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Dying of Consumption

The unequal globalization of the costs of consumption is putting ecosystems and billions of people at risk. Many living within small worlds of prosperity, however, end up seeing more progress than peril around them, pointing to better environmental practices and technologies, to energy-efficient appliances, greener architecture, organic foods. Relatively few in power ever question the side effects of a global political economy producing ever more "new and improved" products—even as threats to just about every ecosystem continue to escalate.

The Darkening Skies

Many natural environments are in crisis.[1] Over half of the world's original forests and wetlands are now gone. The tropical rainforests, wonders of biodiversity, remain under severe threat from loggers and industrial farmers. The tropics are now losing over 13 million hectares (32 million acres) of natural forest every year: Brazil alone is losing over 3 million hectares (7 million acres), while Indonesia is losing nearly 2 million (5 million acres).[2] Meanwhile, the once seemingly infinite oceans now swirl with toxins like mercury. Such pollution has done little to discourage fishing, which persists at levels that are pushing many commercial stocks into collapse. The number of Atlantic bluefin tuna, for example, has fallen by at least 80 percent since 1970.[3] The northern cod off the eastern coast of Canada—whose numbers were so plentiful in the 1600s that sailors could fill a bucket simply by lowering it over the side—is now endangered, its population falling by 99 percent over the last four decades.[4]

Such tales are becoming common across the globe. In its analysis of data on 7,800 species of wild seafood, a 14-person team found worldwide catches of 29 percent of these species are now at least 90 percent

below past averages. Unless measures are taken to curtail harvests, the team predicts a "collapse" of much of the remaining commercial wild seafood before 2050.[5] Another 10-year survey of the global oceans found a 90 percent decline in large predatory fish over the last half century, including cod, flounder, marlin, swordfish, and tuna.[6] Indeed, unless the world changes course, the waters of Ernest Hemingway's *Old Man and the Sea* will soon be empty of the fighting marlin, an outcome arising, not from the heroics of men like Hemingway's old man Santiago, but from industrial fishing boats plying the oceans to feed global markets.

Land and freshwater resources are also under great ecological pressures from human activities. The fate of the Aral Sea illustrates the magnitude of some of these changes: once the world's fourth largest lake, it shrank by half in just three decades as its inflows were diverted to agriculture and hydroelectricity, leaving it as salty as an ocean by the early 1990s. Demand from agriculture, industry, and individuals is continuing to deplete scarce water resources elsewhere, too. Over a billion people are now struggling to survive without access to clean water, and current trends suggest billions more will live with severe water shortages within a few decades.

Changes like these are contributing to the death of between 50 and 150 species every day. Many are microscopic, deep in oceans and forests, and still beyond the reach of scientific cataloguers trying to deal with the estimated 5–30 million species of life on earth. Yet even macroscopic plant and animal species are going extinct, at an average rate 50–100 times higher than the natural one (assuming an average life span of 5–10 million years for a species)—over 1,000 since the beginning of the seventeenth century. The Worldwatch Institute believes the planet is now "in the midst of the biggest wave of animal extinctions since the dinosaurs disappeared 65 million years ago."[7]

The exponential growth in consumption is also saturating the global environment with chemicals. Some, like DDT to kill mosquitoes that spread malaria, save millions of lives every year. Yet these "useful" chemicals are also contaminating ecosystems and poisoning people. Some 75,000 chemicals are registered in the United States alone, yet, of these, scientists have tested the carcinogenicity of only 1,500 (or 2 percent). They know even less about the toxicity of the 11,000 commercial organochlorines or the thousands of accidental—and often unknown—chemical by-products.[8]

One of the greatest sources of chemicals is agriculture. Over the last half century, farmers have come to rely more and more on pesticides and

fertilizers. American farmers, for example, were using 50 million pounds of pesticides per year in the 1940s. By the end of the 1970s, it was over 800 million pounds. Globally, from 1961 to 1999, the use of pesticides went up more than 800 percent. In the same period, the use of nitrogenous fertilizers went up more than 600 percent; that of phosphate fertilizers, more than 200 percent.[9] Such growth in the use of chemicals has most likely played a part in the rising rates of diseases like cancer, but few governments or firms seem eager to investigate the environmental sources of such diseases, focusing instead on diagnosis, treatment, and cures.

Climate change is perhaps the greatest environmental threat of all.[10] In a 700-page report commissioned by Britain's chancellor of the exchequer, former chief economist of the World Bank Nicholas Stern put the potential economic and social disruption of global climate change on a par with that of both World Wars and the Great Depression combined.[11] Just about every aspect of modern consumer life—manufacturing, traveling, heating, cooling, burning, eating—is producing greenhouse gases, notably carbon dioxide, methane, and nitrous oxide. Deforestation is releasing carbon dioxide, too, and now accounts for 25 percent of anthropogenic emissions of carbon dioxide. As a result of all of these activities, total carbon dioxide emissions increased twelvefold over the twentieth century.[12] In the twenty-first century, the rate of increase for carbon dioxide emissions from burning fossil fuels and making cement has more than doubled, from an average of 1.3 percent per year in the 1990s to 3.3 percent per year from 2000 to 2006. The jump in carbon dioxide emissions from 2000 to 2006, according to a study published in the *Proceedings of the National Academy of Sciences*, was the fastest rate of increase over a seven-year period since modern records began at the end of the 1950s. The concentration of carbon dioxide in the atmosphere is now over 380 parts per million—the highest level in at least 650,000 years (and perhaps the highest in 20 million years).[13]

Greenhouse gases, with global emission rates now over 70 percent higher than in 1970, are warming the planet.[14] The earth's average surface temperature rose by about 0.6 degrees Celsius (1.1 degrees Fahrenheit) over the twentieth century. This may not seem like much. Yet it made the twentieth century the warmest one of the last millennium. One obvious sign of global warming is the melting polar ice caps, which have been shrinking by about 9 percent every decade since 1979. Another is the recent melting of the 11,000-year-old permafrost in western Siberia. And the problem of rising temperatures seems to be

worsening. The 1990s was the warmest decade and 2005 the warmest year over at least the last century. Records were broken in just about every year of the last decade. Tied as the second and third warmest years of all time were 2007 and 1998 (a year with a strong El Niño); the fourth warmest was 2002 (a year with a weak El Niño), followed by 2003 and 2006.[15]

The twenty-first century will likely be even warmer. Six scenarios by the United Nations Intergovernmental Panel on Climate Change (released in 2007) show a likely rise in the average worldwide surface temperature over the next century of another 1.1–6.4 degrees Celsius (2.0–11.5 degrees Fahrenheit) from the 1980–1999 average—with best estimates pointing to the fastest rate of change for at least the last 10,000 years. A rise of 3–5 degrees Celsius (5.5–9 degrees Fahrenheit) would, according to NASA's Drew Shindell, "bring us up to the warmest temperatures the world has experienced probably in the last million years."[16]

The future may see even warmer temperatures, however, if the process reaches a "tipping point."[17] Some scientists now worry that global warming is diminishing the capacity of the earth's "sinks" (land, forests, and oceans) to absorb or retain greenhouse gases. Two examples of the latter are in the Antarctic Ocean, where stronger winds linked to warmer temperatures are now churning up waters rich in carbon dioxide, and in Siberia, where the melting permafrost is releasing methane, a gas with 20 times the greenhouse effect of carbon dioxide. A warmer world means more of this permafrost will melt, which will release more methane, which will raise temperatures, which will melt more permafrost. This self-reinforcing feedback could release around 49 billion metric tons of methane (nearly one-sixth of all of the world's methane stored on land) from the northeast Siberian ice complex alone.[18] Other self-reinforcing feedbacks could further accelerate warming.

Warmer temperatures will have many unpredictable and uneven consequences. Wind, rain, and snow patterns will change, with some places becoming hotter and some colder. Rising oceans will engulf low-lying islands. Droughts will disrupt agricultural yields, especially in places like Africa. Severe weather—hurricanes, tornados, hailstorms, droughts—will occur more frequently and with greater intensity. Although the world is unlikely to see the next ice age charge down the streets of New York City like a giant grizzly bear, as it does in the 2004 movie *The Day After Tomorrow*, global warming will be catastrophic for many species. A temperature rise of just 0.8–2.0 degrees Celsius (1.4–3.6 degrees Fahrenheit), for example, could "commit" 18–35 percent of plant

and animal species to extinction by 2050. Other factors, like higher concentrations of carbon dioxide, could lead to even higher rates of extinction.[19]

Changes to the global environment are already harming billions of people, from the Inuit in the Arctic to the Penan of Sarawak to the Brazilians of Rio de Janeiro. One example is the more than 10 million children under the age of five who are dying every year from preventable and treatable causes, with unhealthy environments contributing to almost half of these deaths.

Just as disturbing, many of us are being exposed to health risks as firms experiment on consumers with a rush of new products. The international legal community rightly applauds its success in phasing out chemicals like chlorofluorocarbons (CFCs). But what about the thousands of other chemical "discoveries" now in our food, air, and water? What will happen when these chemicals combine? Some of the chemicals will prove harmless. But some will prove harmful and some even deadly. Scientists are testing, arguing, and analyzing, as are firms, activists, and government agencies. As with CFCs, it will take years, perhaps decades, to see the full consequences of introducing these chemicals into our environments.

Examples of substances with the potential to harm ecosystems—and thus human health—seem to trickle into the daily press in a steady flow. Some are the result of an activist group or reporter sensationalizing a story. But many arise from scientific tests producing truly worrisome results. As the next section shows, current debates over the use of PBDEs in furnishings and electronic devices call to mind those of decades past over the use of DDT around the home to keep mosquitoes at bay.

Consuming Risks

The DDT, PCBs, and CFCs of today include chemicals like PBDEs (polybrominated diphenyl ethers). For over three decades, firms have put PBDEs into household and office items (mattresses, pillows, rugs, curtains, carpet padding, TVs, computers) as flame retardants. These chemicals were heralded as a great advance in consumer safety in the 1970s, able to prevent a TV from bursting into flame or slow a fire in a mattress. Back then, chemists and medical specialists could see few reasons to worry about putting PBDEs inside hard plastics or soft foams. These were only toxic in large quantities; besides, there was no reason to expect they wouldn't remain safely inside a product.

Swedish scientists set off alarms in the late 1990s after discovering that concentrations of PBDEs in human breast milk were rising in some populations. Soon it was clear these chemicals were migrating from consumer products into humans—not, it seems, primarily through food chains as with other persistent organic pollutants like dioxins or PCBs, but by collecting in home environments, especially in indoor air and household dust.[20] Recent tests show U.S. residents now have the highest levels of PBDEs in the world (followed by Canadians). Residents of North America, on average, have 10–70 times higher PBDE levels than residents of Japan or Europe. Some individuals—between 5 and 10 percent of the North American population—appear to have absorbed especially large quantities, perhaps because of exposure to crumbling foam in mattresses and furniture, or perhaps because of exposure to dust as crawling babies. Tests of breast milk, tissue, and blood show these individuals have levels of PBDEs around 1,000 times higher than those with low readings.

In laboratory experiments, such high levels cause symptoms in animals similar to those of hyperactivity and attention deficit in children. PBDEs appear to lower sperm counts as well. Although their chemical structure resembles that of PCBs (some would call them "chemical cousins"), medical researchers are focusing on the unique qualities of PBDEs, which appear to mimic and interfere with human hormones (such as thyroid hormones). Some specialists now think that, unlike typical toxic chemicals, PBDEs may damage the brain in only trace amounts—which doctors would have thought inconsequential in the past—provided exposure occurs at a critical juncture in growth. Recent experiments to test the effect of trace amounts of PBDEs—amounts already present in some humans—found permanent brain damage in rats and mice.

Over the last decade, European governments have taken steps to eliminate two particularly worrisome formulations of PBDEs: those commonly used in mattresses, on the one hand, and in computer housings and monitors (representing about 15 percent of the global market for PBDEs in 2001), on the other. A number of states in the United States have done the same. The Environmental Protection Agency (EPA) has managed to encourage some of the major producers of PBDEs to phase out these two formulations voluntarily. Some manufacturing and retail firms are also taking steps to stop using PBDEs. The Swedish home furnishing company IKEA was one of the first firms to remove them from its products. The U.S. computer company Dell and the Swedish automaker Volvo are examples of firms now working toward eliminating some of the worst formulations of PBDEs.[21]

The latest research findings on the role of pesticides and herbicides in neurodegenerative illnesses are just as alarming as those on PBDEs. In a 2006 epidemiological analysis of the 143,000 participants in an ongoing study by the American Cancer Society, for example, researchers found those regularly exposed to low doses of pesticides and herbicides—such as gardeners, farmers, ranchers, and fishers—had a 70 percent higher incidence of Parkinson's disease than those not so exposed.[22]

Perfluorochemicals are another family of chemicals with worrisome properties for the health of consumers. Researchers are focusing on two members of this family: perfluorooctanoic acid (PFOA) and perfluorooctanyl sulfonate (PFOS). Virtually indestructible, they are used to make Teflon pots and pans nonstick and to make rugs, couches, and raincoats grease-resistant, stain-resistant, and waterproof. You can also find them in pizza boxes, microwave popcorn bags, fast-food burger wrappers, and French-fry containers, as well as in nail polishes and shaving creams.

PFOA and PFOS are migrating (exactly how is still unclear) from consumer goods into the environment and into humans, where, like lead, PBDEs, and pesticides, they are appearing in detectable quantities. Again, as with these other chemicals, an increasing number of doctors now see exposure to low doses over long periods as a potential health threat, especially for children. Recent laboratory tests of PFOA on animals, for example, have found links to low birth weights, damage to thyroid glands, changes in male reproductive hormones, breast cancer, and liver cancer. As tests in the United States and other countries find PFOA and PFOS in some children at levels above those causing measurable harm in laboratory animals, more and more health and environmental specialists are becoming alarmed.[23]

Such findings are particularly disturbing because natural biological processes do not appear to ever break these chemicals down into less harmful substances, as they do with chemicals like DDT. Richard Wiles, vice president of the nongovernmental Environmental Working Group, calls them "the DDT of this millennium," but with much higher stakes because they "last forever." Although humans appear able to excrete PFOA over a period of several decades, still, the wonder chemical that nothing can stick to, seems able to stick to living things long enough for tiny quantities to bioaccumulate until toxic.

DuPont insists its Teflon pots and frying pans are safe if consumers use them properly. Manufacturers use PFOA to produce Teflon, corporate brochures explain, but it's not an "ingredient" in the Teflon itself. David Boothe, DuPont's global manager for products like Teflon,

explains: "When you're using the cookware as it's intended to be used, at the temperatures it's intended to be used, it's perfectly safe."

Many companies—even DuPont—are nevertheless beginning to give up on these chemicals. The first to do so was the U.S. technology firm Minnesota Mining and Manufacturing (called 3M since 2002), when in May 2000, after four decades of production, it began phasing out PFOS from the popular brand Scotchgard. It took steps as well to stop producing PFOA. On the same day 3M made these announcements, the EPA informed governments worldwide of animal tests showing that PFOS "appears to combine persistence, bioaccumulation and toxicity properties to an extraordinary degree." Since 2000, a few other firms have been following 3M's lead in voluntarily reducing use, such as the fast-food chain McDonald's, which no longer uses wrappers containing perfluorochemicals.[24]

Some governments are also now beginning to push firms harder to get rid of PFOA. Both Canada and the United States, for example, began initiating phasedowns and safety reviews of PFOA in 2006. The EPA reached a deal in early 2006 with DuPont and seven other manufacturers to reduce PFOA emissions from their U.S. facilities and PFOA in their products by 95 percent by 2010, with the goal of completely eliminating them by 2015. DuPont took swift measures, cutting back PFOA production by 95 percent in 2006.

Safety reviews of hundreds of other chemicals in widespread use are also now occurring across much of the developed world. On that list is bisphenol A (BPA), a synthetic petrochemical and a main ingredient in polycarbonate plastics and resins. Volumes have been growing steadily since the 1950s—with major producers including Bayer, Dow Chemical, GE Plastics, and Sunoco—and it's now one of the world's most common chemicals in production. Hard, clear plastic water and baby bottles contain bisphenol A. So do compact disks, sports helmets, microwavable plastics, dental sealants, and the lining of many tin cans. Like so many other chemicals, trace amounts of bisphenol A are migrating into the environment and into people. Scientists have known since the 1930s that it can mimic the female hormone estrogen. Still, the scientific consensus for much of the twentieth century was solid: the level of exposure was low and thus posed no danger to health.

Hundreds of experiments over the last decade, however, have found possible links between bisphenol A and prostate cancer, diabetes, low sperm counts, and the early onset of puberty. The converging findings of much of this research challenge a commonsense tenet of toxicology

going back to at least the fifteenth century: that a higher dose equals *more* harm. An increasing number of scientists are coming to conclude that trace amounts of bisphenol A, which the body treats as a hormone (turning on receptors in cells), may in fact cause more harm than larger quantities, which the body treats as a poison (causing receptors to overload and stop functioning). Class action lawsuits are just beginning to draw on this research. The first was against five manufacturers of baby bottles, filed in Los Angeles in March 2007. Cases like this one will raise further questions about the safety of numerous other consumer products containing chemicals that can disrupt hormonal systems.

Efforts to phase out chemicals like PBDEs, PFOA, and BPA will no doubt take considerable time. Manufacturers like DuPont will continue to insist on "science-based approaches" (including funding research). Litigation will drag on, as firms file appeals and countersuits. And the progress across different jurisdictions will inevitably be uneven as these same firms shuffle risk overseas to keep sales and profits healthy. Steven Hentges of the American Plastics Council sounds no different today than most of the other corporate spokespeople of the last century: "BPA is not a risk to human health at the extremely low levels at which people might be exposed from use of, for example, polycarbonate plastic." The reaction of scientists sounds equally familiar. Biology professor Frederick vom Saal, a specialist on hormones and synthetic chemicals, responds: "The chemical companies think they can lie with impunity about the published scientific literature."[25]

Meanwhile, as these debates rage, other chemicals with other side effects, by themselves and in combinations, are entering the global marketplace, adding further to the total ecological burden, with unpredictable consequences for human and environmental health. Clearly, particular chemicals and combinations of chemicals are harming the health of some people, although the pathways of causality are so complex it's impossible to determine precisely how and to what extent. Still, a glance at global cancer rates reveals some disquieting trends.

A Shadow of Cancer?

Could the annual worldwide use of 400 million metric tons of chemicals in part explain the rising cancer rates? What about other environmental changes like ozone depletion, air and water pollution, or climate change? Or factors like the increasing consumption of processed and fast food? Globally, around eight million die every year from cancer—a figure the

World Health Organization predicts will increase to more than 10 million over the next two decades (with more than 15 million new patients a year). It remains, in the prophetic words of French surgeon Stanislas Tanchou in 1843, a "disease of civilization."

Cancer is now the second most common cause of death in the developed world, after cardiovascular disease. Cancer rates in the United States, even after adjusting for longer life expectancies and excluding lung cancer, have been rising steadily (several studies put the increase at around 35 percent since the 1950s).[26] Cancer is now responsible for almost one-quarter of all deaths in the United States. The American Cancer Society estimates the lifetime chance of getting cancer in the United States at nearly one in two for men and just over one in three for women.

Why are cancer rates rising? The reasons are complex: eating habits, exercise choices, ever better diagnostic techniques. It's certainly simplistic to blame chemicals or power lines or pollution alone. Still, it seems sensible to worry about the thousands of recent laboratory results linking cancer in animals to chemicals common in consumer products (from shampoo to gasoline to French fries), drinking water, and air (both indoor and outdoor).[27] I find it just as sensible—even without scientific proof of causality—to worry about the brews of environmental toxins scientists are now finding in the bloodstreams of many people.

How can consumers avoid exposure to chemicals with potentially deadly effects? There's only one way, Ana Soto of Tufts University School of Medicine wryly explains: "Don't eat, don't drink, and don't breathe."[28]

Mapping Ecological Shadows

At the start of the twentieth century, average life expectancy was 30. Today, it's over 66, and just listing all of the medical advances of the last 100 years—antibiotics, obstetrics, heart transplants, pasteurization, vaccines—could fill a book. Still, this does not excuse governments and companies for failing to do more to protect consumers and ecosystems. But to understand what action must be taken, we need to map particular shadows of consumption in detail—to learn how they are affecting us and *why* they are advancing or receding.

Chapters 3–22 do this by analyzing the evolution of how automobiles, gasoline, refrigerators, beef, and seals have been made, raised, or hunted and how they have been consumed. The chapters cover diverse

geographies, eras, sectors, governance structures, and political economies (from low-end natural resource extraction in the seventeenth century to high-end manufacturing in the twenty-first century). Without doubt, however, even this wide-ranging set of cases does not exhaust the nuances of change occurring in the thousands of political economies of consumption. Analyzing other consumer goods, from coffee, bananas, sugar, and tea to whales, elephants, tigers, and pigs would help shed light on some of those nuances. So would analyzing sectors like fisheries, forestry, and mining or issues like biodiversity, pesticides, coal, hazardous waste, and persistent organic pollutants.[29] Still, the five cases that follow survey enough ground in enough depth to reveal the consistent forces of environmental change and the consequences of ecological shadows.

In every case, environmental management is improving some matters, for example, the efficiency of resource use, production processes, per unit impacts, and recycling. Such improvements are occurring for many reasons. Education is altering societal values; more consumers are recycling goods (such as newspapers and bottles) and conserving energy (such as household electricity); norms among some consumers are evolving (such as forgoing a fur coat for moral or environmental reasons); and eco-labeling programs (such as for timber and seafood) and eco-markets (such as for organic beef) are expanding. New technologies (such as catalytic converters for cars or cooling systems for refrigerators) and more efficient production (such as just-in-time assembly lines) are also reducing impacts. Corporate jockeying for market shares and profits and, to a lesser extent, policies like corporate social responsibility are also advancing environmental efficiencies (particularly for higher-end manufacturing sectors like automobiles and refrigerators). Many other forces are shifting ecological shadows, too. Government regulations—not just for the environment, but also for trade and investment—play a key role. So do pressures from nongovernmental organizations like Greenpeace or the WWF (World Wildlife Fund / World Wide Fund for Nature), international agreements to prevent ozone depletion or protect endangered species, and international aid from organizations like the World Bank and Global Environment Facility.

The evidence from this book's five cases is unequivocal: ecological shadows *do* shift, wane, even fade away. But all five also reveal that the *incremental* advances under today's current forms of environmental management are failing to prevent irreparable damage to the global environment. The cumulative progress is not keeping pace with the impact of rising consumption in a globalizing economy of ever more

economic growth and ever more people. Across all of the cases, short-term economic and political factors tend to slow the speed of change. This does not mean a particular pattern of consumption in a particular location never changes appreciably for political, scientific, legal, economic, environmental, or health reasons. There are in fact countless examples arising from consumer boycotts, scientific discoveries, government bans, market crashes, and corporate bankruptcies. On occasion, a sudden change in one location even sets off a chain reaction producing better environmental management worldwide.

Still, stepping back reveals a *global* process of change that is failing to stop the environmental crisis from escalating. It also reveals that many "environmental advances" are permitting—and sometimes even causing—shadows of consumption to intensify. This process of change can also reinforce the tendency of global trade, multinational corporations, and global financing to deflect environmental costs to places and people with less economic and political power and less capacity to adapt, on the one hand, and to transfer benefits to consumers with more political and economic power, on the other.

Such a process of change, as the five cases will document in detail, has many damaging consequences. It tends to aggravate inequalities across and within states, with some people awash in excess and others bereft of the necessities to survive. It tends to allow multinational companies to expand sales in poorer countries during a phasedown of "suspect" products in wealthier ones. It tends to make it difficult to track and assign responsibility, leaving states and firms and consumers less accountable for environmental damage. It tends to expose future generations to health risks as firms pursue profits and states pursue economic growth. And it tends to cause unpredictable spillover effects across time and ecosystems.

As with lead poisoning, the thinning of the ozone layer, climate change, and rising cancer rates, the consequences of consumption can take decades, even generations, to develop. The five cases show that policy makers need to address consequences having no clean lines of causality and to take precautionary steps against effects flowing through complex systems with unpredictable outcomes. The cases also show that states should *not* assume that free trade and capitalism will significantly diminish ecological shadows, much less do away with them. Rather, international rules and institutions need to guide globalization to prevent double standards for multinational corporations, to tighten controls over the ecological impacts of trade, and to ensure that global financing supports

sustainability. They show that consumers need to act locally and governments globally—at the same time. And, finally, they show that environmentalism needs to be transformed to promote more balanced personal consumption and a more balanced global political economy.

Let's turn now to the first case—the automobile—arguably, the most harmful consumer product ever for people's health and safety and for the stability of the earth's environment, yet one under relatively few international controls.

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The Efficient Steer: Fast, Fat, and Cheap

In *An Essay on the Principle of Population* (1798), the scholar Thomas Malthus put forth a seemingly inevitable principle: population, left unchecked, increases exponentially, while food production increases only arithmetically. Thus, following the laws of mathematics, mass starvation must one day ensue, causing a die-off of the human race.

Yet Malthus was wrong, at least about the second premise of his principle: the production of food over the last two centuries has been able to keep up with—and often surpass—the exponential growth of the human population. Today, there's more than enough food for the world's 6.7 billion people, and most starvation arises, not from a basic lack of food, but from inadequate distribution, incompetent governments, or overconsumption.

Malthus's fundamental error was underestimating the capacity of technology to increase efficiencies, extend productive land, and deflect costs into remote ecosystems and the future. He did not foresee the potential of irrigation, pest-resistant seeds, chemical fertilizers, and pesticides to boost crop yields. Nor, for foods like beef, did he foresee the capacity of businesses to produce a more efficient steer by injecting it with hormones to grow faster, feeding it buckets of corn and soy to fatten it more quickly, confining it in a feedlot to keep it marbled and heavy, and treating it with antibiotics to help it survive these unnatural conditions. He did not foresee the potential of disassembling that steer on a fast-moving conveyer belt in industrial slaughterhouses, paying workers next to nothing to carve out every scrap, and of then transporting its meat—ground, dried, frozen, canned—from faraway farmlands to cities. And he did not foresee how efficiently and cheaply multinational corporations could distribute these meat products through supermarket chains and fast-food outlets to the hungry (and not-so-hungry) masses. How, after all, could he have imagined such a future?

Industrial farming, as the history of commercial beef in this chapter shows, has saved many humans from starving. Indeed, in many countries, overconsumption of beef, among other foods, has made obesity a far greater threat to human health than starvation. But rising obesity is not the only unintended consequence of the much expanded production and consumption of beef. As this chapter argues, keeping the output of beef apace with rising populations and surging per capita consumption has generated many shadow effects for people and ecosystems (including farm animals).

Inside the Slaughterhouses

A Lithuanian immigrant from the imagination of Upton Sinclair, Jurgis Rudkus lives a life of unremitting misery. He toils in a slaughterhouse of Packingtown, Chicago, at the beginning of the twentieth century. Shrouded in gloom, knives slash at carcasses with lightning strokes. The floors and walls are cold, slippery, and bloody, the stench gut wrenching. The bosses are brutal, whipping workers to make the *dis*assembly line go faster. The workers are given no training, no benefits, and virtually no wages. Driven by greed, the meatpacking oligopoly greases a city of graft run by gangster politicians.

Every scrap of meat—even the rancid and disease ridden—is shoveled, along with rats and their feces, into the ground beef and sausages, canned and pickled as delicacies. Before long, Jurgis is cheated into debt, then injured and cast aside, without work or pay. Forced to struggle even harder to support the family in this slaughterhouse hell, his young bride goes mad after being sexually abused by her boss.

Then, having served jail time for beating his wife's abuser half to death, when it seems life couldn't possibly get any worse, Jurgis is unable to scrounge up enough money to save his wife from dying in childbirth. Grief stricken, he slogs on, working at menial jobs in Chicago to support his toddler son. When, however, the boy drowns in a ditch steps away from his ramshackle home, life loses all meaning for Jurgis. After this, he lurches about without purpose, becoming a hobo, a strikebreaking scab, a political lackey, a falling-down drunk.

Sinclair's moralizing novel, which without any subtlety he titled *The Jungle*, ends after Jurgis discovers socialism, and from the ashes of his despair comes the hope of an electoral uprising of the workers of America. In his account of a Chicago slaughterhouse in the early years of industrial ranching, Sinclair had sought to show how the pursuit of efficiencies

and savings was turning the family farm into a factory, with bosses exploiting workers to produce more "food," faster and cheaper. *The Jungle* is arguably Sinclair's most influential work in a lifetime of publishing over 90 books. But the reaction of the American public disappointed him. "I aimed at the public's heart," he later wrote in his autobiography, "and by accident I hit it in the stomach."[1]

The reaction of American consumers to such stories—disgust and outrage, then demands for government controls to ensure sanitary working conditions and the quality of meat—has been common elsewhere, too. Meat sales have sometimes declined after readers experienced the shock of "seeing inside" a slaughterhouse, but this has always been temporary, and, as this chapter documents, per capita meat consumption has been rising in every culture since the early 1900s.

Producing Pure Food

The Jungle was a bestseller in the United States. But it did not cause the mass uprising Sinclair had hoped for. To his dismay, the outrage stirred up by his novel was not over the hardships of Jurgis and his fellow workers, but over the unsanitary slaughtering in the meatpacking plants. Wasn't the health of consumers at risk? Sinclair had spent many weeks researching his novel in the meat slums of Chicago: his description was vivid, specific, as seemingly real as any journalistic exposé. Beef sales began to tumble as sales of his novel climbed. Public pressure for action grew; before long, the U.S. Congress passed the Pure Food and Drug Act and the Meat Inspection Act in 1906.[2]

These acts, which created the U.S. Food and Drug Administration, gave the government better control over the quality of the meat bought by the average American consumer. Conditions for U.S. meatpackers in the first half of the twentieth century began to improve, too, under pressure from public health advocates and unions. The stomach-turning scenes in *The Jungle* did not, however, produce a manifesto for a world vegetarian revolution, and after the initial drop in U.S. beef sales, did nothing to alter the trend toward eating more meat. Instead, as this chapter also documents, over the last century, the capitalists of Sinclair's world—who were using assembly lines even before Henry Ford—have managed to further improve the "efficiencies" of producing beef.[3] Ranches are bigger. The cattle fatten faster on a diet of cheap grain, growth hormones, and antibiotics. High-tech disassembly plants process the beef. And cattle graze in chemically fertilized pastures and cleared rainforests.

As a result, industrial farmers over the last century have been able to produce enough beef to easily outpace the needs of growing human populations, so much so that many people now consume too much for a healthy diet. The trend toward consuming ever more beef, as chapter 16 will document, is an increasing strain on environmental resources, from local waterways to tropical rainforests to the global climate. On a more optimistic note, chapter 17 will chart a shift among some consumers toward eating more "sustainable" beef, such as natural, organic, or grass fed. Yet, as that chapter will show, such environmentally friendly change is chasing a stampede of demand for cheap steaks and ground beef sold by industrial meatpackers. Understanding the reasons for this demand requires us to step back and look at the history of consuming farmed meat.

Farming Meat

Agricultural societies began to emerge 8,000 to 10,000 years ago, when nomadic hunter-gatherers began to settle in fixed locales. The resulting increase in consistent food supplies spurred a trend toward larger towns and, eventually, cities. Still, farming practices in traditional agricultural societies did not allow for quick weight gain in domesticated animals. Most farmers kept cattle, horses, or camels for transportation, for plowing and dunging their fields, and for producing milk, rather than for meat. Indeed, archaeological evidence and written records suggest that per capita meat consumption was generally low and stable in most traditional agricultural societies—rarely more than 5–10 kilograms (about 10–20 pounds) a year.[4]

Peasants in many of the subsistence societies of Europe, imperfect records suggest, rarely ate meat more than once a week, and large quantities only during celebratory feasts. Although nobles, wealthy landowners, marching armies, and city dwellers tended to eat more meat than peasants did, their numbers were comparatively small. Animals generally supplied less than 15 percent of all dietary protein in Europe, even into the eighteenth and nineteenth centuries. According to one study, meat accounted for less than 3 percent of the average annual food energy in early-nineteenth-century France. Another study calculated the per capita meat consumption of poor Welsh and English laborers in the late 1700s at just over 8 kilograms (18 pounds) a year. Still another put the annual average consumption of meat in Germany in 1820 at less than 20 kilograms (44 pounds). The per capita consumption of meat was even lower

in most other parts of the world, such as in China, India, and Japan, although colonial settlers in countries like Argentina, Australia, and New Zealand were beginning, even before industrialization, to consume much higher amounts of meat (especially beef and mutton) than those consumed in Europe.[5]

Eating habits changed significantly in western Europe and North America after the mid-1800s as agricultural output rose, cities expanded, and industrialization intensified. The average diet began to include more meat, fish, dairy foods, fruit, and sugar—and less staple cereals and legumes; rising imports of foods from colonies also provided more choices. The beef industry expanded particularly quickly. Beef producers in countries like the United States began to integrate small ranches into industrial meatpacking plants. In 1850, just 185 meatpacking plants were operating in the United States, producing $12 million worth of red meat; by 1919, there were over 1,300 plants, producing $4.2 billion worth.

Similar shifts in diets and meat processing began to occur across the globe over the next 100 years. After World War II, the pace of change accelerated with new crop varieties, new chemical sprays and fertilizers, ever larger mechanized farms, and more efficient processing techniques, and as these changes spread to the populous countries of the developing world, most notably those of East Asia.[6]

Rising Consumption of Meat

The number of farm animals has been climbing rapidly since the 1950s. There are now over 1 billion pigs, 1.3 billion cattle, 1.8 billion sheep and goats, and 17 billion chickens. Worldwide, annual meat production has jumped more than fivefold since 1950—to over 260 million metric tons. Annual per capita consumption of meat from 1950 to 2005 more than doubled: from 17 to 40 kilograms (38 to 88 pounds). Beef accounts for around 25 percent of this total, behind pork at 38 percent and poultry at 30 percent.[7]

China is by far the world's largest national consumer of meat, with annual consumption now over 68 million metric tons and rising, in large part because of steadily increasing per capita consumption, at just over 52 kilograms (115 pounds) a year in 2002. China consumes far more meat than other heavily populated countries like India and Indonesia. India consumed 5.5 million metric tons of meat in 2002, and Indonesia 1.8 million metric tons; this translates into an annual per capita

consumption for that year of 5 kilograms (11 pounds) in India and 8 kilograms (18 pounds) in Indonesia. China is increasingly relying on grains and soy meal to sustain its livestock (and promote rapid weight gains); by 2000 it was already using about one-quarter of its grain to feed livestock—twice as much as in 1980.

Although the United States is the world's second largest national meat consumer, with annual consumption now over 39 million metric tons, its per capita consumption—at 125 kilograms (275 pounds) a year in 2002—is far higher than China's.[8] Beef remains at the core of the American meat diet. The consumption of beef in the United States took off after 1870: the cattle shipped over by European colonists were thriving in the open plains of the American West and the market for beef was expanding as refrigerated railway cars allowed more beef to reach consumers in the growing cities of the East Coast.

Americans, on average, were eating 23 kilograms (about 50 pounds) of beef a year in 1910–15. This average would rise and fall over the twentieth century—from a low of just under 19 kilograms (about 40 pounds) in 1930–35 to a high of close to 39 kilograms (about 85 pounds) in 1970–75—with an overall annual average for the twentieth century of nearly 27 kilograms (about 60 pounds) per person. By the start of the twenty-first century, average annual consumption of beef had risen to around 29 kilograms (64 pounds) per person, an amount not dramatically higher than in 1909 (when the U.S. government first began to keep records) and one that has held fairly steady despite regular advertising campaigns to encourage more beef consumption.[9] The reason is simple: Americans began to eat far more poultry—from an annual total of less than 5 kilograms (about 10 pounds) per person in 1909 to nearly 27 kilograms (about 60 pounds) in 2004. Largely as a result, beef as share of total meat consumption in the United States has declined over the last 100 years, from around 45 percent in 1909 to less than 35 percent in 2004.[10]

Some cultures, such as those of India, have long traditions of vegetarian diets. Others, such as many in Asia, have long culinary histories of popular dishes with little or no meat. Various surveys of consumers in countries like the United States and United Kingdom have also shown rising interest in vegetarian choices. Still, the percentage of vegetarians remains low in wealthy Western countries—with surveys usually finding that between 4 and 10 percent of respondents identify themselves as "vegetarian" (in various senses and with various degrees of commitment).

Although more people across many cultures seem to be choosing a vegetarian diet, this is having little statistical impact on the worldwide consumption of meat as the human population rises and as increasing numbers of people eat more meat. Average meat consumption in developing countries, for example, was 10 kilograms (22 pounds) per person in 1964–66; by 1997–99, it was 26 kilograms (57 pounds). The Food and Agriculture Organization (FAO) expects it will rise to 37 kilograms (82 pounds) per person by 2030—despite continuing rapid rates of population growth.[11] The globalization of industrial meat production over the last century explains how the world has been able to supply so much meat to so many people. The beef industry is typical—with U.S. meatpackers, agricultural companies, and fast-food corporations playing leading roles.

The Beef Industry

Many consumers still imagine beef comes from a vast and rugged ranch—from Wild West Texas or the Aussie outback. Indeed, in much of the world, this is the case. But hundreds of millions of cattle also live at least part of the year in crowded and confined feedlots. Such factory farming methods now account, according to some estimates, for over 40 percent of global beef production.[12] The animals on many industrial farms live with little natural light or fresh air. To "produce" veal, for example, some farms separate calves from their mothers a few days after birth, lock them in stalls so small they cannot lie down or groom comfortably, then feed them a liquid diet from buckets to keep the "meat" tender and pale to meet consumer preferences. These calves are typically slaughtered after 16 weeks.

Few consumers have seen such stomach-turning practices, and fewer still have openly protested the treatment of cattle (unlike the many who have protested the hunting of whales or harp seals). The total number of cattle in these conditions has been rising steadily over the last 100 years. Some 500 million head of cattle roamed the earth at the start of the twentieth century. Now there are nearly three times as many.[13] But the near tripling in the total number of cattle does not accurately reflect an even bigger rise in the consumption of beef as producers bring heavier cattle to the market even faster than when the "Beef Trust," an oligopoly of wealthy Chicago meatpackers, controlled the U.S. beef industry at the start of the twentieth century.

The American Beef Industry

The power of the Beef Trust in the United States peaked in 1917, when the five biggest meatpacking firms accounted for over half of the market. Then, under pressure from "trustbusters" in the federal government, and following a Federal Trade Commission inquiry into collusion among firms to divide markets and fix prices, the largest meatpacking firms agreed to sign a consent decree in 1920 that forced them to sell off stockyards, retail stores, railways, and livestock journals.

The following year, Congress established the Packers and Stockyards Administration to combat price-fixing and collusion in the beef industry. Over the next half century, small ranchers received better prices for cattle through open bidding at auctions. The working conditions within many meatpacking plants were improving as unions won increases in wages and benefits and government regulators forced higher standards for safety and sanitation. These improvements were not to last, however. In the 1960s, the Iowa Beef Packers (IBP) began to recruit migrant workers from Mexico for plants in rural areas (away from union strongholds). As other meatpackers followed suit, wages across the whole industry fell markedly over the next two decades.

Regulation of the beef industry took a sharp turn during the administration of Ronald Reagan (1981–89). By 1980, the market control of the largest beef producers was far less than in the days of the Beef Trust. The Reagan administration, however, began to allow meatpacking firms to merge and gain control over local cattle markets.[14] Today, just four firms control more than 80 percent of the meatpacking: Tyson Foods (which acquired IBP in 2001), Excel (a subsidiary of Cargill), Swift and Company (formerly ConAgra Beef), and the National Beef Packing Company. This market control, as bestselling author Eric Schlosser writes, "is now at the highest level since record-keeping began in the early 20th century."[15]

Today, for many workers, meatpacking is again, as in the days of Jurgis Rudkus, a low-paying and dangerous job, even as U.S. consumers spend about $70 billion a year on beef. A typical plant, according to Schlosser, "now hires an entirely new workforce every year or so."[16] Many of these workers are illegal immigrants.

Because of different geographies, farming traditions, and regulatory systems, considerable differences exist in how ranchers and meatpackers treat cattle across and within countries. Some American farmers, for example, rely solely on grass to feed cattle. Most cattle, however, eat

grass for six months or so on a ranch, then, in the language of industrial farming, are "finished" during the fall and winter months in feedlots holding as many as 100,000 cattle, where they feed on grains, often mixed with antibiotics and protein supplements, to fatten them as quickly as possible.[17]

Corn is the most popular ingredient for cattle feed in the United States, with government subsidies ensuring cheap and plentiful supplies; 50–60 percent of the corn harvest in the United States is now fed to livestock. Grazing cattle, on average, gain no more than 0.5 kilogram (1 pound) a day, whereas cattle in feedlots tend to gain more than twice as much, over 1 kilogram (2 pounds) a day. Many cattle also receive growth hormones, which can increase weight gain by 20 percent. Over 90 percent of cattle raised in the United States by industrial methods now receive growth hormones through injections or implants (a practice banned by the European Community in 1988).[18]

Together, these practices in the United States result in a highly efficient weight-gain program for cattle. Steers at the beginning of the twentieth century would commonly live at least 4–5 years before slaughter. By the 1950s, ranchers were able to get a steer to slaughter weight within 2–3 years. Today, the new antibiotic feeds and hormones can enable a calf to gain over 500 kilograms (and reach a profitable slaughter weight) in as little as 14 months.[19]

Ranchers commonly truck these cattle to slaughterhouses able to process hundreds of carcasses every hour.[20] As in the days of Jurgis Rudkus, efficient slaughtering still relies on workers with razor-sharp knives along a disassembly line. But meatpacking firms have found additional efficiencies and savings, too. Today's machines can, for example, slice even more "legal meat" from carcasses. The merger of firms during the Reagan administration substantially reduced operating costs. Busting unions and relying on illegal labor have made operations cheaper still. Disassembly lines are now faster, too, with some able to handle close to 400 cattle per hour, almost twice the typical rate of 25 years ago. Giant slaughterhouses, such as those of Tyson, Excel, Swift, and National Beef, have been able to reduce costs by as much as 40 percent since the early 1980s, with the result that, according to the Department of Agriculture, wholesale beef prices have gone down almost every year since then.[21]

On the other hand, these advances in producing more affordable beef have not been without costs. The "advanced meat recovery systems" of the 1990s relied on hydraulic pressure to strip any remaining meat off the processed carcass bones. This extra meat was valuable filler for

hamburgers, hotdogs, and pizza toppings. But applying too much pressure—or removing the spinal cord improperly—laced meat with bone and nerve tissue: the USDA, for example, found spinal cord tissue in some of the meat in 1997. Consumer groups, such as the National Consumers League, called for a ban on such meat recovery systems, arguing that the meat recovered was, not proper beef, but beef-bone mush that was leaving consumers at greater risk of mad cow disease.

At the time, the beef industry saw little reason to panic. Used properly, recovery systems did not taint beef. Besides, unlike cattle in the United Kingdom, cattle in the United States did not suffer from mad cow disease. Still, under pressure from consumer groups, and worried about public reactions, some major buyers—notably General Mills and McDonald's—decided to no longer use advanced recovery beef. Several meatpacking firms—facing stricter regulations, rising costs of supervising advanced recovery machines, and purchasing policies of firms like McDonald's—decided to mothball these machines. By 2004, the number of processors using them had fallen from 35 to below 30.

For ranchers, the capacity to fatten and process cattle more quickly has not necessarily meant greater profits. The beef industry has always been a tough business. According to the publisher of the *Cattle Buyers Weekly*, relatively high labor costs and variable cattle prices mean that profit margins for meatpacking firms rarely exceed 2 percent.[22] Dependent on these firms, the latest generation of ranchers raising cattle during the spring and summer months for sale to feedlots are facing especially hard times. "Hell," a South Dakota rancher grumbled in a 2002 interview, "my dad made more money on 250 head than we do on 850."[23] Slim profit margins, however, do not mean meatpacking firms are not prospering. Just the opposite: over the last half century, the globalization of industrial beef production has played a central role in the growing profits of the fast-food industry, whose continued expansion is generating even more demand for cheap beef.

Overconsuming More, Faster

The growth of the fast-food industry over the last 50 years has altered patterns of meat consumption across many cultures. With restaurants in over 120 countries and territories and with record-high revenues in 2007 of nearly $23 billion, the world's largest fast-food chain, McDonald's, serves over 50 million customers a day and is now the largest buyer of beef in countries like the United States. Many other fast-food chains

featuring hamburgers, such as Burger King, Wendy's, A&W, and Hardees, are serving many millions more customers. Still other fast-food outlets offer different choices—fresh submarine sandwiches, thick-crust pizza, fried chicken, and spicy tacos, for example. Indeed, the world's largest submarine sandwich chain, Subway, now operates over 26,000 restaurants in over 80 countries—with, it brags, more outlets in the United States, Canada, and Australia than McDonald's. The world's largest chain of pizza restaurants, Pizza Hut, operates in over 100 countries and territories. The world's biggest chain of fried chicken restaurants, Kentucky Fried Chicken, serves 8 million customers a day from more than 11,000 restaurants in more than 80 countries and territories. These last two chains are part of the world's largest restaurant "system," YUM! Brands—a parent company that also owns Taco Bell, A&W, and Long John Silver's, giving it control of more than 35,000 restaurants.[24]

Supersizing meals is a common strategy among these fast-food chains to entice and keep customers. Take Burger King's Stacker: four slabs of beef, four strips of bacon, and four slices of cheese, for a total of some 1,000 calories. The sales pitch to consumers is hardly subtle: in one Burger King commercial in 2006, a manager yells, "More meat!" at workers making a burger. Nor is the Stacker even the biggest hamburger. Hardee's Thickburger, for example, weighs in at over 1,400 calories—about 70 percent of a typical person's recommended daily calorie intake. Advertising fast food as a deal, as getting "more" for "less," is true even for restaurant chains like Subway, which proudly claims that its subs are so healthy and so fat free that eating them every day is an easy way to diet—a sales pitch the company runs alongside its latest advertising jingle: "Double the meat, double the cheese!"

Other fast-food chains, seeing the growth of ones like Subway, have begun to offer "healthier" choices as well, such as salads, fruit bowls, veggie burgers, and bottled water. The big profits, however, remain with the Big Macs, the Whoppers, the Stackers, and the Thickburgers. Some chains have even lost money on the healthy items. Wendy's fresh fruit bowl, for example, failed to sell well even after a $20 million advertising blitz in 2005. "We listened to consumers who said they want to eat fresh fruit," explained a spokesman for the fast-food chain, "but apparently they lied."[25]

Given such trends, the current global crisis of rising obesity is hardly surprising. The United States has some of the world's highest rates of obesity: two-thirds of adults are now overweight (Body Mass Index of 25 or more) or obese (BMI of 30 or more). Children are overweight, too:

currently about one in six children from 6 to 19 years of age. The U.S. Surgeon General now estimates the total medical cost of illnesses related to obesity at well over $100 billion a year. This is a sharp rise from just two decades ago, when fewer than half of adults were overweight.

Rates of obesity are rising in the rest of the world as well, even in the developing world, where changing lifestyles and diets increasingly high in sugar and fat are causing even the undernourished to gain weight. Over one-and-a-half billion adults are now overweight, with at least 400 million of them obese. Even children under the age of five—some 20 million worldwide—are now overweight.[26]

In this era of Burger King Stackers and Meat Lovers Pizzas, the global consumption of meat is expected to rise even more over the next few decades. On average, people are already consuming around 175 pounds (about 80 kilograms) of meat a year in the developed world. Still, wealthy consumers are capable of eating far more, as annual per capita meat consumption in the United States shows (about 100 pounds higher). Yet the biggest potential for growth is in the developing world. Although, on average, people there are consuming far less meat, per capita consumption has been steadily climbing since the 1970s, and although it will remain well below the First World, all trends suggest the Third World will continue to close the gap over the next decade or so (reaching about 80 pounds per person by 2020).[27] The beef industry will supply much of the future worldwide demand for meat—a trend, as we'll see in chapter 16, that will further intensify and extend the ecological impacts of consuming beef.

16

The Ecology of Big Beef

Producing so much beef involves many ecological costs. Farmers are tilling land with pesticides and fertilizers to grow enough grain to fatten cattle quickly. Waste from feedlots is polluting local waterways and air. Growth hormones are tainting food chains, and antibiotics are flowing through ecosystems. The nutritional value of beef is inconsistent and declining in some places. Ranches and feed crops like soybeans are deforesting biodiversity hotspots like the Amazon. And grazing, fattening, and slaughtering billions of cattle every few years is depleting water supplies and emitting vast quantities of greenhouse gases like methane, nitrous oxide, and carbon dioxide.

These impacts are intensifying as the globalization of beef markets creates opportunities to expand commercial ranching even further. Plantations for animal feed crops like corn and soybeans are spreading in response. This in turn is contributing to a surplus of cheap vegetable oils, with incentives for firms to get people to consume more, whether as salad or cooking oil, in margarine and processed food, or in bakery shortening. What the health consequences will be is an ongoing experiment.

Much of this growth in industrial ranching and agriculture is occurring in developing countries; the beef and feed grains produced there are then exported primarily to developed or transitional economies. Many of these operations are supported by government subsidies, foreign aid, and by multinational companies, whose "support" is increasing the foreign debt of these developing countries and profiting the multinationals disproportionately. Prices that do not account adequately for the social and environmental costs—most notably, the impacts on water, land, and climate—are also stimulating overconsumption as cheap beef becomes more common in more cultures. This globalization of industrial beef production, this chapter argues, is intensifying the shadow effects of

consuming beef, with the costs increasingly deflected into developing countries, the global commons, and people's future health.

Planting Grain-Fed Beef

The increasing global capacity to produce grain during the twentieth century was essential for feeding a rising human population. It also began to alter animal feeding practices. Worldwide, about one-tenth of grains went to feeding farm animals in 1900—mostly for animals working in the fields. This share had risen to one-fifth by 1950. The switch to feeding beef cattle on grain in the First World was spurred along as chemical fertilizers increased grain yields. By the 1960s, developing countries were also beginning to produce grain surpluses, as new seeds, fertilizers, and pesticides of the green revolution allowed crops to grow faster and in harsher conditions. Foreign aid, technical advice from organizations like the Food and Agriculture Organization, and low-interest loans from organizations like the World Bank—along with the investments of companies like Ralston Purina and Cargill—encouraged many developing countries to focus on growing grain for animal feed and even to switch to coarse grains more suitable for livestock.

As a result, the share of grain fed to livestock in the developing world tripled in the second half of the twentieth century (exceeding 21 percent by the end of the century). Over this time, many developing countries also began to export grains to animal-feed markets in developed countries. Countries like Ethiopia, for example, began to produce grain meals to feed livestock in Europe rather than growing food for their own people (with sometimes grave consequences, such as during the 1984 famine in Ethiopia).

These changes occurred even though many industrially produced grains are not natural foods for farm animals. Feeding corn to cattle, for example, can cause bloating, digestive disorders, sometimes even death. Compared to grass feed, corn feed also tends to produce beef higher in fat and lower in omega-3 fatty acids (which have been found to prevent heart disease and to strengthen the immune system). Still, over the last half century, farmers in many countries have been turning increasingly to grains—especially corn—as a cheap and effective way to fatten animals quickly.

Worldwide, over one-third of grain production now goes to feed livestock, with countries like the United States devoting over 60 percent to that purpose, and countries like India less than 5 percent.[1] Feeding beef

cattle so much grain is an efficient means of fattening, but it's an inefficient use of environmental resources. On an industrial ranch, it generally takes 11–17 calories of feed to produce a calorie of beef. Typically, this means it takes one-third more fossil-fuel energy to produce a calorie of beef than, say, a calorie of potatoes. It requires far more water as well. Producing a kilogram (2.2 pounds) of beef can require as much as 125,000 liters (33,000 gallons) of water. And even the more average case of 10,000 liters (2,650 gallons) of water to produce a kilogram of beef is far higher than, say, the water it takes to grow a kilogram of rice or wheat.[2]

Grains are not, moreover, the only agricultural crops used to feed domesticated animals. Farmers over the last half century also began to mix increasing amounts of soybean protein meal with grain, primarily because this can nearly double the efficiency of grain to convert into animal protein. A glance at the global soybean industry over the last 50 years reveals how changing agricultural practices are impacting the nutritional characteristics of global food supplies.

Stuffing Meat with Soy

Global production of soybeans was 16 million metric tons in 1950. Since then, the industry has steadily built new markets: by 2005, production had risen to 220 million metric tons—nearly 14 times higher.[3] Surpluses of soybeans in the United States over the last half century partly explain these expanding markets: the United States, for example, exported surplus soybeans into Europe under the Marshall Plan after World War II. American government subsidies for soybean farming have caused some of these surpluses. Even today, these subsidies remain substantial, with the soybean sector receiving $13 billion between 1998 and 2004.[4]

The phenomenal growth of the soybean industry was made possible in the 1940s, after scientists discovered how to deactivate the enzyme inhibitor in soybean meal so that animals could tolerate it as feed. Soybean meal constitutes nearly 80 percent of the crushed beans after the oil is extracted. Today, it's by far the world's largest source of protein feed for chickens, cattle, pigs, and fish—accounting for 65 percent of global supplies. Around 98 percent of soybean meal goes into livestock feeds in countries like the United States.

Indeed, the United States produces and exports more soybeans than any other country does—around 35 percent of the world's total supply,

worth some $19 billion per year in recent years; soybeans are second only to corn among U.S. crops (farmers commonly rotate soybean and corn crops). Three American companies—Archer Daniels Midland (ADM), Bunge, and Cargill—dominate the soybean market in the United States. These firms have managed to increase the share of soybean meal in livestock and poultry feed in the United States from less than 10 percent in 1964 to almost 20 percent today.[5]

The influence of these companies, however, extends far beyond the United States. They control nearly 80 percent of Europe's soybean-crushing industry and nearly 80 percent of its animal feed manufacturing. In producing soybean meal for animal feed, the soybean-crushing industry produces oil for industrial processes and human consumption. The production of soybean oil rose rapidly alongside soybean meal from 1965 to 2005, especially after the industry was able to improve the oil's smell and taste—increasing almost sevenfold, from 5 to 34 million metric tons.[6]

Soybeans are currently the world's largest source of vegetable oil.[7] Soy in some form is now found in a wide range of foods, including breakfast cereals, breads, noodles, soups, cheeses, mayonnaises, and sausage casings. Over 60 percent of processed food now contains soy in countries like Britain. The fast-food industry uses hydrogenated soybean oil for deep-frying, too. Soybeans now account for about 90 percent of oilseed production in the United States—with canola, cottonseed, rapeseed, peanuts, and sunflower seed trailing far behind. Indeed, soybean oil, used mainly as cooking and salad oil, in margarine, and in bakery shortening, now accounts for about two-thirds of total U.S. consumption of vegetable oils and animal fats. Few consumers seem to worry about this trend; many see soy as a healthy choice. As tofu, in veggie burgers, and in soy milk, it is the basis of many vegetarian diets. And, in countries like the United States, it constitutes nearly one-fifth of infant formula.[8]

But is soy really healthy? The American soy industry wants consumers to think so: it spends almost $80 million every year to research ways to promote more consumption—research the industry finances from a mandatory levy on producers. A glance at Japan, where soy plays a central culinary role—and where life expectancy, at over 80 years, is one of the world's highest—would seem to suggest that soy is indeed a healthy source of protein.

But, because soy contains toxins and plant estrogens, some researchers are now wondering whether, as with so many foods, too much soy might prove unsafe. Some experiments have linked high soy consumption to

thyroid damage and disruptions in menstrual cycles. In 2002, a British expert committee reported on the risks of high soy consumption for some age groups. Still, the soy industry continues to expand; new soybean plantations now reach deep into the rainforests of Brazil. Driving this expansion, the American firms ADM, Bunge, and Cargill now account for some 60 percent of Brazilian soybean exports.[9]

The increase in soy output, then, is changing patterns of global nutrition, directly by flowing into processed, fast, and even health foods, and indirectly by helping farmers to produce more kilograms of beef more cheaply and quickly—and causing them to alter the nature of that beef. Fattening cattle with grain and soybean meal, moreover, requires regular doses of antibiotics to keep the bloated and confined herds "healthy" and fast growing.

Feeding Antibiotics

The feed for the beef industry is flooding ecosystems with antimicrobial drugs, including antibiotics. In the United States, for example, cows, chickens, and pigs receive 50–70 percent of all antimicrobial drugs. Farmers have been adding antimicrobial drugs to livestock feed and water since the 1950s, both to allow animals to gain weight faster on less feed and to prevent illnesses and diseases from spreading, especially in farms with large and homogeneous herds living in tight quarters with poor ventilation. Antibiotics allow ranchers, in the words of one staff veterinarian in Kansas, to "feed" cattle "hard" on corn, soybean meal, and other protein supplements while avoiding a high "death loss" in animals whose delicate digestive systems were designed to convert grass into protein.[10]

Worldwide, half of all antibiotics (by weight) go to livestock and fish in an effort to prevent disease. The use of antibiotics like penicillin, tetracycline, and erythromycin has been rising over time: in the case of beef cattle in the United States, for example, farmers now use at least 28 percent more antimicrobial drugs than in the 1980s. Many of these seem to flow into animal waste undigested—one study found between 25 and 75 percent did—along with bacteria resistant to antibiotics, which can then pose a threat to the health of humans. Some researchers, such as David Wallinga at the Institute for Agriculture and Trade Policy, see antibiotics as a growing danger. "We're sacrificing a future where antibiotics will work for treating sick people," he says, "by squandering them today for animals that are not sick at all."[11]

Heavy doses of antimicrobial drugs don't necessarily make feed safe for cows—or people. For example, bovine spongiform encephalopathy (mad cow disease) is transmitted when bone and other waste tissue from infected carcasses is mixed into cattle feed. Mad cow and other diseases impervious to antimicrobials can spread quickly through vast herds of similar breeds living close to one another—with beef exports and imports multiplying the potential for rapid spread across the globe. Injecting cattle with hormones to stimulate rapid growth also poses health risks to consumers, directly from the beef consumed and indirectly from contamination when farm waste seeps into surrounding water and soil and then into food chains.

Industrial ranching has other consequences for the global environment. The artificial feed leaves the cattle bloated and, without antimicrobial drugs, often sick. Belching and flatulent livestock now account for one-quarter to one-third of worldwide methane emissions from human-related activities. Meanwhile, decomposing manure emits nitrous oxide, which, like methane, is a primary greenhouse gas driving climate change.[12] Most of the energy to raise cattle (growing grain for feed), to process the carcasses (running the slaughterhouses), and to distribute beef (trucking and refrigerating) is generated by burning fossil fuels, which adds still more to global emissions of carbon dioxide. Livestock and livestock waste as a whole contribute to somewhere between 5 and 10 percent of global greenhouse gas emissions. Fattening cattle in feedlots in particular tends to produce large amounts of carbon dioxide—by one analysis, more than twice as much as grazing them on open range- or pastureland. Burning down forests to create pastures in places like the Amazon is also an increasingly large source of carbon dioxide emissions—and an increasingly serious threat to biodiversity.[13]

Ranching the Amazon

The Brazilian Amazon, comprising nine states and covering 500 million hectares (1,930,000 square miles; over 50 percent of Brazil's total land area), holds some of the world's highest concentrations of biodiversity.[14] The Amazon region lost over 17 million hectares (65,500 square miles) of forest in the 1990s alone—an area about the size of Uruguay. By 2000, the total deforested area in the Amazon was nearly 59 million hectares (227,500 square miles).

As more ranchers have cleared more land to graze cattle for a surging beef export market, the average annual deforestation rate has climbed.

Before 1990, ranchers in the Amazon sold most of their beef within this region. The market for Amazon beef became more national in the 1990s: with rising urban incomes, beef consumption in Brazil quadrupled overall (and more than doubled per capita) from 1972 to 1997. Then, in the late 1990s, when low land prices, a devaluation of Brazil's currency, and better control of foot-and-mouth disease made it more profitable, production of beef for export took off. Beef exports grew fivefold from 1997 to 2003—with European Union countries importing close to 40 percent of Brazil's fresh and frozen beef in 1999–2002, followed by Chile and then Egypt.[15]

In 2003, Brazil produced $1.5 billion worth of beef for export—over 3 times more than in 1995. Brazil's beef exports by carcass weight equivalence (which excludes the head, hide, and intestines) grew at an even faster rate—from 232,000 metric tons in 1997 to nearly 1.2 million metric tons in 2003—leaving Brazil ahead of Australia as the world's largest beef exporter by volume. Four-fifths of this growth came from the Amazon. During the 1990s, the number of cattle in Brazil nearly doubled. From 1990 to 2002, the Amazon's share of the country's total herd grew from about 18 percent to almost one-third—or 57 million head. The Amazon region was now losing 2.5 million hectares (9,500 square miles) of rainforest a year—almost half again the average rate of loss during the 1990s: 1.7 million hectares (6,500 square miles). The director-general of the Center for International Forestry Research, David Kaimowitz, seeing this statistical picture, concluded: "Brazil's deforestation rates are skyrocketing and beef production for export is to blame."[16]

Cattle ranching is directly responsible for over half of the deforestation in the Amazon region. But logging, clearing land for crops like soybeans, and small-scale subsistence farming remain core causes of deforestation as well. Logging in the tropics is commonly "selective," with loggers harvesting only the most valuable timber (old-growth trees). Although such harvesting rarely involves clear-cutting, it begins the process of deforestation by degrading forest integrity and biodiversity. Opening the canopy can dry forests out and, along with "kindling" littering the forest floor, leave logged forests more vulnerable to both natural and intentional fires (burning is a cheap and easy way to clear logged forests and in the process fertilize the soil). Logging roads can also provide ranchers, slash-and-burn farmers, and plantation companies with easier access to once remote land. Still, in the Amazon, where the total pastureland is almost 6 times larger than total cropland, cattle ranching is responsible for about 10 times more damage than logging.[17]

Despite continued cases of foot-and-mouth disease across the country (including in the Amazon region), beef exports remain strong. Brazil appears set to hold its ranking as the world's largest exporter of beef: it reached 40 new markets in 2004, selling $2.5 billion worth of beef to a total of 143 countries—$1 billion more than in 2003. Since then, beef exports have been regularly setting monthly records, both in revenues and in volumes, and are now worth about $3 billion a year.

A notable example of the capacity of Brazilian beef exporters to expand into new markets is Russia, which did not import much Brazilian beef before 2000. By 2005—just five years later—this market was worth over $500 million, accounting for over one-quarter of total Brazilian fresh and frozen beef exports.[18] Although beef exports earn valuable foreign exchange for Brazil's developing economy, their continuing growth is accelerating deforestation of the Brazilian Amazon. The total area of rainforest lost climbed in 2004 to more than 2.6 million hectares (10,000 square miles), before falling back in 2005 to just under 1.9 million hectares (7,300 square miles)—more in line with the rate of loss from 1999 to 2001—after commodity prices declined and news of an outbreak of foot-and-mouth disease spread.[19] Still, even with this slowdown, the deforestation rate in the Brazilian Amazon remains one of the world's highest.

The global cattle industry, then, is causing extensive ecological damage. Industrial fields of grain are covering an increasing share of the planet to feed these cattle. Antibiotics and hormones are seeping into local environments and through food chains. Manure is polluting local waterways, and methane from the herds of bloated cattle in feedlots is polluting the upper atmosphere. Ranchers are also carving tropical rainforests into vast "grasslands" and drawing down the world's oil reserves—a core cause of climate change—to subsidize the "efficiencies" of "producing" ever more beef ever faster. This is not to diminish efforts to mitigate these ecological impacts. But, as chapter 17 will show, these efforts are trailing far behind the stampeding consumption of industrial beef.