

**Thinking Globally, Acting Locally:
Investigating Local-Level Capacity in the United States
to Pursue Sustainability**

by

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Submitted to the Department of Civil and Environmental Engineering on January 19, 1996 in
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ABSTRACT

Community-based programs have been gaining popularity in recent years as solutions to environmental problems which have foiled the efforts of so-called “top-down” or “command-and-control” approaches. Many national and international organizations and agencies have argued that efforts to pursue a broad environmental and social issue — sustainability — also require strong local-level components.

While experience in environmental issues has demonstrated the importance of community-based approaches, considerably less attention has been given to the development of a theoretical foundation for these approaches. Local level programs are presumed to be more flexible and effective than their centralized counterparts without a clearly articulated reason for this presumption. This thesis attempts to develop a theoretical framework to explain how local-level approaches can be effective at pursuing sustainability in the United States, and tests this framework with case studies of “sustainable communities.”

The thesis develops the framework in three steps. The first step involves developing a clearer understanding of what is meant by “sustainability.” A review of the literature on sustainability is presented to develop a definition of the term. The second step investigates how to assess the capacity of local institutions to manage the issue of sustainability. To accomplish this, the investigation is divided into two components: first, the theory of mental models, as developed in the field of cognitive psychology, is reviewed to assess the ability of individuals to comprehend the systems involved in issues of sustainability; second, the work of Elinor Ostrom in her book *Governing the Commons* is reviewed to develop a measure of local institutional capacity to manage those systems. The product of this analysis is a framework designed to distinguish potentially successful from unsuccessful local sustainability initiatives. Finally, the framework is tested on nine different sustainable community initiatives in the United States to identify discrepancies between the framework and actual efforts to pursue sustainability at the local level.

The results of the analysis show that the framework is insufficient to evaluate the complexities of pursuing sustainability in the United States. First, the thesis finds that sustainability is not just a technical but also a political concept. Each community needs to define its own objectives, though sustainability requires the consideration of a specific set of issues. Second, the framework developed in the thesis identifies a range of activities which are argued to be necessary for local institutions to pursue sustainability. The results of the analysis demonstrate that the local sustainability initiatives are pursuing some of these activities. However, these initiatives do not carry out two critical ones: they do not, or cannot, clearly define and bound the systems to be managed; and the authority of local institutions to impose sanctions and resolve conflicts is compromised by the pervasiveness of the U.S. legal system. Finally, the analysis also shows how the degree of technological development in the U.S., both in complexity and pervasiveness, affects the potential for communities to pursue sustainability.

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Acknowledgments

A little learning is a dang'rous thing;
Drink deep, or taste not the Pierian spring:
There shallow draughts intoxicate the brain,
And drinking largely sobers us again.

Alexander Pope

Somewhere between the chaotic hustle and bustle of finishing the thesis and the chaotic hustle and bustle of finding a job, there is ideally an opportunity to reflect on everything that has happened in the course of the preceding two, or, in my case, two-and-a-half years. I am grateful that this page is here. A lot has happened since I arrived, and a number of people have played important parts in this experience.

All of my courses have shown me new and different ways of looking at the world, and those new perspectives (and the information gleaned from them) have been very important to me. Above and beyond their responsibilities to those courses, I would like to thank Charles Caldart, Penny Chisholm, Charles H.W. Foster and Jesse Ribot for the time that they gave in conversations whenever I dropped by. I would especially like to thank Nicholas Ashford, John Ehrenfeld and Kristina Hill, who have always given of their time to help me work through a number of ideas. Finally, a thank you to Les Norford, who patiently supported me as I shifted the focus of my studies and interests.

As other alumni of the Technology and Policy Program have said, TPP has been as much as, if not more, about the people than the program. My classmates, within TPP '93 and without, have helped make learning fun. Central to my life have been, of course, all past and present residents of 421 Walden Street (Joe Bailey, Jeff Goldman, Susan London, Don Seville, Burke Smith and Mort Webster), whose games of Hearts, pool playing and lasagna dinners have made my place of residence a home. I am very grateful to Marvin Grossman, whose TPP award sent me to Chile in the Summer of 1994. I would not be able to list everyone else who springs to mind as I think back over the past, but I am extremely grateful for the presence of two individuals — Gail Hickey and Rene Smith — who do so much to provide a soul for TPP.

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Chapter 1: Introduction

“Think Globally, Act Locally”¹

In August, 1995, one of the largest cities in the world began a radically new program to improve the quality of its drinking water. New York City, New York, had been ordered by the United States federal government to construct a \$6 billion filtration plant to protect its citizens from microbial and chemical water pollution.² Rather than resort to this expensive, centralized project, city officials initially proposed a set of measures to protect the watersheds of its reservoirs. These proposals met with fierce resistance from rural farmers, many of whose parents had lost land years ago when the reservoirs were created to supply drinking water for the city. Instead of taking the disagreements to court, city officials and the farmers negotiated a \$35.2 million program, where each farm will receive, on average, \$75,000 for improvements such as “cement liners that keep the manure in barnyards and grassy buffers that absorb nutrients from animal waste.”³ These relatively simple technologies will reduce the amount of pollution in the watershed at the source “and, in most cases, improve production.”⁴ In so doing, the city has begun “one of the nation’s first field tests of the theory that local, flexible efforts to cut pollution can be far more effective than top-down, by-the-book regulation.”⁵

Other cities are also following with these local approaches to pollution control. For example, the New England Region of the U.S. Environmental Protection Agency (NE EPA) is promoting a local-level approach to reducing levels of bacteria in the lower Charles River in the Commonwealth of Massachusetts. Initially, the Massachusetts Water Resources Authority (MWRA) started the construction of a \$1.3 billion combined sewer overflow system to send storm water to the MWRA’s Deer Island wastewater treatment facility. While the construction of the system is underway, “state and local officials now believe that the pollution sources across the Charles are so diffuse — spread across nine

¹ Environmentalist bumper sticker for automobiles in the United States.

² Andrew C. Revkin, “In Unusual Partnership, Farmers Help Safeguard New York Water,” *New York Times* 13 August 1995, 36.

³ Revkin, “Unusual Partnership,” 1.

⁴ Revkin, “Unusual Partnership,” 1.

⁵ Revkin, “Unusual Partnership,” 36.

cities and towns — that the MWRA ... program might not solve the problem.”⁶ Inspections conducted by these towns have found a number of pipes discharging sewage directly into the river, including one from a 90-unit apartment building in Brookline, Massachusetts.

To deal with the problem, the NE EPA is proposing a series of low-cost measures to be undertaken by the towns. These measures range from “better street sweeping and plumbing repairs to increased chlorination of storm water,” with an offer to waive the procedure for storm water discharge permitting (usually a \$500,000 undertaking) in exchange for voluntary cooperation.⁷ The director of the Charles River Watershed Association noted that “the EPA’s cleanup plan represents more cost-conscious thinking about environmental problem-solving, moving away from heavy construction to using common sense to prevent pollution in the first place.”⁸

A New Approach

Both of these programs represent a strategic shift in addressing water pollution. The first comprehensive response of U.S. policy to water pollution was the Clean Water Act (CWA) of 1972, whose objective was to “restore and maintain the chemical, physical and biological integrity of the Nation’s waters” (CWA § 101).⁹ The primary focus of the CWA was to control pollutant emissions from point sources. Point sources fell into essentially two categories, industrial sources and sewage treatment plants,¹⁰ which have in common “discharges that enter receiving water at identifiable, single, or multiple-point locations and the discharges carry pollutants.”¹¹ The CWA required that each point source obtain a National Pollution Discharge Elimination System (NPDES) permit, regulating the concentrations of pollutant emissions. The CWA also requires the EPA to establish “general, technology-based limitations for industrial sources ... on a industry segment-by-segment basis.”¹² Critics have argued that these technology standards fail to address site-specific issues associated with water pollution, occasionally imposing unnecessary costs

⁶ Scott Allen, “Charles Cleanup Gets New EPA Push,” *The Boston Globe*, 22 October 1995b, 33.

⁷ Allen, “Charles Cleanup,” p. 33.

⁸ Allen, “Charles Cleanup,” p. 33.

⁹ Mark Dennison, “A Planner’s Guide to Nonpoint-Source Pollution,” *Environment and Development* (November 1993): 1.

¹⁰ Charles Caldart, “Point Source Regulation under the Clean Water Act: A Brief Look,” notes for “Environmental Law: Pollution Control,” an MIT course (Fall 1993).

¹¹ Vladimir Novotny, “Urban Diffuse Pollution: Sources and Abatement,” *Water Environment and Technology* (December, 1991): 63.

while failing to produce noticeable improvements in water quality. The inability of these technology standards to improve water quality stem, in part, from their neglect of non-point sources (NPS) of pollution, which research has indicated to be significant contributors to water pollution.¹³

The diffuse nature of NPS pollution has required that government agencies adopt less technology-focused and more community-focused approaches to water pollution. NPS pollution is essentially any pollution not from a point source. It includes silt, nutrients, oil and grease, metals, pesticides, other inorganic chemicals and pathogens.¹⁴ These pollutants are collected in the runoff from agricultural, surface mining, urban and other sites, and enter the nation's streams and rivers.¹⁵ While the U.S. Congress addressed this issue in the amendments to the CWA in 1977 (§ 208),¹⁶ this provision failed to meet its objectives. The EPA maintained its focus on technological solutions to point source pollution¹⁷ and avoided "the politically dangerous route of imposing land use controls, permit requirements, and zoning, which would have been necessary for controlling [NPS] pollution."¹⁸ In 1987, Congress added new NPS provisions to the CWA (§ 319), since which time "federal, state and local regulators, water-quality managers, and government planners have invested considerable time, money and effort in developing programs to manage water-quality problems caused by [NPS]."¹⁹ As shown in the two cases which opened this chapter, as well as in other EPA programs (e.g., the Clean Lakes Program, Rural Clean Water Program and the Chesapeake Bay Program), solutions to NPS pollution have moved from imposed land use programs to negotiated programs where the communities act as implementing agencies.²⁰

¹² Caldart, "Point Source Regulation."

¹³ Urban runoff was found to be the source of 48 percent of petroleum hydrocarbons, 3 percent of the low molecular weight [poly-aromatic hydrocarbons (PAHs)], 44 percent of the high molecular weight PAHs, 65 percent of lead, 56 percent of zinc, and 5 percent of copper entering Narragansett Bay annually. See Novotny, "Urban Diffuse Pollution," 63.

¹⁴ Dennison, "A Planner's Guide," 2.

¹⁵ Dennison, "A Planner's Guide," 2.

¹⁶ Section 208 established a process in which local areas were to estimate future needs for municipal treatment as well as develop programs and land use practices to control NPS pollution. See: Kathy Barton, "The Other Water Pollution," *Environment* 20, no. 5 (1978): 17.

¹⁷ Richard L. Hembra, Director, Environmental Protection Issues, Resources, Community, and Economic Development Division, U.S. Environmental Protection Agency, Testimony to the Committee on Governmental Affairs, United States Senate, April 7, 1992.

¹⁸ Barton, "The Other Water Pollution," p. 18.

¹⁹ Dennison, "A Planner's Guide," 1.

²⁰ Dennison, "A Planner's Guide," 2-3.

The possibility exists that these community-based approaches may be well-suited to address a broader range of social and environmental objectives. As the cases in New York and Massachusetts demonstrate, these local programs use simpler, and consequently less expensive, technological solutions. Elsewhere in the United States, many localities have begun experimenting with “alternative technologies” (such as backyard wetlands or composting toilets) to reduce pollutant emissions without the high costs of conventional technologies such as wastewater treatment plants.²¹ The reduction in costs is crucial as the federal government has begun phasing out construction grants for local wastewater treatment.²² Successful examples of local-level programs, with their low costs and high participation rates, demonstrate the potential for accomplishing what centralized and technologically-intensive programs have failed to do.²³ The enthusiasm generated by these water pollution programs has imparted momentum to existing efforts to move environmental management to the local level. In fact, community-level policies and programs are increasingly being viewed as the most appropriate vehicle to address a much more complex environmental and social issue — that of sustainability.

The Push for Pursuing Sustainability at the Local Level

From a U.S. environmental policy perspective, the issue of sustainability concerns the capacity of the natural environment to support the ongoing activities of the citizens of the United States. The questions about whether or not those activities are “sustainable” arise in considering the “carrying capacity” of the environment — the *limited* ability of the natural environment to provide its primary roles for human beings (as well as other species) as a source for inputs (such as food, clean water and clean air), a sink for wastes and a source for aesthetic pleasure or spiritual renewal.²⁴ The concept of the carrying capacity can be divided into three levels:

²¹ Patricia Leigh Brown, “Eco-Privy: A (Very) Private Life of Plants,” *The New York Times* 12 October 1995, C1.

²² Leigh Brown, “Eco-Privy,” C1.

²³ For example, see: Ed Wagner, Deputy Commissioner for Clean Water, Department of Environmental Protection, New York City, keynote address to the 22nd Annual Conference of the Water Resources Planning and Management Division of the American Society of Civil Engineers, “Integrating Water Resources for the 21st Century,” May 7-11, 1995.

²⁴ See: Donella Meadows, Dennis Meadows and Jørgen Randers, *Beyond the Limits* (Post Mills, Vermont: Chelsea Green Publishing Company, 1992); and Sustainable Community Roundtable, *State of the Community: South Puget Sound* (Olympia, Washington: Sustainable Community Roundtable, 1995).

A useful system comes from the military, which frequently places a conflict in one of three different categories ... there are “local” skirmishes, “regional” battles, and “strategic” conflicts. This third category is reserved for struggles that can threaten a nation’s survival and must be understood in a global context.

Environmental threats can be considered in the same way. For example, most instances of water pollution, air pollution, and illegal waste dumping are essentially local in nature. Problems like acid rain, the contamination of underground aquifers, and large oil spills are fundamentally regional ...

... a new class of environmental problems does affect the global ecological system, and these threats are fundamentally strategic. The 600 percent increase in the amount of chlorine in the atmosphere during the last forty years has taken place not just in those countries producing the chlorofluorocarbons but in the air above every country ... global warming is also a strategic threat ...”²⁵

The earth has a carrying capacity on local, regional and global levels. “Sustainability” has ascended as a public policy concern because “our civilization is suddenly capable of affecting the entire global environment” and is affecting the long-term viability of not just local or regional populations, but global populations.²⁶ Addressing the causes of these environmental problems requires the development of policies which alter the behavior of the relevant stakeholders.

Experiences with environmental issues similar to those of NPS pollution have proven that one level at which stakeholders need to be approached is the community level. While it might seem that issues under local purview only concern local environmental problems or, at their worst, regional problems, local issues affect globally “strategic” environmental problems as well. For example, research indicates that land use patterns affect annual emissions of carbon dioxide from transportation, adding to the potential for global climate change:

For example, residents of most Canadian cities annually produce about 20 tons of carbon dioxide per capita, placing Canada among the top three or four nations in terms of per capita contribution to potential climate change. In contrast, citizens of Amsterdam produce only 10 tons of carbon dioxide per capita per year. Sprawl, exclusionary zoning and low density account for much of this difference. According to recent research at the International Institute for Applied Systems Analysis, if North American cities modelled future development on cities like Amsterdam, future carbon dioxide emissions [in Canada]

²⁵ Al Gore, *Earth in the Balance: Ecology and the Human Spirit* (New York: Houghton Mifflin Company, 1992), 28-9.

²⁶ Gore, *Earth in the Balance*, 29.

would only be half as much as current gloomy predictions now indicate.²⁷

Other studies have shown that the differences in energy consumption between North American, European and Asian cities can be explained more by differences in the efficiency and compactness of land use patterns than by the size of cars or the price of gasoline.²⁸ Not only can local decisions affect the potential extent of global climate change, they can also affect the ability of local areas to adapt to climate change by degrading local and regional ecosystems. Thus, as in the case of NPS pollution, community members are relevant players in other issues related to sustainability. Also, as in the case of NPS pollution, local level solutions to sustainability problems could involve relatively simple technologies (such as vegetative buffers along streams and rivers, bicycle lanes or traffic calming measures), which would be much less expensive than more “hard” technology-oriented solutions.

This potential for addressing sustainability issues at the local level has generated activity nationally and internationally. In the United States, the President’s Council on Sustainable Development (PCSD), initiated by President Clinton in 1992, established a Sustainable Communities Task Force “to articulate and emphasize the leadership role of communities in developing integrated approaches to address critical social, economic and environmental issues while creating opportunities for legitimate public participation.”²⁹ A recent U.S. teleconference on sustainable communities listed at least 20 different communities which have pursued a variety of activities under the rubric of sustainability.³⁰ At the international level, the United Nations has recognized the need to involve local initiatives to pursue sustainability objectives:

Local governments have been timid to act in the face of overwhelming evidence of global environmental decline. While resources at the local government level have been scarce, they have been even more inhibited by a narrow and ineffectual conception of the domain of local government concern. The result has been a lack of mobilization to address global problems that are largely rooted in local, day-to-day

²⁷ Mark Roseland, *Toward Sustainable Communities* (Toronto, Ontario: National Roundtable on the Environment and the Economy, 1992), 24-5.

²⁸ Roseland, *Sustainable Communities*, 24.

²⁹ President’s Council on Sustainable Development (PCSD), ‘Sustainable Communities Task Force,’ World Wide Web Home Page, 1995.

http://www.whitehouse.gov/White_House/EOP/pcsd/index.html

http://razorback.arc.nasa.gov/White_House/EOP/pcsd/tf-reports/sustainable-comm.html

³⁰ U.S. Department of Commerce. “Program Book.” National Teleconference on Sustainable Communities, September 13-14, 1995.

activity. Indeed, it is the world's industrial cities that produce most of the world's solid and liquid wastes, consume most of the world's fossil fuels, emit the majority of ozone-depleting compounds and toxic gases, and give economic incentive to the clearing of the world's forests.³¹

As a response, the UN has established its Centre for Human Settlements Sustainable Cities Program, and the World Congress of Local Governments for a Sustainable Future at the United Nations created the International Council for Local Environmental Initiatives.³²

The Need for a Theory of the Local Level

It has yet to be proven whether the arguments for local management of sustainability have substance or are largely rhetorical. The New York watershed management program has been described as among the "first field tests of the theory that local, flexible efforts to cut pollution can be far more effective than top-down, by-the-book regulation."³³ But upon what is this theory based? The successes of NPS pollution initiatives, for example, have yet to be proven the rule rather than the exception. In the cases of New York City and Boston, both an attorney from the Natural Resources Defense Council³⁴ and the Secretary of Environmental Affairs of Massachusetts³⁵ pointed out that the lack of definitive data on NPS pollution makes it difficult to determine whether these programs are succeeding. Further, a study of the North Carolina Erosion and Sedimentation Control Program indicated that "practice falls short of state goals to curb urban erosion and sedimentation," though the authors note that "there are a number of ways the slippage ... in the North Carolina ... program can be reversed so that it is more effective in halting sediment pollution."³⁶ Research points to similar problems with local-level efforts at controlling other environmental issues which are components of sustainability. For example, one study found that "attempts to alter the structure of urban land use patterns via policy intervention may not have much effect on commuting patterns," and therefore carbon dioxide emissions, even if housing and employment are provided in close proximity.³⁷

³¹ Roseland, *Sustainable Communities*, 29.

³² Roseland, *Sustainable Communities*, 44.

³³ Revkin, "Unusual Partnership," 1.

³⁴ Revkin, "Unusual Partnership," 36.

³⁵ Allen, "Charles Cleanup," 33.

³⁶ Raymond J. Burby, Edward J. Kaiser, Michael I. Luger, Robert G. Paterson, H. Rooney Malcom, and Alicia C. Beard, "A Report Card on Urban Erosion and Sedimentation Control in North Carolina," *Carolina Planning* 16, no. 2 (Fall 1990): 28 .

³⁷ Genevieve Giuliano, "The Weakening Transportation-Land Use Connection," *Access*, no. 6 (Spring 1995): 6.

There is a need to develop a theoretical foundation to understand not whether, but how, local level-management can be effective in the pursuit of sustainability. Proponents and opponents to local-level management can each turn to successful or unsuccessful case studies to prove their arguments. Such a strategy, however, will accomplish little to help understand the range of issues involved. The causes of unsustainable behavior are complex and varied, having to do with a wide range of technological, cultural, social, political and economic issues.³⁸ The establishment of a theoretical framework is necessary to take the results of successes and failures and transform them into a better understanding of when local-level management of sustainability will be effective, and when it will not.

Thesis Objective and Structure

The objective of this thesis is to develop and test such a framework. Despite the presence of local level efforts at pursuing sustainability, the development of an analytical framework is not a straightforward task. The first reason for this difficulty is the age of these initiatives. Some are only a decade old, and many more are still younger. These efforts would not have had the time to fully make the transition from an unsustainable to a set of sustainable behaviors. A second reason is definition. Despite the number of definitions of sustainability that have been offered, no one definition has gained a leading consensus, and most definitions are extremely vague.³⁹ The third is measurement. Linked to the problem of definition, a great deal of current debate surrounds how to develop indicators to quantify sustainability and demonstrate progress.⁴⁰ Given these problems, a predictive framework for the local-level pursuit of sustainability in the United States needs to be developed.

This thesis attempts to formulate this framework in two steps. The first step involves the creation of a definition of sustainability. To accomplish this task, the available literature on

³⁸ See: William C. Clark, "Sustainable Development of the Biosphere: Themes for a Research Program," in *Sustainable Development of the Biosphere*, edited by William C. Clark and R. E. Munn, 5-48 (New York: Cambridge University Press, 1986); Robert Goodland, Herman Daly and John Kellenberg, "Burden Sharing in the Transition to Environmental Sustainability," *Futures* 26, no. 2 (1994): 146-155; and Richard B. Norgaard, "Sustainable Development: a Co-evolutionary View," *Futures* 20, no. 6 (1988): 606-621, among others.

³⁹ Norgaard, "A Co-evolutionary View," 606.

⁴⁰ See: Leon Braat, "The Predictive Meaning of Sustainability Indicators" in *In Search of Indicators of Sustainable Development*, edited by Onno Kuik and Harmen Verbruggen, 57-70 (Netherlands: Kluwer Academic Publishers, 1991); Sustainable Seattle, *The Sustainable Seattle 1993 Indicators of Sustainable Community: a Report to Citizens on Long-Term Trends in Our Community*, (Seattle, Washington: Sustainable Seattle, 1993); and Ben ten Brink, "The AMOEBA Approach as a Useful Tool for Establishing Sustainable Development?", in *In Search of Indicators of Sustainable Development*, edited by Onno Kuik and Harmen Verbruggen, 71-88 (Netherlands: Kluwer Academic Publishers, 1991).

sustainability was surveyed and a number of books and articles which seek to provide definitions of sustainability were analyzed. The results of this analysis show that rather than creating a set definition of sustainability, it is more appropriate to identify the range of issues which must be addressed in questions of the sustainable behavior of systems. Chapter 2 reviews the analysis (which is presented in full in Appendix A) and identifies ten elements of sustainability common to the literature.

The second step is the development of a framework for analyzing the capacity of local institutions to address these different elements of sustainability. This task was divided into two different components. The first concerns the ability of individuals, both laypeople and experts, to understand the behavior of complex social and environmental systems. To perform this analysis, literature on the cognitive psychology theory of mental models, and studies on its application in the field of risk assessment, were reviewed. This theory, which describes how individuals develop internal models which approximate real systems, provided insights as to what degree people can be expected to understand the systems involved in sustainability issues. The second component involves understanding the ability of individuals to develop local institutions to manage those systems which influence sustainability. The primary piece of literature used for this component is *Governing the Commons*, a book by Elinor Ostrom which analyzes the characteristics of successful and unsuccessful local institutions which govern common-pool resources. Chapter 3 (and Appendix B) integrate these two components into a framework comprised of three elements — institutional design, technology and institutional supply — which is designed to distinguish potentially successful from unsuccessful local sustainability initiatives.

Chapter 4 applies this framework to efforts within the United States to manage local areas for sustainability. The analysis focuses on seven different cities or regions (Seattle, Washington; South Puget Sound, Washington; Portland, Oregon; Jacksonville, Florida; the Upper Valley Region of Vermont and New Hampshire; Cambridge, Massachusetts; and, Cape Cod, Massachusetts) which were selected primarily for data availability. Two of the cities had two parallel efforts in both local government and the private/non-profit sector, yielding a total of nine initiatives to analyze. The results of the analysis (provided in detail in Appendix C) demonstrate some disparities between the framework and the communities which it was intended to analyze. The results do, however, illustrate how the approaches to managing for sustainability vary from initiative to initiative, and point to relative strengths and weaknesses of different strategies.

Finally, Chapter 5 provides the conclusions of the thesis, integrating the results of the analysis with the issues of sustainability and decentralization raised at the outset. The methodology of the thesis is reviewed and critiqued to determine whether another analytical framework would have been more appropriate for this investigation. It also raises a number of issues relating to the results of the analysis, pointing to areas which might prove interesting as areas for further research.

A summary of the findings of the thesis is as follows:

- Rather than being a strictly technical concept, sustainability is both a technical and a political concept. As such, no one particular definition of sustainability exists — its definition will depend upon the political arena within which the issue is discussed.
- Any discussion about sustainability, however, requires addressing a particular set of elements:
 - first, sustainability requires a systemic perspective, focusing on the interactions between natural environmental, cultural and socio-economic systems over a particular time frame;
 - second, the pursuit of sustainability needs an open acknowledgment of uncertainties in human knowledge of these systems as well as of their future structure and behavior;
 - third, sustainability deals with issues of equity and justice among members of the current generation, between the current and future generations, and also between human beings and other species;
 - finally, sustainability depends heavily upon the development and use of technology, and the flows of information between the interacting systems described above.
- The analytical framework developed from the theory of mental models as well as the work by Elinor Ostrom in *Governing the Commons* classifies a range of issues which local institutions need to address to pursue sustainability. These include: bounding and defining the systems relevant to sustainability; the calculation of costs and benefits of participation by each individual (shaped by understanding of the systems, as well as their values and norms) electing to participate in a local institution; ensuring compatibility between institutional rules and local conditions; creating collective-choice arrangements; locating responsibilities for monitoring, sanctioning and conflict resolution within these local institutions; securing the recognition of local authority by higher-level political institutions; and nesting activities within different levels of institutions (i.e., neighborhoods to cities to regions).
- This framework, however, is insufficient to address the complexity of sustainability issues in the United States. The local sustainability initiatives which are analyzed do not clearly define and bound the systems to be managed, and the authority of local institutions to impose sanctions and resolve conflicts is compromised by the

pervasiveness of the U.S. legal system. Questions remain as to whether pursuing sustainability therefore requires the development of a new framework or changes in the social and political organization of the United States.

- Nonetheless, the sustainable community initiatives are pursuing certain activities deemed necessary by the analytical framework. These include: the establishment of regional institutions to address systems which span jurisdictions; the involvement of a high degree of public participation in decisionmaking; experimentation in alternatives to conflict resolution mechanisms; and the provision of feedback by those projects which have developed sustainability indicators.
- The analysis also demonstrates the crucial roles that technology plays in the pursuit of sustainability:

technology shapes the ways in which relevant systems (the natural environment, culture and values, and social and economic systems) interact;

the technologies discussed within the context of the community initiatives focused on resource efficiency (to prolong time frames for resource use), reductions in pollution generation (to maintain the viability of the natural environment) and information processing and dissemination (to provide feedback and enhance the understanding of systems); and,

the degree of technological development in the United States, both its complexity and its pervasiveness, is partly responsible for the breakdown of the analytical framework. Technology has permitted resource flows to cross not just city or county jurisdictions but international boundaries as well. This has placed the jurisdiction over systems relevant to sustainability beyond local institutions.

Chapter 2: What is Sustainability?

The call for sustainability in the latter 1980s appears pretty vague compared to ... earlier calls for specific controls. Previous environmental movements carefully aimed their limited political power at particular problems. The politics of sustainable development is taking a different course. Environmentalists want environmental systems sustained. Consumers want consumption sustained. Workers want jobs sustained. Capitalists and socialists have their 'isms' while aristocrats, autocrats, bureaucrats and technocrats have their 'cracies.' All are threatened. Thus sustainability calls to and is being called by many, from tribal peoples to the most erudite academics, from Levi-clad eco-activists to pinstripe-suited bankers. With the term meaning something different to everyone, the quest for sustainable development is off to a cacophonous start.¹

The pursuit of sustainability can be a confusing one. It depends completely upon what one chooses to sustain, as well as the ideas of cause and effect that one believes to be relevant. The strength of sustainability is that it has brought together many different people to talk about the future of many different facets of human society. The danger of these public discussions of "sustainability" is that people appear to be talking about the same thing while ignoring the differences in values, beliefs, perspectives and goals.

This is not to say, however, that discussions of sustainability cannot share certain common elements, regardless of what is being sustained. The pursuit of sustainability as a public policy objective involves both social and scientific dimensions. The social dimension stems from the fact that it is individuals' values and beliefs that determine what people want, and for how long they want it.² The scientific dimension involves creating some picture of how society functions, conceptual "models" of society, such that people can determine what actions or changes might be necessary to attain certain goals. Despite differences in both values as well as models, certain issues emerge as being important to the pursuit of sustainability.

¹ Richard B. Norgaard, "Sustainable Development: a Co-evolutionary View," *Futures* 20, no. 6 (1988): 606.

² Ben ten Brink, "The AMOEBA Approach as a Useful Tool for Establishing Sustainable Development?", in *In Search of Indicators of Sustainable Development*, edited by Onno Kuik and Harmen Verbruggen, (Netherlands: Kluwer Academic Publishers, 1991) 72, 82; William C. Clark, "Sustainable Development of the Biosphere: Themes for a Research Program," in *Sustainable Development of the Biosphere*, edited by William C. Clark and R. E. Munn (New York: Cambridge University Press, 1986), 11-12; Helias Udo de Haes, Maarten Nip and Frans Klijn, "Towards Sustainability: Indicators of Environmental Quality," in *In Search of Indicators of Sustainable Development*, edited by Onno Kuik and Harmen Verbruggen

The object of this chapter is to identify those common issues or themes of sustainability to create a framework for evaluating initiatives to “sustain” local communities. It will begin with a discussion of why this concept of sustainability has evolved and what it is being called upon to replace. This will be followed by discussions of how sustainability is viewed from different perspectives, from the sustainability of environmental systems to the sustainability of international development. Finally, the chapter will identify issues common to each of these perspectives to create a set of “dimensions of sustainability” that will function as a definition of sustainability throughout the thesis.

Why Is A Sustainability Paradigm Different?

To understand the many interrelated aspects of sustainability, it may be helpful to introduce why or how the debate started. While debates over the sustainability of many things — religions, work, military supremacy, etc. — have probably taken place throughout history, the shift in the current debates deals with concerns about global limitations, primarily environmental limits. The awareness of these limitations calls into question social and economic patterns conceptually grounded in the absence of limits. It is the inability of current lifestyles and institutions to live within these limits that creates a need to consider the sustainability of society, and how it may need to change.

Origins of the Debate

Thinking about sustainability is grounded in the natural sciences over a concern of the potential limitations of the earth to provide the resources to support growing human populations. These concerns extend far back into history. For example, Plato wrote in his *Critias* that “agricultural activities have transformed the land of Attica into the ‘bones of a wasted body ... the richer and softer parts of the soil having fallen away, and the mere skeleton being left.’”³ The framework for the modern debate was established two centuries ago, when Malthus wrote his *Essay on the Principle of Population*. In this work he speculated that the rate of population growth in England was going to outstrip the rate of growth of food supply. Supporters of Adam Smith, who in his *The Wealth of Nations* had laid the foundation of classical economics, moved to refute Malthus’ predictions, arguing

(Netherlands: Kluwer Academic Publishers, 1991), 90; David Pearce, “Economics, Equity and Sustainable Development,” *Futures* 20, no. 6 (1988): 598.

³ Clark, “Sustainable Development of the Biosphere,” 8.

that economic forces and innovation would allow society to continue to feed itself.⁴ The debate over sustainability has swung between these two perspectives:

“In one extreme form, one pole is determinist in its view of nature, Malthusian in its concern with the adequacy of resources, and conservationist in its prescription for policy. The opposite pole is possibilist in its attitude toward nature, optimistic in its view of technological advance and the sufficiency of resources and generally concerned with technical and managerial problems of development.”⁵

Continued technological advances, particularly in agriculture and transportation, permitted societies to import food and other resources and to continue their expansion.⁶ The dire warnings of Malthus and other neo-Malthusians have not, to this point, been borne out.

What seems to have changed in this debate is the possibility of global, not just local, limits. Again, such considerations have begun in the sciences. Svante Arrhenius, a Swedish chemist writing nearly a century ago, postulated that the increase in carbon dioxide in the atmosphere resulting from fossil fuel combustion could lead to an increased warming of the global atmosphere. Vladimir Ivanovitch Vernadsky, a Russian mineralogist, noted in 1945 that the expansion of knowledge and communication, fostered by advances in technology, had turned human society into a “large-scale geologic force ... chemically, the face of our planet, the biosphere, is being sharply changed by man consciously, and even more so, unconsciously.”⁷ Scientists began to perceive the potential damage from the aggregate sum of human activities.

While these discussions may not have circulated beyond the academic community, the notion of environmental limits and their potential consequences went public with *The Limits to Growth* in the 1970s. This study, sponsored by the Club of Rome, used a computer model to investigate the future behavior of resources, food, population, industrial output, pollution and other indicators of the material standard of living.⁸ Repeated in a sequel report, the model produced a sobering result

⁴ Clark, “Sustainable Development of the Biosphere,” 8.

⁵ Clark, “Sustainable Development of the Biosphere,” 8.

⁶ Herbert Girardet, *The Gaia Atlas of Cities* (London, England, Gaia Books Limited, 1992); Erich J. Plate, “Sustainable Development of Water Resources: a Challenge to Science and Engineering,” *Water International* 18 (1993): 90.

⁷ Clark, “Sustainable Development of the Biosphere,” 10.

⁸ Donella Meadows, Dennis Meadows and Jørgen Randers, *Beyond the Limits* (Post Mills, Vermont: Chelsea Green Publishing Company, 1992), xiv.

If the signal or response from the [physical] limit is delayed and if the environment is irreversibly eroded when overstressed, then the growing economy will overshoot its carrying capacity, degrade its resource base, and collapse [emphasis in original]... the result of this overshoot and collapse is a permanently impoverished environment and material standard of living much lower than what could have been possible if the environment had never been overstressed.⁹

Limits to Growth demonstrated how current social and economic systems fail to account for environmental limits, and discussed in stark detail the potential consequences. While economists attacked the early model for failing to consider market responses, later versions of the model showed no change, even with market corrections.¹⁰ This model predicted that the trajectory of human society is heading toward some form of collapse in the future — the current set of human activities is not sustainable. Either human society will need to change from within, or environmental limits will force a tragic change from without.

This vision of a future collapse can be confronted from two perspectives: first, whether or not it is accurate; and second, whether or not society should respond. The globalization of communications has facilitated the collecting of information, which shows that there may very well be rough times ahead. For example, pollution has contaminated an amount of water equal to the total use by human society.¹¹ Even if pollution were stopped, and all runoff on the planet were collected, that amount of water would be insufficient for the human population 100 years from now, at current consumption and population growth rates.¹² The quest of nations in South America, Africa and Asia to attain a quality of life comparable to that of the average in the United States seems impossible:

... if the entire world population of 5.5 billion were to use land at [the rates of upper-income countries], the total land requirement would be 26.5 billion hectares. However, the total land area of Earth is slightly more than 13 billion hectares, of which only 8.8 billion hectares is productive cropland, pasture or forest.¹³

Looking at resources in addition to agriculture, meeting these consumption levels within environmental limitations calls for a 46-fold increase in technological efficiency.¹⁴

⁹ Meadows, et. al., *Beyond the Limits*, 128.

¹⁰ Meadows, et. al., *Beyond the Limits*, 161-189.

¹¹ Meadows, et. al., *Beyond the Limits*, 56.

¹² Meadows, et. al., *Beyond the Limits*, 56.

¹³ Robert Goodland, Herman Daly and John Kellenberg, "Burden Sharing in the Transition to Environmental Sustainability," *Futures* 26, no. 2 (1994): 150.

¹⁴ Goodland, et. al., "Burden Sharing," 152.

While the data may be compelling, they do not address the moral aspects of the debate. Many people may not, in fact, care whether citizens of Ethiopia or Brazil attain a standard of living equal to that of the United States. Others may not be concerned with the well-being of future generations, or assume that future generations have the responsibility of dealing with future problems. There is undeniably a moral dimension to this debate — people may not care, or, like the pole opposite to the Malthusians, may simply have tremendous faith in the ability of human innovation to deal with whatever problems may arise. That faith, however, may be historically grounded as well as theoretically unfounded.

How Does Sustainability Differ from Prevailing Practices?

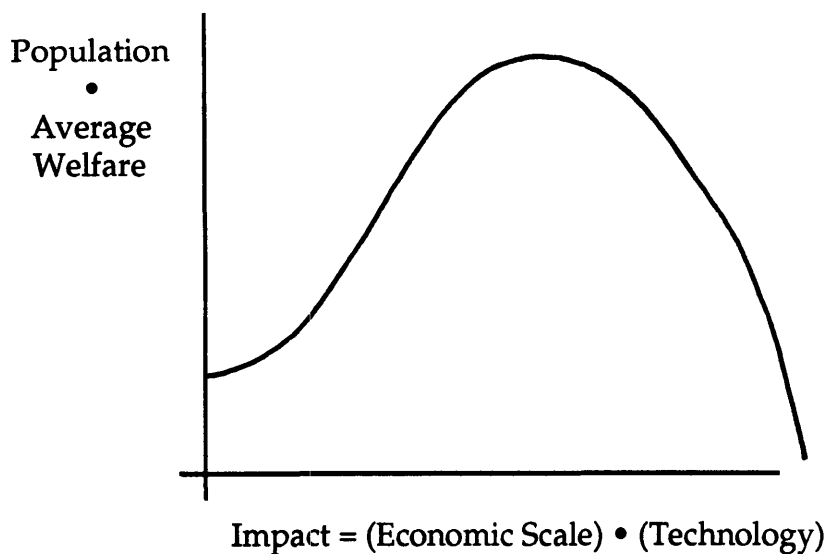
Assuming that sustainability warrants action, questions remain as to how much of a transformation from current practices may be required. Many economists argue that the market, perhaps with some corrections for imperfections, will be able to account for problems associated with environmental limits. In economic theory, prices are the signals which represent the optimum allocation of resources, given the supply and demand characteristics of producers and consumers. The reason that environmental resources are not being protected is because their price does not reflect the full cost of their use.¹⁵ Thus, environmental protection requires “getting the prices right” by incorporating the true costs (the shadow prices) of non-market goods, some of which (such as clean air or water) currently have no price.¹⁶ Economists have worked to develop markets for these goods or finding other ways to value them.¹⁷ Once the correct prices are established, environmental resources will be adequately valued and therefore protected.

Critics from the sustainability perspective argue that economics is *structurally* unsustainable, and that dealing with environmental limits and constraints will require political intervention from outside the marketplace. Neoclassical economics evolved during a time when the environment was fully capable of handling both the absorption of wastes generated by the economy as well as the scale of resources required by the economy (the front-end of the welfare-economic scale curve as shown in Figure 2.1).

¹⁵ Pearce, “Economics, Equity and Sustainable Development,” 604; Richard O. Zerby, Jr. and Dwight D. Dively, *Benefit-Cost Analysis: In Theory and Practice* (United States of America: Harper Collins College Publishers, 1994), 14ff.

¹⁶ Pearce, “Economics, Equity and Sustainable Development,” 604.

¹⁷ Zerby and Dively, *Benefit-Cost Analysis*, 70ff.

Figure 2.1: Global welfare curve

Source: Wetzel and Wetzel

However, as increased demand for resources and increased output of wastes begin to lower the quality of the environment, money and capital will need to be diverted to preserve and maintain that natural quality. At some point, the amount of money spent on remediation will exceed the benefit stream from the environment, and welfare will begin to decline.¹⁸

As a result, economists have found three reasons to attack the reliance on prices to deal with environmental problems:

- First, prices do not exist for goods for which there is no market (so-called “non-market goods”).¹⁹ These goods particularly include “public goods” such as clean air or clean water. The zero price causes the good to be undervalued,²⁰ and most

¹⁸ Kurt R. Wetzel and John F. Wetzel, “Sizing the Earth: Recognition of Economic Carrying Capacity,” *Ecological Economics* 12 (1995): 15.

¹⁹ The reasons given for the absence of a market is the absence of property rights to that good. Property rights provide legal ownership and allow trading of the good. Without these rights, no market can exist.

²⁰ Pearce, “Economics, Equity and Sustainable Development,” 604.

of the methods used to assign a price to public goods have significant analytical or conceptual problems.²¹

- Second, prices are poor signals of carrying capacity. The economist Herman Daly notes that “market prices only measure the value or scarcity of one resource relative to another, not the absolute scarcity of resources in general.”²² As a consequence, price signals do not inform the market that physical or environmental limits are being reached, and therefore neither does the market.²³ Similarly, macroeconomic indicators of performance such as the Gross National Product measure economic activity without reference to scale.²⁴
- Third, the market does not provide information about possible time lags between environmental damage and the manifestation of that damage. Economists Kurt Wetzel and Ted Wetzel note that “the economy, pushed by an expanding population, will almost certainly overshoot the maximum for some time before environmental backlash and resulting negative returns occur.”²⁵

These critics do not, however, feel that the market should absolutely be abolished. Rather, they note that “far from abolishing the market as an allocative mechanism, the goal is to provide the market with the overall social context that its efficient working presupposes” through public policy.²⁶

The failure to deal with absolute environmental limits has also played itself out in business. Microeconomic theory states that the objective of firms is to maximize profits, a behavior which will allow the optimal allocation of resources.²⁷ This thinking has been incorporated into traditional business practices, where it is the “social responsibility of business to increase its profits.”²⁸ As a consequence, corporate law in the United States has created the

²¹ Professor Jerome Rothenberg, Department of Economics, Massachusetts Institute of Technology, class notes from The Economics of Project Evaluation, MIT course taught in Spring, 1995.

²² Herman E. Daly, “Report on Reports: The Resourceful Earth,” review of *The Resourceful Earth* edited by Julian Simon, *Environment* 26, no. 7 (1984): 28.

²³ Daly, “Report on Reports,” 27-8; Wetzel and Wetzel, “Sizing the Earth,” 18.

²⁴ Wetzel and Wetzel, “Sizing the Earth,” 18.

²⁵ Wetzel and Wetzel, “Sizing the Earth,” 17.

²⁶ Daly, “Report on Reports,” 27.

²⁷ Robert S. Pindyck and Daniel L. Rubinfeld, *Microeconomics (Second Edition)* (New York: Macmillan Publishing Company, 1992), 249.

²⁸ Milton Friedman, “The Social Responsibility of Business is to Increase Its Profits,” in *Ethical Theory and Business (Third Edition)*, edited by Tom Beauchamp and Norman Bowie (Englewood Cliffs, New

corporation to maximize shareholder profits, and places tremendous pressure on managers of firms to meet this objective. Managers are highly constrained from allocating resources toward any end except profit maximization.²⁹ However, profit maximization occurs in a market which does not acknowledge the existence of physical limitations to the size of the economy. Allowing firms to work within these environmental constraints will require changes in corporate law and corresponding legislation, an act increasingly unlikely in the current political climate in the United States.

Sustainability is also different because it considers the moral issues associated with distributions of income and resources. Economics does not guarantee an equitable distribution of income among the population — in creating the optimal allocation of resources, it takes the initial distribution as given and then states that allocations which make no one worse off are optimal.³⁰ For those people starting at the bottom end of the distribution, the “sustainability” of this system is a problem, and there are many people at the bottom end:

Of the earth's more than 5 billion people over 1 billion at any one time are eating less food than their bodies require. Somewhere between 500 million and 1 billion people are chronically hungry. Each year 24 million infants are born underweight. In 1990 it was estimated that 204 million children under the age of five were seriously undernourished. Roughly 13 million people die every year of causes related to hunger. That comes to an average of 35,000 deaths from hunger every day.³¹

Studies have indicated that, currently, environmental limits are not yet responsible for this problem.³² In these causes, starvation is caused by a lack of appropriate resources to provide food. In some situations, social and economic pressures (such as taxation or a need for foreign capital) can prevent individuals from dedicating what resources they have toward their own survival.³³ Such pressures are playing large roles in mass migration as well as ethnic strife in some areas.³⁴

Jersey: Prentice Hall, 1993), 87. Friedman argues that “the stockholders or the customers could separately spend their money on the particular action [associated with certain environmental or social objectives] if they wished to do so” (88).

²⁹ William M. Evan, and R. Edward Freeman, “The Stakeholder Theory of the Modern Corporation: Kantian Capitalism,” in *Ethical Theory and Business (Third Edition)*, edited by Tom Beauchamp and Norman Bowie (Englewood Cliffs, New Jersey: Prentice Hall, 1993), 98.

³⁰ Rothenberg, *The Economics of Project Evaluation*; Daly, “Report on Reports,” 27.

³¹ Meadows, et. al., *Beyond the Limits*, 48-9.

³² Meadows, et. al., *Beyond the Limits*, 49-50.

³³ Raymond L. Bryant, “Political Ecology: An Emerging Research Agenda in Third-World Studies,” *Political Geography* 11, no. 1 (1992): 14; Richard A. Schroeder, “Shady Practice: Gendered Tenure in the

What Direction to Follow?

Sustainability involves a shift away from the ways in which society has been conducting its business. Economic growth has focused upon maximizing profits and pursuing comparative advantages for specialization, yet this has hidden the ecological consequences of our actions and ignored possible limits to growth. The question remains, however, as to what the pursuit of sustainability entails. That question is addressed in the next section.

The Common Themes of Sustainability

As the opening quote in this chapter suggests, the problem with the concept of sustainability is that it has different implications for different people. For many, especially those who see the crux of sustainability to be the issue of carrying capacity, this ambiguity has robbed the concept of its meaning.³⁵ For some others, however, ambiguity on the issue of sustainability is inevitable, because it is not just a technical issue, but a technical *and* political issue. William C. Clark, in his introduction to *The Sustainable Development of the Biosphere*, divides sustainability into two separate questions, comparing the Earth to a collective garden:

The first of questions — “what kind of garden do we want?” — ultimately calls for an expression of values ... we seek to distinguish gardening strategies that can be sustained into the indefinite future from those that, however successful in the short run, are likely to leave our children bereft of nature’s support ...

The second question raised above is one of feasibility: “What kind of garden can we get?” While not divorced from value judgments, this latter question is fundamentally one of knowledge and know-how.³⁶

Thus, the specific direction in which sustainability points depends upon what people wish to sustain — what kind of garden they want. Given the range of values and visions present for the many different people on the planet, the creation and imposition of a single definition of sustainability would be impossible.

Gambia’s Green/Orchards,” Paper Prepared for the 88th Annual Meeting of the Association of American Geographers, San Diego, CA, April 18-22, 1992, 1ff.

³⁴ See: Astri Suhrke, “Environmental Degradation and Population Flows,” *Journal of International Affairs* 47, no. 2 (1994): 473-496.

³⁵ Owen Lammers, Executive Director, International Rivers Network, personal communication, July, 1995.

³⁶ Clark, “Sustainable Development of the Biosphere,” 11-12.

Such a perspective does not imply that sustainability is entirely a social and political construct. In general, the literature which seeks to define sustainability consists of people who investigate different things to sustain — the environment, civic infrastructure, development, etc. What became apparent in reviewing the literature, however, was the presence of certain themes common to each definition, regardless of the difference in what this thesis will refer to as either the sustainability “target” or “objective.” Appendix A provides a review of this literature, which was divided into five different (albeit overlapping) sustainability targets — civic infrastructure, environmental systems, social and economic systems, development, and society. At the end of each section in the Appendix, the more salient points related to sustainability were listed. These points were then integrated into the following list of ten common elements of sustainability. Given their prominence in the literature, these elements should form a foundation for any discussion on sustainability.

1.) Thinking About Sustainable Systems

By and large, sustainability involves looking at a system of interacting components. To sustain anything requires looking at all of the possible causes and outcomes, and that necessitates building some kind of model which links causes and effects. Looking at a system also requires defining the system, meaning that system boundaries (either spatial or conceptual) need to be established; if the system is not closed, then flows into and out of the system need to be tracked; similarly, interactions between this system and other systems on small or large scales (e.g., global warming possibilities) need to be identified; and, core variables which describe the system need to be identified and reference values for those variables (quality values as well as quantities) need to be established.

2.) The Environment

All discussions of sustainability contained in this chapter, which were admittedly biased toward questions of public policy (or at least civic infrastructure), included the natural environment as a focus. Human beings, as a biological species, depend upon a certain quality of the environment for their survival, and societies have been built around meeting those needs. As a result, interactions with the environment are necessary, and sustainability involves maintaining a successful interaction. In addition, for many people a certain quality (quite possibly higher) is needed for their quality of life, either from an aesthetic or spiritual dimension. Lastly, many people see that justice is a concept which

should be applied to non-human species as well, thus issues such as the preservation of biodiversity are as moral as they are practical.

3.) Culture and Values

Concerns of sustainability must also look at cultural and value systems. People act in accordance with their needs as well as their values, and values and culture have a mutually-reinforcing relationship. Cultures and value systems which promote short-term considerations work against and can shut out the more long-term perspective involved in promoting intergenerational equity. It also seems evident that even if a culture and value system promotes long-term thinking, it may not lead to sustainability without a strong dose of compassion. If sustainability requires a long-term value focus, then cultural systems must somehow reinforce this value, which will require a transformation.

4.) Social Organization and Decisionmaking

The pursuit of sustainability will also inevitably require changes in the ways in which societies are organized and make decisions. Public institutions, through their rules and histories, are capable of stifling certain values and types of actions. Social organization seems to also have a mutually-reinforcing relationship with values and culture. Thus, institutions and organization will similarly need to change in ways which facilitate long-term considerations in short-term decisionmaking processes. This can and will involve changes in legislation, institutional and organizational structure, levels of public involvement in stages of planning, and so on.

5.) Risks and Uncertainties

Pursuing sustainability involves future possibilities, which automatically involves issues of risk and uncertainty. One mechanism for dealing with this is incorporating future projections into current decisions. Given the relative inability of models and other tools to accurately predict the future, other mechanisms include creating plans for dealing with potential risks, or setting up learning mechanisms to incorporate future information into decisionmaking and planning. Perhaps the best way to deal with this is to be humble in the face of complexity, admit that not everything is knowable, and create a resilient system which is capable of learning and adapting quickly to future changes.

6.) Intergenerational Equity

One of the predominant reasons for even caring about sustainability in the first place stems from a moral concern about the well-being of future generations. Those generations do not have an active voice in expressing their needs and desires for themselves, and those generations will be left with the consequences of our actions. This is the reason that the reversibility of actions and decisions is a factor in some of these discussions on sustainability — will future generations have the ability to undo what the current generation has done, should they so choose? This moral concern is much of what gives sustainability its motivation and the capability for people to act upon it.

7.) Intragenerational Equity

Sustainability will not find a tremendous amount of support from people who are not benefiting from the current system. This is a different moral position than intergenerational equity, because people can easily be concerned about their own children, grandchildren and nebulous “future generations” and not so concerned about many of the people around them. Nonetheless, intragenerational equity has both moral and practical aspects. The moral perspective looks at whether all people in the current generations have equal access to opportunities and resources. The practical aspect considers that sustainability will require the consent of significantly powerful elements of society. The pursuit of sustainability will not mean much in the face of war, meaning that issues of intragenerational equity, particularly in cases of extreme disparity, need to be resolved.

8.) Technology

Technology plays a vital role in the sustainability or unsustainability of any system, since it shapes the ways in which human beings interact with and perceive the environment, their culture and their society. Technologies which will work toward sustainability will preserve the long-term functioning of the natural environment, facilitate a long-term focus in institutions and organizations as well as help manage risks and “unanticipated” events.

9.) Information

Part of what changes in social organization and technology will accomplish is to provide a greater flow of information. As sustainability deals with promoting a long-term view as well as adapting to changes, information will be vital in assessing the state of the system as well as directing action.

10.) Time

This final dimension influences the whole nature of the debate, because it raises the question of how long any given system is to be sustained. It is fine to have a concern for intergenerational equity, but how many generations are being discussed? The amount of time a given system is to be sustained will influence the mechanisms that are adopted to deal with the issues. Concern over children or grandchildren, for example, might try to rely on projections, while concern for the “seventh generation” might require the use of adaptive management and other learning mechanisms to steer the path of the system and to adapt to future changes.

What Are The Implications for Local Sustainability Efforts?

These ten dimensions of sustainability can be applied to any “sustainability target,” be it development, societies or, in the case of this thesis, communities. A “sustainable community” should then, ideally, incorporate at least some aspect of each of these dimensions in the process of pursuing sustainability. The next chapter focuses on whether individuals at the local level have the capacity to create the institutions necessary to address each of these dimensions.

Chapter 3: Sustainability and Local Collective Action

People have lost control over many of the issues that affect their daily lives ... Individuals and communities have come to rely on governments, corporations and professional elites to do many of the things that they once did for themselves. Societies have turned to highly centralized, technologically sophisticated methods of coping with rising energy prices, housing and food shortages, a burgeoning population, and other major problems. We have forgotten that human problems require solutions on a human scale ... People can create local solutions to global problems by changing their values and behavior in response to today's economic and social conditions. By so doing, they can mold more democratic, self-reliant societies.¹

As was discussed in the introduction, policy-makers have begun experimenting with community-based programs to address pollution problems that have not been successfully solved without them. Community “buy-in” in policymaking is particularly important for problems which have their causes in local decisionmaking (e.g., the impacts of private property and land use). The importance of the consent of the community, should not be confused with the ability of communities to manage these issues on their own. Simply because “human problems require solutions on a human scale” does not necessarily imply that individual communities can automatically create the solutions to these problems.

Some argue that tacit assumptions in the “local solutions” rhetoric, while appealing, fail to reflect the reality of modern communities, particularly within many parts of the United States. For example, writing in response to an assertion that “we all know that community must be the center of our life because it is only in community that we can be citizens,” Boyte (1990) states:

[T]his is a 19th century, small-town version of citizenship, where strong normative assumptions about the common good, easy familiarity with each other, and cultural homogeneity shaped people's associational life. It overlooks the prejudices and injustices woven into American social and cultural history: sharply circumscribed roles for women, for instance, harshly discriminatory treatment of Blacks and other minorities ... it simply leaves unaddressed the multiple dangers that shape the environment in which communities find themselves ... a variety of patterns of unresponsive and abusive power ...²

¹ Herbert Gottfried and Mark Butler, *Sustainable Communities: Case Study — Winterset, Iowa* (Ames, Iowa: Iowa State University, 1985), 4.

² Harry C. Boyte, “Community Action: Politics as Education,” *Social Policy* 20, no. 4 (1990): 38.

The modern community of the United States is far more complex than seems to be assumed in many writings which extol the virtues of community-level management of public issues. While the Introduction of this thesis discussed the potential successes for watershed programs, time has not borne out the results of those institutions — some studies have concentrated on their failings.³ Also, it should be kept in mind that the programs cited in the Introduction are cooperations between the state and federal government agencies and the communities. The question remains, can communities generate similar programs on their own?

This chapter seeks to address the question of how community management, unaided by larger level government agencies, can be expected to work toward sustainability. This thesis divides the issue of community management for sustainability into two components, each of which to be addressed in this chapter. First, it investigates the potential for “nonexpert” citizens to understand the complex systems involved in working toward sustainability. To perform this investigation, it examines the work of cognitive psychologists, organizational analysts and risk assessment experts on “mental models” to understand how accurately communities might be expected to describe complex social and physical systems. Second, this chapter explores the institutional capacity of communities in the United States to manage the systems related to sustainability. This section focuses on the work of Elinor Ostrom in her *Governing the Commons*, which investigates the ability of small communities to create their own local institutions to manage common-pool resources (CPRs). The section extrapolates the issues which she identified in describing the potential for success of these CPRs onto modern communities in the United States. Finally, the chapter compares the results of these two sections to generate a framework for analyzing community initiatives for their strengths and weaknesses with regard to sustainability.

Mental Models of Sustainability

As was indicated last chapter, addressing issues of sustainability will require understanding highly complicated social and environmental systems. If the management of sustainability is turned over to a community, that community will need to understand those systems and the ways in which they work. The steps in between deciding “what kind of garden do we

³ See: Raymond J. Burby, Edward J. Kaiser, Michael I. Luger, Robert G. Paterson, H. Rooney Malcom, and Alicia C. Beard, “A Report Card on Urban Erosion and Sedimentation Control in North Carolina,”

want?” and “how do we get that kind of garden?” is the construction of a model which relates causes and effects. The ability of a community to understand the issues related to sustainability depends, in some measure, upon its ability to successfully construct these models.

The theory selected to investigate this issue is the theory of mental models, posited within the discipline of cognitive psychology. In this theory, it is assumed that every individual, both expert and nonexpert, have models of cause and effect for a wide range of phenomenon constructed internally within them. The concept of mental models has been applied within a variety of other disciplines, including organizational behavior theory⁴ and risk communication.⁵ This theory can similarly be used to understand to what degree laypeople can be expected to understand those systems involved in pursuing sustainability.

What Are Mental Models?

The concept of mental models was developed in an attempt to understand how individuals reason. The term was first used by Kenneth Craik in the 1940s, who saw parallels between the way that the mind works as well as the ways in which computational machines were functioning:

... the physical process which [a “computer”] is desired to predict is imitated by some mechanical device or model which is cheaper, or quicker, or more convenient in operation. Here we have a very close parallel to our three stages of reasoning — the ‘translation’ of the external processes into their representations (positions of gears, etc.) in the model; the arrival at other positions of gears, etc., by mechanical processes in the instrument, and finally, the retranslation of these into physical processes of the original type ...

My hypothesis then is that thought models, or parallels, reality ... if the organism carries a ‘small-scale’ model of external reality and of its own possible actions within its head, it is able to try out various alternatives, conclude which is the best of them, react to future situations before they arise, utilize the knowledge of past events

Carolina Planning 16, no. 2 (Fall 1990): 28-36; and Genevieve Giuliano, “The Weakening Transportation-Land Use Connection,” *Access*, no. 6 (Spring 1995): 3-11.

⁴ See: Art Kleiner, Charlotte Roberts, Richard Ross, Peter Senge and Bryan Smith, *The Fifth Discipline Fieldbook* (United States of America: Doubleday, 1994), 235-296; Richard Klimoski and Susan Mohammed, “Team Mental Model: Construct or Metaphor?,” *Journal of Management* 20, no. 2 (1994): 403-437.

⁵ See: Ann Bostrom, Baruch Fischhoff, and M. Granger Morgan, “Characterizing Mental Models of Hazardous Processes: A Methodology and an Application to Radon,” *Journal of Social Issues* 48, no. 4 (1992): 85-100; and M. Granger Morgan, “Prudent Avoidance,” *Public Utilities Fortnightly* 129, no. 6 (1992): 26-9.

in dealing with the present and future, and in every way to react to a much fuller, safer, and more competent manner to the emergencies which face it.⁶

Thus human beings have representations of physical realities in their own minds that “[serve] as a model of an entity in much the same way as, say, a clock functions as a model of the earth’s rotation.”⁷ These models do not, however, need to be “wholly accurate nor correspond completely with what they model in order to be useful.”⁸ The need for a level of accuracy of a model depends upon the way in which an individual reacts with the real entity. For example, a person can successfully use a computer or a television with only a minimal idea of how the device functions — repairing either of the two requires, and also creates, a substantially more complete model.⁹

Cognitive psychologists argue that these models operate on all levels of decisionmaking. The model which Craik described above sounds very calculated and rational — however, many decisions made by individuals are not made after a number of mental simulations of a situation are performed. Mental models operate on two different levels of awareness:

There is an important distinction between two sorts of inference that occur in daily life. On the one hand, the inferences that I have so far considered mostly require a conscious and cold-blooded effort. You must make a voluntary decision to try to make them. They may take time and they are at the forefront of your awareness: they are *explicit*. On the other hand, the inferences that underlie the more mundane processes of intuitive judgment and the comprehension of discourse tend to be rapid, effortless, and outside conscious awareness: they are *implicit*.¹⁰

Mental models exist to help process information for both types of inferences — this provides one explanation, for example, for how children are able to “reason” even if they have not necessarily learned “logic.”¹¹

Finally, some thought must also be given as to whether a group of people can generate a single “mental model,” or at least communicate their own models to agree upon a single one from which to base decisionmaking. Some research has been conducted on this topic of

⁶ P. Johnson-Laird, *Mental Models: Towards a Cognitive Science of Language, Inference and Consciousness* (New York: Oxford University Press, 1983), 3.

⁷ Johnson-Laird, *Mental Models*, 2.

⁸ Johnson-Laird, *Mental Models*, 3.

⁹ Johnson-Laird, *Mental Models*, 3-4.

¹⁰ Johnson-Laird, *Mental Models*, 127.

¹¹ Johnson-Laird, *Mental Models*, 128ff.

“shared mental models” or “team mental models,” though it is not based upon much empirical evidence and no real consensus as of yet exists.¹² Much of the discussion has centered around how shared mental models affect team performance. Teams without a shared model of reality “are forced ... to negotiate reality. The time really needed to be spent ‘on task’ gets diverted and used as team members attempt to surface their mutual perceptions, assumptions, options, and preferences.”¹³ Research on cockpit crew members, for example, showed that crews where each individual had similar notions regarding the distribution of responsibilities and tasks were more effective at responding to emergencies than were crews who did not.¹⁴ The likelihood of a team having a shared mental model is far greater where team members have shared perceptions or experiences.¹⁵

This theory of mental models has a number of implications for any group decisionmaking process. These implications are not limited to so-called “laypeople” alone — every individual, whether nonexpert or expert, has his or her own mental model which “[puts] together a ... picture of that indefinable something we call ‘reality.’”¹⁶ The issues that the theory raises are as follows:

- A group process geared toward creating a public policy will involve the manifestation of both explicit and implicit mental models. Those models will shape not only the topic of discussion but also the ways in which discussion will progress.
- The model of reality will be inherently inaccurate. It will be most accurate in those areas where individuals have more in-depth experience with “reality.”
- The model of reality on which a group bases decisions is likely to be based upon that of the most dominant personality or personalities in the group — social and group dynamics will determine the extent to which each individual’s model is voiced, heard and integrated. The model will consequently be most inaccurate in those areas where the models of dominant personalities are most inaccurate.
- A higher level of diversity in a group will require a longer period to forge a shared mental model. Differences in perceptions about participating in decisionmaking (which may be more implicit) as well as perceptions of the way that the external world works (which may be more explicit) will be harder for groups with more variety in backgrounds.

The following sections review the literature to expand on these issues.

¹² See: Klimoski and Mohammed, “Team Mental Model,” 407-8.

¹³ Klimoski and Mohammed, “Team Mental Model,” 430.

¹⁴ Klimoski and Mohammed, “Team Mental Model,” 413.

¹⁵ Klimoski and Mohammed, “Team Mental Model,” 430.

¹⁶ Garrett Hardin, *Filters Against Folly* (United States: Penguin Books, 1985), 11.

Layperson's Understanding of the Technical "Reality"

Some research has been conducted within the context of mental models to discover the extent to which nonexperts understand the workings of physical systems. This research has been conducted primarily within the context of risk assessment and communication, where researchers have learned that "people do not process and interpret new information, such as risk communication, in isolation. They process and filter such information *with reference* to the knowledge structures and understandings they have already built up."¹⁷ The theory is that risk communication through the use of an "expert model of a risk situation can only be accomplished "if lay people's mental models were organized along the [same] lines."¹⁸

The literature reviewed on two cases — exposure to radon and exposure to extra-low frequency (ELF) electric and magnetic fields — used an "influence diagram" to evaluate lay people's mental models. Influence diagrams are conceptual models generated by technical experts which describe the mechanisms by which risks occur to people. This can either exist as a flow diagram (as shown for Radon in figure 3.1) or as a table of relevant information (as shown for ELF fields in table 3.1). Lay people were then interviewed to assess to what extent their mental models matched the "expert" model as shown on the influence diagram. In addition to this effort, the ELF case also measured the level of confidence which different people expressed in their answers.¹⁹

The results of the two different studies were mixed. Bostrom, et. al., interviewed 24 individuals in Pittsburgh, Pennsylvania, from civic groups or who had responded to a poster in a library, to assess their understanding of the mechanisms associated with radon exposure. The researchers found that respondents reproduced roughly 10 percent of the expert model, with a higher degree of understanding of exposure concepts than effects concepts. The conclusion of the study was that

These statistics showed that respondents here knew relatively few of the facts in the influence diagram, with the known facts concentrated at the

¹⁷ M. Granger Morgan, H. Keith Florig, Indira Nair, Concepcion Cortés, Kevin Marsh, and Karen Pavlosky, "Lay Understanding of Low-Frequency Electric and Magnetic Fields," *Bioelectromagnetics* 11 (1990): 314.

¹⁸ Bostrom, et. al., "Application to Radon," 89.

¹⁹ Morgan, et. al., "Low-Frequency Electric and Magnetic Fields," 318.

Table 3.1: Judgment by the Authors of the Minimal “Mental Model” of Electric and Magnetic Fields That Lay People Should Have to Participate Effectively in Private and Public Decision-Making About the Issue of Possible Risks From Power-Frequency Fields

Basic facts

- There are things called charges
- The quantity of charge on a given object determines its voltage
- There are materials called conductors; charges can flow through them
- A current is a set of charges all flowing in roughly the same direction
- Charges make things called electric fields
- Higher voltages result in stronger electric fields (because there are more charges)
- Electric fields exert forces on charges
- Currents make things called magnetic fields
- Larger currents make stronger magnetic fields
- Magnetic fields exert forces on currents or moving charges
- The strength of fields falls off with distance from the object that makes them
- The fields made by physically extended objects (like power lines) fall off more slowly with distance than the fields made by physically compact objects (like toasters)

Advanced facts

- Electric fields can be shielded; magnetic fields cannot be shielded
- Simple rank ordering of strength of electric fields; general indoors < appliances at meter distances < near distribution lines < appliance at centimeter distances < near transmission lines
- Simple rank ordering of strength of magnetic fields; general indoors < appliances at meter distances < near distribution lines < near transmission lines ≤ appliances at centimeter distances

Source: Morgan, et. al.

highest level of generality and combined with a substantial admixture of nonexpert concepts (some wrong, some imprecise, and some irrelevant). These results suggest that people have a good deal to learn (and unlearn) before they would understand the basic structure of the radon problem ... these misconceptions can blunt the effect of accurate beliefs.²⁰

Morgan, et. al., interviewed blue-collar workers, a “random sample,” electric utility representatives and electrical engineering (EE) juniors in college to assess their knowledge of risks from ELF fields. The study found that “the EE students achieved slightly higher percent correct [of the expert model] but slightly lower correctness scores because they tended to be quite confident in their answers, even when they were wrong.”²¹ The blue-collar workers and the random sample knew roughly half of what the EE students and utility representatives knew, but “their correctness scores are only slightly lower because they appear to recognize the limitations to their knowledge and display less confidence in their answers.” This study concludes that “lay respondents display a variety of incomplete

²⁰ Bostrom, et. al., “Application to Radon,” 97.

²¹ Morgan, et. al., “Low-Frequency Electric and Magnetic Fields,” 318.

and confused understandings about ELF fields, but relatively few beliefs that are outright wrong.”²²

Regrettably, what research that does exist on the “accuracy” of laypeople’s mental models cannot provide much insight on the level to which nonexpert citizens understand physical systems. First, the system(s) involved in sustainability is (are) far larger than just the systems which dictate radon or ELF exposure and health effects — findings from one radon study and one ELF study cannot be used to draw major conclusions. Second, the focus on these mental model studies represents the physical and not the social dimensions, failing to capture details such as “the role of past relations with an agency or firm and how individuals and communities receive and interpret messages.”²³ The “problem” of radon and ELF fields is clearly cast within the field of expertise of those studying the mental models and ignores pertinent information (e.g., what are the mental models people have of risk assessors as they make “objective” risk communications?).

Nonetheless, the two studies lend credence to the relationship between mental models and experience. The higher level of understanding in the ELF case as compared to the radon case could be ascribed to greater levels of experience with the former (e.g., knowing about electricity through repairing appliances) than the latter (e.g., understanding the radioactive decay process of radon and its impact on lung tissue). This can loosely be used to support the claim that people’s mental models become more accurate with increased experience with a given system. What is also of interest in the ELF case is the sense of overconfidence by experts. While the expert’s mental model may be more accurate, an expert may also be less likely to question that model. The potential problems with this are addressed next.

Mental Models in Policy

The process for creating a political response to a given situation, particularly a complex one, involves developing a model of a system which can both describe a given problem as well as suggest a means for addressing that problem. If creating the strategy involves more than one individual, then different mental models will come into play. As described above, the degree to which the mental models differ among individuals in a group affects the level of difficulty involved in coordinating group activity. Groups which do not have the same

²² Morgan, et. al., “Low-Frequency Electric and Magnetic Fields,” 334.

²³ Branden B. Johnson, “‘The Mental Model’ Meets ‘The Planning Process’: Wrestling with Risk Communication Research and Practice,” *Risk Analysis* 13, no. 1 (1993): 6.

mental models will not see reality in the same way, and responses which make sense to some will not make sense to others. The combination of those differences in perception as well as differences in power can create huge problems in dealing with complex systems.

An example of this can be seen in the conflict between fishery managers and fishermen over the proper way to manage the fishing industry off the East coast of Canada and the Northern United States. Those individuals who have influenced fishery management in these regions are largely those with advanced degrees in the sciences — biologists, economists, statisticians and ecologists.²⁴ While their research has provided them with detailed knowledge about certain aspects of the fishing industry, it has also given rise to certain mental models through which they

... see Nature as a “linear” system in which a periodic order or simple repeated pattern can be quantified. This group tends to study defined areas and sub-regions in the marine ecosystem, specific species and generations, and certain ports of call and their landing figures. It tries to define perimeters and parameters and to utilize differential equations to describe processes that change smoothly over time.²⁵

The institutions which governed fisheries have relied upon these individuals to determine such quantities as the “Total Allowable Catch” (TAC) or “Maximum Sustained Yield” (MSY), quantities which would represent the amount of fish that could be harvested annually for an indefinite period.

However, scientists failed to predict the collapse of the Northern cod fishery in Canada in 1992, “despite repeated warnings from inshore fishermen.”²⁶ Subsequent analyses have traced this failing to a number of sources. First, many of the parameters in the models used by scientists are essentially guesses. For example, “many formulae ... assume that there is a constant level of natural mortality of, say, 20 percent from one year to the next, simply because ‘there is no known technique for monitoring natural mortality.’”²⁷ Second, scientists failed to account for all of the available data in their models. While researchers were able to obtain data from larger off-shore fishing vessels, “the many different techniques, the irregular seasonal participation in the industry ... the fact that most inshore fishermen could not be bothered to keep log-books while others could not read or write”

²⁴ M. Estellie Smith, “Chaos, Consensus and Common Sense,” *The Ecologist* 25, no. 2/3 (1995): 81.

²⁵ Smith, “Chaos,” 81.

²⁶ David Ralph Matthews, “Commons Versus Open Access: the Collapse of Canada’s East Coast Fishery,” *The Ecologist* 25, no. 2/3 (1995): 92.

²⁷ Smith, “Chaos,” 81.

prevented the incorporation of data from the inshore fishing sector.²⁸ A third, and possibly more serious failing, is that the scientists are simply wrong in assuming a linear form to fish populations in the fisheries.

Scientists have refused to incorporate this last perspective into their analyses largely because it stems from the mental models of the fishermen themselves. In “Chaos, Consensus and Common Sense,” an article in the May/June 1995 issue of *The Ecologist*, M. Estellie Smith interviewed a number of fishermen and summarized that “[fishermen] do not see nature as random ... but they do view it as essentially unpredictable.”²⁹ One fisherman noted that “if I knew everything that was going to make one fishing trip a winner and another a loser, I’d be God.”³⁰ Smith notes that these perceptions have begun to find “academic” backing in the field of chaos theory, which “argues that the dynamics of systems can unfold in a non-random but unpredictable fashion.”³¹ For example, James Wilson and Peter Klebanof of the University of Maine have recommended a set of fishery management strategies acknowledging “chaotic natural and social environments” which “[rest] upon information about the relatively stable ecological parameters of the fishery. This is the kind of knowledge that fishermen can be expected to acquire through observation and experience.”³²

The differences in mental models have essentially precluded fishery managers and fishermen from being able to work together on fishery management. For the fishery managers, the observations of fishermen are not expressed in terms which are comprehensible to their models. As one manager related,

“... the majority of them have a litany of mumbo-jumbo which they bring forth each time they talk to you. About where the fish are and why they’re not here. They relate it to things like the berries and the trees. Sometimes observations of that sort have some value, such as ‘When the wind is such-and such a way, you get catches.’ That’s acceptable.”³³

The managers also firmly believe in their abilities to predict fish stocks, and attribute failures to political, not scientific, causes. Said a different scientist, “if management were left up to us [the biologists], we could do something. But in the final analysis, scientific

²⁸ Matthews, “Commons Versus Open Access,” 93.

²⁹ Smith, “Chaos,” 82.

³⁰ Smith, “Chaos,” 82.

³¹ Smith, “Chaos,” 82.

³² Smith, “Chaos,” 83.

evidence doesn't matter; it's what plays in the political sector."³⁴ Similarly, the actions of the fishery managers do not fit with the mental models of the fishermen. Said one fisherman,

"By God, those people are stupid! Year after year, they come out here with their charts and graphs and measuring tools and go to the same spot at the same time and try to compare this year's stock with last year's and ten years ago and so on. And they mumble about 'replicability' and 'sampling procedures' and like that. Jesus! Don't they understand that fish swim?"³⁵

The differences in perception have also led to differences in proposed solutions — the scientists advocate fishing quotas to total the MSY, while fishermen want fishing technologies to be regulated. However, the scientists and fishery managers have the power of legitimacy and authority within the government. Fishermen who have attempted to participate in developing management plans "believe their contributions are trivialized, ignored or ridiculed, and that their concerns are dismissed as manifestations of greed or economic opportunism."³⁶ No one has won in these situations.

What Are the Implications of Mental Models for Local Sustainability?

The object of this chapter is to hypothesize what will result from a community initiative to pursue sustainability. As discussed in the previous chapter, pursuing sustainability requires an understanding of the different systems — social and environmental — which affect a given community. Given the research presented on mental models, it seems that the following predictions can be made:

- The model that any group of people generates will automatically be inaccurate. The level of accuracy will increase with the amount of experience that individuals have with a given system, although it is likely that each individual will only have experienced portions of the system.
- Laypeople should not necessarily be expected to create an "inferior" model to one created by experts. Expert knowledge may not be necessary to pursue sustainability — there is a difference in asking what laypeople know about something as opposed to what they need to know "in order to make reasonable private decisions and to participate intelligently in public decision processes."³⁷ Two things, however, should be kept in mind. First, laypeople's knowledge of

³³ Matthews, "Commons Versus Open Access," 93.

³⁴ Smith, "Chaos," 84.

³⁵ Smith, "Chaos," 83.

³⁶ Smith, "Chaos," 84.

³⁷ Morgan, et. al., "Low-Frequency Electric and Magnetic Fields," 315.

systems is highly general, and sustainability strategies will probably reflect that level of generality. Second, the inclusion of expert opinion might be problematic, because experts seem less aware of the limits of their knowledge than laypeople, which may prove a liability in dealing with systems as interdisciplinary as the ones involved in sustainability.

- Public policy is created in a given social and political context, where individuals wield differing levels of power and influence. That power and influence will also shape upon what model a given management strategy is ultimately based. Also, working through the mental models of a number of different individuals can take a considerable amount of time and effort, resources which community members may better put to other uses. Sustainability strategies will probably reflect the mental models of a few, rather than many, individuals, and those individuals will be in positions of the greatest influence over the process.
- The more effective sustainability strategies will probably be developed by more homogeneous communities. By “homogeneous” it is meant that individuals share the same basic sets of experiences and therefore have tremendous similarities in their mental models. It might be expected, for example, that strategies will be developed more readily in rural areas than in urban ones.

These issues dealing with differing mental models inevitably affect the ability for a group of individuals to create or change a local-level institution to promote sustainability. The ways in which the theory of mental models shapes the analysis is summarized in Table 3.3, at the end of this chapter. The process by which community members create or change institutions is the subject of the next section.

Averting the Tragedy of the Commons

The ability of a community to become “sustainable” also hinges upon whether it can organize its members to behave in such a way as to preserve the sustainability targets. Traditional thinking on environmental issues has largely precluded the ability of individuals to accomplish such a task. “The Tragedy of the Commons,” originally an article by the ecologist Garrett Hardin in *Science* magazine in 1968, has become a symbol for what many believe to be the inevitable disastrous outcome of the use of natural resources by self-interested individuals.³⁸

The “tragedy” unfolds as follows. A group of herders use a pasture “open to all” in a socially stable setting where the carrying capacity of the pasture can be exceeded.³⁹ Each

³⁸ Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (United States of America: Cambridge University Press, 1990), 2.

³⁹ Garrett Hardin, “The Tragedy of the Commons,” in *Economics of the Environment*, edited by Robert Dorfman and Nancy S. Dorfman (New York: W.W. Norton and Company, 1993), 9.

herder individually weighs the decision between an additional gain of one more animal in their herd versus a shared loss of overgrazing. To a rational, self-interested individual, the gain outweighs the loss, and the additional animal is added to the pasture:

But this is the conclusion reached by each and every rational herdsman sharing a commons. Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit — in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all.⁴⁰

The “commons” can be extended to a number of issues, from “cattlemen leasing national land on Western ranges” to “the oceans of the world ... maritime nations ... bring species after species of fish and whales closer to extinction” to problems of pollution and overpopulation.⁴¹

To investigate the degree to which communities can overcome the “tragedy of the commons,” this thesis relies heavily upon Elinor Ostrom’s *Governing the Commons*. As mentioned earlier, one of the two sections into which this chapter divides community management of sustainability is the institutional capacity available at the community level. What was needed was a framework for assessing what authority would be needed by a local-level institution to govern those issues identified as related to sustainability. Investigations of literature on sustainability and local planning, public participation or community management did not provide these frameworks. The selection of Ostrom’s work as the basis of the analysis came at the suggestion of an author of one of the works evaluated in Chapter 2.⁴² Ostrom, a political scientist, wrote her work with the intent of creating an understanding of how individuals can, through collective action, create their own institutions to govern their commons. The thrust of this work provided the best, if not only, theoretical and empirical work for analyzing the institutional aspects of local sustainability initiatives.

The Rational Actor Model

Ostrom’s analysis begins with certain assumptions about the individuals who are members and users of their CPRs. At the heart of the analysis is the assumption that people are

⁴⁰ Hardin, “The Tragedy of the Commons,” 9.

⁴¹ Hardin, “The Tragedy of the Commons,” 10-13.

⁴² Kai Lee, Professor, Williams College, personal communication, August, 1995.

rational actors, meaning that they make decisions according to rational choice. This model may be explained as:

- 1.) Actors are able to order their alternative goals, values, tastes, and strategies. This means that the relation of preference and indifference among the alternatives is transitive so that, for a set of alternatives, $A: \{a_1, a_2, \dots, a_m\}$, if a_i is preferred or indifferent to a_j and a_j is preferred or indifferent to a_k , then a_i is preferred or indifferent to a_k .
- 2.) Actors choose from available alternatives so as to maximize their satisfaction.⁴³

The advantage of this model is that it has allowed social scientists to analyze and predict human behavior through quantitative analysis by looking at the potential payoffs to individual actors in different situations. Game theory became the science of these quantitative models, focusing on how every social situation could be considered a “game” where each individual would develop a strategy to maximize his or her welfare.⁴⁴

In time, it became evident that the predictions of game theory were not consistent with observations of political outcomes.⁴⁵ To explain these discrepancies, some social scientists began investigating the impacts of institutions on individual behavior. This new school of thought, which some have labeled “positive political economy,” investigates the ways in which institutional structure and rules affect both the order in which actors make their moves as well as the potential payoffs for actors.⁴⁶ Thus, institutions can shape outcomes in ways which would not be detected by a focus on individual behavior alone. Despite this shift in the focus of the analysis, the heart of positive political economy is still self-interested individuals “[who] calculate the costs and benefits to themselves of various actions they are considering and then choose the alternative most consistent with their fixed preferences.”⁴⁷ Ostrom’s analysis clearly follows suit, as she argues that

⁴³ William H. Riker, “Political Science and Rational Choice,” in *Perspectives on Positive Political Economy*, edited by James E. Alt and Kenneth A. Shepsle (New York: Cambridge University Press, 1990), 172.

⁴⁴ Robert S. Pindyck and Daniel L. Rubinfeld, *Microeconomics (Second Edition)* (New York: Macmillan Publishing Company, 1992), 465ff.

⁴⁵ See: James G. March and Johan P. Olsen, “The New Institutionalism: Organizational Factors in Political Life,” *The American Political Science Review* 78 (1984):734-749; Kenneth A. Shepsle, “Studying Institutions: Some Lessons from the Rational Choice Approach,” *Journal of Theoretical Politics* 1, no. 2 (1989): 133ff.

⁴⁶ Kenneth A. Shepsle, “Institutional Equilibrium and Equilibrium Institutions,” in *Political Science: The Science of Politics*, edited by H. Weisburg (New York: Agathon, 1986), 53.

⁴⁷ Paul Cammack, “The New Institutionalism: Predatory Rule, Institutional Persistence, and Macro-Social Change,” *Economy and Society* 21, no. 4 (1992): 405.

An individual's choice of behavior in any particular situation will depend on how the individual learns about, views, and weighs the benefits and costs of actions and their perceived linkages to outcomes that also involve a mixture of benefits and costs.⁴⁸

She acknowledges a high degree of uncertainty in the decisions made by individual actors, agreeing that foolish actions are not necessarily “irrational” but rather “suggest inquiry into the degree of the actor’s ignorance.”⁴⁹

The theory of mental models introduced earlier challenges some aspects of the rational actor approach. The two are consistent in the respect that mental models do not contradict an assumption that individuals are self-interested — mental models do, however, shape the ways in which individuals will perceive potential costs and benefits to themselves, and thereby can induce different behavior. The main difference is that the theory of the rational actor assumes that all decisionmaking is based upon explicit inferences, through a “cold-blooded” calculation of costs and benefits. As was described in the theory of mental models — and concurred by a more sociological study of institutions known as the New Institutionalism — some mental models operate below the level of conscious thought even while they shape behavior.

New Institutionalists assert that institutions such as industries, professions and nation-states create standardized rules and structures which people follow rather than pursue an active rational choice process for every decision.⁵⁰ That all individuals do not necessarily engage in explicit reasoning in decisionmaking could produce a very different outcome than might be predicted in Ostrom’s analysis.

Creating Institutions to Govern the Commons

The objective of Ostrom’s work is to establish a theory to explain the ability of individual users of a commonly-held natural resource to organize themselves in such a way as to preserve that resource. For her, the “tragedy of the commons” as described by Hardin is a situation in which it is presumed that the herders are unaware of the limitations of the pasture and are unable to organize themselves to avoid such a tragedy. Such assumptions,

⁴⁸ Ostrom, *Governing the Commons*, 33.

⁴⁹ Riker, “Political Science and Rational Choice,” 173.

⁵⁰ See: Paul J. DiMaggio and Water W. Powell, “Introduction,” in *The New Institutionalism in Organizational Analysis*, edited by Paul J. DiMaggio and Walter W. Powell (Chicago: The University of Chicago Press, 1991).

she believes, help justify perceptions that the omniscient “state” or “the market” are the only possible solutions. She states that

instead of presuming that some individuals are incompetent, evil, or irrational, and others are omniscient, I presume that individuals have very similar limited capabilities to reason and figure out the structure of complex environments.⁵¹

To this end, Ostrom investigates situations in which individual users have both succeeded and failed in sustaining their use of a given natural resource and seeks to identify certain characteristics which promote success.

To assess the ability of “the herders” to avert the tragedy of the commons, Ostrom studied 14 common-pool resources (CPR) with the following characteristics:⁵²

- The CPRs are relatively small, located in one country and involving between 50 to 15,000 people.
- The users of the CPR are heavily dependent upon the CPR for economic returns. This situation was selected because in this case “the individuals involved ... are strongly motivated to try to solve the commons problems to enhance their own productivity over time.” Such a situation also ensures that “when self-organization fails, I know that it is not because the collective benefits that could have been obtained were unimportant to the participants.”⁵³
- The users of the CPR have no power in the final-goods market.
- The actions of the users of the CPR do not affect the environment of others who live outside of the CPR.

The youngest of the CPRs which she studies is 100 years old, while the oldest has been in place for over 1,000 years, although the institutional rules may have changed during their lifetimes to adapt to new situations. Those institutions she studies which have endured “have survived droughts, floods, wars, pestilence, and major economic and political changes.”⁵⁴ The focus of her analysis is to identify solutions to three basic problems that local users will have in creating long-lasting CPRs: supplying a new set of institutions; making credible commitments; and mutual monitoring.

⁵¹ Ostrom, *Governing the Commons*, 25.

⁵² According to Ostrom’s definition, a “common-pool resource” refers to a natural or man-made resource system that is sufficiently large as to make it costly (but not impossible) to exclude potential beneficiaries from obtaining benefits from its use.”

⁵³ Ostrom, *Governing the Commons*, 26.

⁵⁴ Ostrom, *Governing the Commons*, 58.

Design Principles for CPR Institutions

On the basis of CPR institutions which have endured, Ostrom generates a set of design principles which characterize these successful examples. The design principles, according to Ostrom, are “essential element[s] or conditions that [help] to account for the success of these institutions in sustaining the CPRs and gaining the compliance of generation after generation of appropriators to the rules in use.”⁵⁵ She adds, however, that she is “not yet willing to argue that these design principles are necessary conditions for achieving institutional robustness in CPR settings,” though she does maintain that eventually “it will be possible to identify a set of necessary design principles and that such a set will contain the core of what has been identified here.”⁵⁶ Her set of design principles is listed in Appendix B, in Table B.1.

These principles address two of the three problems Ostrom identifies. First, the question of monitoring is addressed by having the appropriators themselves perform the monitoring. This helps keep the costs of monitoring low and allows for accurate imposition of sanctions. Second, the question of credible commitment is maintained through the accurate imposition of sanctions as well as an avenue for individuals to contest and change the rules. The low level of the initial sanctions also allows people to gain confidence in the functioning of the institution without being overly damaged by an initial deviation from the rules. These findings are supported by game theory research which demonstrates that “mutual cooperation can emerge in a world of egoists without central control, by starting with a cluster of individuals who rely on reciprocity.”⁵⁷ One condition of this occurrence, however, is that “the possibility of achieving stable mutual cooperation depends upon there being a good chance of continuing interaction.”⁵⁸

These design principles are supported by additional research on CPRs. One study on the success of resin-tappers to sustainably manage their forest indicated that “the key to this success has been the cooperative’s ability to limit access to the forest ... on two occasions, the [resin-tapper] co-op has met with the national director of [the Department of Forestry]

⁵⁵ Ostrom, *Governing the Commons*, 90. “Appropriators” is the term that Ostrom uses for an individual who derives, or “appropriates,” benefits from the CPR. See: Ostrom, *Governing the Commons*, 30.

⁵⁶ Ostrom, *Governing the Commons*, 90-1.

⁵⁷ Robert Axelrod, “The Emergence of Cooperation among Egoists,” *American Political Science Review* 75 (1981): 317

⁵⁸ Axelrod, “Cooperation among Egoists,” 309.

to stop sawmill logging and other outside incursions.”⁵⁹ It also noted the importance of government support of tenure rights for the resin-tappers.⁶⁰ Another study on successful community involvement in the construction of public works in Perú noted that “punitive measures did exist on all projects to ensure the participation of community members and to penalise those who did not meet their obligations.”⁶¹ The monitoring of participation was largely conducted by other community members, since “most of the communities in which these projects were constructed are comparatively small ... social cohesion is high, as is personal visibility, and hence individuals who would not meet their community obligations would be subject to considerable community pressure.”⁶² Also, in the fisheries examples discussed earlier in this chapter, “the traditional regulatory mechanisms were beginning to break down, largely as a result of government interference” and “the attack on the community’s right to control access to its fishing grounds led to a widespread loss of confidence in the authority of the traditional regulations.”⁶³ Finally, Ostrom also investigated CPRs which failed, and found that “no more than three of the design principles characterized by any of the cases in which CPR appropriators were clearly unable to solve the problems they faced.”⁶⁴

The Impact of Technology

Two of the studies also emphasize the impact that technology can have on the success of these CPRs. Both stress that increases in the level of complexity of a technology can severely compromise the ability of institutions to manage their resources. Kent and Carranza Rimarachin, for example, in studying the construction of public works in Perú, state that among the factors which contributed to the success of a community program included “[the employment of] projects of simple or modest technological complexity (i.e., potable water, irrigation canals, and roads).”⁶⁵ In the case of the East coast fisheries, while the government restricted fishing licenses, it failed to restrict “fishing technologies or the size of boats ... hundreds of millions of immature dead and dying fish have been dumped

⁵⁹ Denise Stanley, “Demystifying the Tragedy of the Commons: the Resin Tappers of Honduras,” *Grassroots Development* 15, no. 3 (1991): 29.

⁶⁰ Stanley, “The Resin Tappers of Honduras,” 35.

⁶¹ Robert B. Kent and Jesús Carranza Rimarachin, “Rural Public Works Construction in the Andes of Northern Peru: the Role of Community Participation,” *Third World Planning Review* 16, no. 4 (1994): 369.

⁶² Kent and Carranza Rimarachin, “Rural Public Works Construction,” 370.

⁶³ Matthews, “Commons Versus Open Access,” 89, 94.

⁶⁴ Ostrom, *Governing the Commons*, 179.

⁶⁵ Kent and Carranza Rimarachin, “Rural Public Works Construction,” 371 .

by draggers in Canadian waters in the past 15 years.”⁶⁶ Technological complexity can foil individual mental models, either rendering projects seemingly irrelevant or taking individual impact beyond the realm of comprehension.

The Problem of Institutional Change

While the design principles provide interesting insight as to what types of institutional structures can yield success, they do not answer the question of how or whether a group of individuals will create such an institution. Ostrom simplifies the question of changes through the use of the rational actor model, where the individual weights four variables — expected benefits, expected costs, internalized norms, and discount rates — to determine their behavior. She states “one predicts that individuals will select strategies whose expected benefits will exceed expected costs,” and that new rules or institutions will be created provided that this condition is met for a sufficient number of people.⁶⁷ However, Ostrom adds that attempting prediction with such a model assumes that for each variable, accurate measures exist, individuals are able to “completely and accurately translate information about net benefits and net costs in to expected benefits and expected costs,” and that “individuals behave in a straightforward, rather than a strategic, manner.”⁶⁸ Since these assumptions cannot be maintained in the field, Ostrom proposes that these *summary* variables need to be supplemented by an analysis of *situational* variables.

Situational variables represent the complexity inherent in every CPR where changes in rules or institutions are proposed. The perception of benefits to an individual, for example, depend upon “(1) the objective conditions of the CPR, (2) the type of information that the current institutional arrangements generate and make available to individuals, and (3) the rules proposed as alternatives.”⁶⁹ Situational variables, therefore, reflect the circumstances which could induce the same individual, with the same preferences, to alter his or her decision to support a change in rules or institutions. A summary of which situational variables affect the four summary variables (internal norms, discount rates, expected benefits, and expected costs) is shown in Figure 3.2.

⁶⁶ Matthews, “Commons Versus Open Access,” 88.

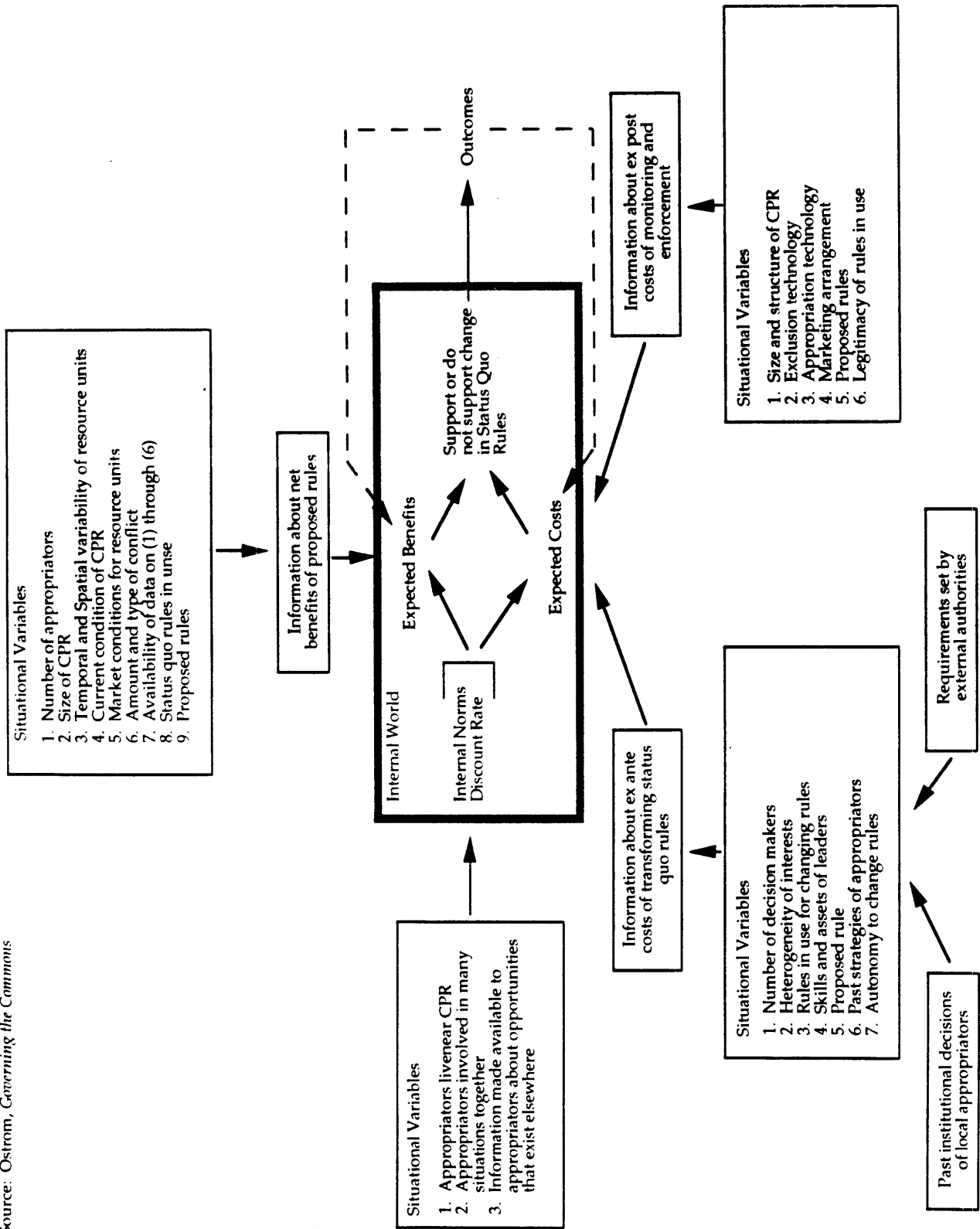
⁶⁷ Ostrom, *Governing the Commons*, 193

⁶⁸ Ostrom, *Governing the Commons*, 194.

⁶⁹ Ostrom, *Governing the Commons*, 197-8.

Figure 3.2: The Impact of Situational Variables on Individual Decisionmaking

Source: Ostrom, *Governing the Commons*



Expected Costs and Benefits

As is shown in the figure, the costs and benefits expected by users of the CPR depend greatly upon the situation. Ostrom divides costs into two categories, up-front transformation costs (*ex ante*) and ongoing costs of monitoring and enforcement (*ex post*). Transformation costs, for example, can be expected to be lower in the presence of skillful leaders, or higher if an outside authority makes the transformation process more difficult. Monitoring and enforcement costs can depend upon the ability to exclude the CPR from outsiders (higher costs for a more open resource) or the ways in which individuals use the CPR:

Milking occurs daily, and variations in yield are rapidly apparent to the herders. Wool is sheared less frequently, but the quality of wool is immediately apparent to those who herd sheep. The quality of meat produced for market is monitored less frequently and may not even be known by herders.⁷⁰

Thus, milking or shearing wool could create lower monitoring costs because monitoring occurs as a part of the economic use of the CPR, rather than as an additional activity. Benefits are similarly dependent upon the characteristics of the CPR as well as its users.

Internal Norms and Discount Rates

Both norms and discount rates affect the perceptions of costs and benefits, and are themselves influenced by certain situational variables. For example, “shared norms related to the legitimacy of the rules and the imperative that they be followed will reduce the costs of monitoring, and their absence will increase those costs.”⁷¹ These *external* norms can also be distinguished from *internal* norms, where sanctioning may take the form of guilt or anxiety rather than ostracism. These norms depend upon the culture of the individuals who use the CPR. Discount rates, on the other hand, can be affected by more physical features of the CPR:

Appropriators who are involved in activities that take them away from their CPR and into an economy in which other opportunities exist are most likely to adopt a high discount rate than are appropriators who presume that they and their children are dependent on the local CPR for major economic returns.⁷²

⁷⁰ Ostrom, *Governing the Commons*, 208.

⁷¹ Ostrom, *Governing the Commons*, 204.

⁷² Ostrom, *Governing the Commons*, 206.

Discount rates can also be affected by norms. For example, “individuals living in a community where disregard for the future is censured by others will have a lower discount rate.”⁷³

Predicting Institutional Change

Despite creating a model within the rational actor paradigm, Ostrom admits that factors not captured within the model are likely to influence the way in which this model functions.

She writes:

Instead of viewing decisions about changes in rules as mechanical calculation processes, a better theoretical stance is to view institutional choices as process of making informed judgments about uncertain benefits and costs. It is then possible to draw on the empirically supported theoretical work of social psychologists concerning the processes of human judgment in an effort to characterize the institutional-choice process.⁷⁴

The research on mental models summarized at the beginning of this chapter proposes such a framework. Ostrom cites other psychological literature which argues that “individuals weight ... potential losses more heavily than potential benefits.”⁷⁵ She also refers to sociological literature which has shown that “individuals are less likely to adopt unfamiliar rules than they are to adopt rules used by others in similar circumstances that have been known to work relatively well,”⁷⁶ an argument supported by organizational analysts.⁷⁷

Ostrom summarizes this information into a set of characteristics of a CPR and its users which would be positively related to the adoption of a series of “incremental changes in operational rules.” These are as follows:⁷⁸

- Most appropriators share a common judgment that they will be harmed if they do not adopt an alternative rule.
- Most appropriators will be affected in similar ways by the proposed rule changes.

⁷³ Ostrom, *Governing the Commons*, 206-7.

⁷⁴ Ostrom, *Governing the Commons*, 208.

⁷⁵ Ostrom, *Governing the Commons*, 208.

⁷⁶ Ostrom, *Governing the Commons*, 209.

⁷⁷ See: Maureen Scully (Sloan School of Management, MIT) and Debra Meyerson (School of Business Administration, University of Michigan), “Before Isomorphism: the Dynamics of Legitimation in the Early Days of Corporate Ethics Programs,” Sloan School of Management, July, 1994; and Pamela S. Tolbert and Lynne G. Zucker, “Institutional Sources of Change in the Formal Structure of Organizations: the Diffusion of Civil Service Reform, 1880-1935,” *Administrative Science Quarterly* 28 (1983): 22-39.

⁷⁸ Ostrom, *Governing the Commons*, 211.

- Most appropriators highly value the continuation activities from this CPR; in other words, they have low discount rates.
- Appropriators face relatively low information, transformation, and enforcement costs.
- Most appropriators share generalized norms of reciprocity and trust that can be used as initial social capital.
- The group appropriating from the CPR is relatively small and stable

It is Ostrom's contention that the creation of such a local institution to govern a CPR is more effective than attempts to impose rules through jurisdiction: "Trying to get local appropriators to commit themselves to follow rules that are perceived to be ineffective and inequitable is difficult, and the costs of monitoring and enforcing such rules are bound to be higher than for rules crafted to fit local circumstances."⁷⁹

Institutional Capacity: Elements for Analysis

This research on common-pool resources, and how communities have created collective action institutions to manage those resources, can be used to create a framework for analyzing the capacity for local institutions in the United States to manage themselves for sustainability. The concepts and structure of three elements of the CPR framework— institutional design characteristics, technology and institutional supply — can be modified for this analysis.

Institutional Design Characteristics

Appendix B provides an account of how the CPR design principles developed by Ostrom (see Table B.1) can be translated into characteristics to analyze sustainable community initiatives. Communities in the United States are far larger and more heterogeneous than those which manage the CPRs, and the systems to be sustained by those communities are likewise larger and more complicated. These differences necessitate some modifications in Ostrom's original design principles. The discussion in Appendix B provides the basis for the set of sustainable community design principles shown in Table 3.2.

⁷⁹ Ostrom, *Governing the Commons*, 214.

Table 3.2: Proposed design principles for sustainable community initiatives

1. Clearly defined sustainability target

The initiative will need to establish a clear definition of what is to be sustained. This definition should include boundaries sufficient to minimize “free-riding,” particularly on the part of people who reside outside of the community.

2. Sustainability target provides substantial benefits, monetary or otherwise

What is to be sustained by the initiative must be sufficiently important to the beneficiaries of the initiative, such that the benefits to be gained will outweigh the imposed costs. Thus the definition of the objective of the initiative must provide benefits to every individual who will be expected to participate.

3. Congruence between rules and local conditions

Any rules associated with a sustainable community initiative should take into account specific community characteristics, such as the nature of local businesses, local institutions, local geography, etc.

4. Collective-choice arrangements

By allowing most or all beneficiaries to participate in the modification of the institutions, a sustainable community initiative could make itself more responsive to changes in conditions or situations.

5. Monitoring

Monitors, who actively audit the sustainability target or targets as well as compliance with the rules of the initiative, are accountable to the members of the community and the initiative.

6. Graduated sanctions

Community members who violate rules should be assessed graduated sanctions (depending on the seriousness and context of the offense) by other members of the community, by the administrators of the initiative, or both.

7. Conflict-resolution mechanisms

Community members and the sustainability initiative administrators have rapid access to low-cost local arenas to resolve conflicts among community members or between community members and administrators.

8. Minimal recognition of rights to organize

The rights of community members to devise their own institutions (i.e., sustainability initiatives) are not challenged by external governmental authorities.

9. Nested enterprises

For larger and more complex communities, the activities generated by a sustainable community initiative are organized in multiple layers of nested enterprises.

Technology

This element affects both institutional design as well as supply. Technology is addressed by Ostrom in her second design characteristic as well as in two other studies which investigate the effectiveness of collective action institutions.⁸⁰ Ostrom notes that appropriation rules which restrict technology must be related to local conditions as well as provision rules. What has happened with the development of technology (primarily in transportation and telecommunications) is that appropriation and provision activities no longer need occur in the same location. The provision of fossil fuels for automobiles or power plants, for example, can take place hundreds or even thousands of miles from where those resources are used. Technology, then, can break down the boundaries of a given resource as well as the link between local conditions and institutional rules.

Another impact of the development of technology is an increase in the level of system complexity. This increase in complexity can confound the ability of community members from understanding the potential benefits and costs associated with the use of that technology, leading to potentially disastrous decisions. Studies have indicated that group projects are more successful for relatively simple levels of technology, where the benefits which will flow from that technology are readily apparent.⁸¹ More powerful technologies, such as the gillnetters in the fishery cases, can defeat the abilities of local institutions to manage them because their systemic impacts are unknown. Thus, it would seem that sustainable community initiatives should direct their efforts at managing simpler (though not necessarily unsophisticated) levels of technology — i.e., technologies whose systemic impacts are understandable.

Sustainability and Institutional Supply

The issues involved with institutional design do not address all of the dimensions of sustainability identified in the previous chapter. Defining the equivalent of the CPR does promote a systems approach to sustainability, and the elements of risk and uncertainty as well as information are incorporated in the monitoring and collective decisionmaking principles. Sustainability issues concerning social organization and decisionmaking are addressed both in institutional rules as well as the interaction between this local institution and the higher levels of authority. Finally, technology has been identified as a separate

⁸⁰ See: Kent and Carranza Rimarachin, "Rural Public Works Construction"; Matthews, "Commons Versus Open Access."

factor affecting institutional design. The remaining elements of sustainability are more appropriately addressed in what Ostrom labeled the problem of institutional supply.

In addition to its presence in the institutional design, questions of social organization and decisionmaking manifest themselves in people's decisions to participate in these local institutions, be they CPRs or sustainable community initiatives. As was shown in figure 3.2, the institutional supply of rules to regulate a CPR depended upon four summary variables — expected benefits, expected costs, norms and discount rates. Two of those variables — the expected benefits and costs — are functions of situational variables, such as the ways in which markets are designed, the conflict which occurs, or the heterogeneity of interests. Each of these sustainability elements affects how a person perceives the possible benefits and costs involved in creating a given institution.

The elements of culture and values, particularly intragenerational and intergenerational equity, affect the discount rate and norms summary variables. CPRs constituted of individuals who believe that they and their descendants will depend on the resource for their economic returns are more likely to preserve a CPR than those who do not. Other research into strategic behavior of self-interested individuals also shows that low discount rates increase the likelihood of collective action toward a public goal.⁸¹ Thus, a culture which ascribes value to a long-term perspective for public goals will be more likely to succeed in pursuing sustainability. Similarly, norms which support cooperation and the integrity of the community are likely to promote sustainable community initiatives, while norms which encourage short-term gains wherever they may be found are likely to undermine the efforts of people to cooperate within a given locale.

The question of institutional supply is difficult to analyze closely because of the number of situational variables involved, as well as the difficulty in getting hard-and-fast numbers relating the costs, benefits and discount rates applied to each individual. Nonetheless, successful sustainable community initiatives must realize that success will depend upon shaping people's values (i.e., their norms and discount rates which they use to interpret costs and benefits) as much as institutional design.

⁸¹ Kent and Carranza Rimarachin, "Rural Public Works Construction," 370-372.

⁸² Axelrod, "Cooperation Among Egoists," 309, 316.

Sustainability and Local Collective Action: A Framework

This chapter was written with the intent to create a framework for analyzing the potential for communities to manage themselves for their own sustainability. It divided this effort into two parts. The first reviewed the literature on the theory of mental models to assess the capacity for individuals to understand the systems which determine the sustainability of particular targets or objectives. The second reviewed a particular theory on collective action, based on positive political economics, which answers questions on how individuals can create local institutions to manage natural resources sustainably. The results of this chapter are summarized in Table 3.3.

While this set of issues raises some very interesting questions with regard to the ability of communities to pursue sustainability in the United States, these issues are still based upon theoretical concepts. Despite the work on mental models in other fields, no literature was found investigating how mental models affect those issues relevant to sustainability. Additionally, the institutional aspects of the analysis are based upon investigation of small, largely rural communities which created institutions to manage a single, typically well-defined resource. Moving beyond the theories will require empirical testing of these issues, which is the subject of the next chapter.

Table 3.3: Summary of issues raised in investigation of mental models and collective action

Mental Models

- People create internal, imperfect replicas of reality to help them interact with reality.
- These models can be both explicit (used through a process of reason) or implicit (used beneath the level of consciousness).
- These models are better developed the more experience an individual has with a particular system. Conversely, models for systems with which people have little experience will be poorly developed and understood.
- Generally, laypeople have a good understanding of the most general elements of many systems (either natural or social). Most, however, lack an intricate knowledge of these systems.
- The greater the variety in mental models among individuals, the more difficult it will be to promote collective action on any particular issue or set of issues.

Institutional Capacity for Collective Action

- In contrast to the common assumption that self-interested individuals are unwilling or unable to sustainably manage a commons, certain communities have succeeded in creating local-level institutions to manage natural resources upon which they depend economically.
 - Those institutions which have succeeded share a common set of design principles which seem to be necessary components for success. These have been modified to address community initiatives in the United States, as shown in Table 3.2.
 - Whether or not individuals choose to create or participate in a collective action institution depends upon their perception of costs and benefits to themselves, shaped by their own set of values and perception of the future (their discount rate).
 - Technology plays an important role in collective action by affecting both the design principles and the evaluation of costs and benefits.
 - By implication, successful community sustainability initiatives should follow the design principles established in Table 3.2, address issues of values and discount rates to increase the likelihood of participation, and utilize technologies which fit within institutional design and facilitate the calculation of costs and benefits to institutional rules.
-

Chapter 4: Institutions and Technologies for Local Level Sustainability

A self-financed contract-enforcement game is no panacea. Such institutional arrangements have many weaknesses in many settings. The herders can overestimate or underestimate the carrying capacity of the meadow. Their own monitoring system may break down. The external enforcer may not be able to enforce *ex post*, after promising to do so *ex ante*. A myriad of problems can occur in natural settings, as is the case with the idealized central-regulation or private-property institutions ... However, as long as analysts presume that individuals cannot change such situations themselves, they do not ask what internal or external variables can enhance or impede the efforts of communities of individuals to deal creatively and constructively with perverse problems such as the tragedy of the commons.¹

Overview

The establishment of a set of institutional criteria to be met and issues to be addressed does not necessarily guarantee that actual efforts toward sustainability will conform to these guidelines. What is needed at this point is an investigation of current efforts to pursue sustainability at the local level to give a general idea of what different communities are attempting as well as the mechanisms being used to accomplish their objectives. The issues raised by the theory of mental models and the elements of analysis for institutional capacity provide, if nothing else, a way to organize the information about the initiatives that allows comparison across those initiatives. That organization can allow characterization of the focus of effort, level of complexity, and degree of objectives. It is possible that community initiatives will address each of the issues identified in Table 3.3. It is also possible that differences between the theory and reality make those issues largely irrelevant to the task of pursuing sustainability at the local level in the United States.

The intent of this chapter is to analyze a series of local level sustainability initiatives to evaluate the veracity of the statements which conclude the previous chapter. Such an analysis will be important in identifying not only the ways in which those conclusions are valid, but also the ways in which the pursuit of sustainability at the local level falls outside of the predictions of these theories. Hopefully, the results of this chapter should also shed

¹ Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (United States of America: Cambridge University Press, 1990), 18-21.

some light on the appropriateness of focusing on the local level for pursuing sustainability in the United States.

Analysis

Assessing the degree to which community initiatives fit within the boundaries established in Table 3.3 is a difficult task, considering the wide and complex range of sustainability targets from which a community might choose. In seeking initiatives to analyze, one criterion was to find initiatives whose management was the responsibility of private, local groups (such as a local non-profit organization) or of a local government agency. A second criterion was to find initiatives which had explicitly defined their sustainability targets, from clean water to affordable housing to other cultural, economic, environmental, social or political targets. A third criterion was to find initiatives which existed at the local level within one organization or institution. Finally, the initiatives were chosen on the basis of notoriety among professionals who work on local-level sustainability issues.

These criteria were intended to help the analysis focus on the issues identified in Chapter 3. A local level focus was chosen to better understand the resources available to local groups and agencies. It was also chosen to better understand those issues which are of importance to communities, rather than agendas which might be imposed by state or federal governments. The reason for which clear sustainability definitions were sought was to identify the degree to which a systemic understanding of sustainability issues was present in these initiatives. These definitions could provide insights to the mental models of community members with regard to sustainability, as well as the systems which were to be governed by the local institutions. The third criterion was intended to simplify, as much as possible, the analysis so that competing visions and authorities of other local organizations would not need to be untangled. Finally, the degree of notoriety simplified the data collection process, since professionals knew how to obtain documentation and whom to contact for interviews.

The Community Initiatives

The initiatives that were selected are: Seattle, Washington (Sustainable Seattle and the City Planning Department of Seattle); South Puget Sound, Washington (the Sustainable Community Roundtable); the Metropolitan Region of Portland, Oregon (Portland Metro Regional Council); Jacksonville, Florida (the "Quality Indicators for Progress" Project); the

Upper Valley Region of Vermont and New Hampshire (Upper Valley 2001 & Beyond); Cambridge, Massachusetts (the Sustainable Cambridge Coalition and the City Planning Department of Cambridge); and Cape Cod (Barnstable County), Massachusetts (the Cape Cod Commission). Census information on each of the communities and regions are shown in Tables 4.1, 4.2 and 4.3.

Seattle, Washington

The City of Seattle is located on the east bank of Puget Sound in the State of Washington, and is connected to the Pacific Ocean through the Strait of Juan de Fuca. In 1990, the city had a population of about 0.5 million, with nearly two million people living in the greater metropolitan area.² The city's economic activity includes the Port of Seattle, the Boeing Company (an aerospace manufacturing company), lumber, food processing, computer software companies (particularly Microsoft), the city's fishing fleet (halibut catch) and some shipbuilding.³

The city has promoted the pursuit of sustainability along two different tracks. The first, Sustainable Seattle, is a non-profit organization working on developing indicators to track certain key characteristics of the city. This organization has also influenced the second initiative, the city's *Toward a Sustainable Seattle* Comprehensive Plan, prepared by the planning department.

Sustainable Seattle has moved from being a volunteer-based organization to a non-profit organization since its inception in 1990. The primary focus of the organization has been its indicators project, an effort to develop indicators which "measure an important dimension of sustainability."⁴ These indicators were developed through an ongoing public process involving a Civic Panel (numbering roughly 150 people) and a "Task Team" which edited and reviewed proposals from the Civic Panel. The members of these panels represented "business, environmental groups, city and county government, labor, the religious community, educators and social activists."⁵ The indicators were reduced from an initial

² George Thomas Kurian, *World Encyclopedia of Cities Volume II: N. America (United States N-Z, and Canada)* (U.S.A.: ABC-CLIO, 1994), 901.

³ Kurian, *World Encyclopedia of Cities*, 901-2.

⁴ Sustainable Seattle, *The Sustainable Seattle 1993 Indicators of Sustainable Community: A Report to Citizens on Long-Term Trends in Our Community* (Seattle, Washington: Sustainable Seattle, 1993), 3.

⁵ Sustainable Seattle, *1993 Indicators of a Sustainable Community*, 4.

Table 4.1: Population and Demographic Data for Sustainable Communities

Community	Elements	Land Area (sq. mi.)	Population	Pop. Density (#/sq. mi.)	Avg. Annual Pop. Growth (1980-1992)	White	Black	Amer Ind., Eskimo or Aleut	Asian or Pacific Islander	Hispanic Origin*
United States		3,536,278.0	255,077,536.0	72.13	1.0%	78.3%	11.8%	0.8%	2.9%	8.8%
Cape Cod	Barnstable County	396.0	189,006	477.29	2.1%	95.0%	1.5%	0.6%	0.5%	1.2%
Jacksonville	Duval County	774.0	700,852	905.49	1.7%	69.9%	23.4%	0.3%	1.8%	2.5%
	Clay County	601.0	114,217	190.04	4.5%	85.5%	4.8%	0.3%	1.6%	2.4%
	Nassau County	652.0	47,127	72.28	3.0%	82.9%	9.6%	0.3%	0.3%	1.0%
	St Johns County	609.0	90,340	148.34	4.8%	83.6%	8.1%	0.2%	0.6%	2.1%
South Puget Sound	Thurston County	727.0	176,567	242.87	3.0%	83.9%	1.6%	1.4%	3.5%	2.8%
Seattle	King County	2,126.0	1,557,537	732.61	1.7%	82.1%	4.9%	1.1%	7.6%	2.8%
	Island County	209.0	65,494	313.37	3.4%	84.0%	2.2%	0.7%	3.9%	3.1%
	Snohomish County	2,090.0	501,380	239.89	3.3%	86.7%	1.0%	1.3%	3.3%	2.1%
Portland	Clackamas County	1,868.0	296,905	158.94	1.7%	90.4%	0.4%	0.7%	1.6%	2.4%
	Columbia County	657.0	39,276	59.78	0.8%	93.0%	0.1%	1.3%	0.7%	1.7%
	Multnomah County	435.0	600,811	1,381.17	0.5%	84.5%	5.8%	1.1%	4.5%	3.1%
	Washington County	724.0	338,170	467.09	2.7%	84.7%	0.6%	0.5%	4.0%	4.3%
	Yamhill County	716.0	69,258	96.73	1.9%	89.7%	0.5%	1.2%	1.1%	6.0%
Cambridge	Cambridge	6.4	93,554	14,617.81	-0.2%	77.1%	13.8%	0.3%	8.6%	7.0%
Upper Valley^	Windsor County, VT	971.0	54,341	55.96	0.5%	98.3%	0.2%	0.2%	0.5%	0.5%
	Grafton County, NH	1,714.0	75,638	44.13	1.2%	97.0%	0.5%	0.2%	1.1%	0.8%

Source: U.S. Bureau of the Census. *County and City Data Book: 1994*. Washington, DC 1994.

* - persons of Hispanic origin in this data base are of any race (white, black, etc.)

^ - the Upper Valley region does not match political boundaries — counties shown are examples

Table 4.2: Household Income Data for Sustainable Communities

Community	Elements	Median Family Income (1989)	Percent of Households with Income of						
			Less than \$15,000	\$15 - \$24,999	\$25 - \$34,999	\$35 - \$49,999	\$50 - \$74,999	\$75,000 or more	
United States		\$ 35,225	24.3%	17.5%	15.8%	17.9%	15.0%	9.5%	
Cape Cod	Barnstable County	\$ 38,117	21.2%	17.3%	16.2%	18.9%	17.1%	9.3%	
Jacksonville	Duval County	\$ 33,548	24.2%	19.2%	17.2%	18.8%	13.6%	7.0%	
	Clay County	\$ 37,779	14.6%	17.1%	18.4%	22.5%	18.8%	8.5%	
	Nassau County	\$ 34,740	23.4%	18.5%	16.6%	18.8%	16.1%	6.5%	
	St Johns County	\$ 34,266	21.4%	19.3%	17.7%	16.1%	14.8%	10.7%	
South Puget Sound	Thurston County	\$ 35,859	20.0%	19.2%	17.9%	20.8%	15.7%	6.4%	
Seattle	King County	\$ 44,555	16.6%	15.5%	15.9%	20.2%	18.9%	12.9%	
	Island County	\$ 31,824	18.0%	22.4%	20.3%	19.1%	13.6%	6.5%	
	Snohomish County	\$ 41,092	14.4%	15.3%	16.9%	23.5%	20.5%	9.4%	
	Clackamas County	\$ 40,078	16.0%	16.3%	17.0%	21.0%	18.5%	11.3%	
Portland	Columbia County	\$ 34,405	23.1%	20.0%	25.8%	20.7%	15.4%	5.0%	
	Multnomah County	\$ 33,502	25.9%	20.4%	17.5%	17.8%	12.1%	6.4%	
	Washington County	\$ 41,429	14.7%	16.6%	17.8%	21.2%	19.3%	10.4%	
	Yamhill County	\$ 32,200	23.9%	19.9%	18.0%	19.1%	12.8%	6.2%	
Cambridge	Cambridge	\$ 39,990	21.0%	15.7%	15.6%	16.7%	16.5%	14.4%	
Upper Valley	Windsor County, VT	\$ 34,691	22.3%	20.3%	16.8%	19.3%	14.1%	7.1%	
	Grafton County, NH	\$ 35,489	23.4%	17.8%	17.2%	19.7%	14.9%	7.0%	

Source: U.S. Bureau of the Census. *County and City Data Book: 1994*. Washington, DC 1994.

Table 4.3 State and Local Government Data for Sustainable Communities

Community	State and Local Government Employment (1990)		Local Government Finances, 1986-87									
	Number	Per 10,000 Pop.	General Revenue					Taxes			Direct General Expenditure	
			Total (\$MM)	Per \$1,000 Pers' Inc.	Inter-Gov'tal (\$MM)	Total (\$MM)	Per Capita	% Property	Total (\$MM)	% Change 1982-87		
United States	15,197,000	609	411,584.1	\$ 110	156,263.4	158,293.5	\$ 65.3	73.6%	392,014.6	48.3%		
Cape Cod	8,705	464	261.2	\$ 71	56.4	168.3	\$ 95.5	96.1%	268.1	68.2%		
Jacksonville	35,450	524	1,179.4	\$ 123	450.7	263.2	\$ 406	82.2%	951.1	49.1%		
Duval County	3,625	338	107.2	\$ 77	59.8	26.6	\$ 278	82.8%	103.3	95.6%		
Clay County	2,121	479	54.1	\$ 87	24.9	17.3	\$ 428	90.7%	52.5	59.5%		
Nassau County	4,106	484	96.0	\$ 77	35.6	36.9	\$ 508	87.5%	92.6	103.4%		
St Johns County	26,703	1,638	204.8	\$ 96	109.0	63.1	\$ 433	71.2%	210.7	54.1%		
Thurston County	107,083	704	2,793.7	\$ 103	997.2	936.2	\$ 666	56.8%	2,647.5	63.9%		
King County	2,244	368	56.9	\$ 80	31.6	11.8	\$ 226	80.0%	55.7	62.6%		
Island County	21,086	447	559.5	\$ 89	261.9	142.7	\$ 352	66.9%	544.6	46.7%		
Snohomish County	11,832	421	365.6	\$ 87	110.5	195.9	\$ 737	95.1%	356.5	32.1%		
Clackamas County	1,729	457	64.4	\$ 142	16.5	30.4	\$ 846	97.7%	61.3	1.7%		
Columbia County	43,924	749	1,223.8	\$ 142	287.1	639.9	\$ 1,135	81.0%	1,168.0	38.2%		
Multnomah County	10,849	344	386.1	\$ 84	91.7	225.0	\$ 797	91.2%	363.2	25.1%		
Washington County	2,885	436	90.1	\$ 119	33.0	38.2	\$ 631	95.0%	90.0	38.6%		
Yamhill County	3,814	398	272.6	\$ 2,845*	55.5	120.8	\$ 1,261	95.3%	287.9			
Cambridge	2,732	504	66.7	\$ 84	15.4	44.6	\$ 840	99.6%	57.6	30.4%		
Windsor County, VT	5,104	681	96.0	\$ 83	16.8	0.7	\$ 967	99.3%	92.9	54.9%		
Grafton County, NH												

Source: U.S. Bureau of the Census. *County and City Data Book: 1994*. Washington, DC 1994.
 * Cambridge data is for 1990-91, and the total general revenue information was only available per capita, rather than per \$1,000 personal income

list of 99 to a final list of 40, 20 of which were featured in the first report in 1993 and all 40 presented in the second report, released in December, 1995.

A different approach toward sustainability has been taken by the city's planning department. According to state legislation, the city is required to complete a growth management plan concerning the following issue areas: land use, transportation, housing, capital facilities and utilities.⁶ In addition, King County legislation requires "an economic development element," and the city's own policies "inspired the inclusion of a neighborhood planning element."⁷ The Comprehensive Plan is a discussion of the issues present in each of the issue areas described above. It also lists general policy planning guidelines, some stringent, some more flexible.

South Puget Sound, Washington

The South Puget Sound region of Washington state lies at the southernmost tip of the Sound at a series of interconnecting coves and inlets. The region consists of the cities of Lacey, Olympia (the state capitol) and Tumwater, all within Thurston County. The population of Thurston County is nearly 250,000.⁸ The economic base includes the Port of Olympia as well as a number of local businesses and manufacturers.

The sustainability initiative in this region is organized by the Sustainable Community Roundtable.⁹ This organization was founded by the City of Olympia in 1991 and became an independent nonprofit organization in 1992.¹⁰ It consists of a core group of individuals who coordinate the activities of various task forces (working on educational and community events) and publish the *State of the Community: South Puget Sound* report. This report, prepared by the staff as well as through a series of workshops involving about 200 citizens, presents the vision of sustainability for the community. The objective of the report is to "document progress toward sustainable community in the South Puget Sound."¹¹

⁶ Seattle City Council, *The City of Seattle Comprehensive Plan: Toward a Sustainable Seattle, a Plan for Managing Growth, 1994 - 2014* (Seattle, Washington: Seattle City Council, 1994), v.

⁷ Seattle City Council, *The City of Seattle Comprehensive Plan*, v.

⁸ Sustainable Community Roundtable, *State of the Community: South Puget Sound* (Olympia, Washington: Sustainable Community Roundtable, 1995), 9.

⁹ Sustainable Community Roundtable, *State of the Community*, ii.

¹⁰ Sustainable Community Roundtable, *State of the Community*, ii.

¹¹ Sustainable Community Roundtable, *State of the Community*, 2.

Portland, Oregon

The City of Portland is located on the South bank of the Columbia River, between the states of Washington and Oregon. In 1990, the city had a population of about 440,000, and the greater metropolitan area had a population of about 1.2 million.¹² Its economic base consists of the port (the third largest on the west coast), a lumber industry, computer chip manufacturing (which provides 50 percent of computer chips sold in the nation), metal processing, sportswear, furniture and chemical manufacturing.¹³

The Portland sustainability initiative is the metropolitan region's growth management plan, known as the Metro 2040 Growth Concept. Citizens of the Portland metropolitan area have become increasingly concerned about "rising housing costs, vanishing open space ... traffic congestion, and issues associated with the growth of the region."¹⁴ Those characteristics which attracted current residents are projected to attract another 485,000 people in the next 20 years — the project is an effort to "deal with the issues accompanying growth."¹⁵ As state legislation requires that the region must create a plan concerning a 20-year land supply, the planning department has attempted to address these issues within that plan, but instead using a 50-year time horizon.¹⁶

Jacksonville, Florida

The city of Jacksonville lies on both sides of the St. John's River in northern Florida on the state's east coast. The city's population in 1992 was 661,177.¹⁷ *The Encyclopedia of American Cities* describes Jacksonville as the "financial, industrial, commercial and transportation center of Florida."¹⁸ The city's economic base consists of naval storage, a wholesale lumber market, coffee importation, insurance, banking, food processing, paper products, chemicals and fertilizers, cigar manufacturing and contract construction.¹⁹

¹² Kurian, *World Encyclopedia of Cities*, 752-3.

¹³ Kurian, *World Encyclopedia of Cities*, 753-4.

¹⁴ Portland Metro Regional Council, "Revised RUGGOs," *Metro 2040 Growth Concept* (Portland, Oregon: Portland Metro Regional Council, 1994), 4.

¹⁵ Portland Metro Regional Council, "Revised RUGGOs," 4.

¹⁶ David Ausherman, Planner, Portland Regional Metro Council, personal communication, November, 1995.

¹⁷ U.S. Bureau of the Census, *County and City Data Book: 1994* (Washington, DC: U.S. Department of Commerce, 1994), 698.

¹⁸ Ory Mazar Nergal, ed., *The Encyclopedia of American Cities* (New York: E.P. Dutton, 1980), 174.

¹⁹ Nergal, *Encyclopedia of American Cities*, 174.

Rather than being a sustainability initiative, the Jacksonville project identifies indicators that measure the “quality of life” of its citizens, and uses those indicators to measure the attainment of community objectives. The program was started through the combined efforts of the Jacksonville Chamber of Commerce and the Jacksonville Community Council Inc. (JCCI). The goal of the project is to “monitor Duval County’s progress on an annual basis by means of selected representative quantitative indicators.”²⁰ The program began in 1985 by developing a model of the “quality of life,” which includes nine elements. These were ranked according to importance by new task forces in 1991 in the following order: education; the economy; public safety; natural environment; health and social environment; with government/politics, culture/recreation and mobility “grouped together at a lower level of importance.”²¹ Indicators were developed for each of these elements, and data were collected and organized from the mid-1970s through 1984-5.

In 1991, a new set of task forces reviewed these indicators and suggested a new set, changing some due to “questionable validity or unavailable data.”²² This set of indicators was complemented by the development of indicator targets by JCCI staff, with grant funding from the Jacksonville Department of Housing and Urban Development, as well as the identification of “priority indicators for community action during the 1990s” by the task forces.²³

The Upper Valley Region of Vermont and New Hampshire

The Upper Valley Region of these two states surrounds the confluence of the White and Connecticut Rivers. The region consists of many small rural towns (up to 37 towns have associated themselves with the region²⁴), most with populations under 10,000.²⁵

The community-based initiative seeks to create a regional set of sustainability indicators and have each community in the region define its own directions for sustainability. The project, Upper Valley 2001 & Beyond, is funded by the Upper Valley Community Foundation, the

²⁰ Jacksonville Community Council, Inc., *Life in Jacksonville: Quality Indicators for Progress* (Jacksonville, Florida: Jacksonville Community Council Inc., 1994), 1.

²¹ Jacksonville Community Council, Inc., *Life in Jacksonville*, 2.

²² Jacksonville Community Council, Inc., *Life in Jacksonville*, 1.

²³ Jacksonville Community Council, Inc., *Life in Jacksonville*, 1.

²⁴ Susan Moore, “2001 and Beyond: Tracking the Valley’s Future,” *Upper Valley Magazine*, July/August 1995, 9.

²⁵ Maureen Hart, *Guide to Sustainable Community Indicators* (Ipswich, Massachusetts: QLF/Atlantic Center for the Environment, 1995), 19.

League of Women Voters Education Fund, the Mascoma Savings Bank Foundation, the New Hampshire Charitable Fund, the Vermont Community Foundation and the Stettenheim Foundation.²⁶ The initiative consists of two projects. The first, the Community Profiles, bring together community members to forge a community vision and develop action plans to achieve that vision. The second component is the Valley VitalSigns, a set of sustainability indicators (modeled after those of Sustainable Seattle) which “monitor those things that we care about most as Upper Valley residents — those things that will create the best legacy for our great, great grandchildren.”²⁷

Cambridge, Massachusetts

Cambridge, Massachusetts, lies on the north bank of the Charles River, across from Boston, close to the river mouth at the Boston Harbor and Massachusetts Bay. In 1992, the city’s population was 93,554.²⁸ The city is highly manufacturing-oriented, producing industrial machinery, instruments and allied components, electronics and allied components, fabricated metals, food and kindred products, primary metals and rubber and plastics.²⁹ The instruments and electronics manufacturers provide the greatest number of jobs. Other economic activities include printing and publishing and apparel production. The printing and publishing services are a part of the two main universities in Cambridge, Harvard University and the Massachusetts Institute of Technology, which are also major employers.

Cambridge has pursued sustainability through two separate venues. The first, the Sustainable Cambridge Coalition (SCC), is an informal group of individuals promoting concepts of sustainability in the city.³⁰ The group has organized a series of activities, including the creation of a “sustainability profile” of Cambridge as well as a series of public meetings (the Cambridge Civic Forums) to discuss a future vision for the city. The second sustainability initiative is the growth management document written by the City of Cambridge. The document was prepared by the Community Development Department to address growth issues facing the city in the 1990s, at the request of the City Council’s

²⁶ Upper Valley 2001 & Beyond, *The Upper Valley: 2001 & Beyond — Community Profile* (Wilder, Vermont: Upper Valley 2001 & Beyond, 1995).

²⁷ Moore, “2001 and Beyond,” 10.

²⁸ U.S. Bureau of the Census, *County and City Data Book*, 746.

²⁹ Sustainable Cambridge Coalition, *Sustainability Profile for the City of Cambridge, Massachusetts* (Cambridge, Massachusetts: Sustainable Cambridge Coalition, 1993), 23-4.

Subcommittees on Economic Development and the Environment.³¹ It presents a future vision for Cambridge as well as policy guidelines to shape future planning decisions in the city. The policies are intended to “help guide the Planning Board and others in future planning decisions and recommendations, [and] reflect the changing context of [the] city and [the] planning assumptions.”³²

Cape Cod, Massachusetts

Cape Cod is the Massachusetts peninsula which juts out into the Gulf of Maine and encloses Massachusetts Bay. Politically, it consists of a number of small cities east of the Cape Cod Canal in Barnstable County, as well as the Cape Cod National Seashore (managed by the U.S. Park Service). The population of the Cape in 1992 was 189,006,³³ although this number varies greatly with the millions of seasonal tourists who come to the Cape to enjoy the climate as well as its character.³⁴ Aside from tourism and its accompanying retail trade, the economic base of the Cape consists of government, light manufacturing, construction, finance, insurance, real estate, wholesale trade, agriculture (particularly cranberries), forestry, fishing and some mining.³⁵

Cape Cod does not have a stated sustainable community initiative, but rather a region-wide planning effort to address the many problems created by the growth of the tourist economy and population in the region. The Cape Cod Commission, created by the Cape Cod Commission Act in 1990, is authorized to regulate major developments on Cape Cod, designate “Districts of Critical Planning Concern,” and prepare and oversee the implementation of the Regional Policy Plan (RPP).³⁶ The RPP outlines “a coherent set of planning policies and objectives to guide development on Cape Cod and to protect its resources.”³⁷ The sustainability initiative being reviewed in this instance is the set of activities performed by the Commission.

³⁰ Rosalie Anders, Environment Department and Co-Founder of the Sustainable Cambridge Coalition, personal communication, December, 1995.

³¹ Cambridge Planning Board and Cambridge Development Department, *Toward a Sustainable Future: Cambridge Growth Policy Document* (Cambridge, Massachusetts: Cambridge Planning Board and Cambridge Development Department, 1993), 1-2.

³² Cambridge Planning Board and Cambridge Development Department, *Toward a Sustainable Future*, 49.

³³ U.S. Bureau of the Census, *County and City Data Book*, 256.

³⁴ Cape Cod Commission, *Regional Policy Plan for Barnstable County* (Barnstable, Massachusetts: Cape Cod Commission, 1991), 1.

³⁵ Cape Cod Commission, *Regional Policy Plan*, 43-5.

³⁶ Cape Cod Commission, *Regional Policy Plan*, 6.

³⁷ Cape Cod Commission, *Regional Policy Plan*, 6.

Characteristics of these Communities

The total number of initiatives from which to choose is actually very small, at least relative to the number of communities in the United States. Those communities chosen should not be perceived as the norm, but represent intensive efforts at attempting to manage complex, interrelated systems for public goals and objectives. The following characteristics should be noted about each of these communities:

- **Ethnic and Racial Composition:** the environmental movement in the United States has a reputation for being dominated by Caucasians, often alienating members of minority communities who sometimes suffer more from environmental problems.³⁸ Since sustainability has been viewed as primarily an environmental issue, one might expect a predominant Caucasian population in these communities. With the exception of Duval County in the Jacksonville metropolitan area and Cambridge, the relative populations of minorities are below the national averages in each of these initiatives.
- **Wealth and Income Distribution:** these communities have median family incomes at or above the national average. The proportions of the population with household incomes of less than \$15,000 are generally lower than the national average (24.3 percent), while the communities have a smaller proportion of households with incomes above \$75,000 as the national average (9.5 percent). This would seem to suggest that these initiatives are occurring in predominantly “middle class” communities.
- **Local Institutional Resources:** with the exception of Portland and Jacksonville, general revenue per \$1,000 personal income for state and local government are below the national average, in some cases substantially below (more than 20 percent). Jacksonville, Seattle and South Puget Sound had per capita state and local taxes substantially below (by about 33 percent, on average) the national average, while the remaining communities had per capita taxes substantially above the average (by about 40 percent, on average).

Methodology

The analysis was performed as follows. First, the framework developed in Chapter 3 was used to create a template for analysis, divided into institutional design (with each design principle), technology, and institutional supply.³⁹ Second, publications from each of the initiatives were analyzed to assess how and to what extent each initiative addressed these elements. This included attempting to define, through the language used and policies recommended (if any), what the initiative was seeking to sustain. Third, issues which the

³⁸ Pat Bryant, ‘Toxics and Racial Justice,’ *Social Policy* 20, no. 1 (1989): 48ff.

³⁹ Research concerning mental models was integrated with research on the first community initiative design principle, “clearly defined sustainability target[s].”

publications failed to address were identified, such as how policy guidelines in planning documents would be translated into actual rules that affect all participants in those initiatives. Fourth, individuals who had played substantial roles in the formation or management of each initiative were interviewed to fill in those data gaps. Finally, the information for each initiative was condensed to create a series of initiative profiles which were then analyzed for strengths and weaknesses, as well as similarities and differences. The results of this data collection are divided into sections corresponding to each element in the framework (Institutional Design Characteristics, Technology, and Institutional Supply).

Results

The summary of the findings of this analysis is too long to be included in this chapter. It is organized according to the elements of the framework (Institutional Design, Technology and Institutional Supply) and is presented in Appendix C. The more salient points, however, are summarized here to provide some background for the following discussion.

Institutional Design

- The initiatives essentially fell into two categories. The first includes initiatives sponsored by non-profit or community organizations. Four of these initiatives (Sustainable Seattle, South Puget Sound, Jacksonville and Upper Valley 2001 & Beyond) either focused on, or incorporated, the development of indicators for their objectives. The fifth (Sustainable Cambridge Coalition) concentrated instead on analyzing resource consumption in the community. The second category consist of land-use planning agencies, either on a regional (Portland Metro and the Cape Cod Commission) or city (Seattle and Cambridge) level.
- The elements of sustainability which are most prominently addressed by these initiatives included the Environment, Social Organization and Decisionmaking, Intragenerational Equity and Information. Those that receive the least attention are Uncertainty, Intergenerational Equity and Time Horizons.
- Many of the initiatives fail to distinguish between stocks (systems or resources which provide benefits) and flows (the benefits themselves). As a consequence, many initiatives call for the sustainability of certain objectives (e.g., employment or education) without clearly identifying the resources which would provide those objectives. This underscores an absence of systemic understanding for many issues.
- All of the initiatives suffer from issues which lay outside of their jurisdiction. Even the regional initiatives are unable to manage some issues (e.g., the economy) which affect their sustainability targets. The indicator projects are less hindered by this fact, essentially because these initiatives do not truly create institutions.
- Issues of collective-choice agreements, monitoring, conflict resolution mechanisms and nested enterprises basically follow the lines of discussion from Chapter 3.

- Issues of sanctioning and rights of recognition, however, are made more complex by virtue of the presence of the U.S. legal system, which functions as the final rule-making authority.

Technology

- The categories of technology focused on by the initiatives include: land use/construction; utilities (energy, water and waste); transportation; communications/information technologies; and miscellaneous technologies/issues.
- Land use technologies were primarily intended to concentrate development to reduce automobile usage. They also called for the recycling of building materials and the promotion of resource efficiency throughout the lifetime of buildings.
- Discussions of utilities also concentrated primarily on efficiency (water, energy and material). There were also some calls for the use of renewable forms of energy and alternative forms of wastewater treatment.
- Transportation issues focused primarily on providing alternatives to the automobile, although some discussion was present on improving automobile fuel efficiency or providing alternatively-fueled vehicles.
- A number of initiatives called for universal access to telecommunications technologies. These technologies were also noted for their ability to collect and process information in ways which are understandable to citizens, particularly through Geographic Information Systems.

Institutional Supply

- All of the non-profit and citizens projects but one were organized by a group of citizens concerned about issues of sustainability. The Jacksonville initiative was sponsored by the Jacksonville Chamber of Commerce and the Jacksonville Community Council, Inc., a non-profit organization that works on community issues.
- Three of the four planning agencies started their initiatives in response to state legislation which sought to protect the interests of certain political groups. The last, the City of Cambridge, developed out of a desire to address issues of growth and their impact on neighborhoods.
- The Jacksonville initiative has led to the creation of a non-profit organization which monitors the water quality of the St. Johns River. It has also led to the creation of a program which brings city services directly to the schools, which has been followed by an increase in high school graduation rates.
- Proactive efforts with regard to institutional supply by the planning agencies center around education campaigns. The Cape Cod Commission publishes a biweekly newsletter, and Portland Metro has produced a videotape about issues of growth in the region.

Discussion

The analysis of the community initiatives led to a number of results which were not anticipated by the framework identified in the previous chapter. First, it was assumed for the analysis that the closer an initiative conformed to the ideas presented in the framework, the greater its potential for success. The comparison between CPRs and communities in Appendix B was intended to adjust the framework sufficiently to apply it to these case studies. Through this comparison, it seemed that the greatest difficulties in its application would stem from the presence of heterogeneous and often competing sets of values and norms, as well as differences between political boundaries and the physical boundaries which define those systems under consideration. It was also expected that those technologies which these initiatives would address would fit within their particular levels of understanding of systems. However, the framework encountered some additional problems in its application.

Problems in Institutional Design

The use of the framework was successful in identifying a number of institutional characteristics present and lacking in these sustainable community initiatives. For example, these initiatives have had difficulty in addressing transboundary issues. Some were created at a regional level and therefore have greater opportunities for managing these problems, but the initiatives have not been in place for a sufficient time period to evaluate their potential for success or failure. Almost all of these initiatives follow collective-choice agreements, where wide levels of participation have been solicited. The only difficulty may be that not everyone chooses to participate at the outset, and for key players to absent themselves, this could be a problem. As an example, the Jacksonville initiative was started by the Chamber of Commerce, creating a sense of legitimacy to the initiative for the business community and paving the way for their assistance as the indicators provided information on the community (as in the case of the Stewards of the St. Johns organization). Sustainable Seattle, while stating that they had participants from the “business community,” is currently preparing itself for a backlash from the community.⁴⁰ It might be possible that key players from each of the constituencies were not present, and that simply stating that members from the business community were there is not sufficient to provide legitimacy to the effort.

⁴⁰ Richard Conlin, Sustainable Seattle, personal communication, December, 1995.

The process of monitoring was demonstrated to potentially impose substantial costs on the initiative and drive away certain constituencies. The Cape Cod Commission, for example, issues its own permits for any Developments of Regional Impact. The costs of performing the studies associated with this permit have become prohibitive in some cases, resulting in some very angry people.⁴¹ Other initiatives, such as Seattle and Portland Metro, rely upon traditional monitoring mechanisms and just work with individual neighborhoods or towns on zoning ordinances, keeping costs low. It has yet to be demonstrated, however, that leaving monitoring to other agencies will be successful. A few of these initiatives have also experimented with alternative-dispute resolution mechanisms as a means to keep costs down and keep the level of antagonism surrounding the initiative relatively low. These initiatives also demonstrated the potential support and obstacles that could be created by activities from state and federal governments. State legislation governing the power of land use planning is the greatest determining factor on the capacity of the planning agencies, particularly at the regional level.⁴²

There are, however, a few points where the parallels between the CPR cases of Ostrom (which formed the basis for the framework) and these communities break down. The major points at which these occur deal with the definition of a sustainability target and the characteristics of sanctioning and rights of recognition.

Definition of Sustainability

As was discussed in the last chapter, the first design characteristic mentioned by Ostrom was the boundedness of the common-pool resource. In her analysis, “individuals or households who have rights to withdraw resource units from the CPR must be clearly defined, as must the boundaries of the CPR itself.”⁴³ The intent of the analysis in this thesis was to uncover the parallels in these communities (with regard to sustainability) to the CPRs and to identify the ways in which those sustainability targets are bounded, as well as how the beneficiaries of the institution would be defined.

Actually defining what the community chose as its sustainability targets, especially in a way which bounded the system related to that target, was extremely difficult, if not impossible.

⁴¹ Jim Salmon, landowner, Cape Cod, Massachusetts, personal communication, December, 1995.

⁴² Terry Szold, Professor, Department of Urban Studies and Planning, Massachusetts Institute of Technology, personal communication, November, 1995.

⁴³ Ostrom, *Governing the Commons*, 90.

In the course of going through the analysis, the information provided in the documents and the interviews could not be fit into discrete and bounded systems. In some instances, the documents and individuals spelled out the systems which they felt affected their sustainability indicators. For the most part, however, the indicators just measured something that people wanted to sustain, and the sets of policies and guidelines set out to govern behavior without clearly spelling out what were the intended results.

There are two possibilities for this gap in the analysis. The first is that the systems are, in fact, understood by the citizens of the communities, and that the information present in the documents and the interviews were insufficient to communicate that context. In that case, the analysis would be strengthened by additional time dedicated to data collection and research. The second is that the systems are too complex for people to understand, and that parallels between a relatively discrete natural resource and the range of sustainability targets for a community cannot be drawn.

While the former reason has undoubtedly played a role in the analysis, the latter is also equally valid. The theory of mental models can be invoked to help explain this hole in the analysis. In the case of a fishery CPR, for example, fishermen have interacted with their resource for a long time, possibly all of their lives. As was explained through the theory of mental models, this means that they have a model that lets them more or less understand what would be necessary to accomplish a certain objective (i.e., sustaining fish populations) as well as the potential costs and benefits. The ability of a modern U.S. citizen to understand, for example, what is necessary to have clean air is much, much less. Such an understanding would require a model which incorporates everything that affects pollution concentrations in the atmosphere, from all of the technologies involved (industry, electricity generation, automobiles) to the social and cultural forces which drive the use of those technologies (economic competition, demands and expectations for mobility and services, etc.) and how the system can be changed.

While people might be interested in clean air, that information is not available to them. Most people only think about whether or not the air is clean when it is visible to them — in

other words, when there is a breakdown of their own expectations about it.⁴⁴ In the interim, the vast majority of people do not even think about the quality of the air, since air quality is not an active part of their daily life. Without that interaction and feedback, people do not integrate such concepts as clean air into their mental models. As a consequence, when people are asked to make a tradeoff between automobile pollutant emissions and their house out in the suburbs, they have no mechanism for comparison, and their support cannot necessarily be expected. An empirical investigation of these matters, however, was not possible in the information provided in documentation and interviews, and lay beyond the scope of this thesis.

Additional problems arise in the differences between CPRs and industrialized communities. Many of the initiatives called for the sustainability and equity of a number of non-environmentally-oriented targets, such as education, public safety, income and housing. As in the case of clean air above, however, the systems which govern these issues are also incompletely understood. Part of the reason can certainly be attributed to discrimination on the basis of race, gender, religion, sexual preference, physical disability, etc. But there are other questions to be addressed in assessing the sustainability of these issues. For example, what is the point of education? In a fishery CPR, a substantial part of education would be directed toward learning about and understanding the CPR and the history of its use. Aspects of life such as education, public safety, income and housing can be intertwined with the use of the CPR itself, as the culture and values of the community are intertwined with system (as per the definition of a “closed community” from Chapter Three). The links between all of these aspects have been severed in open communities, and our culture does not serve to provide us with the information necessary to understand the system. The culture has severed the system, and our education and employment serves to reinforce that lack of understanding.

Without the establishment of bounded resources, Ostrom’s description of institutional characteristics to govern bounded resources seems moot. Failing to clearly identify beneficiaries of a given system shifts the question from collective action to determining whose responsibility it is to deal with these issues. The question to be asked, then, is whether an effort should be made to create boundaries for the systems of certain targets to be sustained and then institutions to govern those targets, or whether an entirely new framework for analysis is needed. Given the degree to which society in the U.S. has split

⁴⁴ Dr. John Ehrenfeld, Senior Associate, Center for Technology, Policy and Industrial Development,

away from an understanding of resources, it may be necessary to create a new analytical framework. The next few sections will underscore this need.

Sanctioning and Rights of Recognition

While Ostrom's analysis did account for the possibility that government action (either on a regional or national level) could interfere with the perceived legitimacy of an institution, her analytical framework is ill-equipped to address the complexity of the legal system in the United States. According to Ostrom, the major threat posed by outside governmental authorities is that

if governmental officials presume that only they have the authority to set the rules, then it will be very difficult for local appropriators to sustain a rule-governed CPR over the long run. In a situation in which one wishes to get around the rules created by the fishers, one may go to the external government and try to get local rules overturned.⁴⁵

The analysis of the initiatives reinforces this perspective, identifying how state and federal government legislation and programs can hinder or support the activities of the local initiatives. What this perspective does not adequately address in the United States is the presence of the courts, which function as checks to legislative power and can be used to overturn initiative proposals, even with the support of the state and federal governments.

The court system imposes limitations on the sanctioning power of these institutions as well as their legitimacy. As demonstrated in the analysis, the initiatives must use the court system (and the law enforcement system which supports it) as a mechanism for imposing sanctions. The high cost of imposing sanctions in this way is causing some of these initiatives to adopt alternative dispute resolution mechanisms to solve these issues informally. In these cases, the legitimacy to impose sanctions is created not by the collective action of the individual participants of the institution but the high cost of sanctioning in the courts. The courts have also been used to challenge the authority of local institutions to pursue certain objectives at the expense of private property rights. For example, the U.S. Supreme Court recently forced the State of South Carolina to buy two house lots for \$975,000 from a landowner as a part of its protection against erosion of beaches on its coastal barrier islands.⁴⁶

personal communication, December, 1995.

⁴⁵ Ostrom, *Governing the Commons*, 101.

⁴⁶ Scott Allen, "Land Grab," *Boston Globe*, 11 December 1995, 29.

Thus, even though a local program may be synchronized with state or federal legislation, the legal history of the U.S. Court system can still overturn any rulings. One way to incorporate this into Ostrom's framework is to note that both governmental authorities and the courts need to recognize the activities and rules of the institutions. The cost, however, of formulating a local institution that fully considers the U.S. Federal Constitution, the constitution of whatever state or commonwealth in which it resides, and common law rulings can be enormous and can seriously inhibit the ability of anyone to create an effective mechanism for dealing with these issues. By functioning on precedent, the courts can also keep the pace of institutional innovation extremely slow. It also increases the necessity of bringing in as many stakeholders as possible, and continually modifying the institutions as new stakeholders enter.

For both of these reasons, it seems that a different framework for defining institutional characteristics for pursue sustainability needs to be developed for the United States. A summary of these results and the ways in which they relate to the framework created in Chapter 3 is shown in Table 4.4 (at the end of the Chapter). The implications of these results within the context of this thesis are addressed in the Conclusions.

Technology

The technologies selected as integral to pursuing sustainability by these initiatives point to a number of important issues regarding technology innovation and management. This discussion focuses on three aspects: resource consumption, transportation and information technologies.

Resource Consumption

Virtually all of the initiatives considered land use, energy, water and waste efficiencies as essential to pursuing sustainability, suggesting that a primary theme in each initiative was that the community was consuming and using too much. The only exception to this rule was Jacksonville — and from that distinction can be found a difference between enhancing “Quality of Life” and pursuing “Sustainability,” where the former does not necessarily recognize any limits. The difficulty with the use of these technologies is largely cost — products such as compact fluorescent lightbulbs or low-flow showerheads inevitably cost more than their less efficiency counterparts, despite their lower life-cycle costs. The

indicator projects and other attempts at education are mechanisms available to these initiatives to promote greater efficiency in resource use.

With the exception of addressing renewable energy, none of the technologies mentioned would serve to aid in bounding the natural systems associated with some of the sustainability targets. Issues of land are already bounded, in the sense that the land itself does correspond to the political boundaries of the communities. However, technologies relating to energy efficiency, water efficiency or waste do not succeed in helping the system become defined in such a way that the community then has jurisdiction over it. By making consumption more efficient, the communities are not placing themselves in control of provision as well as appropriation of the resource. The only real exception made to this is the call for renewable energy, where both the production and consumption of energy can be controlled by a local institution. The reasons for advocating renewable energy, however, had more to do with reducing reliance on non-sustainable fossil fuels (and the pollution associated with their use) and less to do with institutional control.⁴⁷

At the same time, the initiatives did not address mechanisms for integrating their technological perspectives into the existing, capital-intensive infrastructure in the United States. Virtually all of the technologies discussed here are alternatives to present ones — solar or wind power instead of coal and nuclear, the use of artificial wetlands for wastewater treatment instead of conventional primary and secondary treatment plants. Because of the lack of any discussion about current technologies, it is difficult to clearly determine whether conventional technologies were considered for their merits and then rejected, or if alternatives were selected solely because anything conventional is automatically contributing to the lack of sustainability.

While the calls for the use of efficient and alternative technologies are clearly necessary, work needs to be done to assess how to integrate these newer technologies with the existing infrastructure, specifically how the alternatives can be used to replace the current as they near the end of their useful life. Because such discussions were not present in the initiatives, it may be that such issues lie outside of the resources available at the local level. While issues such as the “Not-In-My-Back-Yard” (NIMBY) syndrome and the careful selection of technologies evidenced in this section indicate that the political will at the local

⁴⁷ Sustainable Seattle, *The Sustainable Seattle 1995 Indicators of Sustainable Community: a Report to Citizens on Long-Term Trends in Our Community* (Seattle, Washington: Sustainable Seattle, 1995), 24; Cape Cod Commission, *Regional Policy Plan*, 65.

level calls for less invasive technologies, these desires must somehow be wed with the engineering expertise which has developed and currently understands the existing infrastructure.

Transportation

The initiatives were unanimous in the denunciation of the automobile for its impacts on air quality, water quality and neighborhood character. The alternative solutions which have been proposed — fixing the jobs/housing balance through land use, developing mass transit, creating rights-of-way for bicycles — have each been analyzed in the literature and have been found wanting in terms of actually shifting behavior away from the use of the automobile.⁴⁸ Despite the calls for moving away from the automobile, the general public still gets very upset when taxes are proposed to raise the price of gasoline, thereby making other options (especially fuel-efficient or alternatively-fueled vehicles) more attractive. The presence of a federally-funded highway system and a low price of gasoline could constitute an effective obstacle to the “rights of recognition” through a technological angle, which would need to be addressed if the local objectives are to be viewed as legitimate.

Information Technology

Surprisingly, a number of individuals interviewed for their opinions on technology focused entirely on information technology, ignoring any resource-oriented technologies. The primary reason for this focus centered on the ability of these technologies to provide feedback to individuals on the results of their decisions. Given the high degree of conceptual separation between different systems in our society (economic, natural, social), the provision of this information is crucial to re-establish the links. As was mentioned by planners from both Seattle and Portland Metro, Geographic Information Systems are capable of providing feedback to people in terms which they are capable of understanding.⁴⁹ By the use of maps with different colors and patterns, people can more easily visualize flows of resources and differences in spatial variation. This visualization simplifies the system and allows people to apply their own values dealing with equity and

⁴⁸ Genevieve Giuliano, “The Weakening Transportation-Land Use Connection,” *Access*, no. 6 (Spring 1995): 3-11.

⁴⁹ Ausherman, personal communication; Tom Hauger, Planner, City of Seattle, personal communication, November, 1995.

the environment. Information technology can also facilitate the transfer of both technological and institutional innovation.

The results from this discussion are summarized at the end of this chapter in Table 4.4.

Institutional Supply

None of the initiatives studied in this analysis truly represented the formation of new institutions. The city planning agencies that were identified are existing institutions which have reoriented their focus in accordance with either changing conditions (Cambridge) or the passage of state legislation (Seattle, Portland Metro and Cape Cod Commission). In all of these cases, the shifts have occurred in response to increases in the population and their demand on resources — certain affected interests petitioned the state government to pass those pieces of legislation. As a result, these institutions cannot accurately be viewed as collective action in and of themselves — the institutions is the local government in its entirety, a far more complicated institution to be analyzed as it sits within a historical context interacting with state and federal government as well as the U.S. legal system. The collective action went into forming the local governments, and the legitimacy is tied in with history, not necessarily the modification of these institutions. As such, new institutions can arise with the support of only a bare majority of individuals (as in the case of the Cape Cod Commission).

Such institutions, then, fail to represent the full range of opinions and ideas in the society. As mentioned in Chapter 2, it may not be necessary to represent all opinions and ideas, only those of the most politically powerful. Antagonism on the part of the powerless can be ignored in some instances. But the question remains, should it be ignored? That remains an issue of values and beliefs. If these institutions represent a particular set of values, then, it would make sense that they ought to promote their own viewpoint. It was surprising to see that not all of the planning agencies were actively involved in attempting to provide information to the public.

The indicator projects, while not institutions in and of themselves, are perhaps the most powerful examples of mechanisms to educate the public and shape the variables involved in the question of institutional supply. Without needing to develop a political constituency, a group of individuals can decide to aggregate existing information and provide feedback on what is happening to a particular set of data about a given community. The wider the range

of participants in deciding upon the indicators, the greater the consensus on the importance of the information and the more likely that changes in the data can result in a particular type of action. Donella H. Meadows, one of the authors of *The Limits to Growth* and *Beyond the Limits*, clarified this issue when speaking about Sustainable Seattle:

The indicators a society chooses to report to itself about itself are surprisingly powerful. They reflect collective values and inform collective decisions. A nation that keeps a watchful eye on its salmon runs or the safety of its streets makes different choices than does a nation that is only paying attention to its GNP. The idea of citizens choosing their own indicators is something new under the sun -- something intensely democratic.⁵⁰

The one indicator project which has been in operation for some time — Jacksonville — has seen the information provided in the indicators translate into institutional change. These indicator projects are only a first step, but can be extremely effective at informing people about where their community is going and what issues may need to be made priorities.

The results of this discussion are summarized in Table 4.4.

Implications for Sustainability at the Local Level

The results of this analysis on the possibility for sustainability at the local level are essentially inconclusive. As is shown in Table 4.4, the framework created in Chapter 3 from the theory of mental models and from Elinor Ostrom's work does have some utility in assessing the capabilities of the sustainable community initiatives. However, there are some issues for which this framework is not appropriate for analysis in the United States. The issue of sustainability is too complex in the U.S., crossing many jurisdictional boundaries, involving many different levels of government and dealing with systems that no one really fully understands. This does not, however, preclude the possibility that sustainability cannot be pursued at the local level. It could also point to certain artifacts of the process through which this research was conducted. The next chapter will evaluate the methodology used in this thesis for its own strengths and weaknesses. Using those results, it will discuss additional areas of research that may be important in understanding the potential for pursuing sustainability in the United States at the local level.

⁵⁰ Sustainable Seattle, *1993 Indicators of a Sustainable Community*, 1.

Table 4.4: Summary of the issues raised by the analysis of the sustainable community initiatives

Institutional Design

- The framework from Chapter 3 was successful in identifying certain crucial aspects of institutional design, such as the congruence of appropriation and provision rules (transboundary issues), collective-choice agreements, monitoring and conflict-resolution mechanisms.
- The community sustainability targets were not as well-understood or bounded as were the common-pool resources which formed the basis for the creation of the framework. As a consequence, many of the proposed institutional designs lack the proper context within which to operate.
- The theory of mental models aids in explaining the difficulty in understanding the systems which drive the sustainability targets. It also provides a reason for the importance of the use of information technologies by these initiatives. However, the analysis was not able to empirically verify the explanation which the theory provided.
- The U.S. legal system is far more pervasive than those systems in which the common-pool resource communities were located. The legal system in many cases supersedes local institutions in terms of sanctioning and conflict resolution, and adds another degree of complexity to the “rights of recognition” principle identified by Ostrom.

Technology

- The focus of resource-using technologies was the increase in efficiency of those technologies. Some initiatives mentioned technologies which would decentralize control, but few if any discussed how to integrate these technologies with existing ones.
- All initiatives called for a reduction in automobile use through changes in land-use patterns and promotions of alternative modes (such as mass transit, bicycling or walking).
- Data monitoring and processing (e.g., Geographic Information Systems) was identified as particularly important for communicating information to community members about the potential impacts of decisions.

Institutional Supply

- Surprisingly few of the planning agency initiatives were aggressively involved in providing ongoing information to the public about sustainability issues.
 - The indicators projects represented an innovative mechanism for helping people evaluate the costs and benefits of certain policies in non-monetary terms.
 - Only a couple of the initiatives explicitly called for changes in values as a component of promoting sustainability.
-

Chapter 5: Conclusions

How, in practice can anyone attack these problems? How can the world evolve a social *system* that solves them? That is the real arena for creativity and choice. It is necessary for the present generation not only to bring itself below the earth's limits but to restructure its inner and outer worlds. That process will touch every arena of life. It will require every kind of human talent. It will need not only technical and entrepreneurial innovation, but also communal, social, political, artistic and spiritual innovation ... it is a particularly *human* task, one that will challenge and develop the *humanity* — in the most noble sense of the world — of everyone.¹

In retrospect, the description of the watershed management project for New York City presented in the Introduction now seems fairly star-crossed. What appeared at the outset of this thesis to be an example of how communities can pursue solutions to sustainability issues is now illuminated by the many levels at which the communities themselves were not involved. The New York City government was spurred into action to protect its drinking water by a Federal order from the U.S. Environmental Protection Agency (US EPA). It is unclear whether the city would have taken action prior to the development of a crisis if not for the Federal government. For their part, the farmers would have had little incentive to enter negotiations with city officials if New York City did not have significant political power to propose an enforceable set of watershed management regulations. It can hardly be said that this initiative was truly “local.” Furthermore, this particular example of non-point source pollution is fairly well-defined in terms of its boundaries, where pursuing sustainability would involve this as well as dozens of other issues, each with their own system to understand. Each of these points demonstrates ways in which the pursuit of sustainability in the United States is a more difficult undertaking than was originally supposed.

To understand exactly the level of difficulty inherent in the pursuit of sustainability, this thesis investigated a number of different issues. First, it surveyed the literature on sustainability in an attempt to establish a definition. Next, it generated a framework through which local-level efforts to pursue sustainability could be analyzed for their chances of success. Finally, it surveyed nine different sustainable community initiatives in the United States to test that framework and draw conclusions about the potential for

¹ Donella H. Meadows, Dennis L. Meadows and Jørgen Randers, *Beyond the Limits* (United States of America: Chelsea Green Publishing Company, 1992), 216.

sustainability at the local level. This chapter summarizes those findings in Table 5.1 and discusses them in three sections (Sustainability, Technology and Institutions). It then critiques the methodology used in the analysis and concludes by discussing issues raised by this thesis which merit further investigation.

The Complexity of Sustainability

- *Sustainability is as much a political concept as it is a technical concept. Its definition will be a function of the political arena in which the debate on the issue takes place.*

The political and moral aspects of sustainability make it impossible to develop a simple definition. The concept of this thesis originally began with an investigation into the development of sustainability indicators for project analysis. Upon reading some of the material discussed in Chapter 2, it became evident that sustainability only exists in a particular political context. The ecological concept of carrying capacity, which has given rise to much of the concern over sustainability issues, must be determined for a *specific* community of different species in a *specific* location. The calculation of carrying capacity, then, requires an understanding of all of the individual species and resources (those inside as well as those entering and leaving) which are a part of the system. Sustainability, as a concept applied to human society, is different than carrying capacity because it includes a *choice* of social behavior and organization. In the words of William Clark, it involves figuring out “what kind of garden do we want?” The political and moral dimensions of that question take sustainability out of the realm of technical analysis and place it in the public arena for debate. As with any such issue, the results of that debate will depend upon the characteristics of the arena.

- *Pursuing sustainability does, however, require that a certain set of issues be addressed.*

Rather than propose that the definition of sustainability is wholly dependent upon the political arena, the thesis proposed a set of elements which are essential for any debate on the issue. First and foremost, sustainability is a discussion about how different systems interact with one another. No one component — natural environment, economy, culture — can be treated independently of the others. Second, the debate on sustainability needs to include discussion on all of the systems which interact with one another, which were identified as the natural environment, culture and value systems, and social systems (which

Table 5.1: Summary of findings

The Complexity of Sustainability

- Sustainability is as much a political concept as it is a technical concept. Its definition will be a function of the political arena in which the debate on the issue takes place.
- Pursuing sustainability does, however, require that a certain set of issues be addressed.
- The local-level initiatives studied in this thesis did not address all of these elements of sustainability.

The Impact of Technology on Local Sustainability

- Technology affects sustainability by shaping the ways in which relevant elements and systems interact.
- The degree of technological development and its pervasiveness in the United States partially caused the breakdown of the framework in the analysis.
- The technologies discussed within the context of the community initiatives focused on resource efficiency, reductions in pollution-generating activities and information processing and dissemination. A few mentioned the need to provide universal access to emerging technologies.

Local Institutions and the Pursuit of Sustainability

- The reasons for choosing a local-level focus included: a higher degree of legitimacy at the local level; a better understanding of the local dimensions of issues related to sustainability; a higher degree of concern for individuals; and, the current popularity of the local-level in policy discussions.
- The analytical framework developed in Chapter 3 helped in classifying the range of issues which local institutions would need to address, such as participation, monitoring and enforcement, sanctioning, conflicts with other governmental authorities, etc.
- The framework was unsuccessful in addressing the complexity inherent in sustainability issues.
- The framework was also unable to incorporate the pervasiveness of the legal system in the United States.
- The community initiatives have succeeded in pursuing certain aspects of sustainability: the establishment of regional institutions to address systems which span different jurisdictions; the involvement of a high degree of public participation in decisionmaking; experimentation in alternatives to conflict resolution mechanisms; and the provision of feedback from those projects which create sustainability indicators.

here includes economics and political institutions). Third, sustainability involves discussions of the future, requiring some notion of time (how long these systems are to be sustained) as well as the uncertainties in knowledge about both the present and the future. Fourth, sustainability should involve discussions of equity, with regard to future

generations, different groups within existing generations and for non-human species. Finally, the role of technology in sustainability cannot be understated, since it is primarily through technology that the three systems identified above interact.

- *The local-level initiatives studied in this thesis did not address all of these elements of sustainability.*

Part of the analysis of the thesis was dedicated to investigating what elements of sustainability would be addressed in debates at the local level. The debates analyzed should by no means be considered average — by virtue of the limited number of communities addressing sustainability, these initiatives already demonstrate an awareness of the topic (and the capacity to pursue it) which exceeds most in the United States. Those elements of sustainability which received the greatest attention included the natural environment, social systems, intragenerational equity and information. Some or most of the initiatives focused attention on culture and value systems and technology. Few of the initiatives devoted effort to discussing uncertainty, intergenerational equity or time horizons. It is difficult to assess the degree to which systems thinking pervaded these initiatives — while only a few explicitly addressed how different systems were interrelated, many did so implicitly, either through their focus on land use (as with the planning agencies) or in their selection of indicators. It is difficult to determine, however, the degree to which these “implicit” systems address the full range of interactions, or successfully identify the most important elements of each system.

The Impact of Technology on Local Sustainability

- *Technology affects sustainability by shaping the ways in which relevant elements and systems interact.*

Technology serves as the medium by which different elements of sustainability interact. For example, it is through technology that people consume natural resources to provide services, such as energy or water. It is also through technology that communities are built, and technology regulates the ways in which community members interact. Advances in technology have changed employment relations, automating many different types of jobs and, arguably, eroding the power held by workers to advocate their interests. These technologies have also shaped the paths of education, where access to the technologies by which businesses now operate is a necessity for employment. Scientific research completed because of technological improvements has affected how people view the world,

providing competing and often conflicting visions to religion, ethics and other cultural forces.

- *The degree of technological development and its pervasiveness in the United States partially caused the breakdown of the framework in the analysis.*

The level of technological development present in the United States is one of the main reasons why parallels between Ostrom's CPRs and sustainable communities cannot be drawn. First, individual members of these communities have differing levels of access to technology, a situation not necessarily present in Ostrom's CPRs. Access to and knowledge of computers, for example, is an important component of a well-paying job in the United States. In a vicious cycle, such access and education requires enough wealth to purchase the computers. Differences in socio-economic status can be reinforced, and gaps widened, through such a cycle. The assumption in Ostrom's analysis was a relatively equal level of access to technology. In fact, CPR institutions were undone in cases where access to technology differed, as in the case of inshore fisherman pitted against offshore gillnetters.

Another impact of technology concerns the use of natural resources. Because of technology, communities have not needed to live in the same place where resources are located. This factor is not a new development, as the development of aqueducts long ago allowed communities to import water resources. What has changed, however, is the degree to which these technologies pervade society and extract resources. The development of motor vehicles, telecommunications and high-quality transportation routes and linkages (roads, rail lines, shipping lanes and air transit) make it possible to import substantial quantities of food and materials. Transmission lines can now import energy from other regions. The reason that these decisions make sense is because the costs of doing so are less than if communities needed to depend upon the resources in their immediate area.

That perception of low cost is a second aspect of the impact of technology. The import of these resources is an attractive concept because the area in which these resources originate lies outside of the mental models of the individuals in the community. The only costs of a product or service which individuals are required to understand are in terms of their own immediate surroundings — for example, trading these goods for the services of their labor. The costs associated with any degradation outside of the community has lain outside of their mental models. The times when these "outside" sources suddenly appear are in times

of crisis, as in the oil embargo in the United States in the 1970s. Technology has increased the size of the commons in the United States to a regional or global scale, a situation beyond the assumptions behind the CPR framework.

- *The technologies discussed by the community initiatives focused on resource efficiency and information processing and dissemination. A few mentioned the need to provide universal access to emerging technologies.*

The community initiatives identify and address some of the issues discussed above. As shown in Table C.6, a few of the initiatives note the importance of providing universal access to emerging technologies, particularly telecommunications. A larger number of the proposed technologies involve the more efficient consumption of resources. While efficient consumption is an important component of sustainability (in terms of extending time horizons), it does not address the “out of sight, out of mind” aspects of existing technologies. Some changes proposed by these initiatives do attempt to connect the linkages between supply and demand, from renewable energy production to the promotion of alternatives to the use of the automobile.² Notably, some others also stressed the importance of using telecommunications to reforge the links between resource supply and resource use, through data monitoring and new forms of data presentation, such as Geographic Information Systems. Through whatever means, a number of the initiatives had already drawn the links between resource use, pollution and environmental impacts to call for renewable energy production, local materials use and industrial pollution prevention, among other changes from existing practices.

Local Institutions and the Pursuit of Sustainability

- *The reasons for choosing a local-level focus included: a higher degree of legitimacy at the local level; a better understanding of the local dimensions of issues related to sustainability; a higher degree of concern for individuals; and, the current popularity of the local-level in policy discussions.*

The reasons for choosing a local institutional focus were varied. First and foremost, if sustainability is to involve public choices, it seemed that a debate on “what kind of garden do we want” must be conducted at a level where the participants ascribe some form of

² Modes of mass transit might be able to succeed in increasing energy efficiency, since more people would be moved per vehicle. Gasoline consumption in mass transit could also be replaced by a more efficient use diesel fuel or natural gas (in the case of buses) or coal or natural gas (for coal-fired electric power plants).

legitimacy to the results of the discussion. The institutional history in the United States with regard to the state and federal government is not replete with success stories in this regard. As one of the farmer's in the New York City watershed management case stated,

“The city had made so many promises when they built the reservoirs ... They were going to settle all the claims, maintain the roads. None of that happened, so this time people didn't believe them. People said, ‘You whipped it to us once, but we have good memories. We won't stand for it a second time.’”³

Given the many site-specific issues which relate to sustainability, it also seemed that the most appropriate level for such a discussion would be at the local level. It is at the local level where people's mental models are the most fully developed. Issues such as the Gross National Product or global competitiveness are always translated by people into terms which they can understand, i.e., how it will affect their employment and income, their children's education, and so on. The discussion must not only be legitimate, but it also must be about something which concerns the participants, and many of their concerns focus on what is happening in their community. Finally, as was also mentioned in the Introduction, the thesis chose to investigate local institutions because of the wide popularity the concept of local-level management of sustainability has obtained in the United States as well as internationally.

- *The analytical framework developed in Chapter 3 helped in classifying the range of issues which local institutions would need to address, such as participation, monitoring and enforcement, sanctioning, conflicts with other governmental authorities, etc.*
- *The framework was unsuccessful in addressing the complexity inherent in sustainability issues.*

The thesis sought to allow each initiative to define its own sustainability objectives, and then to follow how institutions and rules were developed to manage each. However, as already discussed in the section on technology, sustainability involves a number of systems over which local governments lack the jurisdiction to control both supply and demand. Further, many of the objectives established in these initiatives selected certain benefits or resource flows to be sustained, without identifying the resources necessary to ensure those benefits or flows. This underscores how much more complicated an issue sustainability in

Reconnecting supply and demand would be accomplished by promoting walking or bicycling, or possibly by powering mass transit with a renewable form of energy.

³ Andrew C. Revkin, “In Unusual Partnership, Farmers Help Safeguard New York Water,” *New York Times* 13 August 1995, 36.

the United States is in comparison to CPRs, which even among themselves have only mixed records of success.

- *The framework was also unable to incorporate the pervasiveness of the legal system in the United States.*

The second aspect concerned the historical legal and institutional context of these communities in the United States. In the CPR examples listed by Ostrom, the primary concern over the “rights of recognition” dealt with whether regional or national governments would overrule these local institutions and confer benefits or rights to others outside of the institution. The United States, however, has a very intricate legal and political system involving local, state and the federal governments as well as its state and federal court system. Jurisdiction over many of the sustainability issues identified by the initiatives have already been partitioned among these different entities and reinforced by case law. Some of the institutional design characteristics identified by Ostrom — monitoring, sanctioning, conflict resolution mechanisms, rights of recognition and nested enterprises — have been in place for some of the sustainability issues for decades. The ability of a local institution to simply take over these responsibilities is severely constrained by legislative oversight as well as the potential for someone to file a lawsuit. Given such a background, it is not reasonable to expect that sustainable community institutions would be able to mimic those characteristics created by Ostrom. The lack of conformance between the proposed framework and the initiatives themselves implies that the results of the thesis are largely inconclusive.

- *The community initiatives have succeeded in pursuing certain aspects of sustainability: the establishment of regional institutions to address systems which span different jurisdictions; the involvement of a high degree of public participation in decisionmaking; experimentation in alternatives to conflict resolution mechanisms; and the provision of feedback from those projects which create sustainability indicators.*

The initiatives did, however, demonstrate that a number of sustainability issues can be addressed at the local level. The creation of regional land use planning agencies which work in conjunction with town governments provides an opportunity to work on issues such as transportation, water use, economics (particularly with regard to agriculture and forestry) and housing. The high level of public participation in these initiatives, especially the degree of input provided by individual towns and neighborhoods, suggests that these local institutions may be building a degree of legitimacy to their actions. The initiatives are also experimenting with alternatives to conflict resolution mechanisms to lower the costs of

pursuing these objectives and building a higher degree of consensus. The indicator projects are also a fantastic innovation for promoting sustainability in these communities. While they do not create institutions themselves, these projects provide the crucial feedback necessary to insert certain issues into public discourse and the mental models of community members. These are also important tools for addressing the uncertainties inherent in dealing with sustainability, since they can be tracked to show system responses to new policies.⁴

Reviewing the Methodology

The results of this thesis have been shaped by certain decisions which were made to structure the analysis. First, a local-level focus was selected for reasons given earlier in this chapter. Second, the findings of Chapter 2 were interpreted to mean that rather than create a set definition of sustainability to impose on the local initiatives, the analysis should focus on what those local initiatives chose for themselves to sustain. Third, the ability of a community to manage those issues related to sustainability was divided into two elements — the ability to understand the systems involved in pursuing sustainability, and the institutional authority and structure to manage those systems. Each of those elements in turn required the selection of a theoretical lens for analysis: the theory of mental models was chosen to analyze the first element; and the theories about institutional design and supply to manage common-pool resources developed by Elinor Ostrom were chosen for the second. Finally, nine different local-level initiatives were chosen as the subjects for analysis, based upon the availability of definitions of sustainability, their organization and their notoriety.

For each of these decisions, a range of alternatives were possible. The analysis and results could have turned out very differently had some of those alternatives been chosen:

- *Selection of a single set definition of sustainability*

It would have been possible to select a single definition of sustainability and measure the degrees to which the community initiatives pursued this definition. Such a decision would

⁴ Care must nonetheless be taken in ensuring that changes in these indicators, either for better or worse, can be ascribed to these policies. This is why attempting to build a systemic understanding is so crucial to pursuing sustainability, because without building that understanding every policy essentially becomes a “shot in the dark.”

have made the analysis much more quantitative in nature and probably made the findings much more conclusive. However, the definition itself would be subject to serious debate as to its validity. Another question to answer would be “to whom is this definition valid?” Such an approach would overlook the importance of what individuals or interest groups would consider such a definition to be legitimate.

- *A different approach to the community management of sustainability.*

The issue of whether communities can manage issues of sustainability could have been divided into questions other than the ability to understand the systems and the institutional capacity to manage those systems. This thesis selected a systems-based approach, which was shaped by the literature analyzed in Chapter 2. A more economics-oriented approach would have analyzed the methods by which communities could internalize social and environmental costs in market prices, or shaped property rights. Alternatively, a planning-based approach would have focused on issues of land use and incorporated theories on how land use patterns affect different aspects of sustainability. Both of these alternative approaches would also have led to the selection of very different case studies for analysis.

- *The selection or investigation of an alternative to the theory of mental models.*

The theory of mental models was particularly useful in addressing questions of the understanding of systems. The language of the theory focuses on cognitive models of cause and effect and their relation to real world systems, a focus which made the theory extremely powerful as a part of this analysis. Its application in organizational learning (with which the author was already familiar) and risk assessment were the primary reasons that mental models were selected. However, this thesis did not attempt to integrate this theory with others which also might explain how individuals would develop an understanding of issues related to sustainability. Such alternatives — for example, the rational actor model — seem tied to analytical approaches other than the systems-based one used here. Nonetheless, it might strengthen this aspect of the analysis to investigate and possibly integrate other models of human understanding and behavior.

- *The selection of an alternative to Governing the Commons for an investigation of the institutional capacity for management.*

With regard to the investigation of institutional capacity, a review of the literature on sustainability found many articles addressing community efforts, but none that went so far

as to formulate a theory on how communities could succeed or fail. Elinor Ostrom's *Governing the Commons* was selected upon the recommendation of one of the authors of the literature reviewed in Chapter 2.⁵ While her work did provide a framework for analyzing local-level institutions, that framework had been developed in empirical situations far different than those involved in the scope of this thesis. Thus, it may have been inappropriate to use this work as a foundation for the analysis, but an alternative which had been developed to a sufficient depth could not be found.

- *The selection of fewer community initiatives for analysis.*

There were more sustainable community initiatives in the United States from which to choose for the analysis, and that number increased during the research process. The thesis selected a fairly large number (nine) in the hopes of being able to provide some recommendations to community members or government officials with regard to the pursuit of sustainability at the local level. This may have proven to be a mistake. The level of detail necessary to understand the systems involved in sustainability, as well as the specific institutional characteristics of the initiative, made a thorough analysis of all nine impossible in the time frame allowed for the research.

It would have been better to select one or two initiatives for analysis, preferably in locations closer to the author where more extensive interviews and research could have been conducted. Such a scope of effort would have been better suited for testing and refining the framework, which could have led to a more extensive analysis at a later date.

Questions for Further Research

This thesis raised more questions than it answered. The discussions of issues, shortcomings in the analytical framework and review of the methodology all suggest a number of topics for which a better understanding would have augmented the strength of the analysis. These topics are summarized in Table 5.2, and discussed below within the categories of Sustainability, Technology and Institutional Design.

⁵ Kai Lee, professor at Williams College and author of *Compass and Gyroscope*, personal communication, August, 1995.

Table 5.2: Summary of issues raised as questions for further study

Definitions of Sustainability

- Which of the sustainability elements identified in Chapter 2 are vital, and which are not? Does the omission of certain elements of sustainability by the community initiatives imply that those elements receiving less attention are actually less important in pursuing sustainability in these communities?
- What empirical evidence corroborates or contradicts the assertion that the inculcation of different values, particularly ones related to inter- and intragenerational equity, is necessary for the pursuit of sustainability?

Issues of Technology

- Can telecommunications and data systems be developed to get people to account for impacts which occur outside of their models of the world? If not, does this imply that changes are needed in economic and political institutions and systems to pursue sustainability?
- How can technological innovation be directed toward the development of decentralized systems which enhance community control and dependence on local resources?

Institutional Design

- Does the breakdown of the analytical framework imply that a new framework must be selected, or does the pursuit of sustainability need local and national political institutions to be reshaped based upon this framework?
 - How do the interactions of the U.S. court system and existing federal, state and local governments and rules affect the pursuit of sustainability? How could the court system be modified, or how can its powers be incorporated into a theory of collective action?
 - What new rules and procedures are needed to make state and federal agencies successful arenas for discussing and mediating issues of sustainability, as well as making their activities more receptive to the concerns of community members?
 - Finally, these sustainable community initiatives should be tracked and indicators of success developed to begin a compilation of data to determine a framework for analyzing structures and strategies are more likely to succeed.
-

Definitions of Sustainability

The results of the analysis raise a number of questions regarding the perception of sustainability in the United States. It is impossible to ascertain, for example, whether the omission of certain elements of sustainability by the community initiatives implies that understanding all of the issues related to sustainability is beyond the resources available at the local level, or that those elements receiving less attention are actually less important in pursuing sustainability in these communities. For example, the culture in the United States may be so heavily bound within its economic and political system that to discuss the two elements separately may be redundant. That the initiatives did not place great emphasis on intergenerational equity, however, is noteworthy. Without directly placing a value on the well-being of future generations, from where is the impetus to work on long-range issues going to arise? How long will these communities succeed in sustaining those aspects of life which are most important to them if the communities are, at most, only concerned about their well-being and that of their children? Such a short-term horizon has been argued to stem from low levels of economic security and access to (or belief in the possibility of) shifting economic and social opportunities, rather than the preservation of existing ones.⁶ It would be very helpful to identify empirical evidence relating the inculcation of different values, particularly ones related to equity, to successful pursuits of sustainability.

Questions on Technology

In a society and culture where the natural environment has been “externalized,” it is difficult to look back and understand how resource-using technologies have shaped not only the economy in the U.S. but its culture as well. It is possible that in freeing people of the constraints of local resources, technology has shaped many aspects of life which people now feel have little to do with the environment. Education, for example, is now geared toward employment in a business world where environmental issues are still largely external to its workings. As a consequence, people have less and less understanding of both how the natural world functions and how the technologies which they use impact the natural world. By removing activities of extraction from the immediate surroundings, people receive little feedback regarding the full impact of their actions and behavior.

⁶ Elinor Ostrom, *Governing the Commons* (United States of America: Cambridge University Press, 1990), 35, 206.

Technology has similarly eroded the need for communities to work together to share resources, since access to resources is now dependent upon money and legal rights rather than living in the area. Interestingly, one aspect of technology which has not been investigated at all with regard to its impact on sustainability is how it affects the use of physical force. The advance of weapons, especially the development of weapons of mass destruction, has played an important role in the ability of one region or nation to export inequitable conditions, including environmental deterioration, to another region.

The questions which this thesis raises in regard to technology point more toward social and political than technical solutions. For example, understanding what impact weapons technology has on sustainability need not go beyond an understanding of which technologies confer an advantage to whom. The issue of access to technology has as much to do with politics (i.e., the placement and development of telecommunications infrastructure) as it does with technology (the development of fiber optic cables and other means of distributing the "Information Superhighway"). Obviously, with regard to the natural environment, an important question is how to make technologies as efficient as possible to prolong the time frames over which natural resources will be available. Yet, the motivation for improving efficiency in the United States often needs to be economic. To direct efforts toward higher efficiency, the economic system must somehow internalize external costs and adjust prices, both of which are political activities.

A final question considers whether technologies could be developed to alleviate the need to change the existing political and economic institutions in the United States to pursue sustainability. For example, will telecommunications technologies and data systems be developed to a sufficient extent that they automatically internalize impacts which are "external" to the economy? Will these technologies provide enough information to people that they realize the full systemic effects of their behavior? After investigating issues of sustainability and mental models, it seems that information technologies can never become extensive enough to permit the successful management of sustainability targets given existing resource-using technologies and institutions. The systems involved are too complex, and the boundaries of those systems are too large. As such, questions arise as to how the innovation of technology can be directed toward the development of decentralized systems which enhance community control and dependence on local resources. These more localized systems can reduce the level of complexity and facilitate the management process.

Questions on Methodology and Institutional Design

The most important question raised in the community analysis concerns whether the breakdown of the analytical framework implies either the need for a new framework, or the need to force local and national political institutions to conform to this framework. While “some elements of both” would be the more tactful response, this thesis does not provide substantial evidence to corroborate that response or to argue for either of the other two cases. On the one hand, changing institutional structure in the United States would be a very difficult task. Each of the differing sustainability objectives operate on different geographic scales, which would require creating a set of new institutions with new and different boundaries and authorities. It might also require steering the path of technological development toward these goals. Given the current backlash in the United States against government involvement in community life, such a goal seems highly unlikely. On the other hand, the current economic and institutional structure does not lend itself to pursuing the variety of sustainability objectives identified in this thesis. The level of complexity has moved many of these issues beyond the resources of local institutions to manage, and larger institutions, in many cases for good reasons, lack the legitimacy to address these issues at the local level and often as well the resources to understand the systems.

These questions provide a wide range of further lines of inquiry. If sustainability is approached through the existing institutional framework, then careful study of the U.S. court system and interactions between existing federal, state and local governments and rules needs to be understood with regard to each of the objectives to be pursued in sustainability. Where possible, linkages among the objectives should be identified within the context of political institutions to simplify the systems. Work should be continued to develop new rules and procedures to make state and federal agencies successful arenas for discussing and mediating issues of sustainability, as well as making their activities more receptive to the concerns of community members. Finally, these sustainable community initiatives should be tracked and indicators of success developed to begin a compilation of data to determine a framework for analyzing structures and strategies that are more likely to succeed. However, if it is assumed that this framework has merit, then research needs to be conducted as to how political institutions can and need to change to define and govern the systems on which the objectives of sustainability depend. In addition, some work could be conducted on determining what elements of sustainability seem sufficiently common across all communities that their management could, in fact, start from the top and work its way down to the local level.

Appendix A: The Common Themes of Sustainability

Specifying a fixed direction for sustainability is difficult because of its dependence on its object. As noted in Chapter 2, different people defining sustainability have investigated different things to sustain. What became apparent in reviewing the literature, however, was the presence of certain themes common to each definition, regardless of the difference in target.

This appendix analyzes the literature to develop common themes of sustainability. The literature has been divided into five different sustainability “targets” — civic infrastructure, environmental systems, social and economic systems, development and society. The divisions between the categories are relatively arbitrary — most authors at least allude to more than one in their articles. However, the accuracy of the division is less important than identifying the common themes. The results of the discussions of each of these targets were compared and integrated into the elements of sustainability listed in Chapter 2.

I. Sustainability of Civic Infrastructure

The sustainability of structures represented an interesting departure from the usual discussions about social- or economic-focused sustainability. One particular author stated that his intent was to evaluate sustainable development, yet his definition of development was clearly equal to the development of infrastructure. Thus, it seemed that infrastructure merited its own investigation. This author systematically identifies 15 issues of sustainability, which can be organized into four categories: future uncertainties, system function, time and people.¹ Some examples of these issues include:

- [Sustainability] requires that already during the planning and design stage one consider in detail potential future changes in the use of water resources system, to meet changing societal needs.
- [Sustainability] requires that the data on which a water resources system depends is continuously improved, and operation rules be upgraded to reflect changes in both the data base and in the demands on the system.
- [Sustainability] means that supply shortages are to be met without undue impact on society.

¹ Erich J. Plate, “Sustainable Development of Water Resources: a Challenge to Science and Engineering, *Water International* 18 (1993): 84-94.

- [Sustainability] implies that structures provide indefinitely the service for which they are designed. Proper maintenance is one key condition to preserve utility of a system.

A similar perspective is presented in the Pacific Institute's *California Water 2020: A Sustainable Vision*, a policy document written for the State of California about the sustainability of its water supply. As a part of this project, the authors generated a set of sustainability criteria for water-related projects. These criteria are:²

- 1.) A minimum water requirement will be guaranteed to all humans to maintain human health.
- 2.) Sufficient water will be guaranteed to restore and maintain the health of ecosystems. Specific amounts will vary depending on climatic and other conditions.
- 3.) Data on water resource availability, use, and quality will be collected and made accessible to all parties.
- 4.) Water quality will be maintained to meet certain minimum standards. These standards will vary depending on location and how the water is to be used.
- 5.) Human actions will not impair the long-term renewability of freshwater stocks and flows.
- 6.) Institutional mechanisms will be set up to prevent and resolve conflicts over water.
- 7.) Water planning and decision-making will be democratic, ensuring representation of all affected parties and fostering direct participation of affected interests.

In comparing these two sets of criteria, a list of elements of sustainability can be created by highlighting the most prominent issues:

- Consider potential future changes
- Improve data quality
- Meet supply shortages without undue impact
- Provide service indefinitely
- Keep future costs low
- Create plans for managing risk
- Ensure that manmade environments do not degrade over time
- Ensure that manmade environments are compatible with natural environments
- Ensure that manmade environments adapt to lifestyles of their "customers"
- Prevent shifting the cost of cleanup to future generations

² Peter Gleick, Penn Loh, Santos V. Gomez and Jason Morrison, *California Water 2020: A Sustainable Vision* (Oakland, California: Pacific Institute for Studies in Development, Environment and Security, 1995), 24.

- Follow a systemic approach
- Provide education to people about the use the system
- Involve people in making resource allocation decisions and operations and maintenance

II. Sustainability of Environmental Systems

This category focuses on the sustainability of environmental systems, both for their own sake as well as for the services which human society derives from the environment. From a more service-oriented viewpoint, environmental systems are regarded as a “stock of natural assets serving economic functions,” such as a supply of natural resources, a means of assimilating wastes, a source of direct human welfare and a set of life support systems.³ Alternatively, but similarly, the focus can be on the functions rather than the stocks, “e.g. the function of ‘supplier of wood’ of forests, the function ‘drinking water’ of water, the function ‘soil for raising crops’ of soil.”⁴ Another important aspect is the quality of the resources which can be undermined by pollution or by deterioration.⁵ Pollution would prevent soil from being “soil for raising crops,” even though the actual stock of soil were still present. The evaluation of the sustainability of these services introduces a number of different dimensions.

The first dimension relates to the time frame over which these systems are meant to be sustained. For example, one can ensure that changes in the quality or quantity of stocks and flows are positive (toward enhancement) or zero (no change).⁶ This implies that sustainability is intended to be indefinite, presuming that the current levels of stocks and flows are acceptable for both current and future use.⁷ Other options could involve planning for a certain time frame (e.g., the “seventh generation” principle in Native American cultures) and revisiting the plans as new events occur and information is made available.

The concept of revisiting plans introduces the second dimension of pursuing sustainability, the uncertainties inherent in these decisions. The complexities of environmental systems

³ David Pearce, “Economics, Equity and Sustainable Development,” *Futures* 20, no. 6 (1988): 599.

⁴ Roefie Hueting and Peter Bosch, “Note on the Correction of National Income for Environmental Losses,” in *In Search of Indicators of Sustainable Development*, edited by Onno Kuik and Harmen Verbruggen (Netherlands: Kluwer Academic Publishers, 1991), 31.

⁵ Hans Opschoor and Lucas Reijnders, “Towards Sustainable Development Indicators,” in *In Search of Indicators of Sustainable Development*, edited by Onno Kuik and Harmen Verbruggen (Netherlands: Kluwer Academic Publishers, 1991), 12ff.

⁶ Opschoor and Reijnders, “Towards Sustainable Development Indicators,” 12.

⁷ Opschoor and Reijnders, “Towards Sustainable Development Indicators,” 12-3.

preclude our ability to accurately predict the behavior of these systems.⁸ As a consequence, sustaining these systems needs to be an experimental process.⁹ This forms the crux of Kai Lee's *Compass and Gyroscope*:

Because human understanding of nature is imperfect, human interactions with nature should be experimental. Adaptive management applies the concept of experimentation to the design and implementation of natural-resource and environmental policies. An adaptive policy is one that is designed from the outset to test clearly formulated hypotheses about the behavior of an ecosystem being changed by human use ... if the policy succeeds, the hypothesis is affirmed. But if the policy fails, an adaptive design still permits learning, so that future decisions can proceed from a better base of understanding.¹⁰

Surprises should be expected from environmental systems, and institutional and social mechanisms should be created to adapt rapidly to these surprises. These surprises will not only originate within the environmental system — surprises will also stem from human innovations in technology or in social organization, and can have greater consequences than the environment alone.¹¹

A final major aspect to emerge from these discussions is the many other social systems which impact environmental systems. For example, many articles on sustainability refer to the “Ehrlich” or “IPAT” equation, which relates population, affluence and technology to environmental impact.¹² While highly aggregate, the equation indicates that reducing environmental impact requires “limiting population growth ... limiting affluence ... or

⁸ William C. Clark, “Sustainable Development of the Biosphere: Themes for a Research Program,” in *Sustainable Development of the Biosphere*, edited by William C. Clark and R. E. Munn (New York: Cambridge University Press, 1986), 31-2.

⁹ See: Ben ten Brink, “The AMOEBA Approach as a Useful Tool for Establishing Sustainable Development?”, in *In Search of Indicators of Sustainable Development*, edited by Onno Kuik and Harmen Verbruggen, 71-88 (Netherlands: Kluwer Academic Publishers, 1991); Kai Lee, *Compass and Gyroscope: Integrating Science and Politics for the Environment* (Washington, DC: Island Press, 1993); and Richard B. Norgaard, “Sustainable Development: a Co-evolutionary View,” *Futures* 20, no. 6 (1988): 606-621.

¹⁰ Lee, *Compass and Gyroscope*, 53.

¹¹ Clark, “Sustainable Development of the Biosphere,” 33.

¹² This equation is written as follows:

$$I = P \cdot A \cdot T$$

where

I = Impact on the environment

P = Total population

A = affluence of that population (per capita material wealth)

T = technological efficiency (environmental impact per material wealth)

See: Robert Goodland, Herman Daly and John Kellenberg, “Burden Sharing in the Transition to Environmental Sustainability,” *Futures* 26, no. 2 (1994): 147.

improving technology, thereby reducing throughput intensity.”¹³ While technology seems to be the most approachable angle, improvements in efficiency are not likely to be sufficient.¹⁴ Rather, limitations in population and in consumption will be more important, although the reasons for that growth, such as “state policies, interstate relations and global capitalism”¹⁵ or gender issues¹⁶ are hidden in the equation.

As a contrast to the preceding discussion, it is important to note that a very strong ethical component of many who are involved in the pursuit of sustainability is the preservation of the environment for its own sake. The primary example is the issue of the biological diversity of species, or “biodiversity.” Biodiversity is threatened throughout the world as the destruction and degradation of natural habitats, particularly in tropical regions of the world, leads to the extinction of species.¹⁷ Some arguments made in favor of preserving biodiversity promote the services that biodiversity can provide for human beings, for example, how genetic material from plant species can be used to create superior crops, new pharmaceuticals, fibers and petroleum substitutes.¹⁸ Such arguments, however, fail to incorporate the moral dimension of protecting biodiversity for the saving of life itself. In his introduction to *Biodiversity*, Harvard biologist E.O. Wilson writes:

The diversity of life forms, so numerous that we have yet to identify most of them, is the greatest wonder of this planet. The biosphere is an intricate tapestry of interwoven life forms. Even the seemingly desolate arctic tundra is sustained by a complex interaction of many species of plants and animals, including the rich arrays of symbiotic lichens. This book ... offers an overall view of this biological diversity and carries the urgent warning that we are rapidly altering and destroying the environments that have fostered the diversity of life forms for more than a billion years.¹⁹

¹³ Goodland et. al., “Burden Sharing,” 147.

¹⁴ Goodland et. al., “Burden Sharing,” 152.

¹⁵ Raymond L. Bryant, “Political Ecology: An Emerging Research Agenda in Third-World Studies,” *Political Geography* 11, no. 1 (1992):14.

¹⁶ See: Richard A. Schroeder, “Shady Practice: Gendered Tenure in the Gambia’s Green/Orchards,” Paper Prepared for the 88th Annual Meeting of the Association of American Geographers, San Diego, CA, April 18-22, 1992.

¹⁷ E.O. Wilson, “The Current State of Biological Diversity,” in *Biodiversity*, edited by E.O. Wilson and Frances M. Peter, (Washington, DC: National Academy Press, 1988), 3.

¹⁸ Wilson, “The Current State of Biological Diversity,” 15

¹⁹ E.O. Wilson, “Editor’s Foreword,” in *Biodiversity*, edited by E.O. Wilson and Frances M. Peter, (Washington, DC: National Academy Press, 1988), v.

In addition to sustainability issues such as justice among human generations and justice between human generations, a third important ethical concept is “justice to nature.”²⁰ The nurturing of such an ethic may be a key component to promoting sustainability.

The following list summarizes the sustainability issues in a context of environmental systems:

- Changes in effectiveness of services are either zero or positive over time
- Certain minimum quality levels must be met
- Time lags between parameters and effects are incorporated
- Limit population growth
- Limit affluence
- Improve technological efficiency
- Make the Environment/Biosphere the bottom line
- Create adaptive policies to better address uncertainties and surprises and to create learning institutions
- Address the social, institutional and cultural aspects behind the human use of the environment, including the ethic of Justice to Nature

III. Sustainability of Social and Economic Systems

This third category focuses on the social and economic systems of societies. Depending upon one’s definitions of “social” and “economic,” this could incorporate the whole of human society. However, the authors’ choice of words and content reveal a primary concern with economic, political and institutional issues — hence the division between the sustainability of these systems and the sustainability of society.

The first aspect that people discussed with relation to sustainable social and economic systems is their relationship with the “natural” environment. Authors note that these systems need to “respect environmental constraints” as well as “avoid irreversible damage to natural systems.”²¹ The reasons for respecting constraints seem to be twofold: first, a healthy environment is an important part of the traditional objectives of social and economic systems, e.g., raising real incomes; and second, “environmental quality is part of the wider ... objective of an improved ‘quality of life.’”²²

²⁰ Pearce, “Economics, Equity and Sustainable Development,” 599.

²¹ Lee, *Compass and Gyroscope*, 186-7.

²² David Pearce, Edward Barbier and Anil Markandya, *Blueprint for a Green Economy* (London: Earthscan Publications Limited, 1989), 2.

A second dimension concerned equity issues between different generations. Authors' emphasized a concern over the "reversibility" of interactions with the natural environment, to ensure that future generations would have the option to return ecosystems to less impacted states. Some noted that working on sustainability involves melding two different time frames, one short-term (between 5-10 years) and one long-term (looking at generations ahead, such as the grandchildren of the current generation).²³ Sustainability should somehow involve equalizing concerns for the current as well as future generations — this notion of "intergenerational equity" is a very strong normative element of sustainability.²⁴

A third aspect deals with the ability to spread the wealth among the members of those systems. A number of authors noted that sustainability includes meeting traditional objectives of social and economic systems, such as rises in real incomes, educational standards, national health and the quality of life.²⁵ In addition to a separate normative element, "intragenerational equity," the ability of a system to meet these objectives has a pragmatic impact on its sustainability:

... a sustainable economy must be efficient enough to permit prosperity among a great majority of members of the society, and fair enough in its outcomes to maintain citizens' support for the governing order.²⁶

Social and economic systems continue largely at the sufferance of the members of society. Should issues such as equity and fairness be sufficiently violated, some individuals may attempt to withdraw their support from the "governing order" — should they have sufficient power, they could crash the system. Thus sustainability relates to equity among the current generation.

A fourth and final aspect of this sustainability concerns the actors in the social and economic system. Individual participants in these systems face certain sets of pressures, either personal or professional. These pressures influence decisionmakers in significant ways, and some authors argue that analysis of sustainability needs to incorporate these issues:

Given that sundry policies have environmental implications, the number of actors involved can be great, including government departments and agencies, national and transnational corporations, non-

²³ Pearce, et. al., *Blueprint*, 2.

²⁴ Pearce, "Economics, Equity and Sustainable Development," 599, 601.

²⁵ Pearce, et. al., *Blueprint*, 180.

²⁶ Lee, *Compass and Gyroscope*, 187.

governmental organizations, multilateral agencies and foreign governments. The challenge is to identify the different and often conflicting pressures on policy-makers in order to understand a particular policy outcome. How previous policy choices contributed to environmental change, and how such change in turn affected the decision-making process.²⁷

A sustainable social and economic system also depends upon the pressures placed upon decisionmakers which can lead to unsustainable outcomes, either in the environment or concerning equity.

The following summarizes those issues addressed in the sustainability of social and economic systems:

- Respect for relationship to the environment
- Reversibility of interactions
- Ability to spread wealth among the population
- What time frame for sustainability?
- Intergenerational equity
- Intragenerational equity
- Pressures on and behavior of stakeholders

IV. Sustainability of Development

Discussions of “sustainable development” revolve around the sustainability of development, where development seems to be an identifiable process. Depending upon one’s point of view, however, development has different meanings. To the international agenda of organizations such as the United Nations, development is a process by which “developing” nations improve the welfare of their citizens, perhaps by emulating the consumption-intensive lifestyles of industrialized nations. To a more domestic perspective, development is less specifically a process of change and improvement.

The most renowned work associated with the international perspective is the World Council on Economic Development’s *Our Common Future*. It states that

Humanity has the ability to make development sustainable — to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED).²⁸

²⁷ Bryant, “Political Ecology,” 18.

²⁸ The World Commission on Environment and Development, *Our Common Future* (New York: Oxford University Press, 1987), 8.

Sustainability has two different elements. First, development must meet the needs of the present, where the needs of the poorer countries on the planet should receive “overriding priority.”²⁹ Second, development should simultaneously preserve the ability of future generations to meet their needs — in effect, recognize environmental constraints to certain development patterns.³⁰ This also includes recognizing the importance of environmental systems in development, especially in the provision of natural resources (e.g., genetic material from biodiversity, timber from forests, etc.) as well as necessary services (e.g., clean water and air). Thus, sustainability from this perspective has elements of both inter- and intra-generational equity.

Further investigations from this perspective echo themes found in other “targets.” Under the predominant vision of development, most poorer countries see it as an opportunity to attain levels of wealth comparable to industrialized and richer nations.³¹ As noted above, however, the opportunities to achieve these goals without severe environmental strain, local and global, may be limited. Given environmental limits, what may need to be changed are the expectations of the development process:

... that kind of development was appropriate for and could only take place in a special historical-ecological niche in which there were both abundant raw materials and extensive capabilities to absorb wastes. Tightening environmental constraints make this development paradigm obsolete ...³²

Sustainability also requires dealing with uncertainties. It is noted that sustainability does not lead to a “fixed state of harmony,” but rather a continuing process of change, all the while struggling to incorporate both present and future needs.³³ Finally, sustainability also requires the marshaling of various social and economic factors, namely “the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change.”³⁴

The second viewpoint of development does not differ greatly from the first. Sustainable development can be applied to the “whole process of economic progress”³⁵ or the whole

²⁹ WCED, *Our Common Future*, 43.

³⁰ WCED, *Our Common Future*, 43.

³¹ Dennis Pirages, “Sustainability as an Evolving Process,” *Futures* 26, no. 2 (1994): 197-8.

³² Pirages, “Sustainability as an Evolving Process,” 201.

³³ WCED, *Our Common Future*, 9.

³⁴ WCED, *Our Common Future*, 46.

³⁵ Pearce, “Economics, Equity and Sustainable Development,” 598.

“economic-ecological system,”³⁶ though most seem to agree that development must lead to improvements in human welfare. These broader discussions of sustainable development do, however, introduce a number of additional points. First, sustainable development can add another type of justice to the two which have already been discussed, namely justice to non-human sentient beings.³⁷ Second, if the object is to sustain development, then development needs to focus on the topic of resilience so that external (or possibly just chaotic shocks) do not undermine the system.³⁸ Doing so requires a focus on preserving “natural capital,”³⁹ the sinks and sources within the environment in the form of “organisms, ecosystems and environmental systems.”⁴⁰

Another important point which is discussed is the variety of possible patterns of development, depending upon variables used to characterize the system. For example, how long a given pattern of development is to be sustained can change the assessment of whether or not a given system is in fact sustainable.⁴¹ Similarly, how one envisions and characterizes development affects that development pattern’s sustainability:

Sustainable development can have many different shapes. The presence of biomass may be sustained, although the quantities may change through time and in some patterns even dramatically collapse before recovery ... sustained development of an ecosystem or socioeconomic system, respectively, involves sequences of growth, decline and replacement of system components ... examples of possible shapes of sustainable development from history and simulated futures lead to the conclusion that there are many different patterns of development of the major variables of man-environment systems which could be called sustainable.⁴²

If a given pattern of development is solely intended to maintain a human presence on the planet, then almost any development pattern can be sustainable. Setting more strict definitions — such as increasing welfare — limit the number of possibilities, but a wide range of options still exists. Thus, different choices of what to measure (i.e., human

³⁶ Braat, “The Predictive Meaning of Sustainability Indicators,” 61.

³⁷ Pearce, “Economics, Equity and Sustainable Development,” 601.

³⁸ See: Clark, “Sustainable Development of the Biosphere,” 32-35; C.S. Holling, “The Resilience of Terrestrial Ecosystems: Local Surprise and Global Change,” in *Sustainable Development of the Biosphere*, edited by William C. Clark and R. E. Munn (New York: Cambridge University Press, 1986), 296ff; and Pearce, “Economics, Equity and Sustainable Development,” 600.

³⁹ Pearce, “Economics, Equity and Sustainable Development,” 600.

⁴⁰ Norgaard, “A Co-evolutionary View,” 608.

⁴¹ Braat, “The Predictive Meaning of Sustainability Indicators,” 62; Pearce, “Economics, Equity and Sustainable Development,” 598.

⁴² Braat, “The Predictive Meaning of Sustainability Indicators,” 62.

population, levels and distribution of human health, etc.) could cause the same development pattern to be sustainable or unsustainable.

The major issues identified in the discussion of the sustainability of development are listed below:

- Meet the needs of the current generation
- Include the concept of intergenerational equity
- Reduce in consumption levels
- Recognize tightening environmental constraints and levels of natural capital stocks
- Recognize that sustainability involves a continuous state of change
- Reorient technology
- Pursue institutional changes consistent with sustainability
- Incorporate an ethic of justice to nature
- Create more resilient systems
- Select major variables to define what is to be sustained

V. Sustainability of Societies

Discussions of the sustainability of society generally take a systems perspective, in that they identify the many interacting components of the whole system that makes up a society. These components include

... a growing human population and its demands, the changing capabilities of the physical environment to absorb the wastes of human activity, the changing possibilities opened up by new knowledge and technological changes and the values, aspirations and institutions that channel human behavior.⁴³

All of these components are interrelated — for example, it is the values, aspirations and even institutions which give shape to many of the demands of human populations. The overall definition of sustainability ascribed to this system is a balance between and among all of the different components of the system, and the ways in which those components interact.⁴⁴ Certain subsystems are emphasized as critical to society.

⁴³ Pirages, "Sustainability as an Evolving Process," 200.

⁴⁴ Helias Udo de Haes, Maarten Nip and Frans Klijn, "Towards Sustainability: Indicators of Environmental Quality," in *In Search of Indicators of Sustainable Development*, edited by Onno Kuik and Harmen Verbruggen (Netherlands: Kluwer Academic Publishers, 1991), 89; Pirages, "Sustainability as an Evolving Process," 200.

Values

The first deals with values. While knowledge informs individuals or societies as to the consequences of their actions, values shape and guide those actions. Values can be shown to have a “co-evolutionary” behavior with cultural and environmental systems, where values shape and are in turn shaped by changes in society and nature.⁴⁵ Recent research has looked at ways in which other cultures have developed their own means to provide for their survival, in an attempt to look for clues on how to build a sustainable society.⁴⁶ The development of sustainable societies will require a shift away from the “growth is good” paradigm instilled by classical economics and instead evaluate different growth opportunities on the basis of other values, such as equity, justice and others.⁴⁷

The Role of Technology

A second important aspect in the discussion on the sustainability of societies is technology. Technology is the medium through which human beings, either at an individual or social level, interact with the world. Such a broad definition encompasses a number of things which are not necessarily “hardware,” yet nonetheless have changed our interactions and have transformed society (even language or money). In doing so, technology can shape value systems:

... technology affects how we perceive the world around us, process observations and store information. It also affects what is important to know. Technology, by changing how we relate to each other and to nature, has made some values more important and stifled the nurturing and transfer of others.⁴⁸

Thus, technology plays a formative role in affecting value systems, which in turn affect the sustainability or unsustainability of society. For example, proper ecosystem management became less important once technological advances permitted the use of fossil fuels, and “social systems evolved around the expanding means of exploiting hydrocarbons and only later adopted institutions to correct the damage this co-evolution entailed for ecosystems.”⁴⁹ Many technological advances have permitted societies to expand at the expense of other regions as well as future generations.

⁴⁵ Norgaard, “A Co-evolutionary View,” 617.

⁴⁶ Norgaard, “A Co-evolutionary View,” 611.

⁴⁷ Meadows, et. al., *Beyond the Limits*, 41.

⁴⁸ Norgaard, “A Co-evolutionary View,” 616.

⁴⁹ Norgaard, “A Co-evolutionary View,” 617.

Technology can, however, play a role in bringing society to some level of sustainability. Many authors emphasize the importance of feedback in society — information that makes people aware of the consequences of their own actions. These feedback loops are what can keep extended growth in check and permit society to exist within its limits.⁵⁰ While advances in transportation may allow continued existence for societies at the expense of deteriorating conditions elsewhere (or possibly even within the society itself), advances in information technologies have begun to bring pictures of that deterioration back home. Thus, telecommunications can and will play a vital role in transporting information so that actions and consequences can again be linked, and value systems may again transform.

Nonetheless, care must be taken that the manufacture and use of these technologies not be too harmful to the environment in and of themselves. The manufacture of telecommunications products, for example, is tremendously inefficient, wasting vast quantities of often toxic chemicals and materials.⁵¹ The economist Herman Daly has identified certain characteristics which technologies should adapt to promote sustainability:

- Artifact maintenance efficiency (AME) ... lengthen[s] the period of time that artifacts (products) are used. The longer that products can be kept in service the less the need to use additional raw materials to make replacements.
- Artifact service efficiency (ASE) ... improv[es] the effectiveness with which a given mix of products can meet social needs.⁵²

Two other efficiencies — ecosystem maintenance efficiency (EME) and ecosystem service efficiency — relate to the effects that technology can have on the environment. Technologies can affect both how “an ecosystem can ... maintain a flow of resources on a reliable basis with minimal long-term harm” (EME) and how “the negative impacts of economic activity are allocated throughout the environment” (ESE).⁵³ These can relate to both “hard” technologies, like computers, or “soft” technologies, like the choice of building materials or residential development patterns which facilitate pedestrian and bicycle traffic. Again, all of these technologies have the potential to shape human behavior, multiplying their impacts on the environment and on sustainability.

⁵⁰ Meadows, et. al., *Beyond the Limits*, 24ff.

⁵¹ Paul Hawken, author of *The Ecology of Commerce*, address to the Harvard Graduate School of Design, April, 1995.

⁵² Pirages, “Sustainability as an Evolving Process,” 202.

⁵³ Pirages, “Sustainability as an Evolving Process,” 202.

Cultural Sustainability

While most of the literature focuses on the physical sustainability of regions, one could also consider cultural sustainability. Richard Norgaard notes that a region could be culturally sustainable only if it were “contributing as much to the knowledge and institutional bases of other regions as [the region were] culturally dependent on others.”⁵⁴ Also, one could look at the sum total of the cultural activities of all of the regions, to assess whether they are moving along “mutually compatible paths, or will they destroy each other through war?”⁵⁵

System Boundaries

If societies are to be viewed as systems, then defining those systems requires establishing system boundaries. While time is one important dimension, spatial scale also plays an important role. For example, a society can be viewed as a local geographic area. If this area is viewed as a closed system, sustainability relates to the practices within those boundaries. If it is an open system, sustainability also relates to “subsidies” to the region, such as food, energy, technology or other inputs⁵⁶ or even exports of wastes outside the area.⁵⁷ On yet another level, one could analyze whether the activities of other regions are affecting this particular area, as in the case of global warming or ozone depletion.⁵⁸ The system to be analyzed then becomes the aggregate of all local areas. Different selections of scale can produce very different “sustainability pictures.”

The Concept of Surprise

The last issue to be addressed by these discussions on the sustainability of societies is the ability of societies to respond to unexpected changes or surprises. It has been pointed out often that sustainability does not simply relate to a harmonious interaction among all of these different elements, but rather it relates to the ability of the system to continue despite the changing nature of the interactions.⁵⁹ New technologies and new ideas, giving rise to new value systems which in turn shape the process of innovation, create new systems. Often these advances show up as “surprises” to society, which is ill-equipped to deal with

⁵⁴ Norgaard, “A Co-evolutionary View,” 607.

⁵⁵ Norgaard, “A Co-evolutionary View,” 607.

⁵⁶ Norgaard, “A Co-evolutionary View,” 607.

⁵⁷ Plate, “Sustainable Development of Water Resources,” 90.

⁵⁸ Norgaard, “A Co-evolutionary View,” 607.

⁵⁹ Norgaard, “A Co-evolutionary View,” 607.

them, and result in dramatic transformations for which current thinking cannot account.⁶⁰ Old concepts of environmental protection and development often assumed that dealing with problems “consisted of adjusting the relative numbers of the parts and the relative strengths of the relations. Action did not change the underlying nature of the systems.”⁶¹ Somehow, the sustainability of a society needs to incorporate the notion of change and facilitate the ability to adapt to changes in the human-environmental relationships. If we “base action on science girded by false beliefs in universals and objectivity, [we will continually experience] ‘unforeseen’ changes in social and environmental systems.”⁶²

The following lists the more prominent issues in the discussion of the sustainability of societies:

- Incorporate a system perspective
- Focus on values and value systems
- Recognize the importance of cultures, cultural systems and cultural interactions
- Reorient technology
- Preserve of environmental sources and sinks
- Provide sufficient information to create feedback
- Improve the efficiency of technology
- Define boundaries for the systems to be sustained
- Recognize the presence of subsidies from outside the system boundary
- Understand the ways in which other regions can impact your region’s sustainability
- Address issues of uncertainties and surprises

⁶⁰ Clark, “Sustainable Development of the Biosphere,” 31-6.

⁶¹ Meadows, et. al., *Beyond the Limits*, 191-2; Norgaard, “A Co-evolutionary View,” 612-3.

⁶² Norgaard, “A Co-evolutionary View,” 613.

Appendix B: Creating Institutional Design Principles for Sustainable Community Initiatives

While Ostrom's *Governing the Commons* provides a useful set of design principles with which to evaluate common-pool resources (CPRs), translating these into a framework for analyzing sustainable community initiatives is not straightforward. Ostrom's discussion focused on specific CPRs where the resource formed the economic basis for a set of clearly-defined users whose interaction with the resource provided sufficient understanding for management. The level of disconnectedness between modern communities and natural resources breaks down many of the assumptions in her work.¹ Gleaning some lessons from *Governing the Commons* will require establishing parallels between CPRs and the modern community, both urban and rural.

What is a Community?

The first question to be answered in understanding the modern meaning of a "sustainable community" is to understand what is meant by a community. As with "sustainability," the definition of a community depends upon the who one asks. One definition rooted in sociology sees the community as a group of people whose relationships are "close knit, enduring and face to face involving a high degree of cooperation," where individuals share "not only common values and ways of life, but also common fates and futures."² A broader definition of a community is

an entity attempting to reproduce itself socially and biologically as a group through time using its culture as a creative tool for the solution of collective problems and the satisfaction of its own primary material and spiritual needs.³

The community can accomplish these goals in a range of forms, bounded by the "closed" or "corporate" community ("bounded social systems with clear cut limits, in relation to both insiders and outsiders" where "members still effectively control their means of production") on one end and an "open" community ("an interacting group or people living in a common

¹ Erich J. Plate, "Sustainable Development of Water Resources: a Challenge to Science and Engineering," *Water International* 18 (1993): 90.

² Bob Evans, "Planning, Sustainability and the Chimera of Community," *Town and Country Planner* 63, no. 4 (1994): 106.

³ Kathleen Truman and Enrique Campos Lopez, "The Community: Perspectives for Its Sustainability," *Technological Forecasting and Social Change* 44 (1993): 292.

location” or a “group of people with common interests”) on the other.⁴ The CPRs investigated in Ostrom’s work lie more toward the “corporate” end of the range.

However, the modern use of the word “community” in the United States seems to have different connotations. The existence of abstract political boundaries dividing areas into cities and towns has created a more physical focus for the definition of a community:

... community may denote the geographic characteristics of a locality, the availability and quality of natural resources, and the economic and social structure of the built environment ... [t]he second is the notion of political community which implies an abstract social group which is not necessarily bound by geography. The two become linked when social relations of political community become enmeshed in physical space of locality, resulting in some form of political and geographic meaning of ‘local community.’⁵

As the links between the cultural, political and physical/environmental aspects of the community have been severed, the definition of a community has come to rely more on the political and physical aspects. The many different cultural communities within these boundaries have been recast as “interests,” each with “often widely diverging expectations, hopes and values, but all sharing the space and territory.”⁶ For the purpose of the following analysis, the “community” will refer to the physical and political space in which a group of people reside, regardless of their cultural differences.⁷

The Differences Between “Sustainable Communities” and CPRs

Given this definition of a community, it is obvious that a number of differences exist between the CPRs that Ostrom studied as well as communities which would be interested in becoming “sustainable.” The first set of difference relates to physical characteristics. The CPRs which Ostrom studied were quite small (50 - 15,000 people), whereas the communities in the United States interested in pursuing sustainability are often much larger (one million people or perhaps more — see Chapter Four). Members of U.S. communities

⁴ Truman and Campos Lopez, “The Community,” 294-5.

⁵ Maureen Reed, “Sustainability and Community: Still Searching for Meaning,” *Environments* 21, no. 2: 50.

⁶ Evans, “Planning, Sustainability and the Chimera of Community,” 107.

⁷ As an aside, it should be noted that this definition of the community suggests a particular system definition for analysis. The first element of sustainability listed in Chapter 2 is that of a systems perspective. It is assumed that a sustainable community initiative will work on the sustainability of the community, and therefore the system boundaries are established at the physical and political limits of the community.

are usually not dependent upon a single common-pool resource for their economic returns, as were users of CPRs. The situation might be that their health depends upon a common resource (such as the quality of a groundwater aquifer), or that their economic returns depend upon a resource located outside of the community (e.g., workers at a pulp and paper factory dependent on timber imports). Thus, most resources are not truly “common-pool resources” but “open access resources,” where boundaries and users cannot be clearly defined. Finally, it has become evident that the actions of community members can clearly affect “the environment of others who live outside of the CPR”⁸ merely by using their automobiles, to say nothing of personal purchasing decisions or actions taken within their place of employment.

A second set of differences is cultural. Much of Ostrom’s discussion on norms and their effects on decisions assumed a single set of norms that would pervade the users of a CPR. The cultural, economic and ethnic heterogeneity of areas of the United States makes this assumption implausible:

The populist heritage, to which many community organizations lay claim, often assumes a homogeneous community. To be successful, future community organizing must make recognizing the plurality of communities that compose our major cities its most pressing task.⁹

The argument has been made that for any community-level endeavor to take place and be successful, the integration of issues of inequality, particularly with regard to race, must be addressed.¹⁰ To be certain, the level of heterogeneity of any community depends upon location in the United States — cities are likely to be more heterogeneous than rural towns, and certain cities more heterogeneous than others. However, the issue of racial differences, like those issues listed above, are all issues which Ostrom did not need to address in her analysis. This implies that Ostrom’s frameworks for both institutional design and supply will need to be adjusted to match the conditions of communities rather than CPRs.

A third set of differences relates to the spatial dimensions associated with resources and the activities required to sustain them. In the CPR examples analyzed by Ostrom, the activities to both appropriate benefits from the resource and to provide and maintain a high-quality

⁸ Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (United States of America: Cambridge University Press, 1990), 31.

⁹ Ted Perlmutter, “The ‘Color Line’ Imperative,” *Social Policy* 19, no. 4 (1989): 40.

resource occurred in the same general location, be it an irrigation district, a fishery, a forest, etc. This assumption cannot be made for modern communities in the United States. Advances in technology now allow communities to import many of the resources necessary for survival — for example, food, clean water, or energy.¹¹ Technologies have also created situations where the degradation of a resource can result from activities outside of the community, as in situations of air or water pollution. Thus, the physical boundary of a community as defined by a political system may not fit the actual boundaries of the resource systems upon which communities depend.¹² This may also be true of non-environmental resources, such as health, education or employment, depending upon the community.

Sustainability and Institutional Design

The task for this Appendix is to identify a set of characteristics of sustainable community initiatives that would enhance their chances of success. Ostrom's set of design principles provides an excellent place to start (see Table B.1). However, the physical differences between "communities" and CPRs, and the implied differences between their pursuits of sustainability, necessitate reconsideration of some of those principles.

Clearly defined boundaries

The most important issue to address is the analog between a common-pool resource and a community. As discussed previously, a CPR is a resource system from which a group of individuals receive some or all of their economic returns. In addition, it is "costly (but not impossible) to exclude potential beneficiaries from obtaining benefits from its use."¹³ Thus, for a CPR, it is possible to establish definitions for both the resource itself as well as the users of that resource. The importance of doing so is that "without defining the boundaries ... [users] face the risk that any benefits they produce by their efforts will be reaped by others who have not contributed to those efforts."¹⁴

¹⁰ See: Pat Bryant, "Toxics and Racial Justice," *Social Policy* 20, no. 1 (1989): 48-52; Perlmutter, "The 'Color Line' Imperative," 39-40.

¹¹ Plate, "Sustainable Development of Water Resources," 90.

¹² See: Atlantic Center for the Environment, 'Beyond borders,' *Nexus* 8, no. 4 (1986): 2ff; Lynne M. Corn, "Ecosystems, Biomes and Watersheds: Definitions and Use," Congressional Research Service, 1993, 2; and Charles H.W. Foster, "Bioregionalism," *Renewable Resources Journal* 4, no. 3 (1986): 12.

¹³ Ostrom, *Governing the Commons*, 30.

¹⁴ Ostrom, *Governing the Commons*, 91.

Table B.1: Design principles illustrated by long-enduring CPR institutions

1. Clearly defined boundaries

Individuals or households who have rights to withdraw resource units from the CPR must be clearly defined, as must the boundaries of the CPR itself.

2. Congruence between appropriation and provision rules and local conditions

Appropriation rules restricting time, place, technology and/or quantity of resource units are related to local conditions and to provision rules requiring labor, material, and/or money.

3. Collective-choice arrangements

Most individuals affected by the operational rules can participate in modifying the operational rules

4. Monitoring

Monitors, who actively audit CPR conditions and appropriator behavior, are accountable to the appropriators or are the appropriators.

5. Graduated sanctions

Appropriators who violate operational rules are likely to be assessed graduated sanctions (depending on the seriousness and context of the offense) by other appropriators, by officials accountable to these appropriators, or by both.

6. Conflict-resolution mechanisms

Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials.

7. Minimal recognition of rights to organize

The rights of appropriators to devise their own institutions are not challenged by external governmental authorities.

For CPRs that are parts of larger systems:

8. Nested enterprises

Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.

Source: Elinor Ostrom, *Governing the Commons*

Every community will determine its own parallel to a CPR. As was discussed in the preceding chapter, the decision of what is to be sustained is a political decision — its form will be a function of the values of the individuals who participate in the decisionmaking, as well as the way in which they participate. Thus, the “resource” to be protected by a community will inevitably be a range of possibilities — a watershed, an airshed, a local forest or a groundwater aquifer. Also, communities need not limit their definitions to natural resource systems — they could easily include public education, public safety or public maintenance as “resources” which need to be sustained. These definitions will depend upon the community members.

From the discussions in Chapter Two on sustainability as well as the preceding discussions on mental models and CPRs, it seems that a successful sustainable community initiative will need the following design characteristics:

- The initiative will need to establish a clear definition of what is to be sustained. This definition should include boundaries sufficient to minimize “free-riding,” particularly on the part of people who reside outside of the community.
- What is to be sustained by the initiative must be sufficiently important to people that the benefits to be gained from the initiative will outweigh the imposed costs. Thus the definition of the objective of the initiative must provide benefits to every individual who will be expected to participate.

Congruence between appropriation and provision rules and local conditions

A second design characteristic relates to how well institutional rules reflect the specific situation of the community. Ostrom divides CPR rules into two different types, *appropriation* and *provision*, to address two different types of problems:

When appropriators face appropriation problems, they are concerned with the effects that various methods of allocating a fixed, or time-independent, quantity of resource units will have on the net return obtained by the appropriators. Provision problems concern the effects of various ways of assigning responsibility for building, restoring, or maintaining the resource system over time, as well as the well-being of the appropriators.¹⁵

In each of the successful CPRs which Ostrom investigated, rules which governed similar activities (e.g., providing water through irrigation systems) were tailored to the individual sets of circumstances at each CPR: “no single set of rules ... could deal with the particular problems in managing each of these broadly similar, but distinctly different, systems.”¹⁶ It should necessarily follow suit that any rules associated with a sustainable community initiative should take into account specific community characteristics.

A second issue considers the links between appropriation and provision rules and the locations for the locus of the activities associated with those rules. It was noted earlier that the resources from which benefits flow to a community may be located outside of that community. In the case of clean water, the source of clean water may lie both within as well as outside of political dimensions of the community — it can consist of the entire watershed, in the case of surface water, or the aquifer, in the case of groundwater. The

¹⁵ Ostrom, *Governing the Commons*, 47.

congruence of appropriation and provision rules also need to factor in the differences in location between the use of a resource and the provision of that resource.

Collective-choice arrangements

The third design characteristic proposed by Ostrom may not fit communities as effectively as CPRs. The advantage to CPRs in this design is that

CPR institutions that use this principle are better able to tailor their rules to local circumstances, because the individuals who directly interact with one another and with the physical world can modify the rules over time so as to better fit them to the specific characteristics of their setting.¹⁷

By allowing most or all individuals to participate in the modification of the institutions, a sustainable community initiative could make itself more responsive to changes in conditions or situations. The difficulty in this, however, lies in the higher level of heterogeneity found in communities as opposed to CPRs. Open participation in CPRs is likely to be less contentious because all members are appropriating from the same resource and are expected to have essentially similar interests and norms. As discussed earlier, various members of the community may have different, if not conflicting, sets of interests as well as mental models regarding the forces which affect their community.

It is at this level that the issues surrounding mental models become so critical. If individuals in the community who are working together to commonly manage a resource, differences in mental models will require time to “negotiate reality.” Despite the amount of time that this would take, it would seem that this step is a necessary one. The definition of the community initiative implies certain benefits, and the receipt of those benefits will depend upon the participation of a certain group, if not all, of the community. As such, all individuals whose participation is needed for the receipt of any benefits must also be guaranteed their benefits as well. This underscores the need for the congruence between rules and local conditions. It also underscores the need for all participants to be able to modify the rules in accordance with the benefits they wish to receive. It will take time to create a collective model that can work and overcome such deterrents as mistrust, but such an effort is necessary, and the goodwill established through the access to decisionmaking will be necessary. Such participation will also provide the information needed to make

¹⁶ Ostrom, *Governing the Commons*, 92.

¹⁷ Ostrom, *Governing the Commons*, 93.

more intelligent institutions, which should be weighed into any cost-benefit analysis performed with regard to the efficacy of public participation.

Monitoring and Graduated Sanctions

The crux of the problem in creating an institution to successfully manage a CPR is in carrying out the monitoring of activity and the penalization of rule infractions. In her analysis, Ostrom reviews literature on contingent behavior and finds that coercion is a necessary element to ensure compliance on the part of CPR appropriators. The reason behind this is that “enforcement increases the confidence of individuals that they are not suckers.”¹⁸ The trick is to create an enforcement mechanism that is effective at both deterring breaking the rules as well as attrition from the institution.

The solution in successful CPRs has been the performance of monitoring and enforcement by the appropriators themselves. This improves the effectiveness of the institution in two different ways. First, it lowers the cost of monitoring. For example,

Irrigation rotation systems ... usually place the two actors most concerned with cheating in direct contact with one another. The irrigator who nears the end of a rotation turn would like to extend the time of his turn (and thus the amount of water obtained). The next irrigator in the rotation system waits nearby for him to finish, and would even like to start early. The presence of the first irrigator deters the second from an early start, and the presence of the second irrigator deters the first from a late ending. Neither has to invest additional resources in monitoring activities.¹⁹

A by-product of this process is that appropriators gain confidence in the working of the system in the course of monitoring — they have the ability to prevent themselves from being “suckers.” A second benefit is that monitoring by appropriators allows the monitor “to learn about the particular circumstances surrounding the infraction, to participate in deciding the appropriate level of sanctioning, and then to decide whether or not to continue compliance.”²⁰ The monitor may wish to impose a mild sentence “to remind the infractor of the importance of compliance” as well as because the monitor “might be in a similar situation someday and would want understanding at that time.”²¹ Graduated sanctions seem to be an important factor in success because large penalties “imposed on a person

¹⁸ Ostrom, *Governing the Commons*, 95.

¹⁹ Ostrom, *Governing the Commons*, 95.

²⁰ Ostrom, *Governing the Commons*, 97.

²¹ Ostrom, *Governing the Commons*, 97.

facing an unusual problem may produce resentment and unwillingness to conform to the rules in the future.”²²

Again, despite the differences between CPRs and communities, the preceding discussion can be used to formulate design criteria for sustainable community initiatives. First, it seems obvious that the underlying theory or model for what the community has decided to sustain must be commonly understood if clear rules for behavior are to be established. The act of monitoring also needs to be clearly tied to the collective benefit. Second, the costs of monitoring imposed on each individual need to be held to the level of expected benefits for each individual. Third, some form of enforcement mechanism needs to be in place to ensure compliance, specifically an enforcement mechanism established by the institution itself. Again, the connection between behavior and the collective benefit needs to be firmly established for such enforcement to take place, otherwise a sanction is simply a cost without a corresponding benefit to protect.

Conflict-resolution mechanisms

Another design characteristic which should be in place for any commonly-managed resource, either a CPR or a community, is a local, low-cost mechanism for conflict resolution. Some individuals will inevitably attempt to find ways to lower their costs for participation while attempting to partake in the collective benefits, and one easy mechanism for doing so is through strategic interpretation of institutional rules. In other circumstances, individuals may break rules by accident or reasons beyond their control. Given that these institutions are meant to be in place for an extended period of time, “there must be a mechanism for discussing and resolving what constitutes an infraction.”²³ In some of the CPRs examined by Ostrom, the mechanisms were fairly informal, in others, “the potential for conflict over a very scarce resource is so high that well-developed court mechanisms have been in place for centuries.”²⁴ The locality of the conflict resolution is key. In the first place, local mediation of conflict can keep costs of participation in an initiative low. In addition, the necessity for outside intervention could, in some cases, undermine the authority of the local institution. This is part of the next characteristic.

²² Ostrom, *Governing the Commons*, 98.

²³ Ostrom, *Governing the Commons*, 100.

²⁴ Ostrom, *Governing the Commons*, p. 101.

Minimal recognition of rights to organize

These local institutions, be they CPRs or sustainable community initiatives, must receive recognition from “higher” levels of authority to function properly. The success of local level collective institutions depends upon their ability to regulate themselves. If it becomes evident that higher-level authorities will intervene on the decisions reached by these institutions, individuals will cease cooperation and will court the favor of these authorities. Such was the case in the example of the New England and Nova Scotia fisheries discussed earlier, where the government overturned decisions reached by the local institutions, effectively undermining well-established rules.²⁵ Sustainable community initiatives will need to establish legitimacy and some degree of autonomy from state and federal officials. The example of the California groundwater basins examined by Ostrom points to an example where state officials not only granted autonomy to the local institutions but also provided technical support to facilitate its activities.

Nested enterprises

This design characteristic, the last of those presented by Ostrom, suggests that more complicated localities create smaller institutions nested within larger ones. For example,

There are two distinct levels in the Philippine federation of irrigation systems. The problems facing irrigators at the level of a tertiary canal are different from the problems facing a larger group sharing a secondary canal. Those, in turn, are different from the problems involved in the management of the main diversion works that affect the entire system. Establishing rules at one level without rules at the other levels, will produce an incomplete system that may not endure over the long run.²⁶

Such a system acknowledges that people can better manage smaller problem definitions; so long as the entire system of rules fits well together, the smaller scope of activities at each level can be more effectively managed.²⁷ Such a system of decisionmaking has worked in communities such as St. Paul (Minnesota), Dayton (Ohio), Portland (Oregon) and Birmingham (Alabama), where these cities have divided “the entire city into well-defined neighborhoods, each with its own recognized neighborhood organization.”²⁸ From

²⁵ David Ralph Matthews, “Commons Versus Open Access: the Collapse of Canada’s East Coast Fishery,” *The Ecologist* 25, no. 2/3 (1995): 89, 94.

²⁶ Ostrom, *Governing the Commons*, 102.

²⁷ Kurt Weick, “Small Wins: Redefining the Scale of Social problems,” *American Psychologist* 39, no. 1: 40.

²⁸ Ken Thomson, “Winning the Big One,” *Social Policy* 20, no. 1 (1989): 38.

Ostrom's description, these nested enterprises should be established at different systemic levels on a functional basis.

Design Characteristics for Sustainable Communities

The final list of institutional design characteristics for sustainable communities does not differ significantly from those created by Ostrom. The major differences are focusing on bounded sustainability objectives rather than CPRs, and creating a second characteristic to assure that the objective is actually important enough to people that they will choose to participate in the institution. These characteristics are listed in Chapter Three, in Table 3.2. However, because communities in the United States are so different from those CPR communities analyzed in *Governing the Commons*, it cannot be asserted that these characteristics are necessarily appropriate for analyzing sustainable community initiatives. This issue is discussed in greater detail in Chapter 3, and investigated in Chapter 4.

Appendix C: Results of the Sustainable Community Analysis

This Appendix summarizes the results of the analysis of the nine different sustainability initiatives. It does so by investigating the ways in which the initiatives addressed issues contained in the three elements of the framework (Institutional Design, Technology and Institutional Supply) developed in Chapter 3.

Institutional Design Characteristics

The analysis of the nine different initiatives showed that each pursued a fairly unique strategy in promoting sustainability. Where possible, this information has been summarized in tables, and similarities and differences highlighted in the text of this report. The writeup considers each of the design characteristics in turn.

1.) Clearly defined sustainability target

This was the most difficult design characteristic to assess. Ostrom's common-pool resources occurred where "individuals or households who have rights to withdraw resource units from the CPR must be clearly defined, as must the boundaries of the CPR itself.¹ The CPR, then, was at least a relatively self-contained system. It was also the primary economic base for the communities in question. As presented in Chapter 2, however, sustainability targets are defined not by the resource in question but are socially defined by the values and expectations of community members. This analysis investigated the objectives and foci of each of these initiatives to determine what each initiative was trying to sustain, and treat those objectives as the equivalent to a CPR. The specific sustainability targets as summarized in the documentation are shown in Table C.5 (at the end of this Appendix).

As the objectives of each initiative spanned a wide range of issues, it was necessary to create a format for their evaluation. To this end, this section will use the dimensions of sustainability developed in Chapter 2 to provide this format. This evaluation will be

¹ Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (United States of America: Cambridge University Press, 1990), 90.

followed by a discussion on how these sustainability objectives can be seen as parallels to Ostrom's CPRs.

Thinking about Sustainable Systems

Initiatives which addressed this element demonstrated an understanding of some kind of model which would link causes and effects, as well as create boundaries to the systems. None of these initiatives, however, went so far as to generate diagrams similar to the influence diagrams discussed in the section on mental models in the previous chapter. The models of systems upon which these initiatives depended were not made fully explicit. The ways in which these models manifest themselves differ according to the organizations which created them.

Those initiatives started by citizens' groups or non-profit organizations (Sustainable Seattle, South Puget Sound, Jacksonville, Upper Valley 2001 and the Sustainable Cambridge Coalition) generally relied upon the creation of indicators or visions to define sustainability. The degree to which these indicators referred to or defined a cause-and-effect system varied. Sustainable Seattle allotted a paragraph or two for each indicator to describe the linkages between the indicator and a range of social and environmental causes and effects.² In doing so, Sustainable Seattle uncovered the models of systems upon which each indicator was based. In contrast, the Jacksonville Quality of Life indicators did not address these issues, focusing more on manifestations of systems rather than the systems themselves. On occasion, the initiative selected certain indicators — such as “alcohol use reported by youth” or “packs of cigarettes sold” — which relied upon a common understanding of how these activities were related to elements of the quality of life, such as health. In these instances, the system behavior can be inferred, but the initiative did not make the system explicit. The Sustainable Cambridge Coalition never went so far as to develop indicators or to define a system. Rather, its discussion implicitly stated that the rates of consumption of certain resources are unsustainable, but it did not provide information on how or why.

While those initiatives created by planning agencies (Seattle, Portland Metro, Cambridge, and the Cape Cod Commission) did not necessarily make their own models explicit, their

² For example, the indicator for wild salmon runs reflects pollution concentration in the water, soil erosion, sedimentation and the amount of electricity locally generated by hydropower.

historical and institutional focus on land use planning anchored their systems perspective. As a consequence, sustainability issues such as transportation, employment and environmental quality were related to land use. The specific mandate of the agencies seemed to dictate which systems were best understood and made most explicit. For example, the Cape Cod Commission is charged with protecting habitat, coastal resources, water quality, and the Cape Cod character, as well as balancing economic growth with these objectives and providing capital facilities.³ Considering its authority over land use issues, it is not surprising that the areas in which the systems were most explicit concerned water resources and transportation. The Commission provided very detailed regulations on land development in wellhead areas and flood plains, septic systems and wastewater treatment to protect the sole-source aquifer for the Cape and the coastal resources upon which the tourism largely depends. It also provided detailed regulations regarding land use and levels of service on roads to mitigate traffic congestion.

Similarly, the foci of other organizations have directed their systemic understanding. The Portland Metro Regional Council was created to manage the conflict between development (spurred by population growth) and the protection of farm and forest lands. The system on which it focuses deals with development, specifically people's desires for styles of residences and how those desires drive the use of land. Its main policy prescription is an Urban Growth Boundary (UGB), which sets restrictions on the areas where development can occur.

The planning agency initiatives have also devoted time and energy to developing models regarding community participation in planning. These thrusts, however, have developed for different reasons, as understanding of the social and political systems in which they operate has emerged. The Cape Cod Commission operates in a state where "home rule" has historically placed authority in the towns, which have fiercely resisted state and regional agencies which reduce their power. The Portland Metro council relies upon the towns to enforce zoning ordinances, and consequently has developed an extensive participation process to develop consensus among the towns.⁴ Seattle underwent a transformation, starting with a top-down approach to growth management and ultimately

³ Cape Cod Commission, *Regional Policy Plan for Barnstable County* (Barnstable, Massachusetts: Cape Cod Commission (CCC), 1991), 6.

⁴ David Ausherman, Planner, Portland Regional Metro Council, personal communication, November, 1995.

creating a system whereby each neighborhood develops its own plan.⁵ Through these efforts, these initiatives have developed systemic understanding in the social and political systems, and as they track the progress of these initiatives, should also develop an understanding of how this mechanism relates to changes in other systems (particularly natural resource and transportation).

The Environment

All of the initiatives addressed, to varying degrees, the issue of the natural environment. The South Puget Sound and Sustainable Cambridge Coalition initiatives placed the environment at the center of their efforts, with a particular focus on the services from the environment upon which human beings depend. As a result, their documents concentrated on issues of carrying capacity and lowering consumption rates.⁶ The indicators of Sustainable Seattle and Upper Valley 2001 & Beyond reflected a wide range of environmental issues, including the issues of biodiversity and the rights of other species. Jacksonville also included environmental indicators — particularly ones dealing with compliance with federal and state air and water quality standards, as well as one concerning the level in the Floridan aquifer.

The planning initiatives also differed in their ways of addressing the natural environment. In their policies, the City of Seattle and the City of Cambridge treated the environment mostly as a public amenity for recreation and community activity, focusing on open space as areas for parks. Such a focus may relate to the level of existing development within the jurisdictions of both cities. In addition to its open space provisions, Seattle included in its transportation and utilities elements a thrust toward “environmental stewardship,” where the focus for transportation in particular is the improvement of air quality.⁷ The City of

⁵ Tom Hauger, Planner, City of Seattle, personal communication, November, 1995.

⁶ Rosalie Anders, Environment Department and Co-Founder of the Sustainable Cambridge Coalition, personal communication, December, 1995; and Dorothy Craig, South Puget Sound Sustainable Community Roundtable, personal communication, 1995.

⁷ According to the City of Seattle Plan, environmental stewardship calls for the following actions: protect and improve the quality of the global and local environments; maintain and enhance conditions necessary for a healthy environment; reduce future liability for environmental cleanup; protect residents’ and taxpayers’ investment in public infrastructure; provide a role model for individuals and businesses in environmental preservation practices ... the City will work with residents, employees, businesses, institutions and neighboring jurisdictions to strive for improvement in the quality of the city’s and region’s air, water, soils, and built environment, and for increases in preserved open space and reductions in noise levels. See: Seattle City Council, *The City of Seattle Comprehensive Plan: Toward a Sustainable Seattle, a Plan for Managing Growth, 1994 - 2014* (Seattle, Washington: Seattle City Council, 1994), vi.

Cambridge is also primarily concerned about air quality, as the Boston metropolitan area is not in compliance with the standards of the federal Clean Air Act Amendments. The Portland Metro Regional council and the Cape Cod Commission treated the environment more comprehensively. Portland openly acknowledges a wide range of issues surrounding water resources, air quality (particularly visibility) and natural areas, and has created policies to manage those issues. The Cape Cod Commission's authorizing legislation calls upon it to deal with many environmental issues, and those have become the foci of many portions of the Regional Plan.

Culture and Values

The element of culture and values is addressed most prominently in the citizens initiatives. Sustainable Seattle established specific indicators for public participation in the arts, volunteer involvement in schools, youth involvement in community service, and others. South Puget Sound similarly established indicators on the fulfillment of learning potential and social harmony. Upper Valley 2001 & Beyond established indicators and discussions through its community profiles on issues such as "our cultural heritage" and "education and social services." The Jacksonville initiative created an extensive set of indicators dealing with education, public safety and the social environment. However, most of these initiatives did not mention how to inculcate values which promote long-term perspectives and beliefs.

The planning initiatives included few issues of culture and values in their discussions. Such an omission may be due to a desire to be "value-neutral" and not risk offending the consensus they have developed to forge their objectives. One type of cultural transformation mentioned in these initiatives concerns education, making it more effective and available throughout different stages in life (particularly worker training). Another cultural issue relates to community character. This dealt mostly with creating new growth patterns, calling for higher densities in "growth centers" or "urban villages." The Cape Cod Commission recommended policies to concentrate growth, while Seattle and Portland Metro provided specific examples of how different residential developments (such as townhouses) can be used to increase land use densities. Such an effort would certainly involve a cultural transformation in a society which places high value on a one- (or more) acre lot for a single family home.

A different angle concerned cultural preservation. The Cape Cod Commission and the City of Cambridge seek to protect the historical patterns of development and architecture which created the aesthetic qualities which attracted many people to their respective neighborhoods. Cambridge also touted the ethnic diversity of the city as a major cultural amenity to sustain, as well as the individual character of each neighborhood within the city. Also, Portland Metro promoted maintaining visibility of the Cascade Mountains and the preservation of habitat as an aspect of the culture of the region in addition to being issues of environmental concern.

Social Organization, Decisionmaking and Services

This element, along with the environment and intragenerational equity, received unanimous attention from the initiatives. The element itself refers to all forms of social organizations and institutions, from public agencies (such as local, state and federal government) to private institutions (such as the market). Most of the initiatives addressed these issues in conjunction with intragenerational equity, focusing on how the benefits which flow from these institutions need to be distributed more equitably among different groups in their communities.

Almost all of the indicators developed for this element in the citizens projects reflected aspects of intragenerational equity (or culture and values). Sustainable Seattle, South Puget Sound, Jacksonville and Upper Valley 2001 developed indicators such as library and community center usage, voter participation, people rating local government leadership good or excellent, economic diversity and vitality, the locality of business and wealth, and others. Those projects which focused on the development of stronger local economies (i.e., South Puget Sound and Upper Valley 2001) came the closest to really calling for changes in the ways in which market forces operated within those communities. The Sustainable Cambridge Coalition investigated the diversity of the economy in its Sustainability Profile, and the Civic Forums both discussed and created a new institution through which people could participate in decisionmaking and planning.

While these indicators were intended to discuss the ways in which society was organized, they also focused on the services which those organizations were intended to provide individuals. These include issues of education, employment, public health and public safety. Such services can also be considered to be results of other elements of sustainability — health can be a function of the environment, for example, and education

and public safety can be a function of culture and values. But, these are also services which are ultimately provided by certain types of organization, apart from the existence of values. In reviewing these initiatives, then, the element has been changed to “Social Organization, Decisionmaking, and Services.”

The planning agencies, as public institutions themselves, devoted a greater proportion of their time to issues of organization and decisionmaking than the citizens initiatives. The City of Seattle dedicated a section of its Comprehensive Plan to the development of a neighborhood planning process, which has subsequently become the most important element of their initiative.⁸ Both the Portland Metro and Cape Cod initiatives resulted from the creation of regional institutions, which necessitated the formation of new relationships between these bodies and the local governments over which they have authority. Portland Metro has established two bodies to oversee the Metro activities, the Metro Policy Advisory Committee and the Metro Committee for Citizen Involvement.

The planning agencies also sought to use their zoning authorities to affect changes in areas outside of the planning process. Use regulations, for example, can attempt to promote the growth of local business in an area and keep wealth within the region. Such activities, however, can be politically contentious and can endanger the constituencies developed to create these initiatives. These agencies have not addressed other sectors involved in social organization, particularly the financial sector. Land use can only go so far in forcing “the market,” and many citizens vigorously resist any regulations which impinge on property rights.

Risks and Uncertainties

While each of the initiatives developed mechanisms for addressing risks and uncertainties, none directly acknowledged these issues. The indicator projects inherently have the ability to address issues of uncertainty, because these projects track the values of their sustainability targets over time. Since these projects monitor whether the sustainability objectives are being met, policies and institutions can be viewed as experiments to move the indicators in the desired direction. Certain indicators themselves attempted to measure the ability of systems to withstand changes and shocks. Initiatives such as Sustainable Seattle, South Puget Sound, and Upper Valley 2001 created indicators to measure targets such as

⁸ Hauger, personal communication.

the diversity of the employment base.⁹ There is, however, a further issue of uncertainty with regard to the indicators themselves. They may reflect only what people currently think of sustainability, or only represent the current set of stakeholders within the community. However, the presence of collective-choice agreements (described below) is an institutional mechanism to adjust to potential changes.

The planning agencies do not address many issues of risk and uncertainty. One example, as in the indicator projects, concerns the issue of economic diversity. The Cape Cod Commission was concerned about its economic resilience because the Cape economy largely relies upon tourism, the revenues from which in turn depend upon the health of economies in the rest of the state and the nation.¹⁰ The Cambridge and Portland Metro initiatives also mentioned this issue. One institutional mechanism created by Seattle and Portland Metro address development uncertainties is the creation of “urban reserves” outside of the Urban Growth Boundary. These reserves are areas which could eventually be urbanized should the redevelopment of existing areas prove insufficient to accommodate new growth. The parts of the policy documents which provided projections on growth, however, did not acknowledge the uncertainties in their calculations.

Intergenerational Equity

This element was measured by viewing the degree to which the initiatives mentioned a concern about the well-being of future generations. Such concerns are made explicit in the efforts of South Puget Sound, Sustainable Seattle and Upper Valley 2001 & Beyond. The focus on resource consumption by the Sustainable Cambridge Coalition implicitly addresses issues of intergenerational equity.

The other initiatives did not openly express a focus on the welfare of future generations. The Jacksonville initiative could be said to incorporate the concerns of all generations, since these indicators will be tracked over time. However, the indicators used do not demonstrate the use of any kind of model which predicts what changes need to be made now to ensure acceptable indicator levels in the future. The Civic Forums created in

⁹ This issue was of particular importance to Seattle, one of whose main employers is Boeing. The cutbacks in military spending in the United States resulted in the layoffs of a large number of workers, causing a number of people to worry about the ability of the Seattle economy to adjust to similar changes. See: Maureen Hart, *Guide to Sustainable Community Indicators* (Ipswich, Massachusetts: QLF/Atlantic Center for the Environment, 1995), 14.

¹⁰ Margo Fenn, Chief Planner, Cape Cod Commission, personal communication, November, 1995.

Cambridge did not really address future issues as much as resolving present ones.¹¹ The time frames in the City of Cambridge and Cape Cod Commission initiatives are never mentioned, and seem to be immediate. The growth management time frames in Seattle and Portland, while longer than most planning horizons (20 and 50 years, respectively), do not overtly weight considerations about the well-being of future generations.

Intragenerational Equity

Intragenerational equity is an extremely important component of sustainability for these initiatives. The indicator initiatives created measures to identify equality with regard to both ethnicity and gender for a wide range of issues, including education, employment, distribution of income, teaching, elected officials and others. The Jacksonville initiative generated an attitudinal indicator, "People Believing Racism Is a Local Problem," and conducted a telephone survey to obtain responses for this measure. The planning agency initiatives focused in particular on the issue of affordable housing, though some also touched on issues such as mobility and business opportunities. The stress placed on intragenerational equity by these initiatives is reflected in their efforts to involve neighborhoods in the planning process, thereby opening the possibility for equity in access to agency resources.

Technology

The technology element will be discussed in greater detail in its own section of the framework. The degree to which technology is specifically addressed as an element of sustainability in these initiatives was relatively small. In many cases, technology emerged as either an issue of public infrastructure (in Seattle, Portland, Upper Valley 2001 & Beyond, Cape Cod) or as something which affected the consumption of natural resources (Sustainable Seattle, South Puget Sound, Upper Valley 2001 & Beyond, Sustainable Cambridge Coalition, Cape Cod). The automobile in particular plays a dominant role in discussions of sustainability in these local initiatives, leading to discussions of alternatives (such as the promotion of pedestrian traffic, bicycling, and mass transit).

¹¹ John Altobello, Organizer of the Cambridge Civic Forums, personal communication, December, 1995.

Information

The importance of the element of information was seen directly through the use of indicators in some of these initiatives. The indicator projects focus on the provision of feedback to individuals about the results of policies and other decisions being made by the community. These initiatives generate measures of the values and objectives held by people in society, and create a mechanism by which people can see whether their own objectives were being met in the public sector.

The planning initiatives, by working more intently with the local level of government and citizens in the planning process, provided a mechanism by which information (in the form of values and objectives) flows in both directions between agency and citizens. The establishment of this flow of information and feedback helps to make the plans based upon a wider constituency, enhancing the likelihood of implementation. Some of the plans (Seattle and Portland Metro in particular) have made extensive use of Geographic Information Systems to enhance their ability to communicate technical issues to citizens and to create a meaningful dialogue on these issues.¹²

Time

With the exception of the time frames of two of the planning agencies (Seattle and Portland Metro), none of the initiatives explicitly discussed the element of time. This element reflected the fact that different time horizons for planning sustainability result in different tradeoffs, costs and decisions that will be made to pursue sustainability — decisions based upon quantities need to incorporate time into the calculations. That the initiatives did not specifically address time seems to reflect two aspects of pursuing sustainability at the local level. The first relates to complexity and the discussion of the element of systems thinking. The intertwining systems that are involved in pursuing sustainability make it virtually impossible to assert how to sustain those systems for a specified time frame. Given the relative lack of resources available at the local level, sustainability becomes more of a vision and conceptual framework than a practical managerial objective. For example, Sustainable Seattle does not attempt to set targets, but states whether the indicators are moving in sustainable or unsustainable directions. Jacksonville sets specific targets for its indicators, but its model focuses on the quality of life rather than the concept of sustainability. The

¹² Ausherman, personal communication); Hauger, personal communication.

second issue relates to the relative inattention paid to the issue of intergenerational equity. Given a (relatively) low priority assigned to that concept, the issue of the time frame for sustainability takes on less significance.

The Difference Between Sustaining Stocks and Flows

A major difference between the sustainability targets identified in these initiatives and CPRs is that the targets are not necessarily resources. Much of what the indicators projects identified — such as high school graduation rates, public health, public safety and pollution prevention — are flows from resources, not the resources themselves. As a consequence, these targets are only indirectly subject to management activities, which necessarily focus on resources. The reason that this distinction is important is because the first institutional design characteristic assumes that the sustainability targets are well-defined, in the sense that they have boundaries (similar to CPRs) and that people can be excluded to prevent free riding or the undermining of the target. What people are choosing to define as their objectives for sustainability, however, are not necessarily stocks (resources), but flows. The difficulty (as already discussed under systems thinking) is that in many cases the stocks which dictate these flows are still, as of yet, unidentified.

All of the initiatives attempted to place a focus on actual resources. Some of the indicators developed measures of resources such as the ethnic diversity of teachers (as a stock which provides equitable education), library and community center usage (a stock which provides community involvement), motor vehicle ownership (a stock which provides air pollution), or public park acreage (a stock which provides recreation). The planning agencies, because of their institutional focus and authority, treat land as the primary stock from which flows originate. This view is in some cases coupled with an understanding of how land use relates to other issues such as surface and groundwater quality, air quality or employment. For these agencies, then, changing the ways in which the built environment is patterned (through zoning ordinances and use regulations) as well as what activities are allowed on the land is seen as a means to regulate the flows of different benefits.

In interviews, however, individuals from the initiatives readily admitted that land use is not the only resource involved in the allocation of certain benefits. For example, land use can create areas for commercial or industrial activity, but only the market would dictate what types of industry and employment benefits will ultimately arise in those areas. Only one interviewee mentioned that addressing that issue might involve changing the structure of

corporations themselves.¹³ Those are stocks over which these initiatives have no authority, limiting their ability to continue to sustain some of the sustainability targets (see the discussion on the congruence of appropriation and provision rules).

2.) Sustainability target provides substantial benefits, monetary or otherwise

This design characteristic was added to modify the first characteristic because of a difference between CPRs and community sustainability targets. Ostrom deliberately selected CPRs where the appropriators were almost exclusively dependent upon the CPR for their livelihood, to ensure that self-interest played the major role in forming their institutions. As a parallel to this, it was assumed that any initiative's sustainability target must be sufficiently important to the beneficiaries that the benefits to be gained from the initiative will outweigh the imposed costs. Interviews conducted with individuals associated with each of the initiatives felt that, because the initiatives involved broad public participation, those targets selected by initiatives were important to people. In particular, the active participation of various interest groups made the interviewees inclined to believe that community members are willing to support the objectives, certainly in terms of time and effort and possibly in terms of a willingness to pay. The presence of some stakeholder resistance to these initiatives (for example, land developers in the cases of the Cape Cod Commission, Seattle and Portland Metro) indicates that the existence of these initiatives depends not on a consensus, but on the initiative being important to either a simple majority of individuals or certain groups of individuals with sufficient political power.¹⁴

3.) Congruence between appropriation and provision rules and local conditions

This design characteristic assesses the actual institutional rules to determine whether the appropriation and provision rules work within local conditions and in congruence with one another.¹⁵ Since the indicators projects do not have institutional rules, they cannot be considered new institutional forms for the governance of sustainability targets. These initiatives, however, can influence the perceptions of community members in identifying priority issues and building a consensus regarding political action (which will be discussed

¹³ Delia Clark, Upper Valley 2001 & Beyond, personal communication, November, 1995.

¹⁴ See: Kai Lee, *Compass and Gyroscope: Integrating Science and Politics for the Environment* (Washington, DC: Island Press, 1993), 187.

¹⁵ As a reminder, appropriation rules concern the use of a resource (flows); provision rules concern the maintenance of the resource itself (stocks).

in the question of institutional supply). With regard to this design characteristic, some of these projects promoted an understanding of the transboundary nature of sustainability issues. For example, Dorothy Craig, director of the South Puget Sound Sustainable Community Roundtable, noted that “conceptually, the region is the South Sound — we wanted to think bioregionally and involve the other communities in the watershed.”¹⁶ The Upper Valley project is starting from a regional perspective, although that initiative has the advantage of most of the people already thinking of themselves as a region. The school districts in the Upper Valley, for example, are mostly multi-town or even, in one instance, multi-state.¹⁷ However, many of these indicators rely upon data which are collected by government agencies, each of which function within their own boundaries. Funding sources can also play a major role in shaping the focus. As a consequence, even the bioregional focus on the South Puget Sound initiative has remained centered on the City of Olympia, rather than all of Thurston County, due to funding and data considerations.¹⁸

The initiatives sponsored by planning agencies are essentially efforts to redefine existing rules, or the guidelines through which the rules are applied, in an effort to achieve the sustainability objectives. By promoting public participation in the creation of the plans, these initiatives have ensured a fairly good congruence between the rules and local conditions. In addition, by working through individual neighborhoods or towns, these initiatives promote institutional recognition of what makes each neighborhood or town unique, and can therefore create more robust and appropriate rules.

The difficulty which these initiatives experience is in creating congruence between appropriation and provision rules. As mentioned earlier, these initiatives have had difficulty defining boundaries for the resources which are the source of the sustainability objectives. One reason for this is that these stocks do not necessarily lie within the institutional jurisdiction of the initiatives. For example, Margo Fenn, Chief Planner of the Cape Cod Commission, said that the Commission has a great deal of difficulty in managing economic issues because

There are always economic forces going on beyond the region. We are what is called a “derivative” economy, where we depend upon the economic health of other areas. That is something that we can’t

¹⁶ Craig, personal communication.

¹⁷ Delia Clark, personal communication.

¹⁸ Craig, personal communication.

control, so we have to follow what happens in Boston or Washington [DC].¹⁹

Thus, while the appropriation activity (revenue and jobs from tourism) occurs within the jurisdiction of the initiative, the provision activities (the disposable income of tourists) exist outside of that jurisdiction. This lack of congruence makes managing these sustainability targets difficult, if not impossible. Another example is traffic in the City of Cambridge. Studies have indicated that the majority of traffic in the city has neither origins nor destinations in Cambridge.²⁰ Despite such imposed measures as a parking freeze or traffic calming measures (e.g., traffic lights or one-way roads), the city has virtually no control over the amount of traffic on its streets.

In response to these issues, some of these institutions have been created to operate on the regional level. The Portland Metro Regional Council and the Cape Cod Commission, for example, have the authority to work on certain regional issues and to promote a regional framework at the town level. The Portland initiative develops a regional framework plan (the Metro 2040 Growth Concept) and a set of goals and objectives to which local plans must conform within a period of three years.²¹ The Cape Cod Commission regulates Developments of Regional Impact (DRIs), where zoning ordinances established by the CCC can supersede those of the town.²² Through these mechanisms, agencies can create a set of rules which govern both provision and appropriation of certain types of resources (at least those for which appropriation and provision occurs within that region). Other stocks, however, such as the labor market or an airshed, can transcend even this regional scope and lie beyond the initiative's jurisdiction.

4.) Collective-choice arrangements

The initiatives use a collective-choice mechanism for essentially those reasons envisioned by Ostrom. For her, a collective-choice agreement would allow the rules to better fit the local situation because appropriators have a better sense of which institutional rules work and which rules do not. The presence of a collective-choice agreement mechanism also lends legitimacy to the institution because that mechanism listens and responds to the voice

¹⁹ Fenn, personal communication.

²⁰ Anders, personal communication.

²¹ Ausherman, personal communication.

²² A Development of Regional Impact is a land use development which surpasses thresholds related to size (acreage), use (a certain number of lots), etc.

of community members.²³ In the case of the sustainability initiatives, collective-choice agreements both made the initiatives more effective and added a greater degree of legitimacy, which is crucial given the heterogeneous sets of interests present in these communities. Most of these initiatives involved extensive public participation to define the sustainability objectives. The initiatives did, however, differ in the degree to which the process for modifying the rules and objectives are governed by collective-choice mechanisms. Those processes adopted by the initiatives are summarized in Table C.1.

5.) Monitoring

The issue of monitoring was crucial for Ostrom, because the success of the initiative depends largely on its ability to detect rule infractions (and to punish them as well). If the process of monitoring depends upon the contribution of members of the initiative, then the costs of monitoring also need to be kept low (for the costs to still remain below the benefits).

This issue was documented the indicator-based initiatives only in relation to how the groups obtained the data on the indicators. The methods varied. For some indicators, information could be obtained from existing organizations or public institutions (either local, regional, state or federal). For example, Sustainable Seattle obtained information on employment concentration from its local utility (Seattle City Light) as well as the Economic Development Council of Seattle and King County.²⁴ Frequently, however, the information which is obtained does not exactly match the data requirements of the indicators themselves, either because the data does not exist, or it exists at too aggregate a level. To address these gaps, the initiatives had to perform the data collection themselves. The Jacksonville Community Council Inc., for example, created its own telephone survey to get information on a number of indicators for which public data simply do not exist.²⁵ Some initiatives could not replicate these efforts due to resource limitations.²⁶

²³ Professor John Ehrenfeld, Senior Associate, Center for Technology, Policy and Industrial Development, MIT, personal communication, December, 1995.

²⁴ Sustainable Seattle, *The Sustainable Seattle 1993 Indicators of Sustainable Community: A Report to Citizens on Long-Term Trends in Our Community* (Seattle, Washington: Sustainable Seattle, 1993), 18.

²⁵ Jacksonville Community Council, Inc., *Life in Jacksonville: Quality Indicators for Progress* (Jacksonville, Florida: Jacksonville Community Council Inc., 1994), 1.

²⁶ Delia Clark, personal communication.

Table C.1: Differing Mechanisms for Promoting Collective-Choice Arrangements in the Formation and Modification of Objectives or Rules

<p>Sustainable Seattle</p> <p><i>Formation</i> The Indicators Project was started by a volunteer task force in the fall of 1991. In the Spring of 1992, the group gathered together 150 individuals to expand the task force's list. In December 1992, the Civic Panel proposed 99 indicators grouped into 10 topic areas. The task force modified the list and then further truncated it due to data availability</p> <p><i>Modification</i></p>	<p>Toward a Sustainable Seattle</p> <p><i>Formation</i> The ideas in the plan were developed over four years through discussion and debate and the creative thinking of thousands of Seattle citizens working with City staff and elected officials</p> <p><i>Modification</i> The process has shifted, where now the planning will be completed more on the community, rather than city, level. The Mayor created a neighborhood planning office which hired, project managers, not planners, to help neighborhoods organize. People can modify plans by participating in their neighborhood planning group.</p>	<p>South Puget Sound</p> <p><i>Formation</i> The report was actually generated by very few people. People working with the Roundtable tried modifying the Sustainable Seattle indicators to their region, but realized that such an effort would not work locally. They created a report with chapters on each issue area.</p> <p><i>Modification</i> A citizens summit after the publication of the first report led to the formation of a group that created a new chapter on Governance. SCR was hoping to have similar groups start for all chapters. Options still available.</p>	<p>Portland Metro Growth Concept</p> <p><i>Formation</i> The Growth Concept was generated through extensive consultation the local towns. In addition, Metro sent out a tabloid questionnaire to every household in the region. It asked four basic questions about tradeoffs, and Metro received 16,000 responses. Public meetings have been held regularly.</p> <p><i>Modification</i> A process for amending the Regional Urban Goals and Objectives is established in the RUGGOs themselves. It involves ...</p>	<p>Jacksonville Quality Indicators</p> <p><i>Formation</i> The Chair of the Chamber of Commerce selected 10 members of the business community to chair the task forces. Through the media asked members of the community to participate in developing the quality of life model and the indicators. Kept any professionals away from their areas of expertise.</p> <p><i>Modification</i> Each year, the JCCI asks 12-20 people from the community who are involved with a particular element to review and report on the indicator.</p>
<p>Upper Valley 2001 & Beyond</p> <p><i>Formation</i> The Valley VitalSigns were created by a group of about 200 individuals who attended in response to public advertisements. They were divided into groups established by the coordinators and created indicators in each of those groups. The Community Profiles have members of the community choose their own issue areas.</p> <p><i>Modification</i> The Valley VitalSigns are still under development. The Community Profile task forces continue to have meetings, and members of the community are welcome to attend, or form their own.</p>	<p>Sustainable Cambridge Coalition</p> <p><i>Formation</i> After a public meeting in Cambridge, the Coalition has formed three focus groups which deal with issues of coalition structure and membership, outreach and public education about sustainability, and research on the current status of the city and possible alternative pathways for promoting more sustainable lifestyles. The Research and Technology Focus Group developed the sustainability profile.</p> <p><i>Modification</i> The group is very loosely defined, and consists of individuals working on the areas. No one has since modified the profile.</p>	<p>Cambridge: Toward a Sustainable Future</p> <p><i>Formation</i> A document setting out planning assumptions, proposed policies, supporting data and the history of recent land use decisions was subsequently drafted. Planning Board members and the Community Development staff also outlined a process for involving the community in shaping the document. Workshops were held with neighborhood residents, business people and people from the city's institutions. Their comments, as well as a public hearing, went into the document</p> <p><i>Modification</i> The document is still a draft copy, and not currently subject to changes.</p>	<p>Cape Cod Regional Plan</p> <p><i>Formation</i> The Regional Plan was informed by extensive public comment. Participants included staff experts, the Regional Policy Plan Advisory Board, local planning committees, the Governor's committee, and various environmental and business groups. It also received feedback through a survey sent to 4,000 Cape residents and a series of public meetings which identified issues and concerns.</p> <p><i>Modification</i> The Commission is required to update the plan every 5 years, and participation will be solicited. There is also an amendment process which has not been used to date.</p>	

The issue of monitoring was not documented in any of the planning agency initiatives and needed to be determined through interviews. The City of Cambridge monitors compliance with its zoning ordinances through the issuance of building permits. However, since its plan has not formally been adopted, it cannot be said whether the implementation of the plan would necessitate a different process for monitoring. The other three initiatives have developed different institutional mechanisms to monitoring compliance with their plans, and these are listed in Table C.2.

As can be seen, Seattle and Portland primarily rely on the individual neighborhoods and towns for direct monitoring (i.e., the issuance of permits) and focus their efforts on working with the towns to develop zoning ordinances and identifying trends. The Cape Cod Commission has a more direct approach, issuing its own permits for any DRIs while also working with towns on their local plans. The review process for DRIs can be extensive and add significantly to the cost of development, or even modification of existing development, and has been a source of criticism of the functioning of the CCC.²⁷ Some people, however, prefer that the cost barrier prevents development, although such an attitude polarizes interests and can lead to more intense conflicts, and possibly jeopardize the constituency. To date, however, more people are still concerned with those issues addressed by the CCC.

6.) Graduated Sanctions

The issue of enforcing compliance and imposing sanctions on people breaking the rules was not discussed in any of the documentation, and was barely addressed by individuals during the interviews. For Ostrom, the imposition of sanctions for rule infractions is necessary, because there will always be individuals who wish to break the rules. Imposing graduated sanctions is necessary because it (1) lets all beneficiaries know that infractions are caught and punished and (2) does not penalize an individual on their first violation so severely that they become an outspoken critic of the institution. She further underscores a need for the appropriators themselves to devise the sanction, since they can best understand what particular set of circumstances leading to the violation might be involved. The presence of the legal system in the United States has dictated the mechanisms by which these initiatives enforce their rules and impose sanctions. The specific mechanisms are shown in Table C.3.

²⁷ Jim Salmon, landowner, Cape Cod, Massachusetts, personal communication, December, 1995.

Table C.2: Monitoring Procedures Developed by Planning Initiatives

Seattle	Portland	Cape Cod
Seattle is working on a monitoring report and developing its own set of indicators, which will be based upon the adopted set of policies and created by the planning office. ²⁸	Every year, Metro revises its population forecast and uses Geographic Information Systems to determine where people are moving. It also tracks economic indicators. Metro also collects all building permit data and geocodes the information. ²⁹	Certificates of compliance must be issued before the towns can issue an occupancy permit. The agency must rely on local building inspectors. ³⁰

Table C.3: Sanctioning Procedures Developed by Planning Initiatives

Seattle	Portland	Cape Cod
Seattle imposes sanctions primarily through the permitting process. Permit metering was proposed (e.g., if 80 percent of allowable permits were issued in a short period of time, the permitting process would be forced to slow down) but not adopted. Sanctions themselves come from state law and the courts. ³¹	Metro ultimately has the authority to reverse the zoning ordinances of local towns, but there is no fine structure. The most effective mechanism found is peer pressure from other towns which have adopted the Metro Growth Concept. ³²	The mechanism for imposing sanctions is through court actions, although the Commission has yet to do that. The other option is to deny the permit. ³³

The Cape Cod Commission, with its oversight on permits, has the ability to deny a permit to force compliance with its rules. Both Portland Metro and Seattle rely more upon the towns for direct interaction with citizens, and therefore focus their authority on the oversight of town zoning ordinances. Portland Metro is able to enforce a change in a town's zoning, but prefers to develop a consensus with the town (especially since it relies upon the towns to regulate the issuance of permits).³⁴ With regard to imposing sanctions for specific offenses (e.g., building a house without a permit), the initiatives ultimately must rely upon the U.S. legal system to impose sanctions. As a consequence, most citizens do not view the specific institutions as the legitimate source of disposing sanctions. However, the increasing costs of the court system are causing people to develop alternative mechanisms for resolving conflict.

²⁸ Hauger, personal communication.

²⁹ Ausherman, personal communication.

³⁰ Fenn, personal communication.

³¹ Hauger, personal communication.

³² Ausherman, personal communication.

³³ Fenn, personal communication.

7.) Conflict Resolution Mechanisms

The importance of conflict resolution mechanisms in Ostrom's analysis is to keep the costs low to participants in the institution. The high costs of conflict resolution in the United States make other forms of dispute resolution attractive, however these initiatives have not extensively experimented with alternatives. The Portland Metro initiative has a Land Use Board of Appeals, which was developed in the late 1970s to hear cases regarding the statewide land use regulations.³⁵ This process is less expensive than court cases. The Cape Cod Commission has encouraged the use of alternative dispute resolution (ADR), usually to mediate or negotiate an issue which has already been challenged in court. Other mechanisms such as binding arbitration will not be used, because the Commission does not want to invest certain powers in a third party.³⁶

8.) Minimal recognition of rights to organize

This issue was raised to address the extent to which a local institution can function autonomously from external governmental or other bodies. The planning initiatives reported that state and federal legislation and programs can either help or hinder their activities. In Portland, for example, an Oregon State Senate bill requires local governments or cities with Urban Growth Boundaries to determine that the UGB can support 20 years of growth, using the rate of growth from five years previously (which may be higher than the current growth rate). While this requirement might have forced Portland Metro to expand its UGB, a rider on the bill allows for new or more efficient uses of land, creating a mechanism for promoting alternative forms of development and keeping a smaller UGB.³⁷ Also, the Cape Cod Commission is seeking to have its policies adopted by the Massachusetts Coastal Zone Management program to create consistency among the actions of both programs.³⁸

In contrast, the City of Cambridge has been subject to competing federal requirements, a call for cleaner air via the federal Clean Air Act Amendments and the provision of greater highway capacity through the federally-funded Central Artery-Third Harbor Tunnel

³⁴ Ausherman, personal communication.

³⁵ Ausherman, personal communication.

³⁶ Fenn, personal communication.

³⁷ Ausherman, personal communication.

³⁸ Fenn, personal communication.

Project.³⁹ It was also noted that the proposed shifts in state and federal responsibilities, as pursued by the current U.S. congress and the Commonwealth of Massachusetts, could easily withdraw those resources which Cambridge needs to pursue its objectives.⁴⁰ The city can only rely upon property and bed taxes to pursue its objectives, and the elimination of federal funds will stretch the city's budget very thin.

As was mentioned in the previous sections on sanctioning and conflict resolution, the U.S. legal system can also create problems of recognition in terms of the legitimacy of these initiatives. If people believe that they can and should take any discrepancies with these initiatives to court, the institution will devote more resources to defending itself than to pursuing its objectives. The court system, therefore, severely circumscribes the power of these institutions in ways not addressed in Ostrom's analysis.

9.) Nested Enterprises

Ostrom included this design characteristic to address the larger and more complex resources. In her analysis, those institutions which successfully manager larger systems created "nested" enterprises, where immediately local issues were addressed by local institutions, whose activities were in turn coordinated by a higher-level institution. The degree to which these initiatives reflected this structure depended upon their available resources and authority. In the case of the indicators projects, data availability and resource constraints largely limited the ability of these initiatives to disaggregate data.⁴¹ Portland Metro and Seattle sought to create a nested structure — they allowed the towns and neighborhoods to implement their zoning ordinances while coordinating the development of those ordinances. The Cape Cod Commission also functions in this manner with the exception of DRIs, where the Commission is solely responsible for the issuance of the permit. The reasoning behind this is that assessing the regional impact of a DRI requires more resources than are possessed by the towns. These nested efforts have not been in place for very long, and will require time to assess their effectiveness.

³⁹ Anders, personal communication.

⁴⁰ Les Barber, Planner, City of Cambridge, personal communication, November, 1995.

⁴¹ Marian Chambers, Consultant and Co-Founder of the Jacksonville Quality of Life Indicators, personal communication, November, 1995; Delia Clark, personal communication.

Technology Choices

The issue of technology has surfaced as being important in two different discussions in this thesis. The first dealt with the relationships between technology and sustainability. As illustrated in Chapter Two, technology shapes the ways in which human beings interact with and perceive the environment, their culture and their society. Technologies which promote sustainability preserve the long-term functioning of natural systems, facilitate a long-term focus in institutions and aid in managing the risks and uncertainties inherent in addressing the future. The second concerned the relationship between technology and institutional capacity. Highly complex technologies can defeat attempts at management if their complexity confounds people's understanding of the impacts of that technology. If the technology works on a level which cannot be understood by individual or local-level mental models, people will not understand the costs and benefits associated with that technology as well as not be able to devise means to manage the use of the technology. As a consequence, part of this analysis was dedicated to analyzing how people viewed technology and its use in the pursuit of sustainability.

The technologies identified as components to the pursuit of technology were primarily decentralized and management-intensive technologies. The technologies as identified by each initiative show these general patterns, as shown in greater detail in Table C.6 (at the end of this Appendix).⁴²

Land Use/Construction

This first set of technologies relates to the use of land and those activities which modify the land. First, all initiatives agreed that land use must somehow discourage the private use of the automobile, although the ability of land use to shape automobile use is questionable.⁴³ Other conditions of land use included the prevention of erosion (Sustainable Seattle) and the provision of community centers (City of Seattle), the maintenance of open space and habitat (Portland Metro Regional Council, City of Cambridge, Cape Cod Commission). A

⁴² The initiatives were examined through their selection of indicators or policies. In the instance of indicator projects, the indicators themselves were occasionally examined for their reasoning to uncover the technological or other causes as viewed by the initiatives. In certain instances, linkages between an indicator and a given technology were not made explicit in the documentation, and a judgment as to whether a given technology was linked to an indicator was performed by the author.

⁴³ See: Genevieve Giuliano, "The Weakening Transportation-Land Use Connection," *Access*, no. 6 (Spring 1995): 3-11.

number of initiatives called for the reuse of existing buildings and housing, and to maintain extant development densities (Portland Metro, City of Cambridge, Cape Cod Commission). Such activities would require the development of new forms of residential and commercial land use, which can provide privacy and space while still maintaining certain areas for open space.⁴⁴

Other technologies associated with this area of discussion relate to the actual construction processes themselves. The South Puget Sound region listed the use of local materials, recycling construction materials, energy efficiency and water efficiency as important technological aspects to incorporate into construction. Other initiatives included issues such as passive solar gain (Upper Valley 2001, Sustainable Cambridge Coalition), accessibility to the disabled (Upper Valley 2001) and the preservation of local architectural styles (Cape Cod Commission).

Utilities (Energy, Water and Waste)

Those aspects of the initiatives which addressed utility-related issues focused on reducing rates of consumption. As they were mentioned in the construction aspects, end-use energy efficiency, the use of passive solar energy and end-use water efficiency were considered crucial aspects to pursuing sustainability in virtually every initiative. Every initiative noted that the reduction of the generation of waste is important, and most included the need to reuse or recycle materials and products where feasible. One agency, the Cape Cod Commission, mentioned the need to purchase goods made of reused and recycled materials. It also underscored the roles for different disposal technologies and mechanisms — recycling and composting, incineration and landfilling.

A second set of issues concerned the production of energy. In this instance, almost all initiatives focused on the need for the integration of renewable energy resources. The technologies called upon in both documents and interviews included direct solar energy for both heating and cooling, photovoltaics, wind turbines and even tidal power. The most far afield energy source mentioned in an interview was the potential for hydrogen gas,

⁴⁴ Craig, personal communication; Portland Metro Regional Council, "Metro Region 2040 Decision-making Kit, Fall 1994," *Metro 2040 Growth Concept* (Portland, Oregon: Portland Metro Regional Council, 1994), 8-14. For example, townhouses in conjunction with neighborhood parks could be used for residential areas as opposed to single-family residences with large amounts of land. The Portland Metro Regional Council has developed a videotape which demonstrates these land use patterns and has made it available to the community through video rental retail stores.

produced from electrolysis powered by solar energy. Two initiatives looked at energy production from slightly different angles. In choosing the wild salmon run as one indicator, Sustainable Seattle noted the effect that the predominantly hydropower-generated electric grid has on salmon habitat. Jacksonville, in contrast to most initiatives, focused on the cost of electricity, stating that a higher quality of life stems from lower electricity costs.

A third set dealt, indirectly, with water supply. These issues could themselves be divided into two categories, pollution prevention and wastewater treatment. Each of the initiatives either noted the importance of preserving water quality, or of encouraging the reduction of the use of toxics and the prevention of the emissions of pollutants. No specific mention was made of how to accomplish these tasks in industry, although two initiatives (South Puget Sound, Sustainable Cambridge Coalition) mentioned the need to eliminate toxics from the presence of household products. Many of the initiatives also noted the need to keep in check the number of septic tanks systems being installed and operated (South Puget Sound, Jacksonville, Cape Cod Commission). A few also mentioned the possibility of using artificial wetlands or other aquaculture systems to treat wastewater, rather than conventional wastewater treatment methods (South Puget Sound, Sustainable Cambridge Coalition).

Transportation

All of the initiatives addressed the topic of transportation, with particular attention being paid to how to reduce automobile usage in each of these cities. Virtually every initiative viewed the automobile as a primary source of urban air pollution, and a few of the initiatives (Sustainable Seattle, South Puget Sound, Sustainable Cambridge Coalition) pointed to other issues, such as global warming or dependence upon a nonrenewable energy source. A number of the initiatives specifically called for improvements to automobiles, from improved emissions controls (Sustainable Seattle, Jacksonville), increased fuel efficiency (Sustainable Seattle, City of Seattle, South Puget Sound) and the development of “clean” alternative fuels (City of Seattle, City of Cambridge). Every initiative called for an improvement in the levels of service provided by public or mass transit (sometimes in conjunction with changes in land use patterns, as described above). A number of initiatives made mention of the need to improve facilities to promote bicycling (Sustainable Seattle, Portland Metro Regional Council, City of Cambridge, Cape Cod Commission). Only one initiative, Jacksonville, addressed some of the non-environmental

aspects associated with transportation issues (indicators developed for motor vehicle accidents as well as total commute time).

Communications/Information Technologies

A fourth set of technologies discussed in these initiatives include communications and information-based technologies. This category is essentially a catch-all for electronic media which either transmit or transform data. One possible form for these technologies includes the use of computers and software programs in educating and training citizens and laborers. Almost all of the initiatives cited education as an important component to sustainability, either for educating students, providing continuing education to adults, or providing training for the community's labor force. It was assumed that technologies could and probably will play a role in these efforts. Another form of these technologies related to the use of telecommunications, particular the development of the Internet. Two initiatives stressed the need to provide universal access to developing telecommunication technologies (City of Seattle, South Puget Sound). Other groups (Upper Valley 2001, Cape Cod Commission) noted the potential for community organizers to use electronic bulletin boards and other means of communicating information on the Internet to work toward the sustainability objectives. Advances in telecommunications could also play a role in one aspect of the Jacksonville initiative by improving the response time of police, fire and emergency medical services.

Another important aspect of these technologies is their ability to process information to provide feedback on elements of sustainability. South Puget Sound, for example, stated that the pursuit of sustainability should involve the development of databases, where indicators of environmental and public health should be tracked and problem areas identified. This perspective seemed in agreement with the responses of interviewees for both the City of Seattle and Portland, who stated that Geographic Information Systems (GIS) were perhaps the most important technology associated with sustainability.⁴⁵ When asked what technology is most important to pursue sustainability in terms of his initiative, a Planner for Portland Metro responded:

We have used GIS extensively, and it has helped people get in touch with where they live. GIS is an important visualization tool for helping people understand what the alternatives are. There is no "silver bullet" with other technologies such as light rail, buses, or whatever —

⁴⁵ Ausherman, personal communication; Hauger, personal communication.

it depends more on what people decide to do, and we can use GIS to help people get over their “growth” vision.⁴⁶

In fact, when representatives of each initiative were asked to mention what technologies were important in pursuing sustainability, seven of the nine initiatives included information technologies (either for data collection or processing), and for a few it was the only type of technology mentioned.

Miscellaneous Technologies/Issues

Some of the initiatives also included types of technologies which did not fit into any of the above characteristics. A number of initiatives stated that proper health care is an important aspect to sustainability (Sustainable Seattle, City of Seattle, South Puget Sound, Jacksonville). Technology is an important component of the health care system, even though the appropriate role of technology in that system is currently under debate. Finally, a few initiatives mentioned agricultural methods for preventing soil erosion (Sustainable Seattle) or for reducing the number of toxic chemicals used in agriculture (South Puget Sound).

Addressing Institutional Supply

A final aspect of these initiatives to be addressed is the question of institutional supply. This can be divided into two separate discussions, the first concerning why and how these initiatives were started in the first place. The reasons for the existence of these initiatives is shown in Table C.4. Three of the four planning initiatives acted in accordance with state legislation requiring them to develop plans to manage population growth in the area. The state legislation originated for different reasons, but essentially sought to protect the interests of certain affected political groups, such as farmers in Oregon⁴⁷ or environmentalists, small property owners and retirees on Cape Cod.⁴⁸ The fourth planning initiative, the City of Cambridge plan, also developed out of a desire to address the issues of growth and their impacts on neighborhoods. However, as was noted earlier, the plan was never adopted when the projected growth rate failed to materialize. The Jacksonville initiative began under the auspices of the Chamber of Commerce and the Jacksonville

⁴⁶ Ausherman, personal communication.

⁴⁷ Ausherman, personal communication.

⁴⁸ “The Cape Cod Commission — A Chance for Regionalism.” *Landletter* (Fall 1993): 3.

Table C.4: Reasons for Which the Sustainable Community Initiatives Were Begun

<p>Sustainable Seattle</p> <p>Sustainable Seattle is a "voluntary network and civic forum, bringing together citizens from many different sectors of our community to promote the concept and practice of sustainability."</p> <p>"The 'Indicators Project' grew out of a one-day conference in November 1990 sponsored by the Washington, D.C.-based Global Tomorrow Coalition in which community leaders from all facets of Seattle life came together around the idea of citizens choosing their own ways of measuring long-term community well-being. In February, 1991, the Sustainable Seattle Network coalesced with 30 volunteers meeting to further the concept of creating indicators to measure the health of Seattle."</p>	<p>Toward a Sustainable Seattle</p> <p>"The Comprehensive Plan is Seattle's response to the Growth Management Act (GMA) of 1990 and Amendments of 1991 (RCW 36.70A) ...</p> <p>The ... Plan ... is a 20-year policy plan (1994-2014) designed to articulate a new vision of how Seattle will grow in ways that sustain its citizens' values ... the building blocks of the ... Plan are the "elements" required by the state's Growth Management Act: land use, transportation, housing, capital facilities and utilities. King County's Countywide Planning Policies require the addition of an economic development element, and the Seattle Framework Policies (Resolution 28535) inspired the inclusion of a neighborhood planning element."</p>	<p>South Puget Sound</p> <p>"The mission of the Sustainable Community Roundtable is to facilitate a process of dialogue, vision, action and celebration to help create sustainable community in South Puget Sound. The Roundtable was initiated by the City of Olympia in 1991 and incorporated as an independent nonprofit organization in 1992."</p>	<p>Portland Metro Growth Concept</p> <p>State legislation dictates that the region must create a plan concerning a 20-year land supply within the urban growth boundary ... The process began when a group of farmers petitioned the state government to manage land use as increasing suburbanization created clashes between the farmers and suburbanites.</p>	<p>Jacksonville Quality Indicators</p> <p>"The Quality-of-Life project is based on a strong motivation for community improvement in Jacksonville/Duval County, Florida. This is an explicitly stated goal of both the Jacksonville Chamber of Commerce and the Jacksonville Community Council Inc. The project represents an effort to monitor Duval County's progress on an annual basis by means of selected representative quantitative indicators."</p>
<p>Upper Valley 2001 & Beyond</p> <p>"Upper Valley 2001 & Beyond is made possible by generous support from: The Upper Valley Community Foundation, the League of Women Voters Education Fund, the Mascoma Savings Bank Foundation, the New Hampshire Charitable Fund, the Vermont Community Foundation, the Stettenheim Foundation and many individual donors."</p> <p>The organization was originally started to create an indicator project similar to that of Sustainable Seattle. The concept has been modified to better fit conditions in the Upper Valley Region</p>	<p>Sustainable Cambridge Coalition</p> <p>"The Sustainable Cambridge Coalition was formed because of growing community awareness of the pressing social and environmental problems facing the world and the city of Cambridge. Concerned and informed activists realized the current patterns of resource use, population, transportation and energy production could not be indefinitely maintained without irreparable damage to the local and global environment."</p>	<p>Cambridge: Toward a Sustainable Future</p> <p>"What makes our neighborhoods special? How can we maintain a vital economy? What uses are appropriate for the city's evolving industrial areas? How shall we protect our environment? What kind of community do we want Cambridge to be as we enter the next century?"</p> <p>These questions, and many others, have prompted much discussion of the city's physical planning and land use issues and the choices they raise. In response, the Community Development Department and the Planning Board have undertaken a comprehensive review of the land use and planning issues facing Cambridge in the 1990s. This document is the product of that review and articulates the Planning Board's vision and planning policies for the future of our city.</p>	<p>Cape Cod Regional Plan</p> <p>"The Cape Cod Commission Act was approved by the voters of Barnstable County in March 1990" to manage growth on the Cape. The Commission is charged with reviewing and regulating Developments of Regional Impact, recommending designation of Districts of Critical Planning Concern, and preparing and overseeing implementation of a regional land use policy plan. The purpose of the Regional Policy Plan is to outline a coherent set of planning policies and objectives to guide development on Cape Cod and to protect its resources.</p>	

Community Council, Inc., a non-profit organization that works on community issues. The remaining initiatives started with the work of concerned citizens.

The second discussion concerns how to get other people to support and participate in the activities of these initiatives. As was shown in Figure 2.2, an individual's decision to participate in an institution depends upon a variety of factors. These factors affect the expected costs and benefits for an individual through participation, as well as the discount rate and norms held by the individual. Chapter Three mentioned that, unlike the CPR communities discussed by Ostrom, many U.S. communities do not share a single set of norms, nor are they inclined to value the future nearly as much as the present, for a variety of possible reasons. As a result, a part of the interview process was dedicated to assessing how these initiatives were attempting to address those issues associated with institutional supply.

The indicator projects themselves are efforts in this direction. By providing information on certain aspects of life within the region, the indicators are capable of moving people from inaction to action. The Jacksonville initiative, which has been in place the longest of any of those analyzed, has already seen this occur in two instances. In the first, the data from the water quality indicators demonstrated the level of pollution in the St. Johns River. The Jacksonville Chamber of Commerce was disturbed at this fact, and worked in conjunction with the St. Johns River Water Management District to create the Stewards of the St. Johns River. This non-profit organization has initiated the formation of a Water Quality Commission in the region, created a River Watch Hotline to report illegal dumping and pollution into the river, and started a Young Stewards group, where students organize clean-up days for the river.⁴⁹

In the second instance, the low high school graduation percentage was identified by the Jacksonville Community Council, Inc., as a cause for concern. In discussions, one recommendation was to move the city's social services for students to the schools themselves, rather than require students (many of whom are bused for desegregation) to travel to other locations. This City and Schools Program has been instituted in 22 schools in the Jacksonville area, and the high school graduation percentage has been increasing.⁵⁰ The potential for institutional change through these indicators can also be shown from

⁴⁹ Chambers, personal communication.

⁵⁰ Chambers, personal communication.

negative responses, as Sustainable Seattle is preparing for a backlash from other members of the community.⁵¹

Most of the initiatives have not proactively addressed issues of values and norms. The City of Seattle, Portland Metro and the Cape Cod Commission each conducted surveys of the citizens to determine what their values about many of these issues were. Seattle, for example, found that a sizable proportion of the citizens would choose to live in “urban villages” (a form of cluster development) if certain amenities were present.⁵² The Sustainable Cambridge Coalition co-sponsored a series of Civic Forums which allowed people to discuss their values and visions for the city.

Those proactive efforts which do exist have centered around education campaigns. The indicator projects clearly function in this manner, providing information to the citizens about what is going on with those issues that are important to them. Certain of the non-profit agencies have attempted to project the concept of sustainability into public discourse and private action, though they admit that it is difficult to assess whether the initiative itself or just increased awareness of issues through the media is the cause.⁵³ Among the agencies, the Cape Cod Commission publishes a biweekly newsletter (with a circulation of about 1,000) and sponsors a speakers’ bureau.⁵⁴ The Portland Metro initiative has been very proactive, aggressively trying to educate people on issues such as “that a 5,000 ft² lot is sufficient” or “how much parking is really necessary?”⁵⁵ The agency has also created a videotape about alternatives to residential and commercial development styles and circulated it through video rental stores in the area. A number of towns are requesting that the implementation of the 2040 Growth Concept begin sooner, rather than later.⁵⁶

⁵¹ Richard Conlin, Sustainable Seattle, personal communication, December, 1995.

⁵² Hauger, personal communication.

⁵³ Delia Clark, personal communication; Craig, personal communication.

⁵⁴ Fenn, personal communication.

⁵⁵ Ausherman, personal communication.

⁵⁶ Ausherman, personal communication.

Table C.5: Sustainability Objectives for Community Initiatives as Defined in Publications

Sustainable Seattle	Toward a Sustainable Seattle
<p><i>Environment</i> Wild Salmon Wetlands Biodiversity Soil Erosion Air Quality Pedestrian-Friendly Streets Open Space in Urban Villages Impervious Surfaces</p> <p><i>Population and Resources</i> Population Residential Water Consumption Solid Waste Generated and Recycled Pollution Prevention and Renewable Energy Use Farm Acreage Vehicle Miles Traveled and Fuel Cons. Renewable and Nonrenewable Energy Use</p> <p><i>Economy</i> Employment Concentration Real Unemployment Distribution of Personal Income Health Care Expenditures Work Required for Basic Needs Housing Affordability Ratio Children Living in Poverty Emergency Room Use for Non-ER Purposes</p> <p><i>Youth and Education</i> Adult Literacy High School Graduation Ethnic Diversity of Teachers Arts Instruction Volunteer Involvement in Schools Juvenile Crime Youth Involvement in Community Service</p> <p><i>Health and Community</i> Equity in Justice Low Birthweight Infants Asthma Hospitalization Rate for Children Voter Participation Library and Community Center Usage Public Participation in the Arts Gardening Activity Neighborliness Perceived Quality of Life</p>	<p><i>Land Use Element</i> Preferred Development Pattern Categories of Urban Villages Distribution of Growth System of Land Use Regulation Open Space Network Annexation</p> <p><i>Transportation Element</i> Environmental Stewardship Changing and Managing Travel Demand and Travel Behavior Land Use and Transportation Use of Streets Level-of-Service Parking Transit and Public Transportation Pedestrians and Bicycles Moving Goods and Services Transportation Financing</p> <p><i>Housing Element</i> Accommodating Growth and Maintaining Affordability Encouraging Housing Diversity and Quality Providing for Housing Affordable to Low-Income Households</p> <p><i>Capital Facilities Element</i> Capital Facilities Policies Proposed New or Expanded Capital Fac's Six-Year Financing Plan Consistency and Coordination Siting Process for Essential Public Fac's</p> <p><i>Utilities Element</i> Utility Service Utility Infrastructure Utility Capital Expenditure Planning Environmental Stewardship Utility Facility Siting and Design Utility Relationships</p> <p><i>Economic Development Element</i> Labor Force Education, Dev't and Training Business Climate Infrastructure and Capital Facilities Business Start-Up and Growth Geographic Strategies</p> <p><i>Neighborhood Planning Element</i></p>

South Puget Sound	Portland Metro Growth Concept
<p><i>Natural Environment</i> Biodiversity (Open space)</p> <p><i>Population</i> Human Impact (Total population)</p> <p><i>Resource Consumption</i> Water Water Consumption (GPD) Food Regionally and Locally-Produced Food (Olympia Farmer’s Market Sales) Raw Materials Solid Waste Generated (Total waste sent to landfill) Energy Energy Consumption (Electricity from fossil fuels and hydropower)</p> <p><i>Transportation</i> Automobile Use (Motor vehicle ownership and CO2 emissions)</p> <p><i>Housing</i> Housing Affordability (Average apartment rent compared to average wage)</p> <p><i>Economy</i> People Whose Basic Needs Are Met (Jobs paying less than the average wage)</p> <p><i>Social Equity and Justice</i> Social Harmony (Violent crime rate)</p> <p><i>Governance</i> Public Participation (Voting by eligible voters)</p> <p><i>Education</i> Fulfillment of Learning Potential</p> <p><i>Health</i> Health of Population (Deaths from heart disease and cancer)</p> <p><i>Spirituality</i></p>	<p><i>Regional Planning Process</i> Citizen Participation Metro Policy Advisory Committee Regional Urban Growth Goals and Objectives (RUGGOs) Applicability of and Amendments to RUGGOs Future Vision</p> <p><i>Natural Environment</i> Water Resources Air Quality Natural Areas, Parks and Wildlife Habitat Protection of Agricultural and Forest Lands</p> <p><i>Built Environment</i> Housing Public Services and Facilities Transportation Economic Opportunity</p> <p><i>Growth Management</i> Urban/Rural Transition Developed Urban Land Urban Growth Boundary Urban Design</p>

Jacksonville Quality Indicators *	Upper Valley 2001 & Beyond
<p><i>Education</i> Public High School Graduation Rate Average Achievement-Test % Scores Public-school Expenditures Per Student</p> <p><i>The Economy</i> Net Job Growth Total/Black Unemployment Gap Effective Buying Income Per Capita</p> <p><i>Public Safety</i> People Feeling Safe Walking Alone at Night Violent Index Crimes Nonviolent Index Crimes</p> <p><i>Natural Environment</i> Days With Air Quality in Good Range River Compliance with Metals Water Stds. River Compliance with Dissolved O2 Stds.</p> <p><i>Health</i> Infant Deaths Per 1,000 Live Births Age-Adjusted Death Rate Per 100,000 Pop. Deaths from Heart Disease Per 100,000 Pop.</p> <p><i>Social Environment</i> People Believing Racism Is A Local Problem Substance-Exposed Newborns Per 1,000 Live Births Child Abuse/Neglect Reports Per 1,000 Children Under 18</p> <p><i>Government/Politics</i> People Rating Local Gov't Lead. Good/Exc. Percent 18 and Older Registered to Vote Percent of Elected Officials Nonwhite</p> <p><i>Culture/Recreation</i> City Financial Support Per Capita of Arts Organizations City Parks and Recreation Expenditures Per Capita Public Park Acreage Per 1,000 Population</p> <p><i>Mobility</i> People Reporting Commuting Time ≤ 25 min. Weekday Commercial Flights In and Out of JIA Destinations with Direct Flights In or Out of JIA</p>	<p><i>Civic Infrastructure</i> Effective Community Leadership: A Broader Definition Informed Citizen Participation: More Than Voter Turn-Out Inter-Group Relations: Celebrating Diversity Within the Community</p> <p><i>Community Infrastructure</i> Our Cultural Heritage: Arts, Festivals and Celebrations Education and Social Services: Meeting Our Citizens' Needs Physical Infrastructure and Services: The Basics That Serve Our Needs</p> <p><i>Environment</i> Use of Natural Resources: Water, Energy and Materials How the Community Looks and Feels: Village, Farm and Forest</p> <p><i>Economy</i> Economic Vitality: Stability Through Diversity Local Business, Local Wealth: Re-Circulating Money Within the Community</p>

(* - only the most important indicator, and two additional examples, are listed)

Sustainable Cambridge Coalition	Cambridge: Toward a Sustainable Future
<p><i>Energy</i> <i>Waste Generation</i> <i>Water Use</i> <i>Transportation</i> <i>Potential Focal Points</i> <i>Population</i> <i>Agriculture</i> <i>Materials Consumption</i> <i>Existing Programs</i> <i>Local Employment</i></p>	<p><i>Land Use Policies</i> Land Use Pattern and Neighborhood Protection Institutional Land Use Nonresidential Districts and Evolving Industrial Areas Special Uses and Environments Pace of Development and Limits to Total Development <i>Transportation</i> Reversing Trends in Travel Movement In and Out of Cambridge Movement Within Cambridge Neighborhood Protection Bicycles and Pedestrian Improvements <i>Housing</i> Neighborhood Character New Affordable Housing and Target Populations in Existing Neighborhoods Rehabilitation of the Existing Stock of Housing Homeownership Redevelopment of Industrial Areas <i>Economic Development and Employment</i> Evolving Industrial Areas Employment Encouraging Business and Industries Diversity Retail Activity <i>Institutions</i> Community Interaction Physical Expansion of Major Institutions Housing Preservation of the City's Tax Base Commercial Investment Smaller Institutions <i>Urban Design and Environment</i> Design Review Urban Design Standards <i>Open Space</i> Use of Open Space Facilities New Open Space in Development Areas Acquisition of New Open Space Retention of Open Space Maintenance of Open Space</p>

Cape Cod Regional Plan

Land Use/Growth Management

Water Resources

Wellhead Protection Areas

Fresh Water Recharge Areas

Marine Water Recharge Areas

Impaired Areas

Water Quality Improvement Areas

Potential Public Water Supply Areas

Coastal Resources

Wetlands

Wildlife/Plant Habitat

Critical Wildlife and Plant Habitat

General Wildlife and Plant Habitat

Economic Development

Transportation

Major Regional Roadways

Regional Roadways with Scenic and
Historic Values

Local Roadways of Regional Significance

Other Local Roadways

Permissible Mitigation Strategies

Solid and Hazardous Waste Management

Source Reduction

Composting

Recycling

Incineration

Landfill

Sludge

Hazardous Wastes

Regionalization

Capital Facilities and Infrastructure

Energy

Affordable Housing

Open Space and Recreation

Historic Preservation/Community

Character

Table C.6: Technologies Identified as Integral to Sustainability

Sustainable Seattle	Toward a Sustainable Seattle
<i>Land Use/Construction</i>	
Land development which has no adverse impacts on streams and rivers (e.g., no sedimentation) Land use patterns which promote pedestrian traffic Minimization of developed acreage (preservation of farmland)	Land use patterns (e.g., urban villages) which promote alternative uses to the automobile Land use patterns to provide community centers/parks
<i>Utilities (Energy, Water and Waste)</i>	
Electricity production which has no adverse impact on streams and rivers (e.g., no hydropower) Water efficiency Renewable energy production Energy efficiency Waste reduction Solar hydrogen fuel	Energy efficiency Water efficiency Waste reduction Reuse and recycling of products/materials Businesses with "quality environmental practices" (environmental quality)
<i>Transportation</i>	
Minimization of automobile use Fuel efficiency Emissions controls Public/mass transit Bicycling	Mass/Public transit (rail, bus, ferry) Reduce air, water and noise pollution from automobiles Energy efficient automobiles Alternative-fuel vehicles Reduce automobile use
<i>Communications/Information Technologies</i>	
Educational technology (literacy)	Universal access to telecommunications Education and training technologies Geographic Information Systems
<i>Miscellaneous Technologies/Issues</i>	
Farm management techniques to prevent erosion Health care technology	Health care technology/systems

South Puget Sound	Portland Metro Growth Concept
<p><i>Land Use/Construction</i></p> <p>Sustainable buildings:</p> <ul style="list-style-type: none"> • Use of local materials • Recycle construction materials • Energy efficiency • Water efficiency <p>Building technologies (which provide space and privacy while being efficient in land consumption)</p> <p>Materials efficiency</p>	<p><i>Land Use/Construction</i></p> <p>Land use patterns (e.g., cluster development) which encourages the use of alternatives to the automobile</p> <p>Redevelopment of existing buildings</p> <p>Land use which maintains open space</p>
<p><i>Utilities (Energy, Water and Waste)</i></p> <p>Use alternatives to septic systems</p> <p>Xeriscaping</p> <p>Alternative waste systems to purify water</p> <p>Recycling and reuse of materials and products</p> <p>Sustainable energy alternatives/renewable energy sources</p> <p>Safe disposal of household toxics and motor oil</p>	<p><i>Utilities (Energy, Water and Waste)</i></p> <p>Energy efficiency (in public services and facilities)</p> <p>Public services should minimize cost, maximize service efficiencies, result in improvements in environmental quality, keep pace with growth while preventing loss of existing service levels, use energy efficiently</p>
<p><i>Transportation</i></p> <p>Reduce automobile use</p> <p>Mass/public transit (rail and bus)</p> <p>Fuel-efficient automobiles</p>	<p><i>Transportation</i></p> <p>Reduce automobile use</p> <p>Mass/Public transit</p> <p>Bicycles</p>
<p><i>Communications/Information Technologies</i></p> <p>Equal access to educational and telecommunications technologies/services</p> <p>Community electronic network</p> <p>Data systems for monitoring health and environmental indicators geographically</p>	<p><i>Communications/Information Technologies</i></p> <p>Education technology (literacy)</p> <p>Communications technology</p> <p>Geographic Information Systems</p>
<p><i>Miscellaneous Technologies/Issues</i></p> <p>Health care technology/systems (specifically reproductive health care)</p> <p>Reduce use of agricultural chemicals</p> <p>Use of Integrated Pest Management</p>	<p><i>Miscellaneous Technologies/Issues</i></p>

Jacksonville Quality Indicators	Upper Valley 2001 & Beyond
<p><i>Land Use/Construction</i></p> <p>Reduce use of billboards/signage</p>	<p><i>Land Use/Construction</i></p> <p>Land use patterns which support the use of alternatives to the automobile</p> <p>Public buildings accessible to people with disabilities</p> <p>Community-supported agriculture (less transportation)</p> <p>Passive solar gain in houses</p>
<p><i>Utilities (Energy, Water and Waste)</i></p> <p>Low-cost electricity production and distribution</p> <p>Minimize installation of septic tanks</p> <p>High levels of public service</p> <p>Pollution prevention (water quality)</p>	<p><i>Utilities (Energy, Water and Waste)</i></p> <p>Renewable energy use</p> <p>Energy conservation/efficiency</p> <p>Recycle waste and use of products made with recycled materials</p> <p>Waste reduction</p> <p>Pollution prevention (water quality)</p>
<p><i>Transportation</i></p> <p>Time-efficient commuting technologies</p> <p>Flexibility/access to air travel</p> <p>Mass transit (buses)</p> <p>Motor vehicle safety</p> <p>Automobile emissions controls</p>	<p><i>Transportation</i></p> <p>Reduction in automobile use</p>
<p><i>Communications/Information Technologies</i></p> <p>Communications and response time for emergency services (police, fire, medical)</p> <p>Education technology</p>	<p><i>Communications/Information Technologies</i></p> <p>Telecommunications</p>
<p><i>Miscellaneous Technologies/Issues</i></p> <p>Health care technology/system</p>	<p><i>Miscellaneous Technologies/Issues</i></p>

Sustainable Cambridge Coalition	Cambridge: Toward a Sustainable Future
<p><i>Land Use/Construction</i></p> <p>Land use patterns which encourage the use of alternatives to the automobile Passive solar heating and cooling in buildings</p>	<p><i>Land Use/Construction</i></p> <p>Availability of transit services should be a determinant of scale of development and mix of uses encouraged Land use maintained at prevailing densities Encouragement of multiple use of zoning areas Rehabilitation of existing housing stock Maintain conservation lands and other environmentally sensitive areas as a part of the city's open space Maintain open space for recreation Roadway improvements to discourage vehicle travel through residential areas</p>
<p><i>Utilities (Energy, Water and Waste)</i></p> <p>Reuse and recycling of products/materials Renewable energy production Energy conservation products Solar and wind energy generation Water conservation/efficiency Gray water reuse Aquaculture for wastewater treatment Pollution prevention for industries Low-toxicity household products Closed loop water recycling in industry</p>	<p><i>Utilities (Energy, Water and Waste)</i></p> <p>Community energy production Pollution prevention Recycling of waste</p>
<p><i>Transportation</i></p> <p>Reduction in automobile use Railway freight Services to accommodate the rise in older middle-aged and senior persons (ride sharing, pedestrian zones)</p>	<p><i>Transportation</i></p> <p>Reduction in automobile use Bicycles Mass/public transit (subway, bus and para-transit) Clean alternative vehicle technologies</p>
<p><i>Communications/Information Technologies</i></p> <p>Telecommunications</p>	<p><i>Communications/Information Technologies</i></p> <p>Education and training technologies</p>
<p><i>Miscellaneous Technologies/Issues</i></p>	<p><i>Miscellaneous Technologies/Issues</i></p>

Cape Cod Regional Plan
<i>Land Use/Construction</i>
Land use patterns (e.g., cluster development) which supports the use of alternatives to the automobile
Reuse/rehabilitate existing buildings
Vegetative buffers between agricultural and developed space
Greenways and wildlife corridors
Use of pervious surfaces (especially for parking lots)
Preservation of traditional Cape Cod architectural style, character and development patterns in development, redevelopment and public investments
Provide shoreline access for the disabled
<i>Utilities (Energy, Water and Waste)</i>
Stormwater treatment
Water efficiency
Minimization of groundwater withdrawal rates
Inspection and maintenance of septic systems
Equipment for oil spill cleanup
Recycling and composting waste
Minimizing incineration and landfilling
Pollution prevention
Purchase of goods made from recycled materials
Use of solar energy (tidal, wind, direct)
<i>Transportation</i>
Reduction in automobile use
Mass/public transit (bus, rail, ferry and shuttle vans)
Bicycles
<i>Communications/Information Technologies</i>
Development of systems to track spending on waste disposal for detection of subsidies
Telecommunication technologies (use of World Wide Web)
<i>Miscellaneous Technologies/Issues</i>

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