GIS Based Composite Delhi Metro Map for Reduced Vehicular Pollution

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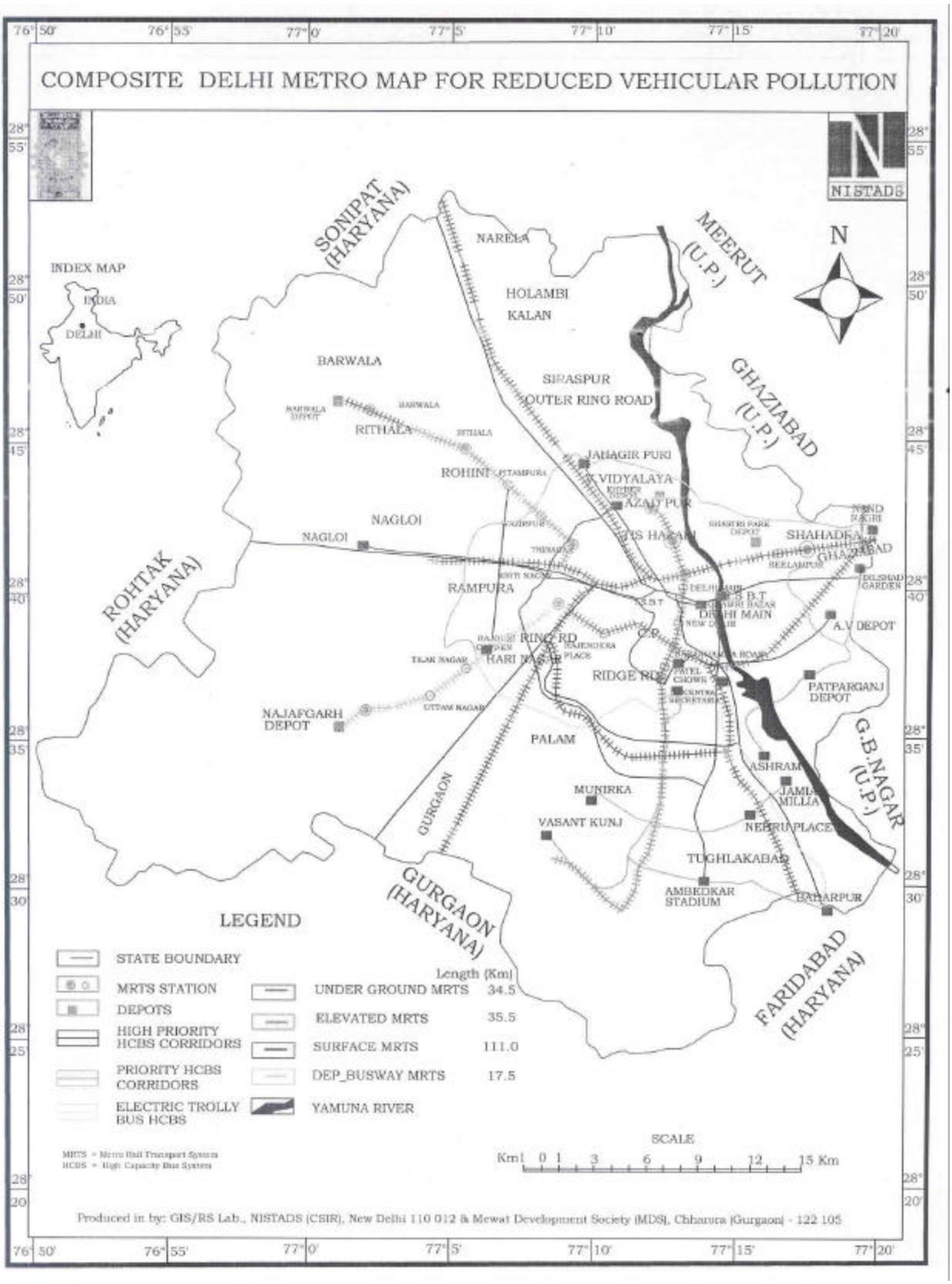
Abstract
Since the increase usage of mapping technology and growing awareness of utility of spatial data in developmental planning, an attempt is made to generate GIS Based Composite Delhi Metro Map specifically to keep in view the reduction in Vehicular Pollution. The National Capital Territory of Delhi covers an area of 1486 sq Kms. The number of Motor Vehicles in Delhi is greater than numbers put together for Mumbai, Calcutta & Chennai metropolitan cities of India. According to an estimate[1], the vehicular traffic contribution alone has increased from 64% to 72% in the last decade in Delhi. The heavy increase in the number of vehicles and consumption of petrol and diesel has contributed significantly. The main sources of pollution in Delhi are motor vehicles 64% - in which 70% are from two-wheelers; power plants 16%; industries 12%; and domestic 8%. On other side, the average number of persons killed per day on roads is five while injured is thirteen and buses contribute to majority of these accidents.

Based on the exhaustive studies on traffic and travel characteristics of Delhi in 1969-70 conducted by the Central Road Research Institute (CRRI), a constituent establishment of Council of Scientific & Industrial Research (CSIR), New Delhi, a recommendation was made for the Mass Rapid Transit Network for Delhi, which after subsequent reviews and modifications, led to an Integrated Multi Modal Mass Rapid Transport System (IMMRTS) for the city and finally it resulted in establishment of Delhi Metro Rail Corporation (DMRC), which was registered on 03-05-1995 under the Companies Act, 1956[2]. For creating a better environment, DMRC is viewed as a 'social sector' project. It is expected that it's benefits will pervade over wide sections of the society. For example, in first phase[2], 21.82 lakh commuter trips per day will be siphoned off the roads, which mean 2,600 less buses on the roads; increase in average speed of road buses from 10.5 km/h to 14 km/h; saving of 26 lakh man hours per day due to reduced journey time; saving in fuel cost worth Rs 500 crores per year; more comfortable and safe travel for the commuters; reduction in accident rates; improvement in the quality of life and reduction in atmospheric pollution. In this phase of Mass Rapid Transit System (MRTS) is expected to be completed by 2005, which is claimed to be one of the most eco-friendly projects in Delhi as it is to be built up using the latest technical now how available in Metro Systems worldwide. The proper care is being taken that 30% of trees in the alignment are saved and it is also ensured that adequate compensatory forestry in consultation with the forest department of Delhi is to be raised in place of all trees and shrubs affected by the construction etc of Mass Rapid Transit System (MRTS). The close check is to be kept on air and noise pollution during construction and adequate rehabilitation and fire protection measures to ensure minimum inconvenience to the public.

In fact, a detailed Environmental Impact Assessment has been done during 1994 to minimize the negative environmental impact of the project particularly at construction stage. Rainwater drains have been identified at various sites for drainage of wastewater from construction and sites have been earmarked at convenient locations for temporary and permanent disposal of soil erosion out of tunneling

and other construction works. In this phase of the project, 38.596 ha of railway land, 180.2357 ha of non-railway government and semi government land and 187.98 ha of private land is to be acquired. The proper rehabilitation and re-settlement of persons affected by the project as well as the coordination work of various bodies to control traffic, water supply, and electricity, telephone lines etc. is to be attempted to provide an efficient and fast transportation system to the people of Delhi with minimum inconvenience[2].

The use of GIS is extremely advantageous for urban networks such as railway network and road network. In the present study, the PC ARC/INFO is used along with other software to generate the composite Delhi metro map. The main outputs of the study was GIS based composite Delhi metro map for reduced vehicular pollution **(Map 1)** containing length in kilometer - underground; elevated; surface; MRTS stations; depots; high priority high capacity bus systems (HCBS) corridors and priority HCBS corridors; electric trolly bus HCBS, etc. It was possible to have a digital metro map for the city and to create data tables connected directly to it at a proper scale, which enable a complex network to be easily and economically maintained effectively. This would also help to decrease costs and increase people's standard of living, take less time and less excavation and road repair works in the city.



Map 1

According to a report[3] of the high powered committee on comprehensive action plan on environment & pollution control in Delhi submitted in 1994, vehicular pollution accounts for more than 2/3rd of the total air pollution in Delhi. In the year 1991, the quantity of emissions is estimated to have increased from 670 MT/day in the year 1987 to about 1800 MT/day. Though transport department of Delhi has launched a vigorous drive for checking vehicular pollution and accordingly 117 petrol pumps have been authorized to check vehicular pollution and also allowed to issue pollution control certificates/fitness certificates. Consequently, more than 13.5 lakh vehicles have been checked, out of which about 4.5 lakh vehicles were found polluting beyond the standards during March 1990 and June 1994 by the state transport department. It had made 10 special squads for enforcing the vehicular pollution. These squads have challaned 34,888 vehicles and has cancelled more than 95,000 pollution under control (PUC) certificates and more than 8,000 certificate of fitness (COF) during April 1990 and June 1994. The department has challaned about 798 vehicles at an average of four vehicles per day, at six out of the seven identified critical locations, during January and July 1994. The Ministry of Surface Transport has also specified mass standards for vehicles at the manufacturing stage effective from 1996.

It was observed that steep rise in vehicular pollution in Delhi is attributable to corresponding steep rise in the number of all registered vehicles in the city. An analysis of last 14 years i.e. 1971-94 shows this trend quiets significantly. In Delhi, in 1994, the motorcycles and scooters constitute 66.64% followed by cars and jeeps (23.32%). The goods vehicles were 5.2% followed by auto-rickshaws (3.22%), buses (1.08%) and taxies (0.53%). GIS database of these vehicles as well as the details of the rail network facilities helps developing system for easier maintenance, high quality treatment and thus application of information in much mode is necessary for effective and economic decision making, therefore the analysis and application of GIS for rail transport only using PC ARC/INFO along with other software such as AutoCAD Map, MapInfo used in this application are discussed here.

It is noted during the exercise that a large amount of information have to be processed and for quality information and therefore higher quantity of system storage for applications such as metro rails, require highly efficient information technology systems. In particular, there are many conditions, which are still valid within rail transport, therefore it is necessary to keep certain register systems of rail links as well, especially from the point of view of the placement of the rail network basic facilities. Such arrangement will help to increase transport efficiency and fluidity and decrease fault liability and the number of accidents to a greater accident. Further, such system will also reduce maintenance, services and designing expenses. The high number of specifications concerning e.g. objects placed in existing areas, towns, institutions and/or authorities need to be maintained. The use of GIS is extremely advantageous for urban networks such as railway network and road network as found in earlier study as well[4].

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The need while using a GIS is to create an open system, as during its future use other needs may occur, which are to be taken into account in the base analysis and preparation of original functional GIS version.

All GIS components must be able to work with standard formats, both text and graphic. Thus, there must be full data compatibility of the different computer programmes used within the newly built GIS. "Acquiring a quality map base may be a relatively costly but necessary. However, it may take years to build the system, so it is very important to utilize existing map bases"[4]. Such studies also explain the possibility of GIS applications in similar areas to display a train network within one map and also to create data tables connected directly to a digitized map, which enable a complex network to be easily and economically maintained or repaired and partially or completely reconstructed. Therefore such a GIS system can find the necessary data quickly and effectively and does not require a large amount of valuable storage space etc. Hence, one can create a unified GIS system for metro rail.

Delhi metro GIS may assists in implementing major recommendations and suggestions such as follows, which are based on the considerations of all the inputs relating to the vehicular pollution problems in Delhi and are based on the points raised and valuable suggestions made in the report of the high powered committee on comprehensive action plan on environment & pollution control in Delhi[3] :

1. In Delhi, vehicular pollution checking including government vehicles should be made more effective and vehicular pollution control more stringent.
2. Some selected areas, which require immediate attention includes Old Delhi Railway Station, Connaught Place (may be made vehicle free zone in the long run), Chandni Chowk, Daryaganj Crossing, Shakarpur Crossing, Dhaula Kuan, Ashram Crossing.
3. Synchronisation in traffic lights depending on traffic density should be attempted.
4. Bus stops should not be provided near traffic crossing and roundabouts and halting time/red light time should be displayed at the crossing and mass awareness needs to be created to stop the vehicle engine if the halting time is more.
5. Public transport system with CNG fuel may be experimented and sufficient CNG should be made available while operating agencies may simultaneously ensure proper maintenance of these vehicles.
6. More fly overs to be provided on traffic junctions particularly on the ring road.
7. Mass Rapid Transport System (MRTS) should be strengthened and circular railway should be re-activated with greater frequency of operation.
8. Construction of bye passes should be expedited to divert through traffic outside Delhi.

REFERENCES:

1. State of Environment Report for Delhi 2001; TERI & Department of Environment, Govt. of National Capital Territory, Delhi

2. www.delhimetrorail.com

3. Report of the High Powered Committee on Comprehensive Action Plan on Environment & Pollution Control in Delhi, 1994

4. Jaroslav Smutny, Urban Geographic System of Rail Transport using ArcInfo, Department of Railway Constructions and Structures, Faculty of Civil Engineering, Technical University of Brno, Czech Republic

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