The Use of Geographic Information Systems in Development Planning in Latin America

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ABSTRACT
In Anglo America planning and technology often accommodate dominant middle income society. However, in Latin America the population majority is low income. Values, technology, management styles and patterns of settlement differ. The roles of development planners and attitudes toward United States based technology also differ. Recent conferences in Latin America on the use of geographic information system (GISs) reflect current applications of GIS and impediments to technology transfer. Recent training and transfer of GIS technology by the Organization of American States (OAS) is discussed. It is concluded that there is a need to examine the relationship between styles of planning and the usefulness of GIS and to draw conclusions within a Latin American context.

INTRODUCTION

The use of GIS in development planning in Latin America involves the role of the development planner and the nature of planning processes. This discussion addresses: 1) the role concepts of development planners and the problems of applying Western theories and planning methods to Latin American planning processes; and 2) the present and potential use of GIS in Latin America. This paper argues that: 1) there are features of Latin America that make the use of GIS unique; 2) there are particular applications in Latin America that benefit from the use of GIS technology; and 3) there is a need for independent research within Latin America.

CONTEXT AND ROLE OF DEVELOPMENT PLANNERS

Planning principles and practices often are introduced to developing countries in Latin America with little or no adjustments for the unique social, cultural, economic and climatic conditions. Third world planning has been characterized as elitist, favoring Western theories, models and strategies which are inappropriate to third world settings (Noe 1981). In Anglo America planning often accommodates dominant middle income society. However, in Latin America the population majority is low income and lives under entirely different circumstances than their Northern counterparts.

Values, technology and patterns of settlement and transportation differ. For example, in Latin America: 1) attitudes toward extended family are extremely important; 2) social values are often more important than materialistic values; 3) privacy and attitudes toward space requirements differ; 4) degree of industrialization differs dramatically; 5) transportation patterns and acceptable commuting patterns differ; 6) standards of living vary; 7) distribution of wealth among socioeconomic classes differs; 8) the ratio of rural to urban settlement patterns, pace of urbanization, land ownership and occupance patterns differ; 9) attitudes toward the

environment, energy use and consumption are different; and 10) local and central government long term commitment to development planning is sometimes lacking. While only a sample of contextual differences, these topics are introduced as a means of depicting differences in the Latin American context of development planning.

Not only does the physical and socioeconomic setting differ, but the professional culture of planners differs. Recently, Knox and Masilela (1989) report from a questionnaire survey on the socioeconomic background and role orientations of third world urban planners. A total of 186 responses were received from several Third World countries including India (52), Zambia (16), Zimbabwe (25), Jamaica (10), Barbados (8) and 75 from United States based "outside experts." While this survey may not be a representative sample of Latin American planners the conclusions are enlightening with regard to contrasting attitudes and backgrounds of Western compared with third **[end p. 337]** world planners.

"Overall, the typical third world urban planner is a male of mid-career age and from a middle-class background. The typical outside expert, on the other hand, is also a male but is significantly older. Over 60 percent of the practitioner group were less than 40 years of age whereas only 17 percent of the outside expert group were less than 40. In terms of education, the great majority of third world practitioners had taken a first degree from a third world institution with almost two-thirds reading some combination of planning, architecture and geography and about one quarter reading engineering. Most of the outside experts had taken their first degree from an institution in the developed world, with relatively few reading planning or engineering and more than a third taking a degree in a social science subject other than geography or planning" (Knox and Masilela 1989, 72).

It is found that the "outside group" is employed at universities and international donor agencies. On the other hand, third world practitioners are employed by central and local government and urban development agencies primarily engaged in physical planning and development control.

It is concluded that, in general, the attitudes of third world planners are different than those of United States based experts. While both groups agree on what constitutes a "good, successful planner" a number of clear areas of disagreement emerge. United States based experts see the track record of planning as poor, technocratic and elitist, with unrealistically high standards; the importance of the informal sector, self-help and citizen participation is emphasized, with a commitment to the disadvantaged and to environmental quality. Third world planners also support citizen participation, the informal sector and a commitment to the disadvantaged and to the environment. In contrast, third world planners do not "see the track record of planning as weak, nor do they regard Western methods, ideas or training as inappropriate to their mission. They do not see the profession as elitist or technocratic; on the contrary, they strongly support the notion of success via technical competence and administrative and managerial skills." (Knox and Masilela 1989, 75).

A second study is conducted by Knox and Masilela in which all respondents are pooled and a cluster analysis undertaken. A six cluster solution is derived revealing six divergent world views, such as radical, conservative and technocratic. This second interpretation somewhat parallels

the professional role orientations described in studies of European and North American urban planners (Smith 1988; Mayo 1984; Howe 1980; Howe and Kaufman 1979). It is suggested that the selective recruitment from the middle class of third world planning students is "compounded by formal education and training, producing a professional culture that is dominated by elitist and technocratic attitudes" (Knox and Masilela 1989, 68).

Zetter examines the contradictions that exist between "the ideology of planning which is embodied in education in developed countries and the indigenous needs of developing countries." (Zetter 1980, 410) He notes that doubt is increasingly cast on the universality or transferability of planning concepts and theory and goes on to compare the differing needs of planning education in Britain and in developing nations. Tips (1986) also looks at the need for a wider spectrum of theories of planning for third world planners in a research survey among Southeast Asian master's level planning students. He notes that third world planners, more than Western planners, "must be entrepreneurs, organizers, coalition builders, and implementation brokers by sheer necessity to be able to function in the type of society they are working in." (Tips 1986, 290) It is suggested from the above discussion that urban planners in Latin America face different issues than their Western counterparts and operate in a different setting.

Considering urban planning from a more abstract perspective, Castells discusses recent urban studies which view space as an expression of society. He sees urban social movements as the agents of urban-spatial transformation. He notes that "all over the world the tendency towards state centralism and domination by the state over the city is being opposed by a massive popular appeal for local autonomy and urban self-management." (Castells 1985, 103) This can be seen in Latin America in the decentralization of the planning process in certain countries, such as Colombia. In contrast to the idea of decentralization, Herington, in the context of Britain, writes that "Any serious commitment to the management of growth in the outer areas requires a coherent central government strategy. Through investment programmes and controls over the use of land, government can manipulate the physical form of urban development and the overall scale of population and employment growth."**[end p. 338]** (Herington 1984, 76) This is a British view for a strong and capable central government which may, in fact, be an appropriate description of the growth management goals in some Latin American countries.

The issue of centralized versus decentralized planning is inherent to any discussion of planning processes. Just as Western planning cannot be generalized as centralized or decentralized, neither can all of Latin American planning be characterized as centralized or decentralized. In the case of Western planning processes, Britain and Europe have strong national planning processes for relatively small size countries whereas the United States has very decentralized planning processes for a large and diverse country. Although a few exceptions prevail, for the most part in the United States development planning and land use control occur at the local level.

Historically, Latin America has tended toward strong national control of development. More recently, there has been increasing public involvement in the planning process and increasing decentralization of land use planning functions. Techniques of planning vary considerably within Latin America; however, the choice of planning process and strategy is dependent upon

the political context and the particular needs and objectives of a particular country. The selection of planning tools is process dependent. Planners in Latin America must be cautious to select a GIS appropriate to their needs.

PRESENT AND POTENTIAL USE OF GIS

This section examines the question "What makes the use of GIS unique in Latin America?" by: 1) discussing two recent GIS conferences in Latin America; and 2) discussing the role of the Organization of American States in the transfer of GIS technology.

Two recent conferences were held in Latin America on the use of GIS. One was held in 1987 in San Jose, Costa Rica (I Conferencia Latinoamericana sobre Informática en Geografía, 5 al 9 de Octubre 1987). The other was held in 1989 in Mérida, Venezuela (II Conferencia Latinoamericana sobre Tecnologia de los Sistemas de Información Geográfica, 25 al 29 de Septiembre 1989) These conferences were attended primarily by Latin American planning professionals, government officials and academics. In both conferences the majority of paper presenters addressed specific applications. This is in contrast to GIS conferences in the United States, which often emphasize theory and technical development. Of the approximately 135 attendees in Mérida most were from Latin America.

According to remarks by Guevara (1989) of Environmental Systems Research Institute (ESRI), although early forms of GIS were in use in countries such as Venezuela, Brazil, Chile, Mexico and Colombia as early as the 1970s, the technology of GIS has yet to be successfully transferred to these and other countries of Latin America. During introductory remarks at the Venezuela conference, Dr. Armando Guevara stated that "The GIS experience, although painful in some cases and fruitful in others, has yet to gain roots in the minds of government officials of Latin America.... There are few successful GIS installations in Latin America" (Proceedings of the II Conferencia Latinoamericana sobre Tecnologia de los Sistemas de Información Geográfica, 1989, xv). There are a number of impediments to the successful transfer of GIS technology to Latin America: 1) frequent change of political leadership fails to provide the necessary stable environment in which GIS technology can develop for the long term; 2) lack of organizational support to maintain GIS installations; 3) unrealistic expectations and misunderstandings regarding the need for data collection to establish a quality cartographic and information database for use in a GIS; 4) susceptibility of existing large national level GISs to the whims of national political change; 5) lack of government support for university research and training of individuals who can perpetuate the transfer of technology; 6) lack of adequate and continuous long term funding of GIS projects; and 7) lack of data sharing among government agencies. These impediments suggest that the use of GIS in Latin America is a contextual issue and a political issue. It is also an issue involving the role of planners and other government officials in the development process. A GIS represents wealth and power in the form of information and the ability to manage the human and natural resources of a country. The political decisions of when, where and how to use a GIS, if at all, must be examined in the economic and social context of each situation.

Representatives from many Latin American countries at the 1989 conference describe the

results of their experiences. Recent planning applications of GIS technology are presented for Chile, Argentina, Puerto Rico, Venezuela, Ecuador, Brazil, Peru, Cuba and Colombia. Of the 21 presentations reviewed, one third deal with urban and transportation topics and about two thirds discuss aspects of natural resource planning and management.

Natural resource planning applications include: 1) management of renewable natural resources at the drainage basin level (Chile); 2) treatment of environmental data in a GIS (Argentina) with emphasis on erosion B>[end p. 339] control (ERDAS and ELAS); 3) organizational structure of a GIS for the eastern region of Guyana (Venezuela) using ARC-INFO; 4) coastal zone study in central Chile; 5) application of GIS for development of the San Antonio province: a case study of forestry (Chile); 6) site selection for reforestation with cypress trees using a low cost GIS (Costa Rica) using PC-MAP; 7) GIS applied to energy development in Brazil using the Intergraph system; 8) United Nations grid based data for natural resource management (future application to Latin America of a global approach to environmental management); 9) water resource planning in arid basins (Peru) using PC-MAP; 10) national planning for the conservation of natural vegetation (park site feasibility in Venezuela) using ARC-INFO; 11) a river basin study in Brazil; 12) level of aggregation of environmental data (Venezuela) and; 13) energy planning and project evaluation (Argentina).

These natural resource applications emphasize forestry in particular and large scale national or regional level inventory projects. Forestry site selection applications address the issues of reforestation, renewability and national park planning. In the case of the Costa Rican study, it is concluded that the great advantage of GIS is that it permits the professional to visualize and quantify immediately the environmental impacts of alternative recommendations. Similarly, in the case of energy planning in Brazil, the results seem optimistic. GIS as a tool for environmental decision making and resource management "enables us to participate more effectively in the planning process, and thus, permits a more noble contribution to the intelligent development of our resources." (Hansen and Scheufler 1989, 491). Using INTERGRAPH hardware and software, planners demonstrate the effectiveness of a GIS in determining environmental impacts of simulated reservoir construction for generation of hydroelectricity and impacts of alternative transmission line corridor construction. It is concluded, "The proper application of GIS provides a way to treat fairly and objectively the integrated analysis of often conflicting issues. GIS techniques can be used to find the best alternative trade-off that reduces both engineering as well as socio-economic and environmental costs." (Hansen and Scheufler 1989, 506). However, in the case of both the Brazilian hydroelectric energy study and the Peruvian water resource study planners expressed problems regarding scale and resolution of map output.

Urban applications include: 1) development of an information system with a geographic database for public administration, regional analysis and public services planning in Puerto Rico; 2) atlas information for Quito, Ecuador; 3) historical archive for the metropolitan area of Buenos Aires (Argentina) using ARC INFO; 4) spatial analysis for transportation planning of Via Mulata, Guantanamo (Cuba) using OSU-MAP; 5) environmental evaluation of alternate road routes on the coast of Lake Maracaibo (Venezuela) using ARC-INFO; 6) automated system of survey registry and maintenance in Caracas (Venezuela) using GIS and CAD; 7)

formation of a new cadastre for creation of an integrated GIS in Bogota (Colombia), and; 8) GIS for Medellín and surrounding areas (Colombia) using AM/FM.

These urban applications emphasize cadastral issues and transportation planning. In the case of urban information in Quito, Ecuador, the problems of data sharing, level of aggregation and data incompatibility are discussed. It is noted that database management and update is critical to the success of a GIS and requires coordination among agencies. In developing historical archives for metropolitan Buenos Aires, GIS technology is applied to local cadastral information, property ownership, public services and taxation for a twenty year period. In addition, the possibility of incorporating satellite data in the GIS is discussed. In the case of Caracas, GIS and CAD are used to establish parcel structure, use and condition of parcels, socioeconomic structure of the city as well as to project growth to the year 2000. In the case of both Bogota and Medellín there is concern with formation of a new cadastre. In the case of Medellín, there is a specific goal of integrated mapping of energy, telephone, water and sewer facilities using an automated mapping/facilities management (AM/FM) system.

The Organization of American States (OAS) is increasingly important to the transfer of GIS technology in Latin America. In particular, since the United Nations has declared the decade of the nineties to be the International Decade of Natural Disaster Reduction, the technical assistance, training and GIS technology transfer by OAS is often made by the Department of Regional Development in the context of development planning and environmental management for long term disaster prevention and vulnerability reduction (Bender 1990). These activities are supported by funding from the Office of Foreign Disaster Assistance of United States Agency for International Development and in collaboration with other international development agencies such as UNDP, UNDRO and IDB. Training activities are usually carried out as part of ongoing technical cooperation programs at the national and regional levels. Recent disaster vulnerability reduction studies have addressed specific economic sectors such as agriculture, transportation, tourism and energy.

[end p. 340]

In particular, since 1987 nine GIS training workshops with application to natural hazards assessment, management and development planning have been completed in Latin America by the Department of Regional Development of the Organization of American States. In 1987 there was a training workshop on GIS applied to natural hazards management and development planning in Tegucigalpa, Honduras. A similar GIS workshop was held in Tegucigalpa in 1988 as well as in San Jose, Costa Rica. In 1989 there were three GIS training programs: 1) installation and training of an upgraded GIS applied to hazards management in the fields of natural resources and energy (San Jose, Costa Rica); 2) installation and user training in GIS applied to natural hazards management and development planning (Bogota, Colombia); and 3) installation and user training in GIS applied to natural hazard and natural resource management (Castries, Saint Lucia). The most recent GIS training programs have occurred in 1990 in Montevideo, Uruguay; Quito, Ecuador, and Managua, Nicaragua (OAS June 1990). Without further research it is not clear to what extent these transfers of GIS technology have succeeded in achieving host country and/or training agency objectives.

CONCLUSION

It is useful to speculate as to future applications of GIS. Certainly in Latin America as in other parts of the world many cities have grown beyond their original administrative boundaries and now occupy several political-administrative units. Fragmentation hinders effective land use planning, control and delivery of public services. Land use information is increasingly important as planners seek to manage growth and improve social and economic conditions. Recent advances incorporating Landsat and SPOT satellite imagery into GIS, improved resolution, frequency of photos and accessibility make remote sensing an increasingly attractive enhancement to GIS technology. It has been suggested that satellite imagery may be applied to resolving land tenure issues. This is closely related to issues of geodetic referencing systems and cadastral surveys.

The problems associated with the use of GIS are unique in Latin America. Increasing population pressures in Latin America are resulting in individual and group land conflicts as well as unofficial and unregulated land markets. Even in the areas covered by cadastral surveys there is often a lack of legal requirements regarding the reporting of land conveyance and transfer of title, making efficient recordkeeping difficult. Remote sensing in combination with GIS may provide a cost effective alternative to traditional ground survey methods.

The use of GIS in Latin America is impeded by a number of political and socio-economic factors. Political instability, unrealistic expectations and lack of long term support of GIS contribute to a difficult and unique development planning context. Lack of GIS research within Latin America results in a paucity of publications or conference proceedings that address issues of theory or issues of technology advancement. There is a need to examine the relationship between Latin American management style and the application of the tools of GIS now available. Perhaps when theoretical and technological research is conducted within Latin America the resultant GIS products and applications will be more successful.

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[end p. 342]