Designing Sustainability Indicator Frameworks for Information Flow: A Case Study of B-Sustainable

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Abstract In the early 1990s, community indicators gained currency as a principal means of turning visions of sustainability into action. In the intervening years, indicator projects have been launched by communities the world over to guide and measure progress towards sustainability, but their effectiveness in serving this purpose has also been questioned. These critiques have focused attention on how information is organized within indicator systems in addition to the content and quality of the information itself. This case study draws on the work of Sustainable Seattle, an early pioneer in developing community indicators through participatory processes, to create a next-generation sustainability indicators system, the B-Sustainable Information Commons. The study aims to make the framework's design explicit according to its purposes by reflexively analyzing the design in relation to the theory and practice of framework development. The framework's most ambitious goal is to stimulate "information flows" that will lead to collective understandings of emerging sustainability patterns.

Keywords Sustainability · Indicator frameworks · Information flows · Social learning

Overture

A nomadic tribe in Ethiopia, called the Afaris, believe it's their sacred responsibility to share information—a process they term "dagu". On meeting up with other Afari families, they will sit down, talk, and listen for hours on everything they have seen and heard during their travels and interpret what these facts mean. The Afaris believe they need all of their members to be

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sensitive and aware of emerging patterns to survive in what is an extremely harsh environment, a feat which they have accomplished for thousands of years. "Dagu" trumps all other responsibilities. It is the process whereby the Afaris make collective sense of emerging patterns (Westley et al. 2006).

Introduction

For close to 40 years sustainability theorists have reasoned that system change will necessarily precede the realization of a just and sustainable world (Meadows et al. 1972; Daly 1973). For nearly as long, sustainability practitioners have struggled with how to bring about this change. The implicit challenge in driving system change is not only to engender a compelling vision of a just, sustainable, and caring world, along with commitment to that vision, but also to create collective understandings of how to get there. For this, we need new tools that address the unfolding nature of our collective understandings.

In the early 1990s, community indicators gained currency as one means of turning visions of sustainability into action. In the intervening years, indicator projects have been launched by communities the world over to guide and measure progress towards sustainability, but their effectiveness in serving this purpose has also been questioned (Brugmann 1997; Innes and Booher 2000). These critiques have focused attention on how information is organized in indicator systems in addition to the content and quality of the information itself.

While there is a significant amount of research focused on indicator selection and development methods, much less attention has been given to the organization of indicator systems, particularly at the community level. In addition, much of what is written on frameworks focuses on the descriptive (MacLaren et al. 1996; Ditor et al. 2001). This is changing—recent research efforts have focused on integrating top-down and bottom-up approaches to framework development (Reed et al. 2005) and the inclusion of different community types in system evaluation (Holden 2009).

The aim of this case study is to contribute to this newly opened body of research. It describes an innovative indicators framework and its use as a tool for making sense of emerging patterns. The study draws on the work of Sustainable Seattle, an early pioneer in developing community indicators through participatory processes, to create a next-generation sustainability indicators system, the B-Sustainable Information Commons. The intent of B-Sustainable is to "empower sustainability advocates and practitioners with the information they need to take effective action—both independently and together."

The study seeks to make the framework's design explicit according to its purposes by reflexively analyzing the design in relation to the theory and practice of framework development. To this end, the analysis draws on both the literature in framework development and the author's firsthand knowledge of B-Sustainable. The author contributed extensively to its development as the Research Director for Sustainable Seattle from January 2006 to June 2007 and again from July 2008 through 2009 through EcoPraxis as a collaborative partner.

Use of Sustainability Indicator Frameworks

Indicator frameworks are ways to organize and systemize indicators according to their intended uses. It follows that the general purpose of frameworks is to help clarify what to measure and what actions are needed to foster a positive direction of change as measured by the indicators. However, the "how and what" of frameworks are embedded in particular worldviews of what is seen as meaningful and effective— usually by their developers and sometimes by their users. As a result, a variety of indicator frameworks have been introduced into use.

The main differences in sustainability indicator frameworks include the ways in which they conceptualize the key dimensions and causal linkages of sustainability; the assumptions underlying the selection of indicators; the way they group the issues to be measured; and the implicit hierarchy and scales of data aggregation (Meadows 1998; United Nations Department of Economic and Social Affairs 2007). The selection of a framework reflects differences among the needs and interests of multiple stakeholders including the target users and the indicators' developers. Framework selection can thus have significant implications for whose worldviews are represented in the development process with consequence for how the selected indicators are subsequently used (Meadows 1998; Reed et al. 2005).

One of the main purposes of indicator frameworks is as a device for sorting indicators into categories to show which issues have been covered and which have been overlooked (Sustainable Measures Inc. & American Forests 2003). Related to this purpose, Maclaren et al. (1996) identified six major types of indicator frameworks: domain-based, goal-based, issue-based, sectoral, causal, and combination. Each framework type exhibits its own particular trade-offs, again principally in relation to the different needs and objectives of the framework's developers and intended users (Ditor et al. 2001).

Domain-based frameworks organize indicators into key dimensions of sustainability with an emphasis on the linkages among the dimensions. They are useful for providing a dynamic, contextual or systems-based understanding of sustainability. A prime example of a domain-based framework is the one Meadows developed with her colleagues in the Balaton Group, which at that time included a great many of the world's foremost practitioners in sustainability indicator development (Meadows 1998). Based on the four "capitals" (natural, built, social and human), the framework draws relationships among ultimate means (natural capital), intermediate means (built and human capital), intermediate ends (human and social capital) and ultimate ends (well-being). Significant challenges in using such a framework are, first, the effort to model the relationships and, then, to educate users on those relationships. Often users can feel overwhelmed by the complexity of the inter-linkages.

Goal-based and issue-based frameworks are commonly used in community indicator systems. Under a goal-based framework, indicators are organized according to how they correspond to various sustainability needs of the community or region under study. The explicit characterization of sustainability in these frameworks helps in the evaluation of whether indicators are showing movement in the preferred direction (Ditor et al. 2001). Goal-based frameworks also lend themselves to the incorporation of community values in the framework which, in turn, requires the "truthing" of those values by different community types.

Depending on the community's needs, the goals can correspond to the specific, such as "Increase access to affordable quality food" or "Improve high school graduation rates in our region", to the general, such as "Affordable housing for all" or "Happy, safe and satisfied citizens". While the latter goals are more inclusive as to their outcomes, they are also harder to satisfy. Issues-based frameworks are similar to goals-based frameworks in that they focus on problem areas but they are more likely to be neutral in their presentation. This stance of objectivity can prevent different community types from engaging with the development process and the community-at-large from using the indicators.

Sectoral-based frameworks organize indicators into areas of responsibility, usually those of government. Examples of such categories are housing, transportation, land use, and education. Sectoral frameworks thus help align indicator development with governmental priorities. Their disadvantage is that they often replicate the compartmentalizing of issues found in government, which hinders system change.

Causal frameworks categorize indicators according to their representation of stakeholder and environmental interactions. Common causal frameworks include the stress-condition-response model and the more elaborate driving forces/pressure/state/impact/response (DPSIR) model (Centre for Urban and Regional Ecology 2003; OECD 2003). Their limitations include the problem of indicators frequently not fitting clearly into a given category. Causal-type frameworks also usually require a high level of understanding of the complexities of a system to construct and therefore tend to be expert-determined. Finally, this type of framework tends to over-simplify causal interactions, defining them in a linear manner (Geniaux et al. 2006).

While the categorization of indicators is the focus of Maclaren's typology, there are other objectives to framework selection. In its guidelines for the development of sustainability indicators based on a study of indicator systems, Environment Canada lays out the following elements as foundational for a good framework (Ditor et al. 2001). They suggest that combination frameworks are best suited to meet these objectives.

- It recognizes and integrates the dimensions of sustainability through a systems approach;
- It is workable, practical and flexible and not limited by jurisdictional mandates and boundaries;
- It results in usable information;
- It is empowering and motivational for individuals and communities and inclusive of key stakeholders' needs and interests;
- It promotes partnerships among stakeholders and between the public and private sectors;
- It is compatible with other issues and frameworks, thereby providing a foundation for action; and
- It is amenable to both quantitative and qualitative data.

While the above criteria round out the idea of what frameworks should do, they also fail to account for some of the most basic assumptions underlying a majority of indicator efforts. One of these is that the principal target audience for indicator systems is governmental policy makers and their staff (International Institute for 1999; Ditor et al. 2001; Holden 2009). This assumption reflects a fairly static view

of power and agency in which government is responsible for the public good and activism is directed at influencing policy. As applied to indicator frameworks, it suggests that frameworks need to be geared towards policy makers' needs, providing high quality analyses that depend on experts for their development, to be effective. But as Holden (2009) points out it is not always in the interests of policy-makers to use indicators in their decision-making, no matter how objective they are.

On the other hand, Brugmann (1997, 1998) and others have critiqued citizen-led sustainability indicator initiatives, (including Sustainable Seattle's earlier projects), as failing to establish the link between indicators and action. In Brugmann's view, governmental accountability should be a key objective of indicator system development. This requires an agreement between citizen representatives and government on which indicators matter, frequently missing in citizen-led projects. Brugmann also contends that citizen-led initiatives often lack the resources to sustain their efforts.

Reed et al. (2005) have also addressed this dichotomy between expert-driven and community-driven indicator processes. They classify frameworks according to two broad methodological paradigms: expert-led and top-down in contrast to community-based and bottom-up. Their contention is that these two approaches need to be integrated for a more nuanced understanding of system interactions. The process of engaging citizens to select indicators ensures they are relevant to the community, while government involvement can enhance data reliability (Fraser et al. 2006; Brugmann 1998).

A second major assumption regards the fairly simplistic linear theory of change that underlies most indicator projects (Innes and Booher 2000). In "rational world model" indicator systems, policy is based on the weighing of objective data in decision-making. Once the data is presented, the choices will be clear. In actuality, real-world decision-making is a much messier process and system change must go beyond policy to effect change in individual and social behaviors throughout the system. As Innes and Booher observe, it is not so much the information itself but the social learning and shared understandings that emerge during the indicator development process that make the critical difference in effecting change.

The implications for framework development of these two assumptions—that governmental policy makers are the target audience for indicators and that information drives action—are discussed next.

Theoretical Roots of B-Sustainable's Framework

The design of the B-Sustainable Information Commons is rooted in complexity and sustainability systems theory as elaborated by Innes and Booher (2000) and Meadows and her colleagues (2005).

In a nutshell, sustainability system theory states that, "[T]he key to transformation is ... *relevant, compelling, select, powerful, timely, accurate* information flowing in new ways to new recipients, carrying new content, suggesting new rules and goals" (Meadows et al. 2005, p.4). That is, systems behave differently when information flows (who and who does not have access to information and what information they have access to) are changed. This is because information conveys feedback and

feedback is the means of control in a system. Differences between actual and desired system conditions (i.e., goals) as encoded in indicators can bring about decisions to act. But for feedback to stir action, the information must be of a quality—e.g. timely, accurate, and contextually relevant—as to motivate action.

Relevancy and timeliness of information flows further suppose the involvement of the community-at-large, not only in indicator development, but also in action. This view is found in Innes and Booher (2000), "Community members have to equate indicators with the things they value and use them routinely as part of their language and guides to action if they are to have influence" (p.173).

But, as Meadows et al. go on to say, systems resist changes in their information flows, especially their rules and goals. Tools that they have discovered for restructuring systems that resist change include the ones based in science and logical thinking but also others: visioning, networking, truth-telling, learning and caring. Information flows are crucial elements of these tools as well. Learning, for example, "means the willingness to go slowly, to try things out, and to collect information about the effects of actions, including information that the action is not working" (p. 8).

Drawing on complexity theory, Innes and Booher expand on the power of such tools for systems change: "We believe that the sustainable community will be promoted when many players in different roles and with differing interests and values are provided with a flow of meaningful information, and where they have opportunity for joint learning and innovative responses to this feedback" (p. 175).

The relevancy of these theories to B-Sustainable's framework design is as follows: Whereas most indicator frameworks derive from a rational world model, sustainability systems theory and complexity theory posit that, in a complex and uncertain world, the need is for distributed intelligence based on experiential knowledge. In other words, social adaptation proceeds through learning-by-doing. Indicator frameworks that "support meaningful understanding of the sustainability challenges we face" are important tools in this development (B-sustainble.org 2009). Such frameworks can facilitate shared understandings of emerging patterns, help coordinate action at all levels, and orient diverse, but interdependent, stakeholders towards common strategies. They blend the codified knowledge found in traditional frameworks with social learning processes.

What is more, the B-Sustainable Information Commons takes as its premise the essential need for participatory engagement of diverse community perspectives in the indicator system development process and beyond. We believe that system change in the direction of greater sustainability necessarily involves the contribution of diverse community members to actions informed by a collective understanding of emerging patterns in sustainability.

The Need from the Bottom-Up

Sustainable Seattle has a long history in developing community sustainability indicators using participatory processes. Its first regional indicators report was issued in 1993 and was quickly followed by a second report in 1995. The 1995 report resulted in an "Excellence in Indicators Best Practice" award from the United

Nations Centre for Human Settlements. A third report was published in 1998. Each of these reports had as their explicit intention the laying of a foundation for action (Miller 1999).

Leading up to and following the publication of the 1998 report, Sustainable Seattle decided to reassess its indicators program, notably because of a perceived lack of influence in affecting policy decisions (Holden 2004). The board felt that publishing indicator reports was not sufficient to spur action and decided to expand the indicator program with a focus on supporting action informed by the indicators.

During this same period, Sustainable Seattle developed a neighborhood indicators program designed to bring the indicator development process closer to home. The thought behind the program was that the scale of regional indicators created a disconnect, making it hard for people to relate indicators to action. Yet, in spite of this focus on community empowerment, the neighborhood indicator program never fundamentally questioned the assumption that information drives change, with the result that any actions consequent to the program were limited. The gist of the problem is that many non-specialists are not familiar with using indicators either to spur action or to hold governments accountable and linking indicators to action isn't intuitive, especially when you have no hand in developing them. It was also the case that data collected through the neighborhood indicators program often lacked context. For example, there was no way of determining whether pedestrian counts in a given business district indicated a healthy level of activity. The neighborhood indicators program was discontinued in 2007 after funding ran out.

While at first the history of Sustainable Seattle's indicator work might indicate mixed success, in retrospect there were some notable achievements. For one thing, Sustainable Seattle successfully pioneered participatory processes in indicators development, reaffirming the value of these processes in change. Holden (2004), who conducted a case analysis of Sustainable Seattle's programs from its beginning in 1990 through 2003, concluded that the intent of Sustainable Seattle's work was broader than can be described by the rational policy-making process model. In practice, its indicator development process involved social learning as evidenced by its selecting an indicator project as a tool for shaping policy; its emphasis on collaboration and system linkages; and its claim for a public voice in policy decision-making.

Miller (1999) has also concluded that Sustainable Seattle's indicator reports were hugely successful in influencing policy, albeit indirectly. Their work supported indicator capacity building in regional planning projects and spurred the development of performance measurement programs inside city and county government. Communities Count, a program of Seattle-King County Health Department, issued its first quality-of-life indicators report in 1994. The program now comprises a sizeable community of practice throughout King County. Other notable performance measurement efforts include King County's Benchmark Program and the Puget Sound Regional Council's trends program.

In turn, Sustainable Seattle's board developed a renewed interest in resurrecting its regional indicators program in 2005 with the understanding that the context for this work had shifted. For one thing, many governmental organizations with deeper pockets than Sustainable Seattle were now engaged in the development of sustainability indicators, though none of these had the breadth of Sustainable

Seattle's earlier work. Issues-focused community organizations, such as Cascade Bicycle Club, were also undertaking sustainability indicator development in the areas of their expertise. If anything, there was now a surfeit of sustainability-related indicators available for consideration, over 1,000 in a recent count. The challenge in this new context was to manage the flow of information.

What had remained constant since Sustainable Seattle's first indicator report in 1993 was the desire of the sustainability community to link indicators to action. However, it was recognized that the thrust of a new program needed to reflect the growing consensus that indicators, in and of themselves, are not enough to drive change. Instead, the view taken was that for indicators to be useful, they must be developed with the active participation of those that will use and learn from them (Innes and Booher 2000).

To meet these challenges, Sustainable Seattle set up to build on the efforts of citizen groups and government agencies to create a new generation of community sustainability indicators. A steering committee comprised of a cross-section of community members along with policy-makers and staff was chosen to guide the process. In addition, other organizations actively engaged in indicator and performance measure development were given representation on the steering committee. In particular, Communities Count played a large role, first on the steering committee and later in providing staff to support community engagement work.

Still, the process began to flounder one year later, overwhelmed by the complexities of choosing indicators in the absence of an articulated framework and a corresponding process for moving indicator development forward. In early 2006, a Technical Committee made up of indicator development practitioners and academics was formed to execute the task of framework development. The intent was to develop a framework that could bring the various indicator efforts together into a single networked system and link this information to action through engaging citizens in using indicators to make choices, both individually and collectively.

To this end, the Technical Committee determined the purpose of the framework was to provide a means of organizing data into information that is meaningful, accessible and actionable in the following senses:

- MEANINGFUL: The framework offers a dynamic systems understanding of sustainability as a context for taking values-based actions.
- ACCESSIBLE: Information is made timely and relevant to users' needs through multiple points of access—such as stories, maps, graphs, and linkages.
- ACTIONABLE: The indicators are chosen to guide and measure progress towards sustainability through potential courses of action for different users.

It now remained for Sustainable Seattle's staff (including this study's author) to develop this design concept into a fully articulated framework. The result is described next.

The Framework's Design Elements

The B-Sustainable Information Commons is designed as a regional resource of relevant, trusted and actionable information (B-Sustainble.org 2009). Spearheaded

by Sustainable Seattle, B-Sustainable is the collaborative effort of many individuals and organizations. In structure, it is a web-based indicators system with extended functionality, including:

- A framework that supports meaningful understanding of the sustainability challenges our region faces.
- A participatory process for identifying goals, indicators and actions based on cross-perspective community dialogues.
- A gateway to in-depth information including the latest research reports on regional sustainability issues.
- A network for sharing information about our progress towards sustainability in the Central Puget Sound region.
- And a forum to promote sustainability strategies, initiatives and actions.

The basic framework is organized around 22 sustainability goals, selected by a representative cross-section of the region's citizens, and defined by indicators that answer the questions: What is happening? Why is it happening? And why is it important? Typically, a goal has a set of 10 to 12 indicators referred to as an indicator map. Goals and indicators are assigned to one of four environments denoted by a color: green for the Natural Environment; blue for the Built Environment; red for the Social Environment; and gold for the Personal Environment. Each goal is also linked to strategies and actions as well as more in-depth resources.

The system includes indicators at various scales, from neighborhood- to regional-level measures, where the region is defined as Washington's four Central Puget Sound counties—King, Kitsap, Pierce, and Snohomish. Often the scale corresponds to the indicator's environment. Indicators in the Natural Environment tend to be more regional in scope, for example, while indicators in the Social and Personal Environments are likely to have more granularity.

An indicator can be shared by more than one goal and may take different positions in the causal chain of upstream-status-and-downstream indicators for different goals. For example, the indicator "Urbanization and Impervious Surface Changes" appears as a status indicator in Fig. 1, the indicator map for the "Responsible land use" goal. It appears as an upstream indicator in the indicator maps for the "Climate protection" and "Sufficient and clean water" goals. The icons

Goal: Responsible Land Use		
Why is This Happening? : Upstream Indicators	**What is Happening? :** Status Indicators	**Why is It Important? :** Downstream Indicators
▲ Land Use Mix	∼ Acres in Forest and Farm Land	∼ Freshwater Habitat Index
▲ Planned Density	▲ Acres of Urban Parks and Open Space	▼ Average Commute Time
▲ Ratio of Land Consumption to Population Growth	▼ Urbanization and Impervious Surface Changes	▼ Energy Consumption by Sector
▲ Resource Land Best Management Practices		▼ Housing Affordability by City
		▼ Prevalence of Overweight & Obese Adults
		∼ Work Commute Choices

Fig. 1 Sample indicator map

in Fig. 1 refer to the indicator's trend direction, with the up arrow signifying a positive trend, the down arrow a negative trend, and the tilde signifying relatively no change in the indicator over time.

It can be seen from this description that the basic framework meets many of Environment Canada's criteria for good frameworks set out above (Ditor et al. 2001). The framework is a combination domain-based, goal-based, and relatively simple causal framework. Its color-coding scheme provides visual cues to the linkages between domains (i.e. environments) for a system's view. It supports a partnership between data providers in the public and private sectors. It empowers communities through providing a space to share stories and promote strategies and actions related to the goals and indicators. And the framework's goal and indicators selection process is based on cross-perspective community dialogues involving a diversity of actors. For example, the indicators selection workshop for the "Income equality" goal involved representatives ranging from a university professor to a welfare mother, as well as social service provider representatives and health professional data practitioners.

Still, the more ambitious goal of the framework is to stimulate "information flows", (inspired by sustainability systems and complexity theory), that will lead to collective understandings of how to respond to emerging sustainability patterns. Table 1, B-Sustainable's Framework Principles and Design Elements, shows the extent of this ambition. The table contrasts B-Sustainable's "systems theory" inspired framework with more conventional "rational policy-making" framework models.

All of the design features in Table 1 are mutually reinforcing but in relation to the purpose of organizing information the "dynamic systems framework" deserves singling out. Sustainable Seattle's indicator reports have always stressed indicator linkages. In the B-Sustainable framework, as mentioned above, these linkages are emphasized visually as well as in narrative. In an indicator map (see Fig. 1 above), one can see the links not only between the indicators in a goal area, but also between domains through the color-coding of the indicators. This feature focuses attention on the interrelated nature of sustainability. In short, the dynamic framework reflects a systems view. As an indicator can be upstream or downstream depending on which goal it is in, the framework also accounts for non-linearity. Furthermore, through analysis of these linkages, it is possible to determine driving forces in the system. For example, the indicators "Income inequality" and "Impervious surfaces" show up in a number of goal areas as upstream causal influences on the goal's status condition.

Perhaps the most important design feature from a resource standpoint is that B-Sustainable functions as an information commons. B-Sustainable's data partners, primarily governmental units responsible for performance measurement (e.g. King County Benchmarks), provide over half of the indicators in the system; another third come from published primary data; and the remaining are developed by Sustainable Seattle. The website's content management system both allows the content providers to claim authorship and protect the data they provide from editing by others.

Several of the design elements in Table 1 speak to the importance of engaging diverse community stakeholders in framework development and indicator use. Participatory processes are used to select goals and goal indicator sets as needed to address emerging sustainability issues. This evolution of the framework's content is

Table 1 B-Sustainable's framework principles and design elements

Rational policy-making frameworks	B-Sustainable framework	B-Sustainable principle	B-Sustainable design element
Focus on policy-makers	Focus on sustainability advocates and practitioners	Power of agency and voice	Platform for sharing of information, strategies, and action
What's important decided by experts	What's important decided by citizens with the help of experts	Experiential learning is basis for shared understandings	Participatory processes used in content development
Is "neutral" and data focused	Values matter	Values embodied in content	Inclusion of stories and other forms of qualitative data
Single source of information	Multiple sources of information and multiple users	Information is non-rivalrous and non-excludable	Information commons
Information drives action	Information flows drive change	Meaningful, timely and relevant information informs decision-making for sustainable choices	Focus on user interaction—multi-directional information flows
Indicators are viewed in isolation	Indicators derive meaning from context	Indicators are inter-dependent	Dynamic systems framework
Scale through growth	Scale through relationship	Network economies	Open source

important to keeping the information in B-Sustainable timely and relevant. For example, when the original goals were selected by citizen panels in 2005, neither "Climate protection" nor a "Sustainable food system" were predominant regional concerns. Both have since been included in the framework. Typically, a goal will take from six to twelve months to develop in its entirety for publishing on the B-Sustainable web site. Emerging issues tend to take longer as they require the development of new indicators.

The design of B-Sustainable as a participatory process framework is meant to affect indicator use as well, forging the crucial bond between indicators and action. As stated in the introduction to this case study, the challenge we are facing on the road to sustainability is not only to create a vision of what's at the end of the road but a shared understanding of how to get there. The design of the web platform to accommodate multi-directional information flows facilitates the development of such understandings. Site users give meaning to the indicators by responding through sharing their experiences and thoughts on why the goals matter and through stories of actions they took that made a difference and suggestions on actions for others to take.

The new framework's success is next assessed in relation to Sustainable Seattle's and its partners' in B-Sustainable earliest engagements with the community-at-large in indicator selection, development and use.

Testing the Framework

Ultimately, the promise of B-Sustainable to "empower sustainability advocates and practitioners with the information they need to take effective action—both independently and together" (B-Sustainble.org 2009) depends on its ability to engender a sense of responsibility in the sustainability community to share information through B-Sustainable.

The framework concept was tested through its presentation to the steering committee and to system development process stakeholders, many of whom were either partners in Sustainable Seattle's programs or who had participated in Sustainable Seattle's earlier work. These presentations gave rise to wildly enthusiastic responses and a deluge of ideas on how the framework could be used to support action.

The first large-scale test of the framework's structure was to use it in a series of 12 workshops to develop the goals' indicator maps. These workshops involved diverse representation from over a 100 organizational entities in the public, private and non-profit sectors. The invitation to participate in the workshops was extended on the basis of the invitee having experiential knowledge of issues related to the goals. Nearly all of the representatives self-identified as leaders and spokespersons within their issue.

The response to the workshop experience was that, while challenging for the participants to think through the causal relationships embodied in the upstream-status-downstream framework, the participants also felt that the workshop stimulated fresh thinking. In addition, the opportunity to engage with diverse perspectives was widely appreciated. The workshops also seemed to result in a strong feeling of

success that came from having produced common understandings around goals and concrete outputs in the form of the indicator maps.

The final test of the indicator framework is in B-Sustainable's use as a tool to inform community action. Since the website's soft launch in 2008, we have engaged a number of groups in experiments in indicator use. An early example was City Club of Seattle which used the framework content on civic engagement to develop community forums on the same topic. The outputs from these forums, in turn, were added into the framework.

Other current efforts include a partnership with the City of Seattle Food Action Initiative to develop outcome indicators for the initiative linked to B-Sustainable's regional indicators for the "Sustainable regional food system" goal, and a partnership with Sustainable Cascadia, a community-based environmental sustainability organization, to develop a sustainability curriculum based on B-Sustainable's framework. We are also working with the Seattle chapter of the Business Alliance for Local Living Economies, the Climate Justice Campaign, and the Vietnamese Friendship Association to integrate the use of B-Sustainable indicators into their projects.

Of final note is a project begun in early 2009 to collaborate with leaders in two very different Seattle neighborhoods to create neighborhood sustainability scorecards based on B-Sustainable's framework. Baseline assessments of neighborhood sustainability were presented in the scorecards. The scorecards were then used to design small-scale neighborhood improvement projects. This approach to neighborhood sustainability indicators differed from Sustainable Seattle's earlier neighborhood indicators program in that the focus of the project was on the community's response to the information encoded in the indicators rather than the indicators themselves. For example, the scorecard for Rainier Beach, Seattle's most ethnically diverse community and one of its poorest, showed a high average electrical consumption rate. This information in tandem with discussions on social cohesion (another scorecard indicator) led to a project in which neighborhood youth will connect ethnic neighborhood businesses with free energy audit services, building community relationships in the process. The project participants are justifiably proud that the connections made by the community between two such different indicators as electrical consumption and social cohesion were the spur for action.

Our initial sense of these experiments is that B-Sustainable has the strong potential to create collective understandings of what actions to take but that extensive relationship-building is needed to shift the paradigm to one in which we all take responsibility for sharing and evaluating information. Given the opportunity afforded by new web technology and sustainability systems theory as embodied in B-Sustainable's framework, there is a real possibility we can create system change by changing the information flows to reach everyone.

Conclusion

Like the Afaris, the Ethiopian tribe who considers it their sacred duty to share information in order to survive, we too have need of collective understandings of what is unfolding around us. For the sake of the planet's health and our own quality of life, we need to align our actions towards sustainability. Dynamic indicator

frameworks are an important tool for helping us make sense of emerging patterns and, in turn, orienting us towards common strategies.

Indicator projects have been roundly criticized for failing to lead to action (Brugmann 1997, 1998; Innes and Booher 2000). The B-Sustainable experience confirms that linking indicators to action requires more than just the development of indicators—support must be given for using the indicators to coordinate action. Sustainable Seattle has seen some promising starts in this direction. Significantly, participants in the B-Sustainable framework development process have greatly valued their engagement in the cross-perspective dialogues as deepening their contextual understanding of the issues. As suggested by Meadows et al. (2005) and Innes and Booher (2000), it is the sharing of information that matters. The potential to strengthen community actions with relevant and timely information is also being recognized by the community, although these efforts are at their beginning stages. The use of the website platform to engage dialogue on indicators and their meaning is more challenging. A critical mass of users is needed to stimulate information flows of the magnitude that will result in system change. Demonstrating the benefits of B-Sustainable to a large audience will take time and resources.

In sum, the B-Sustainable experience confirms that indicator frameworks could play an important role in social learning. At the very least, testing the underlying assumptions of traditional framework models seems a necessary step in their evolution.

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