
The Role of Land Grant Universities: Responsible Innovation

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Land grant institutions share many aspects of their role in society with other public research universities. Unlike those others, however, the land grant universities also have responsibilities assigned to them by congressional legislation.

Beginning with the Morrill Act, signed by President Abraham Lincoln in 1862, federally enacted legislation has specified several roles and responsibilities for land grant universities. When asking what these universities should be doing with regard to the developing biobased economy, it is important to review current societal expectations as well as the evolution of their responsibilities under federal law. It is necessary also to consider how they receive financial support for carrying out their responsibilities, and how well they have met expectations in the past. Finally, it is important to examine the nature of the present challenge, that of assuming a role in fostering the biobased economy, and ways in which these universities might meet this challenge in the future.

FEDERAL LEGISLATION

In 1862, with the absence of dissenting southern members, Congress was able to pass legislation granting public lands to each state as an endowment for a public university. President Lincoln signed the Morrill Act on July 2, 1862¹ and the General Assembly of the State of Iowa was the first to accept its terms, in a special session called for other purposes on September 11, 1862 (Ross 1958). In the Morrill Act, the universities were instructed to carry out their work under state direction “in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life.”

Congress recognized the importance of research in support of the land grant universities’ mission in the Hatch Act of 1887. This legislation authorized funds

for establishing an agricultural experiment station as a “department” within each university. The stations were charged with a series of specific investigations that would bear “directly on the agricultural industry of the United States . . . having due regard to the varying conditions and needs of the respective States or Territories.” In the Adams Act of 1906, Congress authorized additional funds for the stations and repeated this charge.

In 1925, Congress specifically broadened the charge to the stations through the Purnell Act, which authorized additional funding to support:

“ . . . conducting investigations or making experiments bearing directly on the production, manufacture, preparation, use, distribution, and marketing of agricultural products and including such scientific researches as have for their purpose the establishment and maintenance of a permanent and efficient agricultural industry, and such economic and sociological investigations as have for their purpose the development and improvement of the rural home and rural life . . . ”

Ten years later, the Bankhead-Jones Act clearly assigned responsibilities related to new uses for agricultural products to the land grant universities. This legislation authorized additional funding to the universities and asked that both they and the United States Department of Agriculture (USDA) conduct research relating to “ . . . new and extended uses and markets for agricultural commodities and byproducts and manufactures thereof. . . ” An amendment to this legislation, passed in 1946, was even more explicit; among other charges, it called for:

“ . . . research relating to the development of present, new and extended uses and markets for agricultural commodities and byproducts as food or in commerce, manufacture, or trade both at home and abroad . . . research to encourage the discovery, introduction, and breeding of new and useful agricultural crops, plants, and animals, both foreign and native, particularly for those crops and plants which may be adapted to utilization in chemical and manufacturing industries.”

Beginning in the mid-1950s, legislation authorizing various programs of the USDA was consolidated into one large bill — the Farm Bill, in which the programs of the land grant universities formed one section. The effect of this consolidation was to generalize the previously stated responsibilities for the land grant universities, and also to add some specific programs of interest to members of Congress. Funds for marketing research were still managed separately, but, over time, that research focused more on markets for existing uses of commodities rather than on new uses. Interest in new uses for agricultural commodities declined.

The energy crises of the 1970s refocused Congress's attention on the potential for using biomass for fuel, and a special program was authorized within the Farm Bill. When the Department of Energy (DOE) was formed in the late 1970s, it was given responsibility for research on alternative energy sources, including solar energy and biomass. Cooperative programs with the USDA focused some of this work through special grants to researchers in the experiment stations. Unfortunately, funding for these efforts was not adequate to the task, and, under these programs, the work has not been carried out in a coordinated or comprehensive fashion.

Interest waned as petroleum-based fuel sources once again became plentiful. Agricultural commodities as fuel sources remained of interest primarily to certain states, as did new uses of specific alternative crops. Programs aimed at the use of a particular crop to produce fuel (such as ethanol from corn) or the development of an alternative crop for industrial use (such as kenaf for paper) were authorized from time to time. Land grant universities have participated in these programs, focusing on crops and uses of particular local interest, but there has been no comprehensive program to develop biobased materials to replace petrochemicals in industrial uses.

Until recently the Alternative Agricultural Research and Commercialization Corporation (AARC), a wholly government-owned corporation established by Congress with reporting responsibilities to the Secretary of Agriculture, promoted development research and commercialization aimed at introducing biobased industrial products into the marketplace. It was authorized as a means to promote rural development through commercialization of new uses for existing and alternative crops. In my opinion as a former AARC member, the Corporation's efforts were limited by insufficient funding, lack of knowledgeable management within the companies commercializing new products, and, to some extent, by lack of innovations worthy of investment. Land grant universities have participated only to a very limited extent in these efforts, which are focused on the marketplace rather than on more fundamental research. AARC funding was discontinued in 2000.

The Federal Agriculture Improvement and Reform Act of 1996 and the Agricultural Research, Extension and Education Reform Act of 1998 continue to authorize work on "new and alternative uses and production of agricultural commodities and products." The former also talks about "priority mission areas" that include "new uses and new crops" and the need to "protect the environment and maintain an adequate, nutritious and safe supply of food."

LEGISLATION NEEDED FOR THE FUTURE

Throughout the past century, the land grant universities have had a federal mandate to work on new uses for agricultural commodities, and this mandate continues. The mandate has been clearer in some decades than in others, and funding has waxed and waned with the public interest, reflecting only the

circumstances of the moment. The interest of the states, which fund greater portions of the work of these universities than does the federal government, has been fragmentary due to diverse local priorities. There has been no attempt to build a comprehensive program toward the development of the biobased economy.

Although there is widespread recognition that sources of petroleum are finite, there is disagreement as to when they will be exhausted. There is no general sense of crisis due to limitation of sources, although, from time to time, concern is expressed over immediate access to supplies of petroleum due to changing political and economic conditions. Sometimes, emphasis is placed on the environmental pollutants arising from use of petroleum-based fuels, and both federal and local legislation has sought to limit these pollutants.

Usually, however, the need for a biobased economy is seen as being far in the future and, perhaps, only of limited value to the environment. Moreover, public-interest groups, focused on aspects of the environment, have not made a coordinated effort to emphasize the needs for alternatives to industrial uses of petroleum, including as a fuel. Thus, if there is to be a comprehensive program in which the land grant universities participate, aimed toward development of the biobased economy, there must be a concerted effort to impress upon the public and, ultimately, Congress and state legislatures, the need for such a seemingly futuristic endeavor. Traditionally, the federal government has taken the lead in establishing programs aimed at developing new industries. It seems reasonable, therefore, that it should take leadership in programs for developing the biobased economy, which has the potential for spawning many new industries. Full participation of the land grant universities in fostering a biobased economy will require that they have both a clear, forceful mandate, and adequate funding for the task.

RESPONSES OF THE LAND GRANT UNIVERSITIES TO PAST MANDATES

Federal legislation has made it clear that land grant universities have certain specific responsibilities that are not so directed to other universities. The universities have responded to these directives with varying degrees of enthusiasm, but their capability to address issues successfully when requested to do so by the public and when they have the necessary funding, has been clearly demonstrated.

The history of the land grant universities' responses to their various assigned responsibilities is somewhat checkered. There are clear success stories where the mandate was explicit and funds were provided. Some of these are: improvement of seeds, evaluation and standardization of fertilizers, development of hybrid crops, improved farm-management practices, determination of nutrient requirements for farm animals and humans, determination of the nutrient composition of foods, and development of food preservation and food-safety technologies.

There have also been failures, both temporary and long term. An example of a temporary failure that was quickly corrected in one state is provided by the story of the development of a method to extract the oil from soybeans. In the 1940s, the pressure method for oil-extraction was not entirely satisfactory. Therefore, the chemical engineering department at Iowa State College developed a chemical process and the necessary commercial-scale equipment. Three patents for these processes were licensed and put into practice in the early 1950s. When the resulting meal was fed to cattle, however, they died. It was found that the solvent used, trichloroethylene, formed toxic adducts with the protein in the meal. Prior to commercialization, no one had adequately tested the meal to confirm its feed value because the focus had been on complete extraction of the oil. A cursory evaluation had seemed to show that the meal was safe. Research at Iowa State, Minnesota and elsewhere quickly confirmed that the problem was with the solvent. At Iowa State, chemical engineers screened other solvents and determined that hexane worked equally well and did not harm the feed value of the meal.

In this case, financial losses were experienced first by the cattle farmers, who recovered these losses through legal action against the manufacturers. Payments to the farmers diminished company resources and required contributions by Iowa State, which, in turn, diminished resources for other purposes at the university. It was a costly mistake to have disregarded potential consequences and to have insufficiently evaluated the product beforehand. Although the problem was quickly corrected and the harm was not long term, the story provides lessons that are important to our present considerations.

An example of a long-term failure is provided by a more recent occurrence. Over the past 25 years or more, the land grant universities have failed to actively evaluate the applications of new biotechnologies in agricultural production and, especially, in new food products. Those with medical schools have not focused on applications in the human-health industry. There were at least two reasons for this failure: there was little or no funding designated for this purpose and no mechanism for thinking comprehensively about the potential consequences of these innovations for the environment, the economy, and the consumer. Moreover, as a first approximation, they seemed safe enough. There was no obvious reason to consider them potentially harmful.

There are problems today, however, because the land grant universities have not actively evaluated the applications of biotechnology. Although no major adverse consequences of agricultural biotechnologies have been experienced in the environment or by animals or humans consuming resultant products, the failure lies in the fact that the universities are unable to provide data to assuage the increasing fears of a lay public. Concerned groups have raised the specter of potential harm to the environment and to human health, and universities do not have adequate data to address these misgivings. True, most of the innovations have come from industry, but legally required evaluations by

companies do not cover many of the concerns now being raised. Moreover, the public does not always trust possibly self-interested evaluations by companies. Why have the universities not demanded the resources and assembled informed multi-disciplinary teams to broadly consider consequences? Why has the public not insisted that they do so? Does the public believe them to be unable or unwilling to undertake objective evaluations? This has been a long-term failure of almost three decades duration. The current situation provides valuable lessons for our present considerations related to the biobased economy.

RESPONSIBILITIES FOR THE BIOBASED ECONOMY

These lessons provide land grant institutions with a basis from which to discharge their responsibilities with respect to the biobased economy. First, there is opportunity, if the universities will seize it, for research that will result in important innovations. Second, there is the responsibility for broadly based evaluation of consequences of implementing these innovations. Third, there is a need to capture the minds of the students who will be the innovators, evaluators and implementers in the biobased economy in the future. Finally, additional resources must be made available.

Researchers at the land grant universities have been innovators when they have had the necessary resources. The recognition of opportunities for innovation and the acquisition of resources to support that innovation require both scientific and administrative leadership. Failure in leadership on either count would be fatal to the effort; presently, leadership is lacking on both counts. The rate of innovation towards developing agricultural materials for industrial and pharmaceutical products and fuels must increase for continued progress toward the biobased economy, if the potential benefits of that economy are to be realized globally.

Experience shows that innovation alone is not enough. Thoughtful and broadly based evaluation of innovations must take place, involving effective across-discipline communication with mutual sharing of understanding and of within-discipline perspectives of potential consequences. Only with informed multidisciplinary evaluation is it possible to foresee consequences of implementing a particular innovation. The required disciplines exist within the universities, but the researchers lack experience in working together. Moreover, these researchers are frequently distrustful and depreciative of contributions from other disciplines. Such barriers will be overcome only if there is effective leadership, both from scientists and from administrators.

Students represent the best hope that the land grant universities will make their needed contributions to the biobased economy. Again, leadership is required, from faculty and administration alike. Students have a natural interest in the world of the future, much more so than do most middle-aged faculty members and administrators. They are excited by the potential to find solutions to current problems that will contribute to long-term improvements in the environment and to preservation of natural resources.

What effort is being made to turn the attention of students to the potential benefits and risks of the biobased economy? Are the land grant universities using the challenges of the biobased economy to provide stimulation for the collective student imagination? Are they providing opportunities for students to come together from many disciplines to consider these challenges? Do their various curricula require thinking about these matters? This subject provides opportunities to give students needed experience in thinking and talking across disciplines, but will the universities take advantage of them? So far, in most universities, the answers to these questions are in the negative.

CONCLUSIONS AND QUESTIONS

The challenge to the land grant universities relative to their role in the biobased economy is abundantly apparent. It is to provide the innovation, evaluation, and education that will help ensure that society will reap the potential benefits of the biobased economy with minimal exposure to the possible risks. It fits their legislated responsibilities. To be sure, this is a grand challenge that will require additional resources. Will the public partner with these universities to meet the challenge? Will the land grant universities be asked by the public to make a concerted effort to meet this challenge and, if asked, will the universities do so? It is sobering to ask, "If not these universities, then who?"

Each member university of the NABC has the opportunity to provide leadership, individually and collectively, toward these goals. Each voting member of the public and each public action group has the opportunity to press for a clear mandate and funds for these universities to carry out their role. Is there sufficient will to do so?

REFERENCE

E.D. Ross, *The Land-Grant Idea at Iowa State College* (Ames: Iowa State College Press, 1958).

¹Legislation reviewed in this paper can be found in several sources, including the web. For legislation through 1955, consult: H.C. Knoblauch, E.M. Law, and W.P. Meyer, *State Agricultural Experiment Stations: A History of Research Policy and Procedure*, US Department of Agriculture Misc. Publ. No. 904. (Washington: US Government Printing Office, 1962). For legislation through 1985, consult: N.A. Kerr, *The Legacy: A Centennial History of the State Agricultural Experiment Stations*. (Columbia, MO: University of Missouri-Columbia Agricultural Experiment Station, 1987). More recent legislation may be accessed through the US Department of Agriculture's web site.