Building Capacity for Social and Ethical Research and Education in Agrifood Nanotechnology

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Project Overview

The project is designed to develop capacity for social and ethical studies of emerging nanotechnologies within agricultural production, food processing and distribution, food retailing and policy domains relevant to these activities (henceforth, "the agri-food sector"). The project has three interrelated sub-objectives:

1) To review and analyze social science research on the causes and contributing factors that led to extended public controversy and rejection of recombinant DNA methods in the agri-food sector, and to determine whether and to what extent similar factors could influence receptivity to nanotechnology, both within the agrifood sector and generally. This project objective also includes the derivation and extension of succinct findings for educational activities both within the nanoscale science and engineering community and to the public at large.
2) To survey and categorize applications of nanoscale science and engineering that will occur within the agrifood sector over the next 25 years, and to analyze how various actors and interests within the agrifood sector are positioned to develop, utilize, be affected by, or oppose such applications.
3) To identify key standards that will be developed as agrifood nanotechnologies materialize, including technical standards, standard nomenclature, regulatory, product and market standards, and to determine what social and ethical issues are relevant to both the substantive standards that are adopted and to the processes used to develop and promulgate standards.

Methods. For the first sub-objective, the team has merged two methods for identifying promising causal and contributing hypotheses on the biotechnology debate, and for analyzing their relevance to nanotechnology. The team relied on an informal Delphi-type method to identify approximately 10 researchers beyond the team who would prepare papers synthesizing research and participatory experience in the biotechnology debate. These ten papers reflect a variety of social science methodologies from social psychology, sociology of science, law, business analysis and philosophy. This approach was merged with a "knowledge production" model in which different analytic and experiential perspectives are brought together in a designed process of dialog and engagement, resulting in both aggregative learning and also in re-contextualization of personal and disciplinary knowledge that leads to the emergence of a more comprehensive framework in which to develop and apply hypotheses and findings. This knowledge production model based on previous studies on the role of scientists and engineers in international business environments, will itself be a key product of the NIRT. The model is being used both to structure team interactions and to structure workshop activities in which other researchers interact with team members.

With respect to the second and third sub-objectives, project team is developing an integrated methodology for social and ethical studies of science that builds upon the "knowledge production" model described above. Traditional methods for searching and reviewing literature are being combined with recently developed data-base programs and

internet search engines. In this phase an extensive database of citations on agrifood nanotechnology and standards setting is being developed. The team is working iteratively between these data and the creation of a "conceptual map" of issues, analytic perspectives and actors pertaining to agrifood nanotechnology. Team members are also engaging in participant observation studies on standards setting processes currently underway for nanotechnology. These two methods will lead to the development of a protocol for long form, open-ended interviews with scientists, food industry officials, non-governmental organizations and other agrifood sector clients. These interviews will be designed to ascertain what the informants believe to be the needs and the emergent applications for nanotechnology within the agrifood sector, as well as concerns, issues or regulatory and other standards issues they see associated with it. As with the first sub-objective, these methods will be augmented with knowledge production workshops intended to produce an advance in perspectives and understanding of social and ethical issues in agrifood nanotechnology.

Results: The workshop for sub-objective 1 was held in East Lansing in conjunction with a conference entitled "What Can Nano Learn from Bio?" on October 26, 27 and 28, 2005. Eight lead presentations analyzing the source and nature of difficulties encountered by agrifood biotechnology were made, with six shorter discussion presentations. These conference style presentations were followed by a day and a half workshop in which presenters participated with the MSU team (including graduate students) and approximately fifteen additional participants from North America and Europe. Key messages from the event can be summarized as follows:

Allan McHughen (U. California-Riverside), a molecular biologist working with transgenics, believes that the technical potential of transgenic technology is proven There are legitimate risk and social issues associated with transgenics, and scientists must be prepared for the ultimate rejection of technology. But such risks open the door to less than honest exploitation of risk issues by groups whose opposition to biotechnology is based either on minority views to which they are ideologically committed or on perceptions that cannot be supported by science. From the perspective of business economist David Sparling (U. Guelph), agrifood biotechnology is a business success. But some applications have failed because companies and scientists were too focused on immediate technology markets and ignored downstream actors in the supply chain. From the perspective of Margaret Mellon (Union of Concerned Scientists), opposition to agrifood biotechnology is a success story for activists. Technical definitions of biotechnology (or nanotechnology) are less relevant than whether products are consistent with key interests NGOs are organized to protect.

These perspectives were augmented with social science studies. George Gaskell (London School of Economics) presented research on the European public suggesting that uncertainty with respect to either benefit or risk looms large in the public mind. A perception of U.S. bullying and failure to bring products with clear public benefits on line early was critical to the evolution of public resistance. Research presented by Philip McNaughten (University of Lancaster) demonstrates that United Kingdom consumers already associate nanotechnology with the factors that led them to reject biotechnology. This result was especially prominent among relatively well educated women.

A series of shorter presentations discussed the relevance of the agrifood biotechnology findings to emerging areas of nanotechnology, and this topic carried over into the

knowledge-production workshop following the presentations. Key findings and areas where further research is needed are as follows:

1. It is not clear that nanotechnology faces the same risks of public opposition as agrifood biotechnology. Although further research might clarify this question, it is doubtful that, given the state of current theory in the social sciences, one could quantify these risks with any confidence.
2. Analogies between nano and bio are sufficient for scientists, engineers and administrators to become better informed on the leading hypotheses for explaining resistance to agrifood biotechnology. This research suggests several areas where strong leadership in the nanoscience research community could mitigate factors that increase the chance of public opposition. Current evidence of analogies is sufficient to warrant taking action with respect to these areas.
3. It is not clear what level of knowledge exists among the nanoscience community of research-based hypotheses or models on resistance to new technology. Speculation was that it is quite low, suggesting the need for efforts to educate the scientists before trying to educate the public.
4. There is a need to extend research on relationships between agrifood bio and nanotechnology to the public interest community of NGOs currently reviewing nanotechnology.
5. There is a need for more theory building and hypothesis testing on when and why technical projects or new technologies meet public resistance.

Research on sub-objectives 2 and 3 is just beginning. The team is nearing completion on a first cut overview of possible nanotechnology applications within the agrifood sector. Planning on an agrifood nanotechnology conference for next year is just beginning. An initial framework for key social science questions relating to standards development has been developed based on prior research. Key elements of that framework are:

1. Standards must be negotiated. The negotiations include those with respect to the definition of the standard as well as negotiations related to enforcement in particular cases. Who sits at the table when standards are negotiated is of considerable consequence as, quite obviously, those not at the table are unlikely to be heard.
2. Standards determine who gets access to a given market, and may even define the very market itself. For example, a standard for a carbon nanotube would define what could be marketed as a nanotube. Finally, standards pose outcome issues. This aspect might best be phrased as a question: Who wins and who loses? Of considerable import is that the winners and losers need not be limited to those directly affected by the standard. For example, a standard that allows production of a particular product might affect third parties through environmental release.
3. Finally, standards also have an ethical dimension. Three ethical questions may be posed of standards: Engineers and economists often weigh the costs or risks against the benefits of a given technology in attempting to determine how a standard should be formulated. But a second ethical question to be posed is: Whose rights will be supported or weakened by the standard? Privacy rights may be relevant, for example to some logistical applications of nanotechnology in the food industry, and standards may have an impact on these rights. Finally there are

questions about conduct. Standards that are difficult to measure may encourage dishonest behavior.