Food and Population

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Farmers are invisible people, and middle-class city dwellers choose to pretend that the long lines of trucks bringing food into the city at dawn every day have nothing to do with the white-collar world. Perhaps it is a mark of the civilized person to believe that the essentials of food, clothing, and shelter have no relevance to daily life. Yet if the farmers stopped sending food into the great vacuum of the metropolis, the great maw of urbanity, the city would soon start to crumble, as Britain discovered in the year 2000 [5]. The next question, then, is: Where does all this food come from?

Is there such a thing as sustainable agriculture, or is “sustainable agriculture” a self-contradictory term? To keep a piece of land producing crops, it is necessary to maintain a high level of various minerals. The most critical are phosphorus (P), potassium (K), and especially nitrogen (N). These minerals might be abundant in the soil before any cultivation is done, but whenever crops are harvested a certain amount of the three critical elements is removed.

The native people of North America had a simple solution: abandonment [3]. No fertilizer was used, except for the ashes from burned undergrowth and corn stalks. As a result, the soil became exhausted after a few years, so the fields were abandoned and new ones were dug. Primitive agriculture in many other parts of the world has been similar, and sometimes such a technique is called “slash-and-burn.”

A common partial solution to the N-P-K problem, used in many countries for centuries, has been to turn crop waste into compost and put it back onto the land. The problem with that technique, however, is that one cannot create a perpetual-motion machine: every time the compost is recycled, a certain amount of N-P-K is lost, mainly in the form of human and animal excrement (after the crops are eaten) but also as direct leaching and evaporation. One can come closer to sustainability by recycling those human and animal wastes, but the recycling will always be less than perfect. After all, nitrogen, phosphorus, and potassium are elements, and by definition they cannot be created. Of the three elements, nitrogen is by far the most subject to loss by leaching, but to some extent that can also happen with phosphorus and potassium.

In the original organic-gardening movement pioneered by Sir Albert Howard in the early years of the twentieth century, nothing but vegetable compost and animal manure was allowed. In modern organic gardening, a common technique is to replace lost minerals by adding rock powders, particularly rock phosphate and granite dust. For most present-day gardeners and farmers, the usual response to the problem of soil replenishment is to apply artificial fertilizer, N-P-K largely derived from those same types of rock used in organic gardening. (In fact, the use of rock powders in later organic gardening sounds suspiciously like a drift toward artificial fertilizers.) When the fragile international networks of civilization break down, however, then neither rock powders nor artificial fertilizer will be readily available. These materials are very much the products of civilization, requiring a market system that ties together an entire country, or an entire world.

Writing early in the twentieth century [4], F.H. King claimed that farmers in China, Japan, and Korea were managing to grow abundant crops on about one tenth as much cultivable land per capita as Americans, and that they had done so for four thousand years. If they kept their land producing for 40 centuries, what was their secret? The answer, in part, is that most of eastern Asia has an excellent climate, with rainfall most abundant when it is most needed. More importantly, agriculture was sustained by the practice of returning almost all waste to the soil — even human excrement from the cities was carried long distances to the farms. Various legumes, grown in the fields between the planting of food crops, fixed atmospheric nitrogen in the soil. Much of the annually depleted N-P-K, however, was replaced by taking vegetation from the hillsides and mountains, and by the use of silt, which was taken from the irrigation canals but which originated in the mountains. The system, therefore, was not a closed system, because it took materials from outside the farms.

These three countries are, in any case, problematic as sources of agricultural “wisdom.” King remarks that “the first days of travel in these old countries force the over-crowding upon the attention as nothing else can.” In a chapter on Tientsin, he cites a Scottish physician’s description of a common solution to over-crowding: “In times of famine the girls especially are disposed of, often permitted to die when very young for lack of care. Many are sold at such times to go into other provinces.” As for the hard labor and low remuneration, King says of a Japanese rice farmer that “it is difficult for

Americans to understand how it is possible for the will of man, even when spurred by the love of home and family, to hold flesh to tasks like these." The "miracle" of growing so much food on so little land was largely due, therefore, to neither technology nor topography, but to the fact that starvation was the only alternative.

Besides using vegetable compost and animal manure for increasing the sustainability of agricultural land, many societies have employed related techniques, such as crop-rotation, fallowing, cover-cropping, and green manuring. If any of these techniques includes the use of legumes, nitrogen is added to the soil. Such practices also replenish the humus content of the soil, important for retaining moisture and minerals.

In some societies, agriculture meant slow but inexorable burnout, as was the case for most of Europe. In other cultures (China, Japan, Korea etc.) the response was to recycle intensively. As much as possible, vegetable compost and human and animal excrement had to be reclaimed, and other loss was made up by importing soil and vegetation from the wilderness. Even for those cultures, however, a growing population exacerbated the problems.

Vernon Gill Carter and Tom Dale [2] claim that all previous civilizations have managed to destroy their agricultural systems, except for a few societies that were lucky enough to have sufficient annual flooding, thereby replenishing their soils from an outside source. The Egyptians long ago had such replenishment from the Nile, which brought a small but sufficient annual supply of silt from the highlands of Ethiopia and central Africa; it was Egyptian grain that kept the Roman Empire alive. The inhabitants of Mesopotamia received new silt annually from the Tigris and Euphrates. Carter and Dale regard the Indus Valley civilization as in a similar situation to that of Mesopotamia. Perhaps the situation of China, Korea, and especially Japan is similar to that of Egypt, since all three Asian countries (as described by King) used to derive much of their soil fertility from river-borne silt. In describing the Far East, however, Carter and Dale are generally closer to the mark than King. Speaking of China, they note that "erosion as a whole continues to ruin much of the land, reducing China, as a whole, to the status of a poor country with poor undernourished people, mainly because the land has been misused for so long."

In the first chapter of Walden, Thoreau says that it would be better "to select a fresh spot from time to time than to manure the old." Perhaps he was right. His method, which is essentially the type of practice referred to above as abandonment, might not be ecologically sound, since on a large scale it would mean leaving behind a long string of what used to be called "worked-out farms." For a large population of farmers and consumers, such a method would be impractical, although many ancient cultures tried it. On a very small scale, however, it might not be so ecologically unsound, since the abandoned spot would, over many years, revert to reasonably fertile land, particularly if there were wild legumes to replace the nitrogen.

One further possible disadvantage to Thoreau's suggestion is that preparing the "fresh spot" might require a good deal of work. It is noteworthy that the native North Americans preferred forest, rather than grassland, as sites for agriculture — the forest land was more fertile, and digging up heavy sod (especially on the prairies) would have been arduous with the available tools. The native people girdled the trees (cutting a ring of bark from around each tree) to kill them, and then felled the trees much later, with fire and axes.

Actually, if the abandoned land is taken up again at a later date, the practice of abandonment tends to fade into that of fallowing, another practice to be found in many societies. With the traditional European method of fallowing, half the land is left to revert to grass and weeds for a year before being plowed again. Alternately, a farmer's land might be divided into three parts, and the fallow portion might be part of a system of crop rotation.

World agriculture faces the problem of a reduction in arable land, but there is also the problem of water. The natural availability of water has always been one of the most critical factors in farming. Nearly half of the United States receives only 20 inches or less rainfall annually. Low precipitation, however, is a problem on every continent. In a real survival situation, what are the chances that anyone would be able to pick up a plastic hose and get an endless supply of clear cold water? Not very great. Even wells, cisterns, and ponds would be useless if their water flow had been controlled by electricity. When water must be pumped by hand or carried in buckets, it becomes a precious commodity.

One possible response to aridity is dry farming, leaving crops at the mercy of the weather, relying solely on whatever rain may fall [4]. Grains, legumes, potatoes, and several other crops can be farmed in this way. “Dry farming” will again become a popular term, as the aquifers run out of water and modern systems of agriculture become largely impossible. The essence of dry farming is to space out plants so that the distance between them is two or three times greater than usual. The roots can thereby spread out in all directions, finding water that has been stored in the ground in previous months. Because each plant has more room in which to grow, reducing plant density does not lower the total yield by an equal amount. To make the best use of the water in the ground, all weeds must be removed, because most water vanishes by evaporating from the leaves of any plants that are growing on that soil. The ground must be hoed or otherwise cultivated frequently, so that the surface is kept watertight under a “dust mulch”: water does not easily pass through a layer of well-disturbed dust, since the lack of water and the separation of soil particles prevent capillary action [6]. Further conservation of soil moisture can be achieved by the use of windbreaks. Dry farming is an excellent means of producing food without dependence on complex technology. Dry farming, however, can only make better use of the world’s soil; it cannot increase the yield of the world’s crops.

But the world’s food problems cannot be solved merely by devising a method to increase agriculture. The world’s human population is now approaching 7 billion, while the amount of arable land is not great. Massive inputs of artificial fertilizers and pesticides only replace one problem with others: poisoned water, eroded soil, and insufficient humus. Even the world’s present arable land is rapidly disappearing under cities and highways. Nor can we extend that land by pumping more water from underground, because the aquifers cannot be made to yield more water than they receive.

The real solutions bear little resemblance to anything that is intellectually fashionable. What is of primary importance is to discard the glib, facile sermons that are often tacked on: “We must do such-and-such” or “We have to do such-and-such.” After all, who is the “we” in these statements? If “we” means the poor and powerless, then the statements may be false, because often such people cannot force the political and economic elite to make massive changes in policy. If “we” means the rich and powerful, then the statements are even more likely to be false, because these people have only to say, “No, we don’t have to. We are in power, and no one can make us change — certainly not silly book-scribblers.”

There may be something resembling sustainability, depending partly on one’s definitions, but it would have little to do with the simplistic concepts that are usually put forward. In the first place, there is nothing “natural” about agriculture. Agriculture has only been practiced for about ten percent of the entire history of Homo sapiens, and in that sense it is still an experiment with uncertain results. To plow the earth is to “go against Nature,” since it means disturbing the soil, the intricate, complex surface of the planet. Even the slightest and shallowest disturbance causes chemical and biological losses of various sorts. Yet in some countries one can drive for days without seeing an end to cultivated land (or, of course, concrete and asphalt). Almost no attention is paid to the final consequences of such practices, and the relentless quest for money makes it unlikely that serious attention will ever be paid. Even on a theoretical level, the permanent feeding of humanity is not simple. Any long-term solution would require paying as much attention to restoration of the land as has previously been paid to its cultivation.

Secondly and more importantly, to maintain a permanent balance between population and cultivation would require a considerable reduction in the former. It is foolish to say that the gap between food and population can be met by increasing the production of food. The error, a rather obvious one, is that an increase in food is inevitably followed by a further increase in population, which in turn leads to another shortage of food. Since the dawn of the human race, people have been trying to find ways to increase the food supply; often they have succeeded. Perhaps the biggest success of all was agriculture itself, the discovery that one can deliberately put seeds into the ground and foster their growth, rather than going off into the jungle to look for plants growing in the wild. That particular revolution led to a great increase in human population. The original problem, however, simply recurred. The solution (some means of increasing food) always leads straight back to the original problem (an excess population).

But these two forces do not act merely in a circular fashion. It would be more exact to say that they act as an ever-widening spiral. If we double the food supply, and thereby induce a doubling of human population, the new problem (that of excessive population) is not entirely identical to the original problem, because as the spiral widens it creates further dangers.

At some point, we push the planet Earth to the point where it can no longer maintain that spiral. We can convert vast quantities of petrochemicals into fertilizers and pesticides, we can draw water out of the deepest aquifers and even desalinate the oceans, but at some point we have to face the fact that the Earth is only a small rock, small enough that it can be encircled by a jet plane in a matter of hours. We are squeezing both our residential areas and our farmlands beyond endurance. The greatest danger of such a spiral is that when it breaks, it will do so in a far more destructive way than if the problem had been solved earlier. When the human race suddenly finds itself unable to manage the reciprocity of overpopulation and food production, there will be no more choices left to make.

References

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3. Driver, Harold E. Indians of North America. 2nd ed. rev. Chicago: University of Chicago Press, 1961.

4. King, F.H. Farmers of Forty Centuries, or, Permanent Agriculture in China, Korea and Japan. Various editions.

5. McMahon, Kathy. “Remember, Remember the 5th of September, 2000.” Peak Oil Blues. www.peakoilblues.com

6. Solomon, Steve. Water-Wise Vegetables. Seattle: Sasquatch, 1993.

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Further reading:

"Intensive crop culture for high population is unsustainable" on Culture Change, by Peter Salonius, February 3, 2008

Peter Goodchild's previous articles on Culture Change are

Depletion of Key Resources: Facts at Your Fingertips

When the Lights Go Out

Crime in the Post-Peak World

How Much Land Do We Need?

Putting Meat on the Table

Laborers Before Sunrise

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Growing Your Own Grains
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