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Biotechnology: Impact on Iowa's Agricultural Economy

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Biotechnology: A Dilemma for Land-Grant Institutions

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There is at least a *prima facie* moral tension between universities asserting land-grant principles and simultaneously sponsoring biotechnology. The core of the problem is the likely deleterious economic effects of biotechnology on rural communities — the very constituency whose welfare is supposedly promoted by land-grant institutions. Considered are a number of responses to this tension including efforts to show that the tension is only apparent or that it can be eliminated through various public policies. It is argued that these "solutions" fail.

The upshot is that if the land-grant label is to be taken seriously, those institutions should begin allocating considerable resources to anticipating the social consequences of the technologies they sponsor, honestly inform the public of those consequences and encourage the kind of creative programs that will offset the downside of biotechnology in rural communities. It is likely that these programs will have little to do with the traditional emphasis on agricultural productivity.

INDEX DESCRIPTORS: Biotechnology, land-grant universities, ethical issues

Land-grant institutions and perhaps more generally, state universities, face a significant moral dilemma. They want on the one hand to pursue the luster of biotechnology and on the other to be true to their legislative, historical and philosophical charge. Unfortunately these two courses are not always consonant.

Before the argument is joined a few boundary conditions are worth making explicit: (1) There is no need to be overly careful about defining 'biotechnology', but in the central cases it is meant to include recombinant DNA techniques. (2) The discussion of the consequences of these techniques will be restricted to the agricultural sector. There are of course non-agricultural issues and even moral issues within agriculture which will not be mentioned. (3) The *crucial* boundary condition is the premise of holding fixed the market economy as it exists at this time. It may be that it is just this assumption that one will want to come back to and examine. But I shall not do that here.

GROWTH OF BIOTECHNOLOGY RESEARCH IN LAND-GRANT UNIVERSITIES

Throughout the country the charge is on for institutions of higher learning to advance their programs in biotechnology. In addition to the new buildings and the pronouncements of administrators, one quantitative measure comes from the National Association of State Universities and Land-Grant Colleges. In the period 1982-84 the number of full time employees working in biotechnology through state agricultural stations increased by 30%. The expected increase for 1984-86 is 40% (Buttle 1986, p. 4).

What explains the rush of development in land-grant biotechnology programs? There are two basic arguments. According to the first, biotechnology or molecular and cell biology is the central area of biological inquiry. It is, as it is often put, "on the cutting edge." Any university that aspires to have a serious interest in the production of biological knowledge must emphasize biotechnology. The second argument is economic. Land-grant institutions are increasingly expected to play a role in economic development. There is, the argument continues, no area more pregnant with economic goodies than biotechnology.

We should, I suppose, consider ourselves lucky. The two arguments blend harmoniously. It could have turned out that what was intellectually significant had little economic promise or *vice versa*.

I am suspicious of both of these arguments. We would have to develop them in some detail to give them a fair hearing. But there are, right on the surface, grounds for worry. No doubt biotechnology will advance our understanding of the biological realm. But is it where *all* the action is? It appears so to the extent that one is captured by the reductionistic approaches of physics and chemistry. They have worked

well there but they may not be the only way to go in biology. The history of psychology is a good purgative here. Reductionism in psychology has been an abysmal failure. Trying to build psychological understanding out of "atoms" whether they be neurons or S-R connections has not worked. The use of a systems approach and the adoption of metaphors from computer science is at least promising. I am not saying that biotechnology is a research dead end — that would be absurd. I am saying that there may be alternative approaches to biological understanding which deserve not to be swamped in the name of the present fad. Ecology is a likely candidate.

With respect to the economic argument, there is no doubt that biotechnology will create jobs and some useful products. That it will create more jobs than it will take away, or more importantly, that it will create more *worthwhile* jobs than it will take away is far from obvious. The much heralded microelectronics revolution appears to have failed on the job front (Rumberger 1984). Perhaps biotechnology will do better.

Specific economic claims, e.g., biotechnology will benefit the Iowa economy or biotechnology is a step out of the farm crisis, are very speculative. Responsible leaders should be more cautious.

Nevertheless, the crucial point for my argument is not that the above arguments for biotechnology be good arguments but simply that they be believed to be good arguments. And surely this is the case. And surely it explains, at least on an abstract level, the commitment to biotechnology. Biotechnology is believed to be good science and good business.

TRADITIONAL MISSION OF LAND-GRANT UNIVERSITIES

So now we have one half of the dilemma — the commitment to biotechnology. The other half comes from the character of the institutions making the commitment. Land-grant institutions have developed a mission in virtue of certain legislative acts, most notably the Morrill and Hatch acts, and various historical precedents. We could argue about what the founders of the land-grant complex *intended* for their creation. But subtlety aside, along with their general educational task these institutions have typically made a commitment to rural welfare. This is the key conceptual notion. What does and should the commitment to rural welfare come down to?

In the minds of many citizens, public officials, would be public officials, and persons within the land-grant complex the commitment at present comes down to revitalizing the family farm — reestablishing agricultural life as it was 10 years ago. So the other horn of the dilemma is the allegiance to rural welfare where that notion is understood as developed.

DILEMMA BETWEEN BIOTECHNOLOGY AND RURAL WELFARE

The tension between biotechnology and rural welfare is not hard to find. The causes of the farm crisis are no doubt complex. Among experts there is considerable disagreement. Without deciding which factors are immediate and mediate causes and who is responsible, it is clear that there is a tremendous oversupply of farm commodities. There appears to be little chance of change in this situation in the foreseeable future. Hence prices will remain low and family farms will be under serious pressure.

This is of course a great oversimplification. What will actually happen depends at least on legislative action, world climactic conditions and the world economy. But even so the most likely outcome is that supply will remain high and prices low.

During this period of economic pain one would expect land-grant institutions to direct their efforts toward redressing the problems. No doubt there are efforts along these lines. But what about the emphasis on biotechnology? The problem in a word is that biotechnological innovation will exacerbate the present problem. The reason is simple. The immediate source of the present problem is oversupply. Biotechnology will increase efficiency and hence supply.

The well known case of bovine somatotropin is a particularly vivid example. The federal government is killing a million cows in an effort to reduce the one billion dollar cost of milk surpluses. At the same time Cornell University, a land-grant institution, and other universities are aiding the development of growth hormones which will increase an individual cow's productivity 10% to 40%. In an industry plagued with oversupply, supply will be increased.

The absurdity is there for all to see — land-grant institutions sponsoring research for developing a product that farmers do not want. It is not even clear that the public will benefit from the technology. One would expect reduced prices for milk if production efficiency is increased. But there is little reason to expect these results in the present controlled market where enormous oversupply already exists.

This example is, of course, just that, *an* example. But I believe that it is reasonable to believe that a similar scenario will be played out again and again as the biotechnology business develops. The moral dilemma is transparent: land-grant institutions want two incompatible goods.

So what is the appropriate response to the dilemma? From a logical point of view the alternatives are quite straightforward. One can grab either of the horns or try to get between them. The bold strategy of grabbing one of the horns does not appear promising. Abandoning biotechnology is antiscientific or even worse luddite. These are serious charges in our culture. On the other hand, abandoning rural welfare is politically suicidal.

AVOIDING THE DILEMMA

I shall not pursue either of these bold strategies. One might want to come back to them, especially the latter. The notion of rural welfare as popularly understood deserves examination.

The temptation is to try to get between the horns or show that the dilemma is only apparent. Since this posture is widely assumed, I want to examine it. We need to sketch a picture of what it would be like to get between the horns. And then see whether such a sketch is realizable.

Land-grant institutions will need a science policy that promotes both biotechnology and rural welfare. The immediate cause of the farm crisis is oversupply. The flagship of the needed science policy will have to endorse a ban on research that has as its objective increasing the yields of commodities now in gross oversupply. Though such yield increasing research is the staple of the land-grant complex new

directions will have to be found. The development of new crops that do not compete with the present ones or the development of new uses for those commodities in oversupply are coherent goals. (There is a significant second order dilemma here. Is it possible to deemphasize production agriculture and compete in foreign markets? Remember that our concern is the role of land-grant universities in the production of agricultural knowledge.)

Directing biotechnical agricultural research so that it does not have a negative impact on rural welfare is not easy to do. Frederick Buttel, a widely published rural sociologist, believes that an emphasis on reduced-input agriculture is merited.

... I find it difficult to conceive of a scenario for U.S. agriculture over decades in which the overriding agricultural policy problem is not one of dealing with chronic overcapacity and overproduction. Reduced-input practices, if they both reduce per unit production costs and attenuate the historic trajectory of aggregate supply increase, would contribute to solving the overcapacity problem. Put somewhat differently, reduced-input agricultural systems are a means of improving productivity through reduction in input (especially agricultural chemical) usage rather than through output-enhancement — an approach that has much to commend it in a society that will continue to face agricultural overproduction problems and uncertain long-term prospects for growth in exports (Buttel 1986, pp. 5-6).

Buttel's idea is quite clear but so is the difficulty with it. If the research reduces the unit-cost to the farmer (supposing the selling price remains the same) what will the farmer do with his surplus capital? He will of course, do what he does best, plant more crop! The consequence is increased supply — just what we don't want. Reduced-input agriculture has a lot to recommend it, but it is a non-starter when it comes to our dilemma.

Buttel's remarks hint at an appropriate role for biotechnological research. We will all be better off to the extent that agricultural practices are soil and environment conserving. A rather obvious role for state universities is to use their research capabilities to promote these goals. Biotechnology has considerable promise in realizing them.

Along these same lines, there are serious unresolved safety issues related to recombinant DNA research. Both the laboratory safety issue and the deliberate release of organisms issue have received minimal rigorous investigation. Land-grant universities could and should play a leadership role in the development of the methodological studies needed to evaluate the safety issues.

So in a very brief way, a science policy has been sketched which has the promise of getting around the dilemma. On the one hand the policy will emphasize new crops and new uses for old crops, soil and environment conserving practices, and methodological studies pertaining to safety. On the other hand yield increasing research will be deemphasized.

UNIVERSITY SCIENCE POLICY

The next question concerns what chance this sort of science policy has of becoming normative or informing practice. Even supposing a university wished to implement this policy there are at least two reasons for not being optimistic about the chances of success.

1) The policy will require a strong central administration which would have the power to decide which research was acceptable and which was not. Since the Second World War the role of local administrators in determining research direction has become weaker and weaker. The reasons for this are complex and would take us far afield (Schuh 1984). But clearly the role of the federal government in

funding the research of *individuals* and the central place of peer review are important factors. Research is guided by the government and the national scientific community. The economic and intellectual lines flow directly to the investigator. Administrators stand by the side and have very little control of the process. They are more than pleased if their scientists go after outside money. There is no machinery for tightly shaping the research agenda of the local scientific community.

2) Recall that one of the two reasons for pursuing biotechnology was economic development. This development is to be a symbiotic relationship between the university and business. Business will help sponsor university research and university research will fuel business development. The difficulty is that the research agenda outlined will not be particularly attractive to business. They, not surprisingly, are most attracted to basic research that has the potential of increasing yield or reducing costs. It is with products of these sorts that companies stand a chance of increasing their market share. (The paradox, of course, is as a given firm succeeds the over all well-being may be decreased.)

INDEPENDENCE OF BIOTECHNOLOGY RESEARCH

There is one final problem worth mentioning. Beyond the difficulties in constructing a coherent science policy and implementing it is the gnawing worry: will it make any difference? Perhaps integrity can be secured but it is not clear that much else can be.

Molecular biology has moved from the backwater to the vineyard very quickly. Bench scientists have taken to the entrepreneurial spirit far better than the absent-minded unwordly scientist stereotype would allow us to predict. There are seventy-five major firms in the biotech business. These are primarily multinational corporations in the chemical, pharmaceutical, petroleum and food sectors. There are an additional three hundred small biotech firms.

The short of it is that these companies do not need land-grant research. Of course they will take it when it serves their interests. But their R&D will go ahead one way or another.

What are those R&D efforts? Consider Monsanto, which is the largest firm in plant biotechnology. Monsanto just invested one hundred million dollars in research facilities and owns significant chunks of smaller biotech companies. It also has four seed-corn subsidiaries. According to Howard Schneiderman (1987, p.2), senior vice president for research and development, Monsanto wants to make "... American farming a more profitable, reliable and durable business able to compete in both domestic and world markets." The company is going to do this in a number of ways but foremost is increasing yields and efficiency of yields. "Biotechnology promises to have an enormous impact on crop production. It can be the instru-

ment of another 'green revolution' " (1987, p. 3). This, from the farmer's point is precisely what he does not need. But the important point is that with land-grant help or not, Monsanto is going to see to it that he gets it. One should ask what is the *American Agriculture* that Mr. Schneiderman wants to help. We must not forget that Monsanto and land-grant Universities are very different kinds of institutions with very different constituencies and ideals. If Monsanto is not unique, land-grant efforts to foster biotechnology and rural welfare are for naught. Rural welfare may be kept comatose a little longer by these efforts but death will not be avoided.

SUMMARY

If I have been right, it is difficult to come up with a coherent science policy that unites biotechnology and rural welfare. Implementing such a policy is also full of pitfalls. Furthermore, it is not clear that it will make any significant difference. So I am little more sanguine on getting between the horns that I am on grabbing one of them. The dilemma is genuine and serious. We will probably muddle and stumble along without a reflective policy in the hopes that things will work out. It is scary enough to realize that we have no reasons to think things will work out, but it is even scarier to realize what unexamined morass underlies the supposed rational commitments in which we take pride.

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