New Areas Of GIS Application

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ABSTRACT

Geographical Information System (GIS) based on remote sensing, satellite photography and information technology is increasingly finding application in agriculture, forestry, geology and other new fields. The use of personal computers (PCs) and GIS 'Software' packages for various solutions have made GIS a powerful tool for spatial decision support systems in diverse area.

Globally, land resources are being used more intensively and the land use is changing rapidly due to development projects. The most dramatic change in global land use over the last three centuries has been the expansion of agriculture to produce more food and the reduction of forest and grassland as a result of frontier expansion. The process of frontier expansion continues even now in any tropical and mountain regions such as in Amazon in Brazil, West African Countries, South and East Asia, the Andes in South America and the Himalayas in India, Bhutan, Nepal and Myanmar (Burma) in the trial of economic development. The global area of land is estimated at 13,000 billion hectares. A detailed analysis of global land cover reveals that slightly less than one-third is forest cover, two third is farm land the rest occupies the habited rural and urban area and zones otherwise unfavourable for agriculture.

We are familiar with the application of GIS in India for over a decade now in forestry, geology, geomorphology and agriculture and soil survey and urban planning.

In recent years GIS has found application in diverse new areas:

a). Studies in Antarctica for environment, logistics and tourism potential.

b). Hydrology and water resources management.

c). Geo-demographics studies.

d). Flood control monitoring of flood - 'prone' rivers.

e). Development of Urban Land Information.

Some of these new areas of GIS application are discussed here.

The case studies of applications of GIS for surveying and mapping in several new areas recently tried and proved have been discussed here. I am sure these will be useful for various Indian Organizations dealing with these areas.

INTRODUCTION

Geographical Information System (GIS) based on remote sensing, satellite photography and information technology is increasingly finding application in agriculture, forestry, geology and other new fields. The use of personal computers (PCs) and GIS 'Software' packages for various solutions have made GIS a powerful tool for spatial decision support systems in diverse area.

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GIS techniques were first introduced in the European Union countries starting from 1990. By 1995, the European Union countries had been spending about 0.1% of gross national product (GNP) or 6 Billions ECUs for European Union as a whole. The latest estimate puts the expenditure at about 12 Billion ECUs. In the United States the federal agencies spend about $ 4 Billion annually (1994), which is increasing fast with the multiple uses of GIS.

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STUDIES IN ANTARCTICA

Antarctica, the sixth continent, is larger than Australia, USA and the European Union. Its presence around the South Pole profoundly influences global environment systems. It affects atmosphere and oceanic current circulation patterns and much of the world's fresh water is locked up in its icecaps. British Antarctic Survey, a component body of the UK Natural Environment Research Council carried out research in Antarctica. GIS is vital to the coordination of scientific activities in Antarctica.

Geographic information and GIS serves many interests in Antarctica mainly for planning logistics such as aircraft route, fuel availability and fuel consumption for round trips. The entire land area south of 60's is subjected to environmental protection regulation of UNEP. GIS is used to locate and manage vulnerable areas, eg. Crevasses along the only feasible route. GIS is used to establish maps of environmental sensitivity. Scientific research information includes environmental management, solar physics, plate tectonics and flow of great glaciers. Using GIS, it is simple to look at relationships between data gathered by biologists, oceanographers and geophysicists. Tourism is an ever-increasing activity in Antarctica. It is important that the tourists are guided only to less sensitive and vulnerable areas and kept at safe distances from arctic birds and seals.

WATER RESOURCES MANAGEMENT

Water is the world's most precious natural resource, which is becoming scarce in many parts of the world. Unless timely and properly managed, water scarcity may lead to adverse situation. A third of the world already lives in water-stressed areas where consumption far outstrips supply. Appropriate controls at multifaceted levels and augmentation of water resources have to be introduced for sustainable development of available water resources.

There is thus, the utmost need for conservation and efficient use of available water resources data from maps and GIS studies. GIS can integrate administrative policies with available water resources and water use. The enormous data on water resources; Socio economic division and demographics data required for planning can be efficiently handled and studied using GIS. Different management scenarios can also be processed, allowing planners and water managers to study various alternatives before selecting the most appropriate plan. GIS study can be used efficiently for water resources management including (a) Canal information (b) Tank information (c) Watershed management and (d) Ground Water Assessment and Management. GIS is also the most appropriate test for geologist and hydro geologists.

WATERSHED MANAGEMENT

In the field of watershed management GIS can be effectively used for:

(a) Studying the characteristics of watershed and catchment areas to gain better insite into the water inflow to rivers and basins.

(b) Understanding the topological relationships between drainage patterns, land use, soil type and land cover of the catchment area.

(c) Formulation of plans for hydroelectric projects.

(d) Construction of storage reservoirs by studying drainage patterns.

GEODEMOGRAPHIC STUDIES

The Human Science Research Council (HSRC) of South Africa established in 1968, supports human development both on a national level and throughout the rest of Africa by conducting applied social-scientific research projects and by coordinating large-scale collaborative, policy relevant, user driven and public sector oriented research programs. HSRC plays a leading role within Southern African Development Community (SADC), a regional cooperation organisation of fourteen African countries. The HSRC leads the development of geodemographic and life style segmentation information of South Africa at small, special and area level.

Using GIS as the main technology, the HSRC GIS Centre has become the first institution in Africa to be able to spatially display the geodemography of the South African population. Since 1982, the HSRC GIS Centre contributed significantly to the development and use of socio-economic geo-information

in South Africa. The HSRC has mapped all the schools, telephone exchanges, and police stations in the country. Furthermore, important datasets on economic indicators such as Gross Geographic Product (GGP), GINI-coefficient, a measurement of inequality and poverty gap were developed. The importance of geodemographics also recognized and datasets were developed at localized level, using GIS techniques to integrate the 1991 and 1996 census data. These geo-demographic datasets helped in providing a picture of socio-economic changes and trends between 1991 and 1996 which also stratified the location of government pension payout stations are under development.

FLOOD CONTROL MONITORING OF RIVERS

Forecasting of river floods is important to prevent loss of life and to reduce damages to rural and urban sites and sites of high economic importance. Russia is working on flood monitoring of its largest rivers, the Volga, the Ob and the Yenisei. This spatial characteristic of floods is determined by GIS using satellite images and mapping using remote sensing data. This data together with measurements of hydrometric stations at appropriate places, provides the fundamental information of flood forecasting.

The process of flood monitoring requires action before during and after floods. Activities before flood include determination of (a) Rivers site at which flooding poses a threat to human life and economic activity; (b) Location and period of water presence on the floodplain for each of the selected rivers site; (c) Location and dates of full overflow of the floodplain; (d) Period and duration of flooding; (e) Economic Importance of objects situated in the floodplain; (f) Level of damage possible at certain flood level and flood observation; (g) Water levels dangerous for important constructions, installations and human habitation.

During the flood the following actions have to be undertaken:

(a) Ensuring proper functioning of hydro-meteorological network and proper communication of information to all management levels.

(b) Mapping of flood-affected and snow cover using satellite images.

After flood, activities consist of the following:

(a) Performing, ground, aerial and satellite surveys of damages caused by flooding.

(b) Analysis of these surveys, their cartographic maps and hydro-meteorological information.

(c) Estimate of flood damages.

(d) Establishment of measures to prevent future flood damages.

The primary role of GIS in flood control focuses on providing information for carrying out preventive measures well in advance.

DEVELOPMENT OF URBAN LAND INFORMATION

A well- functioning urban property market is considered fundamental for economic growth and prosperity. In order the market to function properly it is necessary to have access to information about, among other things, ownership, encumbrances and property values. Good access to urban information helps in allowing all players in the market to participate on equal terms, to increase transparency and keeps transaction costs down.

Eight European National Urban Land Information Agencies are cooperating in the EULIS project which aims to develop an electronic European Land Information Service, showing what difficulties may arise, how these may be overcome and in demonstrating how such a unified service providing land information from different countries and with different languages, could work. In addition to the technical solution, issues such as conveyancing and mortgaging records will be described, as well as national conditions and routines for information acquisition in the different participating countries. Investigations are presently under way as to how a long-term solution involving new partners can be established.

The EULIS project started in January 2002 is planned to finish by June 2004. During the first year of the project, work focused on the creation of a base for contents and on design and development of technical solution for implementation of the service. Prevalent conditions related to urban land information among the eight countries were investigated and analyzed. Protection of privacy, financing and pricing regimes are being studied. National land registration systems have been described regarding structure and contents, as well as legislation and procedures for land transactions. To achieve the objective of EULIS the final technical solution will be in the form of a portal.

FLOOD CONTROL MEASURES

Dutch Water Board Ablasserwaard ende Vijtheranland (HHSAV) has been active in water management for 725 years. The two phenomena threatening the Dutch Delta are sea level rise and increase in discharged water from the Rhine and the Meuse. Accordingly HHSAV has to make efforts to prevent floods by maintaining dikes at a safe height. The timely and cost-effective availability of reliable, up to date and complete

information is essential. For the past three years one Water Board of The Netherlands HHSAV has carried out laser scanning project using FLI-MAP system. First, Laser Imaging and Mapping Airborne Platform, is a laser altimetry system operated by Fugro-Impart B.V. The system determines X,Y,Z, coordinates of terrain points using two laser scanners mounted on a helicopter, for purposes of die height monitoring. During flight, each laser emits two hundred pulses per second perpendicular to the flying direction. A corridor of 70 metres can be covered.

The first FLI-MAP project carried out for HHSAV in early 2002, resulted in over half a billion points over a track of three Kms. Processing so much data requires specialized software. GIS processing was required for making the data accessible for multiple users, and Arc-view software was developed. The video and photographs were also processed within GIS system. The integration of FLI-MAP system has undergone rapid improvement concerning data acquisition and GIS integration. Data detail, data quality and easy data accessibility have turned the system into an essential tool for HHSAV.

CONCLUSION

The case studies of application of GIS for surveying and mapping in several new areas recently tried and proved have been discussed here. I am sure these will be useful for various Indian organizations dealing with these areas. GIS is a versatile tool with increased speed due to many available software packages. GIS is not only speedy but it is cost-effective which is essential for a developing economy like India.

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