Sustainability for the Americas Initiative: Land Design Institute, Ball State University

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Abstract—*The Ball State University Land Design Institute (LDI) pursues ecologically and culturally sustainable land design through education, research, outreach, and demonstration. LDI seeks to lead communities (local, regional, global) to sustainable futures. It connects communities and sustainability experts to optimize education about land management, planning, and design for sustainability; and innovative monitoring approaches and technologies for measuring ecosystem implications of these activities. LDI is building its biome-based global network, including inter-national sustainability consortia, to enhance understanding of sustainability by sharing information and partnering to translate global calls for sustainability into regional agenda.*

Introduction

Sustainability for the Americas (SFTA) is LDI's first regional initiative within this network. The SFTA's pilot project, the US-Brazil Sustainability Consortium (USBSC), emerged in 2002 to include four universities and two community-based sustainability research-education organizations. It is funded by US and Brazilian departments of education (US-FIPSE and Brazil-CAPES programs). The USBSC is currently building its "education for sustainability" curriculum to include hands-on and web-based sustainability experiences and environmental monitoring science experiences. The USBSC is developing projects including environmental monitoring and interdisciplinary-international sharing of monitoring science knowledge. This second SFTA consortium, the North American Sustainability, Housing and Community Consortium (NASHCC), including 6 universities and 2 community-based organizations, emerged in 2003. Its proposal is currently being reviewed by US, Canadian and Mexican departments of education (US-FIPSE, Canada-HRDC, Mexico-SEP). The NASHCC will include hands-on and web-based sustainability and environmental monitoring science experiences, monitoring projects, and interdisciplinary-international sharing of monitoring science knowledge. The LDI is facilitating emergence of other SFTA sustainability consortia and their environmental monitoring science dimensions. Knowledge from the USBSC, NASHCC, and SFTA Initiative will also inform sustainability consortia and environmental monitoring activities LDI is beginning to facilitate in other global regions.

Global Network of Regional Sustainability Partners

Through the agricultural and industrial ages, cultures moved away from living within resource flows and local limits, and pursued globalization instead of local integration. This produced environmental degradation, loss of community, and other symptoms of a metacrisis of disconnect (Capra 1984). Current global system breakdown is driving the move to sustainability that, in the U.S., includes recognition that key universities need to lead society to a sustainable future. In an effort to help society reconnect with flows and live within limits, the Land Design Institute (LDI) at Ball State University is facilitating emergence of a network pursuing innovation for sustainability; reconnection with local and regional physical, ecological, and human dynamics; community transformation; global-local partnering; and collaboration to enhance knowledge-flow about sustainability.

LDI Sustainability Consortia

LDI's sustainability network includes a consortia network pursuing global-local partnering to integrate

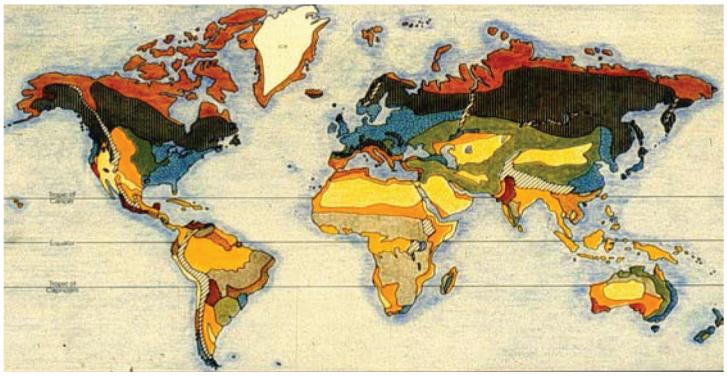

Figure 1. Global Biomes.

with local and regional dynamics. Environmentally, these consortia see global biomes, figure 1, as patterns of physical, chemical, and biological resources and dynamics into which they seek to integrate decisions. Culturally, consortia pursue decisions that integrate with cultural, socio-political, economic, and technological systems and dynamics. They realize that developed regions often sustain their lifestyles at the expense of distant ecologies and cultures, while people in developing countries often pursue markets in ways that destroy their local culture and lifestyle. Both contribute to global ecological and cultural system breakdown and, as resources dwindle, lead to conflict. LDI is building its biome-based consortia network, figure 2, to integrate with biome resource flows, sustain local and distant cultures, help people address their needs, and sustain the health and productivity of physical, ecological, and human systems.

LDI sees the Internet transforming information-flow, accelerating communication, and shortening distances; but often in ways that increase resource consumption and exclude poor people. Through BSU's Global Media Network, LDI seeks to increase accessibility to IT, the knowledge society, and sustainability knowledge-flow. It pursues sustainability in emergent markets (as well as established ones), where poor people benefit from collaboration with industry, government, and international organizations that promote local solutions that improve living conditions, generate local employment, and avoid social and environmental problems (Pauli 1998). LDI develops partnerships among institutes, landlabs, and multi-sector entities to address local and global dimensions of sustainability. It promotes consortia members as regional nodes of sustainability information-flow and behavioral change (Ferguson and Motloch 1996) that connect people to sustainable relationships with resources, build regional sustainability agenda; and function as a global sustainability-implementing network that includes universities that promote a sustainable ethic, educate students to integrate solutions into contextual systems, and empower graduates to lead communities to a sustainable future.

U.S. Partners

Charter U.S. partners of this network include Ball State University's Land Design Institute (LDI), the University of Texas at Austin's Institute for Innovation, Creativity, and Capital (IC2), and the Center for Maximum Potential Building Systems (CMPBS). IC2 is a global innovation institute; CMPBS a global leader in sustainability; and LDI a builder of partnerships that apply innovation and sustainability expertise to identify solutions that integrate with local, regional and global dynamics to help regenerate the health and productivity of environmental and human systems. These partnerships seek to develop tools, identify low-impact regionally-appropriate methods, and implement facilities that demonstrate sustainability. To enhance information-flow and facilitate sustainability, LDI is partnering with IC2 and CMPBS to create international sustainability consortia.

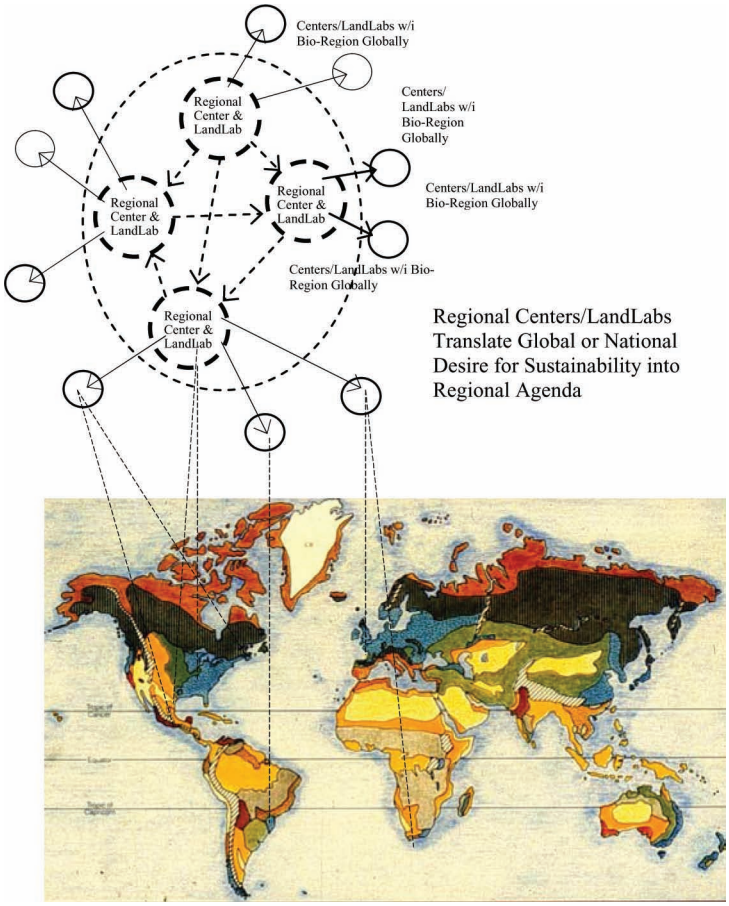

Figure 2. Global Network of Regional LandLabs (from Motloch 2003).

International Consortia-Building

LDI is facilitating LDI-IC2-CMPBS partnering in multi-national consortia; and is networking those consortia into a global network. Non-US partners and their socio-political contexts are different in each consortium, and therefore the process of formation is unique. However, consortia tend to share four developmental stages: emergence, institutional commitment and seeding, implementation start-up and sustained implementation. To facilitate Emergence, LDI identifies and brings together people with experience as sustainability change agents into an intense visioning session (workshop, videoconference, or teleconference) that includes a search for fit, collective visioning, agenda setting, identifying potential projects; and partner commitments to work together to enrich the consortium's sustainability agenda and project list. Partners also agree to pursue Institutional Commitment and Seeding funds from their institutions. Institutional commitment usually includes Letters of Intent and Memoranda of Understanding. Institutional seeding usually includes funding to visit partner facilities, meet administrators, review existing curricula, identify opportunities for sustainability curricula, sign formal inter-institutional agreements, visit benchmark projects and potential consortium projects, meet with potential community partners, develop locally-appropriate strategies for leading communities to sustainability; build community awareness of issues and potential projects; and generate proposals for mid-term funding. Consortium enter Implementation Start-Up by receiving multi-year academic and/or project funding that allows partners to meet regularly, implement sustainability curricula, complete short-term projects, and pursue long-term funding (based on track record of short-term projects). Consortia achieve Sustained Implementation upon receipt of long-term or over-lapping mid-term academic or project funding to sustain the consortium and lead society to a sustainable future (funding in-place for four years; funding targeted for ten years).

(NASHCC) emerged in October 2003 and received four-year funding in August 2004. The USBSC and NASHCC are pilot consortia of the SFTA, which is the pilot program for the LDI's global sustainability network.

Parallel Academic and Project Funding

Members of SFTA consortia have agreed to pursue parallel academic and project funding as the strategy for consortia funding. This includes internal consortium seed funding, academic and short-project start-up funding, and major projects for sustained consortium funding

Nested Sustainability Curricula

As part of four-year funding by the Departments of Education in all four countries (US, Brazil, Mexico, Canada) both the USBSC and NASHCC have committed to a nested sustainability curricula at consortia universities, to be delivered using a range of methods (Internet, visiting lectures, local classrooms, virtual classrooms, projects, field experiences, and others). This curricula has four levels. Level 1, an Internet-based Introduction to Sustainability Core Course, addresses interrelationships of ecology, environmental ethics, and environmental economics in managing, planning, and designing sustainable solutions (in the case of the NASHCC there is also an Introduction to Housing and Community core course). Level 2 is a series of hands-on and web-based Workshops (resource-balancing, systems dynamic modeling, GIS, sustainable economics, etc.). Level 3 consists of hands-on and web-based courses and practical experiences applying sustainability knowledge and skills in academic projects leading to Sustainability Certification. Level 4 is future development of Degree Extensions or Cognates. Graduates of the certificate program can work as interns on anticipated projects that help lead society to a sustainable future.

Sustainability for the Americas

Sustainability for the Americas (SFTA), the first regional group of this global consortia network, figure 3, promotes innovation and sustainability that connects people, ideas, and resources. Its first consortium, the US-Brazil Sustainability Consortium (USBSC), emerged in May 2002 and entered implementation start-up with receipt of four-year funding in June 2003. The second consortium, the North American Sustainability, Housing, and Community Consortium

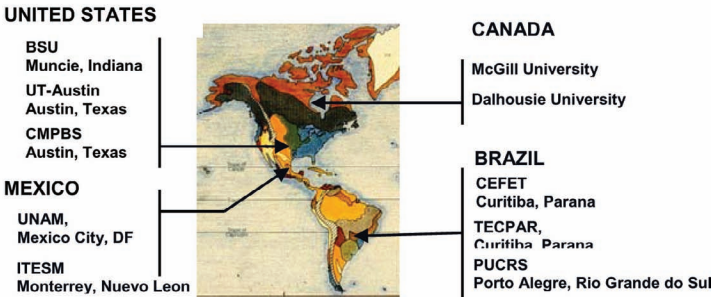

Figure 3. Emerging Suitability for the Americas Network.

Commitment to Collaboration

Organizations that work together use at least six different types of partnerships: monopoly, parallelism, competition, cooperation, coordination, and collaboration (Cervero 1988). These six types differ in their degree of interdependence among organizations. Collaboration is the most interdependent and most widely used by organizations dealing with social and environmental programs. Collaboration builds the highest levels of commitment and perceived authorship of decisions by all members. The SFTA is committed to collaboration as its operational model as a consortium and in its community projects.

U.S. Brazil Sustainability Consortium

The USBSC facilitates sustainability through collaborative knowledge-building and knowledge-sharing among university, public, and private sectors. U.S. partners are Ball State University (BSU), the University of Texas at Austin (UT), and the Center for Maximum Potential Building Systems (CMPBS). Brazilian partners are the Federal Center of Technological Education – Parana (CEFET-PR), the Pontifical Catholic University of Rio Grande do Sul (PUC-RS), and the Technology Institute of Parana (TECPAR).

Sustainability Leadership

The USBSC integrates and expands knowledge networks. It integrates four universities with sustainability leadership, a State-level sustainability agency, and a community sustainability not-for-profit. By accessing the knowledge networks of its members, the USBSC can partner with experts and access information in both countries and globally. By partnering with local, national, international experts, building accessible knowledge networks, and committing to local and biome-based information-flow, the USBSC can help lead societies to a sustainable future.

Sustainability Processes, Tools, Techniques, and Projects

The USBSC seeks to apply existing, and develop new, sustainability processes, tools, techniques, and projects for enhanced flow (resource, energy, capital, information) to all people to promote stable relations, community attachment, and integration with complex contextual systems (Ramina 2003). It seeks to identify, create, and implement integrative tools and technologies including industrial ecology, ecological footprinting and ecobalancing techniques, and sustainable land use and project planning and design (Fisk 2003). It seeks to create and implement tools and techniques that educate through collaboration, build social and psychological contracts and link people, and place through sustainable decisions (Pacheco 2003). The USBSC partners to develop and implement tools and techniques that promote regionally-appropriate, socially-equitable, and economically-viable interventions in complex ecological, physical and cultural systems; and projects that facilitate sustainability education, monitoring science, research, and demonstration (Motloch 2003).

Monitoring Processes, Tools, and Techniques

During its seeding and start-up implementation, the USBSC has begun to identify its program of monitoring processes, tools, techniques, and Brazilian and U.S projects at a range of contexts and scales.. At the Site Scale, U.S. projects include proposed integrated environmental monitoring at predefined strategic control points within an ecobalancing feedback system for making sustainable land management, use, and planning decisions on a BSU field station site, figure 4 (Motloch 2004). This project includes life-cycle based data-mapping (for example, incident radiation, biomass), productive potential mapping (for example, food, energy, clean air, material resources.), ecobalancing methods (balancing upstream and downstream productive potential), and a feedback system of ecological baselines, performance benchmarks, and environmental monitoring of sustainability indicators to assess site changes in relation to baselines and benchmarks. This ecobalancing design model (information-flow system, environmental monitoring, and comparison of environmental performance in relation to benchmarks) is proposed as a process for confirming the efficacy, and desired evolution, of planning and design decisions that seek to implement sustainability.

Potential site scale projects in Brazil include a case-study that addresses Brazilian Environmental regulations that require large enterprises that could have environmental or social impacts to obtain an operation license, granted only after local Environmental Agency approval of an Environmental Impact Assessment-EIA. Although basic guidelines have been identified for conducting the EIA, methods have not been established to guarantee that proposed monitoring considers synergy of all potential impacts. On-going research seeks to develop a simple GIS-based tool that permits consideration of all potential impacts at predefined strategic control points. This case-study is within an Atlantic Forest biome conservation unit

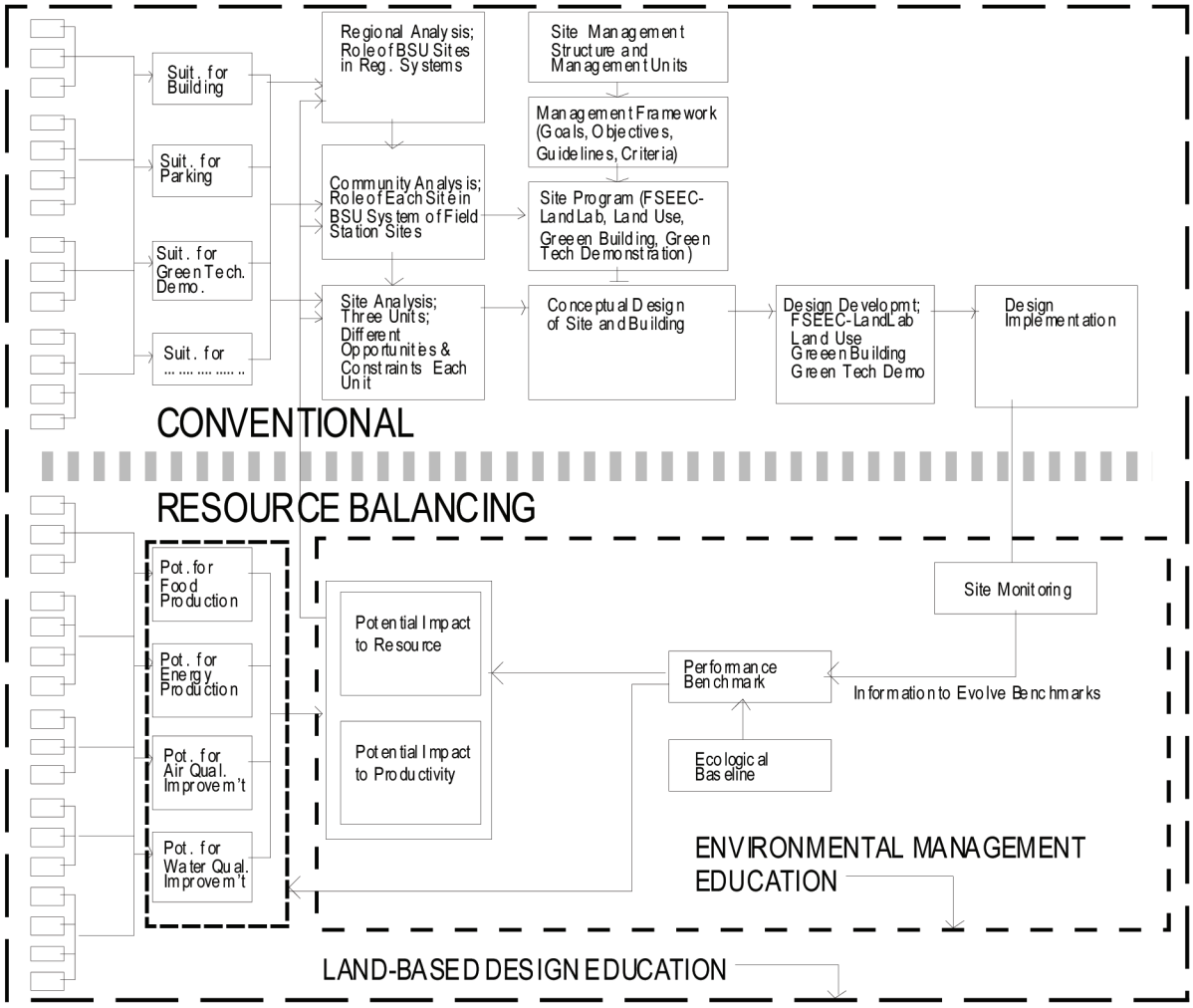

Figure 4. Ecobalancing Design Model (Introduction to Landscape Design, ed2, J. Motloch, 2000) Based on Ecobalance GameTM (CMPBS) and Ecobalancing Work of CMPBS.

currently affected by severe nearby mining activities. Data (water, soil and air quality, forest integrity, infrastructure and built surroundings, and socio-economic) are being collected, quantitatively and qualitatively assessed, and ranked (minor to highly impacted). Using simple GIS database facilities, data will be examined in synergy and areas (defined by points) submitted to easily conduct correlation analyses that allow simultaneously assessment of several impacts. This method assists in identifying the cause and nature of impacts and contributes to identification of areas of risk. It is believed that impacts can be categorized according to different levels of disturbance detected. The inclusion of socio-economic data is aimed to develop a coupled socio-environmental understanding. This is believed to represent the basis for the identification of Indicators that could support future development initiatives and decision making at the local level. This methodology enables the collaboration of specialists from different areas, facilitates decision-making, and gives a systemic perspective to definition of strategies for implementing environmental interventions. It is also a cost-effective tool for implementing monitoring to understand the sustainability of existing enterprises. It is anticipated the method can be disseminated and improved by international interactions proposed by the USBSC via a blended Web-Based Training (WBT) approach where students and professionals communicate, discuss the case-study, and learn through the Web and once a year meet face-to-face in one partner's country to visit sites where the method is being tested.

At the Regional Level, the USBSC is proposing that a similar method be applied to assess possible development scenarios for the Metropolitan Region of Curitiba in the State of Paraná. The area is of interest due to its fragile limestone geological structure and because the water caption reservoirs of the city are located nearby. Strategies to conduct this study include: 1) understanding the ecological function of that landscape using GIS techniques and local expertise, 2) understanding the impacts of existing regional economic activities such as

limestone extraction and agriculture, 3) exploring organic agriculture as a potentially sustainable economic and social regional strategy, and 4) establishing a monitoring plan for organic farming based on environmental and social Indicators. Variables and specific aspects within these two sets of Indicators can be assessed quantitatively or qualitatively in different combinations. This study could define parameters for monitoring the sustainable performance of strategies and correct implementation methods considering ecological and socio-economic aspects. It can include case-study projects where monitoring techniques, land design, and alternative technique models are implemented and tested, and results are assessed and information disseminated as options for regional development

At the regional scale the USBSC also envisions multi-biome and multi-national studies. For example, the USBSC and NASHCC (see below) are proposing a Brazil-Mexico-US bamboo research project that includes monitoring bamboo growth, water quality enhancement, impacts of alternative product manufacture, bamboo treatments to resist insects and fungus, and so on. Proposals are being developed for components of this integrated research in ways that facilitate integrated monitoring and comparative assessments in different biomes. Also, income generation for poor communities engaged in the bamboo technology should be in the guidelines of the projects. The CEFET-PR is developing a pilot project in the Metropolitan Region of Curitiba where 30 families will benefit from 6 years of research. The bamboo project is financed by a private bank through its social care external policies (Casagrande Jr. 2004).

At the Global Scale, the USBSC could document and exchange ideas about hands-on experiences that could be used to build a database of successes and difficulties that could be widely accessed and promoted by the use of IT facilities. These case studies could be the basis of Web-Based Training (WBT) materials that could be built into the education for sustainability dimensions of the network of sustainability consortia and BSU's Global Media Network.

USBSC as Proof of Concept

As pilot study of the SFTA and global sustainability consortia network, the USBSC provided "proof of concept." Rapid movement through emergence and seeding and into start-up implementation spoke to the ability to incubate sustainability consortia. Its nested curriculum and integrated academic-project approach offered opportunities to advance sustainability throughout the universities involved and their contextual communities. The web-based Introduction to Sustainability course offered potential for students within and outside USBSC institutions. During emergence and start-up, the USBSC identified more than 30 potentially fundable community-based projects including information-flow, curricula, ecological sustainability, social sustainability, community development, green demonstration, integrated energy systems, learning games, and information-dissemination projects. This list continues to grow and to serve as excellent community service projects for courses in sustainability curricula of USBSC member institutions as well as projects for which to pursue funding.

North American Sustainability, Housing and Community Consortium

Based on USBSC successes and with North American partners with a somewhat broader agenda, LDI facilitated emergence of the North American Sustainability, Housing, and Community Consortium (NASHCC). U.S. members are the same as the USBSC: Ball State University (BSU), The University of Texas at Austin (UT), and the Center for Maximum Potential Building Systems (CMPBS). Mexican partners are the Autonomous University of Mexico (UNAM), TEC de Monterrey (ITESM) and the Group to Promote Education and Sustainable Development (GRUPEDSAC). Canadian partners are McGill University and Dalhousie University.

NASHCC Evolution

LDI facilitated NASHCC emergence by including its future TEC member in all USBSC activities. The NASHCC emerged in fall 2003, as a BSU-TEC-McGill led consortium with an expanded vision of sustainability, housing, and community. NASHCC seeding began even before all members were on-board. BSU and TEC provided support based on USBSC success and a history of the future NASHCC partners working together on projects. These BSU and TEC partners met on numerous occasions in the U.S., Mexico and elsewhere from May 2002 to April 2004, pursuing multiple agenda. During this time, BSU and TEC committed to enhancing their curricula with interdisciplinary richness in the areas of sustainability (environmental, social, economic), dignified housing, and community. Additional consortium partner institutions were identified based on past partnering of faculty within those institutions. BSU and TEC approached McGill University and with McGill invited Dalhousie University. UNAM was identified as the sixth university partner. The full team adopted parallel academic and project funding strategies; and conceptualized a sustainability, housing, and community curriculum

with international courses and practical experiences that plug into degree programs to address institutional and program needs. With receipt of FIPSE-SEP-HRDC funding, NASHCC entered Implementation Start-up. A number of projects (mainly U.S. and Mexican) have been identified. In Fall 2003 and Spring 2004, BSU and TEC partners worked on a number of these projects together and with their students. During the upcoming year LDI envisions interconnecting the USBSC and NASHCC in projects that involve U.S., Mexico, Canada and Brazilian faculty, students, and communities.

Sustainability, Housing, and Community Processes, Tools, Techniques, and Projects

Like the USBSC, the NASHCC applies existing, and develops new, sustainability processes, tools, techniques, and projects for enhanced flow, increased accessibility, and integration with complex contextual systems. It seeks to identify, create, and implement integrative tools and technologies that educate about sustainable interventions in complex ecological, physical and cultural systems; and projects that facilitate sustainability education, research, and demonstration. With its broader agenda – sustainability, housing, and community – the NASHCC is also committed to accessing, creating, and implementing housing and community development processes, tools, techniques, and projects. This includes emphasis on multi-sector and inter-agency collaboration and International Collaborative Partnerships (ICP), figure 5, that partner residents, government, the private sector, NGOs, and educational institutions on community projects. It sees ICPs offering opportunities for not-for-profit and for-profit organizations to partner to exchange information, expertise, and dollars. ICPs also provide opportunities for community to partner with the NASHCC to access its network of universities, not-for-profits, and agencies, and together partner with industry in inter-agency learning laboratories where each partner contributes knowledge to identify solutions.

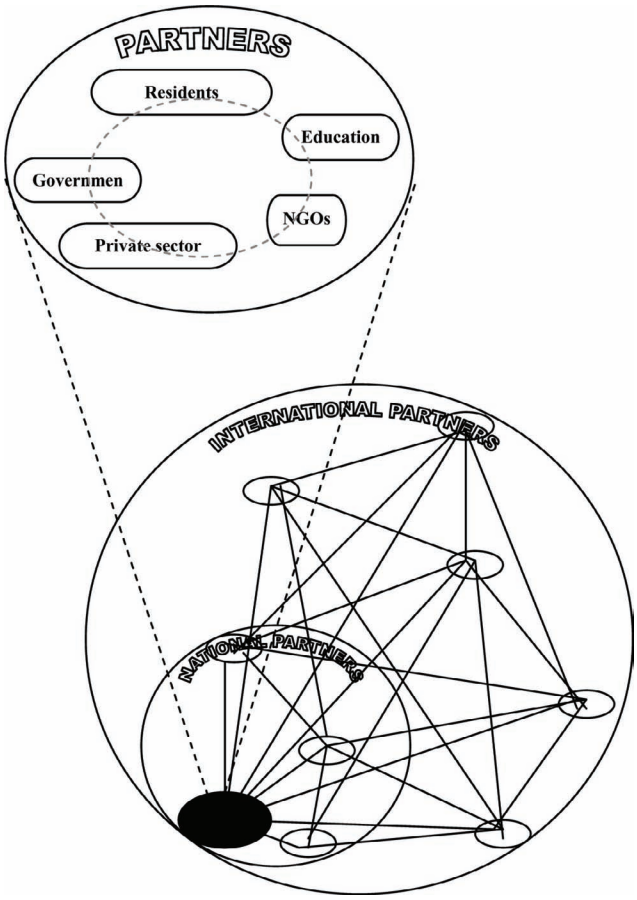

Figure 5. International collaborative partnership (Modified from Pacheco, 2003).

Monitoring Sustainability, Housing, and Community Processes, Tools and Techniques

As the NASHCC enters implementation start-up it is beginning to identify monitoring processes, tools, techniques, and projects at a range of scales and contexts in the U.S., Mexico, and Canada. Some of these, like the Brazil-Mexico-US bamboo research project mentioned above are multi-site projects in different environmental and socio-economic contexts. It is anticipated that these will present many challenges to identify and monitor Environmental and Social Indicators in ways that respond to local contexts, promote community attachment, and provide quantitative and qualitative results that can be assessed for comparisons of performance in different environmental and socio-economic contexts.

Many of the projects that have been identified by the NASHCC are capacity-building projects in the area of sustainability, housing, or community. For these, monitoring will be essential to quantitatively and qualitatively assess performance and trends in relation to baselines and benchmarks.

As the NASHCC develops its agenda of site, regional, and global scale projects, it will benefit from, and in many cases interconnect with, monitoring projects of the USBSC. At the Site Scale, it can link with Ball State integrated environmental monitoring at predefined strategic control site locations as part of the field station site's ecobalancing decision feedback system (Motloch 2003A). It can include projects that address US, Mexican, and Canadian regulation of environmental and social impacts, agency approvals of impact assessments, and guidelines and methods for monitoring potential

impacts. The NASHCC can include case-study monitoring projects of existing and alternative land uses and technologies using methods that easily and effectively identify multiple impacts, the nature of these impacts, and areas of risk. It can embrace collaboration of specialists from different areas taking a systemic approach to define and implement intervention strategies. It can implement cost-effective tools for monitoring sustainability, housing, and community performance of existing, anticipated, and implemented conditions. It can promote information dissemination to all relevant populations and blended Web-Based Training (WBT) where students use the Web and NASHCC members visit monitoring sites in the US, Mexico, Canada (and Brazil and elsewhere).

At the Regional Level, the NASHCC can develop understanding of the ecological function of regional landscapes using GIS and other techniques and local expertise. It can assess the impacts of alternative regional economic activities and identify potentially sustainable economic and social regional strategies. It can assess environmental and social Indicators and establish monitoring plans for alternative regional land uses based on these Indicators. The NASHCC can include quantitatively and qualitatively assessments of Indicators and definition of parameters for monitoring sustainable performance and defining best implementation practices considering ecological and socio-economic aspects. It can include case-study projects where monitoring techniques, land design, and alternative models are implemented, tested, and disseminated as options for regional development Like the USBSC, the NASHCC can envision multi-biome and multi-national studies like the Brazil-Mexico-US bamboo research project program mentioned above that include monitoring plant growth, water quality, and the impacts of bamboo treatments, product manufacture, and so on.

At the Global Scale, members of the NASHCC and USBSC are pioneer partners in the North American and South American portions of the SFTA. These partners include universities that can serve as regional portals for web-based teaching about sustainability, housing, and community. These pioneer partners and future consortia members can lead efforts to document, exchange ideas about hands-on experiences, and participate in building databases of successes and difficulties; and widely disseminating this information via networks, including IT, that are accessible to all. As they do, monitored case studies projects will be essential in database development and program assessment including web-based teaching about sustainability, housing, and community.

Lessons From the SFTA

The following are some of the lessons we have learned already from the SFTA. They include lessons about sustainability and lessons about monitoring.

Observations about Sustainability

From years of individual work in sustainability and in the short time that we have been partnering in the SFTA, several observations can be made.

Place-based definitions of sustainability

Brundtland said that sustainability is a global concept that must be implemented locally (1987). Each culture has a world view through which they define the problems of existence and strategies for coping and addressing these problems; and through which they create socio-political and physical manifestations to address these problems. (Beck and Cowan 1990). Throughout the world many people talk about sustainability in terms of the Triple Bottom Line: ecological responsibility, social equity, and economic viability. They contend that all three must be met for sustainability; and they seek to achieve balance among the three. Partnering among sustainability experts in developed and developing countries and with people in communities in these different contexts reveals that this balance is seen very differently in developed and developing countries. People in developed countries who promote sustainability speak of the Triple Bottom Line but tend to focus primarily on environmental responsibility. People in developing countries who promote sustainability speak of the Triple Bottom Line but focus much more on social equity. The divergence is even greater in the general populations than in the population of sustainability experts, a disproportionate number of whom have studied formally in universities in the developed world where instructors generally teach based on the world view of developed countries.

Data and decision-making

At any given time and place, assessment of sustainability is based on available data; and the nature of data varies significantly among SFTA contexts. For any specific project, the SFTA can assess sustainability at levels appropriate to available data. When feasible, SFTA consortia can pursue projects to develop data to allow more sophisticated analysis. For example, the sustainability of product manufacturing can be assessed using

Input-Output Life Cycle Assessment (I-O/LCA) methods only if all data on inputs and output are available for each sector. In most SFTA partners adequate data does not exists for true input-output analysis. In this case, one SFTA project could conduct process-level LCA, based on levels of data available, rather than true I-O/LCA. Another project could assess available datasets; and to the degree allowed by existing data, develop best guesses of sector impact rankings. It could suggest what industries might be most problematic and suggest these for improvement. Within a targeted industry, it might also identify those areas where maximum impact might be expected to occur as potential targets to address for maximum potential benefit. Another project might identify the scale and type of data needed to assess sustainability at the next level. This could motivate funding to develop the scales and types of data necessary and then initiate true I-O assessment based on this data.

Environmental and social indicators

There is a major need for Environmental and Social Indicators of sustainability that are widely embraced as "good" Indicators. Agencies seek consistent Indicators, so they can manage consistently among different projects and so that they will be confident that Indicators used on a given project are widely perceived as being appropriate. Researchers, especially those involved with parallel projects in different biomes and socio-economic and political contexts need consistent Indicators for reasons of data comparisons among these projects. On the other hand, environments and people vary regionally and locally; and for Indicators to be implemented local communities must embrace these Indicators and implement decision that respond to them. SFTA International Collaborative Partnerships (ICP), using collaboration (most interdependent form of partnering), can build the sense of commitment and authorship of decisions in diverse sectors of the society necessary for the community to embrace Environmental and Social Indicator sets that include Indicators that allow agency management and research interpretations, as well as Indicators that build local multi-sector attachment. These ICPs can engage in projects to identify Environmental and Social Indicators and recommendations for processes that promote decisions informed by these Indicators.

Suggestions for Monitoring

Based on our experiences to date, we have the following observations about anticipated monitoring science opportunities and challenges.

Challenges of different definitions of sustainability

As the USBSC, NASHCC and future members of the SFTA share their views and partner in sustainability projects, we anticipate that place-bound definitions of sustainability will be challenged. This challenge will be most direct in projects that compare case-studies in the different cultures (like the Brazil-Mexico-US bamboo project), where results need to be correlated for different sites in different biomes and socio-economic-political contexts. This will raise many monitoring science challenges in each context. Also, researchers in developed countries and developing countries will be challenged to monitor environmental and social issues (sometimes including upstream and downstream impacts) they may not have previously monitored. They will need to do so with quantitative and/or qualitative methods recognized as valid by the scientific communities in both contexts. Developing methods that will meet these challenges can best be achieved by SFTA ICPs committed to collaboration as the type of partnering, as the ones suggested by the Atlantic Forest and Urban planning Brazil-US project.

Data and decision-making

The monitoring science challenges introduced by cross-biome and cross-cultural research are compounded by the additional challenges of different available type and nature of data in specific SFTA operational environments Where the types and nature of data are inconsistent the SFTA can propose monitoring projects to complete missing data to allow assessment at the next highest level. Where industries that might be most problematic are identified and suggest for improvement, case-study projects can be monitored. When areas with maximum impact are identified within these industries, monitoring programs can assess actual impacts and alternatives for anticipated maximum benefit.

Environmental and social indicators

Once Environmental and Social Indicator are established including consistent Indicators and project-specific ones, and these Indicators and baselined and benchmarked, case-study monitoring is needed to validate these as "good" Indicators. To do this, protocols will need to be developed and tested for their acceptability in diverse biomes and socio-economic and political contexts. Consistent Indicators and protocols will need to be identified collaboratively, and tested in diverse places and audiences, if they are to be widely accepted. Once consistent Indicators and protocols for these are identified,

tested, and evolved, case-study projects will need to be identified collaboratively, tested, and embraced. These Indicators can be baselined, benchmarked, and monitored over time to see whether they move toward benchmarks. The monitoring science challenges introduced by the combination of cross-biome and cross-cultural research, different available type and nature of data in specific SFTA operational environments, the need for consistent Indicators for equitable agency management and data comparisons, and the need for wide multi-sector acceptance of Indicators will be significant. The tools, techniques, and methods embraced by the SFTA including its International Collaborative Partnerships, positions the SFTA to play a significant role in meeting these challenges.

Epilogue

The USBSC and NASHCC are pilot consortia of the SFTA, which is the pilot program for the LDI's global sustainability network. Knowledge and insight gained from these pilot consortia and the SFTA network and its two pilot consortia are helping evolve the consortia vision, operational model (including emergence, seeding, start-up, and long-term sustenance), and tools, techniques and processes to seeks to develop and implement. With USBSC, NASHCC, and SFTA successes, discussions are on-going with potential partners in other regions, including Europe, the Far East, and Africa. The LDI is eager to build consortia with universities in other global regions. We invite people interested in multi-national partnering to enter a dialog that can lead to emergence of a sustainability consortium. To explore consortia or partnerships with the SFTA, with Ball State University and other U.S. partners, contact John L. Motloch, Director, Land Design Institute, Ball State University 765-285-7561, jmotloch@bsu.edu. To discuss opportunities to partner with the Federal Center of Technological Education or Brazilian Universities contact Eloy Casagrande Federal Center of Technological Education of Parana 55 41 310-4719 fassi@ppgte.ainfo.cefetpr.br. To know more about the Atlantic Forest and the Curitiba projects contact Dr Patricia Peralta at the Institute of Sustainable Development, pperalta04@brturbo.com. To explore opportunities to partner with TEC de Monterrey and other Mexican partners, contact Pedro Pacheco, Department of Architecture, TEC de Monterrey ppacheco@itesm.mx.

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