

# The use of Geo-Information Systems for Sustainable Land Use Planning in Guyana

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## 1. Abstract

Guyana possesses a rich variety of natural resources, but needs to develop mechanisms and capacity to properly utilize and manage these resources. In addition, until recently there has been no formal systematic approach to land use planning in the country. There is currently an effort to implement land use planning, utilizing geo-information technology.

Five related land institutions in the country are participating in an integrated GIS effort aimed at producing a scientific database, which will be used as a decision-support tool. Technical training and capacity building are currently under way. Existing hard copy maps are being digitized to create successive layers of spatial information. In addition, the use of remote sensing imagery is being evaluated in a pilot exercise in one of the regions of the country. Remotely sensed data, properly ground truthed and supervised, will be integrated into the GIS. This spatial database will provide a basis for the development of land use options for the country.

## 2. Introduction

Most of Guyana's population lives along the 240 miles of Atlantic coast where most of the physical and social infrastructure development of the country exists. The remainder of the population lives and works in the hinterland, where the vast wealth of the country lies.

The hinterland has dense forest cover and rich deposits of gold and diamonds. There are large deposits of bauxite, and petroleum is also known to exist in several locations. There are many waterfalls in the hundreds of rivers with potential for hydroelectric power generation.

The hinterland is also rich in biodiversity. There are thousands of species of flora and fauna that exist in a pristine environment. This, together with the magnificent waterfalls and varied topography, tends itself to almost limitless eco-tourism potential.

With such vast resource potential and a spatial imbalance in development, there is need for land use planning.

## 3. The Initiation of Land Use Planning

Until very recently, a conscious effort to execute national land use planning in Guyana had never been undertaken. Concomitant with the absence of land use planning is the fact that many of Guyana's sister states in the Caribbean have been forging ahead in this area. Almost all Caribbean states are now engaged in land use planning, and many have in place modern information systems to support land use decisions.

With the upswing in the Guyanese economy in the last few years, and the concomitant increase in natural resource utilization and agriculture, several problems arose that caused land use planning

to be treated as a matter of urgency. There has been evidence of illegal and unregulated mining and forestry activity in the hinterland. This in turn has led to indiscriminate patterns of utilization of the land and land degradation.

At the same time, a linkage has been established between land use planning and national development. Government has emphasized the need to maximize benefits to the population through optimal use of the land while conserving resources for future generations.

Further, with no formal land use policy or institutional mechanisms, there have been conflicts among multiple land users of a common area of land. With no information-based plan or policy, potential land users have no rational basis for land utilization.

Recognizing the need for a rational approach to land use, the Government in 1994 engaged a Natural Resources Management Project (NRMP). This is being executed with technical assistance of the German GTZ. The NRMP has several components including the building of institutional and human capacity, natural resources legislation reform, and very important, land use planning.

A recent land use baseline study showed that one of the many constraints that confronts land use planning in Guyana is an adequate database on which decisions can be made. There is a shortage of data necessary for land use planning. Further, that which is available exists in differing formats. There is also a lack of a proper system for the storage, analysis and management of existing data, as well as data that will be needed in the future. A key set of activities under the NRMP is the establishment of a GIS that can be used as a decision support tool for land use planning.

#### **4. Institutional Arrangement for GIS**

Five institutions have been identified as participating agencies in GIS for natural resources management. They are the Guyana Natural Resources Agency, the Guyana Forestry Commission, the Guyana Geology and Mines Commission, the Lands and Surveys department and the National Agricultural Research Institute. Two representatives from each of these agencies sit on the GIS Working Group, chaired by the National Land Use Coordinator. The working group is responsible for establishing the information base and generating the coverages and maps to support land use planning.

A national work program has been adopted, and each institution plays a role in the execution of the GIS program. The head of the working group coordinates the work of the various institutions and ensures that the work of each fits into the total work plan.

Each of these institutions also have identical hardware and software.

#### **5. The GIS Facility**

The Geographic Information System being established for land use planning in Guyana is PC based. Each of the institutions named above typically has a PC station consisting of a Compaq Desk Pro Tower PC with Intel Pentium processor, CD-Rom and Exabyte tape drive. Each station also has a Laser jet printer, HP DesignJet 750C Plotter, and digitizing tablet. Some of the institutions have GPS equipment, which is shared (Trimble pathfinder and Magellan Garmin).

The Lands and Surveys Department has been identified to house and control the central database, and maintain links with each of the other institutions. It will function as the land information center for the country. Already, under another project, a parcel based land information system is being installed, and there is an economic-ecological project with GIS support. (All of

these projects will complement the total land information needs of the country, and will lend support to decision making about land uses.)

The software being utilized is common to all five agencies, allowing tapes to be moved from one agency to another. Software includes ESRI PC Arcinfo, ESRI ArcView, Borland dbase 5, and Novastor Novaback (SCSI).

At the present time, the system is not networked. This is a conscious decision based on the initial need to digitize existing maps at the institutional level to create a preliminary information base. When this is done and all of the human resources are in place, the intention is to network the stations electronically, with the LSD having central control.

## **6. National Level Information Base**

Guyana is currently at the stage of creating the information base that will support rational land use decisions. Within this phase national level coverages are being created at a 1: one million scale. Guyana's physical size makes this scale a little more realistic than would be the case for some of her smaller neighboring island states.

Covers are being created at this national level for a base map, and for soil, hydrology, geology, vegetation, topography, rainfall and actual land uses. These are expected to be completed by the end of 1997.

## **7. The Use of GIS in District Level Land Use Planning**

GIS will also play a key role in a pilot district land use plan, scheduled to commence January 1998. One of the hinterland districts which possesses a variety of land uses, settlements, and potential alternative uses has been selected to be the pilot planning area.

GIS will be critical to the planning methodology. The information base will consist of coverages for soil, rainfall, topography and vegetation. Using GIS, these four coverages will be synthesized, and planners will demarcate Integrated Terrain Units (ITU)

Additional variables such as population, health, education, income, and physical infrastructure will be entered into a database. These will be considered in each ITU to suggest alternative land use options. Each option will be processed by GIS, and presented to the decision-makers for adoption of a single alternative. Throughout the whole process, the information base will benefit from local consultations and participation.

## **8. Use of Remote Sensing**

Guyana will not rely primarily on satellite imagery to develop its information base. Because of the immediate land use problems that exist and the need for timely results, Guyana is modifying the traditional land use planning process to its own circumstances, and will utilize a mix of data sources in making land use decisions. As far as possible, existing thematic maps from various regulatory bodies will be combined with field knowledge to provide the geographic information necessary for land use planning. Existing thematic maps created from remote sensing data will be digitized and integrated into the GIS database. New remote sensing data will be required for those areas of the country for which data does not exist, for which data is inadequate for land use planning or for which it can be demonstrated that RS information adds significantly to the information base.

At the present time a pilot study is being done to assess the usefulness of using RS imagery in enhancing a GIS information base. Landsat TM imagery was acquired for the pilot area. This was rectified and interpreted to produce an unsupervised land cover classification. Field checking was then done in a systematic way for each of the classes. Following this a supervised classification was made. Overlaying a transparency over the imagery, polygons were drawn for each land cover class. These polygons were then digitized and entered into the GIS database.

GPS is being used for geo-referencing the data. In this way, Guyana is able to integrate satellite data and GPS into its GIS.

After the information base and maps are produced, the land use planning process will proceed to take these outputs and generate land use options for decision-makers to consider.

## **9. The Challenges Ahead**

One of the major challenges is the human resource factor. Guyana is just recovering from a period of stagnation that resulted in many qualified staff leaving the country. Finding enough expertise to manage GIS is a challenge.

A related challenge is to train young new staff to use the system. This is ongoing. However, the problem exists that trained staff may leave for other jobs in the private sector or abroad. Training staff and keeping trained staff are key challenges.

Another issue is to maintain system compatibility within the country. There are other projects besides the NRMP, which are installing GIS. This is also occurring in the private sector. It is desirable that software be compatible, if not identical, to facilitate to exchange of information. Within the public sector there has been some success in this. Various coordination mechanisms are in place in the land use planning arena, and these permit agreement on software type to be reached in the early stages. However, with the rapid expansion in economic activity and technology adoption, the compatibility issue remains a concern.