Biotechnology on the Ground: What Kind of Future Can Farmers Expect and What Kind Should They Create?

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One of the central questions that any new technology poses for farmers is whether or not it will benefit them. Will it either benefit them directly by solving management problems or improving profitability? Or will it benefit them indirectly by enabling them to achieve some social goal that they wish to support?

Such a pragmatic assessment of any technology is, of course, made difficult by the cultural love affair with technology that we have nurtured in our society since the dawn of the industrial revolution. But farmers must know by now that not all new technologies will be friendly to them. Indeed, Willard Cochrane made a compelling case for the opposite view when he coined the phrase "technology treadmill." Even when a technology appears to be beneficial to farmers, like tractors replacing horses for greater labor efficiency, it will put a good number of farmers out of business (Cochrane 1958).

Whether or not such systematic elimination of farmers from farming has been, or continues to be, a social benefit is a subject of debate that we have never had in any democratic forum. But to argue that every new technology is a sign of progress and bound to benefit farmers is a proposition of mythology, not sound business or social policy.

While it is clear that every new technology benefits someone, it is equally clear that not every new technology benefits everyone. Accordingly, with respect to genetic engineering, the question farmers need to ask is whom this technology will benefit. The likely beneficiaries are the corporations developing the technologies and their investors. They wouldn't be investing billions of dollars unless there were a strong likelihood that the objectives (at least the financial ones) can be achieved.

The question that farmers must ask is whether or not the technology will benefit them.

The biotechnology industry claims that farmers will benefit — directly by solving management problems and increasing profitability and indirectly by solving social problems with which farmers can identify. These claimed benefits can generally be subsumed under three categories:

1. That the technology will increase farmers' profitability and make them more competitive in the marketplace: This claim promises direct benefits to farmers.
2. That the technology will simplify farmers' pest management problems and do so in an environmentally benign way: This claim promises to benefit farmers directly and enable them to achieve a social goal.
3. That the technology will enable farmers to feed a world of expanding human population: This claim mostly promises farmers an opportunity to achieve a social goal, but it is generally assumed that it would also provide them with economic opportunities.

Are these claims true? I will argue that the probability that farmers will experience any of these benefits, given the way the technology is currently being applied, is very unlikely.

Let's analyze each of the claims from a farmer's perspective.

That Genetic Engineering will feed the World

There is a fundamental flaw with this claim that is exposed in the conclusion of several decades work by the Nobel Prize winning economist, Amartya Sen. His simple, unassailable conclusion, based on his study of the classic famines of the world, is that hunger is not caused by food availability, but by food entitlement. In other words, hunger is not caused by an insufficient quantity of food, but by insufficient access to food. Feeding the world is therefore largely a social, not a production, problem (Sen 1981, 1986).

Continuing to assume that hunger is a production problem without wrestling with the difficult problem of entitlement ironically ends up exacerbating the problem of hunger. And, in the process, it ends up hurting farmers economically. Brazil stands as a clear example. The production of soybeans in Brazil has increased dramatically in recent years. But the soybeans are produced primarily for export to Europe and Japan where they are used for animal feed, thereby denying local Brazilians entitlement to the food production capacity of their own country. Consequently during the same time that soybean production has exploded, the number of malnourished in Brazil has increased from one third to almost two thirds of the population. And Brazil's increased food requirements will not be supplied by U.S. exports for the simple reason that malnourished Brazilians can't afford them.

Meanwhile the over production of soybeans has pushed the price of soybeans in the U.S. down to four dollars a bushel. Simultaneously, it decreased the availability of land for local Brazilian farmers who used to produce food for local Brazilian populations. This is not a formula that feeds the world, or brings benefits to the majority of farmers. And converting all of the soybeans grown in Brazil to genetically engineered (GE) varieties won't change that.

Furthermore, focusing only on more food as the single solution to expanding human populations detracts our attention from a host of other problems that further overcrowding, by still more humans on the planet, will surely create:

- increased disease,
- destruction of ecosystem services, and
- increased fragility of the entire ecosystem that a further imbalance of humans relative to other species will cause.

Besides, to my knowledge no one ever asked farmers if they wanted to take on the responsibility of feeding the world, or asked them how they wanted to do it if they did.

That Genetic Engineering will Solve Pest Management Problems in an Environmentally Benign Manner

Again, there is a fundamental flaw with this claim. The problem is that current applications of genetic engineering technologies for solving pest problems still adhere to the same paradigm that led to futility in pest management with toxic chemicals. Joe Lewis of the Agricultural Research Service's Insect Biology and Population Management Research Laboratory in Tiffon, GA, together with several colleagues, published a "perspective" paper in the National Academy of Sciences Proceedings in 1997 that clearly and succinctly lays out the problem. Our predominant paradigm for pest management, argues Lewis, has been one of "therapeutic intervention." This approach attempts to eliminate an undesirable element by applying a "direct external counter force against it." That paradigm is now being widely questioned not only in agriculture, but in medicine, social systems, and business management enterprises (Lewis 1997).

As Peter Senge points out in his work on systems dynamics, externally imposed solutions at the expense of analyzing and understanding the functions of the system, generally leads to creating the problem we are trying to solve. The reason is simple. "The long-term, most insidious consequence of applying non-systemic solutions is increased need for more and more of the solution" (Senge 1990). Farmers can certainly relate to that with respect to pest management. In fact, it is precisely that principle at work that led Robert van den Bosh to coin the phrase the "pesticide treadmill" more than twenty years ago. Applying an external solution to a pest problem generally disrupts the natural balance that keeps pests in check and develops resistance in the target pest, thereby increasing the need for more of the solution. While that certainly benefits the company selling the solution, it hardly benefits farmers.

In other words, not only is the therapeutic interventionist paradigm ineffective in providing sustainable relief from pests, it also makes the farmer more dependent on the supplier of the intervention. And as Donella Meadows points out "over time, the intervenor's power grows" over the person who becomes dependent on the intervention. The clear result is less economic empowerment for farmers and more economic power for the provider of the therapy. One can hardly argue that, that scenario is of benefit to farmers. To assess the long-term benefit of any pest management strategy for farmers it must be measured against the "fundamental principle" that Lewis articulates so succinctly:

> . . . application of external corrective actions into a system can be effective only for short term relief. Long term, sustainable solutions must be achieved through restructuring the system . . . The foundation for pest management in agricultural systems should be an understanding and shoring up of the full composite of inherent plant defenses, plant mixtures, soil,natural enemies, and other components of the system. . . The use of pesticides and other "treat-the-symptoms" approaches are unsustainable and should be the last rather than the first line of defense. A pest management strategy should always start with the question "Why is the pest a pest?" and should seek to address the underlying weaknesses in ecosystems and/or agronomic practice(s) that have allowed organisms to reach pest status.

Lewis goes on to point out that this principle holds for molecular biology as well as for toxic chemicals. Since genetic engineering conforms to the same interventionist strategies used in the chemical pest control era, farmers should not expect any long-term pest management benefits from the technology. Resistance to Bt will develop, for example, rendering Bt corn and similar pest management strategies ineffective. That, in turn, will complicate future pest management efforts — not to mention destroy an environmentally benign pest management tool that many farmers have used effectively for more than 20 years. And if the recent study reported in *Science* magazine is correct, (demonstrating that the genes encoding resistance to Bt in European corn borer are dominant, rather than recessive as previously thought) then the high dose/refuge strategy that farmers have been told to use to postpone resistance will be useless (Huang et al. 1999).

That it Will Increase Farmer Profitability and Make Farmers More Competitive

This claimed benefit is even more questionable. The reason farmers are not likely to see much profit from genetic engineering is not rooted in the cost of planting refugia to postpone resistance, or the yield drag of some genetically engineered varieties, or even the technology fees that farmers are required to pay. Some mainline farm magazines argue that GE crops could still pencil out despite these down sides, if one takes a long-term view (Holmberg 1999). I'm skeptical, but perhaps they are correct.

But there is, again, a more fundamental principle that farmers need to consider when assessing the profitability of any technology.

Stewart Smith, an agricultural economist at the University of Maine, perhaps articulated that principle most clearly almost 10 years ago. For most of this century, farmers have been taught to believe that profitability is strictly a matter of price and yield. Indeed, Paul Thompson at Purdue University has suggested that farmers have been so indoctrinated into the higher yield school of profitability that they now operate out of a single ethical principle — "produce as much as possible, regardless of the cost" (Thompson 1995). But Smith suggests that while farmer's fortunes are, to some extent, linked to price and yield, those factors ultimately do not determine farmer profitability. Profitability is determined more by the share of the agricultural economic activity that farmer's command then by the quantity of commodities they produce or the price they get for them. And Smith points out, rather graphically, that the farm sector's share of the agricultural economic activity has steadily eroded for most of the 20th century. According to Smith's study, farm sector economic activity shrank from 41 percent to nine percent during the period from 1910 to 1990. Coincidentally, during that same period of time the input sector economic activity increased from 15 percent to 24 percent and the marketing sector from 44 percent to 67 percent (Smith 1992).

And technology plays a key role in determining who gets what share. Smith points out that "technology is the primary cause of farming activity loss."

The problem is that the kind of technology that has been promoted by both the private and public sector is technology that shifts economic activity away from the farm sector to the input sector. For the most part the technologies developed over the last 100 years have been technologies that exert an external corrective action on a problem, rather than technologies that develop self-regulating systems. Those technologies increase economic activity for input companies but decrease economic activity for farmers. The reason that the private sector develops that kind of technology is readily understandable. It increases the profitably of the corporations producing the technologies. The reason that the public sector promotes this paradigm, according to Smith, is because it is strongly influenced by private funding.

Genetic engineering advances this scenario another quantum leap. Not only does the technology conform to the same paradigm of exerting an external corrective action on the problem, but the technology is instrumental in speeding up the merger mania that is now merging the input and market sectors. Bill Heffernan predicts that by the time the mergers and acquisition process is complete, there will be just four food clusters that will control most of the nation's food supply. These developments portend a future wherein farmers become contract workers forced to contract with one of these four input/market sector clusters. The farmer's only role will be to grow out the firm's seed, into the firm's crop, for the firm's market. As Bill Bishop puts it, “Farmers will not farm; they will fulfill contracts . . . biotechnology gives new meaning to tenant farming” (Bishop 1999).

If anyone thinks that farmers will become economically empowered in this system, they haven’t looked at the broiler industry lately. In this scenario, the only hope farmers may have of retaining any voice at all in their own economic welfare will be through some kind of universal collective bargaining. That may actually not be a bad idea since farmers are already paying their union dues in the form of check-off dollars, but the funds are misdirected. Farmer check-off programs seem to be based on the flawed notion that farmers can produce their way out of this problem. Airline pilots never use their union dues to get more people to fly. They use them to get a fairer share of transportation profits.

A more immediate way to empower farmers economically, however, is to implement Smith’s suggestion regarding the use of public funds and the way farmers must do business. Public funds, Smith argues, must be directed “away from technologies that shift activity from farmers to non-farm firms,” and toward farming systems that “displace purchased inputs.” Such technologies would create self-regulating pest management systems, and on-farm nutrient cycling systems, that displace purchased inputs. Such shifts would also tend to replace economies of scale with economies of scope, and it would, to a much larger extent, put farmers in control of their own costs.

The way farmers do business has to shift from farmers being the suppliers of undifferentiated mass-produced raw materials into a global economy, to becoming the marketers of identity preserved products and marketing those products as directly as possible. Such enterprises need to be owned and operated by farmers, with direct retail links that provide consumers with identity preserved products that conform to consumers’ changing demands.

What Kind of Future Should Farmers Create?

As we contemplate what kind of future farmers should create for themselves, it is important to recognize that the farm sector is developing into two very different kinds of farmers. By some estimates, there are now approximately 200,000 farmers who mass-produce 85 to 90 percent of the undifferentiated commodities that are sold as raw materials into the global market. These are the new wave of industrial farmers. We will likely see these farms dramatically increase in size and decrease in number as they become vertically integrated into the food system through contractual relationships. Some anticipate that the number of these farms will decrease to 25,000 in the next decade. That seems like a reasonable projection.

The production paradigm of these industrialized farms is not likely to change. Genetic engineering will increasingly be the “direct external counter force” used to solve farming problems. In the short-term, these technologies will be successful in solving some production problems. Eventually, we will see the technologies become ineffective and increasingly ecologically worrisome.

But even if they question their long-term effectiveness, these farmers will be required to use these technologies because their contractual relationships will mandate it. But industrial farmers should not expect to generate great profits, with or without genetic engineering, unless they can develop some kind of effective collective bargaining to claim a larger share of the food system profits.

Then there are the 1.5 million farmers who make up the balance of the farm sector. Increasingly, these farmers are developing ways of differentiating their product and shortening the distance between farm gate and consumer table. These are farmers who generally fit the description of the new economy described in detail by futurists like Alvin Toffler and Peter Drucker. Instead of mass producing an undifferentiated commodity in ever increasing economies of scale, these farmers will remain smaller, more flexible, and more innovative, using systems to produce a variety of highly differentiated products produced for specific markets. In other words, they will use "mind" instead of "muscle," as Toffler puts it. These farmers will increasingly shift to new production paradigms that internalize costs, and develop self-regulating and nutrient cycling systems. These shifts will take place not only because consumers demand them, but because energy efficiency and the demand to end public subsidies will require them. Most will eventually gravitate toward whole systems management in their production, as well as in their marketing.

These farmers are not likely to benefit much from the present applications of genetic engineering technologies. In fact many, like the Sinners in Casselton, ND, will gear up to fill market niches created by the consumer backlash against genetic engineering (*Jamestown Sun* 1999). The Sinners have long differentiated their production by certifying and selling seed. For them, identity preserving genetically natural crops is simply another way of differentiating a premium product that consumers want. Of course there are some applications of genetic engineering that this generation of "new economy" farmers can use. Genetic engineering, for example, might help us to better understand and implement self-regulating systems. However, since that application of the technology will result in few product sales, its development will have to be undertaken by public research institutions.

The industrialized farms, in my opinion, will fail in the long run. There are three fundamental reasons for their failure:

1. These farms will be highly centralized, routinized, and specialized. That means there will be little room for flexibility, diversity, or innovation. History does not give us many examples of farming systems designed on those principles that have succeeded. Increasingly these production systems will attempt to force the market to change (witness efforts to get Europeans to accept genetically engineered food, and hormone fed beef) rather than adapting to changing markets. That is not likely to succeed. As *Nature* magazine put it recently, "consumer acceptance" must be part of the equation (*Nature* 1999).

2. The routinization of these farms will dictate that the preferred technologies will be those that serve as a direct external counter force to solve problems, rather than those that make systems changes. There is no good reason to believe that molecular biology, used in that paradigm, will be any more successful than chemistry in creating sustainable pest management systems.
3. Genetic engineering will increase the specialization and routinization of these farms and they will therefore continue to dramatically reduce the biodiversity of farms and the ecosystem in which the farms exist. This further reduction of both genetic and species diversity will make these farming systems increasingly vulnerable to new pests and diseases.

Eventually the system will collapse

For farmers who choose to create their future in the new paradigm, there is hope for a brighter tomorrow. There will, however, be many challenges along the way. Precious little research and technology development has been done to support this alternative direction. Market infrastructures have not been developed, and public policies, for the most part, favor the old paradigm. Public policies that put that alternative on a level playing field would help farmers gain a foothold in this "new economy," "new paradigm" future.

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For additional reasons why genetic engineering will not help feed the world, see the 28-page briefing entitled “Food? Health? Hope? Genetic Engineering and World Hunger,” prepared by The Corner House, PO Box 3137, Station Road, Sturminster Newton, Dorset DT10 1YJ, UK.