
Biotechnology and Mature Capitalism

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INTRODUCTION

Most of the biotechnology products on the market today are pharmaceuticals. They have been introduced with relatively little opposition or public debate. However, agricultural products produced from biotechnology seem to have been surrounded with controversy from the outset. It is this segment that I wish to address.

The recent ban on some of these food products by countries that are major purchasers of food commodities from the United States has created major confusion in farming communities. Farmers were promised that products containing new genetically modified organisms (GMOs) would provide new opportunities for them and would increase profits for farmers willing to embrace them (*Doane's Agricultural Report* 1999). However, between the time farmers purchased their seed and the time they had it planted in the spring of 1999, some learned that certain processing firms would pay a premium for non-GMO products. Others discovered that in receiving certain GMO seed, they had to sign a contract stating that they were responsible for guaranteeing that the products of this seed would not get into the stream of products (or by-products) heading to Europe. All this happened at a time when the world seemed to be awash in grain and oil crops as reflected in commodity prices below the cost of production. These issues were added to the farmers list of negative reactions to the \$6.50 technology fee added to each bag of seed purchased, and to Monsanto's hiring of a detective firm to enter farmers' fields (as allowed by the contract a farmer had signed) to take a tissue sample to ensure the company that the farmer had not planted in the current year seed saved from the previous year. By the summer of 1999, some of the early adopters were wishing they had never heard of these new products.

Those individuals and organizations with research interests in biotechnology and firms that see the opportunity to obtain economic profits from their involvement in biotechnology defend their interests by suggesting that the technology will help to feed the earth's growing population. Although this provides strong moral legitimization, it overlooks a major principle of a capitalist system, namely that a firm's primary motivation is to generate returns for those who provide its capital. Profit is the goal that guides their decision-making. This goal is not necessarily compatible with feeding all people of the world. These firms will focus on feeding that portion of the population that can pay a price that allows a good profit. However, as Per Pinstrup-Andersen noted, about one-fifth of the people of the world are members of families that earn less than a dollar a day. These people are not getting their food from firms that comprise the globalized food system — the same firms that make the major decisions regarding how biotechnology is used — and they are not able to purchase the increasingly expensive inputs to produce such crops.

Today, there are many that argue that we have adequate global food production now and that the real issue is a distribution problem. Some argue against the need for biotechnology and suggest that producing food for the growing population is not the problem. Others defend biotechnology, but do suggest that someone should address the distribution problem. My major concern is that biotechnology is increasing, rather than decreasing, the problem of whom is able to get food versus who needs food. My purpose is to show that under the current form of capitalism evolving in the world, biotechnology is becoming one of the major drivers of change in the global food system resulting in more, not less, inequality in the distribution of food.

There is little doubt that biotechnology is a very powerful scientific technology, but like the development of another powerful technology, nuclear energy, the products of this scientific discovery have the potential to be used for both major societal good and harm. The technology is neither good nor bad. The key question must focus on who will make the decisions about how biotechnology will be used and who will reap the benefits from the technology. To understand this, we must understand how the social system operates, especially political/economic institutions.

Recent documentaries have reminded us of the race between nations to develop the atomic bomb that helped speed the end of World War II. The United States and its allies won that race and were the "benefactors." The conclusions we have drawn about whether that technology was good or bad might have been quite different if Hitler had been the first to develop the bomb. History has shown that even the peace time benefits of nuclear energy have been accompanied by some major costs. In fact, many of the costs have been so great and will be with us for so long that it has not lived up to the expectations many had for it. Nuclear energy has certainly not been the solution to the world's growing energy needs.

In the development of biotechnology, the race is between a few global food firms. I wonder if the same comparisons and observations about societal benefits and costs will someday be said about biotechnology and food. Events in the past year have certainly begun to identify some of the possible costs. My purpose is to examine the globalized, industrialized food system into which food biotechnology is being introduced, and suggest some of the implications the system has for feeding the people of the world and other potential public benefits often listed by supporters of biotechnology.

THE DIMINISHED DECISION-MAKING ROLE OF FARMERS

The movement toward industrialized agriculture with its heavy dependence upon scientific discoveries can be traced back to the beginning of the 20th century, but it was not until mid-century that major structural changes in the food system became obvious. This was the time when hybrid seeds, commercial fertilizer and, soon thereafter, agrichemicals became common inputs on farms. About this time farm equipment also was becoming much larger than that used when horsepower was the major source of energy. Farm families could now farm a much larger acreage than ever before.

This was also the time when the confinement production of large numbers of animals began to emerge. With the movement of animals into confinement came a major structural change in the food production system. Many of the decision-making responsibilities regarding the production of animals moved from the farm family to integrating firms that would provide some of the production inputs, the market for the products, or both. In the case of broiler production (the first major sector to change), the integrating firms provided the birds and feed and made all of the major decisions regarding production, such as the building and equipment designs used, the genetics of the birds, the ration fed, the schedule for when the chicks were delivered to the grower, and when the broilers were taken for processing (Heffernan 1984). The growers provided the land, the capital for the buildings and equipment, and the labor. The growers were no longer involved in marketing because they did not have title to the birds. They received compensation from the integrating firm rather than from the sale of broilers. Payment to the growers was based on a piece rate. Today, growers are paid between three and four cents a pound for the number of pounds produced.

The movement from the family farm system in which the farm family provided the majority of the management, labor, and capital, to an industrialized type of organization in which some of the capital and all of the major management decisions were made by the integrating firms, had begun by the mid 20th century. Eventually, most other animal production systems would follow a similar reorganization. On crop farms, a structure was emerging in which a larger proportion of the labor on the farm was non-family labor. This too was a change from the family farm and was more similar to industrialized production systems that hire workers based on an hourly payment or a wage.

As the 20th century comes to a close, we hear more and more about needing only 20,000 to 30,000 farms in the U.S. producing feed grain, oil crops, and animals for the globalized, industrialized food system. These farms will be operating under a system that includes characteristics of production contracts like those used in the broiler sector, a hired labor system (industrialized system), or most likely a combination of both. None of these alternatives resembles the decentralized decision-making system of the past (i.e., the family farm system). I hear “rumors” that we will be seeing production contracts for non-identity preserved corn, soybeans, and wheat by the next cropping season. Whatever the exact form of the relationships between the farmer and the firms that provide the farmer’s inputs and markets for the farm products, it appears that the relationships will be different from those a half century ago. Then no firm could set the price or conditions of sale for either the inputs or the products grown on the farm since there were many providers of the inputs farmers needed and sufficient markets (processors) available to the farmers. As a major decision-maker in the globalized food system, the management of a few large global food firms or food clusters is rapidly replacing the “farmer.”

CONCENTRATION OF THE MARKETS

For more than a decade, some of us at the University of Missouri have been documenting the growing concentration of ownership and control by a few firms of the processing stages of the major farm commodities produced in the Midwest. Increasingly the food system began to resemble an hourglass, with thousands of farmers producing the farm products that had to pass through a relatively few processing firms before becoming available to the millions of consumers in this and other countries.

The extent of horizontal integration, that is the concentration of ownership and control in the processing stage of selected crop and meat commodities, is shown in Table 1. In the meat sectors, about 80 percent of the beef cattle and 57 percent of hogs are slaughtered by the four largest firms. About one-half of the broilers (chickens produced for meat) are produced and processed by the four largest firms with Tyson Foods now producing and processing almost one-third of the broilers in the United States. In the crop sectors, the four largest firms process from 57 to 76 percent of the corn, wheat, and soybeans in the United States.

Although debate continues as to what constitutes an oligopolistic or near monopolistic market, much of the literature suggests that when four firms control 40 percent or more of any market, these few firms are able to exert influence on the market unlike in a competitive system. Just as the narrow opening of an hourglass controls the flow of sand from top to bottom, the processing firms are able to exert considerable influence on the quantity, type, and quality of the product, the location of production, and the price of the product at the production stage and throughout the entire food system. The

TABLE I

THE FOUR LARGEST COMMODITY PROCESSING FIRMS AND
PERCENT OF U. S. MARKET SHARE THEY CONTROL

Broilers (meat chickens): 49% of production

Tyson-Foods, Gold Kist, Perdue Farms, Pilgrim's Pride

Beef: 79% of slaughter

IBP, ConAgra (Armour, Swift, Monfort, Miller), Cargill (Excel),
Farmland National Beef Pkg.

Pork: 57% of slaughter

Smithfield (Gwaltney, Cudahy, Morrell, Lykes), IBP, ConAgra, Cargill

Sheep: 73% of slaughter

ConAgra, Superior Packing, High Country, Denver Lamb

Turkey: 42% of production

Hormel (Jennie-O) ConAgra (Butterball), Wampler Turkeys,
Cargill Turkeys

Flour Milling: 62% of milling

Archer Daniels Midland, ConAgra, Cargill, Cereal Food Processors

Soybean Crushing: 80% of processing

Archer Daniels Midland, Cargill, Bunge, Ag Processors

Dry Corn Milling: 57% of milling

Bunge, Cargill (Illinois Cereal Mills),
Archer Daniels Midland (Krause Milling),
ConAgra (Lincoln Grain)

Wet Corn Milling: 74% of milling

Archer Daniels Midland, Cargill, A. E. Staley (Tate and Lyle), CPC

Source: W. D. Heffernan, "Concentration of Agricultural Markets," Unpublished paper, Department of Rural Sociology, University of Missouri-Columbia, (January, 1999)

only stages remaining in the food system where there is competition between firms of equal economic power is between processing and retailing stages. In the past year, the retail stores have become much more concentrated, with the 10 largest firms now controlling half of the retail trade.

A quick review of the names of the four largest firms in the processing stage of farm commodities from Table 1 suggests that the same names appear on the list of processors of more than one commodity. Names such as Cargill, ADM (Archer Daniels Midland), ConAgra, Bunge, and IBP (Iowa Beef Processor) appear more than once. ConAgra ranks in the top four processing firms for beef, pork, sheep, turkeys, and seafood, which is not listed. Until 1998, they were in the top four in broiler production and processing. They have now dropped into fifth place.

A second means to concentrate the food system is referred to as vertical integration, which is joining two or more stages in the food system — the process of concentrating ownership and control. ConAgra notes in its 1997 Annual Report that it is the leading distributor of crop chemicals, fertilizer products, and seed in the U.S., Canada, Mexico, UK, and Chile. They own and operate 100 elevators (both local and terminal), 1000 barges, and 2000 railroad cars. They manufacture animal feed, and produce and process their own broilers. The broilers can be purchased as whole fryers, or as further processed foods such as Banquet TV dinners. ConAgra is the second largest processor of food in the U.S., behind Philip Morris.

A third way to concentrate the food system is to expand beyond national borders and become part of the globalized industrialized food system. Slogans like “supermarket to the world” and “world without borders” indicates the global reach of a relatively small number of food firms. Cargill has operations in 70 countries, but its economic transactions extend to many other countries. In fact, the food systems of the world are becoming so integrated by the transnational corporations (TNCs) that it often makes little sense to speak of the food system of a single country.

With the passage of the North American Free Trade Agreement (NAFTA), beef cattle easily travel back and forth across the borders. IBP, Cargill, and ConAgra, which slaughter three-fourths of the beef in U.S., all have feedlots and processing facilities in Canada and about the same market dominance there. It is possible for them to purchase a feeder calf in one country move it across the border as a stocker animal, send it back across the border to their feedlot, and back across the border one more time to have it processed. In fact, one of the firms could purchase the feeder calf in Mexico, feed it in their feedlot in U.S., and slaughter it in Canada. The question then is — in what country was it produced? This question has taken on great significance given the efforts of many cattle producers and their organizations to legislate “country of origin labeling” for red meat. The firms identified above also have production and slaughtering facilities in many countries of the world, including Australia, Brazil, and Argentina.

THE EMERGING GLOBAL FOOD SYSTEM

In the past, most of the global grain firms were family-held operations that tried to maintain low visibility and were quite secretive about their transactions. These firms operated in one or two stages of the food system and in a very few commodities. Today, that system is breaking down as the three processes of horizontal integration, vertical integration, and globalization are combining to develop the globalized, industrialized food system. The emerging global food system is characterized by a few dominant firms that have developed a variety of different alliances with other firms in the system. Acquisition is still a common method of combining two or more firms; but mergers, joint ventures, partnerships, contracts, and less formalized relationships and side agreements are also utilized. We have used the concept of “food system clusters” to represent these new economic arrangements into which the emerging biotechnology will be located (Heffernan et al. 1999). These clusters will make the decisions as to how biotechnology will be used and who will benefit.

Figures 1, 2, and 3 suggest three food system clusters that appear to be emerging. We speculate that one to three more such clusters might develop in the globalized food system, because some of the major life science, chemical, and processing firms are not yet included in the clusters we have identified. Firms like AstraZeneca and Aventis, which is a new joint venture of existing alliances of former European life science and chemical firms, will clearly be major firms along with firms like Dow and DuPont, which now owns Pioneer. Other processing firms like Tyson Foods, Smithfield, and Farmland Industries, a farmer cooperative, and some of the others listed in Table 1 are not included in the diagrammed three food system clusters. We keep watching for other firms from countries other than the U.S. to emerge. (Note that Novartis is based in Switzerland.) The extremely high capital cost of biotechnology research, combined with the U.S. allowing firms to patent their technology to protect their intellectual property rights, has set up the basis for an oligopoly (near monopoly) at the global level.

The introduction of biotechnology and the patent rights the firms have been given is reshaping the hour glass analogy. Increasingly we see the constraining of competition in the food system on the input side of agricultural production to be at least as great and quite possibly greater than the constraints of a few dominant firms at the processing stage (Hayenga 1998). I often have interesting discussions with my agricultural economist colleagues about whether the lack of competition in the system is the result of economic (and political) power acquired by the dominant firms or whether it is the result of “economies of size.” In the case of biotechnology, government-granted patent rights may reduce competition. We feel that each of our food system clusters will include a firm that has access to biotechnology. Those firms, because of exclusive patent rights, will be a dominant firm in the food system cluster. We are not aware of any formal alliance that has ConAgra a dominant firm with a biotechnology

Figure 1

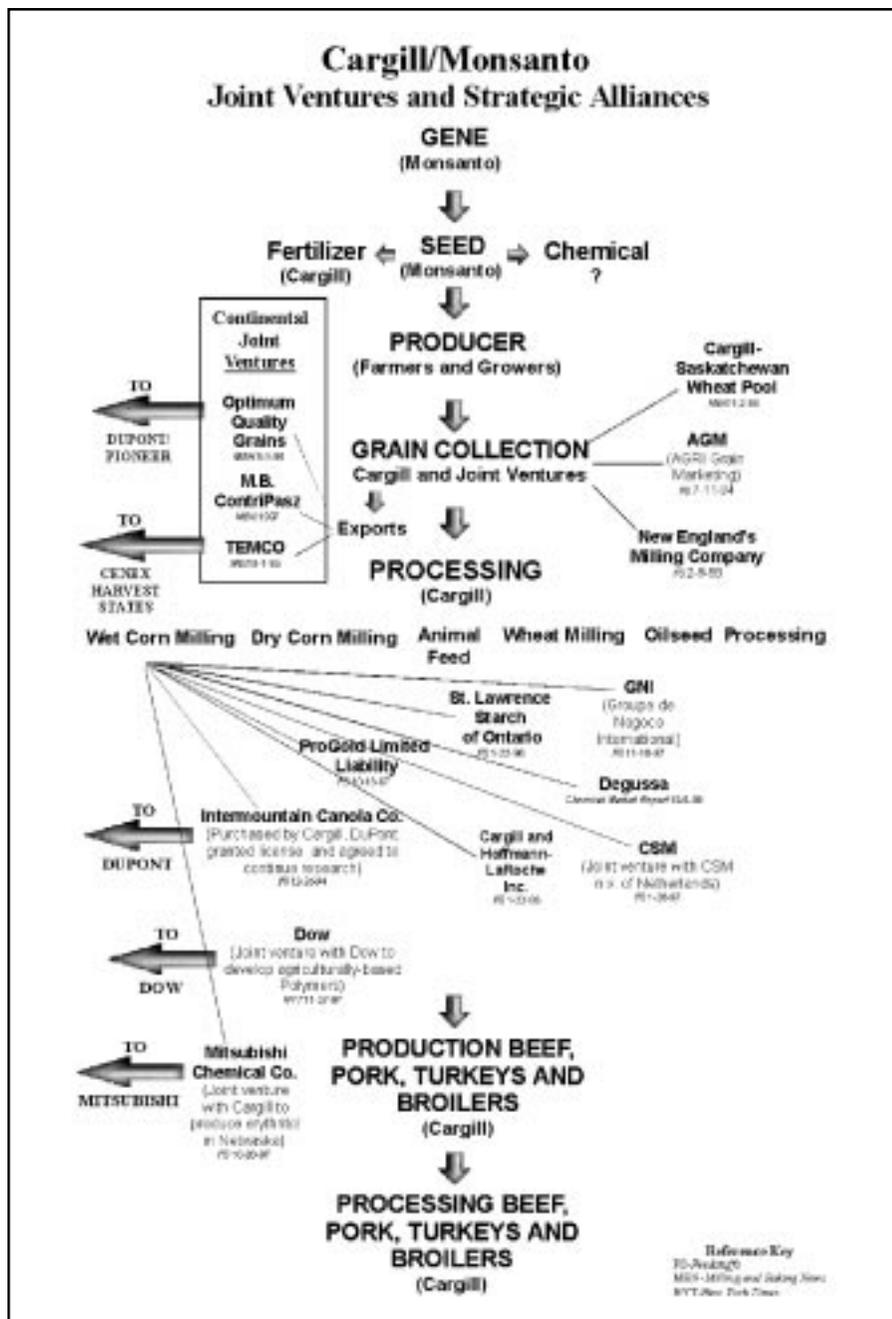


Figure 2

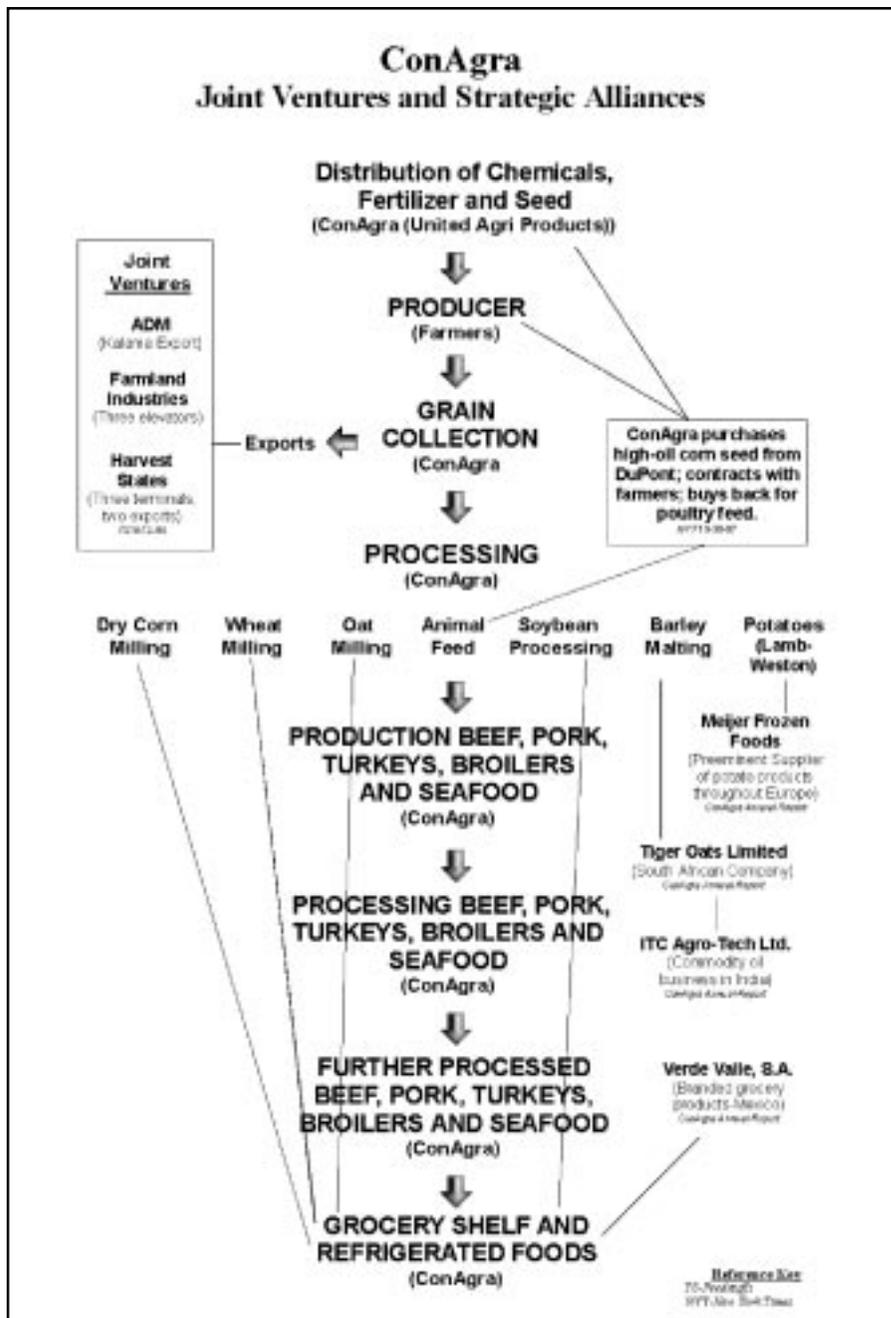
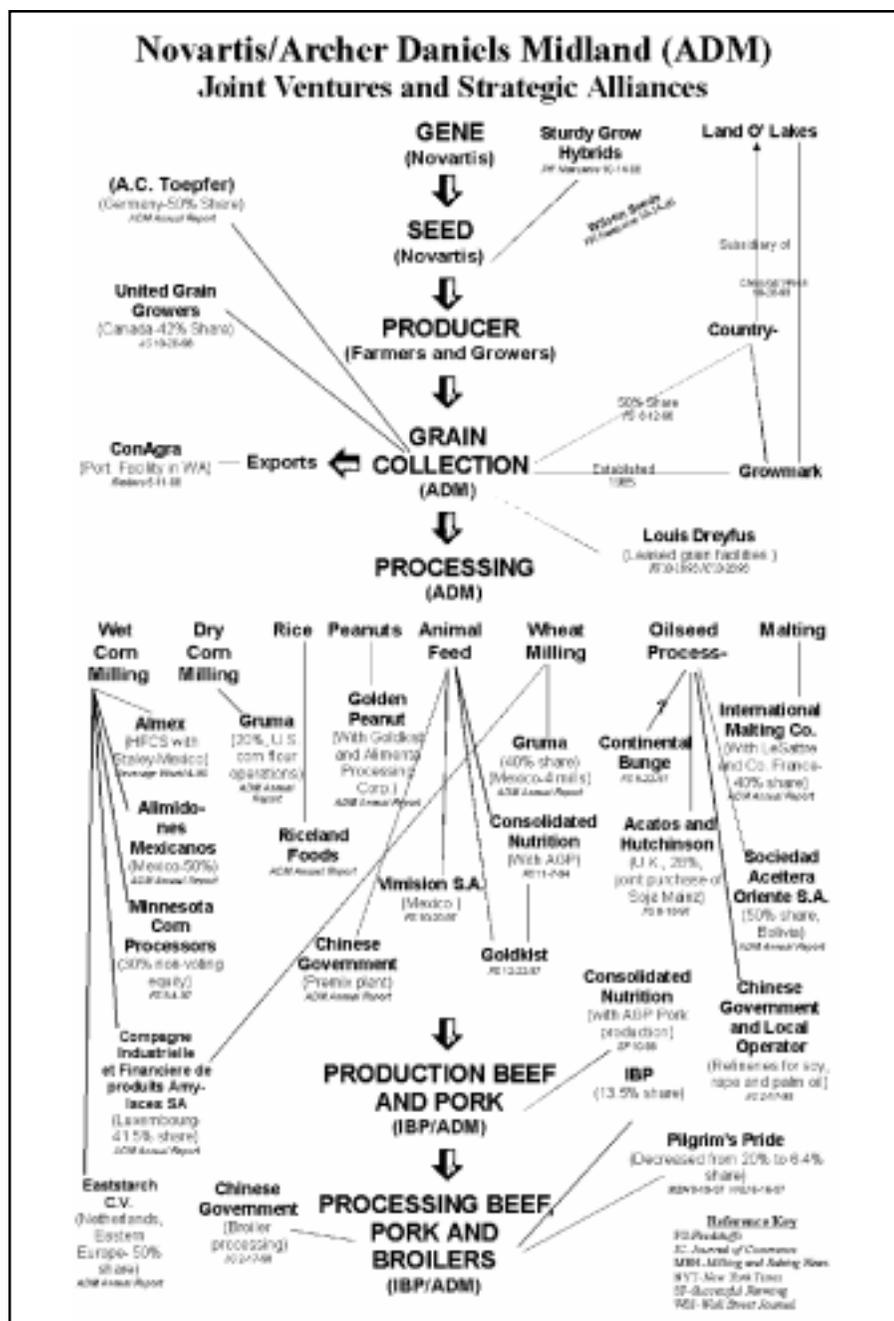


Figure 3



firm (Figure 2). ConAgra does purchase high-oil corn seed from DuPont. This helps to make the point that this system is still very dynamic and still evolving. But the direction or trend seems quite clear — at least in the short term.

The numerous “alliances” in each cluster lead to what is often called a “seamless system,” which describes the emerging, fully integrated food system from the gene to the supermarket shelf. Within this emerging system there will be no markets and thus no “price discovery” from the gene to the shelf. The first time the price of any input in the food system will be public information will be at the supermarket. As this system evolves, the public will not know the price of animal feed and its ingredients, such as the corn, because like today’s broilers the product will not be sold. The firm owns the chick and sends it to its processing facility from which it emerges, perhaps as a TV dinner. In a food system cluster, the food product is passed along from stage to stage. Technically ownership may change, but the location of the key decision-makers does not change. Starting with the intellectual property rights that governments give to the biotechnology firms, the food product always remains the property of a firm or cluster of firms with close working relationships. The farmer becomes a grower, providing the labor and often some of the capital, but never having clear title to the product as it moves through the food system and never making the major decisions.

BIOTECHNOLOGY AND CAPITALISM

The food system is not becoming different from other economic systems of the global economy. In fact, it is becoming more like the banking, computer, automobile, and mass media economic systems. One of the interesting topics some of my fellow sociologists have explored is why the food system, especially the agricultural portion of it, was so slow to follow the industrialized model. Because food is a necessity of human life and is needed on a regular basis, unlike other goods and services exchanged in the global market, the changing structure of the food system may attract more attention than changes in other economic systems.

The concept “capitalism” is often used to describe different types of economic systems. Often the concept capitalism is used to suggest an economic system with limited government intervention and a market system characterized by competition. The characterization of the agriculture/food system in which 1) no firm providing inputs into agriculture or markets for agricultural products had enough market share to influence the price; 2) there existed relative freedom of entry into the input sectors, production sectors, and market sectors; and 3) reasonable public knowledge of local markets prices and conditions existed, was correct until about the middle of the 20th century. This type of capitalism is sometimes referred to as “early capitalism.”

Without strong government intervention to “keep the playing field level,” it is inevitable that certain firms will begin to develop economic, (and possibly

political) power, such that they can begin to squeeze out their competition. The literature on industrial organizations lists many means that firms in the competitive phase can use to gain the edge over their competitors. Two of the most common means used are 1) increasing size to take advantage of economies of size, and 2) becoming one of the earliest adopters of new technology. As an economic system matures, competition becomes greatly reduced. A firm that operates in many commodities, in many stages of the production sector for that commodity, and in numerous countries in the world, can make very difficult the survival of a firm operating in one commodity, in one stage of the production system, and in one country. If small firms hope to survive, they must find a niche where the large diversified firm does not wish to operate.

Because biotechnology is such a capital intensive research enterprise, most small firms soon become marginalized. They cannot generate the capital needed to compete in the research arena. The larger and more powerful firms then receive patents on their technologies, further eliminating competition. One only needs to examine the number of established seed firms that Monsanto has acquired in the past year or so to see the restructuring of the seed input stage of the food system as a result of the dominance of biotechnology. Even a firm as large as Cargill felt it was better to sell the global seed business to Monsanto and form a joint venture with them than it was to try enter the biotechnology field on its own.

Finally, I would return to the goal of corporations — the corporations that are making the major decisions and basically controlling how biotechnology will be used in the food system (Kloppenborg and Burrows 1996). The firms are very honest about their goals. One of the dominant firms suggests that their major mission is to enhance the wealth of their stockholders. In the past several years, the pharmaceutical firms have had the highest rates of return on equity of all firms in the manufacturing sector. In most years, food firms ranked second. The dominant food firms expect to achieve a 20 percent return on stockholder equity by traveling around the world and “sourcing” their products wherever they can get them produced the cheapest. In the globalized system, both capital and technology are very mobile and can be moved anywhere in the world very rapidly.

Food firms are not charitable organizations. They are not concerned with feeding all the people of the world. They are concerned with feeding people who can purchase food products, even those shipped halfway around the world under refrigeration. Poor people in this country and other countries of the world cannot be consumers in such a system. Neither can the farmers (peasants) in poor countries be purchasers of the high-priced inputs that accompany producing agricultural products with biotechnology. Poor people can provide some of the labor needed in food production, but the food they produce may never belong to them or their families. That food may very likely

be sent to more affluent countries, where labor costs and the cost of selected health and environmental regulations result in higher food production costs, and thus higher priced food. This is already happening, but biotechnology will exacerbate it.

Many of us have pension plans and/or personal investments in a variety of for-profit firms. We have come to expect high rates of return from our investments (unless that investment is in farmland or a farm operation). In fact, if we receive only an annual rate of five or six percent return on our investments for a short period of time, we think that it is time for a new CEO. This attitude forces these firms to become very shortsighted. The CEO must be concerned about the firm's financial performance in the next few months if he/she expects to be in that position for the next few years. We are a part of the economic system that has become obsessed with profit and consumerism. Perhaps I have slightly over-dramatized the importance of short-term profits in guiding the global, industrialized food system, but put yourself in the shoes of a CEO of one of the dominant food firms. Ask what criteria you would use in making the many relatively small, daily decisions within the organization that has a major cumulative effect? Would the criteria be different than that used for making major decisions such as involvement in a merger or joint venture? These decisions made in the dominant firms help to shape the globalized system.

Creating a secure and sustainable world food supply is seen by many of those managing the food firms as a concern, but it is not seen as the responsibility of the private sector. It is seen as the responsibility of the society as represented by the government. The irony is that as trade liberalization is extended around the world, it simply means that governments, which are supposed to be responsible for the common good, turn more and more of the decision-making in the economy over to the transnational corporations.

The economic institution has become so strong that it is having a major impact on our entire culture and the institutions that it encompasses. The power of the global economic institution is so strong today that many neo-classical agricultural economists suggest that the growing concentration and power imbalance is part of a "natural system." The implication is that we cannot change the direction of the economic system and must adjust to it. As a sociologist, I disagree that the economic system cannot be changed. The economic system has been created by humans and can be willfully changed, but it will not be done overnight. Not all people have been involved in determining the economic system that clearly serves some better than others. If we want to feed all the people of the world, we will need to take a serious look at the economic system and its relationship with the political system.

Many find it is easy to suggest that the major food problem is "just a problem of distribution." Others recognize there is a distribution problem, but simply suggest that the government needs to take some action. They then move on, fully supporting the development of more technology and hoping that

somehow the new technology will help feed the growing populations. I see very little research funded to help us better deal with the issues of food (or even income) distribution that are the real issues in feeding all the people of the world now and in the future. These issues are probably more difficult to solve than generating more technology. Until we seriously deal with the distribution problem other than in the *de facto* way of allowing it to continue, I do not think biotechnology will make much progress in feeding the people of the world whom now have inadequate diets. I am even suspicious about the voiced concern for feeding the growing population. While it may be one concern of the food system clusters including the biotechnology firms, it doesn't rise to a level of commitment.

My sense is that biotechnology has been introduced much too rapidly into society. The political institutions, as well as the religious and other social institutions, are simply not able to evolve fast enough to deal with the rapid introduction of such a powerful technology. Returning to my comparison with nuclear technology, I ask — what is the purpose of the “race” for biotechnology at a time when we are awash in commodities and show no signs of solving the distribution problem? There are probably two races going on. The first is between a few major firms to see who can make the most profit in the shortest period of time, and the second is between research institutions to see who can garner the most research funding and academic status.

In allowing firms to patent intellectual property, the U.S. government set in place a structure that would greatly reduce competition in the food system. The explanation for this was that it would encourage firms to invest huge sums of capital into biotechnology and bring it to the market in a short period of time. What was the big rush? Would it not have been better to keep this life science technology in the public domain so that there could have been public debate and democratic decision-making involved during the research process? Privatizing the research led to secrecy both in the research and in the development of products. This often increases public suspicion and makes it difficult for other institutions to prepare for such a new technology. At this point in time, it appears societies feel their only choice is that of accepting or rejecting all of biotechnology in the food system. The question is whether there is room for any compromise?

In closing — is it too much to ask that we slow the development of this technology, engage the public in a debate as to its costs and benefits following our democratic tradition, and slow the process until we can determine how to properly engage the other institutions in our society?

REFERENCES

ConAgra *Annual Report*, 1997

“Value-Enhanced Grains — A Progress Report,” *Doanes Agricultural Report* 62 (1999)

- M. Hayenga, "Structural Change: The Biotech Seed and Chemical Industrial Complex," *AgBioForum* 1 (1998)
- W.D. Heffernan, "Constraints in the U.S. Poultry Industry," in *Research in Rural Sociology and Development* 1, ed. H. Schwartzweller, (1984): 237-260
- W.D. Heffernan, M. Hendrickson, and R. Gronski, "Consolidation in the Food and Agriculture System," *Report to the National Farmers Union*, (1999), www.nfu.org
- N.G. Kalaitzandonakes, "The Agricultural Knowledge System: Appropriate Roles and Interactions For The Public and Private Sectors," *AgBioForum* 2 (1999): 1-5
- J. Kloppenburg, and B. Burrows, "Biotechnology to the Rescue? Twelve Reasons Why Biotechnology is Incompatible with Sustainable Agriculture," *The Ecologist* 26 (1996): 61-67