

Defining Mission: Calling upon Land Grant Institutions to Serve Rural America in the Twenty-First Century

(Note: It is the purpose of this position paper to highlight concerns and suggest changes regarding land grant universities; specific examples involving North Dakota State University reflect strengths and weaknesses of the entire system.)

For nearly a century and a half, many pieces of federal legislation have served as signposts for U.S. land grant universities. Without question, these institutions have evolved in ways that would have been unthinkable to the members of Congress whose votes in the late 1800s and early 1900s established the three-part framework within which agricultural colleges were to function. Conversely, lawmakers who today support legislation such as the Bayh-Dole Act of 1980, which encourages university-industry alliances, probably believe this evolution is going according to plan. Beyond legislation, external pressures from business, industry, and the overall economy—i.e., funding—are influencing change. Nonetheless, the higher education system bestows upon administrators, researchers, and educators at land grant universities the flexibility and the responsibility to make prudent, moral decisions regarding these public assets. Therefore, the quintessential signpost that land grant university stewards must always keep in sight is the one pointing the way to the greatest public good.

The Legislative Foundation and Present-Day Architecture

The Morrill Act of 1862 calls on states to provide “at least one college where the leading object shall be [...] to teach such branches of learning as are related to agriculture and the mechanic arts” and “[...] to promote the liberal and practical education of the industrial classes [...].”¹ Those so-called industrial classes were composed of citizens who heretofore had been excluded from higher education—that is, private education—because the price of admittance exceeded their ability to pay. In other words, the founding principle of land grant universities involved serving the public good by serving the underserved.

Adding to that undergirding was the Hatch Act of 1887, which created agricultural experiment stations “[...] to promote a sound and prosperous agriculture and rural life as indispensable to the maintenance of maximum employment and national prosperity and security.”² Clearly, to the industrial mind of the postwar boom, the wording in this section of the Hatch Act is at least quaint, and at worst, dangerously irresponsible in pure economic terms. And yet, despite today’s predominant fixation with economic matters, the fact remains that society, culture—life—cannot exist in an economic vacuum. Employment opportunities, prosperity, and national security, perhaps more so now than ever before, would be enhanced by a vibrant countryside populated with many small cities, villages, and farms—a far safer scenario than the centralized urban planning of “modern” industrialized America, which unwittingly has produced targets of mass destruction and which unfortunately underscores the limits of human capacity, particularly with respect to social and ecological stewardship.

The third component of the land grant system came about through passage of the Smith-Lever Act of 1914, providing for cooperative agricultural extension work, which, via many amendments, “shall consist of the development of practical applications of research knowledge and giving of instruction and practical demonstrations of existing or improved practices or technologies in agriculture, uses of solar energy with respect to agriculture, home economics, and rural energy, and subjects relating thereto [...]” (note: amendment superscript notations omitted in quote).³ In North Dakota, for example, the absence of “solar energy with respect to agriculture” and the lack of truly significant “rural energy” initiatives, despite the state’s vast wind energy potential, serve as reminders of how legislative signposts are often ignored.

Nonetheless, those three prescribed functions remain the hallmark of the land grant system. However, recent concerns have brought about a new round of federal legislation aimed at improving America’s competitiveness, among other economic fixes. The most noteworthy, or notorious, of these federal laws has been the revolutionary Bayh-Dole Act, allowing “universities to patent the results of federally funded research”⁴ and producing these outcomes:

From 1980 to 1998 industry funding for academic research expanded at an annual rate of 8.1 percent, reaching \$1.9 billion in 1997—nearly eight times the level of twenty years ago. Before Bayh-Dole, universities produced roughly 250 patents a year (many of which were never commercialized); in fiscal year 1998, however, universities generated more than 4,800 patent applications.⁵

To the agrarian mind, that phenomenal growth begs a simple question: Is the public good being served? This question—especially as it relates to rural America—quite simply has been going unasked and subsequently unanswered for too long.

The Public Good, Defined

The premise of the land grant system is that it exists to serve the public good, but the changing constituencies of the land grant system, the decline of public funding for research, and the increase in private funding all raise questions about that postulate. For example, “[t]he irreducible idea is that we exist to advance the common good [...] In sum, what are the responsibilities of public higher education to the American people as the twenty-first century dawns?”⁶ The Committee on the Future of Land Grant Colleges of Agriculture appears to begin defining those responsibilities when it says that federal spending is justified for a research project or an extension effort that meets two basic criteria:

It addresses national needs and priorities, and it is aimed at generating *public goods*. Public goods are a class of goods of a ‘common property’ nature, that is, they benefit societal groups but do not provide the means for economic returns to private individuals or firms.⁷

A further refinement says that a pure public good has two characteristics, based on economic terms: one, “non-rivalry,”⁸ which means that one person’s use of it does not reduce the amount available to others; and two, “non-excludability,”⁹ which means that others cannot be prevented from consuming it.

And finally, additional criteria with which the Committee on the Future of Land Grant Colleges of Agriculture justifies public support of research include the following:

- Scale or length of research investment period is too large for private investment.
- Research outcome is too uncertain for stimulation of private investment.
- Markets are too small for adequate rates of return to private research investment.
- Research addresses external (nonmarket) affects of food or agricultural activities.
- Research addresses issues of social equity.¹⁰

Q&A from the Countryside

In 2004 the Northern Plains Sustainable Agriculture Society (NPSAS) must ask this question: During the past half century has the land grant system worked for or against ensuring “a sound and prosperous agriculture and rural life”? One answer, perhaps the most straightforward, comes from author and Kentucky farmer Wendell Berry:

I remember, during the fifties, the outrage with which our political leaders spoke of the forced removal of the populations of villages in communist countries. I also remember that at the same time, in Washington, the word on farming was ‘Get big or get out’—a policy which is still in effect and which has taken an enormous toll. The only difference is that of method: the force used by the communists was military; with us, it has been economic [...] And this community-killing agriculture, with its monomania of bigness, is not primarily the work of farmers, though it has burgeoned on their weaknesses. It is the work of the institutions of agriculture: the university experts, the bureaucrats, and the ‘agribusinessmen,’ who have promoted so-called efficiency at the expense of community (and of real efficiency), and quantity at the expense of quality.¹¹

The “community-killing agriculture” to which Berry refers is largely the result of increasingly expensive production-enhancing technology, which comes packaged not only with a solution (e.g., better weed control in the short term), but also with a new problem (herbicide resistance)—a hidden cost, which requires yet another solution, with yet another hidden cost, and so on and so on. And herein lies the unintended creation of agriculture’s so-called twentieth century revolution: the “technology treadmill,”¹² which serves as an escalator only for input costs. Meanwhile, oversupply sends commodity prices spiraling downward and creates a cost-price squeeze threatening to suffocate farmers who don’t spread their fixed costs across more acres. Or put another way: Economic expediency commands that farmers covet their neighbors’ farms.

Reflecting the pervasive cultural preconception, personnel at land grant universities too often assume that all technologies will have beneficial effects and therefore fail to question whether their assumptions are indeed true. And so, future evaluations need to include not only those who view technology as savior but also those with eyes to spot unintended consequences, which truly can be immoral and not merely the anti-progress bugaboo of “Luddites.” These technology assessments should encompass the social, ecological, and economic ramifications of adoption and involve—at a minimum—rural ethicists, rural social scientists, ecologists, and evolutionary biologists. The key outcome of these assessments must be the development of a holistic, systems approach.

Rising and Falling on Waves of Grain

The Hatch Act's call for a "sound and prosperous agriculture and rural life" seemingly has been forsaken by many colleges of agriculture, including those at the University of Arizona, Purdue University, the University of Nebraska, Ohio State University, and Texas A&M University—all of which as of the year 2000 had incorporated into the schools' respective mission statements the goal of becoming the premier agricultural college in the United States.¹³ What does it mean to be the "premier" agricultural college in the twenty-first century? And, what groups compose the constituency of such an institution?

If being the premier institution means focusing solely on agricultural innovation, then agricultural colleges holding fast to this goal have moved well away from the original purpose for land grant universities, as Robert L. Zimdahl explains:

Most agricultural innovations are scale-positive, in that the benefits are more readily available to large-scale farmers who have access to credit, information and resources. Agricultural technology developed or recommended by agricultural colleges, and that which has been created elsewhere (e.g., pesticides, new machinery), can magnify injustice if small-scale farmers are driven out of agriculture.¹⁴

A case in point: The number of North Dakota farms has plummeted from 66,000 in 1950 to only 30,000 in 2002 (the area of land in farms has changed little when considering the influence of the Conservation Reserve Program).¹⁵ If the percentage collapse in the number of North Dakota farms during this period had been mimicked by a similar implosion in the Dow Jones industrial average, the term affixed to the latter circumstance no doubt would be "crash."

Given the conflict between the Hatch Act's intent and the present reality of a corporative, depopulated countryside, where might concerned citizens, rural and urban alike, look for solutions? Zimdahl holds forth a view that challenges land grant universities:

Increased production has not done much to decrease the number of homeless or hungry in the developing countries or in the US [...] High production does not automatically lead to equal access. The latter demands changes in public policy, and colleges of agriculture have not been public policy advocates.¹⁶

Those comments dispute the maxim that "A rising tide lifts all boats." Indeed, what public good is served if a segment of society merely treads water at a higher level but still is marooned in the same dingy?

The Mission: How Do We Ensure that the Public Good Is Being Served?

By rebalancing its traditional three functions and by incorporating Zimdahl's call to become public policy advocates, the nation's land grant universities could effectively bring about positive, sustainable change in rural America. But in order to succeed, each institution will need to establish goals focusing on local needs, local economic circumstances, and local ecosystems. In North Dakota, that process may be under way,

but only if the following statement is backed up by strong, sincere support and altruistic actions from administrators, researchers, and educators:

The mission of NDSU Agriculture is to foster North Dakota communities as vital economic and social units through the formation of partnerships that educate the public in agriculture, life and environmental disciplines; provide creative, cost-effective solutions to current problems; and pursue all relevant fundamental research.¹⁷

Uplifting sentiment, but as Zimdahl bemoans, “[...] mission statements of colleges of agriculture do not reflect a genuine concern for opening minds or engaging in the agricultural debates about sustainability, soil erosion, pesticide use and misuse, animal treatment and animal rights.”¹⁸ Clearly, NDSU and the other regional land grant universities must begin displaying “genuine concern” about Zimdahl’s aforementioned subjects, and these institutions can do so in a number of ways.

First, colleges of agriculture need to become less institutionalized and more revitalized—that is, less focused on “purchased chemical inputs and mammoth-scale production,”¹⁹ which marginalize “other areas of inquiry, including smaller scale and more environmentally appropriate farming techniques such as organic practices.”²⁰ Nowhere is an expanded research focus more needed than in North Dakota, which leads all states in certified organic grain acreage and is ranked second in terms of certified organic crop acreage and fifth in total certified organic acreage.²¹ Unfortunately, North Dakota is not ranked among the top five organic research states for 2001 (Iowa, Ohio, Minnesota, North Carolina, and West Virginia—all with significantly fewer organic acres than North Dakota).²² Thus, the NDSU college of agriculture should begin its revitalization by offering a parallel-track career path, with equal rewards, incentives, and professional status, for an acreage-proportionate number of administrators, researchers, and educators eager to work solely with small-scale and/or organic agriculture.

Second, after a review of the inherent tension between the public good and private gain, the Committee on the Future of Land Grant Colleges of Agriculture has offered the following recommendation: “Regular and critical evaluations of federally funded research and extension programs should assess the congruence between such programs to which federal funds are devoted and the provision or enhancement of public goods of regional and national significance.”²³ While the committee was primarily concerned about federal funding, the same recommendation also should apply to any research at any land grant university where the publicly funded research infrastructure is used to support privately funded research.

Although there may be legitimate public reasons to subsidize particular projects, researchers with the Wisconsin Rural Development Center (WRDC) found “no set of criteria by which administrators are to judge the importance of projects.”²⁴ Furthermore, they noted that no mechanism existed for obtaining citizen input into this agenda-setting process. While taxpayers pay most of the costs of running land grant universities, they have little say in deciding how researchers use their time. The WRDC researchers recommend that a university-industry relations committee be formed to decide what constitutes “fair and appropriate”²⁵ contract provisions with industry, as well as to

monitor those contracts, and that a majority of the committee's members come from the public at large.

Meanwhile, the Committee on the Future of Land Grant Colleges of Agriculture also has recommended the following:

“[...] receipt by land grant colleges of agriculture of USDA administered research and extension funds should be contingent on their ability to demonstrate that a wide variety of stakeholders have effective input into a systematic prioritization of research, extension, and joint-research activities that specifies areas of increased and decreased emphasis. Further, land grant colleges of agriculture must demonstrate that a wide variety of stakeholders are consulted in resource allocation decision-making processes.”²⁶

That a wide variety of stakeholders should be consulted in the resource allocation decisions at land grant colleges of agriculture is a reflection of the fact that many groups (consumer and environmental groups, small and “alternative” farmers, minorities, low-income families) have felt or have been perceived to be underserved or excluded.²⁷⁻³³

Resource allocation decisions, however, are among the most difficult for land grant institutions. Many of the major issues of significant concern to the country's communities and citizens command insignificant portions of the resources controlled by land grant colleges of agriculture. These concerns include food safety, linkages between diet and health, environmental quality, economic and equity issues such as opportunities for small-scale and family farms, rural vitality and poverty, and access to food.³⁴⁻³⁵ Expanding effective input into the agenda and resource allocation process is essential if programs at land grant colleges of agriculture are to increase program relevance to a wider constituency.

In North Dakota, the framework to enable the democratization of land grant resource allocation decisions already is in place. The State Board of Agricultural Research and Education (SBARE) would need only to be expanded, both in terms of mission and membership, to achieve this objective.³⁶ SBARE could become the model for other colleges of agriculture, thereby making NDSU a national leader on this front, if the North Dakota Legislature reconfigures SBARE's makeup, scope, and authority.

Third, to follow through on its stated goals, administrators at NDSU need to ensure that the college of agriculture works to “develop, improve and apply knowledge”³⁷ and creates “cost-effective solutions to current problems,”³⁸ the most persistent of which for small-scale farmers is the cost of production. Here, the need is for research that looks at more than production enhancements. The focus should be on biodiversity and the cost-competitiveness of multi-species production, or “polycultures,”³⁹ reflecting “agriculture in nature's image.”⁴⁰

Furthermore, these polycultures should be perennial—but only perennial polycultures that simultaneously promote sustainability and small-scale agriculture. To the industrial mind, this ideal probably seems utopian, but to the agrarian mind, perfectly logical.

Regardless of viewpoint, science is proving that this utopia is more than imaginary, as Wes Jackson, who resigned a tenured position as full professor in 1976 at age forty to establish The Land Institute,⁴¹ explains:

[...] we organized our research around four basic questions.

1. Can perennialism and increased seed yield go together at no trade-off cost to the plant?
2. Can a polyculture of species outyield a monoculture?
3. Can perennial species planted in mixtures adequately manage all pests?
4. Can a perennial polyculture sponsor all of its own nitrogen and fertility needs?

We have published positive answers in peer-reviewed scientific journals for questions 1, 2, and 3, and have indirect evidence that supports question 4.⁴²

In the United Kingdom, the Institute for Grassland and Environmental Research (IGER), with four research sites located in Wales and Devon, is perhaps comparable to the U.S. system of experiment stations.⁴³ However, the comparison may stop there: IGER's research focus involves "grassland-related sustainable agriculture with strands impinging on production, environment, amenity and biodiversity [...] studies on soils, plants, animals and micro-organisms and their interactions, and ranges in scale from molecules to landscape."⁴⁴ IGER claims to have developed a worldwide reputation "for its scientific contribution to forage-related plant breeding, plant biology and genetics, animal science and nutrition, organic dairying, soil science and agro-ecology."⁴⁵ If the NDSU college of agriculture and its other regional counterparts want to foster national and international reputations based on innovation, then adapting the IGER principles to fit the northern Great Plains would seem to be a logical progression, rather than continuing to glom onto the status quo of industrialism, which, for example, all too willingly attempts to overlay the concept of concentrated animal feeding operations (CAFOs) onto the bedrock of rural sustainability and health.

One example of the type of IGER research that is under way involves using a grass diet and including flaxseed as part of a concentrate feed to determine whether the fatty acid composition of beef is alterable. Researchers have concluded that it is possible to produce beef that is low in fat, with a lower concentration of saturated fat and higher concentrations of monounsaturated fatty acids and polyunsaturated fatty acids. Also, researchers have been successful at increasing the content of beneficial omega-3 polyunsaturated fatty acids in beef.⁴⁶ Research similar to IGER's is occurring at NDSU and other partnering land grants.⁴⁷⁻⁴⁸ This type of research, relying on regionally available feedstuffs, will without question go a long way toward helping beef producers on the northern Great Plains gain more control over their input costs while supplying a more nutritious product to health-conscious consumers.

To their credit, a team of NDSU researchers also has analyzed the efficiency of hoop barn systems for raising hogs and concluded that "[a]ccounting for all business parameters, rearing in the hoop structures returned the greatest net return per pig."⁴⁹ In addition, the

authors acknowledge the need to reduce input costs for family sized pork operations, and they cite two key environmental benefits that hoop systems provide: one, producers can distribute the composted manure from deep bedding over a larger land area and thereby reduce the potential for runoff or leaching and subsequent surface or groundwater contamination; and two, compared to liquid manure, composted manure from deep bedding produces significantly less odor.⁵⁰ Unfortunately, economic analysis alone is ineffective at spurring the type of creativity required to develop and expand a concept such as deep-bedding, which originated in Sweden. Now, research under way at Iowa State University's Leopold Center is looking at hoop barn systems incorporating deep bedding for other animals besides hogs.⁵¹

Meanwhile, other types of research could help refine holistic techniques such as rotational grazing systems that integrate dairy, beef, and sheep. If knowledge is power, then site-specific knowledge unarguably is most powerful, and the region's land grant universities need to engage in research that helps sustainable producers not only adopt, but also innovate, based on what they know about their own farms and ranches.

Finally, colleges of agriculture need to ensure that the boundaries between public and private benefits remain clearly demarcated. Researchers from the Biotechnology Project of the Wisconsin Rural Development Center (WRDC) reviewed thirty-nine research agreements between the faculty of the University of Wisconsin College of Agriculture and Life Sciences (CALs) and public and private funding agencies. They concluded that private industry support for biotechnology research alters the "terms, structure, and objectives"⁵² of CALs research. As the researchers stated: "By funding a specific research project, industry sponsors, with relatively small amounts of discretionary spending, are able to obtain public facilities and publicly funded researchers for their private research agenda."⁵³

The WRDC researchers discovered other problems: for example, University of Wisconsin policies allowed university researchers to assign patent rights to corporate sponsors as a condition of receiving the grant; also, industry support was predicated on agreements that restricted the free flow of information, especially where trade secrets or other proprietary information was used in carrying out the research; and finally, many of the university's stellar researchers received lucrative consulting contracts with the industries that sponsor their research, thereby raising questions about whose interests are being served, and when. The researchers were concerned that these problems will become more severe as research funds become scarcer. They concluded that the problems lie not with the researchers but with university policies that do not sufficiently protect researchers from industry pressure to dictate the terms of research.⁵⁴

Based on his review of the WRDC research, as well as the increasing number of privately funded research contracts involving technology transfer between the University of California and private industry, David Campbell offers the following questions concerning sustainable agriculture:

If land-grant universities increasingly define their mission as developing and transferring technology to commercial interests, what will happen to

the broader goals and constituencies that land grants were originally created to serve? Will industry interests, however valid, exclude from the agenda competing social interests? Will the effort to upgrade salaries and facilities in order to attract industry-funded research drain funds from research and extension services that directly aid farmers, farm workers, and rural communities?⁵⁵

Campbell says few colleges of agriculture have policy mechanisms in place to keep research and extension agendas oriented toward the broader public good. He concludes, “Opinions on the proper role of various biotechnologies in the future of agriculture vary, and land grants must consider the interests of all of their constituents before moving forward.”⁵⁶

That conflicts between the public good and commercial interests might exist has been identified by the Committee on the Future of Land Grant Colleges of Agriculture in the book *Colleges of Agriculture at the Land Grant Universities: Public Service and Public Policy*. The committee recognized that despite attempts to deal with potential conflicts before contracts are finalized and to keep the process open to public scrutiny, the following concerns prevailed:

Does the university really benefit sufficiently—for example are overhead charges and royalties high enough? Does this kind of activity taint objectivity of university scientists? Is a larger-than-desirable infrastructure maintained, resulting in, for example, training artificially high numbers of graduate students in some fields?⁵⁷

Committee members concluded that a more in-depth examination of public-private partnerships, including publication rights, royalties, and patents is needed. In addition, the implications for objectivity, academic freedom, and the types of research conducted with public funds is an important area of further study.⁵⁸

In all likelihood, public-private partnerships, and the demarcation these relationships demand, will require land grant administrators to heed Zimdahl’s advice—that is, to forgo the fear of wading into public policy waters. The goal of ensuring adequate federal funds is making this move a necessity, as Derek Bok, former President of Harvard University and Dean of the Harvard Law School, explains:

[...] if federal support for science is cut severely, the balance will shift too far from basic inquiry toward applied, commercially funded research [...] Unless universities create an environment in which the prevailing incentives and procedures reinforce intellectual standards instead of weakening them, commercial temptations are bound to take a continuing toll on essential academic values.⁵⁹

Thus far, the most disturbing “weakening” of values within many colleges of agriculture across the nation has been the comfort with which some administrators hide behind the claim of proprietary information and private, nonprofit, tax-exempt status to conceal what many believe should be public information. At NDSU, this scenario is being played out most conspicuously by the NDSU Research Foundation, a 501(c)(3) nonprofit organization that claims it is not subject to the federal Freedom of Information Act (FOIA) and state open records laws.⁶⁰ How can the taxpayers who continue to support

much of the work at land grant universities know whether a proper public/private relationship has been developed if there is no opportunity to review basic documents such as contracts involving the management of publicly owned germ plasm? Like tangible property, public confidence is not an asset to be squandered.

The constituents of agricultural colleges—students, farmers, others who rely on extension information, consumers, businesses, industry, and taxpayers—need assurances that administrators, researchers, and educators are aware of the signposts directing their behavior. Never, except in their nightmares, should constituents believe “[...] the signposts had been bent to the / ground and covered over.”⁶¹ Never, should constituents awaken to the reality that their land grant university has been sold out “[...] for the sake of the objective [...]”⁶² Always, may land grant universities succeed by providing solutions that serve, first and foremost, the greatest public good, which is to say the land and its people.

Notes

¹“First Morrill Act.” ch. 130, 12 Stat. 503, 7 U.S.C. 301 et seq. 2 July 1862. U.S. Dept. of Agriculture, Washington. 1 Dec. 2003 <<http://www.reeusda.gov/1700/legis/morrill1.htm>>.

²“Hatch Act of 1887.” ch. 314, 24 Stat. 440, 7 U.S.C. 361a et seq. 2 March 1887. (as amended 11 Aug. 1995). U.S. Dept. of Agriculture, Washington. 1 Dec. 2003 <<http://www.reeusda.gov/1700/legis/hatch.htm>>.

³“Smith-Lever Act.” ch. 79, 38 Stat. 372, 7 U.S.C. 341 et seq. 8 May 1914 (as amended 26 June 1953; by National Agricultural Research, Extension, and Teaching Policy Act of 1977; by the Biomass Energy and Alcohol Fuels Act of 1980). U.S. Dept. of Agriculture, Washington. 1 Dec. 2003 <<http://www.reeusda.gov/1700/legis/s-l.htm>>.

⁴E. Press and J. Washburn, “The Kept University,” The Atlantic online Mar. 2000, 25 Sept. 2003 <<http://www.theatlantic.com/issues/2000/03/press.htm>>.

⁵Press and Washburn <<http://www.theatlantic.com/issues/2000/03/press.htm>>.

⁶Renewing the Covenant: Learning, Discovery, and Engagement in a New and Different World (Sixth Report). Kellogg Commission on the Future of State and Land Grant Universities, March 2000, National Association of State Universities and Land Grant Colleges, 21 Dec. 2003 <http://www.nasulgc.org/publications/Kellogg/Kellogg2000_covenant.pdf>.

⁷Committee on the Future of Land Grant Colleges of Agriculture, Board of Agriculture of the National Research Council, Colleges of Agriculture at the Land Grant Universities: Public Service and Public Policy. (Washington: National Academy Press, 1996), 21 December 2003 <<http://books.nap.edu/html/landgrant/chap2.html>>.

⁸P.A. Samuelson, "The pure theory of public expenditure," Rev. Econ. Stat. 36 (1954): 387-89.

⁹Samuelson, 387-89.

¹⁰Committee <<http://books.nap.edu/html/landgrant/chap2.html>>.

¹¹W. Berry, The Unsettling of America (San Francisco: Sierra Club, 1977) 41-42.

¹²Sustainable Farming. "Breaking the technology treadmill through long-term research," by REAP Canada. 1991. Ecological Agriculture Projects, McGill University (Macdonald Campus), Ste-Anne-de-Bellevue, Quebec, Canada. 1 Dec. 2003 <<http://www.eap.mcgill.ca/MagRack/SF/Spring%2091%20A.htm>>.

¹³N. E. Harl, "Relevance of the Land Grant Mission in the Twenty-First Century," speech, presented at Kansas State University, Manhattan, 18 Nov. 2003.

¹⁴R. L. Zimdahl, "The mission of land grant colleges of agriculture," American Journal of Alternative Agriculture 18.2 (2003): 107.

¹⁵U.S. Dept. of Agriculture, National Agricultural Statistics Service. Number of Farms, Land in Farms, and Average Farm Size. 2003. 1 Dec. 2003 <<http://www.nass.usda.gov:81/ipedb/>>.

¹⁶Zimdahl, 113.

¹⁷NDSU Agriculture Mission. 2003. North Dakota State University College of Agriculture, Food Systems, and Natural Resources. 11 Nov. 2003 <<http://www.ag.ndsu.nodak.edu/ag-vp/vp-missn.htm>>.

¹⁸Zimdahl, 114.

¹⁹Organic Farming Research Foundation. State of the States 2nd Edition: Organic Farming Systems Research at Land Grant Institutions, 2001 ~ 2003. (Santa Cruz: OFRM, 2003) vi.

²⁰Organic Farming Research Foundation, vi.

²¹U.S. Dept. of Agriculture, Economic Research Service, U.S. Organic Farming in 2000-2001: Adoption of Certified Systems. (Washington: Resource Economics Division, 2003) 8-12.

²²Organic Farming Research Foundation, vii.

²³Committee <<http://books.nap.edu/html/landgrant/chap2.html>>.

²⁴D. Campbell, rev. of Private Interests, Public Responsibilities, and the College of Agriculture and Life Sciences, Wisconsin Rural Development Center, (Mt. Horeb: WRDC, 1993), Sustainable Agriculture (Summer 1993) 21 Dec. 2003 <<http://www.sarep.ucdavis.edu/NEWSLTR/v5n4/sa-14.htm>>.

²⁵Campbell <<http://www.sarep.ucdavis.edu/NEWSLTR/v5n4/sa-14.htm>>.

²⁶Committee <<http://books.nap.edu/html/landgrant/chap2.html>>.

²⁷C. E. Beus and R. E. Dunlap, "The alternative-conventional agriculture debate: Where do agricultural faculty stand?," *Rural Sociol.* 57 (1992): 363-380.

²⁸E. Castle, Agricultural Education and Research: Academic Crown Jewel or Country Cousin? (Washington: Resources for the Future, 1981).

²⁹D. Debertin, "Building consumer support for agricultural research and educational programs," Choices 4th quarter (1993): 34-35.

³⁰C. Hassebrook and G. Hegyes. *Choices for the Heartland: Alternative Directions in Biotechnology and Implications for Family Farming, Rural Communities, and the Environment.* (Ames: ISU Press, 1989).

³¹J.P. Madden, "Toward a new covenant for agricultural academe," *The Agricultural Scientific Enterprise*, eds. L. Busch and W. B. Lacy (Boulder, Colo.: Westview Press, 1986): 269-279.

³²E. Marston, "Piece by piece we're losing the land," High Country News 26 July 1993.

³³M. Strange, The Path Not Taken (Walthill, Nebr.: Center for Rural Affairs, 1982).

³⁴K. Reichelderfer, "What does society want?," Agriculture's Contract with Society: A Proceedings of the ASAE Roundtable Series (St. Joseph, Mich.: American Society of Agricultural Engineers, 1991): 11-21.

³⁵E. Roberts and K. R. Smith, eds., Learning from the Grassroots: Input for Federal Food and Agricultural Research and Extension Programs (College Park, Md.: Charles Valentine Riley Memorial Foundation Press, 1995).

³⁶State Board of Agricultural Research and Education Statement of Policy and Rules of Procedure 22 Dec. 20003 <<http://www.ag.ndsu.nodak.edu/sbare/mission.htm>>.

³⁷Solutions (Fargo: North Dakota State University, [2002]): 1.

³⁸NDSU Ag. Mission. 24 Nov. 2003 <<http://www.ag.ndsu.nodak.edu/ag-vp/vp-missn.htm>>.

³⁹W. Jackson, "Farming in Nature's Image: Natural Systems Agriculture," Fatal Harvest: The Tragedy of Industrial Agriculture, ed. Andrew Kimbrell (Washington: Island, 2002) 44.

⁴⁰Jackson, 44.

⁴¹Jackson, 41.

⁴²Jackson, 44.

⁴³Location of IGER Sites. IGER Web site. 15 Dec. 2003 <http://www.iger.bbsrc.ac.uk/About_IGER/location.htm>.

⁴⁴Scope of IGER Science. IGER Web site. 15 Dec. 2003 <http://www.iger.bbsrc.ac.uk/About_IGER/scope.htm>.

⁴⁵IGER Home Page. IGER Web site. 15 Dec. 2003 <<http://www.iger.bbsrc.ac.uk/>>.

⁴⁶N. Scollan, "Strategies for Optimising the Fatty Acid Composition of Beef," IGER Innovations 7 (2003). 15 Dec. 2003 <<http://www.iger.bbsrc.ac.uk/Publications/Innovations/2003/Ch7.pdf>>.

⁴⁷"Flaxseed as Feed for Cattle Could Benefit North Dakota Flax Producers." News NDSU—NDSU Agriculture Communication 11 Sept. 2003. 22 Jan. 2004 <<http://www.ext.nodak.edu/extnews/newsrelease/2003/091103/10flaxse.htm>>.

⁴⁸T.D. Maddock, V.L. Anderson, P.T. Berg, R.J. Maddock, and M.J. Marchello, "Influence of Level of Flaxseed Addition and Time Fed Flaxseed on Carcass Characteristics, Sensory Panel Evaluation, and Fatty Acid Content of Fresh Beef," Beef Research Report, Carrington Research Extension Center, NDSU, 2003, 8 Feb. 2004 <http://www.ag.ndsu.nodak.edu/carringt/livestock/Beef%20Report%2003/2003_beef_research_report.htm>.

⁴⁹D.G. Landblom, W.W. Poland, B. Nelson, and E. Janzen, "An Economic Analysis of Swine Rearing Systems for North Dakota," Annual Report, Dickinson Research Extension Center, NDSU, 2001, 15 Dec. 2003 <<http://www.ag.ndsu.nodak.edu/dickinso/research/2000/swine00c.htm>>.

⁵⁰Landblom, 15 Dec. 2003 <<http://www.ag.ndsu.nodak.edu/dickinso/research/2000/swine00c.htm>>.

⁵¹F. Kirschenmann, e-mail to co-author, 15 Dec. 2003.

⁵²Campbell <<http://www.sarep.ucdavis.edu/NEWSLTR/v5n4/sa-14.htm>>.

⁵³Campbell <<http://www.sarep.ucdavis.edu/NEWSLTR/v5n4/sa-14.htm>>.

⁵⁴Campbell <<http://www.sarep.ucdavis.edu/NEWSLTR/v5n4/sa-14.htm>>.

⁵⁵Campbell <<http://www.sarep.ucdavis.edu/NEWSLTR/v5n4/sa-14.htm>>.

⁵⁶Campbell <<http://www.sarep.ucdavis.edu/NEWSLTR/v5n4/sa-14.htm>>.

⁵⁷Committee <<http://books.nap.edu/html/landgrant/chap2.html>>.

⁵⁸Committee <<http://books.nap.edu/html/landgrant/chap2.html>>.

⁵⁹D. Bok, Universities in the Marketplace: The Commercialization of Higher Education (Princeton: Princeton UP) 197-98.

⁶⁰A Citizen's Guide to North Dakota's Open Records and Open Meetings Laws. 2003. Office of the Attorney General. 4 Jan. 2004
<<http://www.ag.state.nd.us/Brochures/ORandOM%20Brochure-citizen-2003.pdf>>.

⁶¹W. Berry, A Timbered Choir: The Sabbath Poems 1979-1997 (Washington: Counterpoint) 209.

⁶²Berry, 208.