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Part II

Diet for a Small Planet
One Less Hamburger?

I 
REMEMBER RIDICULING Hubert Humphrey's comment that if we all just ate one less hamburger a week, the hunger crisis would be conquered. Yet even while I scoffed at that notion in 1974, my own writing was often taken to be saying the same thing. In the 1975 edition I asked my readers to pretend they were seated in a restaurant, eating an eight-ounce steak—and to appreciate that the grain used to produce the steak could have filled the empty bowls of 40 people in the room.

The first two editions implied that our grain-fed-meat diet denied grain to the hungry abroad who lacked the resources to feed themselves. But as I did research for Food First, my view began to shift. I came to learn that virtually every country has the capacity to grow enough food for its people. No country is a hopeless basket case. Moreover, only a minuscule fraction of our food exports ever reach the hungry.

Much of our research for Food First focused on the food-producing potential of some of the world's most densely populated countries, such as Bangladesh, and some of the most agriculturally resource-poor countries, such as the nations south of the Sahara Desert, known as the Sahel.

In Bangladesh, we learned, enough food is already pro-
duced to prevent malnutrition; if it had been fairly distributed, grain alone would have provided over 2,200 calories per person per day in 1979. And the stunning agriculture potential of Bangladesh, where rice yields are only half as large as in China, has hardly been tapped. I was struck by the conclusion of a 1976 report to Congress: “The country is rich enough in fertile land, water, manpower and natural gas for fertilizer, not only to be self-sufficient in food but a food exporter, even with its rapidly increasing population size.”

We focused on the Sahel because severe famine threatened the region in the years just before we began Food First. We saw so many TV images of hungry people dying on desolate, parched earth that we were certain that if ever there were a case of nature-caused famine, this had to be it.

But to our dismay, we learned that with the possible exception of Mauritania (a country rich in minerals), every country in the Sahel actually produced enough grain to feed its total population even during the worst years of the drought of the early 1970s. Moreover, in a number of the Sahelian countries production of export crops such as cotton, peanuts, and vegetables actually increased.

In researching what became Diet for a Small Planet, I was struck by the tremendous abundance in the U.S. food system, and I assumed that many other countries would be forever dependent on our grain exports because they did not have the soil and climate suitable for basic food production. But I learned that while the United States is blessed with exceptional agricultural resources, third world countries are not doomed to be perpetually dependent on U.S. exports.

I learned that what so many Americans are made to see as inevitable third world dependence on grain imports is the result of five forces:

1. A small minority controls more and more of the farm-land. In most third world countries, roughly 80 percent of the agricultural land is, on average, controlled by a tiny 3 percent of those who own land. This minority underuses and misuses the land.

2. Agricultural development of basic foods is neglected,
One Less Hamburger?

while production for export climbs. Elites now in control in most third world countries prefer urban industrialization to basic rural development that could benefit the majority. Of 71 underdeveloped countries studied in the mid-1970s, three-quarters allocated less than 10 percent of their central government expenditures to agriculture. Moreover, as the majority of people are increasingly impoverished, the domestic market for basic food shrinks. So food production is oriented toward the more lucrative foreign markets and the tastes of the small urban class. The meager investment in agriculture which does take place is primarily private investment in export crops. In Asia, for example, “the new export-oriented luxury food agribusiness is undoubtedly the fastest growing agriculture sector,” the prestigious Far Eastern Economic Review notes. “Fruit, vegetables, seafood and poultry [from southeastern Asian countries] are filling European, American and, above all, Japanese supermarket shelves.”

3. More and more basic grains go to livestock. As the gap between rich and poor widens, basic grains are fed increasingly to livestock in the third world, even in the face of deepening hunger for the majority there. Not only is more and more grain fed to animals, but much land that could be growing basic food is used to graze livestock, often for export. Two-thirds of the agriculturally productive land in Central America is devoted to livestock production, yet the poor majority cannot afford the meat, which is eaten by the well-to-do or exported.

4. Poverty pushes up population growth rates. The poverty and powerlessness of the poor produces large families. The poor must have many children to compensate for their high infant death rate, to provide laborers to supplement meager family income, and to provide the only old age security the poor have. High birthrates also reflect the social powerlessness of women, exacerbated by poverty.

5. Conscious “market development” strategies of the U. S. government help to make other economies dependent on our grain. (See “The Meat Mystique,” Part II, Chapter 3, to learn how market development works.)

These forces that generate needless hunger are hidden from most Americans, so when they hear that the poorest
underdeveloped countries are importing twice as much grain as they did ten years ago, Americans inevitably conclude that scarcity of resources is their basic problem. Americans then urge more food exports, including food aid.

In writing *Food First*, however, we learned that two-thirds of U.S. agricultural exports go to the industrial countries, not the third world, and that most of what does go to the third world is fed to livestock, not to the hungry people. In writing *Aid as Obstacle: Twenty Questions about Our Foreign Aid and the Hungry*, we learned that chronic food aid to elite-based, repressive governments not only fails to reach the hungry in most cases, it actually hurts them. Food aid, we found, is largely a disguised form of economic assistance, concentrated on a handful of governments that U.S. policymakers view as allies. Because food aid is often sold to the people by recipient governments, it serves as general budgetary support, reinforcing the power of these elite-based governments. In 1980, ten countries received three-quarters of all our food aid.\(^{10}\) Among them were Egypt, India, Bangladesh, Indonesia, Pakistan, and South Korea. Notorious for their neglect of the poor, such governments block genuine agrarian reform that could unchain their country’s productive potential. Indonesia, for example, squanders its spectacular oil wealth—\$10 billion in 1980—on luxury imports, militarism, and showy capital-intensive industrial projects which don’t even provide many jobs.

What I have just said does not diminish our responsibility to send food to relieve famine, as was needed in Kampuchea in 1980 and Africa in 1981. (Note that disaster and famine relief are only 11 percent of our government’s food aid program.) But even in the face of famine, as in Kampuchea or Somalia, we learned, the U.S. government often operates more out of political than humanitarian considerations—to the detriment of the hungry. Famine relief funds channeled through private voluntary agencies often have a better chance of helping.

In writing *Food First* and the books that followed, I had to learn some painful lessons. In the back of my mind I
was always asking, what does all of this mean for the message of *Diet for a Small Planet*?

If our food is not getting to the hungry, if our food exports actually prop up some of the world’s most repressive governments, then why exhort Americans to feed less grain to livestock? Why not pour even more of our grain into livestock, so that at least it does not block needed change abroad?

At the same time I was asking myself these questions, I was studying the agricultural system in the United States. In the process, *Diet for a Small Planet* took on new and deeper meaning. The first edition of this book explained how our production system takes abundant grain, which hungry people can’t afford, and shrinks it into meat, which better-off people will pay for. But I didn’t fully appreciate that our production system not only reduces abundance but actually mines the very resources on which our future food security rests.
A few months ago a Brazilian friend, Mauro, passed through town. As he sat down to eat at a friend’s house, his friend lifted a sizzling piece of prime beef off the stove. “You’re eating that today,” Mauro remarked, “but you won’t be in ten years. Would you drive a Cadillac? Ten years from now you’ll realize that eating that chunk of meat is as crazy as driving a Cadillac.”

Mauro is right: a grain-fed-meat-centered diet is like driving a Cadillac. Yet many Americans who have reluctantly given up their gas-guzzling cars would never think of questioning the resource costs of their grain-fed-meat diet. So let me try to give you some sense of the enormity of the resources flowing into livestock production in the United States. The consequences of a grain-fed-meat diet may be as severe as those of a nation of Cadillac drivers.

A detailed 1978 study sponsored by the Departments of Interior and Commerce produced startling figures showing that the value of raw materials consumed to produce food from livestock is greater than the value of all oil, gas, and coal consumed in this country.¹ Expressed another way, one-third of the value of all raw materials consumed for all purposes in the United States is consumed in livestock foods.²

How can this be?
Excluding exports, about one-half of our harvested acreage goes to feed livestock. Over the last forty years the amount of grain, soybeans, and special feeds going to American livestock has doubled. Now approaching 200 million tons, it is equal in volume to all the grain that is now imported throughout the world. Today our livestock consume ten times the grain that we Americans eat directly and they outweigh the human population of our country four to one.

These staggering estimates reflect the revolution that has taken place in meat and poultry production and consumption since about 1950.

First, beef. Because cattle are ruminants, they don’t need to consume protein sources like grain or soybeans to produce protein for us. Ruminants have the simplest nutritional requirements of any animal because of a unique fermentation “vat” in front of their true stomach. This vat, the rumen, is a protein factory. With the help of billions of bacteria and protozoa, the rumen produces microbial protein, which then passes on to the true stomach, where it is treated just like any other protein. Not only does the rumen enable the ruminant to thrive without dietary protein, B vitamins, or essential fatty acids, it also enables the animal to digest large quantities of fibrous foodstuffs inedible by humans.

The ruminant can recycle a wide variety of waste products into high-protein foods. Successful animal feeds have come from orange juice squeeze remainders in Florida, cocoa residue in Ghana, coffee processing residue in Britain, and bananas (too ripe to export) in the Caribbean. Ruminants will thrive on single-celled protein, such as bacteria or yeast produced in special factories, and they can utilize some of the cellulose in waste products such as wood pulp, newsprint, and bark. In Marin County, near my home in San Francisco, ranchers are feeding apple pulp and cottonseed to their cattle. Such is the “hidden talent” of livestock.
Because of this "hidden talent," cattle have been prized for millennia as a means of transforming grazing land unsuited for cropping into a source of highly usable protein, meat. But in the last 40 years we in the United States have turned that equation on its head. Instead of just protein factories, we have turned cattle into protein disposal systems, too.

Yes, our cattle still graze. In fact, from one-third to one-half of the continental land mass is used for grazing. But since the 1940s we have developed a system of feeding grain to cattle that is unique in human history. Instead of going from pasture to slaughter, most cattle in the United States now first pass through feedlots where they are each fed over 2,500 pounds of grain and soybean products (about 22 pounds a day) plus hormones and antibiotics.

Before 1950 relatively few cattle were fed grain before slaughter, but by the early 1970s about three-quarters were grain-fed. During this time, the number of cattle more than doubled. And we now feed one-third more grain to produce each pound of beef than we did in the early 1960s. With grain cheap, more animals have been fed to heavier weights, at which it takes increasingly more grain to put on each additional pound.

In addition to cattle, poultry have also become a big consumer of our harvested crops. Poultry can't eat grass. Unlike cows, they need a source of protein. But it doesn't have to be grain. Although prepared feed played an important role in the past, chickens also scratched the barnyard for seeds, worms, and bits of organic matter. They also got scraps from the kitchen. But after 1950, when poultry moved from the barnyard into huge factorylike compounds, production leaped more than threefold, and the volume of grain fed to poultry climbed almost as much.

Hogs, too, are big grain consumers in the United States, taking almost a third of the total fed to livestock. Many countries, however, raise hogs exclusively on waste products and on plants which humans don't eat. When Nobel Prize winner Norman Borlaug heard that China had 250 million pigs, about four times the number here, he could hardly believe it. What could they possibly eat? He went to China and saw "pretty scrawny pigs." Their growth was
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slow, but by the time they reached maturity they were decent-looking hogs, he admitted in awe. And all on cotton leaves, corn stalks, rice husks, water hyacinths, and peanut shells. In the United States hogs are now fed about as much grain as is fed to cattle.

All told, each grain-consuming animal “unit” (as the Department of Agriculture calls our livestock) eats almost two and a half tons of grain, soy, and other feeds each year.

WHAT DO WE GET BACK?

For every 16 pounds of grain and soy fed to beef cattle in the United States we only get 1 pound back in meat on our plates. The other 15 pounds are inaccessible to us, either used by the animal to produce energy or to make some part of its own body that we do not eat (like hair or bones) or excreted.

To give you some basis for comparison, 16 pounds of grain has twenty-one times more calories and eight times more protein—but only three times more fat—than a pound of hamburger.

Livestock other than cattle are markedly more efficient in converting grain to meat, as you can see in Figure 1; hogs consume 6, turkeys 4, and chickens 3 pounds of grain and soy to produce 1 pound of meat. Milk production is even more efficient, with less than 1 pound of grain fed for every pint of milk produced. (This is partly because we don’t have to grow a new cow every time we milk one.)

Now let us put these two factors together: the large quantities of humanly edible plants fed to animals and their inefficient conversion into meat for us to eat. Some very startling statistics result. If we exclude dairy cows, the average ratio of all U.S. livestock is 7 pounds of grain and soy fed to produce 1 pound of edible food. Thus, of the 145 million tons of grain and soy fed to our beef cattle, poultry, and hogs in 1979, only 21 million tons were returned to us in meat, poultry, and eggs. The rest, about 124 million tons of grain and soybeans, became inaccessible to human consumption. (We also feed considerable quantities
Pounds of Grain and Soy* Fed to Get One Pound of Meat, Poultry, or Eggs

Figure 1. A Protein Factory in Reverse

Source: USDA, Economic Research Service, Beltsville, Maryland.
*Soy constitutes only 12% of steer feed and 20–25% of poultry.
of wheat germ, milk products, and fishmeal to livestock, but here I am including only grain and soybeans.) To put this enormous quantity in some perspective, consider that 120 million tons is worth over $20 billion. If cooked, it is the equivalent of 1 cup of grain for every single human being on earth every day for a year.¹⁶

Not surprisingly, *Diet for a Small Planet*’s description of the systemic waste in our nation’s meat production put the livestock industry on the defensive. They even set a team of cooks to work to prove the recipes unpalatable! (Actually, they had to admit that they tasted pretty good.)

Some countered by arguing that you get *more* protein out of cattle than the humanly edible protein you put in! Most of these calculations use one simple technique to make cattle appear incredibly efficient: on the “in” side of the equation they included only the grain and soy fed, but on the “out” side they include the meat put on by the grain feeding *plus* all the meat the animal put on during the grazing period. Giving grain feeding credit for all of the meat in the animal is misleading, to say the least, since it accounts for only about 40 percent. In my equation I have included only the meat put on the animal as a result of the grain and soy feeding. Obviously all the other meat, put on by forage, would have been there for us anyway—just as it was before the feedlot system was developed. (My calculations are in note 13 for this chapter, so you can see exactly how I arrived at my estimate.)

**The Feedlot Logic: More Grain, Lower Cost**

On the surface it would seem that beef produced by feeding grain to livestock would be more expensive than beef produced solely on the range. For, after all, isn’t grain more expensive than grass? To us it might be, but not to the cattle producer. As long as the cost of grain is cheap in relation to the price of meat, the lowest production costs per pound are achieved by putting the animal in the feedlot as soon as possible after weaning and feeding it as long as it continues to gain significant weight.¹⁷ This is true in
large part because an animal gains weight three times faster in the feedlot on a grain and high-protein feed diet than on the range.

As a byproduct, our beef has gotten fattier, since the more grain fed, the more fat on the animal. American consumers have been told that our beef became fattier because we demanded it. Says the U.S. Department of Agriculture: "most cattle are fed today because U.S. feed consumers have a preference for [grain]fed beef." But the evidence is that our beef became fattier in spite of consumer preference, not because of it. A 1957 report in the Journal of Animal Science noted that the public prefers "good" grade (less fatty) beef and would buy more of it if it were available. And studies at Iowa State University indicate that the fat content of meat is not the key element in its taste anyway. Nevertheless, more and more marbled "choice" meat was produced, and "good" lean meat became increasingly scarce as cattle were fed more grain. In 1957 less than half of marketed beef was graded "choice"; ten years later "choice" accounted for two-thirds of it.

Many have misunderstood the economic logic of cattle feeding. Knowing that grain puts on fat and that our grading system rewards fatty meat with tantalizing names like "choice" and "prime," people target the grading system as the reason so much grain goes to livestock. They assume that if we could just overhaul the grading system, grain going to livestock would drop significantly and our beef would be less fatty. (The grading system was altered in 1976, but it still rewards fattier meat with higher prices and more appealing-sounding labels.)

But what would happen if the grading system stopped rewarding fatty meat entirely? Would less fatty meat be produced? Would less grain be fed? Probably only marginally less. As long as grain is cheap in relation to the price of meat, it would still make economic sense for the producer to put the animal in the feedlot and feed it lots of grain. The irony is that, given our economic imperatives that produce cheap grain, most of the fat is an inevitable consequence of producing the cheapest possible meat. We got fatty meat not because we demanded fatty meat but because fatty meat was the cheapest to produce. If we had
demanded the same amount of leaner meat, meat prices would have been higher over the last 30 years.22

The Livestock Explosion and the Illusion of Cheap Grain

If we are feeding millions of tons of grain to livestock, it must be because it makes economic sense. Indeed, it does “make sense” under the rules of our economy. But that fact might better be seen as the problem, rather than the explanation that should put our concerns to rest. We got hooked on grain-fed meat just as we got hooked on gas-guzzling automobiles. Big cars “made sense” only when oil was cheap; grain-fed meat “makes sense” only because the true costs of producing it are not counted.

But why is grain in America so cheap? If grain is cheap simply because there is so much of it and it will go to waste unless we feed it to livestock, doesn’t grain-fed meat represent a sound use of our resources? Here we need to back up to another, more basic question: why is there so much grain in the first place?

In our production system each farmer must compete against every other farmer; the only way a farmer can compete is to produce more. Therefore, every farmer is motivated to use any new technology—higher yielding seeds, fertilizers, or machines—which will grow more and require less labor. In the last 30 years crop production has virtually doubled as farmers have adopted hybrid seeds and applied ever more fertilizer and pesticides. Since the 1940s fertilizer use has increased fivefold, and corn yields have tripled.

But this production imperative is ultimately self-defeating. As soon as one farmer adopts the more productive technology, all other farmers must do the same or go out of business. This is because those using the more productive technology can afford to sell their grain at a lower price, making up in volume what they lose in profit per bushel. That means constant downward pressure on the price of grain.

Since World War II real grain prices have sometimes
fluctuated wildly, but the indisputable trend has been downward. The price of corn peaked at $6.43 per bushel in 1947 and fell to about $2.00 in 1967. In the early 1970s prices swung wildly up, but then fell to a low of $1.12 in 1977, or about one-sixth the price 30 years earlier. (All prices are in 1967 dollars.)

This production imperative doesn't fully explain why production of feed doubled after 1950. In the 1950s the problem of agricultural surplus was seen as too much of certain crops, such as wheat, cotton, and tobacco; so government programs subsidized cutbacks of certain crops, but allowed farmers to expand their acreage in others, such as the feed crops barley, soybeans, and grain sorghum. In Texas, for example, sorghum production leaped sevenfold after cotton acreage was limited by law in the 1950s.

But neglected in this explanation of the low price of grain are the hidden production costs which we and future generations are subsidizing: the fossil fuels and water consumed, the groundwater mined, the topsoil lost, the fertilizer resources depleted, and the water polluted.

**Fossil Fuel Costs**

Agricultural production uses the equivalent of about 10 percent of all of the fossil fuel imported into the United States.

Besides the cost of the grain used to produce meat, we can also measure the cost of the fossil fuel energy used compared with the food value we receive. Each calorie of protein we get from feedlot-produced beef costs us 78 calories of fossil fuel, as we learn from Figure 2, prepared from the work of Drs. Marcia and David Pimentel at Cornell. Grains and beans are from 22 to almost 40 times less fossil-fuel costly.
Figure 2. Calories of Fossil Fuel Expended to Get 1 Calorie of Protein

Feedlot Beef 78
Milk 36
Pork 35
Broilers 22
Eggs 13
Range-Fed Beef 10
Corn. Wheat. Beans 3.5*
Soybeans 2**

*3.5 is approximate. Pimentel’s exact figures are: beans and wheat, 3.44; corn, 3.6.
**Includes energy for processing beans for livestock feeding.
Enough Water to Float a Destroyer

"We are in a crisis over our water that is every bit as important and deep as our energy crisis," says Fred Powledge, who has just written the first in-depth book on our national water crisis.*

According to food geographer Georg Borgstrom, to produce a 1-pound steak requires 2,500 gallons of water!26 The average U.S. diet requires 4,200 gallons of water a day for each person, and of this he estimates animal products account for over 80 percent.27

"The water that goes into a 1,000-pound steer would float a destroyer," Newsweek recently reported.28 When I sat down with my calculator, I realized that the water used to produce just 10 pounds of steak equals the household consumption of my family for the entire year.

Figure 3, based on the estimates of David Pimentel at Cornell, shows that to produce 1 pound of beef protein can require as much as fifteen times the amount of water needed to produce the protein in plant food.

MINING OUR WATER

Irrigation to grow food for livestock, including hay, corn, sorghum, and pasture, uses 50 out of every 100 gallons of water "consumed" in the United States.*29 Other farm uses—mainly irrigation for food crops—add another 35 gallons, so agriculture's total use of water equals 85 out of every 100 gallons consumed. (Water is "consumed" when it doesn't return to our rivers and streams.)

Over the past fifteen years grain-fed-beef production has been shifting from the rain-fed Corn Belt to newly


* Some of this production is exported, but not the major share, since close to half of the irrigated land used for livestock is for pasture and hay.
Figure 3. Amount of Water to Produce 1 Pound of Protein from Various Food Sources

<table>
<thead>
<tr>
<th>Fresh*</th>
<th>Processed</th>
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<tr>
<td>Beef stew (1 cup)</td>
<td>Chef BOY-AR-DEE Beef Stew</td>
</tr>
<tr>
<td>290 mgs</td>
<td>Oscar Mayer Beef Franks</td>
</tr>
<tr>
<td>Hamburger, lean (3 oz)</td>
<td>Chicken Breast, baked (8 oz)</td>
</tr>
<tr>
<td>60 mgs 880 mgs</td>
<td>StoUFFER'S Baked Chicken Breast</td>
</tr>
<tr>
<td>Rice, uncooked (1/2 cup)</td>
<td>Minute Rice Fried Rice</td>
</tr>
<tr>
<td>1 mgs 700 mgs</td>
<td>Mrs. Paul's Flounder (w/lemon butter)</td>
</tr>
<tr>
<td>Flounder, cooked w/butter</td>
<td>Swift Premium Bologna</td>
</tr>
<tr>
<td>40 mgs 610 mgs</td>
<td>Kraft Pasteurized Processed Cheese</td>
</tr>
<tr>
<td>Pork Chops, broiled (2 oz)</td>
<td>Canned Corn*</td>
</tr>
<tr>
<td>Cheddar cheese, natural</td>
<td>Post Fortified Oat Flakes</td>
</tr>
<tr>
<td>200 mgs 500 mgs</td>
<td></td>
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*roughly 2000 mgs sodium = 1 tsp salt (total daily recommended maximum)

Source: Dr. David Pimentel, Cornell University, 1981.

*Includes irrigation water.
irrigated acres in the Great Plains. Just four Great Plains states, Nebraska, Kansas, Oklahoma, and Texas, have accounted for over three-fourths of the new irrigation since 1964, and most of that irrigation has been used to grow more feed. Today half of the grain-fed beef in the United States is produced in states that depend for irrigation on an enormous underground lake called the Ogallala Aquifer.\(^{30}\)

But much of this irrigation just can't last.

Rainwater seeps into this underground lake so slowly in some areas that scientists consider parts of the aquifer a virtually nonrenewable resource, much like oil deposits. With all the new irrigation, farmers now withdraw more water each year from the Ogallala Aquifer than the entire annual flow of the Colorado River. Pumping water at this rate is causing water tables to drop six inches a year in some areas, six feet a year in others. And lower water tables mean higher and higher costs to pump the water. The Department of Agriculture predicts that in 40 years the number of irrigated acres in the Great Plains will have shrunk by 30 percent.\(^{31}\)

In only two decades Texans have used up one-quarter of their groundwater.\(^{32}\) Already some wells in northern Texas are running dry, and with rising fuel costs, farmers are unable to afford pumping from deeper wells. Why is this water being mined in Texas? Mostly to grow sorghum for the feedlots which have sprung up in the last decade.

When most of us think of California's irrigated acres, we visualize lush fields growing tomatoes, artichokes, strawberries, and grapes. But in California, the biggest user of underground water, more irrigation water is used for feed crops and pasture than for all these specialty crops combined. In fact, 42 percent of California's irrigation goes to produce livestock.\(^{33}\) Not only are water tables dropping, but in some parts of California the earth itself is sinking as groundwater is drawn out. According to a 1980 government survey, 5,000 square miles of the rich San Joaquin Valley have already sunk, in some areas as much as 29 feet.\(^{34}\)

The fact that water is free encourages this mammoth waste. Whoever has the $450 an acre needed to level the land and install pumping equipment can take groundwater for nothing. The replacement cost—the cost of an equal
amount of water when present wells have run dry—is not taken into consideration. This no-price, no-plan policy leads to the rapid depletion of our resources, bringing the day closer when alternatives must be found—but at the same time postponing any search for alternatives.

Ironically, our tax laws actually entice farmers to mine groundwater. In Texas, Kansas, and New Mexico, landowners get a depletion allowance on the groundwater to compensate for the fact that their pumping costs rise as their groundwater mining lowers the water table. Moreover, the costs of buying the equipment and sinking the well are tax-deductible. Irrigation increases the value of the land enormously, but when the land is sold the profits from the sale are taxed according to the capital gains provisions; that is, only 40 percent of the difference between the original cost of the farm and its sale price is taxed as ordinary income. The rest is not taxed at all.

Few of us—and certainly not those whose wealth depends on the mining of nonrenewable resources—can face the fact that soon we will suffer for this waste of water. Donald Worster, author of *Dust Bowl: The Southern Plains in the 1930's* (New York: Oxford University Press, 1979), interviewed a landowner in Haskell County, Kansas, where $27.4 million in corn for feed is produced on about 100,000 acres of land irrigated with groundwater. He asked one of the groundwater-made millionaires, "What happens when the irrigation water runs out?"

"I don't think that in our time it can," the woman replied. "And if it does, we'll get more from someplace else. The Lord never intended us to do without water." 

**The Soil in Our Steaks**

Most of us think of soil as a renewable resource. After all, in parts of Europe and Asia, haven't crops been grown on the same land for thousands of years? It's true, soil should be a renewable resource; but in the United States, we have not allowed it to be.

We are losing two bushels of topsoil for every bushel of
corn harvested on Iowa's sloping soils, warned Iowa state conservation official William Brune in 1976. Few listened. "It can take 100 to 500 years to create an inch of topsoil," but under current farming practices in Iowa, an inch of topsoil "can wash away in a single heavy rainstorm," Brune said after the spring rains in 1980. On many slopes in Iowa we have only six inches of topsoil left.

Few would argue with Brune. Few would dispute that our topsoil loss is a national catastrophe, or that in the last two decades we have backpedaled on protecting our topsoil, or that in some places erosion is as bad as or worse than during the Dust Bowl era. Few dispute that excessive erosion is reducing the soil's productive capacity, making chemical fertilizers ever more necessary while their cost soars. The only dispute is how many billions of dollars topsoil erosion is costing Americans and how soon the impact will be felt in higher food prices and the end of farming on land that could have been abundant for years to come.

Since we began tilling the fields in our prime farming states we have lost one-third of our topsoil. Each year we lose nearly 4 billion tons of topsoil from cropland, range, pasture, and forest land just because of rain-related water erosion. That 4 billion tons could put two inches of topsoil on all of the cropland in Pennsylvania, New York, and New Jersey. Adding wind erosion, estimated at 3 billion tons, we hit a total erosion figure of nearly 7 billion tons a year.

Robin Hur is a mathematician and Harvard Business School graduate who has spent the last year documenting the resource cost of livestock production for his forthcoming book. "How much of our topsoil erosion is associated with crops destined for livestock and overgrazing of range-land?" I asked him. "Most of it—about 5.9 billion tons," he calculates, including erosion associated with exported feed grains. This is true not only because feed crops cover half of our harvested acres, but because these crops, especially corn and soybeans, are among the worst offenders when it comes to soil erosion. According to the Department of Agriculture, one-quarter of all soil erosion in the United States can be attributed to corn alone.
The loss of billions of tons of topsoil threatens our food security only if we are losing topsoil faster than nature is building it. The difficulty is knowing how fast nature works. The most widely accepted rule of thumb is that we can lose up to five tons of topsoil per acre per year without outpacing nature's rebuilding rate—yet one-third of the nation's cropland already exceeds this limit, the Department of Agriculture estimates, and one out of eight acres exceeds the limit almost three times over. This is bad enough, but many soil scientists challenge the standard itself, suggesting it applies only to the top layer of the soil. Soil formation from the underlying bedrock may proceed ten times more slowly. If these scientists are correct, we are mining the soil on most of our cropland.

In some areas we are already experiencing lower yields due to erosion and the reduction in fertility it causes. The Department of Agriculture estimates the annual dollar value of the loss just from water erosion at $540 million to $810 million. Adding wind erosion may increase that estimate by 30 percent.

"In our area of Nebraska you see hilltops eroded—completely naked," says Marty Strange of the Center for Rural Affairs. "Yet farmers are still getting 90 to 95 bushels of corn an acre. Farmers don't believe they are losing productivity." They use chemicals to make up for the soil's lost natural fertility, but the cost of fertilizer has risen 200 percent since 1967 and is likely to keep rising. Higher production costs must ultimately mean higher food prices.

We also pay in our taxes, for billions of dollars have gone toward conservation measures (although this spending is shrinking, while the need increases). Moreover, the soil washed from farmlands ends up in rivers, streams, and reservoirs. Dredging sediment from rivers and harbors, the
reduction in the useful life of reservoirs, and water purification—these costs amount to $500 million to $1 billion a year.46

Thus, the direct and indirect costs of soil erosion already approach $2 billion a year.

**BUT WHY?**

Why is soil erosion accelerating, despite 34 Department of Agriculture programs related to soil and water conservation? There are several reasons:

- the increased tillage of soil so fragile it probably should have remained uncultivated. The government estimates that 43 percent of the land used for row crops in the Corn Belt is composed of highly erodible soils.47
- the increased planting of row crops, especially the feed crops corn and soybeans, which make the land particularly susceptible to erosion.
- the growing neglect of conservation practices, including the removal of shelterbelts planted during the Dust Bowl era to protect the soil. By 1975 the total real value of soil conservation improvements had deteriorated over 20 percent from its peak in 1955.48

These are the reasons, but what are the causes? Unfortunately, they lie in the economic givens that most Americans take as normal and proper. Squeezed between ever higher costs of production and falling prices, farmers must increase their production. They plant more acres, including marginal land susceptible to erosion, and they plant what brings the highest return, even if this means continuous planting of the most erosion-inducing crops, corn and soybeans. “The most erosive production system—continuous corn—produces the highest net income,” according to researchers at the University of Minnesota.49

**Fertilizers: Becoming Import-Dependent**

To determine a price for grain which reflects all its costs would also mean looking at the fertilizers required to
mask our lost fertility and continually increase production. Higher yields and continuous cropping deplete soil nutrients, so that ever greater quantities of fertilizer must be used. This vicious circle caused our nation's use of chemical fertilizer to increase fivefold between the 1940s and the 1970s. Just in the last ten years, the use of ammonia (for nitrogen fertilizer) has increased by almost 200 percent and that of potash by almost 300 percent. Higher yields and continuous cropping deplete soil nutrients, so that ever greater quantities of fertilizer must be used. This vicious circle caused our nation's use of chemical fertilizer to increase fivefold between the 1940s and the 1970s. Just in the last ten years, the use of ammonia (for nitrogen fertilizer) has increased by almost 200 percent and that of potash by almost 300 percent.\(^5\) Corn, the major national feed grain, which occupies about 23 percent of all our cropland, uses more fertilizer than any other crop—about 40 percent of the total.\(^5\)

Because fertilizer has been relatively cheap, farmers have been encouraged to apply ever greater quantities in their desperate struggle to produce. As with topsoil and groundwater, we squander fertilizer resources today without considering the consequences tomorrow. One of the consequences of our heavy consumption of fertilizer is increasing dependence on imports. Americans might be alarmed at how our dependence on imported strategic metals can be used to justify U.S. political or even military intervention abroad. Americans would probably be even more alarmed about becoming dependent on imported food. But is being dependent on the fertilizer needed to produce food really much different?

Let's look at the three major types of fertilizer:

_Nitrogen fertilizer._ We won't run out of nitrogen, since it makes up about 78 percent of our air, but the price of natural gas, used to make ammonia, the most common nitrogen fertilizer, has risen so rapidly that we have begun to import ammonia from countries with cheap supplies of natural gas. We now import about 20 percent of our supplies.\(^52\)

_Potash._ Today we import about 85 percent of our potash (from Canada), and by the year 2000 we are expected to import 90 percent.\(^53\)

_Phosphate fertilizer._ The U.S. is the world's leading producer, but our high-grade reserves will probably be exhausted over the next 30 to 40 years at the current rate of use, according to a 1979 government report. "We will probably move from assured self-sufficiency and a dominant exporter position to one of increasing dependency on
possibly unreliable foreign sources of supply,” says the omi-
nous report. “Since phosphates are a fundamental necessity
to agriculture... the situation... is somewhat analo-
gous to that now being experienced with oil” (my em-
phasis).

Livestock Pollution

Some people believe that although we feed enormous
quantities of high-grade plant food to livestock with rela-
tively little return to us as food, there is really no loss.
After all, we live in a closed system, don’t we? Animal
waste returns to the soil, providing nutrients for the crops
that the animals themselves will eventually eat, thus com-
pleting a natural ecological cycle.

Unfortunately, it doesn’t work that way anymore. Most
manure is not returned to the land. Animal waste in the
United States amounts to 2 billion tons annually, equivalent
to the waste of almost half of the world’s human popula-
tion. Much of the nitrogen-containing waste from live-
stock is converted into ammonia and into nitrates, which
leach into the groundwater beneath the soil or run directly
into surface water, thus contributing to high nitrate levels
in the rural wells which tap the groundwater. In streams
and lakes, high levels of waste runoff contribute to oxygen
depletion and algae overgrowth. American livestock con-
tribute five times more harmful organic waste to water
pollution than do people, and twice that of industry, esti-
mates food geographer Georg Borgstrom.

Cheap Water for Cheap Grain

In a true accounting, the two bushels of topsoil washed
away with every bushel of corn grown on Iowa’s sloping
land would be seen as a subsidy to our cheap grain. In
other words, if we were to use all of the conservation mea-
sures we know of to prevent this erosion, the cost of pro-
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ducing our grain would go up, as it would if we were to add in all of the costs of dredging the soil from our waterways or charge for feedlot pollution. Failing to account for these costs amounts to hidden subsidies. But in addition, you and I as taxpayers are paying direct subsidies right now.

Our tax dollars have paid for more than one-half of the net value of all irrigation facilities in the United States as of 1975. Since the turn of the century the federal government has sponsored 32 irrigation projects in 17 western states where 20 percent of the acreage is now irrigated with the help of government subsidies. A recent General Accounting Office study concluded that even though farmers are legally required to repay irrigation construction costs, in the cases studied the repayments amounted to less than 8 percent of the cost to the federal government.

In some of the projects, the irrigators pay even less. Take the Fryingpan-Arkansas Project near Pueblo, Colorado. This half-billion-dollar project helps farmers grow corn, sorghum, and alfalfa for feed. The GAO calculated the full cost of water delivered to be $54 per acre-foot, but the farmers are being charged only 7¢ per acre-foot. (And the GAO's "full cost" is based on an interest rate of 7½ percent.) According to Fortune magazine, the huge California Central Valley irrigation project is being subsidized at a rate of $79,000 a day.

Cheap water encourages farmers to grow livestock feed. "Because water is so cheap, its use is based on its price and not its supposed scarcity," observes Fortune. "Many farmers . . . use inferior land to grow low value crops that require large amounts of water, like alfalfa and sorghum" for feed.

Government subsidies are so large that "the market value of the crops to be grown with federal water is less than the cost of the water and the other farming supplies used to grow those crops," the government study concluded. But Robin Hur has an even dimmer view of the economics of federal irrigation. After studying federal irrigation in the Pacific Northwest, he calculated that in six major projects the value of the crops produced doesn't cover even the cost of the water alone!

Federally subsidized irrigation water helps keep grain
cheap. It also helps make people rich. To a farmer with 2,200 irrigated acres in California's Westlands district, the federal water subsidy is worth $3.4 million—that's how much more the land is worth simply because of what the government contributes to irrigation.4

A key 1902 federal law stipulated that beneficiaries of the subsidized irrigation were to be small farmers only, those owning no more than 160 acres. But the law has never been enforced, despite suits filed by National Land for People and others seeking the irrigated land they are legally entitled to. Today one-quarter of the federally subsidized irrigated land is owned by a mere 2 percent of the landholders, who own far more land than the legal limit. In California, for example, over a million and a half acres of federally subsidized water are controlled illegally—that is, by farms over the legal acreage limit.5 Southern Pacific alone controls land almost 700 times the legal limit for an individual. (All told, Southern Pacific owns almost 4 million acres in three states.6)

Tax Benefits at the Feedlot, Too

Besides directly and indirectly subsidizing the feedlot system by keeping the price of grain low, we taxpayers also subsidize the feedlot operations themselves. Tax laws favoring feedlot owners and investors in feedlot cattle shift the tax burden onto the rest of us. While these tax advantages were cut back in 1976, there are still “income tax management strategies” that can benefit cattle owners who contract with feedlots to fatten their cattle, putting on the last 200 to 600 pounds of each head.7 According to a Department of Agriculture report, the law that allows farmers to use cash accounting for tax purposes can also profit investors in feedlot cattle, especially those with high nonfarm incomes seeking to reduce their taxable income. More than a quarter of “custom feeding” clients in the Southern Plains are such outside investors, including doctors, lawyers, and bankers.8

Agricultural economists V. James Rhodes and the late
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Joseph C. Meisner of the University of Missouri offer this observation of tax favors to feedlot operations:

Subsidies to large-size feedlot firms, indirect though they be, would tend to lead to survival and growth of those firms on a basis of other than economic efficiency. . . . If the nation seeks to subsidize beef production, direct grants to feedlot firms is an alternative. Then, true economic costs of the subsidies would be more apparent. However, in a world of growing concern for energy supplies, the beef industry would seem to be a most unlikely recipient of national subsidy.69

A Fatal Blindness

After reading this account of the resource costs of our current production system, you probably are amazed that more people are not aware and alarmed. I am continually amazed. Again and again I have to learn this lesson: often those with the most information concerning our society's basic problems are those so schooled in defending the status quo that they are blind to the implications of what they know.

As I was preparing this chapter I came across a book that read as if designed to be the definitive rebuttal to Diet for a Small Planet. Three noted livestock economists conclude that "total resource use in this [livestock] production has decreased dramatically." To arrive here, they had, of course, to ignore such hidden costs as I've just outlined—the fossil fuel used, the water consumed (including groundwater that is irreplaceable), the topsoil eroded, and the domestic fertilizer depleted as we attempt to make up for our soil's declining fertility. They also ignore feedlot pollution and hidden tax subsidies. All this I would have expected. What really shocked me was their attempt to prove that we are producing more meat using less resources. Their evidence? A decline in labor used and a dramatic drop in acres devoted to feed grains between 1944 and about 1960, while meat production rose. What they fail to tell us is that about one-third of our total cropland
was released from feed-grain production between 1930 and 1955 by the rapid replacement of grain-consuming draft animals by fuel-consuming tractors. Thus, much of the decline in feed-grain acres had nothing to do with increased efficiency of meat production. Just as appalling, these economists ignore the fact that livestock eat more than feed grains. Since 1960 there has been a spectacular rise in soybean use as animal feed. Tripling since 1960, acres in soybeans now exceed two-thirds of total acres in feed grains.\(^7\) (Almost half of those acres are used to feed domestic livestock,* the rest for export.) Soybeans are not even mentioned by these economists as a resource in livestock production.

While it is useful to keep these gross oversights in mind for the next time we feel cowed by an “authority” questioning our facts, they sidetrack us a bit from the basic argument used by such defenders of the status quo. Most economists defend our current meat production system by arguing that feeding grain to livestock is the cheapest way to produce meat. The fatal blindness in this argument is attention only to price. As we have seen, the price of our grain is an illusion. It results from the powerlessness of farmers to pass on their costs of production and the fact that so many of the costs of production—topsoil and groundwater, for example—carry no price at all.

In writing this chapter I came to realize more clearly than ever that our production system is ultimately self-destructive because it is self-deceptive; it can’t incorporate the many costs I’ve outlined here. It can’t look to the future. And it blinds those closest to it from even seeing what is happening. Thus, the task of opening our eyes lies more heavily with the rest of us—those less committed to protecting the status quo. As awakening stewards of this small planet, we have a lot to learn—and fast.

But now, let’s turn abroad. If the food-producing resources of our country—one blessed with exceptional agricultural wealth—are threatened, what does this production system mean for countries much less well endowed?

* The protein concentrate made from soybeans is an excellent livestock ration, and the oil extracted is used to make margarine, salad oil, etc.