ESPP: VISIONING THE NEXT FIVE YEARS

T. Dietz

4 December 2007

"The dogmas of the quiet past are inadequate to the stormy present. The occasion is piled high with difficulty, and we must rise with the occasion. As our case is new, so we must think anew, and act anew."
Abraham Lincoln, Second Annual Message to Congress, December 1, 1862

The challenges facing the globe, the nation, Michigan and Michigan State are more evident and perhaps more urgent than they were five years ago when ESPP was founded. ESPP grew out of a discussion among both MSU administrators and the faculty. I had the privilege of acting as "provocateur" in that initial discussion. After five years it is time to re-invigorate our efforts, attending to the challenges and opportunities of the "stormy present." Certainly some of our focus should be on what we have done, including ways to improve what is currently underway. But perhaps more important is the challenge of identifying new priorities and directions that will complement our current trajectory. This document is meant to provoke reflection and conversation among members of the MSU community, including faculty, students, the partner administrators, the public and visitors who will give us advice. We have created a "blog" for this conversation which will allow you to post your thoughts and engage with each other. (See http://espp.msu.edu/about/nextfiveyears.html)

THE FIRST FIVE YEARS

ESPP was established in January 2003. Three initial goals had been articulated from faculty fora held in Spring 2002 and from discussions among the ESPP "Administrative Partners."[1] These goals are:

- Build graduate education programs that are innovative, interdisciplinary and campus wide;

- Facilitate interdisciplinary environmental research at MSU, and in particular, align MSU research with national and global research priorities;

- Make MSU's areas of excellence better connected with and more visible in national and global efforts.

1- Then the Partners were the Deans of the Colleges of Agriculture and Natural Resources, Natural Science, Social Science and the Graduate School, and the Director of the Michigan Agricultural Experiment Station. The group has expanded to include the Dean of the College of Engineering and the Vice President for Research and Graduate Studies. The Provost has always provided substantial support for ESPP but given schedule constraints has not been a regular participant in meetings of this group, which we often refer to as the "Board."

I believe that these goals are still appropriate. We have made progress on each of them, but there is still much more to be done. The critical questions are: "What have we accomplished towards meeting these goals?" and "What should guide our next steps?"

What has been done? What is being done?

The *Environmental Science and Policy Program Self-Study Review* (*http://environment.msu.edu/news/ESPP_selfstudy.pdf*) provides a detailed description of the philosophy that has guided ESPP, the specific activities we have undertaken and what has been accomplished. Of course, most of these activities are ongoing. Briefly, the major steps have been the following:

- Initiated the Environmental Research Initiative (ERI) to strengthen interdisciplinary faculty collaborative networks. The ERI funded 12 teams in emerging and critical areas of environmental research.

- Established a Doctoral Specialization in Environmental Science and Policy. The specialization offers a sequence of four courses designed to show how various disciplines conceptualize environmental issues and how scientific information can be brought to bear on environmental decision-making and environmental policy.

- Instituted ongoing Doctoral Fellowships for recruiting top interdisciplinary students to MSU.

- Provided a framework for hiring faculty in areas of interest to the cross-campus environmental community. We hired two new faculty (Arvai and McCormick) and are searching for five faculty at present with four new searches anticipated.

- Created environment.msu.edu to serve as an evolving hub for communications about environmental work at MSU, including a faculty expertise database; an extensive list of research, funding and education opportunities; Michigan ECHO giving access to all major Michigan newspaper stories on environment; and a variety of other resources.

Several other steps are emerging:

- An initiative to form partnerships in graduate education and research with Zhejiang University in China;

- Ongoing activities on "Climate Change in the Great Lakes Region" to bring together MSU research, engage with decision makers and make MSU a hub for work on this critical issue;

- Engagement to consider the human and environmental dimensions of the bioeconomy;

- A proposal for an Environmental Policy Graduate Specialization which is working its way through the approval process.

THE NEXT FIVE YEARS

Five emergent areas

Even as we continue with our ongoing activities, we need to identify emerging areas and approaches. Some of these, such as sustainability science, have been the subject of conversations initiated by ESPP five years ago and others are emerging. I would suggest five areas to be our foci for new activities:

Coupled human and natural systems
Ecosystems and human well being
New methodological and conceptual challenges
Risk, values and decisions
Sustainability science

These areas have several characteristics in common. Each is:

--an area where *we have substantial strength*, though our strengths are not always articulated in terms of the emerging areas.
--*attracting considerable attention* on the part of the global scientific leadership and the national and international funding communities.
--*overarching and overlapping*. Any one of them could subsume the other, each of them is a principle element in an effective approach to all of the others.
-- built on traditional areas of science, but *challenges existing disciplines and approaches to develop new concepts, theories and methods*.
--based on *broad, interdisciplinary, international networks*.

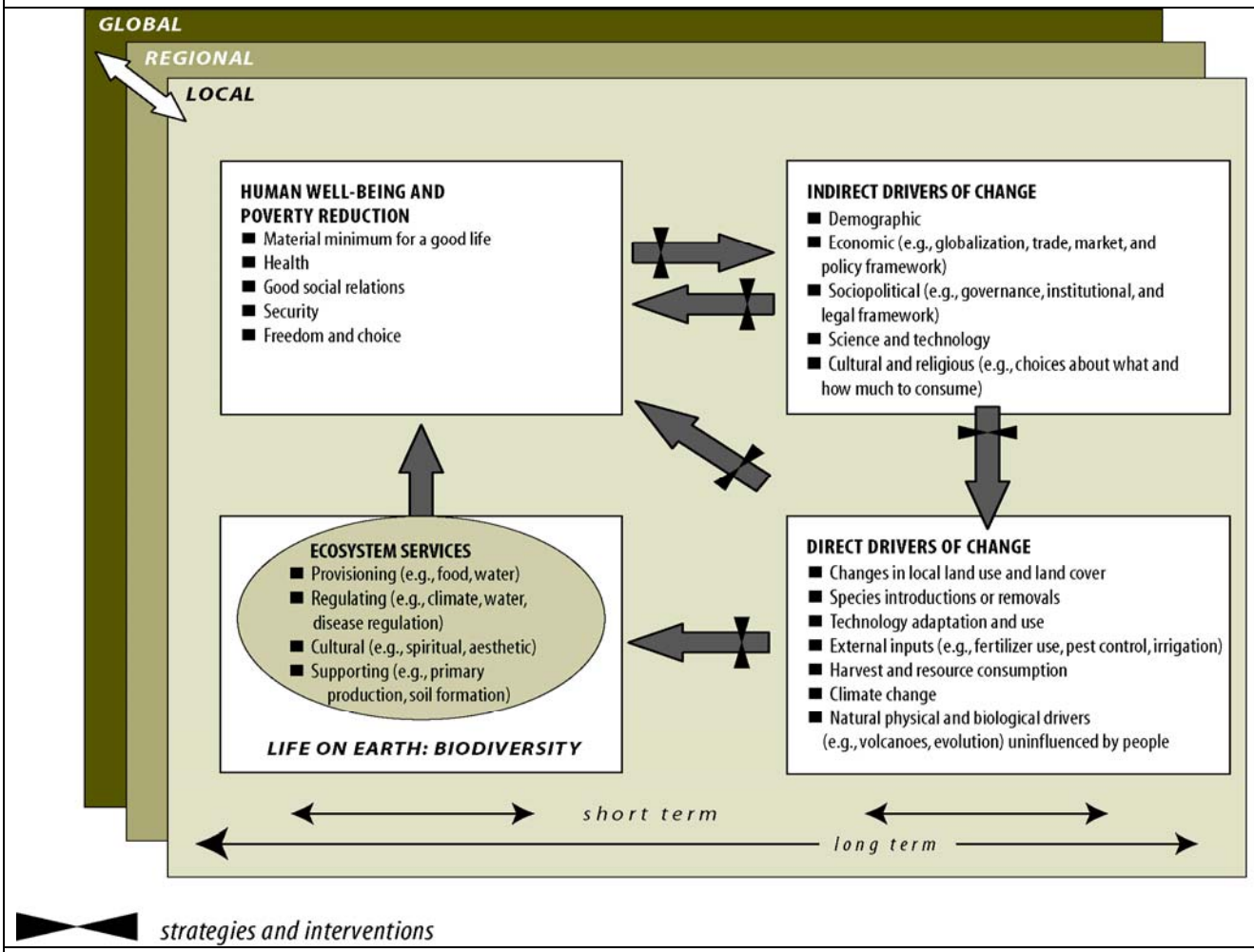
Coupled Human and Natural Systems. Several recent papers have described emerging approaches to understanding the links between human systems and ecosystems (Liu et al. 2007, Forthcoming). These approaches build on venerable traditions in the social and ecological sciences, but offer some important new insights in concepts and methods.

MSU is already poised to be a leader in this field. NSF is beginning a new permanent program in the area (http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13681) and the Ecological Society of America is considering a new interest section in Human Ecology. MSU faculty have been especially successful in competitions that were the prelude to the permanent NSF program,,so we expect this success to continue. We have a number of leaders in the effort to create the new ESA section. Four searches currently underway in ESPP emphasize coupled human and natural systems and modeling, and we anticipate two searches in this area next year, so our existing strength will be enhanced considerably. Details on the searches are at: *http://environment.msu.edu/news/esppgeopssoc_opportunities.html*

Ecosystems and Human Well Being. The Millennium Ecosystem Assessment (*http://www.millenniumassessment.org/en/index.aspx*) was organized around changes in ecosystems and the implications of the those changes for human well being (Alcalmo et al. 2003, Reid et al. 2005, Carpenter et al. 2006). Figures 1 and 2 are the key MEA diagrams that outline the scope of this approach. The MEA resonates with but adds new dimensions to our thinking about the bioeconomy. Of course, the MEA was developed to reflect the global situation, so when we apply the framework to any smaller area, such as Michigan, we must examine what elements of both ecosystems are most important here, and develop a consensus on what elements of human well being matter most to the citizens of the state. Developing the equivalent of Figure 2 would be an interesting research challenge in itself, and would have important implications for public and private policy.

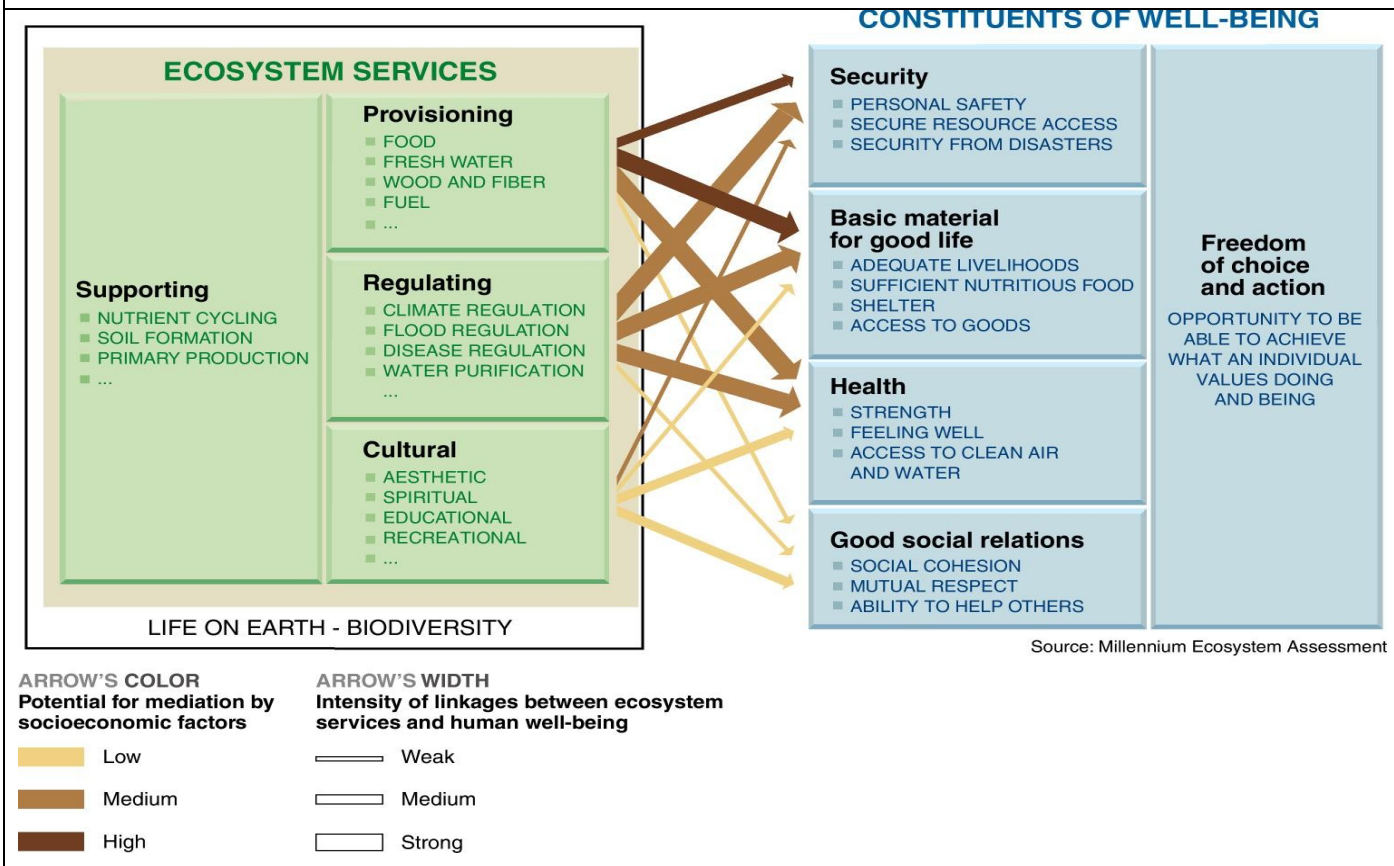
Figure 2-Michigan sketches what such an analysis for Michigan might look like. Of course, the analysis that underpins such a diagram would have to emerge from an iterated process of scientific analysis and public deliberation. But clarifying what we value, how ecosystems contribute to those values and how Michigan ecosystems are changing is an essential starting point for both appropriate decision making and for guiding future research.

Figure 1. Millennium Ecosystem Assessment Conceptual Framework



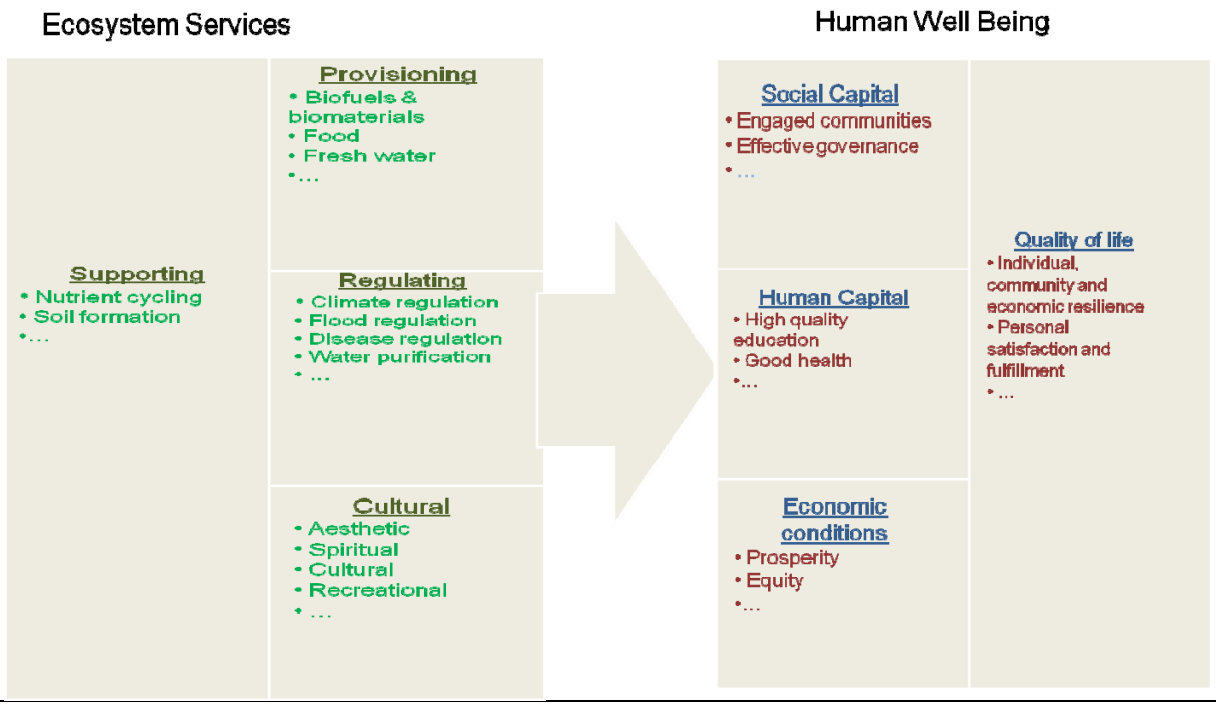
Source: www.milleniumassessment.org

Figure 2. Millennium Ecosystem Assessment Analysis of Ecosystems and Human Well Being at a Global Level



Source: www.milleniumassessment.org

Figure 2- Michigan. Hypothetical links between ecosystems and human well being in Michigan



New Methodological and Conceptual Challenges. Science rests on method, indeed some argue that method is the essence of science. Each discipline develops its own tools for collecting data. There is little if any commonality in data collection technologies that span all the disciplines engaged in environmental science and policy. But the ways we structure data collection, the ways we structure our data sets, and the statistical, modeling and visualization tools we use to understand and communicate our data are often common across a broad array of disciplines. Historically this has been an area of great synergy, so much so that it makes as much sense to aggregate fields of inquiry by their fundamental methodology—experimental vs. historical observation—as by the traditional divisions into physical, biological, engineering and social sciences. The problems of experimental design are common to many domains of engineering, physical science, biological science and social science.[2] The problems of extracting causal relationships from non-experimental data engage researchers across this span of disciplines as well. Thus it is not surprising that a suite of conceptual issues and related tools are emerging that span disciplines. Agent based modeling, analysis of hierarchical systems, data mining, spatial analysis, data visualization and the management of real time and other immense data streams are among the challenges and opportunities we face.

[2] Even the term experiment has different meanings across fields. In most disciplines the term is reserved for studies where the researcher can assign treatments at random and use that randomization as the basis for causal inference. But in some fields the term experiment is also used to describe well organized observational studies without randomization.

Risk, Values and Decisions. All environmental science involves substantial uncertainty, and this uncertainty must be melded with diverse values in making effective decisions. But risk is not unique to environmental issues, it permeates all areas of decision making. Indeed, some have termed the contemporary world "the risk society" (Beck 1992 [1986]) and risk analysis and management has become a major area of global research and policy (Renn 2005).

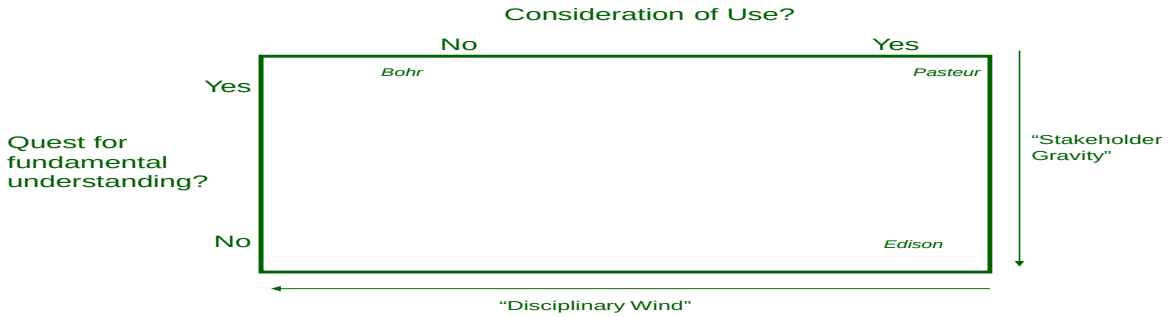
MSU has considerable strength in a number of areas of risk, including climate change, cybersecurity, environmental risk, fire safety, food safety, and terrorism. A working group of faculty have identified our need for new hires who work on risk, per se. We hope to add faculty in areas such as decision sciences, risk analysis, risk modeling and risk communication to fill key gaps in our expertise.. In Spring and Fall 2008 we will bring to campus some of the world's leading risk scholars to help us conceptualize a major initiative in this area, leading to an expanded graduate curriculum and a better integration of our portfolio of expertise in this area.

Sustainability Science. Sustainability science is the effort to deploy 21st century science for solving the challenges of sustainability (U.S. National Research Council 1999a, Clark and Dickson 2003, Clark 2007). Given MSU's long history of work on the environment, community, international development, and the continuing commitment of MSU on global engagement, we are "pre-adapted" to work on sustainability science. While the issue of sustainability science is a natural focus for a world grant university, we have only begun the discussion of how to instantiate this approach in MSU research and graduate education. Clearly, our work in this area will have to be innovative and university-wide. A special challenge will be attending to national and global research priorities even while we are attentive to the Michigan context. Indeed, one contribution MSU can make to Michigan is to help the state become more aware of and resilient in the face of global change.

Three continuing orientations for our work

Moving to Pasteur's Quadrant. From the start, we have kept three principles in mind to guide our work. The first is represented in Figure 3. It is based on the now well known idea of Pasteur's Quadrant (Stokes 1997). Making contributions to fundamental knowledge while solving practical problems is a central theme at land grant institution. But we have amended Stokes' diagram to remind us that there are structural forces that pull research away from Pasteur's Quadrant. Disciplines exert a sort of "wind" pulling research towards their priorities, while stakeholders exert a sort of "gravity" towards the practical problems they define as most important. As we go forward we need to have continuing dialogue with both our core disciplines and with the public to insure that we our research is both useful and contributes to fundamental understanding.

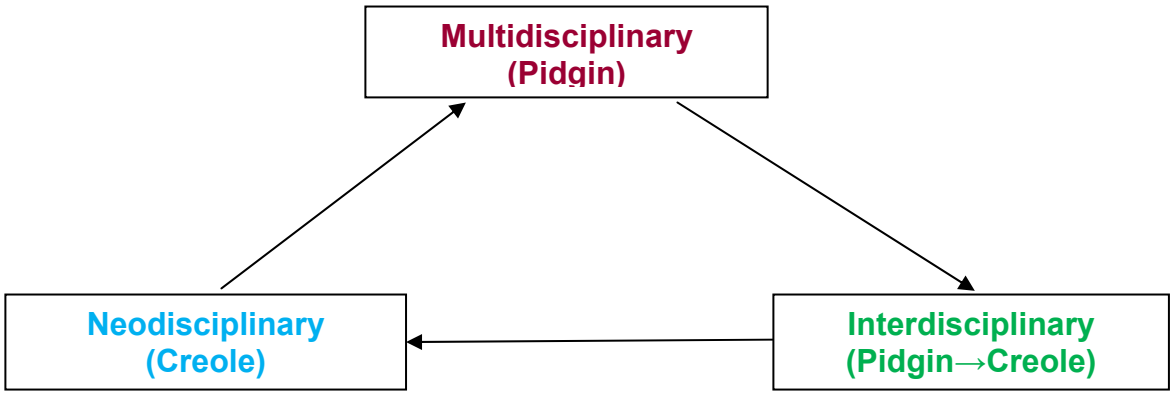
Figure 3. Moving to Pasteur's Quadrant



Source: Modified from Stokes (1997)

Building Language for Emergent Knowledge. Figure 4 represents another of our ongoing orientations. We build on the existing disciplines but emphasize communication across disciplines and the potential for new languages and new disciplines to emerge. Galison's analysis of interdisciplinary teams in high energy physics provides a useful conceptualization of this process (Galison 1997). As we work together, we develop pidgin languages that serve the purpose of the projects at hand. But over time, through repeated interaction, those pidgins can evolve into creoles—rich and creative languages in their own right. These creoles represent new disciplines. It is hard to predict where such neodisciplines will emerge. We do know that the last half of the 20th century was replete with the flowering of fields we now consider disciplines but that at their onset were interdisciplinary efforts to address emergent problems and to exploit new methods (e.g. biochemistry, computer science). Sometimes the pidgin suffices. But sometimes articulate creoles evolve that provide us with new ways to think. In either case, we must be attentive to and commit special effort to developing common language in our endeavors. This is a major goal of both ESPP graduate programs and our efforts to strengthen faculty collaborative networks.

Figure 4. From discipline to neodiscipline.



After Galison (1997)

Linking Analysis to Deliberation. As a land grant institution, MSU has a long and continuing engagement with those interested in and affected by our work, what Dewey (Dewey 1923) terms "the public." Our history anticipates the development of recent calls for using linked, iterative processes of scientific analysis and public deliberation in shaping environmental decisions (Stern and Fineberg 1996, Dietz and Stern 1998, U.S. National Research Council 1999b). But the complex challenges we face require a renewed effort in linking scientific analysis and public deliberation. We must engage a broader spectrum of the public than in the past, and develop new methods to link scientific analysis and public deliberation. This is a place where we can lead not only in Michigan but nationally and globally.

A COMMUNITY DISCUSSION

What might ESPP look like in five years?

Our discussion is likely to be more productive and focused if we begin with some scenarios. John Robinson and his colleagues (Robinson 1988, Tansey et al. 2002, Tansey 2007) have argued that it is helpful to envision a future we want and then work back to the steps needed to get there. To begin our discussion, I offer some images of what MSU engagement in environmental science and policy might look like in five years. The goal is to help us "think anew" and "act anew."

Honing our existing programs. We have established graduate programs and promoted formation of interdisciplinary faculty networks. These must continue to evolve.

Typically less than half the students in the first three courses in the Doctoral Specialization in Environmental Science and Policy (ESP 801, 802, 803) complete the four-course specialization. This suggests these courses are serving a need over and above the specialization. It also suggests that the four-course specialization may not be serving the needs of many students interested in environmental science and policy. Over the next five years we should be attentive to that as we modify our activities. The new three-course Environmental Policy Specialization may meet some demand that we are not currently satisfying. Clearly, we should have more than one program in place for what are very heterogeneous needs and interests among the top students we want to recruit.

Our newer research networks vary, but the most mature of the emerging networks (e.g., biogeochemistry, invasive species) are built around areas that are candidates to become what I have termed "neodisciplines." These groups could develop their own curricula (often built on linking and coordinating existing courses), persuade departments to hire faculty fill critical gaps, perhaps initiate center-like activities and establish international reputations for MSU. Other faculty networks that have been identified through the Signature Program and Environmental Research Initiative processes may not follow the same model, but should evolve to a considerable maturity and be major elements of our graduate education and research portfolios.

Overall, I would suggest that we should continue to do these things we have been doing. But that we must look at the last five years of experience to understand what role these efforts actually play. This can be the basis for modifying these efforts.

From place based to comparative analysis, from problem focused to integrative assessment.

Towards comparative analysis. Much of MSU research will continue to be focused on Michigan, and even more of it will be placed-based, in the sense that it will involve relatively intensive study of a local or regional system. However, over the usual time scales of our research, place based approaches have limited ability to examine the effects of contextual variables, such as climate, ecological history, basic biogeochemical process, culture, institutions and policies. Thus, we should reconfigure our placed based analyses so that they are embedded in larger comparative studies. We should be implementing comparable designs at multiple sites and collaborating globally to build the comparative data needed for richer analysis.

We have begun collaborations with Zhejiang University in China and with various researchers and institutions in Brazil via an ERI project. We have extensive collaborative networks in China and Africa through Jack Liu's, Runsheng Yin's and David Campbell's NSF Coupled Human and Natural Systems Projects. These are just some of the international networks created by MSU environmental researchers. We should solidify these links and also develop new collaborations intended to enhance our ability to do comparative research. In particular, we might look to stronger partnerships with Canada because of the ease of such links and our many common problems. We should also be active partners in emerging global networks of place based research developing around the Millennium Ecosystem Assessment and related efforts.

Towards integrative assessment. While MSU is an easy place for collaboration across disciplines, we still tend to end up in silos defined by media and problems. Thus we have strong networks centered, inter alia, on biogeochemistry, on climate change, on invasive species, on toxics, on land use, on water. But we have not much engaged in integrated assessments that consider the full range of problems that local areas and regions face. Nor have MSU faculty been much involved in national and global integrated assessments, such as the National Assessment of Climate Change, the Intergovernmental Panel on Climate Change, and the Millennium Ecosystem Assessment.

Integrated assessment approaches are essential for the success of some of MSU's major initiatives, notably our efforts on the Michigan Bioeconomy. Such assessments also provide a mechanism for putting our place based assessments in comparative context, as the "sub-global" follow-ons to the Millennium Assessment are demonstrating. We need to engage with the integrated assessment approach. We need more faculty who are participants in the global and national efforts. And we might hold an annual meeting to consider the issues of Michigan, perhaps "Ecosystems and Human Well Being: The State of Michigan."

<u>New models for leading edge-education</u>.

The graduate specialization remains a very effective model for accomplishing the goals of a university-wide integrative program. We have begun discussions of a graduate specialization in the area of "Risk, Values and Decisions," although implementing such a program will require new faculty. But we might consider other models for providing graduate education responsive to the five emerging areas noted above. Many biological stations, including KBS, provide high quality summer programs. The Inter-University Consortium on Political and Social Research has a similar model. Modular courses on emerging topics could be offered for our students and also be the basis for an MSU program that attracts visiting students and instructors from around the globe. This could be a path to global leadership in these areas.

<u>What should we do? What can we do?</u>

It is relatively easy to sketch an ambitious program. However, we have to acknowledge that we are all already busy and that we have limited resources. Part of our discussion must address a realistic assessment of both what is most important to us and what is feasible to do within the constraints we have.

To initiate the discussion, I propose a number of questions for us:

“What are the emergent approaches that we should engage?”

“How do we better connect MSU with the scientific communities at the leading edge of emergent approaches?”

“How do we structure graduate education so that our students are advancing the leading edge of emergent approaches?”

“How do we organize research at MSU to effectively meet these new challenges and opportunities?”

“How do we form a more effective way of engaging with the public in analytic deliberative processes to insure that we not only get the science right but get the right science?”

“What other questions should we be asking?”

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