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Strategy for Indicator Development Border 2012: U.S.-Mexico Environmental Program Report

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Strategy for Indicator Development

Border 2012: U.S.-Mexico Environmental Program

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Notice

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Abstract

This report is intended to guide the coordinating bodies of the Border 2012 program in the development of indicators for the U.S.-Mexico border region. It explains how the Border Indicators Task Force (BITF) defines indicators and proposes six general steps to delineate the indicator development process. The Driving forces-Pressure-State-Impact-Response (DPSIR) conceptual framework, which encompasses both environmental and human health information, and ranked criteria for the selection of indicators were chosen for the Border 2012 program.

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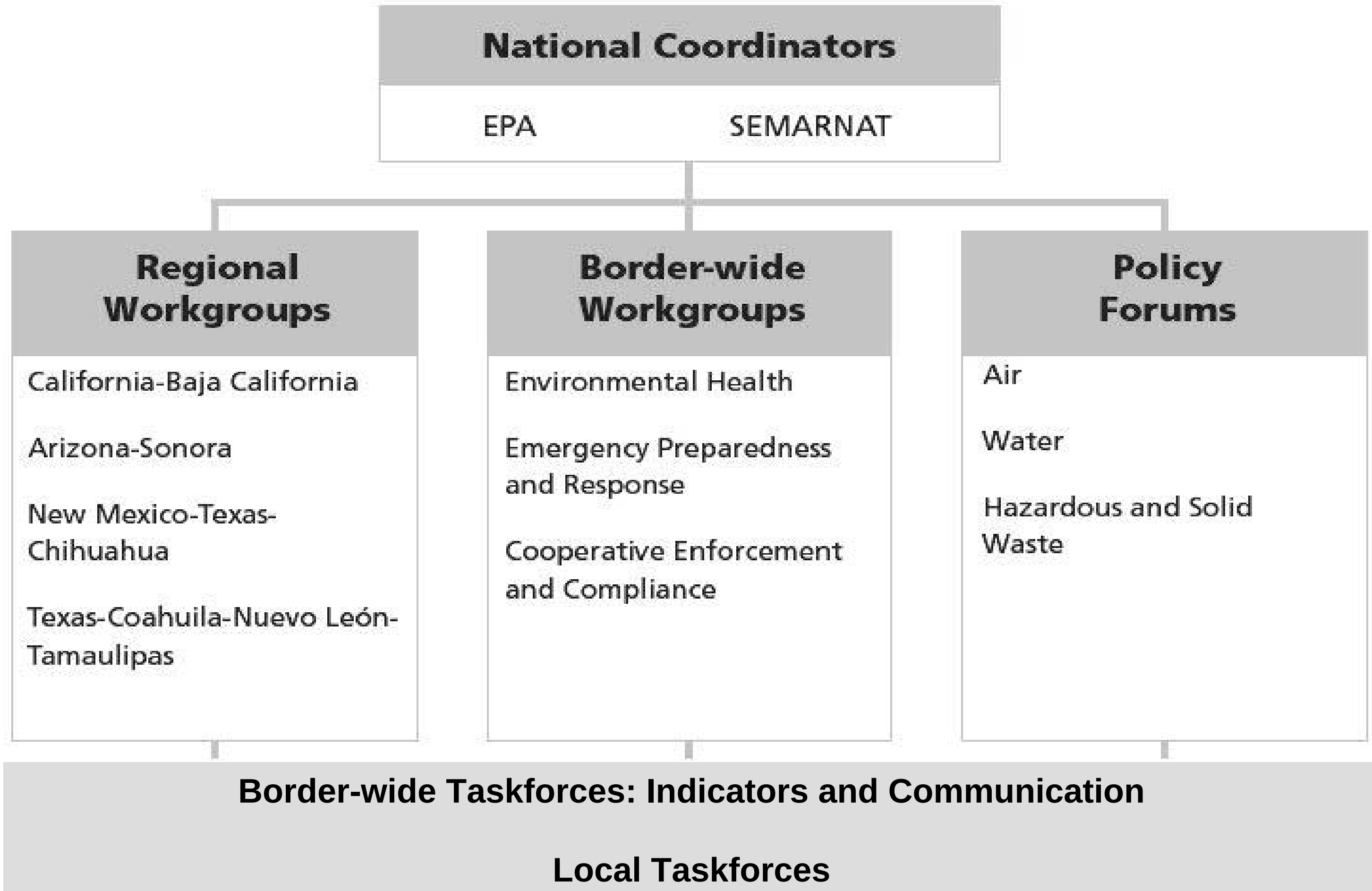
Acronyms and Abbreviations

BITF	Border Indicators Task Force	Equipo de Trabajo de Indicadores Fronterizos
CDC	Centers for Disease Control and Prevention	Centro para el Control y la Prevención de Enfermedades
DPSIR	Driving Forces-Pressure-State-Impact-Response	Fuerza Motriz- Presión-Estado-Impacto-Respuesta
EPA	U.S. Environmental Protection Agency	Agencia de Protección Ambiental de los EE.UU
OECD	Organization for Economic Co-operation and Development	Organización para la Cooperación y el Desarrollo Económico (OCDE)
PAHO	Pan American Health Organization	Organización Panamericana de la Salud (OPS)
PSR	Pressure-State-Response	Presión-Estado-Respuesta (PER)
SCERP	Southwest Consortium for Environmental Research and Policy	Centro de Investigación y Política Ambiental del Suroeste
SEMARNAT	Mexico’s Secretariat of Environment and Natural Resources	Secretaría de Medio Ambiente y Recursos Naturales
UNEP	United Nations Environment Program	Programa de la Naciones Unidas para el Medio Ambiente (PNUMA)
WHO	World Health Organization	Organización Mundial de la Salud (OMS)

Border 2012 Organization Chart



Coordinating bodies refers to regional and border-wide workgroups, policy fora, and local taskforces.
Stakeholders refer to coordinating bodies and partners at a minimum; a more comprehensive term.

I. Introduction

Border 2012 is a binational environmental program coordinated and managed by the U.S. Environmental Protection Agency (EPA) and Mexico's Secretariat of Environment and Natural Resources (SEMARNAT). Its mission is to "protect the environment and public health in the U.S.-Mexico border region, consistent with the principles of sustainable development." Possessing adequate information is essential to protecting the environment and public health; recognizing this, the National Coordinators of the Border 2012 program agreed to "measure program progress through development of environmental and public health-based indicators," "achieve concrete, measurable results" and "strengthen capacity of local community residents and other stakeholders to manage environmental and environmentally-related public health issues."[1] The purpose of this strategic document is to provide Border 2012 coordinating bodies (regional and border-wide workgroups, policy fora and local taskforces) with a foundation for the identification, development, and use of a set of environmental and performance indicators.

The Border Indicators Task Force (BITF) defines an indicator as a single variable or output value from a set of data that describes the state of the border region in a way that is meaningful for stakeholders. Therefore, indicators developed will present available information regarding the state of the environment and public health along the U.S.-Mexico border, creating a basis for tracking, evaluating, and associating changes. These indicators should also help to monitor the effectiveness of the U.S.-Mexico Border 2012 program and measure progress toward achieving its goals and objectives. Collectively, indicators will provide information that both policy-makers and the public can understand, enabling them to make well informed decisions.

This strategic document outlines an indicator development process, which includes the identification of a conceptual framework, criteria for indicator selection, and a context for understanding border indicators. As a result, it should also improve communication and foster cooperative work between and within the coordinating bodies of the Border 2012 program. The border indicators effort builds upon previous indicator works and strengthens partner relationships in order to address the needs of the local communities, the target audience of Border 2012 program. Ultimately, the development and maintenance of sound indicators that are applicable binationally will benefit border stakeholders.

II. Background

The U.S.-Mexico border region is influenced by rapid population and economic growth that could contribute to further impacts on the environment and health of border communities. These driving forces have resulted in events such as unplanned development, increased demand for land and energy, traffic congestion, increased waste generation, and overburdened or unavailable waste treatment and disposal facilities.[2] There is a documented relationship between these environmental conditions and health problems such as waterborne and respiratory diseases in border residents.[3] These issues underscore the need for, and pose a challenge to, timely and adequate development of environmental and health infrastructure and capacities to effectively manage issues at local and regional levels. Consequently, since the 1983 La Paz Agreement,[i] the United States and Mexico governments have undertaken cooperative initiatives implemented through multi-year binational programs to improve and protect the environment and public health of the border region.

Consistent with worldwide indicator trends, interest in the development and use of U.S.-Mexico border indicators started increasing in the mid-1990s. Border XXI (1996 to 2000) preceded the Border 2012 program and marked the first binational attempt to develop environmental indicators for the border region, making tangible contributions to understanding the quality of the environment and its likely impact on public health. The Border 2012 program uses indicators to track trends, monitor program progress, and plan next actions. This aligns with indicator uses at international organizations (including the United Nations Environment Program (UNEP), the World Health Organization (WHO), and the Organization for Economic Cooperation and Development (OECD)), federal and state governments of countries across the world, as well as non-governmental organizations.

The current binational agreement, Border 2012, sets goals and objectives through the year 2012 to be accomplished by the coordinating bodies. This program emphasizes a bottom-up approach and includes local decision-making, priority-setting, and project implementation. The Border 2012 goals encompass aspects of air, water, and land contamination; environmental health; chemical exposure via accidental release and terrorism; and compliance, enforcement and environmental stewardship. More information about the program can be found at the Border 2012 Web site www.epa.gov/border2012/.

To ensure that these goals are met and to increase overall capacity to respond to environmental and health problems at the border, the Border Indicators Task Force was established in December 2003. Border 2012 mandates that indicators be developed and used to measure real and meaningful results. The role of the BITF is to collaborate with all Border 2012 coordinating bodies in order to define a set of indicators as well as prepare protocols for the collection, analysis, and quality control of the data necessary for the calculation and interpretation of those indicators. Ongoing review of these indicators will provide local

[i] Agreement between the United States of America and the United Mexican States on Cooperation for the Protection and Improvement of the Environment in the Border Area

communities, partners, and decision-makers with informative tools that can help shape research and public health and environmental policy priorities.

Various stakeholders will be involved in the development and use of indicators. In addition to the federal environmental agencies - the EPA and SEMARNAT - federal health agencies such as the U.S. Department of Health and Human Services, in particular its Centers for Disease Control and Prevention (CDC), and the Mexican Secretariat of Health (Secretaría de Salud) participate in the Border 2012 program. The state and local health and environmental departments on both sides of the border are also instrumental in this process, as well as international organizations such as the Pan American Health Organization (PAHO) and the Southwest Center for Environmental Research and Policy (SCERP).

III. Process for Indicator Development

Developing indicators using a systematic method, standardized to all Border 2012 coordinating bodies, is important as a common approach will allow for continuity between partners and efforts. The development process for Border 2012 indicators can be broken down into six distinct steps:[4]

1. Define the information need
2. Select a conceptual framework
3. Identify potential indicators
4. Evaluate potential indicators on the basis of selection criteria
5. Adopt/develop/implement indicators
6. Review indicators

1. Define the information need

The Border 2012 program identifies six goals, each representing binational priority areas: (1) water, (2) air, (3) land, (4) environmental public health, (5) emergency preparedness and response, and (6) cooperative enforcement and compliance. Available data is needed about each area to develop quality indicators that measure changes in environmental and health conditions of the border region and progress towards achieving program goals and objectives.

Indicators are more than just any given measurement; they are the interpretation of available data. The 2003 United Nations World Water Development Report stated that "an indicator, comprising a single datum (a variable) or an output value from a set of data (aggregation of variables), describes a system or process such that it has significance beyond the face value of its components. It aims to communicate information on the system or process."[5]

Both environmental and performance indicators are necessary to track environmental changes and program actions in order to evaluate the effectiveness of the Border 2012 program. Although the two indicator types should not be used interchangeably, the use of an integrated set of indicators will provide representative, meaningful information that will aid decision makers. Definitions and further discussion on indicator types are explained in the following section.

2. Select a conceptual framework

Indicators become useful, informative tools when they are related to a conceptual framework that holistically describes the interactions within a system. Hence, a conceptual framework of the border region system assists the Border 2012 program by helping to:[6]

- Systematically conceptualize information from many different sources
- Incorporate new information as a result of the framework's flexible and dynamic characteristics
- Establish a shared knowledge base and thereby improve communication and participation of stakeholders
- Increase understanding and transparency of program goals and objectives
- Strengthen the capacity of stakeholders to manage environmental and environmentally-related public health issues

In the previous Border XXI program, the **Pressure-State-Response (PSR)** conceptual framework was used to conduct indicators work.[7] This primarily linear model follows the logic that a Pressure causes a change in State, which then evokes a societal Response. However, the PSR framework is limited in its application, since it does not account for complex ecological processes and human-environment interactions. More specifically, it provides no explanation for impacts that may result from changes in State, nor does it provide a means for Responses to affect the system in a dynamic, cyclical manner. The Border 2012 program requires a more comprehensive conceptual framework that provides context for events and accounts for outcomes within the border region.

After a thorough review by the Border Indicators Task Force, the **Driving Forces-Pressure-State-Impact-Response (DPSIR)** conceptual framework, an extended PSR model, was selected as most suitable for the needs of the Border 2012 program. DPSIR is also favorable as it builds on the previous indicator framework of Border XXI.

Similar to PSR, DPSIR is based on the idea that anthropogenic activities impact the environment, and that adverse environmental activities or impacts induce humans to curtail or manage factors affecting any stage of the system (see Figure 1).[8] However, this framework introduces two additional concepts: 1) "Driving forces," which account for how economic pressures and society's behavior affect the environment and thus, human and ecological well-being; and 2) "Impacts," which show that human well-being is related to environmental quality.[9] Therefore, in the DPSIR framework, societal Driving forces lead to anthropogenic Pressures, which lead to a State, which generates Impacts that evoke Reponses. The "Responses" compartment feeds back into every other compartment, showing that interventions can occur at each point along the causal spectrum.

It is possible to divide "Impact" into two different components: "Exposure" and "Effect." This accounts for traditional considerations of health frameworks, but does not preclude the importance of ecological outcomes. Exposure refers to the intersection between people and hazards inherent in the environment, while Effect refers to the health effects caused directly by exposure to environmental hazards. With this modification, there is a directional path from State to Exposure to Effect, before finally linking to Response. Further explanation and examples of each compartment are given below.

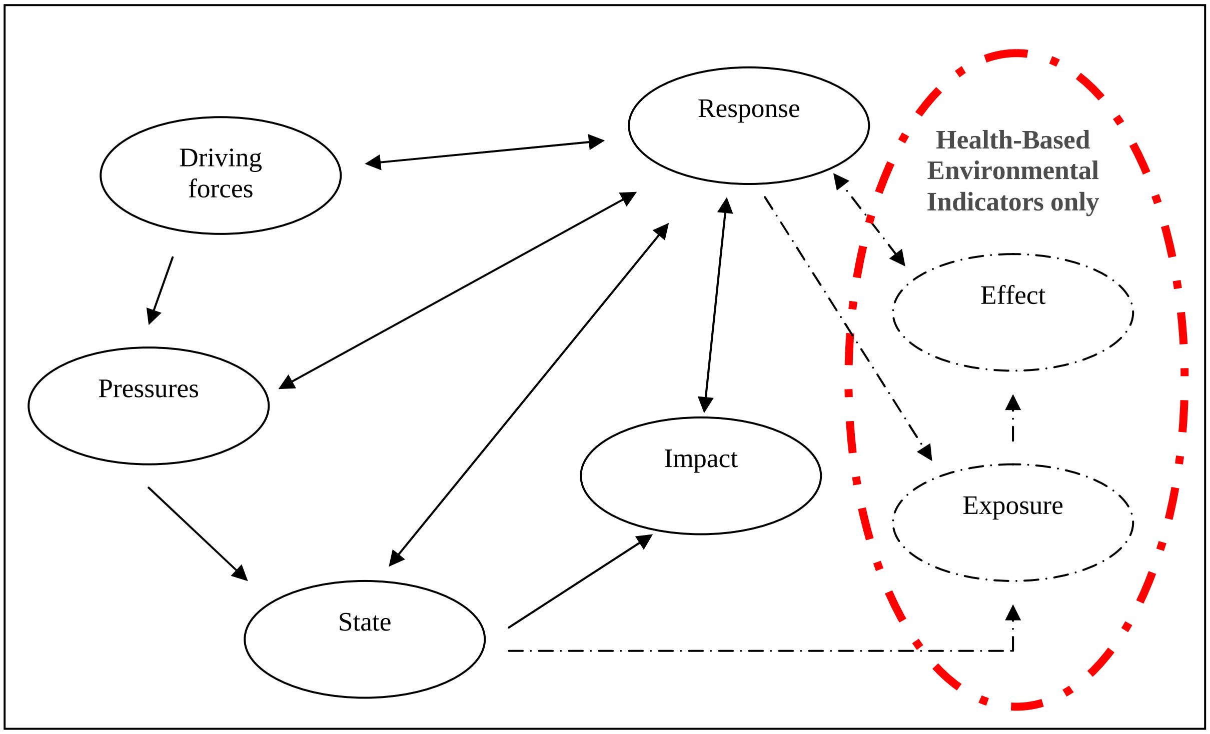


Figure 1: Modified DPSIR Conceptual Framework **(Source: Edwards, 2004; see Reference 8)**

Driving Forces

Driving Forces are socio-economic factors that cause or influence environmental change which positively or negatively influence pressures on the environment. Common examples of Driving Forces are income, population size and make-up, use of resources, and education levels (e.g., per capita income, number of inhabitants, or household energy consumption).[10]

Pressures

Pressures are natural or anthropogenic factors that directly influence the state of the environment. As the OECD describes, Pressures "change [the environment's] quality and quantity of natural resources."[11] Common examples are the level of output from sources and the amount of resource loss (e.g., the number of carbon dioxide-emitting vehicles on the road, the amount of effluent released from point-sources into rivers, or the amount of forest harvested).

State

State refers to measures of the quality of the environment and the quantity of natural resources, as influenced by Pressures. A typical example is the concentration of a particular pollutant in a medium (e.g., concentration of ozone-damaging pollutant in the air or count of fecal coliform in water).[12]

Impacts

Impacts are the results of the condition of the environment on people, animals, and ecological processes. For health-based environmental indicators, Impacts can be further separated into both Exposure and Effect. A common example is exposure to environmental contaminants in biological populations (e.g., incidence of gastro-intestinal disease in a county).

Responses

Responses are the efforts undertaken by society to respond to environmental changes and issues. As targeted action measures, Responses are typically expressed as program activities (e.g., number of farm workers trained on pesticide risks or stricter laws for wastewater discharge).

DPSIR is able to provide a comprehensive and unified conceptual framework for the diverse, binational coordinating bodies of Border 2012, thereby facilitating communication and cooperation. It is a resilient model that can be tailored to fit the needs of specific programs by emphasizing the indicator compartments of interest. Finally, DPSIR is well suited to the Border 2012 program because it allows for the identification and analysis of relationships between border-specific development actions and the effects produced on the environment and human health. The enhanced understanding of these relationships will allow policy-makers to develop the region in a sustainable manner, aware of potential environmental and human health consequences. In addition, while this framework serves to systematically guide the development of indicators, coordinating bodies should not be limited by it. Specifically, indicators do not have to be identified for all of the compartments.

Indicator Definitions

For the purpose of the Border 2012 program, indicators will be identified as either environmental or performance indicators, and further classified according to the DPSIR framework. These two types of indicators are defined in the following manner:

Environmental indicators communicate information regarding the region's environmental and health *conditions*. They aid in:

- Measuring progress toward meeting Border 2012 outlined goals and objectives;
- Assessing conditions and trends in the Driving Forces, Pressures, State, or Impacts compartments of DPSIR in order to show improvement or deficiencies in the system; and/or
- Understanding the relationship between the different compartments in order to make predictive associations between two compartments of DPSIR and formulate policy. Associations should be quantitative (when available), and either correlative or causative.

Performance indicators communicate information regarding environmental management *activities and targeted response measures*. They aid in:

- Measuring progress toward meeting Border 2012 outlined goals and objectives; and/or
- Understanding the relationship of response actions (the Response compartment) on another DPSIR compartment and/or on influencing the overall DPSIR system in order to evaluate the program.

Indicators are therefore able to serve the many needs of the Border 2012 program, including describing an environmental factor at a given moment, showing trends, or measuring progress towards a given goal. Indicators can also gauge program accomplishments and can significantly aid in planning and management processes. Moreover, a set of indicators helps to describe the overall system, increasing understanding of the border region, assisting in highlighting data gaps, and providing a basis on which to make well informed decisions.

3. Identify potential indicators

The previous Border XXI program initiated the binational indicator development process, thus facilitating the identification of potential environmental and public health indicators for the Border 2012 program. Indicator efforts conducted by partner organizations such as SCERP and PAHO, and by the state and federal governments of the U.S. and Mexico, serve as additional resources for the identification of indicators. Input is necessary from all stakeholders, particularly with regards to identifying indicators that are representative of actions implemented to improve the environmental and health conditions of the border region. The outcome will be a binational set of potential Border 2012 indicators, which should then be evaluated on the basis of selection criteria.

4. Evaluate potential indicators on the basis of selection criteria

Each potential indicator should be evaluated on the basis of selection criteria, which is organized into three tiers: core, data availability, and media-specific. Although the final indicator criteria may vary slightly due to stringency or specificity of a coordinating body's needs, there is a set of criteria that is fundamental to the Border 2012 program.

Tier 1: Core Criteria

Core criteria[13] are of equal importance and should be met by <u>all</u> indicators developed for the Border 2012 program.

Representative
All indicators should be representative of what they purport to describe in a binational nature. Although the ideal indicator would be one measure that can be collected on both sides of the border, it is also possible to have a matched pair of indicators collected in both countries that are comparable in scope and have the potential to be harmonized. This caveat is created specifically for situations in which it is not feasible to collect data by the same method in each country.

Policy relevance
Indicators must provide relevant information to management and policy areas as well as to society's concerns about ecological conditions and/or human health. Specifically, indicators should provide useful and accurate information about the state of the border's environment and health, and measure changes and trends in those conditions. As a result, indicators should help clarify the relationship between the natural environment and human activities, providing a useful tool for improved decisions and policies. For Border 2012 indicators, "policy relevance" can be defined as the ability of an indicator to address program objectives and goals and lead to policy applications along the U.S.-Mexico border.

Scientific validity and methodological rigor
Technical and scientific accuracy are characteristics that support the reliability and validity of an indicator. Ideally, indicators should be based on accurate

measurements (or data) that describe the condition as adequately as possible. The data must also be precise enough to produce consistent and reproducible results, and therefore, the indicator development process must be well documented. Requiring a quantifiable measure does not mean that indicators should be complicated. On the contrary, it is important to keep indicators simple and easy to interpret.

Sensitive to change
Indicators must be flexible and responsive to changes in the border region. To effectively measure changes that occur over time, indicators may require target or baseline data. Sensitivity is needed to acknowledge the factors that can affect the values represented by the indicators: errors of measurement or natural variability (spatial or temporal).[14] For this reason, the data of border indicators should be collected and reviewed frequently enough for it to help reflect the true conditions of the border region.

Public understanding and acceptance
Indicators play an important role in raising public awareness. Hence, indicators should be transparent and simple enough to be understood by the border communities. A well informed public is more likely to be involved in the Border 2012 program. Public acceptance of border indicators will depend on the active participation of communities in identifying their own perceptions and interests regarding their information needs. Ultimately, public acceptance will affect overall policy performance.

Tier 2: Data Availability Criteria

After this first evaluation, potential indicators need to be assessed with regard to the availability and compatibility of quality data.

Information availability
The availability of valid data is a fundamental consideration for an indicator. In most cases, it is preferable to propose indicators derived from pre-existing data sets because it may result in timelier indicator development and facilitate the establishment of a baseline. On the other hand, a data gap should not prohibit the development of an indicator if its potential uses are deemed sufficiently valuable. The feasibility of collecting the necessary data should be determined. If development of a particular indicator is not feasible at present or in the future, an alternate indicator must be identified and used.

Information compatibility
Indicator data must be accessible by a variety of stakeholders in both countries to be used for any given number of purposes. This means that datasets that easily serve various Border 2012 indicator tasks will be more appealing than sources that are singular or unique. The compatibility of data is particularly crucial since Border 2012 indicators will be used across national boundaries. Also, where feasible, indicators

should be similar to or the same as the indicators used to report on national environmental conditions respectively in the U.S. and Mexico.

Tier 3: Media-specific Criteria

Because the objectives of each Border 2012 coordinating body differ, additional criteria should be introduced by the individual groups as necessary. A sample list of additional criteria is included here.

Appropriate spatial and temporal scale
The consideration of scale brings up the aggregation or disaggregation of data: the ability of data to be combined or separated to obtain relevant information. For example, data gathered at a local spatial scale may not be applicable to the border region. Alternately, data gathered with a specific temporal scale may not adequately account for trends such as seasonality or concurrence with an environmental or health event. Ideally, border indicators will be based on datasets that can be aggregated to a regional spatial scale. However, this does not preclude the importance of developing and reporting on specific local indicators.

Feasibility/cost effectiveness of implementation
Indicators must be developed with consideration of costs, logistics, and institutional requirements, including administrative time. The development and maintenance of a systematic and reliable database requires monitoring and updating that can be costly enough to exceed the benefits of developing the indicators. The developers of indicators should be able to predict that a net benefit will result from their investment.

After assessing the potential indicators by the above criteria, those that meet the criteria will be recommended for the Border 2012 program. Agreeing to track a common set of indicators will make binational, border-wide analysis feasible. It is important to note that the set of indicators may change over time to accommodate better indicators, or to include more specific, localized indicators that have increased in border-wide importance.

5. Adopt/Develop/Implement indicators

Once the set of indicators has been recommended, the next step is to reach border-wide consensus in order to develop and implement these indicators. In developing the indicators, caveats may surface such as a lack of sufficient or adequate data or a lack of resources to gather and process data. Indicators that cannot be feasibly developed will not be selected for the initial indicator set, but may be incorporated in the future. The selection of an indicator to be implemented will require the consensus of program stakeholders. The implementers should feel confident that the indicator is of high quality and, similarly, the regional work groups should feel confident that the indicator will provide them with a valuable resource in addressing local issues. Through the consensus of workgroup and policy forum co-chairs, the Border 2012 program will officially adopt a set of indicators as the basis for tracking progress toward achieving the Program goals and objectives, and for reporting on changes in border environmental and health conditions.

6. Review indicators

Indicators can be used on either an ongoing basis or for a finite period of time. Regardless of the length of data collection or indicator usage, a review process is necessary to evaluate the performance and quality of the indicator. What may be a useful indicator at the present may change with time, given the development of technology, further improvements along the border, changing needs of the public or increased insights in policy or science. The review should answer at least the following questions:

- Purpose – *Why was the indicator developed?*
- Data collection and management – *What protocol was followed?*
- Data reliability – *Is the source reliable?*
- Quality assurance – *How accurate and precise are the data?*
- Information – *What does the indicator convey? Is it true to its purpose? How does the information compare to the standard?*
- Limitations – *What are the outstanding gaps or limitations of the indicator?*
- Conclusion – *Are the data useful? Should the indicator continue to be used?*[15]

The BITF proposes that a review occur two years after an indicator is first implemented. However, ultimate decision lies with the National Coordinators, who will periodically review the indicators and report the result to the workgroups, policy fora, and the public.

IV. Strategy - Vision for Border 2012 Indicators

With the selection of a conceptual framework, indicator selection criteria, and defined terminology, the Border Indicators Task Force hopes to provide a solid foundation for the development of indicators. As this is a collaborative process, all coordinating bodies are responsible for developing indicators and assuring that there is at least one candidate indicator that meets each of the Border 2012 objectives.

As indicators are developed, it is important to remember that communication is key between and among Border 2012 coordinating bodies. Both successes and lessons learned should be shared widely, especially with the BITF and National Program Coordinators. Additionally, indicators will only be successful if they are truly binational in nature, so it is essential that final documents be made available in both languages. Indicators should also be transparent and simple to understand by the border communities in order to effectively evaluate the outcomes of the Border 2012 program, assess and adjust policy, and ensure accountability.

Broad participation and representation in the Border Indicators Task Force is equally important. Tribes, states, local community leaders, and program partners should be included in all steps of development to ensure that the indicators selected and developed are relevant and beneficial to border community needs.

V. Conclusion

The mission statement of the Border 2012 program commits to protecting the environment and the health of the public in the border region, in the context of sustainable development. Guided by the goals and objectives listed in the Border 2012 framework document,[16] this commitment has generated numerous programs and efforts to prevent or remedy environmental degradation, and to document and improve human health outcomes. Since the majority of the objectives listed in the framework document are performance measures, stakeholders should strive to achieve these objectives**,** yet also reach beyond the guidelines of the framework. This is important because fulfilling the mission will require a broad perspective, careful research, and monitoring of progress.

The use of indicators has emerged as a promising tool that allows events in complex systems to be monitored, modeled, and ultimately predicted. These capacities will provide policy-makers tools with which to address the needs of the communities they serve. Because the participants of the Border 2012 program represent many different interests, a common method of documenting and analyzing border conditions and Program progress is necessary. The Border Indicators Task Force has sought with this strategy document to provide a framework for a common methodology and conceptualization of indicators.

The BITF's goal is that Border 2012 indicators will be sustainable and well maintained, so that they remain useful resources. Indicator development – as an ongoing, flexible process – will continue to be adapted as data become available and conditions change.

The BITF expects that increasing understanding of border conditions, strengthening the capacity of health professionals, environmental regulators, and policy makers to respond to crises, and reporting accurately the strengths and weaknesses of Border 2012 projects will be the outputs of the indicators project. These successes will provide the necessary evidence and possible solutions to make lasting improvements in health and environmental quality in the border region.

The United States and Mexico share problems in the border region; these countries must learn to share solutions as well. The Border 2012 program will be at its strongest when its members are able to work cooperatively. Likewise, the indicator program will function best when it has input from all stakeholders. Despite the challenges of binational work, the BITF believes that indicator development will strengthen communication, data-sharing, technology transfer, and scientific collaboration across the border. Working together will enable us to have more complete sets of knowledge and resources to help create a healthy border region for everyone.

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