CHAPTER 1

Environmental Problems and Society

"PASS THE HOMINY, *please.*"

It was a lovely brunch with fruit salad, homemade coffee cake, a great pan of scrambled eggs, bread, butter, jam, coffee, tea—and hominy grits. Mike's friends Dan and Sarah had invited him, his wife, and their son over that morning to meet some friends of theirs. The grown-ups sat around the dining room table, and the kids (four in all) careened from their own table in the kitchen to the pile of toys in the living room, and often into each other. Each family had contributed something to the feast before them. It was all good food, but for some reason the hominy grits (which Mike had never had before) were the most popular.

There was a pleasant mix of personalities, and the adults soon got into one of those excited chats that leads from one topic to another as unfamiliar people seek to get to know each other a bit better. Eventually, the inevitable question came Mike's way: "So, what do you do?"

"I'm an environmental sociologist."

"Environmental sociology. That's interesting. I've never heard of it. What does sociology have to do with the environment?"

It's a question all four of us—Ike, Laura, Loka, and Mike—sometimes get. But Mike, the oldest of us, used to get it a lot, as in this breakfast conversation from many years ago. Today, we sense a change in general attitudes. Environmental problems are everywhere, and people know that our species has much to do with them. Most people we meet have still never heard of the field, but more and more of them immediately get the basic idea behind it: society and environment interrelate.

And more and more, the people we meet recognize that this interrelation has to confront some significant problems—perhaps the most fundamental problems facing the future of life, human and otherwise. They readily understand that environmental problems are not only problems of technology and industry, of ecology and biology, of pollution control and pollution prevention. Environmental problems are also social problems. Environmental problems are problems *for* society—problems that threaten our existing patterns of social organization and social thought. Environmental problems are as well problems *of* society—problems that challenge us to change those patterns of organization and thought. Increasingly, those we meet appreciate that it is people who create environmental problems, and it is people who must resolve them.

That recognition is good news. But we—every one of us—sure have a lot to do. And we'll need the insights of every discipline, from the biophysical sciences, to the social sciences, to the humanities. There is an environmental dimension to all knowledge. This book aims to bring the sociological imagination to this necessarily pan-disciplinary conversation.

The phrase "sociological imagination" comes from the great twentieth-century sociologist C. Wright Mills. He famously defined it as the ability to "grasp history and biography and the relations between the two within society" in order to understand our lives "as minute points of the intersections of biography and history within society."[1] His point was that life is lived in context. You can't do just anything you might want to do. And what you might want to do is likewise shaped by context to begin with. Our social life is a mighty factor in that context. Our decisions are not merely our own.

But there is another mighty factor in that context. We should add at the end of each of those famous phrases "and ecology." Gaining the ability to grasp history and biography and the relations between the two within society and ecology—to learn to understand our lives as minute points of the intersections of biography and history within society and ecology—is what we might call the *environmental sociological imagination*.[2] Our decisions about how to lead our lives, and our hopes about how we might live otherwise, are embedded in the constraints and possibilities of both our social and ecological contexts.

To live contextually (and there is no other way to live) is also to live relationally. Action requires interaction. To get along you have to get along. You may be on your own, but still you're not alone, neither socially nor environmentally. The environmental sociological imagination, with its contextual and therefore relational way of thinking about the world, suggests the following definition of environmental sociology itself. *Environmental sociology is the study of community in the largest possible sense, the community of all.* People, other animals, land, water, air—all of these are closely interconnected. They interact and interrelate. Together they form a kind of togetherness. As in any community, there are also conflicts in the midst of the interconnections, interactions, and interrelations. Environmental sociology studies the community of all with an eye to understanding the origins of, and proposing solutions to, these all-too-real social and biophysical conflicts.

But who are environmental sociologists? They are participants in a wide-ranging conversation among scholars from many social science disciplines who share a passion for studying community in the largest possible sense. Some might call themselves "political ecologists" or "social ecologists" or "human ecologists" or "ecological economists." Or they might prefer to think of themselves as "environmental geographers" or "environmental anthropologists" or "environmental economists" or "environmental psychologists." It is not the disciplinary label that is important but the passion to study this largest of communities, with its many conflicts. Increasingly, academic conferences focus on an issue like climate change, sustainable consumption, sustainable agriculture, or environmental justice and not on a specific discipline's take on it. The research papers that come out of these conferences similarly cite scholars from across this wide spectrum. We all have our starting points, of course, our distinctive voices and angles of vision to bring to the conversation, which is great. That is how, and why, one learns from others. But it is the goals that matter, not the disciplines—the aims, not the names. In this book, we discuss contributions from scholars with all these many different departments on their business cards. These many voices and angles of vision help widen our imagination for a better tomorrow as we better understand today.

This wideness of imagination is particularly important as we deal with the heavy matters of inequality, which are at the center of gravity of environmental sociology. Not only are the effects of environmental problems distributed unequally across the human and nonhuman community, but inequality is deeply involved in causing those problems in the first place. Inequality is both a product and a producer of climate change, pollution, overconsumption, resource depletion, habitat loss, risky technology, and rapid population growth. Inequality also influences how we understand what our environmental problems are. And most fundamentally, it can influence how we envision nature itself, for inequality shapes our experiences, and our experiences shape all our knowledge.

This returns us to the question of community. Inequality cannot be understood apart from the justice of the communities in which it takes place. Ecology is often described as the study of natural communities. Sociology is often described as the study of human communities. Environmental sociology is the study of both together, the *social ecology* of the single commons of the Earth we humans share, sometimes grudgingly, with others—other people, other forms of life, and the rocks and water and oil and air that support all life.[3] Environmental sociology is the study of this, the biggest community of all.

Joining the Dialogue

The biggest community of all—clearly, the topic of environmental sociology—is vast. Not even a book the length of this one can cover all of it, at least not in any detail. In the pages to come, we will take up the main conversations about the state of relations within this vast community. We won't take up all the side conversations, but we will invite the reader into a good many of them to trace how the larger debates play out in particular neighborhoods of discussion and investigation. We do so in the three main parts of the book:

The Material: How health, consumption, the economy, science, technology, development, and population shape our environmental conditions

The Ideal: How culture, ideology, symbols, moral values, and social relations influence the way we think about and act toward the environment

The Practical: How we can bring about a just ecological society through governance, mobilization, and the politics of our everyday lives

Of course, it is not possible to fully separate these three topics. The deep union of the material, the ideal, and the practical is one of the most important insights that environmental sociology has to offer. The parts of this book represent only a sequence of emphases, not rigid conceptual boundaries. A number of themes running throughout the book help unite the parts:

- The central importance of inequality and questions of justice in environmental problems
- The dialogic—or interactive and unfinished—character of causality in environmental sociology
- The interplay of material and ideal factors with each other, constituting the practical conditions of lived experience
- The value of understanding these social and ecological dynamics as matters of community
- The important influence of political institutions and commitments on our environmental practices
- The many, many, many possibilities—and demonstrated successes—for resolving conflicts and achieving justice in the biggest community of all

The overarching goal of this biggest community, it seems to us authors, is to help all as we help each one. How? Recognizing our ties opens the door to forging them, giving us the imaginative fodder for a more just tomorrow. It's a tall charge but one that has to start somewhere. And why not start here, with this invitation to environmental sociology?

We hope you find our invitation welcoming and open to all as we seek to engage with you as one. Our capacity to be inviting, though, is undoubtedly informed and sometimes limited by what we four as authors have come to know and not know in our lives. We certainly do not know everything about you or about the topics at hand. We make a few assumptions that are best for us to be up front about. Although we welcome a wider readership, we assume that most who turn the pages of this book do so in the United States and Canada as part of college courses. That means our readers tend to be better off financially than others domestically and internationally—but not always. College students and others are a diverse lot. We assume that our readers bring diverse perspectives and experiences across differences of race, nationality, class, ability, gender, sexuality, and many other dimensions. As we try to engage with the biggest community of all through the environmental sociological imagination, we may not imagine quite enough. Or we may imagine too much. In any event, stay with us and even reach out to us, as we try to write—and rewrite with every new edition—the most inclusive text we can to work toward a more just and ecological tomorrow.

The Ecology of Dialogue

Engaging with the social ecology of the biggest community of all asks us to step back and consider how the ideals we try to put into practice are shaped, and sometimes even compromised, by our material positions. By approaching environmental sociology in this way, we bridge a long-standing debate among scholars about the relationship between environment and society—and indeed about all of life—a debate between more *materialist* and *idealist* views about our practices of living. Materialists argue that environmental problems cannot be understood apart from the material threats posed by the way we have organized our societies, including the organization of ecologic relations. They believe that we can ill afford to ignore the material truth of organizational problems and their ecologic consequences. Idealists do not necessarily disagree, but they emphasize the influence of social life on how we conceptualize those problems or the lack of those problems. Idealists focus on the ideological origins of environmental problems—including their very definition *as* problems (or as nonproblems). A materialist might say, for example, that climate change is a dangerous consequence of how we currently organize the economic side of social life. An idealist might say that to recognize the danger—or even the existence—of climate change, we must wear the appropriate conceptual and ideological eyeglasses, which we gain through our social relations.

Although this debate sometimes gets quite abstract, it has important consequences. Materialists argue that the practical thing to do is to solve the social organizational issues behind environmental problems, like the way land use laws and current technologies encourage the overuse of cars. Idealists argue that the first step must be to understand our environmental ideologies, with all their insights and oversights, and their social connections and disconnections, lest our solutions lead to still other conflicts.[4]

Note that we mean "materialist" here in the philosophical sense of emphasizing the material conditions of life, not in the sense of material acquisitiveness. And we similarly mean "idealist" in the philosophical sense of emphasizing the role of ideas, not in the sense of what is the best or highest. But in practice (and despite the polarization that sometimes arises in academic debates), no scholar uses only one or the other perspective. Following a materialist position inevitably leads you to consider the ideas by which we understand material reality, sometimes to our regret. Similarly, following an idealist position long enough leads you to recognize that the world resists what we say about it and that our ideas are shaped by this resistance. Each helps constitute the other.

To understand the mutually constitutive relationship between the material and the ideal, and its practical consequences, let's turn to an ancient fable from India. A group of blind people encounters an elephant for the first time. One grabs the elephant's tail and says, "An elephant is like a snake!" Another grabs a leg and says, "An elephant is like a tree!" A third grabs an ear and says, "An elephant is like a big leaf!" To the materialist, the fable shows how misinformed all three blind people are, for a sighted person can plainly see how the "snake," "tree," and "big leaf" connect together into what an elephant really is. To the idealist, the fable says that we all have our ideological blindnesses and there is no fully sighted person who can see the whole elephant—that we are all wildly grasping at the elusive truth of the world.

The approach we take to this ancient debate is that the material and the ideal dimensions of the environment depend upon and interact with each other and together constitute the practical conditions of our social ecology.

What we believe depends on what we see and feel, and what we see and feel depends on what we believe—and therefore do. It is not a matter of either/or; rather, it is a matter of both together. Each helps constitute and reconstitute the other in a process that will never, we must hope, finish. We term this mutual and unfinalizable interrelationship *ecological dialogue*.[5] Throughout the book, we consider the constant conversation between the material and ideal dimensions of this never-ending dialogue of life and how our environmental practices emerge from it.

Ecological dialogue is also a way to conceptualize power—to conceptualize the environmental relations that shape our scope for action: our ability to do, to think, to be. These relations of power include both the organizational factors of materiality and the knowledge factors of our ideas, which in turn, shape each other. By using the word *dialogue*, we don't mean that everything in this interrelationship is happy and respectful, smooth and trouble free, or even that it always should be. Dialogue is not a state we reach when we have overcome power; it only happens *because of* power—the power to engage another's response and the power another grants by responding. There is often conflict involved, which is one of the main ways that the material and the ideal continually reshape each other and express themselves in our practices of living.

And conflict is not necessarily a bad thing. Sometimes it is exactly what is needed to get us to pay attention. Neither is power all kicking and yelling. There is much cooperative and complementary action in the dialogue of ecology, much conviviality that we relish and that constantly changes us. We experience power in cooperative and complementary action, too. Nor is power necessarily a bad thing. (Imagine for a moment having no power at all in your life and what an awful circumstance that would be.) It's a matter of who has power, what power does and how and why, and the legitimacy of power's balances and imbalances. These are moral questions that we need to continually ask and re-ask.

Maybe a diagram will help. Have a look at Figure 1.1, a kind of environmental sociological reinterpretation of the *Taijitu*, the ancient Chinese yin–yang icon. The *Taijitu* suggests that the world is constituted through the interaction of yin and yang, which together create a unity between notions of Earth and Heaven—between the material and the ideal. Often the *Taijitu* is interpreted to mean that yin and yang are opposites, but the black dot in the white side and the white dot in the black side are supposed to indicate that each is the seed of the other. Also, the *Taijitu* indicates the interactiveness of yin and yang through curved inter-nesting of the two sides instead of a straight line dividing yin and yang into oppositional hemispheres. It's one of history's great images.

But from the perspective of ecological dialogue, the *Taijitu* represents the world as overly unified, static, and finished. Figure 1.1 suggests the changing, unfinished, and sometimes conflictual character of the world through showing the material and the ideal as two partial moon faces in practical dialogue with each other. Together, the moons of the "material" and the "ideal," which tuck together in a basket weave at their edges, making a circle and a kind of ecological holism. That holism is always unfinished, though, and thus never fully whole, which the diagram represents through the open space between the partial moons. But the open space is not empty. Rather, it is an active space of interchange, interaction, and interrelation through the "practical"—the ideas and materialisms we put into joint practice. Some of that practice may be conflictual, and some may be cooperative and complementary. Through it, the ideal and material shape each other and change each other, shaping and changing the practical at the same time. To further represent this mutual constitution of the material and the ideal, through the relations of the practical, Figure 1.1 takes the seed imagery of the *Taijitu* and converts it to eyes, one of the central organs of communication, with a black eye on the white side and a white eye on the black side. Plus, the imagery of the moon faces is meant to suggest the motion of light and shadow across the ever-unfinished holism, like phases of a moon, as white becomes black and black becomes white over time.

The open pocket of space between the partial moons can be especially meaningful. Environmental issues are often a real downer. But we will continually emphasize in this book that positive and practical environmental change is possible through the engagement of the material with the ideal. We know this is true because people have so marvelously often achieved it already. People have done it by coming to see themselves as part of ecological dialogue, that is, as part of the creative community of the Earth and all its inhabitants, ever working out our ever-changing samenesses and differences, connections and disconnections, in the practical art of social ecology.[6] The biggest community of all is thus the biggest dialogue of all.

Figure 1.1 Ecological Dialogue

Source: Matt Robinson & Michael M. Bell

The Dialogue of Environmental Justice

But what stands in the way of ecological dialogue? The common breakdown of our dialogue with each other and the Earth is a symptom of a broader disease: the untying of life from its potential to thrive in community. Thankfully, that problem has a positive corollary because we can retie what we have untied or make new ties as we think about a transformative framework for the future. This is what we authors understand as *environmental justice*—the flourishing of mutual aid through communal ties within and across social ecology. Environmental justice is not only a question of fairness for humans and nonhumans alike. Even the equal distribution of a harm (what we sometimes call fair) doesn't capture the transformative need for justice beckoned by ecological dialogue. There's nothing fair about the equal distribution of a harm when that harm could be prevented in the first place. Neither is environmental justice just a question of equality. After all, not all inequality is unfair. Everyone differs and thus has different needs, wants, and gifts to share. That is part of the beauty of the world.

Transformative justice calls for identifying and changing gaps in mutual aid. Such gaps (and possibilities for making ties anew) manifest themselves within three intersecting axes of environmental justice: *across time*, *across social space*, and *across species*. Environmental justice across time concerns what are often called issues of "sustainability." Environmental justice across social space is often simply called "environmental justice" to designate disproportional burdens carried by particular social groups, commonly abbreviated as "EJ." Environmental justice across species raises questions about the rights and sustenance of the nonhuman, which humans understand through ideas of "ecological beauty" and what we cherish and what we do not. In earlier editions of this book, we referred to these intersecting three dimensions as sustainability, environmental justice in the purely human sense, and ecological beauty, as is commonly done in environmental discussions. We introduce here new language, for we have come to conclude that, analytically, all three are aspects of what should be seen as the central moral and practical challenge of social ecology: what we will term the *one justice* of environmental justice.[7] It's justice of all in all, for the biggest community of all.

Environmental Justice Across Time

How long can we keep doing what we're doing? Is it sustainable—that is, can we continue doing what we're doing without compromising the needs of the future, both for humans and nonhumans? Are we aiding future generations or taking from them?

"You say you love your children above all else, and yet you are stealing their future in front of their very eyes," said then-fifteen-year-old Swedish activist and Nobel Peace Prize nominee Greta Thunberg, speaking at the UN Climate Summit in Poland in December 2018. Thunberg's call to action poses the essential question of environmental justice across time.

The list of threats to environmental sustainability is long indeed.[8] Yet it's difficult to wrap our minds around such threats because we struggle to process complex and uncertain challenges of the future. Scientists call this temporal myopia *contempocentrism*.[9] We are generally good at planning for the immediate future: next meal, next week, next quarter profits. But when the needs and consequences of our actions are further away, taking action is not exactly our strong suit.

Tying into the future thus requires us to take a *precautionary* approach to ecological relations—to watch for environmental "yellow lights" about what may be coming down the ecological pike and to hit the breaks to avert worst-case scenarios when the lights are clearly red. The precautionary principle calls for us to think about what's ahead as we think about what we face now while remaining mindful that questions of time are also questions of social space and species. We sure have a lot to think about: issues of climate change, energy, smog, land, water, food, disease, and more.

Global Climate Change

How much longer can we keep doing what we're doing to our climate?

Some say don't worry, and some even say it's a hoax. But it's not a hoax. Given the controversy in some quarters, we'll take up the scientific evidence about climate change in detail. Yet in the minds of the overwhelming majority of scientists—the same people who helped provide us the modern comforts we routinely enjoy—the debate is over. The global climate is warming, mostly due to human actions. The continuing scientific controversy concerns what we should do about it.

Scientists are not alone in this judgment. A majority of people in most countries agree that climate change is happening. Even in the United States, where climate change skepticism is unusually high, a majority of people agree that the effects of climate change are here now or will begin within a few years, according to eighteen straight years of Gallup polls, from 2001 to 2018.[10] After all, there is plenty of evidence you don't need statistical software to appreciate. Broiling hot summers. Drought alerts. Floods. Rising sea levels. Record hurricanes. Melting glaciers. Decreased snow cover. Open-water fishing at the North Pole. Palm trees and peaches where they never grew before. Diseases and insects our grandparents' generation never had to contend with in our own regions. Or even hardly any insects at all. People notice such things in their own lives, and that makes a difference.

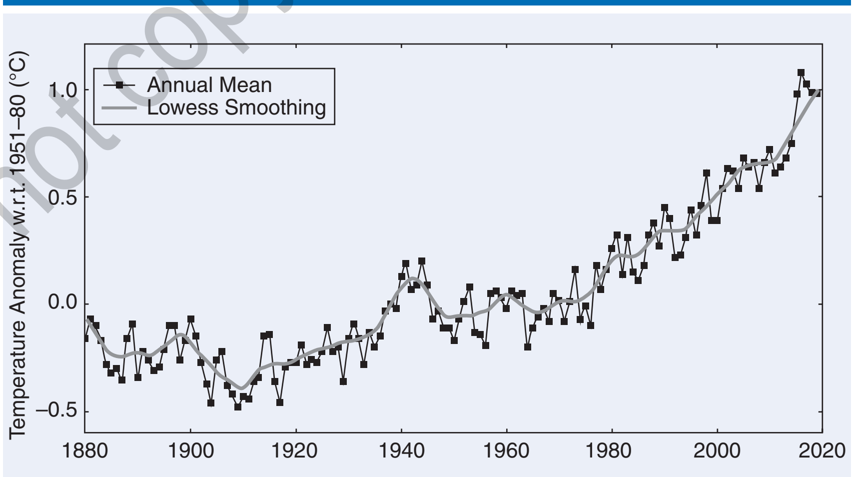
And here it is in numbers: When averages are calculated for the entire globe, the ten warmest years on record (through 2019) have all occurred since 1997. The five warmest years are the last five years.[11] The warmest ever was 2017.[12] The second warmest was 2019.[13] The third warmest was 2018[14] (see Figure 1.2). And it is a sure bet that by the time this edition is in print, or shortly afterward, those years will be topped. At least that has been the case with every previous edition of this book because the overall trend is continuously upward. The 1970s were hotter than the 1960s, the 1980s were hotter than the 1970s, the 1990s were still hotter, the 2000s were hotter yet, and the 2010s were even hotter than that.[15] Wow.

Long-term weather records also show that there was a grain of truth to an earlier generation's fireside stories about having to walk to school through 3 feet of chilling snow, barefoot and uphill both ways. The eighteenth- and nineteenth-century images of the whole town out for a skating party, or of Hans Brinker and his silver skates on the frozen canals of the Netherlands, are more than merely romantic. It really was colder back then. Winters were longer, blizzards were stronger, and glaciers used to come down farther out of the mountains. The year 1997 was the last time Dutch canals froze enough to hold the "Tour of Eleven Towns," once an annual skating event with thousands of participants.[16] There are reports that Long Island Sound, the body of salt water between Long Island and the Connecticut coast, used to freeze over some winters, and people would drive fifteen miles across the ice with a team and wagon. That kind of freeze hasn't happened in 150 years.[17]

It's not heating up everywhere, however, although it is in most places. And the changes going on entail a lot more than warming. Different places are experiencing a wide range of climatic disruptions, which is why scientists have historically preferred to call the issue "global climate change" rather than the more popular phrase "global warming." Plus, some areas may not experience much warming in one particular year. But overall, the heat is on, globally.

We are already feeling the effects of what many scientists call not just global climate change but the "climate emergency."[18] Our best knowledge comes from the Intergovernmental Panel on Climate Change (IPCC), a group of hundreds of scientists from around the world that periodically summarizes what we know.[19] It documents that already climatic zones have shifted, rainfall patterns have changed, weather conditions have become more variable, and sea level is rising—and more, much more. Some of these changes—like how cool it gets in an average evening—are relatively subtle. But if climate

Figure 1.2 A Warming World: Global Surface Temperatures, 1880 to 2019



Source: NASA (2020).

change trends continue, the IPCC says that by 2100 we will see major environmental changes that will drastically compromise the lives of billions.

Why is it happening? You'd have to be living in a cave not to have heard by now that scientists place the blame most squarely on carbon dioxide emissions from fossil fuel use. The excess carbon dioxide in turn leads to an increased "greenhouse effect" through the ability of carbon dioxide to trap heat that would otherwise radiate out into space. The greenhouse effect is not a new discovery. Scientists figured out 150 years ago that the Earth would be a cold and barren place without it. But too much of a good thing is, well, too much of a good thing.

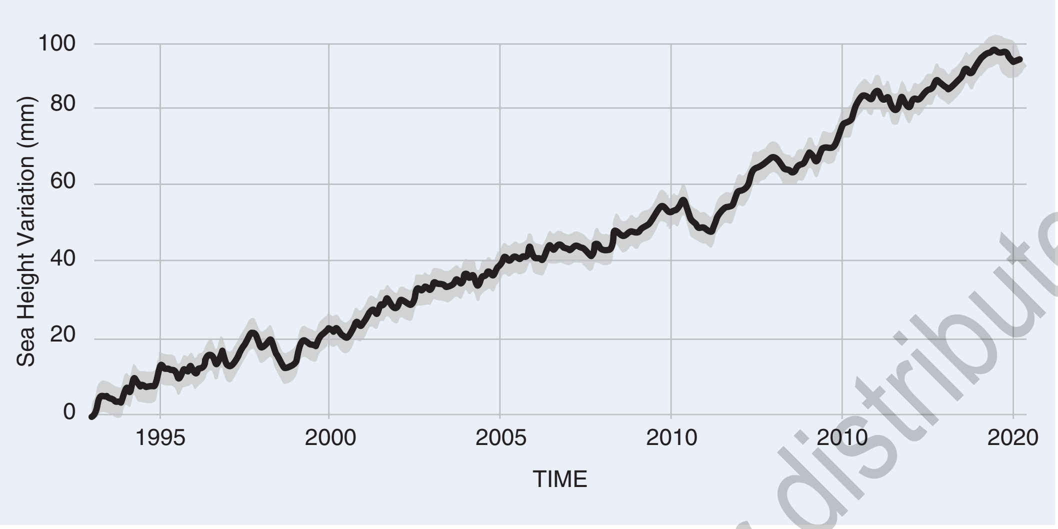
However, extra carbon dioxide accounts for only about 58 percent of human-induced climate "forcing," as climatologists say.[20] Other greenhouse gases like methane, nitrous oxide, chlorofluorocarbons (CFCs), and ozone, as well as the soot or "black carbon" released by the myriad combustion processes of human activity, together account for the rest.[21] Methane is the most important of these, amounting to about half of the other forcings. But note this: most forcings other than carbon dioxide also come about through the burning of carbon-based fuels, directly or indirectly. Here's where a lot of the controversy comes, of course. The great engine of modern life is currently utterly dependent on carbon-based fuels.

The good news, as we'll discuss in the next section, is that our current dependence on fossil fuels is largely unnecessary. There are workable alternatives. But we'd better implement them really soon—like now. Our situation is pretty scary if we don't.

Take sea-level rise. As the global climate warms, glaciers and the ice caps melt, and ocean water heats up and expands. Sea level has already risen significantly (see Figure 1.3), increasing the danger of flooding during storm surges. Plus, the IPCC projects that the average level will go up another 0.44 to 0.74 meters (1.4 to 2.4 feet) by the beginning of the twenty-second century.[22] That may not seem like all that much unless you happen to live in a place like New Orleans, Amsterdam, or the low-lying Pacific Island nations of Tuvalu and Kiribati. Some 3.7 million people in the United States live on land less than a meter (3.3 feet) above the high tide line.[23] Moreover, a recent study by the U.S. National Aeronautics and Space Administration (NASA) found that it was "physically plausible" that sea-level rise by 2100 could top 8 feet.[24] The average elevation of Tuvalu is only 6.6 feet—an entire nation basically washed away. Globally, a 2019 study found that 187 million people would be displaced.[25]

Or consider the ecological disruptions climate change will bring. A particularly unnerving one is ocean acidification. Until recently, even scientists didn't consider this effect much. But it turns out that oceans absorb a third of our carbon dioxide emissions—22 million tons a day.[26] That lessens the greenhouse effect of excess carbon dioxide, which is helpful. Yet it also changes the chemistry of ocean water, leaving it more acidic, which makes it harder for shelled organisms to grow. To pull dissolved calcium carbonate out of ocean water—calcium carbonate being the basic building block of shells—organisms have to lower the acidity at the specific spots where their shells are growing. A more acidic ocean leaves such creatures struggling to

Figure 1.3 Oceans on the Rise: Global Mean Sea Level, 1993–2019, Based on Satellite Data



Source: NASA (2020).

do so. If we don't take any additional steps to control our emissions, by 2100 easily half of corals, echinoderms, and mollusks would be affected.[27] It is even plausible that oceans will become so acidic that shellfish cannot make shells.[28] Think of the massive species extinction that would result. It would also mean that coral reefs will no longer grow.[29] Not only would that be a tragedy in its own right; it might even undermine the calcium carbonate platforms that hold up coral islands, causing them to collapse into the sea with the next big storm.

And consider these other ecological impacts. Increased risk of extinction for up to 30 percent of species.[30] Gradual replacement of tropical forests with savanna in eastern Amazonia.[31] More disease, as our warmer weather creates conditions more hospitable to mosquitoes, ticks, rodents, bacteria, and viruses.[32] More variable weather, probably much more variable. More storms. More floods. More wildfires.[33] More drinking-water shortages and heat waves. More drought stress.[34] More competition among human uses for surface waters until little is left, like Lake Urmia, once Iran's largest lake and the sixth-largest saltwater lake in the world. Now, it's 90 percent dried up due to drought, water wells, and irrigation—a graveyard for rusting cruise ships.[35]

If you live in the western and southwestern United States or Australia, these last issues—wildfires, drought stress, and competition for the water that remains—are no longer abstract and far away. The wildfires and brushfires have perhaps the most direct impact: highways closed, mandatory evacuations, warnings not to go outside because of smoke inhalation. Social space is violently reshaped as whole neighborhoods are consumed by fire, like the more than 1,600 homes burned in August of 2018 in the Carr Fire in California's Shasta and Trinity Counties or the Camp Fire in November of 2018 in Butte County of California, which destroyed more than 18,000 structures and caused 85 fatalities.[36] Scientists estimate that at least 800 million animals were affected in the Australian state of New South Wales, where more than 12 million acres burned.[37] No one will ever know precisely how many suffered.

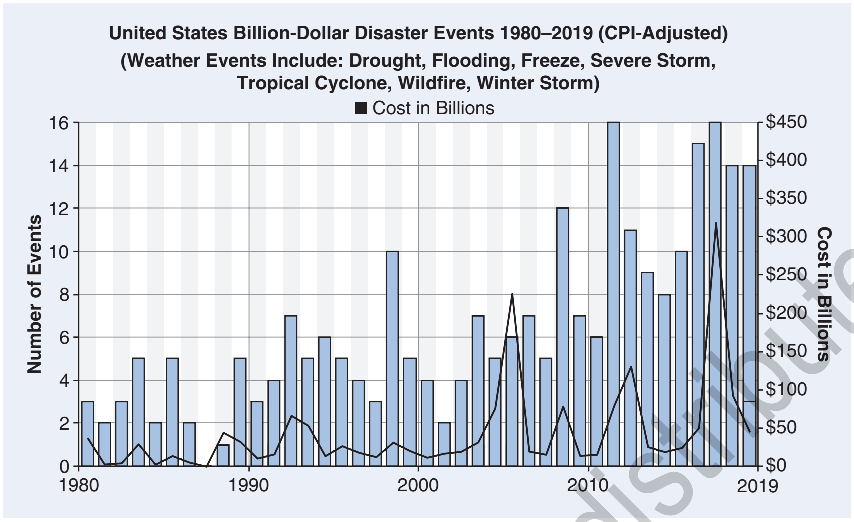
Meanwhile, the Great Lakes and St. Lawrence River drainage basin is, as of 2019, at record high water levels, with widespread shoreline flooding due to record rainfalls. Climate change is like that—much less water in some regions, much more in some others.

If we don't turn things around, the consequences for agriculture will be complex but pretty scary overall. Some farming areas are already stricken with drier conditions. Others are submerged under 100-year floods. But many of these newly wetter regions around the world do not have the same quality of soil as, say, Iowa. To add to the complexity, carbon dioxide can stimulate growth in some crop plants; one study found a 17 percent yield boost in soybeans.[38] However, this stimulation does not always result in actual increased crop yields because of other limiting factors, such as low rainfall, poor soil conditions, and the existence of other pollutants in the air.[39] Taking these pluses and minuses together, the IPCC finds an overall minus for agriculture.

And we're not just talking about projections anymore. We are already seeing an increase in scorching heat waves, devastating storms, and epic floods. Among other things, these events cost money, lots of it. In the United States alone, the National Oceanic and Atmospheric Association (NOAA) found that in 2017 alone there were sixteen climate change–related extreme weather events that each caused more than $1 billion in damages (see Figure 1.4). After adjusting for inflation, every year since 2003 has seen at least five weather-related disasters that topped $1 billion in damages. In the 1980s, most years saw three or less, and no year saw more than five.[40] In 2017, Hurricane Harvey hit Texas and Louisiana, causing $130 billion in damages in just one storm.

Plus the world is melting, literally. About 10 percent of the surface of the Earth is permanently covered by snow and ice. Seasonal fluctuations can bring the coverage up to about a third of the Earth's surface. But that coverage is wasting away. Here are a few alarming facts. When the U.S. Park Service established Glacier National Park in 1910, the park hosted some 150 glaciers. As of 2015, it was down to about twenty-six, and most of those have shrunk drastically.[41] Sea ice in the Arctic is thinning, and its area is down about a third in the last thirty years.[42] The decline in area is especially worrying because less white surface cover on the Earth means less solar energy is reflected back out to space, heating the planet even more. Now there are even frequent sizable stretches of open water at the Arctic ice cap during the summer.[43]

Figure 1.4 Billion-Dollar U.S. Weather Disasters 1980–2019



Source: NOAA (2020).

Then there are implications for infectious disease. Warmer world weather tends to encourage the spread of pathogens, their hosts, and their ability to be transmitted to humans. (Typically, microbes thrive with heat.) The World Health Organization (WHO) has found that climate change increases malaria, dengue, diarrhea, Lyme disease, tick-borne encephalitis, and food-borne pathogens such as salmonella.[44] As we write, scientists are still working to understand if climate change has had any role in the spread of COVID-19. But this much we already know for sure: In areas where a population's disease resistance is already weakened by malnutrition and other health challenges, any increases in infectious disease are particularly problematic. In the face of factors like these, WHO expects climate change to cause an additional 250,000 deaths worldwide per year between 2030 and 2050.[45]

Meanwhile, greenhouse gas emissions continue to rise. Annual mean carbon dioxide, as measured at Hawaii's Mauna Loa Observatory as of 2019, is up to 4011.4 parts per million in the atmosphere and first crossed over the line to the low 400s during seasonal fluctuations in 2013 and 2014.[46] In the mid-eighteenth century, the number was about 277 parts per million, according to data from ice cores drilled in Antarctica.[47] But growth still hasn't leveled out, despite the initial efforts of many nations around the world. Recently, the concentration has been going up about 2 parts per million per year as we continue to force the climate and push our luck.[48]

You could think of human-induced climate forcings as acting like extra blankets on a warm night, gradually stifling the planet. We say "on a warm night" because solar radiation is also on the rise, adding a climate forcing about a tenth as strong as human-induced forcings.[49] Taking all the forcings together—and there are indeed a few working in the direction of cooling, such as increased reflectivity back into outer space from increased cloudiness—the IPCC estimates that by 2100 average temperatures will likely exceed 1.5 to 2 degrees Celsius over where they were in the late nineteenth century, depending on the scenario and model.[50] These are enormous increases when you consider that an average drop of 6 degrees Celsius caused the ice ages, covering much of the northern latitudes with a mile-thick sheet of ice.[51]

Think about it the next hot summer evening as you ponder whether you should crank the air-conditioner up another notch, causing your local utility to burn just that much more carbon-based fuel and to release that much more smog and soot to generate the necessary electricity.[52] More cooling for you will mean more heating for all of us.

Energy

And how long can we keep doing what we're doing with regard to our energy sources? Not any longer at all. The trouble is we want more energy than we have—or at least more than we can easily get. The issues of this mismatch confront the world already. Rising costs. Pollution of land, air, and water. Declining stocks of some sources. Competition for space to produce energy. Tense international politics and even, say some, war. And, of course, our increasing climate emergency.

What to do? When you don't have enough of something, there are two basic ways to go: Get more or use less. Or maybe do both. There is a caveat, too, especially with regard to energy: Make sure that any way you go is clean, safe, and just. Given our record with energy recently, we'll have to inspect our options with care.

First, let's review where we get energy from now, as of 2017 (see Figure 1.5). About 32 percent of the world's energy supply comes from oil, the most of any source. Coal, peat, and oil shale are next at a combined 27.1 percent, followed by natural gas at 22.2 percent. Add all that together, and we're up to 81.3 percent of our energy coming from fossil carbon. That's a lot of fossil carbon. And then add in what the International Energy Agency (the keeper of these statistics) calls biofuels and waste—firewood, ethanol, and other such fuels, plus whatever else people can get to burn, like municipal solid waste and animal dung—at 9.5 percent. That's a lot of total carbon. Combined, we're up to a 90.8 percent carbon energy economy.[53]

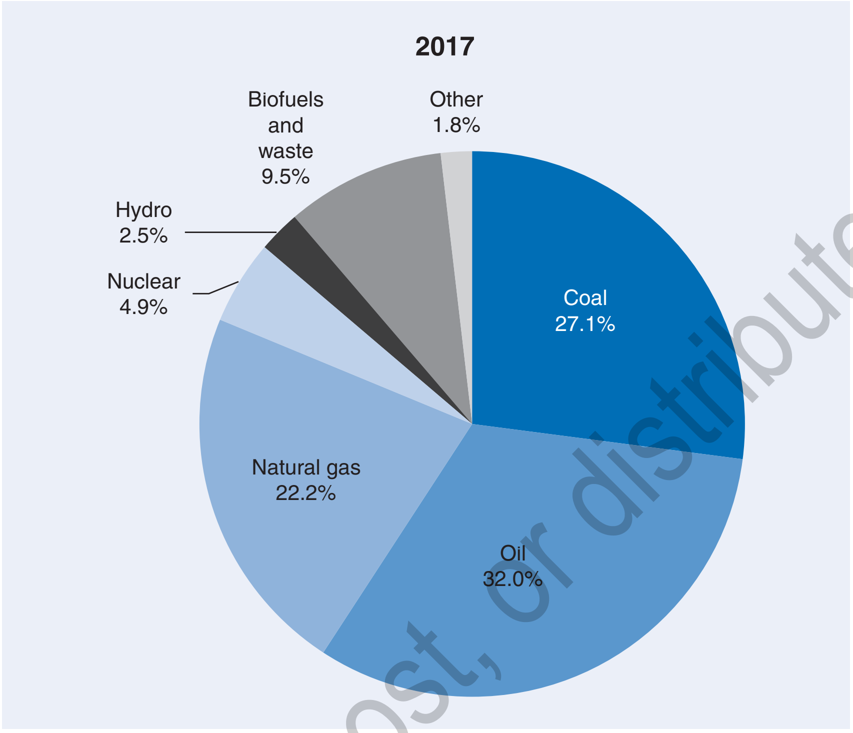
The rest? Some 4.9 percent of the world's total energy is from nuclear, and 2.5 percent from hydropower. The rest is so quantitatively insignificant that the International Energy Agency lumps it all into a single "other" category of 1.8 percent: mostly wind, solar, and geothermal.

Can we get more? There are a lot of unknowns of geology and technology here. And can we do it without wrecking the planet? A lot of money and jobs hang on this question, so clear and straight answers are hard to come by.

Fossil Fuels

Much attention has been given to the contention that we have now reached a "peak oil" state, fulfilling M. King Hubbert's prediction in the 1950s that we would soon see terminal decline in oil and gas production, albeit a few

Figure 1.5 Share of Total World Primary Energy Supply by Type of Fuel in 2017



Source: Based on IEA data from Key World Energy Statistics © OECD/IEA 2019, IEA Publishing; modified by Sage Publications. License: www.iea.org/t&c.

decades later than Hubbert thought. There is some truth to the idea. Yes, we still have substantial reserves of oil and gas in the world and some regions that have not been fully prospected. But the big and easy petroleum fields appear to have been pretty much all found.

So now companies are reverting to more difficult, dirty, and dangerous sources. Consider the huge Gulf of Mexico spill in the spring and summer of 2010 from the explosion of the Deepwater Horizon drilling platform. The Deepwater Horizon well was part of a push into deeper waters, further offshore, where water pressure is higher and infrastructure is chancier. There may be a lot of oil out there, but it's harder to get—which is why companies hadn't pumped it earlier.

Similarly, Canada and Venezuela boast huge reserves of what used to be known as *tar sands* but recently have come to have the more polite name *oil sands*. *Tar sands* is more accurate to describe the form these deposits take in the ground: thick, rigid, and sticky, in need of vast investments in digging equipment for surface mining and heating equipment for pumping it out through steam injection, which makes the tar flow. The resulting landscape is not pretty. Getting the tar to flow takes a monumental amount of fresh water, which ends up in toxic waste pools. Great pyramids of sulfur extracted from the tar rise above the land. Dust clouds swirl from the mining operations. Hundreds of square miles of forest and peatland lay decimated. Plus it takes a lot of energy to cook the oil out of the tar, reducing efficiency and increasing climate impact.[54]

Another new method of oil and gas production is "fracking," or hydraulic fracturing. Drillers stimulate the flow of oil and gas by injecting at high pressure a soup of water and chemicals mixed with fine-grained sand deep into the bedrock. The high-pressure soup opens up a network of micro-fractures in the rock, and the sand holds those micro-fractures open after drillers stop pumping in the chemicals. Huge gains in the production of oil and gas often result. Instead of finding new oil and gas fields, fracking allows companies to squeeze a lot more out of the ones they know about already. But it's expensive, so the production gains have to be high. And it's messy, very messy. The chemicals get into water wells. The gases too—to the point where some residents in fracking areas can literally light their water faucets like they were Bunsen burners.[55] In fact, the gases can seep out everywhere, polluting the air and contributing to climate change. The high pressure not only fractures the rock but also sometimes induces earthquakes—small ones generally but sometimes large enough to damage buildings. A lot of the drill water comes back up to the surface after the injecting is done, and these wastewaters can pick up radiation underground—in addition to their toxic mixture of drilling chemicals—and that wastewater is often poorly handled. And the special "frack sand" entails extensive surface mining, radically reshaping local landscapes, broadcasting fine dust particles into the air, and using vast quantities of water to wash and sort the grains. In sum, fracking bumps oil and gas production yet also poses major challenges to environmental justice—not just across time but also across social space and species. As the environmental sociologist Colin Jerolmack puts it, community itself gets fracked.[56]

How about coal, the next biggest of our current energy sources? There is still a lot of it in the ground, to be sure. But coal is infamously dirty. In addition to climate change, burning it contributes to smog, acid rain, particulates, and most of the rest of our carbon woes. Plus, coal has some special zingers of its own. Take the continued despoliation of land from coal mining. Take the billions of gallons of hot water discharged from coal-fired power plants into surrounding lakes and rivers. Take the hundreds of thousands of tons of highly toxic ash and sludge from smokestack scrubbers that a typical coal-fired power plant produces each year. Take the airborne mercury deposition from coal-fired power plants that has led to health guidelines on how many wild-caught fish from lakes in the U.S. Midwest one can safely eat. Or take the continued loss of miners' lives, like the twenty-nine coal miners who died in the Upper Big Branch Mine disaster on April 5, 2010, in Raleigh County, West Virginia, or the 104 miners who died in a coal mine explosion on November 21, 2009, in China's Heilongjiang Province.

Consequently, despite these new methods and sources, the portion of the world's energy supplied by fossil fuels has declined from about 94.1 percent in 1973 to the 81.3 percent registered in 2017.[57] The stuff is simply getting harder to extract from the Earth, and the damage done along the way is continually rising.

Non-Fossil Energy Sources

Yet there is some reason to cheer here. In a world that often seems to agree on little, politicians from across the political spectrum now often speak of the need to transition to non–fossil fuel energy sources. There are a few notable exceptions, unfortunately. But several countries have made remarkable progress, demonstrating the possibility of a world that has kicked its fossil carbon addiction.

Nuclear energy enthuses many as a solution to the carbon economy, and it is rapidly growing. Nuclear now comprises 4.9 percent of the world's energy sources, as we noted earlier, up from 1.3 percent in 1973. But nuclear energy also worries many. For sometimes the grandest of technological marvels fail, and their decoupling from the social and ecological lifeforms around them comes into full specter. The 2011 Fukushima Daiichi reactor meltdowns in Japan were only the latest in a long and scary history of nuclear accidents. The Chernobyl and Three Mile Island accidents were terrible too—especially Chernobyl, which killed several thousand as a direct result of the explosion and is expected in time to cause at least another 4,000 deaths (some say tens of thousands more) due to radiation exposure.[58] The worry is not just the potential for accidents and plant malfunctions from earthquakes, tsunamis, tornados, hurricanes, engineering problems, and operator errors. There are also issues of terrorism, nuclear proliferation and warfare, and the challenge of safely storing the waste for 100,000 years, with dangerous interactions for all three dimensions of environmental justice.

Nonetheless, others contend that these risks are better than floods, droughts, heat waves, strip mining, air pollution, oil spills, coal mine accidents, and the rest of the carbon economy mess. Whether or not the risks of nuclear are worth it, of this we can be sure. The situation can't be good if the choices are so bad.

Or are they so bad? Renewables increasingly demonstrate that they are a realistic option, showing the potential to power our economy with the Sun, the wind, the water, the tide, the heat of the Earth, and the living power of biofuels. Some countries, such as Germany and Costa Rica, have made huge progress. As of 2018, Germany was getting 37.8 percent of its electricity from renewables and 16.7 percent of its total energy, thanks to policies like "feed-in tariffs" that require utilities to buy from renewable sources.[59] The country's aims are even grander: 45 percent renewable energy by 2030.[60] In Germany now, it is utterly routine to see a house with photovoltaic solar panels on the roof. Costa Rica is arguably the world leader. In 2016, Costa Rica generated 98.1 percent of its electricity from renewables—about 80 percent from hydropower but also from geothermal, photovoltaics, and wind power.[61]

Wind power has also been growing rapidly and has huge potential for further increases. In percentage terms, Denmark is tops in wind production. As of 2017, wind energy provided Denmark consumers with 43.4 percent of their electric energy.[62] The world adds about 50 gigawatts of new wind power capacity every year. That's a lot—about the same generating capacity as fifty nuclear reactors. In absolute terms, China produces the most energy from wind, churning out 35.7 percent of the world's installed capacity, and is working hard to have a whole lot more (as well as to have a whole lot more nuclear, it must be said). The United States is next, with 16.3 percent of the world's installed wind capacity.[63] Offshore wind power is now only a small part of total wind-generating capacity—just 4 percent as of 2018.[64] But its potential contribution is vast. According to a study by the International Energy Agency, offshore wind energy from floating turbines could by 2040 generate eleven times more than the world's total electricity demand. To repeat: not just meet that demand but meet it eleven times over.[65]

The winds of change are blowing.

Imagine this way of living. Heat and cool our houses with heat pumps run through the soil. Light them with wind and photovoltaic roofing tiles, and power our transportation that way, too. Concentrate sunlight with some well-placed mirrors, or split hydrogen from water with the sun, or set up axial turbines to catch the tide, greening the energy of our schools, offices, hospitals, and factories. It can all be done, and it is being done. Moreover, many non-nuclear alternatives—especially wind—are now cheaper to install per megawatt than fossil fuel or nuclear generation, once subsidies are discounted.[66] And they are much cheaper once one takes into account the high cost of the environmental and health damage caused by fossil fuels and the risks of nuclear.

But renewable energy sources have their costs and consequences, too—arguably considerably lower and fewer than with oil and gas, coal, and nuclear energy—but costs and consequences nonetheless with implications for justice across the generations for humans and nonhumans alike. Bright light radiating from turbines and their turning noise can alter the daily lives of those who live in proximity to wind power production sites. Hydropower dams up the flow of ecology with the flow of water and displaces people from their lands and homes. Biofuels also consume space, competing with land for food and habitat, as well as needing to be combusted to yield energy, contributing to the ills of the carbon economy we look to them to help resolve. Photovoltaics, heat pumps, and tidal turbines also aren't without their environmental impacts, from the mining needed for batteries and copper tubing to the wider array of power lines required to feed more spread-out energy sources into a nation's electrical grid.

Using Less

So maybe "get more" isn't the best approach to solving our energy needs. Maybe "use less" is the better emphasis. How about not just a little conservation and efficiency but a whole lot of it? That hasn't been tried much either, after all. And using less almost certainly means abusing less. This seems right to us and to essentially all environmental thinkers. There is huge agreement here.

Of course, you shouldn't necessarily rush out and ditch the gas-guzzling SUV you bought three years ago to spring for a Prius or a Tesla instead. Tossing out the not-very-old for something that is more efficient can introduce significant inefficiencies of waste, like the embedded energy and environmental damage in the manufacture of any car, even a Prius. You'd probably do more good by driving the gas-guzzler less, and slower, and by buying a bike. This points to one of the great challenges of conservation: the slow transition time caused by the investments we have already made.

The good news is that when you invest in something more efficient, its advantages continue on through the years. That's hard to give up: Something efficient should last longer, and we'll want to keep it longer, if it is truly efficient—a point that we will come back to at the end of this chapter.

There are two other huge challenges for energy conservation: Some interests profit through waste, and our appetite for energy goes up with many of the ways we put population and aspiration into practice. But these challenges are not as inevitable as we might fear in our darker moments. There is a lot of money to be made and jobs to be had in selling conservation, as businesses around the world are starting to recognize. And there is plenty of money and lots of jobs in replacing our current energy sources with more benign ones like renewables. (Even with a vast decrease in energy use, we will still need some energy generation.) As of 2018, the renewable energy sector in Germany employed some 338,000 people.[67] And the form and consequences of our population and aspiration, and even of our aspiration for population, depend upon how we constitute our lives as social and ecological beings.

We can do better, much better.

Threats to Land and Water

There's a well-known saying about land: They aren't making any more of it. The same is true of water. And we're not using any less of either, each year. Indeed, in a way, there is less of both land and water for us to use as the expansion of industry, agriculture, and development erodes and pollutes what we have, reducing the world's capacity to sustain life.

Consider soil erosion in the United States. Soil erodes from U.S. farmland at least ten times faster than it can be replaced by ecological processes.[68] Despite decades of work in reducing soil erosion, largely in response to the lessons of the Dust Bowl, it still takes a bushel of soil erosion to grow a bushel of corn.[69] The Conservation Reserve Program, implemented by the U.S. Congress in 1985, led to some initial significant improvements by offering farmers contracts to take the most erodible land out of production. Many farmers also switched to less erosive cropping practices. Consequently, soil erosion dropped 31 percent from 1982 to 2007.[70] But since then, there has been no overall improvement.[71]

Elsewhere, the situation is equally grim. Soil erosion exceeds replacement rates on a third of the world's agricultural land.[72] And all those wildfires brought about by climate change aren't helping anything, leaving massive spaces of land without vegetation to help hold the soil in place. Overgrazing associated with poor pasture management isn't helping either. Worldwide, almost a quarter—23 percent—of cropland, pastureland, forests, and woodlands have become degraded.[73] The United Nations (UN) estimates that the decline in soil fertility costs about $40 billion globally every year, excluding costs of fertilizer and loss of biodiversity.[74]

Soil erosion is only one of many serious threats to farmland. Much of the twentieth century's gain in crop production was due to irrigation. But irrigation can also salinize soils. Because most irrigation occurs in parched regions, the abundant sunlight of dry climates evaporates much of the water away, leaving salts behind. Irrigation can also waterlog poorly drained soils. This, in turn, can lead to salinization as waterlogged soils bake in the sun. Thus, over-irrigation can turn soils both swampy and salty at the same time.

Irrigation of cropland, combined with the growing thirst of cities, is leading to an even more fundamental problem: a lack of fresh water. Some 4 billion people around the world experience severe water scarcity—when demand for fresh water is double or more than the supply—for at least a month every year. Some 500 million experience severe water scarcity all the time.[75] A new vogue term is "day zero," first coined when Cape Town, South Africa, projected that the city would simply run out of water on April 16, 2018, if drastic action wasn't taken to cut water use. Fortunately, government and city residents responded with strong conservation efforts until plentiful rains finally arrived in June, and the worst outcomes were avoided. Chennai, India, wasn't so fortunate. This city of 7 million people, capital of the Indian state of Tamil Nadu, hit "day zero" on June 19, 2019. The city's four reservoirs simply ran out of water. The monsoons failed three years in a row, and a scorching heat wave began in May 2019 baking dry what little water was left.

Even in countries not classified as facing severe water stress, the situation is increasingly dire. Take the United States and Mexico. By the time it reaches the ocean in the Gulf of California, the Colorado is probably the world's most famous "non-river," for not a running drop remains after the farms and cities of the United States and Mexico have drunk their fill. Similar situations afflict the planet elsewhere. Like the Murray River in Australia, which is nearly dry by the time it reaches the sea due to diversion for irrigation[76]—or the Aral Sea in central Asia, once the world's fourth-largest lake. Diversion for irrigation reduced the Aral's surface area to 10 percent of its original size.[77] The former area of the rest of the Aral has a new name, now: the Aralkum Desert. Really—look it up.

Surface water isn't the only issue. Groundwater is also being rapidly depleted. Around the world, extraction of groundwater for cities and farms is exceeding replenishment rates. In the dry Great Plains of the United States, farmers pump the famous Ogallala Aquifer eight times faster than it recharges from precipitation, endangering a fifth of the corn, wheat, cotton, and cattle production in the United States.[78] Nearly 10 percent of the Ogallala's water reserves have already been pumped out, and the taps have had to be turned off in many places.[79] It took thousands of years for the environment to fill the Ogallala, and we are rapidly draining it. In the North China Plain, a major grain-producing area, water tables have been dropping at the rate of 3 to 5 feet each year due to overdraw for irrigation.[80] In some regions, the lowering of water tables is causing major land subsidence. Downtown Mexico City has dropped nearly 25 feet.[81] Venice has dropped 10 centimeters because of pumping the freshwater aquifer beneath it—which may not sound like a lot, but for a city at the water line, that is an alarming figure.[82] With rising sea levels and continued groundwater extraction, researchers expect that Venice could sink another 3.2 inches in the next twenty years. Already, St. Marks Square commonly floods—three times in one particularly bad week in November of 2019.[83]

Much of the fresh water that remains is badly polluted. Some years ago, in 1992, Donella Meadows, Dennis Meadows, and Jorgen Randers calculated that "the amount of water made unusable by pollution is almost as great as the amount actually used by the human economy."[84] They also noted then that we are close to using, or making unusable, all the easily accessible fresh water—fresh water that is close to where people live (as opposed to rivers in the Arctic, say) and that can be stored in rivers, lakes, and aquifers (as opposed to the huge amounts of fresh water lost to the sea during seasonal floods, which cannot be easily stored).[85] The situation around the world today remains dire. The remaining margin for growth in freshwater use is disturbingly narrow.

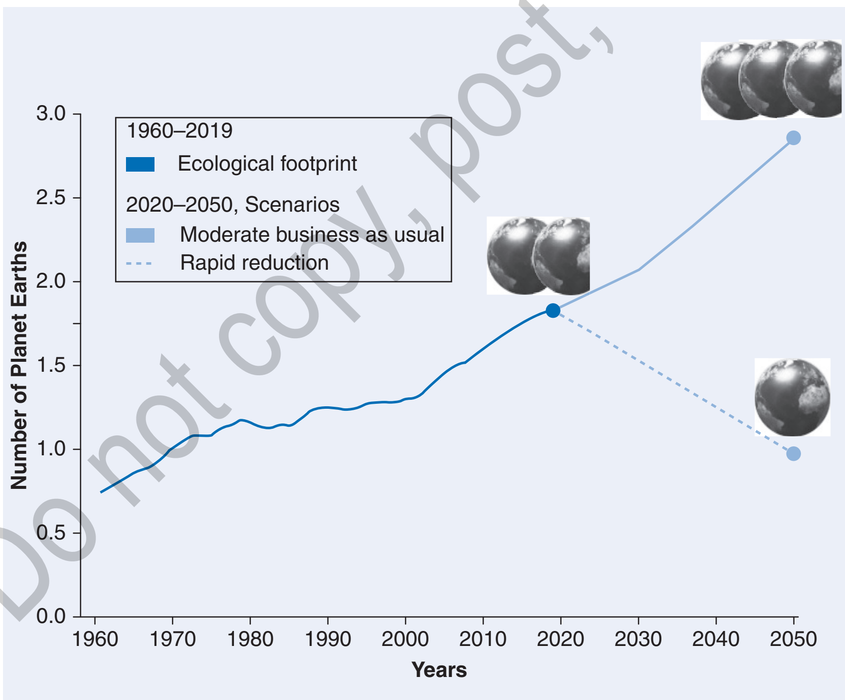
Cleaning up water pollution is one way to increase that vital margin, and industrial water pollution has diminished in many areas. We have also made progress in controlling agricultural water pollution. But we still have a long way to go. From 1950 to 2001, farmers across the world upped their use of commercial fertilizers eightfold and their use of pesticides thirty-two-fold.[86] Worldwide consumption of fertilizer is now around 200 million tons per year, and after a bit of a lull because of the development of stronger chemicals, the pounds of pesticide applied are rising once again.[87] Many countries in the Global South are continuing a "green revolution" approach to food production, using all available agricultural chemistry. And in wealthy nations, use has increased with the widespread planting of herbicide-tolerant genetically modified organism (GMO) crops like "Roundup Ready" corn and soybeans—that is, crops with a gene spliced in that lets farmers increase their use of Roundup, a popular herbicide, without hurting the crop. The resulting runoff continues to threaten the safety of many drinking water supplies. As Chapter 2 discusses in detail, many pesticides are quite hazardous for human health. Excess nitrogen fertilizer in the water is, too. We all need something to eat and something to drink, but some of our efforts at maintaining food production put us in the untenable position of trading food to eat for water to drink.

Or are we trading them both away? In addition to the threats to agricultural production caused by soil erosion, salinization, waterlogging, and water shortages, we are losing considerable amounts of productive farmland to the expansion of roads and suburbs, particularly in the wealthiest nations. Cities need food; thus, the sensible place to build a city is in the midst of productive agricultural land. And that is just what people have done for centuries. But the advent of the automobile made possible (although not inevitable) the sprawling forms of low-density development so characteristic of the modern city. The result is that cities now gobble up not only food but also the best land for growing it. The problem is worst in the United States, which has both a large proportion of the world's best agricultural land and some of the world's most land-consuming patterns of development. The United States loses about 1.5 million acres of farmland every year to development or about 30 million acres every twenty years.[88] That's an area larger than the entire state of Pennsylvania. Typically, this is high-quality farmland, adjacent to metropolitan areas, and thus in the places where it is most needed: close to where people live.

We're not running out of food. Hunger mainly has other causes, which we'll explore later in this book, especially Chapter 6 and a little bit later in this chapter. In fact, we have more food per capita in the world now than we did in the twentieth century. Plus we lose and waste about a third of what we grow.[89] The UN's Food and Agriculture Organization calculates a vitally important number with a boring name: what it calls the Per Capita Net Production Index, normed at 100 for years 2004 to 2006. In 1994, the index registered 87. As of 2016, the index registered 112—but at huge cost, ecologically, economically, and socially.[90] Can we keep increasing this index? Can we maintain it in the long term? And can we distribute its benefits more justly for humans and nonhumans alike? These are central issues of sustainability—of environmental justice across time—and its implications across social space and species.

Let's face it. We're eating up the world. An increasingly popular way to represent our overconsumption on an ecological scale is ecological footprint analysis, which converts all the demands we make on the Earth's ecosystems to a measure of area. Since about 1975, our collective footprint has been larger than the Earth itself (see Figure 1.6). As of 2019, we are demanding about 1.75 Earths.[91] We are provided with only one. You can't eat your Earth and have it too.

Figure 1.6 Living Beyond Our Means: Global Ecological Footprint, 1961 to 2050



Source: Global Footprint Network (2020).

Unless dramatic steps are taken to reduce consumption, by 2050 humanity will be consuming at a rate of nearly three earths.

The Ozone "Hole"

One of the consequences of how we are eating the Earth is the large "hole" that has appeared in the upper atmosphere ozone layer.

Ozone forms when groups of three oxygen atoms bond together into single molecules, which chemists signify as O_3. Most atmospheric oxygen is in the form of two bonded oxygen atoms, or O_2, but a vital layer of O_3 up high helps protect life on the Earth's surface from the effects of the Sun's ultraviolet radiation. Ultraviolet light can cause skin cancer, promote cataracts, damage immune systems, and disrupt ecosystems. Were there no ozone layer in the upper atmosphere, life on Earth would have evolved in quite different ways—if indeed it had begun at all. In any event, current life forms are not equipped to tolerate much more ultraviolet radiation than the surface of the Earth currently receives. We badly need the upper-atmosphere ozone layer.

In 1974, two chemists, Mario Molina and Sherwood Rowland, proposed that chlorofluorocarbons (CFCs)—which are also a potent force in climate change—could be reacting with the ozone layer and breaking it down. Molina and Rowland predicted that CFCs could ultimately make their way into the upper atmosphere and attack the integrity of the ozone layer. In 1985, scientists poring over satellite imagery of the atmosphere over Antarctica discovered (almost accidentally) that the ozone layer over the South Pole had, in fact, grown dangerously depleted.

Many studies later, we now know that this "ozone hole," as it has come to be called, is dramatically large. We also know that it changes in size with the seasons, has a much smaller mate over the North Pole, and stretches to some degree everywhere on the planet except the tropics. In fact, it's not a hole. It is more accurate to say that outside the tropics, the ozone layer is *depleted*, particularly over the South Pole. (See Chapter 9 for a sociological discussion about the use of the metaphor of an ozone "hole.") At times, the layer depletes to as low as 25 percent of the levels observed in the 1970s.[92] Most worrisome is that the area of high depletion might spread to heavily populated areas. In 2000, the high-depletion area passed over the tip of South America for nine days, including the Chilean city of Punta Arenas. The perimeter of the hole skirts Punta Arenas most years now.[93] Australians and New Zealanders have yet to experience this, but they're plenty worried. Levels of depletion there are already worse than in other populated regions, skin cancer rates are the highest in the world, and classes in "Sun health" have become an essential feature of the school curriculum.[94]

Skin cancer rates are growing in the United States too. New cases emerge for about twenty-two people out of every 100,000, as of 2016, versus a rate of around fifteen new cases for every 100,000 in 1999.[95] That's almost a 50 percent increase. Plus it's adjusted for the fact that people tend to live longer now. Why the increase? Lifestyle changes have a lot to do with it. But also, we are seeing significant ozone depletion over the United States too, especially in summer months.[96]

This is scary stuff. But it has galvanized a truculent world into unusually cooperative action.[97] In 1987, the major industrial countries signed the first of a series of agreements, known as the Montreal Protocol, to reduce the production of CFCs. As a result of these agreements, CFC production for use in these countries ended on December 31, 1995, and ended throughout the world on December 31, 2010.

There is more good news to report: The ozone hole is no longer increasing. Since 2000, the amount of ozone at the poles has been essentially stable and perhaps now trending down.[98] It will be many decades until the depletion is repaired, however. The ozone-damaging chlorine that CFCs contain remains resident in the atmosphere for some time, and the hydrochlorofluorocarbons (HCFCs) that industrial countries first turned to as a substitute also damage the ozone layer to some extent. Plus, like CFCs, HCFCs are a potent greenhouse gas. Chlorine-free "Greenfreeze" refrigerants do not damage the upper-atmosphere ozone layer and do not contribute to climate change. Greenfreeze technology now dominates the refrigerator market in Europe and is taking hold in South America, Japan, China, and finally, the United States. Still, the current expert view is that ozone depletion will be with us until the middle of the century at least and likely longer than that.[99]

The banning of CFC production and resulting stabilization of the ozone hole is nevertheless one of the great success stories of the environmental movement and perhaps the greatest. Despite our differences, sometimes we can achieve the international cooperation necessary to make major progress on big problems like climate change. We know we can because, in the case of CFCs, we have done it.

The Two Kinds of Smog

Less progress, however, has been made on another ozone problem: ozone at ground level. Hardly a city in the world is free of a frequent brown haze above which only the tallest buildings rise (see Figure 1.7). Ozone is the principal component of this haze, now an unpleasantly familiar feature of modern urban life.

Ground-level ozone forms when sunlight glares down on a city's dirty air. As a result of fossil fuel combustion, cars and factories discharge large volumes of a whole array of nitrogen oxide compounds. NO_X (pronounced "knocks") is the usual term for this varied nitrous mixture. In sunlight, NO_X reacts with volatile organic compounds (VOCs) to produce ozone. (The VOCs themselves are also produced during fossil fuel combustion as well as by off-gassing from drying paint and other industrial processes.) If the day is warm and still, this ozone will hug the ground. Because it needs sunlight to form, scientists often call the resulting haze "photochemical smog." More popularly, it is called "brown smog."

Although we need ozone up high to protect us from the Sun, down low, in the inhabited part of the atmosphere, ozone burns the lung tissue of animals and the leaf tissue of plants. This can kill. The 2017 Global Burden of Diseases study, published by the journal *Lancet*, estimated that 472,000 people around the world suffer premature death each year because of ozone pollution.[101] Stop for a moment: That's a huge number of premature deaths. A 2004 study found that even small differences in ozone concentration have measurable effects on mortality.[102] Smog alerts have become an everyday feature of big-city life in all industrial countries. Walking and bicycling are increasingly unhealthful and unpleasant, driving people even

Figure 1.7 Mexico City Disappears in the Smog, Trapped by the Mountains That Surround the City, December 23, 2009

Levels of ground-level ozone that exceed air quality standards occur about half the year in mexico city.[100] But thirty years ago, before a huge cleanup campaign, the figure was more than 300 days a year.

more into their cars and causing even more smog. When it drifts out of the city and into the countryside, the brown smog of ground-level ozone also reduces crop production and damages forests. For example, soybeans suffer a 20 percent loss in yield due to ozone—not an insignificant amount in a hungry world.[103]

And yet there is another form of smog, too—one less recognized but potentially even more dangerous: the "white smog" of particulates in the air, 10 microns or smaller in size. Particularly dangerous are "fine particulates," which are 2.5 microns or smaller in size, much smaller than the diameter of a human hair. The technical term is "PM 2.5." These fine particulates penetrate deeply into lung tissue. In contrast to the brownish color of photochemical smog, particulates envelop cities and suburbs with a whitish smog. About half of these particulates are basically dust, mainly released because of poor fuel combustion in cars, trucks, power plants, wood stoves, and outdoor burning or kicked up by traffic, construction, and wind erosion from farms. Most of the rest are tiny pieces and droplets of sulfates, nitrates, and VOCs formed in the atmosphere following the burning of fossil fuels, such as the coal used for electric generation; together, these are called "secondary" particulates.[104] Ammonium and ammonium compounds also contribute significantly to secondary fine-particulate pollution, mainly due to emissions from livestock and fertilizers.

PM 2.5 is not a memorable name, so it's a quiet killer, despite its potency. According to the 2017 Global Burden of Diseases study, 2.94 million people around the world die prematurely each year due to fine particulates.[105] Stop again: That's 2.94 million premature deaths. Another study found that in U.S. cities with the most fine particulates, residents are 15 to 17 percent more likely to die prematurely.[106] A study in Sydney, Australia, found premature death rates to be double even those of U.S. studies.[107] Children in Los Angeles who live closer to roads have decreased lung capacity, largely because of fine particulates.[108] Fine particulates also increase heart attack rates, which along with studies of lung capacity and asthma effects, helps explain the higher death rates associated with areas that have higher levels of fine particulates.[109]

This is serious stuff—really serious stuff. And it's a problem not just for future generations but also for those here right now. Alas, these present consequences are typically quite unequal in their effects across differences in social space—the dimension of environmental justice we turn our focus to now.

Environmental Justice Across Social Space

"It's the worst thing you'd ever want to see: a loved one, lying in that bed, pining away, dying," says Mary Hampton. "Just to sit and look at them, and know you can't do anything about it."[110]

That pain is an everyday experience in Reserve, Louisiana, where the risk of cancer is not just double, not just triple, but fifty times the U.S. national average. Mary's brother used to live next door, but he died of cancer. Another brother's home is on the other side of Mary's. He still lives, but his wife died of cancer. The neighbor across the street died of cancer too.

"Almost every household has somebody that died with cancer or that's battling cancer," reports Mary. These aren't anecdotes. A 2015 report by the U.S. Environmental Protection Agency (EPA) agrees: This is the highest cancer risk town in the United States.

It is also a working-class, and mainly Black, town.

Why is the cancer rate so high? Direct causal connections are pretty much impossible to establish with any kind of cancer. The molecules of toxic chemicals are the tiniest of bullets, even when they are shot out of a very large gun—like the Pontchartrain Works chemical plant, founded by Dow Chemical in 1968. And, yes, it is a smoking gun. The plant's stacks, which loom over Mary's neighborhood, pour out more than fifty toxic chemicals. Chloroprene is likely the most dangerous. The Pontchartrain Works uses it to make neoprene. But how do you track a molecule of chloroprene into Mary's neighbors' lungs, and then into their muscles and tissues, where it disrupts the normal processes of cell growth?

In short, lawyers can argue about the cause. And they do. But Mary and her neighbors can't afford the lawyers that Dow can, or more precisely, that Dow no longer has to afford because it sold the Pontchartrain Works to Denka, a company from Japan, shortly after the EPA report came out and complicated Dow's lawyers' arguments. Who is liable now? Not Dow, it hopes. It doesn't own the plant anymore. Not Denka, it hopes. It's not a U.S. company.

The residents of Reserve aren't giving up. Lydia Gerard lives a few blocks from Mary. In 2018, Lydia's husband died of cancer, but she's still carrying the fight forward. "We can't give up, and we won't," she says. "We have to continue to let those plants know that we are looking at them. It may not be in my lifetime that anything gets done, but I'm praying that it is."

The experience of the residents of Reserve, Louisiana, is a vivid example of a common worldwide pattern: Those with the least power get the most pollution. Their experience is also an outrage. Black lives matter. This inequity is a call for us all to reckon with another of the three central issues of environmental justice: its frequent and tragic disparities across social space. We say "social space" and not just physical space because these disparities manifest across the many dimensions of differences in social power, such as heritage, gender, sexuality, class, age, and more. These dimensions commonly show up across differences in physical space, like the extreme cancer rates in Reserve. But they may even manifest in differences within one community, one neighborhood, even one household. And the differences in physical space most fundamentally reflect social differences.

Importantly, disparities in environmental justice across social space find expression in the distribution of environmental costs and environmental benefits alike. There is a striking unevenness in both—in the distribution of what might be termed *environmental bads* and *environmental goods*.[111] The well-connected and well-to-do are typically most able to avoid the bad things in our ecological lives, like chloroprene, and to garner the good things, like food, shelter, clean water, and clean air. We all deserve to be protected from the bad things and to gain a healthy measure of the good things. But the socially well-off are almost always also the environmentally well-off.

Who Gets the Bads?

One prominent basis of being well-off is a person's social heritage, as a large number of sociological studies have depressingly documented, and as everyday social experience routinely proves. Within issues of environmental justice across social space, there are special challenges of *environmental racism*—that is, social heritage differences in the distribution of environmental goods and bads due to either intentional or institutional reasons.

Let's consider the bads first, bads like hazardous wastes. Much research in environmental racism has shown that people of color are more likely to live in communities with hazardous waste problems. In 1987, the United Church of Christ's Commission for Racial Justice released the first of two notable reports. Based on studies of zip codes, the reports concluded that Black people and other people of color were two to three times as likely as other people in the United States to live in communities with commercial hazardous waste landfills.[112] A 1992 study found that 3 percent of all white people and 11 percent of all people of color in the Detroit region live within a mile of hazardous waste facilities—a difference of a factor of nearly four.[113]

Findings like these were central to the emergence in the early 1990s of the *environmental justice movement*. Originally a largely grassroots movement of local activists concerned about pollution disparities, environmental justice now has a prominent place on the agenda of most national and international environmental organizations and has grown to become the principal way by which we understand the challenge of all environmental issues, including those that cross time and species as well as those that cross social space. Environmental justice has become one of the central civil rights issues in the world, helping create a political climate for change.[114]

Environmental disparities across social space are more than racial. Some studies of hazardous waste siting have found that social class predicts who gets the bads better than race does.[115] But within the United States at least, race and income closely correspond and intertwine. To talk about one is largely (but not entirely) to talk about the other. [116] Moreover, and unsurprisingly, the results vary considerably by specific context. Thus, about a third of empirical studies of environmental justice across social space find that race is significant, a third find that class is significant, and a third find that both are significant. Depressingly, they virtually all find evidence of environmental inequality.[117]

For example, they found that Los Angeles schools with high proportions of students of color tend to be located in areas with high levels of airborne toxics (see Figure 1.8).[118] They found that in Florida, people of color face much higher odds that their homes are located near a toxic chemical plant—up to five times higher in some cases.[119] They found that in Michigan, poor people and people of color are more likely to live in areas subjected to the toxic releases registered in the EPA's Toxic Release Inventory.[120] They found that industrial-scale hog farms in Missouri are more likely to be located in counties with lower average income.[121] They found that in Massachusetts, low-income communities experience 8.5 times as many chemical releases from industry as high-income communities and that communities with a high proportion of people of color receive ten times as many releases as communities with a low proportion of people of color.[122] They found that poor people across the United States experience higher levels of ambient and indoor air pollution, worse drinking water quality, and more ambient noise (e.g., from streets and highways) where they live.[123] They found that people of color disproportionately hold the dirtiest and most dangerous jobs in the United States and typically are poorly paid for their sacrifices.[124] These very kinds of exposures likely play a crucial role in why people of color are particularly afflicted by COVID-19—more than triple the rate of whites in some states, in both proportion of cases and rates of death.[125]

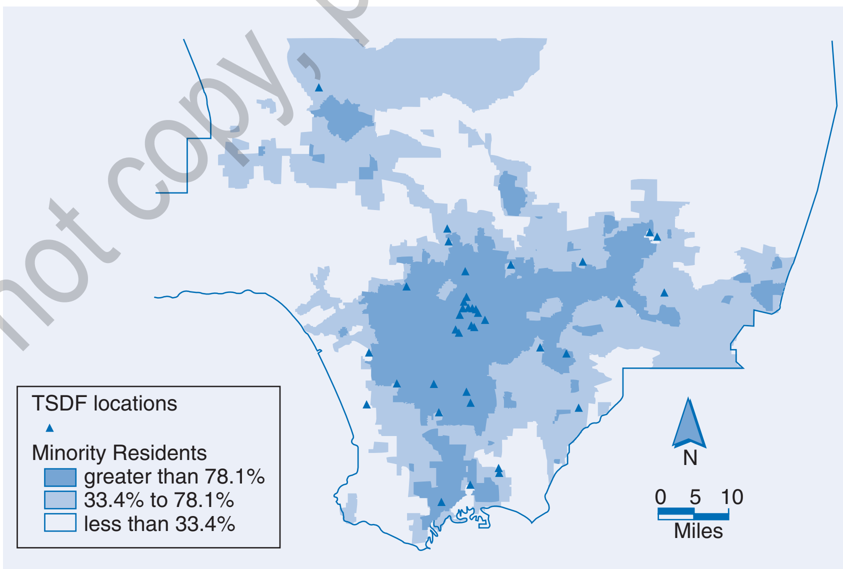
But whether along race or class lines or any other dimension of social difference, such biases are a challenge to the environment and justice we all have a right to enjoy.

One of those other dimensions of social difference is whether one lives in a rich country or a poor one. Take the hazardous waste crisis, for instance. Wealthy countries are now finding that there is more to disposing of garbage than simply putting it in a can on the curb. One response has been to pay others to take it. We now have a vigorous international trade, much of it illegal, in waste too hazardous for rich countries to dispose of at home. Finding such practices unjust, 186 countries have signed the Basel Convention, which is supposed to control international toxic shipments.[126] (The United States has signed it but not ratified it.) Yet loopholes are large enough and enforcement lax enough that these shipments still go on. Take the 2014 discovery of an illegal toxic waste dump in southern Italy run by the Mafia in cahoots with industrialists looking for a cheap way to dispose of trash. A Mafia insider tipped off officials about a burial site started in the 1990s that contained millions of tons of waste. Finally, local residents gained an understanding of the causes behind their cancer-borne nickname, "Triangle of Death."[127]

Plus, much that most people regard as environmentally unjust is perfectly legal. Perhaps most glaringly, no international conventions currently stop companies from merely relocating their most hazardous production practices to poorer countries or from purchasing from companies that use the laxer environmental and labor regulations and enforcement in most poorer countries to save on production costs. Like the many companies that buy from the textile, toy, and electronics factories of China, which have so badly polluted the land, water, and people of the "factory to the world." Like the companies that buy from the sweatshops of Southeast Asia, India, Africa, and Latin America. Like Union Carbide, which operated the infamous pesticide plant at Bhopal, India, that killed more than 5,000 people in a single night, due to a chemical leak on December 2, 1984. (See Chapter 2 for the awful story of what happened.) Many of our industrial practices expose workers—generally those on the production line as opposed to those in the head office—to environmental hazards. Exporting hazardous jobs does not lessen the degree of environmental inequality involved, however.

All this seems to take place far away—until a toxic disaster happens in your own community. The growing placelessness of the marketplace makes it easy to overlook the devastating impact untempered industrialism can

Figure 1.8 Evidence of Environmental Racism



Source: Adapted from Pastor, Sadd, and Hipp (2001).

Sites of toxic releases to the air and percentage minority in los angeles county, based on the federal toxic release inventory.

have on the daily lives of the farmworker applying alachlor in the field and the factory worker running a noisy machine on a dirty and dangerous assembly line. When we shop, we meet a product's retailers, usually not the people who made it, and the product itself tells no tales.

Who Gets the Goods?

Environmental justice across social space also concerns patterns of inequality in the distribution of environmental goods. These patterns closely reflect inequality in the distribution of wealth and income. In most of the world today, the main way we access environmental benefits is with money. Thus, those who are concerned about environmental justice often point to the huge inequalities in average income, country to country and person to person.

Income Inequality

Let's do the numbers, based on gross national income (GNI) per capita in 2018 in U.S. dollars, beginning with the figures for those on top.[128] The average annual per capita income of economies across the world is $11,098. In contrast, the average annual income in the world's ten wealthiest economies is $70,440. In the United States, it is $62,850. In Switzerland, it is $83,580 per capita. In Monaco, it is $185,741.

With all that income flowing to the top, hardly any is left for those on the bottom. The 10.5 million people of Burundi have the lowest average: just $280 per capita per year. That's 77 cents a day for the average Burundian. The situation is hardly better for the people of the Malawi: just $360, or 99 cents a day. True, the cost of living is unusually low in those countries. That $280 annual income in Burundi buys about what $740 buys in the United States. Still, imagine living on $740 a year—just $14.23 a week.

Moreover, despite the many advances in technology and the change to a more globalized, market-oriented world economy—and some say because of these advances and this change, as Chapters 3 and 4 discuss—income inequality remains severe. As of 2018, the fifth of the world's people living in its richest countries command thirty times as much of the world's income as the fifth of people living in the poorest countries—an average of $37,086 per capita per year versus $1,255 per capita per year. The 20 percent living in the poorest countries receive just 2 percent of the world's income. The good news is that the situation has improved considerably in recent years in the middle income nations. In 2006, the richest fifth commanded fifty-five times as much income as the poorest fifth, but the 60 percent of countries in the middle have seen their economies expand considerably since then. For the poorest, though, there has been little change. Those countries received just 1.5 percent of world income in 2006—hardly different from the 2 percent of world income they get today.[129]

These figures are all based on averages for the populations of whole countries. But there are also substantial levels of income inequality *within* countries. In about half of countries, the income differential between the richest 20 percent and poorest 20 percent within a country is seven to one or less.[130] In many poor and middle-income countries, however, the numbers are far higher. The ratio is twenty-eight to one in South Africa, the world's most unequal country by this measure. In about ten countries, including Brazil, the ratio is fifteen to one or higher.[131]

Although there is usually less inequality in wealthy countries, some do exceed the world norm of seven to one. In the United States, the ratio is 9.4 to 1.[132] In fact, the United States has the most unequal income distribution of all twenty-six Organisation for Economic Co-operation and Development (OECD) nations, once tax policies are taken into account.[133] The income inequality in the United States is highly stratified by race and gender. The median weekly earnings of Black men in the United States who are employed full time are 75.1 percent of those of white men, and the earnings of Hispanic men are 69.6 percent of those of white men. Black women's and Hispanic women's pay is a bit better—85 percent and 77.7 percent—in comparison to white women. But women in general in the United States earn 79.7 percent as much as men.[134]

Interestingly, the situation in the United States represents a historical reversal. In the 1920s (the first decade for which these figures are available), the United States was one of the most economically egalitarian countries, giving America the image of the land of opportunity. In comparison, most European countries, such as Britain, were more wealth stratified at the time.[135] Today, European countries are all less stratified, in most cases much less so—such as the four-to-one or lower figures for the Scandinavian countries and the five-to-one and six-to-one figures for France, Belgium, Germany, Switzerland, Spain, and the Netherlands. Countries with a Muslim majority typically have exceptionally egalitarian income ratios.[136] The lowest figure in the world is for Azerbaijan, 2.3 to 1.[137]

Inequality within countries means that the thirty-to-one ratio of income between the fifth of people living in the richest countries and the fifth living in the poorest considerably understates the level of global inequality. Consider the ratio if the richest and poorest of the world population from all countries were put together. If we apply the average seven-to-one income ratio of richest fifth to poorest fifth within countries as a rough approximation, we get a world figure of 210 to 1 (see Figure 1.9). And the higher up and lower down you go, the wider the disparities grow. As of 2016, the top 1 percent of the world takes home 20 percent of the world's income, whereas the entire bottom 50 percent takes home only 10 percent.[138]

And with each passing year, the gap gets wider yet. Yes, the world's poor are on the whole doing a bit better in recent years—or were before the spread of COVID-19. Over the period from 1980 to 2016, the poorest 50 percent of the world gained 12 percent of the value of all the economic growth in that period, roughly doubly their incomes. But the top 1 percent gained 27 percent of the fruits of economic growth, and their income more than tripled. The poor got a bit more, but the rich got a lot more.[139]

Consequently, taking the world's population as a whole, the number of poor people is staggering. The World Bank defines "extreme poverty" as living on $1.90 a day or less in terms of local purchasing power.[140] As of 2015, *736 million* people live in this deplorable condition—about 10 percent of the world's total population.[141] The economic contraction associated with COVID-19 seems certain to send tens of millions more into these dire straits, possibly as many as 80 million more with a 5 percent contraction and 180 million more with a 10 percent contraction, according to a UN estimate.[142]

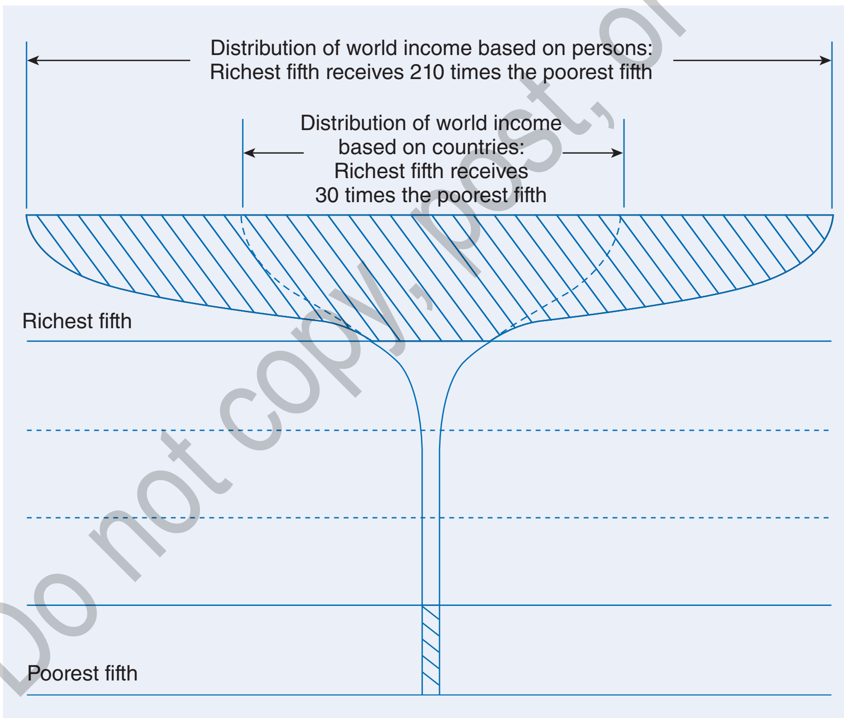
The good news is that there have been substantial improvements. In 1990, a total of 1.895 billion were living on $1.90 a day or less—about 36 percent of the world.[143] But $1.90 a day is a tiny sum, especially in the wealthier nations. That's about $700 a year—barely enough for a single month's rent in most U.S. cities, let alone food or any other necessities. So the World Bank also tabulates rates for two less extreme definitions of poverty: $3.20 a day and $5.50 a day—$1,169 a year and $2,009 a year. As of 2015, 26 percent of the world lives on $3.20 a day or less, and 46 percent live on $5.50 a day or less.[144]

Imagine trying to get by on so little. Billions have to.

Wealth Inequality

Income isn't the same as wealth, though. One's command of riches can come in many forms: savings accounts, land, buildings, possessions, investments,

Figure 1.9 The Champagne Glass of World Income Distribution



Source: Authors' calculations, based on Korten (1995) and World Bank (n.d.).

The fifth of world population from the world's richest countries receives about 30 times the income of the fifth of world population from the poorest countries. When calculated on the basis of the richest fifth of persons from all countries versus the poorest fifth from all countries, the ratio of income disparity likely rises to 210 to 1 or more.

and more. The discrepancy in distribution of environmental goods gets even more extreme when we calculate it by wealth instead of income because the wealth of the poor is usually pretty much only in the form of income because their assets are so minimal. So try this comparison. The 400 richest people in the United States have a combined wealth of $2.96 trillion as of 2019.[145] That's a lot of money—an awful lot. In fact, it's more than the combined wealth of nearly the poorest two-thirds (64 percent to be exact) of U.S. households.[146] The richest three people in the United States—Jeff Bezos, Warren Buffett, and Bill Gates—have as much wealth of the poorest 50 percent of people in the United States.[147] Three people are as wealthy as 160 million of their fellow citizens combined. Not even feudal lords had it so rich.

As with income inequality, wealth inequality in the United States is highly racialized. The median Black household in the United States has 12 percent as much wealth as the median white household: $15,000 versus $140,000. Moreover, there has been essentially no change in this ratio in fifty years, despite continuing economic growth.[148] Because of inflation, the significance of being a millionaire (as opposed to a billionaire) is much less than it was. Notably, as of 2016, one in seven white households in the United States were millionaires, which is more than double the proportion in 1992. But as of 2016, only one in fifty Black households and only one in forty-four Hispanic households in the United States were millionaires.[149]

Global figures show much the same pattern of extreme wealth concentration. Incredibly, as of 2019, the wealth of just 26 billionaires totals $1.4 trillion, the same amount as the world's poorest half of the world.[150] Pause for a moment. That's twenty-six individuals holding the same wealth as 3.8 billion people. And it's getting worse. In 2014, it took eighty billionaires to sum up to the wealth of the poorest half of the world.[151] We are talking such enormous inequality that it's hard to fully fathom.

As of 2019, the world's richest person is Jeff Bezos, the founder of Amazon, at a staggering $131 billion. Microsoft co-founder Bill Gates, long the world's richest person, is now number two at $96.5 billion. Investor Warren Buffett is number three at $82.5 billion. At least Buffett and Gates are planning to give most of their wealth away and have already given huge sums to charity. Nice. (There's no word yet on what Jeff Bezos plans ultimately to do with it all.)

Meanwhile, Jeff Bezos's dragon's hoard continues to swell—by $22.2 billion in 2018 alone, and growing, with the returns piling up in thanks to a surge in COVID-19 home deliveries.[152] To put that income in scale, the entire 2018 Gross National Income (GNI) of Afghanistan was $20.3 billion, yet one person made more money than all 32 million people in Afghanistan combined. And not just Afghanistan. Eighty-two countries around the world had a lower 2018 GNI than Jeff Bezos's $22.2 billion in gains.

Consumption Inequality

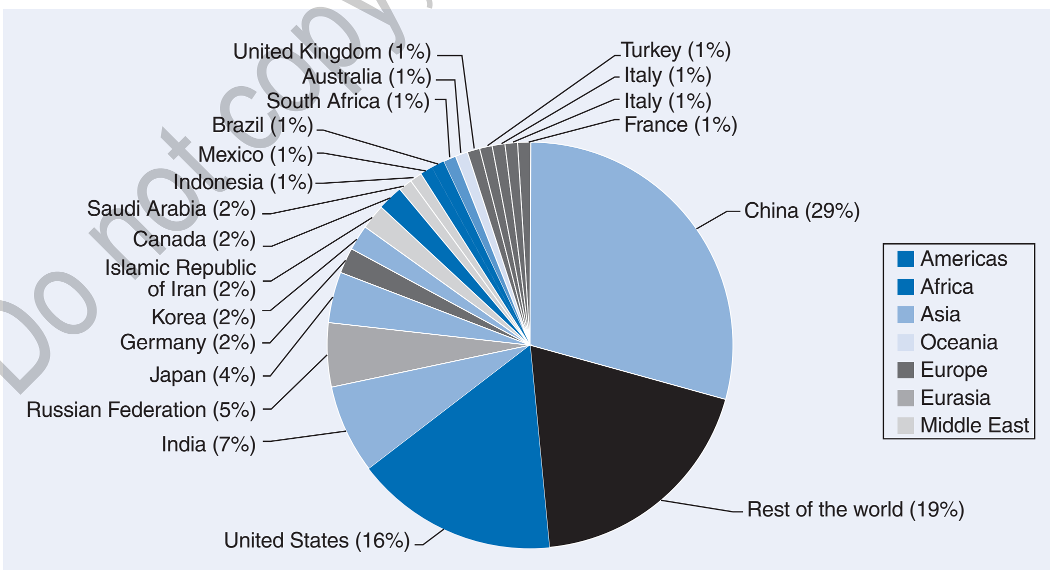
The wealth of the average person in rich countries leads to a substantial global consumption gap. The average person in rich countries consumes three times as much grain, fish, and fresh water; six times as much meat; ten times as much energy and timber; thirteen times as much iron and steel;

and fourteen times as much paper as the average resident of a poor country. And that average person from a rich country uses eighteen times as much in chemicals along the way.[153]

Along with the consumption gap comes an equally significant pollution gap. The wealthy of the world create far more pollution per capita than do the poor. For example, take a look at the world's top global contributors to carbon dioxide emissions based on energy consumption (see Figure 1.10).[154] Even though China produces more carbon dioxide emissions in total than the United States, per capita China's emissions are 6.4 metric tons versus the United States' 15.0 tons. Moreover, the rich countries are also more able to arrange their circumstances such that effects of the pollution they cause are not as significantly felt locally, as with the export of toxic wastes and dirty forms of manufacturing noted earlier.

The consumption gap in food is especially significant. The Global Information and Early Warning System of the Food and Agriculture Organization (FAO) regularly reports that thirty or more countries at any one time are in need of external food assistance. As of early 2020, even before COVID-19 began to spread widely, forty-one countries were in need of food. Mostly, those needy countries are in Africa and Asia.[155] In 2018, the FAO estimated that about 822 million people were chronically undernourished, that is, around 10.8 percent of the world.[156] Things were getting a bit better. In the mid-1990s, the chronically malnourished percentage of the world was generally around 13 to 14 percent. But in 2015, the needle got stuck—meaning that the number of hungry people in the world began increasing at the same

Figure 1.10 Each Country's Share of 2016 Total Carbon Dioxide Emissions From the Consumption of Energy



Source: Union of Concerned Scientists (2019).

rate as the population increased. And since COVID-19, reports from around the world suggest that the needle is now moving alarmingly upward.

It wouldn't take all that much to do a whole lot better. An estimate by the World Food Programme in 2014 found that only $3.2 billion is needed to reach 66 million hungry school-age children across the world.[157] That $3.2 billion is only 14 percent of Jeff Bezos's 2018 income. And hunger and malnutrition cause 45 percent of child mortality worldwide.[158] Even if hungry children survive, they often grow up smaller, have trouble learning, and experience lifelong damage to their mental capacities.[159]

Hunger can also exist in conditions of prosperity. Take the United States, for example. Some 11.1 percent of U.S. households experienced *food insecurity* in 2018, 2.7 million of which included children. Here too there are wide racial disparities; rates of food insecurity are 21.2 percent for Black non-Hispanic households in the United States, and 16.2 percent for Hispanic households, versus 8.1 percent (which is quite bad enough) for white non-Hispanic households.[160] As a result, people are forced to reduce the "quality, variety, or desirability" of their diet without necessarily experiencing hunger, according to the U.S. Department of Agriculture (USDA) definition of food insecurity.[161] But some 4.3 percent of U.S. households experienced "very low food security" during the year, meaning they experienced hunger—what the USDA defines as "multiple indications of disrupted eating patterns and reduced food intake."

We do make efforts to respond to these needs. For example, as of 2018, a total of 40.4 million people in the United States were receiving food stamps, or 12 percent of the U.S. population.[162] In that year, the USDA provided 29.7 million schoolchildren with low-cost or free lunches.[163] Wealthy countries also donate food internationally. In 2018, the United States gave $1.7 billion, or about 1.4 million metric tons of food, in food assistance to hungry people overseas—great[164]. True, that's a miniscule fraction—0.04 percent—of the U.S. federal budget, yet it's something. But shouldn't we also address what leads to these dire situations to begin with?

Health Inequality

Among the most crucial of the good things in life is the ability to protect you and your community from the bad things—an ability that the world's poor often find they do not have or only barely have. As of 2014, an estimated 30 percent of the world's urban populations live in slums—over a billion people—generally in shelter that does not adequately protect them from environmental hazards such as rain, snow, heat, cold, filth, and rats and other disease-carrying pests.[165] In sub-Saharan Africa, 61.4 percent of the total urban population lives in slums—slums like Alexandra Township in Johannesburg, South Africa, where 200,000 people live in 7 square kilometers of squalor, sometimes ten people or more crammed into a one-room shack.[166] (Mike works with an urban agriculture project for AIDS orphans in Alexandra.) Moreover, the world's poor are more likely to live on steep slopes prone to landslides and in low-lying areas prone to floods.

Many people have no homes at all, even in the wealthy countries. In the United States, as of January of 2019, 567,715 people are homeless, some 6 percent of whom are youth living on their own.[167] A 2016 study estimated that 860,000 people in Germany are homeless.[168] Typically, some 5,000 in England are "sleeping rough," with no roof at all.[169] Between 2012 and 2016, one estimate found that more than 13,000 homeless people died on the streets of France.[170]

Sanitation is also crucial to health. But as of 2017, about 2 billion people have no access to toilets and latrines, and for 673 million, their conditions are so limited that they are forced to defecate in the open.[171] And 2 billion people drink water that is contaminated with feces.[172] Half a million children under five die of diarrheal diseases every year, which often result from poor water, inadequate sanitation, and poor hygiene.[173]

It is also possible to have too much of the good things in life. Around the world, 39 percent of adults are overweight—about 2 billion in all. Of that 2 billion, about 650 billion are obese, or 13 percent of all adults, according to WHO.[174] The situation is most severe in the wealthy countries. In the United Kingdom, as of 2017, 64 percent of adults are now overweight, including 28 percent who are obese.[175] The numbers for the United States are even higher, with some 72 percent of all adults being overweight and 40 percent obese as of 2016.[176] Adult obesity in the United States has nearly quadrupled since 1962, and for children age 6 to 11 it has gone up by almost a factor of five.[177] Other wealthy countries have also experienced rapid rises as lifestyles have become more sedentary and calorie intake has increased. The diseases associated with too much food are increasing as well: diabetes (especially type II), hypertension, heart disease, stroke, and many forms of cancer.

But undernutrition and overnutrition can exist side by side in the same population and across the life course in the same person—what epidemiologists call the *double burden of malnutrition*. People need good food to eat, not just lots of food. The double burden exists in rich countries too but is starker in poorer nations. Alongside widespread hunger, weight problems are rising dramatically in less developed countries, as people increasingly take up more sedentary lives there, too, and as food consumption shifts more into the marketplace and away from home production, making healthier, nutrient-dense foods less readily available for the poor. Snack foods and soda are widely sold in small shops in even the most remote rural areas, and people increasingly turn to them to relieve an otherwise dull and sparse diet. In North Africa and the Middle East, 58 percent of the population is obese or overweight. In many regions, we also find substantial gender disparities in obesity, as in southern sub-Saharan Africa, where 18.7 of men and 36.7 of women are obese.[178] The problem is particularly pronounced in urban areas. In some cities in China, 20 percent or more are obese.[179] In urban Samoa, as many as 75 percent of adults are obese—not just overweight but obese.[180] With excess weight comes its many deleterious effects on health. Yet the world's wealthy are generally better able to protect themselves from the consequences of high weight. Medical treatments for diabetes, circulation problems, and cancer are far less accessible for the poor.

Considering these stark facts, it comes as no surprise that people in wealthy countries typically live nearly two decades longer than those in the poor countries—80.6 years versus 60.8—despite great advances in the availability of medical care.[181] In six poor countries, life expectancy is fifty-five years or less. In Sierra Leone, it is just 52.2 years.[182] In six countries, 10 percent or more won't even make it to age 5.[183] The good news is that in recent years, the life expectancy gap between rich and poor has closed a good bit. But it remains wide and stark.

Income and wealth, food and health—these are the most basic of benefits we can expect from our environment. Yet people's capabilities to attain them are highly unequal. As Tom Athanasiou has observed, ours is a "divided planet."[184]

Environmental Justice for Everyone

But you don't have to be poor or a person of color to live in a social space with environmental injustice. Many environmental hazards cross social boundaries as they cross bodily ones.

Take the nine people, including journalist Bill Moyers, who in 2003 volunteered to let Mount Sinai Hospital researchers search their bodies for traces of industrial chemicals and pollutants—chemicals that their own bodies did not make. None of the nine had jobs that exposed them to hazardous chemicals in their workplace, and none of them lived near industrial facilities; these were middle-class and upper-class folks. Yet when researchers took blood and urine samples, they found in the volunteers' bodies an average of ninety-one different chemical pollutants. Among these chemicals, the volunteers averaged fifty-three that cause cancer, sixty-two neurotoxins, fifty-three immune system disrupters, fifty-five that cause birth defects or disrupt the body's normal development, and thirty-four that damage hearing. (Many of these chemicals have more than one effect.) Of course, these chemicals were present in only trace amounts, and the researchers used sophisticated equipment to detect them. But they were there. And although this was a comprehensive assessment of individual *body burden*, as toxicologists call it, there were many kinds of common chemical pollutants that the researchers were not able to study. Indeed, some 80,000 chemicals circulate in products on the market in the United States today, and only a few hundred of them have been screened for their safety.[185] So it is likely that ninety-one was a low estimate of the number of trace pollutants.[186]

Can trace amounts sometimes amount to something? Many observers now think unfortunately yes. Increasingly, the leading medical journals are filling up with studies that link environmental chemicals with a host of diseases. Not all the studies show this link. But more and more do. For decades, cancer researchers had estimated that environmental factors account for 2 to 4 percent of all cancers and have attributed most cancer to inheritance and pathogens, matters that are largely unavoidable and therefore apolitical.[187] Then in 2010, the President's Cancer Panel—appointed earlier by President George W. Bush—declared that those low estimates are "woefully out of date" and that "the true burden of environmentally induced cancer has been grossly underestimated."[188] These were controversial statements, and many voices rushed to rebut them, including the American Cancer Society. However, many voices, such as the Science and Environmental Health Network, also rushed to support them.[189]

No matter how socially advantaged you are, you can't run far enough, or build a gated community secure enough, to escape the body burden of industrialism. True, the wealthy and racially privileged are better able to avoid these effects through buying organic food, working cleaner jobs, and living in less-polluted neighborhoods. For example, poor and minority sections of major cities often experience temperatures on hot days that are as much as 20 degrees higher than the leafier, whiter suburbs—days that climate change has made more frequent.[190] The hotter conditions and higher levels of air pollution are not just unpleasant: They increase rates of premature, underweight, and stillborn children, especially among Black mothers, according to a study published in the *Journal of the American Medical Association*.[191] There is definitely huge inequality in the impact of industrialism's dirty side. But it wouldn't make it just if there were some way to divide the impact equally. Even if everyone suffers from something that is preventable, it is still preventable suffering. Environmental justice is an issue for everyone.

Environmental Justice Across Species

Moreover, environmental justice isn't just something for humans, argue many. It's for us all, human and nonhuman alike.

Some find such a broad concern to be an ethical stretch. Shouldn't we care first and foremost about people, given that we are people? Perhaps so. But even from a human point of view (which, after all, is the only point of view we humans can have), the well-being of other creatures is a concern. It's a concern for us because we depend on ecological relations for our own well-being. And even putting our own interests aside, many humans find it deeply troubling to see other creatures suffer, lose their habitat, and even go extinct. Many think that's just a romantic feeling. But it's a true and widespread human feeling nonetheless.

"A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise."[192] These are probably the most famous lines ever written by Aldo Leopold, one of the most important figures in the history of the environmental movement. Leopold's words direct our attention to a sense of a biotic community—to a sense of *ecos*, of home, of the habitat we share with so many others. Understood in this way, environmental justice does indeed concern not only the conditions of human life but also the conditions of the lives of nonhumans. For to talk about a sense of biotic community—what we earlier termed the "biggest community of all"—is to talk about the interdependence of justice for all.

Leopold also directs our attention to a word that is certainly one of the hardest of all to define but is no less significant for that difficulty: *beauty*.[193] Romantic or not, few humans are unmoved by the wonders of ecology. The forms of our appreciation may differ, but the existence of the pull of ecological beauty seems nearly universal in human experience. The unfathomable complexity of ecology continues to capture even us who live in modern industrialized settings. We are never quite demystified of its charms (see Figure 1.11).

For many, and we include ourselves here, an essential part of beauty is the justice of what we behold. To speak about the beauty of ecology, then, is to speak about every living thing's capacity to have a home, a habitat that is sustainably beautiful and beautifully sustainable.

Figure 1.11 The Beauty of Ecology: Sunrise Over Grenadier Island, St. Lawrence River, 2007

Decline and Loss of Species

And yet, threats to the integrity, stability, and beauty of ecology are manifold. Take the loss of species. For example, of the 11,126 known species of birds, some 14 percent were threatened with extinction as of 2019.[194] Many have already gone, such as the passenger pigeon, the dodo, and the ivory-billed woodpecker. Since 1800, at least 103 have gone extinct.[195] New Zealand has perhaps been the hardest hit. Before people arrived around 1300 CE, New Zealand's birds had no mammalian predators and thus no evolutionary pressure to adapt to them. Since then, half the bird species of the North and South Islands have disappeared, including all eleven species of moa—among them the wondrous *Dinornis robustus* and *Dinornis novaezealandiae*, which grew to 500 pounds and 12 feet tall.[196]

Many of these losses are not just of obscure birds in obscure places. One of the most striking everyday declines is the drastic shrinking of the population of starlings. The bird once often called the "common starling" is no longer so common, having suffered a 66 percent decline in Britain, where it is a native species, and a 49 decline in the United States, where it was introduced in the 1890s.[197] The starling is now even considered to be threatened with extinction in Britain.[198]

Who cares about starlings, especially out of their native range? Whether or not one has experienced the exhilaration of a murmuration of starlings—hundreds or even thousands of birds swooping through the sky in tightly coordinated, quickly shifting patterns and shapes, like a single organism—it's telling to consider that this once common sight has become rare. The fate of the starling makes it a kind of canary in the mine shaft of industrialism, an indicator of a broader threat. For bird populations are plummeting overall. The sheer number of birds in the United States and Canada is down 29 percent since 1970—some 2.9 billion birds lost.[199] Common birds have declined 14 percent since 1980 in Europe, and farmland birds have declined 57 percent.[200]

Why this loss of birds? There's a lot of debate here, but some scientists point to the alarming evidence of an "insect Armageddon" of vast declines in insect numbers. A 2017 study of nature reserves in Germany found a 76 percent drop in the total biomass of flying insects since monitoring began in 1989.[201] Pesticides and agricultural intensification seems to be the main cause because humans compete with insects for food. That means less food for birds, like starlings, which dote on insects.

The overall decline of insects is another quiet loss of what was once everyday. It used to be a common annoyance of a long car trip in the summer in North America that you would have to periodically stop to scrape a spattered layer of insects off your windshield and scrub your front grill when you arrived. Mike and Loka (the oldest of us four authors) remember doing it a lot years ago. And one still has to from time to time. But these 65- and 70-mile-an-hour insect collection traps—that is, cars—are also showing a significant decline in the biomass they register. Again, why should we care? Isn't it great not to have insect mess all over the front of your car? But what annoys us in the moment is often, like a rain shower, a vital part of what sustains us all long term.

And with these declines come the risk of outright extinction. Estimates of extinction rates for all species vary widely because we still do not have a good count of how many there are or ever were. Many species are still unknown or survive in such low numbers that they are hard to study. But even the low estimates are staggering. Perhaps the most widely regarded account, based entirely on individual assessments for each species, is the "Red List" of the World Conservation Union, known by the acronym IUCN, a 140-nation organization (see Figure 1.12). As of 2020, the Red List registered 31,030 species as threatened with extinction. In addition to the 14 percent of bird species, extinction is now a real and present possibility for 25 percent of mammal species and 40 percent of amphibians, according to the 2020 Red List.[202] But although the IUCN has reviewed the status of all bird species and about 72 percent of all vertebrate species, little is yet known about the status of invertebrates and plants.

The overall extinction rate is thus in the realm of educated guesswork, given the spotty data we have. Richard Leakey, the famous paleontologist, is one who has made a try. He suggests that we could lose as many as 50 percent of all species on Earth in the next 100 years, largely because of high rates of extinction among invertebrates, the group we know the least about. (For example, nearly half of the insect species that the IUCN has assessed are threatened. However, evaluations often focus on species at risk.) If Leakey is anywhere near right, that would put the current period of extinction on the same scale as the one that did in most dinosaurs and much of everything else 65 million years ago and four earlier periods that had a similar effect on

Figure 1.12 A Leaking Gene Pool: The IUCN Estimated "Red List" of Threatened Species, an Annually Updated Inventory

	Estimated Number of described species[1]	**Number of species evaluated by 2020** (IUCN Red List version 2020-1)	**% of described species evaluated by 2020** (IUCN Red List version 2020-1)	**Number of threatened species**[2] **by 2020** (IUCN Red List version 2020-1)	**Estimated % threatened species in 2019** (IUCN Red List version 2020-1)[2,3,4]		
					Lower estimate (threatened spp. as % of extant evaluated species)	**Best estimate** (threatened spp. as % of extant data sufficient evaluated species)	**Upper estimate** (threatened and DD spp. as % of extant evaluated species)
VERTEBRATES							
Mammals[5]	6,495	5,851	90%	1,246	22%	25%	37%
Birds	11,147	11,147	100%	1,486	14%	14%	14%
Reptiles	11,136	7,830	70%	1,408		*Insufficient coverage*	
Amphibians	8,126	6,824	84%	2,202	32%	41%	53%
Fishes	35,423	20,341	57%	2,721		*Insufficient coverage*	
Subtotal	**72,327**	**51,993**	**72%**	**9,063**			
INVERTEBRATES							
Insects	1,053,578	9,425	0.9%	1,759		*Insufficient coverage*	
Molluscs	90,213	8,748	10%	2,250		*Insufficient coverage*	
Crustaceans[6]	80,604	3,181	4%	733		*Insufficient coverage*	
Corals	2,175	864	40%	237		*Insufficient coverage*	
Arachnids	110,615	344	0.31%	197		*Insufficient coverage*	
Velvet Worms	183	11	6%	9		*Insufficient coverage*	
Horseshoe Crabs	4	4	100%	2	50%	100%	100%
Others	164,209	839	0.51%	146		*Insufficient coverage*	
Subtotal	**1,501,581**	**23,416**	**2%**	**5,333**			

PLANTS[7]							
Mosses[8]	21,925	281	1.3%	164		*Insufficient coverage*	
Ferns and Allies[9]	11,800	656	6%	261		*Insufficient coverage*	
Gymnosperms	1,113	1,015	91%	402	40%	40%	42%
Flowering Plants	369,000	38,445	10%	15,624		*Insufficient coverage*	
Green Algae[10]	11,620	13	0.1%	0		*Insufficient coverage*	
Red Algae[10]	7,298	58	0.8%	9		*Insufficient coverage*	
Subtotal	**422,756**	**40,468**	**10%**	**16,460**			
FUNGI & PROTISTS[11]							
Lichens	17,000	30	0.2%	27		*Insufficient coverage*	
Mushrooms, etc.	120,000	255	0.2%	141		*Insufficient coverage*	
Brown Algae[10]	4,275	15	0.4%	6		*Insufficient coverage*	
Subtotal	**141,275**	**300**	**0.2%**	**174**			
TOTAL	**2,137,939**	**116,177**	**5%**	**31,030**			

Source: IUCN (2020).

the Earth's living things. That's why Leakey and Roger Lewin call the current period the "sixth extinction."[203] When we add in the extinction of subspecies and subvarieties, the decreasing diversity of planetary life is even more dramatic.

Of course, species have always come and gone, as Charles Darwin famously observed in his theory of natural selection (we'll get to that more in Chapter 9). But the rate of these losses has greatly increased since the beginning of the Industrial Revolution. Some have disappeared because of habitat loss, as forestlands have been cleared, grasslands plowed, and wetlands drained and filled. Some have suffered from pollution of their habitat. Some have found themselves with no defenses against animals, plants, and diseases that humans have brought, often unintentionally, from other regions of the world into their habitat. The Earth is a single, gigantic preserve for life, and we have not been honoring its boundaries and protecting its inhabitants.

The loss of species is both a moral issue of justice and an instrumental issue of sustainability for all. The leaking global gene pool means a declining genetic resource base for the development of new crops, drugs, and chemicals. In addition, most ecologists suspect that decreased diversity destabilizes ecosystems—ecosystems that we, too, need to survive. But the ethical and aesthetic impact of the loss of so many forms of life may be as great.

Loss of Landscapes

The loss is not only of forms of life but also of forms of landscape. Take deforestation. The Earth has lost nearly a third of its original area of forestland, as world forest cover has decreased from 45 percent of the Earth's land area to 31 percent as of 2015, the most recent global assessment.[204] Between 1990 and 2015, 7.6 million hectares of forested landscapes were converted to other uses every year. A lot of forest was also replanted—about 4.3 million hectares a year. But that resulted in a net loss of 3.3 million hectares of forest every year. All told over that period, the total amount of forest land declined by 129 million hectares, an area about the size of South Africa and about three times the size of California.[205] Alarmingly, 80 percent of the continuing net loss—some 4 million hectares annually—is of these primary forests with their richness of species and habitat.[206] Only a third of the forests that remain are primary.[207] Replanted forests are poor substitutes for the primary forests they replace, at least in terms of biodiversity—the ecological equivalent of exchanging the paintings in the Louvre for a permanent display of engineering blueprints.

Acid rain is another threat to landscapes, reminding us of the stark consequences for all species when humans live as if the future will not come and as if their ecology is not larger than themselves. This is an issue that has largely dropped from sight, after a flurry of concern in the 1970s and early 1980s over sharp declines in the populations of some fish and frogs and extensive signs of plant stress and dieback in many forests. But acid rain is still falling from the sky, despite substantial efforts to reduce acidifying emissions of sulfur dioxide and NOx (which also have other dangerous impacts, as we have seen). These pollutants combine with water in the atmosphere to acidify rain, resulting in direct damage to plant tissues, as well as the leaching of nutrients from soil and the acidification of lake waters, which, in turn, affect most wildlife—particularly in areas with normally acidic conditions, where ecosystems have less capacity to buffer the effects of acid fallout. When things get bad enough, lakes die and trees refuse to grow, like the miles of blasted heath in the acid deposition zone surrounding the old nickel smelters in Sudbury, Ontario. The situation is especially severe in northern Europe, where more than 90 percent of natural ecosystems have been damaged by acid rain; a survey by the European Union found that 22 percent of all trees in Europe have lost 25 percent or more of their leaves.[208] Conditions are also quite worrisome in much of Canada and in China. One study found defoliation rates as high as 40 percent in some Chinese forests.[209] A 2013 compilation of recent studies calls acid rain a "severe" threat to India, China, and other developing countries.[210]

Efforts to reduce acidifying emissions of sulfur dioxide and NOx have made a great difference in some regions.[211] For example, across a 20,000-square-kilometer area in southern Norway in the 1990s, salmon were virtually wiped out by acid rain. But by 2014, the most recent assessment, reduced emissions and the application of lime to many lakes and rivers had restored healthy water to all but some 7 percent of Norway's area.[212] Deposition rates for sulfate from rain are down considerably in much of the United States. But there are many areas of the country, mostly in the Midwest and Mississippi Valley, that as of 2018 are still receiving more than 5 kilograms per hectare of sulfate from the sky each year—five times more than falls in most of the western United States. A few spots are receiving 10 or more kilograms per hectare of sulphate.[213] Ecologists have established an estimate of the "critical load" of acid pollution that a lake's ecology can tolerate without significant harm. In the late 1980s, acid rain exceeded the critical load in 45 percent of the lakes in New York's Adirondack Mountains. Between 2006 and 2008, the most recent comprehensive assessment, it was still 30 percent—a significant improvement but still pretty high.[214] Unfortunately, the U.S. National Atmospheric Deposition Program has been badly underfunded in recent years, and we don't really know the current situation.

In other words, as far as we know, the situation is encouraging but remains problematic. Why, after so many years of effort, does acid rain still threaten? Technological improvements, international treaties, and domestic legislation have all contributed to a sharp decline in sulfur emissions in most countries. But we have made little overall progress in reducing nitrogen emissions. Industry's advances have been overwhelmed by increased emissions from automobiles and trucks as the world comes to rely ever more on these highly polluting forms of transportation.[215] Plus, there is evidence that the ability of sensitive ecosystems to handle acid rain has been damaged such that slight improvement in the acidity of rain often does not result in any improvement in the condition of lakes and forests.[216]

Loss of Intimacy

Whether humans, or birds, or insects, or trees, species-related losses that shape matters of injustice are not just about life and death. There's another loss, too—the disappearance of a kind of quiet intimacy with the Earth, the sense of being connected to the land and to each other through land. It is a common complaint that modern technology removes us from contact with a greater, wilder, and somehow realer reality. This removal, it should be said, has been the whole point of modern technology, but some have come to wonder whether our lives are emptier because of it. It's another romantic concern, perhaps. But do we want a world without romance? Given the widespread experience of the pull of ecological beauty, apparently not.

Moreover, the loss of quiet intimacy is not merely a philosophical matter. There can be a physical dimension as well. We in the industrialized world are seldom away from the sound of machines, and we generally interact with the world by means of machines. Got something you need to do? Get a machine. Try to escape from the constant sound of machines? Good luck. Saturday morning in the suburbs, and the lawn mowers and leaf blowers are at it. Late into the summer night, the air-conditioners hum, and the highways growl. Out in the countryside, the situation is often no better: tractors, snowmobiles, Jet Skis, motorcycles, passing airplanes, chain saws, all manner of power tools, and the nearly inescapable sound of the highway except in the remotest locations. Back at the office, the lights buzz, the printer cranks, the air-handling equipment rushes with a constant Darth Vader exhale, and the traffic—always the traffic—invades the sanctum of the ear with an ever-present tinnitus of technology. And we hardly seem to notice. We have lost our hearing, our hearing for habitat.

Is it just for us to make such great transformations in the world? Nothing lasts forever, of course. Over millions of years, even a mountain is worn away by erosion. Wind, rain, ice, and changes in temperature constantly sculpt the land, and the shape of the Earth's surface constantly changes as a result. But geologists now recognize humans to be the most significant erosive force on the planet.[217] Agriculture, forest cutting, road building, mining, construction, landscaping, and the weathering effects of acid rain—all these have resulted in enormous increases in the amount of sediment that rivers carry into the oceans. We wield the biggest sculptor's chisel now. Perhaps it is our right. If so, then it is also our responsibility.

Although we have not covered the question of environmental justice across species in much detail, let us conclude here. After all these pages on the challenges of environmental justice, we're exhausted. Maybe that's the most difficult of the challenges to environmental justice: There are so many of them.

The Social Constitution of Environmental Problems and Solutions

Well, that was all pretty grim. We've got issues, folks, lots of them.

So what do we do? Load up second helpings of fruit salad, coffee cake, scrambled eggs, bread, butter, and maybe some hominy grits, as Mike did at that brunch some years ago? Get used to living with a bit of guilt over your environmental gilt because it's all so big and beyond your control anyway?

Do you refuse to turn on the switch on the electric oven to bake the coffee cake you want to bring to a brunch because the power in your community comes from a nuclear or a coal plant? Do you refuse the food others bring because the scrambled eggs weren't from free-range hens and because the fruit salad has bananas likely raised on deforested land and picked by laborers poorly protected from pesticides? And do you refuse the invitation to even come to the brunch because the buses don't run regularly on a Sunday morning, because a twenty-minute ride in the bike trailer in below-freezing weather seems too harsh and long for your five-year-old, and because no one nearby enough to carpool with is coming to the meal? The switch is there for the flipping, the food is there for the eating, and that car is there for the driving. Do you refuse them?

Likely not.

So here's some good news—really, really good news. What leads to this sidelining of environmental concern and action is the same thing that can lead to environmental solutions: the *social constitution of daily life*—how we as a human community institute the many structures and motivations that pattern our days, making some actions convenient and immediately sensible and other actions not.[218] Caught in the flow of society, we carry on and carry on and carry on, perhaps pausing when we can to get a view of where we're eventually headed, but in the main just trying to keep afloat, to be sociable, and to get to where we want to go on time. Our lives are guided by the possibilities our social situation presents to us and by our vision of what those possibilities are—that vision itself being guided in particular directions by our social situation. That is to say, it is a matter of the social organization of our material conditions, the ideas we bring to bear upon them, and the practices we therefore enact. The environmental justice implications of those conditions, ideas, and practices are seldom a prominent part of how we socially constitute our situation. We have so many other things to worry about, after all.

But that's not necessarily a bad thing.

Let's cut to the quick of it: If it is hard for people to be environmentally just, well, then being environmentally just will be hard. So let's make it easy to be environmentally just. Let's make it cheap, convenient, safe, beautiful, and even fun. Let's make being environmentally just what everyone just does. Let's make it routine, something you don't have to think about amid all the other stresses and concerns of your day because it is built into the pattern of ordinary life. Let's remake the way we do things into what we will term throughout this book *normal environmentalism*—environmentalism you don't have to worry about because you just find yourself doing it anyway. It's simply the normal thing to do—no fuss, no bother, no extra expense, no weird looks. You no longer have to make a fuss for justice because the structure is already there to reduce disparities across time, social space, and species that keep holding back the community of all for all. What's just becomes what's normal.

Like environmentalism in the usual sense, normal environmentalism is walking or taking your bicycle to work. It's using less heating, cooling, construction materials, and water. It's replacing old appliances with energy-efficient ones. It's buying food produced with sustainable production methods and where workers get a fair wage and decent working conditions. Yet normal environmentalism means doing these things not because you've made a conscious decision to be environmentally just today but because these were the cheapest, safest, most convenient, and most enjoyable things to do. Normal environmentalism is being environmentally good without having to be environmentally good.

We think it is safe to say that normal environmentalism is a lot more likely to be popular with the general public than environmentalism by guilt, cajoling, and shaming.

So how do we get normal environmentalism? How do we induce people to be environmentally good without having to be environmentally good?

By organizing social life so that it encourages environmentally friendly decisions. So it's enjoyable, safe, and convenient to bike to work. So there are frequent buses and centrally located businesses, stores, schools, government offices, restaurants, and places of worship that are easily accessible. So the foods and products we buy are made in ways that do not undermine the well-being of the places and people that made them without having to check the labels and research them online. So everybody is doing things in these ways, and you're not an oddball who makes everyone else uncomfortable by acting on behalf of the planet.

In short, we have to reconstitute the constitution of everyday life.

Normal environmentalism, then, means making environmentalism easy. The trouble is that it is often hard to make things easy. Social reconstitution usually requires a terrific effort. But when we do reconstitute society, we've really done something, something lasting and important—precisely *because* it is so hard to do. If social reconstitution were easy, it probably wouldn't be social reconstitution at all. It can be done. And it is done all the time. But we have to do it. We can become environmental without trying—but only if we try.

What is necessary is to think carefully about how we as a community organize the circumstances in which people make environmentally significant decisions. What is necessary is to create social situations in which people take the environmentally appropriate action, even when, as will usually be the case, they are not at that moment consciously considering the environmental consequences of those actions. What is necessary is ecological dialogue about how to bring our material circumstances in line with our commitments to all three dimensions of environmental justice, reconstituting our lives so what we daily find ourselves doing compromises neither our social nor our environmental values. What is necessary is to have a truly social ecology.

The challenge of environmental sociology is to illuminate the issues such a reconstitution must consider.