

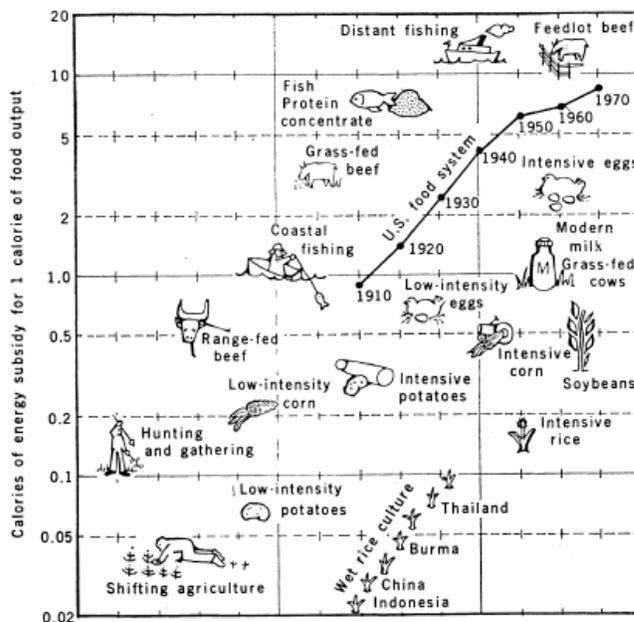
Food, Feed, Fuel and CO₂

By Pat Murphy

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Wendell Berry said there are really only two systems in the world, the agrarian and the industrial.¹ About 250 years ago, industrialism was born with the invention of a particular machine – the steam engine – and a particular philosophy – capitalism. And from that time on, the relationship between the old world and the new one has been one of conquest of the agrarian world by the industrial world. But because of peak oil (and a future peak for natural gas, coal and uranium) in combination with accelerating climate change, industrialism will be relatively short lived. I do not see this as a complete tragedy – the world we have created is violent, with extreme inequity and poverty, and destructive of what many agrarians hold dear – clean water, fertile soils, clear skies, wilderness, and animals of all kinds.

Modern humans have become dependent on consuming increasing amounts of fossil fuels –



resources that are dwindling even as their consumption generates more and more deadly greenhouse gases. The US has abandoned almost all sustainable practices of living and replaced them with practices that require fossil fuel energy. Hand tools and physical skills have been replaced with fossil fuel driven-machinery and fossil fuel-based chemicals. The unfortunate result is that, particularly in the developed world, much knowledge and many ordinary physical talents have been lost. If electricity were to suddenly disappear, not only would scientists and engineers not have slide rules to turn to but they might not know how to use them even if they could find a supply.

With food, this loss of traditional skills is particularly dangerous. Not only has much of the knowledge of how to grow food without fossil fuels been lost, but the understanding of good food and nutrition is also disappearing. Some of the most nutritious vegetables, such as kale, collard and Swiss chard, are no longer reported in the US government's agriculture statistics. Many people don't even know how to cook them.

Green Revolution = Fossil Fuel Revolution

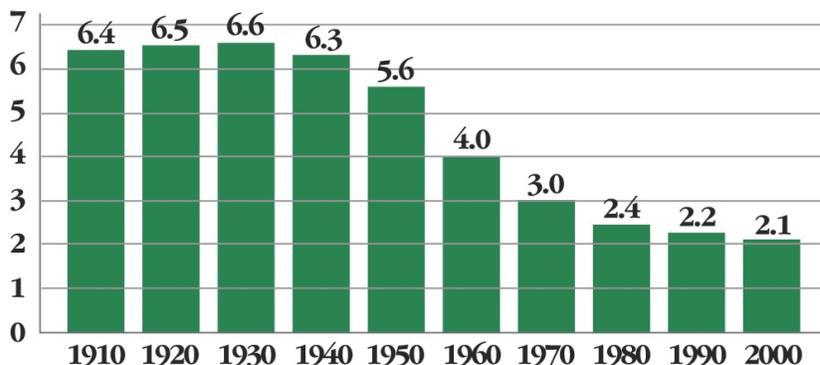
In the mid 1940s at the end of what I define as the agrarian period, the green revolution began in Mexico. Over the next 30 years, it spread throughout the world. In the popular view, the green revolution was based on miracle seeds - so called High Yielding Varieties (HYVs), which were designed to increase production. HYVs significantly outperformed traditional

varieties in the presence of adequate irrigation, pesticides and fertilizers.² But in the absence of these inputs, traditional varieties may outperform HYVs. The production increases of the green revolution were due as much to refocusing WWII munitions technology on fertilizers and pesticides as to seed development. Thus the green revolution was a fossil fuel based agricultural revolution, not a biological one. The Green Revolution was not the result of discovering some new corn plant or finding an innovative way to naturally increase yields. Rather it was a discovery that crop yields increased when artificial fertilizers, made from fossil fuels (mostly natural gas), were applied to hybridized seeds. The Green Revolution simply traded off a six-fold increase in yields from the use of huge amounts of fossil fuels. Before the green revolution it took no fossil fuels to produce a food calorie. Now it takes 10 fossil fuel calories to deliver 1 food calorie to a consumer in America. The 10 calories include not just what is involved in growing crops but all the energy involved in getting food products to consumers - packaging, transportation and refrigeration.

The Loss of the Family Farm

In most of the rest of the world, food growing is still sustainable with a high percent of the population on farms. But in the US, once the green revolution had proven itself, government decided to change society. Monoculture crops require only 1/6 the labor. Farmers were driven from their homes and fields and into slums and factories under mottos like “Get Big or Get Out” (first formulated by US Secretary of Agriculture Ezra Taft Benson in the 1950s) and "Adapt or die" (US Secretary of Agriculture Earl Butz 20 years later).³ Farmers were now free to find another line of work, but their vocation of farming and their love for the land was not considered. Similar to forced collectivization in the Soviet Union, it was a war on peasants and in the US was highly successful with great suffering for family farmers (which continues still).

Millions of Farms in the U.S. 1910-2000



As fossil fuel-intensive agribusinesses and petrochemicals replaced the skilled small farmer, much US food production became regionalized rather than local. Vegetables are grown in California, corn in the Midwest, potatoes in Idaho and wheat in eastern Washington. These foods are then shipped all over the country. Today, one bright spot in North America is an increasing appreciation of the need to grow food organically. However, truly sustainable practices require that food be grown closer to the point of consumption in order to reduce the use of fossil fuels for shipping food long distances.

But making such changes will not be easy. Current farmers, who have become mere operators of machines and mixers of chemicals, may not have the skills to develop a local, sustainable agriculture. A new generation of farmers, numbering in the tens of millions, will need to be trained and relocated to rural communities. Other farmers (or more aptly gardeners) will be needed for suburban and urban agriculture. But to actually reduce green house gases and save fuel, it will be necessary to change the American diet – and to do that we need to understand where our food comes from.

Manufacturing the American Diet

One way to analyze the food habits of Americans is to walk the aisles of a supermarket. There are 300,000 food and beverage products in the United States, and an average supermarket carries 30,000 to 40,000. The popular view is that “the industry has brought Americans a food supply of astonishing variety, independent of season and geography.”⁴ But people don't eat 30,000 different foods. In fact, they eat a relatively small number of foods. The amazing choices are merely different recipes, or, in the parlance of the grocery manufacturing industry, different brands. Call it what you will -- Wheaties, Wheat Thins, Yippee, Zoom, Real Crisp, Morning Delight or any other marketing name -- breakfast cereals and snacks, like so many food products, are basically wheat or corn with sugar, salt, and oil added. Factories combine white wheat flour, hydrogenated soybean oil and corn sweeteners with flavoring and coloring from chemicals in various ways to create most food North American eat.

Even the flavor of processed foods is manufactured. North America's flavor industry is located along the New Jersey turnpike, a small area that produces about 2/3 of the flavor additives sold in the US.⁵ This \$1.4 billion industry manufactures the additives that provide not just the flavor, but often the color, shape and texture for products as diverse as potato chips, corn chips, breads, crackers, breakfast cereals and pet foods, as well as ice creams, cookies, candies, toothpastes and mouthwashes. Once the core components have been mixed, flavored, shaped and dyed, they are placed in colorful, attractive packages -- 300,000 products, yes, but in reality nothing more than variations of a few basic foods. Unfortunately, to transform these few basic food components into manufactured foods requires massive consumption of oil and other fossil fuels.

The Main Crops – Food and Feed

To determine what we actually eat – real foods and not the various recipes or branded products – we must figuratively walk the rows of crops in the fields rather than the aisles of supermarkets. Food comes from the soil, either as plants grown in fields or as meat and dairy products, which come from animals eating the plants grown in the fields. More than 99.7% of all US food comes from the land, while less than .3% comes from the ocean or other aquatic ecosystems.⁶

The United States Department of Agriculture (USDA) uses the word food to describe what humans eat and the word feed to describe what farm animals eat. The USDA also uses the term crops to describe the major food and feed plants. Most of the cultivated area in the US is devoted to four such crops - corn, hay, soybeans and wheat. Corn and hay are used principally to feed livestock, mostly beef cattle and dairy cows. Corn is also the major source of food and drink sweeteners. Soybeans are a major feed crop for livestock, mostly for pigs

and chickens, and are secondarily a source of food oil. Wheat is mostly used for human food but a significant part is also used as animal feed. Figure 3 (Figure 4?) shows the distribution of the so-called crops.

The total acreage harvested in 2004 for the four major crops (corn, hay, wheat, soybeans) was 265 million acres – about 85% of the land farmed in the US.⁸ Other crops (as defined by the USDA) include the secondary grain crops of sorghum, barley, rice, oats, millet and rye. In addition to grain crops there are several plants that provide oils that are a key part of the American diet. These oil seed crops include sunflowers, canola, flaxseed, safflower, mustard seed and rapeseed. Peanuts, cotton, sugar beets, sugar cane and tobacco are crops that require another 6 million acres (or 2% of the nation’s fields) – rather insignificant when compared to the big four.

To give a more complete perspective of agricultural land use, we should consider fruits, vegetables and nuts as well. The USDA does not define these as crops, but places them in different categories. These three food types use another nine million acres, about three percent (3%) of the agricultural area.

Crop (2004)	Harvested Acres	% of Acres	Yield/ Acre	Yield Unit
Grains				
Corn (grain)	73,631,000	25.2%	160.4	bu
Wheat	49,999,000	17.1%	43.2	bu
Sorghum	6,517,000	2.2%	69.6	bu
Barley	4,021,000	1.4%	69.6	bu
Rice	3,325,000	1.1%	69.9	cwt
Oats	1,787,000	0.6%	64.7	bu
Millet	595,000	0.2%	25.3	bu
Rye	300,000	0.1%	27.5	bu
Total	140,175,000	48.0%		
Hay				
Hay	61,966,000	21.2%	2.6	ton
Total	61,966,000	21.2%		
Oilseeds				
Soybeans	73,958,000	25.3%	42.2	bu
Sunflower	1,711,000	0.6%	12.0	cwt
Peanuts	1,394,000	0.5%	30.8	cwt
Canola	828,000	0.3%	16.2	cwt
Flaxseed	511,000	0.2%	20.3	bu
Safflower	159,000	0.1%	12.0	cwt
Mustard Seed	68,700	0.0%	8.2	cwt
Rape Seed	7,800	0.0%	13.9	cwt
Total	78,637,500	26.9%		
Sugar				
Sugar Beets	1,306,900	0.4%	23.0	ton
Sugarcane	879,500	0.3%	31.0	ton
Total	2,186,400	0.7%		

Legumes				
Dry Beans	1,219,300	0.4%	14.6	cwt
Dry Peas	507,800	0.2%		
Lentils	329,000	0.1%		
Total	2,056,100	0.7%		
Fruits/Vegetables/Nuts				
Fruits	3,088,800	1.1%	1.0	ton
Vegetables	3,236,890	1.1%	1.0	ton
Nuts	926,200	0.3%	1.0	ton
Total	7,251,890	2.5%		
Grand Total	292,272,890	100.0%		

Measuring the Fields – Raw Materials for Manufactured Foods

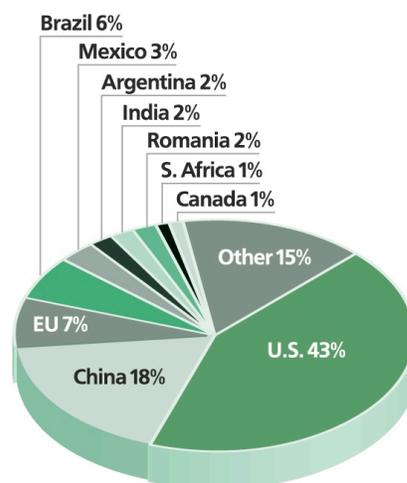
As noted above, the industrial food system relies primarily on corn, white flour from wheat, soybeans and hay and has replaced more direct food production with a very complex manufacturing system heavily dependent on fossil fuels. The Grocery Manufacturers Association (GMA) represents the world's leading branded food, beverage and consumer product companies. GMA member companies employ more than 2.5 million workers across the US and account for more than \$680 billion in annual sales.⁹ The use of the word manufacturer in the organization's name is testimony to the industrial nature of the food products they make and sell, an industrial process that has led to soil depletion, air pollution, water pollution and unhealthy food. It's important to understand the food and feed crops that are the basis of this system.

Corn

The US is the largest producer of corn in the world, growing the grain on 400,000 farms. In 2004/2005, the US produced 256 million metric tons of corn, 41 % of total worldwide production.¹⁰

Of the 11.8 billion bushels produced in 2004, 1.8 billion bushels were exported, leaving about 10 billion bushels for US domestic consumption. These 10 billion bushels convert to 560 billion pounds of corn, or about *1,900 pounds per person* (using a 2004 population number of 295 million).¹¹ That most of this corn is used in manufactured foods is clear since, on average, people in the US eat only 2,200 pounds of food in total per year.¹² USDA food consumption numbers show the average person directly consumes only about 11 pounds of corn and about 30 pounds of corn flour each year.¹³ Little corn is consumed *directly*, but much is consumed *indirectly*, principally through meat and sweeteners. In 2004, 6.2 billion bushels were used as feed in Contained Animal Feeding Operations (CAFO).¹⁴ So the US's largest crop is not used for direct human consumption but as feed for cattle and as sweeteners for food.

World Corn Production 2004-05*



Wheat

The second largest grain crop is wheat. Wheat is the fourth major crop in terms of acreage planted and harvested, following corn, soybeans and hay. It is the only grain crop used mostly for human food rather than animal feed. In 2004, 2,158 million bushels of wheat were harvested from 50 million acres, of which 1,063 million bushels were exported, or about 49% of the total. Domestic use was 1,172 million bushels, including 905 million bushels for human food and 79 million bushels for animal feed.¹⁵ There are sixty pounds of wheat in each bushel so the 905 million bushels for food is about 184 pounds of unprocessed wheat per person.

Unfortunately for human health, most wheat flour in the US is highly processed. More than 98% of the 150 pounds of wheat flour (most of the wheat grown) consumed per capita in 1997 was refined, a process that removes fiber and many nutrients including vitamins, minerals and phytochemicals.¹⁶ Most of these nutrients are not restored to refined flour, but instead fed to livestock.

Other grains

88% of grain acreage in the US is allocated to growing corn and wheat. The remaining grains (including sorghum, barley, oats, millet and rye) use only 12% of the farmland devoted to grain growing. These grains are also used for feed. The third largest grain crop (after corn and wheat) is sorghum. In the US it is used primarily as an animal feed. Barley is the next grain crop in terms of acreage harvested and is also used for animal feed. Human per capita consumption of barley was only .7 pounds per person in 2004. The US produces about 1.8% of the total rice grown in the world. Per capita rice consumption in the US was 22.4 pounds per person in 2004. In the US oats are consumed mostly in the form of breakfast cereal, 4.7 pounds per person per year. Rye per capita consumption in the US is less than one pound per person. The amounts of different grains grown in the U.S. have important implications. One is that the food supply is much less diverse than popularly thought.

Soybeans and other Oil Seeds

The amount of arable land allocated to soybeans in the US is about the same as that allocated to corn, about 25%. The basic products of soybeans are oil, meal, and hulls. According to the United Soybean Board, soybean oil, used in both food manufacturing and for frying and sautéing, represents approximately 79 percent of all edible oil consumed in the United States. After the oil has been extracted from the soybean, the remaining materials, mostly complex carbohydrates, are fed to livestock (mainly pigs, chickens and turkeys) who consume over 30 million tons of soybean meal yearly. The hulls are used as a component of cattle feed even though corn is the main feed crop for beef cattle.

94% of the total oil seed acreage in the US is allocated to growing soybeans. The remaining seven oil seed crops (sunflower, peanuts, canola, flax, safflower, mustard and rape seed) account for only 6% of the acreage. Like corn, soybeans are a modern crop. And like corn, soybeans are not consumed directly but are raw materials for other kinds of foods and feeds. When consumed by people, soybeans are normally part of highly processed foods. Annually about 400 pounds of soybeans per person goes into feed for animals and for manufactured foods.

Hay

Hay is the next largest planting in the US after corn and soybeans – 62 million acres for hay versus 148 million acres for the other two crops. Hay growing uses 21% of arable land in the US.¹⁷ Hay is the product of any of a variety of perennial crops, typically grasses or legumes, which are used as feed for ruminant animals, mostly dairy and beef cattle.

Sugar

Sugar cane and sugar beets are relatively minor contributors to the American diet. Acreage allocated for these crops is only about 7/10ths of one percent of the farmed acreage. Of the 141 pounds of sweeteners consumed by each person yearly, 61.5 pounds come from sugar cane and sugar beets, while 78.1 pounds comes from corn sweeteners, which predominate in the manufactured foods market.

Summarizing the raw materials

Hay, grains, oil seeds and sugar plants cover 96% of the U.S. cultivated land. (Table 1) Excluding wheat, which is mostly consumed as food rather than feed, the acreage devoted to the remaining plants is 79% of the total acreage. Little of the available land is used for more "nutritious foods," such as legumes, nuts, fruits and vegetables (less than 4% of the cultivated land). This is because the U.S. food system uses 10 calories of fossil fuels to provide one calorie of food energy from a handful of plants mostly used for meat and manufactured foods.

Measuring the Fields – Nutritious Foods

Common dietary knowledge suggests we avoid manufactured foods and high fat foods. Our modern meats are very high in fat along with manufactured foods. A healthier diet would avoid many of our common foods and focus on four main categories: beans (or legumes), vegetables, fruits and nuts.

Beans (Legumes)

The US consumes a disproportionately large amount of the world's grains and oil seeds but consumes far fewer beans than other nations. Only .7% of the harvested acreage in the US is allocated to beans, peas and lentils. Historically beans have been a staple crop for protein in much of the world. Only in recent times has meat become a replacement source of protein. Figure 6 shows that the same weight of beans provides more protein but much less fat than meat.

Food NDB No (USDA)		Kidney Beans 16027	Beef Chuck 13936
<i>Nutrient</i>	<i>Units</i>	<i>Value/100 gr</i>	<i>Value/100 gr</i>
Energy	kcal	333.0	129.0
Protein	g	23.6	19.5
Total lipid (fat)	g	0.8	5.1
Carbohydrate	g	60.0	0
Fiber	g	24.9	0

Vegetables

1.1% of US farmland is used to grow vegetables with the average American consuming 411.5 pounds of vegetables in a year. Potatoes account for 134.5 pounds, about 1/3 of the vegetables poundage eaten. There are 263 calories in a pound of potatoes, significantly more than the other vegetables. Thus potatoes alone provide 47% of the vegetable calories Americans consume each year. The next chapter lists the principle vegetables consumed in the US.

Fruits

Americans consume about 272 pounds of fruit in a year with 113 of the 272 pounds consumed as fruit juices. (Many nutrients and most of the fiber are lost when fruit is juiced.) On average, each pound of fruit contains 236 Calories, almost twice that of vegetables. The top five fruits account for 70% of the fruit by weight and 69% by calories even though the USDA provides data on nearly 40 kinds of fruit eaten in the US. Unfortunately much fruit is highly processed. Sweeteners and preservatives are also added to most commercial juice drinks, increasing calories at the expense of nutrients. 1.1% of US farmland is devoted to fruits production.

Nuts

People in the US eat very few nuts. Of 10.9 pounds of nuts per person eaten each year, 6.7 pounds are peanuts, which is a tuber rather than a true nut from a tree. Peanuts, almonds and walnuts provide about 75% of the pounds and calories in the nut category. Only .3% of farm land is used for nut growing.

Harming Ourselves

What I have called nutritious foods are those that are minimally processed and which contain more vitamins, minerals and phytochemicals than manufactured products. They are also the foods that require more care and attention in growing and harvesting. These foods do not deplete the soil as much, require less fossil fuels and are not subsidized as heavily as US grain and oil crops. Essentially they contribute more to health both because they are more nutrient intense and also because they are lower in fats and refined carbohydrates.

Of all the industrialized rich nations, Americans are the unhealthiest. By way of example, the US now spends about \$6,000 per person per year on health care and its citizens' life expectancy is 77 years, while Canada spends about \$3,200 per person per year on health care and Canadians have a life expectancy of about 80 years.¹⁸ US medical costs per capita are twice those of most Europeans.¹⁹ In other parts of the world as people begin to eat more meat, they tend toward Western disease patterns, a trend so common that it has been named the *nutrition transition*.

The US is known for its cheap food (per capita food expenses are about \$3,410 per person),²⁰ and its citizens buy and consume more than they need. Two-thirds of Americans are overweight or obese.²¹ The US economy is committed to growth, implying continuous increases in consumption for a wide range of products. Industrial food companies have grown by changing the way people eat. Their advertising encourages people to eat *animals*

that eat plants as well as to eat numerous manufactured, highly processed foods made from combinations of plants. Because these companies' products are food, one result of their growth has been larger, fatter, unhealthy consumers. Thus, food companies have achieved growth at the cost of poor health for the consumer.

Meat Consumption

Historically, animals grazing from lands that were not easily cultivated, such as steep hillsides and other marginal land, have provided food for people. Cows, goats and sheep can live on grass and turn this plant source, indigestible by humans, into meat and milk that humans *can* digest. For most of history people ate a diet with large amounts of vegetables and small amounts of meat and fish. The US diet changed dramatically from this norm with the rapid increase in the use of fossil fuels that began at the end of World War II. In 1999, total US meat consumption (red meat, poultry, and fish) amounted to 197 pounds (boneless, trimmed-weight equivalent) per person, 91 pounds more than the 106 pounds consumed in the 1930s. This was about half today's per capita consumption.²² From World War II until now, world consumption of oil increased eightfold, from 11 million barrels per day to 84 million barrels per day.²³ During the same period global meat production increased five fold.²⁴ Fossil fuels made this increase possible.

In 1961 world per capita meat consumption was 51 pounds per person per year, divided into 21 pounds per person in the developing world and 116 pounds per person in the developed world. Today world meat consumption is 92 pounds per person for the world, 68.2 pounds per person in developing countries and 187 pounds per person in developed countries (with the US at 271 pounds).²⁵ Per capita consumption almost doubled in less than 50 years.

North America	271 lbs.
South America	154 lbs.
Asia	62 lbs.
Sub Sahara Africa	29 lbs.
Europe	163 lbs.
Central America	103 lbs.
North Africa	57 lbs.

Figure 9 shows annual per capita meat consumption for various world regions. North Americans eat over 100 pounds more per person than Europeans.

Meat and Fossil Fuels

Of the ten calories of fossil fuels necessary to provide one calorie of food energy, one third is allocated to growing the food and feed crops, another third to processing and packaging (the manufactured version of foods) and a final third to distribution and cooking.²⁶ The US food system uses about 17% of the total fossil fuels consumed each year in nation.²⁷ This is the equivalent of 400 gallons of oil per person per year or about 9.5 BOE (barrels of oil equivalent) per person per year for food alone. Compare this to the *total average energy use* of the developing world (5.4 billion people of 7.3 barrels of oil equivalent per person per year).²⁸ In other words, the amount of fossil fuel each American uses *for food alone* exceeds the amount of fossil fuels used by citizens of the developing world *for all purposes*. The

approximate CO₂ generated from the fossil fuels used in the food system is about 7,000 pounds. Recall that Americans need about 2,200 pounds of food per year.

Today, the average US citizen consumes directly 202 pounds per year of food grain and indirectly (through meat eating) 1,795 pounds of feed grains. The average Chinese person consumes directly 851 pounds per year of food grains and indirectly 154 pounds of feed grains. Essentially the Chinese are eating grain grown in the fields while Americans are passing the grain through animals, a highly inefficient process.²⁹

The energy differential between generating protein from plants and generating protein from meat is profound. To produce one calorie of plant protein requires 2.2 calories of fossil fuel energy, while to produce one calorie of animal protein requires 25 calories of fossil fuel energy. Thus it takes 11 times as many fossil fuel calories to get the same amount of protein from meat as from plants.³⁰ Meat from corn and soybeans provide much of America's diet. The increase in meat consumption is related to the increase in the production of corn and soybeans.

Meat and Climate Change

The change from eating grains directly to eating animals fed by grains has and is causing great harm to the environment. Livestock are a major emitter of the greenhouse gases that contribute to climate change. As meat consumption increases around the world, changing our diets may prove to be as important and as difficult as changing our transportation vehicles. A 2006 report by the Food and Agricultural Organization of the United Nations found that the world's rapidly growing herds of cattle are a major threat to the climate, to forests and to wildlife. While the report also analyzes the damage done by sheep, chickens, pigs and goats, it is the world's 1.5 billion cattle that do the most damage.³¹

Livestock generate nine percent of all CO₂ emissions, 37 percent of methane emissions, and 65 percent of nitrous oxide emissions.³² Methane has 23 times the global warming potential of CO₂, and nitrous oxide has 296 times the potential. When methane and nitrous oxide are measured in CO₂ equivalent units, livestock are responsible for 18 percent of the total greenhouse gases that cause global warming worldwide - *more greenhouse gas than that generated by cars, planes and all other forms of transportation combined.*³³

These emissions are not simply cattle flatulence and manure. Changing from pastures to feed crops as the basis for raising animals requires more use of fossil fuel energy to produce fertilizers, pesticides, herbicides and fungicides, along with electricity to pump water. Additionally, deforestation in developing countries removes one of the planet's sinks for greenhouse gases. Ranching is the major driver of deforestation worldwide, and overgrazing is turning grassland into desert.

Cows also drink vast amounts of water, requiring 990 liters to produce one liter of milk.³⁴ Pollution from this modern form of industrial meat and milk production also washes down to the sea, creating dead zones devoid of life. One such dead zone, in the Gulf of Mexico, is largely the result of US beef production waste that is carried down the Mississippi River.³⁵

Meat or the Planet?

Like many present-day industrial practices, the process of providing meat for our tables has grown increasingly problematic. As climate change worsens, factory meat farming will become unsustainable. As fossil fuels become ever more limited and expensive, a return to humane practices -- using sunlight to grow grasses rather than fossil fuels to grow grain -- will most likely occur. Animals will again be raised on the same farm with crops so that their manure can be used as fertilizer. However, it will be necessary to change perspectives because growing meat in a sustainable manner will cost more and supplies will be more limited. The Contained Animal Feeding Operations (CAFO) system is only 50 years old. Thus, more sustainable ways of producing meats should be neither hard to comprehend nor difficult to implement. But it will still be necessary to eat less.

As with houses and cars, consumer food choices have a major influence on the environment. A recent study by researchers at the Union of Concerned Scientists named food as one of the most environmentally harmful consumer activities. According to this study, the second most effective environmental choice that a consumer can make is to eat less meat and poultry (second to driving less and/or driving an energy efficient car). The authors list buying organic produce as a very effective environmental choice after eating less meat. They suggest that such food choices have a greater positive environmental impact than household changes such as installing efficient lighting and appliances, and certainly more impact than the much less significant options of "paper versus plastic" or throwing away a disposable cup.³⁶

The difference in fossil fuel energy required to sustain a meat-based versus a vegetarian diet is surprising. David Pimentel calculates that providing a 3,600 daily Calorie diet with 1,000 Calories coming from animal products requires about 35,000 Calories of fossil fuel energy whereas a 3,600 Calorie vegetarian diet (with more than sufficient levels of protein) takes about 18,000 Calories of fossil fuel energy – about half that of the non-vegetarian diet. A lacto-ovo vegetarian diet (including milk and eggs) requires around 25,000 Calories of fossil fuel energy. From a CO₂ generation standpoint, choosing a vegetarian diet, or at least one greatly reduced in animal products, significantly reduces the environmental impact.

Other Meat Consideration

The previous sections deal with the energy costs of growing animal food and producing meat. There are several side effects that are also harmful.

Torturing Food Animals

The Livestock Revolution led to a system of meat production that also causes incredible suffering to animals. Animals, like people, have a natural way of living. Cows and sheep graze, pigs root and chickens scratch in the dirt -- traditionally, animals ate foods readily available in the natural world around them. Today, animals are confined in buildings removed from the natural world. As an analogy, imagine a child born in a hospital who never leaves the building. Or, more aptly, imagine a child born who never leaves its crib – the crib being sized to allow a full growth to six feet or so. This large crib would be located so that the child would never see the outside world, all of which constitutes an appalling situation, but still not as bad as that which millions of animals actually face every day. Veal calves and pigs, for example, are imprisoned in cages so that they can never turn around. They spend

their life facing one direction with a view of another animal in a cage in front of them. Chickens are placed six to a cage with a floor area about the size of a place mat. The animals live their lives constantly breathing fecal matter. Beef cattle are allowed to live in small pens and can move around, but they are always standing in fecal material and urine. Pig fecal material drops into vats beneath their cages from which a powerful odor constantly assails their nostrils.

Most of the antibiotics in the US are used to fight the bacteria rampant in these feeding enclosures. The antibiotics keep the animals alive but do nothing to alleviate their suffering. Their lives are agony from birth to death, and the mortality rate is high. The grain based diets are foreign to their natures and designed to produce as much meat as fast as possible. By the end of their short lives, their bodies are unhealthy with dangerous levels of fat embedded in the meat.³⁷

Killing the Soil

A square foot of healthy soil contains thousands of living creatures. In a natural cycle, food comes from the soil and is consumed by animals, including humans, who then give nutrients back to the soil in the form of feces, urine and corpses, enabling the soil to produce more food, which is consumed again by animals, etc. Humans have broken this cycle in dangerous ways, particularly with Confined Animal Feeding Operations (CAFO). Now, instead of the natural food-waste cycle, there are enormous amounts of animal sewage to contend with, along with declining soil fertility.

Failure to return decaying matter (both animal and plant) to the soil, combined with the aggressive use of machinery for tilling and harvesting, also leads to erosion, further undermining the natural cycle. Currently, the US is losing about an inch of topsoil from its croplands every 34 years.³⁸ Under an ideal agriculture situation, where soil is supplemented with large amounts of fertile organic matter, an inch of soil would be rejuvenated in perhaps 30 years. Unfortunately, left to heal itself land takes approximately 500 years to form an inch of soil.³⁹ A significant danger to US food security is that our US agricultural land is so damaged that it will take several years of active rebuilding - using organic methods of soil restoration - to regain the fertility lost by unsustainable practices. Many of our farm fields are so void of nutrients and life that yields would be extremely poor without fossil fuel inputs.

Exploiting Farmers and Farm Workers

Our system is cruel to animals, damaging to other wildlife and destructive of the soil. It has also caused great harm and suffering to farmers. The suicide rate among farmers is three times that of the country as a whole.⁴⁰ People who love their farms, care about the farm animals and protect the soil for future generations have been replaced with large agribusiness farms and Contained Animal Feeding Operations (CAFO). The loss of the personal touch of the dedicated farmer at the expense of fossil fuel based methods of growing has increased yields while damaging land, waterways and lives.

While the ranks of small farmers are being decimated, farm workers, most of them immigrants, take on the dangerous, arduous and toxic work of laboring in the fields. The average US farm worker has a life expectancy of just 49 years. Farm laborers are generally paid piecework rates. Their average earnings are \$7,500 a year, or \$150 a week, the lowest

wage of any occupation. Few receive overtime pay, medical insurance or sick leave and rarely are they permitted to organize. In many states, farm workers are excluded from workers' compensation and unemployment benefits.⁴¹ Agricultural interests and government ignore the plight of the farm worker. The 1935 Wagner Act, allowing workers to organize unions without interference from employers and the 1938 Fair Labor Standards Act both excluded farm workers.

Since the 1970s, the public has demanded that Congress pass laws to protect the physical environment. Businesses in the United States are now forced to consider environmental factors as part of the cost of doing business. Environmentally abusive industrial methods might produce cheaper consumer products, but such an approach is no longer considered acceptable. Unfortunately human misery is not considered part of the environment. Consumers may criticize environmentally unsound growing practices but rarely speak up for exploited farm workers. Farmers are more at risk than any other group for cancer caused mortality.⁴² Farming is one of the top ten most hazardous occupations after logging, fishing, commercial aviation, construction and refuse work.⁴³

Part of a sustainable world is to provide decent livings for both small farmers and farm workers, things sadly missing in the US. America's exploitation of illegal immigrants helps to obscure the poor working conditions of farm laborers. And the American disdain for manual work, plus people's insistence on cheap food, exploits and destroys family farmers.

The Bottom Line – Changing Diets

As people search for options to combat oil depletion and global warming, it will be necessary to look carefully at all the patterns of living that consume fuel and generate CO₂. Many patterns of living can be changed with some discomfort. For example, without a car, a person can walk, hitchhike, ride a bus or ride a bike. He or she can use a down sleeping bag in the home and, if the situation is desperate, go without heat. But people cannot live without food. Americans must reduce consumption of energy by living differently and, of utmost importance, eat differently. Change is required, and the wise will begin this change by modifying their own eating habits. Lobbying for government policy change is useful, and community food development can be important. Community Supported Agriculture (CSA) is a very positive step. But such practices will do little as long as Americans consume food in their habitual way. The most important step is for each person to begin changing their diet. No other option offers a way to dramatically cut energy consumption, exploitation of farm workers and protection of the soil. Personal change is mandatory to make national change.

[For complete references see the book, New Society Publishers, <http://www.newsociety.com>]