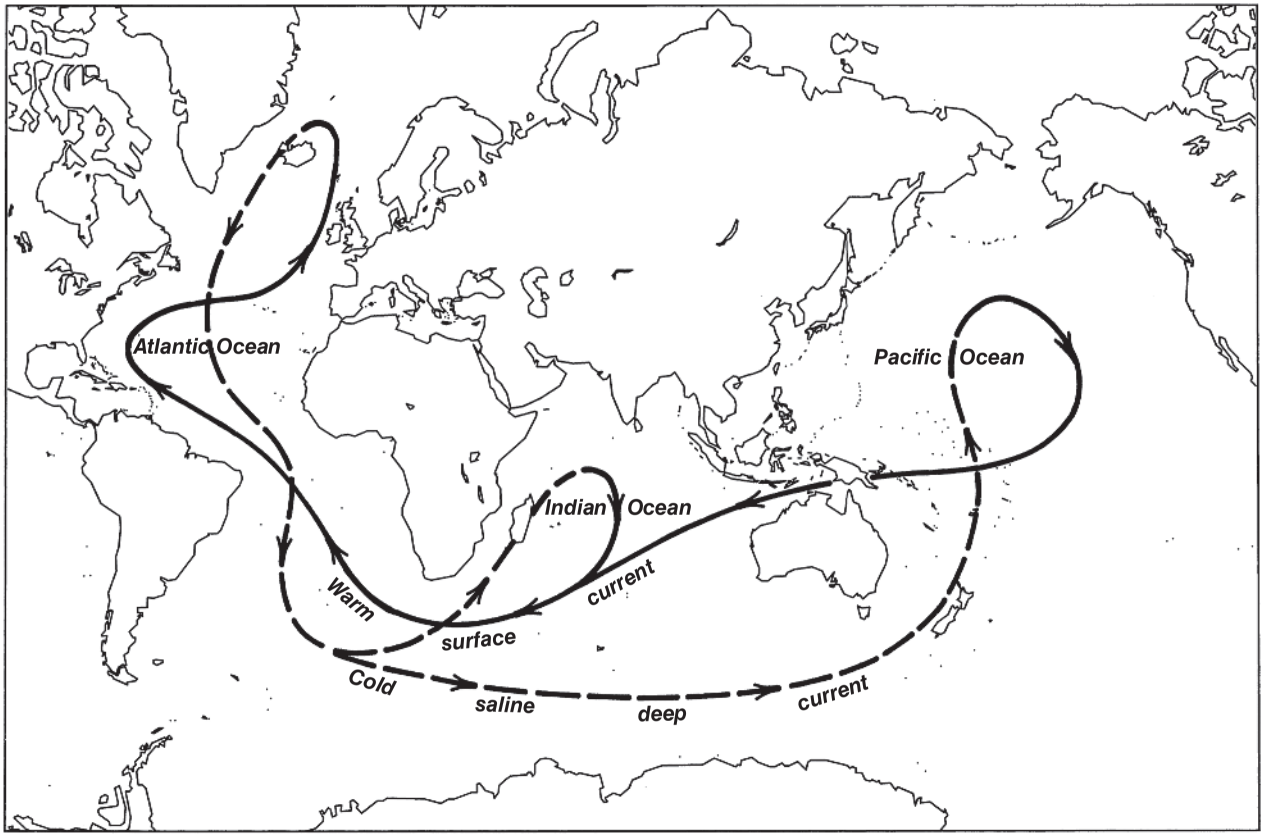

Figure 1.4 Oceanic conveyor belt. Global warming is expected to disrupt the conveyor belt that regulates climate. *Source*: Based on Broecker 1991, p. 79.

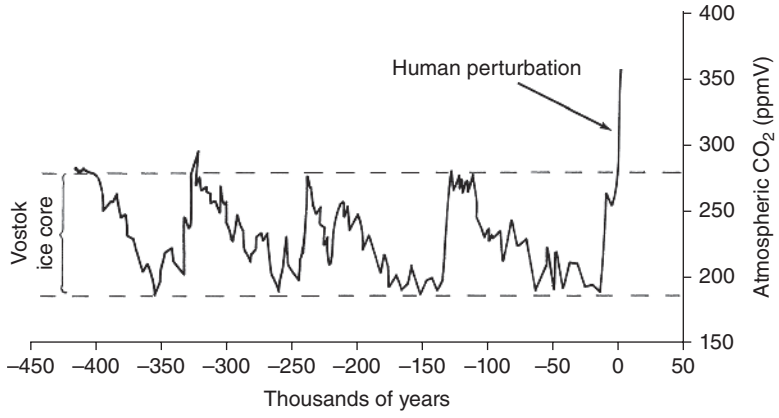

Figure 1.5 Vostok Ice Core provides the best current record of carbon dioxide for the past 450,000 years. *Source*: Adapted from Petit et al. 1999, p. 399.

while Northern Europe would be spared. Yet this view overlooks the interconnected nature of our world, and of Europe, where both direct and indirect impacts matter, and that key elements of the economy are climate sensitive, such as forestry, fisheries, and hydropower (O'Brien et al. 2006). In fact, complacency comes from a fundamental misunderstanding of how climate change works believing that atmospheric greenhouse gases can be stabilized while continuing to emit greenhouse gases at rates higher than can be offset by sequestration or other methods (Stearman and Sweeney 2007). Complacency and low public support for mitigation policies seems to come from misconceptions of climate dynamics, rather than from uncertainties about the impacts of climate change (Ibid.).

Once we begin to operate well above any recorded levels not just for one but for many measurable parameters, the question has to be asked if we have begun to play a reckless game with the survival of our species on planet Earth. Do we recognize that business-as-usual threatens the end of life as we know it? Do we recognize our own contribution to it in choices made each day? Are we willing to use our considerable mental capacity, and exercise our political will, to ensure our survival and that of our children? Or are we so self-satisfied in our own material success that we cannot recognize overwhelming

evidence when we see it? Is the evidence above sufficient? What else might one need to know? In the answer lies our likelihood of having a future in a world worth living in.

Looking Back and Looking Forward

In the chapters that follow, we look back at our evolution as a species and how we have managed our relations with nature, and we look at what we might have to do in the near future to reverse current destructive trends. This story is characterized by changes in how we have made use of our social and cultural tools to learn about and use natural resources. In Chapter 2, we examine the history of human–environment interactions with a focus on Western cultural traditions in the study of human–environment interactions. The dichotomy between people and the physical environment is deeply embedded in Western thought and religions – a dichotomy that to this day influences our choices and actions – and that seems to facilitate a view that treats the environment as external to our being, and subject to control and domination. This is in stark contrast to some of the Eastern religions and cultures which view human existence as profoundly embedded in nature through cycles of incarnation and reincarnation. An examination of the archeological record further elucidates this problem in the frequency with which it seems that societies which built complex systems of control over key resources, such as water, collapsed in time due to a series of miscalculations and both internal and external forces (discussed in Chapter 3, and in Diamond 2005). In other words, Chapters 2 and 3 review approaches from the social sciences to the study of environmental issues. In Chapter 4, we discuss the web of life and how closely tied we are in it, and the fundamental principles of ecosystem productivity that lay the foundations for our capacity to use the Earth's biotic resources. This examination of human impacts focus in this chapter on land use changes with particular attention given to the dynamics of contemporary deforestation in the Amazon Basin (an area where I, and many colleagues, have worked for over 30 years). In Chapter 5, we look at one important aspect of adaptation, i.e., how we use information and make decisions that affect our environment. In a new chapter for this

second edition, the new Chapter 6, we examine the role of population dynamics in shaping our decisions and how our modes of production have been shaped by population growth and by our decisions to either mitigate or adapt to changes in our environment. Information and learning are discussed in the context of demographic patterns, choices about reproduction, and the various ways different populations think how to manage population. It is important to recall that our current environmental crisis is tied at some level to the breakdown of local institutions' capacity to manage the local environment because of the larger forces unleashed by population growth, globalization, and other political economic forces. In Chapter 7, we examine the role of institutions and self-organization, how we can avoid tragedies of the commons, and how we might address the restoration of trust and community as part of a strategy to find once again balance with nature. Chapter 8 examines patterns of consumption in developing and developed countries, and provides a critique of our current patterns of consumption that value accumulation of material goods over other things such as human dignity, trust, and reciprocity. In the ninth and final chapter, I provide a personal examination of our environmental crisis and of viable solutions that can be tried to restore our balance on the planet by valuing community, trust and reciprocity, and to find happiness in each other and in a biocentric world, rather than in a self-centered materialist world that is leading our planet towards a collapse as has never been seen before. Do we value life more than we value things? Our own self-interest should help us make the choice.

Additional Resources

- Land–ocean interactions information available at www.loicz.org
- Information on the Global Land Project at www.globallandproject.org
- Overviews of global change research at http://dels.nas.edu.
- Useful materials from the Center for International Earth Science Information network at www.ciesin.org
- The Forum on Science and Innovation for Sustainable Development has overviews of research on climate change and sustainability at http://sustainabilityscience.org

– No-Till on the Plains, a Kansas-based nonprofit devoted to educating growers about agricultural methods that model nature at www.notill.org
– "Story of Stuff" video at www.storyofstuff.org

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