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## EDITORIAL

**Paul Bozuwa**  
Dartmouth Journal Services

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# Council of Science Editors Task Force on Science Journals, Poverty, and Human Development

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In September 2000, nearly 200 world leaders formulated the Millennium Development Goals (MDGs), a set of ambitious objectives to promote international social justice. Fundamental directives were established in eight main areas: poverty and hunger, education, women's equality, child mortality, maternal health, disease, environmental sustainability, and global development partnerships. All United Nations member countries agreed to meet the MDGs by 2015.

Many global institutions, most notably the World Bank, the International Monetary Fund, and the Organization for Economic Cooperation and Development, have also pledged support for the MDGs. However, the United Nations reports that progress reaching the specific targets has been slow and uneven. The global body has therefore restructured implementation of the goals and given priority to country-level monitoring that stresses advocacy, practical assistance, local expertise, and additional financial resources.

In the international effort to achieve the MDGs, scientific journals have an important role to play promoting the goals within each discipline and fostering cross-disciplinary discussions. Reaching across intellectual boundaries is particularly critical to understanding the relationships among the different MDGs, to advancing scientific knowledge, and to encouraging policy decisions that harmonize sustainability with economic development.

A chief objective of the MDGs is to cut in half the one billion people who currently survive on less than US\$1 per day. It is devastating to think that even if this were to occur, by 2015 more than 500 million people will still be living in extreme poverty.

Equally compelling is the aim to "ensure environmental sustainability." The impact of contemporary lifestyles on the global environment can certainly be ameliorated by 2015 if we are able to sustainably bring the global population of nearly 6.5 billion people up the development ladder. However,

there is little question that science and discipline will need to conquer apathy and greed if we are to enjoy broader prosperity without imposing huge burdens on global biogeochemical systems. We should not underestimate the enormity of this challenge. William Ruckelshaus (1989), the founding administrator of the Environmental Protection Agency in the United States, posed the question nearly two decades ago in the following terms:

Can we move nations and people in the direction of sustainability? Such a move would be a modification of society comparable in scale to only two other changes: the Agricultural Revolution of the late Neolithic and the Industrial Revolution of the past two centuries. These revolutions were gradual, spontaneous, and largely unconscious. This one will have to be a fully conscious operation, guided by the best foresight that science can provide. If we actually do it, the undertaking will be absolutely unique in humanity's stay on earth.

The Council of Science Editors (CSE) has formed a task force to define the role of scientific journals in alleviating poverty and promoting human development. Clearly, as the arbiters of formalized scientific knowledge, science publishers and editors have an enormous role in achieving the MDGs and in ensuring that success in meeting the development-oriented objectives does not overwhelm efforts toward environmental sustainability. In this context, it merits noting that CSE has recently broadened its focus from serving as a professional association for the biological sciences to representing the broader community of science editors. This widening of mission is reflected in the organization's name change from the Council of Biology Editors. Contemporary concerns such as Avian Flu, Severe Acute Respiratory Syndrome (SARS), and HIV-AIDS highlighted

the need to transition science beyond its traditional disciplinary boundaries.

The task force was energized at its inception by working with Jeffrey Sachs, the Director of the Earth Institute at Columbia University and Special Advisor to the United Nations Secretary-General Kofi Annan on the MDGs. The efforts of the task force in its first year have been directed at the following issues:

- Fostering research and publishing capacity in the developing world
- Raising awareness of poverty and the role scientific journals can play in combating its consequences
- Identifying existing programs involving the scientific publishing community and issues pertaining to poverty
- Establishing a statement of principles describing journal editors' responsibilities to the developing world

The task force is anxious to amplify existing programs to build publishing capacity in the developing world within the context of initiatives such as the International Network for the Availability to Scientific Publications (INASP) (<http://www.inasp.info>) and to help disseminate scientific knowledge regarding the developing world through such tools as SciDevNet (<http://www.scidev.net>). The task force is additionally seeking to enhance the availability of free or reduced-cost research resources, such as the World Health Organization's Health InterNetwork Access to Research Initiative (HINARI) (<http://www.who.int/hinari/en/>) and the United Nations Food and Agriculture Organization's Access to Global Online Research in Agriculture (AGORA) (<http://www.aginternetwork.org/en/>). It has also assisted in launching a series of other projects such as AuthorAid (<http://www.jphp.umb.edu/documents/Authoraid.pdf>), an initiative to mentor scholars from developing countries prepare studies for local or international publication.

World leaders often look to science to solve intractable human problems. Scientific journals play a key role in this process, as publication in respected venues validates investigation and generates professional credentials for further research. Editors have a responsibility to the MDGs and should honor this obligation by examining issues of the developing world, by increasing developing-world membership in their author and peer-review pools, and by encouraging local research and publication.

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## About the Author

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## ARTICLE

# The sustainability of telework: an ecological-footprinting approach

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This paper demonstrates the importance of a comprehensive framework to assess how telework affects sustainability. Sustainability-policy evaluation rarely considers substitution effects despite broad recognition that overall lifestyles must be analyzed to gauge how policy-induced behavioral changes translate into net environmental impact. Case-study data indicate that telework has far-reaching, complex, and varied effects on lifestyle practices, with potentially important environmental implications. Because adjustments occur across numerous consumption categories, the assessment of telework's environmental dimensions must move beyond single-issue studies and single-dataset analysis. Ecological-footprint analysis, in combination with qualitative data, can suggest solutions to sustainability problems.

KEYWORDS: environmental impact sources, commuting, environmental policy, human-environment relationship, case studies

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## Introduction

Both national and international institutions have launched policies to reduce the environmental impacts of consumerism in affluent nations (see, e.g., Cohen et al. 2005; Martens & Spaargaren, 2005; Sanches, 2005). However, single-issue policies may well result in an array of adjustments that ultimately have unanticipated combined effects. For example, policies aimed at decreasing automobile commuting curtail harmful emissions, but if these savings are then spent on foreign travel or consumer goods, the net effects on the environment may be negligible or even perverse. Even with all the attention given to sustainability-assessment tools and policies, the consideration of substitution effects or demand-side issues is not yet fully developed.<sup>1</sup> For sustainability science to move forward, progress must be made both in conducting more thoroughgoing studies and in

exploring the complex pathways that give rise to particular outcomes. This article provides an exploratory, but comprehensive, methodology to evaluate the sustainability implications of telework. Following Castells (2000), we can view the trend toward telework as a manifestation of broader socioeconomic and technological changes related to workplace restructuring and advances in information technology. However, as illustrated here, many environmental effects of this transition emerge through a complex set of individual adjustments.

The article begins with a definition of telework and an overview of its diffusion as a workplace practice. It then reviews the literature relevant to the environmental implications of telework that has accumulated over the past decade or so. A framework for individual-level sustainability analysis is then developed employing the concept of ecological footprinting. The article uses two Canadian case studies to explore pathways and to provisionally measure the environmental effects associated with telework. The discussion highlights the importance of considering numerous environmental consequences to capture the full array of substitution effects and to demonstrate the potential range of ramifying changes that depend on individual circumstances and preferences. We conclude by considering research-design issues and the challenges of including additional sustainability dimensions.

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<sup>1</sup> Skaburskis (2006) shows, for instance, that while New Urbanist forms of development are thought to help achieve sustainable urban forms, the demand-side issues have not been previously considered. He finds that those residing in a New Urbanist community near Toronto have typically moved from smaller dwellings, or were planning on increasing their housing expenditures in the future. The demand-side analysis used in this case study questions the sustainability of New Urbanism.

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## The Telework Trend

Telework is an umbrella term for the use of “information and communications technology to perform work ‘at a distance’,” and thus includes salaried, contractual, and self-employed workers, as well as after-hours work activity by commuters (Mokhtarian et al. 2004). Telecommuters, or paid employees who work from home instead of commuting daily, are a subset of teleworkers and are the focus of current attention. By considering only full-time telecommuters, we hope to make behavioral responses distinctly visible.

While adoption of telework was slow during the 1980s, the subsequent decade’s information revolution resulted in considerable growth in new work forms (Doherty et al. 2000; Bailey & Kurland, 2002; Robertson, 2005; CTA, 2006). Technological progress, coupled with growth in the service and knowledge-based economic sectors, is creating increasingly location-independent employment positions (Yen, 2000; Sohn et al. 2003). At the dawn of the millennium, upwards of three percent of the American and European workforces were telecommuting at least some days each week, although estimates vary widely due to definitional differences and challenges associated with documenting this dynamic, frequently informal, and usually part-time work arrangement (Mokhtarian, 1991; Mokhtarian et al. 2004). There is, though, large variation in diffusion rates across countries and regions, with higher overall adoption in the United States than in Europe (Mariani, 2000; Werdigier & Niebuhr, 2000; Mokhtarian et al. 2005). Recent evidence, however, suggests that telework in the United States may now be growing more slowly than previously the case (Mokhtarian et al. 2005). Nevertheless, it is evident that telework, while currently undertaken by only a small proportion of the workforce, has achieved a degree of acceptability and potential for further growth. Furthermore, studying telework can illuminate our understanding of important sustainability implications of broader changes in work arrangements.<sup>2</sup>

<sup>2</sup> While telework is often enabled by some form of technology, the use of this technology and the act of working from home are by no means exclusive to formal teleworkers. Societal sustainability implications of information technology may in fact be difficult to infer by focusing on such a narrow segment of the workforce. The professionalization of the workforce is perhaps more closely tied with technological change; and with the growth of knowledge-intensive industries work is carried away from the traditional workplace in many instances, even if one is not labelled as a formal home worker (e.g., BlackBerries, laptops, cell phones). Future study can broaden the definition of telework to include many types of “mobile” work. See Helling & Mokhtarian (2001) and Haddon & Brynin (2005) for classifications of different types

## A Framework for Analysis

At present, our understanding of the environmental implications of telework is limited. Most research to date has focused on the implementation, adoption, and growth of telework programs (Bailey & Kurland, 2002; Kitou & Horvath, 2003). Moreover, studies of impacts have typically had a disciplinary, single-issue focus, with only a few more comprehensive reports (e.g., Hopkinson et al. 2002; Schallaböck & Utzmann, 2003). While the dynamic and complex nature of telework cannot be easily resolved, a broader framework would likely provide a more complete assessment of its environmental implications.

Sustainable development provides one comprehensive framework for examining telework. First popularized in the early 1980s by the International Union for the Conservation of Nature, the sustainable-development concept involves improvement of the quality of social and economic processes while remaining within environmental carrying capacity (IUCN et al. 1980; see also Wackernagel & Rees, 1996; Chambers et al. 2000). Telework could potentially affect multiple aspects of sustainability. We focus here on the environmental aspects of sustainability, while recognizing that the adoption of telework is often motivated by the pursuit of either corporate cost savings or productivity increases (DuBrin, 1991; McCune, 1998; Doherty et al. 2000; Mariani, 2000; Verespej, 2001; Atkyns et al. 2002) or employee optimism that such practices can improve their quality of life (Mariani, 2000; Mirchandani, 2000; EURESCOM, 2001; BT, 2003; Shaw et al. 2003). At the same time, telework is frequently promoted on environmental grounds because of its potential to reduce automobile use (e.g., Atkyns et al. 2002; Harpaz, 2002). However, some authors question whether the net environmental effects of telework are positive (Heinonen & Lahti, 2002), as various rebound effects, such as increased non-work travel and/or higher home-energy consumption, may offset the benefits of less commuting (Schallaböck & Utzmann, 2003; Kitou & Horvath, 2003).

The environmental consequences of telework on land-use patterns, consumption behavior, and waste generation have not to date been comprehensively accounted for and the processes that give rise to behavioral adjustments are not well understood. More fundamentally, there is no generally accepted method for assessing the overall environmental implications of lifestyle changes such as telework (Devuyst & Van Volsem, 2001). Since lifestyle alterations are rarely

of telework depending on extent, employment arrangements, and use of technology.

linear, combinations of decisions that can cause unexpected and offsetting results are likely to occur. Without assessing the complete spectrum of environmental consequences, the net effects will remain uncertain.

One way to tackle the measurement challenge is to use ecological footprinting (EF). EF has been widely adopted in assessment because of its comprehensiveness and capacity to relate consumption to sustainability. Wackernagel & Rees (1996), the creators of EF, define it as an environmental accounting tool “that enables us to estimate the resource consumption and waste assimilation requirements of a defined human population or economy in terms of a corresponding productive land area.” Total equivalent land area available on the planet is used to measure carrying capacity. It is assumed that humanity’s total EF can only temporarily exceed aggregate productive capacity, as seems to be happening currently, before the system collapses (Chambers et al. 2000).

As outlined above, implicit in the commonly accepted definition of sustainability is some acceptance of the concept of carrying capacity, or need to live within certain biospheric limits (Holmberg et al. 1999). The EF is one of the few sustainability tools that allows inferences on whether a specific socioeconomic, political, or behavioral modification moves individuals or society closer to consuming only “their share” of the earth’s total resources.

The EF approach has been widely used to compare environmental impacts of specific activities and to measure relative progress toward sustainability for various countries and regions (Wackernagel et al. 2002; Jorgenson, 2003; Senbel et al. 2003). Much of the work on EF focuses on its methodological foundations at national and international scales, though critics of the technique such as van den Bergh & Verbruggen (1999) and van Kooten & Bulte (2000) largely focus on its utility as a policy tool at the national level. However, EF has also been applied at regional scales by authors such as Wackernagel (1998) and Barrett (2001) and is gaining ground in applications such as tourism (Gössling et al. 2002; Hunter, 2002) and product assessment (Chambers et al. 2000). While some analysts have developed individual and small-scale applications of EF (Simmons & Chambers, 1998; Roy & Caird, 2001; Wood & Lenzen, 2003; Holden, 2004), few studies have critically considered the EF’s utility for small-scale sustainability assessment (Wood, 2003; Moos et al. 2006).

## Telework’s Environmental Sustainability

While scholars have devoted considerable attention to the transport implications of home-based telework, the same cannot be said for other potential environmental impacts associated within this work practice. The following discussion summarizes our knowledge of the environmental implications of telework, organized around the impact categories typically used in EF analysis—transportation, residence, energy, goods, services, food, and waste.

From an environmental perspective, transportation is of paramount concern because available evidence, while still limited primarily to California-based studies of early adopters, suggests that “vehicle-miles traveled are substantially reduced for those who telecommute, on days that they telecommute, for as long as they telecommute” (Choo et al. 2005). Studies from other countries confirm that telework is associated with reductions in automobile use (Wood, 2003), and there is little evidence of new travel generation for the individual (i.e., increases in personal travel). However, it is still unclear to what extent household- or aggregate-level trips might be induced (Helling & Mokhtarian, 2001; Hopkinson et al. 2002; Choo et al. 2005) moreover, telework can contribute to residential relocation, as recent evidence suggests that individuals adapt their residential choice to the flexibility that telework provides (EURESCOM, 2001). Particular concern has emerged that teleworking households may move away from central areas (Helling & Mokhtarian, 2001; Audirac, 2003; Tayyaran et al. 2003; Lake, 2004) and thus contribute to the economic, social, and environmental problems created by sprawl and low density development patterns that are common in most North American cities (Wiewel et al. 1999; Duany et al. 2000; Burchell et al. 2002; Krieger, 2004). At present, however, the types of longitudinal data needed to address these issues are limited (Helling & Mokhtarian, 2001; Tayyaran et al. 2003), and thus one can only conclude that telework-induced travel changes appear environmentally positive, though modest (Choo et al. 2005; Andrey et al. 2005).

There are also indications that living space expands for home-based teleworkers (Yen, 2000). Larger homes increase the EF through the consumption of materials related to construction, renovations, and yard size, as well as associated changes in interior heating and cooling. However, if the growth in telework is driven, as Cornford and colleagues (1997) observe, by “push factors of corporate downsizing” and not voluntary adoption, relocation to larger dwellings may not be significant on a net basis.

Other potential environmental-impact changes are associated with increased home-energy use,

work-related purchases, and changed eating habits or other non-work activities. Of these adjustments, only energy use has received serious consideration, and studies have documented increased home-energy demand—though the extent to which home-energy use is offset by decreased workplace-energy consumption has not been determined (Hopkinson et al. 2002; Kitou & Horvath, 2003). As for the work process, the main effects appear to be an increase in electronic equipment, paper, and furniture at the telework site. Again, employer reductions may offset some of these impacts. Net effects could still be greater, however, due to the intensified use of technology or more rapid obsolescence.<sup>3</sup> Additionally, more time spent within the home may influence non-work activities, such as eating and recreation, but these issues have not received detailed empirical consideration.

Finally, it is generally assumed that telework increases wastes disposed of through domestic systems (Hopkinson et al. 2002). Some of this quantity is offset by reductions in the volume of waste produced at the workplace, while some may represent new waste related to duplication of equipment or records. However, virtually no empirical literature exists on this topic either.

In summary, with the exception of transportation and energy use, the range and extent—and even the overall direction—of change in the environmental impacts associated with telework remains unclear. The present study examines telework's array of environmental impacts and provides some exploratory data on their extent. This approach differs from previous investigations in considering a broader array of environmental impacts of this novel work practice and also uses EF to relate these effects to the planet's carrying capacity. We know of only one previous study that attempted to connect telework's transportation-related impacts to planetary resource constraints (Wood, 2003). This analysis demonstrated that commuting reductions for a sample of British teleworkers decreased individuals' EF by 0.14 hectares on average, or approximately two percent of the total footprint.

## The Case Studies

The empirical evidence for this investigation comes from two Canadian small-sample employer-based case studies. Case 1 is a large private-sector financial firm and Case 2 is a large public-sector employer. The employers provided the sampling frames for the surveys and contact lists of workers with formal telework arrangements. All of the individuals on the two lists were invited to participate in the study via e-mail contact.<sup>4</sup> The response rate was 24 out of 51 for Case 1, and 9 out of 40 for Case 2. Participants in both cases were employed in professional, managerial, or administrative jobs that required them to travel to client meetings in dispersed locations.

For Case 1, the participants had residential addresses that spanned the entire country. For some of these individuals, telework had recently been introduced as a condition of employment; other study participants had initiated telework arrangements on their own. The group consisted of 21 women and 3 men ranging from approximately 30 to 60 years of age. Respondents' household demographics varied widely, from single adults with or without dependent children to couples living with or without children. Household incomes varied from Can\$30,000 to over Can\$100,000, and highest education level ranged from high-school diplomas to university degrees.

Case 2 consisted of nine public-sector staff, all working in the same department, who resided mainly in the various metropolitan centers of Ontario. Telework was a condition of employment. The sample consisted of four women and five men, all in households with a partner; four respondents had dependent children. Participants ranged from 30 to over 60 years of age. Household incomes were from Can\$40,000 to over Can\$150,000, and all participants had at least one university degree (and four held one or more post-graduate degrees).

For Case 1, participants provided qualitative information through personal interviews on how telework had changed their respective housing situation and personal behavior.<sup>5</sup> In Case 2, we used an exploratory survey to shed light on the utility of the EF in this type of application. Questions were administered in a computer-based questionnaire and trans-

<sup>3</sup> Some study participants indicated that they upgraded their computers at home more frequently than was the case at the office because of the need to have the newest and quickest Internet connection. The speed of Internet connections was also noted as a constraint for teleworkers living in the countryside. Hopkinson et al. (2002) indicates that telework would likely be more technology intensive than office work given the need for more equipment and more frequent updates. However, it is certainly debatable whether these views are solely the perceptions of individual teleworkers.

<sup>4</sup> For challenges associated with Internet and e-mail surveys see, for example, Cook et al. (2000) and Porter & Whitcomb (2003).

<sup>5</sup> Case 1 provides insight on the range of environmental impacts and the variability of lifestyle change. The interviews followed a semi-structured format, were conducted either in person or by telephone, lasted about one hour, were tape recorded, and subsequently transcribed. These transcripts were used to identify dominant themes related to how telework contributed to changes in lifestyle with resultant environmental implications.



lated into an EF score.<sup>6</sup> Information was collected for both case studies in the seven EF categories—transportation, residence, energy, goods, services, food, and waste.

Both surveys were designed to provide before-and-after comparisons, based on participant recall. The before-and-after design is more appropriate than cross-sectional data for gaining insight into whether telework is the agent of change in altering individuals' environmental impacts, particularly when working with small samples where it is difficult to statistically control other variables. However, as the closing section will discuss, other challenges related to comparisons over time became apparent. A second design issue relates to the use of the individual teleworker as the unit of analysis for this investigation. The associated insights thus do not account for any offsetting changes by other household members or by the respective employers. This matter is also considered further in the discussion.

## Results

Analysis of the data from the two case studies indicates that telework altered behavioral patterns for all participants. In many instances, changes occurred in the same category and in the same direction, but individual circumstances translated into differences in the extent of change. Two main findings emerge. First, telework affected a range of factors that, in combination, make overall impacts highly variable and difficult to predict. Second, for any given impact there were myriad pathways of change.

### *Case 1: Pathways of Change*

For transportation, findings from Case 1 are consistent with previous studies, in that commuting trips were reduced and other personal-travel modifications were relatively minor, although changes occurred in both directions and in various ways. Fourteen participants (from a sample of 24) eliminated their daily commute completely with only occasional trips (i.e., once a month) to the office. Most other participants

reduced commuting by two to four days per week. Accordingly, a large majority of participants reported traveling less overall after adopting telework. In some instances, the net travel reduction was related to the lack of a commute. In the words of one respondent,

I would say I drive less...there would be less use of my car overall.

Some respondents indicated that home-based work allowed more efficient travel, with better planned and combined trips, since it was no longer necessary to "rush home" after work to cook supper, pick up children from daycare, or look after pets. However, in a few cases, participants did note that personal travel was either induced by telework or increased overall. One respondent commented,

[B]ecause I am in a home office, I need to get out, so on the weekends I [travel to see relatives by car].

Another participant noted that her travel modes had changed. In this instance, the respondent's flexible schedule allowed her to walk her children to school, as opposed to driving them on the way to work.

With respect to residential changes, findings indicate that telework can affect housing decisions and investments. Eleven respondents stated that they made at least some modifications to their homes (e.g., renovate basement, complete additions) due to telework. There was also evidence that telework factored into decisions regarding multiple-home ownership, for example, with one respondent dwelling in the country and another closer to the corporate office for days requiring office-based activity. Telework was also associated with relocation into larger dwellings for two of the 24 participants:

In fact [telework] was part of the reason why we moved [to the suburbs]...into a bigger home where I could devote one of the bedrooms to an office.

I moved from an apartment into a townhouse [partly motivated by telework] where I could have a separate room for my office.

As for energy consumption, several Case 1 participants noted that, when the home office was located in a basement, space heaters were required in addition to raising the central-furnace thermostat. For two respondents, space-heating requirements rose

<sup>6</sup> A spreadsheet developed by Wackernagel et al. (2003) was used to assess an individual teleworker's EF. Average consumption data for each component is available to calculate the EF for an average person in the United States (9.7 hectares). For average Canadian consumption data, the consumption values were scaled down to make the overall EF reflect their reported Canadian average (8.8 hectares). This figure assumes that the difference between the United States and Canadian data originates solely with respect to consumption (not the supporting land-conversion values) and that for each component, consumption is proportionately less. The net effect of this assumption, however, should be minimal because the present undertaking is mainly concerned with changes in EF, not absolute value. In the EF, seven impact categories are considered: transportation, residence, energy, goods, services, food, and waste.

due to an increase in dwelling size, and in the households of three participants electricity consumption increased due to more frequent meal preparation within the home and use of electronic equipment. In fact, when asked generally about the comfort of their home offices or the drawbacks of telework, 11 of the 24 participants specifically noted an increase in electricity and space-heating use. The comments of one individual are instructive:

There is an increase in heating and electricity cost. When [I was not working from home] I kept the thermostat at about 17 [degrees Celsius], and now of course it has to be higher because I am home all day.

The interviews also revealed that telework increased goods consumption in certain instances (e.g., furniture, electronic equipment), but prompted a decrease in other areas (e.g., clothing). All of the respondents in this case study acquired an additional computer, fax, printer, scanner, and telephone—paid for by the employer. Fifteen teleworkers purchased additional furniture, ranging from a new chair to completely new office furnishings. One participant explained this upgrade in the following terms:

[Due to working from home] I got a filing cabinet, a desk that has a bookcase on top of it...I've got a chair, that is an ergonomic chair. And I've got a protector plastic mat on the floor.

At this point it remains unclear as to how many of these acquisitions were offset by a corresponding decrease in goods at the workplace. It is evident from our interviews that some compensation did occur. For example, one respondent reported that her customary work desk was simply sent home, and, in most cases, employees no longer retained a dedicated workspace at the central office. However, we also heard accounts of non-telework-related acquisitions. Eight participants purchased extra furniture and/or stereo systems, or redecorated their houses because they now spent more time at home. There was also intimation from two respondents that working from home reduced the lifespan of their office equipment because of a need for more frequent updates to stay connected with the workplace. It was not, however, clear whether actual updates were more frequent than under prior circumstances or whether there was a perception of increased frequency due to having to make the purchases oneself. In addition to these direct effects on consumption, the new work practices also altered the acquisition of products not normally

considered. For example, one respondent reported that

I used to have a closet full of clothes that I used to wear five days a week...but I really don't need that much anymore [working from home].

Another noted,

I need more garbage bags, more light bulbs, more storage containers and a shredder working from home.

Participants also indicated an increased type and quantity of services consumed. All of the Case 1 participants reported installing an extra Internet and phone connection due to telework, and five indicated more frequent use of courier services to communicate with the central office. For example, a respondent observed specifically,

The courier comes almost every day [now that I work at home].

In terms of personal services, some Case 1 participants discussed how they were able to reduce their external laundry or dry-cleaning requirements. However, some also noticed an increase in their spending on hotels/motels when visiting the central office, because it was now further from their homes.

With respect to food, several participants discussed how telework had caused a shift to healthier diets (i.e., increase in vegetable consumption, decrease in meat consumption), which would logically decrease food-related environmental impacts. A reduction in expenditures on restaurant meals was also frequent. In fact, eight participants made specific comments about their changed eating habits. A representative observation was,

I cook more [working from home] than I used to [working from an office]...because I'm home right at 4:30 I make a real supper most nights, instead of picking up a cooked chicken at [the grocery store] on the way home or whatever...so I cook more.

Participants also generally indicated that working from home allowed them to reduce lunch expenditures. When asked how home-based work affected participants' health, eight reported a positive change in their diet. For example:

I ate very healthy [working from home]...I would often eat carrots as my snack

food...that was huge... [for lunch] I had a poached egg or something like that rather than eating junk food at a restaurant or cafeteria.

Respondents attributed these dietary changes to a more flexible schedule and easier access to nutritious food. Only one participant noted a negative change in diet.

Finally, the interviews revealed that telework likely raised waste flows into the municipal system, primarily due to an increase in consumption. There were, though, indications of elevated recycling rates, as captured in the following comment:

You know when I am finished with my files I write on the back of them, it is my scrap paper, whereas [working from the corporate office] I felt obliged to throw all that stuff out.

### Case 2: The Magnitude of Change

The second case study involved data gathering on consumption from a sample of public employees. In a self-administered survey, participants were asked to indicate the percentage change that occurred in their behavior in all EF categories since taking up telework and specify how much of this change could actually be attributed to telework as opposed to other lifestyle factors. These percentage changes were then combined with data on the average Canadian EF to estimate the change in EF due to telework. This approach assumes that these teleworkers, as a group, were average in their behavior before they began teleworking. Participants were also asked to comment on difficulties they encountered in answering the question.

The findings confirm that telework influences many aspects of participants' lives and the extent of change for different impact categories is variable across study participants (Figure 1). Interestingly, for these respondents, all of the net effects were increases in the EF, indicating that telework's sustainability effects are not guaranteed for every individual. Figure 1 illustrates the change in EF in each of the six impact categories for the nine respondents that comprised this case study. Each bar corresponds to a specific respondent, and the right-hand total indicates the net change in EF for each participant.

Increases in total individual EF ranged from approximately 0.3 hectares to over 1.1 hectares. For purposes of comparison, the current Canadian EF is 8.8 hectares, and approximately 1 hectare can be gained from an extra 10-hour trip by airplane each year. Hence, the change in EF due to telework makes a sizeable contribution to the total for some sample

participants. In terms of the six consumption categories, food showed the least degree of change. Four participants reported no change, four others decreased slightly the food component of their EF due to adjustments in their meal preparation, and one noted the opposite trend.

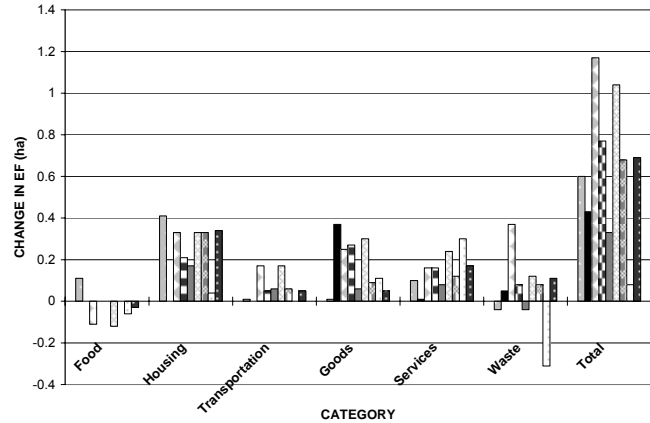


Figure 1. Change in ecological footprint of Case 2 participants attributed to telework.

The next four consumption categories—housing, transportation, goods, and services—all increased or remained unchanged for each of the nine participants. Housing contributed almost half of the total increase in EF for five participants and about 30% of the total increase for two participants. Two other respondents, however, evinced little change in their housing footprint. Transportation increased for most participants (despite the opposite trend reported in the literature), although these changes, as discussed in the next section, seem attributable to factors other than telework alone.<sup>7</sup> Goods consumption increased for all participants, but ranged from less than 0.1 hectare to over 0.35 hectare. The extent of the change depends on whether participants attributed purchases of secondary-household items, in addition to office furniture, to telework. Increases in service consumption also varied by participant, from less than 0.1 hectare to less than 0.3 hectare. However, six of the nine participants increased the service component of their EF on the order of 0.1 hectare. These increases are mainly related to greater use of the Internet and courier services. One participant required regular hotel accommodation due to spatial separation of her home from the central office.

Finally, changes in EF in the waste category fluctuated widely among participants. One individual

<sup>7</sup> On a hypothetical note, even if all nine participants had achieved reductions in the transport component of their overall EF that were similar in magnitude (0.14 hectares) to those in Woods' (2003) study of British teleworkers, eight of the Canadians would still have experienced an increase in total EF.

attributed almost half of the increase in total EF to waste, while another respondent saw a change similar in magnitude, but opposite in direction. Two other individuals saw more modest decreases, and five increased the waste component of their EF by approximately 0.1 hectare. The difference in direction depends on whether participants felt that working at home allowed for more re-use of materials and more stringent recycling systems. Increases in waste are related to the duplication of equipment and the transfer of documents between home and central offices.

## Results in the Context of the Literature

Table 1 summarizes the direction of change for each impact category, as generally reported in the extant literature and the two Canadian case studies described here. Apart from transportation data, the direction of change is consistent across the three information sources. The food component of the EF decreases, but residence, energy, goods, services, and waste increase. Work-related transportation impacts for the Case 2 participants were found to increase due to job-responsibility changes over time. In fact, the three participants who reported less work travel were the only ones who held the same job, or jobs with similar travel requirements, in the before-and-after periods. Six other individuals moved on to other positions. At a societal level, the opportunities afforded by telework resulted in an enlarged transportation footprint. Nevertheless, the before-and-after comparison at the individual level does not allow for a firm determination of telework-induced transport changes *per se*, because changes in jobs confound these adjustments.

**Table 1** Direction of change in environmental impact due to telework.

CATEGORY	LITERATURE	CASE 1	CASE 2
Food	N/A	↓	↓
Residence	↑	↑	↑
Energy	↑	↑	↑
Transportation	↓	↓	↑*
Goods	↑	↑	↑
Services	N/A	↑	↑
Waste	↑	↑	↑
Total	↑ or ↓	N/A	↑

\*See text for explanation

Both case studies, however, provide a basis for considering various theories of environmental behavior, particularly the importance of barriers to change (McKenzie-Mohr, 2000; Kennedy et al. 2001). In many instances, telework removed a barrier to a preferred and more sustainable lifestyle change. For example, the replacement of a rigid work schedule with a flexible means of managing work allowed

participants time for exercise, healthier eating, and improved housework and childcare management (see also Shaw et al. 2003). Similarly, the elimination of commuting time created opportunities for respondents to plan travel more efficiently. In other instances, however, telework introduced new motivations for environmentally harmful behaviors that were not curbed by structural barriers. For example, the social isolation caused by telework appears to motivate increased personal travel, and the need to spend more time at home spurs the purchase of new home-entertainment systems. In summary, the study of barriers alone cannot completely illuminate the various lifestyle changes that accompany the adoption of telework, and data limitations prohibit firm conclusions with respect to behavioral change. Nevertheless, this topic warrants further investigation as a way of facilitating change toward sustainability.

## Research Design and Sustainability Assessment

The current study also provides a basis for commenting on research-design issues more broadly related to sustainability assessment. The identification and measurement of change is generally based on before-and-after comparisons, especially when the sample size is modest. However, participants in both case studies had difficulties with recall and were not always able to separate telework impacts from other lifestyle changes. In other before-and-after comparisons, workers have been observed in their office settings and then again after telework was introduced (see, e.g., Statistics Canada, 1995). However, this methodology requires advance appraisal of organizational decisions and cannot avoid the problem of “honeymoon” effects unless the study has a long duration. An alternative approach is to use a with-without design in which data on office workers and teleworkers are compared after controlling for external variables. However, large public data-sets do not yet provide sufficiently detailed information. In sampling teleworkers, it is difficult to generate large respondent pools because telework is often informal and institutions are typically reluctant to allow researchers to interview employees on organizational policies (McCloskey & Igbaria, 1998; Bailey & Kurland, 2002). Therefore, before-and-after comparisons can provide a reasonable indication of telework as an agent of change, but some impact categories must be interpreted with more caution than others.

In terms of the EF, the collection of self-reported data has limitations. Case 2 participants, for instance, were asked directly about consumption patterns. The main problem here is that participants generally lack sufficient knowledge to provide accurate consumption data in the form required for EF calculations

(e.g., weight of furniture owned). Respondents were therefore asked to place themselves within a category of percent change. Nevertheless, the accuracy of the data was constrained because some participants did not track certain changes. Thus, the reliability of self-report data as a measure of environmental impacts has not been addressed in previous EF studies, a potentially important issue regarding individual behavioral change (Hamilton, 1985; Newell et al. 1999; Yu et al. 2000; Parslow et al. 2003; Tucker, 2003).

Another matter that warrants comment is the use of the individual as the unit of analysis. In transportation-related studies of telework, it is widely recognized that other household members are crucial to gaining a complete picture of telework-induced travel changes (Helling & Mokhtarian, 2001; Andrey et al. 2005). There is also growing appreciation that travel effects are even possible at the societal level, such as induced or latent travel demand when congestion is indeed reduced. For other impact categories, such as goods and services, the actions of employers, rather than other household members, are fundamental to understanding the extent and nature of overall change. In the current study, these matters could not be addressed completely because our focus was on the individual teleworking employee. For example, it is known that the organization employing Case 1 participants did eliminate some office space previously dedicated to the affected work groups, while the Case 2 employer fully duplicated office space. However, without additional data we cannot ascertain the net effect of these different institutional decisions. Efforts to gain insight into firm decisions may be difficult and costly. Nonetheless, including other household members in transportation research is common and past EF studies have already incorporated research designs that measure consumption at the household or organizational level (Roy & Caird, 2001; Wackernagel et al. 2003; Wood, 2003; Andrey et al. 2005). The light that integrated assessments of telework can shed on behavioral processes and the environmental impacts of changing work arrangements can aid efforts to secure funding for comprehensive studies.

Furthermore, the EF does not require an understanding about causal relationships between various influences on individual behavior. While this simplifies analysis and ensures all impacts are considered even if causal relationships are not understood (obviously, often the case in individual behavioral change), it also renders the tool less useful as the basis for planning and policymaking. For instance, an EF provides no details on the number and type of automobile trips and the motivations that caused them, yet planners and policymakers require this information for transportation management. Despite

this drawback, the EF creates a common denominator that allows for the comparative analysis of various opposing impacts. Moreover, other environmental indicators often require analysts to subjectively weight relative impacts.

### *The Three Dimensions of Sustainability*

Although this paper only considers environmental sustainability, it is important that the three dimensions of sustainability—environmental, social and economic—be addressed so that a comprehensive understanding of telework can facilitate appropriate policies and practices. This is easier said than done. While a range of qualitative sustainability-assessment tools is available to capture all three dimensions, it is usually necessary to make value judgments by assigning weights. While these tools may work at larger scales, where sustainability assessment includes broad community participation, they are unable to provide a consistent multi-scaler basis for sustainability analysis and hence would not work well at the individual level. A multi-tool research design, using a combination of interviews and surveys, in conjunction with spending and travel diaries, would be required to gain sufficient insight into all dimensions of sustainability. The environmental data for the Case 1 participants discussed above are complemented with rich and varied data on the social implications of telework, as reported in Shaw et al. (2003) and Johnson et al. (2007). However, the study's intensive nature resulted in a modest sample size which necessarily limits the generalizability of the results. Also, several steps were integral to getting support from prospective participants: contact through their employer with a promise of absolute confidentiality for individual responses (but that mutual concerns and best practices would be shared with corporate management); contact by the principal researcher; and payment of an honorarium for each of the study components. Even so, the sample size under such circumstances is likely to be modest and the costs of conducting a true before-and-after study on a statistically representative sample are large. These dilemmas make it difficult to adequately address the trade-offs among the three dimensions of sustainability.

Therefore, rather than weighing environmental versus social or economic gains/losses, innovative research may suggest sustainability solutions to try to ensure benefits within each of the three dimensions and to optimize particular salient benefits. Because of recognition that telework benefits are not automatic, a European Union project, for example, has begun to advise employers and employees on designing telework programs to ensure overall social gains (Hopkinson et al. 2002). Heinonen & Lahti (2002) also

speculate that telework may have detrimental effects and thus recommend the concept of “eco-managed” teleworkers, where employers and employees agree on best-practice patterns of telework and mobility. Preferred actions include eliminating or sharing workplace office space, avoiding duplicating equipment and corporate reports, moving existing office furniture into home offices, and discussing travel behavior with teleworkers. Laura Johnson (1999, 2003) has illustrated how satellite offices—commonly referred to as telework offices or telecenters—could reduce fears of social isolation commonly associated with home-based telework. Perhaps all that can be done in practice is to highlight a comprehensive range of social, economic, and environmental impacts that can arise from telework so that planners, policymakers, employers, and employees can make informed choices (e.g., Hopkinson et al. 2002).

## Conclusion

The interview and questionnaire data assembled for the current study indicate that, beyond creating far-reaching changes in participants’ lives, telework has potentially important environmental impacts. Of particular interest is that the range and pathways of change varied markedly across individuals—even among respondents at similar life stages with similar jobs—and this lack of congruity highlights the complex nature of the behavioral responses associated with telework. Because changes occurred in various categories, assessment of telework’s environmental implications must move beyond single-issue studies. For example, the assumed benefits of telework for society at large must be carefully examined to avoid promoting telework’s ostensible tendency to reduce air pollution only to find that other harmful effects offset these gains. We have provided here an exploratory investigation that we hope will be the start of a long succession of studies on the sustainability implications of telework.

While researchers must be aware of data limitations, the EF framework works well in this context because it considers a broader array of environmental consequences in relation to carrying capacity. The EF has been applauded for being an easy-to-use sustainability-assessment tool. However, at this point it is still unclear whether it can illuminate our understanding of sustainability solutions. The qualitative information provided by the first case study tells us how to enhance the sustainability of policy-induced socioeconomic changes. The EF, however, can inform us how far from sustainability we actually are—an important initial step in trying to find effective solutions. Qualitative information on pathways of change therefore seems to complement quantitative

estimates of environmental consequences. Indeed, we would argue that this type of comprehensive thinking should guide assessments of behavioral responses and socioeconomic changes in the sustainability context in general.

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## ARTICLE

# Collaboration for sustainability? A framework for analyzing government impacts in collaborative-environmental management

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Citizen participation and empowerment are critical sustainability elements. One increasingly popular form of citizen participation is collaborative-environmental management (CEM). This approach has been described as a new way of governing for environmental issues, an alternative to government-centered processes, that empowers stakeholders and citizens to play a dominant role in planning and decision making. This paper describes a new analytical framework, called the Governmental Impact Framework, for understanding how government affects CEM and the sustainability of outcomes. This framework incorporates institutional analysis to illuminate government-stakeholder relationships and the interplay of biophysical and social factors. Applying the framework to a collaborative land-use planning case in the American state of Ohio indicates that governments are more dominant in collaborative processes than previously thought, and that the channels of influence vary along several dimensions.

**KEYWORDS:** community involvement, sustainable development, local planning, environmental management, environmental incentives, government programs, environmental policy, human impact, environmental planning, land use

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## Introduction

A key component of sustainability and sustainable development is citizen empowerment in decisions shaping social and environmental conditions. Across a wide range of settings, community participation has been found to affect sustainability prospects. This supports the Brundtland Commission's seminal report on sustainable development (WCED, 1987), which argued that, for communities to articulate and enforce their common interest in sustaining natural resources, community members need to effectively participate in decision making. Moreover, a leading scholar in common pool resource management concluded that including affected individuals in rule making about resources is critical for sustainable human-environment systems (Ostrom, 1990). In addition, the "seeds of change" approach to sustainable development argues that empowering local citizens to participate and take action in their own "backyards" is a prerequisite for sustainable communities (Cuthill, 2002).

One strategy to foster citizen participation and empowerment is the decentralization, or transfer of authority, from central governments to local governments or community organizations. While this may seem straightforward, it often does not happen. Moreover, such divestment neglects possible governmental contributions in expertise, technical infor-

mation, manpower, institutional networks, or other resources. In fact, sustainability scholars have emphasized the importance of collaboration among a range of individuals, both within and outside formal government structures (Becker et al. 1999; de Jongh & Captain, 1999).

While many government policies have led to unsustainable results, government also assists in fostering sustainability. At a minimum, government can recognize community rights to make resource-use decisions and rules tailored to the local context (Ostrom, 1990). Structures and institutions that increase government transparency and accountability can strengthen citizen empowerment to achieve sustainable results (Lyons et al. 2001). More actively, government might create institutions to encourage individual behavioral changes and encourage policy changes that address local environmental issues (Rich et al. 1995).

An increasingly popular institution for addressing environmental issues is collaborative-environmental management (CEM). Collaboration refers to a process of engaging citizens, along with government officials and other interested stakeholders, in all phases of the policy process. Whereas some forms of participation are directed at gathering citizen input on plans developed by public administrators, collaboration involves engaging stakeholders in priority setting and in the planning, implementation, and evaluation of solutions. It is a process in which diverse stake-

holders work together to resolve a conflict or develop and advance a shared vision (Gray, 1989). By coming together and deliberating, stakeholders generate a more comprehensive understanding of problems and possible remedies.<sup>1</sup>

CEM has arisen in a wide variety of contexts. Sometimes, government agencies promote it to generate outcomes unattainable via more traditional approaches. In the United States, the Environmental Protection Agency has expended millions of dollars through its Section 319 grant program to provide funding for collaborative-watershed projects. States such as Ohio, Colorado, West Virginia, Washington, and California have promoted collaborative-watershed efforts through technical assistance, funding, and provision of personnel (Collins et al. 1998; Schott & Koontz 2002; Steelman & Carmin, 2002; Sabatier et al. 2005). CEM has also been conducted in the Netherlands, Canada, Australia, the United Kingdom, and Southeast Asia (de Jongh & Captain, 1999; Meadowcroft, 1999; Leach & Pelkey, 2001).

Grassroots-citizen organizations have initiated some CEM efforts. In such cases, concerned citizens typically perceive an environmental-management crisis that government has caused or has not adequately addressed. The citizens respond by creating a collaborative group that draws in government officials as participants. One such case was the Applegate partnership in Oregon, as described by Moseley (1999). In the face of litigation and acrimony surrounding northern spotted-owl protection, the Forest Service and Bureau of Land Management dramatically reduced timber-harvesting activities from federal public lands in the Applegate Valley. Residents concerned about jobs, social conditions, and the environment united to advance their shared interests in the public lands, inviting federal officials to participate. Marsten (2001), Snow (2001), Steelman & Carmin (2001), Weber (2003), and others have described similar citizen initiated “grassroots” collaborative efforts.

Whether citizen-initiated or government sparked, CEM efforts often have been described as a new way of governing and an alternative to government-centered policy. But governments rarely leave the picture entirely. They are often key stakeholders and, even if not, provide the institutional and political setting within which CEM efforts play out. As more citizens and government officials grapple with increasingly complex, multi-media, multi-jurisdictional environmental-management issues, and as more parties engage in collaborative efforts, we need to examine

more carefully governmental roles in CEM, and how these roles affect sustainability.

This paper uses the analytical framework developed by Koontz et al. (2004) to examine a collaborative-management effort in the United States. After explaining how the framework combines environmental and social elements, the paper then applies it to a multiple-case study of collaborative planning for farmland preservation. Although sustainability may be most often associated with forests and watersheds, productive farmland represents a critical resource at the human-environment interface that has long been viewed as important for social and ecological sustainability (Olson & Lyson, 1999). The paper concludes with a discussion of how collaboration in farmland preservation suggests broader implications for sustainability and government involvement in other collaborative efforts.

### A New Analytical Framework

The analytical framework employed here draws on prior research about the factors affecting CEM processes and outcomes, combined with insights from institutional analysis. In particular, the Institutional Analysis and Development (IAD) framework developed by Ostrom and colleagues (1994) provides a key foundation. The IAD framework suggests sets of variables likely to affect outcomes arising from human interaction in light of biophysical, cultural, and institutional contexts. As a framework rather than a theory, IAD organizes inquiry and can be animated by particular theories to match a given setting. For example, scholars attempting to understand behavior within markets may employ neoclassical microeconomic theory, while those who study behavior in hierarchies may draw on principal-agent theories.

The IAD framework emphasizes the importance of rules and institutions. Rules are prescriptions that forbid, permit, or require certain actions in particular contexts and specify the sanctions authorized if the prescriptions are violated (Crawford & Ostrom, 1995). By creating, enforcing, and changing rules, a group of individuals may be able to overcome collective-action dilemmas. More broadly, people create other institutions, such as norms and shared strategies that influence individual choices. Fundamentally, human action both affects, and is affected by, institutions. Thus, the IAD framework draws the analyst's attention to the interactions between institutions and individual decision making, as well as the interactions of these variables with aspects of the physical world and community culture. The focal point in the IAD framework is the “action arena” where participants decide among diverse actions (Ostrom, 1990; Ostrom et al. 1994; Imperial, 1999).

<sup>1</sup> For key works addressing CEM see Cortner & Moote, 1999; Wondolleck & Yaffee, 2000; Brick et al. 2001; Leach et al. 2002; Koontz et al. 2004; Sabatier et al. 2005.

The IAD framework provides a solid foundation for questions about interorganizational and interpersonal relationships relating to the environment and decision making. From this basis, plus additional insights from other scholarship, Koontz et al. (2004) developed a framework for analyzing governmental impacts on collaborative-environmental management. This new framework specifies that governments, both as institutions and as actors, affect CEM efforts. Government impacts CEM through three primary channels: issue definition, resources, and structure/decision processes. Figure 1 illustrates the analytical framework.

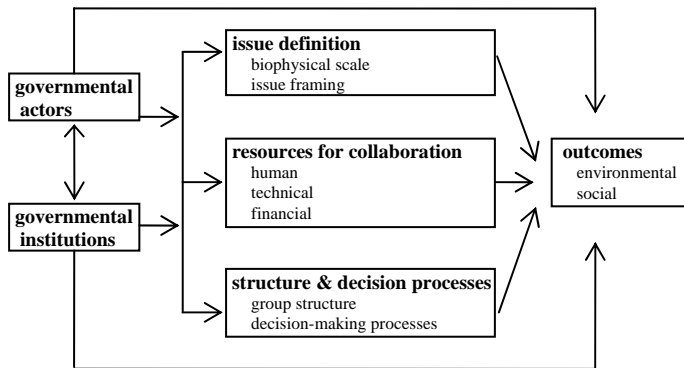


Figure 1. Framework for Analyzing Governmental Impacts on Collaborative-Environmental Management (Koontz et al. 2004)

Governmental actors are people with attitudes, beliefs, skills, and values who engage in decision making and interactions that can influence collaborative processes and outcomes. Governmental institutions are the rules, structures, laws, norms, and socio-cultural processes of the administrative state that shape human action. While governmental institutions provide constraints and opportunities within which governmental actors work, at the same time governmental actors may shape and alter governmental institutions.

Issue definition refers to how an issue is framed, what set of solutions is considered, and the issue's scale. Political scientists and policy scholars have long examined the struggles over framing an issue, which can greatly affect which stakeholders become involved and how the issue works through political and administrative processes (Schattschneider, 1960; Snow & Benford, 1988). The biophysical scale of an issue is of particular importance for environmental management, because it involves multiple scales across a landscape. For example, on a fine scale, watershed-management efforts may involve tributaries or portions of stream reaches, but these are embedded in broader-scale units, including sub-basins and ba-

sins that may cover thousands of square miles. Choices about the ecological scale of management can have profound effects on collaborative processes and outcomes (Thomas, 1999).

Resources for collaboration divide into three broad categories: human, technical, and financial. Human resources include a collaborative effort's volunteers, leaders, and staff members. These individuals possess knowledge, skills, and experience that may advance collaboration. In many cases, an entrepreneurial leader must be available to establish a new collaborative group (see Moseley, 1999). Technical resources refer to knowledge about the environment, and about the local context, that can inform collaborative efforts. Such capabilities may be found among group members or garnered from external sources. Finally, financial resources are the funding and in-kind contributions that allow a group to conduct business and perform activities. The amount and sources of funding shapes group activities substantially. For instance, member donations may be applied to a wide variety of activities, while grants may stipulate the activities to be performed (Steelman & Carmin, 2001).

Group structure refers to the way membership and activities are organized. Some groups rely on a strong leader while others create shared leadership through advisory boards or executive councils. Group structure includes the administrative processes that coordinate work, such as monthly meetings and standing or ad-hoc committees. Group decision-making processes are the means of aggregating individual preferences into decisions. A common decision rule is consensus, though not all collaborative groups use this approach, and different rules may be used for different types of group decisions. Group decision-making processes may be used to select participants, create plans, choose strategies, and allocate resources, among other things. A group's authority to make externally binding decisions is important. Often, collaborative groups are advisory only, in that policymakers (government agencies and elected officials) can accept or reject any recommendations, but in some instances collaborative groups may be granted policy authority.

CEM outcomes are notoriously difficult to evaluate. Many scholars argue that the ultimate measure of success is ecological conditions (Schweik & Thomas, 2002; Conley & Moote, 2003; Sabatier et al. 2005). Environmental sustainability, by its very nature, suggests conditions that endure. But it is extremely difficult to link CEM processes to ecological conditions due to long time horizons and multiple interacting variables. Moreover, few CEM groups monitor their activities' environmental-quality effects; instead they focus on more tangible outcomes

like plans, projects, best-management practices, and policy changes. In this study, the focus is on these more concrete outcomes, especially farmland preservation-plan creation and implementation.

In addition to environmental conditions, social conditions are a core element of sustainability. Thus, measurement can include social outcomes such as individual well-being, equity, and enhanced community cohesion regarding pressing problems. Prior studies indicate that collaboration may lead to improved trust and understanding among diverse stakeholders, as well as to increased legitimacy in the broader community for particular activities. In this study, social-outcome measures focus on community-capacity enhancement to solve problems, including network building and understanding.

### **Applying the Framework to Farmland Preservation**

Farmland is an important natural resource critical to both human societies and ecological systems. But 1.2 million acres of productive farmland in the United States is converted each year to development (American Farmland Trust, 2006). Conversion of prime farmland to housing, roads, parking lots, and other physical infrastructure has harmed rural cultures and economies in many parts of the country (Daniels, 1999; Olson & Lyson, 1999) and degraded biodiversity, wildlife habitat, and water quality (Reilly 1996; Heimlich & Anderson 2001; Hansen et al. 2005; Theobald et al. 2005). A number of states have responded by encouraging preservation planning. The state of Ohio, for instance, created a grant program to encourage local-stakeholder collaboration to preserve farmland, as described below.

#### ***The Ohio Farmland Preservation Planning Program***

In June 1998, the Ohio Department of Development's Office of Housing and Community Partnerships (OHCP) announced a matching-grant program encouraging rural counties to prepare local farmland-preservation plans. The OHCP was following a recommendation from the Ohio Farmland Preservation Task Force (OFPTF), formed in 1996 to develop locally-based tools for promoting farmland preservation. The program's objective was to encourage counties to "gather appropriate data from which local goals [could] be established relative to the agricultural industry and farmland" (Graves, 1998). Goal setting was seen as a prerequisite for strategic planning. By encouraging local planning that included farmers, the OFPTF hoped to build grassroots support to sway state legislators to support farmland preservation (Wise, 2000). The Ohio Farmland Pres-

ervation Planning Program (OFPPP) was independent from other local land use-planning processes. It should be noted that Ohio has no statewide-planning mandate and local governments decide whether or not to do land-use planning. In some counties with broader programs, farmland preservation-task forces interfaced with these prior initiatives.

The OFPPP made grants of up to US\$10,000 available to each of the 81 counties eligible for Federal Small Cities Community Development Block Grant funds. Funding was contingent on the counties providing a 1:1 match in dollars or in-kind and each jurisdiction establishing a county farmland-preservation task-force that included a "cross section of interests" (Graves, 1998). The state granted the funds to county commissioners who were then responsible for creating the task forces. The grants came with very few strings attached, requiring only that each task force produce a plan that included soils information, submit it to the OHCP by December 31, 1999, and include a "cross section of interests" in creating the plan. This flexibility reflected the understanding that different counties had different capacity and readiness to address farmland preservation (Wise, 2000).

Of the 81 eligible counties, 61 participated in the grant program. The non-participating counties were disproportionately located in the economically challenged Appalachian region of southeast Ohio. The underrepresentation of this area stemmed from the low salience of farmland preservation and lack of available matching funds (Wise, 2000).

A notable, but not that unusual, aspect of the grant program was its decentralized nature. Task forces were free to operate as they saw fit, with little oversight from state officials or interaction with other task forces. Thus, local stakeholders were allowed to choose topics for investigation and emphasis in a bottom-up fashion (within the bounds of farmland preservation), as recommended by Becker et al. (1999). While county commissioners served as the official grant recipients, in practice many delegated responsibility for convening the task force to other governmental actors or to citizens. The individual leaders organized and managed the task forces in different ways across the state. In a few instances, counties folded the task forces into ongoing land-planning efforts, but most of them were stand-alone organizations.

Like many other grant programs, the OFPPP is a government institution whereby the granting agency provides financial resources and then steps aside as the grantees craft processes tailored to their local circumstances. Less politically charged than regulations, grants may be especially attractive, and they appear to support widely held commitments to vest greater authority in local decision making. But government-

grant programs, as institutions, may have a bigger impact on collaboration than conventionally thought. To investigate OFPPP impacts on task-force process and outcomes, a multiple-case study was conducted.

### Research Methods

The results described below come from a comparative case study of fifteen farmland preservation-task forces participating in the OFPPP. The principal investigator selected cases to ensure a wide range of geographic locations and urbanization levels within the American state of Ohio. First, at least two cases come from each of the following regions: central, northwest, northeast, southwest, and southeast. Second, although all of the counties in the program are designated as rural, they exhibit a range of urbanization levels. Following Sharp & Vinland (2000), at least two cases come from each non-urban county category: non-metropolitan, small metropolitan fringe, small metropolitan core, and large metropolitan fringe.

To gather information about task-force processes and outcomes, the research team interviewed two to four key informants for each task-force with each interview lasting about one hour. Outside the task forces, the research team interviewed a state official who worked closely with the county-task forces, as well as county commissioners in each of the fifteen counties two years after the task-force plans were completed. Although the research team did not attend any task-force meetings, the principal investigator was present at a statewide farmland-preservation conference that included representatives from most of the 61 grant-receiving counties. An additional data source was documentary, with the research team conducting content analysis of fifteen completed farmland-preservation plans. Other documents included task force meeting-attendance records and expenditure reports. These data yielded information about how governmental actors and institutions affected issue definition, resources, group structure and decision processes, and subsequently outcomes.

### Results

**Issue Definition:** Government grants targeted to particular issues, such as farmland preservation, play an integral role in issue definition. The OFPPP established objectives centering on preserving farmland, a fairly narrow construction, compared to a more general land-use definition, or even such alternatives as green space or open space. *Framing* the issue in terms of agricultural landscapes and farming issues is not too surprising since the grant program's impetus was a recommendation of the OFPTF that included members with high stakes in farmland preservation.

Thus, county task-force leaders invited participants primarily from the agricultural community, rather than a more diverse range of affected interests. In particular, environmental and urban interests often lacked representation on the task forces (see Table 1), diminishing support, beyond the agricultural community, for many task-force recommendations.

The grant program established the *biophysical boundaries* as the county level in rural areas (urban counties were not eligible). The county-level spatial scale was appropriate in several regards. First, the grant-program creators were aware that existing soil data from the Natural Resource Conservation Service and Ohio Department of Natural Resources were aggregated at the county level, and thus readily available for county-level planning. Second, counties in Ohio are small enough to make task-force meetings accessible to any county resident. Third, as an important political subdivision of the state, the county is where most of the land-use authority resides. This meant that task-force recommendations could be readily transmitted to the appropriate government officials. In fact, the incorporation of task-force recommendations into county land-use plans was one goal of the program (Wise, 2000).

However, by focusing only on the county scale, task forces were hindered on several fronts. In many instances, agricultural issues and farmland preservation were affected by land-use trends in other counties, yet neighboring counties were not included in the task-force deliberations. For example, watershed boundaries typically do not fall along county lines, yet land uses upstream can influence the quality of downstream water and land substantially. As another example growing urban populations and associated development in nearby counties can pressure land use in a given county, yet such forces were beyond the purview of task-force plans. It is also worth mentioning that, in some locations, land-use authority rests not with counties but with smaller townships, so the county is not always the most appropriate level for policy planning.

The OFPPP, a statewide governmental institution, was added to a set of existing governmental land-use institutions that substantially affected issue definition, especially through limits on the set of feasible policy solutions. In locations with land-use zoning ordinances in place, zoning was seen as a powerful tool for farmland-preservation plans. But in locales without existing land-use zoning ordinances, task-force members were acutely aware of the negative political ramifications of recommending zoning. As one member said, "We did not use the 'Z' word...The more rural you get, the more resistant people are to zoning."

**Table 1** Summary of governmental impacts on collaborative processes and outcomes

Item	Government as Actor	Government as Institution
Issue framing	No impact	State program framed issue as need to encourage collaborative approach to farmland conservation; local governmental-zoning rules affected feasible alternatives
Biophysical scale	No impact	State program set scale based on county boundaries
Human resources	Majority of participants in most task forces were local-governmental actors; governmental actors played leadership roles on many task forces	By delegating authority to county commissioners, program fostered participation of governmental actors; by defining issue as farmland rather than open space, the grant encouraged narrow set of interests to participate
Technical resources	Some groups received assistance from local-governmental experts	Program guidelines encouraged use of government-information sources
Financial resources	Local-governmental actors made additional contributions in some cases	State program was key funding source; flexibility led to varying ways funds were spent
Group structure	Local-governmental actors in leadership positions made group structure decisions	State-grant program did not specify structure; allowed local flexibility
Decision processes	Local-governmental actors played key role in some task forces	State grant did not specify decision making; decisions were nonbinding
Environmental outcomes	In many task forces, local-governmental officials played important leadership roles, bringing technical expertise and financial resources and making decisions about group structure and decision processes	Program funding and guidelines shaped quality of data and analysis, though plan contents varied substantially across cases; local zoning influenced plan recommendations
Social outcomes	Local-governmental actors in some task forces contributed to the development of new network ties	Grant program promoted interaction among local stakeholders

**Resources:** Through the state-grant program, counties received important *financial resources* in the form of US\$10,000 awards. Task forces could use the funds to establish groups, provide meeting space and resources, obtain technical information, and create plans. The flexibility of the grants allowed each task force to tailor its expenditures to its needs. From the state's perspective, the 1:1 match requirement created leverage to bring local resources to bear on the planning process. Task forces in a few counties garnered more than the US\$10,000 match through the entrepreneurial efforts of local political leaders and agency personnel who linked farmland preservation to other land use-planning efforts underway in their jurisdictions.

The OFPPP did not directly provide any *human resources* from the state. Rather, county commissioners were delegated authority to oversee the creation of the task forces. Such devolution of authority can help to build local capacity and increase trust, especially in a state such as Ohio with a strong tradition of local control ("home rule") in land-use matters (see Thomas, 1999). In practice, it can also hinder attempts to draw in diverse interests that are not presently part of the local-power structure. Instead of seeking leadership beyond traditional-government officials, most task forces were led by local-govern-

ment actors.

Human resources include not only group leaders, but members as well. By defining the issue as farmland preservation and by delegating responsibility to county commissioners, the state program encouraged participation by farmers and local government officials in most task forces. While these members may have had the greatest stake in farmland preservation, they also recognized that the issue did not generate much concern or policy agreement in the broader community.

The OFPPP grant guidelines had minimal *technical* requirements—only that the eventual plan include a soils map. But task forces typically went beyond this requirement, seeking to incorporate technical data. The state program did not systematically provide such information, although state officials did cooperate in convening an annual farmland-preservation conference that was well attended by task-force members from across the state. Few of the task forces turned to their peers for technical data as the grant provisions did not explicitly require or encourage them to do so. Instead, the task forces gathered information largely through trial and error. Data included in final farmland-preservation plans tended to draw on material from the census of agriculture that was not customized to fit the local conditions. Rather,

the plans typically just listed categories used in the census. The ready availability of government sources made them attractive to task forces seeking technical data.

**Group structure and decision processes:** The state-grant rules were silent on matters of group structure and decision process, so government institutions were not influential here. However, government actors led many of the task forces and their engagement in this regard led to notable impacts on this variable. Groups created a variety of structures, ranging from none to many committees and monthly to quarterly meetings with a range of agenda items. Decision processes in some task forces were consensus-based, while in others majority rule was used. The one decision rule common to all of the taskforces was their advisory function; no task-force decisions or recommendations were binding outside of the group. Thus, the task forces' ability to affect policy rested with their persuasiveness to policymakers.

**Outcomes:** The primary *environmental-management* outcome for the OFPPP planning effort was the final farmland-preservation plan. Given the diversity of resources, group structures, and decision processes, and the fact that different counties faced different political, social, economic, and land-use circumstances, it is not surprising that final plans varied considerably across the fifteen task forces. As a simple measure of complexity, the plan page counts ranged from 14 to 331, and the number of elements suggested by the state-program guidelines (e.g., number of farms in the county, geographic location of farmed acres in the county) ranged from one to twelve. The single technical requirement, that the plan contain a county-soil map, was met by just twelve of the fifteen final plans. In terms of plan implementation, two years after plan completion, commissioners in eight of the fifteen counties could point to particular recommendations that had been adopted into policy, ranging from incorporation into "smart growth" and comprehensive planning, to funding decisions for purchasing land use-development rights, to changing zoning ordinances.

These environmental outcomes are linked, in part, to the local-governmental actors who played leadership roles on many task forces. Group structure and decision-process choices shaped how they functioned and created their plans. The state-grant program, as a governmental institution, influenced plan contents by defining the issue as farmland preservation and setting the biophysical scale as the county, and by encouraging governmental actors to participate. The flexibility in how funds could be spent and in group structure and decision process led to a di-

verse array of plan contents. Local zoning ordinances, as a governmental institution, influenced the recommended set of feasible policy alternatives.

In addition to environmental outcomes, task forces generated many *social outcomes*. Social capital was often enhanced, with many members more willing to participate in future community problem-solving. At the same time, however, some task-force members' motivation was dampened by a lack of implementation. Members who expected their recommendations to lead to change were frustrated when policy enactment proved slow. Another social outcome, network building, was widely realized with key informants in twelve of the fifteen task forces reporting improved network ties after the planning process. These ties were often prompted by governmental actors who shared their connections with people and organizations outside the task forces. Finally, in all fifteen cases, key informants reported that the grant program led to increased stakeholder interaction and greater understanding of farmland-preservation issues and possible solutions.

## Discussion

As described above, the framework for analyzing governmental impact can help us to understand how government as both institution and actor can affect CEM through issue definition, resources, and group structure and decision processes. In the case of farmland-preservation planning, the OFPPP, a governmental institution, sparked the initial collaborative efforts, defined the issue, and provided the bulk of the financial resources for many groups. The program also interfaced with local-governmental institutions—zoning ordinances—which constrained the recommended set of feasible policy alternatives.

The role of government as actor was played not by state officials, but by a wide range of local-government officials who were involved in creating and maintaining task forces and planning activities. In many groups, governmental actors provided critical human, technical, and financial resources. Moreover, governmental actors participating in the task forces were involved in establishing group structures and processes. The importance of local-governmental institutions and actors in shaping the task forces indicates that, even as one government seeks to spark collaboration through purely institutional means, the way in which that collaboration plays out can depend on governmental actors and institutions at other levels.

Overall, the farmland-preservation study illustrates that, when government resources encourage collaboration they typically have wide-ranging impacts beyond resource levels. While a grantor may

desire to let its grantees work with flexibility and be responsive to local conditions, in fact the recipient is not likely to work “outside of government.” Rather, government actors and institutions at multiple levels will affect local collaborative efforts. Thus, collaboration is not an alternative to government; rather, it occurs within constraints and opportunities created by existing governmental institutions.

While governmental institutions often significantly affect collaborative activities, it is important to note that governmental actors can mediate the impact of institutional initiatives. For example, entrepreneurial government actors in some of the county-task forces were able to tap into other government institutions for additional resources.

Another implication of this study is the importance of stakeholder expectations. The OFPPP created a purely advisory role for the county-task forces. Yet some key informants expressed disappointment at the limited degree to which their recommendations were adopted by county commissioners. For task-force members who had expended considerable time and energy in the collaborative process, seeing their recommendations “gathering dust on a shelf” reduced their enthusiasm for future collaboration. Obviously, this diminishes the social outcome of increasing community capacity to work together to solve future problems. In fact, such collaborative “fatigue” has been noted in other research studies (e.g., Korfmacher, 1998).

These results lead to suggestions for public managers and policymakers looking to CEM to solve environmental problems. For managers, it is important to be explicit about citizens’ roles in the policy process, especially the degree to which collaborative recommendations will be binding. Participants who expect that their recommendations will carry weight in policymaking can become disillusioned and distrustful if they are subsequently treated only as advisory, rather than empowered as Cuthill (2002) and others recommend.

For policymakers, it is important to consider the costs and benefits of collaborative approaches and to choose when and where to support such efforts. Collaboration is more likely to succeed when agencies and actors are willing to adopt more flexible approaches to planning and implementation, as compared with traditional regulatory approaches. This can foster the Brundtland Commission’s recommendation to provide community members with opportunities to effectively participate in decision-making processes (WCED, 1987). Allowing local groups to address issues in contextually relevant ways is likely to yield outcomes that vary across locations. Some agencies with strong traditions of technocratic exper-

tise may have a culture and bureaucratic structures that resist collaboration.

## Conclusion

Citizen participation in policy and decision making is an important element of sustainability. Government and citizens have been collaborating in the environmental arena for a number of years, yet careful empirical study across cases is just beginning. While each case of collaboration is born of a specific context, with a particular set of stakeholders facing particular issues, social scientists need to seek underlying concepts to better inform public managers, policymakers, and citizens about the links between government and collaborative efforts, and how these efforts affect sustainability.

This paper has presented an analytical framework, developed from prior research and cross-case analysis, to orient researchers to particular sets of variables for investigation. The framework suggests governmental actors and institutions influence CEM processes primarily through issue definition, resources, and group structure and decision processes, which ultimately affect environmental and social outcomes. These dimensions provide guidance for understanding the workings of a farmland-preservation program implemented in the American state of Ohio. While government-as-institution determined issue definition and provided critical financial resources, government-as-actor shaped human and technical resources and group structure and decision processes. In the end, high plan variability reflected differences in local contexts, even as the program led to substantial social outcomes across most of the groups.

The results highlight the thorny issue of citizen roles and expectations, including whether group recommendations will be binding. Since citizen trust and future capacity to solve collective issues depends, in part, on congruence between expectations and reality, managers should clearly articulate the degree to which authority will be shared with citizens. Some governmental actors, especially those that emphasize technocratic expertise, may resist such sharing of authority.

If we are to make informed choices about collaborative solutions for environmental and social problems, we need analytical tools to empirically examine this growing approach. Unpacking the term “government” into the concepts of actors and institutions can help to clarify governmental roles and influence on collaborative efforts. Thus, the framework presented here should provide useful guidance for understanding CEM and its contributions to sustainability.



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## ARTICLE

# Understanding decentralized forest governance: an application of the institutional analysis and development framework

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This paper analyzes how local institutional arrangements shape outcomes in the increasingly decentralized policy regimes of the non-industrialized world. The goal is to evaluate local institutional strategies associated with effective forest governance. I use the Institutional Analysis and Development (IAD) framework to study the institutional conditions conducive to effective decentralized forest governance and how these relate to sustainability. The IAD-guided analysis allows me to formulate a series of testable hypotheses about which institutional factors influence the likelihood for successful governance outcomes in a decentralized context. I then test the hypotheses using recent empirical data from forestry-sector activities in 32 randomly selected municipal governments in Bolivia. Preliminary results suggest that local governance systems are more successful when the system's governance actors enjoy favorable conditions for information exchange and learning.

KEYWORDS: local planning, local politics, developing world, forestry, resource management, development policy

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## Introduction

During the past two decades, extensive policy reforms have fundamentally transformed the institutional conditions for natural-resource governance in most developing countries. In the aftermath of colonialism, centralized governments in the developing world took it upon themselves to govern all of the valuable resources under their territorial control. More recently, however, practically all non-industrial nations have witnessed major policy shifts. As both centralized and free-market-oriented solutions have floundered, new, more decentralized institutional arrangements that seek to incorporate local actors and communities have emerged. Today, a much larger number of actors have come to influence how environmental assets are used.

These ongoing policy reforms have attracted the attention of policy analysts, academics, and activists. The literature on the subject has literally exploded in the last decade. For many observers, decentralization policies are a panacea that will solve all past problems regarding unsustainable development. For others, they are a tragedy that will lead to disordered resource use and a "race to the bottom" in which local governments will undercut each others' leniency to attract investment. For yet another group of commentators, nothing much has changed. The existing ambivalence is likely related, at least in part, to inconclusive empirical evidence. There is also a lack of

studies that move beyond the in-depth, qualitative examination of selected localized experiences, making it difficult to draw general inferences about tendencies in governance outcomes.

The emerging, complex governance regimes call for new methods and evidence to untangle how policy reforms have changed the way different actors relate to each other and the environment. This paper presents an analytical approach that seeks to assist students, researchers, and practitioners interested in the prospects for local actors to achieve sustainable outcomes within the new context of decentralized forest governance. The paper proposes a framework to help analysts systematically structure the empirical study of policy and institutions.

In this paper I outline the analytical agenda for improving our understanding of how local institutions related to policy reforms end up shaping decisions, actions, and environmental outcomes in the developing world. I start out by reviewing the existing literature on decentralized natural-resource management and discuss underlying assumptions about the relationships among reforms, local resource users, their decisions, and observable policy outcomes. After identifying the main analytical constraints to date, I propose a local governance approach to the study of natural resource policy reforms in developing countries. This approach advances the study of sustainability in developing countries by defining the process by which reforms affect governance outcomes

and by specifying the decentralized decision-making process and context. After explaining the approach, I present the various components of the analytical framework and describe the data-collection procedure. To illustrate the viability of the “local governance approach” to the study of decentralization policy, I apply the Institutional Analysis and Development framework to the case of Bolivia. I conclude with a discussion of implications for sustainability policy and future research.

### Core Findings in the Decentralization Literature

As decentralization reforms become a more popular means for national governments to reconcile competing natural resource management challenges, an increasing number of empirical studies have examined the conditions under which such reforms succeed. While theoretical thrusts, geographical areas, and thematic foci vary a great deal across these studies, many of them arrive at similar findings. These, what we might call core findings of the decentralized governance literature, may be summarized as four overarching conclusions.

First, most studies agree that positive outcomes in decentralized environmental governance are unlikely in the absence of popular participation in local decision making (e.g., Singleton, 1998; Blair, 2000; Larson, 2002). One of the basic premises for successful decentralized governance is the relatively superior cost-effectiveness of local vis-à-vis central authorities to incorporate local information of time and place into public policies. Such improvements are not likely to materialize, however, unless local resource users are allowed a seat at the decision-making table. Resource-user participation may require national government recognition of local political authority to adopt the rules agreed upon in the participatory decision-making forum, something that is not always the case in decentralized systems (Agrawal & Ribot, 1999; Agrawal & Ostrom, 2001; Smoke, 2003).

Second, most researchers agree that positive outcomes in a decentralized environmental-governance framework rely on local governments being downwardly accountable to resource users (e.g., Crook & Manor, 1998; Agrawal & Ribot, 1999; de Oliveira, 2002; Ribot, 2002). These mechanisms provide essential checks and balances between the different governance actors involved in the public-policy process and, perhaps most importantly, give resource users a voice to hold officials responsible for their actions. While democratic elections of local officials seem necessary, elections are hardly sufficient to guarantee a transparent and demand-driven public

economy. Traditional and informal social networks characterized by severe power asymmetries and patronage relationships often trump formal democratic structures and hamper any real democratic decentralized governance of natural resources (Andersson, 2002; Platteau, 2004).

Third, one of the most universally accepted findings is that successful decentralized governance of natural resources relies on the technical capacity of the local unit to which governance responsibilities have been devolved (e.g., World Bank, 1988; Kaimowitz et al. 1998; Flores & Ridder, 2000; Pacheco, 2000; Contreras & Vargas, 2001). Even if local governments are downwardly accountable and include users in decision making, such efforts are not likely to succeed unless the governance system can generate appropriate technical responses to problems. For example, what are the best forest-management options for local users, or what species seem most adequate for soil conservation and watershed management? If no available technical expertise can proficiently address these questions, the action taken may not solve the problem.

Finally, all studies also agree that without a secure source of funding, local governments can do little about natural-resource governance (e.g., Fiszbein, 1997; Kaimowitz et al. 1998; de Mello, 2000; Pacheco, 2000). Financial resources are needed not only to hire professional staff, but also to equip and train these professionals to effectively carry out their activities, as well as for activities in resource-user communities. Despite the widely recognized need for financial resources, most local governments in decentralized public sectors in developing countries have a largely underfunded mandate (Gibson, 1999; Boone, 2003; Andersson et al. 2004).

These core contributions to the decentralization literature share several important limitations that this paper seeks to address. While many of these studies consider how local variations in institutional performance affect overall governance outcomes (i.e., Crook & Manor, 1998; Agrawal & Ribot, 1999; Pacheco, 2000; Agrawal & Ostrom, 2001; Larson, 2002), most of this extant work focuses exclusively on the performance of a single local organization such as a village council, a municipal government, or a regional agency (but see Carrol, 1992; Brinkerhoff, 2000; Andersson, 2004). I argue that by doing so, one overlooks a large part of the picture. I suggest an approach that widens the unit of analysis from the local *government* to the local *governance* system, so as to explicitly recognize the important governance role played by other political actors, such as resource-user groups, non-governmental organizations (NGOs), and private firms.

Many existing studies do not use measures of governance outcomes as their dependent variables. Arguably, the measures used in previous research represent input variables in the local governance system rather than outcomes. For instance, several studies estimate whether decentralization reforms have contributed to building capacity in the local government or whether there is more participation in decision making after the introduction of reforms (Fiszbein, 1997; Blair, 2000). Still others investigate how the reforms have affected the amount of resources that local governments spend on resource-management activities and the type of activities undertaken (i.e., Pacheco 2000; Larson, 2002). While these measures are important aspects of decentralized environmental governance, they do not represent *outcomes* of the governance activities.

Finally, the vast majority of research in this area relies on isolated case studies of a small number of selected local governments. While these case studies are unparalleled in terms of rich details on how local actors perceive the new decentralized policy environment, it is difficult to draw more general conclusions from them about the most important tendencies related to governance activities and their results in a particular region or country.

This paper seeks to address these shortcomings in the current literature. A useful start is to construct an analytical framework that will help organize the relationships among the central concepts in decentralized environmental governance. The next section describes the framework that I use to organize my study of decentralized forest governance.

### An Institutional Framework for Environmental Policy Analysis

This study emphasizes the role of local institutions in shaping how decentralization reforms affect governance outcomes. I use a theoretical framework, adapted from earlier efforts by Ostrom and her colleagues (1994); Andersson (2002), and Gibson and his colleagues (2005) to specify the process by which local institutional arrangements affect governance outcomes. Figure 1 displays this framework.

The most important aspect of this framework is that it introduces the context in which local actors interact to create the institutional arrangements that shape their collective decisions and individual actions. Regardless of how resource policies at the regional, national, or international levels might change, the ultimate effects are filtered through the local context. The local actors—which may include resource users and their communities, municipal-government officials, central-government representatives who work in the locality, private firms, and NGO

representatives—will interpret these policy changes according to the specific institutional context as shaped by biophysical and socioeconomic attributes. For instance, the interests of local actors in organizing institutions for forest-management activities depend on the specific context. The interests to manage a forest will be quite different for a community controlling forestlands that contain several valuable timber species than for a community that owns only degraded forestlands, or no forest at all. The interest to protect a forest will be different in a poor community in which livelihoods depend on non-timber forest products compared to a community where most of the members rely on urban employment.

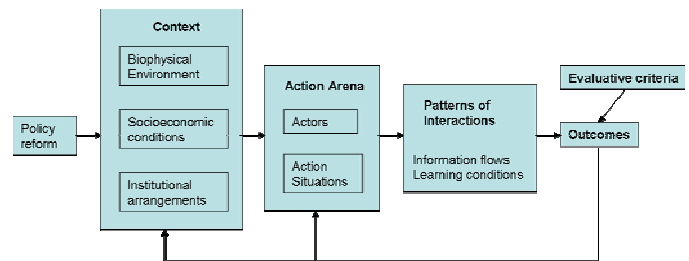


Figure 1. The Institutional Analysis and Development (IAD) Framework

In a nutshell, the framework conceptualizes the outcomes of the decentralization reforms as the result of how local governance actors organize the institutional arrangements to respond to the post-decentralization opportunities and constraints. In the next section, I apply this framework to the study of decentralized forest governance.

### Institutional Analysis of Decentralized Forestry Governance

#### *What is the action arena?*

The very first step in an institutional analysis is to establish the boundaries of the analysis: to delineate the action arena. To identify the factors that influence the variation in local government success in a country's forestry sector, the action arena may be defined as the forestry sector, or even the forestry sector in a particular part of the country or level of governance. The ultimate level of specificity applied to the analysis will depend on the researcher's objectives.

#### *Who are the actors?*

Once the general arena is defined, it is necessary to identify the main actors. Outcomes in a decentralized forest-governance regime depend on the behavior of several actors. Those most important to consider depend on the particular institutional design of

each country's forestry policy, and may include any combination of private landholders, rural community groups, forest-user groups, NGOs, externally funded project representatives, municipal governments, central-government agents, private forestry firms, and others.

What action situations do actors in the decentralized regime participate in? The different groups interact to produce the collective goods and services that make up forest governance. Central government representatives may, for example, decide to devolve responsibilities to municipal governments, as they are believed to perform these responsibilities more efficiently. The action situation refers to the specific type of interaction that these actors engage in to arrive at such a decision. Another example of an action situation is the possible conflicts that may arise between different forest-user groups with unclear boundaries, or forest property rights. The behavior of each of the actors in these action situations can be explained in terms of a set of contextual factors that the IAD framework breaks up into three main categories: 1) physical conditions, 2) community attributes, and 3) local institutional arrangements.

### ***The Biophysical Environment: What is the nature of the good?***

Perhaps the most important issue in institutional analysis is to define the nature of the good that is involved in the action situation. At the most fundamental level, the general characteristics of the country's forest resources frequently resemble a loosely regulated common-pool resource (CPR) and such a characterization helps to define the physical conditions of the action arena's context.<sup>1</sup> Prior theoretical knowledge of CPRs suggests that human institutions are needed to prevent a "tragedy of the commons outcome" in which individual forest users pursue their narrowly defined, short-term, self-interest, which ultimately destroys the resource. Collective-action institutions are needed to stymie this short-term self-interest. One of the central aims of forest-resource governance is, therefore, to provide the institutions needed to constrain the individual, short-term incentive to over-harvest. The traditional way of providing these institutions has been for the central government to introduce either command-and-control rules (prohibitions or quotas) or individual forest privatization. However, both of these traditional policy remedies have been largely unsuccessful, especially in developing countries, in regulating access and enforcing exclusion rights to forests (Gibson et al. 2000). Yet the provision of the required human in-

stitutions or set of agreed-upon rules, to solve the CPR dilemma is far from a straightforward process, as the establishment of human institutions is subject to its own social dilemmas.

### ***Socioeconomic Conditions: How do actors associate in forestry?***

The physical conditions set the stage for the community attributes. Under this heading we examine how actors relate within and between clusters of other actors. We consider the historical background, culture, religion, values, beliefs, knowledge, skills, health conditions, poverty level, and other socioeconomic characteristics of the groups defined as the main actors. If groups of actors share a history of mutually beneficial interactions, chances are that trust has developed in their relationship and this sense of mutual reciprocity will, in all likelihood, facilitate solutions.

### ***What are the rules-in-use of the local institutional arrangements?***

The rules-in-use refer to the norms that are actually respected by the actors participating in an action situation. These are the most important independent variables in an institutional analysis because these rules influence the incentives that each actor faces and thus ultimately help determine behavior (for more on how rules-in-use relate to incentives, see Gibson et al. 2005; Ostrom, 2005). The focus on the rules-in-use requires the institutional analyst to rely on first-hand field observations rather than on secondary data about formal rules. It is what is actually acted upon that counts when documenting rules-in-use, not just what is written (the rules-in-form). One of the central questions that the analyst should ask here is whether the observed rules-in-use are likely to solve the previously identified social dilemmas related to forest governance.

### ***Patterns of Interactions: The conditions for learning***

The multiple interactions in the different action situations create patterns of interaction that, over time, result in predictable outcomes. By studying these patterns, one can identify the institutional incentives of the different actors in a given action situation. Because of the framework's design, these incentives can be traced back to specific contextual factors that seem to generate the observed incentives. The outcome, the extent to which the social dilemmas are resolved, may be evaluated with different criteria such as sustainability, equity, efficiency, and effectiveness. The process is reiterative, as whatever outcome results will affect the contextual variables as well as the action arena in future interactions.

<sup>1</sup> Common pool resources have attributes that make them easy to deplete and difficult to protect (McKean, 2000).

Within the patterns of interactions, actors face varying opportunities to learn from the experience of other individuals, depending to a great extent on the social connectivity. From organization learning, we know that information diffuses by three broad processes (Levitt & March, 1988): 1) diffusion from a single source such as governmental agencies and professional organizations; 2) interactions with individuals who work for the organization as temporary resource people, representing links with experiences, ideas, and information from other, similar organizations (examples of such individuals are consultants and contractors); and 3) normative processes through experts and through trade and popular publications.

The IAD framework-guided analysis explicitly relates the information available to different groups of actors and asks the researcher to characterize the information flow in the action arena. We try to answer two main questions in this part of the analysis: Who has access to what information? And to what extent is the flow of information transparent to others? Below we consider three dimensions of information flow that seem crucial for organizational learning and good local governance.

*Downward flow:* This form of information movement can occur when a central-government agent or a national expert informs local government representatives or citizens about decisions or new knowledge. Without a constant downward flow of information, local people will not learn about formal government rules that may (or may not) protect their rights to natural-resource management or government programs. Citizens also need a transparent process to learn about government performance to hold the relevant officials accountable (Putnam, 1993; Ribot, 1999; Andersson, 2002). A transparent downward flow of information allows citizens better engagement in upward learning, that is, learning about processes at higher levels of the governance hierarchy.

*Upward flow:* This form of information movement occurs when officials learn about local conditions, problems, and needs. With an effective upward flow of information, conceivably through recurrent meetings between government officials and local people, both local and national officials will be in a position to differentiate policy interventions according to important local variations (Korten, 1980; Ostrom et al. 1988; Pretty & Chambers, 1992; Oaker, 1999). Government officials can improve the upward flow of information about local conditions by inviting stakeholders to participate in policy decision making (Ascher & Healy, 1990; Varughese, 1999; Blair, 2000; Klooster, 2000; Osmani, 2001). When there is a transparent upward information flow, government actors are in a better position to engage in

downward learning, that is, government officials can learn about the local realities.

*Horizontal flow:* This form of information movement occurs when groups of local farmers travel to a neighboring village to learn about accessing technical assistance from a governmental agency. Farmer-to-farmer extension activities are another example of horizontal learning. Within a local cluster, information barriers are often less constraining, making information sharing within each cluster relatively easy. This makes the possibility of acquiring information from outside the cluster even more important, as such contacts might generate new ideas and new learning experiences (Chambers et al. 1989). The links with the outside may be strong and formal in character, but sometimes weak, informal links can be just as important. Granovetter (1973) recognized the strength of such “weak links” after identifying their pivotal importance in improving job applicant success rates. Within the decentralized regimes, this means that municipalities should benefit from experience in other municipalities by exchanging information on successes and failures in forestry governance. Such exchange might be facilitated by governmental information sources or meetings of municipal representatives.

The institutional analysis has led us to hypothesize that if successful municipal governance of forests is to emerge from the decentralized regime the actors at the municipal level need to organize themselves to share essential information about resource-management activities and results. I test this hypothesis empirically using field data from 32 randomly selected municipalities in the forest-rich lowlands of Bolivia.

## Decentralized Forest Governance in Bolivia

According to Bolivia’s decentralized forestry regime, the governance functions are shared by six different organizations, as illustrated in Table 1. The bulk of the funding for these functions comes from private forestry firms. Each year they are charged one dollar per hectare of forest that they hold. Municipal governments that host such concessions on their territory receive 25% of the centrally collected concession fees and, in return, they must establish a municipal forestry program within six months of receiving their first payment (Government of Bolivia, 1996).

Many of the tasks that the decentralized regime asks of municipal governments relate directly to improving forest-tenure security for smallholders. For instance, the municipal government may propose to set aside up to 20% of the public forestland in its territory for the creation of a municipal forest

**Table 1** The Municipal Mandate for Forest Governance in Bolivia

Organization	Competence and Functions
Ministry of Sustainable Development and Planning (MSDP)	<ul style="list-style-type: none"> <li>■ Formulate forest policies, strategies, and regulations</li> <li>■ Classify land and evaluate its forest management potential</li> <li>■ Demarcate concession areas for timber companies and local groups</li> <li>■ Set prices for concession fees and volume-based taxes</li> <li>■ Promote research, extension, and education</li> <li>■ Look for technical assistance and funding for plans, programs, and projects</li> </ul>
Superintendencia Forestal (SIF)	<ul style="list-style-type: none"> <li>■ Supervise overall technical compliance with the forestry regime</li> <li>■ Grant management rights to eligible forest users</li> <li>■ Approve management plans and private sector agreements with indigenous territories</li> <li>■ Enforce forest regulations and sanction illegal forest users</li> <li>■ Organize register of concessions, authorizations, and logging permits</li> <li>■ Inspect forest areas and activities, expropriate unauthorized timber and auction it through public bidding</li> <li>■ Request external forest audits of forest operations</li> <li>■ Collect concession fees and volume-based taxes and distribute them</li> </ul>
Municipal Governments	<ul style="list-style-type: none"> <li>■ Propose to MSDP the boundaries of municipal forest reserves to be granted as community concessions to local user groups</li> <li>■ Offer technical assistance to local user groups</li> <li>■ Organize training for local user groups</li> <li>■ Facilitate and promote local commercial activities in their sectors</li> <li>■ Inspect local forestry activities and request external audits as needed</li> <li>■ Set up municipal databases of existing forest plantations in their sectors</li> </ul>
FONABOSQUE	<ul style="list-style-type: none"> <li>■ Finances projects related to the sustainable management and protection of forests</li> </ul>
Ministry of Economic Development (MED)	<ul style="list-style-type: none"> <li>■ Promote forest investments, production, and productivity of the forest industry</li> <li>■ Promote forest marketing and the introduction of lesser known species in national and international markets</li> <li>■ Promote value-added production in coordination with prefectures and municipalities</li> </ul>
Prefectures	<ul style="list-style-type: none"> <li>■ Design and implement public investment projects at departmental level in the fields of local forestry development, research and extension, afforestation, reforestation, and watershed conservation</li> <li>■ Support municipalities in their forestry activities</li> <li>■ Execute functions delegated to them by MSDP, MED, and SIF</li> </ul>

reserve (Government of Bolivia, 1996). It is also the municipal administration's task to facilitate the organization of previously informal user groups into official forest-user groups with formal rights to manage forests. Once groups are formally organized and recognized, the municipal government asks the Ministry of Sustainable Development and Planning to allocate forest-user rights in the form of community-forest concessions within the municipal forest reserve.<sup>2</sup> If such rights are granted, the local groups must develop a formal forest-management plan to be eligible for the required commercial extraction permits. The municipal government is then to provide technical advice to the user groups in developing such a plan, but final approval rests with the Superintendencia Forestal (SIF) that serves as the central government's technical forestry agency (see Table 1). Once harvesting is underway by the formally recognized user groups, the municipality is to assist the SIF in monitoring and enforcing the rules associated

with the granted management rights (Government of Bolivia, 1996).

Whether or not municipal governments will actually act in the best interest of the collectivity of local forest users is a different question. The next section explores the hypothesis that sustainability enhancing governance outcomes are more likely in municipal systems that have developed institutions for regular information exchange and organizational learning.

## Empirical Analysis

To test the above hypothesis, I draw on fieldwork in the Bolivian Lowlands carried out in 2001. Fieldwork consisted primarily of in-depth interviews with regional forestry-sector actors in a random sample of 32 municipal governments that had a forestry program in 1999–2000. Interviews were structured to record the different actors' perceptions about their internal relationships and those with external actors, such as central government agencies, forest-user groups, NGOs, and private groups operating within the forestry sector. In each of the selected municipalities, three different actors were interviewed: 1)

<sup>2</sup> The Forestry Law refers to these community concessions as ASL concessions. ASL stands for *Agrupaciones Sociales del Lugar*, loosely translated to Local Social Groups.



the mayor who held office between 1996 and 1999;<sup>3</sup> 2) the municipal forestry officer; and 3) the president of the municipal oversight committee, a group consisting of representatives from the municipal territory's rural communities.

In each selected municipality, our field-research team interviewed these three actors in face-to-face meetings that lasted about one hour each. The survey instrument was designed to elicit information regarding each actor's perception of policy priorities, staff, relationship with central and non-governmental agencies, and relationship with citizens. It employed a variety of techniques to understand incentives and behavior. Based on crosschecks with census data, we believe the survey is highly reliable.<sup>4</sup> In addition to the survey data, the research teams collected structural, biophysical, and socioeconomic information for each municipality from subnational census data and the national forestry databases (INE, 2002; INE, 1993).

### **Dependent Variable**

As a proxy measure for successful municipal governance I employ the scores of user satisfaction with the municipal provision of forestry services. The user ratings have been converted into a dichotomous variable indicating whether the quality of forestry services provided by the municipal government in 1999–2000 was regarded as either “responding well to the rural population's needs in the forestry sector” or “responding poorly.” The variable was derived from interviews with the presidents of the municipal oversight committees in the 32 municipal governments providing forestry services in 1999–2000.

### **Independent Variables**

- *Upward Learning:* The conditions for upward learning were estimated by combining the number of monthly, forestry-related direct interactions between representatives of rural community-based organizations (*Organizaciones Territoriales de Base*) and 1) mayor; 2) municipal council, 3) technical municipal staff, and 4) central government Forestry Superintendence (the formal entity ultimately responsible for municipal forestry unit performance). The number of monthly interactions with the different actors

was then added to form an additive index. As such, this independent variable is not a direct measure of transparency or accountability, but rather a proxy variable for the underlying conditions that allow for rural resource users to hold municipal officials accountable.

- *Downward Learning:* This independent variable was created by aggregating three different variables: 1) the permanence of municipal forestry staff, 2) the number of days per week that forestry staff spends in the field, and 3) whether the forestry unit has transportation to the municipality's rural areas. The scores of the three variables were then added to represent the capacity of municipal staff to learn about local conditions.
- *Horizontal Learning:* The variable measured the relative frequency of meetings between the municipal government and organizations that work in the municipal territory, such as 1) the forestry superintendence, 2) the land-reform agency (INRA), 3) associations with other municipal governments (*mancomunidades*), and 4) NGOs. As such, the variable reflects the conditions for the exchange of important information for forestry-sector planning, coordination, and implementation. The theoretical prediction of the influence of this variable is that for any given municipality, the more interinstitutional coordination and information sharing, the better the quality of forestry sector municipal services.

Taken together, these independent variables reflect the conditions for achieving cooperation between the crucial actors of municipal-forest governance. The theoretical prediction of the influence of these variables is that, for any given municipality, the more interactions, the more successful will be the cooperative outcomes of municipal-forest governance. Given the binary-outcome variable, the effect of these variables will be analyzed using a logit regression model.

To control for other possible influences on the dependent variable, the analysis incorporates the following municipal-level control variables:

- *The ratio of municipal government budget per capita:* A municipal government with more resources per capita could provide effective services more easily than a poorer municipality.<sup>5</sup>
- *The average literacy rate in the municipality:* Municipalities that have a higher proportion of literate people are likely to achieve better results, because cooperation between a government au-

<sup>3</sup> If the mayor was not able to be interviewed his or her designated alternate participated instead.

<sup>4</sup> We took several steps to ensure the interview data's reliability, first field-testing questions in several municipalities to make sure they were well understood, and then adjusting the survey before interviewing. We also carefully avoided pitching this as an interview about forestry, but presented our research topic as the general performance of the municipality in dealing with the new decentralized structure.

<sup>5</sup> The variable was constructed with data from Superintendencia Forestal (2001) and Government of Bolivia (2000).

thority and literate forest users is likely to be easier (Government of Bolivia, 2000).

- *The amount of available forest resources per capita:* It is easier for the governance actors to be effective in allocating and enforcing formal property rights in municipalities where forest resources are more abundant and there is less rivalry among users.<sup>6</sup>

## Results

Why are some decentralized modules more successful than others in delivering services? I suggest that the local governance system's adaptive capacity is critical, as the local actors must be able to learn what activities to do and how to implement them effectively. Employing citizen-satisfaction ratings of the municipal-forestry programs as a proxy for governance success, I test this argument by carrying out a logit regression analysis in which variables measuring the conditions for the three types of learning and three control variables are included.<sup>7</sup> The result of the binary logit regression is displayed in Table 2.

The results in Table 2 indicate a systematic association between the conditions for the various types of learning and the citizen-satisfaction ratings. The model is statistically significant ( $p=0.0290$ ) and about 28% of the observed variance in the satisfaction ratings is explained by the six independent variables included in the analysis. None of the three control variables are significant at the 0.05 level.

**Table 2** Binary Logit Estimates

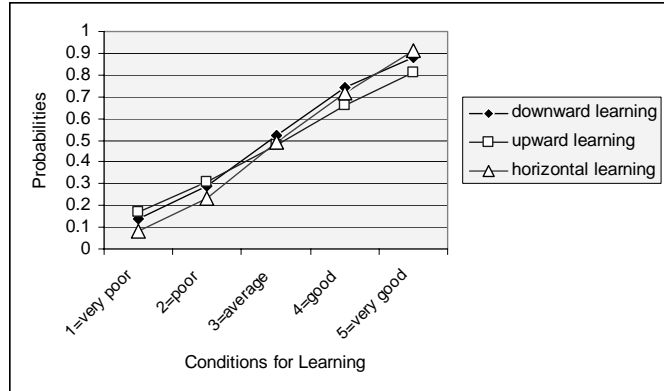
Independent variables	Coefficients
Horizontal Learning	1.1712** (0.4730)
Downward Learning	0.9482** (0.4527)
Upward Learning	0.7432** (0.3836)
Per capita municipal resources	-0.0003 (0.0003)
Literacy rates	-0.0392 (0.0438)
Population density	-0.0403 (0.0968)
<i>n</i>	32
<i>Prob. &gt; <math>\chi^2</math></i>	0.029
<i>Pseudo R<sup>2</sup></i>	0.2809

\*\* Significant at the 95% confidence level

Note: Logit estimators. Standard errors are in parentheses.

Controlling for other possibly influential variables—such as literacy rates, population densities, and financial endowments of the municipal govern-

ment—all three types of learning have positive and statistically significant coefficients at the 0.05 level. Results in Figure 2 suggest that all three variables positively affect the probability of users perceiving governance success.



**Figure 2.** Changes in Probabilities for Achieving Positive Citizen Ratings under Varying Conditions for Learning

### Downward Learning

The conditions for government officials to engage in downward learning about local conditions are associated with the transparency of upward information flow. This aspect seems essential for institutional innovation since, as the government agent communicates about other local group actions and organization, this may stimulate groups to learn. The results confirm this relationship, as the probability of the governance system receiving high approval ratings goes from 15% when conditions for downward learning are poor to over 85% when those conditions are high.

### Upward Learning

The conditions for upward learning represent the ability of resource users to learn about government programs, formal rules, and government officials' performance. These conditions relate to the transparency of downward information flow. Empirical analysis confirms that hierarchically vertical information exchange is essential for making accountability mechanisms work locally. The better the conditions for upward learning, the higher the likelihood resource users approve of their municipal governance systems.

### Horizontal Learning

The conditions for horizontal learning correspond to the predisposition of local actors to learn about each others' activities. Horizontal learning

<sup>6</sup> This variable was calculated using a geographic information system by overlaying INRA's population and municipal boundary records with the SIF's map of lands designated to forestry by the national land-use planning process. The SIF map is referred to in Spanish as the *Tierras de Producción Forestal Permanente*.

<sup>7</sup> According to the responses from the presidents of the municipal oversight committees, the forest users in 50% of the municipalities rated the municipal services in the forestry sector as successful.

among municipal-level actors seems essential for coordination and institutional innovation, especially when addressing management issues that overlap the boundaries of several municipalities. In the quantitative analysis, this has the most dramatic effect on governance outcomes of all three learning conditions. When these conditions are at their minimum, the likelihood of successful governance is less than 10%, but when those conditions are at their maximum the same likelihood increases to above 90%.

## Discussion and Conclusions

The results of the institutional analysis suggest that successful outcomes within a decentralized governance regime—here defined as positive forest-user ratings of local government performance—rest to a significant extent on the institutional conditions for exploration and learning among the local actors. These conditions include the institutional incentives that may be seen as an underlying structure influencing the predisposition of actors to learn.

This is not to say that other factors, for instance personality and monetary resources, would not also influence the likelihood of successful governance outcomes. In fact, among the 32 cases included in this analysis, in at least three municipalities the local learning conditions were far from optimal, but the municipal government nevertheless achieved positive user ratings. These apparent successes were at least partly the result of the mayors' personal leadership, and in one case a very active NGO. On the other hand, in an even greater number of municipalities, the professional staff, and even the mayor, were personally motivated regarding the forestry sector, but local conditions were not otherwise supportive. These circumstances stifled municipal actors' from addressing of forestry-sector issues.

The most common institutional hurdle to successful municipal governance of forest resources in Bolivia may be the extremely high turnover rates of both mayors and municipal professional staff. Based on our data for 1996–1999, municipal staff working on forestry issues had an average professional life expectancy of just 13 months (Andersson, 2004). Such circumstances severely reduce the overall likelihood of developing effective and lasting local governance. In our interviews, we explored this problem with the municipal actors and found two main reasons for these discontinuities.

First, the provisions of the Municipal Law of 1999 made it easy for members of the Municipal Council to “censure” the elected mayor, which entailed voting for removal on grounds of incompetence, inefficiency, or corruption. Second, an election's winning coalition would often negotiate to

have each party's leader be mayor for part of the term, resulting in a rapid rotation. Such administrative changes would automatically precipitate a complete replacement of all municipal staff, even if the departing mayor came from a party within the same coalition as the entering mayor. A presidential decree in 2001 made the frequent change of mayors more difficult, requiring councils to present evidence of illegal activity in order to strip sitting mayors of their offices. Although no data are available for the subsequent period, recent conversations with colleagues in the Bolivia Forestry Service suggest that, despite the new formal rules, the lack of continuity among municipal staff remains a significant constraint.

The conditions for three different forms of learning explain, at least in part, why some municipalities' forestry-related services achieve relatively higher ratings among forest users. One should note, however, that this measure of success does not necessarily coincide with the goals of sustainable forest governance or the central government's policy objectives. It is possible that local users think that good governance occurs when the municipal government minimizes their interventions into the users' forestry activities. Future research should seek to sort out such plausible discrepancies between different proxy measures of good governance and sustainability. One way of doing this would be to employ ecological-outcome variables as proxies for good resource governance (for efforts along these lines, see Agrawal & Ostrom, 2001; Oyono, 2005; Andersson & Gibson, *in press*).

It also merits noting that, while the conditions for learning seem systematically linked to positive perceptions of governance among resource users, this does not mean that these conditions alone will improve governance. Consistent with earlier findings by Leeuwis (2000), this analysis suggests that favorable conditions for the three different types of organizational learning seem necessary for promoting good governance and sustainability, but they are not sufficient.

This study illustrates the usefulness of considering a wide variety of cases, not just the successes. The random selection from all municipalities with a forestry program—regardless of their level of success—allows the analyst to make more generalizable inferences. One important advantage of this approach is the possibility of identifying key elements in successful governance. These elements may be used as indicators in monitoring the effectiveness of existing policies. Such monitoring programs would be important means for learning about how the decentralization experiment evolves, and how existing policies might need adjustment to improve municipal governance performance.

The IAD framework is a useful analytical tool, especially when studying how variations in local institutional arrangements influence natural-resource governance. For the study of decentralized forest governance, the IAD framework may be useful for a variety of tasks, such as 1) diagnosing the local context in new sites and using this to select sites adequate for the research design; 2) identifying conditions conducive to good natural-resource governance; and 3) structuring efforts to monitor and learn about the impact of past and current policy interventions to foster sustainability.

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## COMMUNITY ESSAY

### Sustainability: science or fiction?

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#### Author's Personal Statement:

It is clear that in making the concept of sustainable development concrete, one has to take into account a number of practical elements and obstacles. There is little doubt that integrated approaches are required to support sustainable development. Therefore, a new research paradigm is needed that is better able to reflect the complexity and the multidimensional character of sustainable development. The new paradigm, referred to as sustainability science, must be able to encompass different magnitudes of scales (of time, space, and function), multiple balances (dynamics), multiple actors (interests) and multiple failures (systemic faults). I also think that sustainability science has to play a major role in the integration of different styles of knowledge creation in order to bridge the gulf between science, practice, and politics—which is central to successfully moving the new paradigm forward.

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#### What is Sustainable Development?

The essence of sustainable development is simply this: to provide for the fundamental needs of humankind without doing violence to the natural system of life on earth. This idea arose in the early 1980s and came out of a scientific look at the relationship between nature and society. The concept of sustainable development reflected the struggle of the world population for peace, freedom, better living conditions, and a healthy environment (NRC, 1999). During the latter half of the 20th century, these four goals recurred regularly as worldwide, basic ideals.

With the end of World War II in 1945, it was widely believed that the first goal of peace had actually been achieved. But then came the arms race and, although a kind of global peace was maintained, the Cold War led to a range of conflicts fought out at the local level. When one looks today at many parts of the world—the Middle East and Central Africa for example—it is all too evident that peace is still a long way off.

Under the banner of freedom, people fought for the extension of human rights and for national independence. Today, the poorest two thirds of the world population see “development” as the most important goal, by means of which they hope to achieve the same material well-being as the wealthy one third.

But this ideal, upon which so much emphasis has been laid recently, has to reckon with the earth itself. This reckoning began with concern about the exhaustion of our natural resources and only later did it dawn on us that a disturbance of the complex systems

upon which our lives depend can have enormous consequences.

The last 25 years have been characterized by an attempt to link together the four ideals cited above—peace, freedom, improved living conditions, and a healthy environment (NRC, 1999), an ambition that stems from the realization that striving for one of these principles often means that we must strive for the others as well. This struggle for “sustainable development” is one of the great challenges for today’s society.

Sustainable development is a complex idea that can neither be unequivocally described nor simply applied. There are scores of different definitions, but we shall restrict ourselves to the most frequently quoted, that of the Brundtland Commission (WCED, 1987): “Sustainable development is development which meets the needs of the present without compromising the ability of future generations to meet their own needs.”

If we look at the lowest common denominator of the different definitions and interpretations of sustainable development, it is possible to identify four common characteristics (Grosskurth & Rotmans, 2005). The first indicates that sustainable development is an *intergenerational* phenomenon: It is a process of transference from one to another generation. In other words, if we wish to say anything meaningful about sustainable development, we have to take into account a time span of at least two generations. The time period appropriate to sustainable development is thus around 25 to 50 years.

The second common characteristic is the *level of scale*. Sustainable development is a process played out on several levels, ranging from the global to the regional and the local. What may be seen as sustainable at the national level, however, is not necessarily sustainable at an international level. This geographic incompatibility is due to shunting mechanisms, as a result of which negative consequences for a particular country or region are moved to other countries or regions.

The third common characteristic is that of *multiple domains*. Sustainable development consists of at least three: the economic, the ecological, and the socio-cultural domains. Although sustainable development can be defined in terms of each of these domains alone, the significance of the concept lies precisely in the interrelation among them.

The aim of sustainable social development is to influence the development of people and societies in such a way that justice, living conditions, and health play an important role. In sustainable ecological development the controlled use and protection of natural systems is the main focus of concern and the maintenance of our natural resources is of primary importance. In sustainable economic development, the focus is on the development of the economic infrastructure and on an efficient management of natural and social resources.

At issue here are three aspects of sustainable development that in theory need not conflict, but that often do in practice. The underlying principles are also essentially different: with sustainable economic development efficiency has a primary role, whereas with sustainable social development the same may be said of justice, and with sustainable ecological development resilience or capacity for recovery is primary.

The fourth common characteristic concerns the *multiple interpretations* of sustainable development. Each definition demands a projection of current and future social needs and how these can be provided for. However, no such estimate can be really objective and, furthermore, any such estimate is inevitably surrounded by uncertainties. As a consequence, the idea of sustainable development can be interpreted and applied from a variety of perspectives.

As is apparent from the above discussion, a concept such as sustainable development is difficult to pin down. Because it is by its nature complex, normative, subjective, and ambiguous, it has been criticized both from a social and from a scientific point of view. One way of escaping from the “sustainability dilemma” is to begin from the opposite position: that of *non-sustainable* development. Non-sustainable, or unsustainable, development is only too visible in a number of intractable problems entrenched in our social systems and that cannot be solved through cur-

rent policies. These obdurate problems are characterized by the involvement of multiple interests, as well as by their great complexity, lack of structure, structural uncertainty, and apparent uncontrollability.

Such problems can be recognized in many national and global economic sectors. One sees them in agriculture, for example, with its many facets of unsustainability becoming manifest in the form of protein-related diseases such as BSE (mad cow disease) and in foot-and-mouth disease. The water sector has to deal with such symptoms as flooding, droughts, and water quality problems, while the energy sector performs in a one-sided manner and—as a direct result—harms the environment. One sees the same symptoms in traffic and transport systems where atmospheric pollution and congestion are symptoms of unsustainability. As far as our health is concerned, the spread of severe acute respiratory syndrome (SARS) and the global increase in malaria, as well as malnutrition and its counterpart obesity, are all far from sustainable.

These unsustainable developments reflect systemic faults embedded in our society. In contrast to market faults, systemic faults derive from deep-seated deficiencies or imbalances in society. They cannot be corrected through the “market” and form a serious impediment to the optimal functioning of our social system. Systemic faults operate at various levels and can be of economic, social, or institutional in nature. If such intractable problems are a sign of an unsustainable development, they can only be solved through fundamental changes in our society. Only thus can non-sustainable conditions be transformed and put on a more sustainable basis.

### Sustainability Science: A New Paradigm

It is clear that in making the concept of sustainable development concrete, one has to take into account a number of practical elements and obstacles. Thus there is little doubt that integrated approaches are needed to support sustainable development. Questions as to exactly how such integration—underpinned by the right research—should be conceived and put into effect have so far been the preserve of a select group.

On a global scale, great progress has been achieved, within the framework of the international “global change” research program, in the integration of previously separated disciplines. Fifteen years ago, atmospheric chemists and biologists were not sharing the knowledge emerging from their studies of atmospheric change—despite the fact that biological processes are an important factor in regulating the composition of the atmosphere. Nor was either discipline well integrated with atmospheric physics, oceanogra-

phy, or climatology. Today these disciplines are much more closely linked and together, on the basis of integrated research and risk analysis, they form the core of our knowledge about global climate change.

The international research community that is concerned with global change has thus made huge progress in coupling the various relevant natural sciences. Unfortunately, however, despite great national and international commitment, there has been far less progress in understanding the interactions between humankind and environment.

To realize the high level of expectations, a new research paradigm is needed that is better able to reflect the complexity and the multidimensional character of sustainable development. The new paradigm must be able to encompass different magnitudes of scales (of time, space, and function), multiple balances (dynamics), multiple actors (interests) and multiple failures (systemic faults).

This new paradigm emerges from a scientific sub-current that characterizes the evolution of science in general—a shift from mode-1 to mode-2 science (see Table 1) (Gibbons, 1994). Mode-1 science is completely academic in nature, monodisciplinary and the scientists themselves are mainly responsible for their own professional performance. In mode-2 science, which is at core both inter- and intra-disciplinary, the scientists are part of a heterogeneous network. Their scientific tasks are components of an extensive process of knowledge production and they are also responsible for more than merely scientific production.

Another paradigm that is gaining increasing influence is what is known as post-normal science (Funtowicz & Ravetz, 1993). It is impossible to eradicate uncertainty from decision-making processes, and therefore it must be adequately managed through organized participatory processes in which different kinds of knowledge—not only scientific knowledge—come into play. As a result, those making policy need to be as well informed as possible about complex social problems of major importance.

**Table 1** Properties of mode-1 and mode-2 science

Mode-1 science	Mode-2 science
Academic	Academic and social
Mono-disciplinary	Trans- and interdisciplinary
Technocratic	Participative
Certain	Uncertain
Predictive	Exploratory

The research program that is beginning to emerge from this movement is known as “Sustainability Science” (Kates et al. 2001). The virtual Forum on Science and Technology for Sustainability (<http://sust.harvard.edu>) is at the moment one of the

motors behind this initiative. Sustainability science, however, is not an independent profession, let alone a discipline. It is rather a vital area in which science, practice, and visions of North and South meet one another, with contributions from the whole spectrum of the natural sciences, economics, and social sciences. Sustainability is characterized by a number of shared research principles. “Shared” here implies a broad recognition by a growing group of people who—in a steadily extending network—are active in the area of sustainability science. The central elements of sustainability science are:

- inter- and intra-disciplinary research
- co-production of knowledge
- co-evolution of a complex system and its environment
- learning through doing and doing through learning
- system innovation instead of system optimization

Simply stated, this new model can be represented as *co-evolution*, *co-production*, and *co-learning*. The theory of complex systems can be employed as an umbrella mechanism to bring together the various parts of the sustainability puzzle.

### Integrated Analysis of Sustainability

This new paradigm has far-reaching consequences for the methods and techniques that need to be developed before an integrated analysis of sustainability can be carried out. These novel methods and techniques can be characterized as follows:

- from supply-driven to demand-driven
- from technocratic to participant
- from objective to subjective
- from predictive to exploratory
- from certain to uncertain

In short, the character of our instruments of integrated analysis is changing. While previous generations of these instruments were construed as “truth machines,” the current and future generations will be seen more as heuristic instruments, as aids in the acquisition of better insight into complex problems of sustainability. At each stage in the research of sustainability science, new methods and techniques will need to be used, extended, or invented. The methodologies that are used and developed in the integrated assessment community are highly suitable for this purpose (Rotmans, 1998; Van Asselt & Rijkens-Klom, 2002).



Generally speaking, there are a number of different approaches for the integrated assessment of sustainability: analytic methods, participative methods, and more managerial methods. Analytic methods mainly look at the nature of sustainable development, employing among other approaches, the theory of complexity. In participative research approaches, non-scientists such as policy-makers, representatives from the business world, social organizations, and citizens also play an active role. The more managerial methods are used to investigate the policy aspects and the controllability of sustainable transitions.

An example of an analytic instrument for the assessment of sustainability is the integrated assessment model that allows one to describe and explain changes between periods of dynamic balance. This model consists of a system-dynamic representation of the driving forces, system changes, consequences, feedbacks, and potential lock-ins and lock-outs of a particular development in a specific area. Another analytic instrument is the scenario that describes sustainable and unsustainable developments, including unexpected events, changes, and lines of fracture.

Participatory methods differ according to the aim of the study and its participants. Thus negotiation processes are mimicked in so-called policy exercises, whether or not these are supported by simulations. In the method of mutual learning, the analysis is enriched by the integration of the knowledge possessed by participants from diverse areas of expertise.

An example of a new kind of policy instrument is provided by transition management (Rotmans et al. 2001; Kemp & Rotmans, 2004). Transition management is a visionary, evolutionary learning process that is progressively constructed by undertaking following the steps:

1. Develop a long-term vision of sustainable development and a common agenda (macro-scale)
2. Formulate and execute a local experiment in renewal that could perhaps contribute to the transition to sustainability (micro-scale)
3. Evaluate and learn from these experiments
4. Assemble the vision and the strategy for sustainability based on what has been learned (this boils down to a cyclical “search and learn” process that one might call evolutionary steering). This approach constitutes a new kind of planning with understanding that is predicated upon learning through doing and doing through learning.

Now that the first steps toward an integrated sustainability science have been taken, there is a prospect of making some major leaps forward.

## **Toward a Strategy for Sustainable Development**

### ***Breaking Down the Barriers***

A research framework for sustainability science will need to be further built on existing sciences and scientific programs. I have also shown that the principal opportunities and policies for transitions to sustainability are multiple, cumulative, and interactive. We need more breadth and depth, however, before we can study the sustainability of the interaction between the planet and its ecosystems and peoples.

It should be clear that sustainability science will have to be above all an integrative science, a science that sets out to break down the barriers that divide the traditional sciences. It will have to promote the integration among such different scientific disciplines as economics, earth sciences, biology, social sciences, and technology.

The same can be said for sectoral approaches in which such closely linked aspects of human activity as energy, agriculture, health, and transport are still addressed as separate subjects.

The most significant threats to sustainability appear in certain regions, with their specific social and ecological characteristics. In fact, a sustainable transition will often have to occur within the local surroundings. However, sustainability science will need to promote integration on a larger geographical scale to get beyond the often common, but ultimately artificial, division between global and local perspectives. Regardless of what spatial scale is found most suitable for the investigation of any particular sustainability issues, gaining insight into the linkages between events on both the macro and the micro scale is one of the major challenges facing sustainability science.

Finally, sustainability science must ensure the integration of different styles of knowledge creation to bridge the gulf across science, practice, and politics.

### ***Sustainable Policy***

If we look at the consequences of this new vision of sustainability for policy, we can note the following. It is important for policy-makers—both in politics and in the business community—that specific policy aims, along with their associated time limits, are clearly determined. Several possibilities are shown in Figure 1. One of the options the policy-maker has—and this is not so far from the current situation—is to go for short-term goals and simple or cheap means of achieving them. In contrast to such an approach, a more pro-active, innovative standpoint can be adopted that pursues longer-term goals, taking into account developments on different levels of scale

and in different sectors. Unquestionably, sustainable development demands the latter approach.

To facilitate decision making, sustainability scientists must assist in the task of making concrete both problems and solutions on all relevant temporal and spatial scales. This means that sustainability at the systemic level must be assessed, bringing to bear the following procedural elements: *analysis* of deeper-lying structures of the system, *projection into the future*, and *assessment* of sustainable and unsustainable trends. *Evaluation* of the effects of sustainable policy and the *design* of possible solutions through sustainable strategies also belong here.

Fortunately, integrated approaches to sustainability issues in such areas as environment and development are not entirely new. For example, research has already been carried out into the interactions between urban, rural, industrial, and natural ecosystems to gain more insight into policy implications for the management of water. The search for integrated theories that combine different disciplinary strengths is an excellent way of creating a better basis for decision making on sustainability.

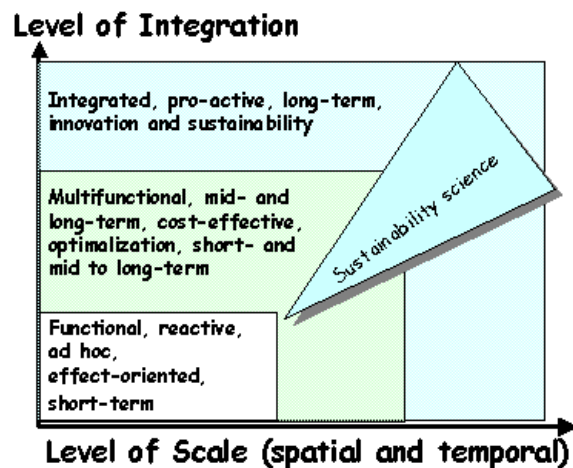


Figure 1. The role of sustainability science in the policy process

### Sustainable Education

It will hardly come as a surprise to hear that the development of a healthy, just, and sustainable society demands a major shift in our thinking, our values, and our actions.

Today's students will be the business leaders, scientific researchers, politicians, artists, and citizens of tomorrow. The extent to which they will be prepared to make decisions in favor of a sustainable future depends on the awareness, knowledge, expertise, and values they have acquired during their studies and in the subsequent years. For this reason, the concepts and themes of sustainability should be inte-

grated into all levels of education. Curricula must be revised so that sustainable development forms a guiding principle throughout the entire period of their studies—and afterwards too (see Orr, 1992). With an increasingly widespread awareness of this need, the United Nations has now proclaimed the coming decade as the “Decade of Education for Sustainable Development.”

The basic qualities that future sustainability scientists will need are: analytical insight, problem-solving competence, and good skills in both verbal and written presentation. No less important is knowledge of the diversity of instruments provided by the various disciplines involved, ranging from mathematics to history, from health sciences to economics. The range of skills needed is so wide that it can only be acquired through interdisciplinary study.

Another essential quality is the capacity to break down the barriers referred to earlier among the various scientific disciplines involved, policy-makers, and citizens. And, last but by no means least, there is a need to devote great attention to the philosophy and the ethics that underpin sustainability science. At the present moment, however, there is a manifest lack in sustainability science of both fundamental and applied “research capacity.” In addition, there is a need for a greater diversity of approaches. It is essential, therefore, that in the coming decades we put everything into the effort to build up this extra capacity in both the northern and the southern hemispheres.

### Conclusion

Richard Feynman, one of the greatest physicists of the last century, once remarked: “Whoever says that he understands quantum theory, in all probability does not.” The same is true of sustainable development. Whoever says he knows what “sustainability” is, in all probability does not. In a certain sense, a sustainable world is a fiction.

Thus, the concept of sustainable development does not contemplate any statistical state of affairs or finite stocks, but rather emphasizes a positive evolution and positive lines of development. Sustainable development can, in fact, be described as “the capacity of a society to move itself, in a certain time period, between satisfactory, adaptable and viable conditions” (Giampietro, 2003).

As I have tried to explain above, however, it is actually possible to lay a scientific foundation under this concept of sustainable development. And further, this can be given a practical content that can vary from sustainable health to the sustainable use of our oceans and rivers, from sustainable tourism to sustainable enterprise and sustainable regional development.

Those in other sections of society such as the business community must also be encouraged to take responsibility for a sustainable future. They must be mobilized so that they will actively participate in giving shape to sustainable development. Such a broad social front will be a necessary condition for making the abstract term “sustainable development” both concrete and achievable.

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## BOOK REVIEW PERSPECTIVES

### Jared Diamond, *Collapse: How Societies Choose to Fail or Succeed*

Viking, 2004, 592pp, ISBN: 0670033375

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*Collapse: How Societies Choose to Fail or Succeed* by Jared Diamond (The best-selling author of *Guns, Germs and Steel*) is an invigorating book. Invigorating because you have that moment when you start reading it, and that is where you think, “I would have loved to have written this book!”—especially if you are a sustainability practitioner. Combining the essences of the rise and fall of civilizations dotted throughout history with those of present-day environmental calamities, Diamond is like a master chef, delivering an appetizing concoction that the audience will lap up. Unlike doomsday scenarios that are often depressing and sometimes one-sided stories about why the human race will not be able to sustain itself, Diamond gives examples of both past communities that have failed and those that have lived sustainably for thousands of years, giving us a glimpse of optimism. He articulates a five-point scale for the success or failure of civilizations—climate change, hostile neighbors, friendly trade partners, environmental damage, and response to environmental problems. Diamond suggests that the first four may or may not prove significant in each society’s demise, but claims that the fifth always is, because a society’s response to environmental problems is largely within its control, unlike the other factors. Hence, as his subtitle puts it, a society can “choose to fail.” He expresses an all-new meaning to the words “learning from our past.”

Diamond, who teaches geography at UCLA, is well known for his Pulitzer Prize-winning best seller *Guns, Germs, and Steel*, which focuses on environmental and structural factors to gauge why Western societies came to dominate the world. In *Collapse*, he continues this theme, but this time considers societies that made their choices, whether, as he says, to succeed or fail. *Collapse* is mostly about the basic elements of the earth’s ecosystem—flora, fauna, climate, and geology—that when preserved make us

more sustainable, because societies fail, in Diamond’s view, when they mismanage these resources.

Diamond examines the lost civilizations of Easter Island, the Maya, and the Norse colony on Greenland to show how a combination of cultural and population factors, and a disregard for natural resources, contributed to their collapse. Extending those lessons, he shows how environmental and population pressures affect present conditions in Haiti and Rwanda, and how events in China, Australia, and Montana could follow the same path.

Diamond then identifies twelve environmental problems that portend doom: natural habitat destruction (mainly through deforestation); wild food reduction; biodiversity loss; soil erosion; natural resource depletion; freshwater pollution; natural photosynthetic resource maximizations; human introduction of toxins and alien species; climate change induction; and finally, overpopulation impact.

It is striking that the World Business Council for Sustainable Development has spelled out a similar list of ten environmental issues that threaten the planet’s ecosystem viability: crop and grazing land loss, tropical forest depletion, species extinction, rapid population growth, fresh water resource shortages, overfishing, habitat destruction, marine pollution, human health threats, climate change, acid rain, and energy resource pressures.<sup>1</sup>

What was then, is what is now. This is the essence of the book. For those critics that say that Diamond does not consider contemporary technological advances that could slow down, or prevent, a collapse, I would argue that the environmental issues of today are more global and widespread, requiring exponentially more knowledge.

The historical fate of Easter Island presents a challenge to our own civilization. One day in the middle of the seventeenth century, the very last tree on Easter Island was felled. Diamond asks, “What went through the mind of the person who cut down that last tree?” What indeed went through the mind of

<sup>1</sup> World Business Council for Sustainable Development. 1997. Exploring Sustainable Development: WBCSD Global Scenarios 2000 – 2050, Summary Brochure. <http://www.wbcsd.ch/DocRoot/FFiAJwJBGGNjlawOAipD/exploringscenarios.pdf>. January 13, 2006.

the person who killed that (second) last Tasmanian Tiger (the last one died in captivity)? And what will the person who uses the last gallon of petrol be thinking? To reiterate an old Cree Indian saying, “Only after the last tree has been cut down/only after the last river has been poisoned/only after the last fish has been caught/only then will you know/that money cannot be eaten.” This is the lesson the book provides.

Because Diamond covers a vast span of time, as well as several serious issues, he invariably glosses over some key matters, makes significant assumptions, and commits large omissions, like, say, the collapse of Rome. Still, he weaves around these potholes and, in general, the book provides a compelling and well-conceived account of historical evidence. He connects the dots, from the collapses of medieval Greenland and the Maya, to the seriousness of climate change, to the future of the planet, leading to a series of present-day mini-collapses, or “ecocides” (ecological suicides), such as dry land salinity in Australia and the mass murder of Tutsi civilians in Rwanda. *Collapse* is a long book, and Diamond gives away the ending at the very beginning. Like a true scientist, he postulates his hypothesis early and then sets out to prove it through supporting evidence. Accordingly, one could read the introduction, gloss over the table of contents, and read the last few chapters to get the point. But, then one would miss the book’s essence, which proceeds through telling captivating stories, like the old Cree Indian once did.

“The societies that ended up collapsing were (like the Maya) among the most creative and (for a time) advanced and successful of their times . . . past peoples were neither ignorant bad managers who deserved to be exterminated or dispossessed, nor all-knowing conscientious environmentalists who solved problems that we can’t solve today. They were people like us, facing problems broadly similar to those that we now face. They were prone either to succeed or to fail,” lest we forget. In this realm, one example that Diamond has left out, since it had not yet occurred, is New Orleans post-Hurricane Katrina. The *Boston Globe* calls Katrina’s real name global warming and predicts that, as the atmosphere warms, it will generate longer droughts, more intense downpours, more-frequent heat waves, and more severe storms. New Orleans collapsed before I managed to experience the jazz, just as we all missed the sun worship of the Inca and the statue building of the Easter Islanders. This is what makes the book so relevant a case study in history for a range of issues faced by today’s global community.

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In 2005, Jared Diamond, the award-winning author of *Germes, Guns and Steel*, *The Third Chimpanzee*, and *Why Is Sex Fun?*, gave the world another masterpiece. His *Collapse: How Societies Choose to Fail or Succeed* is an encyclopedic work that explains why some societies have prevailed and others have not. He examines the causes of success or failure of thirteen past and present societies, big and small, in different parts of the world, under different environmental, climatic, economic, and technological conditions. How these societies managed their environment emerges as a strong determinant of their fates.

Diamond argues that past societies faced eight categories of threats: deforestation and habitat destruction, soil problems (erosion, salinization, fertility losses), water management problems, overhunting, overfishing, introduced species, human population growth, and increased per capita human impact. To these, he adds four additional threats faced by modern societies: human-induced climate change, toxic chemical buildup, energy shortages, and limits to using earth’s photosynthetic capacity. He predicts that most of these dozen threats will become globally critical within the next few decades (some of them are already critical today in many places).

In the past, the unsustainable use of environmental resources, initially driven by deforestation, led to the loss of soils and agricultural productivity. In the end, it destroyed the conditions that allowed societies to survive and prosper. The case of mysterious Easter Island, with its giant stone statues, is impressive. Initially a rainforest island when humans first inhabited it more than a thousand years ago, they started cutting its forest, a process that continued up to the last tree. It was a complete environmental disaster, with deforestation, soil erosion, loss of biodiversity, reduced support capacity to sustain life, and finally societal collapse. How Diamond was able to amass the existing historical and scientific knowledge to tell the story of Easter Island is amazing, and could only be done by a very keen, privileged, and dedicated mind. He has been equally successful in solving the puzzles of other past societies that left no written records, such as the Anasazi in North America, or those that left some documentary evidence, such as the Maya. Even in the case of the Greenland Norse, who knew how to read and write, Diamond’s analysis includes non-literate material, like mittens, indicating that certain cultural factors prevented the Norse from adapting existing resources; for instance, they would

not eat specific foods. In contrast, the Inuit, who lived in the same adverse environment, used all conceivable resources to survive. The story of the Mayan collapse is skillfully told, and it is even more impressive because this was a large, advanced civilization. The book also includes the cases of several modern societies: Rwanda, Haiti and the Dominican Republic, Australia, and China, among others. In all of them, how people learned to manage the environment is the key variable.

The book's analysis focuses on how each human society has used the environment throughout its development. However, the environment is not the only factor affecting the fate of civilizations, and sometimes it is difficult to single out one or another. Diamond has devised what he calls a five-point framework of possible contributing factors: environmental damage, climate change, hostile neighbors, friendly trade partners, and a given society's response to threats. These factors, which may complement or compensate each other, work together or separately to eventually determine the fate of entire civilizations. One key lesson is that environmental management is important, and how societies react to problems and adapt to existing unfavorable conditions (for instance, how they create institutions to face the tragedy of the commons) determines their destiny.

In the final chapter, Diamond asks, "what does it all mean to us today?" He analyzes the dozen threat categories in the context of present, globalized societies. Deforestation, which he contends "was a or the major factor in all collapses of the past," is still a problem in many places. Outside of the book, much has been said about deforestation in the Amazon and other rainforests, and this remains a major concern. The problem of the semi-arid regions of Asia, Africa, and the Americas is perhaps even more serious because sizeable populations live in these regions, almost all of them in developing countries. If it were not for the presence of the other five factors (such as trade and migration), societies in these regions would already have reached the point of collapse. In my native Northeast Brazil, emigration has been the traditional way to reduce population growth and trade with other Brazilian regions, plus governmental assistance, has deferred societal collapse.

After reading the book, we are inevitably left with the question: can our global society be saved? Diamond responds with a note of "cautious optimism." The problems are too serious, and solutions are not apparent, such as how to stimulate needed changes in consumption patterns, especially given the legitimate aspirations of the developing countries to reach the levels (the lifestyles) of rich countries. On the other hand, there is increasing information and awareness about environmental and population

problems. This reminds me of a story that I heard in a small city of the Brazilian semi-arid Northeast that is continually concerned about drought. One farmer said to the other: "It will rain this year." And the second farmer asked why he was so sure. The response was: "Because we would not survive another drought." We have to find ways to overcome the problems that threaten our civilization, because otherwise it may not survive. In the same spirit, Diamond asserts that, "the world's environmental problems *will* get resolved," either "in pleasant ways of our own choice, or in unpleasant ways not of our choice."

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As a strong environmentalist, I was predisposed to accept what I expected to be this book's basic premise: that humans should stop fooling around with Mother Nature. What I did not anticipate was the detailed, engrossing stories that Jared Diamond develops about how and why numerous past human societies have overdeveloped their natural resources, and basically starved to death when the natural environment around them became so degraded that it could no longer support human needs. This phenomenon has occurred numerous times over the course of human history, and, unfortunately, is still happening today. We all know that the experiences of particular groups—for example the Easter Island, Mayan, and Anasazi civilizations—have not been marked by happy-ever-after outcomes. However, it is another thing to be presented with all the details, as reconstructed from archaeological evidence, explaining how it happened. One of this book's objectives is to elucidate the events along the pathways to either collapse or recovery, and to try to reconcile how the peoples involved could "let that happen." A second objective, very relevant to the present, is to learn from the choices made by successful societies in the hope that we might take the necessary actions to assure our survival.

Diamond bases his treatise on a mind-boggling variety of past and present human societies, from tiny Pitcairn Island, to the Viking migrations, to present-day China and Australia. What kept coming to mind as I digested the various case studies was: deforestation, deforestation, deforestation! The destruction of forest cover appears to be the first and most important impact these extinct human societies inflicted on their environments: deforestation to clear land for farming, for building materials, for fuel. No matter

the reason, deforestation under the wrong environmental conditions or safeguards results in topsoil loss, and this, in turn, reduces the cleared land's productivity and precipitates human starvation. Forests are still being felled all around us at an alarming rate, and we seem to be doing nothing significant about it. Diamond also points out the role of increased human population, which in all cases can be identified as the ultimate precursor of forest destruction. Again, in much of the world today, human populations are out-running their resources, and millions of people are starving each year. Diamond also presents a few cases, including Tikopia, Papua New Guinea, and Japan, in which wise judgment (and action) to protect and manage forest resources, has successfully turned the situation around.

These accounts are necessarily more complex than just terminal deforestation along with overpopulation. Also prominent are (unexpected) climate changes, over-hunting of wild food resources and overfishing, and, especially, problematic societal responses. Several of these failed societies colonized their new homelands during warm, wet periods when their populations thrived, only to collapse when the climate turned extremely cold and/or dry. From my perspective, human overpopulation, abusive land clearing, and unrestricted hunting and gathering of renewable resources are the three "biggies," because they occur in all of Diamond's examples, and they affect the natural and human systems that I have experienced first hand.

As a coral reef ecologist, I have over the past 40 years witnessed the loss of over 50 percent of the coral cover for Caribbean reefs, the shift from coral to algal dominance (that hurts coral reef integrity), and the disappearance of most edible larger fishes and invertebrates. In my field, we have shifted from emphasizing basic research on reef biology and ecology to debating and documenting the rates and causes of species loss—the big cause, by the way, is global warming—and rushing to find ways to stop the decline. Since I am decidedly "coral-o-centric," I see the humans as the bad guys, and my standard response to the inevitable question of "What can we do to save coral reefs?" has been "Tell people to move to Montana (and stop having babies)!" Thus, imagine my surprise when the first chapter of the book is a treatise on the environmental-human drama occurring in Montana, one of the few places that I naïvely thought, despite the changes on land all around me, had few human impacts due to its sparse population. Therefore, it was quite mind-opening for me to learn how few people it takes to initiate environmental degradation, and how difficult it is to stop destructive actions, even when the small number of people seems to make the issues less complex.

Diamond points out that many failed societies, with characteristics similar to those found today in the Caribbean, survived as long as external trade helped them to meet their basic needs. Many Caribbean island societies would likely fail without trade and tourism—much of it obviously dependent upon healthy coral reefs. Ecologists refer to this as an "extinction debt," or, in common parlance, "living on borrowed time." What will happen to these people if their numbers continue to increase and their environments become degraded to the point that tourists no longer visit?

After presenting his historical studies of failed societies, Diamond describes the tragic situations in Haiti and Rwanda, contemporary Third World societies that have collapsed into extreme suffering because of overpopulation and loss of environmental resources. I visited Haiti thirty years ago, when it was in less desperate shape, and saw the treeless landscape and the devastating poverty. I have seen the begging children who sleep on the streets of Manila. And I have visited small villages in Africa and Latin America where people make due with little to no comfort compared to what we First World people think is necessary to survive. If more North Americans could experience this extreme poverty in person, perhaps there would be hope that we could make good future choices.

Diamond also studies superficially successful societies with underlying problems. A worrisome chapter on China, the rising Third World megapower that will dominate world ecology and resources in the decades to come just because of its sheer population size and the fact that its citizenry aspires to live as we do. He also discusses Australia, a large but low-population (by modern standards) First World country. I found it ironic that, until very recently, Australian authorities encouraged more land clearing and more immigration to compete with neighbors such as China. As Diamond points out, based on an assessment of Australia's natural resources, the country has been overpopulated for decades and its deteriorating environment is making it difficult for the domestic population to feed itself.

Diamond ends his book with a somewhat hopeful outlook because of some positive turn-arounds he has observed in big business practices and evidence that in some places human population growth is slowing. This slowing, however, occurs mainly in First World countries where both parents now work two jobs to provide a small number of children with all of the "stuff" we consider essential for modern life. Diamond was hopeful enough to have children when he was 50 (now, they are 17-year-old twins). I, too, have a 17-year-old child, and I have lost sleep at night worrying about what kind of

world she will live in when she reaches my age, and even more, worrying about the world any potential grandchild might encounter. I want to be optimistic that we can make the correct choices.

It must be noted that this is a very long book (525+ pages) and Diamond tends to repeat himself in a number of places. I encourage the author and his publisher to produce an abridged edition that could be assigned to all college freshmen. In the mean time, it is important to spread the word about the currently-available version. If enough people read *Collapse* (and books like it), *and* tell their friends to read it, *and* we elect wise people into power (which we appear unable to do in this country), *and* we all agree to make self-sacrifices in terms of our lifestyles and ecological foot-prints, *and* we help the developing countries to drastically reduce their population growth rates (other than through death from disease, starvation, genocide, and warfare—the other forms of family planning), there may be reason to maintain a sense of hopefulness. Unfortunately, I feel like a passenger on a giant cruise ship headed toward the big rocks that will tear the bottom off the vessel so that we all drown. We have so much momentum that even if the captain, finally seeing the rocks, puts us into full reverse and turns the wheel full starboard, we will not be able to stop in time. I hope that I am wrong and that Diamond is right. So, please spread the word. Give copies of this book to your young friends and colleagues, the ones who still can alter the courses of their family planning and lifestyle choices. Maybe if everyone kicks to the same side we can turn this ship around.