

An analysis of urban growth trends in the post-economic reforms period in India

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Abstract

Significant changes have been observed since 1991 in the nature and pattern of urban growth in India. Our cities are in the midst of restructuring space, in terms of both use and form. The paper addresses various complex urban issues associated with the present pattern of urban development through review of urban development of selected metropolitan cities of India which have experienced the impacts of LPG (Liberalization, Privatization and Globalization) process. Spatial trends, prevailing zoning, building bye laws (Floor Area Ratio and density) development control regulations, urban housing and transport are analyzed in the context of the current phenomenon of urban sprawl witnessed in India. The implications of such growth patterns of India are projected and the impacts analyzed. In conclusion, the need for an alternative sustainable urban development pattern is outlined for future metropolitan cities of India.

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1. Introduction

There are many important years in the history of India, but as far as economic history is concerned, the year 1991 has definitely to be termed as a “landmark”. The economic reforms of the 1990s included, significant industrial and trade liberalization, financial deregulation, improvements

in supervisory and regulatory systems and policies more conducive to privatization and Foreign Direct Investment (FDI) (Gopinath, 2008).

The emergence of the software and services outsourcing industry in India is one of the most visible outcomes of globalization, stimulated by the spread of modern Information Communication and Entertainment Technologies (ICETs) and the restructuring of global capitalism since the 1980s (Upadhyay, 2006). Consequent to these reforms phenomenon, key cities in India are in the midst of restructuring space, in terms of both use and form.

The Liberalization, Privatization and Globalization (LPG) policies of the government of India and opening up of FDI in real estate sector have brought a big boom in the development of large scale private townships variously known as Integrated, NRI or High-Tech townships. These kind of townships are coming up on the peripheral

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areas of large cities like Mumbai, Pune, Delhi, Gurgaon, Chennai, Hyderabad, Ahmedabad and Bangalore occupy areas up to 1000 acres and beyond.

Rapid urban growth, marked by the number of million-plus cities increasing from 23 in 1991 to 35 in 2001, has led to the problems of urban sprawl, unregulated ribbon development, increasing problems of inadequate urban infrastructure and deteriorating quality of urban livability. The lack of planning that characterizes most suburban growth has resulted in higher transportation costs in terms of money, time and inconvenience for suburban residents, in higher public sector costs, in undesirable land use patterns and in the inadequate supply of open spaces, recreational facilities and other amenities. Overall, the unplanned and uncontrolled rapid growth has resulted in serious negative effects on the urban dwellers and their environment.

2. Materials and methods

The paper deals with in-depth analysis of various urban development issues that have emerged in the post LPG period. The analysis is carried out in two different sections. The first section of the analysis undertakes thorough literature review of the selected Indian Metropolitan cities which have experienced the impact of LPG phenomenon. The key aspects covered are urban development patterns including spatial trends, prevailing zoning, building by-laws (FAR – ‘Floor Area Ratio’ and ‘Density’) and development control regulations, urban housing and transport. In the second section, implications of the urban growth trends referring to all the key aspects discussed above are projected and the impacts analyzed. The outcome of the projections and calculations are further used as a basis for formulating an alternative conceptual sustainable urban development model for future metropolitan cities of India. The secondary data sources used to carry out analysis are listed below:

- Census reports, Planning statistics, Annual reports of Government agencies, Technical and Master plan reports and such other official publications.
- Books, Journals, Conference proceedings, Study reports, Newspaper articles and Internet based information.

The analysis is done with the help of MS Excel software, logical calculations and projections. GIS based urban sprawl maps procured from secondary data sources are used for spatial analysis and graphical output. AutoCAD software is used for digitizing map and to prepare relevant drawings.

3. Results and discussion

3.1. Changing employment scenario

Indian Cities are in the process of adapting new economic realities. City-level economic development is

slowly shifting away from industrial activities to more sophisticated knowledge base systems. According to [Muttur \(2008\)](#), total labor force in urban areas increased from 57.15 million in 1983 to 80.6 million in 1993–1994 and to 92.95 million in 1999–2000. The ratio of urban to rural labor productivity increased from 2.32 in 1980–1981 to 2.34 in 1993–1994 and to 2.83 in 1999–2000. In addition, the annual growth of urban labor shows a remarkable increase from 2.26% during 1993–1994 to 8.38% during 1999–2000.

The post-1991 period is marked by a significantly slower growth of ‘organized’ sector (comprises enterprises for which the statistics are available from the budget documents or reports) employment. Compared to an average annual growth of 2.04% in the 1983–1993 periods, the employment growth since 1993 has been around 1% annually. In line with the global trends, much of the new employment generation (73%) has taken place in the services sector. On the other hand, the primary sector employment has declined by 23% during this period ([Mathur, 2003](#)).

3.2. Demographic changes

India’s total population has increased from 238.4 million in 1901 to 1028 million in 2001 whereas urban population has increased from 25.8 million in 1901 to 286.1 million in 2001 (nearly 30% of total population). India’s urban population of 286 million was larger in size as compared to the combined total population of 12 countries in West Asia (=192.4 million) or 5 countries in East Asia (=206.8 million) excluding China (=1285 million), 40% of the European continent (=726.3 million) ([Muttur, 2008](#)). The percentage of urban population living in Class I cities (more than 100,000 population) has increased from 65% in 1991 to 69% in 2001 ([Ministry of Housing, 2007](#)).

Strong urbanization effects are augmenting the growth potential arising from India’s young, expanding population. According to Planning Commission forecasts, the urban population is expected to rise more than 40% by 2020 ([PREI, 2006](#)). The last census survey in 2001 reported roughly 192 million households in India, about 40 million more than 10 years earlier ([DB Research, 2006](#)). Household formation is growing due to population growth and the shift from joint families to nuclear families. The average number in each household has fallen from 5.8 in 1990 to 5.3 in 2005 ([PREI, 2006](#)). Median household incomes are expected to grow from US\$2000 in 2005 to US\$3200 by 2010. A large middle class has emerged, currently estimated at 120 million, half of whom are under 25 years. India’s National Council of Applied Economic Research expects a further 180 million to join the middle classes by 2010. At 300 million, it will be larger than the USA ([LaSalle, 2006](#)).

3.3. Urban real estate growth

India’s globalization and consequently urbanization have shown remarkable selective growth by city sizes,

regions and sectors. Higher growth and larger concentration of urban population in metropolitan areas is an important feature of India's urbanization in post-globalization period. The globalization period has been out of changes in key urban sectors like Housing, Transport, Commercial and Information Technology Enabled Services/Business Process Outsourcing (ITES/BPO) segment. The opening up of 100% FDI in real estate has brought in big boom to the industry and was able to attract international private players to invest in Indian cities in joint venture with local partners.

The vested interests in urban development have increased through the route of private sector participation in urban services sector. Privatization has pushed the governments (national, state and local) to withdraw from certain development sectors like housing, infrastructure services including water supply, sanitation, sewage systems, urban transport, tourism, health services, telecommunication and electricity. The demand for infrastructure investment during the 11th Five Year Plan (2007–2011) has been estimated to be US\$492.5 billion (Planning Commission, 2007a). To meet this growing demand, Government of India has planned to raise the investment in infrastructure from the present 4.7% of GDP to around 7.5–8% of GDP in the 11th Five Year Plan. In general, efforts towards infrastructure development is continued to focus on the key areas of physical and social infrastructure. The spatial manifestation of investments and economic change is discernible through continuous or discontinuous sprawl with poly-nodal centers along the corridors.

According to Planning Commission (2007b) during the period 1994–1995 to 1999–2000 the real estate services, housing and construction sector grew by 4.6%. In this, housing sector grew by 2.8% only while the construction sector grew by 6.4%. As per FICCI (2005) the size of the real estate industry in India is around US\$12 billion. This figure is growing annually at a pace of 30% for the last few years. Almost 80% of real estate developed in India, is residential space and the rest comprise office, shopping malls, hotels and hospitals. As per estimates, there is demand for 66 million square feet of IT space over the next five years. On the contrary, as per the Report of the Technical Group on Estimation of Housing Shortage constituted in the context of formulation of the Eleventh Five-Year Plan, housing shortage is estimated to be around 24.71 million. About 99% of such households are from Economically Weaker Section (EWS) and Low Income Groups (LIG).

In Delhi, several new townships consisting of 500–1000 residential dwelling units with quality infrastructure and back-up services and office space have been developed to accommodate the offices of multinationals, airlines, and financial institutions. In Bangalore, at least seven such townships in sizes up to 220 acres have been established during the post-1994 period. Specialized parks for software and technology have come up in Mumbai, Bangalore, Hyderabad, Chennai and Pune.

3.4. *Special Economic Zones (SEZ)*

In 2000, the government replaced the old EPZ (Export Processing Zone or Free Trade Zone) regime by a new scheme of “Special Economic Zones” (SEZs) with several lucrative incentives/benefits that were not available in the earlier scheme. During 2005–2006, exports from functioning SEZs, which are mainly the former EPZs were around US\$5 billion. At present 1016 units are in operation in these SEZs providing direct employment to over 179,000 persons (about 40% of whom are women). Private investment by entrepreneurs for establishing units in these SEZs is of the order of about Rs. 31.63 billion. After the SEZ Act and SEZ Rules came into effect on February 10, 2006, formal approval has so far been granted to 237 SEZ proposals and in-principle approval has been granted to 164 SEZ proposals. Out of the 237 formal approvals, notifications have already been issued in respect of 63 SEZs. In these 63 new generation SEZs which have come up after February 10, 2006, investment of the order of Rs. 111.94 million has already been made in less than one year. These SEZs have so far provided direct employment to 15,097 persons. It is expected that total investment in these SEZs would be around Rs. 584.59 million and 890,700 additional jobs will be created by December 2009. It is also expected that if all the 237 SEZs become operational, investment of the order of Rs. 3000 billion may take place and 4 million additional jobs may be created (De, 2007). The share of the four most industrialized states (Tamil Nadu, Karnataka, Gujarat and Maharashtra) in total SEZ approvals is around 50% (Aggarwal, 2006a).

3.5. *Eco-city initiatives*

Eco-cities are a concept to achieve sustainability by taking the ecological principles as the central driving principles for the planning of our cities (Huang et al., 2002). An Eco-city builds on the synergy and interdependence of ecological and economic sustainability, and their fundamental ability to reinforce each other in the urban context (World Bank, 2010). Eco-city aims at developing an urban ecosystem which is ecologically sound minimizing the negative impact of development on the environment. Eco-city helps in the reduction of ecological footprint of development and achieving environmental sustainability through reduced greenhouse gas emissions, utilization of renewable energy and green transportation. In India discussions on Eco cities started in 2000 and starting 2001 six medium and small Eco-cities were planned by the Ministry of Environment and Forest (MoEF) in association with Central Pollution Control Board (CPCB) and with technical assistance from German technical cooperation (GTZ). The focus of the project is pollution control, improvement of environmental quality, protection of environmental resources like rivers and lakes, improving sanitary conditions, improving the needed infrastructure and creating aesthetic environs in the chosen towns. The cities included Tirupathi,

Vrindavan, Kottayam, Ujjain, Puri and Thanjavur. The Delhi Mumbai Industrial Corridor Development Corporation (DMICDC) has also aimed to develop smart Eco-cities along the Delhi Mumbai Corridor with investment from companies in Japan. The DMICDC and the Haryana State Industrial & Infrastructure Development Corporation (HSIIDC) have planned to develop an Eco-city at Manesar in Gurgaon, Haryana. This is planned as a pilot model, and if it succeeds similar models will be developed in different regions of the country in the future. This has been planned based on the Japanese Eco cities of Yokohama and Kitakyushu (Dhanapal, 2011).

3.6. Urbanization

Urbanization in India is neither unique nor exclusive but is similar to a world-wide phenomenon. Indian urbanization has proceeded as it has elsewhere in the world as a part and product of economic change (Sivaramakrishnan

and Singh, 2005a). The process of urbanization in India is marked by increasing concentration in comparatively larger cities.

According to census 2001, there are 35 million plus cities consisting of 107.9 million urban population constituting nearly 39% of urban population in the country (Bhagat, 2005). The number of million plus cities has increased from 5 in 1951 to 23 in 1991 and to 35 in 2001. The distribution of million plus cities across different regions of the country is shown in Fig. 1. It could be seen that, the million plus cities are fairly uniformly distributed, except in the hilly and desert regions, across the country which is indication of not only the large population of India but also widespread distribution of population concentration and low man–land ratio.

Unlike most developing countries where a single city commands a disproportionately large portion of population and economic activities in relation to the second largest city, India's urban system is spatially dispersed, and not characterized by primacy (Mathur, 2003).

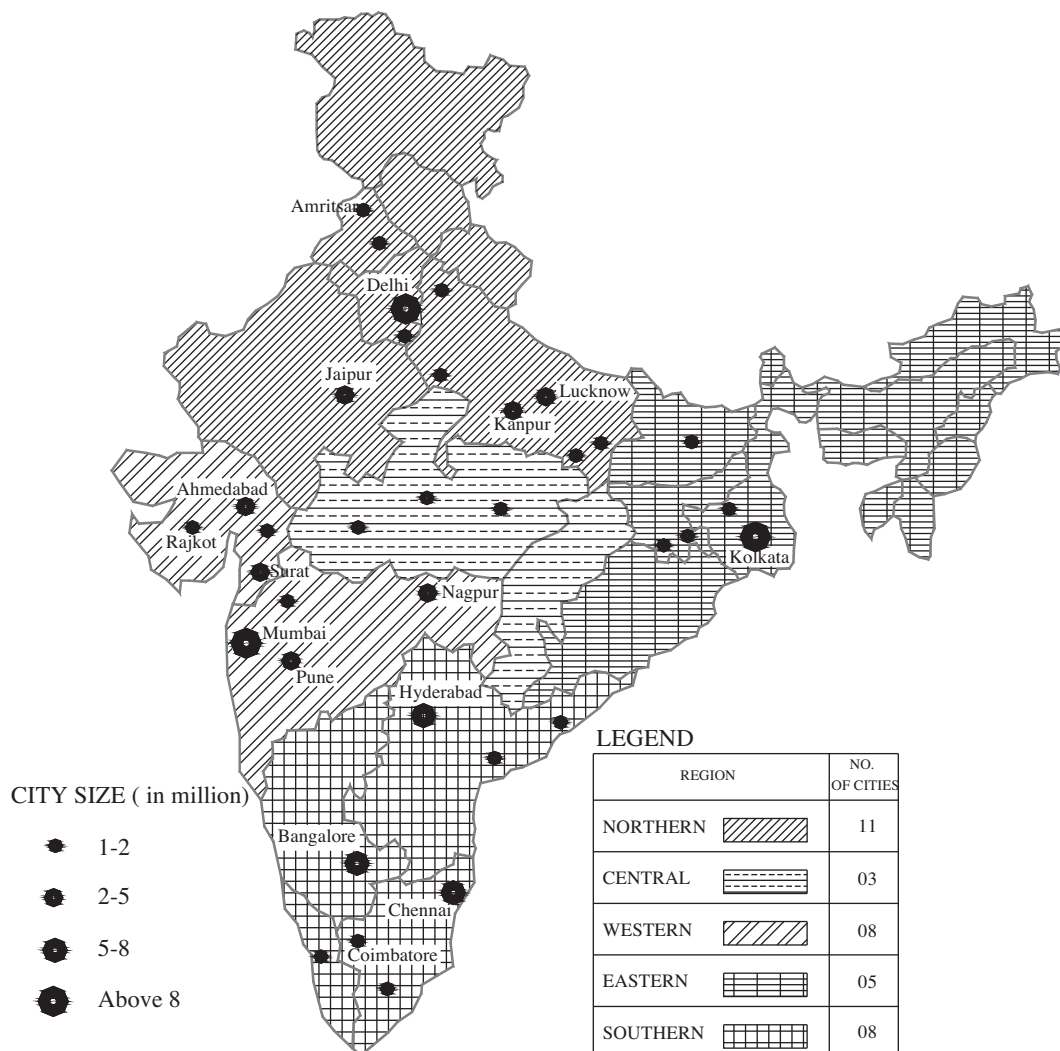


Fig. 1. Distribution of 35 million plus cities across different regions. Source: Author based on Census of India 1971, 1981, 1991 and 2001.

The regional variations in the distribution of urban population are significant. A large proportion of urban population is concentrated in the six most urbanized states, namely, Maharashtra, Gujarat, Tamil Nadu, Karnataka, Punjab and West Bengal, accounting for about half of the country's urban population. According to 2001 Census figures of individual states separately, Goa emerges as the most urbanized state in the country with 49.77% of its population within the urban frame, besides the union capital territory of Delhi and other union territories. However, among the major states, Tamil Nadu has claimed to be the most urbanized state comprising 43.86% urban population, followed by Maharashtra (42.40%), Gujarat (37.35%), Karnataka (33.98%), Punjab (33.95%), and West Bengal (28.03%) (Mathur, 2003).

Emergence of urban corridors, particularly originating from Mumbai, Ahmedabad, Chennai, Bangalore and Hyderabad, linking several important urban centers and

absorbing new investments is an extremely important feature of urban growth of the post-1991 period (Fig. 2). Most of these urban centers are linked with expressways and rail connections. For instance, few of the noteworthy express corridors are Ahmedabad–Vadodara in Gujarat, Pune–Mumbai in Maharashtra, New Delhi–Gurgaon in National Capital Region (NCR), Mohali–Phagwara connecting Amritsar and Jalandhar in Punjab, Bangalore–Mysore in Karnataka and many more in pipeline.

3.7. Urban development policies and programmes

During Post-Economic reforms period, India recognized the need and importance of infrastructure facilities for better living, economic growth, and for making cities competitive in attracting national and global business and investment. Several national level programmes for urban development have been implemented in the recent past,

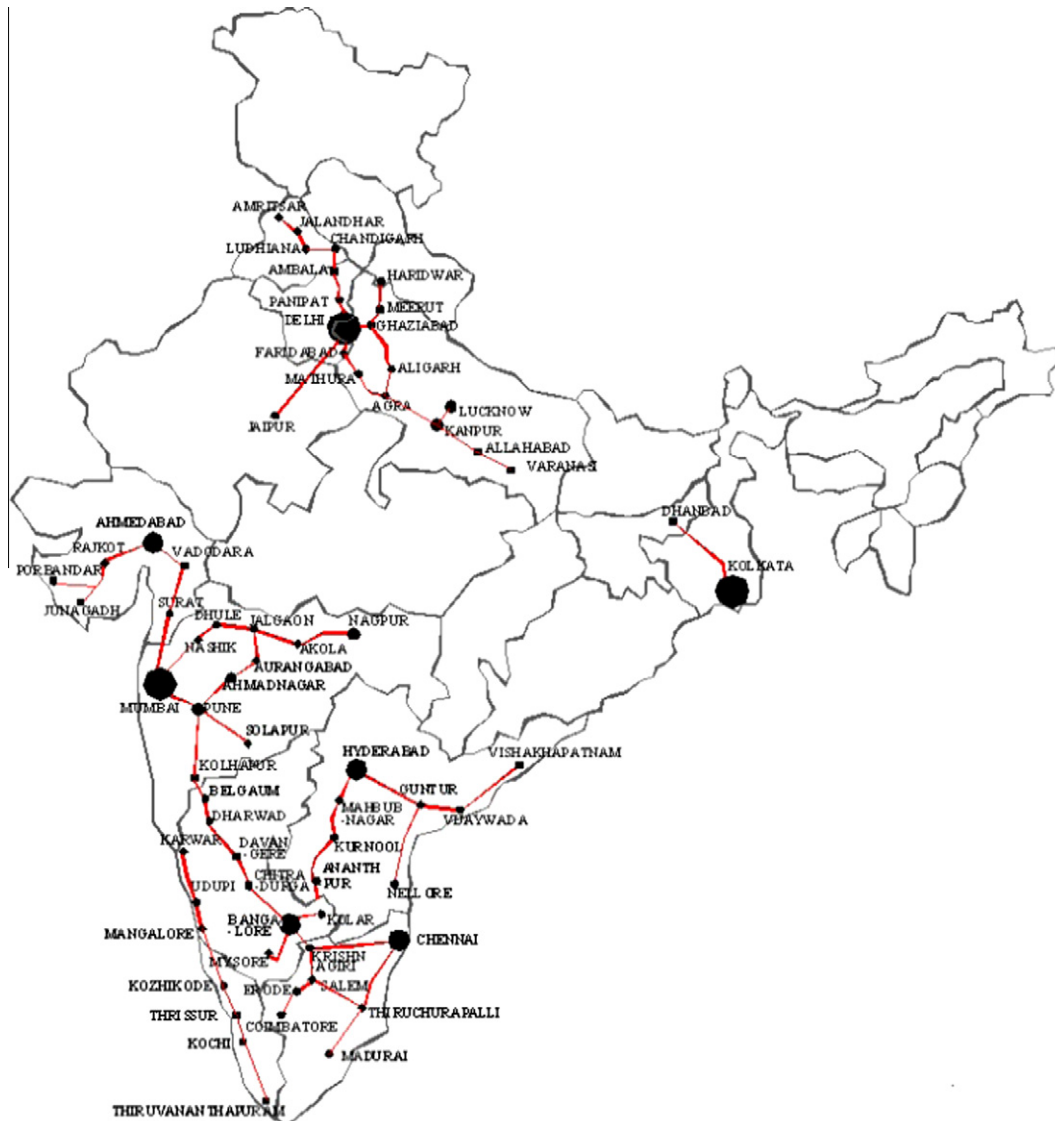


Fig. 2. Urban Transport Corridors and Emerging Conurbations of India. Source: Author based on study by Centre for Policy Research (2001), New Delhi.

viz., Jawaharlal Nehru National Urban Renewal Mission (JNURM), and Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT). The programmes cover all size class of cities and towns in India, and recognize that urban problems are national problems. These programmes make a beginning for a national policy for urban development for the globalizing urban India.

Interestingly, both the programmes comprise mandatory and optional reforms to be carried out by the implementing agencies at the State and urban local body levels. Mandatory reforms are distinguished between State and urban local body levels. Mandatory reforms at urban local levels include levy of user charges such that operations and maintenance cost are fully recoverable within seven years; and introduction of e-governance using information technology for delivery of services and efficiency in collection of property taxes. State level mandatory reforms include repeal or modifications to urban land ceiling and rent control acts. Optional reforms are common for all implementing agencies and include earmarking at least 20–25% of developed land in all housing projects for economically weaker sections and low income group category with a system of cross subsidization; simplifications of land conversion from agricultural to non-agricultural purposes; and computerized process of registration of land and property. In essence, overall urban development is contemplated in formulation and implementation of these schemes with special reference to the needs of the urban poor (Muttur, 2008).

3.8. Dimensions of urban growth trends

A recent study on urban sprawl by Iyer et al. (2007) shows that conversion of open land into non-agricultural land after 1991 is very rapid in Bangalore urban agglomeration (Fig. 3)

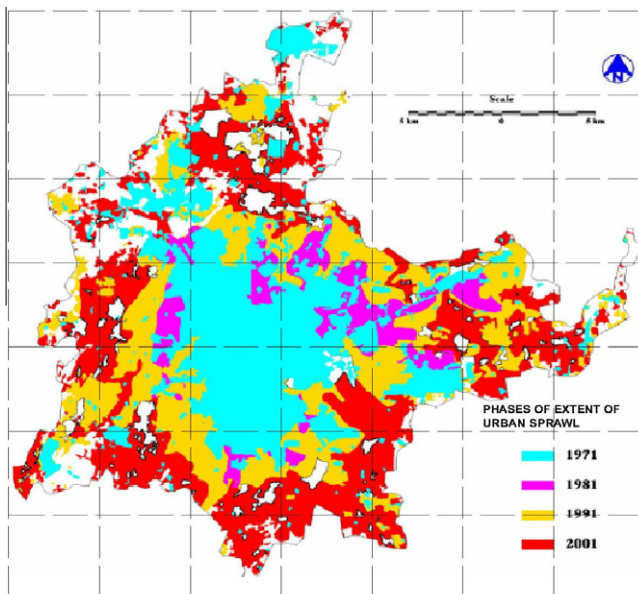


Fig. 3. Urban Sprawl of Bangalore Urban Agglomeration (1971–2001). Source: Author based on Iyer et al. (2007).

Table 1
Distribution of built up densities in Bangalore.

Category	Area (km ²)		Percentage	
	1992	2000	1992	2000
Low density	183.49	310.78	55.71	62.41
Medium density	66.88	109.22	20.30	21.93
High density	78.99	77.94	23.98	15.65

Source: Sudhira and Ramachandra (2007).

evidenced by the increase in the low and medium density areas and decrease in the high density areas in a time span of 8 years between 1992 and 2000 as shown in Table 1 (see Appendix A for facts at a glance of Bangalore).

On the contrary the real estate investment in Hyderabad Urban Agglomeration (HUA) had taken place in the outer areas resulting in the development of scattered built up pockets leaving behind vacant spaces in between (Fig. 4). As the city sprawl increased in dispersed low density pattern, the urban expansion devoured the agricultural lands and water bodies. In Hyderabad, the residential land use of fringe area has increased from 147.03 km² (8.69%) in 1993 to 214.17 (12.66%) in 2000. On the contrary the agricultural and vacant land use has declined from 1209.17 km² (71.45%) in 1993 to 1117.73 km² (66.05%) in 2000 (see Appendix B for facts at a glance of Hyderabad).

In the case of Delhi, between 1974 and 1999, the city has experienced a sprawl development with an increase in population of 4.2 million (Fig. 5). Delhi was able to accommodate this population by losing 60,000 ha of agricultural land (see Appendix C for facts at a glance of Delhi).

Similarly, during the same period, Chennai Metropolitan area (CMA) along with other urban settlements in the hinterland has experienced a rapid pace of urbanization

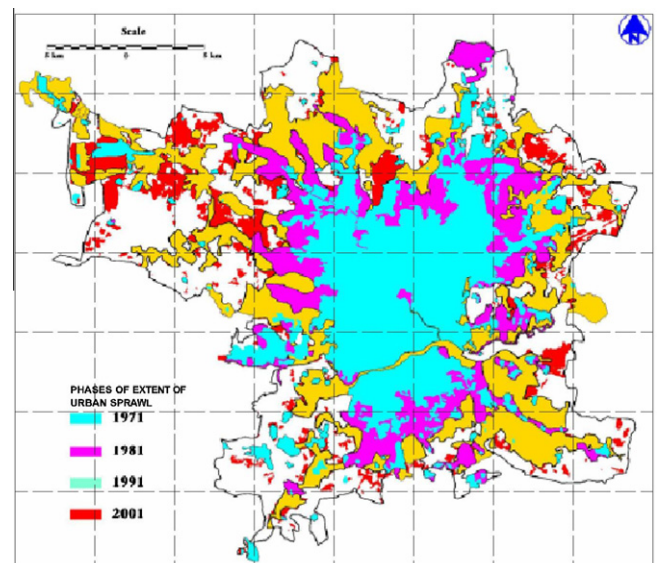


Fig. 4. Urban Sprawl of Hyderabad Urban Agglomeration (1971–2001). Source: Author based on Iyer et al. (2007).

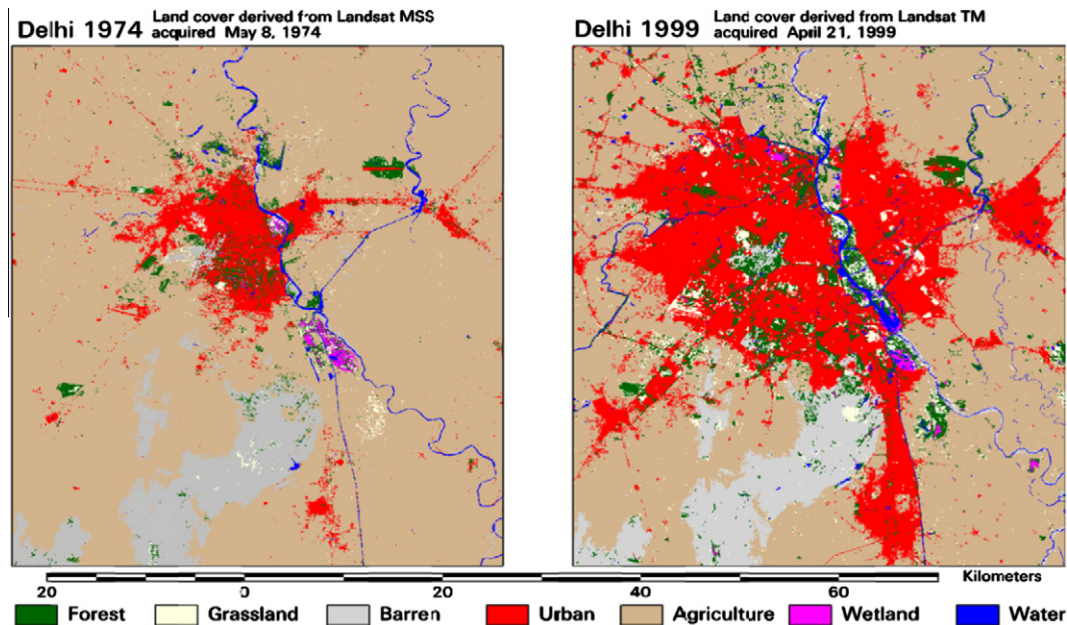


Fig. 5. Urban Sprawl of Delhi Metropolitan Region (1974–1999). Source: Srinivasan and Rogers (2009).

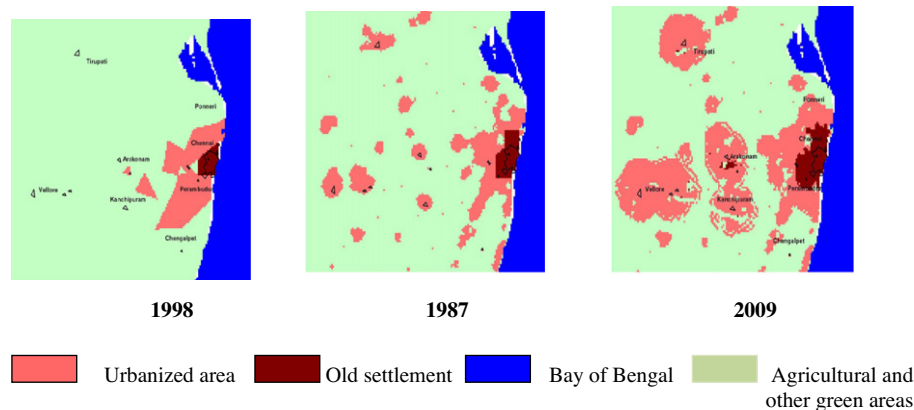


Fig. 6. Urban Sprawl of Chennai Metropolitan area and its Hinterland (1987–2009). Source: Srinivasan and Rogers (2009).

(Fig. 6). In the process, CMA has lost agricultural land from 40,991 ha in 1991 to 22,130 ha in 2004 (CMDA, 2001) (see Appendix D for facts at a glance of Chennai).

3.9. Private townships and housing shortage

The liberalization policy of the Government vide Press Note 4 (2001 series) permitted 100% Foreign Direct Investment (FDI) in Integrated Township Development, that would include all allied infrastructure facilities including roads, bridges, power and telecommunication distribution networks, water supply and sanitation including solid waste management, and other social infrastructure, etc. Depending on the context and state policies, they are popularly known as Integrated/NRI/High-Tech townships. The minimum area under such schemes would be 100 acres with the minimum capitalization of US\$10 million (for a wholly owned subsidiary) and US\$5 million (for joint ven-

tures with Indian partner/s). These private and government agencies approved townships are coming up on the fringe areas and along the transport corridors of the large cities mainly Delhi including NCR, Bangalore, Hyderabad, Chennai, Pune, Ahmedabad and Chandigarh. The development of these townships would mainly include a mix of residential, commercial, corporate and institutional complexes, besides provision of roads, power, water supply, waste management, storm water drainage as also a mix of social infrastructure – medical, community and education facilities. A variety of residential accommodation is made available from private developers operating at large, medium and small scale. The housing development normally includes a combination of different typologies ranging from plotted, group housing, duplex villas, small scale apartments and service apartments. These townships mainly target for high end users and depending on individual state policies, a very small percentage ranging between

10% and 20% is reserved for EWS and LIG households. It is surprising to know that, most of the high end consumers are looking at housing sector as an investment option. As a result of this, the newly added housing stock, in terms of plots and flats, remain vacant.

On the other hand, over the decades, the urban housing shortage at national level has increased from 3.6 million in 1961 to 10.6 million in 2001 (Table 2). According to Eleventh Five Year Plan estimates, there is nearly a shortage of 25 million houses in India, 99% of which is in the category of EWS (Economically Weaker Sections) and Low Income Group (LIG) Societies (Table 3).

The increasing housing shortage, in turn, has contributed to the rapid growth of slum population across metropolitan cities. Growth of slums in India has been at least three times higher than the growth of urban population, leading to sizeable number of urban population living in slums. As per TCPO estimate 2001, 21.7% urban population lives in slums (GOI, 2005). On an average, the percentage share of slum population to the total population in metropolitan cities has increased from 20% to 24% during 1991–2001.

The percentage of population living in slums within Municipal area for key Metropolitan Cities (1991–2001) is given in Table 4.

3.10. Loss of agriculture land for urban development

The per capita availability of arable land in India has decreased from 0.5 ha in 1950–1951 to 0.15 ha in 1999–2000 owing to population escalation and it is further expected to come down to 0.09 ha by 2031 (Balaguravaiah, 2003; Singh, 2006). Total cultivable land has declined to 182.57 million hectares in 2005–2006 from 185.09 million hectares in 1980–1981. The land for non-agricultural uses mainly housing, industry and others (in short, for human settlements) has increased from 9.36 million hectares in 1951 to 22.97 million hectares in 2001, an increase of 2.5 times. It is a paradoxical situation that on the one hand more production is required from the scarce soil resources for meeting the demand of ever-expanding population and on the other hand vast areas are either going out of cultivation or showing reduction in productivity due to land degradation at an alarming rate.

3.11. Zoning, FAR (Floor Area Ratio) and density

All Indian city plans reflect the strict zoning while ground conditions reflect mixed use and multiple uses.

Table 2
Housing shortage (1961–2001) (in million).

Year	1961	1971	1981	1991	2001
Total	15.2	14.6	23.3	22.9	24.7
Rural	11.6	11.6	16.3	14.7	14.1
Urban	3.6	3.0	7.0	8.2	10.6

Source: GOI (2006b).

Table 3

Housing shortage in different income group category as on 2007 (in million).

Category	Housing shortage in million as on 2007	
EWS	21.78	(88.1%)
LIG	2.89	(11.7%)
MIG – A	0.04	(0.2%)
HIG – B		
Total	24.71	

Source: GOI (2006a).

Table 4

Percentage of population living in slums within Municipal area for Key Metropolitan Cities (1991–2001).

City	% of slum population	
	1991	2001
Chennai	17	25.60
Bangalore	12.5	8.04
Ahmedabad	16	25.77
Hyderabad	19.6	17.43
Pune	33.64	40.38
	Avg. 20	Avg. 24

Source: Census of India 1991 and 2001.

The mixed-use concept is at its infancy and is slowly finding its way into the rigid zoning and land use models. Further, the current practice of land use planning focuses on the two dimensional model of the city and misses the third dimension and the temporal dimensions which are crucial for the Indian context (Toutain and Gopiprasad, 2006).

Mohan and Dasgupta (2004) referring to Land policy constraints in India expressed that building byelaws have a significant impact on the form of the city thereby having a comprehensive impact on its economy. Brueckner (2007) referring to FAR (Floor Area Ratio) regulations in Indian context state that maximum FAR values in the central areas of Mumbai, Bangalore and other major Indian cities are much lower than free-market values.

As per 2001 Census and various Master Plan reports, the gross average population density of key metropolitan cities is 195 persons/ha within municipal limits and a mere 25 persons/ha outside the limits within metropolitan area (refer Table 5). The reason for the low density development is that all Indian cities generally follow a very stringent inflexible development controls and building bye laws in terms of zoning regulations, FAR, ground coverage, setbacks and height restrictions, not allowing cities to grow in compact form (Brueckner, 2007).

3.12. Urban transport problems

The rapid growth of India's cities has generated a correspondingly rapid growth in travel demand, overwhelming the limited transport infrastructure (Pucher et al., 2005). The expansion of cities has increased the length of trips for most urban residents, leading to more overall travel

Table 5
Population, area and density of metropolitan cities.

City	City population (lakhs) (P2)	Municipal corporation area (ha) (A2)	Popln. density (P2/A2) within city (in persons/ha)	Metropolitan population (lakhs) (P1)	Metropolitan area (ha) (A1)	Population density (P1/A1) within metropolitan area (in persons/ha)	Population outside municipal limits (P3) P1–P2	Area outside municipal limits (A3) A1–A2	Density of the area outside municipal limits P1–P2/A1–A2 (persons/ha)
Ahmedabad	3,520,085	19,084.00	184.45	4,709,180	133,008	35.40	1,189,095	113,924	10.40
Bangalore	4,301,326	22,606.43	190.27	6,170,000	107,287	57.50	1,868,674	84,680.57	22.06
Chennai	4,343,645	17,600.00	246.79	7,041,000	118,900	59.20	2,697,355	101,300	26.60
Hyderabad	3,637,483	17,200.00	211.48	6,380,000	190,500	33.50	2,742,517	173,300	15.80
Kolkata	4,572,876	19,754.00	231.49	14,720,000	185,141	79.50	10,147,124	16,5387	61.30
Pune	2,538,473	24,396.00	104.05	3,755,525	150,000	25.50	1,217,052	125,604	9.60
Total	22,913,888 (54%)		Average: 195 persons/ha	Total 42,775,705		Average: 48 (persons/ha)	Total 19,861,817 (46%)		Average 25 (persons/ha)

Source: Author based on Census 2001 and Master Plan reports.

demand and thus more traffic on the roadways. The sprawling, low-density development around Indian cities has made cars and motorcycles increasingly necessary to get around, especially given the unsatisfactory alternative of slow, overcrowded, undependable, and dangerous public transport services. At the same time rising incomes among the Indian middle and upper classes have made car and motorcycle ownership increasingly affordable. Moreover, increased trip distances make walking and cycling less feasible than before, thus encouraging a shift from non-motorized to motorized modes (Pucher et al., 2007). The crude oil consumption has increased from 62.9 million tons in 1997 to 103.5 million tons in 2001 registering an annual growth rate of more than 10% and the oil deficit is growing at a rate of more than 18% per annum.

The number of road accidents has increased, from about 161,000 in 1981 to over 400,000 in 2001. The number of fatalities has gone up from 28,400 to almost 80,000 during this period. The fatalities per 10,000 vehicles in India are 21 as against one to two in high-income countries and four to six in some lower income countries. Buses carry more than 90% of public transport in Indian cities. Yet only eight of the 35 million-plus cities have dedicated bus services. Buses themselves are seriously overcrowded, must negotiate extremely congested, narrow streets, with no separate rights-of-way at all, having to fight with an array of mixed modes of traffic including animal drawn carts pedestrians, cyclists, and street vendors (Agarwal, 2006b).

3.13. Assessment of impacts of present growth pattern

It is evident from the above discussion that, LPG process has affected various sectors of the urban system mainly urban land use development patterns, issues related to urban transport and housing. There is a growing concern among the more serious planners about the implications of the impacts of these urban development trends. What do these impact add up to in quantifiable terms? What do these trends mean on consumption of our scarce resources? An attempt is made to project the likely impacts in terms of urban land

consumption, motor vehicle growth, fuel demand, road accidents, slum population growth and urban housing shortage scenario in metropolitan India. For each of the attributes, projection and scenario building work is carried out for the year 2051. Two scenarios are developed, one on the basis of existing growth trends with ‘do-nothing’ and the other with planned intervention by modifying legal provisions and adopting improved technology. The outcome of the projections and calculations are further used as a basis for suggesting an alternative sustainable urban development pattern for future metropolitan cities of India. The methodological approaches followed for projections and scenario building are discussed below in detail.

3.13.1. Projected land consumption for urban development

3.13.1.1. Basis for projections and analysis. Based on Table 5, the existing average gross density for metropolitan cities vary from 195 and 25 persons/ha within and outside municipal limits. Growth trends and population per million plus cities is studied and analyzed based on the secondary source of information referred from Bhagat (2005). According to Ribeiro (2003), the projected population in India in the year 2051 will be 1732 million, out of which 47.5% will be urban, that is 820 million. As per straight line projection method, the total population percentage of million plus cities to total urban population in 2051 will be 68%. This basis is used further to estimate the total number of million plus cities having an average population size of 3.2 million (based on Bhagat, 2005) expected by 2051. The total number of new million plus cities expected by 2051 will be 139 excluding the present 35. Table 5 clearly reveals that, the existing population percentage share of Municipal and outside Municipal limit areas to the metropolitan population is 54% and 46%, respectively. The present pace of urban development in the fringe areas of the metro cities indicates that in the coming decades, they are going to accommodate a major share of the metropolitan area; whereas the capacity of city area to attract population will get saturated. With this assumption, the future land area needs are projected with a reverse scenario considering

the population share of city and outside limits as 40% and 60%, respectively.

3.13.1.2. Calculation of future land area requirement.

3.13.1.2.1. Within Municipal limit (Gross average density @195 persons/ha). Based on the above discussion and referring to analysis done in Table 5, it is concluded that, in order to accommodate 223 million population (40% of total number of million plus cities i.e. 558 million) @195 persons/ha, the total land area required for settlement will be 1,140,000 (A) hectares. The existing area of 35 million plus cities within municipal limits will be 298,974 (B) hectares. The additional land area required to accommodate 223 million population will be 841,026 ha (A and B). This additional land area of 841,026 ha will be made available within the existing municipal limits by extending municipal limits wherever possible in all the directions, redevelopment of existing buildings by increasing FAR and productive utilization of pockets of vacant land. If, on the other hand the gross average density within municipal limit is planned at different higher densities of 400, 600 and 800 persons/ha, the additional land area requirement will be 557,500, 371,666 and 278,750 ha, respectively. Therefore, it is evident from the above analysis that if the future development within municipal limit is allowed to occur @400, 600 and 800 persons/ha (gross density), it will consume only 0.56, 0.37 and 0.28 million hectares of land, respectively, as against consumption of 0.84 million hectares (additional land area) in case of 195 persons/ha. In other words, if the development is allowed to take place @400, 600 and 800 persons/ha (gross density), there will be saving of 33.4%, 56% and 67% of land respectively as against the present growth pattern.

3.13.1.2.2. Outside Municipal limit (Gross average density @25 persons/ha). In this category, projections and calculations are undertaken following similar methodological approach discussed in the above section. It is concluded that, if the present pattern of development is allowed to continue without proper planning, additional area of 11.4 million hectares will be consumed from prime agricultural fields.

If, on the other hand the gross average density outside municipal limit is planned at different densities of 200, 300 and 400 persons/ha, it will consume only 1.67, 1.11 and 0.83 million hectares of land respectively, as against consumption of 11.4 million hectares (additional land area) in case of 25 persons/ha. In other words, if the development is allowed to take place @200, 300 and 400 persons/ha (gross density), there will be saving of 85.4%, 90.3% and 93% of land respectively as against the present growth pattern.

3.13.2. Projected motor vehicle growth

According to statistics provided by the Ministry of Road Transport and Highways (2001), the annual rate of growth of motor vehicle population in India has been about 10% during the last decade. With an assumption that, in the near future till 2051, the motor vehicles will

grow at an average annual growth rate of 10%. From the calculations, it is seen that, by the year 2051 there will be an increase of 329 million vehicle population on roads which is almost six times more from the existing one. If the existing road network is not developed with the same pace, it will lead to serious traffic problem coupled with air pollution.

3.13.3. Projected road traffic fatalities

According to statistics provided by the Ministry of Road Transport and Highways (2003), the number of vehicle population during 1981–2001 have grown more than 10 times. On the other hand, proportionately the number of fatalities has increased more than 2.5 times during the same period. The average decadal percentage increase in fatalities during 1981–2001 is 70%. Assuming that, the decadal percentage increase in fatalities for the next five decades will be @70%. The increase in fatalities per decade @70% will be 56,000. The proportionate sum of fatalities for five decades will be 280,000. Therefore, the total increase in the number of fatalities by the year 2051 will be 80,000 (Existing) plus 280,000. It can be estimated that, for the total projected 329 million vehicle population in the year 2051, the proportionate number of fatalities will be 360,000. This is definitely a mind boggling and unacceptable figure.

3.13.4. Crude oil demand projection

Present crude oil consumption during 2007–2008 fiscal year is 133 million tons/year (Ministry of Petroleum and Natural Gas, 2005). Out of total energy consumption, 30% share goes to Transport sector. Thirty percent of 133 million tons will be 40 million tons (MT). Out of the total transport sector demand, 80% share will be of Road Transport that is 32 MT. Out of the total road transport, 80% share goes to personalized two and four wheelers (cars including jeeps and taxis). The existing vehicle population of two wheelers and cars is 45 million (Ministry of Road Transport and Highways, 2001). The crude oil consumption by the existing 45 million vehicle population will be 80% of 32 MT that is 26 MT. The projected total vehicle population (two wheelers and cars) for the year 2051 will be 273 million (based on author's calculation). The projected annual crude oil demand by the year 2051 from 273 million personalized vehicle population will be 158 million tons (6 times the present level of consumption for personalized motor vehicles.)

3.13.5. Projected increase in slum population and housing shortage

3.13.5.1. Slum population growth. As per the Government of India estimate, the present growth of slum population is at least three times higher than the growth of urban population (GOI, 2005). On the other hand, the projected urban population of India for the year 2051 is 820 million, closely 3 times more than the existing urban population of 285 million (Ribeiro, 2003). Therefore, if the present trend is allowed to continue 'with do nothing', the projected

growth of slum population will be six times more than the existing.

The existing percentage of urban population living in slums is 21.7 (GOI, 2005).

$$21.7 \times 285 \text{ million (existing urban population)} / 100 \\ = 61.8 \text{ million}$$

The projected percentage of urban population living in slums in 2051 will be 61.8×6 times more from the existing = 371 million (45% of total projected urban population of 820 million).

3.13.5.2. Increase in urban housing shortage. As per the GOI (2006a) estimate, the urban housing shortage has increased from 10.6 million in 2001 to 24.71 million in 2007 (more than twice). If suppose assuming, the housing shortage grows in the same manner with a decadal increase of more than double from the existing. The total housing shortage in the year 2051 will be almost 8 times more than the existing.

$$24.7 \times 8 = 198 \text{ million (shortage in 2051).}$$

It is seen from the impact analysis that, if the present pattern of urban development is allowed, to continue in the same manner with do-nothing, it will consume 11.4 million hectares of agricultural land outside municipal limits, there will be increase of 329 million vehicle population on roads, the crude oil demand for transport sector alone will be 158 million tons, road traffic fatalities will increase to 360,000, and the growth of urban slum population and housing shortage will be 371 and 198 million, respectively. Projections clearly indicate that, the present urban growth pattern is most likely to lead to adverse environmental implications and it raises several questions relating to its sustainability.

From the foregoing review and impact analysis of prevailing urban growth pattern of India, particularly of the metropolitan cities experiencing the impact of economic reforms in the post-1991 period, the relevant findings can be summarized as given below.

- i. Occurrence of dispersed and low-density sprawl along transport corridors leading to inadequate and costly infrastructure, which can be solved by redensification, redevelopment and high density compact development.
- ii. Alarming rate of loss of cultivable agricultural land for urban expansion, which can be prevented and large quantities of fertile land conserved by adopting high density development.
- iii. New urban extensions occurring at low densities and in such patterns making it unviable for public transport.
- iv. Increasing ownership of private motorized vehicles causing traffic congestion, delay and pollution. The only way to avoid the undesirable and unsustainable

growth of private modes of transport is to develop cities and city extensions oriented to public and sustainable modes of transport.

- v. Prescription of low FARs and other housing policies making adequate housing unaffordable to large sections of metropolitan households. An alarming urban housing scenario of 'sprawling slums', housing shortage and cities full of shelter less population can be prevented by making appropriate changes in relevant Institutional mechanisms and legislative measures including development controls, zoning and building byelaws.

4. Conclusions

In order to preserve, the loss of fertile agricultural land and to make available, affordable housing units with efficient public transport accessibility, it is imperative to evolve and adopt an alternative sustainable urban development pattern. The sustainable urban development concepts like Compact city, New Urbanism, Transport Oriented Development and Smart Growth which have evolved in response to the increasing need for a resource-conserving, sustainable, and people-centric city, have already found enthusiastic supporters among governments, urban development agencies, planners and urban designers in many parts of the world outside India. These diverse approaches share the important characteristics of compact, mixed use development, pedestrian and bicycle friendly environment, walkable communities and transit-based development. An alternative sustainable urban development pattern for future metropolitan cities of India need to be developed by combining and suitably modifying the underlying principles of various concepts of sustainable urban developments which could be summed up as given below:

- Adopt, with suitable modifications for Indian situations, "Traditional Neighborhood Design" that provides more livable and walkable neighborhoods' in a more pedestrian friendly environment. Create and maintain aesthetically appealing, functionally efficient and healthy built environment, which is designed to the last possible detail – "New Urbanism"
- Create a "mixed-use community that encourages people to live near transit services in sufficient density to make public transport viable and attractive to decrease their dependence on driving. Provide high capacity, high speed, multi-modal and multi-level transport corridors connecting cities – "Transit Oriented Development" (TOD).
- Adopt appropriate, innovative planning and development strategies, and urban design techniques to make cities conserving and efficient in resource use. Develop a variety of housing types which will provide affordable choices for families and individuals, of diverse

socioeconomic strata. Enforce conservation of agricultural land by containing urban expansion through appropriate development controls and zoning regulations – “Smart Growth”.

- Compact, high density, mixed land use development in terms of walkable, bicycle-oriented and anthropo-centric communities which are safe, secure and universally accessible and where all community facilities are available within easy accessibility – “Compact City”.
- Maximize the accessibility of an area to people of different sexes, age groups, abilities and economic class. Create economic opportunities particularly for the people of EWS and LIG strata by facilitating and integrating informal sector activities at sector and city levels – “Inclusive Design” or “Universal Design”.
- Use indigenous resources and technological mixes that respect and emulate the natural ecosystems and respect local social and cultural patterns in achieving self-sustainability. Develop a city of human scale, slow intra-city and rapid inter-city transportation, multi-functional economic base, self-sustainability in basic and other needs, and integration of resource conservation measures in settlement development at all levels. Decentralize infrastructural development and maintenance functions of the city making the best possible use of resources and technology options available and involving community participation – “Eco-Development”.
- Design streets to accommodate variety of transport modes and activity patterns and sustainable transport management. Use diverse modes of slow and medium speed transport within and between communities including walking, cycling, and other environment friendly para- transports, LRTS and BRTS – “Traffic Calming and Sustainable Transport Management”.
- Integrate urban and rural lifestyles into a symbiotic, inter-dependant and holistic system through integration of land use and transportation, planning and design, and functional efficiency and aesthetic appeal – “Synergic Development”.
- Encourage urban development and life style incorporating and utilizing the benefits of ICE technologies and e-governance and replacing and reducing dependence on transport-based lifestyles and development – “ICET and e-Governance Based Development” and “Connected Urban Development”. (CUD).

Based on the projections and calculations worked out for different attributes in the foregoing discussion and analysis of empirical studies on various concepts of sustainable urban developments outlined above, a set of detailed planning and development guidelines for new urban extensions of existing cities and new cities could be evolved to make future urban development sustainable environmentally, socially and economically.

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Appendix A. Facts at a glance of Bangalore

Land area	Municipal corporation area: 22,606.43 ha Metropolitan area: 107,287 ha Area outside Municipal limits: 84,680.57 ha
Population (2001 census)	Municipal corporation area: 4,301,326 Metropolitan area: 6,170,000 Area outside Municipal limits: 1,868,674
Density	Municipal corporation area: 190.27 persons/ha Metropolitan area: 57.50 persons/ha Area outside Municipal limits: 22.06 persons/ha
Slums	Slum population as % of total population 8.04%
Public transportation	Buses are the major form of public transport in Bangalore. The metro is being developed.
Vehicular population	Registered vehicle in 2005: 3 million Two wheeler: 1,896,907 Light motor vehicle: 405,622 Auto rickshaw: 81,502 HTV: 24,126 HGV: 97,801 Others: 11,407
Land use	Land use 2003
	Residential 37.91%
	Commercial 3.04%
	Industrial 13.96%
	Open spaces 3.11%
	Public and semi-public uses 11.05%
	Public utilities 0.59%
	Offices & services 1.01%
	Transport & communication 20.96%
	Unclassified 8.37%

Appendix B. Facts at a glance of Hyderabad

Land area	Municipal corporation area: 17,200.00 ha Metropolitan area: 190,500 ha Area outside Municipal limits: 173,300 ha
Population (2001 census)	Municipal corporation area: 3,637,483 Metropolitan area: 6,380,000 Area outside Municipal limits: 2,742,517
Density	Municipal corporation area: 211.48 persons/ha Metropolitan area: 33.50 persons/ha Area outside Municipal limits: 15.80 persons/ha
Slums	Slum population as % of total population 17.43%
Public transportation	The major role is played by bus transport. Rail based Multi Modal Transport System (MMTS) is also present. Three and seven seated autos acting as the Para transit
Vehicular population	Motor cycles: 856,397 Motor cars & jeeps: 126,472 Autos: 58,851 APSRTC: 2395
Land use	Existing land use 2001 (non-fringe area)
	Residential 43.57%
	Commercial 11.94%
	Manufacturing 1.78%
	Public-semi public 13.6%
	Open spaces 4.42%
	Agricultural & vacant land 11.65%
	Forest 0%
	Water bodies 5%
	Transport & communication 7.81%

Appendix C. Facts at a glance of Delhi

Land area	1483 km ²
Population (2001 census)	13.78 million
Density (NCT)	92 persons/ha (Gross)
Slums	35%
Public transportation	The major role is played by buses and MRTS has been introduced. BRTS projects have also been launched.

Vehicular population

Four wheeler , three wheeler and two wheeler: 32.38 lakhs
Buses: 41,483

Land use (2001)

Residential	44%
Commercial	2%
Industrial	5%
Public and semi public	15%
Recreation	24%
Transport	8%
Railways	2%
Agriculture	0.3%

Appendix D. Facts at a glance of Chennai

Land area	Municipal corporation area: 17,600.00 ha Metropolitan area: 118,900 ha Area outside Municipal limits: 101,300 ha
Population (2001 census)	Municipal corporation area: 4,343,645 Metropolitan area: 7,041,000 Area outside Municipal limits: 2,697,355
Density	Municipal corporation area: 246.79 persons/ha Metropolitan area: 59.20 persons/ha Area outside Municipal limits: 26.60 persons/ha
Slums	Slum population as % of total population 25.60%
Public transportation	Buses and suburban train form the major public transport. Metro services are also there. Share autos, auto rickshaw are other form of public transport. There are proposals for BRTS, MRTS and monorail
Vehicular population	1,519,357 (2007)

Land use	Chennai City	Rest of CMA
	Residential	54.25% 21.87%
	Commercial	7.09% 0.37%
	Industrial	5.17% 6.28%
	Institutional	18.48% 3.01%
	Open space & recreation	2.09% 0.19%
	Agricultural	0.57% 11.92%
	Non urban	0.47% 2.33%
	Others (Vacant, Forest, Hills, Low lying, Water bodies, etc.)	11.89% 54.03%

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