Staff Paper

An Era of Confusion: The Land Grant Research Agenda and Biotechnology

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Abstract

The Land Grant College and University (LGCU) research system is in a state of confusion. Public research privatization, industry concentration, and balancing money and the Land Grant mission are issues LGCUs currently face. The ag-biotechnology revolution complicates these issues. This paper provides four mission related policy recommendations for the LGCU system.

Key Words: Biotechnology, Land Grant Mission, Research

> "It shall be the object and duty of the State agricultural experiment stations...to conduct original and other researches, investigations, and experiments...including researches basic to the problems of agriculture in its broadest aspects, and such investigations as have for their purpose and development and improvement of the rural home and rural life and the maximum contribution by agriculture to the welfare of the consumer..." (The Hatch Act)

The Land Grant College and University (LGCU) system is in a state of confusion. This confusion is most evident in the agricultural research sector where privatization is raising questions about the public-good nature of agricultural research, where the delivery of product to the consumer as originally stated in the Hatch Act of 1887 is hampered by increasing protection of intellectual property, and where there is no clear vision as to how 21st century agriculture is supposed to look. How can LGCUs maximize agriculture's contribution to the improvement of rural life or consumer welfare if we have no clear vision of where we are going? Strong and focused leadership is the key to a healthy LGCU system. However, it appears that playing politics is more important than seeking ways to maximize the public's welfare, raising the issue of who in the system is thinking through what an LGCU should look like this century.

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Adding to the confusion is the advent of biotechnology. This revolution has further complicated this crisis and is changing not only what is deemed as public research, but also the role of LGCUs as providers of public agricultural research. It is often unclear what return the public gets for their investment in LGCU research efforts, particularly when innovations are patented, contracted with a private firm or otherwise legally protected. This begs the question, if the public were to start from scratch and design a land-grant system for the 21st century, would this system resemble its current structure? What is the role of LGCU's in the ag-biotechnology era?

This paper examines the sources of confusion for the LGCU agricultural research system and addresses the influence of ag-biotechnology on it. The paper has two objectives: 1) to define the nature of the confusion with respect to ag-biotechnology, and 2) to make recommendations for how 21st century agricultural research can address the underlying issues of these problems.

Three Tensions Heightened by Biotechnology

LGCUs face three tensions that contribute to the confusion: mission versus money, dissemination versus commercialization of discoveries, and the family farm versus industrialized agriculture.

Mission v. Money

The Land Grant's research mission is to "respond to societal needs, with special regard to the problems less likely to be addressed adequately by the private sector" (Tefft et al., 1999). Part of the LGCU confusion is the search for a healthy balance between mission and money, especially in times of limited funding opportunities. Key trends impacting LGCU funding include:

- Increasingly flat nominal research expenditures since the early 1980's (Alston and Pardey, 1996).
- Declining real funding for public R&D.
- Increasing funding of public research by the private sector at a nominal rate nearly 1.5 times that of the state and federal governments (Figure 1).
- Potential private sector leveraging of the public research agenda by providing much-needed operating expenses for projects of specific interest to the private sector.

With these trends in mind, is LGCU research actually public research if the private sector becomes a critical source of funding and the dominant player in determining the public research agenda?

Ag-biotechnology is placing even more pressure on LGCUs to pursue private funding sources. Biotechnology research is more costly than traditional research because of higher purchase prices for technology use rights, stronger ownership schemes of intellectual property, increased secrecy within and outside of the public and private research sector, increased resources needed to attain information, and rising regulatory costs. At an individual level, in several departments across the nation, it is evident that some scientists are seeking private gain while remaining public servants (e.g., remaining a faculty member while starting a small business based on innovations discovered in the lab). This combination has not worked well historically and is not expected to work well in the future given current policies and laws (Collins, 1999). Whether at an individual or university level, increased reliance on private-sector funding and greater intra- and inter-university competition for these funds over-emphasizes the need for proprietary ownership of research results. The cross-pollination of ideas typically found in a research program at an LGCU is stifled and is in danger of becoming extinct. If graduate students, faculty and staff are not being exposed to cutting edge research outside of their lab and cannot communicate their own results outside of the lab, where is the public good?

Dissemination versus Commercialization

Prior to the advent of biotechnology, LGCUs emphasized broad dissemination of their results, either at no cost or for a nominal charge. The Bayh-Dole Act of 1980 and Public Law 98-620 of 1984 gave universities intellectual property rights (IPRs) for federally funded research discoveries and the mandate to commercialize such discoveries (Maredia et al., 1999). Universities have responded by taking advantage of the full range of institutions available for IPR protection. Prior to the [Bayh-Dole] Act, fewer than 250 patents were issued to U.S. universities each year and even fewer innovations were commercialized. By the late 1990's this average has increased to more than 3800 patents per year (AUTM, 1995 and 1997). Another popular approach is for Universities to create small and medium university-related firms (SMURFs) to commercialize these innovations. The existence of SMURFs is usually based on the discovery(ies) of a single or a small team of scientists (Oehmke et al., 2000). Since the Bayh-Dole Act, universities have created 2,578 new SMURFs (14% in 1998) based on protected, academic,

intellectual property (AUTM, 1998). The data show similar increases in university use of invention disclosures, licenses and options, and equity interest for protection and commercialization of intellectual property (Table 1). In other words, the public sector is behaving more and more as the private sector behaves.

This behavioral change is nowhere more apparent than in biotechnology. In 1980, Chakrabarty v. Diamond validated the use of utility patents to protect living tissue as intellectual property. Ensuing case law has expanded this court decision to IPR protection for genetic material. In 1997, 70% of the patents issued to Universities in were in the area of biotechnology (AUTM, 1997). Recently, the University of California at Berkeley signed an agreement which gives Novartis right of first refusal to any life-science innovations discovered in two academic departments. The LGCU mission is being jeopardized by the move toward protecting intellectual property rights (IPR) and by LGCUs partnering with private industry. What are the implications of LGCUs partnering with large private firms for the smaller players in the agri-food system? Should the public continue to fund university ag-biotechnology research under these conditions?

Family Farm versus Industrialized Agriculture

As the Hatch Act was deliberated, it is unlikely that our forefathers ever conceived of today's industrialized agricultural system. In pork packing, for example, the four-firm concentration ratio increased from 40 percent in 1990 to 56 percent in 1998 and continues to rise (USDA-GIPSA). During that same period, vertical control by packers tightened as the percentage of hogs produced via production contracts increased rapidly from less than 3 percent to more than 25 percent. In the broiler industry producers are under contract to one of a few large poultry integrators, who own the animals and specify the production practices to be used. This rapidly evolving agriculture fuels an ongoing debate regarding the social welfare effects of today's tightly coordinated or integrated agricultural subsystems, which are driven primarily by large corporate enterprises (Heffernan 1999, Drabenstott 1999). Biotechnology is likely to provide continued impetus to the trend of tighter integration and concentration over the next decade. In this new agricultural system, can LGCUs partner with private industry and still fulfill the role of conducting and disseminating unbiased research for the benefit of the public and of the consumer? Do such

alliances and interactions with private industry hasten the extinction of smaller enterprises that help maintain the system's competitiveness?

If LGCUs redirect research agendas based on commercialization potential or restrict access to their discoveries so as to generate higher rents, the greater good is not well served nor is the Land Grant mission of conducting and disseminating unbiased research achieved. Wolf and Zilberman argue that LGCUs' role is to keep the system more competitive by producing basic knowledge and maintaining access to information and technology for a wide range of private sector agents. The debate over public-private alliances hinges on the definition of access. Rausser (1999) argues that restrictive alliances such as the U.C. Berkeley/Novartis agreement are "consistent with the fundamental complementary relationships" espoused in land-grant principles. However, the original language of the Hatch Act is clear in its intent to make basic knowledge accessible to the public. Unfortunately, as Wolf and Zilberman point out, "we are on a trajectory that is increasingly narrow in terms of access to and control of the technology."

Implications for Society

Agricultural biotechnology is pushing LGCUs toward compromising mission in favor of money, toward greater commercialization of intellectual property, and toward stronger links with large agricultural corporations. These LGCU actions, when coupled with current trends in the agricultural economy, will

- Result in the university research agenda being dictated by private industry.
- Lead to a loss of status as the check and balance between industry and society.
- Limit small and minority LGCU's access to technology and other intellectual property necessary for research and education in the agricultural sciences.
- Increasingly force farmers to become subcontractors for large corporations.
- Cause further decline in the health of rural communities.
- Stifle the cultural voices of minority cultures.
- Limit consumer access to the biotechnologies they need, with access determined largely by ability to pay.

The Land Grant system must work toward a vision where the food system provides social justice for all; that is, it must provide market participants an opportunity to compete on the merits of a level playing field. The decisions currently being made in LGCUs call into question whether this leveling is occurring. The implication is that in the

biotechnology era, LGCUs are still struggling to find a way to discharge the Hatch Act mandate to "promote the efficient ... utilization of products of the farm as essential to the health and welfare of our peoples."

Policy Recommendations

Policy 1: Get out of the Ivory Tower

LGCUs have not engaged in public debate about the advantages and disadvantages of public ag-biotechnology research. People are extremely passionate about genetically modified organism (GMOs) issues–whether pro or con. Can LGCU biotechnology research successfully serve the needs of these desperate groups? One sure recipe for failure would be to exclude or ignore selected groups - particularly critics of the Land Grant system.

A recent article by Lemaux (1999) exposes complacency and fear of ridicule as major contributors to the silence about ag-biotechnology research at LGCUs. She questions whether we as scientists can

> "let misunderstandings about modern plant biology and biotechnology go unchallenged....Few controversies in biology have caused this level of public debate....Those (scientists) who chose to venture out into the public arena were often misquoted or misrepresented, only serving to drive them further into their "ivory towers."

Ruttan points out that as agricultural scientists, we have focused on the science itself and have failed to spend much time considering the impact of the science on society. Hysteria has prevailed in society's response to GMOs. The public needs assistance in understanding the science of genetically modifying food and agricultural products and the potential impacts of the science, both positive and negative. The most objective source for that debate and flow of information is the university system, specifically the Land Grant system with its many years of food production research. The LGCUs need to be the brokers and create an honest and inclusive dialogue among groups concerned with ag-biotechnology while interjecting rationalism and providing factual information for all groups.

Policy 2: Policy Implications for Public Sector Interaction with the Private Sector

Money versus mission will continue to be the most important issue that the LGCUs must address. This leaves us with the paradox of balancing our mandates of assisting agribusinesses, keeping the playing field level and improving the welfare of consumers. A cultural change has taken place in the Land Grant system, partially due to the change in our clientele. The average size and concentration level of farms and agribusiness firms has increased dramatically. Along with increased concentration, these groups have increased their political power. The agribusiness political machines are making policy for LGCUs, which may be a detriment to the public's and consumers' welfare. The LGCUs must reexamine their mission and assure that they are serving not only large agribusinesses, but also their "traditional" clientele by improving rural life and assisting in leveling the playing field. Simultaneously, the LGCUs must recognize that 'consumers' is a misnomer for diverse groups with different preferences, the majority of whom dwell mostly in urban and suburban areas.

The LGCUs have a responsibility to help provide access to ag-biotechnology products for those who want them and inform those populations who may be harmed by it. Providing access means, to the extent possible, insuring that ag-biotechnology products are widely distributed at an affordable cost (without jeopardizing future research budgets). Providing access also means creating alternatives to transgenic modifications (or whatever the objectionable product is) and protecting all cultures by expanding the traditional benefit-cost calculus and political decision making to include the impacts on items of cultural importance.

Policy 3: Targeted Research

The advent of ag-biotechnology, along with increasing industry concentration and vertical coordination, has affected the public-good nature of agricultural research. The rationale for the public sector's investment in agricultural research is that private-sector returns are significantly lower than social returns, hence generating a need for public research (Ruttan). However, the private sector is highly invested in ag-biotechnology, which means the public sector needs to reevaluate its research focus. This reassessment by LGCUs of targeted public research should result in:

- Decreased traditional commodity sector research.
- An increased role of the LGCUs as the honest broker concerning externalities between industry R&D and the public.
- Increased niche market research to assist both producers and consumers.

Policy 4: Leveling the Playing Field for All LGCUs

There are numerous actions essential to involving small and minority Land Grant colleges and universities (SMLGCUs) in this area of research and education. Increased funding and building infrastructure are the most obvious ways to assist SMLGCUs in the short run, given how expensive biotechnology research is. Access to current and future technology is a major restriction that these institutions face. Partnering with international agencies, industry, government agencies and other LGCUs is imperative. Firms and individual government agencies need to be encouraged and rewarded for partnering with SMLGCUs.

Earlier the question was raised whether a fresh start in designing an LGCU system in 2000 would result in a system that looks anything like our present day system. The USDA and Land Grant system need to restructure funding, tear down walls, and address the Land Grant culture to make it more inclusive in serving all people. Key policy points to address include:

- Cooperation among the different classes of Land Grants (teaching institutions, research institutions, etc.).
- Rewards for and encouragement of inter-university research agendas, particularly between SMLGCU and large LGCUs.
- Acknowledgment and promotion of diversity in thought, culture, and research approaches. George Washington Carver used a spiritual research methodology approach which was extremely successful when measured in Hatch Act terms of serving the public. This type of program would most likely not be supported at any LGCU today.
- Promotion of transparency within the whole Land Grant system (i.e. eliminate the good ol' boy image of agriculture).
- Reevaluation of the reward system. Publications and patents are good for ranking research programs at universities, but is there a healthy balance between these activities and pursuing the fulfillment of the public's needs?

Conclusions

Ag-biotechnology has had and will continue to have a tremendous effect on Land Grant universities. LGCU's are struggling with several key issues that jeopardize their ability to fulfill the Land Grant mission of providing teaching, outreach and research to increase the social welfare of US citizens. The primary struggle is seeking a

balance between fulfilling the mission and securing adequate funding in an atmosphere of increasing funding pressures, including the relatively high cost of conducting research in the ag-biotechnology area and slow to zero growth in research budgets from traditional funding sources. LGCU's are also struggling with how to achieve public dissemination of unbiased research findings in an atmosphere where the nature of ag-biotechnology research increasingly encourages securing intellectual property rights for public research findings with the goal of commercialization and when public ag-biotechnology research is increasingly privately funded. A third struggle is how to justly serve our diverse clientele in agriculture. LGCU alliances with large, private firms who can commercialize ag-biotechnology may add fuel to the already strong trend of tighter integration and concentration over the next decade. Such trends may hasten the extinction of smaller enterprises that help maintain the system's competitiveness. Essentially, the fundamental structure and objectives of LGCUs have changed and the incentive system has begun to reflect that protecting knowledge is the way to get promoted within the LGCU system. The winners in this structure are not clear; however, society's welfare is the clear loser. The new Land Grant culture of pseudo private research enterprises does not add value to the education and research systems.

Society loses in this situation for a number of reasons. The fact that every Land Grant university innovation will most likely be kept secret or patented will slow down innovations as well as the release of knowledge to the public. This phenomenon is further exacerbated by the increasing consolidation of the food supply chain. Fewer and fewer firms are entering ag-biotechnology races because they have been either bought out or are strapped for funds. With fewer firms and the new trend for Land Grant universities to privatize research results, the overall effect is that there may be fewer innovations and a decline in the diversity of products in the market. Hence, consumer and social welfare would decline. The Land Grant institutions were created for the purpose of increasing the public's welfare. How we continue to privatize knowledge and increase society's welfare simultaneously is the question for this millennium.

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Figure 1. Public Research Dollars by Source.

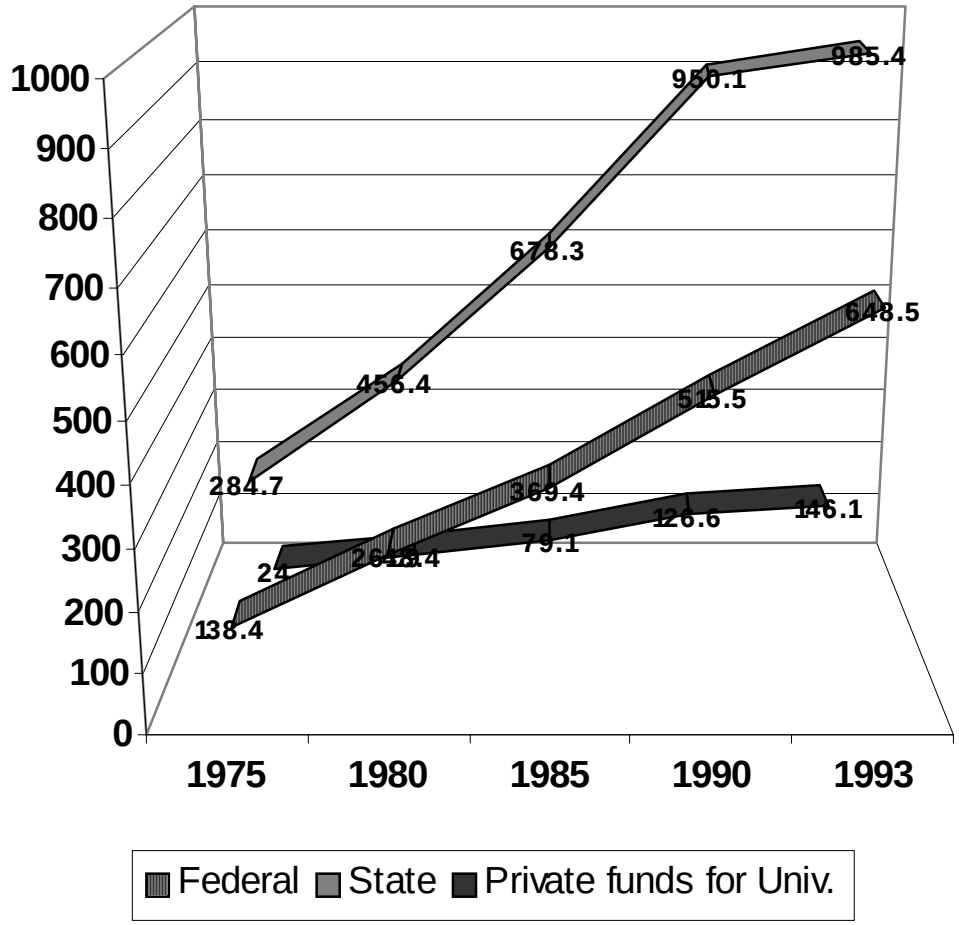

Table 1. Protection and Commercialization of Academic Intellectual Property

Type of Protection/ Commercialization	Aggregate	1995	1996	1997	1998
Invention Discoveries	Not Available	9,784	10,178	11,303	11,784
New Patent Applications	Not Available	2,872	3,261	4,267	4,808
Patents Issued	13,274 since FY 1993	1,833	2,095	2,645	3,224
Licenses and Options	17,088 active in FY 1998	2,616	2,741	3,328	3,668
SMURFs	2,578 formed since 1980	223	248	333	364
Equity Interest		99	167	251	272

Source: AUTM, 1999.