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STRUCTURAL VARIATIONS IN THE CITIES OF ASSAM AND THE USAGE OF PARATRANSIT MODES

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ABSTRACT

The use of paratransit modes with respect to the structural variation in the cities of Assam has been evaluated in this study. Three cities have been selected for the study considering the type of vehicular movements and the size of the city. The structural variations in the three cities has been studied with respect to their physical size, population, population distribution, land use location and distribution and transport network characteristics. The shares of passenger carried by each mode were obtained from traffic volume survey and vehicular occupancy survey conducted by the author in all the three cities under consideration. The variations of modal share in the cities have been explained with respect to the structural changes of the cities. The paratransit users in the cities of Assam have been identified in terms of mode captivity and household income.

1. INTRODUCTION

The topography of the cities of Assam is either hilly with occasional stiff gradients or flat. Guwahati, the capital of Assam, is a hilly city with varying gradients along the roads from 1: 400 to 1: 15 while Dibrugarh and Barpeta are on flat lands with average road gradient of about 1: 300. In spite of the variations in road gradients paratransit modes both fast and slow-moving operate in the cities due to (a) low levels of vehicular ownership, (b) availability of cheap labour to operate paratransit vehicles and (c) low density dispersed development in the cities.

Operation of transit service like city buses is not economically feasible in the small and medium size cities like Barpeta and Dibrugarh due to low passenger volumes. Paratransit modes like cycle rickshaws and auto rickshaws play a major role in transportation of urban passengers in these cities. Paratransit also plays a significant role in Guwahati, where city buses are the major public transportation mode. Paratransit provides feeder service to the public mass transportation system in the city core while in the fringe areas they are the only public transport modes in operation. As stated by Vuchic, 1979 "...low travel volumes are best served by low investment low capacity modes; with increasing volumes higher investment / higher capacity modes become superior in terms of both performance and operation...". The streets in majority of the cities are ".....irregular in pattern, narrow and crooked. The main vehicular thoroughfares are rarely more than thirty or forty feet in width, often without

sidewalks, and encroached upon by booths and the projecting open fronts of the shops which line them. The side streets and alleys are usually much narrower and so crooked as to be almost impassable for wheeled vehicles" (Brush, 1962). Cycle rickshaws operate through these narrow streets. Auto rickshaw can also operate through these narrow secondary streets, which are not accessible to the buses.

With the increase in city size the area of operation of the paratransit modes get limited. In the small urban areas like Barpeta the slow-moving paratransit such as cycle rickshaws traverse the entire extent of the town. In Dibrugarh the operation of cycle rickshaws are limited to zonal levels while fast moving auto rickshaws traverse the entire extent of the city. Cycle rickshaws operate locally in Guwahati. They operate within a particular locality of the city while the fast moving paratransit modes like auto rickshaws and taxis operate throughout the city.

Bicycle and cycle rickshaws are the predominant modes of transportation in these small urban areas and most of the urban areas of the region fall under this category. Cycle rickshaws are the only mode of public transportation in these towns. As the population increases beyond 50,000 the auto rickshaws start growing in addition to the existing cycle rickshaws. Mass transit systems like city bus services are found to be viable for cities with population size of about 5 lakhs or more. Guwahati, with population size of about 8 lakhs is the only city of the region with extensive city bus service in addition to the paratransit services.

2. CASE STUDY OF THE SELECTED CITIES

Three cities have been selected for the present study considering the type of vehicular movements and the size of the city. Barpeta, the district headquarters, is a small township with population of about 50,000. Cycle rickshaws are the predominant mode of public transport in this town. Dibrugarh with a population of about 130,000 is the administrative headquarters of Dibrugarh district. Both cycle rickshaw and auto rickshaw play important roles in movement of people in the city. Guwahati, the Capital of Assam and the district headquarters of Kamrup district, is situated on the southern bank of the river Brahmaputra. The population of the city is about 800,000. It acts as the nodal centre for the seven states of the north eastern region of India. The city bus service plays a major role in urban passenger movement in Guwahati while the operation of cycle rickshaw is localized.

2.1 Location of the Cities

The three cities selected for this study are situated in Assam and are located between 90° and 95° East longitudes and between 26° and 28° North latitudes. Barpeta is located in lower Assam (to the west) whereas Dibrugarh is in upper Assam (to the east) and Guwahati is in the upper half of lower Assam (in between).

Barpeta is located on the north bank of mighty river Brahmaputra, 140 km north-west of Guwahati. The town is connected to Guwahati by state highway via Doulasal and Hajo. There is also an alternative roadway to Guwahati via NH – 31, which bypasses the town at a distance of 12 km. The railway does not connect to the town directly. Barpeta Road at a distance of about 23 km away from Barpeta is the nearest railway station.

Dibrugarh is surrounded by tea gardens with the Himalayas in the background. The town as its name implies was built on the south bank of the river Dibru, a small tributary of the river Brahmaputra. In the course of time the river Dibru was encroached upon by the river Brahmaputra, and thus bringing the town to its bank. Dibrugarh is 448 kms from Guwahati in the east and 48 kms from Tinsukia in the west. NH-37 passes through

the city. It is well connected by road, rail and air with other important towns of Assam and the rest of the Country.

Guwahati, the nodal city of north eastern region, is situated in between Barpeta and Dibrugarh. The River Brahmaputra flows through the northern half of the city. Though the main city lies in the southern bank of the Brahmaputra, the northern bank is also developing as an industrial belt. The north, south and eastern sides are surrounded by rows of wooded hillocks. In the centre of the river Brahmaputra there is a rocky island in which the famous 'Umananda' temple is located. The city is well connected to the rest of the country by road, rail and air.

2.2 Structural Variation of the Cities

The structure of a city influences the use of the alternative modes to a great extent. "The structure of a given city refers to a particular articulation of its adapted spaces" (Hutchinson, 1974). The variations of structure bring about changes in the distance of travel and quantum of travel. The topographical variations of a city also bring about changes in the levels of utility of the different category of paratransit modes. These changes coupled with the income of people and the quality of demand is responsible for the use of multiple modes in the cities of Assam. In this study, the variations in the use of paratransit modes are studied with the reference to (a) size in terms of physical extent and population; (b) location and distribution of activities; and (c) transport network characteristics.

Physical Extent and Population: The size of the city is one of the major factors, which determine the choice of vehicular mode for intra city movement. As the size in terms of physical extent and population increases, new and faster modes start operating. The introduction of faster modes does not mean the removal of existing slow-moving modes. They remain operative at the local levels serving the short distance trips.

Population density is one of the determinants for existence of a particular mode of travel. For a low-density sparsely developed city, buses are not economically viable but smaller vehicles like auto-rickshaw and cycle rickshaw may be ideal modes.

Table 1: Size and Population of the Chosen Cities

City	Size(Sq. Km)	Population(1991 Census)	Density (1991, Persons/ Sq. Km)	Population (2001 Census)	Density (2001, Persons/ Sq. Km)
Barpeta	3.86	25,387	6,577	41,175	10,667
Dibrugarh	16.13	125,667	7,791	127,805	7,924
Guwahati	224.79	596,927	2,655	824,152	3,666

Sources: Town Directory, Assam, Census of India 1991. <http://censusindia.net/> (for 2001)

A low level of employment in the cities and their regions is the major cause of availability of cheap labour willing to operate paratransit vehicles for a bare minimum living. These together with the low-density development have increased the levels of utility of paratransit modes in the cities of Assam. The size, population and population density for the year 1991 and 2001 of the three cities are indicated in Table 1.

Barpeta: Barpeta municipal town is about 2 km x 2 km square covering an area of 3.86 sq km. The maximum distance one has to travel is about 2 km to come to the main market area. The bus stand is situated within the central business district (CBD) area. The distance can conveniently be traversed by walking or slow-moving modes such as bicycle or cycle-rickshaw. The population density of Barpeta in 1991 was 6,577 persons per sq. km. The population increased to 41,175 with a density of 10,667 persons per sq. km in the year 2001. Though the population density is found to be highest among the cities, the city bus service does not exist in Barpeta due to bear minimum size and population.

Dibrugarh: Dibrugarh is a medium size city with an area of 16.13 sq. km and population of 127,805 according to the 2001 census. The maximum stretch of the city is about 8 km in east-west direction. The population of Dibrugarh was only 80,348 in 1971, which reached the figure 127,805 in 2001. The growth was due to establishment of government offices, establishment of various higher educational institutions, growth of commercial activities and rural urban migration. Auto-rickshaws operate all over the city and are found to be the main public transportation mode. Cycle rickshaws operate at the local level. Though city bus services were introduced it could not be continued due less passenger volume.

Guwahati: Guwahati is the largest and fast growing urban agglomeration in the north-eastern region. It is major centre of trade, commerce, education and cultural in the north eastern region of India. The city was developed as a linear city along the river Brahmaputra. The longest stretch of the city is about 25 km from east to west and about 13 km in the north south direction. The population of the city in 2001 was 824,152 with an area of 224.79 sq. km. The population density in Guwahati is very low (Table 1) due to presence of hillocks and large water bodies. City bus service is catering the major passenger movement in the city. Though auto-rickshaws operate throughout the city, cycle-rickshaws are operated locally as the city stretch is beyond the reach of traverse by the mode.

Major Activities of the Cities - Location and Distribution: The major urban activities in the cities of Assam are commercial, institutional, educational, health, transportation, industrial and recreational. The trip distance of these activity centres from the residence plays a major role in selection of the mode for travel. A shorter trip may be performed on foot or bicycle or cycle-rickshaw but as the trip length increase automated fast modes come into operation. Public mass transport systems become economical when an activity centre attracts large number of trips at specific hours of the day. The existing landuse maps of the three selected cities are indicated in Fig. 1, 2 and 3. The landuse patterns of the cities are shown in Table 2. It is observed from the table that about 50 percent of the developed area in the cities is occupied by residential activity. Commercial landuse is found to be adequate where as industrial activity is almost negligible in all the three cities under consideration. This is why the major arterial roads in all the cities are passing through or near the commercial hubs. The

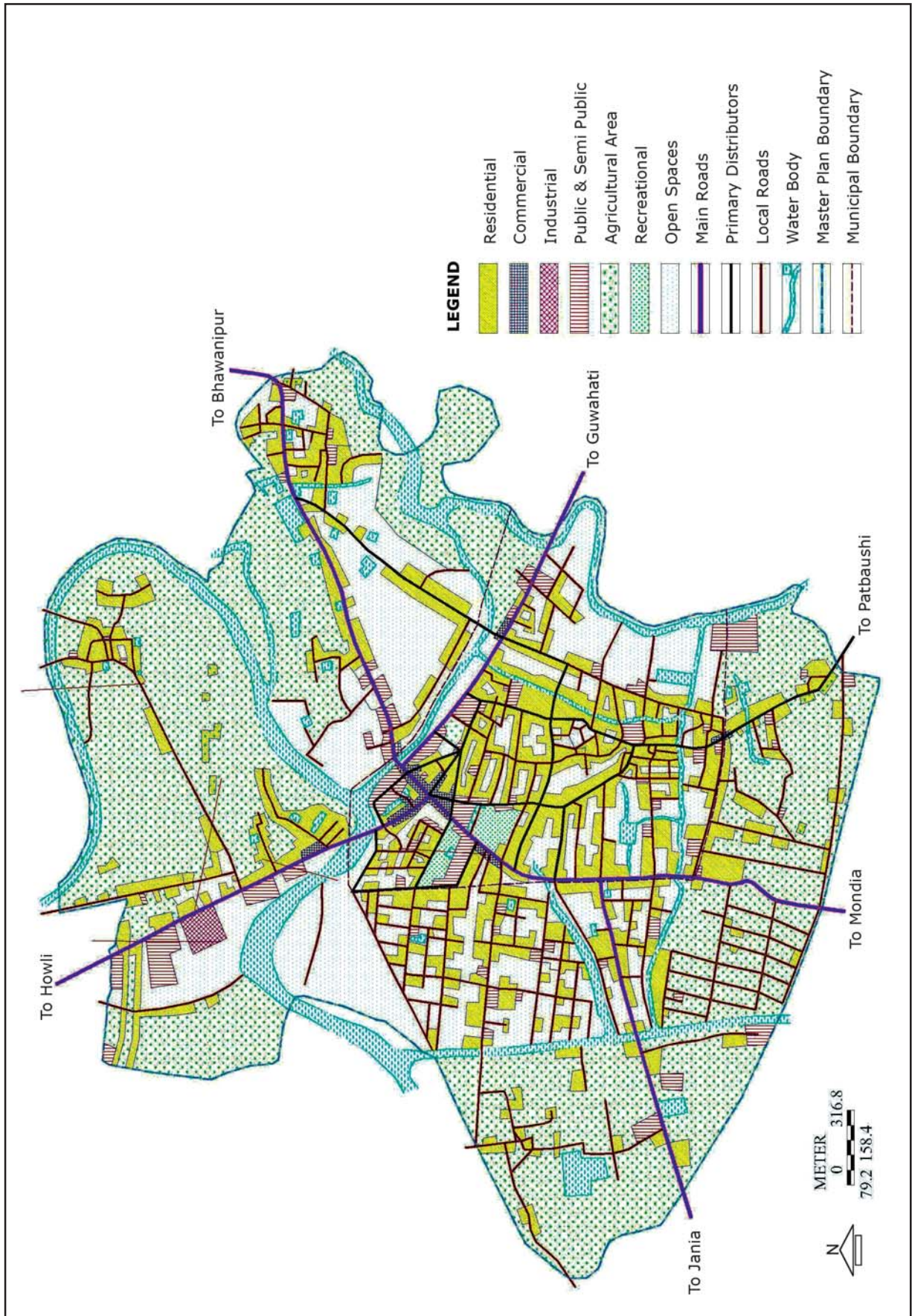


Fig. 1: Existing Landuse Plan: Master Plan Area Barpeta

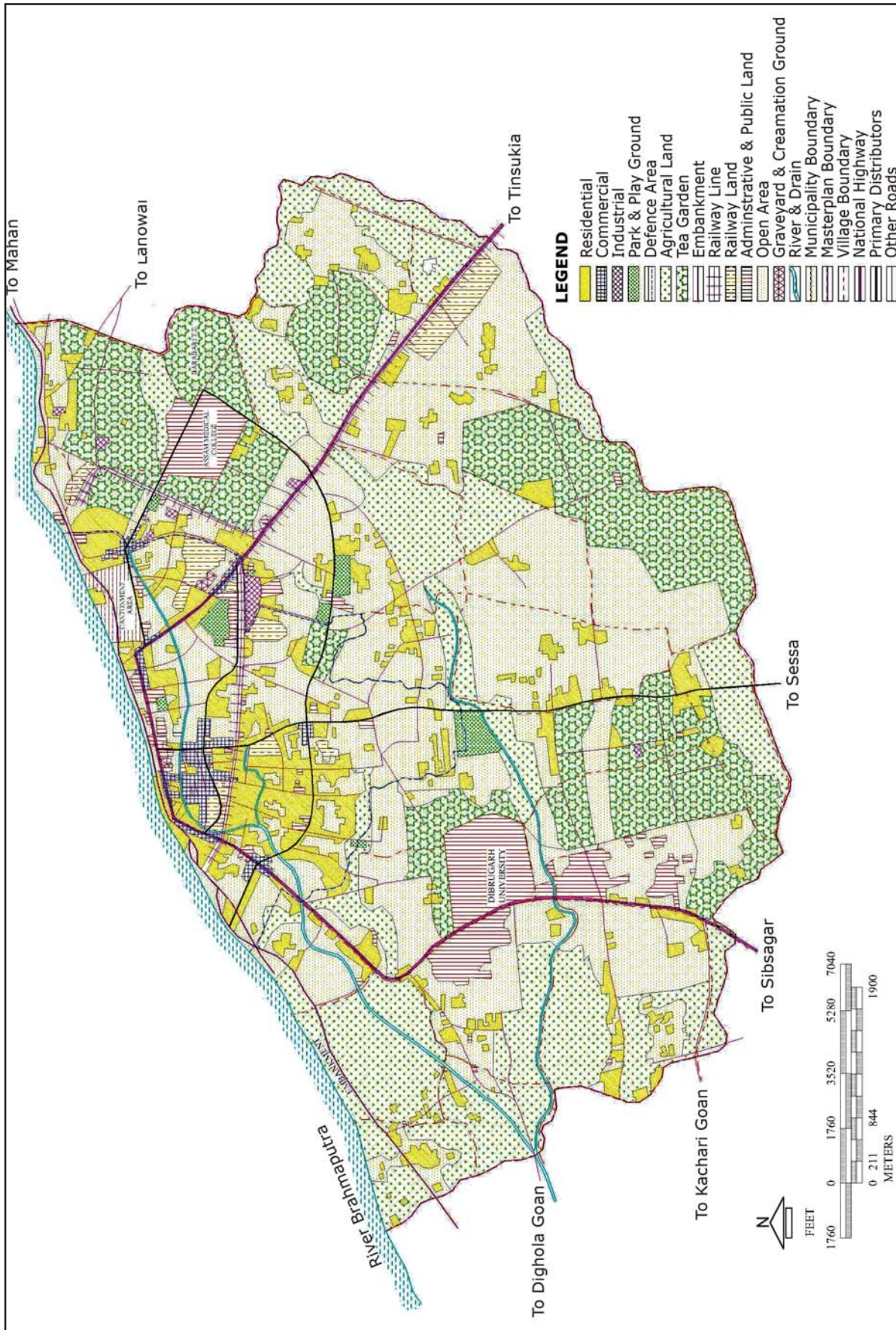


Fig. 2: Existing Landuse Plan: Master Plan Area, Dibrugarh

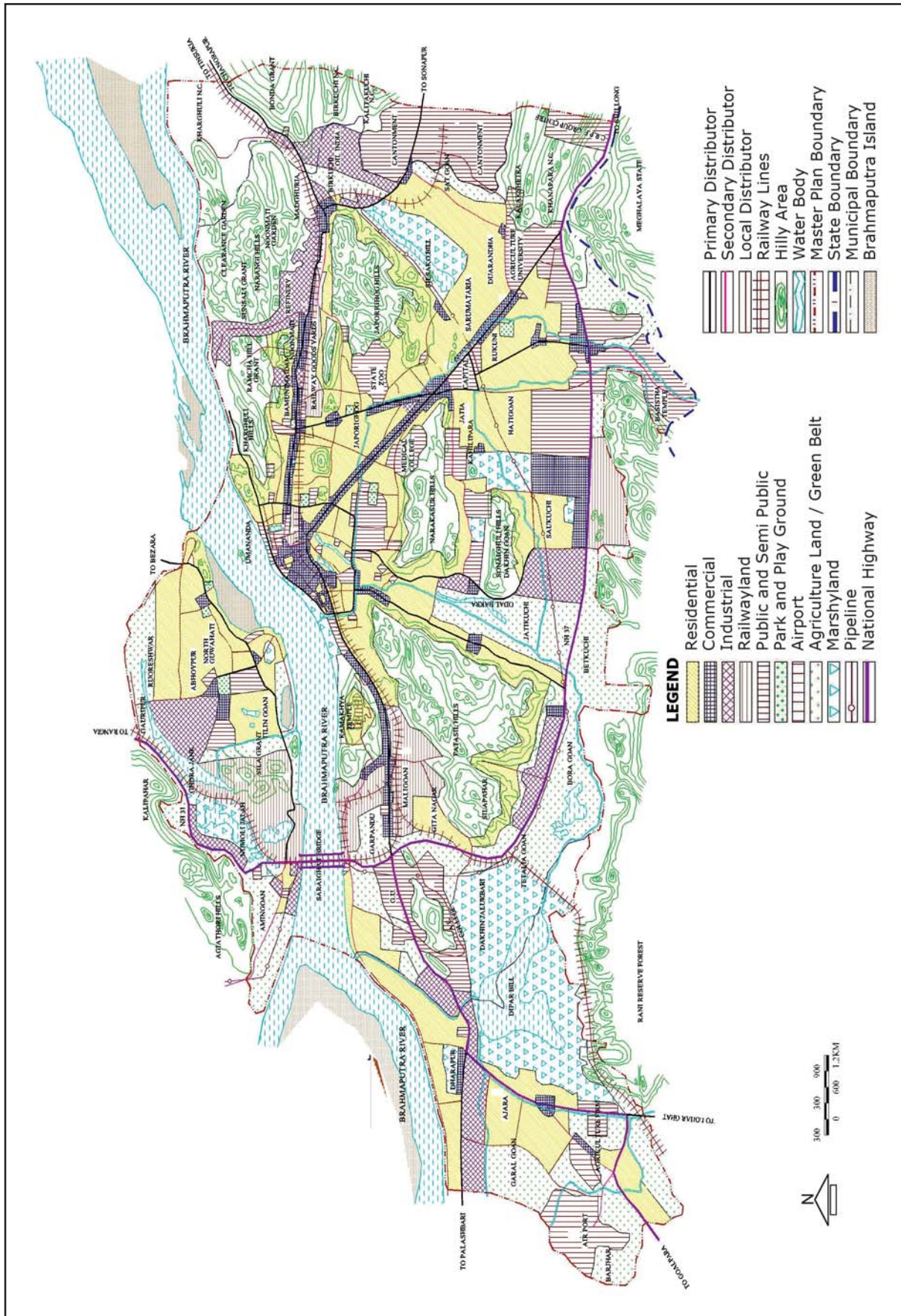


Fig. 3: Existing Landuse Plan: Master Plan, Guwahati

Table 2: Existing Land Use Pattern of the Chosen Cities

Land use	Barpeta		Dibrugarh		Guwahati	
	M.P.A.	D.A.	M.P.A.	D.A.	M.P.A.	D.A.
Residential	13.85	51.05	10.38	58.21	11.12	45.11
Commercial	0.70	2.58	0.50	2.82	1.12	4.52
Industrial	0.24	0.88	0.43	2.44	1.55	6.30
Public and Semi-public	2.02	7.45	2.17	12.11	3.49	14.17
Recreational	0.32	1.18	0.40	2.25	0.10	0.45
Defence/ Special Use	-	-	0.68	3.81	3.16	12.85
Transportation	10.00	36.86	3.28	18.36	4.09	16.62
Tea Estate	-	-	17.98	-	-	-
Water Bodies	7.35	-	0.72	-	-	-
Agricultural	65.52	-	45.68	-	-	-
Vacant land – Usable	-	-	17.86	-	37.16	-
Vacant land – Unusable	-	-	-	-	38.21	-
Total	100.00	100.00	100.00	100.00	100.00	100.00

M.P.A.: Master Plan Area

D.A.: Developed Area

Source: Mater Plan Report of the Cities.

percentage of land under transportation is bear minimum in Dibrugarh and Guwahati.

Barpeta: Barpeta town is primarily an administrative centre with trade and commerce supporting it. It is the headquarters of Barpeta district since the formation of the district in 1983. The District Commissioner office, the Circuit House, District Collector office, District Court, District Block office, District Election office, District Transport office, District Planning office, District Police headquarters and Municipality office are located in and around the city centre providing service to the people of the district. Cycle-rickshaws are the major access mode to the activity centres from the regional bus stands.

Paratransit modes in Barpeta are mainly used for feeder trips to regional bus terminals, shopping trips, school trips, social visits, recreational trips and health trips. The civil hospital located at the southern side of the central area provides health service to the population of the entire district. Taxis and auto rickshaws are used for the transportation of patients from the region to the civil hospital. Auto-rickshaws in Barpeta also operate along fixed routes to the near by villages providing an alternative to bus services. The location of the city centre and important activity centres within the city are indicated the land use map given in Fig. 1.

Dibrugarh: Dibrugarh is the leading city for trade, commerce, education and health in upper Assam in addition to being the administrative centre of the district. Oil and Tea are the two major industries of the district. Most of the government administrative offices are located in the Chowkidinghi area, which is about 4 km from the regional bus terminal. Paratransit modes are used to access the administrative offices from the regional bus terminals. Higher educational institutes like the University, Medical College, Polytechnic, Arts College, Science College, Commerce College, Industrial Training Institute, Teachers Training Institute, Law College and the schools are distributed all over the city. Students as well as the employees of the educational institutes use auto-rickshaws and cycle-rickshaws. The auto-rickshaws are also used for the work trips in Dibrugarh city. Auto-rickshaw in Dibrugarh is frequently used as shared travel mode for all types of trips. The city centre located at New Market area attracts people from the region in addition to the local inhabitants. The railway station, day and night super bus terminal, regional bus terminal, hotels, tourist agencies and entertainment centres are also located within the city hub. All these activities are responsible for large number of paratransit trips to and from the area.

Dibrugarh is an important health centre within the state. In addition to the government hospital and

Medical College, there are about 20 numbers of well-equipped private nursing homes within the city. Paratransit modes are extensively used by the patients and people accompanying them. The land use plan of Dibrugarh Master Plan area showing activity locations is given in Fig. 2.

Guwahati: Guwahati being the capital of Assam is the nodal city for the north-eastern states. Guwahati is the first major city in the north-eastern region having direct rail, road and air connection with the rest of the country. Apart from its importance as administrative centre, Guwahati is also considered as the economic capital of Assam. The city is considered as the centre of political, educational, commercial, industrial and other activities in the entire north-eastern region of the country. Guwahati experienced phenomenal growth after independence of the country due to establishment of major educational institutions like the Guwahati University, Engineering College, Medical College, and Veterinary College and finally the establishment of IIT Guwahati in 1994 has boosted up the educational facilities to the international level. The North-Eastern Frontier (NEF) Railway headquarters at Maligoan, Refinery at Noonmati, Oil India Limited (OIL) at Birukuchi and the Amingaoan industrial area are the major industrial areas of the city. The High Court of Assam is also located here, which has now been converted as High Court for the other north-eastern states. All these activities generate high demand for transit and paratransit services. Cycle rickshaws in Guwahati operate at the local level where as the auto-rickshaws traverse throughout the city.

Paratransit are the major feeder modes of movement from and to the regional buses, railways and airport. Paltanbazar area in Guwahati is the main attraction of paratransit operators due to the location of railway station, Assam State Transport Corporation (ASTC) bus terminal, day and night super bus terminals, airlines offices, tourist agencies and hotels. Guwahati has numerous places of worship such as the Kamakhya, Bhuvaneshwari, Umananda, Vasishtha, Navagraha, Sukleswar, Mangalchandi, Ugratara, Shyam Mandir, DouL Gobinda, Ashwaktanta and Balaji temples. Poya Mucca and Madan Kamdev are situated at a distance of 40

kms from the city. All these temples attract large number of tourists not only from the State but also from various parts of the Country. As most of the temples are located either on the hilltops or at isolated places, the auto-rickshaw is the convenient option for the tourists. In addition, The State Museum, The State Zoo and Botanical Garden, Sankardev Kalakshetra, Planetarium and Science Museum also attract tourists demanding paratransit services. The land use map of the city showing the activities locations are indicated in Fig. 3.

Transport Network Characteristics: Transport network characteristic of a particular area determine the modal accessibility of the area. The road network patterns, gradient, type of roads, width of the road, width of carriageway, surface conditions vary not only between cities but also within a city. An area may be accessible by bicycles, cycle-rickshaw and two-wheelers but inaccessible by cars, buses and trucks. Again some areas are only accessible by automated vehicles and not by bicycle and cycle-rickshaw because of its steep gradients. The road networks are irregular in most of the cities in Assam.

Barpeta: The road network in Barpeta does not follow any specific pattern. The four main roads, Barpeta-Howli Road, Barpeta-Mondia Road, Barpeta-Vellah Road and Barpeta-Bhawanipur Road are the radials within the town. Regional buses run through these four routes. Barpeta-Howli Road is the only two lane road in the town with carriageway width of 7 m. Other roads are 4 to 5 m wide carrying two-way traffic. The secondary and local streets do not follow any specific pattern. They are narrow and inaccessible to buses and other large size vehicles. Cycle-rickshaws and bicycles operate easily because of the flat topography of the town. The narrow streets with improper road geometries and bad surface condition results in very low travel speed for all the modes.

Dibrugarh: Dibrugarh grew as an organic city and the road network is not planned. The road network does not have any specific pattern. Only in New Market area the roads are laid in grid pattern. The important roads in Dibrugarh city are Assam Trunk Road (NH-37), Mancotta Road,

RKB Road, Circuit House Road and the Convoy Road. The NH-37 passes through the heart of the city. The traffic on the highway passing through the city creates problems for intra-city traffic. The Mancotta Road runs from north to south of the city having a railway overpass at Thana Chariali. RKB Road connects the railway station, New Market and most of the schools and colleges are situated by the side of this road. Circuit House Road connects the circuit house and the Medical College with the AT Road. Convoy Road run through the southern part of the city connecting some tea gardens to the city. All these roads are motorable. The carriageway width of the roads varies from 4.5 m to 7.5 m at various sections. The volume of traffic in these roads has exceeded the acceptable limits of capacity. Local roads are mainly kutchra and too narrow to carry vehicular traffic. Dibrugarh is situated on flat land. The flat topography and narrow streets combined with sparse development are responsible for the extensive use of paratransit.

Guwahati: There is complete lack of any pattern in the road network in Guwahati. The railway has played a significant role in the development of roads in Guwahati. The railway line passes through the heart of the city. The line acts as a barrier to the north-south movement in the city. Three over bridges and thirteen level crossings provide connections between the northern and southern halves of the city. The National Highway - 37 bypasses the city in the south. The National Highway - 31 ends in Guwahati. They connect the city to the rest of the State and the Country. Intra-urban traffic also operates through them. The major roads in Guwahati are the Assam Trunk road, Guwahati-Shillong road, Radha Govinda Barua road and Gopi Nath Bordaloi road. They connect most of the major land uses in the city. All the above roads are having four lanes with central divider. These roads are mainly used by cars, auto-rickshaws and buses. The second order important roads in the city are Bharalomukh Gorchowk road, Paltanbazar Lokhara road, Dispur Basistha road, Ganeshguri Hatigoan road, Jalukbari Rudreshwar road, Ganeshguri Kalapahar road and Ulubari Kahilipara road. The above all-weather roads are two lanes wide. All types of vehicles use these roads including the slow-moving cycle-rickshaws. City buses operate on all these roads.

The local roads are narrow and congested. Guwahati is situated in between ranges of hills. There are many hills even within the Municipal Corporation area. The elevation of Deepar Bill is 48 m from the mean sea level (MSL) where as the height of Silapahar is 330 m from MSL. In general the road network in Guwahati is guided by the contour and not by any specific pattern. The gradient in some parts of the road network is steep and is negotiable by non-motorized modes. Cycle-rickshaws operate at the local level through the narrow local streets. Auto-rickshaws ply throughout the city. The mode share of taxi in the intra-urban passenger movement is insignificant.

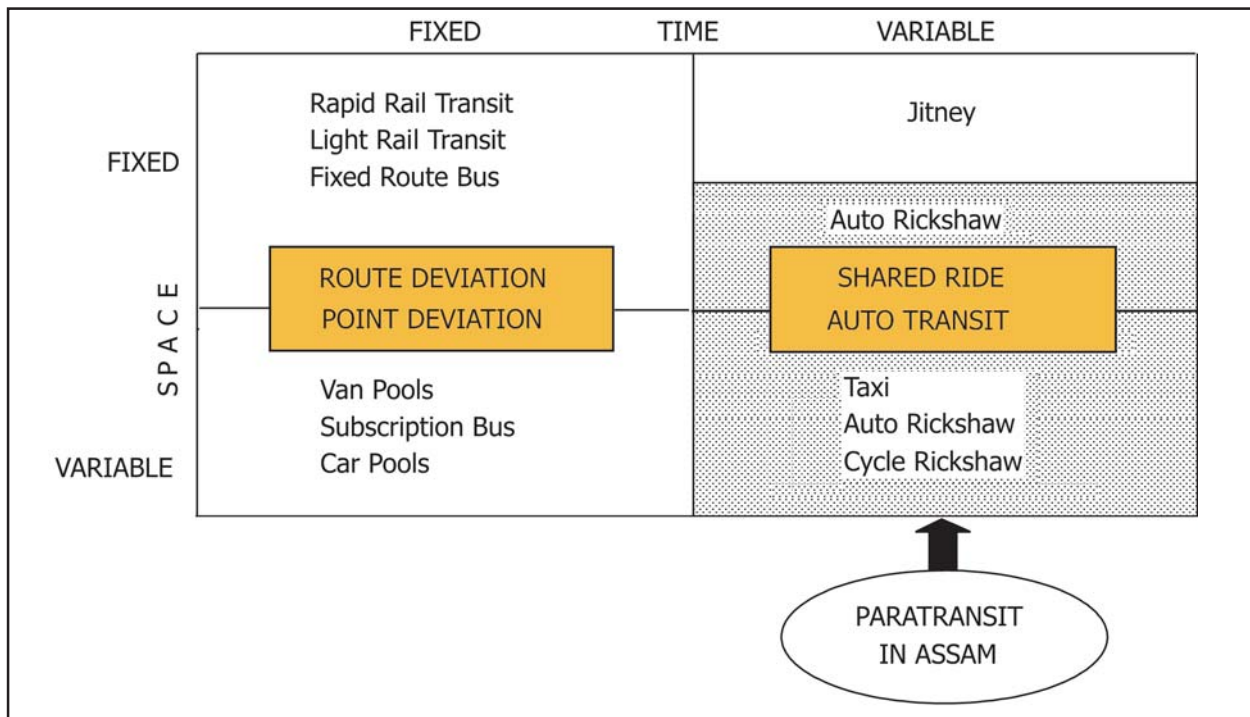
2.3 Paratransit

Paratransit, also known as intermediate public transport (IPT), can be defined as the intermediate mode between the privately owned automobiles and the conventional transit that has fixed routes and schedules. It is an on-hire urban passenger transportation service provided by an operator and available to all users who pay the prescribed fare. The service conveniently meets the individual user's travel desire. Most paratransit modes do not have fixed routes and schedules.

Vuchic (1979) states, "Paratransit is urban passenger transportation service usually in highway vehicles operated on public streets and highways in mixed traffic; it is provided by private or public operators and it is available to certain groups of users or to the general public, but adaptable in its routing and scheduling to individual user's desire in varying degrees".

Roos (1979) classified paratransit by time and space characteristics. The family of paratransit services represents different spatial and temporal service responses to travel desires. Some trips made by an individual are periodic in nature occurring between the same origin and destination pairs (work trips) that can be best served by transit. On the other hand some trips occur between scattered and non-repeating origin-destination pairs (social visits and recreational trips), which are best served by paratransit services. Transit operates in fixed time (the schedule) and fixed space (the route). On the opposite extreme, the paratransit operates in

Fig. 4: Temporal Spatial Characteristics of Urban Transportation Alternatives



Source: Daniel Roos, 1979

completely flexible time and flexible space. These attributes of time and space can be utilized to define the complete spectrum of paratransit and transit alternatives, which is shown in the figure 4. The shaded area of the figure represents the paratransit modes available in the cities of Assam.

Usage of Paratransit Modes in the Study Area: Three types of paratransit modes are operating in the cities of Assam for urban

passenger transportation and are discussed as follows:

Cycle-Rickshaw: The hand-rickshaw, or jin riki sha in Japanese, literally meaning ‘man powered vehicle’ was designed and introduced in about 1870 in Japan. Within as little as a decade of its invention in Japan, the hand-rickshaw was first seen in Simla in the hills of north India, the summer capital of British Raj, in 1880. Twenty years later

Table 3: Share of Paratransit Modes in the Study Areas (% Passenger Carried)

Mode	Barpeta		Dibrugarh		Guwahati	
	percent of all Modes	percent of Public Transportation Mode	percent of all Modes	percent of Public Transportation Mode	percent of all Modes	percent of Public Transportation Mode
Taxi	0	0	0	0	2	3
Auto rickshaw	1	2	44	75	8	10
Cycle rickshaw	54	98	15	25	5	7
Paratransit	55	100	59	100	15	20
City Bus	0	-	0	-	57	80
Private modes	45	-	41	-	28	-
All modes	100	-	100	-	100	-

Source: Traffic survey conducted by the researcher, 2001

Table 4: Number of Vehicles on Road as on 31st March 2001

Urban Area		Barpeta	Dibrugarh	Guwahati
Transit Vehicle (City Bus)	Omni Bus	-	-	955
	Mini Bus	-	11	1,454
	Deluxe Bus	-	-	133
	ASTC Bus	-	-	78
	Total	-	11	2,620
Paratransit Vehicle	Taxi	5	30	* 2,196
	Auto Rickshaw	12	401	*10,352
	Cycle Rickshaw	1,200	2,500	16,900
	Total	1,217	2,931	29,448
Private Vehicle	Car	* 678	* 4,307	* 38,215
	Two-Wheeler	* 6,061	*12,142	*129,669
	Bicycle	10,500	15,000	20,000
	Total	17,239	31,449	187,884
Grand Total		18,456	34,391	219,952

Sources: District Transport Office: Barpeta, Dibrugarh and Kamrup Municipality Office: Barpeta, Dibrugarh and Guwahati

* Respective District data including the urban area

members of Chinese community introduced them in Calcutta for the carriage of goods. In 1914 the hand-rickshaw was first used for passenger transportation in Calcutta. The three-wheeler cycle rickshaw was first introduced in 1930's and 40' in India (Sen, 1998). The existing cycle-rickshaw hardly changed since its introduction but very recently several improved models of man powered and electrical powered cycle-rickshaw have been developed by the Institute for Transportation and Development Policy (ITDP), the Nimbkar Agricultural Research Institute (NARI), the Asian Institute for Transport Development (AITD) and Indian Institute of Technology, Delhi (IITD), which may replace the existing traditional cycle-rickshaws gradually (Rajvanshi, 2002). It is estimated that about one million cycle rickshaws ply in the Indian roads serving about 3 to 4 billion passenger-km per year (Rajvanshi, 2002). In many cities they are the major means of public transportation. They are easily manoeuvrable and are non-polluting.

Cycle-rickshaw is found in all urban areas of Assam serving trips less than 3 kms length. Cycle-rickshaw is predominant mode of travel in the smaller urban areas. It is equally popular in the larger urban areas and caters to the short distance trips. In the hilly cities like Shillong, Aizwal, and Jowai cycle-rickshaw

cannot operate because of its grade limitations. Table 3 indicates the share of paratransit modes in terms of passenger carried in the study areas. The shares of cycle-rickshaws to public modes transported passenger are about 98 percent, 25 percent and 7 percent in Barpeta, Dibrugarh and Guwahati respectively. Though the percentage of urban passengers carried by cycle-rickshaws reduces with the increase in city size the number of cycle-rickshaw operating increases with its size. In Table 4 it is indicated that the number of cycle rickshaws operating in Barpeta, Dibrugarh and Guwahati are 1,200, 2,500 and 16,900 respectively. The trips served by cycle-rickshaws in the cities of Assam are:

- Short distance trips for door-to-door service;
- Trips confined to central areas;
- Shopping trips and short distance socio-cultural trips;
- Short distance work trips;
- Feeder trips to and from other transit terminals with luggage; and
- School trips particularly at the elementary standard.

Auto-Rickshaw: Edward Butler in Great Britain built the first commercial three-wheeler in 1884.

Morgan of United Kingdom built the famous Morgan three-wheeler in the year 1909 with a 7 hp Peugeot engine. Subsequently there were many developments of the vehicle in terms of engine performance as well as the physical shape and size to suit the local requirements. There are different models of petrol, diesel, compressed natural gas (CNG) and electric motor powered three-wheelers in Indian cities. There is about 1.5 millions petrol and diesel powered three-wheelers in India and they are growing at a rate of 15 percent per annum (Rajvanshi, 2002). The Scooter India Limited has developed the zero emission electric battery driven three-wheeler (Vikram EV) in the year 1999 (Sharma, 2000).

Automated three-wheeler vehicles carrying three to six passengers are found in the cities of Assam. The mode is widely used between trip lengths of 3 kms to 10 kms. Auto-rickshaws are normally used for feeder trips to railway, bus terminals and airport. The mode is also used for shopping trips, social visits, recreational trips and some other specialized trips. Auto-rickshaws are operated for door-to-door movement as well as for shared travel service. In Dibrugarh, the mode is used for shared travel mode in addition to door-to-door service. In Guwahati, the mode is mainly used for door-door services but in some areas it is also used as a shared travel mode. In Barpeta, the mode is not popular as we can see from Table 3 and 4. There are only 12 numbers of auto rickshaws operating in Barpeta carrying about 2 percent of the public modes transported passengers. The trips made by auto-rickshaw in Barpeta are not intra urban trips. They are being used for long distance specialized trips to the nearby villages where regional bus service is not available. In Dibrugarh auto-rickshaw accounts for about 75 percent of public modes where as it is only 10 percent in Guwahati. The number of auto-rickshaws in Guwahati and Dibrugarh are 10,352 and 401 respectively. The important trips that are being served by auto rickshaw in the cities of Assam are:

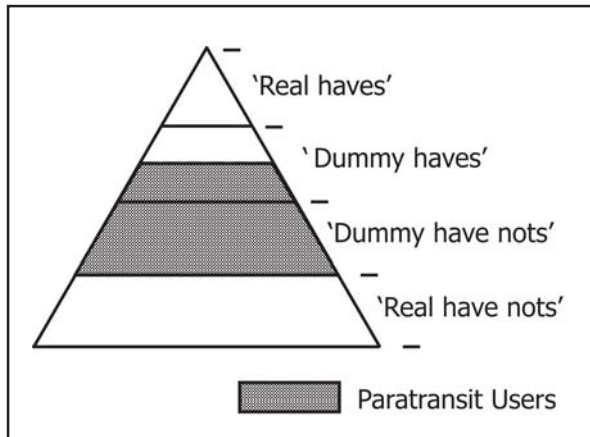
- Feeder trips to railway stations, regional bus terminals and airport;
- Door-to-door trips often a substitute of private car for the urban middle class; and

- Fixed route shared ride services often as a city bus services.

Taxi: Taxi is costliest among the paratransit services. Taxi vehicles are normally designated either by colour, or by sign on the door or roof, or by some special symbol. The taxis in the cities under investigation are not distinguishable from private cars other than the colour of the number plates. Mainly petrol engine taxis are found in the three cities. Taxi service is not popular in the cities of Assam. Taxi is used for specialised trips such as feeder trips to airport and railway station, trips made by tourists, long trips made for movement of patients and elderly persons and some occasional trips. In Barpeta and Dibrugarh taxis are normally not found. In Guwahati most of the taxi stands are located at the Paltanbazar area where the railway station, airlines office, day night super bus terminals, tourist agencies and hotels are located. All the taxis are non-metered and are operated as on-hired mode. Most of the trips made by taxis are long distance, which may even be a day's journey. The only exception is the trips to airport and railway station. The share of taxi in public transportation is found to be about 3 percent in Guwahati, which normally serves long distance regional trips. The use of taxi increases with the city size. The number of registered taxis operating in Barpeta, Dibrugarh and Kamrup districts are 5, 30 and 2,196 respectively. As the share of intra urban passengers carried by taxis is very insignificant, the mode has not been considered in analysis with other paratransit modes in this study.

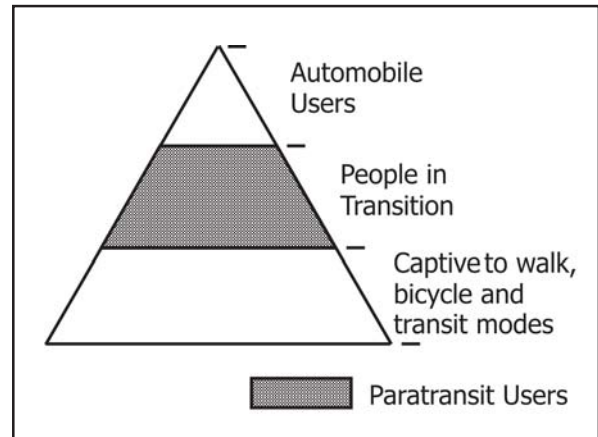
Paratransit User: Rangnekar (1981) classified the Indian urban population into four categories. They are 'The real haves', 'The dummy haves', 'The dummy have nots' and 'The real have nots'. These four categories of people follow distinct patterns in terms of their use of travel modes (Datta, 1984). The 'real haves' (the rich business class) move in their private cars and hardly use any paratransit modes. The 'dummy haves' (the high salaried executive class working in government, semi-government and private sectors) occasionally use paratransit. Mostly, they travel in company cars or company subsidized cars. For personal trips this class uses either their private cars (if owned) or paratransit service. The

Fig. 5: Schematic Diagram of Rangnekar's Economic Classes



number of 'real haves' and 'dummy haves' increase with the size of the city, which explains the increase in number of cars with the city size. The 'dummy have nots' (medium salaried employees in organized sectors, small businessmen, shop owners) are the main users of cycle-rickshaws and auto-rickshaws in the smaller cities and public transport in the larger cities. Many of this group own two-wheelers to reduce transportation cost and time. The 'real have nots' (low paid workers in organized sectors) generally cling near to their work place to avoid transportation cost and do not use any paratransit modes. They walk in small cities and use public transportation in larger cities only when it is

Fig. 6: Schematic Diagram of Mode Captivity



absolutely necessary. The Rangnekar population categories superimposed by paratransit users are shown by schematic diagram in Fig. 5.

According to the use of modes the urban population in Assam can be classified into 'automobile users', 'people in transition' and 'captive to walk, bicycle and transit modes' as shown in Fig. 6. The urbanites in the 'people in transition' group use paratransit services extensively.

The 'dummy have nots' are the major users of paratransit modes in most of the cities in Assam. The income group wise paratransit users in

Table 5: Paratransit Users in the Chosen Cities for This Study

City	Income Range (rupees)	percent of Mode Users			percent Within Paratransit users	percent Of Respondent
		Transit	Paratransit	Private		
Barpeta	£ 3,000	-	60	40	6	6
	3,000 – 10,000	-	64	36	92	89
	>10,000	-	25	75	2	5
Dibrugarh	£ 3,000	-	65	35	25	18
	3,000 – 10,000	-	70	30	51	47
	>10,000	-	52	48	24	35
Guwahati	£ 3,000	51	21	28	7	8
	3,000 – 10,000	15	38	47	76	48
	>10,000	21	7	72	17	44

Source: Primary Survey conducted by the researcher, 2001

comparison to other modes in the cities studied are shown in Table 5. The percentage of paratransit users among different income groups within a city is also indicated in the table. The data are obtained from household survey conducted by the researcher. The respondents are divided into three income groups in an attempt to represent the mode captivity as shown in Fig. 6. The percentage of respondents under each income group is also shown in the table.

It is observed that the maximum paratransit users are in the middle income range i.e. Rs. 3,000 to Rs. 10,000 per month in all the three cities. About 64 percent of the respondents of this group in Barpeta, 70 percent in Dibrugarh and 38 percent in Guwahati use paratransit in comparison to other alternative modes. About 92 percent paratransit users in Barpeta, 51 percent in Dibrugarh and 76 percent in Guwahati fall in the above income range. In Dibrugarh it is observed that about 25 percent of the lower income group people use paratransit service due to the availability of shared travel mode auto rickshaws service.

3. CONCLUSIONS

It is evident from the discussions above that the three cities namely Barpeta, Dibrugarh and Guwahati differ in terms of size of population, physical extent, functions, locations and distributions of activities and road network characteristics. Therefore, the levels of utility of paratransit modes are different in these three cities. Cycle-rickshaw is the predominant mode of public transportation in Barpeta where as auto-rickshaw plays major role in Dibrugarh city. City buses are predominant mode of passenger transportation in Guwahati, while cycle-rickshaw operates at local levels and auto-rickshaw serves convenient personalized trips. Taxi does not have a significant role in carrying intra urban passengers in the cities of Assam. Fast and high occupancy modes start operating with the increase in city sizes and population. Paratransit modes are mainly used for feeder trips to regional transit terminals, shopping trips, social visits and recreational trips. It is also used for work trips in varying degrees in the cities

of Assam. Techno-economically the paratransit modes have their own limits of operation and within these limits they satisfy the variable demand in terms of travel cost, travel time, comfort, convenience, reliability and safety of a wide range of populations from the 'dummy haves' to the 'dummy have nots'. The people in transition with income ranging from Rs. 3,000 to Rs. 10,000 per month are found to use paratransit modes extensively in all the cities. The diesel operated taxi and auto rickshaw create air as well as noise pollution. The cycle rickshaws are non-polluting and environmentally neutral mode.

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ENVIRONMENTAL REFUGEES: ISSUES AND SPECIFIC OPTIONS

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ABSTRACT

The first part of this article titled 'Environmental Degradation and Consequent Refugees Problems', published in Vol. 4 No. 4 of this Journal, discussed the problems emerging from the increasing frequency and growing seriousness of environmental calamities, giving rise to increasing number of environmental refugees.

The second and final part of the article, entitled 'Environmental Refugees: Issues and Specific Options' analyses some of the fundamental issues facing environmental refugees. The Article mentions the programmes launched in India during the last 35 years to make a dent on the problem of natural disasters and scarcity of rains, drought conditions, desertification and to improve the working of the institutions created for forecasting system. However, efforts are lagging when disasters strike. The burgeoning problem of environmental refugees calls for an urgent need of official recognition and finally stresses the need for defining the nature and scope of the problem of environmental refugees. The problem of international refugees legislation is central to these category of refugees, because environmental refugees are not included in it.

1. INTRODUCTION

The number of environmental refugees, those who leave their homes because of environmental problems, is increasing rapidly. Red Cross research shows more people are now displaced by environmental disasters than by wars. As far back as 1995, 'the environmental refugees totaled at least 25 million people, compared with 27 million traditional refugees (people fleeing political oppression, religious persecution and ethnic troubles). The environmental refugees' total could well double between 1995 and 2010' (Norman Myers). Myers confided that environmental refugees could become one of the foremost human crises of our times. To date, however, it has been viewed as a peripheral concern, a kind of aberration from the normal order of things – even though it is an outward manifestation of profound deprivation and despair. While it derives primarily from environmental problems, it generates myriad problems of political, social and economic sorts. As such, it could readily become a cause of turmoil and confrontation, leading to conflict and violence.

Over and above, there are limits of the host states or even countries' capacity, let alone willingness, to take in outsiders. Migrants alone present abundant scope for popular resentment, however unjust this reaction. In the wake of perceived threats to social cohesion and identity, migrants can become an excuse of ethnic tension and civil disorder.

Despite recognitions by the numerous environmental organizations and development agencies and large number of workers, scientists and others that there are millions of environmental refugees (migrants) in the world, and their number is growing both in absolute terms and as a proportion of the uprooted and displaced people. Yet there is no recognition either on the part of governments or international agencies, of an environmental refugees problem at all.

2. ENVIRONMENTAL PROBLEMS

There can be number of reasons for environmental deterioration and consequent displacement of population. One can think of natural causes like floods, earthquakes, severe coastal storms, including tropical cyclones and volcanic eruptions. But very often a disaster can be a combination of natural and human factors such as drought due to extreme climate events and inefficient irrigation system; the formation of landslides due to natural absence of vegetation in the higher reaches of catchment areas and human interventions in the form of road building activities and indiscriminate felling of trees; increasing population pressures on natural disaster-prone areas; increased vulnerability of natural disasters due to poverty. Other reasons of deterioration are purely human-induced; for instance, severe deforestation, destruction or transformation of mangrove forests, landlessness, along with chemical accidents, environmental problems associated with development projects, etc.

The number of incidents that cause people to flee in the face of environmental problems is increasing rapidly. The recent spate of natural disasters – Tsunami (December 2004), Hurricanes Katrina (August, 2005) Rita (September, 2005), Wilma (October, 2005) all in Mississippi River Delta; Kashmir earthquake (October, 2005), Floods in the island of Sumatra, in India and Bangladesh (July-September 2007) – demonstrates that thousand of people can be driven from their homes with no place to go other than away from the devastation.

Cyclone Sidr, also known as Very Severe Cyclone Storm Sidr, wreaked havoc on southwest Bangladesh on 15 November 2007. The storm caused large scale evacuations in Bangladesh, and has affected an estimated 2.7 million people and damaged 773,000 houses, according to the Ministry of Disaster Management, Bangladesh. At least 3,447 people have died; Bangladesh Red Crescent Society reported on 18 November, 2007 that the number of deaths could be upto 10,000.

The global climate disruption and rising sea levels and consequent submergence of islands and coastal lands threaten to make evacuations for environmental reasons a more frequent occurrence. Earthquakes, floods and other natural disasters could kill millions in the world's teeming mega cities. Drought is less traumatic, but is one of the worst natural disasters because its onset is slow, the area affected is quite widespread and the adverse impacts are ruinous.

There is much scope that the developing countries themselves can do to face the environmental refugees' challenges and reduce the motivation to migrate by ensuring an acceptable livelihood in established homeland, if they learn to live in harmony with the natural surroundings they have inherited and their management systems are equitable and sustainable.

There are some natural disasters, like earthquakes and cyclones over which mankind has little control. But the impact of the event can be considerably mitigated by taking anticipatory, concurrent and post disaster measures. Here it is what marks the quality of governance. For instance, Hurricane Katrina ravaged areas of the Mississippi Delta (New

Orleans). U.S. administration failed to anticipate the scale of calamity and continued to fail to bring relief to the hundreds of thousands affected. "The Federal Emergency Management Agency (FEMA) had listed before 9/11 the three most likely catastrophes facing America: a terrorist attack in New York, a major earthquake in San Francisco and a hurricane strike in New Orleans. And yet, from what one can make out, it would almost appear that Katrina came out of the blue. With preventive action not taken by the authorities, one would expect that a post disaster mechanism and relief co-ordination system would be in place. But here again, the army, voluntary organizations and the private sector are behaving in an incoherent manner (Hindustan Times, New Delhi, September 5, 2005 editorial).

The Kashmir earthquake, also known as a South Asia earthquake or Pakistan earthquake in October 2005 killed some 74,500 persons and injured 106,000 persons. Japan, India and Pakistan are most prone to earthquakes. The people of Japan, however, are far less vulnerable because Japan has strictly enforced, codes, zoning regulations and earthquake emergency tracing and communication systems, where as in Pakistan and India most people are still living in top heavy mud and stone houses, built on hillsides, making themselves vulnerable.

A performance audit by Comptroller General of India on Tsunami relief and rehabilitation has exposed some irregularities. The audit holds the Ministry of Environment and Forests, responsible for not strictly enforcing Coastal Regulation Zone rules which would have prevented destruction in coastal areas. It also noted deficiencies in financial management which were reflected in cases of irregular, avoidable and excess expenditure. Only 61 percent of funds allocated for Andaman and Nicobar Islands were unutilized. The scene was not better in Andhra Pradesh and Tamil Nadu where 56 percent and 27 percent of the funds respectively were unutilized (Times of India, New Delhi, 26 December 2006).

In the last 35 years or so, enormous resources have been used in India to overcome the problems of natural hazards. In order to reduce the impact

of disaster as well as the socio-economic vulnerabilities, the Government of India has identified areas which were prone to scarcity of rain or drought conditions and introduced Drought Prone Areas Programme in such identified areas of the country. The Programme is being implemented since 1972 – 1973. To minimize the adverse effects of drought in the desert areas, to control desertification and to restore ecological balance of the areas in the long run through conservation, development and harnessing of land, water and other natural resources, the Desert Development Programme was started in 1977-1978. A central sector scheme, namely Natural Disaster Management Programme (NDMP) to enhance the national capacity for disaster reduction, preparedness and mitigation, was started in 1993. A National Centre for Disaster Management, carrying out disaster reduction related activities in the sector of human resources development, was established in 1995. The Vulnerability Atlas of India, brought out in 1997 has identified the vulnerability of the Indian landscape to multi-hazard risks due to natural calamities. The Indian Meteorological Department (IMD) and the Geological Survey of India (GSI) established networking of scientific instrumentation and disaster warning and forecasting systems, are making significant contributions to long term preventive planning. The user friendly technological inputs from the Central Building Research Institute (CBRI), Structural Engineering Research Centre (SERC), IIT Roorkee and the standardization efforts of the Bureau of Indian Standards need special mention.

Yet, when a disaster strikes, very often the efforts are found lagging far behind in coping with the problems. The natural disaster control measures are generally adhoc and lack scientific and rational approach in the assessment of natural disasters, their impacts and costs of relief.

There is no appraisal from time to time of the performance of the disaster mitigation measures. The emphasis is not on preventive measures but only on relief. The disaster management approach is excessively bureaucratized, top-down and non-integrated. Experiences are not institutionalized. They remain with individual persons causing lack of institutionalized processes. The departments' lack of building confidence in the lower levels of

the administrative hierarchy and the delegation of the authority to them to cope with critical situations have discouraged and slowed down or hindered the active involvement of the personnel engaged in disaster operations. There is lack of co-ordination between the various implementing and enforcing agencies. Of the major natural hazards, drought receives relatively low priority and delayed response as it is less traumatic but it is one of the worst natural disasters because its slow onset, the affected areas quite widespread and the adverse impacts are ruinous. It imparts a creeping long term setback to the socio-economic fabric of the society. Operations in the nature of fire fighting will not have long term effect. For this, environmental initiatives must be taken in the context of development policies.

3. DEVELOPMENT POLICIES

Environmental initiatives can not be effective unless they are implemented in the context of development policies. Lack of development and inappropriate development are both contributing to environmental degradation. The countries in the developing regions are beset with potentially devastating effects of high population levels; rapid population growth and unbalanced distribution; persistent mass poverty; decreasing quality of land, air and water; decreasing capacities of ecosystem to absorb shocks such as floods or extended droughts; rapid changing global climate. The consequences of ignoring the environmental implications of development in agriculture, urbanization and industrialization are exacerbating this situation. These interdependent and interconnected environmental challenges contain an important inherent message for all the developing countries; to broaden the vision of economic growth in a holistic perspective of environmentally sound and sustainable development.

3.1 Promoting Environmentally Sustainable Development

The World Commission on Environment and Development (WCED), set up by the General Assembly of the United Nations in 1987, defined sustainable development as 'paths of progress which meet the needs and aspirations of the present generation, without compromising with the ability of future generations, to meet their

needs'. It contains within it three key concepts: the concept of needs, in particular the essential needs of the world's poor to which overriding priority should be given; the idea of the vicious circle of poverty, rapid population growth and over population and exploitation of the resource base, leading to environmental degradation; thirdly, the trade-off between environment and development. It requires merging of environment and economics in decision making.

The Commission called for a faster economic growth (at least 5 percent per year) for the countries which are caught in a vicious circle of economic decline, increasing poverty and environmental degradation. The growth, as the Commission felt 'need not be environmentally degrading and that growth, in fact, creates the capacity to solve environmental problems, and is also absolutely necessary to overcome mass poverty'. Sustainable development understood in this way is 'growth which respects the limits to environmental resources such as clean air, water, forests and soils; growth which maintains genetic diversity; growth which uses energy and raw materials efficiently'.

There is a general feeling that while this definition of sustainable development is adequate for advocacy and debate, the planning for action programmes would need to be more specific in elaborating the concept of sustainable development. A good guideline for developing countries is to assure that development is 'environmentally, economically, financially and institutionally sustainable' (Brown, 1990). Furthermore, it is felt that environmentally sound and sustainable development is not a static concept. The productive potential of natural systems would depend on the state of the technology and the degree of the social organization brought to bear on the resource base (WCED, 1987).

General Assembly Resolution 46/182, which was adopted by consensus on 19 December 1991, has very emphatically emphasized that economic growth and sustainable development are essential for the prevention of and preparedness against natural disasters and other emergencies. Thus, basically there are two approaches to planning for disaster prone areas, namely 'prevention and

preparedness' as suggested by the United Nations in 1987.

Prevention may be described as measures designed to prevent natural phenomena from causing or resulting in disaster or other related emergency situations. It concerns the formulation and implementation of long range policies and programmes to prevent or eliminate the impact of disasters on the basis of a vulnerability analysis of all risks. Prevention also includes legislation and regulatory measures, principally in the field of land use and physical planning, public works and building, as well as poverty alleviation, since the victims of drought, floods, earthquakes and cyclones, are usually the poor occupying the most hazard prone areas.

Preparedness includes actions designed to minimize loss of life and damage and to organize and facilitate timely and effective rescue, relief and rehabilitation in cases of disaster. Preparedness is supported by the necessary legislation and means to cope with disaster situations or similar emergencies which cannot be avoided. Preparedness is concerned with warning, education and training the population, organization for and management of, disaster situations, including the preparation of operational plans, the training of relief groups, stockpiling of supplies and the earmarking of necessary funds.

The whole philosophy of the Resolution 46/182 of 19 December, 1991 referred to above is encapsulated in the concept of 'relief to development continuum', rather than a set of rigidly defined stages of preparedness, relief and rehabilitation.

The Johannesburg Declaration on Sustainable Development 2000 confirms the 'global environment continues to suffer. Loss of biodiversity continues, fish stock continue to be depleted, desertification claim more and more fertile land, the adverse effects of climate change are already evident, natural disasters are more frequent and more devastating and developing countries are becoming more vulnerable, and air, water and marine pollution continue to rob million of a decent life'.

Further, the implementation of Agenda 21, adopted by the Earth Summit convened in Rio-

De-Janeiro in 1992 and the plan of implementation of the World Summit on Sustainable Development, convened in Johannesburg in 2002, to preserve environmental conditions and rehabilitate the deteriorated ecosystems in vulnerable areas to reduce the number and plight of environmental refugees, encourage to promote a culture of safety in all countries especially those that are disaster prone and vulnerable to environment deterioration.

The central objective of the global environment movement is to urge human society to live in harmony with nature. The nature must be treated with respect and transformations must be gentle, non-violent and sustainable. People who live in the desert or in the flood plains or hills must learn to live with the perennial problems of their area. Water harvesting is deeply rooted in the social fabric of the ill-watered sand track of the Thar Desert of India. There is need to construct and improve the existing traditional water harvesting systems. The habitability, prosperity and wealth of the desert area despite its inhospitable character, is based on extremely sagacious use of the natural resource base. Floods are not entirely a bad phenomenon. They also bring several ecological advantages, but need ecologically sound management in river basins and coordinated use of multipurpose dams between irrigation, electricity and flood control. Survival on the hills is not possible without a good forest cover as the hill people so well know. No doubt, the power to displace people for development works is a fundamental right of governments, but displacement must lead to positive transformation of the life of the displaced people.

3.2 Illustrative Cases

Three illustrative cases – one, the Development of Drought Prone Area; two, the Co-ordinated Development of River Basin; and three, the Positive Rehabilitation of People Displaced due to Development Projects, are discussed. These cases suggest that the onus of adaptation lies on human society and not on nature. We must learn to live with the perennial problem of these areas and management systems must be equitable and sustainable. There should be balance between the need for land for development activities and at the same time, protect the interests of the land

owners, and others, such as tenants, the landless, agricultural and non-agricultural laborers whose livelihood depends on land.

Development of Drought Prone Area: The Thar Desert of India: The driest Thar Desert in India provides a good example where an integrated development of agriculture, with focuses on restoration of ecological balance, can mitigate the effects of droughts. The Desert, characterized by the natural resource scarcity and economic backwardness, is a well known drought prone area in India. Agriculture in the area is extremely precarious and four out of every 10 years are drought years. The economic prospects, however, are not so dismal, provided efforts are made to mitigate lack of natural resources by infrastructural development. The soil is intrinsically rich and the problem of over population has not arisen so far. The agricultural intensity is still very low, indicating there is great scope for agricultural prosperity, provided water is made available.

By and large, land use in the Thar is dependent on rainfall. In good rainfall years, large areas are cropped, cattle thrive on extensive pastures and substantial amounts of hay are stored for future use. Rain water is stored in ponds and underground tanks. Rains in the desert region, though of a short duration, are often torrential, generating floods, but in the absence of good rain harvesting system, water is lost and the region remains an easy victim of drought. There is a dire need to construct and improve the existing traditional water harvesting systems, thereby alleviate losses due to natural hazards like drought and floods.

The provision of irrigation facilities will increase the cropping intensity and will bring vast tracts of cultivable waste and fallow lands under cultivation and pastures. Special efforts should be made to introduce drought resisting crops and grasses particularly in the desert, where water is scarce, irrigation facilities highly limited and soil moisture meager. The Desert region has great diversity in vegetation. As many as 700 species of plants are found in the area, of which 107 are of grass alone. These plants are deep rooted and tenacious enough to withstand extended droughts and yet efficient enough to gain biomass rapidly during a

favorable season. The local grasses are generally prolific seeders and most of the species are palatable, fairly nutritious and rich in minerals.

Irrigation facilities will also increase the supporting capacity for the livestock by solving the pattern of fodder scarcity. Better management of pastures and maintaining a balance between fodder availability and number of animals will also better the quality of livestock and return per animal. The Thar Desert is endowed with some of the best breeds of livestock in the country. Nearly 50 percent of the country's wool is produced in Rajasthan and the area has been the main exporter of bullocks to the northern states of the country. Improvement of means of transport, particularly roads, and availability of power will encourage industrial development in the region. There is a good promise in the region for industries based on agro and livestock raw materials.

Water is, however, a critical factor for development in the Thar Desert. Competing water demands from different sectors, such as agriculture, industries, and drinking water have resulted in misuse of resources in the absence of a comprehensive water policy. The success of rain harvesting scheme, namely 'Build Your own Check Dam' (BYOD) in Gujarat's Saurashtra Region, a part of the Thar Desert, has resolved water crisis which had been put together by the people themselves in partnership with the villagers who shouldered the responsibility through voluntary labor. In a span of just five months, people of more than 2,000 villages in the six districts, which comprise Saurashtra, had 10,000 check dams.

Water supply in the Thar Desert area has been changing over the last three decades. While most households used pond water earlier, the percentage of households using well water has increased over time because of the increasing number of dug wells, constructed with the help of loans provided by the government. Tube wells have also been introduced during the last two decades.

Co-ordinated Development of River Basin: Mahanadi Basin in Orissa: Mahanadi, a great silt carrying river in Orissa is known for floods, which have ravaged various parts of the Mahanadi

Basin, especially the delta areas, and have caused untold havoc to its human and animal population. They have debilitated the agricultural and industrial economy and posed grave problems of relief and rehabilitation. In view of the havoc caused by floods, the need for effective measures to control the floods was felt necessary and the Hirakud Dam was constructed in 1958, as a multipurpose project. Irrigation and electricity generation, however, were to be of secondary importance because of the serious flood menace in the Mahanadi Delta.

A number of studies have shown that dams and embankments by themselves can not reduce flood damages unless measures are taken at various levels across a river basin. The Hirakud Dam is no exception. The various studies on the usefulness of the Hirakud Dam, as a flood control device, shows quite conflicting results. The share of large and very large floods went down from 76 percent to 42 percent after the dam, while the share of small and medium floods went up from 24 percent to 58 percent. It was estimated that about 0.14 million hectare of cropped area was flooded, on an average, every year in the pre-dam period, over a period of over 80 years upto 1954. But post dam period data, from 1958 to 1982, show that the average annual crop area affected by flood is estimated at 0.21 million hectare. The dam has therefore been unable to reduce the extent of the damage to cropped area. In most cases, flood damages occur in the Mahanadi delta goes above 27m. In fact, the dam is supposed to control all floods when the water level at Naraj is less than 27m. But still there are several incidences of floods in the delta, including large to very large flood, during the post dam period.

Other factors responsible for floods in the delta area are lack of co-ordination between the use of dam for irrigation, electricity and flood control. The dam reservoir is generally filled up by August end to generate electricity. This reduces the intake capacity of the dam in September leading to floods in case of late rain storm. The 1980 flood which came in late September, for instance, was caused entirely by a forced release from the reservoir. Moreover, due to deforestation in the catchment, the inflows into the reservoir have also increased since the dam was constructed. Situation of the

reservoirs has also led to a loss of storage capacity of the dam. The downstream catchment has a crucial role to play in flood control. Since 1960, there has been significant deforestation in the catchment of the Mahanadi, both above Hirakud and below, which could be accelerating the run off in the post dam period. The contribution of the downstream catchment is probably the main cause of the low and medium floods in the post dam period with the situation worsening because of deforestation. Human occupation of the flood plains, with a lot of haphazard and unauthorized constructions, led to higher flood levels and breach in the embankment.

Management of the problems in downstream of the dam depends a great deal on integration and co-ordination of command area development processes conforming to project objectives. The flood plain areas are with extremely high population densities, extreme privatization of land, extreme irregularities, intensive concentration of land in the hands of a few, utter poverty and landlessness. There is a need for ecologically sound management of flood plains this can be achieved by bringing disciplined land use and settlement policies, land reforms and involvement of the poor in the management of their natural resources.

Positive Rehabilitation of People Displaced due to Development Projects: The power to displace people for development works is a right of governments. But displacement must lead to positive transformations of the community's life. The purpose of rehabilitation is much more than mere monetary compensation for land acquired. Implicit in it is a holistic approach that takes into account the process required for a community's evolution into a different way of life in a new environment.

The establishment of large steel plants and their townships in India, for instance, has revealed that the rehabilitation and resettlement of displaced people are deplorable:

- The rehabilitation and resettlement of the displaced people was left mainly to the state governments.
- In most cases alternate land for cultivation was not provided to these people because of

which, they had to change their occupations and became largely unskilled or semi-skilled laborers.

- As the plants neared completion and were commissioned, these people lost their jobs as the highly skilled jobs within the plants were not easily available to them nor were they able to undertake those tasks.
- The plants were manned mainly by people from outside their areas. The locals had to resort to employment in services and other unstable occupations.
- Financial compensation that they got was frittered away by families that have never handled large sums. They had no steady income stream and lost their livelihood and dignity. They were transformed from owners to refugees.
- The establishment of the steel plants led to the disruption of the economic pattern of the areas. The creation of a large scale non-agricultural employment upset the old pattern but did not introduce a new satisfactory pattern to take the place of the old ones. There was rise in prices of food stuffs, vegetables, milk, etc; because of the demand. Rent also shot up and the local population had to suffer a great deal of hardship and their income did not increase proportionately.
- The isolation and insulation of the steel plants and the townships economically, socially and physically from the surrounding areas led to development of a large number of undesirable slums and semi urbanized pockets which could not be removed or properly developed by the local bodies or the state governments. Because of this isolation, full integration of the projects with the economy of the surrounding areas could not materialize. There has not been sufficient identification of the local people with the projects in any form. Even administratively the projects were somewhat alien to the local population.

The consideration that should be kept in mind in regard to the acquisition of land, rehabilitation and resettlement of the displaced persons and the establishment of projects may be enunciated as follows:

- Acquisition of land and displacement of people is a major human and economic issue. There should be meaningful acquisition of land and sustained rehabilitation of indigenous people.
- As far as possible there should be least displacement of people. Industry, housing, irrigation and power projects should be housed on land which is unsuitable for cultivation or is least fertile. Double cropped land should not be touched.
- If possible, the *abadi* (village residential) areas should not be acquired even if the surrounding is. If homesteads are left intact within the project, acquisition will not displace physically. From their homestead, they can supply labor and other household commodities to project staff.
- The question of displacement of the people of the area for the establishment of project and township should be dealt with in a more organic way by resetting them in their present occupation elsewhere or training them in advance for jobs that may be created by the project itself and absorbing them fully within the project or by creating some income generating projects for the displaced persons. Thus, the displaced people would feel the project belongs to them and they would identify themselves with the project.

Conversely the project itself and the people engaged in the project should identify themselves with the area they are located in and the project must take a major role in promoting and participating in such development process. Such identification and participation will help in bringing about a better co-ordination amongst the activities sponsored by the state governments for the development of the area around the project and this would help to maximize the output from the project and also increase the benefits to the area.

4. ENVIRONMENTAL REFUGEES: IN SEARCH FOR A RECOGNITION

The number of incidents that cause people to flee from environmental problems is increasing rapidly and so the number of environmental refugees. Despite the recognition by scholars, humanitarians, environmentalists and development agencies that there are millions of

environmental refugees in the world and their number is growing, yet there is no official recognition of the environmental refugees and their problems and there is no single organization which is exclusively engaged with the issues and focuses explicitly on the problems of these refugees.

Organizations like the International Organisation for Migration (IOM), the United Nations Environment Programme (UNEP), and the Intergovernmental Panel on Climate Change (IPCC) have shown an interest in the issue of environmental refugees: sponsoring a wide range of reports and taking initiatives. Norman Myers, in particular, has been prominent in highlighting the problems of environmental refugees. He warned that 'environmental refugees could become one of the foremost human crises of our times' and 'for all countries, whether developing or developed, the overriding objective must be to reduce the motivation for environmentally destitute people to migrate by supporting them with acceptable life styles'. For developed countries, in particular, the prospect will increasingly become a case of 'export the wherewithal for sustaining development for communities at risk or import growing numbers of environmental refugees'. For him, the best way to deal with the problems is to 'pre-empt it, to recognize it, to comprehend it, and to respond by tackling the sources of the problem rather than tackling to its system'.

5. CONCLUSIONS

One of the ways to prevent growth of environmental refugees is to be clear about the dimension of the problems, which constitute the environmental refugees, their nature and scope. According to the international refugee legislation, refugees are defined as persons with a well found fear of persecution due to their race, religion, nationality, political convictions or social class, and are granted the rights that belong to this status. The main conditions are that a person finds himself in a foreign country and does not have legal protection in the country of his nationality. As such, environmental refugees are not included under such a definition.

The nature and scope of the international refugee regime 'has been a matter of arguments to extend

the regime, and or the convention. Most recent amongst these is the growing consensus about internally displaced persons should be brought under some form of international protection and or assistance (Holbrooke, 2000). Another strong group of candidates for inclusion has been those displaced by development projects (Cernea and McDowell, 2000).

The Institute of the United Nations University for Environment and Human Security is now looking at the issue of the environmental refugees, and considering how best to recognize and support them. One of the big questions is how to precisely define environmental refugees (Jamais Casio). The term has been vigorously criticized by, among other, McGregor (1993) and Kilbreab (1994) for being poorly defined, legally meaningless and confusing. Since the environmental refugees are not those refugees who have been politically persecuted and crossed international borders, some would argue that it would be more constructive to talk of 'environmental migrants' or 'environmentally displaced persons' (Stranks, 1997). In recent years, a large number of scholars, humanitarians and environmentalists including organizations such as the Toledo Initiative on Environmental Refugees and Ecological Restoration in Spain have expressed a growing need to recognize and define a new category of refugees: those displaced by or fleeing from environmental causes.

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TRANSPORT ACCESSIBILITY AND MOBILITY LEVELS OF SELECTED VILLAGES ON URBAN FRINGE OF DELHI

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ABSTRACT

Villages in urban fringes of metropolitan cities exhibit varying levels of socio-economic and mobility patterns on account of various infrastructure factors of which transport accessibility is a key factor. Although there have been attempts to relate accessibility with mobility patterns and socio-economic development within urban areas, there is relatively little research evidence to study such a relationship for villages located in urban fringes. This paper is based on an empirical study carried out in two villages located on the fringes of Delhi. The paper discusses the concept of accessibility in general and public transport accessibility in particular. It analyses the socio-economic and mobility levels for two case villages, namely Satbari and Mandi, with varying levels of accessibility. The study concludes that village with higher level of transport accessibility exhibit a higher degree of economic development manifesting in higher mobility levels. The study recommends that an understanding of transport accessibility levels is extremely useful in evolving meaningful transport policies and strategies for development of villages in urban fringes.

1. INTRODUCTION

The rapid and uncontrolled expansion of urban areas along their peripheries is a typical phenomenon of urban landscapes in developing countries in general and in India in particular. The emergence of fringe zone with its complex problems of adjustments in between rural and urban ways of life has led to serious land use problems - loss of agricultural lands, unauthorized urban sprawl, high land values, land litigation problems, etc; which has assumed great dimensions but sadly remains a neglected area of research. With further increase in the levels of urbanization, problems in fringe areas are likely to compound unless the planners and policy makers take up concerted actions.

The fringe areas are dependent on the core city for their functional needs. The opportunities to take part in various activities in different parts of the city is provided by roads and public transport and hence transport accessibility is very vital in the overall development of the fringe areas. Villages in urban fringes of metropolitan areas exhibit varying levels of socio-economic and mobility patterns on account of various infrastructure factors of which transport accessibility is a key factor. There has been generally a lack of a scientific and quantitative appreciation of the relationship between transport accessibility and fringe area development, which has contributed to the skewed and lopsided pattern of development in the urban fringes. This paper is based on an empirical study carried out to assess

the accessibility and mobility characteristics of two villages, namely Satbari and Mandi on the fringes of Delhi.

2. CONCEPT OF PERI-URBAN AREAS

Peri-urban areas are the transition zone, or interaction zone, where urban and rural activities are juxtaposed, and landscape features are subject to rapid modifications, induced by human activities. These critical areas of land cover change, leading to transformations, ecological and socio-economic systems, are often neglected by both rural and urban. These peri-urban areas which are often inadequately defined as 'suburbs' or 'sprawl', require further attention and analysis to highlight the new challenges and opportunities that often fall outside traditional problems faced by rural and urban areas. In vibrant economies, the peri-urban area is at once the location of some of the greatest economic activity, but also the place where that activity could stall, as the challenges faced by private investors outstrip the opportunities. Peri-urban areas lie at the interface between urban and rural, and are often places in crisis. Typically, they are outside the responsibility of city authorities. They are the places where the greatest pressure on the natural resource base, on poor people's livelihood strategies, on access to land, and on public amenities takes place. In vibrant economies, the peri-urban area is at the location of some of the greatest economic activity but often at the point where the lack of public services, transport congestion, social tension, and environmental pollution make this an uncomfortable place to be.

This not only affects growth, but it also has a profound effect on the lives of poor people. It affects both those who have moved to the area for work, but also the local population, many of whom sold their land to new developers, only to find that that short term gain has led to a longer term loss of assets. Rural local authorities however, who are responsible for managing peri-urban areas, lack both the capacity and the resources to manage their unplanned development; while urban government are not necessarily keen to take them on.

3. CONCEPT OF ACCESSIBILITY AND MOBILITY

Accessibility is a term often used in transport and land use planning and is generally understood to mean, approximately 'ease of reaching' (Jones, 1981). It is concerned with the opportunity that an individual or type of person at a given location possesses to take part in a particular activity or set of activities. It is a function of the mobility of the individual or type of person, of the spatial location of the opportunities relative to the starting point of the individual, of the times at which the individual is able to participate in the activity and at times at which the activity is available. Thus accessibility is concerned not with behavior but with the opportunity, or potential, provided by transport and land use system for different types of people to engage in activities. Accessibility depends on infrastructure and available and affordable modes of transport for the movement of people and their loads. Accessibility therefore depends on physical proximity and mobility. It may be improved by greater mobility and / or improved proximity. The calibration of land use location models has shown that accessibility has a significant effect on the location of industrial, commercial and residential development. Accessibility indicators can also be used to model the relationship between accessibility and urban development (Gupta et al, 2000). Accessibility measures can assist in the determination of the locational value of land use. It can also be used to identify the best locations for major facilities such as hospitals, schools and colleges, administrative and recreation centers.

Mobility is simply a measure of the ability of people to move themselves or their goods around. This

involves two components. The first of these depends on the performance of the transport system, which is affected by where the person is, the time of day and the direction in which they wish to travel. The second component depends on the characteristics of the individual such as whether she has a bicycle or car available, can afford taxi, bus, or rail fares, is able to walk or use public transport, or has knowledge of the options available. In other words, the first element is concerned with the effectiveness of the transport system in connecting spatially separated locations, and the second element is concerned with the extent to which a particular individual or type of person is able to make use of the transport system.

4. CHARACTERISTICS OF SELECTED URBAN FRINGES IN INDIA

4.1 Chennai

Major findings of the WP2 study in Chennai Metropolitan area indicated that peri-urban development is greatly influenced along transport corridors whether it is road transport or rail transport corridor. If the corridor is served by road and rail transport the development is found to be faster. The case studies established the fact that though the rate of peri-urban formation is more along the corridor, the interiors settlements also under go transformation depending upon the type of road connectivity, linkage with the nearest urban centers, availability of good water source, cheap land and availability of public and semi-public transport facilities. The transformation were visible in these settlements in the area of socio-economic characteristics (Agriculture, non-agriculture workers ratio, workers participation, dependents ratio, income levels vehicle ownership, type of employment, distance traveled for work, education, etc;), land use changes and travel pattern. It is seen that in all the settlements, which are closer to the NH-45 corridor, private, and government sector employment is predominant, labor and agriculture workers form very less percentage in most of the settlements whereas in most of the settlements along the Tambaram Velachery – road and IT corridor the agricultural labor force is significance. Thus the level of accessibility is an important factor in the process of conversion of rural settlement into peri-urban settlement. While work trips are predominant, the

education trips, shopping trips and health trips also find significant share in all the settlements, which are closer to the major corridor. The share of work trips and education trips is more in the interior settlements also, where there are more of agriculture activities. It is seen that the share of work trips is more in rural settlement, less in peri-urban settlement and significant reduction is seen in urban area. Share of work towards the city is the least in the case of rural settlement, significant in the case of peri-urban and urban area. The share of work trips finding destinations within CMA is prominent in all categories, indicating the fact that majority of the work force in the settlements find job opportunities in the nearby settlements which are more urbanized. Similar trends are shown in the case of education trips originating from the settlements are more towards urban areas as facilities for higher studies are more in urban areas. Settlements along NH-45 which are accessible to both road (bus) and rail transport, predominantly use public transport for work and education purposes where as interior settlements and settlements along IT corridor and Tambaram-Velachery corridor depend on bus, intermediate public transport, two-wheelers and bicycles. The major share of the bus users trips is for work and education. Thus investments made in rural settlements in the urban fringe because of availability of land at cheaper cost has not only induced rural transformation but also forced the authorities to provide for better transportation access. Thus it is found that while higher accessibility provided by transportation corridors induce peri-urban formation, large scale private investments in rural settlements also induce peri-urban formation

4.2 Noida

A study carried out by School of Planning and Architecture, Delhi in Noida (1989) provided an interesting comparison of rural mobility between urban (developed and undeveloped), fringe and rural areas. It was observed that almost similar priority is given to need based essential travel purposes like work, education, shopping, and health in all the four types of areas. In terms of daily trip making behavior, the proportion of education trips increases consistently from 22 percent in developed urban areas to 27.7 percent in fringe and 28.2 percent in the rural areas. The percentage share of trips by buses decreases

consistently from 59 percent in developed urban areas to 19 percent in fringe areas and nearly 6 percent in rural areas. On the contrary, the share of walk trips increases consistently from nearly 22 percent in developed urban areas to 44 percent in fringe areas and 70 percent in rural areas. In terms of mode usage the share of cycle and tractors were more in fringe areas (29 percent) as compared to other areas. Expressing mobility in terms of travel distances revealed that nearly 82 percent of the trips were within a distance of 2 km in rural areas as compared to 54 percent in the fringe areas and 31 percent in urban areas respectively. For long distance trips only 10 percent of the trips were above 10 km in rural areas as compared to 23 percent in fringe areas and 50 percent in urban areas.

The NCT of Delhi has been divided into 15 Zones from A to H and J to P, of which 8 Zones are in the urban area, one in Riverbed and remaining 6 in the rural area. So far, Zonal Plans in respect of 11 zones (including sub-cities of Dwarka, Rohini and Narela) have been notified with the approval of the Government of India. The villages in Delhi have undergone significant physical and functional transformation related with their specific location. Villages are characterized by a mix of different land uses and have similarities in compact built form, narrow circulation space and low-rise high-density developments. These mainly accommodate residential, commercial and industrial uses and function as a mix.

The fringe areas for this study were delineated taking into account a number of factors such as urban radius achieved by accumulating population from the center, population density patterns and administrative boundaries. The fringe area thus delineated as per census 1991 covers an area of 61,197 hectare. It broadly covers six Planning Division, namely J, P, M, N, K and L. It has 13 census towns and 124 villages. The total population of the fringe area was 4,97,495 as per 1991 census with a gross density of 8.13 persons per ha. For the present study the fringe pocket lying in Planning Zone J was selected in which two villages, namely Satbari and Mandi were identified for an in-depth study:

The data base for the study comprised of secondary as well as primary data. The secondary

data relating to socio economic and demographic information of villages in fringe areas which was collected from the Registrar's General Office. Besides these information pertaining to road network system was collected from MCD office while details related to public transport system was collected from Delhi Transport Corporation and State Transport Authority offices to develop transport accessibility indices. In addition to secondary data, primary surveys comprising Household Survey and Public Transport Survey were also carried out in 1998 for two selected villages of Satbari and Mandi to analyze the socio-economic and trip characteristics.

5. TRANSPORT AND EMPLOYMENT ACCESSIBILITY LEVELS IN CASE VILLAGES

5.1 Public Transport Accessibility

Transport accessibility of an area could largely be expressed in terms of road network accessibility and accessibility by public transport. The road network accessibility can be constructed using Graph Theory concepts. In the present study instead of road network accessibility which is more useful to compare regional / sub-regional accessibility levels, public transport (bus) accessibility has been considered. The frequency of bus service in a zone is an important indicator of the accessibility by public transport in a zone.

$$AI = \sum_i \sqrt{N_{ij} / A_j}$$

Bus Accessibility index is given by:

where AI = Accessibility index by Bus

N_{ij} = Off-peak frequency on route 'i' and passing through Zone 'j'

A_j = Area of zone 'j'

In the present context, since the study is focused on the fringe areas which are non-urban in character, an overall bus frequency collected from secondary sources was considered for accessibility calculations

5.2 Accessibility to Employment Opportunities

Accessibility is also viewed as the opportunity, which an individual at a given location possesses to take

part in a particular activity, sometimes incorporating the characteristics of the resident population also. For assessment of accessibility to employment opportunities a Hansen measure has been adopted in this study. The approach of this type of measure is that the opportunities available in each zone are discounted (or reduced) according to the difficulty of reaching that zone. The 'generalized Hansen measure', which incorporates a more generalized measure of travel difficulty, is expressed by:

$$A_i = \sum_j B_j f(C_{ij})$$

where A_i = Accessibility of zone 'i'

B_j = opportunities at zone j for a given purpose

f(C_{ij}) = some function to represent the deterrent effect of the travel cost

In the present study the impedance measure used is the 'shortest distance (D_{ij}) between the zone centroid. The impedance function used is f(C_{ij}) = 1/D_{ij}.

The accessibility to employment opportunities both by public and private transport was also analysed considering employment opportunities in the nearest planning zone from the case villages, namely zone F (South Delhi). Table 1 shows the accessibility levels, both for public transport and employment opportunities, for the case villages. In both the accessibility levels village Satbari has a higher value compared to village Mandi.

It is observed that from the Table 1 that that village Satbari, has a higher public transport accessibility index (1.24) compared to village Mandi (0.71) besides possessing higher employment accessibility levels.

Table 1: Public Transport Accessibility and Employment Accessibility Levels of Case Villages

Village	Public transport accessibility index	Employment accessibility index (distance based)	Employment accessibility index (cost based)
Satbari	1.24	31.55	89.59
Mandi	0.71	23.70	67.97

6. SOCIO-ECONOMIC AND MOBILITY CHARACTERISTICS OF CASE STUDY VILLAGES

6.1 Socio-Economic Characteristics

The salient socio-economic characteristics as analysed from the secondary information coupled with household survey for the two case study villages, Satbari and Mandi are shown in Table 2. It can be inferred from the Table 2 that that village Satbari, which has a higher public transport accessibility index and higher employment accessibility levels in comparison to village Mandi, is more economically developed as reflected by higher parametric values of household income, number of earners per family and monthly household expenditure besides higher literacy levels. In comparison the city level household income was much higher at Rs.4,437 in 1994 and Rs.7,737 in 2001 at current prices indicating that urban fringes generally comprise of lower income population. However, the number of earners per household in the fringe is higher than the city average of 1.69 in 1994 although the per capita incomes are lower in fringe areas.

6.2 Mobility Characteristics

A comparative assessment of the household characteristics analysed from the primary surveys is presented in Table 3. It can be observed that per capita trip rate (PCTR), an indicator of mobility, for Satbari is higher by 69.23 percent in case of vehicular trips and by 10.41 percent taking walk also into account. Again the trips destination outside the village are higher in case of Satbari

Table 2 : Salient Socio -Economic Characteristics of Case Villages

Characteristic	Satbari Village	Mandi Village
a) Village Level		
1. Density(pph)	4.06	3.95
2. WFPR (%)	32.29	43.64
3. Tertiary Workers (%)	55.94	63.05
4. Literacy Rate (%)	42.4	37.79
b) Household Level		
1. Monthly Income (Rs)	3227	2312
2. Number of Earners	2.14	1.96
3. Monthly Expdr. (Rs)	2813	2143

(36.05 percent) compared to Mandi (16.67 percent) indicating a higher level of interaction of village Satbari with DUA. This interaction is also facilitated by the presence of higher transport accessibility in Satbari. In both the villages 'walk' is the predominant mode primarily to cater to shorter lengths of intra village commuting. The share of work trips is almost similar in both the villages. Bus is the predominant mode of transport in both the villages though Satbari has a higher share of bus in total trips (37.28 percent) as compared to 32.28 percent in Mandi which is also due to better bus accessibility in village Satbari. Share of two wheeler trips in Mandi are marginally higher than Satbari partly to offset the deficiency in bus accessibility levels. Overall it can be inferred that transport and employment accessibility of Satbari does have an impact on the mobility patterns of the villages.

Table 3 : Salient Travel Characteristics of Case villages

Characteristic	Satbari Village	Mandi Village
1. Per Capita Trip Rate		
- Vehicular	0.44	0.26
- overall	0.53	0.48
2. Trips by Purpose (%)		
- Work	53.48	56.25
- Education	26.58	33.32
- Business	9.30	5.21
- Social / Recreation	10.45	4.16
3. Trips within zone (%)	63.95	78.33
4. Trips by Modes (%)		
- Car / 1jeep	1.11	1.04
- Two wheeler	3.48	6.26
- Bicycle	17.44	16.67
- Bus	37.28	32.28
- Walk	40.69	45.83
5. Average Trip length by bus (km)	6.16	4.27
6. Average waiting Time for Bus (min.)	13.33	21.67
7. Average Travel time by bus (min.)	28.34	20.04

In comparison to mobility levels in fringe areas the per capita trip rate of the city (RITES 2002) was 1.27 including walk and 0.87 excluding walk (vehicular) respectively indicating that the mobility levels in the city are at least twice that in the fringe area. The purpose wise distribution of trips in the city in 2001 indicated that work, education, business and other trips accounted for 36.5 percent, 43.3 percent, 12.7 percent and 7.4 percent respectively which indicates that education trips are relatively lesser in the fringe owing to poor literacy levels. In terms of modal split the share of cars, two wheelers, cycle, bus and walk accounted for 7 percent, 11.6 percent, 3.6 percent, 40.2 percent and 32.7 percent respectively in the city in 2001. There is a clear dependence on personalized motorized vehicles on trip making in the city besides the buses accounting for 60 percent share whereas in the fringe areas cycles and buses constitute the major modes of movement accounting for 50 percent-55 percent share. It is amply clear that there is a heavy dependence of the fringe population on public transport system in the absence of low motorized vehicular ownership levels. Hence, there is need to improve the public transport supply in the fringe areas so that the local population could access all the opportunities outside their villages using a safe and faster mode of travel such as buses in comparison to cycles.

7. CONCLUSIONS

Suburbanization and sprawl are the emerging key challenges for many urban areas. Peri-urban areas are important entities in the city's economic growth and prosperity. Access from surrounding areas into and out of major metropolitan areas is a key issue. Global experiences have indicated that inadequate public transport infrastructure within peri-urban areas is having an impact both on private vehicle use and increasing levels of social and economic exclusion for those without private vehicles. Improved public transport infrastructure and mobility management will not only benefit the peri-urban areas but also support more sustainable access for city dwellers to the open spaces of surrounding peri-urban areas. Access and mobility policies for urban areas need to encompass peri-urban regions otherwise the support function offered by peri-urban areas is hampered. More attention needs to be paid to the peri-urban areas in order to define their shared

characteristics, opportunities and challenges. The complex issues of peri-urban areas require innovative, smart responses and the relevant policies and resources to carry them out not only in urban areas but the peri-urban areas around them.

A review of literature in the present study context indicates that fringe area development policy and practices in Indian cities has sadly remained a neglected area of attention by researchers, planners and policy makers. The impact of transport accessibility on the socio-economic development patterns of villages in urban fringes has not been accounted for in policy formulation resulting in a skewed and lopsided development of urban fringes. The present study reveals that urban fringe areas have distinct characteristics in comparison to the main city. Results from the present empirical study indicates that transport accessibility by public transport system and in terms of access to employment opportunities does indicate that there are impacts on the socio-economic development patterns of villages in urban fringes of Delhi. Villages with higher degree of accessibility exhibit a higher level of socio-economic development. There is an urgent need to augment the public transport supply provisions in the urban fringes. It is recommended that an in-depth understanding of transport accessibility and its likely impact on socio-economic development must be made to evolve meaningful policies and strategies for development of villages in fringe areas. In this regard there is a need to evolve analytical methods which could guide the policy planners regarding the likely changes in socio-economic development patterns of villages in urban fringes on account of various transport policy interventions in urban fringes.

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IMPACT OF CNG ON DELHI METROPOLITAN AREA

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ABSTRACT

Level of urbanization in Delhi is rising day by day but does the city always mean only bright light or does it have dark shades as well. The popular perception of a place may not be the only reality of it. Urbanization of this city also brought into picture the dark clouds of pollution. Seeing the level of increasing pollution the government has to think over this and ultimately on 1 April, 2001 the Supreme Court took a decision to ban the old vehicles and permit the CNG vehicles to run on the road. This paper stresses on the pre and post CNG period taking into account the social, economical as well as the environmental factors. The paper emphasizes the importance of CNG in day to day life and the environment around him.

1. INTRODUCTION

From its long slow evolution the city of Delhi has emerged into a revolutionary stage. It has undergone substantial qualitative as well as quantitative change from the conventional urban structure so that it is no longer merely a large version of traditional city but a new and very different kind of form of human settlement which is known as a metropolis. This is what our capital city Delhi is.

The Delhi Metropolitan area also possesses the character of being the nation's economic hub and houses the administrative, educational, and cultural headquarters of highest hierarchy. This character of Delhi makes it so attractive that almost 40,000 people are gravitating every year in search of employment and for availing of the highest facilities.

The rapid growth of urbanization in the capital is inevitably reflected by its environmental pollution. The most apparent anthropogenic stress is brought by the atmospheric pollutants like SO_2 , NOX , CO , Hydrocarbons, metal dust, fluoride 2 , pesticides, fly ash soot and radioactive substances.

Viewing this increase in pollutants day by day, the Supreme Court took a major step, which required all public vehicles in the capital to switch to compressed natural gas (CNG) engines by April 1, 2001. This decision had brought noticeable changes in the economical, social and atmospheric conditions.

For the preparation of this paper, extensive survey and study has been done to show the environmental changes in the pre and post CNG period at different places in Delhi. Some secondary data has also been gathered to stress on the pre CNG problems and alternative solutions and their feasibility. The acceptance of the CNG by the various countries with the development of present infrastructure facilities has also been highlighted. In this way an approach has been made to make the reader understand the changing trend and adopt this new concept for a safe, pollution free environment for the coming future.

2. PRE-CNG PERIOD

Delhi being the nation's capital has become the nucleus of activities. Largest numbers of motor vehicles ply on the roads of Delhi (refer Table 1).

Table 1: Trend in vehicular population growth in Delhi

(in '00000)

Type	1985	1990	1995
Car/Jeep/Stn wagon (Petrol)	1.57	3.47	5.75
Scooter/Motor Cycle	5.79	11.2	16.2
3 wheelers	0.3	0.59	0.75
Taxi	0.08	0.09	0.12
Buses(Diesel)	0.14	0.18	0.26
Goods Vehicles	0.52	0.92	1.20
Total	8.40	16.4	24.3

Source: White Paper, Ministry of Environment and Forest, Government of India

Problems being faced by the city included the following:

- This leads to congestion, slow traffic movements, mixed traffic and parking problems and of course environmental pollution;
- Among the other factors, pollution has become the most deadly one. The vehicles of these days are dependent on mainly two types of fuels i.e. Gasoline and Diesel;
- These fuels emit a complex mixture, which is responsible in the formation of ground level Ozone that results into the green house effect. These fuels are toxic in nature too. Burning these fuels emit huge amount of CO₂, CO, SO₂, NO₂ and various hydrocarbons;
- The amount of fuel available in our country doesn't meet the present requirement hence we have to depend on the other countries to import the additional amount. This is the reason why the fuel cost is high and people are still depending on it;
- Another constraint is that the vehicles are designed in such a manner that it can't adapt to any other fuel with their present design all of a sudden; and
- Parking of vehicles off the road exceeded so much that the vehicles encroached upon the roads creating bottlenecks of several points for the spreading vehicles.

Accidents on roads have increased tremendously (refer Fig. 1). The main reason of road accidents

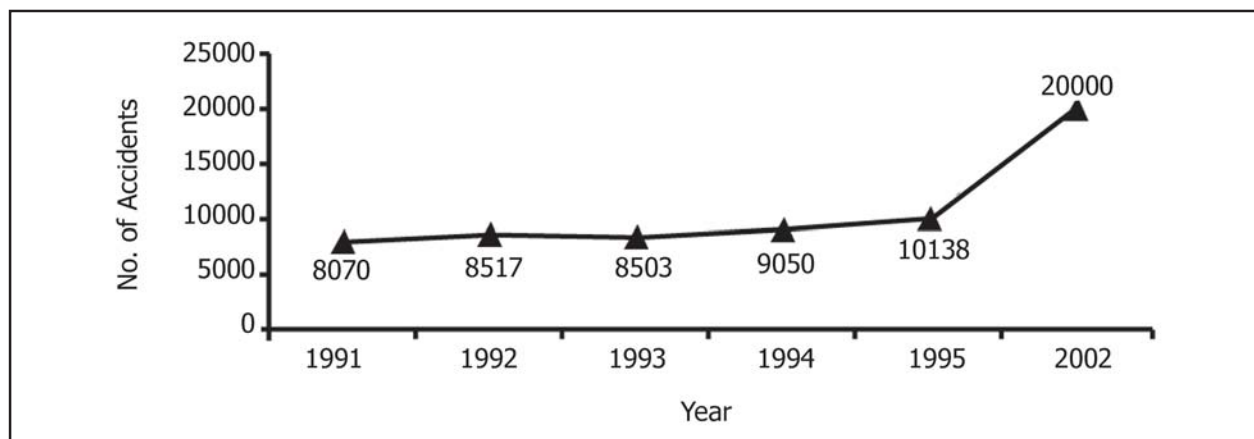
are overcrowding and mixing of vehicles and to some extent due to the lack of management. The graph below shows the number of accidents taken place in the past few years.

Air pollution from different categories of vehicles:

- Two Wheelers: They account for about 2/3 of total vehicular population in Delhi. These two wheelers emit 20-40 percent of the fuel un-burnt/partially burnt, more than 70 percent of hydrocarbons and nearly 50 percent of CO in Delhi. As these emissions are less visible people are not aware its effects which is deteriorating the air quality day by day;
- Three-wheelers: Out of 80,000 three wheelers in Delhi, nearly 97 percent are petrol driven. These vehicles are emitters of CO and hydrocarbons. In addition to this it is widely believed that if petrol is adulterated, the vehicle emits thick black smoke; and
- DTC buses and trucks – Their recommended age limit is 4-5 years but the owners run them for 8-10 years or more. Use of old vehicles as well as overloading cause high smoke emissions.

Delhi metropolitan area being a nucleus of activities is one of the most polluted cities in India. The emission like CO₂ shoots up with urbanization in association with vehicularisation and industrialization. SO₂ emissions are estimated about 45,000 tonnes per year by 2000 whose major sources are industries and thermal power

Fig. 1: Growth in Accidents



Source: Statistical Handbook 1998

plants. Like SO₂ emissions the dominant sources of SPM emissions was about 115,700 tonnes per year to 122,600 tonnes per year by 2000 whose 90 percent sources are the industries and the thermal power plants.

And the levels of air pollution discharged from various sources concentrate in a particular area due to local meteorological conditions, existing regulations and urban geometry. This is the reason the daily maximum and minimum temperature has shown Safdarjang is warmer than Palam, Safdarjang being situated very close to the city core. The core pockets are found to be at higher temperature due to thermal radiation emissions due to concrete / tar roads and built up areas,

Table 2 Carbon Monoxide concentration at ITO crossing, Delhi

Year	Annual Mean Concentration	% Variation (Base 1989)
1989(Jan-Dec)	2905	
1990(Jan-Dec)	2688	(-)7
1991(Jan-Dec)	3464	(+)19
1992(Jan-Dec)	3259	(+)12
1993(Jan-Dec)	4628	(+)59
1994(Jan-Dec)	3343	(+)15
1995(Jan-Dec)	3916	(+)35
1996(Jan-Dec)	5587	(+)92
1997(Jan-Dec)	2392	
1998(Jan-Dec)	4847	(+)103

Source: Analysis of Delhi's Air Quality Data- TERI, Aug 2001

population / pollution are concentrated more in the core areas. Similarly relative humidity is lower and the surface wind is higher in the core area than the fringes.

Vehicular emissions constitute a very important component of air pollution in Delhi. To assess this impact of vehicular emissions on the ambient air, the Central Pollution Control Board (CPCB) monitors the air quality in terms of SO₂; oxides of nitrogen and CO at ten major traffic intersections and at IARI campus, which is a relatively low pollution area.

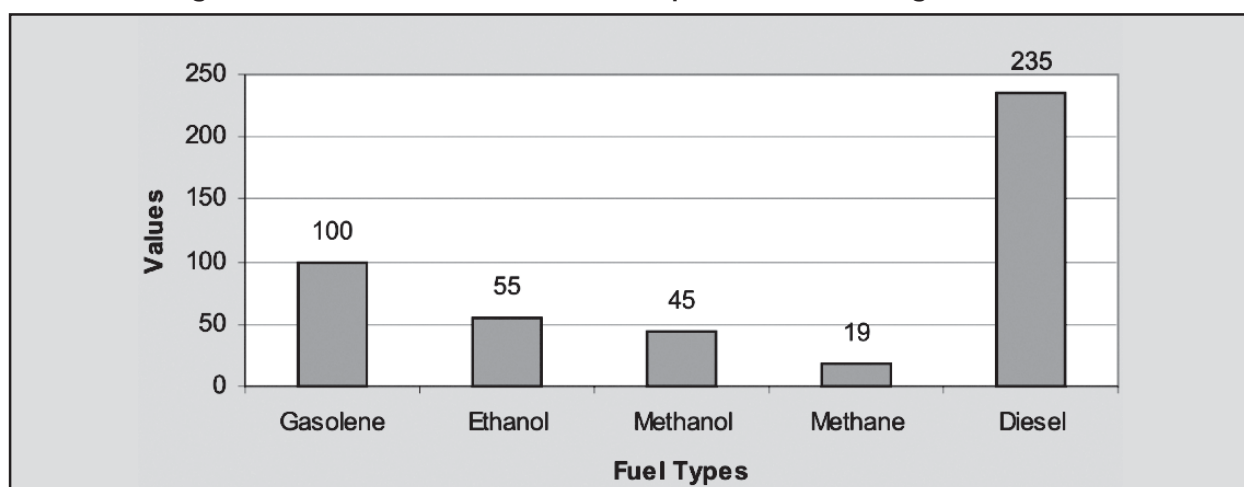
The annual average values found in the observations are given in the Table 2.

The emissions caused by the air pollutants are responsible for causing numerous diseases. The most effective one is the particulate matter, which causes respiratory diseases such as bronchitis, asthma and breathing troubles for children and old people. These minor diseases also cause Lung cancer (Fig. 2) in the long run. Corrosion of materials and damage of plant life is another effect of air pollution.

The toxicity of the particulate matter (Table 3) depends on the source. Diesel is the worst source as it emits particulate matter containing poly aromatic hydrocarbons, which are carcinogenic.

The Central Road Research Institute, New Delhi carried out a study and compared the health problems such as irritation of eye and throat

Fig. 2 Cancer Risk for Various Fuel Options for Passenger Car Index



Source : Report- TERI

Table3 Particulate Lead Concentration

Location	1989-90 ($\mu\text{gm}/\text{m}^3$) (Annual Mean)	1996-97 ($\mu\text{gm}/\text{m}^3$) (Annual Mean)	% Variation 1989-90
Ashok Vihar	0.200	0.179	(-)
Sirifort	0.117	0.161	(+)
Janakpuri	0.112	0.142	(+)
Nizamuddin	0.218	0.092	(-)
B.S.Z. Marg	0.251	0.210	(-)
Shahadara	1.570	0.222	(-)
Shahazad- abag	0.391	0.381	(-)
Average of seven stations	0.408	0.198	(-)

Source: Analysis of Delhi's Air Quality Data- TERI, Aug 2001

among the traffic policemen and those work in the offices. The study showed that eye irritation was far more common (94 percent) among the policemen than among the office workers (28 percent).

Problems related to throat were equally high in policemen where the fig among the office workers was less than 15 percent. Also polluting the city's air is carbon monoxide, which obstructs oxygen supply to the blood. In this way the increasing level of air pollution had caused grave concern for the residents in Delhi.

3. METHODS TO OVERCOME AIR POLLUTION

Many countries other than India are trying alternative methods to fight with the present pollution problems. They also tried to develop innovative emission control technologies, their establishment, inspection and maintenance programme. The following alternatives like electricity, ethanol, methanol, natural gas (Methane), propane, and reformed gasoline were tried out. The positive and negative sides of each of them are as mentioned below.

3.1 Electricity

It is very advantageous being a zero emission fuel for vehicles. Electricity is produced in power plants where the emission is easily controllable. The

engines can be easily recharged at night when the power consumption by others is the least. Lack of technology, high fuel cost, low pickup and very low range of vehicles had made it unacceptable.

3.2 Ethanol

Ethanol is an excellent fuel with very low emissions. It is also made from renewable sources, which can also be produced domestically. There has been very little effort made to improve this technology. Hence, only few ranges of vehicles are available. The high fuel cost is another factor, which has made this fuel unacceptable.

3.3 Methanol

It is also an excellent fuel for vehicles whose emission is also very low. It is a renewable fuel and can be made from feed stocks. But vehicles using this fuel are of lower range.

3.4 Natural gas (methane)

This gas has also got low emission property. It is less toxic and gives out less carbon monoxide gas. It is less in use due to its high cost and refueling problems. That is why the vehicle range using this fuel is low.

3.5 Propane

This gas is cheaper than gasoline and proves to be an excellent and widely available fuel. The fuel has got less toxicity. The cost of propane is higher hence the demand is also less. This needs live supply and distribution and no energy security.

3.6 Reform gasoline

This fuel can be used in all cars without changing its distribution system. It has got a lower emission also. The cost of this fuel is high with less energy security and trade balance benefits.

None of these products could practically give an alternative solution to gasoline, the reason being their high cost, which has made them uneconomical and unacceptable (refer Table 4).

4. THE CNG SOLUTION

CNG or the Compressed Natural Gas was ultimately accepted globally as the best alternative solution.

Table 4 Showing the comparison of the prices of petrol and other fuels:

Country	USA	Canada	Italy	France	Swiss	Russia	Australia	Czech
Price of Petrol (Per Ltr.)	100	100	100	100	100	100	100	100
Price of Diesel (Per Ltr.)	94	78.2	57.5	59.3	61.1	77.2	-	-
Price of LPG (Per Ltr.)	49.6	36.9	49.3	47.6	50.7	57.8	-	-
Price of CNG (Per Ltr.)	38.8	23.6	44.0	42.5	46.3	35.7	30.5	<50

There are various reasons for its acceptance due to its properties (refer Table 5) like:

- Less pollution causing fuel;
- Energy security; and
- Economical

It is an alternative to gasoline, which could overcome the large oil demand and reduce the ground level pollution substantially. Use of CNG will reduce the ozone forming hydrocarbons. There is no evaporative emission of CNG. As far as vehicle adaptively is concerned, single fuel vehicles can be launched with high octave, cold starting, more engine life, low engine deposits and less lube oil deteriorating.

4.1 Implication of Supreme Court's order of April 2001

Viewing the change of air quality over the past years the court felt that this change is motivated by the enhancing transport system.

The court's directives are classified under two categories. One specifies the technology, where the other lay down the standards for fuels and emissions and CNG was found to be an eminent solution to solve the pollution problem marginally. The order for using CNG bus illustrates the mandating of technology approach and imposing progressively stringent emission norms on non commercial four wheeled vehicles and scooters, motorcycles and mopeds.

5. POST CNG PERIOD

Due to the low emission and pollution free property of CNG, the level of toxic gases came down significantly. In the tables 5, 6, 7, 8 and 9 a comparison of the air quality has been shown to get an idea of the improvement of the air quality in the post CNG period.

6. IMPACT ON SOCIAL LIFE

The immediate effect of CNG was seen when the ruling led to disappearance of 15000 taxis and 10000 buses from the city. School going children and workers couldn't reach to their respective places. Prices of various commodities shoot up. And as a result people started reacting to the government's decision.

Nearly 2,800 buses went off the road after the order was sanctioned. The transport department sources said 2114 permit has been surrendered till April 30. The monopoly of these buses had finally been broken. The Apex court had also directed that owners of diesel buses would be fined Rs. 500 from April 6 and RS. 1,000 from 6 May 2002. At the end of April the city government collected RS. 5,69,78,000 and this money had been deposited under the account of the Apex court.

As a result of the fine charged from the transporters the fare of the commercial vehicles rose up. Bus, Taxi and auto rickshaw fares went up to 28% hike. The base fare of auto rickshaw was set Rs. 5 instead of Rs. 2.5. Similarly for the Taxi's the base fare rose up to Rs. 10 instead of Rs. 5. The buses, which used to charge Rs 2 for 4 kms did not change however for 4-8 kms the fare

Table 5 CNG proves to be safer to use as compared to other fuels in different aspects

Properties	Natural gas	Gasoline	Diesel
Flammability limit	5-15	1.4-7.6	0.6-5.5
Auto ignition temp in °C	842	572	446
Min ignition energy in air (10 ⁻⁶ BTU)	0.27	0.23	0.23
Peak flame temp	3423	3591	3729

Source: Indraprastha Gas Limited

Table 6 Compares the average levels of particulate matter during twelve months after April 1, 2000, (Ban on old commercial vehicles) with that during twelve months prior to this date.

Station	Total suspended particulate matter ($\mu\text{g}/\text{m}^3$) [Permissible limit=200 $\mu\text{g}/\text{m}^3$]		Respirable suspended particulate matter ($\mu\text{g}/\text{m}^3$) [Permissible Limit=100 $\mu\text{g}/\text{m}^3$]	
	April 1999- March 2000	April 2000- March 2001	April 1999- March 2000	April 2000- March 2001
Ashok Vihar (CPCB)	352	421	NM	NM
Janak Puri (CPCB)	333	368	NM	NM
Nizamuddin (CPCB)	314	383	NM	NM
Shahadra(CPCB)	338	397	NM	NM
Shahazada Bag (CPCB)	352	488	NM	NM
Siri Fort (CPCB)	343	342	NM	NM
ITO Crossing (CPCB)	427	493	207	179
Lodi Road(TERI)	NM	NM	199	198

Source: Analysis of Delhi's Air Quality Data- TERI, Aug 2001

Table 7 Compares the average levels of gaseous pollution during the winter after the ban of old commercial vehicles from April 1, 2000 with the winter prior to this date.

Station	Nitrogen Oxide ($\mu\text{g}/\text{m}^3$) [Permissible limit=80 $\mu\text{g}/\text{m}^3$]		Sulphur dioxide ($\mu\text{g}/\text{m}^3$) [Permissible Limit=80 $\mu\text{g}/\text{m}^3$]	
	Nov 1999- Feb 2000	Nov 2000- Feb 2001	Nov 1999- Feb 2000	Nov 2000- Feb 2001
Ashok Vihar (CPCB)	31	25	13	11
Janak Puri (CPCB)	29	40	20	18
Nizamuddin (CPCB)	39	40	22	20
Shahadra(CPCB)	31	25	25	15
Shahazada Bag (CPCB)	46	39	22	14
Siri Fort (CPCB)	27	28	22	17
ITO Crossing (CPCB)	71	68	23	17
Lodi Road(TERI)	51	66	18	11

Source: Analysis of Delhi's Air Quality Data- TERI, Aug 2001

Table 8 Compares the average levels of particulate matter during the two months after April 1, 2001 (CNG ruling) with that during the same period last year.

Station	Total suspended particulate matter ($\mu\text{g}/\text{m}^3$) [Permissible limit=200 $\mu\text{g}/\text{m}^3$]		Respirable suspended particulate matter ($\mu\text{g}/\text{m}^3$) [Permissible Limit=100 $\mu\text{g}/\text{m}^3$]	
	April-May 2000	April-May 2001	April-May 2000	April-May 2001
Ashok Vihar (CPCB)	474	275	NM	NM
Janak Puri (CPCB)	481	NM	NM	NM
Nizamuddin (CPCB)	619	336	NM	NM
Shahadra(CPCB)	617	373	NM	NM
Shahazada Bag (CPCB)	625	496	NM	NM
Siri Fort (CPCB)	424	458	NM	NM
ITO Crossing (CPCB)	580	565	208	172
Lodi Road(TERI)	NM	NM	229	221

Source: Analysis of Delhi's Air Quality Data- TERI, Aug 2001

Table 9 Compares the average levels of gaseous pollutants during the two months after April 1, 2001 (CNG ruling) with that during the same period last year.

Station	Nitrogen Oxide($\mu\text{g}/\text{m}^3$) [Permissible limit= $80 \mu\text{g}/\text{m}^3$]		Sulphur dioxide ($\mu\text{g}/\text{m}^3$) [Permissible Limit= $80 \mu\text{g}/\text{m}^3$]	
	April-May 2000	April-May 2001	April-May 2000	April-May 2001
Ashok Vihar (CPCB)	22	21	11	10
Janak Puri (CPCB)	37	NM	19	NM
Nizamuddin (CPCB)	27	37	18	17
Shahadra(CPCB)	30	21	23	12
Shahazada Bag (CPCB)	44	37	23	17
Siri Fort (CPCB)	23	19	17	12
ITO Crossing (CPCB)	47	60	18	15
Lodi Road(TERI)	46	50	16	10

Source: Analysis of Delhi's Air Quality Data- TERI, Aug 2001

has been hiked to Rs. 5 to Rs. 4. For 8-12 kms, the fare has been hiked to Rs. 7 from Rs. 6 and above 12 kms; the fare is Rs. 10. These charges have been passed by the cabinet of Delhi State government also.

The fare hike depended on the taxi or auto nor bus driver, who charged at their will irrespective of the fares fixed by the transport department. Till this fare hike was notified by the governor, with the commuters to face this kind of situation. However, the transporters think that the government has taken care of the commuters' interest but not theirs and they think that the fare hike will definitely be below their expectations.

To cope up with the situation of lack of commuting media, high travel fare people went impatient and started taking out their private vehicles. This led to increase of traffic volume on road tremendously causing various problems like slow traffic movement, high emissions at traffic junctions traffic congestion and chaos on road during the peak hours.

7. AVAILABILITY OF CNG IN CITY

The demand and supply of this fuel didn't match with each other. The auto-rickshaws and other small commercial vehicles face this situation by waiting in a long queue of three to four kms in front of filling stations daily. Sometimes the autos have to wait not only for long hours but for 1 to 2 days also. IGL is the only company that supplies

CNG to the whole lot of vehicles of Delhi. The present demand of Delhi city is 3.3 lakhs kg /day where as the present supply is only 2.2 lakhs kg/day. M/S IGL has only 94 stations in Delhi as on date.

Moreover there are only 3 companies that manufacture CNG cylinders. These are the basic hindrances coming on the way of implementation of this project. The existing CNG supply is being used to fuel nearly 5,000 buses, 2,200 RTVs, 44,000 autos and taxis apart from over 10,000 private vehicles. If this problem persists then catering to CNG requirement of all the CNG vehicles on the road of Delhi shall be difficult and will lead to chaotic problems.

Government couldn't arrange to provide sufficient infrastructure for refueling purpose. Lack of financial and technical calculations led to this insufficiency. The situation has become more and more sensitive because along with this persisting crisis there are 3 cases of accidents due to CNG in the capital. The HBJ pipeline capacity is only 33.4 million std cubic meter per day which needs advancement in technology for increasing its efficiency along with the increase in network system.

Viewing this crisis Mr. Ram Naik promised that the additional required infrastructure will be built within 1 to 2 years. As a step forward, the Union Government has doubled the allocation of CNG to Delhi from June 2003 till then the long queues

outside gas stations shall continue. The additional allocation shall be sufficient to fuel 10,000 buses, 80,000 autos, 30000 taxis and as many private vehicles. It will be a boost to public transport as more buses running on CNG will be able to come on the road. The sole producer of CNG, Indraprastha Gas Limited, is planning to set up 115 filling stations with some mega stations by June 2003. The mega stations shall be able to solve gas dispensing problems to a great extent.

As CNG has proved itself to be a clean and pollution free gas, it will certainly improve the environment substantially in the coming days. But looking at another side of this face, which made the public violent by the sudden implication of rule, it is suggested to bring this change in a phased manner with proper arrangements. We can also try out for the use of other clean fuels simultaneously to release the load from this only fuel. Research can also go on to improvement of technologies and result in the production of various ranges of vehicles. Proper traffic management, widening of roads, improving the road surfaces speed lanes, separation of pedestrians from the vehicles are several other ways to improve the traffic conditions and can further decrease the emission level.

Table 10 Number of Vehicles and Gas Station in Different Country

Country	Number of Vehicle	No. of Gas filling Stations
Italy	450000	480
Australia	400000	30
Holland	700000	1988
Spain	40000	350
New Zealand	380000	480
China	3000	98
Japan	300000	600
Canada	25000	250
USA	380000	480
Germany	1100	45
Mexico	75000	620
Algeria	20000	100
Argentina	380000	480
France	600	4

Table 11 Number of CNG and LPG Powered in Different Countries

Country	No. of CNG powered auto vehicles	No. of LPG powered auto vehicles
CIS	380000	480
Canada	32000	180
USA	1700000	1250
France	50000	1539
Russia	380000	480
Japan	15000	150
Italy	1100000	1550
New Zealand	40000	800

Some countries (Table 10 and 11) have already started taking action in this field. 8,500 vehicles in U.S and 300000 vehicles run with the help of natural gas. Japan has followed the same way and working to improve the technologies also. Our neighboring country Pakistan is also stressing its people to use CNG.

The present world annual auto vehicle production has reached 50 million, with the amount of registered auto vehicles of nearly 700 million. It is estimated that by 2030, the world's registered auto vehicles will be as many as 1 billion. In China, annual auto vehicle production has reached 1.45 million with the total amount of registered auto vehicles of 12.70 million. Estimates also show that the number of registered auto vehicles will increase to 20 million by the year 2000.

Nowadays in many countries, comparative mature technologies and advanced equipment as well as strict norms / standards and management experiences have already become available for utilizing natural gas as a substitute auto vehicle fuel for petrol. An enhanced technical exchange with these countries will surely facilitate us to learn more experiences and lessons, and obtain the latest information and data concerned, which in turn will facilitate our import of advanced technologies and equipment from abroad thus further activating the technical advancement and the natural gas powered auto vehicle industry.

8. CONCLUSIONS

At the present time, of various alternative energy sources developed for consumption by auto vehicles, natural gas is an outstanding one for it can help reduce 25 percent of the CO₂ which would otherwise be discharged in the tail gas of the vehicles. Besides, natural gas can help reduce 80 percent of the CH₄ compounds emission, 70.5 percent of SO₂ emission in the tail gas, 99.99 percent of SO in the tail gas, 41.67 percent of particle pollutants, 52.8 percent of non-methane hydrocarbon, 89.73 percent of CO, 40% of noise and the emission of Pb eliminated. Results from experiments and tests show that environmental pollution can be alleviated to a large extent by using natural gas powered auto vehicles. In addition, natural gas powered auto vehicles also offer advantages of better safety and optimal economy. With lower prices of CNG compared with petrol and diesel presently in many countries, the operation costs of auto vehicles powered by these fuels is only about 60 percent that of petrol.

Other than vehicles there are other sources of pollutants too which contribute to the air pollution. GDP from Indian Economic Survey 97'- 98' and Pollution load based on CSE Study, 1998 shows that the growth due to vehicular and industrial pollution has outstripped the economic growth by 7.5 times and 3.47 times respectively. The CNG rule has shown significant change in the environment of our capital Delhi leaving aside the hazardous chemical and electronic industries which are also responsible for causing pollution.

This shows that the experiment with CNG has not failed. This implementation can bring better results if the conversion is done in phases however, MRTS

(Mass Rapid Transportation System) is better and more practical solutions to other general problems of Delhi like congestion, irregular traffic apart from helping reduce pollution. This will also address the social cause by helping the commuters belonging to mass population.

Now a day the environment has become the focal point of growing concern and attention. Our target should be to improve the environment in a time bound manner to achieve the predefined objectives (Green, Clean and Safe Delhi). By this way our environment can be maintained and developed like any other assets.

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STATUS OF NON-MOTORIZED VEHICLES IN URBAN AREAS

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ABSTRACT

Various modes of transport in urban areas can be classified as motorized, non-motorized and pedestrians. Their use is determined by the distance traveled and socio-economic conditions of the user. Thus, their percent share to total travel trips varies from city to city. This paper describes how, over a period of time there has been a shift from non-motorized modes to motorized modes. It is found that government policies and urban structure has led to increase in the use of motorized vehicles. Paper also explains how improper road designs have made non-motorized vehicles or NMV users the most vulnerable due to road accidents. It is concluded that a well functioning road design could fulfill the requirements of all road users.

1. INTRODUCTION

For mobility of a person or material from one destination to another, one required transport modes. The transport modes can be classified as motorized, non-motorized, and walking. Logically speaking, the choice of mode of transport depends upon the distance to be traveled, or the time to be taken to travel a given distance. In simple terms, longer distances are covered by motorized modes and the shorter distances are covered by non-motorized or by foot. But still there are other factors, which influence the selection of mode for a particular trip, like considering the less availability of time, a particular distance, which can be covered on foot or by any non-motorized mode of transport is done by a motorized mode. Seeing the busy and fast lifestyle in the urban areas, this is a common practice. Another factor is the economic status. A person, who was making short trips by non-motorized modes when his economic situation was not very sound, prefers motorized mode for the same trips with the increase in his economic status. Thus one can say that the selection of the mode of travel depends on the distance to be traveled, time to be taken, and the affordability of a person to choose between various modes.

Now from the above background it may sound that the use of non-motorized vehicles (NMVs) should have decreased in the urban areas, but the fact shows that though its percent share in the total travel trips has reduced, the absolute number has shown an increasing trend. Over the

period with the increasing number of motorized vehicles (MVs), the existence of NMVs has been continuously ignored in the traffic planning in the urban areas. The present paper highlights the vulnerability of NMVs on the urban roads. For this, the paper is divided into various sections, starting from the type of transport modes, how the industrialization and urbanization lead to the decrease in the use of non-motorized mode of travel, government's policies to encourage the use of motorized modes and not giving a due consideration to the NM modes, and how the road designs has ignored the NM users.

2. TYPE OF TRANSPORT MODES

Based on the mass transported, the transportation modes can be classified as Public-transport and private transport. The modes used for this transport can be further categorized as: motorized, non-motorized and pedestrian. Motorized modes are heavier, faster and often accorded higher social status than NMVs. On the other hand NMVs are lighter, slower and are considered as assets of poor. The variety of vehicles varies in sizes with dimensions ranging from 0.60 mt to 2.6 mt, and speed varies from 15 km per hour to 100 km per hour. Though having such varied characteristics, still all these modes share the same carriageway, with no mode segregation and lack of effective channelization, leading to traffic chaos. It is a very common site to find the whole traffic is following the slowest vehicle on the carriageway (refer Fig. 1). As the slowest modes are the NMVs, so the whole blame is shifted to the NMVs.

Fig. 1 Traffic Following the Lowest Vehicles



3. A SHIFT FROM NMV TO MV

Before the industrial revolution or one can say mechanical revolution, the cities were usually small in size, so the most of the travel trips were used to be done either walking or using animal carts, bicycles, cycle-rickshaws, etc. But with the coming up of mechanized mode of transport / motorized vehicles, the distances became smaller. This leads to the expansion of cities. The connectivity between inter-cities, intra-cities and cities with its suburbs became easy. The mechanized modes intended to make the travel trips easier, but their continuous and uncontrolled growth lead to many problems like congestion, air-pollution, and noise pollution.

In India, like in other developing countries, the motorized revolution started in early 80's and is still growing. Transport planning and investment has focused predominantly on the motorized transport sector. Even though non-motorized transport accounts for 25-80% of the total trips in many Asian Cities, the transport planning has ignored the needs of the non-motorized transport. Though, the NMVs are rising, but their future is threatened by the increased use of motorization, change in urban form and the lack of safe street space for them.

4. GOVERNMENT POLICIES REGARDING THE TRAFFIC

Urban transport in Indian cities reflects the heterogeneity in the socio-economic and land use patterns. It is dominated by walk trips, non-motorized modes such as bicycles and rickshaws, and motorized para transit and public transport

depending on the size of the city. A high share of non-motorized vehicles and motorized two wheelers characterizes the transport system of Indian cities.

The recent trend in road development is much biased for the motorized vehicles. The road space for NMVs has been ignored in new roads constructed in the urban areas, and on existing space being eaten away to accommodate new motorized vehicles. The development of new road projects cannot merely be a blind and reckless passage towards economic growth and benefit only the upper section of the society. It must measure the price of such growth, both in absolute and relative terms. Government should support the investments that make walking and cycling safer to encourage people to use NMVs.

Another important constraint to NMVs is the import duty levied by the government on the bicycles and bicycle parts. Bicycles and carriages, which fall under the codes 8713, attract a total import duty of 35.2 percent. This includes 30 per cent basic duty and four per cent special additional duty. Total import duty on bicycle parts, which comes under the HS code 8712 and 871491 to 871494, is higher at 40.61 per cent. This is because of the 16 per cent additional duty imposed on these items, in addition to the 30 per cent basic duty and four per cent special additional duty.

5. APPROACH REGARDING NMVS

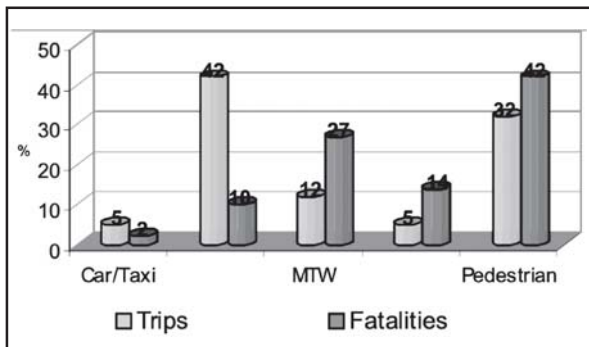
Though the share of bicycle trips has shown a decreasing trend in urban areas, but the absolute numbers of bicycles have never the less increased even in mega cities. In the year 2002-03, 15 million units were sold in India, while China produced 22 million. The usage per person of cycles is very low in India than other developing countries. It has been estimated that the demand for the cycles will be growing at a rate of 10-12 percent annually, and the main market will be focused on the urban areas (Jaya Basu). So all these underrated vehicles will require more space on the urban road.

Thus, their increasing number does not allow the transport planner to avoid it, while designing the road infrastructure. In addition to bicycles, non-

motorized rickshaws are used for the delivery of goods such as furniture, refrigerators and washing machines. The demand for bicycles and rickshaws is therefore considerable at present and is likely to continue to be so. There is a continuous rise in the number of cycles and cycle rickshaws in the cities. But still in policy document and transport planning a very little thought is given on improving facilities for non-motorized transport modes.

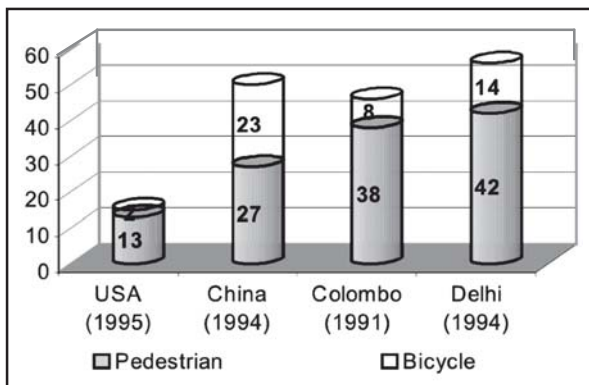
For a well functioning of traffic, the road infrastructure must satisfy the requirements of all road users like pedestrians, bicyclists and non-motorized rickshaws, which are the most critical elements in mixed traffic in Indian cities. But unfortunately, the safety and convenient movement of NMVs has been ignored while designing the road space. Fig. 2 shows the percent share of various modes of transport and the percent share of casualties on Delhi roads (1994).

Fig. 2 Percentage Share of Various Modes and the Casualties on Delhi Roads (1994)



Source: Dinesh Moha,n Indian Institute of Technology Delhi

Fig. 3 Share of Casualties of Pedestrian and Bicycles in Total Road Accident Casualties



Source: Review of Urban Transport in India

The pedestrians and the bicyclists form a large proportion of road crash victims on the urban roads. This is because there is virtually no provision in the transport facilities to separate the motorized traffic from the bicycles, cycle rickshaws and pedestrians. Thus NMVs faces the higher risk of traffic accidents on Indian roads.

Fig. 3 shows the percent of pedestrians and cyclists deaths in road accidents in various countries. The developing countries show a very high casualties rate under the two categories compared to the developed countries.

6. TRAFFIC MOVEMENT FLOWS ON ROAD JUNCTIONS AND ROAD STRETCH

On a three-lane road, two right lanes are used by MVs and the left most lane is used by NMVs (Indian condition). With no physical segregation between the slow and fast moving lanes, the danger to cyclists because of conflicts with MVs is unacceptable. The following illustration shows some of the typical forms of traffic flow movements at the road junctions.

The slow moving vehicles (NMVs) occupies the left most lane on the Right of Way. The problem arises at the junctions when these NMVs have to turn right. At signalized junction, two types of traffic signal cycles are followed:

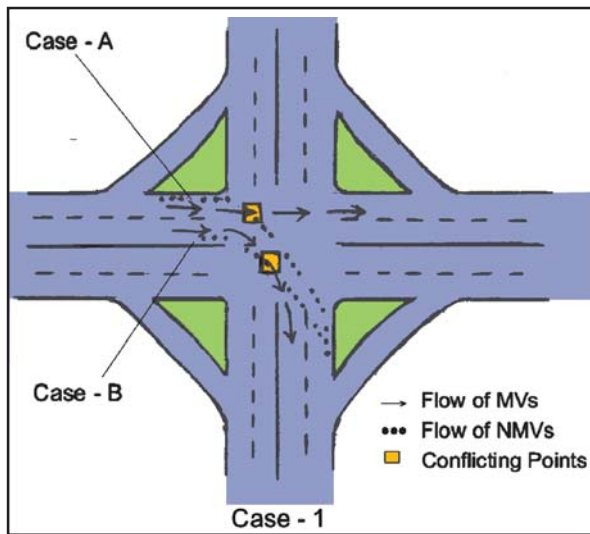
6.1 Case – I: The straight and right turning traffic released together

In this case the NMVs, which have to turn right stands at two locations (A) left most lane (if they have not changed the lane before reaching the junction); (B) right most lane, along the median curb (in case they have changed the lane before reaching the junction).

Case – A: As the signal turns green for the straight and right moving traffic, the NMVs, which were standing on the left most lane, and have to turn right, creates hindrance to the traffic which have to go straight. This situation creates conflicting points and posses' accident threat (see Fig. 4).

Case – B: In this case, as the signal turns green, the NMVs standing along the median curb, forces

Fig. 4 Movement of Vehicle During Straight and Right Turning Traffic Moves Simultaneously



them to cross the other vehicles by merging with their line of movement. This thus again creates the chaos (see Fig. 4). It is the case – B, which is followed very commonly by cyclist and other NMVs on Indian roads.

6.2 Case – II : Straight and Right turning traffic released at different time

This signal is followed where a minor road cuts the major road, and the straight moving traffic is more

than the turning traffic. In this case, NMVs stands along the median curb as discussed in the Case – B of the above example (see Fig. 5). But the safest point to stand and wait for their signal to turn green to turn right is to stand on the left most lane and wait for straight signal to turn red and the right signal to turn green. But because of lack of awareness, the NMV users least follow this.

Now other than junction, the other point of conflict of NMVs with the MVs, especially the buses on a road stretch is the bus shelter. In a normal practice, cutting the footpath provides bus bay. The buses, during entry and exit, cuts through the lane reserved or used by the NMVs, thus makes them vulnerable to the accidents (see Fig. 6).

The lesser safety measures in the road designs make the NMV users, who in this case are urban poor, are most vulnerable to the fatal accidents. Thus, there is a need for a serious attempt to make the roads safer for cycle and walk, or provide a targeted subsidized public transport to them.

Thus, there have to be a segregated right of way for the NMVs. This will not only improve the safety but will also improve the traffic flow with the increase speed of traffic and thus will also reduce the emission resulting from the slow speed of MVs.

Fig. 5 Movement of Vehicles when Straight Moving and Right Turning Traffic Released at Different Times.

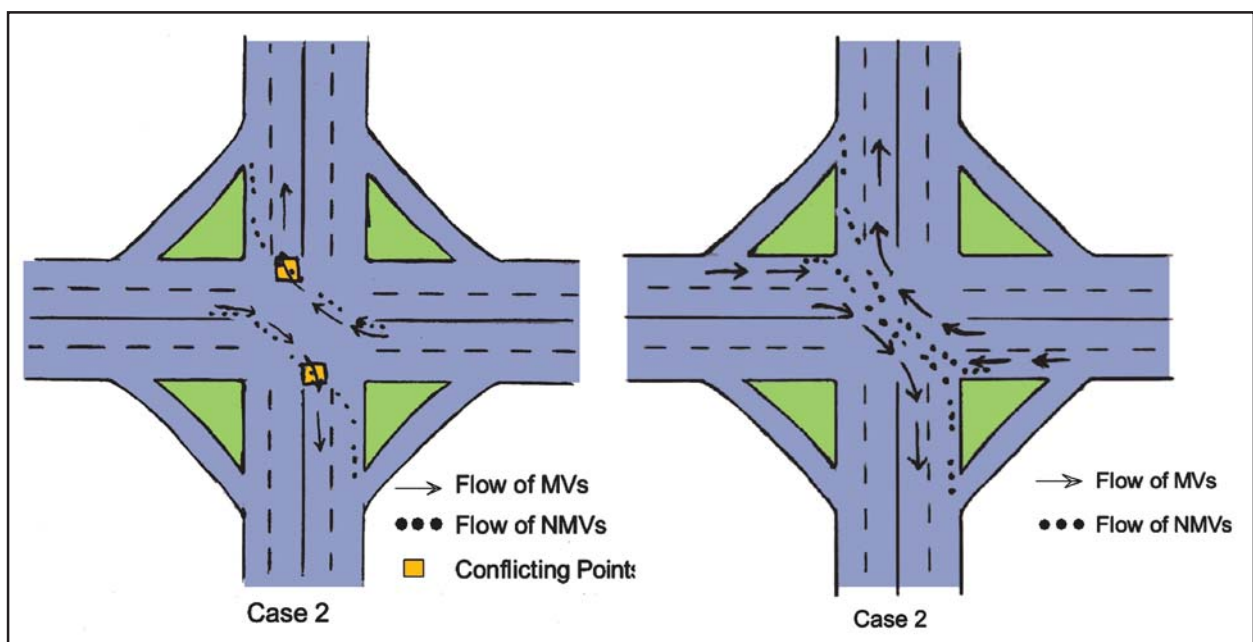
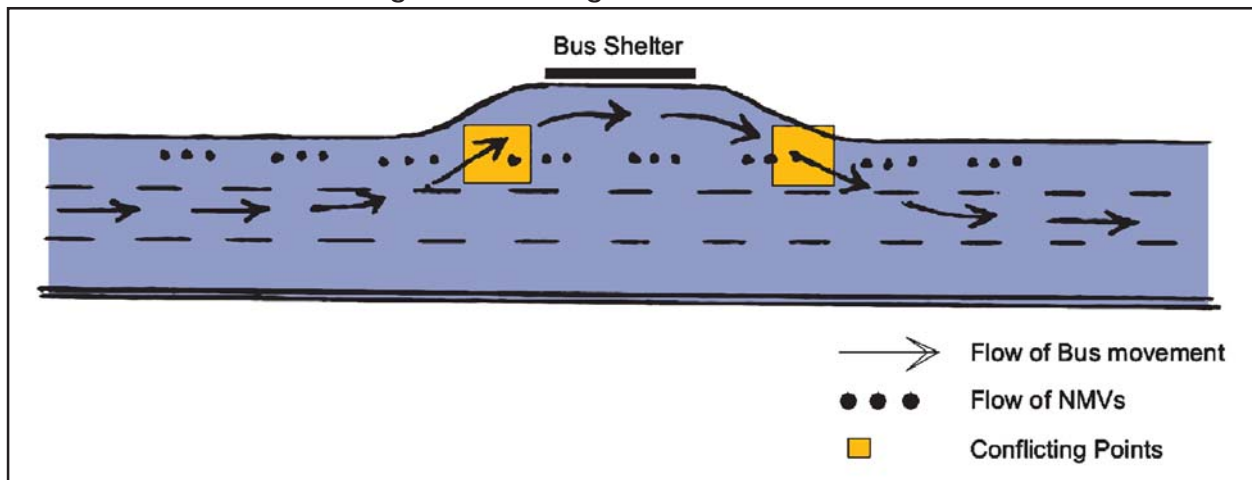


Fig. 6 Conflicting Points at Bus Shelter



7 CONCLUSIONS

The above discussion shows that there is certainly a drift in usage of transport modes from NMVs to the MVs. The road designs and the government policies are such that these are encouraging the usage of motorized modes of transport. But still the large sections of society, especially the urban poor, who cannot afford the public transport, are using the NM modes for their daily trips, and form a significant volume too. These NMVs are viewed as a major reason for congestion on the roads, but still these are the most ignored one in the planning and design of the roads. The low income people using the NMVs or walking to commute will continue to use the same, weather the road design have the specific consideration for them or not. Seeing the presence of diverse socio-economic condition of the people and thus the diverse mode for transport, a well functioning road design should be there, which must fulfill the requirements of all the road users.

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UNDERSTANDING URBAN DISASTERS FOR SAFER CITY: THE CASE OF SHIMLA CITY

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ABSTRACT

In this paper safer city concept has been explained from the point of view of disasters, taking case study of Shimla. The state capital of a young state, is pulsating with tremendous pressure of activities. Every conceivable space, which is being utilized, in Shimla, generates further additional activities inviting more people from various corners of the state and outside due to this the city appears to be a possible target for any 'Na-tech'. So there is an urgent need to look for a strategy to meet this challenge in a near future and to look for a methodology to meet the challenge of a possible disaster to make Shimla a safe city.

1. INTRODUCTION

In 1995, 2.4 billion people were living in cities, out of the world's total population of 5.7 billion. The number of urban dweller will double by 2025 to nearly 5 billion. At least 80 percent of the population growth in 1990s occurred in urban areas. It was experienced in last decade that most of urban growth took place in small and medium sized urban centers.

In developing world, cities with over 1 million people jumped six fold between 1950 and 1995 (from 34 to 213). By comparison, in the developed world, the number of cities with over 1 million people only doubled (from 49 to 112). Eighty percent of the world's urban residents will be in developing countries by the year 2025.

This growth has threatened to make cities unsustainable. City authorities in many developing countries have difficulty in providing basic infrastructure and services. As a result, 30 to 60 percent of people in the largest cities of the developing world live in densely populated squatter settlements. Most of the cities of the developing world are targets of disasters of various types. There are very few cities in the world which have drawn plans to meet the challenges posed by disasters. They have learned to tackle the problems due to their experience of regular disasters. But most of the cities of the developing world are heading towards a possible disaster due to their haphazard growth and ecological imbalance. In this situation it becomes necessary to understand the nature of the problem specific to a city and accordingly take preventive measures.

2. WHAT IS A SAFER CITY?

Safer city concept can be explained from various viewpoints like, safe city for women and children, safer city from crimes, safer city from traffic and transportation hazards and so on. In this paper safer city concept has been explained from the point of view of disasters, a city having the capacity to mitigate disaster whenever they occur. Hence, a city which has a mechanism to meet the possible threat of a disaster and ensures the safety of inhabitants and their property known as safer city.

2.1 Objectives of safer city

Main objective of the safe city can be described as following:

- Sustainable development practices;
- Revitalization of deteriorating areas;
- Proper land use planning;
- Risk assessment;
- Disaster impact assessment;
- Plans to cope up emergency situations;
- Special programmes for high risk situation;
- Public awareness about possible disaster threats; and
- Enforcement of proper construction and planning guidelines.

3. URBANIZATION AND DISASTERS

Increasing urbanization has caused increased pressure on cities in case of disasters. Current trends of rapid urban growth and environmental degradation increases people's vulnerability to

disasters. If left unchanged, disaster will take an even greater toll on lives and property. Demand for land in cities has led to use of unsuitable terrain (floodplains, unstable slopes) prone to natural hazards. Urban development increases the flood risk by disrupting natural drainage channels, increasing number of poorly constructed or badly maintained buildings lead to unnecessary deaths, hazardous materials act as source of secondary hazards like fire, explosion or radiation in the event of natural hazards. The number of people affected by disasters has been growing 6 percent each year since 1960. Of these victims 90 percent have been affected by natural disasters many in urban areas.

3.1 Major causes of vulnerability of a city to disaster

There are various causes and factors which make cities vulnerable to disasters. Sometimes, it may be only one prominent factor or a combination of two or more than two factors. Some of the main factors which can be listed are as following:

- Rapid growth and Inadequate Planning;
- Ecological Imbalance;
- Population Density;
- Poor Infrastructure and Services;
- Concentrated Political, Economic and other Resources; and
- Inappropriate Construction.

In today's context there could be broad two categories of disasters in urban areas i.e. natural disasters and technological disasters.

Natural Disasters: Natural disasters may include following:

- Earthquakes;
- Landslides;
- Volcanic Eruptions;
- Tsunami;
- Cyclones;
- Floods;
- Wildfires; and
- Droughts.

Technological disasters: These are basically secondary type of disasters which may occur after a natural disaster has struck like:

- System failures;

- Chemical accidents;
- Industrial explosions; and
- Spillage in ground, water or air.

3.2 Understanding the relationship between Natural and Technological Disasters

There are several examples how natural disasters can lead to technological ones. Earthquakes may cause gas pipelines rupture, causing major fires as happened in 1995 Kobe earthquake. During floods in the US Midwest in 1993, liquid gas tanks floated down the Mississippi river, posing a major technological threat. Drought and windstorms spread radioactive materials over a wide area in Russia in a 20 year period.

Similarly there are also examples of how development practices, based on technological innovations can lead to natural disasters. Deforestation is one such example, leading to erosion and landslides during heavy rains. In another example, as land in cities is replaced by concrete, the ground's, natural ability to absorb water declines, leading to flash floods. These compound disasters are sometimes labeled as "Na-techs" (natural / technological disasters). These days 'Na-techs' are the clearest evidence of how distinctions between 'natural' and 'technological' disasters have become blurred.

While all urban areas have 'Na-tech' risks, those most at risk to 'Na-techs' are rapidly growing cities in developing countries. Often, it is the same rapidly growing cities which are most at risk to natural disasters that are most at risk to technological disasters.

4. THE CASE OF SHIMLA

Shimla was declared summer capital of British India in 1864. At that time it was planned for only 25000 population. Evolution of Shimla can be divided in to three main parts:

- Before British era;
- During British era; and
- After Independence.

Before British period, it was a small village under Nepali kingdom. Development trend started only after the Britishers came here. Although, developmental activities were many during British time also but they were all properly planned. It

was only after independence that development activities in Shimla picked up an uncontrolled trend.

Present day, Shimla is in great contrast to its past. Being the state capital of a young state, it is pulsating with tremendous pressure of activities, due to large number of development programmes, numerous departmental and administrative functions of a capital, leading to the problems of governance and management. Total area of Shimla is 9950 hectares and present population is 1,74,789. 82 percent of the total population is residing in MC limits which has only 14 percent of the total area, which has resulted in very high densities in certain pockets of the city and some parts of the city has started showing signs of decay.

Growth of Shimla appears to be unplanned and haphazard. Every conceivable space, which is being utilized, in Shimla, generates further additional activities inviting more people from various corners of the state and outside, in addition to the additional tourist population. Shimla is a favored destination of domestic and overseas tourists. A large number of trees have been cut only to be replaced with ugly buildings. Multi-storey buildings have become a major eyesore. Offices are spread out in a rather haphazard manner. Most of the city is littered with solid wastes. Sewers and drains are choked in many places. Due to faulty and choked sewerage pipes, slide planes have developed over hillsides and some parts of the city are showing signs of sinking and collapsing. This is particularly noticeable on the western side of the Ridge. Development control regulations are treated with disdain and viewed as anti-growth. Vehicular pollution, traffic snarls and bottlenecks, lack of parking spaces and terminal facilities, haphazard growth of offices and residences have serious debilitating effects on the environment of the city. Planning violations, encroachments, unauthorized construction, and growth of slums have defaced this once beautiful city – the queen of hills.

All these factors have resulted in changing the face of the city over the past few decades. Tourism and administration are two prime activities which has created a great impact on development pattern of the city. Due to these activities following problems have cropped up over the years:

- Congestion;
- Pressure on transportation network;
- Crumbling infrastructure;

- Poor housing conditions;
- Environmental degradation; and
- Ecological threats.

Considering all these things the city appears to be a possible target for any 'Na-tech'. So there is an urgent need to look for a strategy to meet this challenge in near future.

4.1 Possible Disaster threats in Shimla

Shimla is highly a mountainous region. There is hardly any flat land in and around Shimla. Because of this reason planning in such an area becomes a challenging job. At present almost 75 percent of the construction have taken place on slopes greater than 65 deg. This has resulted on the excessive pressure on unstable slopes and some pockets of the city have developed sliding planes. There are no proper roads in residential colonies which are being developed on various locations in the city. And in case of any disaster, this situation can endanger the life and property of inhabitants. Possible natural disasters which can attack Shimla can be enlisted as following:

- Earthquakes;
- Landslides; and
- Fires.

Some of the unsafe practices of the city can be enlisted as following:

- Construction on unstable slopes;
- Inadequate Emergency planning;
- Lack of proper urban planning;
- Very high density developments; and
- Poorly maintained services and facilities.

Although threat seems quite visible if one visits any of the densely developed area but there is no action plans with authorities to meet this challenge. Considering this scenario it becomes impertinent to look for a methodology to meet the challenge of a possible disaster to make Shimla a safe city.

4.2 Solutions to Disaster challenges

Although there can not be any fool proof solution in case of a disaster but an effort should be made to minimize the extent of damage. We should not be surprised to see no damage even in case of sever disasters if measures are adopted adequately. There can be a comprehensive list of the measure which should be taken to meet the disaster challenge as following:

- Prevention;
- Awareness;
- Partnerships;
- Community based solutions;
- Structural measures with the help of technical knowledge;
- Appropriate land use planning;
- Enactment of appropriate laws;
- Political and financial commitment;
- Scientific research and monitoring;
- Environmental programmes; and
- Civic education.

In Shimla city following strategy can be effective in case of any possible disasters and can take city nearer to safer city objectives:

Assessment: At present there are various high risk areas in the city considering earthquakes, landslides and fire threats. There is no classification available on high risk and low risk areas. So first step to tackle the possible threat should be to map whole city regarding various possible threats and identify various high and low risk zones in the city. There should be a proper risk and disaster impact assessment of the various high risk areas of the city.

Prevention: Next step will focus on preventive measures. Authorities should ensure that all developmental activities should be banned in the high risk area as identified from assessment study. If there are already existing buildings in the high risk areas, relocation plans should be prepared to ensure the safety of people and property. Although construction activities are banned in central core area of the city but relocation or revitalization has not been thought till date. This core area is highly prone to fire hazard due to old wooden construction. So, preventive measures need to be adopted in terms of relocation or revitalization of the high risk pockets of a city like Shimla.

Appropriate land use planning: Land use planning should conform to the various risk zones of the city. Land use plan should become an instrument to regulate planning oriented towards disaster mitigation. Land use planning should also see the availability of open spaces in various zones.

4.3 Emergency Planning

Authorities should consider a contingency plan for disaster situation. A thorough study of the city should be conducted from emergency planning point of view and accordingly a number of measures should be suggested to meet the disaster situation. One of the main components of the study can be identification of evacuation routes in case of emergency especially in core area of the city.

Number of awareness campaigns should be launched to educate people about the various types of risks and ways and means to meet the challenge. If severity of the problem is properly spread among public, there will be ease to implement various measure taken by authorities like revitalization, relocation and implementation of emergency plans.

5. CONCLUSIONS

Cities can be made safe in case of disasters only with the help of commitment and will, to meet the challenge. Reducing the impact of the disaster on any area is not something, which will happen overnight, nor even within the time span of decades. There are various solutions which are available to meet the possible challenges posed by disasters in a city, but what is needed is change in the people's attitude, based on the conviction that cities can organize themselves to resist disasters and the will to act on this conviction. To make cities safer from disaster the 'Culture of prevention' should be adequately developed.

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PLANNING FOR DISTRICT HEADQUARTERS TOWNSHIP AT BARUIPUR IN SOUTH TWENTY FOUR PARGANAS

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ABSTRACT

Government of West Bengal has decided to shift the South twenty four Parganas District Headquarters from Alipur in Kolkata city to Baruipur at South 24 Parganas district, along with development of a township. The proposed development will not only provide ease to the people visiting the District Head Quarter from remote places of the district, but also act as a growth centre in the region with an effort towards metropolitan decentralisation. The proposal is included in Vision 2025: a perspective plan of KMA (Kolkata Metropolitan Area) published by KMDA (Kolkata Metropolitan Development Authority) during 2005. The article attempts to study general problems of relocated capital cities, metropolitan decentralisation approaches, new town planning and policies and tools and techniques of developing a new urban centre. An effort has been made to integrate the proposed township with the KMA as well as the region. The proposal has been made in the form of structure plans showing broad land use as well as policy guidelines and suggestions on protecting environment, land acquisition issues, resource mobilisation and sustainable development.

1. INTRODUCTION

People of the South Twenty Four Parganas have been demanding for a long time to relocate the district headquarters from Alipur, Kolkata. The present location of Alipur is not only inconvenient to the people of the district due to its eccentric location and distance factor; it also puts undesired pressure and conflict to Kolkata city proper. Hence, relocation of District HQ is very much necessary from Alipur, Kolkata.

Further, there has been uncontrolled urbanisation in the south east part of KMA, which is intensified due to recent extension of metro rail and EM bypass. This has resulted in consuming valuable agricultural land and formation of low density leap frog development leading to low revenue earning and limiting scope for future planned development. Hence a planned township is required not only to check sprawl, but also to revive the economy and culture of the region.

In this paper, attempts have been made to propose a structure plan of the integrated township, which would hold a considerable share of future population and activities to relieve the metro core. It will act as an efficient district capital to serve the region and as a growth node to boost economy of the region. It will also act as an intermediary node between metro centre and rural hinterland to trigger collaborative development through

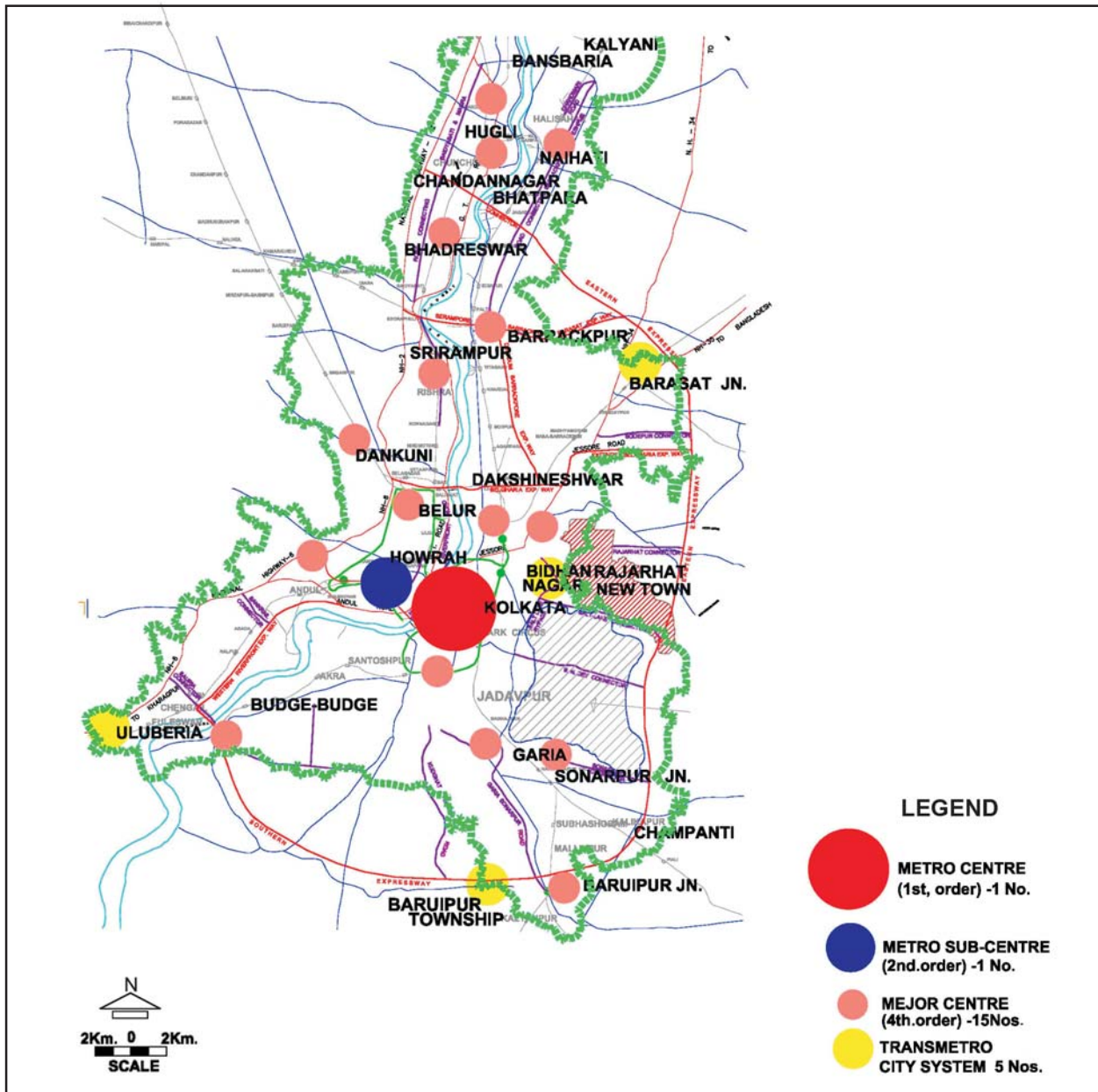
trickling down effect. The main objectives of this paper are: first, to relocate district headquarters and its associated activities at new location for efficient functioning. Second, to develop a self sustaining, environment friendly, township, and integrate the headquarters with the township and subsequently with the region and KMA as a whole. Additionally, to achieve the following objectives:

- To understand the structure and function of district headquarters.
- To evolve planned methodology after study of the region for developing a growth node.
- To assess provision for higher order / metro function and evolve a structure plan.
- To suggest guidelines / policies (environmental, land acquisition, development control)
- To provide options for development, management and finance.
- To focus on areas of sustainable development, environment protection, affordable shelter, and efficient transport system.

2. REGIONAL CONTEXT

An analysis of demographic and physical characters of KMA shows that there would be a housing shortage of 35 lakh in KMA by 2025. As per KMDA, the nodal agency for planning activities

Fig. 1: KMA showing Order of Growth Centres (Baruipur as Transmetro Centre)



Source: KMDA

of KMA, the population of KMA, which is at present 147.18 lakh, is expected to increase to 220 lakh in the year 2025. An analysis on land holding capacity emphasizes on creation of new settlements with employment opportunity. In Vision 2025, there is a proposal to develop five major trans-metro growth centres; Baruipur is one of them (refer fig. 1). Hence, the proposal of district HQ and township is a part of comprehensive plan programme.

South 24 Parganas district comprises 5 sub-divisions (Diamond Harbour, Canning, Baruipur,

Alipur and Kakdwip), 29 blocks and 7 municipal towns. It is a complex district diversified from Kolkata metro to Sunderban forest with vast rural marshy land in between. It has a huge resource base of agriculture and forest. With creation of physical infrastructure like roads, bridges, water supply, power by the Government in the region, the ground is now ready for development. The huge regional disparity is expected to be reduced with planned intervention.

The site for district headquarters and township is located at Baruipur block (refer fig. 2) in South 24

Parganas district about 25 km away from CBD (BBD Bag) of Kolkata. KMDA initially delineated eight mouzas under Baruipur and Sonarpur PS for this purpose. However, on feed back from experts, adjoining five mouzas under Bishnupur and Baruipur PS have been included, the area thus works out to 4000 acre (refer fig. 3). The site is about 4 km away from Baruipur Municipality and accessed through Baruipur-Amtala Road connecting NH 117 (Diamond Harbour Road). Railway connectivity on Sealdah- Diamond Harbour route is available nearby. It is situated mostly on fallow land in between Adiganga and Keorapukur Khal, and partly serviced by piped water supply from Hooghly River through Budge-Budge treatment pump. Ground Water is contaminated with arsenic in the whole region. The site is proposed to have adequate infrastructure and road regionally along with couple of economic centres as per the KMDA perspective plan. This includes southern expressway from Barasat to Haldia, port connectivity to Kolkata dock and widening of Amtala road. Only two mouzas are covered under KMA jurisdiction and

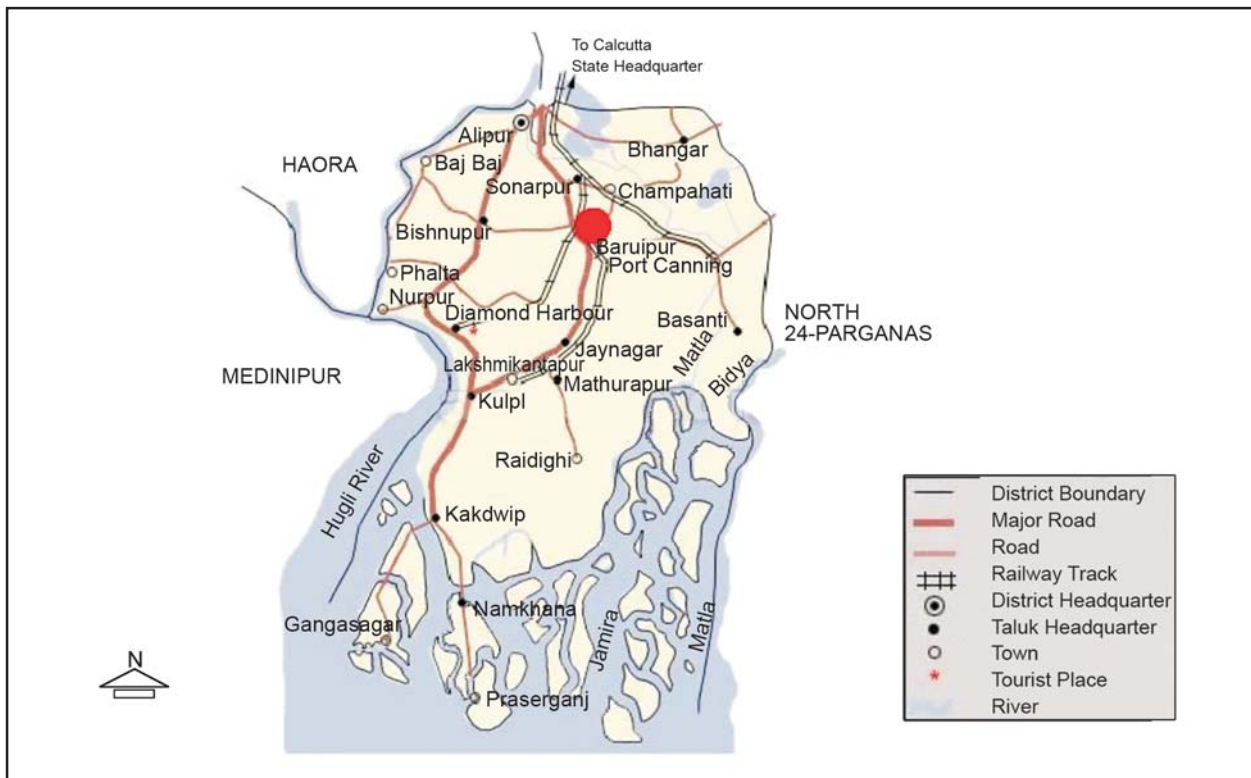
the remaining area of the proposed township is being included to KMA soon.

As per 2001 census, population of the existing 13 villages is 12,500 with average density of 13 pph. The extent of main and marginal worker is 30 percent and 4 percent respectively with high percentages of household workers. Agricultural labours accounts for 26 percent with negative growth. 75 percent of land is low lying and 70 percent accounts for agriculture though only two villages have multi-crop land. Growth of marginal labour, fast changing of occupation from primary to tertiary sector, growing orchards, poor higher order facilities for education and health, need for modernising household manufacturing and agriculture linked industry are the major planning issues of the study area.

3. LITERATURE STUDY

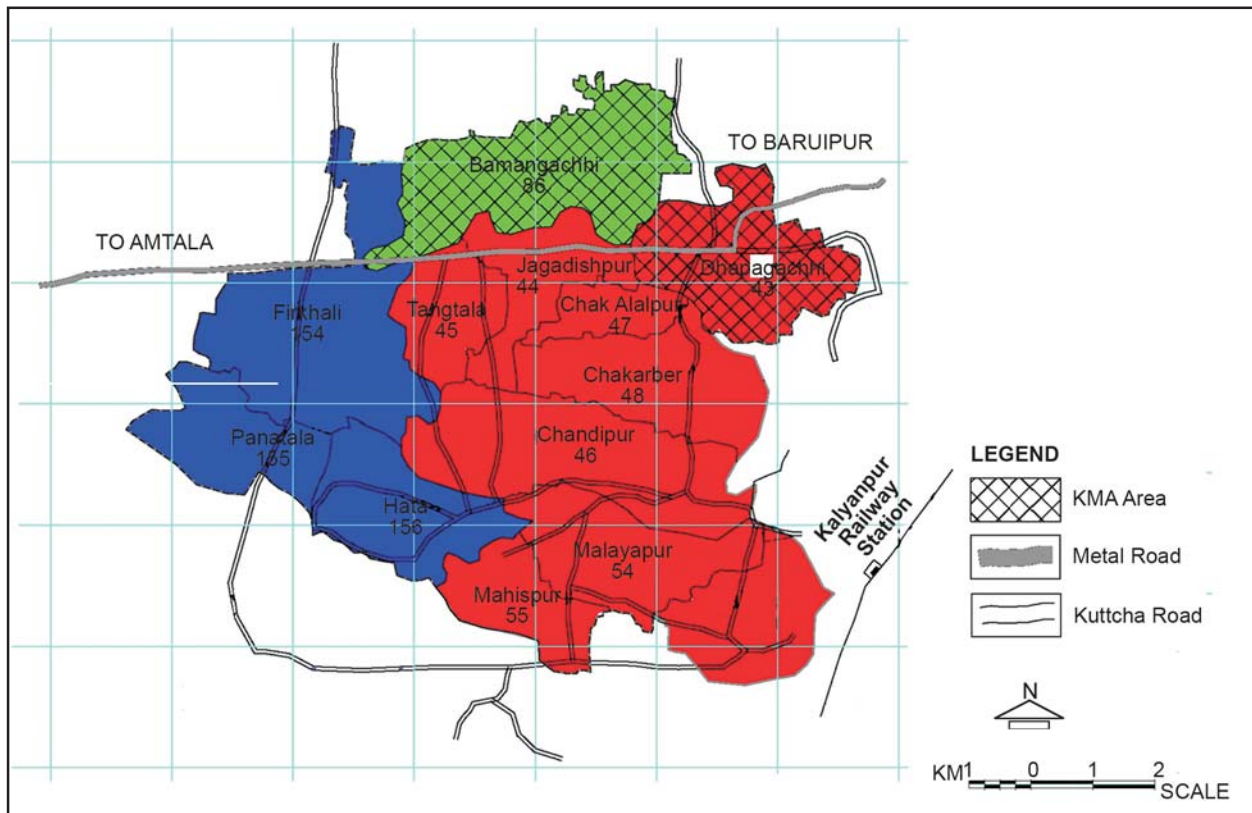
Literature study has been carried out in two parts covering theories and concepts of planning and relevant case studies. The first part covers various theories and concepts of metropolitan

Fig. 2 : South 24 Parganas District Map showing Baruipur and other places (Baruipur as Transmetro Centre)



Source: KMDA

Fig. 3: Project Site Showing Revenue Villages and KMA Area - Administrative Jurisdiction



decentralization, urban forms, growth node, neighbourhood planning, PURA (provision for urban amenities in rural area) and new urban settlement. Further, application of concept in the context of regional and local area, policy and programme documents viz. perspective plan of KMA, various Government plan viz. State and District plan, environment and urban development policy have also been included in literature study.

The second part of literature study covers the case studies of new townships towards metro decentralization like NCR (Rohini, Dwarka) and Navi Mumbai at national level and Salt Lake and Rajarhat, Kolkata at local level. During the study, their strength and weakness have been reviewed. In order to plan for a self sustained integrated capital town, knowledge on importance, impact and structure of capital town is required to be acquired. Hence success and failure of internationally acclaimed relocated capital viz. Brazil and Islamabad or important new national capital like Ahmedabad and Chandigarh were also studied. Also, capital complex at local level based on organic development viz. Midnapore and Barasat, West

Bengal were studied considering their proximity of location.

During the process of Data collection, in addition to secondary survey, extensive primary survey mainly through structured questionnaire was conducted as many of the desired information in secondary form were either not available or dated. Secondary survey has been carried out in institutions like District Administration, Bureau of Applied Economics and Statistics, Census, KMDA, Irrigation, PHE, NATMO, HUDCO and local urban and rural bodies. Documents have been collected on the aspect of regional growth, population, economy, infrastructure, agriculture, land use, development, management and information related to case study area.

Primary survey has been carried out in the form of expert opinion survey (12 bureaucrats, politician and professional), reconnaissance survey at existing district headquarters, project site, and interviews through questionnaire with 12 local people at headquarters and 53 project sites including their perception. Collection of data and

interview has been carried out from macro level (like MP or DM at district) to local level (like MLA or BDO at block).

4. CHARACTERISTICS OF THE REGION

The region observes a high rainfall, annually 1750 mm which provides scope for rain water harvesting apart from scientific agriculture activity. 20.27 percent of district population lives in KMA which is again 9.51 percent of KMA region. Further 23.63 percent of KMA region is covered by South 24 Parganas district, which is only 4.39 percent of the district. This indicates regional disparity and excessive population concentration near Kolkata. It is situated on Gangetic deltaic region and largest producer of guava and litchi which demands for fruit processing industry and organized market.

As per 2001 data, rapid increase of marginal labour (270 percent), higher percentage of non-worker (67.53 percent) and lower per capita income (Rs 18547/- per year) is a concern and demands for industrial development. This would also check first transformation of occupation from primary to tertiary sector if industry is made agriculture linked and lead to total economic development. Household manufacturing (6.07 percent) which is potential of the region needs proper facility, quality improvement and market. While there is deficiency in higher education and medical facilities, there is great demand for land from prospective investors in this field. Poor drainage facility and low lying area has made the land unsuitable for viable agricultural activity. The canals need to be de-silted and maintained. However, the higher land is being converted into (annually 2 percent) orchards and other non-agricultural activities for more financial return. A huge quantum of agro-labourers (60 percent) with less amount of agricultural land (72 percent) indicates smaller per capita land and needs logical inclusion while forming rehabilitation policy. The population except 3 villages is very low and can be rehabilitated on site gradually.

It is worth mentioning that average annual population growth of West Bengal is 3.64 percent over decade against 1.53 percent of India. The ratio of population to land of the state is 0.13 against country average of 0.36. This demands

for a careful, rational and scientific approach, when the planning intervention is made.

4.1 Ranking Locations for Development

Multi-criteria analysis has been carried out based on several weighted parameters to rank location from macro to micro level as per following. This exercise has been carried out to avoid controversy in the issue of deciding location for development:

- To rank KMA districts viz. South and North 24 Parganas, Howrah, Hooghly, Kolkata and Nadia to assess need of urban development and it's potential.
- To review justification of Government decision on relocation of district headquarters and township development amongst options of Baruipur, Diamond Harbor, Jaynagar, Canning (refer Table 1)
- To prioritise project site within Baruipur block amongst eastern and western part of it

The Cumulative Weightage has been calculated as:

$$Cw = Wi \times Si \quad \text{Where,}$$

Cw = Cumulative Weightage for a location,

Wi = Weightage of a Parameter,

Si = Score of a particular location

The point(s) towards weightage and score is given in ascending order that is the most important one gets the least point and least important one gets the highest.

While ranking of blocks to decide on location of projects, it is found that Baruipur gets the least cumulative weightage that is the highest priority for development for district head quarters and township (refer Table 1).

4.2 Scale of Development Zones

Land suitability analysis has been carried out by dividing the proposed site into a matrix of 19 zones to find out the land suitability considering the criteria of land cover, agriculture (mono / multi

Table 1 : Ranking of Blocks

Parameter	Weightage (Wi)	Ranking of Blocks (Si)			
		Baruipur	Damond Harbour	Jaynagar	Canning
General					
Centrality	1	1	3	2	4
Availability of Suitable Vacant Land	2	1	3	4	2
Potential for Future Investment	3	1	2	4	3
Growth Population Density	4	2	4	3	1
Extensive Development against Density	5	2	4	3	1
Location					
Proximity to Major Industry / Eco. Activity	1	2	1	4	3
Proximity to Kolkata	2	1	3	4	2
Proximity to Airport	3	1	2	4	3
Proximity to Port	4	1	2	3	4
Infrastructure					
Connectivity and Network-Roads and Rail	1	1	2	3	4
Availability of Natural Resource (Water Drainage)	2	3	1	4	2
Present Roads	3	4	1	2	3
Human Resource					
Availability of Manpower-Main Worker	1	1	3	4	2
Marginal Worker	2	3	4	2	1
Availability of Literate People	3	2	1	3	4
Agriculture					
Development against Agriculture Use	1	2	4	1	3
Development Against Agriculture Productivity	2	4	1	3	2
Weighted Score (Cw = Wi x Si)		73	97	120	90

crop), non agriculture activity (settlement / orchard), land situation (high / low), employment, and population density. Subsequently, considering the parameters like economic potential, accessibility and linkages, infrastructure provision, suitability of land and availability of resources, each zone is assigned for different scale of development viz. extensive, restrictive and protective to shelter and agriculture / orchards (refer Fig 4). Finally after assessing potential, proximity, land compatibility and inter-relationship, each zone is assigned with specific land use through land suitability matrix (refer Table 2).

4.3 Economic Potential

Assessment of future demographic and economic activity has been made through trend analysis of time series data in macro and local level like growth

of employment, population, non-agricultural occupation, occupational distribution and growth coupled with expert opinion and government proposal for economic activity and transportation in the region (refer Table no 3 and 4).

4.4 Occupational Distribution

Primary: Agriculture activity thro farmer's cooperatives, pisciculture, hatcheries, etc.

Secondary: At macro level downstream industries of Falta EPZ, Bantala Leather and IT, and proposed SEZ at Kulpi and Haldia and at local level manufacturing industries like chemical, plastic and toy making, SSI thro' clusters in surgical instruments, rice and fruit processing, relocating existing industries with state's incentives, IT based industry and SEZ, real estate etc.

Fig. 4 : Land Cover and Development zones, 1. Restrictive 2. Protective to agriculture / Orchard / settlement 3. Unrestricted / Development Zones

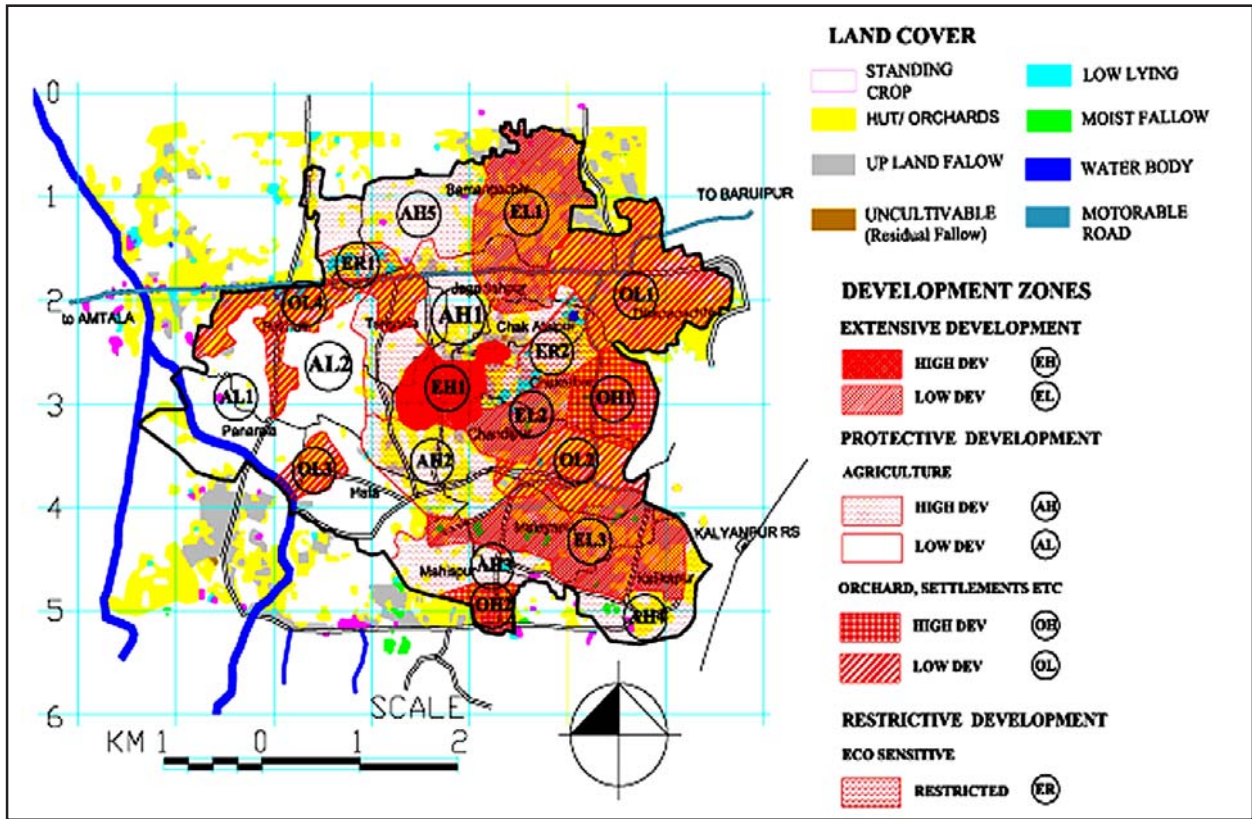


Table 2 : Land Suitability Chart and Development Zones

Zone	Preferred Type of Development	Proposed Land Suitability	Preservation	Upgradation	Rehabilitation
EH1, EL2, OH1	Highly Extensive	Commercial, Institutional Sports and Culture, Office Mixed	Vacant, Agriculture Shleter, Orchard, Water Body	Road, Shleter, Densification, Khal Restoration	Shelter, Agriculture labour, On site Rehabilitation, Land against Land
EL1, AH5	Highly Extensive	Capital Complex, Group housing, software park commercial, Bus Terminus			
EL3	Extensive	Housing-Groups and Plots, Industry			
AH3, AH4, OH2	Extensive	Industry, Truck terminus, Wholesale			
AH1, AH2	Extensive	Housing-Groups and Plots, Commerical			
ER1, ER2	Restricited	Recreation, Open Spce			
OL1, OL2, OL3, OL4	Protective-Orchard and Settlement	Settlement, Commerical, Mixed Orchards			
AL1, AL2	Protective-Agriculture	Vacant Urban Agricu-Iture Utility Housing			

Table 3: Occupational Distribution and Projection

Occupation	WB (U)	Dist (U)	Baruipur (U)	Proposed for Project
Cultivation	1.94	2.27	14.34	1.00
Agriculture	3.36	7.08	10.59	3.50
Live Stock	1.18	0.82	0.17	0.50
Mining	1.74	0.23	0.45	
Primary	8.22	10.40	25.55	5.00
Household Manufacture	3.03	7.81	1.85	5.00
Other than household	28.21	33.21	14.17	30.00
Secondary	31.23	41.02	16.02	35.00
Construction	3.54	2.68	3.75	5.00
Trade Commerce	23.84	16.58	23.08	25.00
Tranportation	9.92	9.05	10.42	12.00
Others	23.25	20.26	21.18	18.00
Tertiary	60.55	48.57	58.43	60.00
Total	100.00	100.00	100.00	100.00

Source: Economic Review, 2004-2005

Table 4: Non- Agricultural Occupation

Sectors	KMA	WB	Proposed
Manufacturing	25.58	26.87	25.00
Construction	0.99	1.22	5.00
Wholesale	7.21	7.82	7.00
Retail Trade	55.64	53.22	50.00
Restaurant & Hotels	6.83	7.08	8.00
Real Estate, Finance Services	3.75	3.78	5.00

Source: Economic Review, 2004-2005

Tertiary Sector: Transport terminal, wholesale market, warehouse and agro-based market, higher education and medical, hospitality and recreation, retailing, banking and insurance, BPO, administrative services, sports and Culture

4.5 Proposed Land Use Break Up

Considering gross density of 175 pph and net density of 625 pph after comparing with guidelines and case studies under the backdrop of Vision-2025, the population projected is 4 lakh including floating population of 1 lakh. After linking with occupational distribution and following UDPFI guidelines and expert's feed back, following is the proposed land-use break up in percent:

Residential (existing: 12.30, New: 20.50), industry: 6.5, commercial: 4.9, mixed: 1.6, public and semi public: 14.00, recreation: 9.20, transport: 14.50, water body: 6.00, agriculture, Orchard and vacant: 10.50

5. PROPOSALS

During the planning process due importance has been given to site conditions (land topography, land use, infrastructure), major function with supporting sub-function (Headquarters, Institution, housing), lesson from case studies, provision of social services and public utilities with transportation, preservation of existing settlement area in suitable sizes with low population densities, provision of large spaces for green areas and recreation facilities and efficient development and management programme including future expansion. Due care has been taken to protect multi-crop land and orchards along with existing settlement areas. Proposal has been formulated in two forms 1) Physical structure plan proposal; and 2) Policy guidelines and suggestions

Under physical structure plan proposal, three alternative structure plans have been proposed. The first and second alternatives are based on concept of organic city and compact radial city

with peripheral corridor respectively. Both the plans have a number of strength and weakness. In order to eliminate their weakness the third and final structure plan has been prepared through combining both the above structure plans, which is based on linear city with mixing of grid iron and radial pattern.

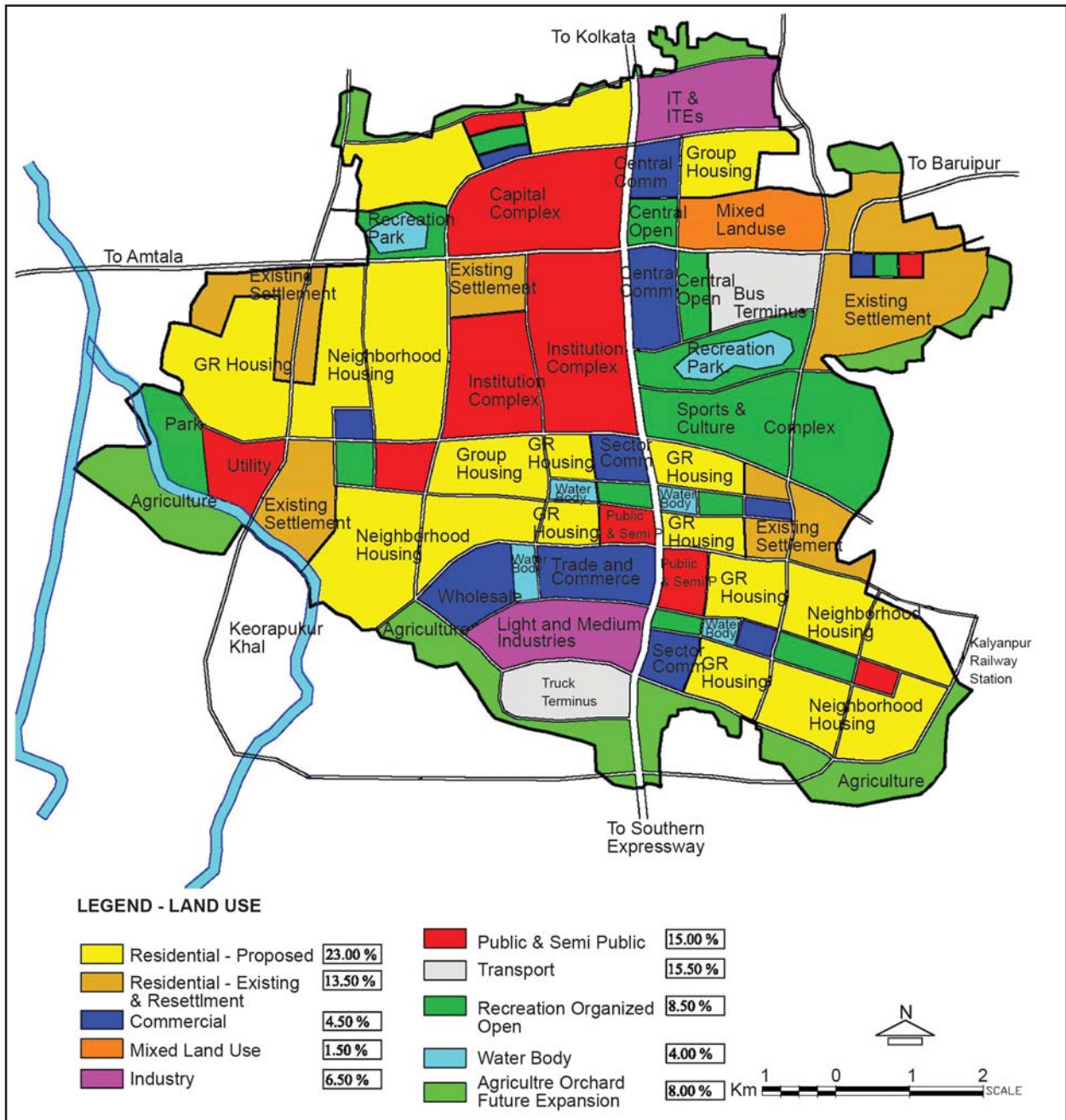
5.1 Alternative Structure Plan Proposals

Plan - 1: Organic City: In order to preserve the existing physical set up to the best possible way

and to meet the public demand, a structure plan (refer fig. 5) on organic city form is prepared. Disadvantages are irregular shaped plots, low mobility, complex and irregular street layout which cause difficulty in laying and maintaining services.

Plan - 2: Compact Radial city and Peripheral Corridor: The plan (refer fig. 6) aims to ensure high intensity development and achieve benefit of saving agricultural land, shorter commute trips and economies of agglomeration. However, there

Fig. 5: Alternative Structure Plan-1 Based on Concept of Organic City



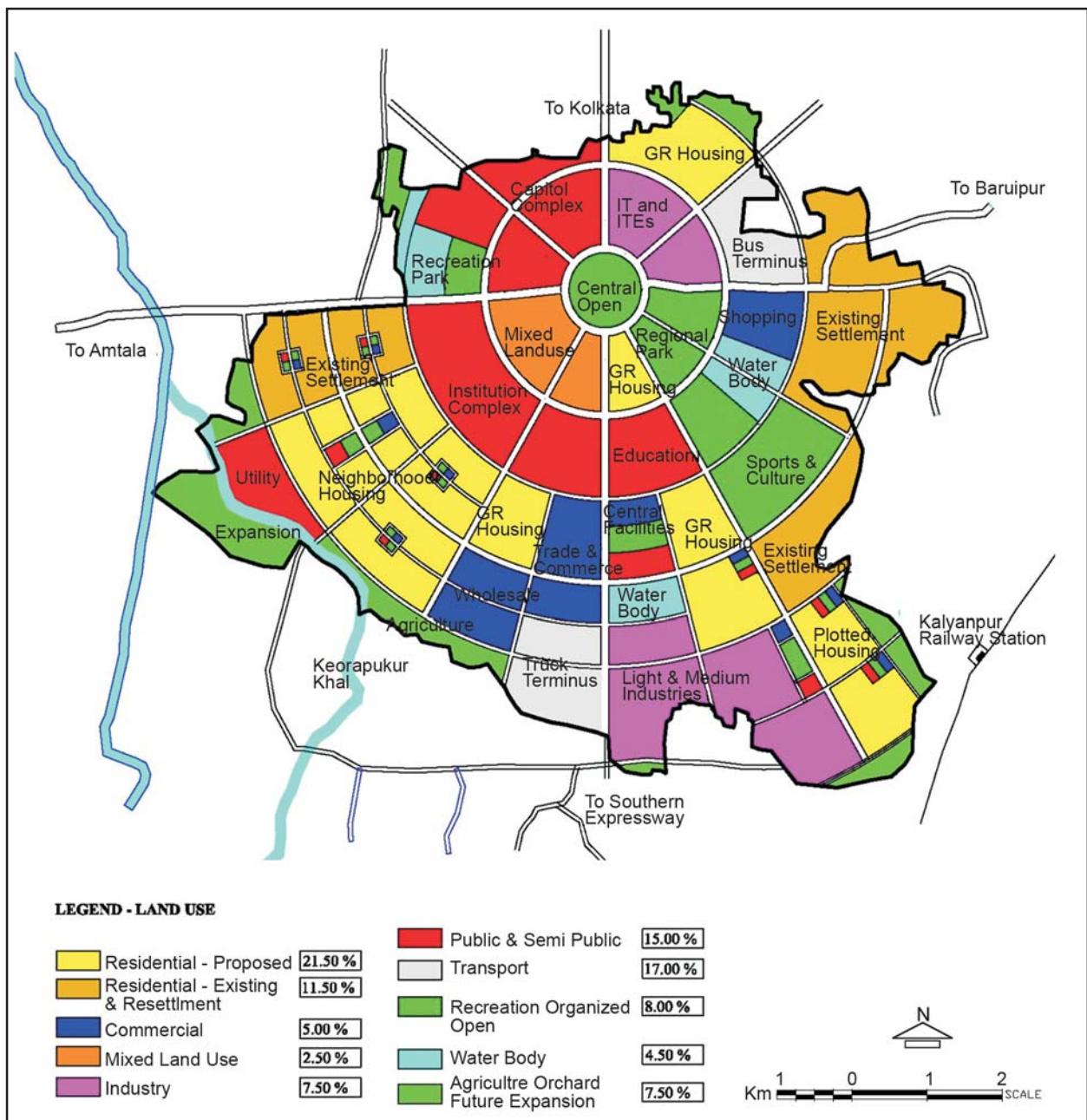
are negative externalities such as increasing land rents and strain on congestible amenities, environmental, social and management problem.

Plan -3 (Final Plan): Mixing of grid iron and radial pattern: In order to avoid the problems associated with above two proposals, an irregular grid of dual carriageway (inner and outer ring) roads for through traffic to intersect at intervals serving a mix of land uses dispersed throughout the city is proposed (refer fig. 7) . The dispersal

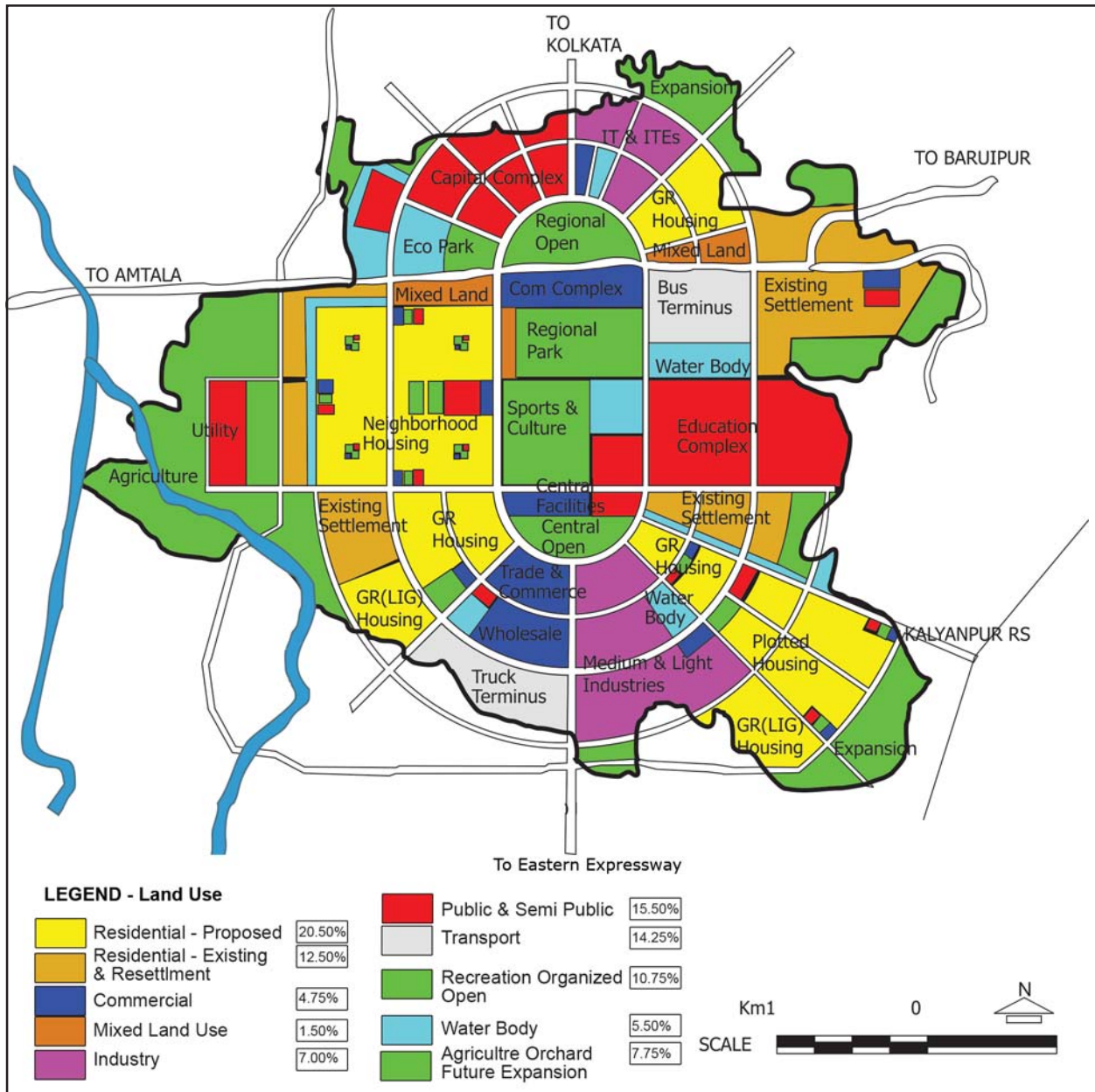
of homes and jobs ensure even distribution of traffic and the road system is designed to avoid the rush-hour congestion associated with typical radial town plans. High density development around the mass transport corridor ensures mobility and freedom of choice apart from saving valuable land.

Evaluation of Structure Plan - Acceptance of Plan-3: Considering the strength in the following issues the third alternative has been selected as final structure plan:

Fig. 6: Alternative Structure Plan-2, Based on Concept of Compact Radial city



**Fig. 7: Alternative Structure Plan-3, (Final Plan)
- Linear City with Mixing of Grid Iron and Radial Pattern**



- Balance care between preservation of settlement, natural resources and extensive future development,
- Efficient transportation system with focus on both mass transport and pedestrians,
- Distribution of economic centres and population,
- Clear hierarchy of facilities with overlapping catchments area and interconnectedness,
- Freedom of choice for recreation and commercial facilities,

- Advantages of both radial and grid iron form,
- Urban form and geometry of roads to control as well as induce development,
- Clear hierarchy of roads to guide from macro to micro level development,
- Expansion, image making and attractiveness to industrialist and investors.

5.2 Zoning Principles

Capital Complex – Integration with Region:
Relocated capital will be the seat of government

Fig. 8: proposed Layout Plan of Capital Complex



with 7000 workers and symbol of physical and social spaces. District HQ functions viz. executive, judiciary, legislative and police function has been suitably proposed following interrelatedness with provision for future expansion and parking. The proposed headquarters is centrally placed in region but not in township, considering connectivity, land value and topography. Lay out (refer Fig. 8) includes residential facilities and commercial / mixed use which will keep the place busy even after office hours.

More than 50,000 visitors would come daily to the capital complex and a part of the visitors also avail central service and facilities located in different parts of the township. Families would gradually be

shifted to township with creation of facilities. A large number of people would be shifted from Kolkata due to congestion and from hinterland due to improved facilities to the township. This people would commute to their workplaces either within the township or to the region through the improved regional transport facilities. Thus, the capital complex, the township and the regional would be highly integrated.

Housing for All: In KMA the housing gap is increasing as the annual addition of new unit is about 15,000 against need of 75,000 per year. Moderately high gross density of 175 pph and net density of 625 pph is considered as per UDPFI / NBC guidelines to save valuable land, to balance

under utilization and overcrowding and ensure urban amenities. Group and plotted housing have been equally distributed with suitable mix of people of different income category. Hierarchy of housing pockets near mass transport system with community facilities and alternative pedestrian route at sector, neighbourhood, and cluster level have been proposed. The most of the existing settlement area have been protected with provision for adequate social and physical infrastructure facilities and is proposed for densification to accommodate future population increase. Adequate provision for on site rehabilitation of the evictees and informal sector people including those to be involved in development process has been made in new settlement area of the township.

Commerce and Recreation: Commercial facilities have been provided at different levels with overlapping catchments and inter-connectedness to ensure freedom of choice. Central facilities have been distributed over CBD and Sub-CBD. CBD accommodating shopping, business, retail, entertainment and civic is the major economic generator to set image of the city and act as magnet to the region. Both provision of malls / multiplex and small shop at different level and righteous mixed land use to ensure dispersed activity are proposed.

Recreation is linked to citizen's happiness subject to affordability. Hence both free and fee based system is proposed for sustenance. Ecological parks by delineating water body and low lying area, culture and sports centre and mela ground for regional congregation and enrichment, urban forestry are the few examples provided as recreational facilities apart from lower level facilities at sector and neighbourhood level.

5.3 Infrastructure and Utility Services

Water Supply: In addition to augmentation of piped water supply, as alternative source storage in lakes and depressions through rain water harvesting is proposed. Sinking of deeper aquifer based big diameter tube wells and installation of arsenic removal plant is also proposed as alternative measures.

Swerage and Drainage: Compulsory production of compost from urban waste and recycle of waste water is proposed with treatment plant at western part of the township near existing canal. Artificial canal is proposed to be excavated to save existing low lying settlement from drainage point of view. Regional canal at the south connecting Keorapukur Khal and Adi Ganga for comprehensive regional system is proposed.

Solid Waste Management: As disposal systems of solid wastes, sanitary landfill with compaction and layer of soil, composting with windrow method and vermi-composting and incineration with primary and secondary combustion are proposed.

5.4 Policy Guidelines

Urban Design and Imagibility: Urban design is a tool to promote image and quality built environment. As a part of urban design policy, building heights have been distributed rationally to enhance character of localities, relief and massing of developments. Existing local settlements areas, which are of low rise and low density, have been preserved to diversity. While the landmarks are proposed at important nodes and civic / commercial centres, lower buildings such as community hall, schools, are used as interface and as visual and spatial relief. Waterfront site is proposed to be developed near Keorapukur canal by bringing the people to the canal and the canal to people. Hence, in order to develop the township in the above direction a policy guideline in the form a comprehensive Land use and Development Control Plan (LUDCP) has to be prepared which may be enforced in due course.

Sustainable Development: Environmental sustainability invites pollution control mechanism, development control policy, and waste management programme. Socio-cultural sustainability demands community facilities, cultural activity and people's participation. Economic sustainability requires poverty reduction, small and medium industries, transport and utility services. Eco-friendly and alternative building materials and technology, urban forestry, rainwater harvesting, use of fly ash, recycling and

reuse of waste are the key components proposed for sustainable development. Innovative use of resources like linking solar energy to main grid, production of bio-fuel, medicinal plants and pisciculture at recreational park are also recommended.

Environment Protection: As per environment protection act, any big township project needs clearance from government through environment impact assessment report, which will also indicate measures to save environment. Under the proposal, provision for green barrier between industry and residential area, afforestation, preservation of orchards, greenery / water body are made to prevent pollution. Large water bodies are to act as holding pond and to receive treated effluent. De-siltation of canals, rain water harvesting and treatment and recycle of waste are the proposals to save environment. Prevent encroachment in the canal side and other Government land and ensure participation of people and proper road network are the measures to ensure formation of environment friendly town.

6. DEVELOPMENT, MANAGEMENT AND FINANCE

6.1 Development

The development process includes company formation, land acquisition, selection of agencies for development, execution, marketing, finance and management. The most efficient and rational method of development is found through Public-Private-Partnership (PPP). PPP ensures sharing responsibility, ownership, service, risk and reward. This would provide greater benefits like cost-effectiveness, higher productivity, accelerated delivery, clear customer focus, and user charges.

The proposed project period is 18 years (2007-25) which is divided in 3 phases. The initiation phase (28 percent) will accommodate capital complex with supplementary activities like commercial, bus terminus, housing and up-gradation of existing settlement. With operation of township, other land would be included in development (48 percent) and maturity (24 percent) phase. In respect of saleability of developed land, 47 percent would be saleable, 32 percent would be non

saleable and 21 percent towards lease and rent. The phasing is initiated considering least disturbance to locals and proximity to urban centre. Sale price is fixed based on break-even sale and comparative analysis of market.

6.2 Management

As per 74th Constitution Amendment Act, compulsory municipal governance will be effected on full operation of township. However, during the development stage a special purpose vehicle (SPV) company may be formed to develop and maintain external services against service charges. Vacant tax will be charged to optimum use of infrastructure and avoid land speculation. While NGOs may be involved for social sector management like health, education, participation of private sector may narrow gap between investment and budget, levy user charges and ensure efficient operation and maintenance.

Apart from acquisition on negotiated price, grant of TDR, integrating villagers in development process, return part of developed / undeveloped land to the villagers, training and building up entrepreneurship by award of contracts, are the proposals for smooth land acquisition process. Due care is taken to avoid acquisition of multi-crop land, orchards and settlements.

6.3 Finance

As Government incentives and grant schemes like funds under Jawaharlal Nehru National Urban Renewal Mission (JNNURM), viability gap funding for less remunerative infrastructure projects may be tapped. Financial models like Financial Guarantee (FG), Asset-Based Securitization (ABS), Domestic and Foreign Investment under General Purpose Vehicle (GPV) and Private Public Partnership (PPP) and Foreign Direct Investments (FDI) under Special Purpose Vehicle (SPV) may be suitably explored to avail mixed financial resources. With the sale of land against advance even during development stage backed with proper marketing strategy, it is aimed to make the project fully self financed.

7. CONCLUSIONS

All successful projects have independent administrative authority with powers and

responsibilities. Hence, formation of SPV is strongly recommended. Suitable mix of financing from various sources as basket approach with efficient financial management and innovative resource recovery mechanism would give maximum financial return.

Built on industrial bases and within a Master Plan that incorporates economical and physical aspects locally and regionally, township would be a self-sufficient growth node. Private sector contribution can not be achieved without investment incentives from government through infrastructure and other facilities. Hence government's commitment is a must.

Long gestation period has been considered since long process involved in development. During the end of each phase, there would be flexibility for modification of project proposals. As experts say that most successful projects are planned and executed in the framework of a national, regional and local plan, we have followed the KMA: Vision 2025.

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DEVELOPMENT OF FRINGE AREAS OF URBAN SETTLEMENTS A CASE FOR PROPOSAL THRESHOLD SIZE PRESCRIPTION

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ABSTRACT

Land parcels of awkward shapes and sizes come up for development in a haphazard and sporadic manner leading to problems of accessibility, sub-optimal exploitation of development potential, creation of bottlenecks in provision of infrastructural services and above all development coming up in a disorderly manner. Author therefore suggests of enforcing minimum size of proposal to take up land development as introduced in our acts and development control regulations. Proposals of land of regular shapes and enjoying good accessibility offer a decent built form and are able to realize full development potential.

1. INTRODUCTION

With liberalization, privatization and globalization of India's economy, the rate of urbanization has accelerated across all categories of human settlements. It has resulted in a dramatic change in the scenario of land development not only within the administrative limits of towns and cities but also in their fringe areas. As a result there is an urgent need to ensure planned and orderly development in these areas to achieve the objective of ensuring comfort, convenience, safety and health of prospective residents of these areas. Therefore, there is a strong case now to lay down the threshold size of proposals for development of lands situated in the fringe areas while considering such applications for grant of permissions. The development control regulations in most of the towns and cities prescribe minimum plot size for various social facilities, public utilities, etc. However, none of them prescribe the minimum size of proposal to grant NOC for new town, development permission for various activities like industries, commerce, residential, recreational use, etc. This paper deals with these issues.

2. PLANNING NORMS FOR NEW DEVELOPMENT

2.1 The Concept

Logically speaking as the settlement grows in size and population around diverges around the radial routes, larger swathes of land open up for development. Therefore, bigger the size of the settlement larger should be the size of the proposal to be considered for grant of development

permission. Depending upon the size of the settlement, the minimum size of the proposal for which permission could be granted, needs to be prescribed. This logic should be acceptable to planners, administrators and above all the developers.

2.2 Benefits

Normally, it is observed that land parcels of awkward shapes and sizes come up for development in a haphazard and sporadic manner leading to problems of accessibility, sub-optimal exploitation of development potential, creation of bottlenecks in provision of infrastructural services and above all development coming up in a disorderly manner. Therefore, it is high time the concept of enforcing minimum size of proposal to take up land development is introduced in our acts and development control regulations. Proposals of land of regular shapes and enjoying good accessibility offer a decent built form and are able to realize full development potential. They also promote health, hygiene, safety and convenience to the people at large. Such a restriction will also enhance the techno-economic viability of land development.

2.3 Proposal

The minimum size of the proposal for approval within and more particularly outside the towns and cities of varying sizes could be laid down as under:

The proponents of the development shall be free to assemble land parcels of any shape in any direction, but will have to follow the aforesaid criterion. These parcels have to be necessarily

physically contiguous. While doing so in case there are any location constraints, procedural hindrances and ownership issues, some relaxation could be given. However, the applicant should be bound to amalgamate as much land as possible.

Ideally when such proposals come up for development, the promoter should be directed to ensure that the owners of constituent land parcels get a developable and properly shaped resultant plot having accessibility and well developed infrastructure on the site before the first plot holder comes to the planning authority to seek building permission for the intended development. While doing so, the planning authority should ensure that such proposals together contribute at least 5 percent land towards public utility plots, 12.5 percent towards road network, 12.5 percent towards common recreational open space and 10 percent for social facilities. In other words, only 60 percent of the gross land under the development proposal shall be allowed for exploitation.

2.4 Relaxations

It is likely that in certain cases there could be constraints as a result of which developer may not be able to assemble the land parcels up to the size prescribed in the aforesaid Table 1. For example, built up spaces, existing or proposed

roads, administrative boundaries, physical barriers like water bodies, rivers, mountains, lands of certain tenures such as *Adivasi* land, Forest land, *Inami* lands, *Gaothan* lands, leased land, lands under litigation, restricted areas such as no development zone, coastal regulation zone, heritage precincts, defense establishments, railway lands, lands held by public authorities as also those situated close to atomic power projects, airports, etc. In all such cases exemption should be given to the extent required based on merit.

2.5 Modalities

While approving such proposals to begin with, an outline development plan or layout approval or a group housing scheme approval shall be given and the finer details and actual building plans shall be attended to at a later stage. With this at least some semblance of planning is achieved in the initial stage itself.

2.6 Proactive Role

Planning authorities should in a big way promote private sector initiative in developing a town planning scheme and should not get itself involved in the whole exercise of determining land values, betterment levies, etc. However the planning authority should provide internal infrastructure in such layouts on payment of infrastructure cost as worked out by it.

By granting approvals for layouts consisting of regular shaped plots abutting reasonably wider roads an opportunity for laying the infrastructure at site in a phased manner is available for the promoter whereas the plot holder gets the freedom to take up development of his land as and when he wishes. Thus he is not dependant (unlike in other cases) on the development of certain lands placed in an advantageous position to cash the opportunity and enjoy the fruits of development. He may defer developing his own plot at the right time as per his needs.

Table 1 Size of Settlement and Minimum Plot Sizes

SNo.	Size of the settlement as per 2001 census (persons)	Minimum size of proposal (Hectare)
1.	< 1000	0.02
2.	1001 – 5,000	0.1
3.	5,001 – 20,000	0.5
4.	20,001 – 50,000	2
5.	50,001 – 1,00,000	5
6.	1 to 5 lakh	10
7.	5 to 10 lakh	50
8.	10 to 25 lakh	100
9.	25 to 50 lakh	250
10.	50 to 100 lakh	500
11.	> 100 lakh	1,000

3. MODUS OPERANDI

- Planning authorities shall be directed by way of amendments in the relevant acts of the central and state government, etc; to introduce in their Development Control Regulations, the mandate to prescribe the threshold size for submission of applications

for NOC for layout and development permissions in the fringe areas of the towns and cities under their jurisdiction.

- Planning Authority should not accept applications for development permission from individuals or group of individuals for parcels of land in the notified areas unless the threshold size prescribed by them is attained or relaxation is made with due proofs and strong justification.
- The application as also the drawings for NOC for plotted development and group housing scheme should be signed by all the land owners concerned with all other documentary proofs of ownership through a licensed surveyor or town planner. In case of proposals of size in excess of 50 ha a town planner's association with the project throughout its execution shall be made mandatory.
- An approval could be given either for a group housing scheme or plotted development in a layout. The layout approval will also mention the plot wise area along with the maximum built up area that can be constructed there, considering Global FSI of 1 for the layout proposed. This FSI shall be distributed across the plots on a pro-rata basis depending upon the size of the plot and the maximum FSI permissible thereupon as a matter of policy.
- Planning Authority shall bring to the door step of the layout the necessary off site infrastructure and charge for the same to the promoter. If desired detailed, micro-level infrastructure within the layout shall also be developed by the planning authority at a cost. Else he may do it himself.
- The chief promoter of the project shall intimate to the Planning Authority about completion of all infrastructure at site.
- Thereafter, the constituent plot owners shall submit the application for grant of development permission on their individual plots along with necessary fees, development charges, premiums, etc; to the Planning Authority as and when they wish.
- All plot holders shall take due approvals and occupation certificates directly from Planning Authority at various stages as may be required.

- Maintenance of services shall rest with the local authorities concerned upon handing over of completed social and physical infrastructure within the layout and group housing scheme by the promoter.

4. CORPORATE INITIATIVE AND WIN-WIN SITUATION

These days we are witnessing corporatization of the secondary (manufacturing), tertiary (services) or quaternary (information exchange) sectors of our economy, but also the primary sector (agriculture, fishing, etc;). For example, retail business through a chain of malls or the matrimonial services providers. Therefore, in the real estate sector too, we should welcome such a trend of development through entry of corporate entities. In fact the government itself is promoting Foreign Direct Investment in real estate sector or development of integrated private sector townships in the fringe areas of metropolitan cities, thereby underlining the pressure of corporate sector.

The promoter may even think of floating a company with his majority shares and rest of the shares being given to land owners based on the location attributes of the constituent land parcels, their shape, size, fertility, development potential, etc. Such a real estate company can pay dividends on an annual basis to these shareholders proportionately. This will blunt the opposition to large scale developments such as private townships or Special Economic Zones coming up within the limits of large towns, cities and their fringes.

5. CONCLUSIONS

Government and the public have to remain open to new and innovative ideas for brining about physical development in a planned manner. It is hoped that the initiative suggested in the foregoing paragraphs is accepted with an open mind by the government departments and planning authorities functioning under them to not only aim at ensuing orderly and planned development in the fringe areas of urban settlements but also offer land owners an opportunity to reap the benefits of rapid urbanization.



EMERGENCE OF INFORMATION TECHNOLOGY INDUSTRY IN INDIAN CITIES

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ABSTRACT

India has emerged as one of the favoured Information Technology destinations by attracting major information technology related activities. An investigation was done in the paper by having the objective to find out the strength of few Indian cities taking in to consideration outsourcing categorise and evaluation has been done in four tiers system, based on various factors including infrastructure, skill availability, skills retention, access, cost of living, political support and quality of life. There is enough reason to believe that Tier-II cities across the country can also become centres of this activity. If properly handled, it can be the thin end of the wedge use to transform the Indian cities, and if badly handled, not only global competitiveness will be destroyed, but India will descent into urban hell.

1. INTRODUCTION

Technological advancements have been shaping the socio-economic and spatial developments in the cities of the world. During the 19th century, industrialisation gave rise to manufacturing plants and factory towns, while the steam engine led to the growth of seaport cities and a system of railroads that linked cities and towns. Technological advancements in the form of Information Technology (IT), which represent an outgrowth of developments in electronics and microelectronics, the technologies of which are central to both communications and computing bound to affect every aspect of human life including cities and their functions. Emerging Information Technologies have started to transfer the economic role of cities, and their pattern of spatial development. In this process, many cities have lost their roles as corporate headquarters, and manufacturing centres, while some have attracted Information Technology based activities and emerged as Information Technology hubs.

Advancement in information-communication technologies and subsequent reduction in the cost of information transfer has contributed towards the dispersal of Information Technology related economic activities. It has potential of both decentralisation and centralisation, and it has further shown decentralisation trend at global level by off shoring to the developing countries for minimising costs, while centralisation has been felt through their accumulation in the already developed metropolitan cities in the backdrop of

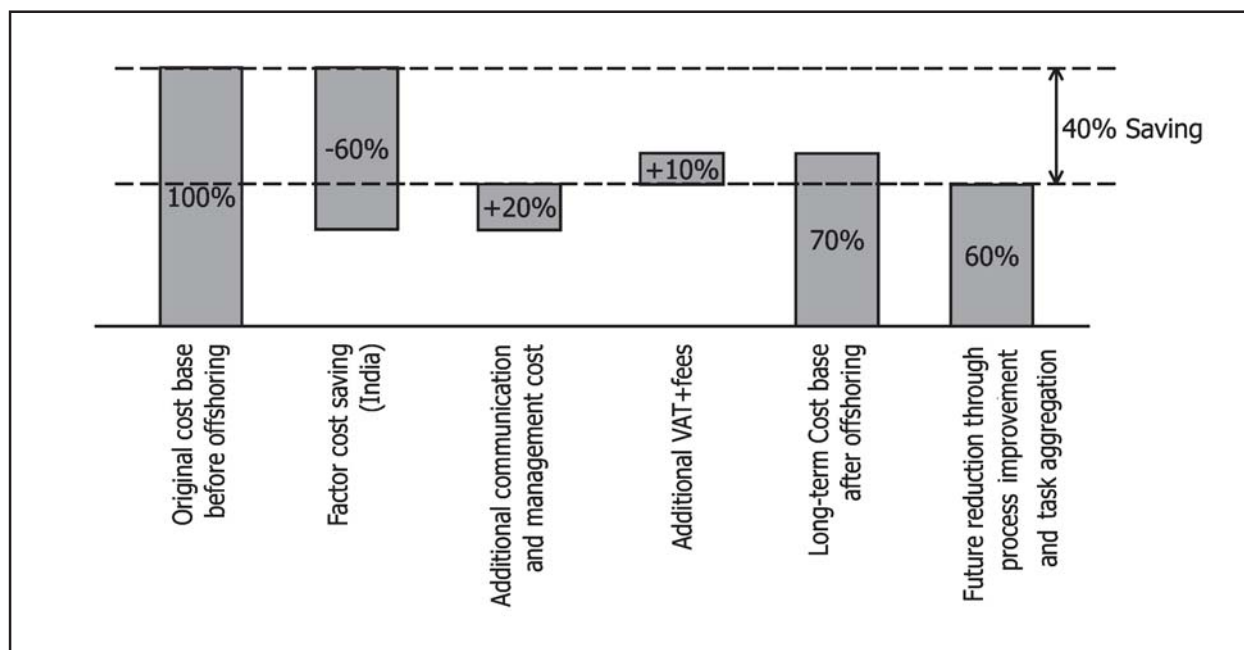
infrastructure availability. In recent years, it is observed that many cities across the globe are experiencing this phenomenon.

The Indian cities are not exceptional in this regard, since India has emerged as one of the favoured Information Technology destinations by attracting major Information Technology related activities. Indian cities are expanding rapidly with large investments flowing in this sector. The boom may have only begun, and as more investments come, Indian cities are bound to grow even further. Indian cities are having opportunities and challenges in this regard and the impact on urban infrastructure is being felt in several cities.

2. EMERGENCE OF INFORMATION TECHNOLOGY (IT) INDUSTRY

In the last 50 years or so, since the evolution of mainframe based computing in 1950s, the concept of Information Technology (IT) as a tool for aiding the business processes for both manufacturing as well as the services sectors have undergone dramatic changes. It has enabled the manufactures and the service providers to offer better quality products and services, and helped in better planning tools to reduce costs significantly at all stages, i.e. manufacturing as well as distribution, especially for the services sector, it has fuelled tremendous amount of innovation in the areas of customer interaction and delivery. Advancement in Information Technology has profound impact on the economy and having tremendous amount of potential for becoming an engine of accelerated economic growth,

Fig. 1: Offshore Business Benefit Analysis



Source: A. T. Kearney, Bank of America, Economist, Gartner, 2004

productivity improvement for all sectors of the economy.

The increasing convergence of technologies and content has created tremendous opportunities as well as challenges for both developed at developing countries at the global level. Companies face pressure to improve business performance, as they face a looming skills shortage, an exhaustion of standard option to increase productivity, and to reduce the cost of production. Off shoring of business process and functional activities are the options available to them to improve business performance. The benefits from off shoring is through ability to access relevant skills at appropriate costs such that the savings are much higher than the incremental cost of telecom connectivity and control / co-ordination activity involved. Additional benefits could arise from economies of scale and re-engineering benefits at the offshore location. Some global companies have seen business benefits to the extent of 35.00 to 55.00 per cent saving in relevant cost through off shoring as presented in Fig 1.

The rapid globalisation in IT industry in recent years has focussed a great deal of attention on India; whose IT industry is now a small but a growing part of the international division of labour. India

not only has the largest number of people working in this IT industry but also apparently even the highest rate of growth of revenue, by providing less wage to the employees compared to the developed nations. It is supported by the salary structure of the IT industry provided in India as presented in Table 1. This table shows that the estimated wage costs in India were about 20.00 per cent to 30.00 per cent of the corresponding United States of America (USA) levels for comparable work.

Emergence of IT industry is an economic aspect of Information Technology revolution, which requires knowledge and communication as basic things, and skilled human resource to process it. It is widely believed that the key to the success of the Indian IT industry is the availability of trained, low cost software professionals with an average of 12 hours time difference with respect to United States of America (USA) and European Countries, whereby companies can have 24X7 operations through workforce rotation.

3. INFORMATION TECHNOLOGY INDUSTRY IN INDIA

Economic crisis of 1991, caused by the large and persistent macroeconomic imbalances that developed over the 1980s, was the root cause for economic reforms in India. Being crisis induced,

Table 1: Software Professionals: Comparative Salaries, 1997

Designation	USA (\$ Per annum)	India (\$ Per annum)
Programmer	32500.00-39000.00	2200.00-2900.00
System Analyst	46000.00-57000.00	8200.00-10700.00
Programmer Analyst	39000.00-50000.00	5400.00-7000.00
Network Administrator	36000.00-55000.00	15700.00-19200.00
Database Administrator	54000.00-67500.00	15700.00-19200.00
Help-desk Support Technician	25000.00-35000.00	5400.00-7000.00
Software Developer	49000.00-67500.00	15700.00-19200.00

Source: INFAC-1997, Mumbai.

Note: 1: Converted at exchange rate of INR 41.50 / USA \$ (as per 1997 value)

2: Figures are starting salaries for large establishments employing more than 50 Software professionals.

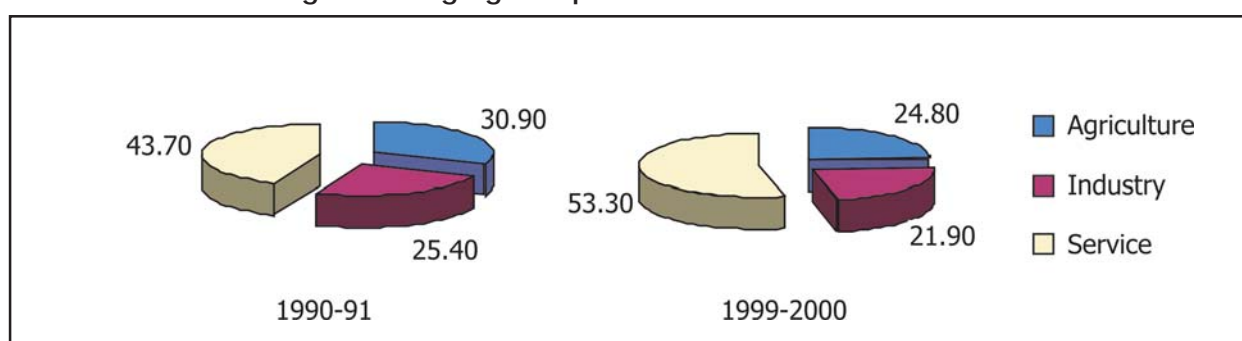
the reforms in India have had to focus initially towards macroeconomic stabilisation. Simultaneously, the Government of India initiated reforms with regard to industrial policy, trade and exchange rate policies, foreign investment policy, taxation, financial sector, public sector, etc., which brought economic revolution in the country.

In India, the growth of the tertiary sector is quite steady with respect to the other sectors of the economy, since the economic reforms started. The tertiary sector has taken over the contribution of industry sector in overall economic growth, and this can be judged in terms of Gross Domestic Product (GDP) contribution with respect to the other sectors of the economy as presented in Fig. 2. This figure explains that the characteristics feature of growth in tertiary sector and has been observed that the share of services has risen from 43.70 per cent in 1990-91 to 53.30 per cent in 1999-00. However, the contribution of industrial sector in Gross Domestic Product (GDP) has decreased from 25.40 per cent in 1990-91 to 21.90 per cent in 1999-00. Information

Technology industry is a major contributor for the significance growth of tertiary sector in India.

Growth of IT industry is judged in terms of export revenue, which has increased from INR 65,300 million in 1997-1998 to INR 600,000 million in 2003-2004 as revealed in Table 2. At same time, per cent share in Gross Domestic Product (GDP) has increased from 1.22 per cent in 1997-1998 to 3.64 per cent in 2003-2004. Yearly export revenue in INR in million and yearly growth in export in per cent, with its percentage share in Gross Domestic Product (GDP) is presented in the table, and subsequently the export of Information Technology industrial output, its Gross Domestic Product (GDP) share is presented in Fig. 3.

Economic growth is caused either by a growth in inputs of factors (labour and capital), or reallocation of misallocated resources, or finally due to increases in productivity of labour and capital. The fact that in Information Technology sector, it is India's highly educated, who are the driving force raises the possibility that 'if India can turn into a fast-growth economy, and it will be the first

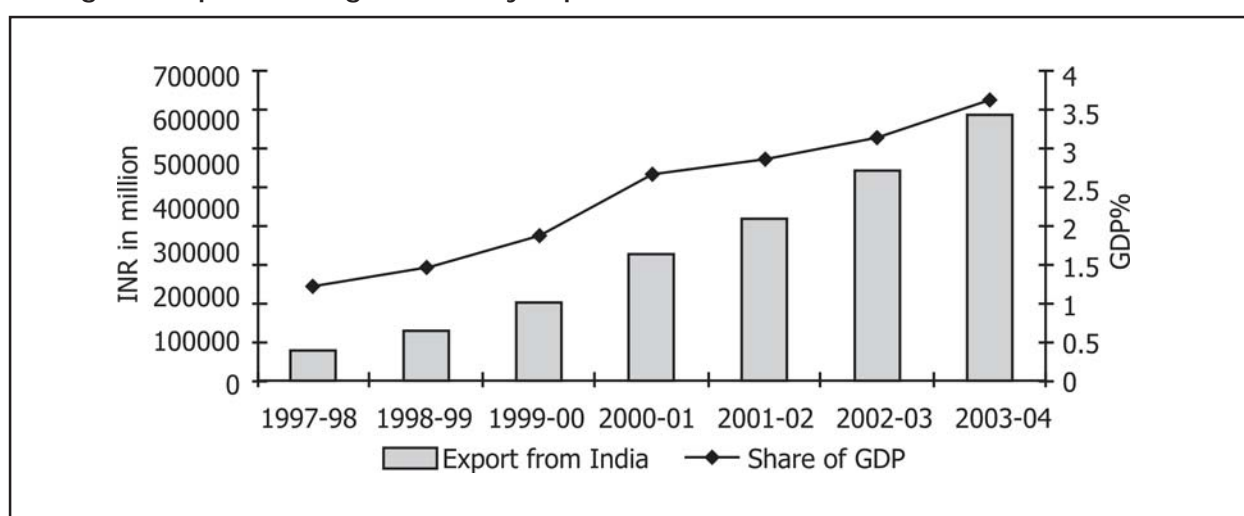
Fig. 2: Changing Composition of GDP in Terms of %

Source: NASSCOM, 2004

Table 2: Growth of Information Technology Industry in India.

Year	Export from India (INR in million)	Growth per cent	Share in GDP per cent
1997-98	65300.00	-	1.22
1998-99	109400.00	67.53	1.45
1999-00	171500.00	56.76	1.87
2000-01	283500.00	65.30	2.66
2001-02	365000.00	28.74	2.87
2002-03	475000.00	30.13	3.15
2003-04	600000.00	28.00	3.64

Source: NASSCOM, 2004.

Fig. 3: Graph Showing IT industry Export and its Share in India's GDP in terms of %

Source: NASSCOM, 2004.

(INR in million)

developing nation that used its brainpower, not natural resources or the raw muscle of factory labour, as the catalyst'. The performance of India's Information Technology sector, with an export growth of more than 50.00 per cent for more than five years is testimony to the robust growth of industry. This is a peculiar phenomenon that is abnormal, since it signifies a process of 'leapfrogging' from the agricultural phase to the tertiary / service phase, and bypassing the industrial phase as witnessed in other developing countries.

4. INFORMATION TECHNOLOGY CITY SCENARIO IN INDIA

In India, a few decades after independence (1947), administrative capitals, and urban centres were chosen to locate large public sector enterprises to serve as engines of economic growth. Larger size of manufacturing units formed in cities in an

amorphous manner lacked adequate housing and other infrastructure services such as, power, road, water supply, sanitation, and housing. In fact, larger size of urbanisation also took place in these cities. In 1980's rapid advances in Information Technologies pose major challenge to city-based financial, healthcare, and educational institutions and to city's roles as centre for commerce, and culture. In this context, Indian cities have emerged as favoured Information Technology destination since 1990's by attracting major Information Technology related economic activities.

Availability of skilled human resource; and a timely and positive response given by various Government Authorities, at different levels in the form of policy reforms, incentives, amendments of acts, and formation of Software Technology Parks (STPs) in various cities, etc., have played supportive role to strengthen this Information

Technology initiated phenomena. The Indian IT industry has emerged as one of the fastest growing sectors in the Indian economy. As a consequence, Indian cities are expanding rapidly with larger size of investment flowing into the Information Technology sector on one hand, and reduction in transportation and communication cost occur on the other, which further stimulate Information Technology related economic activities to spread at lower level cities to achieve steady economic growth and development.

4.1 Perspectives of Indian Cities

Location choice is an integral part to overall off shoring decision process for most companies. The choice of the right location, in terms of costs as well as availability of specific resources, such as skilled labour, and specific infrastructure services like real estate and telecom facilities, transportation, utility services, etc., is one the critical segments for overall development. An investigation was done by having the objective to find out the strength of few Indian cities pertain to outsourcing and are categorised and evaluated into four tiers based on various factors including infrastructure, skill availability, skills retention, access, cost of living, political support and quality of life, and are presented in Table 3. The table explains that in all these categories, Mumbai, and, Bangalore have been rated as 'good', but their status is worsening. Where as, infrastructure position in Bangalore is rated as 'good', but it is steadily deteriorating. It has been observed that Chennai, Pune and Hyderabad are expected to outdo Mumbai and Bangalore, and would become the next hot favourite Information Technology outsourcing destinations by 2010. Further, it has been also

observed that in skill retention, cost of living, political support system, and the quality of life in India's Silicon Valley, Bangalore and Mumbai are not much varying.

NASSCOM - KPMG studied 13 clusters across ten States in India, contributing to over 85.00 per cent of the country's Software Industry and Information Technology enabled Services (ITeS) Industry export in 2002-03, and observed that almost every plus point balanced out by a minus point. As per the report, a key strength and concern area of the Indian cities is presented in Table 4. The study explores the attractiveness of locations from two points of view: first, it looks at overall factors that have driven ITeS companies' preferences for specific locations in India. In another study by NASSCOM-KPMG in 2002-03, different cities / cluster are classified into four categories based on their inherent focus on Infrastructure or Human Resources to support ITeS and is presented in Fig. 4. These include Business Centres (e.g. Mumbai), Education Centres (e.g. Kolkata), Tourist Destination (e.g. Jaipur), and Planned Cities (e.g. Chandigarh). Each of these categories has its advantages, disadvantages as well as suitability for specific ITeS requirements.

The study, at first also includes an assessment of individual cities / cluster based on a mix of qualitative and quantitative aspects for ITeS. The spread of ITeS operations across locations in India suggests that different companies have different assessment preferences. Secondly, the study also reviews that the factor level efforts being made at these locations to sustain / enhance attractiveness

Table 3: Tale of Few Indian Cities

Cities	Infrastructure	Cost of Living	Quality of Life
Bangalore	G (-)	F (-)	E (-)
Mumbai	VG (*)	P (-)	F (-)
Delhi	VG (*)	G (-)	G (*)
Chennai	G (+)	VG (+)	VG (+)
Hyderabad	VG (+)	VG (+)	VG (+)
Pune	F (+)	VG (+)	VG (+)
Navi-Mumbai	G (+)	VG (+)	G (-)

Source: Gartner, Indian Express, dated 15-12-2004

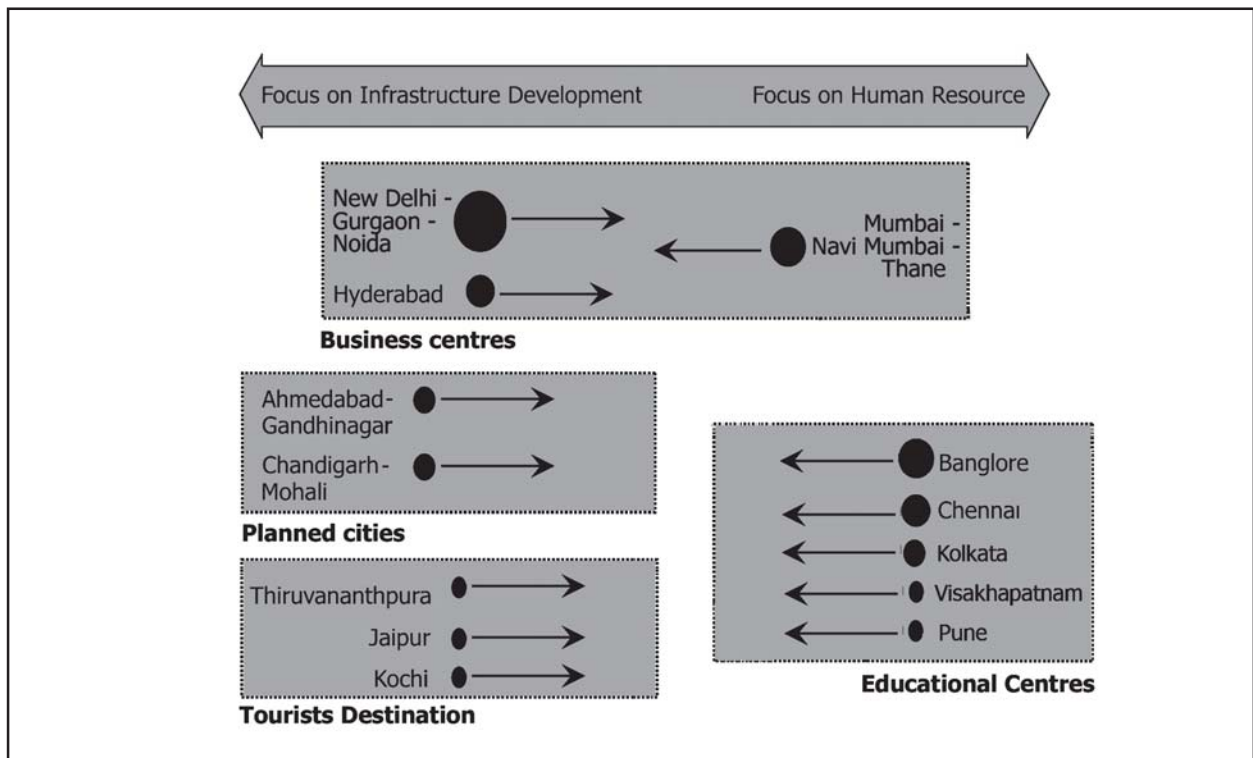
Note: G: Good, F: Fair, E: Excellent, VG: Very Good, (+): Improving, (-): Worsening, (*): Unchanged

Table 4: The Key Strength and Concern Areas of the Indian Cities

City	Key Strength	Area of Concern
Ahmedabad-Gandhinagar	NRI Support	Absence of large MNCs
Bangalore	Active Information Technology / ITeS industry	Rising salary costs, attrition
Chandigarh-Mohali	Highly 'Live-able'	Lack specific skills
Chennai	Strong resource base	Absence of marketing
Hyderabad-Secunderabad	Government support	No feeder towns
Jaipur	Entrepreneurial culture	Low awareness level
Kochi	Good infrastructure	Lack of trained skills
Kolkata	Low cost skills	Absence of large MNCs
Mumbai-Navi Mumbai-Thane	Skilled resources	Increasing skill cost
New Delhi-Gurgaon-Noida	Large number of global Information Technology companies	Attrition. Rising cost
Pune	Educational institutions	Low global awareness
Thiruvananthapuram	World class Information Technology / ITeS facility	Poor public transport
Visakhapatnam	New planned investment	Lack of local ITeS skills

Source: NASSCOM –KPMG report (2004), the Hindu, February 6, 2004.

Fig. 4: City Cluster in India



Source: NASSCOM –KPMG, 2003

- ↔ Position of circle indicates current primary focus area for the location and is not meant to indicate relative positioning between cities/clusters.
- Size of circles indicates number of ITeS companies operating out of the city.
- ➔ Arrow indicates primary direction for action planned for the location over the near / medium term.

as a preferred destination for ITes. There is enough reason to believe that Tier-II cities across the country can also become centres of this activity. Once again, the economic value capture, if it is properly leveraged, can go a long way in ensuring that Indian cities have all round development. In this context, Indian cities need to wake up to the fact that the brand appeal of a city is measured in relation to that of its rivals. Inter-city competition is increasingly becoming a central fact of modern economic life. Like in more other aspects of economic activity, this competition ought to compel the State Governments to improve the quality of cities and their urban agglomerations.

5. PLANNING FOR INFORMATION TECHNOLOGY INDUSTRY

In the days of license era, entrepreneurs could locate their industries only in places for which permission was granted. For commodities and energy, industries are located wherever the resource is available or where the demand is available for the end products (output). Industries that do not have locational bias, i.e. footloose industries like automobiles decide on the basis of subsidies and tax exemptions. The IT industry, on the other hand, essentially makes its decision on the quality and availability of human resources, and the quality of infrastructure available in the city. Good quality infrastructure creates the quality of life that attracts human capital. This is not just the availability of usual roads, airports, communication, housing, and power, but includes education, shopping and leisure and entertainment facilities. Being people-intensive industry, it is essential to have both commercial as well as residential infrastructures for literally millions of people. These people, young and relatively far better paid than their parents, will be big spenders as well as comfortable with consumer credit. They rely on the rest of the city to provide them residence and other required infrastructure.

6. CONCLUSIONS

The Information Technology industry is at the intersection of urbanisation and globalisation.

Properly handled, it can be the thin end of the wedge use to transform the Indian cities. If badly handled, not only global competitiveness will be destroyed, but India will descent into urban hell. It has long been obvious that the quality of life and infrastructure that cities offer drive their investment patterns. Adequate attention have to be given for this non-Information Technology infrastructure, otherwise overall infrastructure of the Indian cities will collapse. Therefore, it is an inevitable requirement of evolving strategies for integrated development of infrastructure services, and the integrated strategy will not only address the Information Technology industry, but also should address the quality of life in the Indian cities.

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