

# Traffic problem in Kathmandu and Use of GIS in Urban Traffic Management

Authors: Anil Marsani\*, Jeni Rajbamshi\*\*

\* Corresponding Author: Transportation College, South East University, Nanjing-210096, China.

Email: - [anilmarsani@hotmail.com](mailto:anilmarsani@hotmail.com)

Tel: - 0086-25-83791509

\*\* GIS Unit, Nepasoft Solutions Pvt. Ltd., WDN, Kathmandu, Nepal.

Email:- [jeni@ccnep.com.np](mailto:jeni@ccnep.com.np)

## Abstract

This paper first points out the root causes of traffic problem in the capital city of Nepal (Kathmandu) and hence some of the remedial measures to solve the problems are put forward along with the introduction of the concept of urban traffic management planning which is relatively new in the context of Nepal. At last this paper gives a comprehensive view to how GIS can be applied in the field of urban traffic management especially focusing on the travel demand analysis.

*Keywords: urban transport, traffic problem, remedial measures, traffic management planning, GIS technology, travel demand analysis, urban traffic management.*

## 1. Introduction to Present day Traffic Scenario in Kathmandu Valley

During the past some years, the populations of many have doubled and this is accompanied by the rapid growth of city centers. In Nepal, although fast urban growth is fairly recent, around 5% annual population growth rate of Kathmandu (table-1) generates a strong demand for the further land development, expansion of infrastructure and other important urban services. These changes have placed new and heavy demands on urban transport that the city has been unable to meet. This problem is particularly acute in the case of Nepal because of the lack of resources and the very high cost of transport infrastructure. It has arisen more rapidly and officials have been less able to deal with it as the major roads and the networks are generally small and of low standard. Beyond the failure to match supply and demand, the problem is exacerbated by failure to use the available roads efficiently. The main traffic problems that exist in the city can be summarized as below.

- Small road space available for roads despite higher number of vehicles most of them being two and three wheelers (table-2).
- Heavy traffic congestion despite low level of private car ownership (table-2)
- Increasing level of accidents in terms of numbers and severity (table-3).
- Mixed traffic condition: Wide variety of traffic sharing the limited right of way is a serious factor in congestion. Most road sections in Kathmandu city are not channelized for motor vehicles, bicycles and pedestrians.
- Scarce parking spaces: There are only 13 authorized paid-parking zones in Kathmandu Metropolitan city which are mostly situated at the city centers like Bishal Bazar in New Road, Bir Hospital vicinity and Durbar Marg area.
- Inadequate public transport services: The development of public transport is often hindered by a lack of capacity, low operating speed, and outdated equipment and management practices. As there is no single bus terminus and very little traffic related information on display it is very difficult to find different places from where buses leave.
- Lack of attention to pedestrians and cyclists in planning and managing roads
- Poor road maintenance: Roads are inadequately maintained. Visual inspection and evaluation of road network conditions show failures of the road pavement. A key factor contributing to this situation is the lack of funding for the maintenance by the government.

- Poor road users behavior: The striking feature of the city traffic is the poor driving behavior. Our license issuing system is also extremely unscientific and impractical, and it is helping in adding traffic accidents indirectly. It is reported that in Kathmandu valley the number of accidents are higher than in the rest parts of Nepal and it can be said that the root cause of increasing traffic accidents is the lack of traffic awareness among drivers and also pedestrians.
- Encroachment of road space and footpaths by street shops, illegal parking etc.
- Inadequate and inefficient traffic control measures: The reduced road capacity of the city is due to uncontrolled parking of vehicles of all kinds and ineffective signal timings and other traffic control measures. Manual control of junctions at peak hours is often required and traffic signal timings are not appropriate. None of all the existing traffic signals in the urban area are coordinated, most of them operating under two phase fixed time control. The majority of the junctions have not been channelized and sometimes traffic island itself is creating the traffic problem due to its inappropriate placement and bad design. Traffic signs and markings are too much insufficient. There is still a striking need for better provision of pedestrian crossing facilities to give pedestrians safer ways to cross the road.
- Air and Noise pollution: According to a report published by the Nepal Health Research Council, noise level at the Bir Hospital area is on an average of 80- 85 decibels (DBA) that is 54.5 and 21 per cent higher than the recommendations made by the United States Environment Protection Agency (USEPA) and the World Health Organization (WHO) respectively.
- Urban patterns: Physical patterns of cities also compound the difficulties. Central business districts are typically not so clearly demarcated as in the developed world. The main activities centers are however often concentrated in narrow streets prone to the intense congestion.

## 2. Remedial Measures: -

As mentioned earlier, with the rapid growth in demand for transport, Kathmandu is facing serious traffic problems. The immediate concern in the city is to maintain the existing levels of service of the road system and personal mobility, whilst reducing the potential for road accidents. For this, traffic management measures are to be utilized which typically will include junction improvements, one way streets, segregation of two wheel vehicles with motor vehicle, channelization, markings, signaling, selective road widening and provision of pedestrian facilities, continuous traffic awareness program through the involvement of all the sectors of the society. But traffic management is the concern of the number of policy and executive agencies. As a result there is pressing need for close coordination, effective decision making machinery and enforcement, and clearly defined responsibilities because the success or failure of traffic management measures largely depend on the institutional arrangements. If the traffic management is to be truly effective in contributing towards the development of an efficient and safe urban transport system, it must interface and be coordinated with five other areas of responsibilities, which include:

- ❖ Strategic planning of urban development
- ❖ Engineering, design and construction of transport infrastructure
- ❖ Public road operations
- ❖ Road safety programs
- ❖ Law enforcement

The following steps are helpful in managing the traffic problem of the Kathmandu city:

- **Change in Urban Pattern:** - Land use must be arranged so that residential areas are mixed (in income and type) and are provided with nearby opportunities for employment, shopping, education and entertainment, as much as these things can be efficiently provided on a local scale. With this the demand management for the transport facilities

can be pursued efficiently. There is also a need to correct structural deficiencies in the road network while improving traffic management. The roads should be widened where possible and necessary and intersections should be redesigned to optimize its capacity.

- **Road safety:** - From a traffic management perspective, the requirement is to optimize both road safety and the need to ensure public mobility. Consideration of the needs of the most vulnerable traveler groups, cyclists and pedestrians, should be adequately addressed by providing separate cycle track and enough space for the footpath. All of the concerned agencies including the traffic police, department of roads, department of transport management, municipalities, private vehicle entrepreneurs should have better coordination to prevent accidents.
- **Public transport:** - There is an urgent need to finance on public transportation sector by the government. The trolley bus and “Sajha” Bus in the valley have restarted their services recently but their management still needs to be restructured. There is a need to improve public transport sector by replacing expired assets, catching up on maintenance and rehabilitation backlogs and expanding capacity. A policy is needed which a) maximizes operational efficiency of public transport b) improve cost recovery by setting fares at a reasonable level and c) sets user charges for private sector modes at a level which recognizes true costs and uses the revenues to assist public transport.
- **Air pollution:** - Combating the air pollution problem in the Kathmandu valley requires the introduction of efficient transportation system. Environment friendly vehicles (like Electric Vehicles) have a reduced noise level. They are appropriate because EV operations suit low traffic speeds, short traveling distances, and mobility in narrow roads. Therefore EV operation should be accorded a high priority in the context of the ever-deteriorating air quality of Kathmandu but it may have some problem in the undulated areas due to its tractive power.
- **Parking control:** - Parking control is an important traffic control management tool. There is a need to carry out a parking study in order to develop a parking plan for the city that is coordinated with other road network, traffic management measures and urban development strategy. Some open space available can be effectively used for this purpose and bus bays are to be constructed for the public bus service in the city.
- **Urban traffic control measures:** - In their most simple form, such systems may control one or a few sets of traffic signals, often incorporating some form of co-ordination in order to minimize overall travel time. More complex systems may be demand responsive either optimizing a particular set of traffic signals or a wider grouping of signals. Further developments of such systems allow the detection of incidents such as accidents, the provision of special priority for emergency vehicles, priority to public transport vehicles and travel information systems, which issue warnings of delays, or parking information. The use modern traffic management system like Intelligent Transportation System (ITS) should be gradually started in the city to cope with the traffic problem. The use of GIS technology in city’s urban traffic management should be gradually introduced.

### 3. Concept of Urban Traffic Management Planning

Over the past some decades, the solution approach of urban transportation problem in the developed countries has changed from capital-intensive to management-intensive schemes. It has been recognized that many transport problems can be resolved without large-scale investment in transport facilities. But the transportation facilities in the developing country like Nepal are far from required and the available facilities are also not evenly distributed. Therefore implementation of efficient traffic management plans and the construction of basic transport infrastructures should be conducted side by side. It should be noted that emphasizing only in the construction of facilities is not going to solve the urban traffic problem as the construction of new transportation facilities, though reduces the travel time, but also

produces new demand, and after some period of time the new level of congestion will be reached.

As the urban traffic management is the sole direction in solving the urban transport problem, there should be a scientific solution to the questions like what does urban traffic planning do, what is the target group, when, where and how to apply the urban traffic management schemes. Answers to these questions have given scope to the development of the concept of urban traffic management planning. It is a scientific process of determining the rules of vehicle movement (transporting objects) in the urban road network and the policies to obtain the required target or the operational process.

In the context of Nepal, there is lack of serious attention by the concerned authorities in the field of urban traffic management. There is no institution involved in conducting the systematic study of urban traffic management planning which results in the lack of theoretical basis for management techniques that further causes inappropriate decision-making and further wasting of scarce resources. In addition, whole burden of traffic management is carried by traffic police. So there is an urgent need for the institute building with sufficient human and physical resources to perform the traffic management task and to conduct the study on traffic management planning to produce some results in this field that is best suited to the traffic condition of the country.

#### **4. GIS in Urban Traffic Management**

Urban traffic management being a spatial phenomenon can be effectively managed by GIS technology. This is because most of the data related to urban transportation have spatial distribution characteristics and GIS is the effective method in processing these kind of data. Though GIS technology is being successfully applied in many areas within the country, its use in transportation field is not so obvious till this date. The following are some of the areas from where the use of GIS can be started:

- Transport planning: - Urban traffic planning should be based on the reliable traffic data which can be of the following two types viz. traffic survey data (survey data related to individual's travel, vehicles travel, road side interview, public transportation, traffic volume, land use, road facilities etc.) and traffic survey related data which can be urban road related data (length, travel distance, passenger seats on vehicles etc.), public transport related data, census data (distribution of population, residential areas, job locations etc.), land area (city centers, CBDs, suburban areas, government office areas etc.). All these data have spatial characteristics and GIS can be used to produce traffic characteristics distribution maps like land use distribution maps, urban roads/traffic facilities distribution maps, traffic production/attraction center distribution maps. These kinds of maps can be used in analyzing characteristics of present and future urban transport.
- GIS also has the network analysis capacity, which can be used in urban road network to determine shortest path, route choice, network corrections etc. The concrete and visible information provided by GIS makes urban transport planners and decision makers more convenient.
- Traffic demand analysis: GIS not only can be used to store traffic data but the latest trend is to concentrate on the development of traffic analysis models. Spatial analysis technique of GIS provides the opportunity for the developments of disaggregate demand modeling, which is based on individual's travel behavior. The spatial analysis technique of addresses and network can support the disaggregate demand modeling in traffic survey, modal development etc. GIS can also be used for the integration of land use and transport analysis model, which are two important aspects of traffic analysis.
- Public transportation: Depiction of bus routes on road maps at selected bus stops (in addition to depicting all bus routes passing via the bus stops), the details of bus timings

and frequency along with the origin and destinations. Web based GIS can provide bus routes and timings, distance-fare calculations and driving directions.

- Traffic management: By the use of GIS and GPS, the locations of vehicles can be continuously tracked at any point of time in the network. For this, the vehicles should be fitted with small GPS device so that the central traffic control room can view and analyze every vehicle on the roads. By the use of this advanced technology it is also possible to generate alternate routes in case of congestion and to know the number of vehicles plying on the roads everyday. This data can be stored and used for traffic planning and management. Data related to number of vehicles, information about the congested road sections, details of alternate roads, availability of parking spaces etc. can be displayed in electronic message boards that can be installed at important junctions, road sections or even on the internet. This kind of information can be disseminated using FM radios at certain time interval.

By the use of GIS technology in urban traffic management, the following major benefits can be achieved:

- Timely receiving of spatial and non-spatial data during model development
- Minimum loss of information during the data collection
- More frequent data capturing and updating for the respective database
- More meaningful presentation of transportation analysis reports with the help of supportive information available with another agencies

## 5. Conclusion: -

The urban transport problem is fundamentally similar in all large cities throughout the world. The basic causes are the same and so are many of the consequences although there are some differences of degree between developed and developing cities. But while the problems are similar, the solutions are not. Rich cities can afford motorways, multistory car parks, rapid transit and sophisticated control systems but in the case of Nepal and its capital Kathmandu it is irrelevant since it can't afford them anyway. The only possible solution at present is a low cost solution, which in practice means extensive bus priorities, traffic management and traffic restraint together with selective road improvements. And for this purpose there is a great need of proper transport management planning to determine cost effective solution. There should also be long-term policy to gradually implement modern traffic management measures like ITS and can be started by the use of GIS technology in the field of urban traffic management.

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