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**National data infrastructures: sharing geospatial  
information as an asset for environmental public policies\*\***

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## **National Data Infrastructures: sharing geo-spatial information as an asset for environmental public policies**

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### **Abstract**

A decade ago in the Latin American and Caribbean region, national mapping agencies' main concern was the production of topographic and thematic maps of their territories. Computer Cartography and Cartographic Information Systems as well as GIS were becoming integral part of their operation and the "supply-driven approach" was dominant in the organizational processes. Although the concept of "Geo-spatial Data Infrastructures" (GDI) has been present in the literature for more than a decade, it has only been in the past few years that some countries in Latin America have turned their attention into the importance of adopting a more holistic and "demand driven" approach to meet the societal needs of geo-spatial information and knowledge.

There have been some advances in the region, such as the incorporation of metadata standards, the adoption of digital technology, improvements in geo-spatial data libraries and the integration of cartographic data bases. Although there have been some successful experiences in the incorporation of geo-spatial applications in public policy processes, both in government and at the community level, the concept of a geo-spatial data infrastructure has not been made explicit.

One of the areas in which the Latin American and Caribbean community is demanding a more comprehensive spatial framework is in the design and implementation of environmental public policies. Spatial considerations are integral to environmental information and knowledge. Therefore, the establishment of the political, legal and organizational frameworks to develop the environmental component of the GDI in the Latin American and Caribbean region is an important priority.

Developing improved mechanisms for "data sharing" will be an important element of a successful data infrastructure, and countries have not dedicated enough attention to this issue. Due to cultural characteristics of the region, there are very few mechanisms in place to promote efficient use of resources in the production and dissemination of geo-spatial products and services. A regional initiative that builds on the efforts of international organizations such as the International Cartographic Association and the United Nations Environmental Program could be a driving force to establish a regional policy for geo-spatial data sharing. Services such as regional geo-spatial data libraries, environmental atlases, and real-time satellite image services could be developed to serve as resources for the different countries of the region.

The participation of the mapping organizations of the region in the 8<sup>th</sup> UNRCC-A (United Nations Regional Cartographic Conference for the Americas) offers a unique opportunity to start a dialogue about the role that these organizations could play to launch a process for building sound regional policies to support the development of a geo-spatial data infrastructure.

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## 1. Introduction

As mentioned by Wilson and Neil (1999) there have been a number of initiatives to create National Spatial Data Infrastructures (NSDI), such as the efforts of the Federal Geographic Data Committee in the United States, the National Geo-spatial Data Framework (NGDF) of the United Kingdom and the Canadian Geo-spatial Data Infrastructure (CGDI). The lessons learned from these initiatives and other worldwide experiences can inform the efforts of the Latin American and Caribbean region in the development and implementation of National and Regional Spatial Data Infrastructures.

According to the Federal Geographic Data Committee (FGDC) of the U.S., the NSDI

is conceived to be an umbrella of policies, standards, and procedures under which organizations and technologies interact to foster more efficient use, management and production of geo-spatial data. The NSDI requires and will facilitate cooperation and interaction among various levels of government, the private sector, and academia.... Strategies to build the NSDI include establishing forums for communication, facilitating access to data, building framework and thematic data sets, developing educational and training programs, and fostering partnerships for data sharing. (Executive Summary, 1994)

More than ten years ago, reports estimated that U.S. federal agencies alone were spending \$3 billion annually to collect and manage domestic geo-spatial data (FGDC, 1994, pp. 2). To ensure the efficient use of these resources, the FGDC identified the need to establish mechanisms, procedures and technologies that stimulate sharing high-quality digital geo-spatial data.

On the Canadian side, the main objectives of the CGDI are to facilitate access, partnerships, framework data sets, supportive policies and standards. The CGDI vision is “...to enable timely access to geospatial data holdings and services in support of policy, decision making and economic development through a co-operative interconnected infrastructure of government, private sector and academia participants” (Coleman, 1999).

Coleman identifies the following issues as of particular importance:

- Data should be collected once, closest to the source and in the most efficient way possible, with a view towards increasing the vertical integration of the data.
- Ideally, partners should contribute equitably to the costs of collecting and managing the data, and should be allowed to integrate the resulting information into their own databases, for their use and for further distribution to their stakeholders. The development of partnership agreements can facilitate this type of cooperation.
- Agreements between agencies are usually negotiated on a case-by-case bilateral or multilateral basis, according to specific principles of partnership.
- To be successful, CGDI must consist of a set of coordinated and interrelated policies, practices and possibilities that build on this vision.

Geo-connections outlines the strategy for developing the CGDI. Its five guiding principles are: Access, Standards, Framework Data, Partners and Policies (Nichols, Coleman and Saylam, 1999, pp. 1). Geo-Gratis is one of the main components of Geo-connections, and is dedicated to providing a wide range of free vector and raster geospatial data sets. The National Atlas of Canada plays a key role in this data development and dissemination (Cameron and O'Neill, 1999).

There are a number of issues common to the various initiatives that may offer “lessons learned”, including the following:

- The implementation of a National Data Infrastructure (NSDI) faces social and political challenges in addition to technological issues.
- The NSDI cannot be built by the federal government alone - other actors, including non-governmental users of data, must participate.
- Recommendations to governmental agencies sometimes elicit a “defensive reaction” from the agencies.
- Recommendations regarding major changes in governmental organizations have resulted in significant resistance. For example, the recommendations to create the NSDI, as well as a National Spatial Data Council and a Geographic Data Service within the Department of the Interior were met with significant resistance in the US.
- “Information sharing” is a key consideration.
- The creation of bodies such as the National Spatial Data Council could bring all the stakeholders together while avoiding control from a single group and ensuring that citizens have full access to quality geographic information.
- Collaboration between partners from government, business and local communities are needed to develop a successful NSDI.
- Sufficient financial resources are needed to create NSDI. For example, as reported in Hissong (1999), the US spent over \$1,000,000.00 in 1995 responding key questions such as: a) is geographic information acquisition and analysis, and distribution critical to keeping the United States competitive in a global economy? b) What are the most important uses of this information on a national scale? c) given recent technological and sociological trends, what is the appropriate role of the federal government in surveying, mapping and gathering other types of geographic information?
- There are some success stories such as Geo-Gratis which can inform efforts in other countries.

There are a number of conceptual, technical and organizational challenges facing the creation of a GDI for each of the countries of the Latin American and Caribbean region as well as a Regional GDI. The cultural, organizational and social heterogeneity of the region, as well as the differences in the level of geographical knowledge and the level of geo-technology available, will require substantial efforts in collaboration from government, private sector, academia and other information users.

The purpose of this paper is to explore the essential elements of a GDI that could support the design of environmental public policies and to propose possible actions that could contribute to the efforts of the countries of the Latin American and Caribbean region. Such a regional effort could receive important support from international organizations that have an impact on the region, such as the United Nations, the Organization of American States, the International Cartographic Association, and others.

## **2. Geo-spatial information for environmental public policy and natural resource management**

Since the 1992 United Nations Conference in Rio de Janeiro, Brazil, governments, international organizations, academia and NGO’s have made considerable efforts to satisfy the need to process and disseminate data to

support environmental projects and programs. State of the environment reports, information systems, journals, magazines, radio programs, and films focused on environmental information are now available in various formats, including hundreds of WEB sites. Each region of the world, every country and many sub national territories has been involved in some level of compiling and disseminating environmental information, depending on the needs and the resources available.

In Mexico there have also been important efforts from different sectors of society to provide the necessary information to support environmental management and public policy. In the past administration (1995-2000) the Ministry of the Environment and Natural Resources (SEMARNAT), in compliance with the Mexican Law of the Environment (Ley General del Equilibrio Ecológico y la Protección al Ambiente), undertook a project for the conceptual design of a National Environmental and Natural Resources Information System (SNIARN).

Agenda 21 served as an important reference in the design of SNIARN specifically those chapters related to information. The following considerations drawn from Agenda 21 are particularly important:

- Recognize the importance of developing an information system regarding control on trade.
- Establish an Information Coordination Center to support anti-poverty programs.
- Broaden and promote data bases on production and consumption.
- Establish national data bases tracking the trends and demographic factors as well as the environment, using ecological regions as the organizing framework.
- Focus on information and educational programs regarding human reproduction.
- Offer information about the effects of contamination on health.
- Establish mechanisms that facilitate the interchange of information and foster dialogue on the environment in communities.
- Establish information systems on land use and territorial planning.

Chapter 40 is specifically dedicated to information issues and establishes several objectives such as:

- Seeking to better satisfy the need of users at the local, national, regional and global levels.
- Strengthening the capacity at the different levels to use information for decision making purposes, particularly in developing countries.
- Creating and strengthening the mechanisms at different levels so that the different sectors involved in sustainable development have access to usable, accurate and timely information.
- Facilitating access to information.

With respect to access to information, it is widely recognized that a vast amount of data and information has been acquired and processed that could be utilized more effectively with improved access. However, access is still unequal and ineffective due to the uncertainty about how best to ensure this access given the lack of resources and trained personnel in many developing countries.

Capacity-building is also a critical issue. Additional training in data acquisition and evaluation is needed for personnel at different levels and in different organizations so that they can support the use of information in decision making.

Since Agenda 21 only identifies general areas of interest, each country has to develop its own National Agenda. One of the main national strategies has been to strengthen the liaisons among the different sectors and to develop a shared medium and long term vision that could support a re-orientation of the development of the country towards sustainability. Such a realignment requires a clear articulation of how environmental public policies can be integrated with the national economic and social strategies.

## **2.1 Geo-spatial information and environmental public policy**

In Latin America, geo-spatial or territorial (place-based) approaches have been adopted to support environmental public policies focused on environmental impact studies, enforcement of ecological land planning and the protection of natural areas. In order to support these approaches, the generation, processing and dissemination of geo-spatial information has become a key issue in the region. The development of a system to manage this information is particularly important to support the development of policies at the local level and to promote the integration between environmental policies and policies in sectors such as agriculture, industry and tourism. Traditionally, the strategies designed for these sectors have either ignored environmental issues or have given them only marginal consideration. A territorial or “place-based” approach offers a common framework that can for the policies affecting different sectors.

With the conceptual advancements in sustainable development and growing experience in the application of public policies, the importance of incorporating explicitly the place-based dimension of policy implementation into policy development – particularly with respect to environmental policies - has become increasingly evident.

The evolution of sustainability paradigms has had an impact on the design of public policies in general and the role of the geo-spatial information in policy development and evaluation is becoming clearer. For example, a variety of approaches have developed that are more holistic and that adopt the notion of “complexity” in conceptual models, such as the human ecosystem and urban ecosystems approaches presented by the International Council of Science (2002).

The development of environmental information systems, the amount of data available and the wide variety of technological solutions that are accessible to data users are all contributing in various issues to the understanding of societal tensions due to environmental problems, to the understanding of concepts such as “environmental services” and to the understanding of urban-rural interactions.

In the Latin American and Caribbean region, there is a need for more effective policies and for frameworks which encourage a higher level of participation by the different economic and social agents throughout the public policy cycle. Two of the main issues are to transition from isolated policies for each sector into a more holistic territorial approach and to support greater coordination among the various agents involved. In both issues, geo-spatial information plays a key role.

Finally, it is worth mentioning that the increasing public interest in environmental issues is creating a demand for new ways of communicating problems, strategies, policies and possible solutions for environmental issues. Feedback on these issues and proposed solutions from communities and from the various agents involved is essential to ensure that territorial considerations are included in policies and that policy implementation is adapted as needed. In this sense, geo-spatial knowledge and information as well as innovative technological

tools that are incorporated into the process of design and implementation of environmental public policies can be invaluable resources for the advancement of sustainability in the region.

## **2.2 Geo-spatial information for environmental and natural resource management**

As part of the conceptual design of the National Environmental and Natural Resources Information System for Mexico, six basic components were identified:

- Inventory component - For natural resources management to be effective, inventories of the main characteristics and location of forests, rivers, flora, fauna etc. are essential. Although some countries of the region are quite advanced in this area, overall natural resource inventories are still a challenge in the region.
- Monitoring component - Once the inventories are established, data must be updated regularly through established monitoring methodologies.
- Public policy component - As mentioned previously, the role of geo-spatial information is becoming increasingly important in the design of public policies.
- Planning component - Geo-spatial information can be useful at different stages of governmental management. Planning is often one of the weakest components in policy development in the countries of the region. Geo-spatial information and modeling can make important contributions to planning through diagnosis, creation of scenarios, and impact analysis.
- Participative decision making component – Most of the countries of the region have societal structures that historically have not included participatory processes. The benefits of such approaches are widely recognized and well documented in developed countries and in international organizations. The new technologies in computing science and telecommunications could greatly facilitate the incorporation of such approaches to the region.
- Research and education – The amount of resources dedicated to research and education in the region falls far behind the levels in developed countries. However, there is an awareness among Latin American and Caribbean citizens of the need to strengthen the investment in these two key areas.

Although each country has its own requirements in terms of geographic information and geo-spatial analytic tools, the abovementioned framework could be used as a point of departure to identify the main components or subsystems of a National Environmental and Natural Resource Information System.

## **3. Final remarks**

Is it worthwhile to undertake projects such as the NSDI and the CDSI for each of the Latin American and Caribbean countries and for the region as a whole? There are certainly economic, social and cultural differences between the region and countries such as Canada and the U.S.A. Therefore, just as Canada and other countries have designed their own conceptual framework for a Spatial Data Infrastructure that is appropriate to their needs and objectives, the Latin American and Caribbean region would have to undertake such a task. An advantage at this point is that there are already several models in place and there are lessons learned from past experiences which can inform these efforts.

As mentioned before, one of the key issues in the region is geo-spatial “data sharing”. The limited resources to acquire updated, quality data and the large gap between the availability of geo-spatial data between Latin America and countries such as the U.S. is putting constraints on the development and implementation of appropriate environmental public policies and on the development of effective natural resources management programs.

The sharing of geo-spatial data for the region must be considered a key component of the Regional Spatial Data Infrastructure. Other elements, such as the need for standards and metadata, are closely related to data sharing issues.

This paper has sought to take a pragmatic approach in identifying the most important considerations in the process of building a NSDI which has a long term perspective. The following four main recommendations regarding data sharing summarize these points:

First recommendation. - The Latin American and Caribbean region and each of the countries should take a pragmatic and collaborative approach to expand their efforts to design and implement Spatial Data Infrastructures, making sure to incorporate the characteristics that respond to their specific needs.

To support this effort, it would be useful to establish regional policies and normative frameworks for data sharing that incorporate the contributions and best practices of the international community.

Of particular relevance to this effort is the need to adopt from the beginning a territorial or geo-spatial approach for the design of conceptual models regarding environmental information. There are important opportunities for collaboration among partners to ensure compatibility with countries and regions that are more advanced in the development of conceptual models.

Second recommendation - There should be a regional effort led by international organizations influential in Latin America and the Caribbean, to support a territorial perspective as a driving force for development.

This leadership must promote on-going sub regional projects, like the *Mesoamerican Biological Corridor*, the regional component of Geo4 conducted by UNEP, and the Cepal’s REDESA, just to name some of the more emblematic efforts. The basic idea would be to try to establish solid connections between these type of projects, based on shared standards for spatial information that will allow data sharing and reduce the duplication in efforts and resources. It will be very useful to promote the practice of posting the results of these regional and sub regional projects on the Internet, not only for data sharing purposes, but also to share conceptual models and successful methodologies that incorporate geo-spatial information in the environmental public policy process.

In this effort of joint leadership, a key issue at a regional level is the necessary convergence of all the main institutions of the United Nations with respect to their standards, practices and regional projects related to environmental geospatial information. At a national level there is a similar situation: the governmental institutions responsible for geospatial information must develop broad linkages with the environmental ministries.

At both levels, regional and national, the promotion of linkages with the research and development organizations specialized in geo-spatial environmental information is another key issue; these linkages will enrich the design and implementation of conceptual frameworks and methodologies that will catalyze the data sharing process.



Third recommendation. The best practices and lessons learned from other initiatives, such as geo-spatial data libraries, Global Mapping, and the US digital initiative, should be taken into consideration for the development of NSDI.

It might be useful to adapt those initiatives already in place and functioning such as the Geo-Gratis component of the CGDI.

Fourth recommendation. - We must stop thinking of data in terms of products and ownership. Providing access to geo-spatial data and services to users should be the main priority (Morrisson, 1999), and we need to think of them as public goods and public services.

**Final statement. – The Latin American and Caribbean region has both the potential and timely opportunities to become a leader in the development of Geomatics in general and specifically in the adoption of “data sharing” practices that would substantially advance the competitiveness of the region, and which would especially enhance the development and implementation of environmental public policies.**

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