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Urban Planning Model by Integrating Transport Networks and Land use in GIS

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***Abstract*--Cities are now emerging as centers of domestic and international investments in an era of economic reforms, liberalization and globalization. Land use patterns experience constant changes due to the changing needs of human activities over time. Changes of transportation systems and land use patterns are interdependent with one another. The conventional planning approaches are inadequate for both the present and future scenario. As fine-grained data about land use and travel activity are available, there is an opportunity to interact with land use and transportation planning. Better co-ordination of transportation planning with local land use planning can help to identify transportation facilities and services needed to serve or modify land uses and help to co-ordinate the nature and pattern of land development with available transportation models.**

Keywords: Transportation network, Urban planning model, Uplan, GIS

I. INTRODUCTION

Land use is influenced by economic, cultural, political, and historical and land – tenure factors at multiple scales. Land use referred to as man's activities and the various uses which are carried on land. Transportation is one of the measures of nation's economic, social and industrial growth. Transportation planning focus on future demand, interaction among different transportation systems and facilities, relationships among land use, economic activity and transportation, alternative ways of operating transportation systems, and the social economic and environmental impacts of proposed transportation system. The primary objective of transportation planning is to ensure that there is an efficient balance between land use activity and transport capability and also a proper co-ordination among various travel modes for safe, convenient and efficient movement. The present and future travel demand characteristics and the future land use characteristics should be taken into account in transportation planning. The inter-relationships between travel demand characteristics and the urban environmental factors are then analyzed and transportation models are built out of these inter-relationships. Both Land Use and Transportation Model belong to the mathematical family of models. Land use models are used to simulate demographic and economic transition in land based activities. These models describe the population (usually in terms of income and employment) and built-space environment (floor space) for a given urban area. Travel demand is influenced not only by the location and amount of land use, but the design, density, diversity and accessibility of land use. Travel demand models are used to simulate travel patterns on a transportation network. Building of travel demand forecasting models is the most challenging part of transportation planning and it is the key to forecast future travel demands.Socio economic character and Location since it Plays an important role in trip production and attraction. Street congestion parking and other environmental attributes can increase or decrease the number of trips that an area produces or attracts.

Urban, suburban, rural land use patterns including issues such as renewal, sprawl, environmental concerns and economic growth are all affected by transportation strategies The trips generated and attracted in different area are dependent on the land use characteristics, which in turn controls the distribution of population and the economic activities, social, and cultural activities of the people. Better co-ordination of regional transportation planning with local land use planning can help to identify transportation facilities and services needed to serve or modify land uses and help to co-ordinate the nature and pattern of land development with available transportation models. The pressure exerted by the population and the demand for intensive uses of land have brought in drastic changes in the land use dynamics in the recent years. Many residential locations have been converted into commercial development or any other higher order uses such as Industrial or Institutional land uses, and low density residential developed into high density residential. The main objective is To give future allocation growth in Residential, Commercial and Industrial activities in the study area by using suitable integrated land use and transport planning model.

II. STUDYAREA

Study area is the corridor from Thiruvanmiyur to Mamallapuram along the East coast, of Tamil Nadu, India. Present study area witnessed rapid development during past decades in terms of urbanization, industrialization, and also population increase substantially. Mixed land uses are the exclusiveness of this study area. Due to the agglomerations large Peri urban area developed, where urban activities mix in big number with rural ones. This Peri urban area includes rural villages and small towns. This corridor mainly covers Institutions, Software industries, and other land use activities such as agriculture, salt pan, forest, etc., Beach resorts, leisure parks also located in this corridor due to this a large volume of vehicle trips attracted towards these activities. The study area with a buffer of 5KM around the IT corridor is as shown in the fig:1.

Data used:

Satellite imagery - IRS 1C + PAN merged data. Date of acquisition 9th July 2002.Resolution is 5.8m.

Socio economic data - Data regarding Population, Agricultural Workers, Cultivators, Other workers etc., taken from Census of India for the year1991 & 2001.

Village maps - Maps to a scale of 1:5000 from Survey and Land records.

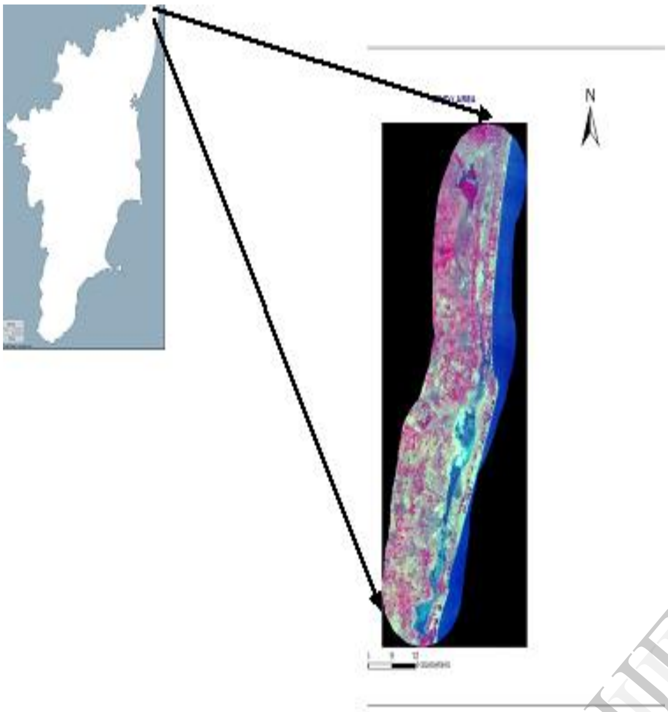

Fig:1

III. METHODOLOGY

A. PREPARATION OF LANDUSE LAYERS

The remote sensing data of geo referenced and merged data of IRS IC + PAN of 2002 in the digital mode are obtained from the National Remote Sensing Agency (NRSA), Government of India, Hyderabad, and used. The spatial resolutions of LISS III and PAN are 23.5 and 5.8 meters, and spectral resolutions are 4 and 1 meters, respectively. The study area is delineated from the imagery by using ERDAS image processing software. By giving GCP points at selected points the image is geo referenced .The geo referenced image is digitized in ARCINFO GIS software. After rectifying the undershoot, overshoot, labeling errors in the digitized map land use classifications given. The land use classification given as per and CMDA classifications up to the CMDA limit. For the remaining stretch NRSA classification has been carried out. Linear features such as road network railways, Buckingham canal, Features like agricultural, forest, saltpans, and salt affected lands, are digitized. Since the study area is along the east coast, the coastal features such as beach, Bay of Bengal, coastal sand are also digitized. The land use map is given as a general plan for running the Uplan model. The land use map is as shown in the fig 2.

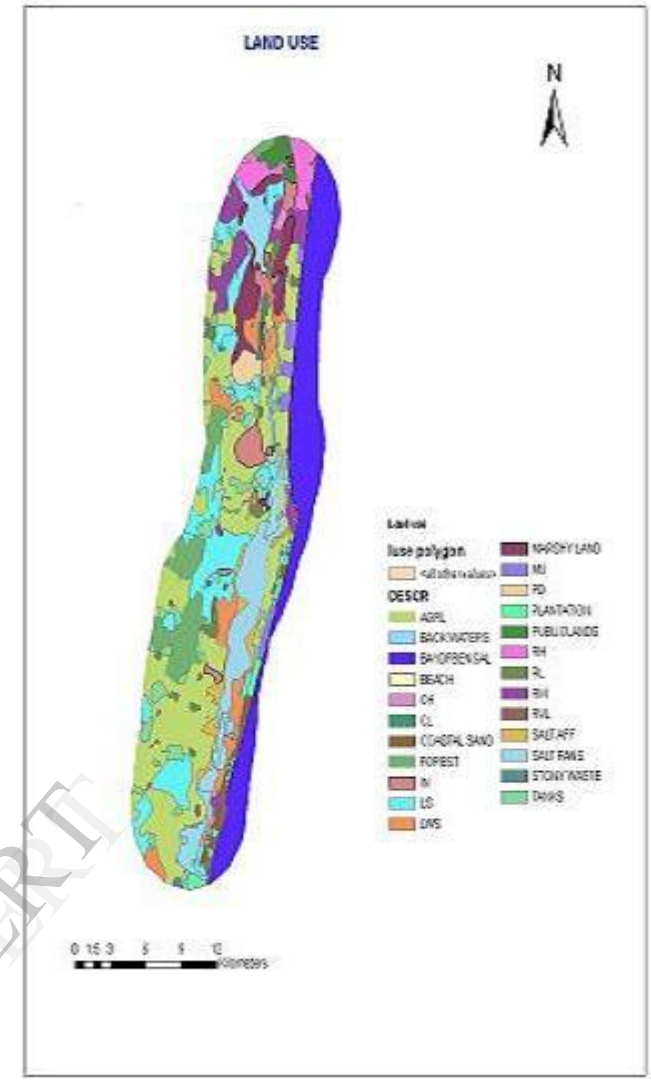

Fig:2

B. Transportation Networks

Since the proposed model is especiallay integrating transport network and Urban land use in generating the model the road net works that attracted for the urban settlements, the transportation network is digitized separately as an arc entity. The road network and railway network near the study area such as Old mamallapuram road, East coast road,MRTS, and other village roads are digitized in Arcinfo GIS as shown in the Fig 3.

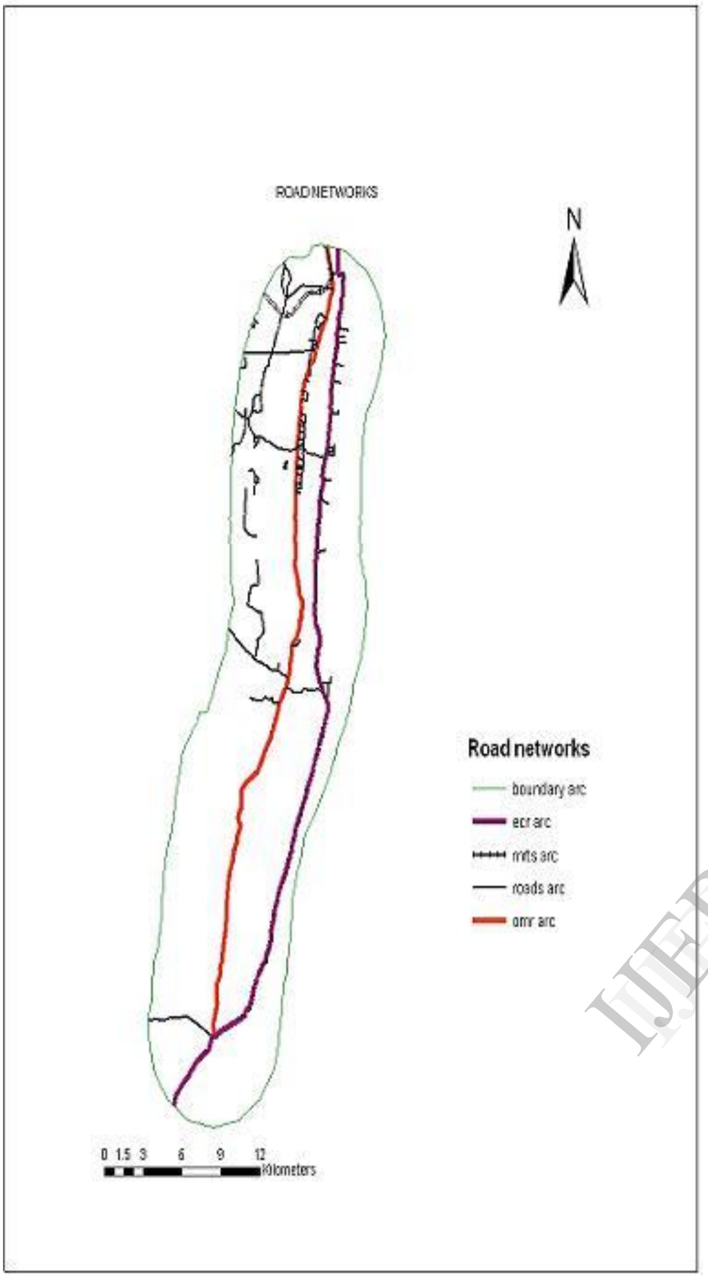

Fig:3

C. *General plan for the model*

The proposed integrated land use and transportation planning model requires a separate general plan for which features such as public lands, water bodies, urban developable lands are digitized. Land use classification based on activities such as High density residential, Medium density residential, Low density residential and Very low residential density, High density commercial, Low density commercial and Industrial are also digitized in the general plan of the study area.

All the coverages have been converted into Shape files using the Spatial Analyst tool in ArcViewGIS. The spatial analyst is a tool, which is used to understand the spatial relationship in the data. The main component of the spatial analyst is the grid theme. The shape files are then converted into grid themes by giving a suitable output grid extent, usually the shape file itself taken as the extent. A suitable cell size is given, since the model runs in 50m-grid cell size all the grid themes are converted to 50m. Lu-code has been taken as the conversion factor.

IV. MODEL BUILDING

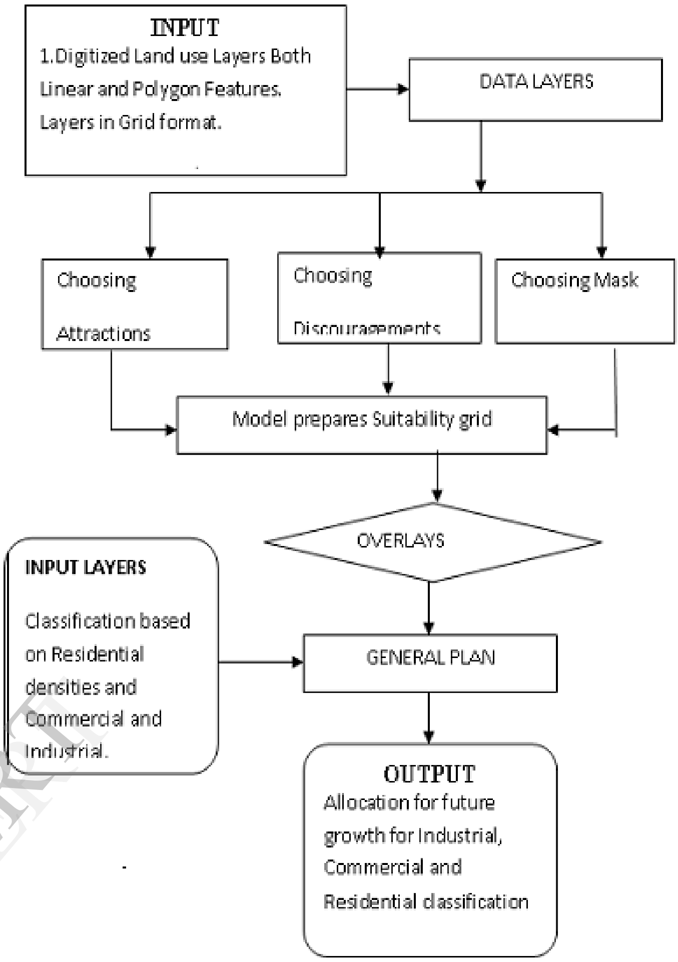

Fig4. Flow chart for modelling

This integrated model projects urban growth in the study area by using several land use layers

A. *Data Considerations*

The model uses grid spatial data sets because they require less disk space and reduces the model runtime, compared to vector data. Furthermore, each grid cell can roughly represent average parcel size, allowing detailed allocation results. The model currently uses 50m raster data, but runtime can be reduced as cell size increases (data sets also become smaller). . Grid data sets typically have attribute tables that are limited to two fields, cell values and a cell count of each of the values. This becomes important when constructing grid data that represent study areas and the general plan that applies to the study area. For each of these grids, the value field in the attribute table should consist of numbers that denote an analysis area or a land use type (e.g., 5 = high density residential). Normally, these numbers are included as a field in the vector data from which the grid was derived. Where this is the case, one can specify the vector field to be used as the value field when creating the grid in ArcView. This is important because the model refers to the grid values when looking for geographic and general plan areas that receive appropriate allocations.

B. Demographic Parameters

The conversion starts with population projections for the entire region. The details of persons per household, percent of households in each density class, and average parcel size for each density class are specified as input residential parameters. Similar details, such as workers per household, percent of workers in each employment class, and average area per worker (in acres) are used for employment parameters. The model produces a table of acres demanded for each land use category from which the model operates its allocation routine.

C. Attractions to Development

It is assumed that development occurs in areas that are attractive due to their proximity to existing urban areas and transportation facilities, such as highway ramps. It is also assumed that the closer a vacant property is to an attraction, the more likely it will be developed in the future. User-specified buffers surround each development attraction. The number and size of the buffer intervals and attractiveness weight can be given to each buffer. Buffer specifications are applied to each of the attraction grids and then the grids are overlaid and added together to make a composite Attraction Grid. The composite Attraction Grid is a single grid of the sum of the weights specified for each individual attraction grid. Each cell in this grid has a value resulting from the summation. Grid cells with the highest value are considered the most attractive areas for development.

D. Discouragements and Exclusions to Development

Areas where development cannot occur, called exclusions. Exclusions include features such as lakes and rivers, public open space, existing built-out urban areas, and other such areas. The model adds together the various exclusion grids to generate a Mask. Like the composite Attraction Grid, the Mask Grid is a sum of the individual exclusion grids. Any features, which will discourage development, can be used as discouragements. The user can specify the range of buffers. The discouragements will be combined with attractions to form a final attraction grid.

E. Allocation of Future Growth

Once the Attraction Grid and the Mask Grid are generated, the model overlays the two grids and attraction cells that fall within the mask are converted to no data cells, thereby removing them from possible development allocations. This process creates the Suitability Grid, which becomes the template for the allocation of projected land consumed in the future. The Suitability Grid is overlaid with a grid of the General Plan land use map for the region, enabling the model to further isolate areas, which are suitable for each of the land use categories that are allocated. The model is then ready to allocate projected acres of land consumed in the future.

V. CONCLUSION

The model gives an output of total allocation in different densities .It allocates in the order of Industrial, Commercial High density, Residential High density, Commercial low density, Residential Medium density, Residential low density and Residential very low density. The model allocates the future based on strict compliance such as it allocates the land use type of Industry to Industry and for Commercial High density to high density. It converts some cells, which are nearer to attraction grid and commercial low density to commercial high density. The model allocates High-density residential and Medium density residential as in general plan and the cells nearby attraction grid and existing urban area. The model changes the vacant land (urban land without scrub and urbanisable land) to Low density residential and Very low density residential.

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