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Analysing Urban Land Use Change in GIS Environment

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Abstract: Urban areas are growing at an unprecedented rate creating far-reaching urban landscapes. The gradual transformation from farmlands, forested areas into urban concrete landscape has caught the attention of urban planners and academicians. It is understood that in order to monitor and assess these gradual changes in urban environments, modern technology of remote sensing can provide better and efficient management. Therefore, this present paper emphasise the ability of the modern technology to map and monitor the spatial extent of the built environment, and associated temporal changes, which has important societal and economic relevance. Further, the paper underline the utility of Multi-temporal satellite data which can now provide the potential for mapping and monitoring urban land use change.

Keywords: ***urban, land use, change, data, satellite, monitor.***

Introduction: Urban growth and the concentration of people in urban areas are creating societal problems world-wide. One hundred years ago, approximately 15 percent of the world's population was living in urban areas. Today, the percentage is nearly 50 percent. In the last 200 years, world population has increased six times, over that same time period; the urban population has increased 100 times concentrating more people on less land even as the total land devoted to urbanization expands. Yet the temporal and spatial dimensions of the land use changes that shape urbanization are little known.

Many towns and cities all over the world are growing at unprecedented rates, creating extensive urban landscapes. The forest areas, farmlands, wetlands that formed India have been transformed during the past 50 years. Almost everyone has seen these changes to their local environment but without a clear understanding of their impacts. It is not until we study these landscapes from a spatial perspective and the time scale of decades that we can begin to measure the changes that have occurred and predict the impact of changes to come.

Using sources such as historic maps, aerial photographs, and satellite data, the Department of Space in India scientists first assemble retrospective urban land use data bases that reflect several decades of change. These databases are then used to analyze the effects of urbanization on the landscape, and to model urban growth and land use change under alternative growth scenarios.

Land Use Change

Most cities face the growing problems of urban sprawl, loss of natural vegetation and open space, and a general decline in the extent and connectivity of wet lands and wildlife habitat. The public identifies with these problems when they see residential and commercial development replacing undeveloped land around them. Urban growth rates show no signs of slowing, especially

when viewed at the global scale, since these problems can be generally attributed to increasing population. Cities have changed from small, isolated population centres to large, interconnected economic, physical, and environmental features.

Fig 1: The urban map of Shillong shows the overpopulation. This map, compiled from google earth, shows city sprawling in all direction as per 2013.

Databases on Shillong urban areas are very vague on urban extent, transportation routes, water features, and other important land uses except for academic reports and surveys that are available for inter conjunction with historical significance that determines the time period. Features are interpreted from diverse data sources including historical topographic maps, satellite images, census statistics, and aerial photographs. The resulting temporal database is a spatial record of the pace and extent of the urbanization process.

A temporal database can be visualized as a sequence of maps below. Sequential maps show urbanization as a static pattern that change with each time period that is mapped. Animations illustrate the temporal dynamics, revealing patterns and trends that are not possible to discern from tabular data or static maps

Understanding Land Use Change

The geographic understanding of land use change in urban areas is a key aspect of the analysing urban areas. By analyzing a temporal database for spatial patterns, rates of change, and trends, it can provide insight into how urban areas have developed under varying social, economic, and environmental conditions. This analysis requires understanding of an area's land use history. Population data, timelines of historical events, and related information are all used to explain the mapped changes. Population data are correlated with the temporal database so that human movement can be tracked and factored into these interpretations.

Population increases suggest economic growth and the availability of jobs in an area, and population declines suggest a decline in liveability or economic issues that cause people to leave a region. Timelines of past events and other historical compilations aid in identifying the issues that affected the development of the region In addition to gathering statistical and

historical information, scientists must have a physiographic understanding of the place and its greater region. Topographic features, climate, and adequate supplies of water and other natural resources can limit or encourage growth and change.

The existence and accessibility of transportation routes have often dictated patterns of urban growth. Urban areas that were established in the since the city origin were usually located along a common settlement especially in a hill area reflecting connectivity of one hamlet to the other for the trans port of goods and people.

Land Use Change Modelling

Historical land use patterns, together with current trends in a region, are used to model future land use. Results from modelling urban growth and land use change can be used by the public, land use planners, and policy makers to anticipate and plan for the future. Land use change models can also generate alternative landscape predictions on the basis of different land use policies and environmental constraints.

These land use change models use simple parameters including present urban extent, major

transportation routes, topography, and protected lands. Other factors, such as employ- ment opportunities, land prices, and the millions of personal decisions people make, are not considered in this modelling approach. The primary focus of the modelling effort is to account for physical controls on land use.

Impacts of Land Use Change

Urban Dynamics research in landscape characterization, urban growth models, and geographic understanding provides the data necessary for analyzing the impacts of population growth and land use change. This information can be used to analyze the causes of urban congestion, pollution, and loss of natural resources. Each of these impacts is linked to changes in the extent of urban, agricultural, and forested lands, and (or) transportation systems. Planners use Urban Dynamics data to evaluate environmental impacts, to delineate urban growth boundaries or service areas, to develop land use zoning plans, and to gauge future infrastructure requirements. Traffic congestion, a common malady of urbanization, is the result of urban growth, increases in population density, and out-dated transportation infrastructure.

By evaluating trends associated with land use change over time, solutions to traffic congestion may be obtainable.

Another specific application is the correlation of air pollution records with the temporal database to determine if control strategies for reducing pollution have been effective. Many pollution control strategies have been used in the past three decades. Correlation between land use change and pollution helps researchers establish positive or negative trends that indicate whether pollution control strategies have been successful. With this information, policy makers, resource managers, and the public can make appropriate changes for the future

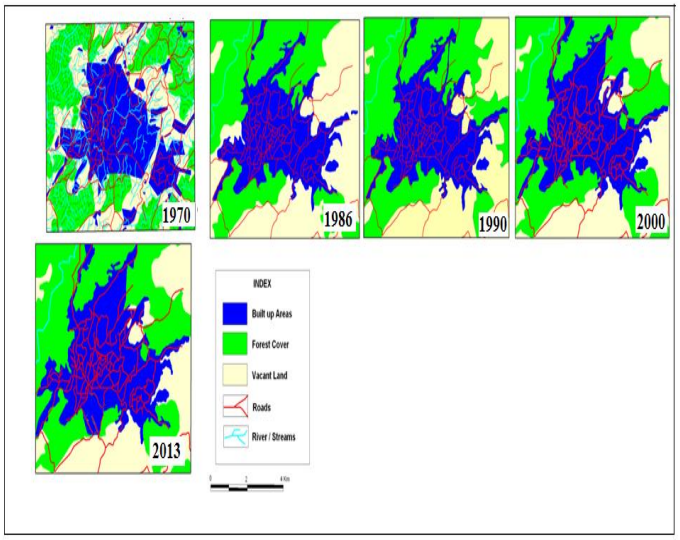

Fig:2- *This series of maps shows more than 30 years of urban growth in and around the Shillong city area. The background in each map is a shaded-relief image. The blue areas represent urban extent for each time period and the green is reduced vegetation cover over time scale.*

Hydrologists can use Urban Dynamics data to evaluate new water sources for future urbanization and to analyze water pollution a problem common to urban areas, industrial sites, and agricultural lands. The amount and degree of water pollution in rivers, lakes, can be predicted on the basis of past and future trends in land use change. A study currently underway in the Umshyrpi and Wah Umkhrah focuses on the sources of water pollution over time. In this study, temporal change maps of urban, and forest lands are used to identify and quantify historic trends in sediment and nutrient loads in waters draining into the Umiam lake.

Geologists can use data on land use change to evaluate the availability of building materials, such as sand, gravel, and cement. Geologists also use data on existing hazards to correlate with the data available to predict the impacts of future natural disasters and the potential damage they may cause

Policy makers can then use these damage or hazard projections to direct future development away from the most at-risk areas. Finally, biologists also can use land use change data to

compile maps on habitats, species distribution, and land management. Predictions about future urbanization are critical to the protection of ecosystems and the sustain ability of communities.

Conclusions

Thus, continued wide availability of affordable satellite imagery (or comparable observational data sets) will ensure valuable continuity in the production of highly accurate maps of the built environment, including subpixel impervious surface area and exurban sprawl maps like those presented here. Similarly, with further use of continuous advances in very high resolution observational data sets from the commercial sector (e.g., Ikonos and QuickBird) provide valuable synergy for algorithm and map development, validation of derived products, and extension of information content in regional and national data sets. These land data products provide critical input to resource management and decision support applications, and have substantial societal and economic benefit for community planning and development.

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