



## Presidential Address: "Sustainable Development" in Geographic Perspective

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# Presidential Address

## "Sustainable Development" in Geographic Perspective

Thomas J. Wilbanks

Oak Ridge National Laboratory

It is possible that life as we know it on this earth is not sustainable if we continue to live as we do: improbable maybe, but not inconceivable. This intuitive sense of a threat to human survival lies behind the power of the term "sustainable development."

For geographers, both the seriousness of this issue and the power of the term are challenges that should be very welcome. Seldom does an academic discipline have an opportunity to draw so deeply upon its strengths to contribute so profoundly to questions of such significance to both general learning and social decision-making.

As a contribution to mapping geography's perspectives onto sustainable development issues, this paper first revisits the term and its impact, along with some of the reasons for its emergence as a focus for resource allocation and action. It considers the intellectual value and practical utility of several of geography's distinctive concepts, emphasizing central issues rather than offering a comprehensive review of literature that ranges far beyond sustainable development as such. It follows with some suggestions of directions for theory-building related to sustainable development, and it ends with some thoughts about the prospects for truly sustainable development in the next century.

### The Concern About Sustainable Development

"Sustainable development" is not a concept that, at this point, can be used as a basis for

either theory or action. Rather, it is more of a slogan (however oxymoronic) that has taken on a life of its own, becoming a screen behind which resources are being allocated and decisions made, regardless of whether the forcing term is understood or not. The danger, of course, is that without real understanding, the resource allocations and decisions will be subject to a kind of incremental guesswork, even if well-intentioned, that will make the lives of billions of people on this earth—and the earth itself—worse rather than better.

### The Force of the Term

"Sustainable development" has become a catchword for discussion and action because it seems to capture a widespread feeling that "the state of the earth is somewhat precarious" (Mannion 1991:309). On the one hand, we see around us evidence of progressive deforestation, changes in the atmosphere such as the thinning of the ozone layer, a loss of biological diversity, and growing volumes of wastes that we are unprepared to handle. Many of our fellow citizens have a deep sense that somehow we may have let the relationship between society and nature in this world get out of balance, that we may be creating a threat to our very survival.<sup>1</sup>

On the other hand, not in opposition but in parallel, we see around us evidence that our economic and social systems are not delivering sustained progress toward a better life for most of the world's population. We see poverty, violence, homelessness, hunger—and we see that in too many ways, for too many people, eco-

conomic and social conditions are getting worse, not better. In fact, we have a growing sense that economic pressures are threatening our social fabric, nationally and internationally.<sup>2</sup>

Together, these perceptions create a nagging unease that comfortable, secure human life cannot be sustained indefinitely unless we rethink the ways we live with each other and with our earth (e.g., Kaplan 1994). Two kinds of potential crises seem to be converging at the same time in human history, rooted especially in those places we usually call developing countries but increasingly related to what we see in our own places as well. And both of these concerns are being rolled into a single notion of "sustainable development."

### Origins and Definitions of the Term

This notion developed first from concerns in the industrialized countries about conserving nature in the face of global economic and demographic pressures, related especially to geographic exploration in the tropics (Stoddart 1986) and pushed by a sense of crisis about the implications of population growth (e.g., Ehrlich 1968), along with the general rise in awareness of environmental issues in the late 1960s. In the same year that *The Limits to Growth* was published (Meadows et al. 1972), a United Nations' conference in Stockholm responded to a new sense of crisis about environmental problems on an international scale. In its declaration, the Stockholm Conference stated that "Man [sic] has the fundamental right to freedom, equality and adequate conditions of life, in an environment of a quality that permits a life of dignity and well-being" (World Commission on Environment and Development 1987:330–332).

These developments, with roots ranging from George Perkins Marsh (Marsh 1965 [1864]; Thomas 1956) to the International Geophysical Year in 1957–58, stimulated a new level of attention to global environmental challenges. On the research side, the Scientific Committee on the Protection of the Environment (SCOPE)—an activity of the International Council of Scientific Unions (ICSU)—and the international Man and Biosphere Programme grew in visibility. On the policy side, in 1980 the International Union for the Conservation of Nature and Natural Resources (IUCN) issued a World Conservation Strategy, as environmental

experts began to dig into broader challenges of development; and the United Nations Environment Programme (UNEP), established as a result of the Stockholm Conference, promoted the concept of "ecodevelopment" which couples ecosystem dynamics with "small is beautiful" philosophies (Schumacher 1973).

The ecodevelopment effort led in 1983 to the U.N. General Assembly's establishment of a World Commission on Environment and Development. The Commission's 1987 report—usually called the Brundtland Report, after the Commission's chair—emphasized the importance of sustainable development, related mainly to meeting basic human needs and recognizing environmental limits (World Commission on Environment and Development 1987).<sup>3</sup> The publication of this report coincided with an upswell of concern about global climate change, especially atmospheric ozone depletion, which led in turn to the creation of an active Intergovernmental Panel on Climate Change (IPCC) and to the precedent-setting international Montreal Protocol on Substances that Deplete the Ozone Layer (United Nations 1990).

The move toward government action as well as research and policy analysis culminated in the 1992 United Nations' Conference on Environment and Development (UNCED) in Rio de Janeiro. Organized in part to mark the twenty-year anniversary of the Stockholm Conference, UNCED issued an international Declaration on Environment and Development on behalf of the 170 participating countries, a legally binding international Climate Change Convention and Biodiversity Convention, and "Agenda 21," a comprehensive blueprint for a "Global Partnership for Sustainable Development" (United Nations, 1993).

Out of this mix of political and intellectual discourse has come a growing focus on the concept of "sustainable development." As defined in the Brundtland Report, this term referred to "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development 1987:43). While this definition captures the forward-looking intergenerational nature of the concept, it skates across many of the other central issues. Somewhat more specifically, sustainable development may be seen as "economic growth that is ecologically sustainable and satisfies the essen-

tial needs of the underclass" (Eckholm 1982:8) or as "a continuing process of mediation among social, economic, and environmental needs which results in positive socioeconomic change that does not undermine the ecological and social systems upon which communities and society are dependent" (Carley and Christie 1993:48).<sup>4</sup>

Clearly, the concept revolves around our capacity for meeting the basic needs of the world's population—especially if that population continues to grow—without running into environmental limits. In fact, behind the perceived crises of human ecology and social economy lies a third perceived crisis of demography—of human population increase—which adds to the sense of urgency about the other two.

In any event, the basic idea of sustainable development is quite familiar to most geographers. Sustainable economic progress, and especially progress that reduces the gap between the wealthy and the poor of the world, will mean ever-heavier demands on a physical environment that is already seriously under stress. At some point, and perhaps very soon in some areas, persistent exploitation of the physical surroundings will exact a growing economic and social price in diminishing resources and/or increasing pollution. Eventually, that *environmental* price will rise to the point where *economic* progress is unsustainable. This notion of linking long-term equitable economic progress with a balanced relationship with our physical environment is what, in the end, makes the notion of sustainable development distinctive.<sup>5</sup>

### The Power of the Concept

Meanwhile, governments and other constituencies have been remarkably receptive to the concerns embedded in the concept of sustainable development. Within the past several years, for example, President Clinton has established a Presidential Council on Sustainable Development and the United Nations has created a new Commission on Sustainable Development. Agenda 21 calls for every developing country to produce a sustainable development plan, with the process funded by the industrial countries (United Nations 1993). Such influential non-governmental organizations as the World Resources Institute, the Sierra Club, and

the Union of Concerned Scientists have re-focused their rhetoric, their advocacy, and their program development on sustainable development. Even the private sector is paying attention, through such groups as the international Business Council for Sustainable Development (Schmidheiny 1992).

### Implications of the Concept

Why the power of this concept? I would suggest two reasons which at the same time help to explain why the concept has been so hard to use as a basis for building a good theory. One reason is the ambiguity of the term sustainable development. Neither "sustainable" nor "development" is easy to define as either an independent or a dependent variable. But ambiguity has the virtue of versatility in shaping a broad consensus about a need for global action, because different people can accept it sincerely while they mean somewhat different things by it. For instance, people in industrialized countries tend to focus on environmental management with as little negative impact on economic development as possible. They are mainly concerned about environmental conservation, especially in rural areas in the humid tropics, concerns that grew as we learned more about the countryside of our global village. We are looking toward *them*. People in developing countries, meanwhile, tend to focus on economic development with as little negative impact on the environment as possible. Their position is rooted in poverty and economic inequity that can be traced to a historical period when the industrialized world created a yawning economic gap by acting as if we could dominate the environment without limit. They are looking toward *us*. The general themes of environment and development are shared, but the objective functions are different.

Another reason that the label has turned out to be useful is that it is integrative; by pulling a variety of agendas and subject-matter under one umbrella, it forces us to confront the possibility of profound choices among environmental, economic, and social goals and to confront the possibility of a need for structures of mediation that go beyond those which are available to us now. Consider four major debates that have been incorporated in the sprawling literature on sustainable development:

- (1) *Conservation versus Growth*. If we are required to choose between conserving nature and developing economies in industrialized or developing countries, which way do we lean—and why? Clearly, biodiversity is the current focus of this debate where it encounters decisionmaking, but the debate also taps other issues such as landscape preservation.
- (2) *Freedom versus Control*. In dealing with these kinds of questions, can we trust populist, democratic, market-oriented decision processes to do the right things for the people involved and for global sustainability; or do some hard decisions need to be made more centrally and realized in ways that call for controls on individual action? Can we depend on democratic societies to choose difficult courses of action in the interest of future generations?
- (3) *Centralization versus Decentralization*. Related to both of the preceding points, should the focus of decisions and actions be at a scale of countries or groups of countries or at a scale of localities? What is more important, the power and resources of larger groupings or the social relations and local knowledge of smaller ones?
- (4) *Reformism versus Revolution*. Is it realistic to think that we can respond to the challenge that is posed by sustainable development by making incremental changes in policies, institutions, and preferences; or will truly sustainable development require more revolutionary changes in how we do things on this earth (for example, see Turner 1988)?

Note that, in these terms, sustainable development is not just a matter of the environmental and the economic sciences, as the “two crisis” notion seems to imply. It is a concept that is fundamentally *political*. Its realization lies in answers to such questions as who is in control, who sets agendas, who allocates resources, who mediates disputes, who sets the rules of the game. It depends fundamentally on research and learning not only in such fields as tropical forest ecology and rational choice behavior, but also in fields concerned with sociopolitical structures. If population increase is the third dimension in the sustainable development calculus, politics and decision-making are the fourth.

### Challenges in Realizing Sustainability

In confronting the ambiguity of the concept and the range of debates raging around it, one finds two major points of view about the directions ahead. The majority view maintains that the developmental part of the sustainable development equation will call for a great deal of economic growth in order to spread benefits to a much larger proportion of the world's growing population, perhaps as much as a five-to-tenfold increase in the world's total economic activity (MacNeill 1989). Even so, most observers are skeptical that this much economic growth (or even considerably less) can take place in the same way as it did in Europe and the United States. Our historic paths for economic growth simply make too many demands on the environment, in terms of resources withdrawn and wastes returned, to be sustainable at that magnitude at a global scale in the twenty-first century. Accordingly, it will be necessary to come up with new paths for economic and social development—paths that emphasize renewable resource use patterns, resource-use efficiency, and environmental management—without slowing down the development process or increasing centralized decisionmaking. For most analysts, that is the central challenge of sustainable development. The problem is that we cannot even identify those alternative paths at this stage, much less figure out how to implement them.

The minority view holds that we cannot have both development and sustainability. There are *no* paths that will enable both. Sustainable development will require cultural changes that not only make most countries, industrialized and developing, more content with less development, but that reduce national standards of living in industrialized countries in order to reduce global inequalities (e.g., Daly 1990). If this is what is necessary, then it is difficult to imagine a process of democratic decisionmaking at local, national, and international scales that would lead to a smooth transition to such a future.

One example of the dilemma is the challenge of providing reliable, affordable energy services for sustainable development. Energy services such as comfort, convenience, mobility, and labor productivity are essential for social and economic development, but the dominant energy supply sources for these services

worldwide are both nonrenewable and polluting. Looking toward the future, the underlying concern is that economic growth of 1 percent per capita in a developing country historically has been associated with an increase in the consumption of "modern" fuels such as electricity and liquid fuels of 1.3 to 2 percent per capita (Oak Ridge National Laboratory 1985). As a result, in an era when energy consumption in industrialized countries has leveled, most analysts expect developing countries to account for a large majority of the increase in global energy consumption in the next century (e.g., World Energy Council 1993), and the expectation is that most of this increase will be based on fossil fuels, especially coal, in such large and growing economies as China and India, even if one is very optimistic about prospects for renewable energy options and nuclear energy.

Clearly, such a future is nonsustainable, especially if greenhouse gas emissions from fossil fuel use are shown to cause global climate change; but it is difficult to conclude that energy needs in developing countries should be denied. On the average, energy consumption per person in developing countries is about one-quarter of the global average. According to World Bank data, consumption per person in India is about 3 percent that of the United States and Ethiopia's is less than three-tenths of one percent of the level in the U.S. (World Bank 1991:Table 5). This means less electricity consumed in homes and offices, less energy in industrial and agricultural production, and less energy in transporting goods and people. As development proceeds, the use of energy-consuming equipment that industrialized countries take for granted—for personal highway vehicles, home appliances, and factory and office automation—is certain to increase, and those who share the belief that the North-South economic gap needs to be narrowed can only hope that it does.

The challenge to the energy sector in contributing to sustainable development is to bring about a historic shift in energy sources at the same time that supplies of energy services are increasing substantially. In one sense, the requirement entails a shift from an orientation toward primary fuel supply to an orientation toward services delivered, recognizing potentials for efficiency improvement (Wilbanks 1992). In another sense, the requirement en-

tails a shift from nonrenewable fossil fuels to renewable energy sources, a shift that is comparable to the conversion from wood to coal associated with the Industrial Revolution in Europe, except, of course, that the scale will be much grander (Georgescu-Rodan 1983; Wilbanks 1988). The answer for the long term seems likely to come from technologies not now available, along with an increased emphasis on technological and institutional innovation relative to the emphasis on physical resource endowment; but the answer for the short term remains disturbingly unclear.

## Geographic Perspectives on Sustainable Development

As one of the great intellectual and policy issues of the next generation, sustainable development connects remarkably well with our heritage and our strengths as a discipline. It is defined by relationships between human and physical processes. It relates nature-society issues to spatial pattern issues. It can draw from both location theory and social theory. It is linked directly to many of the same questions that underlie society's recent rush of interest in geography—globalization, environmental problems, and applications of Geographic Information Systems (GIS). It has the potential, in fact, to serve as an intellectual dynamic and a normative focus for integrating our different perspectives on the world around us (see, for instance, Blaikie 1985).

Consider, as a starting point, four of the distinctive viewpoints that geography offers to discussions of sustainable development, drawn in part from the ongoing discussions of the National Academy of Sciences/National Research Council Committee on Rediscovering Geography: New Relevance for the New Century.<sup>6</sup>

### Diversity

The main intellectual challenge associated with sustainable development is the diversity associated with it: topical diversity in subject-matter, ecological diversity as an aspect of sustainability, and spatial or regional diversity in the new paths that may make sense. None of

these aspects of diversity is well-understood. For instance, the reality of topical diversity presents a fundamental problem for traditional scientific disciplines that have thrived by focusing on particular aspects of reality: ecologists focused on biodiversity to the exclusion of economics, economists focused on market forces to the exclusion of issues of justice, political theorists focused on issues of justice to the exclusion of issues of environmental costs.

What is needed from geography, I would suggest, is leadership in building diversity into the sustainable development enterprise in ways that are intellectually sound and robust as well as pragmatic, related to two different issues: the *value* of diversity for sustainable systems and the *tractability* of diversity in coming to a clear understanding of sustainable development. Regarding the first, for example, what can we offer beyond extensions of the diversity-stability hypothesis from ecology, extensions of Prigogine's theory that random factors introduce opportunities for growth into otherwise decaying entropic systems (Prigogine and Stengers 1984) or partnership in the search for a new science of complexity (e.g., Waldrop 1992; Lewin 1992)? Clearly, we start with the knowledge that similar combinations of social and environmental processes can lead to different nature-society relationships in different places because different places represent different combinations of historical experience and external influences. Regarding the second issue, can we be more active in working toward methods and other tools for *integration*—systematic, reproducible steps for putting pieces together in ways that are closer to real life than so much of traditional science? Should we not be in the lead, for instance, in responding to the current demand for more effective approaches to integrated assessment (e.g., Dowlatabadi and Morgan 1993)?

## Flows

Geographers have always been fascinated with flows: flows within places in nature, in society, and between nature and society; flows between places that take on patterns that in turn illuminate processes; flows through time that shape both of those. An eminent nongeographer, in fact, recently suggested that geography's most fundamental contribution

should be as the *science of flows*—seeking general truths that help in understanding a wide variety of kinds of flows (Adams 1993; also Gould 1991). It is evident, at least, that several flow-related questions are central to the sustainable development discussion and these could benefit from geography's perspectives.

In the case of *nature-society* flows, for example, how is sustainable development related to human responses to natural hazards and risk (Burton, Kates, and White 1978)? How does it reflect resource use in a social and political context (Blaikie 1985; Blaikie and Brookfield 1987; and Watts 1983)? How important is it to improve the understanding of land use (Turner et al. 1990; Turner et al. 1994)? From this foundation, should we not be asking which physical resources are essential to development as we know it and which of these has no known technological substitutes, at least that we can afford? Should we not be asking which ecosystems are vital for sustainable human development (and why), and whether they are essential regardless of economic and social tradeoffs, and to what degree essentiality is a social construct? Should we not be revisiting what we know about how relatively stable human ecologies shift from one state to another, and why, and what the transitions mean in terms of both nature-society and socioeconomic sustainability? In the meantime, other geographic perspectives also deserve greater visibility, e.g., the complexity of reconciling rates of change in society with rates of change in nature and the importance of value systems in determining sustainability's meaning in various societies.

In the case of *spatial* flows, we may draw upon perspectives that are so familiar to us that we underestimate their role in the current debate. The fact is that the operational definition of sustainable development invariably focuses on particular geographical areas. Agenda 21 focuses on the country; Project 2050—a project organized in 1993 by the World Resources Institute, The Brookings Institution, and the Santa Fe Institute—focuses on the region, leaving the interpretation of that term to various participants from around the world. It may be up to geographers to assure that these areas (however they are defined) are placed in spatial context, that their sustainability is seen in the context of their relationships with other places,

and that their identity is recognized as a social perception (e.g., Couclelis 1992).

Geographers can be especially important in helping to illuminate how flows of resources, capital, and political-economic control shape the sustainability of uses of different places. Historically, the sustainability of political-economic systems in some places has usually been based on the nonsustainable exploitation of others, which is itself a nonsustainable situation. Going beyond our notions of pattern as both an indicator of and a parameter for process, geographers have often taken the lead in thinking about the interdependence of places (e.g., Brookfield 1975). Note in particular our perspectives on the dynamics of land markets (where spatial economic, social, and environmental flows meet) and the growing significance of flows of capital and information (relative to, say, commodities) in shaping a shrinking world (e.g., Harvey 1989; Smith 1991; Brunn and Leinbach 1991).<sup>7</sup>

It seems to me that we have things to say about the interplay of flows related to exploitation versus flows related to positive innovation; of access in exchange for control versus access with the retention of control; of tensions between scale economies and democratization; of the inertia of pattern versus the rapidity of change. Geographers should also note with interest the preoccupation of the sustainable development literature with *peripheral* areas, where sustainability depends vitally on what is happening in *core* areas as well, on us and our choices as well as on them and theirs. It is especially interesting to consider this interdependence in terms of the dimension of sustainable development which serves to reduce economic inequities.

Furthermore, we need to assure that sustainability is seen in the context of *changes* in spatial flows such as the acceleration of flows when space is compressed by processes of technological change and globalization (Harvey 1989). Changes in spatial flows reshape the character of places and the lives of people who live there, and they reshape how place and space are defined, as spatial structures produced under one set of conditions are displaced by others. How does sustainable development embrace this fluid kind of reality?

Related to *temporal* flows, geographers can help others in understanding the directionality

and path dependence of human ecologies as they evolve in space and place. Our emphases on historical perspectives on places, on changing spatial structures, and on sustainable versus nonsustainable ecologies are exactly what is needed in the debate over sustainable development. Consider just three examples: 1) Butzer's work on evolutions of cultural ecologies over long periods (e.g., Butzer 1984; 1990) with its accent on adaptation as an ongoing process, on transitions from isolation to openness, on changing definitions of "carrying capacity," and on transitions from stability to instability as perturbations intrude from nature or external society; 2) Harvey's research on "time-space compression" and its transformation of the human experience with time and place through such mechanisms as the acceleration of capital rotation (Harvey 1989)<sup>8</sup>; and 3) Berry's analysis of long waves in economic history, reflecting temporal unevenness in the development of new markets following instances of major technological change (Berry 1991; 1993).<sup>9</sup>

### Scale

In a forum where issues of centralization and decentralization are so prominent, geographers can make powerful contributions to questions of scale. Consider four questions as a start. First, if sustainable development paths are to be defined in terms of discrete geographical areas, as is almost certain to be the case, and if decisions are to be based on participative democracy in the areas concerned, what scale of action does this imply? Before Yugoslavia disintegrated into tragedy, for example, an attempt was made to construct a political system on this basis, turning most kinds of governance over to local units usually translated into English as *communes*. Over a period of a decade and a half, commune boundary systems were allowed to shift until they stabilized at a scale where self-governance worked best (Figure 1), and at that scale 494 of the 512 communes contained areas of less than 1200 km<sup>2</sup>—roughly equal to a square 21 miles to a side or a circle with a radius of 12 miles. Are areal units of this small size what human-ecological self-determination is likely to mean?

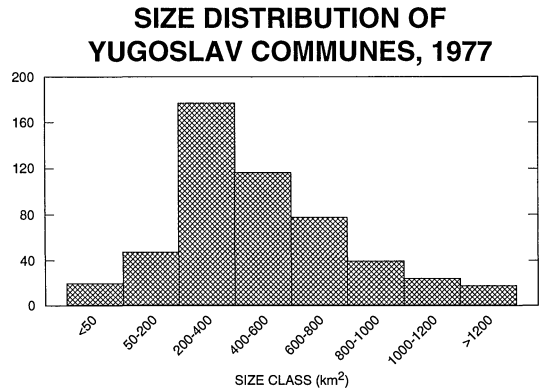
Such a question relates to several streams of geographic research on relationships between



scale and sociopolitical participation (e.g., Wilbanks 1984). For example, there is abundant evidence that the most important influences on many decisions are personal communications, which are related to a kind of “choreography” of human interaction (Parkes and Thrift 1980, after Hägerstrand 1975). Essentially, because time is limited and person-to-person interaction takes time, such interaction is fundamentally limited; and, moreover, because movement takes time, the more and the farther we move, the less time is available for interaction. These constraints suggest that there are limits to the social and spatial scale at which consensus or accommodation can be reached for some purposes—an idea that is reinforced by Friedmann’s theory of “transactive” societal planning and action (Friedmann and Weaver 1979).

Second, it is possible that many of the environmental and economic systems that need to be sustained are more viable—or indeed *only* viable—at a certain geographic scale, and that scale may differ from the scale that is most appropriate for human self-determination. For instance, Thompson’s classic book *On Growth and Form* offers repeated examples of situations where larger organisms are less agile and smaller ones are proportionately stronger (1942), and modern organization theory is saying much the same thing (Drucker 1988). But what can we say about ecologies in nature? In 1979, the Smithsonian Institution initiated a project to define the minimum-sized area at which a relatively diverse natural ecology is viable (Lovejoy and Bierregaard 1990)—an extremely relevant question. But because the answer was elusive and the project has largely shifted to other issues, emphasizing the biological dynamics of forest fragmentation, the opportunity and the need for delimiting ecological scales remain. Here perhaps is an opportunity to follow up Clark’s suggestion that not only are scale domains characteristic of certain kinds of systems, but the domains differ between systems that may be superimposed in geographical space (Clark 1985).

Third, how do these scales fit into existing spatial-administrative frameworks? Sustainable development will need boundary systems that correspond more or less to the scale at which it is carried out. Daniel Bell has suggested, for instance, that our national boundary systems in many parts of the world are both too large and



**Figure 1.** Size distribution of Yugoslav communes, 1977. Source: Federal People’s Republic of Yugoslavia 1980.

too small to handle such challenges as sustainable development: too large for the mediation of complicated issues to be handled in a participative manner and too small for the necessary resources to be allocated in ways that will get the job done (Bell 1989).

This suggests a fourth question that is critically important in understanding global change: how actions and processes operating at one scale, say global, relate to actions and processes at another, say regional or local. From one direction, it is easy to see how local conditions may be affected by global economic and environmental processes, but it is harder to see how global processes may be affected by local actions. Consider the experience of the Peace Corps—with its powerful impacts in many localities but very little evidence of impacts at a national level, much less globally (Stone 1992:205). From the other direction, it is clear that global processes are in fact the result of a myriad of local decisions. It is also clear that many of the complex relationships among environment, economy, and society at the global scale can only begin to be unraveled by careful locality-specific research. This is doubly true if localities are going to be given a chance to determine their own paths, since we do not yet have a sound understanding of how processes at different scales interact with one another (see Meyer et al. 1992; Harvey 1989;

and Soja 1989). Geography has a chance to play a major role in addressing this need.

### Visualization<sup>10</sup>

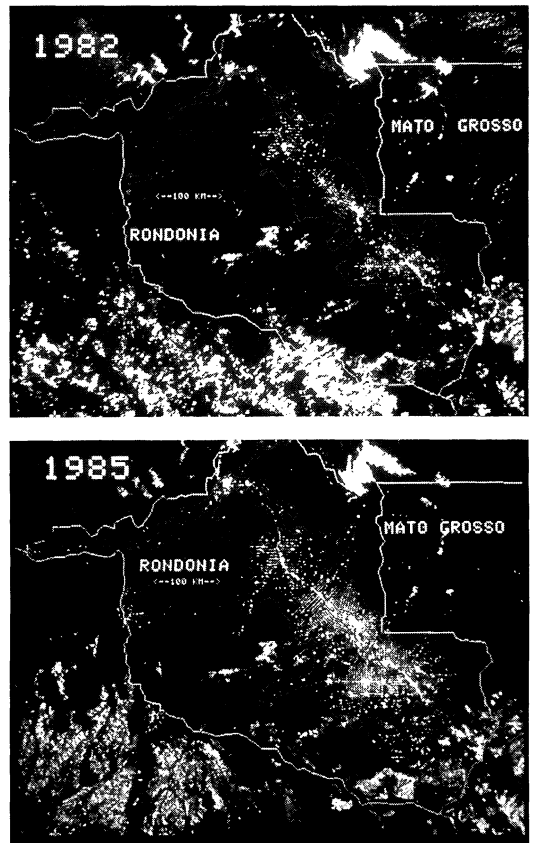
Finally, I think we should recognize the growing power of the visual image in human communication in this age of an information revolution. Across the world, the creation and diffusion of visual images is displacing the printed word as a triggering mechanism for issue identification, constituency building, and agenda-setting. And visual images, including computer mapping and aerial photography, are increasingly used to identify threats to sustainability and to examine alternative paths.<sup>11</sup> No other form of communication is as powerful among such a wide variety of audiences, including scholars who are trying to associate creative thinking with empirical observations (Miller 1981; also Hilborn 1994: especially Chapter 11; and Nicolas and Prigogine 1989).

In this age of new "information superhighways," our skills in GIS—emphasizing their connections with subject-matter knowledge—will be part of our contribution to the art and science of sustainable development, especially as computer mapping is combined with photographic and other images in hypermedia information systems. We need to understand how to do this equitably, inexpensively, and well—at the same time that we remind ourselves and others that the communication of visual images is highly *value*-laden and that the message can be swamped by the medium (e.g., Gregory 1994). Concomitantly, our uses of images should be grounded in our tradition of field work that links the abundance of secondary data and images to primary data of personal observation and experience.

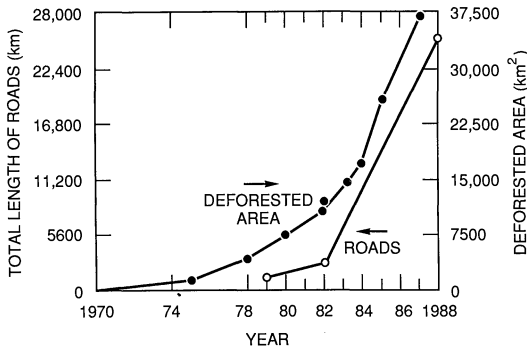
One example of visualization's role in the sustainable development dialogue comes from deforestation in the area drained by the Amazon.<sup>12</sup> Few other issues of global environmental change have achieved as much immediacy through photographic images of, for example, land clearing and wood burning. In the early 1980s, earth satellite imagery documented (and communicated) the extent of land-use change (Figure 2). Correlations between deforestation and transportation (Figure 3) have been sharpened by maps of evolving road patterns (Figure 4); and spatial diagrams are effective

ways to show the consequences of different courses of action (Figure 5).<sup>13</sup>

As we think about visualization as a basic geographic concept, however, I suspect that we will think of other applications as well. One example with implications for sustainable development is what might be called "visual capital"—landscapes, natural and artificial, that may be as precious and as threatened (and as hard to attach monetary values to) as endangered species. How do we incorporate visual capital as a dimension of the choices and the mediation associated with sustainable development?



**Figure 2.** Deforestation in the Southern Amazon Basin, 1982 and 1985. Source: From the Global Inventory Monitoring and Modeling Study of the NASA/Goddard Space Flight Center (see Malingreau and Tucker 1988). Used by permission of NASA.



**Figure 3.** Relationships between deforestation and road construction in Rondonia, Brazil, 1970–1988. Source: Southworth n.d.

## Toward a Geographic System Theory of Sustainable Development

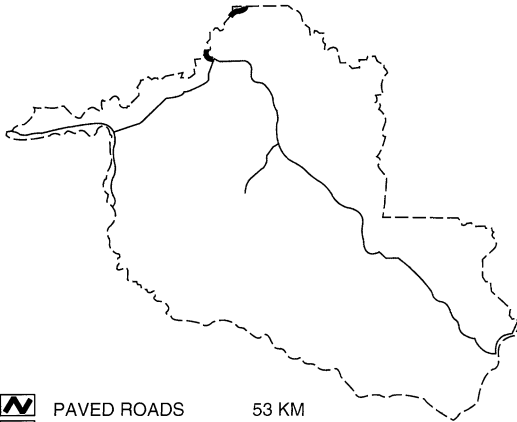
Given these prospects for interesting and useful professional contributions to the effort to make sustainable development a reality, can we dare to take one more step—toward developing general theoretical concepts related to sustainable development? I think we might, provided that we understand that such concepts cannot be developed by any one of us alone. They would need to reflect instead the new epistemology of *group* research that has attracted considerable attention in discussions of global economic competitiveness (e.g., Kash 1989). They would need to balance our search for generality with our characteristic appreciation of diversity. They would need to address understandings of system possibilities as well as predictions of system outcomes (Sheppard 1994). And they would need to see theory as a heuristic device rather than as a reflection of a mechanistic view of what is “efficient” or “right.” But scholars in geography and other disciplines need to fill the void of theory and intellectual substance that undermines sustainable development as a commitment for global and local action.



Without claiming to meet all of these conditions and in a spirit of preliminary discourse, let me offer a few thoughts on the kinds of

fairly general insights we might offer. We know that the central challenge involves seeking sustainability in a world of constant change, which seems virtually a contradiction in terms. In this context, it seems to me that we might start our theory-building by offering a number of postulates as a basis for discussion and investigation:

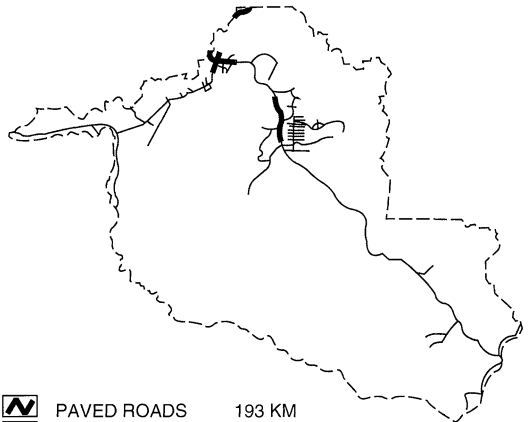
- (1) Given the reality of complex flows within and between places, sustainable development must be pursued in open systems. It is futile to endeavor to sustain by isolating; the path to sustainability lies in assuring that diverse flows contribute to the pursuit of such goals as environmental management, economic progress, and participative decisionmaking—not in arbitrary efforts to truncate flows.
- (2) Because “innovations,” in the sense of new ideas or practices, mutations, rare events, or other novel phenomena, are constantly being introduced at some places and spread to others through spatial systems—through human creativity if from no other source—a long-term steady state or equilibrium is not a realistic target for any locality at any scale. Sustainable development is not a *product* but a *process* in which relatively near-equilibrium states are joined through time by periods of transition from one state to another (Wilbanks 1980:382–384, 406–407). It is more a matter of near-equilibrium *paths* than of near-equilibrium *states*.
- (3) In such a context, under pressure from human aspirations and technological change, both internally and externally, sustainability depends on a balance between entropy-countering change stimuli and instability-countering mechanisms for assimilation, all embedded in pervasive uncertainty. Without the stimuli, systems decay rather than progress, and without the mechanisms for assimilation, systems can careen out of control. The challenge is to modulate the stimuli by feedbacks, generally based in social institutions, that guide the system onto paths that improve system quality rather than destroying it.
- (4) There is more than one possible near-equilibrium state for a locale at a particular time and more than one possible near-equilibrium path as that locale moves from state to state. Sustainable development does not



## 1979 ROADS IN RONDONIA



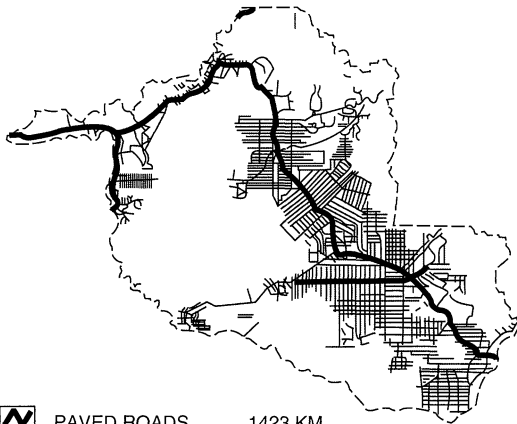
 PAVED ROADS 53 KM  
 UNPAVED ROADS 1381 KM


## 1982 ROADS IN RONDONIA



 PAVED ROADS 193 KM  
 UNPAVED ROADS 2598 KM

## 1988 ROADS IN RONDONIA



 PAVED ROADS 1423 KM  
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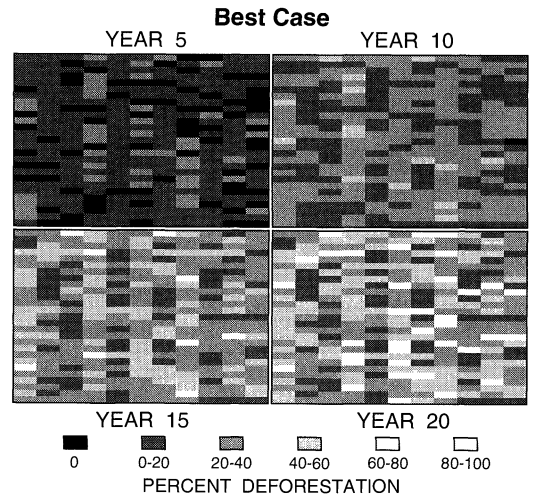
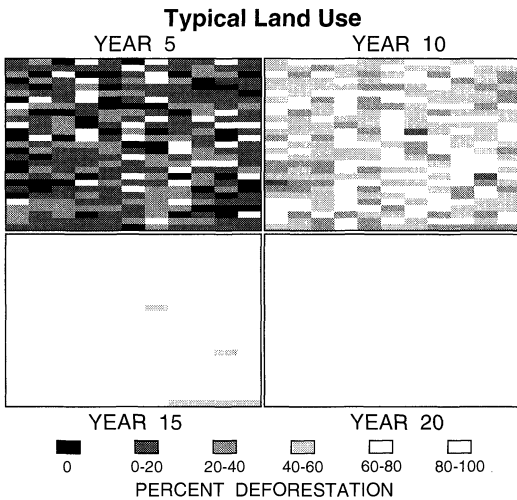
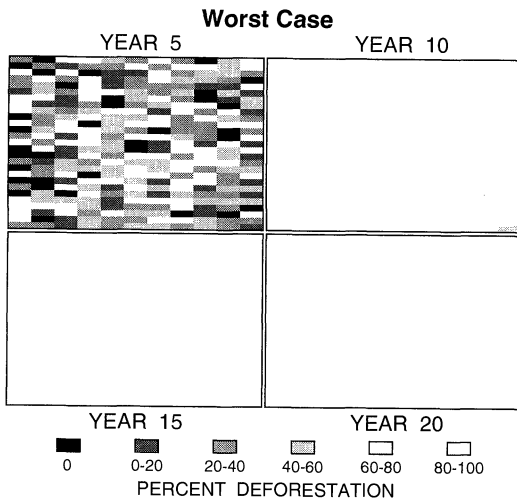
**Figure 4.** Evolving road networks in Rondonia, Brazil, 1979, 1982, and 1988. Source: Southworth n.d.

mean a single answer for each place. It is strongly conditioned by social context and values and by external relationships; it is strongly path-dependent; and it exhibits considerable geographic differentiation. It may be associated with limits which are themselves subject to change—as when technological development results in substitutes for scarce physical resources—but it embraces a considerable range of choice.

- (5) Where sustainability is concerned, the major decision points occur not during periods of near-equilibrium but during times of stress, when urgency can be converted

into radical action, near-equilibrium conditions can shift far from equilibrium, and relatively orderly adaptive transitions tend to be replaced by discontinuous jumps involving considerable unpredictability. The work of Prigogine and the complexity scientists points to conditions at a boundary between normal orderly behavior and uncontrollable chaos, at which some combination of system complexity, survival instinct, learning, and perhaps luck enables some systems not only to survive but to take revolutionary steps toward improvement and advancement. But it is also possible, and in some circumstances likely, that the outcome will be destructive for some or all parts of a system.

- (6) Such stresses are more a function of *rates* of change in the parameters of a locality than of *magnitudes* of change, except when critical thresholds are involved. In any locale, there is a rate of change beyond which existing systems cannot be maintained, and this rate of change is related to the period over which it is maintained. The longer a given rate is continued, the lower will be the rate that can be assimilated without major decision points.



**Figure 5.** Projected patterns of deforestation under different assumptions: worst-case, typical land-use, and best-case scenarios for years 5, 10, 15, and 20. Source: Dale et al. 1994. Used by permission of *Conservation Biology*.

(7) Rates of change that can be assimilated vary among systems according to their resilience or elasticity with respect to relatively rapid change, which is related to coping mechanisms such as linkage with broader networks (e.g., Carley and Christie 1993:169-173). In many cases, a locality's most important coping mechanism is its overall level of social and economic development since its capacity to find paths that keep stress within manageable limits varies directly with its human, technological, and financial resources.

(8) In the long term, sustainable development is probably unrealizable in most localities until it is also approached in most others. Unless and until development is sustainable nearly everywhere, the global system remains a threat to local sustainability nearly everywhere because it tends to spread instability from place to place: for example, through population migration, the transport of environmental degradation, political conflict, or economic exploitation.

### Putting Geography's Perspectives in Perspective

The central question in sustainable development is whether, during the next century or two, or even in the next generation or two, the world can simultaneously sustain four things: 1) economic development for all; 2) reasonable environmental stability; 3) continued population growth; and 4) decisionmaking without coercion (recent events suggest that coercion is not sustainable as a basic mode of mediation

under conditions of widespread information flow). In order to be able to have all four, we will have to be able to be highly innovative in improving our understanding of complex systems, their resilience, and their propensity to change; and in creating options that take the pressure off through technological and institutional change.

That is a great deal to ask, especially if the pressures grow quickly in the first or second quarters of the next century. A best guess is that our innovativeness may buy time to make the hard decisions without sacrificing economic opportunity, environmental quality, or self-determination—and it is very important to buy that time—but that we will find in the lifetimes of our children that we cannot have all four of these things. In order to achieve sustainable development, something will have to give—and that is an excruciating prospect. Clearly, population growth represents a challenge that the world *must* address in the next century; it is the obvious first target. Beyond this, though, it is unclear whether we can realize sustainability's three remaining dimensions (equitable economic development, a healthy environment, and the right to make one's own choices) as long as we continue to live in a world where our choices are both self-determined and very strongly self-interested, where equity is someone else's worry and balance is something to be left to a fuzzy future.

During the 1992 International Geographical Congress, former U.S. Senator Gaylord Nelson argued that the key to unlocking real sustainability is a much stronger and more widely-shared environmental ethic (Nelson 1992)—to which we might add a stronger social ethic as well. It is possible that sustainable development will require an *ethical revolution* to go along with the other revolutions of our time: globalization, scarcity, information, and democratization. If this is true, then geography's challenge goes far beyond our roles as scholars and practitioners to our roles as teachers (in the fullest sense) and as citizens who, through our research, our counsel, our information dissemination, and our personal examples, advocate the principles of economic fairness and nature-society balance.<sup>14</sup>

This, it seems to me, is the final opportunity for integration that lies in attention by geographers to the sustainable development issue. In addition to integrating knowledge in order to

meet pressing social needs and helping to unify our various traditions as a discipline, sustainable development focuses our attention on a great problem of mutual concern that can help to integrate the various pieces of our individual professional lives—to integrate them in the interest of a problem that we care enough about to go that extra mile to do extraordinarily well, not only in our scholarship but in every aspect of the ways that we live as experts in something the world needs very badly.

## Notes

1. This sense can be compared with certain social perspectives on nuclear science and engineering during the 1960s and 1970s which, though taking the form of opposition to such specific actions as nuclear weapons testing and nuclear power plant construction, seem to have been based on inchoate deeper fears that in tampering with the atom we were risking human survival (Weart 1982).
2. Whether or not the facts indicate that economic and social conditions are getting worse, or whether the information revolution is simply increasing our awareness of problems that are not getting better quickly enough, is sometimes in dispute. But regardless, one can argue that in too many ways economic and social progress has not kept pace with technological progress, and this disparity is a legitimate cause for social concern (Handler 1979) and a possible source of social tension (Mumford 1934).
3. The history of these developments through 1987 is thoughtfully reviewed by Adams (1990).
4. For a review of terminology and relationships with other concepts, see Brown et al. (1987).
5. Some prefer the term "sustainability" to "sustainable development" because it seems less oxymoronic, at least partly because it concentrates on continuity rather than change. One can argue, however, that use of the term "sustainable development" makes it more difficult to avoid the central challenge, which is to combine sustainable environmental management with sustainable human economic and social progress.
6. Established in 1993 under the auspices of the Board on Earth Sciences and Resources, Commission on Geosciences, Environment, and Resources, National Research Council. The Committee is due to report in 1995.
7. See, for example, the recent attention to spatial-economic systems of money flow, including indebtedness; Corbridge, Thrift, and Martin (1994) and Corbridge (1993).
8. To get a sense of the challenge to both theory and practice, see O'Brien (1992) who argues that global economic integration has rendered the concept of place irrelevant.
9. Also note Couclelis (1988) who shows that very small differences in initial local circumstances can lead to widely different outcomes.

10. Defined as the "use of concrete visual representations to make contexts and problems visible" in order "to engage the most powerful human information-processing abilities"; MacEachren et al. 1992:101.
11. It may not be coincidental that the growing concern about global environmental sustainability coincides with humanity's exposure to images of the earth from space.
12. See, for example, Hecht (1985); Foresta (1991); and Dale et al. (1994).
13. The insightful issue-oriented presentations at The Presidential Plenary Session at the 1994 Annual Meeting of the Association of American Geographers, "Geographer-Led Interdisciplinary Research," included the use of traditional choropleth maps, computer maps, photographs, spatial diagrams, and film.
14. For example, in our research we might address subtle connections between equity and self interest (Wilbanks 1991) (including solid empirical relationships in cultural ecology and political economy), between doing good and doing well.

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For geographers, both the seriousness of the sustainable development issue and the power of the term are challenges that are very welcome. The intellectual value and practical utility of such distinctive concepts as diversity, flow (nature-society, spatial, and temporal), scale, and visualization represent opportunities to contribute profoundly to questions of significance to both general learning and social decisionmaking. Moreover, geography's perspectives can help to address the pressing need for a stronger theoretical basis for understanding sustainable development. In the end, however, our contributions will depend on a demonstration in our roles as teachers and citizens, as well as scholars, that we recognize the importance of an ethical revolution as well as increased scientific understanding. **Key Words:** geography, global change, integrated assessment, scale, sustainable development.