Spatial Information Systems and Their Role in Development Projects

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1. INTRODUCTION

Many agencies are actively promoting the use of spatial information systems in development projects and although there are many advantages to using quantitative computer techniques, there are many obstacles that make such investments questionable (Fox, 1991, 1995). Operating information systems in remote areas is a challenge and we feel that four components need to be met for successful implementation in a development project. The choice of hardware, and software are the first issues but these can easily be addressed if money is available. The issues of people and spatial data are also an integral part of using information systems. To be successful, access to skilled people is a prerequisite, but simply training individuals in computer skills is not the solution. Resource people trained in forestry, engineering, hydrology, soil science, agriculture, socio-economics etc. with an interest in computer skills are required. These individuals are rare and in great demand. The most critical issue is one of spatial data on biophysical and socio-economic resources. Data collection and conversions are critical issues and there are few short-term answers but many long term headaches. The purpose of this paper is to share our experiences in utilizing spatial information systems, discuss some of the difficulties encountered, and indicate the direction we have taken in the use of this technology.

2. RETROSPECTIVE

In 1988 we set up XT computer in Nepal to analyze the Land Resource Mapping Project data (LRMP, 1986). At the time this database was the only reliable spatially referenced resource data which covered the country systematically at a 1:50,000 scale (Schreier, 1990, 1991). The use of a PC-based GIS system (Terrasoft) was felt to be appropriate given the electricity problems in Kathmandu at that time, and the lack of technical support and skilled manpower available. GIS was introduced because it provided a perfect platform to integrate both bio-physical and socio-economic data in a quantitative manner.

We quickly realized that to use this technology successfully a long term investment was needed. Fortunately the International Development Research Centre (IDRC) in Ottawa was receptive to this idea and allowed us to purchase an updated computer system, and train the Mountain Resource Management (MRM) team in the use of GIS, portable computers, automated data loggers and database management. The team members were experts in geology, soil science, land use and geography but had limited computer exposure at that time. Over the six years of the IDRC project all team members received intensive annual training sessions in both Nepal and Canada, and this continuous training effort has resulted in the Nepali MRM staff being self-sufficient in the use of the GIS, generating the necessary spatial data in the field, maintaining a comprehensive computer database and analyzing information in an effective and efficient manner. This was achieved with a relatively modest financial investment, the purchase of a 286 AT computer in the initial phase (1989) and a 486 DX computer system in 1992. The success was due to the effort of the highly motivated MRM team which already had experience working in a interdisciplinary manner through their involvement in the LRMP project.

The major emphasis over the first three years was to develop a spatially referenced resource database for the watershed which required mapping of soils, geology, current and historic land use from aerial photographs and generating baseline data on climate, hydrology, erosion and soil nutrients.

Only after this initial effort was GIS effective as a tool to analyze, display and overlay information, and develop models and scenarios. Because the computer technology changed rapidly over this time period of the project, constant adjustments and upgrading were made in the equipment used and the training provided. With a modest investments it was also possible to expand the monitoring network and to generate large environmental databases that were focused on measuring processes and rates of change.

It was quickly realized that GIS was a very time consuming and data demanding technique and this led to the introduction of digital field-data logging equipment which enabled us to generate data that could not easily be produced by manual efforts. This also meant that we required access to power in the field which in turn lead to the introduction of solar panels in the project. With this evolving approach to using spatial information systems we were able to generate one of the most comprehensive resource databases for a single watershed in this part of the Himalayas.

While these are very positive steps it should be emphasized that in spite of dedicated efforts by the Nepali team it required a long time to reach the level of understanding of the resources discussed during this workshop. Even with this effort our understanding is still modest and restricted to the watershed and sub-watershed scales and additional efforts will be needed to relate this watershed study to the regional and continental scales as advocated by Grosjean et al. (1995).

3. GIS AND ITS EVOLVING ROLE WITHIN THE PROJECT

Initially we focused on GIS as the tool to integrate and display data in the many forms for which GIS is famous (overlay, 3D, selective queries, graphic displays etc.). The next step was to add modelling capabilities to produce "what if?" scenarios. We quickly realized that modelling is often more efficient outside of the CAD (computer-assisted drawing) in the database system. If the spatial integrity is maintained it becomes possible to link GIS and external modelling techniques and use the two in combination. Unfortunately , GIS processing of large datasets is slow even with modern workstations, and interactive model demonstrations are not easily developed, or readily portable. This lead us to explore Hypertext, which is defined by Comejo (1994) as "documentary treatment of data in multidimensional space". This is a generic computer software technology which enables us to combine databases, text, graphics, GIS, and images into an electronic document that is interactive and easy to run. A demonstration of the use of this technology was provided during the workshop in Kathmandu. Most of the GIS maps resulting from the project were incorporated into the Hypertext document and combined with text and images to produce a computer book of the project in multidimensional space. A low end DOS version was produced that can run on any PC computer with a VGA monitor and requires about 4 MB of hardware space. Function keys were incorporated to enable users to easily navigate through the document. The product is very portable and easy to use even in remote areas with access to simple computer technology. However, it has the disadvantage that the image quality is low (640x480 resolutions and 16 colours).

To overcome this deficiency a new window based version was produced which will run on any PC computer which supports 1024x768 resolution and 256 colours. The advantage of this new version is the improved graphic quality, windows operating platform, and its distribution via Internet. We anticipate that the full version will be accessible via the PAN-Asia network and can be accessed via Internet at your convenience.

The advantage of hypertext documents is that they can be distributed free of cost, no software needs to be purchased, the programs are easy to learn, and since all the images, maps, graphics and data were generated by the project team no copyrights are needed for free and wide distribution. While we are very excited about the new product it should be noted that the end product is not an interactive GIS where a user can change data

or assumptions and test the response interactively. Instead it is a computerbook that contains over 100 photos from the watershed, more than 70 graphs and GIS maps illustrated with text and annotation.

4. WHY HYPERTEXT AND WHO IS THE AUDIENCE

We view hypertext as a new initiative to make scientific information more attractive to managers and politicians, to serve as an educational tool for students, and to communicate scientific results more widely and at a reduced cost. To produce all the GIS maps, photos and graphics in colour in a conventional book format would be prohibitively expensive and we would only be able to produce a few copies. With the Hypertext document of the MRM project the production costs are modest and the distribution cost is minimal. We view this as an appropriate technology for development and hope you will get a chance to view it over the worldwide web.

5. FUTURE DIRECTIONS

Since the development of these techniques is ongoing we should indicate that a host of additional options are open in the development of an even more comprehensive communication tool. The first is the production of a CD-ROM and with it the addition of sound and video images. This requires access to more elaborate technology which is not yet readily available in the developing world. However, we anticipate that this technology is readily transferable, will be cost effective in the near future and will foster better communication, information exchange and development.

6. REFERENCES

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