PROCIG
Proyecto Centroamericano de Información Geográfica
Central American Geographic Information Project

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July 16, 2001

Final Report to the *info*Dev Program

This is the final report of the project originally entitled, "Developing user-friendly data products for sale and distribution to agricultural data users in Central America" (*info*Dev ID Number: 970508 -207). The project is now referred to as PROCIG - El Proyecto Centroamericano de Información Geográfica / Central American Geographic Information Project.

**Contacts: Glenn Hyman, Kate Lance, German Lema, and Claudia Perea
International Center for Tropical Agriculture, Cali, Colombia**

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1. Introduction

This document is the final report for the Central American Geographic Information Project (PROCIG), in compliance with the guidelines set forth by i*nfo*Dev for project implementation. PROCIG is an i*nfo*Dev-funded initiative to promote the use of geographic information technology in governmental organizations (GOs) in Central America. The International Center for Tropical Agriculture (CIAT), which is based in Cali, Colombia, leads the project. Twenty-three GOs in agricultural and environmental ministries, statistical and census institutes, and national geographic institutes of Central America participate in the project. Readers will find more information about PROCIG on our project Web site (http://www.procig.org)

The concept for PROCIG originated during a 1996 regional conference of the statistical and census institutes of Central America. Participants recognized the need to geographically reference their tabular data for data integration with other information tied to locations. Geographic information systems (GIS) facilitate data integration because any information using standard geographic coordinates can be spatially linked to other information using the same coordinate system. This technology is relatively new in the statistics and census institutes of Central America and developing capacity in geographic information technology (IT) within them requires significant investment. First, the institutes need software and hardware, and they need training to take advantage of the new opportunities for using geographic information for sustainable development. Further, they need to form alliances with other government agencies working with GIS technology. With these needs in mind, participants in the 1996 Regional Statistics and Census Conference began thinking about how they could build capacity in GIS. Their discussions led to the idea that a project could be formed and that funding could be sought that would help them address their concerns. About the same time, the *info*Dev program made a call for proposals for projects promoting information and communication technologies (ICT). CIAT offered to draft a project proposal for review and discussion. In early 1998, a revised proposal was sent to the *info*Dev program and was accepted for funding later that year. The 2-year project eventually began in March 1999 and was given a 3-month extension until June 2001.

The agricultural and environmental ministries were included in the project to promote inter-institutional collaboration within countries. Census and agricultural organizations in Central American governments already had strong links through their agricultural census development, although their GIS laboratories collaborated little. Including the environmental ministries facilitated the combination of environmental data (e.g., climate, soils, and vegetation cover) with tabular information (e.g., population and demographic data from surveys and censuses).

In the original proposal, PROCIG intended to include the large Caribbean countries in the project. High costs and logistical obstacles forced us to focus on the six Spanish-speaking Central American countries. However, we were able to bring Belize into the project in May 2001.

The project design included support from the Environmental Systems Research Institute (ESRI), Redlands, California, makers of ARC/INFO and a series of geographic IT software products. Donations from ESRI included ArcView 3.1 desktop GIS software, plus the Spatial Analyst and 3D Analyst extensions. The Tropical Agronomy Center for

Research and Training (CATIE) in Turrialba, Costa Rica, participated as an advisor to project coordination, as a full participant in the two major project meetings, and to facilitate some of the country activities. The project evolved to work closely with professionals from the United States Geological Survey (USGS), stationed in Tegucigalpa, Honduras. The PROCIG collaboration with the USGS Mitch Clearinghouse Project functioned well because of common goals between the two initiatives and of effective working relationships between coordinators of both efforts. PROCIG developed a sound working relationship with the Agustin Codazzi Geographic Institute (IGAC) in Bogota, Colombia. We benefited from two important meetings led by IGAC. Their efforts to integrate organizations working in geographic information management in Latin America benefited from strong representation from Central America.

Our initial goals were to build capacity and to develop data products in the national statistics institutes, and to link these institutes more closely with the environmental and agricultural ministries. Participants from each country identified a data product that they could put together as a group. The products contain information from each of the participating institutions. They put the information in a thematic or problem-focused context, document the data, and then put them on a platform for publication. Because project partners are producing useful information that has potential for greater use, our goal was to promote data dissemination. The project largely had a technical focus.

In time, however, it became apparent that institutional issues needed more focus, especially because the project was developing products for distribution, which involves information policies, access mechanisms, and data protection. Also, as institutions were combining data sets, the lack of data standards between institutions impeded data integration. In order to address policies and standards, we recognized that the national mapping agencies needed to participate in the project. Despite the initial reluctance of the National Geographic Institutes (IGNs) to join PROCIG, they gradually integrated themselves into the project in 2000 and 2001. For some of the IGNs, there was sufficient time to develop country project activities. We are still working to arrange software donations for the IGNs.

During the second year of the project, we built upon the inter-institutional relationships established during the first year. Rather than focus entirely on the development of data projects as the end result of the project, we "used" the products as a means to foster collaboration between institutions and to promote spatial data infrastructures (SDI). National Spatial Data Infrastructure (NSDI) refers to an institutional framework for managing and disseminating spatial data. It includes a set of policies, agreements, data, technologies, standards, delivery mechanisms, and financial and human resources to promote sharing of data across all levels of government, the private and non-profit sectors, and the academic community. Given that PROCIG aimed to increase data use and dissemination of data products, clearly the basic infrastructure needed development first.

In this report, we discuss all activities and results through the funded period of the project. Several project activities will continue in the coming months, and the project as a whole has established several mechanisms to sustain itself. Section 2 of this report discusses Internet communication within countries, throughout the region, and with others interested in GIS technology in Central America. The third section evaluates our national-level projects with a country-by-country summary of the activities, obstacles,

successes, and results of that work. More detailed descriptions of country-level work are reported on our project Web page.

In section four we set out the PROCIG research and development component of NSDIs. Our research results are of immediate value to any country that is developing NSDI. Section 5 presents the results of participants' evaluation of the project completed shortly after our May 2001 Cartagena meeting. We summarize the views that project partners gave of the project. The sixth section deals with our experience in promoting GIS in the context of larger trends in ICT development. We discuss what worked and what failed, and make some recommendations for the future. This section includes discussion of issues related to geographic information management and general project experience in ICT. In section seven, we discuss project sustainability for the future. We mention new proposals under development, including an initiative to create a regional Web mapping pilot project. We discuss partner commitments for the future, efforts to reach out to the private and non-governmental sectors, and the initiation of the Regional Spatial Data Infrastructure of Central America. A brief conclusion ends the report.

Four appendices are included for easy reference of acronyms and abbreviations used, the program agendas of the first and second PROCIG workshops, summaries of country activities and the Acta de Cartagena agreements of Central American IGNs.

2. Networking and Communication

Central American professionals in fields related to geographic IT can take advantage of experiences, lessons learned, and information exchange by improved communication and networking, within countries and throughout the region. PROCIG made efforts to unite the GIS laboratories of participating government agencies. Working in isolation, national-level GOs lack the financial and human resources to make large investments in technology development. United, they have the potential to achieve economies of scale otherwise difficult to acquire. We sought to improve communication and networking amongst GOs through project meetings, E-mail communication, and the PROCIG Web page. This section of the report describes the communications and networking efforts.

At the national level, project partners met with one another to a varying degree, depending on the projects they pursued and whether project-supported NSDI activities were underway. At the regional level, project partners met together twice as a group during the project's 2-year duration (See Appendix I for program agendas). The first meeting was held in Cali, Colombia at CIAT headquarters and initiated the project. We conducted training seminars in ArcView 3.1 software, database management, and population mapping. Presentations were also given on data and product development, and time was dedicated to planning future activities for the project.

The second meeting was held in Cartagena, Colombia, parallel to the 5th International Meeting on Global Spatial Data Infrastructures (GSDI5) and the 3rd meeting of the Permanent Committee for SDI for the Americas. Our original plan was to hold the second meeting in Costa Rica at CATIE. We made the change so that our partners could take advantage of activities related to SDI at the Cartagena meeting. In their final evaluations of the project, participants unanimously praised the idea of having the meeting in conjunction with GSDI. They not only learned from other experiences in Central America, but also found out about experiences of other countries in geographic

IT throughout the world. Had we not arranged for the PROCIG meeting to coincide with GSDI5, little or no Central American representation would have occurred in Cartagena. This was a significant meeting of GIS leaders. In total, about 350 GIS specialists from 37 countries attended.

The two project meetings were essential to advancing the project. They did more than provide a forum for communication; they functioned as milestone events for establishing work plans and building a network of government GIS users. Participation in the meeting required that participants be prepared to present the results of their activities and on-going projects. Most of us were excited at the prospect of visiting another country, and this built up enthusiasm. The level of activity and communication increased markedly in the months preceding our meetings, especially the second meeting in Cartagena. Our experience confirmed recent studies, which show that the magnitude of communication in face-to-face meetings is far greater than by telephone or E-mail communication. Advancing project work is much easier when you can sit down and discuss issues in a "give and take" atmosphere. Although electronic communication over the Internet has great advantages, it can never replace the need for face-to-face project meetings.

A third meeting, although not originally part of the PROCIG project design, also contributed to the project goals. Working with IGAC, CIAT developed a proposal for the *info*Dev Conference Scholarship Fund so that at least one PROCIG participant from each country could attend an international seminar on NSDI in Bogota in February 2000. The IGN Directors were also sponsored, which was an important first step in bringing them into the project. During the seminar, PROCIG partners received training on how to document geographic information in a standardized way to facilitate data identification and acquisition. CIAT helped with developing the NSDI seminar program, identifying key participants, and preparing background materials. The conference brought together decision makers and other key actors involved in the development of NSDI throughout Latin America. In addition to addressing policies and technical issues, the conference set the stage for future activities in the Americas related to geographic information management. At the close of the meeting, 21 countries signed an agreement to form the Permanent Committee for Spatial Data Infrastructure for the Americas (PC-IDEA). Had these funds not been obtained, far fewer countries would have participated in the seminar and signed the agreement.

Electronic mail communication was a significant component of the project, although we cannot point to any outstanding or extraordinary result from its use. Undoubtedly, E-mail helped save project funds; however, we still needed to send the most important messages by fax to make sure that everyone received the communication. About a third of individual project participants lacked a personal E-mail account. Many had to use an institutional account - that of their department or supervisor. More participants acquired individual accounts during the latter part of the project period. At one point we considered putting together an E-mail list server, but rejected this option because of our limited number of partners; we had a manageable number to maintain regular E-mail correspondence.

We did not establish a system for monitoring E-mail communication in the project. We could have asked participants to count their messages, or CIAT could have reviewed our own messages, especially between coordinators and participants. However, we decided that such an analysis would give us few new or interesting insights (other than a greater

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appreciation of the amount of time needed to coordinate a project, especially one involving seven countries and over 20 institutions). E-mail enabled cost savings on telephone calls and faxes. We also experienced negative aspects of E-mail communication, involving a significant portion of our working day spent in replying to correspondence. Future project evaluations might want to look more carefully at the utility of E-mail communication compared to time investment.

The project made most communications and networking efforts through the project Web site (http://www.procig.org), available in both Spanish and English. The Web site has served as an exchange mechanism for partners in the 23 Central American institutions and is also a communication tool for external partners. More recently, the Web site has become a focal point for GIS and NSDI information in Central America. The site was first put online in March 2000. We used WebTrends software to monitor traffic. The project coordinators from CIAT developed most of the content for the Web site and all the programming and site design. The partners did not contribute to the Web site as we had hoped. One reason may have been that many partners did not have frequent access to the Internet, and thus rarely visited the site. Partners were asked by E-mail to provide information for the Web site on a number of occasions, but hardly any responded. All partners were asked to include a link from their institutional Web sites to the PROCIG Web site, but only a few complied. Many partners may not have viewed the Web site as "theirs," but rather as belonging to the CIAT coordinators, despite our effort to include all partners. The domain name of the site is unique so as to avoid the impression that the project belongs to any one institution. We deliberately exclude institutional logos from the site.

The most likely factor resulting in minimal partner input to project Web design and construction was that the PROCIG partners did not give it priority in terms of their overall work responsibilities. They had more pressing work to do, and did not appreciate how they could benefit from the Web site. However, at the end of the project, many acknowledged that the Web site, with all its content, was a valuable source of information on SDI and provided an effective mechanism for information exchange between the countries. For multi-institutional collaborative projects, a theme-based Web site with no explicit institutional link seems to be an appropriate arrangement. A project participant commented on the value of having an autonomous organization such as PROCIG to facilitate efforts in national and regional integration (see quote from meeting press bulletin on the PROCIG Web page). To the extent that the site is viewed as the best source of information on regional-level GIS and SDIs in Central America, we can expect to have greater participation in its development. Even so, partners may still have less incentive to develop content for a Web site that is jointly managed as opposed to something that is clearly part of their own institution.

In the following paragraphs, we analyze Web site traffic (see also Table 1) to help us understand the impact of Web communications on our project objectives. The full statistics are available on the PROCIG Web site, with a more detailed analysis of site traffic. The PROCIG site was accessed over 60,000 times during the period of analysis. These constituted more than 6,000 user sessions, averaging 11 visits per day. The number of unique visitors was 2,641; 1998 visitors came to the Web page only once without returning; 643 visitors came to the page more than once.

Contacts pages were frequently accessed, showing the need for information on people, and suggesting an interest in building networks. Before the PROCIG Web site existed, finding information on GIS specialists in government institutions in Central America was very difficult.

Table 1.   Central American Geographic Information Project (PROCIG) Web site statistics.

Hits	Total number of successful visits	61,737
	Average number of daily visits	114
Document accessions	Number of printed pages	15,638
	Number of printed pages per day	29
	Number of documents viewed (not printed)	15,634
User sessions	Total number of user sessions	6,360
	Number of user sessions per day	11
	Average duration of user sessions	13 m 54 s
	International user sessions (%)	67.2
	User sessions of unknown origin (%)	31.6
	User sessions from Colombia (%)	1.2
Users	Number of unique visitors	2,641
	Number of visitors that visited once only	1,998
	Number of visitors that visited more than once	643

Web page traffic increased steadily over the last year (Figure 1). The total number of visitors is increasing, and we notice an increase in downloads, repeat visitors, and time spent at the site. Between January and April 2001 the number of monthly sessions increased from about 300 to 1200. Note that the project coordinators never registered the site with search engines; the cost for doing so had not been budgeted into the project. Thus, the increase in use was largely due to people who found the URL through other means or who accessed the PROCIG Web site via a link from another Web site. We did send out word about the Web site via Latin American list servers. When we searched on several popular Web search engines using the acronym "PROCIG" or the name "Central American Geographic Information Project," none of the searches returned links to the opening page of the PROCIG site. The search engines return sites that include links to the project or some internal pages on SDIs. In hindsight, we should have developed a strategy at the beginning of the project for publicizing the Web page. However, we can still register the site with the major Internet search engines (depending on the cost and available funds).
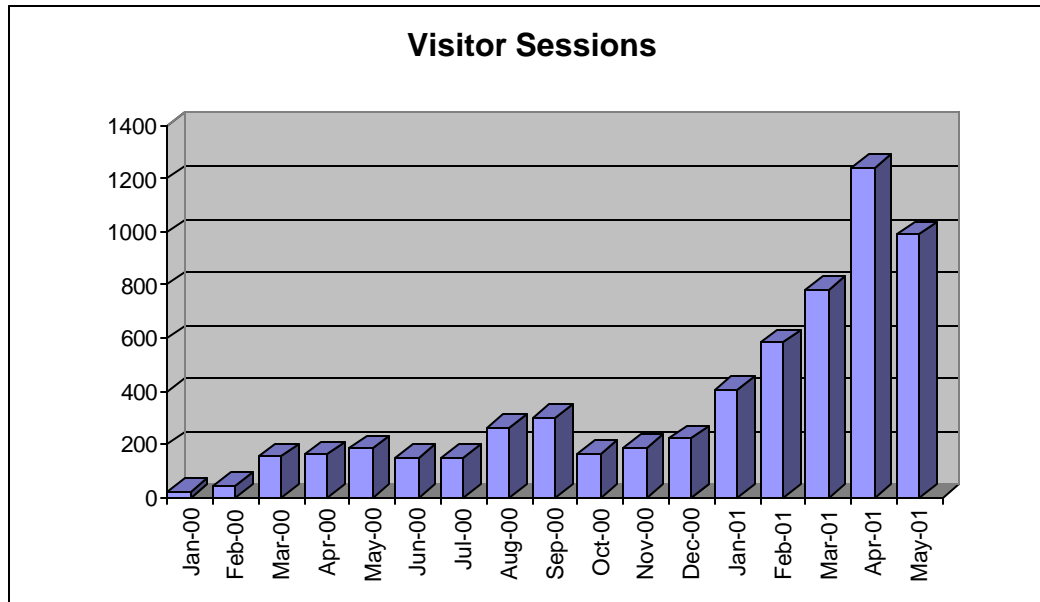
Visitor Sessions

Figure 1. Central American Geographic Information Project (PROCIG) Web page traffic, January 2000 to May 2001.

The most frequently visited Web pages within the site are the initial page (17% of all visits), the initial page in English (4%), the contact listings (3.3%), the introductory page on NSDIs (3%), and the page introducing the project (3%). The pages least visited are for individual links to documents and resources. Visitors downloaded the NSDI surveys 4131 times. Users downloaded the Argentina, Dominican Republic, Cuba, and Colombia surveys most often; they acquired our compilation of GIS literature in Spanish least often. We should make a more prominent link to this bibliography because it will probably be useful to Spanish-speaking professionals searching for literature on GIS.

The visitors to the Web site came from all countries of the Americas and from Europe. Interpreting these statistics is difficult because users may have entered the site from a domain in the United States. All entries from centers of the Consultative Group on International Agricultural Research (CGIAR) show up as entering from the USA, even though they are located in other countries. For example, when users from CIAT enter the Web site, the origins are listed as from the USA (2105 visitors). Visitors from Mexico (103), Spain (76), Argentina (51), and Colombia (50) were the most frequent non-USA users. Central American users were few, suggesting that project participants rarely visited the site, or were entering through a US domain. No visitors were listed from Honduras, Guatemala, or Belize. We need to make greater efforts to publicize our Web site to other ICT projects, nongovernmental organizations (NGOs), and the private sector in the Central American region. Interestingly, no visits came from Africa or Asia. These regions would likely benefit from learning more about Latin American efforts to build SDIs. The links to resources on SDI may also be of use. Future effort should be made to publicize the Web site in other world regions.

A breakdown of the type of organizations shows that NGOs are clearly the most frequent users, although many of these sessions may have been project coordinators using the

page for project work (Table 2). Visitors from commercial and network domains came frequently to the site. Government domain visitors were few, although the project is made up of GOs. Certainly we need to publicize the site better in the Central American government sector, but this statistic is partly due to many government agencies in Latin America not having government domains, because they use commercial providers. The domain suffix (i.e., .com, .net, and .org) is not a reliable indicator of activity of the organization accessing the Web site.

Table 2.   Project Web site activity by type of organization.

	Organization	Hits	% of total	Sessions
1	Organization	8832	42.83	334
2	Commercial	5515	26.75	1521
3	Network	4825	23.40	427
4	Educational	1124	5.45	81
5	Governmental	267	1.29	18
6	Military	41	0.20	3
7	International	17	0.08	1
	Total	20621	100.00	2385

The use of Web site statistics was new to the project coordinators who still lack understanding of how best to interpret them. Nevertheless, the Web site statistics helped us develop some recommendations for our site that we can incorporate in the short term:

- Register the site on major Internet search engines.
- Publicize the site more within the Central American government sector (continue to ask the partners to include a link from government institutional sites to the PROCIG site).
- Publicize the site in other world regions.
- Improve navigation so that users are aware of less popular content of potential interest.
- Increase the visibility of infrequently downloaded documents such as the Spanish language GIS bibliography.
- Create a list of the top 10 downloads or pages visited so that new visitors can quickly find popular information.

We have encouraged all project partners to monitor their institutions' Web sites by generating statistics. We provided them with information on free statistical software for Web sites. We recognize that Web statistics provide a valuable measure of the use of the Web site, but they still do not demonstrate its impact. Were the NSDI surveys actually used by professionals to help them develop their own NSDI? Did the contact information lead to some effort or initiative that otherwise would never have been started? Did users request information from Central American government agencies that was later used for decision making? How easy was it to navigate the Web site? A potential means of getting some of this information is to require users to fill out an on-line form indicating what they plan to use the information for – a technique that might work well for the NSDI surveys. However, such a device irritates many people. We could

develop a user survey for visitors to fill out voluntarily. Developing a clear picture of the utility of the Web site remains a difficult task. We did not envision a need for this kind of analysis in the project design. Future development of similar projects should include a component for making in-depth analysis of Web site use.

3. The Country Projects

Each country group worked on an activity producing a result at the national level for that country. We originally envisioned that each participating institution would develop a data product for their clients. We scaled back our expectations when it became apparent that all participating institutions could not develop the data product. One result per country addressed our goal of improving inter-institutional collaboration within countries. Also, we made a point of developing projects that fit within already established institutional goals. The projects were meant to support existing activities, building upon them, rather than create unrelated, new work. We needed to be flexible, so that as the demands and personnel of the institutions changed, the PROCIG projects could also change.

The following section is a country-by-country summary of the activities of the PROCIG partners. The reader will find a full description of country activities on the PROCIG Web page. Here, we give a description of each country project and then discuss obstacles to collaboration, and successes and failures. In most of the Central American countries the projects are still in development, that is, they are on going. In some cases, this is because the projects had a late start, but in others, the projects actually are new institutional activities that have been adopted for the long-term. We start in northern Central America and move southward. Note that Belize has just joined the project, and therefore is not represented here.

Guatemala

The Guatemalans are developing dynamic mapping capabilities for the Internet. Their Web site visitors will be able to view, query, and overlay multiple maps within their Internet browser. PROCIG is supporting this activity to give added value to the larger effort of the Guatemalan government to build the National Geographic Information System (SNIG, the Spanish acronym). The SNIG is an inter-agency governmental project to develop and make available digital base maps for sustainable development in Guatemala. The project is led by the IGN and the Guatemalan Planning and Programming Secretariat (SEGEPLAN) and includes 16 GOs in Guatemala. The SNIG project partners formed committees to address administrative, logistical, technical, commercial, and training issues related to geographic information. The project is developing data, metadata, policies and procedures, geographic information standards, and other components of SDIs. PROCIG funds and staff time are supporting the development of dynamic mapping capabilities for the SNIG and IGN Web sites.

Two courses to be taken by Guatemalan professionals in Web server maintenance and Web page creation using FrontPage software will be funded by PROCIG. The training will build capacity in the IGN to develop their Web pages and manage Web servers for optimal use. During the second half of 2001, the IGN will receive practical training in Guatemala from CIAT IT and GIS professionals. We will examine different possibilities for serving dynamic maps on the Internet. The maps should be more than static GIF or

JPEG images. Users should be able to query the map data and look at tabular information for map features. They will have the ability to zoom in and out on the map graphic. They need to be able to find background information or metadata, which includes information on original map development, data quality and error levels, spatial referencing information, and distribution and access constraints. The training will be practical in the sense that IGN professionals will learn about dynamic Internet mapping as they put together the Web site.

The dynamic Web mapping activity began late in the overall development of the PROCIG project and coincided with the inclusion of the IGN as a project partner. Guatemalan government agencies replied positively to our initial invitation to participate in PROCIG. However, when we visited these agencies before the first project-wide meeting, we could not get appointments with appropriate individuals. Officials from the environmental and agricultural ministries never followed up on our invitations or repeated E-mail requests. The only organization that fully participated at the outset was the National Statistics Institute (INE). Through the first half of the project period, the INE official contact for PROCIG participated actively in project activities. Unfortunately, his position was eliminated and INE did not designate a new contact for the project until 9 months later. The official with newly assigned PROCIG responsibilities remained in INE for only 4 months after being designated the official contact. To date, the new INE contact for PROCIG remains to be assigned. The initial idea of INE was to put together a socioeconomic and environmental atlas for Guatemala. The project concept was stalled because of changing personnel and the lack of interest of agricultural and environmental ministries.

El Salvador

The Salvadorans are developing the "Salvadoran Infrastructure of Spatial Data" or ISDE, its Spanish acronym. PROCIG strongly supported this development through generally involving Salvadorans in PROCIG, promoting Salvadoran participation in a Latin American SDI meeting held in Bogota, Colombia in February 2000, and CIAT coordinators participating in a national kick-off meeting for the ISDE. CIAT helped develop the agenda for the meeting and provided reference material.

PROCIG more directly supported these efforts in El Salvador through logistical support for the development of a prototype Web page of the El Salvador NSDI (http://gisWeb.ciat.cgiar.org/avmaps/salvador). PROCIG partners from the Ministry of the Environment and Natural Resources (MARN), the General Directorate of Statistics and Census (DIGESTYC), the General Directorate of Agricultural Economy (DGEA), and the Vice Ministry of Housing and Urban Development (VMVDU) spent 10 days at CIAT headquarters in Cali to develop the Web page.

The prototype Web site includes introductory information, contact information for each participating organization, information about NSDIs, dynamic map data, and metadata. The dynamic mapping component of the work utilizes ESRI's ArcView Internet Map Server (IMS). The site serves graphic maps of:

- Base cartography,
- Agricultural production,
- Population and socioeconomic information,

- Biological resources and protected areas, and
- Hydrological resources.

The metadata were developed using public domain MetaLite software acquired from the USGS's Earth Resources Observing System (EROS) Data Center.

Carrying out the Salvadoran work in Cali was beneficial for several reasons. Most importantly, the professionals could concentrate on the task at hand without the usual interruptions for telephone calls, E-mail, and meetings that they would normally have in their offices. A second benefit was that they could take advantage of a strong GIS infrastructure in CIAT, including software, hardware, and human resources. But this benefit also has negative aspects. Will they be able to do similar work in El Salvador in the future? Can they migrate the prototype Web page to their own server (or the USGS Mitch Clearinghouse server) in El Salvador once it is fully operating? At the moment, the Web site continues to be hosted on CIAT's server.

Prospects for future development of NSDI in El Salvador are the most advanced of all Central American countries. The Minister of the Environment and other high-level government officials support the initiative (see El Salvador Letter of Understanding on the PROCIG Web page). The PROCIG coordinators promoted the formation of a high-level technical committee for NSDI in El Salvador. The IGN is leading the effort. A strong core of dedicated GIS professionals is in place. The USGS Mitch Clearinghouse Project has made significant advances in developing metadata and a clearinghouse for geographic information. The Salvadorans can combine the efforts of individual government organizations, the PROCIG initiative, and the Mitch Clearinghouse Project to further advance geographic IT and SDIs in El Salvador.

Honduras

The Honduran partners are developing a geographic information inventory for the Agriculture and Livestock Secretariat (SAG), the National Statistics Institute (INE), the National Geographic Institute (IGN), and the Environment and Natural Resources Secretariat (SERNA). The inventory will be published on the Web site of the National Environmental Information System (SINIA) and will be included as metadata on SERNA's metadata clearinghouse node registered with the Federal Geographic Data Committee (FGDC). Potential users of the geographic information of these institutions will be able to search for data by key words, location, or author.

Institutional instability was the principal obstacle to collaboration in Honduras. Initially, we designed PROCIG to be led by the census and statistics institutes in each country. The government of Honduras eliminated the General Directorate of Statistics and Census (DGEC) midway through the project. The DGEC had a wide range of problems in its management and functioning. Many viewed the institution as having political motives and as incapable of producing objective statistics for Honduras. International donors contracted an autonomous organization to develop the year 2000 population census. The government of Honduras set up the National Statistics Institute (INE) to replace DGEC. Three months before the end of the project, INE designated a staff member to be the PROCIG contact and collaboration is working again.

Personnel changes created some difficulties in developing the PROCIG activity in Honduras. Originally, PROCIG was to support a data product called GeoAtlas, which was to be developed principally through SERNA, but with the collaboration of all the partners. But SERNA changed the PROCIG contact, moving this responsibility to the SINIA coordinator. The change weakened momentum for the GeoAtlas activity. Because all partners were interested in documenting data held by their institutions, and SINIA needed documentation, the new activity took hold and now has produced metadata records for the different participating GOs.

The PROCIG partner institutions have difficulty devoting time and human resources to develop the information products planned for the project. Given this constraint, our partners in Honduras asked that PROCIG arrange for an intern to assist them for 3 months. The intern provided key support to their activities and was able to bring the partners together around the inventory activity.

The IGN entered the project more recently, but not in time to fully participate in specific PROCIG metadata activities. However, it is developing metadata and a clearinghouse node through the USGS Mitch Clearinghouse Project, and has participated in recent PROCIG-USGS efforts to establishing a national metadata working group. Honduras needs improved geographic information management, and the IGN has shown signs that it will take up this responsibility. With support from the PROCIG and USGS project coordinators in Honduras, it hosted a national seminar on SDI in March 2001.

PROCIG set up effective links with the USGS working in Honduras on projects responding to damage from Hurricane Mitch in 1998. The Mitch Clearinghouse Project, an initiative funded by the United States Agency for International Development (USAID), develops geographic information clearinghouses for the four countries that were most affected by the hurricane. Because both CIAT and USGS have offices in Tegucigalpa, Honduras, project coordinators took advantage of opportunities to meet and work out how the two projects could work together. Collaboration with USGS worked in Honduras and other countries where PROCIG and the Mitch Clearinghouse Project have activities.

Nicaragua

The Nicaraguan PROCIG partners are developing the Rural Atlas of Nicaragua on CD-ROM. The atlas was originally envisioned as a paper publication that would describe the major development issues affecting the agricultural and rural sectors of Nicaragua. The activity was separate from PROCIG. A common difficulty in many countries is the lack of information in digital formats. Data providers produce volumes of information in book format. Their digital data publishing efforts are still in the early stages of development. By making the Rural Atlas into an electronic product, the participating institutions can have much stronger impact when their clients use the data for further analysis or for any other work that can take advantage of this digital geographic information. The data can be applied to analyses of forestry issues, crop production, rural population, and many others.

Users of GIS data commonly share information in the form of a digital map. The digital map files often lack information describing the characteristics, quality, and proper use of the information. Producing the digital Rural Atlas needs GIS formats that users can handle and sufficient data documentation. The partners made the maps with ArcView

software using shape files, a common GIS format and one that can usually be translated or read by the major GIS software packages. Potential users of the Atlas will need documentation on:

- Institutional author of data set,
- Publication date,
- Title of data set,
- Data description,
- Purpose of the data,
- Quality and error,
- Scale of original source maps,
- Cartographic projection parameters of the data,
- Time period of the content,
- Status of the data set with respect to updates,
- Contacts for acquiring more information,
- Use constraints, and
- Distribution constraints: copyright or license agreement.

The PROCIG partners use MetaLite software for creating standardized documentation files. They plan to release the Atlas on CD-ROM in August 2001. At the same time, they will host an inter-institutional NSDI seminar, at which point, planning for better implementation of data standards, access policies, pricing polices, data protection, and data archiving will be discussed.

Inter-institutional collaboration among the PROCIG partners in Nicaragua has great potential in the future, despite obstacles that slowed this group at the outset. The original data product to be developed was an analysis of relationships between people and water resources. Lack of a full set of location information for populated places frustrated attempts to put together this product. They envisioned the Rural Atlas in digital format as more feasible with the potential to have a significant impact.

Costa Rica

The Costa Rican PROCIG partners analyzed population and agricultural pressures on their national park and protected area systems. Tourism accounts for one third of the national economy. International tourists visit Costa Rica for the famous rain forests, volcanoes, tropical rivers, and beaches. Because of the importance of protected areas to the livelihoods of many Costa Ricans, any pressures negatively affecting national parks and nature reserves cause great concern. Where do high concentrations of population or agricultural activities coincide with protected areas and what might be the impact? The study combined agricultural information from the Ministry of Agriculture and Livestock (MAG), population and demographic data from the National Statistics and Census Institute (INEC), and protected area information from the National System of Conservation Areas (SINAC) in the Ministry of the Environment and Energy (MINAE). In June 2001, the Costa Rican PROCIG partners released a compact disk accompanying the study and including all the information used in the analysis. They made a poster to advertise the CD to a range of potential users and to generate interest from the government, NGOs, the private sector, and academic communities. So far, the study has been well received and generated substantial interest from colleagues in the Costa

Rican government. Many opportunities exist to do further in-depth analysis or extend the research to focus on other issues.

The elements of success of the Costa Rican project include an obvious interest of the partners to put together this particular product, a solid information base from which to build, and a spirit of professionalism and cooperation between three highly capable participating professionals. But perhaps the key factor in their success was their employment of a student intern to assist the project. The intern, a US national who had recently completed her bachelor's degree, had one responsibility – to work on the PROCIG activity. She dedicated her time to organizing data from the three institutions into a common system for analysis, carrying out analyses, and preparing the final maps. The Costa Rican partners had many competing demands on their time, but because the student continually appeared in their offices, they were compelled to advance their part of the project.

Costa Rica PROCIG partners produced a national survey of elements of NSDIs as an additional result of their activities. The PROCIG project coordinator provided input for the questionnaire. The survey, led by the IGN, asked GOs about their current GIS infrastructure and their needs for inter-agency collaboration. Survey results are available on the PROCIG Web page. The IGN plans to lead further efforts at building the Costa Rica geographic information infrastructure and this survey provides an important information base for planning the infrastructure.

Panama

The Panama PROCIG activities lend support to on-going national efforts to develop their SDIs and the National Geographic Information Center (CNIG). In January 2001, the PROCIG coordinator helped organize, and actively participated in, a national seminar on GIS activities in Panama. The IGN hosted the meeting and led discussions on data development in Panama, standards, and data sharing. The PROCIG project coordinator worked with the national mapping agency in developing a GIS questionnaire in order to assess the state of GIS in Panama prior to the workshop. During this meeting, we made a plan to support two national-level workshops in Panama. Professionals from 16 GOs attended the first workshop in May 2001, which focused on metadata standards and how they function as part of the NSDI. PROCIG covered travel expenses and the cost of coffee breaks. The USGS-led Mitch Clearinghouse Project contributed the time of a GIS specialist to conduct the seminar. This in-kind contribution to the seminar brought substantial experience to Panama's national metadata development. The seminar gave training in the USGS-developed MetaLite software. Leveraging USGS support was a key factor in the success of the workshop. It is notable that USGS supported the workshop for a country that is not part of the Mitch Clearinghouse Project. With support from PROCIG and USGS, the Panama IGN agreed to develop metadata and establish a clearinghouse node, which will be the first for Panama.

The Panama IGN is planning the second PROCIG-sponsored workshop for late 2001. Geographic information standards will be the theme and the IGN will try to bring in a few outside experts to develop the activity.

The NSDI activities occupied the PROCIG-Panama agenda only during the last 9 months of the project period. The original plan had been to put a population mapping

application on the Web. This effort lost momentum for several different reasons. The PROCIG contact in the INE was not fully integrated into the GIS activities of the institution. PROCIG partners received ArcView GIS software, but the INE had already made a major investment in Intergraph's GeoMedia software. The PROCIG contact from the National Environment Authority (ANAM) partner changed. We were unable to integrate the new ANAM partner until the end of the project.

The original idea of putting together a Web product on population mapping survived within INE. But, instead of a national-level population system, they decided to put together the mapping component of a Panama City urban information system. The project uses ESRI's Map Objects Internet Map Server and will be made public sometime in 2001.

4. Spatial Data Infrastructure Research and Development

PROCIG made a major evolutionary change when our agenda moved from a product focus to more emphasis on NSDI. In the Americas, the management of geographic information varies in maturity by country. Some nations have developed mature, consistent infrastructures to help manage geographic data in a compatible manner. Other countries suffer from data produced by many different organizations, in an uncoordinated way, and under heterogeneous specifications. Formats, prices, and access conditions differ significantly. Redundant, inconsistent, or incompatible data limit the possibilities for their integration and proper use, which ultimately prevents users from taking advantage of the data's potential. Another troubling problem is the lack of documentation of spatial data, referred to as metadata. Metadata describe origins, scale, quality, technical specifications, access and distribution constraints, and intellectual property status of geographic information. They provide a mechanism for indexing and cataloguing data. Because metadata are lacking, users have difficulty finding out what data are available and evaluating the fitness of the data for various applications.

The need for an NSDI emphasis is clear from any assessment of the state of geographic information and technology development, in Central America and in all countries. CIAT had been involved in NSDI activities in the past in both Honduras and Nicaragua, but at that time we failed to recognize the existence of an emerging field with dedicated professionals working on NSDI issues throughout the world. The type of inter-agency, GIS collaboration our project desired requires a common language for geographic data management. In the same way that the Internet is built on HTML, FTP, and other common standards, exchanging geographic information requires a series of standards, allowing users to share data. Trends toward greater use of the Internet, increased use of location services, and dynamic mapping on the Web further strengthen the need to build NSDI concepts into geographic information management activities.

Participant evaluations of PROCIG clearly indicate that all partners have positively endorsed our NSDI emphasis, a change suggested by our project coordinator. The effect of our new emphasis is seen in the country project activities, our Web page, and in an NSDI research and development component built into the project.

The PROCIG research and development component consists of:

- Our participation in a regional NSDI meeting in Bogota, Colombia,
- Linking an academic thesis project to our activities,
- Our involvement in the development of a global survey on NSDI,
- A new survey on organizational issues,
- Support for NSDI in Central America,
- A review of past projects in Central America, and
- Identification of institutional constraints to NSDI implementation.

The global survey is part of an effort coordinated by the FGDC as a contribution to the GSDI. Dr Harlan Onsrud of the University of Maine leads this effort to make national-level analyses of NSDI throughout the world. We were interested in acquiring the survey responses for the Central American countries, but neither they nor most Latin American countries had filled out the questionnaire. After discussions with Dr Onsrud, we decided to translate the questionnaire to Spanish. We collaborated with Colombia's IGAC to disseminate the questionnaire to professionals working in geographic IT in Latin America.

The PROCIG coordinators presented the results of the translated survey for Latin America in the February 2000 meeting, "Infrastructuras Nacionales de Datos Espaciales", held in Bogota, Colombia. The PROCIG coordinators from CIAT participated on the organizing committee of this meeting. We helped IGAC write a proposal to acquire funds from *info*Dev's conference scholarship fund to bring in conference participants, several of whom were PROCIG partners. Our efforts also facilitated the participation of Dr Ana Maria Majano, Minister of the Environment and Natural Resources of El Salvador. Shortly after the conference, Dr Majano took a proposal to the Council of Ministers to form the Salvadoran Spatial Data Infrastructure.

The PROCIG coordinators continued to work with El Salvador, helping them organize the first national meeting on NSDI and participating as invited speakers. PROCIG continued to collaborate with our partners in USGS to promote NSDI throughout the region. Many of these activities are described above in the country summaries. They mostly consist of supporting meetings, sharing documentation and information, and E-mail interaction with PROCIG partners. A new survey was developed on organizational aspects of NSDI, and results are being shared with all partners. These initiatives advance our strategy of pooling resources, knowledge, and information at the regional level and thereby achieve economies of scale unattainable by countries working alone. Although the PROCIG coordinators supported these efforts, the professionals in the GIS laboratories of the government agencies are the ones who are getting behind these initiatives and moving them forward.

As with many information and communication technologies, the most difficult obstacles to NSDI implementation are not technical, but rather deal with policy, legal questions, and organizational issues. Our research review of past SDI projects in Central America and analysis of institutional constraints shows how research can impact development activities. We expect these research results to be of immediate value to any country developing NSDI. The PROCIG software and hardware donations to individual

institutions may be of little use if we lack the infrastructure to communicate and share geographic information. Research results from efforts linked to PROCIG will be posted to our Web page over the next year.

5. Participants' Evaluation of the Project

How do participants view PROCIG? What lessons might we learn from their opinions? This section explores these two questions by analyzing a questionnaire that participants filled out on the final day of our Cartagena meeting. The questionnaire is subjective; we did not use solicit-scaled responses. A future questionnaire might include questions that permit a more quantitative analysis of participant views, and it could focus more on issues related to ICT development in general. The analyses presented here are the CIAT coordinators' interpretation of the responses. The questionnaire responses are available to our donors or other interested individuals by contacting the project coordinators. We encourage project reviewers or others to contact participants for more information on the development of the project. The questions covered issues related to project coordination, software donation, utility of the Web page, country projects, inter-institutional collaboration between partners, participant perception of the project, and NSDIs.

When asked how well the coordinators in CIAT communicated with participants and were accessible to them, all partners stated that communication was good or excellent. Some respondents praised the organization of the two project meetings. One respondent would have liked more communication about obstacles to advancing the country projects. Partners who came in late to the project could not comment on the communication question because of their low level of involvement up to that point.

Participants gave near-universal praise for the software donation. Almost all participants agreed they would not have developed similar activities or products if they had not received the software. The three participants who already had the software found the donation still useful because it permitted another person in the office to use ArcView. Only one participant stated that he would have developed similar activities and products without the donation. Some participants cited lack of financial resources to buy software as an obstacle to developing this type of work. Another lacked a demonstration project to show supervisors the value of GIS technology. Before PROCIG, his institution had no demonstration projects because they had no software. Two respondents stated that they could only develop this type of capacity in the long term, suggesting the project "jump started" their efforts. On the whole, ESRI's software donation was seen as a vital component of the project.

Participants found the Web page useful and stated it should be maintained in the future. One participant who entered the project late was unaware that the Web site existed. Several participants knew about the Web site, but were unfamiliar with all the information available there until they attended the Cartagena meeting. Another participant stated that time pressures and connection problems prevented him from visiting the Web page. Participants praised the information on NSDI found on the page. Several participants asked that PROCIG partners should continually send updates on NSDI activities in their countries. One participant wanted the Web page to inform users of developments associated with GSDI and PC-IDEA. Another partner suggested the page could be the entry portal for a proposed Web mapping pilot project (see section 7).

Participants' views of the country projects were mixed. We asked project participants to evaluate technical and administrative constraints and accomplishments in carrying out country activities, who might be the users of their results, and whether their activities would continue after PROCIG funding ended. Almost half of the respondents lacked sufficient time to work on the country activities; their other institutional activities were more important. Their supervisors gave little priority to the PROCIG work, even though we tried to develop projects that coincided with institutional agendas. In-country coordination from the CIAT coordinators was lacking in one country because the CIAT staff member who was going to assist with the project was relocated. Several respondents needed a dedicated coordinator for their country. Technical obstacles to advancing inter-institutional country work included:

- Incompatible coding of information between organizations,
- Incompatible cartographic projections,
- Lack of complete or ordered data,
- Lack of data documentation (metadata), and
- Internet connectivity problems.

Most participants stated that the country project would continue in the future even though PROCIG funding had ended. One participant was pleased that GIS was now on the agenda of his supervisor. Six participants praised the benefit that inter-institutional coordination in the country projects fostered. They exchanged data that were helpful for their institutions. Some partners found the country projects added to their knowledge of ArcView software.

Inter-institutional cooperation between partners took several forms and varied in utility between countries. We asked project participants whether their disposition to collaborate with other institutions is now greater, if this type of collaboration is useful, and how they arranged their collaboration. The partners replied that their collaboration went forward by verbal agreement, although many institutions wrote bilateral letters of agreement. Some partners stated that the PROCIG work solidified existing agreements between institutions. Most participants agreed that inter-institutional collaboration is a good model for project development. One participant from a statistics institute stated that the PROCIG work generated awareness and deep interest in future inter-institutional collaboration among others in his institution. A respondent wrote that focusing collaboration around the development of a concrete product was useful. Two participants mentioned that their supervisors now placed more value on inter-institutional collaboration. Several respondents stated that collaboration saved money by sharing data and technology, and by avoiding duplication of effort. Only one respondent informed us of no improvement in data exchange between countries. The rest noted an improvement in data exchange; a few suggesting it was a major PROCIG achievement.

Many obstacles remain for the dissemination of data products. Returns on training in Web page design or dynamic Web mapping cannot be realized until institutions have better Internet connectivity. Some partners have the content for Web pages and CDs, but still lack mechanisms to deliver that content.

Finally, most respondents answered positively when asked if they were willing to support future regional projects on NSDI. They stated that they support regional integration in Central America. Future regional work will have software, hardware, and training needs.

They want to work on their own NSDIs parallel to any development of a regional infrastructure. Regional efforts should support the NSDI initiatives.

6. Project Experience in GIS/ICT Development in Central America

Out of our experience in developing PROCIG over the last 2 years came particular and general lessons, some of which are perhaps unique to projects promoting geographic IT. Other lessons may apply to development projects in general, or to Central America as a region. In this section, we briefly review lessons learned related to project design and execution, and include recommendations for future projects on similar themes.

Project design should include effective mechanisms for ensuring that commitments are kept. Our project lacked sufficient structure to ensure that each participating institution would fulfill the commitments made. We received letters accepting participation in PROCIG and making commitments to the activities and results. However, we should have written letters of agreement to be signed both by the coordinating agency and by the directors of each individual agency. We expected that workshop participation and software and hardware donations would be sufficient to compel the partners to follow through on data product development. For the project coordinators, lack of partner activity in advancing data product development was our greatest frustration. However, we understand that Central American government institutions are under-funded and under-staffed. The partners have insufficient time to devote to relatively small projects outside their normal responsibilities. In large, multi-agency, networking projects, proponents need to think carefully about the project design for making sure that commitments are kept. *info*Dev and other ICT donors need to include an analysis of the mechanisms for ensuring commitments are kept in their evaluation of project proposals.

Our project and partners derived a substantial benefit from the donation by ESRI, makers of the ArcView software we used in the project. Most Central American government agencies cannot afford software that is marketed to developed country organizations with the capacity to make these kinds of technology investments. Unfortunately, free public domain GIS software lacks sufficient functionality for the wide range of applications our partners are developing. The PROCIG participants unanimously praised the software donation, saying that it had an impact on their activities. During our PROCIG event in Cartagena, Colombia, we met with Jack Dangermond, the president of ESRI. To express our gratitude to ESRI for the software donation, all the partners contributed PowerPoint slides to a presentation for Mr. Dangermond and other ESRI officials. The most notable uses of ESRI-donated software include post-earthquake damage analysis, dynamic mapping for a prototype NSDI Web page, analysis of demographic pressures on conservation areas, and an urban information system for the Internet. The presentation is available on our Web page. The range of uses of the software indicates the impact that these kinds of donations can have. Interestingly, during the GSDI meeting, ESRI announced their intention of making a 5 million-dollar, in-kind donation to developing countries involved in their NSDI. The donation will include software and training. The PROCIG experience shows that software donations can have substantial impact and can address a "digital divide" in the development of geographic IT.

Instability of personnel or institutions reduced our capacity to carry through planned PROCIG activities in three of the six partner countries. The outstanding case is in Honduras where the DGEC was eliminated. In some cases, political cycles affected personnel. Many Latin American countries suffer from changes in activities and personnel when new government officials are elected. They lack civil service systems where government technicians are appointed according to merit and cannot be dismissed for political reasons. Developing regional projects could potentially overcome political cycles. If projects were part of international agreements or structures, new government administrations would have some obligation to complete activities started by a previous government. Although this would not guarantee that they fulfill their obligations, it might increase the likelihood that project commitments are kept. PROCIG partners should be protected from instability caused by political changes because their jobs are largely technical.

Change of personnel also occurred at the coordination level. Three CIAT staff initiated the project – the overall project leader, a coordinator, and an assistant. The coordinator was replaced midway through the first year of the project. Posting our coordinator to Honduras functioned well because of the collaboration we were able to achieve with USGS. A second CIAT staff member was supposed to be based in another partner country, but subsequently he was relocated. We added a dedicated Web specialist 1 year into project implementation. Personnel changes are perhaps inevitable. Project design and implementation should work to avoid problems related to instability of personnel.

Student interns can advance project development in significant ways, as our experience in Costa Rica and Honduras showed. The partners overestimated the time that would be available to work on PROCIG activities. Students are always seeking internships that give them experience that they can apply later in their professional careers. Future projects can develop links to developing and developed country academic and research institutions to include student interns in project design.

A CIAT objective in the PROCIG project was to evaluate the effectiveness of its design for implementing GIS in Central America. Historically, GIS development projects sought a technological solution. Many projects evolved around the purchasing and installation of hardware and software to establish a GIS. However, once the projects finished, the computers fell into disuse. Donors realized that capacity building was needed, and in time the emphasis of projects shifted from technology to training. Yet, even after staff had been trained, the institutions themselves lacked the capacity to make use of the knowledge. Thus, the next phase of GIS development projects provided training sessions and worked with institutions in producing products based on their training. This was the model under which PROCIG was designed. However, we have seen that the institutions lack the time to devote to the project. They have the technical capacity and the vision for a product, but they are under-staffed or distracted with administrative matters. Ultimately, we find ourselves asking, "What can we do to see that the planned products are produced?" The use of interns is an interesting adaptation to the project design model. The first choice would be to incorporate a local university student into the institution's work plan. In doing so, additional capacity is built in the country. Alternatively, a foreign student can provide significant capacity building as well. For example, CIAT's first meeting was a 2-week training session, and although participants said that they learned a great deal, 2 weeks was still a limited time period for them to

absorb all the information. With a foreign student, possessing specialization in GIS and based within the institution, the project partners are able to work beside someone with advanced training on a daily basis for several months. In addition to the capacity building factor, the intern ensures that the GIS product is produced, and ultimately the institutions have a sense of ownership of the product. This has proven to be a successful model through PROCIG.

The IGNs of Central America should have been included in PROCIG from the beginning. Central American countries have laws and policies giving their IGNs mandates to develop official base maps. The IGNs traditionally house the expertise to manage national geodetic and mapping programs. However, in most cases they have fallen behind in the technology development of digital mapping because they are under-funded, under-staffed, or otherwise lack sufficient vision to advance new developments in GIS. Government agencies throughout the region are looking to the IGNs to take a leadership role in GIS development, but they lack the human and technical resources to fulfill this role. The development of GIS and NSDI is further advanced in countries with strong IGNs, such as Colombia. This problem deserves much greater attention from Central American governments and international development agencies. The IGNs need institutional change. If IGN leaders fail to move their agencies to the forefront of digital geographic IT development in their countries, their institutions risk becoming obsolete, a no-win scenario for everyone.

Political commitment from high government officials makes a critical difference in furthering the type of inter-agency cooperation sought by PROCIG. Perhaps the most concrete development in which PROCIG played a role is the development of the Salvadoran SDI. The Salvadoran PROCIG partners facilitated the participation of the Environment Minister in an NSDI regional workshop. The Minister subsequently pushed their NSDI initiative through the Salvadoran government. The Vice-Minister of Planning and Urban Development and the Director of the National Registry fully support the NSDI initiative. Projects to advance geographic IT need to educate high government officials in the utility of these efforts. We need better studies showing the impact of NSDI on overall technology development. El Salvador now has an opportunity to show how NSDI can help avoid the duplication of effort in GIS development, save budgetary resources, and improve efficiency in the use of IT.

Dedicated individuals – or "champions" – are a key difference in whether a project succeeds or fails. Of course, this is no new revelation. Even so, it is notable how little attention many projects pay to identifying project champions, the people that work tirelessly to advance a cause in which they believe. Our experience shows that the involvement of these key individuals is critical at all levels, from overall PROCIG project coordination to individual country activities. In some of the PROCIG countries, we were unable to identify these champions, and the activities likewise suffered. ICT projects should make extra efforts to identify project champions at all levels, and be flexible enough to adapt the project (and project budget) to include the champions. *info*Dev should investigate further how they can improve criteria for identifying projects that include these dedicated individuals.

Many of the ministries and government institutes are at a critical transition point from analog to digital, from "guarding" their information to trying to disseminate it on-line. CIAT (through PROCIG) was well timed for participating in the process and providing insights

to a range of government agencies. Although initiatives are now underway, the national frameworks in Central America are fragile, subject to changes in government. More work is needed to ensure that geographic information is consistent, available, and affordable. CIAT, CATIE, USGS, and others can play a role in facilitating the development of such frameworks at the national level. For national initiatives supported by PROCIG, we provided reference material, sample policy documents, and recommendations for developing programs. We kept key people, such as the IGN Directors, informed of advances in neighboring countries.

There is an overall trend in Latin America towards pricing data for "cost recovery" and increasing restrictions on use of data. Legal restrictions may prohibit normal scientific practices, such as sharing the data with colleagues, publishing the data in scientific journals, or using them to address different scientific problems. And high data prices are likely to affect decision making, in that potential data users may not be able to afford the data they needed for their GIS. In the NSDI survey that was conducted through PROCIG, most countries listed legal issues and funding as their greatest concerns. We should expect that copyright, licensing, and other forms of database protection will become more common and that prices for digital data will increase (i.e., without intervention). Given the regional inclination for database protection and cost recovery, champions or donors and international agencies need to provide an "alternative voice" and promote policies that enhance public access and participation in land-related decisions.

In the future, more emphasis will be needed at the municipal level. Generally, we are seeing the benefits of GIS at the national and regional (Central America) levels. Yet, locally generated data and knowledge are increasingly important because new developments in technology make it possible for local people to:

- More readily gather local geographic information germane to their own needs,
- Obtain data from on-line sources,
- Develop information products,
- Use data for decision making and, ideally,
- Contribute their locally gathered data back to a national data management structure.

The NSDI initiatives thus far have largely focused at the national level, and that makes sense because first you need national support. However, NSDI ultimately encompasses the technical and institutional means to support data development and use within a local-national-global continuum.

7. Project Sustainability

The PROCIG project results indicate high potential for sustaining activities well into the future. We are reaching out to the private sector and other organizations to further our goals. Our Web page traffic is increasing and our visibility has been enhanced in the public media. During our Cartagena meeting, project partners made significant commitments to advance regional activities into the future. The IGNs are leading a new effort to build the regional SDI for Central America.

We are advancing new project proposals including a regional statistics and mapping project, national and regional NSDI projects, a project to build on the Costa Rica country-level activity, and a Web mapping pilot project for Central America. Concept notes have been written and we have some level of donor interest for each of these projects.

The regional statistics and mapping project would build on previous work funded by the European Community for the Andean countries. National and regional atlases would be produced throughout Central America. We have donor interest for our proposal for an NSDI project in Honduras. We are preparing a concept note for a regional project that would include the seven Central American countries.

We are developing a proposal to study demographic and agricultural pressures on the Mesoamerican Biological Corridor. This study would build on the Costa Rica country study, learning from the successes and failures of that work. Each PROCIG partner in the environmental ministries is delivering a copy of the Costa Rica CD and poster to the principal project officers of the Mesoamerican Biological Corridor Project in each country. We are gauging their interest in developing a region-wide project. The government of Norway expressed interest in supporting this type of project.

We are investigating the possibility of participating in a pilot project that demonstrates dynamic mapping on the Internet. For our Cartagena meeting, we invited Doug Nebert of the US FGDC and Michael Gould of the Universidad Jaume I in Spain to give a presentation on the open GIS movement and dynamic Web mapping. They are both involved in the Open GIS Consortium (http://www.opengis.org). The presentation showed a real-time, multi-server, Web mapping interface (Figure 2).
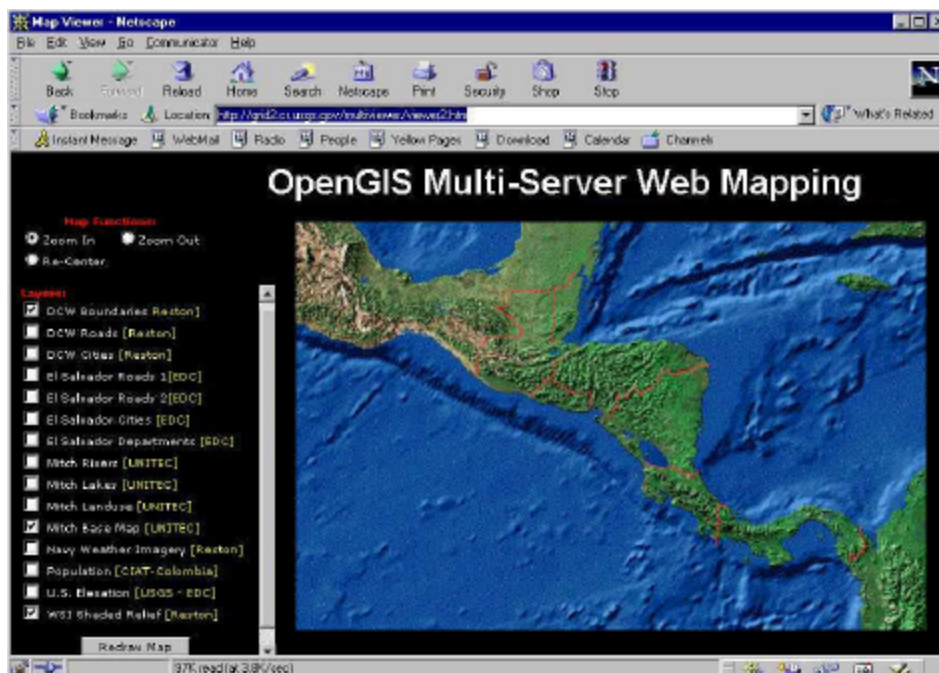

Figure 2. OpenGIS multi-server browser for viewing digital geographic data from different servers in real time.

Internet users can use their browser to enter a site that has a map-based graphical interface. Through the site they can display digital maps from different servers in real time. Even though data providers may have different software packages, the user takes advantage of Open GIS protocols to dynamically overlay data from different sources.

In the demonstration, Doug Nebert made dynamic visual overlays of Central American map information from map servers at USGS National Mapping Center in Reston, VA, the Technological University in Tegucigalpa, Honduras, the Eros Data Center in Sioux Falls, South Dakota, and CIAT in Cali, Colombia. The test site still has bugs that need solving. At present, the viewer only works with Netscape 4.6 and 4.7. However, the demonstration clearly shows the coming trend of GIS on the Internet. We invite readers to visit the project Web site at http://grid2.cr.usgs.gov/multiviewer/viewer2.htm.

The sustainability mechanisms listed above require some level of international donor support. Some doubt exists as to whether all the countries have the capacity to make significant advances over the next year without financial input from donors. GSDI5 and PROCIG's second meeting in Cartagena were valuable mediums for diffusing NSDI concepts (policies, institutional framework, standards, etc.). The ideas are there, but realistically, each country must evaluate its priorities, finances, and human resources in order to determine how it will move forward.

PROCIG fostered interaction between government institutions at a time when the norm was for institutions to function relatively independently. The PROCIG network of GIS professionals established relationships that will prove useful for future collaboration. Before PROCIG, many of the GIS technicians had never worked together or exchanged data. The individuals now know one another, have worked together, and know one another's capabilities. We anticipate the project partners will continue to cultivate these relationships and add to other regional efforts in building a well-connected GIS professional community in Central America.

At the close of the Cartagena meeting, the IGNs signed a declaration to carry forward NSDI activities in Central America (Appendix III). The IGN Directors agreed to several resolutions, including leading the development of NSDI in their respective countries, galvanizing support for national inter-institutional NSDI committees, dedicating at least one staff member to NSDI coordination, and developing an NSDI Web site in each country. The resolutions acknowledge PROCIG as a catalyst in promoting NSDI in Central America, and they stress the need for continuing the regional network of GIS data producers and users.

PROCIG partners made new commitments to advance our common agenda on the last day of our Cartagena meeting. Most of the commitments were to carry forward logistical matters such as sharing trip reports, updating our participant contact list, sending our final report to all partners, and sending press releases to media outlets. However, a number of commitments indicate the level of sustainability we have tried to achieve:

- A region-wide committee of six partners will write a software technical report on the utility of the ArcView software for the country projects. The report will include obstacles to effective use of the software and we will send it to ESRI and *info*Dev.

- A committee of six partners agreed to work on developing a regional NSDI proposal, to be circulated among all partners.

- All PROCIG partners agreed that it would be useful to have a national "NSDI Web page" located within the national official Web-portal. A PROCIG representative from each country will investigate how to arrange for this Web site to be set up within their national portals.

- All PROCIG partners expressed the interest of their institutions in participating in a regional Web mapping project. Our colleagues at OpenGIS Consortium are putting together the technical specifications. We will include the open-source software for developing the network in our final report with CD to PROCIG partners. We are trying to attract donor and private sector interest in this concept.

- A committee of seven PROCIG partners is investing interest of national coordinators of the Mesoamerican Biological Corridor project in replicating the country study that was done by the Costa Rican group.

All interested parties should follow these developments to see what kind of sustainability was achieved. Will the verbal commitments made in the Cartagena meeting translate into action? Whether the project can be truly sustainable into the future remains to be seen. Nevertheless, the commitments made in Cartagena suggest that sustainability is possible and positive action in the future has great potential.

8. Conclusion

In this PROCIG project report, we discuss networking and communication, our country projects, an SDI research and development project component, participant evaluation of the project, project experiences in ICT development, and future project sustainability. Although this report summarizes PROCIG activities over the 2 years of project funding, we expect new developments in the coming year.

Networking and communication within the project and with external partners has generally worked well. Our Web page is a useful source of information on geographic information management in Central America, and SDIs in all Latin America. Although our country projects faced several obstacles, our partners have developed, and are still putting together, valuable results for their countries and the region as a whole. Research on SDI has led to significant insights that are informing our development activities. In the course of project development, we learned many lessons that point the way forward for developing geographic information and ICT efforts in the future.

Central American countries face unsustainable population growth, vulnerability from natural and human-induced disasters, severe environmental problems, and high poverty levels in many areas. But they also have many reasons to be optimistic about a better future. The Mesoamerican Biological Corridor is one of the most innovative conservation projects in the world, and has great potential to conserve environmentally valuable lands throughout the region. Central America appears to have moved beyond the period of civil strife of decades past. New efforts to foster regional integration, such as the

Central American Integration System (SICA), hold great promise for the region. Geographic information management and information and communications technologies have a pivotal role to play in helping Central Americans meet their challenges and build a better future.

APPENDICES

APPENDIX I

PROGRAM AGENDAS OF THE FIRST AND SECOND PROCIG WORKSHOPS

Program of the 1st International Workshop- *info*Dev Project:
Place: CIAT, Cali (Colombia)
Date: 20 September to 1 October

Monday, September 20

7:30 – 9:30	Registration of participants
9:30 – 10:00	Act of Inauguration
	Dr Rafael Posada, Director-Regional Cooperation
	Glenn Hyman,
	(Conference Area, Muisca Room)
10:00 – 10:30	Snack
10:30 – 11:00	Presentations of participating countries
	(Conference Area, Muisca Room)
	GUATEMALA
11:00 – 11:30	PANAMA
11:30 – 12:30	HONDURAS

➢ Territorial legislation and the territorial information system (Use of information since Hurricane Mitch)
➢ Statistics and Census (Preparation of the 2000 population census)
➢ Agriculture (Agronomic inventory and its representation in thematic maps)

12:30 – 13:30	Lunch
13:30 – 14:00	EL SALVADOR
14:00 – 14:30	NICARAGUA

    ➢ Biophysical regionalization for agricultural development (Chinandega Department): Classification of territories by advantages for their development, social problems, main limitations, level to which affected, level of development.

14:30 – 15:30	COSTA RICA

    ➢ Agricultural zoning in the Central Pacific Region at a scale of 1:50 000
    ➢ Location of coffee farms in the North Huetar region for the control of coffee borers from Nicaragua
    ➢ INFOAGRO Project

15:30 – 16:00	Snack
16:00 – 17:30	GIS theory and geographic concepts
	ESRI news
	Sergio Velásquez
	PROSIS (ESRI)
	(Conference Area, Muisca Room)

Tuesday, September 21

8:00 – 10:00   Methods of data capture using GIS:
              GPS
              Scanner
              Digitizing in ArcView
              Darío Hoyos, Silvia Castaño, Victor Soto
    (Groups will develop the three activities during the morning. The GPS session will take place on CIAT land and the two other activities in the offices of the Land Use Program - GIS)

10:00 – 10:30   Snack
10:30 – 12:30   Methods of data capture using GIS:
              GPS, Scanner, Digitizing in ArcView
12:30 – 14:00   Lunch
14:00 – 15:30   Relational databases:
              Structure and theory. applications in GIS
              Steffen Schillinger
              José Hernán Trejos
              (Land Use Program Meeting Room)
15:30 – 16:00   Snack
16:00 – 17:30   Relational databases:
              Practice with own data
              Steffen Schillinger
              José Hernán Trejos
              (Land Use Program Meeting Room)

Wednesday, September 22

8:00 – 10:00 Classification methods: Cluster analysis and its application in ArcView
              Otoniel Madrid
              Germán Lema
              (Conference Area, Muisca Room)
10:00 – 10:30   Snack
10:30 – 12:30   Projections:
              Theory and applications in Central America
               Sergio Velásquez
              (Conference Area, Muisca Room)
12:30 – 14:00   Lunch
14:00 – 15:30   Group work by country using own data
              (Land Use Program Meeting Room)
15:30 – 16:00   Snack
16:00 – 17:30   Group work by country using own data
              (Land Use Program Meeting Room)

Thursday, September 23

8:00 – 10:00   Introduction to geoprocessing in ArcView 3.1

	Elizabeth Barona
	(Land Use Program Meeting Room)
10:00 – 10:30	Snack
10:30 – 12:30	Introduction of the 3D analyst in ArcView 3.1
	Sergio Velásquez
	(Land Use Program Meeting Room)
12:30 – 14:00	Lunch
14:00 – 15:30	Group work by country using own data
	(Land Use Program Meeting Room)
15:30 – 16:00	Snack
16:00 – 17:30	Group work by country using own data
	(Land Use Program Meeting Room)

Friday, September 24

8:00 – 10:00	Display methods and presentation of maps and data in ArcView
	Elizabeth Barona
	(Land Use Program Meeting Room)
10:00 – 10:30	Snack
10:30 – 12:30	Group work by country using own data
	(Land Use Program Meeting Room)
12:30 – 14:00	Lunch
14:30 – 15:30	Group work by country using own data
	(Land Use Program Meeting Room)
15:30 – 16:00	Lunch
16:00 – 17:30	Group work by country using own data
	(Land Use Program Meeting Room)

Monday, September 27

8:00 – 10:00	Programming in GIS: Avenue, Visual Basic, MapObjects
	Presentation of applications developed in CIAT: FloraMap and
	Mitch Atlas
	Gregorio Leclerc
	Alexander Gladkov
	(Conference Area, Muisca Room)
10:00 – 10:30	Snack
10:30 – 12:00	Tools for decision-making: Environment and sustainability indicators
	Manuel Winograd
	(Conference Area, Muisca Room)
12:00 – 13:30	Lunch
13:30 – 15:30	Remote Sensing and GIS:
	CIAT examples
	Aerial photography and stereography:
	CATIE examples
	Nathalie Beaulieu
	Javier Puig
	LEICA S.A.

15:30 – 16:00	Snack
16:00 – 17:30	Group work by country using own data
	(Land Use Program Meeting Room)

Tuesday, September 28

8:00 – 10:00	Methods in advanced GIS:
	Map algebra
	Glenn Hyman
	(Conference Area, Muisca Room)
10:00 – 10:30	Snack
10:30 – 12:30	Distributed GIS and Internet GIS
	PROSIS (ESRI)
	(Conference Area, Muisca Room)
12:30 – 14:00	Lunch
14:00 – 15:30	Group work by country using own data
	(Land Use Program Meeting Room)
15:30 – 16:00	Snack
16:00 – 17:30	Group work by country using own data
	(Land Use Program Meeting Room)

Wednesday, September 29

8:00 – 10:00	Communication and Information Networks:
	CIAT experiences
	Nathan Russell
	Eduardo Figueroa
	Mariano Mejía
	Juan Carlos Serna
	PROSIS (ESRI)
	(Conference Area, Muisca Room)
10:00 – 10:30	Snack
10:30 – 12:30	Communication and Information Networks:
	CIAT experiences
	Nathan Russell
	Eduardo Figueroa
	Mariano Mejía
	Juan Carlos Serna
	PROSIS (ESRI)
	(Conference Area, Muisca Room)
12:30 – 14:00	Lunch
14:00 – 15:30	Development of Web pages:
	Begoña Arana
	Compuclub
	(Land Use Program Meeting Room)
15:30 – 16:00	Snack
16:00 – 17:30	Development of Web pages:
	Begoña Arana
	Compuclub

(Land Use Program Meeting Room)

Thursday, September 30

During Thursday and Friday we will put together proposals for the development of the project. Outline objectives, responsibilities, and roles of the institutions; define short- and long-term goals and activities to develop for their achievement.

Friday, October 1

During Thursday and Friday we will put together proposals for the development of the project. Outline objectives, responsibilities, and roles of the institutions; define short- and long-term goals and activities to develop for their achievement.

PROCIG II in Cartagena, Colombia 18 to 26 May 2001
Program

Friday, May 18

20:00-21:00   Introduction to the Meeting, discussion of different subjects
21:00-22:00   Informal cocktail in Glenn Hyman's room

Saturday, May 19

Moderator: MSc Sergio Velásquez M, CATIE

08:00-11:00   Permanent Committee for Spatial Data Infrastructure for the Americas (PC-IDEA)
                  Denis Fuentes (IGN Tommy Guardia of Panama),
                  Carlos Elizondo (IGN of Costa Rica)
(10:00-10:15)   Snack
11:00-12:30   Definition of basic data and discussion of financing problems for their production
12:30-13:30   Lunch
13:30-15:30   Presentations on advances of projects and INDE in each country (three countries, 45 m each)
                      Costa Rica
                      Belize
                      Guatemala
15:30-17:00   Future plans for regional work and financing proposals. Projects in the process of planning followed by brainstorming

Sunday, May 20

Group excursion to the Rosario Islands– Hotel San Pedro de Majagua. Welcome snack and buffet lunch.

Monday, May 21

Moderator: MSc Sergio Velásquez M, CATIE

08:00-11:00   Presentations on advances of projects and INDE in each country (four countries, 45 m each)
                      El Salvador
                      Nicaragua
                      Panama
                      Honduras

(10:00-10:15)	Snack
11:00-12:30	PROCIG's Web page: How to improve it and future plans and strategies (e.g., a Web page on INDE for Central America)
	Glenn Hyman, Claudia Perea, Kate Lance, German Lema
12:30-13:30	Lunch
13:30-15:00	ESRI news
	Myriam Ardila, PROSIS
14:00-17:00	Participation in the PC-IDEA Meeting

Tuesday, May 22

08:00-18:00	GSDI-5, sessions and activities all day
12:30-14:00	Lunch with GSDI-5
18:00-18:30	Central America Meeting with Jack Dangermond, President of the Environmental Systems Research Institute (ESRI) and Merrill Lyew, Leader for Latin America (ESRI)

Wednesday, May 23

| 08:00-18:00 | GSDI-5, sessions and activities all day |
| 12:30-14:00 | Lunch with GSDI-5 |

Thursday, May 24

08:00-18:00	GSDI-5, sessions and activities all day
12:30-14:00	Working lunch. OpenGIS and Dynamic Mapping on the Internet.
	Michael Gould, Senior Lecturer, Dept. of Information Systems, Universidad Jaume I, Castellón, España. Meeting for Central America. Application of Open GIS.
	Douglas Nebert, Federal Geographic Data Committee.

Friday, May 25

| Moderator: | MSc Sergio Velásquez M, CATIE |

08:00-10:30	Comments on the GSDI-5 presentations
	Monitoring the progress of INDE in each country / Monitoring the use of geographic information (e.g., evaluation of Mitch Atlas)
	Regional and national standards. Recommendations.
	Regionals and national legal aspects (executive order, author rights). Recommendations.
10:30-10:45	Snack
11:00-11:30	Mechanisms for financing projects of spatial data infrastructures through international development organizations
	William Brooner, Consultant

11:30-12:30	Role of the private sector Brainstorming for the next Cartographic Week in Panama (2002) (perhaps the next regional meeting of the PC-IDEA Sub-Committee for Central America)
12:30-13:30	Lunch
13:30-14:00	Activities in the infrastructures of spatial data in CATIE: The role of regional organizations MSc Sergio Velásquez M, CATIE
14:00-14:30	Indicators of sustainability for Central America Andrew Farrow (CIAT)
14:30-15:30	Discussion of previous projects that have been successful or failed. Lessons learned. How can INDE projects be assured of success? Kate Lance
15:30-16:30	Information and discussion of presentations on INDE and GSDI that all participants can use for informing their institutions (e.g., material for trip reports)
16:30-17:00	Evaluation of PROCIG Glenn Hyman

Saturday, May 26

Return

APPENDIX II

COUNTRY SUMMARIES

BELIZE

GEOGRAPHIC INFORMATION SYSTEM IN BELIZE
Land Information Center (LIC) - Belize
Prepared by P. Noreen Fairwather

Background

The last 10 -15 years have seen tremendous advancements in enabling technologies, having the capability to improve our effectiveness and efficiency through modeling and analysis one such technology is Geographic Information Systems.

Belize's first introduction to Geographic Information Systems (GIS) was in the Sugar Cane Industry. The Belize Sugar Industries (BSI) used GIS/Remote Sensing during the mid to late eighties to monitor crop potential and harvesting among other things. The second such venture came from government, when in 1992 the Ministry of Natural Resources established the Land Information Centre (LIC) with GIS capability. Digitization of our baseline database (roads, rivers, administrative boundaries etc.) started immediately using 1:50,000 maps as base. Our settlement/community data was derived from our 1990 Census data which had geo-referenced data for all locations derived from GPS.

GIS Organizations (LIC): The Land Information Centres primary objective is to develop and use its data resources to improve all aspects of land management, protection and conservation in Belize. The LIC actively promotes data sharing to the mutual benefit of all parties, and by the nature of its activities, the LIC transcends sectoral boundaries and integrates not only information but also organizations. The Centre comprises of four components, the Land Administration System (LAS), the Conservation and Environmental Data System (CEDS) and the Geographic Information System (GIS) and more recently the Information Technology Unit (ITU).

The Information Technology Unit supports Wide Area Network (WAN) and Local Area Network (LAN) of the LAS/GIS/CEDS, as well as respond to any technological requirements in regards to recommendations, procurement, acceptance testing of equipment, maintenance and repairs of all the ministry computers both on and off the Network.

The LAS component was designed to improve the handling of the legal and fiscal aspects of land titling; manual procedures are being replaced by a computerized system. Leading to improved efficiency and accountability and more regulated land allocation practices. Over 100,000 parcels are currently in our LAS. In July of this year the MNREI will enter into a loan contract with the IADB for the implementation of a Land Management Project. A part of this project will focus on advancing the national cadastre through survey and mapping, land registration, policy formulation and land use planning.

The project will assist the MNREI to link its LAS to the GIS for improved planning and analysis.

The CEDS is intended to formalize the relationship between data gathering organization both within government and without. The basis of this relationship is data sharing, so often a weakness in other countries. The CEDS concept acknowledges that government cannot hope to gather all the data required for informed planning and policymaking. Subsequently the CEDS constitutes a network of sixteen members, whose data holdings are currently being compiled. Members can access the system remotely through the use of modems.

Membership to the CEDS is opened to National Agencies, Departments of the Government of Belize, registered Non-government organizations, National Foreign-assisted Projects and National Education/ Research Organizations involved in Natural Resources and Environmental activities. The CEDS Network has been designated as the National Network for Belize and Node for the Sistema Mesoamericano de Información sobre La Biodiversidad (SIMEBIO).

The GIS component supports activities of physical planning, forestry, agriculture, fisheries, health, national security, education and many others. Significant links have been made with a number of national foreign-assisted projects and research/educational institutions both at home and abroad.

We have used GIS to complete a number of projects in areas such as :

- Regional Development - the upgrading of the Southern Highway project where it was recognized that a series of programs development was needed to compliment the civil works. Some of the products included land use plans, zoning plans, transport infrastructure, distribution of health facilities and amenities.
- Forest License Mapping - this information is used to monitor the extent of the various type of logging and timber extraction in association with forest management plans.
- Electoral Boundaries - recently some redistricting has been approved in the south of the country.
- Zoning Plans - we refer to these as Special Development Plans (SDA), which basically outlines and assist in guiding land use development.
- Conservation Management - protected areas of Belize and the establishment of biological corridors mapping.

The LIC databases consist of a number of national coverages. These include, Lands Systems, Agricultural Potential, Land Use, Natural Vegetation, Forest Cover and Protected Areas. There are also other complementary datasets such as surveys, development zoning plans and satellite imagery.

Data Request: Our processing of request for GIS assistance is by completion of a simple form, which has check boxes for all our major coverages. Any more intricate request is explained in more detail on the reverse of the form.

Data Release: With regards to release of digital data. Our policy is that baseline data has a direct over the counter sale. All other release has to be under a standard MOU. This limit release to AOI only, no third party release, and citation for data used in

publications, and digital exchange of non-confidential data derived from the use of our data or other digital data. This is normally reflected in any cost. A history/source data sheet normally accompanies data submitted.

Future of GIS (Potential Negative Impacts)

Even though Belize has a number of organizations involved with GIS applications, there exists a need to build knowledge and capacity within these organizations. Some areas that have been identified are indicated in summary below.

Spatial Analysis, some organizations are using GIS strictly for map outputs (single themes only), which cause the absence of important information being fed into the planning process.

Technical Assistance and Training is needed for existing users and for marginal users to become more operational and capable of managing information.

Increased awareness (particularly in the natural resource and environmental disciplines) of the power and capabilities of a GIS. A national body to promote the use of GIS would help in this area. We try to do our part by supporting work experience programs from the colleges and the University of Belize.

The Legal and Policy Framework needs to be further developed, in order to ensure standardization and quality of GIS products. The establishment of a national body to guide GIS development in the country. As well as, to support a plan of action and direction for GIS users in an effort to eliminate duplication and increase efficiency, as well as, incorporation into the copyrights law.

With particular reference to the LIC, as previously mentioned we have three other components. Our response to GIS request would become secondary if there is a need to give additional attention to the LAS. The reality of this situation is the LAS is a large revenue earner (millions/annum), while the GIS averages about US$ 50,000 per annum.

Conclusion

The LAS is critical for the successful management and allocation of the country's land and other natural resources and particularly for revenue collection. The merger of the LAS and the GIS will significant improve the current system e.g. an immediate benefit will be the possibility of mass land valuation.

The introduction of GIS in Belize is facilitating the development of integrated resource management through strengthened planning, environmental management and monitoring. However simply viewing this in terms of the adaptation of computer hardware and software denies the vital importance of accompanying technical implementation with the institutional structure capable of supporting and ensuring that the integrative abilities of the technology are maximized. If these changes are made, GIS technology can continue to play a central roll in encouraging inter-sectoral cooperation and increased information exchange and ultimately balanced and sustainable development.

In addition to the forgoing, it is absolutely important that experienced and qualified professionals be brought on stream as soon as possible to man the technical unit and

adequately staff the Land Information Center. If government efforts to introduce a legislative and policy-making framework to land resource and environmental management are to succeed, a reliable and dynamic information base must underpin them with support staff committed to improvement and quality service. The success of these like many other initiatives will rely heavily on the political will to make it work by ensuring the allocation of appropriate human and financial resources.

COSTA RICA

PROJECT SUMMARY
Central American Project for Geographic Information
COSTA RICA
A GIS Analysis of Population and Agricultural Pressures on the Protected Areas
and Conservation Areas System

1. Participating Institutions

The following government institutions are the participating groups in the Central American Project for Geographic Information (known as PROCIG for its abbreviation in Spanish) for Costa Rica: the Ministry of Environment and Energy (MINAE, in Spanish), the Ministry of Agriculture and Livestock Farming (MAG, in Spanish), the National Institute of Census and Statistics (INEC, in Spanish), and the National Geographic Institute (IGN, in Spanish). A GIS Assistant was hired for the project by the International Center for Tropical Agriculture (CIAT, in Spanish) to assist in the analysis and work between the four participating institutions. Below is the contact information for the participants:

Ministry of Agriculture and Livestock Farming
Ministerio de Agricultura y Ganadería (MAG)
Participant: Rodolfo Méndez Chinchilla
Address: Ministerio de Agricultura y Ganadería
Dirección de Investigaciones
Departamento de Suelos y Evaluación de Tierras
Apdo. 10094-1000   San José, Costa Rica
Email: rmendez@ns.mag.go.cr
Tel: (506) 231-2344 ext.325 , 296-2586
Fax: (506) 232-7166

Ministry of Environment and Energy
Ministerio del Ambiente y Energía (MINAE)
National System of Conservation Areas
Sistema Nacional de Áreas de Conservación (SINAC)
Participant: Francisco Javier González Salas
Address: Sistema Nacional de Áreas de Conservación
250 metros Sur de la Casa Italia
Apdo. 10104-1000   San José, Costa Rica
Email: fgsalas@ns.minae.go.cr
Tel: (506) 283-8004 ext.130
Fax: (506) 283-7343

National Institute of Census and Statistics
Instituto Nacional de Estadísticas y Censos (INEC)
Participant: Roger Gutiérrez Moraga
Address: Área de Censos y Encuestas
Unidad de Cartografía
Edificio Rex, Avenida 4 Calle 0
Apdo. 10163-1000   San José, Costa Rica

Email: rogergm@costarricense.com , inecutsi@racsa.co.cr
Tel: (506) 258-0033 ext.336
Fax: (506) 223-0813

National Geographic Institute
Instituto Geográfico Nacional (IGN)
Participant (s): Carlos Elizondo , Marta E. Aguilar
Address: Departamento Cartográfico
Ministerio de Obras Públicas y Transporte
Apdo. 2272-1000   San José, Costa Rica
Email: celizondo@racsa.co.cr, maragui@racsa.co.cr
Tel: (506) 257-7798 ext.2632
Fax: (506) 257-5246

International Center for Tropical Agriculture
Centro Internacional de Agricultura Tropical (CIAT)
Participant: Margaret Vivian Buck
GIS Assistant
Email: maggie_buck@yahoo.com

2. Project Objective

The principal objective of the Central American Project for Geographic Information (PROCIG) is to promote the development of GIS as well as the exchange of geographical information and technical GIS skills between the participating institutions. MINAE, MAG and INEC all participated in the first reunion of PROCIG in 1999 and there they decided to develop a project where they could integrate their geographic information and work together to develop an analysis that would be valuable to decision-makers from each institution. The objective of the analysis would be to identify the pressures of human population growth and agriculture on the national protected areas system, according to each of the 11 Conservation Areas. Using GIS technology (ArcView from ESRI), the final analysis overlays and compares statistical data on demography and agriculture (using census data from 1984 and projections to 2000) with information on land cover, land use and protected areas to develop a model of existing and future pressures on the protected areas. During the first reunion, the participants also decided to hire a GIS assistant (through CIAT) who could work in each of the three institutions between the months of July and October of 2000. The final products of the study are a CD with the final analysis document as well as digital maps and an informational poster on the project to be distributed to the other ministries of the government as well as various NGO's (the final document analysis and the digital maps are available on the PROCIG website – http://www.procig.org).

The National Geographic Institute (IGN) became actively involved in the PROCIG effort in November of 2000. For the months of November and December of 2000, the IGN participants, along with the GIS project assistant, developed a characterization survey for the development of a National Geo-Spatial Data Infrastructure and interviewed 21 institutions in Costa Rica that develop and manage geographic information. These 21 institutions were chosen to take part in the survey because they are known at a national level for their work in GIS (even though the scale of their geographic analyses could be

smaller). In the majority of the institutions, the interview and survey were performed within the GIS labs or departments, or in the areas of information systems. Once the surveys were all gathered, the participants wrote an analysis of the results, which are available as well on the PROCIG website. This survey is seen as the first phase in an assessment of GIS in Costa Rica and IGN plans to continue with a more extensive survey that will aid in the development of NSDI.

3. Summary of Results from Population and Agriculture Analysis

Human Population Growth and Environment

Approximately 25 % of the total land area of Costa Rica (51,100 km²) is under management protection and classified as protected area land (Management classes include: National Parks, Biological Reserves, and Wildlife Refuges, among others). Politically, Costa Rica is divided into 7 provinces, 81 cantons, and 463 districts.

The total population of the country is close to 4 million inhabitants (Census 2000), which implies a general population of 74.4 inhabitants per square kilometer, of which approximately 26% live in the Greater Metropolitan Area of San José, which consists of the capital city of San José and the capitals of the three principal provinces (San José, Heredia, and Alajuela) and which are located in the Conservation Areas of the Central Volcanic Range (Área de Conservación Cordillera Volcánica Central) and of the Central Pacific (Área de Conservación Pacifico Central). The population projection for 2010, calculated as part of the analysis reveals a significant growth in the Conservation Areas of Tortuguero, La Amistad Caribe and Tempisque which could bring additional pressure to the protected areas in those regions.

The demographic growth between 1984 and 2000 is estimated at 63% (3.95% annually). As part of the population analysis, the project also examined statistics on male and female population distribution, as well as the youth population distribution (for youth under 20 years of age). Once analyzed using GIS, for example, a concentration of the youth population could be observed in the border areas of Costa Rica (especially the northern border which is perhaps an example of the migrating Nicaraguan population). For 1984, the average illiteracy rate was estimated at around 7%, with highest illiteracy rates in the border region with Nicaragua (22-34%) and the lowest being in the Greater Metropolitan Area of San José.

Agricultural Pressures and Land Use/Land Cover Changes

The largest concentration of cultivated land in Costa Rica in 1984 was located in the Conservation Areas of Arenal Huetar Norte, Guanacaste and Tempisque. The border region with Panama had the lowest percentage of cultivated land at that time, mostly due to the presence of the mountain range which includes Cerro Chirripo, the highest peak in Costa Rica at 3,800 meters.   It is interesting to compare the human population concentration and the % of cultivated land per district and see where there is evidence in 1984 of the agricultural activities surrounding the large banana and palm oil plantations in the country.

In Costa Rica, there are approximately 700 small, often communal, government-owned farms, known as asentamientos campesinos, administered by the Institute for Agrarian Development (Instituto de Desarrollo Agrario – IDA), the majority of which are located in the Conservation Areas of Arenal Huetar Norte and La Amistad Pacífico.

In terms of land cover study, the analysis notes a high concentration of primary forest cover still remaining within the boundaries of the protected areas, but also reveals a high level of forest fragmentation throughout the country during the course of the 1990's.

Tourism and the Protected Areas

Approximately every 6 out of 10 visitors to Costa Rica come for its natural beauty and high level of biodiversity. Of the over 140 existing protected areas, only a portion receive visitors or have the infrastructure for visitation. The most popular among tourists are the National Parks of the Poás Volcano, the Irazú Volcano and Manuel Antonio, the first two perhaps related to their close proximity to the Greater Metropolitan Area of San José. Another example of the growing tourism pressure associated with protected areas is in the case of the Monteverde Biological Reserve, an area which in the 1990's had approximately 10 hotels for tourism and today there are over 40, and growing.

Deforestation and Protected Areas

Analyzing the changes in land use between 1979 and 1992 in relation to the protected areas system, it is clear that the majority of loss of forest cover occurred outside of the limits of the protected areas and that the principal forest blocks that remained were located within the boundaries of these areas, an additional indicator of the importance of these areas in forest conservation. The two conservation areas with the most forest cover in 1992 were the areas of La Amistad Caribe and Tempisque. In the conservation area Osa, more than 80% of the existing forest cover in 1992 was located within the limits of the protected areas.

Land Use and Soil Capacity

Even though the soil capacity class 9 is classified as having a soil capacity suitable only for protection, only 75% of the total area of class 9 is located within the protected areas system. The Ministry of the Environment, through a program called Environmental Service Projects (PSA- Proyecto Servicios Ambientales), to aid in protecting the soils that were in danger of overuse, established tools and incentives to regulate economic activities within forest reserves, protected zones and wildlife reserves.

Accessibility to the Protected Areas

In an effort to determine the population distribution at a resolution finer than the district level, and using information from satellite images, road networks, population centers and digital elevation models, the project was able to determine that approximately 22 of the protected areas have a high value of accessibility and that at least half of these are located in the conservation area Cordillera Volcánica Central. Low levels of accessibility were encountered in the conservation areas of Osa, La Amistad Caribe, Tortuguero and Arenal Huetar Norte.

4. Future Plans for the Project

For the analysis done by the Ministry of the Environment, the Ministry of Agriculture, and the National Statistics and Census Institute, a primary objective for the future is the development of metadata for the coverages and maps generated for the project, including the original coverages existing in each institution as well as those which were obtained from other sources. For the months June-August of 2001, these three institutions, along with the PROCIG participant Margaret Buck, have developed a metadata pilot project, with the objective of developing geographic data inventories and metadata for each institution, as well as publishing that information on the institutional websites and registering the metadata with a Clearinghouse Node of the FGDC Gateway.

All of the maps and digital coverages from the project will remain in each institution and the three representatives will be in charge of maintaining and distributing the information. From the positive experience of working together in this analysis, the group can see how several possibilities exist for further work in the future and would like to continue with projects that encourage the interchange of information and collaborative efforts between the institutions. Also, in terms of the analysis done on population and agricultural pressures on the protected areas, the group would like to integrate the data from the just completed Population and Dwelling Census of 2000 as well as the next Agricultural Census (scheduled for 2002). From the success of this inter-institutional study and the presentation at the 2nd PROCIG reunion in Cartagena in May of 2001, the entire PROCIG group discussed doing a similar study at a regional level (including all of Central America).

The National Geographic Institute is planning to proceed to the second phase of their study and do a survey of more institutions at the national level. Along with the other three institutions, and with collaborative efforts with the pilot metadata project, the IGN is planning a national symposium for the end of July 2001 to discuss a National Spatial Data Infrastructure and to form a national committee for NSDI.

GUATEMALA

SUMMARY

The Guatemalans are developing dynamic mapping capabilities for the Internet. PROCIG is supporting this activity to give added value to the larger effort of the Guatemalan government to build the National Geographic Information System (SNIG is the Spanish initials). SNIG is an inter-agency governmental project to develop and make available digital base maps for sustainable development in Guatemala. The project is led by the National Geographic Institute (IGN) and the Guatemalan Planning Secretariat (SEGEPLAN), and includes 16 government organizations in Guatemala. SNIG project partners formed committees to address administrative, logistical, technical, commercial and training issues related to geographic information. The SNIG project is developing data, metadata, policies and procedures, geographic information standards, and other components of spatial data infrastructures. PROCIG indirectly supports this work through participation of IGN as a project partner. Our direct support aids the development of dynamic mapping capabilities for the SNIG and IGN web sites.

PROCIG is funding two courses to be taken by IGN professionals in web server maintenance and web page creation using FrontPage software. The training will build capacity in IGN to develop their web pages and manage web servers for optimal use. During the second half of 2001, IGN will receive practical training in Guatemala from CIAT IT and GIS professionals. We will examine different possibilities for serving dynamic maps on the Internet. The maps should be more than static GIF or JPEG images. Users should be able to query the map data and look at tabular information for map features. They will have the ability to zoom in and out on the map graphic. They need to be able to find background information or metadata, which includes information on original map development, data quality and error levels, spatial referencing information and distribution and access constraints. The training will be practical in the sense that IGN professionals will learn about dynamic Internet mapping as they put together the web site.

SUMMARY SNIG
NATIONAL GEOGRAPHIC INFORMATION SYSTEM
Prepared by IGN-Guatemala

Background

Geographic information related to social, economic and biophysical characteristics at national, regional, departmental, municipal y village levels is in great demand for guiding public investments.

Due to this demand, the national Coordinating Commission of the Information System for Geographic Modernization (CCMSIG) was formed as an initiative of the Presidency to strengthen, modernize and standardize geographic information systems of Guatemala. The commission included delegates from the office of the Presidency, the Geographic Military Institute (IGM – today the National Geographic Institute), the Planning and Programming Secretariat of the Presidency, Agency for International Development (AID)

consultants, the World Bank, the Property Registry, the National Statistics Institute, the Ministry of Defense and other advisors.

The objectives of the commission at that time consisted of efforts promote common work plans, concept and technical specification, and included:

- Promoting inter-institutional integration
- Elaborating standards and guidelines for generating geographic information
- Providing basic guidelines for developing the national property registry
- Seeking international support

The national property registry formed part of the Peace Accords that were signed at the end of 1996.

In 1998, the commission saw the first results of requests for international cooperation (Canada, Switzerland, France, Japan) to modernize the National Geographic Information System. Through Canadian cooperation, 1:50,000 scale maps in image format were developed with the software Softmap. With support of the French government, 22 map sheets were digitized and structured in a GIS as part of the PAABANC project. The Swiss supported training, technical assistance, and specialize technical advice. Mexico, through specialized personnel from INEGI gave advice on new GIS and digital technologies. The Japanese cooperation project is still in the planning stages.

Through support of the Office of the Presidency for Modernization of the State, and the Ministry of Food, Agriculture and Livestock, multiple requests and visits to different countries were made between 1996 and 1998. Information was acquired on methodologies, technical specifications and other element for implementing SNIG.

In May 1999, institutional cooperation was initiated, and the INTER-INSTITUTIONAL SUPPORT UNIT FOR DEVELOPMENT OF THE NATIONAL GEOGRAPHIC INFORMATION SYSTEM DATABASE was formed. The unit is nothing more than a coordinated and organized group of institutions in charge of promoting and organizing the use of Geographic Information Systems at the national level, as well as defining and applying cartographic and technical standards.

The National Geographic Information System is being coordinated by the National Geographic Institute (IGN) and The Planning and Programming Secretariat of the Presidency (SEGEPLAN), with the active participation of:

- Legal Technical Unit (UTJ/PROTIERRA)
- Geographical Military Department (DGM)
- University of the Valley of Guatemala (UVG)
- Ministry of Energy and Mines (MEM)
- National Environmental Commission (CONAMA)
- Ministry of Education (MINEDUC)
- National Statistics Institute (INE)
- National Forest Institute (INAB)
- National Protected Areas Council (CONAP)
- Ministry of Food, Agriculture and Livestock (MAGA)
- National Institution of Seismology, Volcanology, Meteorology and Hydrology (INSIVUMEH)

- Latin American Social Science Faculty (FLACSO)
- Social Investment Fund (FIS)
- Guatemalan Tourism Institute (INGUAT)
- Agronomy Faculty of the University of San Carlos (FAUSAC)
- Strategic Issues Secretariat of the Totonicapan Development Project (PRODETOTO)

To complete the SNIG strategic plan, 5 committees made up of personnel from participating institutions have been formed:

- Administrative Commission: in charge of coordinating the SNIG as well as seeking financial resources for project sustainability.
- Technical Commission: in charge of defining and applying technical standards and regulations.
- Promotion Commission: in charge of promoting and advertising the benefits of SNIG, as well as implementing mechanisms for selling SNIG products.
- Operations Commission: in charge of identifying resources and necessities of SNIG, as well as formulating strategies, planes and projects for SNIG implementation.
- Training Commission: in charge of identifying, formulating, and executing training plans

Mission

The SNIG is the official and permanent system that facilitates integrated geographic information of Guatemala. The information is reliable, accurate, up-to-date and of high quality. The information, generated by different sectors producing information in accordance with their own missions, is for interested individuals and institutions at national and international levels.

2006 VISION

The SNIG is formed as a mechanism for providing reliable, accurate, and up-to-date information. It holds the necessary infrastructure, human and financial resources to guarantee high standards of quality.
As such, the system integrates all geographic data providers and permits information updates. It promotes development of high-priority data for planning and sustainable development of the country.

COMPONENTS OF SNIG:

What is to be gained?

- Shared geographic and statistical databases, with reliable, accurate, high quality data and metadata.
- An Infrastructure for exchange, support and flow of data necessary for decision-making
- Strengthening institutional capacity in decision-making, evaluation and monitoring.
- Tools for analyzing development policies and efficient distribution of financial resources.
- Mechanisms for analyzing institutions and exchanging and integrating information.

Completed Activities
- National Geographic Database Structure completed at two levels (1:50:000, 1:250:000)
- Initiation and continuatio of PAABANC databasse (1:50,000 scale)
- Completion of SUNIL database (1:50,000 scale)
- Strategic plan and logical framework of SNIG
- Mitch Clearinghouse Project Development
- SNIG Strategic Plan and Logical Framework Evaluation

Future Activities
- Application integration; these will be generated by institutions that form part of the Inter-institutional unit, using cartographic base information developed by IGN
- Information updates
- Inter-institutional coordination for the generation of geographic information and the possibility for exchanging information

- Inter-institutional coordination for the generation of geographic information and the possibility for exchanging information
- Modernize the National Geographic Institute to obtain, maintain, update and administer the geographic information base of the country

Results Produced for SNIG
- PAABANC Database: base map at 1:50,000 scale, 30 of the 259 topographic sheets have been digitized.
- SUNIL Database: 1:250,000 base map completed
- Thematic series: life zones, geology, physiography, soil series, land use, land capacity, land use intensity, among others; to be completed at the 1:250,000 scale using the SUNIL base
- Hazards map, vulnerability and risk at 1:250,000 scale, using SUNIL base map
- Forest cover map, with SUNIL base
- Poverty map, with SUNIL base

EL SALVADOR

EL SALVADOR
NATIONAL SPATIAL DATA INFRASTRUCTURE (NSDI)
Prepared by IGN, VMVDU and MARN

Background.

The idea to implement an NSDI in El Salvador gained force through the participation of the IGN and the Ministry of the Environment in the February 2000 workshop that formed the Permanent Committee on Spatial Data Infrastructures in the Americas (CP-IDEA). In November 2000 the directors of the CNR, MARN and VMVDU called a meeting of high government officials from institutions that produce geographic information to form a committee that would be in charge of creating the NSDI.

In March 2001, the first symposium to establish the NSDI was held. The participating institutions were:
United States Geological Survey (USGS)
National Imaging and Mapping Agency (NIMA)
Agency for International Development (AID)
International Center for Tropical Agriculture (CIAT)

This event was organized by: the National Registry Center (CNR), Viceministry of Housing, Ministry of the Environment and Natural Resources, and included the following institutions:

Armed Forces of El Salvador, General Directorate of Statistics and Census (DIGYSTIC), Directorate of Agricultural Economics, SETEFE, National Civil Police, Technical Secretariat of the Presidency, Planning Office of the AMSS, Ministry of Agriculture and Livestock, Geotechnical Research Center, Directorate of Renewable Resources.

Principal themes of the symposium. The most important themes covered included:

a---- Technical Obstacles of the NSDI Proposal:
- IGN should define a standard platform for different applications
- Standardized coding of base cartography
- Defining a strategy for acquiring base cartography
- Pricing policies
- Information access and distribution policies
- Development of a coding inventory for thematic and base maps
- Creating an update strategy
- Permanent training programs
-

b--- Needs with respect to the legal framework of the NSDI and access policies. Suggestions for the structure of the NSDI committee and strategies for its implementation. Proposal :
- Create a an executive decree for ordering and facilitating the exchange of free geographic information, when its use is for the public good. This decree will be submitted to the Council of Ministers for approval.

- Formalize a spatial data infrastructure committee, composed of all the public institutions working on issues related to this theme.
- Develop institutional policies for the establishment and exchange of geographic information.
- Define a national pricing policy for data access and reform current pricing policy for particular geographic information products, as well establish a legal mechanism for the donation of these products to institutions that make up the NSDI committee.
- Within legal frameworks, it is necessary to promote reform of the intellectual property law to adapt it to the management and use of digital information.

Strategies for sustainability of NSDI activities

Proposal.
- Assign a general coordinator for the entire project
- Develop a national work plan
- Search for funding (Government, International Organizations)
- Develop process for elaborating an executive decree y later a legislative initiative
- Designate full-time personnel – publicity campaigns – integration of efforts
- Search for improved information transfer mechanisms, that improve quality and frequency of exchange
- Monitoring and evaluation systems for programs and planning
- Training and technology transfer between institutions
- Attention to emergencies

What do we want from the NSDI?

- Organize and take advantage of geographic information resources in the country
- Involve all the institutions that work in the production of geographic information

With respect to impact, we expect:

- To contribute to economic, social and political development of the country
- To improve capacity to respond natural disasters
- To promote the use and production of geographic information
- To standardize the information products from each institution

Requirements

- Resources for developing implementation activities (financial, human)
- Standardization of databases
- Training in the application of standards
- Definition of information exchange and access policies
- Financing for the generation of data
- Adequate accessibility to electronic communication and networks

Current Strengths

- Political will
- Good coordination at the technical level
- Updated technological base
- International support

Existing problems. Clear differences exist as a result of working with different technical specifications, scales, datums, and other elements.

CLEARINGHOUSE

What is a clearinghouse? We will respond to this question from different angles. From the institutional point of view, it is the infrastructure to find out who has information. From the technical point of view, it is the combination of telecommunication services for providing access to information. METADATA. The following institutions are participating in the creation of geographic information metadata:

- Ministry of the Environment
- National Registry/IGN
- Vice-ministry of Housing and Urban Development
- San Salvador Metropolitan Area Planning Office
- General Directorate of Agricultural Economics

Hardware, software and training support has been acquired from:

- United States Geological Survey (USGS), with financing from the Agency for International Development (AID)
- Panamerican Institute of Geography and History (IPGH)

At present, a map server was donated by USGS and is housed at CNR/IGN. The Internet address is: http://clearinghouse.cnr.gob.sv/metadatos/index.com.

GEOGRAPHIC INFORMATION SYSTEMS (GIS)

At present, the 1:250,000 base map is being developed. After field verification, it will be linked to tabular databases. We will look for results in terms of potential for decision-making.

What do we want from GIS? Basically, we are looking for:

- A tool for manipulating information using digital maps and relational databases in user-friendly environments
- Reliable information

- A resource for studies carried out by scientists, professionals and the general public at all levels

What is the impact? Holding these types of digital maps with relational databases, we will provide
useful information for improving the capacity to carry out diverse studies (geological, social, etc) on different themes. We will improve the capacity of the authorities to make decisions in the economic, social and political sectors.

HONDURAS

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PROJECT SUMMARY
Central American Geographic Information Project
HONDURAS

</div>

1. Participating Institutions

At the beginning of the Central American Project for Geographic Information (PROCIG, for its abbreviation in Spanish), the following institutions were involved:

- Area of Territorial Planning (Área de Ordenamiento Territorial) of the Secretariat of Natural Resources and Environment (SERNA, in Spanish)
- Department of Planning and Evaluation of Development (Unidad de Planeamiento y Evaluación de Gestión) of the Secretariat of Agriculture and Livestock Farming (SAG, in Spanish)
- General Direction of Statistics and Census (Dirección General de Estadísticas y Censos)

After some changes in government (the General Direction of Statistics and Census was terminated in June of 2000 and in January of 2001, the Republic of Honduras established the new National Statistics Institute (INE, in Spanish)), also because of personnel changes within institutions, the Project at this time involves the following participants and institutions:

Secretariat of Natural Resources and Environment
Secretaria de Recursos Naturales y Ambiente (SERNA)
National System of Environmental Information
Sistema Nacional de Información Ambiental (SINIA)
Participants: Jorge A. Cueva (National Coordinator SINIA/SERNA)
Edgardo Romero (Systems Operator, SINIA/SERNA)
Address: 100 metros al sur del Estadio Nacional
Tegucigalpa, M.D.C.
5625 Honduras
Tel: (504) 232-2011
Fax: (504) 232-6250
Email: jcueva@unete.com , ansacromero@yahoo.com

Secretaria of Agriculture and Livestock Farming
Secretaría de Agricultura y Ganadería (SAG)
Department of Planning and Evaluation of Development
Unidad de Planeamiento y Evaluación de Gestión (UPEG)
Participant: Jorge Amaya (Technician, UPEG/SAG)
Address: Avenida de la FAO
Boulevard Miraflores
Tegucigalpa, M.D.C.
5625 Honduras
Tel: (504) 232-9232 , (504) 232-4105
Fax: (504) 231-0051
Email: upeg@sdnhon.org.hn

National Statistics Institute
Instituto Nacional de Estadísticas (INE)
Participants: Antonio Rene Soler Orellana (Executive Sub-Director)
José Francisco Calix Ramirez (Director, Dept. of Technology and Information)
Address: Col. Florencia Sur, Edificio Gómez
Boulevard Suyapa
Tegucigalpa, M.D.C.
Apartado Postal: 9412 Honduras
Tel: (504) 239-8612 , (504) 239-8768
Email: rene.soler@ine.online.hn , francisco.calix@ine.online.hn

National Geographic Institute
Instituto Geográfico Nacional (IGN)
Participants: Dr. Noe Portillo Pineda (Executive Director)
Lic. Reina Portillo (GIS Department Director)
Address: Barrio La Bolsa
Tegucigalpa – Comayagüela, M.D.C.
20706   Honduras
Tel: (504) 225-2759
Fax: (504) 225-4789
Email: ign@sdnhon.org.hn

PROCIG – CIAT
International Center for Tropical Agriculture
Centro Internacional de Agricultura Tropical
Participant: Margaret V. Buck
Project Assistant
Email: maggie_buck@yahoo.com

2. Project Objective

The principal objective of the PROCIG project is to promote and development and interchange of geographic information between the participating institutions. At first, the PROCIG Honduras participants decided to work on a project aimed at publishing the digital Atlas of Honduras (created by SERNA) in the Internet with interactive mapping functions. However, with the changes in personnel and institutions, there was very little progress made in this original objective (for the most part, during the year 2000). Therefore, in January of 2001, the participants changed the objective and also decided to incorporate the work of a project assistant (provided by CIAT) to help in the project's development within each institution.

Currently, the aim of PROCIG Honduras is to create an inventory of the geographic information existing in each participating institution, develop metadata files for each coverage, map, or table (that can be georeferenced) in that inventory, and place the inventory and the metadata files online, as a Clearinghouse Node of geographic information. Included as part of the project is capacity building and instruction in GIS and in the development of metadata records for the participants in each institution.

3. Current Project Status

SINIA – SERNA

The Secretaria of Natural Resources and Environment has two departments where GIS and other mapping work is being done: the Area of Territorial Planning (AOT) and the National System of Environmental Information (SINIA). Within SINIA, the project participants and the Project Assistant assembled an inventory of geographic information existing in SERNA and developed metadata records (using the MetaLite program) of each map in that inventory (at this time, there are 36 map records in the inventory). The project is currently in the process of designing the Web page of Geographic Information (using the program Macromedia Dreamweaver 4) in order to publish the inventory and metadata records in the website of SERNA/SINIA, as well as to then register them in a Clearinghouse Node. Even though neither SINIA or SERNA have a their published websites active in the Internet, the idea is that once the connection exists, SINIA will manage the Clearinghouse Node through its server.

UPEG – SAG

The Secretariat of Agriculture and Livestock Farming (SAG, in Spanish), through their Department of Planning and Evaluation of Development (UPEG) has as its principal objective the recollection and systemization of databases and geospatial data generated by the different projects within SAG, and to provide that data for use by the decisionmakers, scientists and technicians of the agricultural sector and the general public. Even though SAG documents itself as having this primary goal, as of yet no Geographic Information Center exists in the Secretariat. GIS (Geographic Information Systems) are relatively new to SAG and before the arrival of this technology, there was not a center of Cartography where mapping of the agricultural sector as focused. In fact SAG administers many individual projects (with national and international funds) which have various objectives – sustainable rural development, land administration and titlement, aid to small and medium campesino farmers, and micro-businesses for women, among others. In the year 2001, there are over 63 active projects in SAG. The project participant from UPEG/SAG and the project assistant identified ten projects and programs which manage GIS and/or geographic information (including tabular databases which can be georeferenced):

- PAAR – Proyecto Administración de Areas Rurales (Administration of Rural Areas)
- PROLANCHO – Programa de Apoyo a los Pequeños y Medianos Campesinos de la Zona Olancho – Aid Program to Small and Medium Campesino Farmer from the Zone of Olancho
- Proyecto Guayape – Proyecto de Desarrollo Agrícola del Valle del Guayape – Agricultural Development Project of the Guayape Valley
- PROSOC – Proyecto de Desarrollo Rural en el Sur de Occidente – Rural Development Project in the South-western part of Honduras
- Plan Trifinio – Comisión Trinacional del Plan Trifinio – Tri-National Commission of Plan Trifinio

- PRONADERS – Programa Nacional de Desarrollo Sostenible – National Sustainable Development Program
- DICTA – Dirección de Ciencia y Tecnología Agrícola – Direction of Agricultural Science and Technology
- UPEG – Unidad de Planeamiento y Evaluación de Gestión - Department of Planning and Evaluation of Development

After making visits and communicating with these projects and the GIS technicians within each, the present work of the project in SAG includes the completion of the geographical inventory as well as the completion of the metadata records. The coordination and collection of information took a substantial amount of the project time, and so the design of the website for geographic information is still not complete. The project was able to pull together an important meeting of the decisionmakers and GIS technicians from three main entities in SAG (UPEG, DICTA and PRONADERS) to present its results as well as to discuss the status of GIS and metadata in SAG and how to form a working group to address the problems of communication and coordination of projects within the institution.

INE

Since the National Statistics Institute began its work in January of 2001, the participants were not able to participate actively in PROCIG until the middle of April of 2001. At this time, the participants and the project assistant began with a series of instruction sessions in ArcView GIS and MetaLite. Currently, the participants are in the process of assembling an inventory of INE's geographic information, the majority of which is located within their Cartography department in paper format. Similar to the situation in SAG, the use of GIS is relatively new for INE y the Institute has as an objective the transfer of its existing geographic information to digital format and to work in GIS to incorporate in the Census data in thematic mapping analyses.

4. Future Work in the Project

Once the participating institutions have their completed inventories, metadata records and designed Web pages, the information will be published in the Internet and managed by the server in SINIA/SERNA. The metadata technicians from each institution will update the metadata records and the website information periodically (between 30 days and 3 months, depending on the pace of work within each institution). In addition, it is the goal of the project that the metadata contacts from each institution meet every 1-2 months to discuss the development of metadata, capacity building in metadata and GIS, the development of national standards for geographic information, and other topics – all of which involve the formation of a National Spatial Data Infrastructure for Honduras (NSDI).

NICARAGUA

GEOGRAPHIC INFORMATION IN NICARAGUA
Prepared by INETER, MAGFOR, INEC and MARENA

- Information Systems in Nicaragua
- History of GIS in Nicaragua
- GIS Applications in Nicaragua

Geographic Information Systems in Nicaragua Current State. A National Spatial Data Infrastructure has not yet been established in Nicaragua. However, institutional and legal conditions suggest that soon the NSDI will be established. The most outstanding aspects that contribute to NSDI development include"

1 – Institutional and legal goals reached. The Land Use Planning policy established the following guidelines on this theme:

a. As a basic contribution, study and research on the national territory, in all its aspects at regional, departmental, municipal and urban levels.
b. Development and Maintenance of Geographic Information Systems in function of Land Use Planning y the mitigation and prevention of natural disasters.

2 – Organic Law of INETER. This is an important legal instrument for the creation of GIS and basic information management for the country. The most significant aspects of this law include:

a. Development of the National System of Digital Cartography
b. Promotion and coordination of multi-sector relations and GIS technology
c. Maintenance of the National Catastral System
d. Use of GIS in the management of meteorological, hydrological, natural disaster nad land use planning information.

GIS Problems. We want to emphasize some difficulties that we have had in the management of basic information and GIS.

a. There has been little inter-institutional coordination
b. Difficulty in accessing data
c. Private sector consulting firms want free data
d. The institutions exercise too much control over their own data due to the commercialization of that same data by users for their own benefit.
e. Local governments have poor access to information managed by government institutions.
f. There is a tendency to us GIS to make pretty maps, without taking advantage of the full possibilities for analysis

3 – Other goals reached.

a. Establishment of GIS for vulnerability analysis in areas affected by Hurricane Mitch. INETER with BID funds.
b. Catastral modernization project. World Bank.

c. National Cartography Relational Data Base. INETER Management Project to standardize base data and reduce database preparation costs.

History of GIS in Nicaragua

1990 – First GIS (ILWIS) in INETER and MARENA
1992 – Municipal and Electoral Mapping (Microstation)
1993 – SPOT Imagery – MARENA – Forestry Project
1995 – MAGFOR Information System
1996 – First workshop of GIS units – Diagnostic survey on GIS
1998 – First National Workshop of Geomatica
2000 – Organization of National Environmental Information System
2001- Organization of Agricultural and Forestry Information System

GIS Applications in Nicaragua

- Natural Resources Biodiversity (MARENA)
- Environmental Quality (MARENA)
- Agriculture (MAGFOR)
- Forestry (MAGFOR)
- Electoral Cartography (CSE)
- National Census (INEC)
- Mining Concessions (MIFIC)
- Infrastructure (MTI, Energy, Waster, Army, Finance)
- Natural Disasters (INETER, SNPMDS)
- Local Development (INIFOM-SIM)
- Official Cartography, Base Maps (INETER)
- University (UCA, UNA, UNI, UNAM)
- Private Consulting Firms

METADATA IN NICARAGUA

Nicaragua Metadata Project

IABIN-PNUMA Project – An effort was made to contact those agencies that produce and use biodiversity data and encourage them generate metadata. The project included training and installation of a web server with more than 100 metadata records. MARENA, MAGFOR, Universities and NGO's participated in the project, as well as agencies from Guatemala, Honduras, El Salvador and Nicaragua.

MITCH CLEARINGHOUSE Project (USGS-USAID). This project came about in response to the heavy impact of Hurricane Mitch in October 1998. The disaster showed decision-makers and users in general the lack of integrated information related to natural disasters, in particular geographic information in manageable formats. This system will provide access to existing data of the national participating organizations: MARENA,

INETER, MAGFOR, ALISTAR. This project will implement clearinghouse nodes in El Salvador, Honduras, Nicaragua and Guatemala.

PROCIG PROJECT
CONCLUSIONS OF THE NICARAGUA GROUP

1 – NSDI initiatives in Nicaragua are not structured under a government policy. Nevertheless these efforts have been developed with success and today there is a good foundation of data at the national level (INETER, MAGFOR, MARENA, INEC, MIFIC, SAS)

2 – The lack of inter-institutional coordination to data has prevented work efficiency. However, projects such as PROCIG, Mitch Clearinghouse, CIAT-Hillsides, Food Security Project, SIA, SINIA show signals of change in attitude with respect to inter-institutional collaboration.

3 – PROCIG has contributed to the improvement of technical capacity en each country. However, a more important acheivement has been to raise regional awareness of National Spatial Data Infrastructures (NSDI)

4 – PROCIG should not end, but rather continue to develop in the future.

PANAMA

**SUMMARY
SECOND SEMINAR/WORKSHOP
NATIONAL SPATIAL DATA INFRASTRUCTURE: CLEARINGHOUSE AND
METADATA TECHNOLOGIES**

Prepared by IGN, Contraloría, SENACYT and ANAM

- **General Information**

Date: March 14 – 16, 2001
Organizers: SENACYT, IGNTG
Address : Edificio 213 de la Antigua Base de Clayton
Tel. (507) 317 0014 to (507) 317 0020
Fax: (507) 317 0023 and (507) 317 0024
Apartado postal 7250, Zona 5, Panamá
Email: senacyt@senacyt.gob.pa
Collaborators: International Center for Tropical Agriculture (CAIT), United States Geological Survey (USGS), Central American Geographic Information Project (PROCIG). Trainer: Diego Pedreros – USGS/EROS Data Center

- **Development of the Activity**

It is important to note that the act of inauguration of the Second Workshop Seminar on Spatial Data Infrastructure: Clearinghouse and Metadata Technologies, was lead by the National Secretary of SENACYT, Dr. Gonzalo Córdoba and by the Director of the National Geographical Institute Tommy Guardia, Ing. Denis Fuentes.

The capacity building event included the participation of 13 government institutions and 2 universities.

To begin the Seminar, the trainer presented basic Metadata and Clearinghouse concepts, explained how these fit in within the overall framework for National Spatial Data Infrastructure (NSDI), and stressed their importance at both local and regional levels.

Next, the trainer reviewed in depth the content of the Standards Manual from the workbook for Digital Geoespacial Metadata. Ten sections were presented, as follows:

- Identification de Information
- Quality of Information
- Quality of Spatial Organization of Information
- Spatial Reference of Information
- Entities and Attributes of Information
- Distribution of Information
- Metadata of Information
- Source of Information
- Time and Period la Information
- Contact Information

Then, the content and graphs of each section of the Manual were described in detail.

During the second day, two evaluation mechanisms were applied : the first searches the possible information contained in the metadata record, the specific number, and each section found in the manual. The second mechanism works inversely; it identifies the section and corresponding specific number to a specific Program (software) to generate Metadata.

This same day, the Metalite program was installed onto computers and participants proceeded to create a file and develop a metadata record.

During the third day, there was a presentation on the Utilization of Geographical Information Systems and Global Positioning Systems for studying Pre-Columbian Accession Underneath the Villa River - Peninsula of Azuero Peninsula, by Archeologist Isaza Aizpurúa, Ph.D. candidate, Archaeology Department of Boston University, and Scholarship Recipient of SENACYT's 2003 Scholarship Program.

After this masterful presentation, the program followed up on activities from the previous day, running other software programs for creating metadata. Participants observed that Metalite was the most advanced for facilitating metadata development. The session on the third day ended with a collective exercise, in which questions related to the coruse were answered. After this exercise was completed, a written evaluation of the course was filled out, using a format supplied by the organizers of the event. (See attached results of the participant evaluation).

Closing words for the workshop were provided by the National Secretary of SENACYT, Dr. Gonzalo Córdoba.

Then, workshop certificates were presented to all participants. In conclusion to the preparation of this workshop report, we would like to present a list of topics that could be included in future training:

- Managing a GIS
- GIS System Design and Architecture
- Infrastructure Development for a Distributed GIS
- Definitation/Development of GIS base data
- Spatial Analysis with GIS
- Introduction to LIDAR: Theory, Tecnology, Tecniques and Applications
- Application of Remote Sensing in GIS
- Introduction to Digital Photogrammetry and its application in GIS
- Design and Implementation of Spatial Standards
- Administration of Geographic Databases and Relational Databases (RDBMS; Arc SDI; ORACLE; SQL Server)
- Introduction to Object-oriented Geographic Databases
- Tools and Techniques for sharing geographic information between institutions

- **Course Participants**

INSTITUTIÓN	NAME
1. MICI – Mineral Resources	Juan De Dios Villa
2. ACP	Carlos Contreras, Rogelio Paredes, Arizmendis Montoya
3. MEF – Cadastre	Irving Algandona
4. MINSA	Washington Lum, Alexis González
5. CONTRALORÍA	Víctor Coma
6. FIS	Osmín Pino
7. UTP	Mavis de De Sedas
8. UNIVERSIDAD DE PANAMÁ	Enrique Vargas
9. POLICIA NACIONAL	Jobanis A. Barrios
10. MIVI	Guisselle Araúz
11. MIDA – Agririan Reform	Vianka del Carmen Navarro Coronado
12. IDIAP	Carlos Ortiz
13. ARI	Alexander Ruíz
14. IGNTG	Javier Posam, Carlos Bazán, Neyra Herrera - Coordinadora
15. SENACYT	Alejandro James M., Gustavo Dowerds, Antonia de la Cruz - Coordinator
16. INDEPENDENT	Octavio E. Carrasquilla S.
Trainer	**Diego Pedreros**

TRAINING AND IMPLEMENTATION OF A METADATA CLEARINGHOUSE IN TOMMY GUARDIA
Ing. Denis Fuentes.

This project responds to the need and interest in Panama for providing access to geographic information. During a recent inter-institutional conference hosted by Instituto Geografico Nacional Tommy Guardia, January 16-17, 2001, there was a clear consensus among the participants to establish a Metadata Clearinghouse in Panama. Nineteen institutions attended the "First Seminar/Workshop on National Spatial Data Infrastructure: current state of GIS in Panama," sponsored by the Comite Technico Consultivo para Informacion Geografica (CTC).

Metadata provides a standardized inventory of existing geospatial data. It provides a potential end-user with sufficient information to ascertain whether a geospatial dataset is appropriate for his/her needs. Unfortunately, few institutions in Panama have begun documenting their data resources. Generally, data have been produced by many different organizations, in an uncoordinated way, and under heterogeneous specifications. Inconsistent data limits the possibilities for integrating and using it properly. Also, there is duplication of effort. Because metadata is lacking, users have difficulty finding out what data are already available.

A Clearinghouse is a distributed service to locate geospatial data based on the standardized characteristics provided in the metadata. A Clearinghouse allows one to pose a query, using dates, key words, place names, and/or geographic coordinates. In this way, a user can quickly determine what data are available. At the same time, a Clearinghouse helps:

- Minimize duplication of effort in spatial data collection and processing, and
- provide a means for a data producer to publicize the existence of its data resources.

IGN Tommy Guardia organized on behalf of the CTC a course on metadata and clearinghouse development. This course provided training in data inventory, documentation, searching, and delivery. It was conducted by a native Spanish-speaking trainer from United States Geological Survey/EROS Data Center (EDC) with materials developed by EDC and the U.S. Federal Geographic Data Committee (FGDC). The training emphasized upgraded Metalite, and reviewed how to use other metadata software, e.g., Corpsman and extensions in ArcInfo and ArcView. The course also included instruction in the establishment of a Clearinghouse. Following the workshop, IGN "Tommy Guardia" is developing an institutional metadata work plan that will result in a functional, registered metadata Clearinghouse.

This project represents the commitment of IGN Tommy Guardia to support capacity building and technology transfer in the areas of spatial data development, Metadata Clearinghouses, and information access and delivery. In recent years, Clearinghouses have been established in Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua. It is important that Panama, too, advances in this effort. Clearinghouses offer tremendous promise and opportunity for improved government efficiency, and for research, education, and commerce.

NEIGHBORHOOD SECTORIZATION OF PANAMA CITY
General Controllership of the Republic (Contraloría General de la República)

Between projects developed by the Office of Statistics and Census and by the General Controllership of the Republic is the installation of the National Geo-Statistical System. Within this framework, the Panama Century XXI project is advancing; its principal objective is to present census information generated by National Censuses (Population, Housing, Agricultural and Economic -each of which are being conducted this decade) in digital format and to display the geographical area from which the information originates. The geographical delimination of urban neighborhoods is one of the components of this project -- one that seeks to contribute to national development by providing to the state a tool that serves of guide for the development and implementation of public policies.

APPENDIX III

CARTAGENA ACT – AGREEMENTS OF THE NATIONAL GEOGRAPHIC INSTITUTES OF CENTRAL AMERICA

FIRST DECLARATION OF THE CD-IDEAC

In Cartagena de Indias, Colombia, on 25th May 2001, the signatories below, convened during the 5th Global Spatial Data Infrastructure (GSDI) Conference, the 8th International Steering Committee for Global Mapping (ISCGM) Meeting, the 3rd Permanent Committee on Spatial Data Infrastructure for the Americas (CP-IDEA) Meeting, and the 2nd Central American Geographic Information Project (PROCIG) Meeting, 18 to 25 May 2001, considering that:

- Within the framework of the XVIII Cartographic Week of Central America (SCAC), held in 2000 in San José, Costa Rica, with official delegates from all countries in the region, Resolution XIII of the Final Act was signed. It concerned the constitution of the Steering Committee for the Spatial Data Infrastructure for Central America (CD-IDEAC).

- During the 2nd PROCIG Project Meeting, this resolution was declared and the need for promoting and implementing a regional project for the development of the Spatial Data Infrastructure was determined.

- Participants from Central American countries attending these international meetings have expressed their interest in putting into action the resolution signed in Costa Rica in September 2000.

- In the 3rd CP-IDEA Meeting, the IDEA statutes were approved, the name "Geospatial Data Infrastructure for the Americas" incorporated, and the acronym IDEA kept because of the initial concept of the name. This change avoids the confusion that the term "spatial data" has caused in some countries.

- In this CP-IDEA meeting, the initiative of the Central American cartographic entities was declared. The implementation of the CD-IDEAC as the subregional entity for organizing and managing Geospatial Data Infrastructure for the Americas (IDEA) was unanimously approved.

WE AGREE

FIRST:
To appoint the CD-IDEAC, established in September 2000, as **"Steering Committee of Geospatial Data Infrastructure for Central America"**, keeping the acronym **"CD-IDEAC"**, and to encourage the use of relevant terms such as *"geospatial information"* or *"geospatial data"* in reference to the type of information or data that are part of established infrastructures at different levels.

SECOND:
To manage the establishment of **a specialized unit on Geospatial Data Infrastructure** within the signatories' institutions, with all possible technological facilities, and to designate at least one professional permanently in charge of monitoring planned activities, arrangements, policies, projects, proposals, agreements, or other initiatives at global, regional, national, or local level.

THIRD:
To encourage, as quickly as possible, the establishment of the respective **National Inter-institutional Commission** in those countries that have not yet begun the process, to promote the development of the **National Geospatial Data Infrastructure (INDE).** To involve as collaborators the participants and respective institutional authorities of the Central American Geographic Information Project (PROCIG) in each country.

FOURTH:
To initiate the necessary process for implementing, developing, and maintaining an **INDE Web page** in each country, with the participation of the diverse national entities involved in the different processes of geographic information systems (GIS). And to prepare the necessary bases for regional management for establishing the **IDEAC Web page** incorporating components of projects concerned with the Central American region and generating links to their Web pages. Examples are projects of the International Center for Tropical Agriculture (CIAT) in Colombia, the Tropical Agronomy Center for Research and Training (CATIE) in Costa Rica, and the Cartographic Week of Central America (SCAC), among others.

FIFTH:
By appropriate mechanisms, to present to the authorities of the Pan American Institute of Geography and History (IPGH), in its next XVII General Assembly, to be held in October 2001 in Bogotá, Colombia, a **proposal for establishing a Geospatial Data Infrastructure Committee within the Cartography Commission of IPGH**. Its objective is to promote the development of the respective management of the infrastructures, with technical and financial help and support for training, research, and technology transfer projects on this topic.

SIXTH:
To make, as soon as possible, all necessary effort to comply with the commitments made in September 2000 and revised at this date in Cartagena, Colombia. These will permit holding the **2nd CD-IDEAC Meeting** in the first semester of 2002 during the *4th CP-IDEA Meeting* in Venezuela or during the *XIX Cartographic Week of Central America (XIX SCAC 2002)* in Panama, to approve respective statutes, review agreements, define policies, and generate projects of interest to IDEAC.

SEVENTH:
To offer possible means or mechanisms in each country for establishing the sustainability and inter-institutional maintenance of the GIS network generated by the PROCIG project so as to benefit the entire region.

EIGHTH:
To make known to competent entities and the respective authorities at the national, regional, and international levels the resolution put forth at the 3rd CP-IDEA Meeting

regarding its acceptance of establishing the Geospatial Data Infrastructure for Central America (IDEAC). And to make known the agreements in this Act made by representative members of the Steering Committee of the signatory entities.

We endorse this Act as present members of CD-IDEAC, representatives during these meetings of the cartographic institutions of Central America,

BELICE

Ing. Noreen Fairweather
Principal Land Information Officer
Land Information Center

COSTA RICA

MSc. Carlos Elizondo Solís
Subdirector General
Instituto Geográfico Nacional

EL SALVADOR

Ing. Roberto López Meyer
Director General
Instituto Geográfico Nacional

GUATEMALA

Ing. Fernando Boiton Velásquez
Director General
Instituto Geográfico Nacional

HONDURAS

Dr. Noé Pineda Portilla
Director General
Instituto Geográfico Nacional

NICARAGUA

Ing. Luis Zúñiga Mendieta
Director General de
Ordenamiento Territorial -INETER

PANAMA

Ing. Denis Fuentes Montenegro
Director General
Instituto Geográfico Nacional

May 25th 2001, Cartagena de Indias, Colombia.

APPENDIX IV

Acronyms and Abbreviations Used

ANAM	*Autoridad Nacional del Ambiente* (National Environment Authority), Panama
CIAT	*Centro Internacional de Agricultura Tropical* (International Center for Tropical Agriculture), Cali, Colombia
CATIE	*Centro Agronómico Tropical de Investigación y Enseñanza* (Tropical Agronomy Center for Research and Training), Costa Rica
CD	compact disk
CD-IDEAC	*Comité Director para la Infraestructura de Datos Espaciales de América Central* (Directorate Committee for Spatial Data Infrastructure of Central America)
CGIAR	Consultative Group on International Agricultural Research
CNIG	*Centro Nacional de Información Geográfica* (National Geographic Information Center), Panama
CP-IDEA	*Comité Permanente para la Infraestructura de Datos Espaciales de las Américas* (Permanent Committee for Spatial Data Infrastructures for the Americas)
DGEA	*Dirección General de Economía Agropecuaria* (General Directorate of Agricultural Economy), El Salvador
DGEC	*Dirección General de Estadísticas y Censos* (General Directorate of Statistics and Census), Honduras
DIGESTYC	*Dirección General de Estadística y Censos* (General Directorate of Statistics and Census), El Salvador
EROS	Earth Resources Observing System
ESRI	Environmental Systems Research Institute, Redlands, California
FGDC	Federal Geographic Data Committee, USA
GIS	geographic information systems (SIG in Spanish)
GPS	global positioning system
GSDI5	Global Spatial Data Infrastructure 5th International Meeting, Cartagena, Colombia
ICT	information and communication technologies
IGAC	*Instituto Geografico Agustin Codazzi* (Agustín Codazzi Geographic Institute), Colombia
IGN	*Instituto Geográfico Nacional* (National Geographic Institute)
IMS	Internet Map Server of ESRI's ArcView
INDE	*Infraestructura Nacional de Datos Geoespaciales* (National Spatial Data Infrastructures)
INE	*Instituto Nacional de Estadística* (National Statistics Institute), Guatemala and Honduras
INEC	*Instituto Nacional de Estadísticas y Censos* (National Statistics and Census Institute), Costa Rica
INETER	*Instituto Nicaraguense de Estudios Territoriales* (Nicaraguan Institute of Territorial Studies)
*info*DEV	Information for Development Program of the World Bank
IPGH	*Instituto Panamericano de Geografía e Historia* (Panamerican Institute of Geography and History)
ISCGM	International Steering Committee for Global Map

ISDE	*Infrastructura Salvadoreña de Datos Espaciales* (Salvadoran Infrastructure of Spatial Data)
IT	Information Technology
MAG	*Ministerio de Agricultura y Ganadería* (Ministry of Agriculture and Livestock), Costa Rica
MARN	*Ministerio de Ambiente y Recursos Naturales* (Ministry of the Environment and Natural Resources), El Salvador
MINAE	*Ministerio de Ambiente y Energía* (Ministry of Environment and Energy), Costa Rica
NGOs	nongovernmental organizations
NSDI	National Spatial Data Infrastructures
PC-IDEA	Permanent Committee for Spatial Data Infrastructure for the Americas
PROCIG	*Proyecto Centroamericano de Información Geográfica* (Central American Geographic Information Project)
SAG	*Secretaria de Agricultura y Ganadería* (Agriculture and Livestock Secretariat), Honduras
SCAC	*Semana Cartográfica de América Central* (Central American Cartographic Week)
SDIs	spatial data infrastructures
SEGEPLAN	Planning and Programming Secretariat, Guatemala
SERNA	*Secretaria de Recursos Naturales y Ambiente* (Natural Resources and Environment Secretariat), Honduras
SICA	*Sistema de Integracion Centroamericana* (Central American Integration System)
SIG	*sistemas de información geográfica* (GIS in English)
SINAC	*Sistema Nacional de Areas de Conservación* (National Conservation Areas System), Costa Rica
SINIA	National Environmental Information System
SNIG	*Sistema Nacional de Información Geográfica* (National Geographic Information System), Guatemala
USAID	United States Agency for International Development, Washington
USGS	United States Geological Survey
VMVDU	*Vice Ministerio de Vivienda y Desarrollo Urbano* (Vice Ministry of Housing and Urban Development), El Salvador