

## **EXPLORING THE PUBLIC'S ROLE IN AGRICULTURAL BIOTECHNOLOGY RESEARCH**

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The potential for market failure resulting from under-investment in research is one justification for public agricultural research. This justification seems less germane given recent developments regarding intellectual property protection and the size of private biotechnology firms. This article explores an alternative justification for public support of biotechnology research in agriculture.

*Key words:* biotechnology; public research support; innovation; market failure

As noted in previous issues of *AgBioForum*, the introduction of biotechnology into agricultural systems has generated considerable interest and controversy, both within the agricultural community and in society at large. Many are optimistic that biotechnology will trigger economic growth and forestall world hunger, but others see the potential for disruptions to the environment and even ecological tragedy. Intertwined with these uncertainties are less visible questions regarding the appropriate levels of public research support for agricultural biotechnology.

Even among those who are confident that biotechnology will be beneficial for agriculture, there is real uncertainty about the role of public investment as these technologies evolve. Several times this winter, we have heard farmers and other representatives of the agricultural sector raise this kind of question: “With the vast resources that the major biotechnology companies are investing in agriculture, why should the public sector be trying to compete?”

This, it seems to us, is a crucial question, not only from the perspective of the farmer but also for all employed in the public agricultural sector, especially at Land Grant universities. It gets to the heart of optimal allocation of the scarce resources available for agricultural research.

### **Rationales For Public Support**

There can be no question that agricultural research in the United States has generated an attractive social rate of return. Even as the amount of private sector research has increased significantly in

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recent years, the return to public research has remained strong. Returns in the neighborhood of 35% are commonly cited (Fuglie, *et. al.* ). This level of payback appears to be attractive relative to numerous alternatives.

Not only are the benefits from agricultural research high, they are also widely distributed. Consumers benefit from more abundant, low cost, safe and desirable food products. Producers benefit when costs are lowered and returns are enhanced. Society benefits from an expanded general knowledge base and from a greater understanding of the interactions of the agricultural sector with natural and social systems. Agribusiness and food-related firms benefit from access to new information and to students who understand the context of agriculture and have research experience. The size and diversity of payoffs tend to argue for public support of agricultural research. So does the “public nature” of some of these payoffs.

Consider the fundamental role of markets in a capitalistic society. Conceptually the market exists as a means to ensure that the benefits of economic activity accrue to consumers and society. In the classic world of Adam Smith, individual decision-makers focus on increasing profits but the collective result is maximization of societal benefit. From this widely accepted social perspective, profits to the firm are a means, not an end. They are the incentives used by private decision-makers to make socially beneficial decisions.

Market failures can occur, though, when the impact of market forces is not consistent with the most socially preferred outcome. One type of market failure is the result of firms having “too much” market power. Anti-trust regulations are well known instruments to redress such monopoly-based imbalances. Market failure can also occur when firms lack the market resources to capture sufficient benefits from research. In these cases, firms may not invest in innovation at levels sufficient to rapidly generate societal benefits.

Hybrid seed is a good historical example of a shift that allowed firms to realize the benefits from research. Proprietary benefits simply could not be captured when individual farms were small and when seed was open pollinated. Thus, there were few expectations that private sector investment in crop variety development would be socially optimal. Adoption of hybrid seed changed those expectations, leading to increased private sector research and development.

One historic rationale for public support of agricultural research is that individual farm and agribusiness firms would, as in the case of open pollinated seed, underinvest relative to the socially optimally level. The competitive nature of the farming sector and its ability to transfer benefits quickly to consumers also provided a strong rationale for public support.

Several aspects of these historical justifications are not germane to today’s agricultural biotechnology. Intellectual property rights can be secured for entire organisms and other biological materials, thus restricting the copying and distribution of genetic improvements. Furthermore, although there are major economies of scale associated with biotechnology research, several agricultural biotechnology firms are large enough to conduct such research effectively. Indeed, such scale economies have raised fears that biotechnology firms may achieve excessive market power relative to farmers and consumers.

### **Justification Of Public Research As An Independent Source Of Innovation**

We need to remember that there is another means to respond to—indeed, to anticipate—the danger of too much strength in the marketplace. This is to ensure that innovation can be applied broadly and in such a manner that it threatens the power of firms in the market. Although enhanced germplasm is

the primary avenue by which the results of biotechnology are now entering the market, at a more fundamental level, the fruits of research in agricultural biotechnology represent an enhanced knowledge base. And it is this database that is likely to be exploited in the future, in ways that we cannot currently anticipate. Growth and control of access to this library of information are key issues relating to both the potential for future innovation and for the distribution of benefits from biotechnology.

We have found it thought provoking to focus on this knowledge base for agricultural biotechnology as we visit with agricultural leaders. The analogy of the role and benefits of public libraries has been useful in these discussions. Society, of course, invests in public libraries for purposes that have little to do with economics and the functioning of markets. But as chronicled by Shapiro and Varian (1999), information availability has been and is central to economic advance. Imagine for a moment a world where access to the knowledge contained in books on a particular topic—say, heart disease or diesel engines—was limited and where there was no public access to that one source. Having only one private library would be highly cost effective. After all, if we just want to preserve knowledge, there is no need to produce multiple copies of the same book. It is just expensive and unnecessary duplication.

Under these circumstances, there would be strong incentives to link control of the knowledge to the economic activities dependent on the library's knowledge base. What drug company would not wish to have exclusive knowledge of an important disease? And which truck manufacturer could not benefit from an exclusive understanding of diesel engines? But if the books were all in private hands, there would soon be incentives to retard the rate of innovative use of the special knowledge base. Such innovation would actually reduce the potential stream of economic rents from existing products and services. Indeed, restricted access to what we might call the library of knowledge, could counteract the market forces inherent in Schumpeter's notion that creative destruction is the natural result of capitalistic markets.

We see value in recognizing the notion that today's research in agricultural biotechnology is directed to creating a knowledge base, and that access to this information is in many ways similar to the availability of books in libraries. Framed in this fashion, we recognize that putting knowledge to work, and not just discovering it, creates market value.

Much of the history of market application of biotechnology, in general, has involved small, entrepreneurial firms driving innovation. Often, these firms exploited publicly available knowledge to overcome their lack of scale. Relative to agricultural biotechnology, an important role of publicly supported research may be to create knowledge that can be used to fuel innovation in the marketplace.

### **How Much And For What Specific Purposes?**

The preceding sections of this article have advanced the notion that the public must invest in agricultural biotechnology, if that information is to become a source of independent innovation in the marketplace. But there are other strategic questions relative to public investment in agricultural biotechnology sector, and each warrants thoughtful debate. For instance:

- Which component of research in agricultural biotechnology is most worthy of public investment? Is it the mapping of certain genomes? Linking genetic information to the behavior of the whole organism? Or some sort of focused data mining? This is the question of which books belong in the library.

- Printing books is expensive, and so is the creation of multiple copies of genome maps of significant organisms. Are there mechanisms by which the public and private sectors can share such information, without the expense of duplication of the processes for knowledge creation?
- What should be the form and nature of independence? If private sector firms fund research at universities and if existing private sector firms commercialize many of the results of research, then how can the public sector maintain sufficient independence to be a source of innovation to reduce the market power of those firms?
- Increasingly, innovations in agricultural biotechnology are having system effects. What is the value of public sector research capabilities to measure and monitor effects across several components of the sector?

We believe that public sector research as a source of innovation provides one key justification for public research investment in agricultural biotechnology. The future will require critically important dialogue and analysis to extend the concept: How much should be invested? And which parts of the spectrum warrant investment? We hope that this article will spark further dialogue on these topics in AgBioForum and other venues.

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