CURRENT ISSUES IN AGRICULTURAL SCIENCE AND TECHNOLOGY POLICY

G. Middendorf
Department of Sociology, Anthropology and Social Work, Kansas State University, USA

E. Ransom
Department of Sociology and Anthropology, University of Richmond, USA

L. Busch
Department of Sociology, Michigan State University, USA and the Center for Economic and Social Aspects of Genomics, Lancaster University, UK

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Summary

As global trade in agricultural commodities expands and the technological base for agrifood system development is increasingly proprietary, agricultural science and technology policy is at a crossroads of sorts. On the one hand, some argue that policies which encourage science and technologies for the advancement of the current market model (e.g., technologies that help producers and processors participate in export markets more competitively) are the most beneficial. In this scenario, policy encourages research and technologies that facilitate the growth of exports and the expansion of trade. Consequently, wealth would increase generally and those who do not produce the food they require would have the income to purchase it from retailers. Others, on the other hand, argue that market oriented science and technology policies will simply encourage research on profitable technologies where lucrative markets exist, and will marginalize research on questions of public good.

We find the major issues facing policy makers include both institutional and technological innovations. Institutional changes, such as the more restrictive intellectual property regimes, tax laws and funding opportunities, have provided the incentive structure that has encouraged certain kinds of research and development, such as major private investments in agricultural biotechnology research. Major technological changes that pose challenges for policy makers include the new agricultural biotechnologies, pharmafoods, nutraceuticals and precision farming. Finally, we ask: What is at stake as we consider the formulation of policy in this rapidly changing context? The four areas we consider in our response to this question are the environment, food security, control of the agrifood system and the public interest. All of these can be profoundly impacted be changes in agricultural science and technology policy. We conclude by arguing that policy making must be made more democratic. Since policy formulation fundamentally involves a negotiation of sometimes competing values, debate and compromise must be at the center of the policy process. This process must also include the broadest range possible of stakeholders, so that the likelihood that the relevant values are considered is increased. This will not ensure outcomes that are always satisfactory to all parties, but it will help to ensure that the public interest is served.

1. Introduction and Context

The worldwide reduction of tariff barriers has ushered in an era of unprecedented trade in agricultural commodities. Facilitating this expansion of trade is the implementation of global food and agricultural standards that provide information to remote buyers and sellers, allowing them to participate in new markets. Producers and processors around the world are now in direct competition with each other. Affluent consumers increasingly want more information about food products than what is typically available through visual inspection and current labeling. Information about a product’s origin, nutritional value, conditions of production, environmental impacts, labor conditions, specific pesticides used, and the fairness of trade is becoming increasingly important to many consumers. Yet, even in an era of unprecedented production and productivity, food security remains an issue for a majority of the world’s population. The contradictions in the new landscape of the global agrifood system have profound implications for agricultural science and technology policy. Increased emphasis on standardization implies uniformity all the way back to the seed, sperm and egg – in short, increasingly precise scientific control over life forms. Yet, while new food and agricultural technologies hold great promise, they have also proven to be insufficient by themselves to resolve the world's basic food security problems.

Of what significance is an increasingly global agrifood system for science and technology policy? No longer does it make sense to think of agricultural science and technology solely in terms of farm-level production. A broader perspective is needed that reflects the multifarious nature of contemporary agrifood systems, which comprise the entire chain of actors from life science/input corporations, universities, government agencies, and multilateral organizations to producers, processors, distributors, retailers, and consumers, all of which are less restricted by national boundaries than ever before. Beginning in the 1960s, nontraditional constituencies in some industrialized nations began to criticize the agricultural research system for the deleterious impacts of agriculture on the environment and communities, and for encouraging economic concentration, increased size of production units, and capital and energy intensity. Currently, these critiques are continuing on a broader scale. The recent international protest over the proposed development of seed sterilization technology, in which seeds are genetically engineered to be viable for only one generation, is one illustration of this point. The destruction of transgenic maize seed in 1998 at a French Novartis facility by members of the *Confédération Paysanne* is another. Thus, it is necessary to think of science and technology policy in terms of its impacts within an interdependent system that crosses national boundaries.

Yet, it seems that the central tension in agricultural science and technology policy remains unchanged. On the one hand, there are those who argue that in the absence of continuing technological innovations in agriculture – especially those aimed towards increasing yields – it is unlikely that the human population (now over six billion and expected to double in about 50 years at present growth rates) could be supported nutritionally in the future. Sustaining large, urban industrial and service economies requires that those remaining on the land produce far more than they can consume themselves. Food security remains a high priority morally, and politically it is a source of national security for industrialized and developing countries alike. On the other hand, the negative environmental and social impacts of the current agrifood system have been amply documented. Soil erosion, loss of biodiversity, heavy agrochemical dependency, as well as devastated rural communities, concentration of wealth and power, and loss of autonomy on the part of farmers are well-known outcomes of the technological treadmill around the world. Moreover, people continue to suffer from malnutrition even in countries that export surplus food.

Still, the predominant response to the food security issue has been to rely on new technologies to increase the production and efficiency of agriculture, and to improve the speed and reliability of the processing and distribution systems. Consider, for example, the new agricultural biotechnologies. While these technologies hold great promise, the principal commercial applications thus far have been quite disappointing with respect to food security. As of 1999, 99% of the global acreage in transgenic crops was planted in three countries: the US (72%), Argentina (17%) and Canada (10%). Moreover, almost all of this transgenic acreage (93%) represents only two modified traits: herbicide tolerance (71%) and insect resistance through the insertion of *Bt* (***Bacillus thuringiensis)*** into the crop (22%). While these technologies may cut costs for farmers, and arguably reduce chemical usage, they do not enhance productivity. Hence, the direct contribution of these efforts towards enhancing food security is not at all obvious.

There have also been a number of developments outside of agriculture that have had a significant impact on agrifood systems. The continuing information revolution is spawning new technologies that are already having repercussions in agriculture. For example, the combination of GIS and GPS has allowed farmers to engage in precision farming – the collection and use of geographic information to direct the movements of equipment more accurately, providing more precise and efficient application of chemical inputs. In processing technologies, more effective refrigeration and freezing (e.g., flash-freezing) technologies and more efficient transportation have permitted processors and retailers to expand the range of products that are available at any given time of the year.

1.1 A Second Green Revolution?

While the technological gains have been impressive, critics still question whether science and technology policy is encouraging inquiry that is for the benefit of a broad public. The substantial concentration of ownership and control in the agrifood system raises concerns about the values that are represented in the resulting technologies. Are we headed for a second green revolution characterized by increasing inequalities, food insecurity despite unprecedented productivity, and decreased environmental capacity? Perkins recently summarized concisely the main views on this question. He argues that there are those (crusaders) who see science and technology as the road to human salvation; there are others who are less optimistic, seeing science as only a temporary fix for an inevitable population explosion; in addition, there are critics who point to agricultural technologies as the source of much of the social inequity in agriculture, especially for the smaller, less educated, less capitalized farmers of the world; finally, there are other critics who focus on the environmental degradation produced by technological/industrial agriculture. It is fair to say that the central questions in agriculture today are about technology choices and negotiating among the competing values represented in those choices. The remainder of this article analyzes in more depth these issues in current agricultural science and technology policy. Finally, it will ask: What is at stake as we consider the formulation of policy in this rapidly changing context?

2. Current Issues

2.1 Institutional Changes

A number of changes in the policy context have driven recent developments in agricultural science and technology. These changes have provided the incentive structure that has encouraged certain kinds of research and development. For example, changes in intellectual property regimes, tax laws and funding opportunities provided significant incentives for a variety of actors to invest in agricultural biotechnology research. Laws strengthening intellectual property rights have been passed or broadened. In 1961, several western European nations agreed to common plant variety protection laws. Several years later, in 1970, the US Congress passed the Plant Variety Protection Act. These laws provide patent-like protection for plant varieties that are novel, uniform and stable and reproduce sexually.

A decade later, a 1980 US Supreme Court decision extended utility patent protection to genetically engineered microorganisms, and a 1985 ruling by the US Board of Patent Appeals and Interferences granted utility patents for novel plants. These changes in patent law sent the signal to the corporate, university and government research communities that they would be able to legally protect their research investments in biotechnology. Not surprisingly, applications for biotechnology patents surged in the 1980s and 1990s.

Although somewhat less dramatic, there have been several key developments in the European context as well. A consequence of these changes was an expansion of what was considered to be patentable, and legally defensible as such. A 1983 decision by the Technical Board of Appeals of the European Patent Office essentially said that anything that was not a plant variety was patentable.

In a later decision the same board maintained that a process for breeding hybrid plants was nonbiological and therefore patentable, and that indeed anything deemed 'essentially nonbiological' could be patented. In 1994 the European Patent Office issued a patent on *all* transgenic varieties of soybeans to Agracetus. These changes increased the value of seed companies, many of which had since been bought by large chemical and pharmaceutical companies. While there was certainly activity in this area in other countries, the changes in the US and Europe are important because they are the two major areas in which commercial interests were seeking protection for intellectual property. Therefore, decisions made in the US and Europe were driving these issues to the fore.

Changes in the US tax code as it relates to research investments also helped to provide a more favorable environment for investments in biotechnology research. Generous tax incentives lured venture capital into biotechnology research. By 1983 there were more than 250 start-up biotechnology firms in the US; several years later there were as many as 400 such firms. As large multinational corporations perceived the potential for profits, they also began to expand their own capabilities in this area. In areas where they were reluctant to invest heavily, they sought out strategic partnerships, often with universities.

For their part, US universities had already begun as early as the 1970s to seek out private sector support for research as costs rose beyond the funding available from traditional public resources. These resources were threatened because of declining support for the welfare state. Thus, the 1970s and 1980s saw an intensification of strategic industry-university research partnerships. Venture capital start-ups were less of a phenomenon in Europe, although there was some activity in the United Kingdom. Most venture capital start-ups in the US and the UK either failed or were bought out by multinational chemical or pharmaceutical companies.

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Biographical Sketches

Gerad Middendorf is Associate Professor and Director of Graduate Studies in Sociology at Kansas State University. His research interests are in the areas of rural and environmental studies, the sociology of agriculture and food, international development, and science and technology studies. His recent work has included a study of information needs of organic growers and retailers, and a study of agrarian landscape transition in eastern Kansas. He has published a number of articles and chapters on the implications of agricultural biotechnologies and on agricultural science and technology policy. He and a colleague recently published *The Fight Over Food: Producers, Consumers, and Activists Challenge the Global Food System* (Penn State Press, 2008). Middendorf is currently engaged in projects on the role of Latinos in agriculture in the Great Plains, and on biofuels development in the Midwest.

Elizabeth Ransom is Assistant Professor in Sociology at the University of Richmond. Her research interests are in the areas of international development and globalization, the sociology of agriculture and food, and social studies of science and technology. Her current research focuses on the linkages between Southern African (South Africa, Botswana, and Namibia) red meat industries and global food systems. She has published several articles focused on the global red meat trade, agricultural biotechnologies, and the patterns and problems surrounding modern food consumption practices.

Lawrence Busch is University Distinguished Professor of Sociology at Michigan State University and Chair at the Center for Economic and Social Aspects of Genomics (CESAGEN) at Lancaster University. He is co-author or coeditor of several volumes including, most recently, Food and Agricultural Standards (Springer, 2006), as well as more than 100 other publications. He is past president of the Rural Sociological Society and past president of the Agriculture, Food, and Human Values Society. Dr. Busch's interests include biotechnology policy, food and agricultural standards, agricultural science and technology policy, higher education in agriculture, and public participation in the policy process.