VII

Toward the Use of Binational Border Indicators: A Cautionary Tale

Colin Griswold and Glen Sparrow

ABSTRACT
In reviewing and seeking indicators for a major binational exercise, the concept of the indicator project has become much more clear. This paper is an attempt to share some this newly discovered understanding to assist those who may decide to undertake programs of this nature in the future.

In setting off on an indicators project all parties directly involved should understand that it is a major undertaking. Preparation is critical. Goals must be clear, as should the intended audience. Goals are important for reasons of focus and clear objectives, but also because indicators must match the goals and the item to be measured by the indicator must be clear. Additionally, clearly recognizing and understanding the audience is important because often the audience will dictate the type of bias that enters the project. Bias is neither necessarily bad nor disastrous to the undertaking, but it should be accepted and understood. More to the point, bias should be recognized and acknowledged, and there should be an understanding of why it is present and how it will affect the project. Bias in a municipal, booster-type project attempting to mobilize public opinion is to be expected, but it will be different from the bias present in a more scientific or technical undertaking that educates a smaller and more professional audience. Bias should be expected, but it should be the type that creeps inadvertently into preferences, not the type that crashes into our choices.

Indicator projects also present substantial potential for public oversight and criticism, just as there is the potential for political and/or professional/collegial overview and evaluation. This is not necessarily a bad thing, but it should be recognized as a possibility prior to undertaking this type of venture. The criticism can come from all quarters, some of it based on political opposition and some on professional or technical objections.

This project developed binational indicators for the U.S.-Mexican border region. Much of this chapter will be focused on that experience and on findings about undertaking both a binational and a municipal-binational project. Based on that experience, these suggestions for binational indicator projects have been developed:

- Clearly define the goals prior to undertaking the project
- Perform an initial categorization; the categorization (disciplinary and based upon political or a combination of political jurisdictions) of projects used in the literature review would be sufficient

- Determine the audience and decide how rigorous the project is to be—if the goal is to affect public policy, the project needs to be transparent and involve the public as much as possible from the beginning
- Allow for local data collection and consider selecting local indicators when selecting indicators overall
- When implying or stating that there is a connection between an indicator and a larger category, ensure that the match is strong—depending on the already-established rigor of the project, talk with experts and/or use statistical analysis to ensure a match
- Ensure projects are truly binational by using a significant proportion of indicators that are comparable (if there are separate indicators for each side) and measure real binational concerns
- Adopt "response" or "action" indicators that fit within the Pressure-State-Response (P-S-R) or Driving Forces-Pressures-State-Exposure-Effects-Action models developed by the Organisation for Economic Co-operation and Development (OECD) and the United Nations World Health Organization (WHO), respectively, to track changes in the environment
- Be wary of allowing the availability of data or the popularity of certain issues to drive indicator selection
- Be explicit about the limitations of the selected indicators
- When the project is complete, ensure its availability to the target audience and stakeholders by holding public meetings, designing Web pages, and circulating hard copies, among other activities, and strive for legitimacy from this audience (feedback mechanisms may be a good manner of achieving this)
- After time, consider a second iteration of the project with new, better, or more contemporary indicators and/or the use of indicators that measure different points in the spectrum of the problem
- Be prepared to listen to criticism and change indicators if the logic of the argument from the audience—be it general public or professional/technical—warrants it

These more complex indicator projects are a relatively new way to access information, make comparisons and projections, and to attempt to alter public policy based on less than complete knowledge. The understanding of and mechanisms for using indicators are still being designed, tested, and adapted in numerous undertakings. Those who intend to employ indicators in the future need to be attentive to the ways indicators are employed by others, analytical but not judgmental, flexible in planning, and willing to learn from those who have come before.

INTRODUCTION

During the past decade the study, interest in, and use of indicators has come into vogue. From the municipal to the global, the concept of indicators has seen extensive use. The typical uses have been to address sustainability—a combination of "ecological, economic, and social phenomena" (Blair 2001)—as

well as other economic, environmental, or health issues. Municipal uses have tended toward quality of life and civic boosterism, the national studies have emphasized sustainability, and the global efforts have inclined toward environmental health. Regardless of the emphasis on a particular issue, indicator projects are used to observe, over time, some measurable portion of a major phenomenon so that changes in its condition can be recorded and determinations made as to whether the changes are trending in a positive or negative manner. Then, the data and information on the trends are used to influence public opinion that produces pressure on policy makers to either maintain the current policy if the trend is considered positive, or produce changes that will adjust the trends in what the producers of the project consider a more encouraging direction.

Anyone who has observed the growth of the phenomena of indicators would note that there is significant room for bias in all phases of this process. Here, the definition of bias is not used in a pejorative manner as, for instance, prejudice, which is based upon insufficient knowledge or unfounded belief. In this project, bias has a less-negative meaning and is defined as an inclination of temperament or outlook—that is, one's inability to completely shed cultural, educational or personal skin. Bias here is not the prejudice that crashes into personal choices but the bias that creeps inadvertently into personal preferences. The bias addressed here is that which informs many of the choices made by indicator selectors, not in order to indoctrinate but rather in a genuine attempt to inform.

The thrust of this chapter is to review the indicator process and see how it may be used in a bias-neutral manner to study and produce positive change in binational border regions—specifically the U.S.-Mexican border region. This will be accomplished through an analysis of commonly used definitions and descriptions of many contemporary indicator studies, and a review of some of the more influential indicator projects. In the review, the projects will be categorized according to geographic focus and discipline. Additionally, the indicator selection group(s) and intended audience for each project will be discussed along with the potential for bias. While dealing with these issues, the paper will focus on a discussion of the U.S.-Mexican border region.

WHAT ARE INDICATORS?

The use of indicators is not new; they have been used for centuries in an effort to predict changes in all sorts of conditions. The canary in the coal mine that determined the quality and quantity of air is a simple example. Of course, the change this no doubt led to was first evacuation and then better air circulation systems. Another familiar use includes economic indicators such as the stock market's Dow Jones Industrials Average that many observers continually follow as it moderates up and down, representing only a small portion of the stocks on the New York Stock Exchange but indicating for many the state of the national (and perhaps to some, the global) economy. Similarly, the use of public opinion

polling or focus groups to predict political, cultural, or consumer trends acts as another familiar indicator. Another example, in this instance an environmental indicator, could be core samples of the snow pack in the Sierra Nevada that could be used to predict drought, fire danger, and/or flooding.

Some Recent Discussion of Indicators

In order to analyze and evaluate the selection, use, and effectiveness of indicators, it is necessary to understand them. These global, national, and community sources give further explanations of what indicators are and how they are used, as well as what expectations are held for them.

John Blair, in a critical analysis of the use of sustainability indicators in a binational context, notes of indicators and their current uses that "[e]ssentially indicators are pieces of information presented in a formalized way. What is innovative is the way suites [categories/clusters] of indicators are being combined into programs to monitor global, national and community condition" (Blair 2001). In drawing attention to the "clustering" of indicators into "suites," Blair is highlighting a recent trend in indicator studies that draws a great deal of attention in contemporary indicator projects. For example "nesting" was used in a 2002 Southwest Center for Environmental Research and Policy (SCERP) study for the U.S. Environmental Protection Agency (EPA) in order to better address the problem of scale (SCERP 2002).

For a look at local examples, *The Community Indicators Handbook* (Redefining Progress 1997) speaks to the issue of indicators and their use in a number of ways:

- Indicators are small bits of information that reflect the status of larger systems
- In technical terms, indicators are presentations of data that show changes and trends over time
- Indicators are the mechanism for getting feedback about a system that might otherwise be too big or complex to understand
- Indicators are a window into the complexities of modern life; they make it possible to make informed decisions and be accountable for the results
- Indicators help communities build participation, set priorities, develop action plans, and track progress toward the realization of a new vision

An ongoing effort in Phoenix, *What Matters in Greater Phoenix*, presents three criteria that were used in the selection of indicators:

- "Is the indicator measurable? If so are the data available at regularly measured intervals?
- Is the indicator relevant to the quality of life of a large portion of Greater Phoenix citizens? Is it understandable to people?
- Will the indicator respond to changes in policy and law?" (Morrison Institute for Public Policy 1999)

At a national level, the Heinz Center recently published *The State of the Nation's Ecosystems* (2002), a report that:

- "…is written for decision makers and opinion leaders concerned about the 'big picture' of the nation's ecosystems"
- …identifies a succinct set of strategic indicators to characterize the nation's ecosystems"
- "…provides scientific information on which decisions can be based, while avoiding value judgments and policy recommendations"
- "…focuses on the *state* (or condition) of the nation's ecosystems"
- Includes indicators that "…reflect both key properties relating to ecosystem condition and the goods and services derived from ecosystems"
- "…identifies critical gaps in data and in monitoring programs that must be filled in order to fully, and in a balanced way, characterize the state of the nation's ecosystems"

This attempt clearly has an ambitious set of objectives well beyond those of previous indicator projects.

One organization that has undertaken the task of addressing indicators globally has been the Organisation for Economic Cooperation and Development (OECD). A major contribution of OECD has been the popularization of the Pressure-State-Response (P-S-R) framework for indicators. This has been widely adopted by a number of indicator users, especially at the governmental-based national, binational, and global levels. Pressure indicators are environmental stresses caused by human activities; state indicators measure the current condition of the environment (i.e. quality, quantity of resources, and human health effects); and response indicators assess the public policy activities aimed at improving the environment. This has special significance for this chapter as EPA and Mexico's Secretaría del Medio Ambiente y Recursos Naturales (SEMARNAT) Border XXI indicators projects have adopted this approach.

Another take on this type of framework is the following, which offers the example of a Threat-Capacity/Capital-Response (T-C-R) framework on the U.S.-Mexican border and is offered by D. Rick Van Schoik of SCERP. Because the old P-S-R framework had semantic and interpretation problems
in the binational-bilingual context, SCERP decided to take another approach. To make indicators most relevant, and the programs they design and measure most responsive to need, it was felt that the indicators should relate to threats and vulnerabilities. They should examine the capacity of existing agencies to respond to threats as well as the human, natural, and financial capital those organizations have available. Finally, they should reflect the changes, effects, and results of projects, or lack of engineering or other technological interventions. Thus a Threat-Capacity/Capital-Response framework is suggested.

The World Health Organization (WHO) has investigated indicators on a global scale. Specifically, citing the limitations of the OECD's P-S-R model, WHO

developed its own Driving Forces-Pressures-State-Exposure-Effects-Action (DPSEEA) model, which is particularly useful for environmental health indicator projects. The driving forces component of the model deals with large-scale factors, "which motivate and push the environmental processes involved" (World Health Organization 2000). The pressures component is identical to that in the P-S-R model: It represents pressures "expressed through human occupation or exploitation of the environment" (World Health Organization 2000). The state component is also similar to that in the P-S-R model, although WHO emphasizes changes in the environment (World Health Organization 2000). The next level consists of the exposure component, which "refers to the intersection between people and the hazards inherent in the environment" (World Health Organization 2000). Exposure leads to effects, which in this case are related to human health (World Health Organization 2000). The final component, actions, corresponds with the response component of the P-S-R model. Thus, actions refer to the activities undertaken to positively affect the environment and/or human health (World Health Organization 2000). The DPSEEA model, which is a more complex and comprehensive attempt to use indicators in a more scientific framework, is most commonly used by the United Nations, WHO, and WHO's regional offices, such as the Pan American Health Organization (PAHO).

From the more limited perspective, in terms of attention and number of studies, of the binational border is an ongoing study of the U.S.-Mexican border undertaken by EPA and SEMARNAT under the Border XXI program and Border 2012. In a 2002 paper produced for this project, SCERP described environmental indicators along the U.S.-Mexican border as follows:

> "Indicators are statistical data about characteristics of the physical world and human society over a period of time. They measure variation during a specific interlude and eventually will provide a longitudinal comparison of physical and human changes, in this instance, along the U.S.-Mexican border. If properly used, through the measurement of environmental change they will test program effectiveness and thus provide guidance for policy-makers. These indicators will measure both change within the physical environment on the U.S.-Mexican border as well as public institutions' efforts to effect positive changes on this environment."

One final source offers a rather helpful listing of what indicators may do. Winograd (1999) opines that while indicators serve a number of purposes, in general they help:

- Prioritize areas of action
- Catalyze increased awareness about environmental issues among the public at large
- Monitor and evaluate progress in managing natural resources
- Monitor and evaluate progress on environmental policy
- Monitor and evaluate social and economic trends in general

These examples provide a sample of the types of uses and discussions of what indicators are, the way that they have been and may be used, and some ideas of the expectations that are held for indicators. Also, the information noted above demonstrates the types of organizations that have and will be using indicators, as well as the types of uses—from those that approach the scientific to those that are designed to better examine and explain one's surroundings.

LITERATURE REVIEW

This literature review focuses on indicator projects the authors view as both significant and relevant. That is, the focus is on those studies that are most likely to affect this task of understanding binational border indicators projects. The review is by no means all-inclusive as thousands of indicator projects exist. This objective in this exercise is to introduce some of the various approaches to indicator projects and the organizations who use them, and then categorize them in a useful manner. As each example is discussed, an attempt is made to comment on the strengths and limitations posed by both the examples and the use of indicators.

In recognition of the concept of the nation state and their sub-national governments, the existing indicator projects have been ordered by political or multi-political jurisdictions: municipal, state, national, binational, multinational, and global. This categorization in itself is a significant contribution to the field that will aid those who currently work with indicators as well as those who will undertake indicator endeavors in the future. Additionally, within these political categories, the projects have been labeled as social, scientific, or social/scientific. This categorization is according to the criteria that are discussed about indicator project discipline. A visual representation of this literature review appears in Appendix A.

Municipal

What Matters in Greater Phoenix

This is a municipal, quality of life indicators project carried out by Arizona State University's Morrison Institute for Public Policy. This local attempt to track the changing condition of the Phoenix metropolitan region is often cited as an example for other metropolitan regions that wish to undertake an indicators program. The project discipline is categorized as social, since the environmental indicators contain little scientific rigor. One of the primary assets often attributed to the project is that it exemplifies community involvement in that public opinion (through the use of focus groups, public meetings, interviews, surveys, etc.) forms a major portion of the study. The 1997 study provides a baseline that is updated yearly and purports to measure "core values for the region." In addition, each iteration of the Phoenix project will add new indicators if public feedback determines changes are necessary. As with many municipal-level projects in the United States, the Phoenix project often compares the city's performance to that of other cities.

Imaging the Region: South Florida via Indicators and Public Opinions
This is another municipal quality of life indicators project. The report is presented by the Florida Atlantic University/Florida International University Joint Center for Urban and Environmental Problems. Like the Phoenix study, the South Florida report falls under the social discipline and probes public opinion (in addition to data collection). Unlike the Phoenix study, however, the South Florida report aggregates beyond the immediate municipal area—it focuses mainly on Miami-Dade, Broward, and Palm Beach counties (Joint Center for Urban and Environmental Problems). The South Florida report also makes use of a simple system of "performance trends," which makes indicators easily understandable for the general public. "Performance is improving" is symbolized by an up arrow, "no significant change in performance" is symbolized by a horizontal arrow pointing both left and right, and "performance is declining" is symbolized by a down arrow (Joint Center for Urban and Environmental Problems).

A Community Indicator Program for the San Diego-Tijuana Metropolitan Region
This unique quality of life project was undertaken by the Institute for Regional Studies of the Californias (IRSC) at San Diego State University. While being binational in scope, the focus is on the San Diego-Tijuana metropolitan region, hence it has been placed in the binational category. The program, which is still being refined, can best be thought of as social/scientific due to its inclusion of indicators from both disciplines. This effort at creating a binational metropolitan regional indicators project initially sought data that was compatible for both nations, consistently gathered by legitimate and reliable organizations, and an indication of the quality of life in a border metropolitan region. Upon reviewing other metropolitan indicators projects such as those discussed above, the San Diego-Tijuana program undertook both a binational public opinion survey and community focus groups to include community attitudes in the data (IRSC 2001). The program presents 35 indicators: 15 for Tijuana and 20 for San Diego (IRSC 2001). The program is aimed at informing influential members of the community about the conditions of the region (IRSC 2001).

State
Environmental Protection Indicators for California (EPIC)
This project, which is carried out by Cal/EPA's Office of Environmental Health Hazard Assessment (OEHHA), is a scientific one aimed ultimately at measuring California's human and ecosystem health. The project is built around the Pressure-State-Effects-Response (PSER) model, which is a variation of the popular P-S-R model developed by the OECD (OEHHA 2002). The April 2002 EPIC report contains indicators for media such as air quality; water; land, waste and materials management; pesticides; human health; and economic system health (OEHHA 2002). Interestingly, the report also contains indicators for transboundary issues, which include global and transboundary (U.S.-Mexican) pollution (OEHHA 2002). Only experts were consulted in the development of the indicators (OEHHA 2002). While EPIC seeks to communicate to a broad

audience via meetings and its website (OEHHA 2002), the report is not explicitly aimed at the general public.

National

National Air and Radiation Indicators Project (NARIP)

NARIP, a scientific project with national scope, is a cooperative agreement between the EPA Office of Air and Radiation (OAR) and the Florida Center for Public Management (FCPM) at Florida State University (OAR and FCPM 1997). The focus is on air and radiation resources. Conditions, trends, and effects on human health are assessed in a scientifically rigorous manner with numerous indicators. These indicators were chosen by four expert working groups consisting of state, tribal, non-governmental, private industry and EPA members (OAR and FCPM 1997). The indicators, which were selected during workshops, are designed to be used by these very same groups (OAR and FCPM 1997).

The State of the Nation's Ecosystems

This recent report by the H. John Heinz III Center for Science, Economics and the Environment is the first in a series of reports on the ecosystems of the United States (H. John Heinz III Center for Science, Economics and the Environment 2002). The initial report contains a variety of scientific indicators in specific types of natural—or in the last case, built—habitat in the following areas: coasts and oceans, farmlands, forests, fresh waters, grasslands and shrublands, and urban and suburban lands. Core national indicators are presented as well (H. John Heinz III Center for Science, Economics and the Environment 2002). The Heinz Center purports that the report does not focus on "pollution or other stresses," and avoids both categorizing the ecosystems' condition as good or bad and "recommending policies or actions" (H. John Heinz III Center for Science, Economics and the Environment 2002). The report was prepared by experts for use by influential people and informed citizens (H. John Heinz III Center for Science, Economics and the Environment 2002). The use of selected experts, an argument that it is unbiased, and the ongoing nature of this well-funded (the U.S. government, NGOs, foundations and U.S. corporations are listed as sponsors) study are offered as the strengths of this report. The audience appears to be an attentive elite set of decision makers.

Sustainable Development in the United States

In this project, the U.S. Interagency Working Group on Sustainable Development Indicators presents an experimental set of 40 sustainable development indicators for the United States. The project includes a mix of both scientific and social indicators, which are grouped into three main categories: economic indicators, environmental indicators, and social indicators (U.S. Interagency Working Group on Sustainable Development Indicators 1998). These indicators were built on the P-S-R model (U.S. Interagency Working Group on Sustainable Development Indicators 1998) and were selected through discussions with experts (U.S. Interagency Working Group on Sustainable Development Indicators 1998). Still, the report is easily understandable for the average citizen and includes a web

page for public access (U.S. Interagency Working Group on Sustainable Development Indicators 1998).

Environmental Public Health Indicators

This project by the Centers for Disease Control and Prevention (CDC), National Center for Environmental Health, Division of Environmental Hazards and Health Effects proposes a set of environmental health indicators for national application. The scientific indicators are aimed at better connecting the environment with human health (Centers for Disease Control and Prevention (CDC), National Center for Environmental Health, Division of Environmental Hazards and Health Effects 2002). To this end, four types of environmental public health indicators are proposed: hazard indicators, exposure indicators, health effect indicators, and intervention indicators (Centers for Disease Control and Prevention (CDC), National Center for Environmental Health, Division of Environmental Hazards and Health Effects 2002). The Council of State and Territorial Epidemiologists and the CDC identified the specific indicators, which can be helpful for state health departments (Centers for Disease Control and Prevention (CDC), National Center for Environmental Health, Division of Environmental Hazards and Health Effects 2002).

Sustainable Development Indicators of Mexico

Mexico's National Institute of Statistics, Geography and Informatics (INEGI) and the National Institute of Ecology (INE)/SEMARNAT published *Sustainable Development Indicators of Mexico* in 2000. The publication is part of a U.N. Commission on Sustainable Development project for the establishment of global sustainable development indicators (INEGI, INE/SEMARNAT 2000). The social and scientific indicators—which are divided into the categories of social, economic, environmental, and institutional—contained in the report were designed for both experts and the general public (INEGI, INE/SEMARNAT 2000). The indicators were originally developed by international organizations including the UN itself and use the P-S-R model (INEGI, INE/SEMARNAT 2000).

Binational

The following examples are all from the U.S.-Mexican binational region, however, others exist.

Mortality Profiles of the Sister Communities on the United States-Mexico Border

This scientific report published by PAHO is significant in that it is binational and focuses specifically on the 14 sister communities in the U.S.-Mexican border region. The indicators, which were designed by technical experts on both sides of the border (PAHO 1999), relate specifically to mortality and hence are designed for the health community.

Environmental Health Indicators for the U.S.-Mexico Border

This is also a PAHO concept document, which proposes a set of scientific environmental health indicators for future use in the U.S.-Mexico border region.

The indicators—which are designed for political officials, general publics, as well as environment and public health practitioners and managers in the U.S.-Mexico border region (PAHO 2001)—were ranked and selected by Mexican officials and PAHO representatives at a two-day workshop (PAHO 2001). The document recommends the use of the WHO-developed DPSEEA model over the P-S-R model (PAHO 2001).

United States-Mexico Border Environmental Indicators 1997

As part of the Border XXI program, which was initiated in 1996, EPA and Mexico's SEMARNAT aimed to develop and use environmental indicators to assess the state of the environment and measure program performance in the U.S.-Mexico border region (EPA 1998). Out of this objective was borne the initial report containing actual indicators: *United States-Mexico Border Environmental Indicators 1997*. The indicators in the report are scientific in nature, organized according to the P-S-R model, and were developed by the expert Border XXI workgroups, all of which are binational and organized around environmental media (e.g. water, air, hazardous and solid waste, etc.) (EPA 1998). In the report, EPA and SEMARNAT admit that additions and modifications to the indicators will occur and stress that they "will continue to involve border communities, state and local agencies, tribal governments, concerned citizens and citizen groups, and industry and business groups" (EPA 1998).

U.S.-Mexico Border XXI Program: Progress Report 1996-2000

This is the follow-up report for *United States-Mexico Border Environmental Indicators 1997*, the initial Border XXI report. Thus, the original indicators are updated (EPA 2000). The report also describes progress achieved due to Border XXI Program activities (EPA 2000).

An Evaluation of the EPA's Border Environmental Indicators: Are They Measuring Up?

In this SCERP project, John M. Blair evaluates the indicators presented under the U.S.-Mexico Border XXI Program. Blair frames his evaluation of the indicators program according to three research questions: 1) "Is this a plausible program?" 2) "Is this a sustainability program?" and 3) "How effective is the program?" (Blair 2000). Blair finds that the program is quite plausible, ranks low in terms of sustainability, has modest performance (Blair 2000). In addition to these less-than-favorable results, Blair declares that "only 20% of Border XXI objectives are measured with indicators" and points out data gaps such as the fact that "[o]f the program's 50 indicators in nine policy areas, 40% remain un-activated with data" (Blair 2000). While acknowledging the uniqueness of the Border XXI indicators effort, Blair is generally quite critical of the program.

SCERP, U.S.-Mexican Border Program: Development of Environmental Indicators—Phase I

Learning from the experience of the Border XXI Program and keeping in mind Blair's critique, in 2002, SCERP set out on an endeavor to improve the program for its next iteration: Border 2012. First, SCERP set up a focus group consisting

of experts from a variety of U.S. and Mexican organizations. From this focus group and subsequent discussions with U.S. and Mexican officials, SCERP arrived at a list of 93 suggested indicators. These indicators, of which the majority are scientific with some social focus, are congruent with the objectives set up by EPA and SEMARNAT for Border 2012. In addition to the suggested indicators, SCERP also provides Government Performance and Results Act (GPRA) information and a cost estimate for data collection of the suggested indicators.

Border 2012: U.S.-Mexico Environmental Program
As discussed above, the Border 2012 program is a follow-up to the Border XXI program. The main focus of efforts under Border 2012 is environmental health. The EPA and SEMARNAT have created six specific goals (for example, reduce water contamination) each with its own objectives. For example, the program aims to increase by 25% the number of homes connected to potable water supply and wastewater collection and treatment systems by 2012 (Draft Border 2012 Goals and Measurable Objectives, as of March 3, 2003). This version of the Border XXI series also establishes a set of "Tools" to achieve its goals, establishes EPA and SEMARNAT National Coordinators, and "three types of coordinating bodies" to be found at the regional and local levels. This appears to be an action-oriented approach that anticipates cooperation and the use of an ambitious policy-maker/expert/citizen-populated organization network.

Multinational
European Environment Agency (EEA) Indicators
This European Union (EU) indicators program is an example of a multinational indicator project. On its website, EEA presents a list of published indicators to measure the state of the environment in the EU. The indicators are scientific and categorized according to theme (such as media), policy issue, DPSIR (a variation of the P-S-R framework) position, and trend assessment (EU EEA). Presumably, the indicators have been developed by the EEA itself. The indicators are presented in a simple format, which includes the use of smiling and frowning faces to represent trend assessment, which allows for dissemination among the general public.

Global
The State of the Environment
This global study, published in 1991 by OECD, provided a major contribution to the area of indicator research in its establishment of the sustainability-based P-S-R model. Winograd notes that the P-S-R "framework is constructed to indicate the chain of causality between human activities and environmental degradation" (1999) and seems to have as its audiences the scientific and indicator-attentive communities.

Health and Environment Analysis for Decision-Making Project (HEADLAMP)

HEADLAMP is a WHO initiative that attempts to combine global and local elements in the field of environmental health indicator research. In particular, with HEADLAMP, WHO proposes a global process for selecting indicators for municipal and national environmental health indicator projects. HEADLAMP involves a three-step process: the problem must be defined; relevant environmental health indicators must be compiled, assessed, and quantified; and appropriate policies must be formulated and implemented (WHO 2000). According to WHO, "HEADLAMP takes a deliberately interdisciplinary and intersect oral approach" (WHO 2000). The results of HEADLAMP studies are geared at "decision-makers, environmental health professionals and the community" (WHO 2000). HEADLAMP uses the DPSEEA model.

Concern Over the Selection and Use of Indicators

As can be noted from this brief review, the use of indicators is widespread and the purposes for them are many. Indicators are necessary in this complex and information-rich world, for they provide a method of simplifying often intricate and massive scientific knowledge and complicated concepts. As well, they make possible the presentation of this information to the public in an understandable and manageable form. In a democratic society that operates through the transparent development and implementation of public policy based upon popular opinion the assembly, presentation and understanding of information is crucial. The use of indicators, however, should be undertaken with caution.

There appear to be numerous ways for using indicators and many valuable reasons for their use. But, the presence or appearance of bias becomes entwined in these otherwise valuable efforts to provide a basis for reasonable inference.

Likewise, the rigor applied to various indicator projects may vary; all indicator projects do not use the same type of scientific rigor to choose or use their indicators. Often the less rigorous use brings disfavor upon those who are more scrupulous in their approach. Examples vary from the community attempts to monitor and motivate change in public attitudes to the use of sophisticated and scientific approaches to inform and initiate discussion of troubling global issues. The debate over global warming could be used to represent these problems of bias and rigor. Rigorous scientific study—much of it using various types of warming indicators—has been undertaken and conclusions drawn that call for the initiation of specific types of public policy. Yet, challenges of the results, assumptions, and measurements of scientific evidence usually are made on the basis of the chosen indicators. The opponents question both the bias and the rigor of the process and the indicators. The choice, and hence the rigor, of the study of indicators are questioned as a way of attacking the concept and the conclusions. The general population that has a direct interest and the power of public opinion that could move this policy along becomes confused and seems to choose not to act or to act very cautiously.

Another concern is in the choice of indicators and how well they represent aggregate information of some phenomenon. Indicators should be used when they can clearly be the legitimate surrogate for a complete category or system. Those electing to use indicators as a means of monitoring a natural or social phenomenon must be completely clear as to what they are attempting. They need to be equally clear as to the limitations of the concept. These distinctions need to be clear to those who rely upon them as well. For example, if the public is expected to use the results of a longitudinal indicator project to affect public policy, it should be made clear to them exactly what is being measured, for what reason, and in what manner. If, on the other hand, the audience is composed of more sophisticated experts or policy makers the measurements will no doubt be, and will be understood by the users to be, more advanced. The example of the use of a municipal region to inform and mobilize public opinion would be the Phoenix project that will use a different level and number of indicators than would, for example, the SCERP binational study. The Phoenix study used nine "categories" with some having as many as four and as few as two indicators each (the study has also begun using a public opinion survey to include "public perceptions") (Morrison 1999). The SCERP study, which was produced for the professional staff at EPA and SEMARNAT produced more than 100 indicators divided into primary and secondary categories for eleven "clusters" (SCERP 2002).

Also, the indicator can sometimes be the stand-in for a rather large category or suite. This means that care needs to be taken when selecting an indicator to ensure the match of the two—indicator/category—is strong. Additionally, care needs to be taken when signifying what the indicator is representing. An example of both of these concerns—match and representation—could be illustrated by asking: What does the Dow Jones Industrial Average measure? Answers might range from the fitness of the nation's economy to the economic health of the New York Stock Exchange, or merely the composite value of the 30 stocks included in the index. Use of this indicator can have far reaching consequences when the concept is placed in the hands—and minds—of the general public and not just economists. Additionally, the question could also be asked why not use any one of a dozen other indices such as the NASDAQ, S&P 500, NYSE, or AMEX. The point is that those promoting indicator programs must know who they are attempting to inform about, or convince of, the need for policy change.

How well should an indicator represent a category? This is a question about which those using indicator projects need to be very clear. Too often indicators are selected because they represent a concept that is relatively easily measured; a category that has readily available data that is cheap, consistent and collected on a convenient basis; recognizable by the intended audience; or measures a concept that has popular support or would be more eligible for change. Indicator selection should not be driven by the availability of data or the passing popularity of certain issues. The questions that need to be addressed when selecting indicators should include: How well does the indicator represent a category of

data? And, can a single indicator be the surrogate from which a significant conclusion may be drawn, for example, can the ongoing measurement of the number of citizens voting indicate the strength and legitimacy of a democracy?

Finally, some discussion is necessary about the choice of indicators and their use for a limited time to represent a category and then to change them as circumstances are altered. Consideration should be given to the use of indicators that change as the ability to measure becomes more sophisticated. Allowances need to be made for the use of a relatively simplistic indicator that may provide a more accurate measure of the manner in which the category is progressing as opposed to a very complex indicator that provides a poor measurement. For example, in monitoring air quality in a binational region, some combination of ambient air concentrations of select criteria for air pollutants, including $PM_{2.5}$, PM_{10}, Ozone, Lead (Pb), CO, SO_x, NO_x, may be desirable. But the capability of the jurisdiction is well below that needed to measure these criteria, which may often be the case in a binational situation where there are significant asymmetries between the two nations. In this case perhaps a valid early indicator may be how many trained measurement personnel there are, after measuring this for a time until sufficient personnel are recruited and trained the indicator might change to quality of measuring equipment, and after measuring this for a time the indicator may change to number of measuring stations. Eventually, the indicator would become the measurement for the various air pollutants, but until that level of complexity was achieved, the use of the evolving measurement process would provide an accurate indication of how the issue of air pollution was being addressed and at what pace.

Bias and Rigor

The value of an indicator, as is so often the case, is based upon the motives of the purveyor of the indicator concept. In using indicators for political advantage—often the case in the metropolitan examples—the object is to select indicators that are dramatic, recognizable, easily understood, and relate to the public's understanding of the world. If the value is to further understand a complex process or phenomenon and the audience is more sophisticated in its understanding of the notion—the case in the global examples—than the approach may need to be more intellectual and scholarly. If, on the third hand, the value of the indicator is in its ability to inform and build consensus—this seems to be the binational instance—the process of selection is perhaps more important than the results.

Issues of selection and use of indicators require attention to these potential problem areas: bias in the selection, study and reporting; rigor in attention to detail and thoroughness; ensuring the indicator properly corresponds to the category or phenomenon being represented; and that the selection criteria determine the best—not the most convenient—indicator. If the end result of an indicator project is the design and implementation of public policies that will produce a better outcome than that currently being monitored by the indicator,

one possible method of guarding against the problems noted above might be to more fully involve the public in the process. Often experts are quick to undertake an indicators program, the goal of which being to motivate the public into changing public policy, but leave the public out of the process and only involve them in the final step of agreeing to the results of the project. Daniel Yankelovich, a noted polling researcher, remarked recently regarding the involvement of the public in the public decision-making process:

> "One huge trouble is that all over the country, elites and establishments and experts get together and the last thing that occurs to anybody is the public. In all the meetings I've attended, you find the various interest groups negotiating with one another, talking afterward about how to bring in the public. The public's actual concerns are an afterthought that's almost startling when you bring it up ... If leadership does think about the public it's in terms of a PR campaign of how can we sell the public the decisions that we've made, as distinct from how do you bring the perspective and point of view of the public into account." (Morgan 2003)

Perhaps earlier and greater involvement of the public in those indicator projects that have as the primary goal the specific modification of public policy would, at least, reduce the potential for this bias of exclusion. After all, in democratic societies could one suggest less? And they might also provide some good ideas. One might conclude that in order to succeed as a mechanism to influence public policy, indicators need to be created in an inclusive and transparent manner.

In looking to the three examples of values that inform the decisions that we noted above—the political outcome, the scholarly outcome, or the consensual outcome—the variable seems to be the audience. The focus for the remainder of this chapter will be on the binational or consensual approaches to indicators. International boundaries pose special considerations for those who want to use indicators to understand the nature of the environment, sustainability, or quality of life of a border region.

In order to address the indicator issues of a binational region, it is necessary to briefly discuss borders in general and the U.S-Mexican border region in particular. The function, appearance, and organization of borders are undergoing substantial change. The introduction of continental-based arrangements such as the EU and the North American Free Trade Agreement (NAFTA) in the late 20th century have dramatically changed the role of borders, with the impact being noted even beyond the regions influenced by these treaty agreements. As concepts such as the nation state, sovereignty, and boundaries—born in the 17th century and refined in the following three centuries—become increasing problematic, border regions are among the arenas of transition (Ganster et al. 1997; Ganster 2001). Sparrow, an observer of international borders, noted recently:

> "Historically, international boundaries have denoted a clash of cultures, races, economies and governments. Toward the end of the twentieth century, borders that were formerly barriers to interaction, have, due to globalization, and the end of the Cold War, reduced their barrier function" (2001).

As transboundary regions adapt to these new changes in their functions and relationships and undertake a dynamic of closer coordination and cooperation on both sides of an increasingly irrelevant line, greater interest in binational understanding and problem-solving begins to emerge.

One example of this new interest in the borderlands is the Border XXI project, instituted in 1996, which brought together the national government agencies of EPA and SEMARNAT. The effort to develop an environmental picture of the U.S.-Mexican border region was a project without precedent in North America (and perhaps the world) and called for a level of cooperation between national, state, and local administrators that had not occurred before. A major pitfall that must be avoided in this—or any binational (or multi-national) project—is to avoid national bias. For those directly involved in the design, selection, and implementation of a binational indicators project, the ability to put aside nationalistic influences, pre-judgments, and pre-conceptions and view the project as strictly binational is difficult but necessary.

The Border XXI program, which is seeing its most recent iteration as Border 2012, is a good example of an indicators project that exhibits the bias of consensus. This occurs when a primary goal of the project is to further cooperation between the two nations (and their respective governments) and produce an understanding of the issues being studied, and to reach consensus as to how to study, understand, and solve the issues of sustainability along the 2,000-mile border.

This binational indicators project incorporates two nations that share the same boundary but have significant differences. In the terms of boundary scholars there is the issue of "symmetry and asymmetry." One set of scholars lists the indicators of symmetry/asymmetry as:

- Standards of living, wages, scales, and other basic socio-economic indicators
- Demography, population size, and population dynamics
- Financial resources available to local and senior governments
- Sectoral development and the degree of industrialization
- The issue of local power and the degree of political decentralization
- Similarities and differences in political culture and legal traditions
- Degrees of cultural and linguistic affinities across national borders (Scott et al. 1997)

These are especially important when applied to the U.S.-Mexican border, as the differences in some indicators are about as pronounced as they can be. This can make cooperative ventures (such as Border XXI) difficult. Hence, the challenge for a binational indicator project is to recognize the asymmetries; undertake a program that approaches scientific rigor; understand that the audience for the program will be primarily politicians, middle and senior level staff, academics, NGOs, and attentive publics; realize that cultural and political differences must be recognized and accommodated; be transparent and inclusive; and above all, achieve consensus among the representatives of the two nations.

These then represent some of the obvious reasons for the bias that will often attend a binational indicators project. Rigor and specificity is sometimes sacrificed in the process but the goal may be a cooperative project rather than absolute precision. The political audience for the product of an indicator program may not desire that either nation “lose face” due to indicator selection or outcomes or that the product of the indicators demands outcomes that either or both nations cannot achieve, or in some instances, even attempt. For example, on the U.S.-Mexican border it is recognized that particulate patter (PM) is a major cause of air pollution and possibly asthma, and that the primary reason is the miles of unpaved roads in Mexico, but there is not adequate funding to pave these roads. Therefore, PM as an indicator is not going to produce significant change in public policy.

These binational programs need to begin and will evolve into more rigorous and comprehensive programs as those involved learn to work together. Binational programs will grow and advance. The initial set of goals or indicators are not necessarily the best or the final set. The indicators and the knowledge they generate will change over time. They may be more of a process than a product. Such is the burden of binational research and cooperation.

Another set of issues that follow from these discussions of bias—exclusion, consensus or national—is what can be referred to as the relativity of indicators, which also poses the potential for bias.

Relativity of Indicators

The best, most effective indicators are relative. Conversely, the selection and use of non-specific, or aggregated, indicators can lead to bias. The relativity, or specificity, of indicators can be measured in terms of two general variables: geography and time. Geography simply refers to the geographic scope of an indicator; time deals with the inevitable changes in the environment, public needs, and policy that occur over time.

Geographic Relativity

Effective, unbiased indicator projects are geographically specific in terms of indicator selection and/or data collection. Hence, geographically aggregate indicator projects that allow for little geographic specificity will tend to be more

subject to bias. A global environmental health indicator project, for example, that proposes a global set of indicators and non-local data collection has significant potential for bias. The reasoning is quite simple: environmental and social realities differ significantly throughout the world. Not all indicators are applicable everywhere and the comparison of aggregate data across such a large set of locations would make little or no sense. For these very reasons, all indicator projects must have a touch of "local."

With its HEADLAMP process, WHO achieves this touch of local while still being global in nature. In the first step of the process, the issues or problems to be addressed are arrived at through local contact ("through the concerns of the local community, as a result of local investigations," etc.) (WHO 2000). Then, local data are analyzed to compile the environmental health indicators (WHO 2000). In the actual application of the process as well, WHO is careful not to aggregate too much in terms of indicator selection, data collection, and comparison (WHO 2000).

Geographic specificity is particularly important for indicator projects focusing on the U.S.-Mexican border region. The border region is large and reflects multiple environmental and social realities. Simple observation shows that there is significant asymmetry between the United States and Mexico, as well as differentiation along the border from east to west. Thus, a tremendous potential for bias exists when we speak of border-wide indicator projects.

The solution to eradicating bias in border-wide indicator projects is in careful selection of local indicators and/or local data collection. Most recent U.S.-Mexico binational border indicator projects have focused on the latter option. For example, PAHO's Mortality Profiles of the Sister Communities on the United States-Mexico Border and Environmental Health Indicators for the U.S.-Mexico Border, EPA and SEMARNAT's United States-Mexico Border Environmental Indicators 1997 and Border 2012: U.S.-Mexico Environmental Program, as well as SCERP's 2002 contribution to Border 2012 all contain indicators for which data is to be collected locally at the sister-city level.

Those initiating or considering undertaking indicator projects that aim at measuring conditions in the entire U.S.-Mexican border region should take the further step of selecting geographic-specific indicators to minimize the potential for bias from aggregation. This could be achieved by drawing on municipal projects such as IRSC's A Community Indicator Program for the San Diego-Tijuana Metropolitan Region.

Of course, care must be taken to ensure that projects are truly binational. The inclusion of indicators that are only relevant for one side of the border allows bias to creep in.

Time Relativity

Changes invariably occur during an indicator project's life cycle. Indicators are time-sensitive; as discussed above, indicators should measure present and future conditions (not the past—although inclusion of past data may provide for a more comprehensive time-series). Not adjusting to change can allow bias to surface. Bias from time aggregation can be prevented by selecting proper indicators and/or allowing for multiple project iterations.

The solution to dealing with inevitable change can actually be brought about in the beginning stages of a project as the indicators are selected. In other words, appropriate indicators can be selected to help monitor change. One simple way to deal with this is to include indicators that can be populated with trend data. Also, the P-S-R and DPSEEA models offer us the "response" and "actions" indicator categories around which progress-related indicators can be adopted.

While effective indicator selection helps deal with environmental changes, time may also bring about changes in priorities, public needs, and/or policy. In these cases, it will be necessary to conduct another iteration of the project. Specifically, a re-evaluation of project objectives, the indicator suites, and individual indicators will be necessary. EPA's and SEMARNAT's efforts provide an excellent example of the use of iterations to deal with changes over time. As part of Border XXI, the two governmental organizations released a series of indicators in 1997 that were subsequently updated in 2000. Then the indicators and the overall project were critiqued by an expert (Blair) in the field. Next, SCERP was engaged to help develop a new set of indicators that would form part of Border 2012, the next iteration of Border XXI. Border 2012 now contains different objectives, indicator suites, and indicators than those presented under Border XXI. This may provide a classic example of the value of allowing a project to evolve; of course, in evolution it is difficult to analyze the end product while observing the process.

How Should Indicators Be Used?

What follows are some somewhat specific observations regarding indicators and their use that have surfaced through the above comments and this experience with using indicators in a binational setting:

1. The goals of an undertaking using indicators must be unambiguous and the indicators must match the goals.

2. What the indicator is expected to measure must be clear; attempts to measure intangibles will lead nowhere.

3. Indicators are normally of two types: environmental or social/economic/political; or a combination of the two that may be used to determine quality of life or environmental health.

4. Indicators can be considered as pointers that, like the hand on a dial or gauge, direct toward a particular condition or trend.

5. Indicators do not represent the total system (suite/category/cluster) but serve as a reasonable inference for it.

6. Indicators must be capable of being measured and tracked over time, which implies that the data be valid, consistent, and the collection regular.

7. If the data do not meet this criteria the indicator should not be considered invalid, but if it is a properly selected indicator—that is, one that is necessary in order to illustrate the total system—and if it is feasible, ways need to be found to collect the data.

8. Indicators should present data that is understandable or useful to the public for which it is intended.

9. Indicators may be used to inform, educate and/or maintain or change public policy; as such the audience may be the attentive public or policy makers.

10. Any indicator project needs to be transparent in order to attract and maintain the confidence of its designated audience.

11. Indicators should be used to track trends over time and should be maintained in a consistent manner in order for the data to remain reliable.

12. Indicators should focus on the present and future, not the past.

13. Indicator projects should strive to be unbiased—however, Blair makes a compelling case for “normative standards” that could introduce bias.

14. Indicator projects need to be observed in a structured manner over a span of time in order to be considered valid, and therefore must be carefully budgeted and adequately funded.

15. Indicator projects will suffer the loss of popular support or legitimacy if they are not acknowledged or at least recognized by policy-making bodies.

16. The end point of indicators is to illuminate the consequence of human influence on processes—ecological, social, and/or economic—and thus inform, educate and hopefully, in a democratic context, produce policy change. Ignoring indicator projects will invalidate their consequence.

Indicators and indicator projects should be viewed individually and each should be created and designed to meet the particular needs of the project or the sponsors. These more complex indicator projects are a relatively new way to access information, make comparisons and projections, and to attempt to alter public policy based on less than complete knowledge. The process of indicators is still being designed, tested, and adapted to numerous undertakings. Those

who intend to use these mechanisms in the future need to be attentive to the way they are used by others, analytical but not judgmental, flexible in planning, and willing to learn from those who have come before.

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Appendix A. Literature Review Matrix

Name of Indicator Project	Sponsor(s)	Description
What Matters in Greater Phoenix	Morrison Institute for Public Policy, Arizona State University	Assessment of quality of life in Greater Phoenix. Set up in the form of community dialogue.
Imaging the Region: South Florida Via Indicators and Public Opinions	Florida Atlantic University/Florida International University Joint Center for Urban and Environmental Problems	Quality of life report on South Florida. Makes use of objective data as well as public opinion surveys.
A Community Indicator Program for the San Diego-Tijuana Metropolitan Region	Institute for Regional Studies of the Californias (IRSC), San Diego State University	Assessment of quality of life in the San Diego-Tijuana municipal region.
Environmental Protection Indicators for California (EPIC)	Cal/EPA's Office of Environmental Health Hazard Assessment (OEHHA)	Aimed at measuring California's environmental quality in terms of human and ecosystem health.
National Air and Radiation Indicators Project (NARIP)	EPA Office of Air and Radiation (OAR) and the Florida Center for Public Management (FCPM), Florida State University	National environmental indicators aimed specifically at describing the conditions and trends of air and radiation resources.
The State of the Nation's Ecosystems	The Heinz Center	Through the use of indicators, describes the condition of U.S. ecosystems.
Sustainable Development in the United States	U.S. Interagency Working Group on Sustainable Development Indicators	An experimental set of 40 sustainable development indicators for the United States.
Environmental Public Health Indicators	Centers for Disease Control and Prevention (CDC), National Center for Environmental Health, Division of Environmental Hazards and Health Effects	A set of environmental health indicators proposed for national (U.S.) application.
Sustainable Development Indicators of Mexico	INEGI & INE/SEMARNAT	Statiscal report on sustainable development in Mexico.
Mortality Profiles of the Sister Communities on the United States-Mexico Border	Pan American Health Organization (PAHO)	Presents information on the structure of mortality in the U.S.-Mexico border region. Focus is on the 14 pairs of Sister Communities.
Environmental Health Indicators for the U.S.-Mexico Border	U.S.-Mexico Border Field Office of the Pan American Health Organization	Proposes a set of environmental health indicators for future use in the U.S.-Mexico border region.
United States-Mexico Border Environmental Indicators 1997	U.S. EPA & SEMARNAP	A set of binational indicators to assess the environment in the U.S.-Mexico border region.
U.S. EPA, U.S.-Mexico Border XXI Program: Progress Report 1996-2000	U.S. EPA & SEMARNAP	Progress report for *United States-Mexico Border Environmental Indicators 1997* and Border XXI Program activities.
An Evaluation of the EPA'S Border Environmental Indicators: Are They Measuring Up?	Southwest Center for Environmental Research & Policy (SCERP)	An evaluation of *United States-Mexico Border Environmental Indicators 1997* using program evaluation techniques.
SCERP, U.S.-Mexico Border Program: Development of Environmental Indicators - Phase I	Southwest Center for Environmental Research & Policy (SCERP)	A consultative project presenting a list of suggested indicators for the Border 2012 program along with GPRA information and a data collection cost estimate.

Border 2012: U.S.-Mexico Environmental Program	U.S. EPA & SEMARNAT	The follow-up to the Border XXI Program. Goals and objectives set up with a main focus on environmental health.
European Environment Agency (EEA) Indicators	European Union (EU)	A list of indicators assessing the environmental situation in the EU.
The State of the Environment	Organization for Economic Cooperation and Development (OECD)	Presents the widely-used PSR framework.
Health and Environment Analysis for Decision-Making Project (HEADLAMP)	World Health Organization (WHO)	Establishes a global process for measuring environmental health at the local and national levels