ECONOMY, POPULATION AND URBAN SPRAWL A COMPARATIVE STUDY OF URBAN AGGLOMERATIONS OF BANGALORE AND HYDERABAD, INDIA USING REMOTE SENSING AND GIS TECHNIQUES

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Abstract : *In India, big cities and urban agglomerations have been the magnets that attract investment, which leads to development of industrial and service sector, employment generation, migration and population growth. Expanding industries like manufacturing, construction, trade and service of all kinds opens avenues of employment and has become the pull factor for the ever-increasing migration. The present study brings out the association between investment patterns, economic activities, migration, and land use changes in urban agglomerations of Bangalore and Hyderabad (1971-2001), to bring out the population aspect and its effect on land use in spatial perspective using Remote Sensing and GIS Techniques.*

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1. Introduction

A variety of factors affect the supply of and demand for the land and its uses in an urban area. Supply is affected by such factors as location, laws related to land, structure of land, transportation facilities, market facilities, industrial development, investment pattern, management etc. However the ever increasing population influx in the urban areas and the physical expansion of the built up area beyond the city limits are envisaged as important factors for raising the demands for more land as well as land use changes.

Government and private sector decisions change the economic structure of the city and also industrial location. This in turn acts as the pull factor for the migrants not only from the rural areas but also from the other urban areas. The resultant changes in land use are also to be noted for the future development of the areas. The employment potential of the region, the carrying capacity and the surplus it can generate determines the patterns of migration flows. The question whether population change and migration will lead to land use changes is important for India's urban future.

2. Review of Literature

In earlier land use studies, more emphasis has been placed on the economic determinants than on other factors (Alonoso, 1964). Land use studies have to an extent ignored the effect of the migration patterns. The population research pertaining to migration characteristics has concentrated mainly on the pattern and characteristics of the migrants. The subsequent consequence on the land use pattern has not been touched upon in detail. Pioneering work on land use studies in India were Shafi (1960, 1984), Singh (1974, 1976), Garg (1969), Bhatia (1970), Bharadwaj (1971) and Joshi (1972) have covered the aspects such as land utilization and regional imbalances as well as relationship between population and land use. Recently India has participated in a comprehensive three country project (National Science Academies of USA,

2000) which studies the relationship between population and land use through investment economic structure and policies. (Kulkarni, 2000)

As far as the urban studies are concerned a number of city surveys sponsored by the Research Programmes Committee of the Indian Planning Commission during the 1950's and the early 1960's described the growth of the selected cities during the first half of this century, the pattern of in migrants and the characteristics of the in migrants Some other important studies relating to the migrants to the cities have been conducted by Rao and Desai (1965) on Delhi, Mitra (1963, 1970) on Calcutta and Delhi respectively, Chauhan (1966) on Agra, Lakdawala (1963), Zachariah (1968) and Gore (1970) on Mumbai. Some studies explaining relation between investment pattern, migration and industrial structure was examined by Mathur (2005), S. Mukherji (1976) and Asok Mitra, S. Mukherji and Ranendranath Bose (1980). Premi and Tom (1983) conclude from their study that migration in the cities can best be explained by the characteristics of those cities themselves in terms of functional specialization, location in relation to various resources, industrial development and the consequential employment opportunities created.

Study by Manzoor Alam and W. Khan (1972) is the first attempt in India to study a metropolitian center in a regional context. It analyses demographic and economic profile of the region and brings out the imbalances and outlines a strategy for its development. It examines the planning and development problems of Hyderabad – Secunderabad city. Based on the primary data by conducting a household survey, supplemented by secondary data, the study by Prakash Rao and Tiwari (1979) provides information on the socio-economic-demographic structure of Bangalore in spatial perspective. It not only provides valuable insights for urban planners but also provides a methodology for micro-urban analysis. Sita and Bhagat (2003) have examined the effect of government and private investment decisions on the urban scenario of Maharashtra especially neighboring districts of Mumbai. In another study Sita (2006) has examined the functional land scape of Mumbai in the recent context of new economic policy.

The major break-through in the field of land use studies came due to the development of ***Remote Sensing Technology*** since 1980's. Land use studies up to late 60's and early 70's have been based on conventional surveys which are very expensive and time consuming. But Land use / land cover changes are dynamic in nature and have to be monitored at specific intervals. The remotely sensed data from space borne sensors provides repetitive coverage and data in digital form which are amenable to computer analysis using GIS. Development of Remote Sensing technology opened up the opportunity for measuring the dynamic land use changes with greater precision and study their relationship with population and other related factors.

The first comprehensive land use classification system for aerial photo-interpretation was developed by Anderson in 1971. The significant contribution in this respect has been made by the Human Settlement Analysis Group (IIRS/NRSA/DOS) for Jaipur, Coimbatore, Ujjain, Delhi, Kanpur, Dehradun, Lucknow, Bhubaneswar, Bangalore and Jammu. Similarly Space Application Centre (SAC/ISRO/DOS) has undertaken the land use mapping for Mumbai, Ahmedabad, and Calcutta and National Remote Sensing Agency (NRSA/DOS) for Chennai and Hyderabad (Pathan et.al, 1989, 1991 & 1992; NRSA, 1990 & 1994; Raghavaswamy et.al, 1994). The growth of Bangalore City has been analyzed using historical maps and remote sensing Imagery by Bahera (1985). Urban land use mapping has been done for Hyderabad and its surroundings by Prasada Raju (1988). National Remote Sensing Agency has carried out the urban mapping and change analysis for Greater Mumbai (NRSA, 2002, 2005). National Remote Sensing Agency (NRSA/DOS), in a joint project with Hyderabad Urban Development Authority, carried out land use and base mapping for the HDA area using Remote Sensing and GIS Techniques (HUDA, 2003). Bangalore Urban District land use mapping and change assessment was carried out jointly by Indian Space Research Organization (ISRO/DOS) and Karnataka State Remote Sensing Agency (1996 – 2002) as a proto type study for Natural Resources Census (ISRO/KSRSAC, 2005).

3. Need for the Study

In India, big cities and urban agglomerations have been the magnets that attract investment, which leads to development of industrial and service sector, employment generation, migration and population growth. This process has significant implications in terms of land use changes especially in the context of privatization and globalization. Review of earlier work shows that separate studies are there pertaining to migration and land use, but very few studies the association between the economic activities, migration, and land use changes, to bring out the population aspect and its effect on land use. Secondly, a study on the linkage concentrates mainly on cities and very few have taken urban agglomerations. This study proposes to take care of these lacunas, by covering changes in population structure, migration & land use and study their association in spatial perspective.

4. Study Area

Taking into account the recent context of globalization and IT Boom, it was thought appropriate to select Urban Agglomerations (UA) of Bangalore and Hyderabad as study area since they have emerged as the new magnets for migrants and offering competition even to cities like Mumbai in attracting inflows from all over the country, especially in recent times due to the coming of age of Information Technology (IT) which, today is the prime driving force, fuelling the growth of the cities (**Figure 1**).

Bangalore Urban Agglomeration (BUA) extends from 12°50’26” to 13°08’58” N Latitude and 77°27’54” to 77°46’44” E Longitude covering an area of around 500 sq km (2001). The population of Bangalore Urban Agglomeration stands at 5.70 million as per 2001 census records. Hyderabad, the administrative capital of Andhra Pradesh, has established itself as a centre for sunrise industries such as Information Technology and accounts for 10% of IT exports of the country. Hyderabad Urban Agglomeration (HUA), the fifth largest metropolis in India, extends from 17°15’29” to 17°33’40” N Latitude and 78°15’04” to 78°37’30” E Longitude covering more

than 775 sq. km area and is currently home to over 5.75 million persons**.** The Urban agglomeration boundary had been taken following the Municipal boundary and its contiguous out-growths (OGs) of 2001.

5. Objectives

1. To analyze and compare the changes in Bangalore UA and Hyderabad UA with respect to following dimensions
    a. Demographic Scenario : Population Growth, Major Characteristics, Spatial Distribution
    b. In Migration : Magnitude Growth, Major Characteristics, Reasons for migration
    c. Land Use : Land Use Pattern, Urban Sprawl and change

6. Data Sources

1. For Population : Census of India: State Reports for Karnataka and Andhra Pradesh, Primary Census Abstract, Town Directory, Migration Tables.
2. For Land Use : Survey of India Toposheets (1971); Satellite Data of Landsat Multi Spectral Scanner (MSS) (1981); Landsat Thematic Mapper (TM) (1991); Landsat Enhanced Thematic Mapper (ETM) (2001) ; Published Maps/ Reports of Hyderabad Urban Development Authority (HUDA) and Bangalore Development Authority (BDA)

7. Methodology

The conceptual framework is shown in **Figure 2**. For studying the objectives 2a & 2b the following indicators for 1971, 1981, 1991 and 2001 are analyzed mostly by using bivariate tables for both Urban Agglomerations (UA)

A] (i) Population Size; (ii) Decadal Growth Rate of Population; (iii) Density; (iv) Sex Ratio; (v) Literacy Rate; (vi) Young and Old age Dependency Ratio; (vii) Median Age; (viii)Percent Share

in Other Workers; (ix) Work Participation Rate; (x) Sectoral Distribution of Workers by Industrial Classification.

B] For Total, Intra-district, Inter-district, Inter-state and International Migrants, with duration less than ten years for Urban Agglomerations : (i) Size; (ii) Growth Rate; (iii) Percent Urban of Origin; (iv) Sex Ratio; (v) Educational Attainment; (vi) Reasons for Migration; (vii) State of Origin of Migrants.

C] For the Objective 2c for examining the land use changes Remote Sensing Data interpretation has been done using ERDAS Imagine (Version -8.7) Image Processing software. Analysis has been carried out in GIS Domain using ESRI-ARC GIS (Version-9.0). Ground Truth data collection and Field verification has been done for the two study areas to strengthen the classification accuracy. Spatial thematic Maps pertaining to the land use for the years 1971, 1981, 1991 and 2001 has been prepared for the two urban agglomerations. The urban sprawl and land use change detection analysis/ mapping has been carried out.

8. Analysis and Findings

Demographic Scenario

- Both the urban agglomerations, Bangalore BUA and Hyderabad (HUA) had population of about 5.7 million in 2001 but HUA h area (778 sq. kms) is more than one and half times that of BUA(492.5 sq. kms.) Both are today considered to be the leaders and ‘crowning glory ‘of India’s IT sector and having the potential to become global cities.

- Both the cities have history of more than 400 years. Starting from the humble beginnings as small trading centres they flourished as capitals of the kingdoms of different rulers: Bangalore under Kempegowda, Odeyars later under Hyder Ali and Tipu sultan; Hyderabad under Nizam.

- Establishment of military cantonment and construction of railway lines linking them to Bombay, madras etc. were major developments under British rule for further growth. It was after

the formation of State's Re-organization on linguistic basis in 1956 that both became the capitals of the respective states, Mysore (Karnataka) and Andhra Pradesh and planning process for the development of these metropolitan areas gathered momentum.

- Today after 5 decades both are on the way to become a global city due to concentration of microelectronics, telecommunications and software engineering firms linked to global pattern of industrialization. The transition can be better understood by reviewing the historical factors and major landmarks in terms of policies adopted and the institutional structure created in both the UAs

Economic Structure and Recent Investment Trends

- Bangalore and Hyderabad UA contribute 23 and 14percent respectively to the total no of non-agricultural workers in their states.

- During 1971-2001, work participation rate of Bangalore UA increased (30 to 36) but that of Hyderabad UA remained the same at 28.Increase in work participation rate in Bangalore UA is due to increase in both city area and non-municipal corporation area while stability of Hyderabad UA WPR is due to stability in the core city area inspite of the decline in non-municipal corporation areas.

- Trade & commerce and Construction recorded the highest growth rate (13-14%) in non-municipal areas of both UAs and also manufacturing sector of non-municipal areas of Hyderabad UA.

- There is evidence of **diversification of economies** of both the UAs and **spread of economic activity to non-municipal areas** as revealed by the following findings

- Both the UAs are predominantly tertiary function UAs, Hyderabad being much more so (2/3s 0f workers) than Bangalore(more than half the workers)

- Both have experienced decline in tertiary sector during 1971-91, mainly due to decline in "other services' category and in spite of notable increase in 'trade and commerce'.

- Both experienced during 1971-91, increase in secondary sector activity mainly due to expanding construction sector. Manufacturing sector of Bangalore UA (1/3rd of all workers) in 1991 is larger than Hyderabad UA (1/4th of all workers), though from 1971, it remained stable in Bangalore UA but increased moderately in Hyderabad.

- Trade and commerce and construction sector has grown substantially in both UAs- in city core area as well as in non-municipal areas, especially in the cantonment area of Hyderabad.

- Primary sector of non-municipal areas of Hyderabad UA (11 percent) even in 2001 is double that of Bangalore (5%), in spite of spectacular decline since 1971 from 22percent to 11 percent.

- Further evidence of decentralization of economic activity to peripheral areas is revealed by substantial decline in the share of city area in the total workers in each sector in both the UAs. The process is much more pronounced in Hyderabad U A than in Bangalore UA as shown by steeper decline in the workers percentage share of city area in each sector

- Decline in the share of workers in city area for Bangalore UA for different sectors is less than 20 percentage points (except primary sector 21 points) while for Hyderabad UA, it is 26 and 32 points in construction and Manufacturing sector.

- Growth rate of employment in non- municipal corporation areas has been higher than that of city area in case of both the UAs in all the three decades but the big leap in non city areas is much higher in the middle decade, followed by decline in non-municipal areas of both UAs in the last decade. The leap as well as decline is more sharp for Hyderabad UA

- In both UAs growth rates of employment in non-municipal areas. During 1971-91 for most of the sectors are higher than that of municipal areas (about 4 times those of city area in Hyderabad but for Bangalore about double)

- Unlike Bangalore , Hyderabad city records negative growth rates for 2 sectors – primary sector and household industry accompanied by rapid growth of these sectors in non- mc areas

- Trade & commerce and Construction recorded the highest growth rate(13-14%) in non-municipal areas of both UAs and also manufacturing sector of non-municipal areas of Hyderabad UA

- Taking into account share in the total employment as well as growth rate of employment the following are likely to be potential sectors of growth in the components of two UAs

  - BUA MC area – construction, trade & commerce, other services
  - BUA Non-MC area - construction, trade & commerce, transport & communications.
  - HUA MC area : trade & commerce
  - HUA Cantonment area. trade & commerce, manufacturing
  - HUA Non-MC area —manufacturing

Migration to Bangalore and Hyderabad Urban Agglomerations

Due to the economic diversification discussed above both UAs emerged as strong magnets for migrants within and outside the respective states**.** Analysis of **I**n migration , based on data regarding place of last residence with 10 years or less duration of residence in Bangalore and Hyderabad available in the 1981,1991,2001 Census of India, reveals that—

- Total number of migrants to Bangalore UA doubled during the 3 decades from about 6 lakhs during 1971-81 to 12.6 lakhs during 1991-2001 while in case of Hyderabad UA it trebled - from 3 lakhs to 9 and half lakhs.

- Importance of migration as a component of decadal growth (during 1971- 81 compared to 1991-01) has substantially improved in both the UAs. – From 47percent to 78percent for Bangalore UA and from 39 percent to 71 percent for Hyderabad UA.

- During all the 3 decades, for Hyderabad UA, inter-district migration has contributed more to the decadal growth than the other types of migrants while for Bangalore UA the contribution of both inter-district and interstate migrants has been equally important. International migrants are less than one percent of all migrants in both the UAs during the 3 decades

- In both the UAs, nearly one fourth of all migrants came for employment during each of the 3 decades , except that the proportion was less for BUA during the last decade (18%).

- During the last decade, share of migrants coming for education has reduced to nearly half its share in the first 2 decades (from 8to4percent in BUA and from 6 to3percent in HUA).

- More and more rural persons have been migrating recently to both UAs. Among inter-district and interstate migrants who came for employment, percentage coming from urban areas has drastically declined in case of both the UAs

- Among migrants who came for education, percentage coming from urban areas has increased substantially among interstate migrants to Bangalore UA and marginally increased among inter-district migrants to HUA and drastically declined among interstate migrants to Hyderabad UA.

- Migration of almost all types (by area of origin) has become more male dominated leading to lower sex ratio among migrants to both BUA and HUA, except interstate migration to HUA. Migration for education and employment continues to be heavily male dominated. In some educational categories , however, over the 3 decades, it has become less male dominated e.g. illiterates and literate but below SSC in both the UAs.

- Migration from U.P., West Bengal and Bihar to BUA and from Orissa and Bihar to H UA during the last decade was extremely male dominated (sex ratio 500-609). Migration to HUA from Maharashtra and Kerala during the last decade was female dominated (sex ratio 1037 and 1200 respectively).

- In case of BUA, percentage of migrants from Tamil Nadu had a drastic decline. In case of HUA, migration from all the neighboring states Tamil Nadu, Kerala and Maharashtra declined. Census 2001 shows that nearly 30percent migrants to HUA come from Northern and Eastern states while for BUA, their share in migration is still only 18 percent (**Figure 3, Figure 4**).

Population Growth and Change in Spatial Distribution

Migration on such a large scale is expected to change the demographic scenario in terms of size, growth rate, characteristics, and age structure. It can also change the spatial distribution as migrants are likely to settle in the peripheral areas.

- Both the UAs now have the same population size (57 lakhs in 2001) but in 1971, the population of HUA was bigger than BUA by 1.5 lakhs. During the last 3 decades, population of BUA increased more than 3 and ½ times while that of HUA increased slightly more than 3 times.

- BUA experienced rapid population growth during 1971 -81 while HUA had such phase a decade later. In the following decade however the growth rate of HUA drastically declined (2.81%). BUA experienced the decline in growth rate also a decade earlier (81-91)but during the last decade it is growing at a faster rate than HUA.(3.22).

- HUA area is 1 and1/2 times the BUA area. During the last 3 decades, both have expanded 2 and ½ times indicating the same extent of urban sprawl. BUA is much more densely populated (11546 per sq. km.) than HUA (7391 per sq. km.). Even in 1971, density of BUA was more than 1 and ½ times that of HUA.

- Sex ratio in both the UAs has been unfavorable to females but it is more so in BUA than HUA (908 and 931 respectively.) Three decades back it was more unfavorable in BUA (874) indicating that earlier more males were migrating without family and over the year's female migration and /or migration of males with family has increased.

- Literacy rate in Hyderabad has been throughout lower than that of Bangalore UA (68 and 75 percent in 2001).

- Three decades back 90 - 92 percent population of both the UAs lived in the city area (Municipal Corporation) but in 2001 only 75percent of the BUA population and 63percent of the HUA population lives in the city. Population growth rate of non- MC areas was very high during 1971-81 for BUA (13percent per annum) and during 1981-91 for HUA (16 %).

- Population share of non –MC areas in BUA has increased only 3and ½ times during 1971 - 2001 but the share of non-MC areas excluding cantonment area of HUA has increased 6 times. In 2001 more than one third of HUA population lived in non-MC areas.

- In both the UAs, share of aged population has increased 3 times in the last 3 decades (from about 2 percent to above 6%) while the share of child population (0 -14) declined from 19percent to 13percent in BUA and from 20percent to about 15percent in HUA. Decline in overall dependency ratio is marginal in HUA, (44 to 43) but more in BUA (from 42 to 39).

Land Use Changes and Urban Sprawl

Large scale changes in economic structure, the in-migration resulting into population growth/changes in the population composition and spatial distribution are likely to affect the pattern of land utilization as per the changing needs of the different economic activities and people. Remote Sensing and GIS Techniques have been used for land use spatio-temporal analysis. **Figure 5**, **Figure 6** shows the land use/land cover details of Urban Agglomerations of

Bangalore and Hyderabad respectively for the year 2001. Urban Sprawl Maps were also prepared for Bangalore UA (**Figure 7**) and Hyderabad UA (**Figure 6**) for the period 1971-2001.

- In both the urban agglomerations, decrease in agricultural land suggested both conversion of land to urban land use or discontinuation of agricultural activities in anticipation of conversion to urban areas. This is resulting in such lands being left undeveloped as vacant land or converted into layouts for considerable period of time to speculate higher land values.

- The urban growth not only explains the increase in urban built-up area and population but also the continuity of trend with much more accelerated pace since Bangalore and Hyderabad qualified as Mega City.

- In 1971 half of Bangalore UA land was crop land and 8percent was scrub land and grasses. The situation in Hyderabad UA was opposite 56 percent scrub land and 6 percent crop land.

- Over 3 decades 1971-2201, crop land proportion in BUA declined gradually in the first decade to 47percent drastically in the 2nd decade to 11percent and further to 8percent in 2001.

- The Scrub land declined only marginally. On the contrary in HUA the scrub land declined gradually in the first decade to 46percent and then drastically to 4 and 2 percent in the next two decades while crop land increased almost one and half times from six to nine percent.

- Due to clearance of cropland after 1981, the open land in Bangalore increased from 6 percent to 29 percent in 1991. There after it was utilized for non-agricultural uses and declined to negligible proportion. On the contrary in HUA, due to clearance of scrub land after 1981, open land increased to 26 percent in 1991. There after due to utilization for non-agricultural open land declined to 17 percent. It implies, that conversion of open land into non-agricultural land after 1991 is much faster in BUA than in HUA.

- As a result of utilization of Land for non-agricultural purposes (residential and commercial), percentage of mixed built-up land has increased from 20 percent to nearly 70 percent in case of BUA. In HUA this process is very slow that is increase from 23 percent to only 37 percent.

- Proportion of industrial area in 2001 in both UAs is almost 4 to 5percent but the expanse is much larger in HUA because it is 5 percent of total area almost double that of Bangalore.

- Urban sprawl map of Bangalore and Hyderabad shows that Bangalore has grown in circles, where as Hyderabad has adopted a radial pattern of urban sprawl, mainly along the transportation corridors. Due to less price of land in the periphery areas included in the vast area of HUDA.

- The real estate investment in HUA had taken place in the outer areas. This has resulted in the development of scattered built up area leaving behind vacant spaces in between. This process is not very prominent.

- The urban growth intensified along main transportation corridors in all directions, but more apparent along National Highway no. 5 and 7 towards Northwest and Southeast in a radial pattern. This has created wedges within the built-up area with vacant lands where the process of intermittent infilling occurs leading to contiguous urban sprawl over a period of time. The city developed in a dispersed and low density pattern leaving pockets of vacant land or underdeveloped land within itself. As the city sprawl increased, the built-up land devoured the agricultural lands and water bodies.

- In case of Bangalore recommendations were made to seriously curb the growth in Bangalore Local Planning Area and encourage growth of other small and medium towns in the states. This has resulted in development of the city out growths in dense manner in circular pattern rather than radial.

- Other salient differences in land use pattern between the two urban agglomerations are as follows.

- Area under water is about 3 to 4 percent in both the UAs and during the last three decades it has marginally declined in both. A number of water bodies have been lost. A number of water bodies have been lost. Binnamangala Tank of Bangalore has become residential area (BDA, 1995). Water bodies lost in Hyderabad include Masab Tank, Batukamma cheruvu (Amberpet), Bowenpally cheruvu, Baghlingampally tank, etc (NRSA, 1994).
- Area under parks and gardens in BUA has declined from 5 to 3percent while in HUA it shed an increased more than 2 and half times reaching 7 percent in 1991 and got stabilized there after. This is mainly due to Green Hyderabad Programme.

- It is noticed that the residential development has taken place on all directions in a contiguous pattern due to availability of land in all directions in case of Hyderabad.

- In short metropolitan planning in Bangalore has been more effective in the sense that Hyderabad Development pattern has been more haphazard manner in the non-Municipal areas, the while in Bangalore they have allowed the development to take place in dense manner around the core area. But the disadvantages of this pattern of development Bangalore is facing now in terms of strain on the transport systems, lesser availability of amenities etc.

- An important demographic feature in urban agglomerations of India is that the periphery including the outgrowths has been growing at a faster rate than the core city. While this feature is observed for most of the cities, Bangalore proves to be an exception where the core city has continued to register an exceptionally high annual growth during 1991-2001.

- The decadal change in the built up area very was high in case of Bangalore with the center core area developing for public/semipublic use.

- While the city has shown a tendency to grow on all sides, the growth is more predominant on the western side in case of Bangalore UA.

- The major public/semi-public / institutional land use mapped include the Osmania University, Hyderabad Central University, Police Academy etc in Hyderabad UA and Bangalore University, Indian Institute of Science etc in Bangalore UA

- The mapping of industrial complex shows that there was an increase in the industrial area about four fold during the period of 1971-2001 both in case of Hyderabad and Bangalore UA. In case of Bangalore the main industrial areas were located the North West portion.

- Haphazard urban growth and increase in built-up area have resulted into loss of productive agricultural land, green areas, loss in surface water bodies.

- Keeping in view of 'Andhra Pradesh Vision 2020', it is proposed (HUDA, 2003) that further concentration of manufacturing industries in Hyderabad Urban Development Area is not advisable.

9. Results and Policy/ Research Implications

The above findings clearly indicate how the technological developments and global forces leading to migration flows and rapid population growth can reshape the functional and spatial structure of urban agglomerations. Government ***policies are an important mechanism*** through which adverse effects of this process on quality of life can be mitigated to some extent. It can also encourage the land use changes first to change the location of opportunities of growth and divert the flow of capital and people in the desired directions. Growth of Bangalore has been more planned but the area under the Development Authority (BDA) was smaller as compared to HUDA of Hyderabad. HUA has on one hand has the advantage of larger area jurisdiction, but until recently its growth was unplanned and haphazard leaving behind vacant spaces in-between. Thus both need suitable policies to contain the rapid population growth and economic expansion as well as to provide space for future growth of population and urban sprawl**.**

Available data shows that employment growth generated in ancillary activities (manufacturing, construction, trade & transport, communications as well as cleaning, catering, security and other jobs locally outsourced) due to expansion of IT sector is nearly 3 times the jobs created in the IT industries themselves. Both the UAs need to provide space and amenities keeping this ***multiplier effect*** in mind

Urgent steps to reduce the stress on infrastructural facilities in core areas are required in view of the problems faced at present such as traffic jams, water shortage, and narrow roads not equipped to handle the phenomenal growth of private vehicles, inadequate and irregular public transport. In both UAs, decentralization of economic activity has resulted into shift to non-municipal areas which do not have adequate facilities in terms of roads, transport network, water availability, electricity etc. High priority needs to be given to this aspect.

Rapid and unplanned growth of construction sector calls for strict action to regulate the activities of private builders as well as to release more plots for development with well defined rules and regulations. Side by side the growth of high tech industries, both UAs have a sizable informal sector. Unless some action is taken to regulate it, effective land use planning is not possible.

Alarming increase in the built up area at the cost of water bodies and open space and loss of greenery pinpoint the need to provide green belts encircling urban growth to curb radial pattern of development along major transportation networks. Programmes of increasing greenery or 'Urban Forestry' to be undertaken in Bangalore similar to Green Hyderabad Environmental Programme (GHEP) of Hyderabad.

Increasing predominance of young population is another feature to be taken into account in planning for future facilities for schooling, health, recreation etc. Transition from mono- cultural to multicultural society due to new migration trends highlight the need to encourage activities to reduce social tensions and create social awareness for the smooth assimilation of migrants.

Finally there is a need to adapt a comprehensive regional approach and develop alternate growth poles to act as counter magnets and to reduce the pressure on the two urban agglomerations.

As regards to implications for further research, better understanding of micro-level scenario is essential for effective land use planning. Present study, as it is based on secondary data, indicates only broad trends at urban agglomeration level. For intra-UA analysis further break-up of demographic and economic data will be required. For detailed land use study, High Resolution Satellite Data for the 'Hot Spot Areas' will be useful.

If such detailed data are available in future, micro level studies based on such data supplemented by collection of primary data through sample survey of households and business enterprises will provide useful insights for sustainable development of Mega Cities and Urban Agglomerations.

Table 1: Demographic Characteristics of Bangalore UA (1971-2001)

BANGALORE UA	1971	1981	1991	2001
Population Size (`000s)	1,654	2,922	4,130	5,701
Decadal Growth (`000s)	--	1,268	1,209	1,571
% Decadal Growth	--	76.67	41.36	38.04
% Annual Growth Rate (exponential)	--	5.69	3.46	3.22
Area (sq km)	174.71	365.65	413.03	492.55
Density (per sq km)	9,465.85	7,990.57	9,99.97	11,545.72
Sex Ratio	874.39	895.52	903.52	907.76
% Literates	58.90	63.53	68.31	74.87
% Work Participation Rate	29.50	29.76	32.54	36.27

Table 2: Demographic Characteristics of Hyderabad UA (1971-2001)

Hyderabad UA	1971	1981	1991	2001
Population Size (000)	1,796	2,546	4,344	5,752 ®
Decadal Growth	--	749	1,799	1,407
% Decadal Growth	--	41.72	70.65	32.39
% Annual Growth Rate (exponential)	--	3.49	5.34	2.81
Area (sq km)	298.51	371.50	726.66	778.17
Density (per sq km)	6017.68	6852.86	5978.64	7391.42
Sex Ratio	916.71	919.06	929.62	931.34
% Literates	52.95	57.79	59.37	68.37
% Work Participation Rate	28.39	28.11	28.01	27.88

® Revised figure by HUDA, 2003

Table 3: Population of Components of Bangalore UA (1971-2001)

Bangalore Urban Agglomeration		1971	1981	1991	2001
Bangalore Municipal Corporation	Population Size (`000)	1540	2476	3302	4313
	Decadal Growth (`000)	--	936	826	1,011
	% Decadal Growth	--	60.72	33.35	30.61
	% Annual Growth Rate (exponential)	--	4.75	2.88	2.67
	% Share to BUA	92.58	84.76	79.95	75.65
Non-BMC : {CMCs, CTs, TMCs, OGs}	Population Size (`000)	124	446	828	1388
	Decadal Growth (`000)	--	322	383	560
	% Decadal Growth	--	260.74	85.90	67.66
	% Annual Growth Rate (exponential)	--	12.83	6.20	5.17
	% Share to BUA	7.42	15.24	20.05	24.35

Note : CMC : City Municipal Council; TMC : own Municipal Council; CT : Census Towns; OG : Out Growths

Table 4: Population of Components of Hyderabad UA (1971-2001)

Hyderabad Urban Agglomeration		1971	1981	1991	2001
Municipal Corporation of Hyderabad	Population Size (`000)	1618	2187	3058	3638
	Decadal Growth (`000)	--	569	871	579
	% Decadal Growth	--	35.14	39.81	18.95
	% Annual Growth Rate (exponential)	--	3.01	3.35	1.74
	% Share to HUA	90.10	85.92	70.39	63.24
Non-MCH : Mty, OGs, CTs,(Excl. Cant)	Population Size (`000)	83	223	1115	1908
	Decadal Growth (`000)	--	139	893	793
	% Decadal Growth	--	166.76	401.03	71.11
	% Annual Growth Rate (exponential)	--	9.81	16.11	5.37
	% Share to HUA	4.64	8.74	25.67	33.18
Non-MCH Cantonment	Population Size (`000)	94	136	171	206
	Decadal Growth (`000)	--	42	35	35
	% Decadal Growth	--	44.04	25.85	20.42
	% Annual Growth Rate (exponential)	--	3.65	2.30	1.86
	% Share to HUA	5.26	5.34	3.94	3.58

Note : Mty : Municipality; OG : Out Growths; CT : Census Towns; Cant. : Cantonment

Table 5: Distribution of Migrants to Bangalore UA

BANGALORE UA 1991-2001	Total (no)	% total Population	% Share in Decadal Growth	% Share to total Migrants	Sex Ratio	Percent Urban
Total Population (1991)	5701446	100.00	--	--	--	--
Decadal Growth	1621940	28.45	100.00	--	--	--
Total Migrants	1260176	22.10	77.70	100.00	849	34.55
Intra District	290434	5.09	17.91	23.05	838	0.00
Inter-District	514352	9.02	31.71	40.82	886	37.30
Inter-state	447530	7.85	27.59	35.51	817	53.82
International	7860	0.14	0.48	0.62	696	--

Table 6: Distribution of Migrants to Hyderabad UA

HYDERABAD UA 1991-2001	Total (no)	% total Population	% Share in Decadal Growth	% Share to total Migrants	Sex Ratio	Percent Urban
Total Population (1991)	5751780	100.00	--	--	--	--
Decadal Growth	1344764	23.38	100.00	--	--	--
Total Migrants	954567	16.60	70.98	100.00	910	27.16
Intra District	165824	2.88	12.33	17.37	923	0.00
Inter-District	643982	11.20	47.89	67.46	914	29.64
Inter-state	140583	2.44	10.45	14.73	890	47.84
International	4178	0.07	0.31	0.44	639	--

Table 7: Type of Migrants and reasons for Migration to Bangalore UA and Hyderabad UA

1991-01	Bangalore UA					Hyderabad UA				
	Total Migrants	Intra District	Inter-District	Inter-state	Inter-national	Total Migrants	Intra District	Inter-District	Inter-state	Inter-national
Total Migrants	1,260,176	290434	514352	447530	7860	954,567	165824	643982	140583	4178
Employment	23.37	3.64	28.92	29.80	23.28	18.41	6.03	20.55	23.16	19.39
Business	1.30	0.21	1.12	2.21	1.76	1.73	0.51	1.75	3.10	2.13
Education	3.71	0.28	3.28	6.16	19.55	3.07	0.67	3.96	1.78	3.64
Family moved	16.14	3.57	18.36	21.63	22.37	19.71	9.07	21.60	23.56	20.15
Moved after Birth	10.37	1.76	13.61	12.31	5.00	6.76	2.92	7.66	7.30	3.33
Marriage	4.89	1.46	6.22	5.62	2.91	3.85	2.25	4.23	4.00	3.30
Others	40.22	89.08	28.48	22.27	25.13	46.47	78.55	40.25	37.10	48.06

Table 8: Type of Migrants and reasons for Migration to Hyderabad UA

Table -4.3c % Urban -1991-01	Bangalore UA				Hyderabad UA			
	Total Migrants	Intra District	Inter-District	Inter-state	Total Migrants	Intra District	Inter-District	Inter-state
Total Migrants	34.55	0.00	37.30	53.82	27.16	0.00	29.64	47.84
Employment	41.87	0.00	35.01	52.83	33.13	0.00	30.62	53.54
Business	53.65	0.00	48.31	60.12	46.69	0.00	43.64	63.55
Education	64.16	0.00	50.32	74.56	43.83	0.00	42.94	72.53
Family moved	50.57	0.00	44.57	61.83	35.86	0.00	33.86	60.55
Marriage	46.01	0.00	41.48	56.04	34.93	0.00	33.51	58.22
Moved after birth	50.18	0.00	49.61	59.36	36.16	0.00	36.90	56.59
Others	15.79	0.00	28.32	38.37	17.40	0.00	23.46	30.73

Table 9 : Sectoral distribution of Main Workers of Bangalore UA (1971, 1991)

Bangalore Urban Agglomeration	BMC		NON-BMC		BUA	
	1971	1991	1971	1991	1971	1991
Primary Sector	**1.78**	**1.78**	**5.44**	**4.81**	**2.04**	**2.36**
Secondary Sector	**39.54**	**40.92**	**54.30**	**52.41**	**40.62**	**43.11**
House Hold Industry	2.78	1.42	1.37	0.90	2.68	1.32
Manufacturing	32.28	31.14	46.42	39.06	33.30	32.65
Construction	4.49	8.37	6.51	12.45	4.63	9.15
Tertiary Sector	**58.68**	**57.29**	**40.26**	**42.78**	**57.34**	**54.53**
Trade and Commerce	19.29	24.29	6.74	15.50	18.38	22.61
Transport and Communication	12.75	8.78	5.63	7.38	12.23	8.51
Other Services	26.64	24.23	27.89	19.91	26.73	23.40
Total Main Workers	**452490**	**1087681**	**35430**	**256284**	**487920**	**1343965**

Table 10 : Sectoral distribution of Main Workers of Hyderbad UA (1971,1991)

Hyderabad Urban Agglomeration	MCH		Cantonment		NON-MCH		HUA	
	1971	1991	1971	1991	1971	1991	1971	1991
Primary Sector	**2.57**	**1.21**	**3.32**	**0.55**	**21.95**	**10.67**	**3.82**	**3.85**
Secondary Sector	**27.18**	**27.36**	**12.85**	**23.54**	**35.26**	**44.33**	**26.72**	**31.97**
House Hold Industry	2.19	0.52	0.94	0.31	1.72	0.49	2.08	0.50
Manufacturing	20.41	19.19	10.24	14.50	25.66	33.81	20.06	23.09
Construction	4.57	7.65	1.67	8.73	7.88	10.04	4.58	8.38
Tertiary Sector	**70.25**	**71.44**	**83.82**	**75.91**	**42.79**	**45.00**	**69.46**	**64.19**
Trade and Commerce	23.09	29.25	5.96	16.07	10.02	13.96	21.15	24.31
Transport & Communication	13.85	12.39	11.01	9.10	10.54	9.01	13.46	11.28
Other Services	33.31	29.80	66.85	50.74	22.23	22.03	34.86	28.59
Total Main Workers (100%)	**444576**	**815871**	**33966**	**57660**	**31415**	**343540**	**509957**	**1217071**

Table 11 : Land Use/ Land Cover Area (Estimate) of Bangalore UA (1971, 1981, 1991, 2001)

LAND USE/ LAND COVER	1971	1981	1991	2001
Mixed Built (Residential & Commercial)	19.69	26.37	38.99	69.05
Layout	3.53	1.88	0.00	0.00
Airport and other Transportation	1.88	1.88	1.88	1.88
Industrial	0.00	0.00	1.93	4.30
Educational	0.00	0.00	2.53	2.53
Crop land	51.53	47.67	10.84	7.70
Plantation	0.00	0.00	1.09	1.09
Forest	0.05	0.05	0.21	0.21
Parks/Gardens/Public-semi public	5.39	5.39	3.01	3.01
Barren Rocky	0.77	0.77	0.40	0.44
Scrubland/grasses	7.85	6.69	6.60	6.56
Brick kilns and others	0.00	0.00	0.00	0.00
Water	3.49	3.49	3.15	3.15
Open Land	5.81	5.81	29.37	0.08
Defence land	0.00	0.00	0.00	0.00
Total Area in sq km (100%)	**492.55**	**492.55**	**492.55**	**492.55**

Table 12 : Land Use/ Land Cover Area (Estimate) of Hyderabad UA (1971, 1981, 1991, 2001)

LAND USE/ LAND COVER	1971	1981	1991	2001
Mixed Built (Residential & Commercial)	22.56	32.11	32.31	37.35
Layout	0.64	0.58	1.33	5.50
Airport and other Transportation	0.20	0.81	0.48	0.48
Industrial	0.00	0.00	3.84	5.58
Educational	0.00	0.00	0.00	0.00
Crop land	6.43	6.21	9.36	9.36
Plantation	0.00	0.00	1.19	1.19
Forest	0.15	0.15	1.44	1.44
Parks/Gardens/Public-semi public	2.77	2.77	7.07	7.07
Barren Rocky	3.12	3.12	1.21	1.21
Scrubland/grasses	56.09	46.22	4.31	1.99
Brick kilns and others	0.00	0.00	0.64	1.22
Water	4.86	4.86	3.59	3.59
Open Land	3.16	3.16	26.05	16.85
Defence land	0.00	0.00	7.19	7.19
Total Area in sq km (100%)	778.17	778.17	778.17	778.17

Figure 1 : Location Map of The Study Area

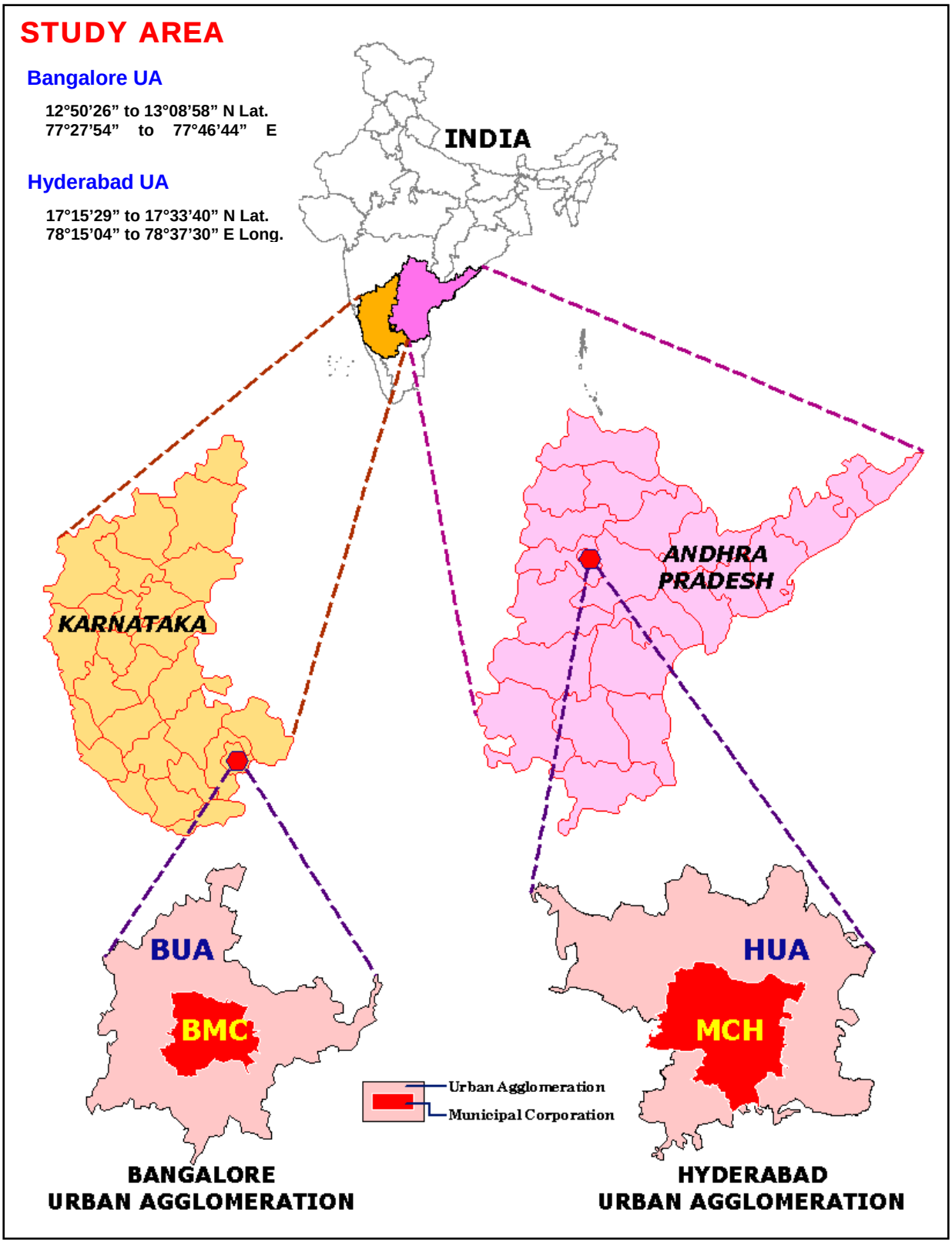


Figure 2

CONCEPTUAL FRAME WORK

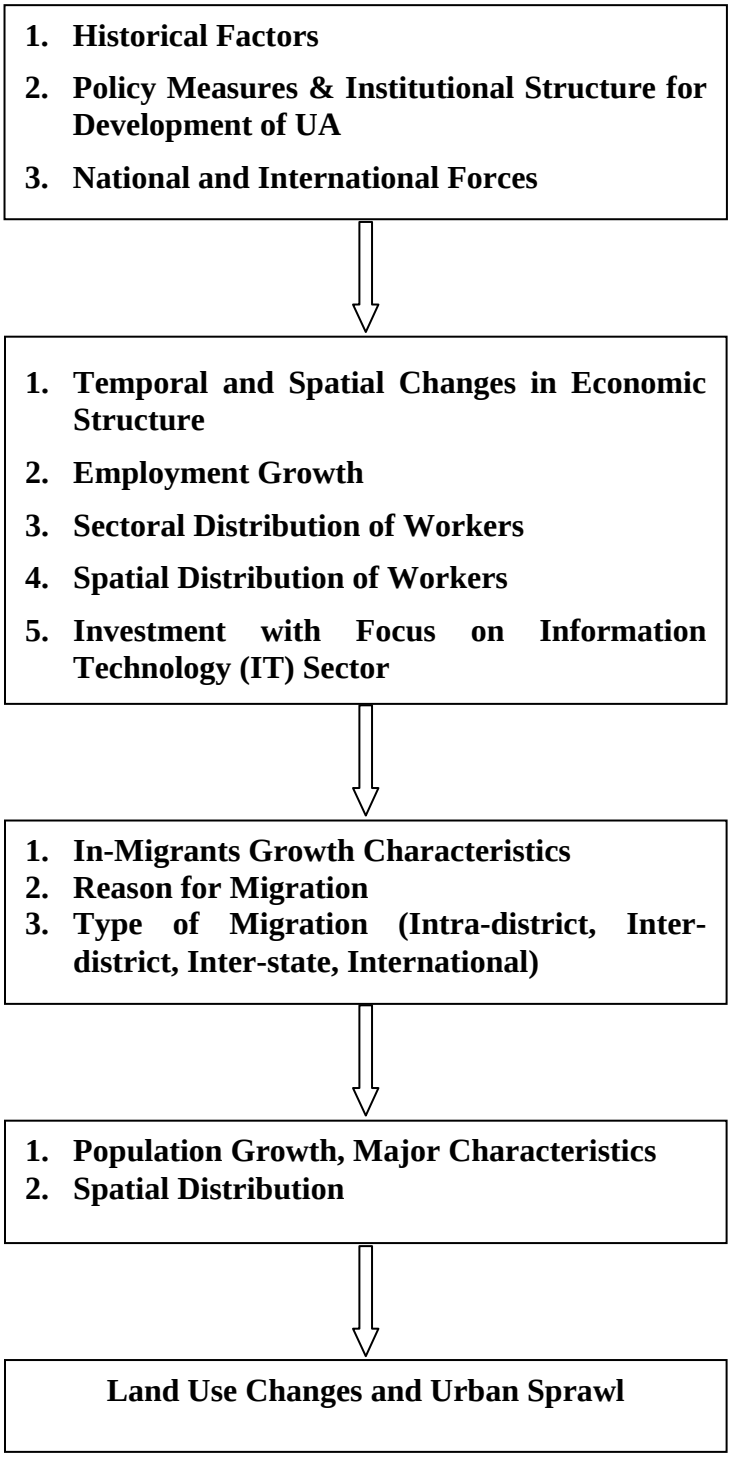


Figure 3 : Distribution of Inter-State Migration To Bangalore UA By State of Origin (1971-81, 1981-91, 1991-2001) with a Back Drop of 1991-2001 Inter-State Migration.

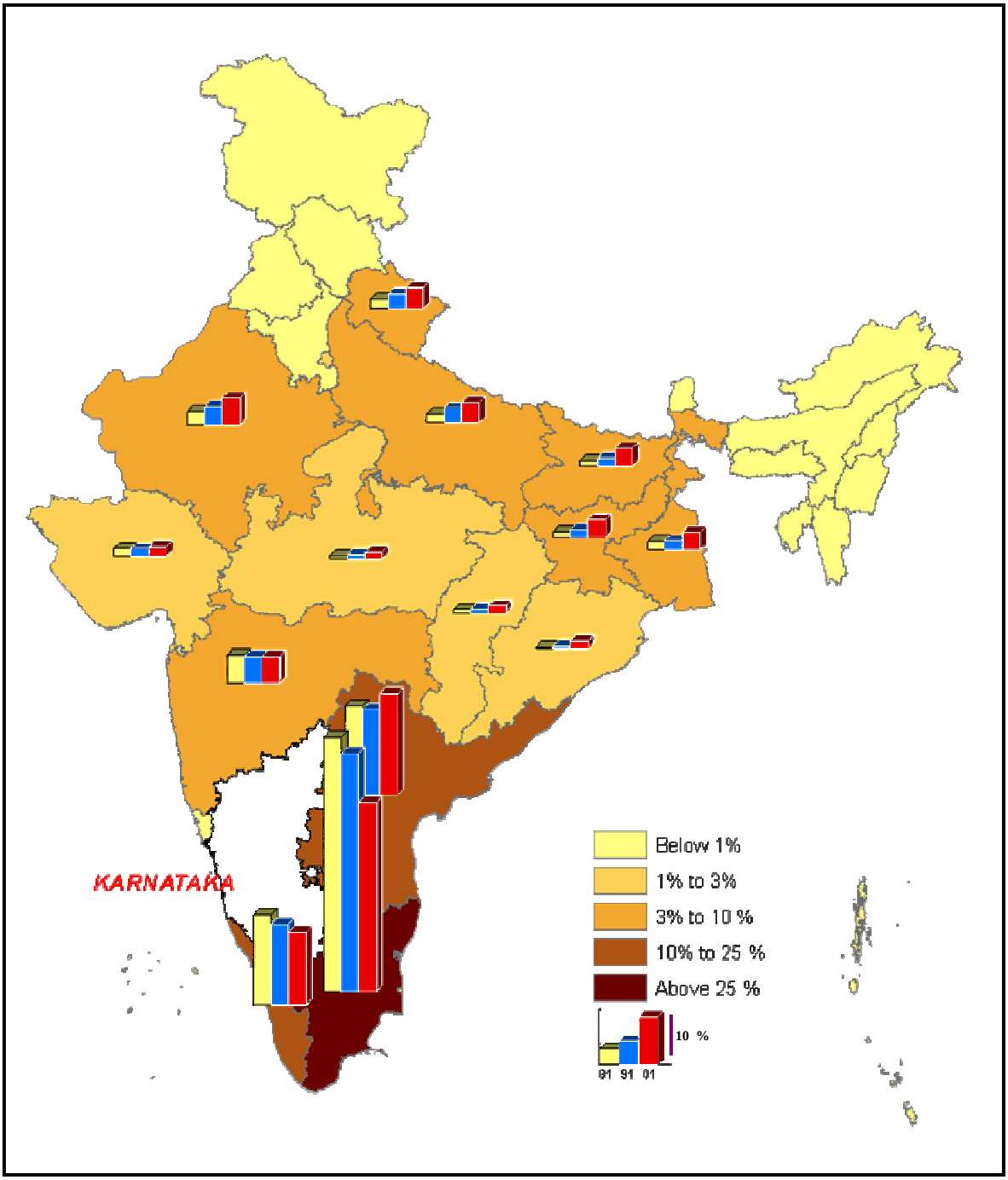


Figure 4 : Distribution of Inter-State Migration To Hyderabad UA By State of Origin (1971-81, 1981-91, 1991-2001) with a Back Drop of 1991-2001 Inter-State Migration.

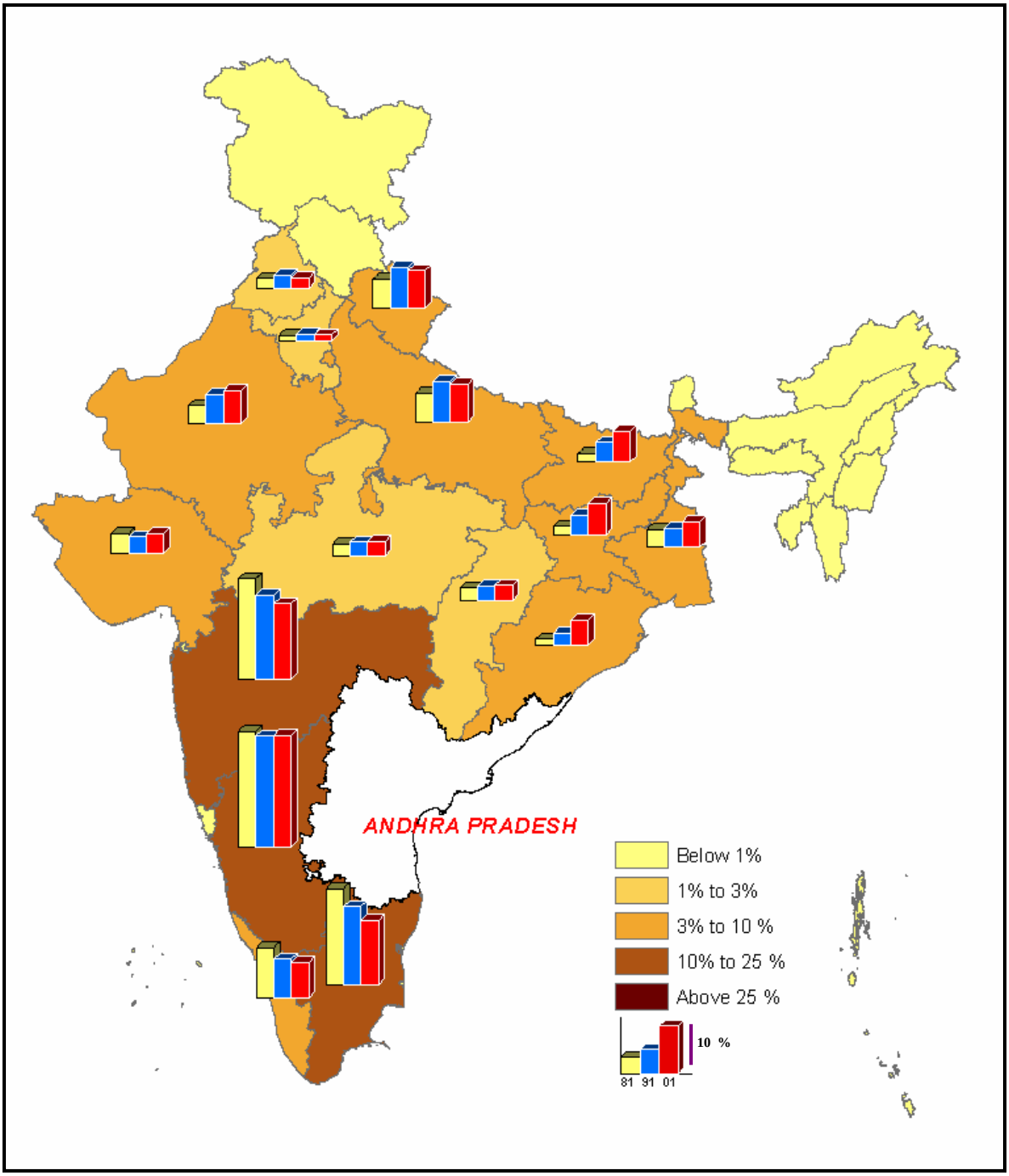


Figure 5

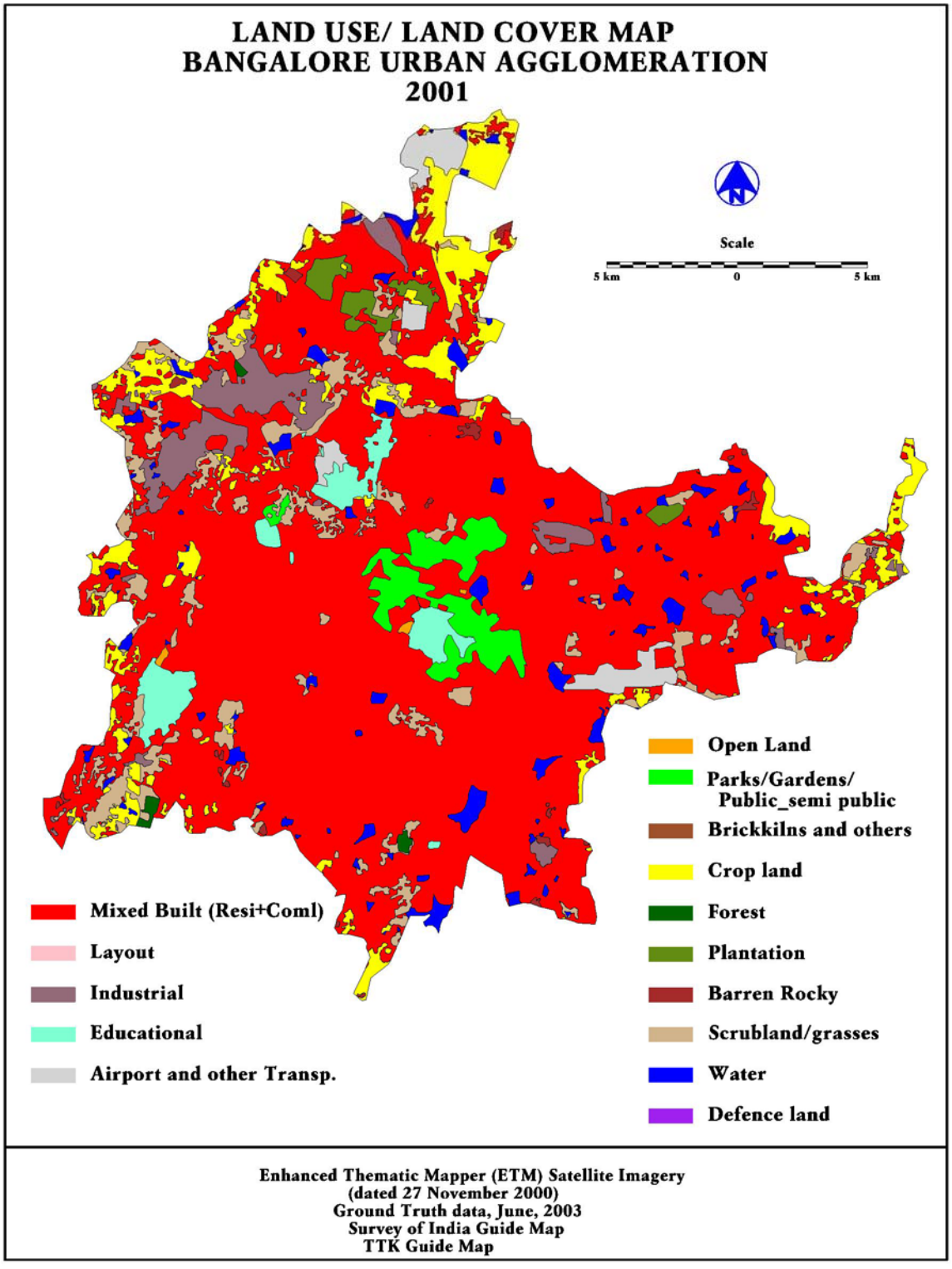

LAND USE/ LAND COVER MAP
BANGALORE URBAN AGGLOMERATION
2001
Scale
5 km
0
5 km
Mixed Built (Resi+Coml)
Layout
Industrial
Educational
Airport and other Transp.
Open Land
Parks/Gardens/
Public_semi public
Brickkilns and others
Crop land
Forest
Plantation
Barren Rocky
Scrubland/grasses
Water
Defence land
Enhanced Thematic Mapper (ETM) Satellite Imagery
(dated 27 November 2000)
Ground Truth data, June, 2003
Survey of India Guide Map
TTK Guide Map

Figure 6.

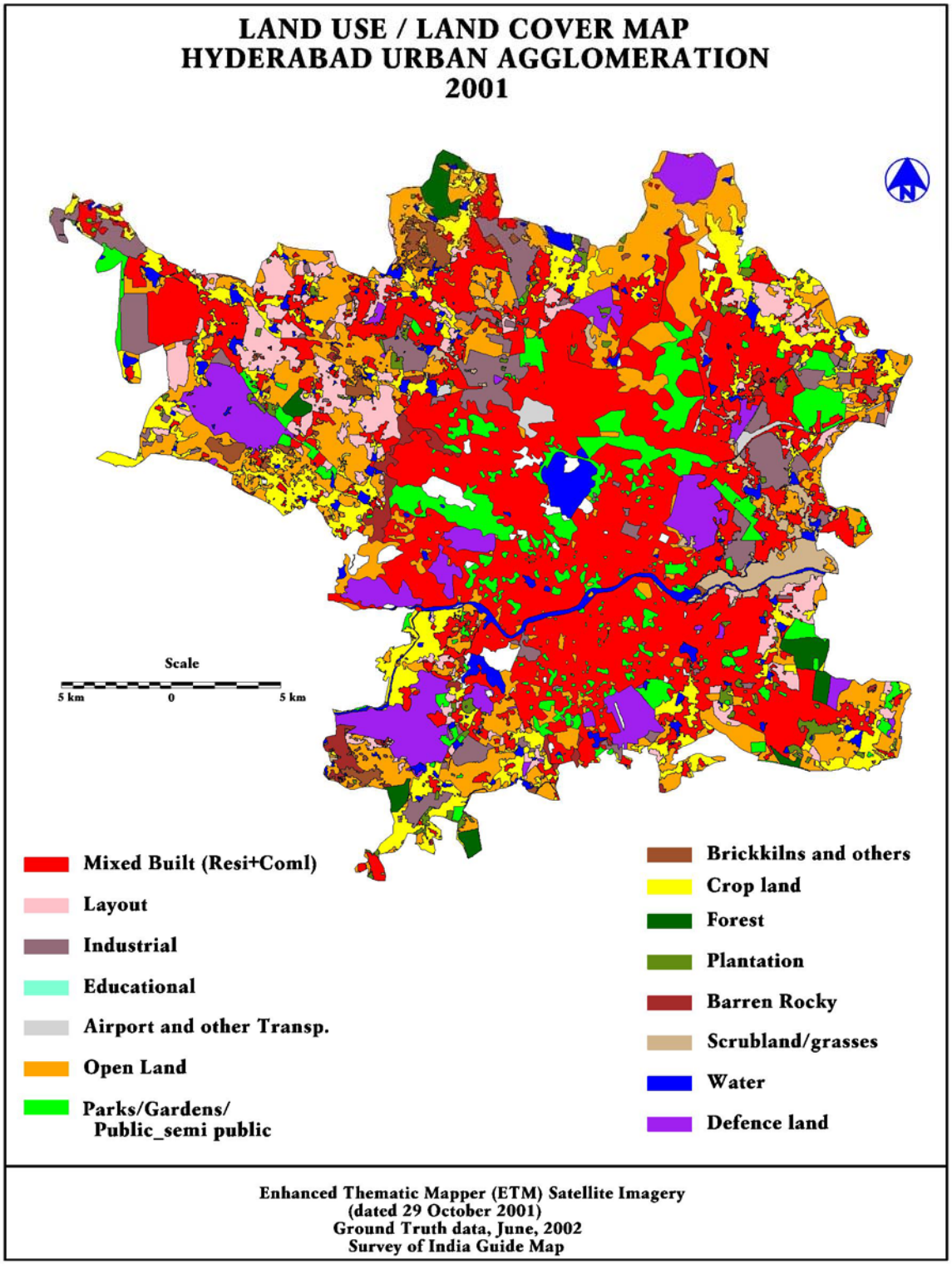

LAND USE / LAND COVER MAP
HYDERABAD URBAN AGGLOMERATION
2001
N
Scale
5 km
0
5 km
Mixed Built (Resi+Coml)
Layout
Industrial
Educational
Airport and other Transp.
Open Land
Parks/Gardens/
Public_semi public
Brickkilns and others
Crop land
Forest
Plantation
Barren Rocky
Scrubland/grasses
Water
Defence land
Enhanced Thematic Mapper (ETM) Satellite Imagery
(dated 29 October 2001)
Ground Truth data, June, 2002
Survey of India Guide Map

Figure 7

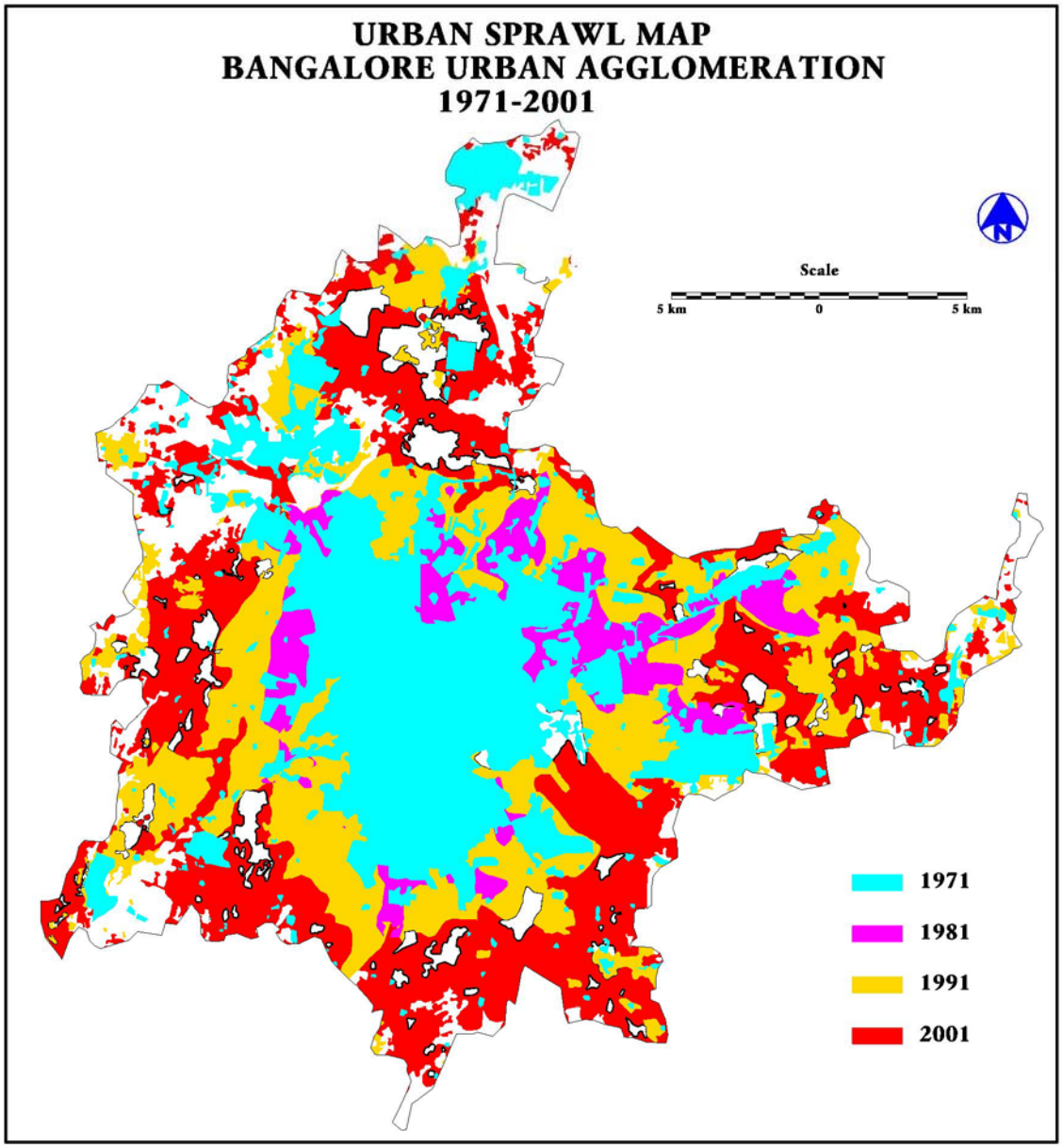
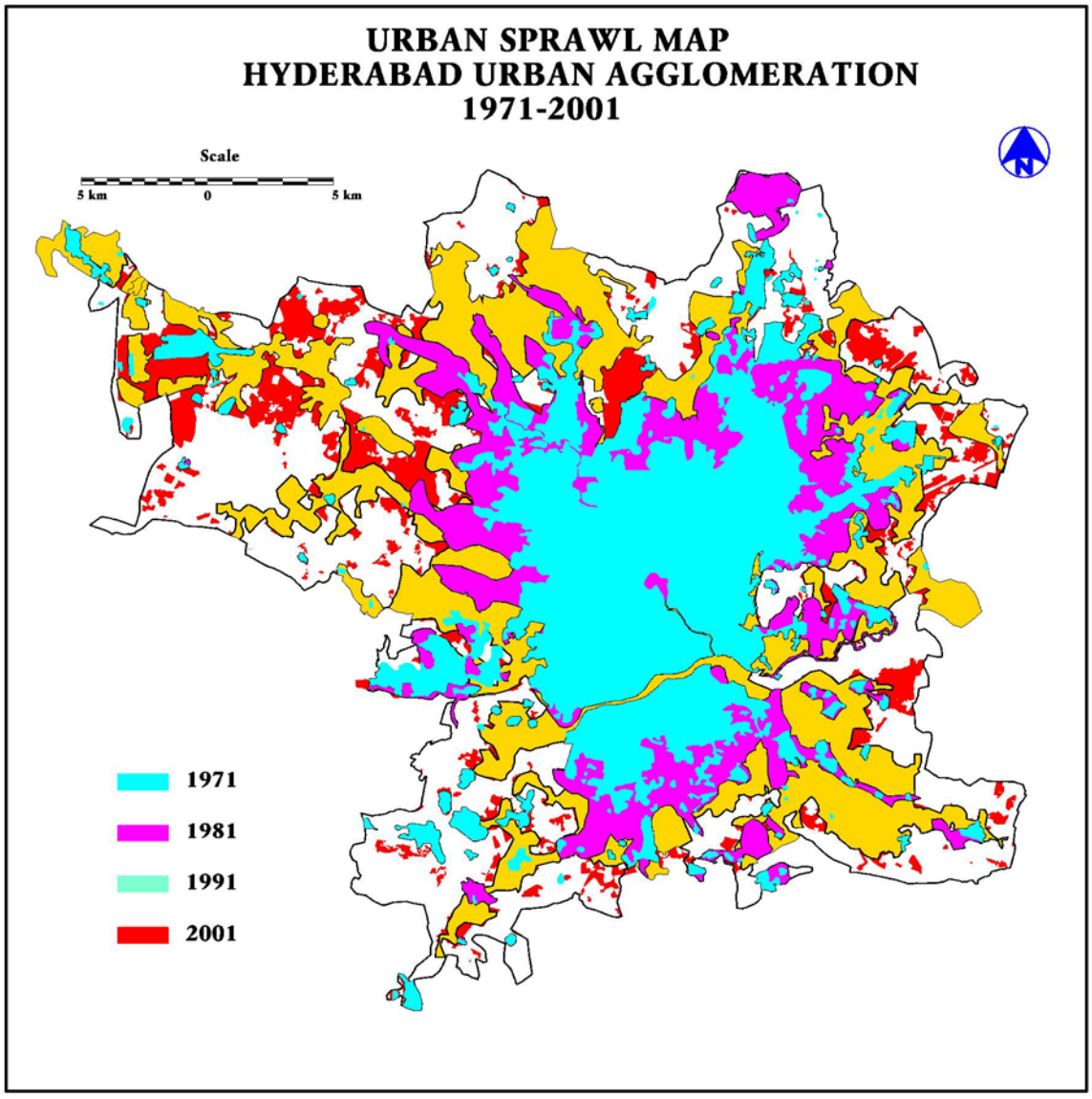

URBAN SPRAWL MAP
BANGALORE URBAN AGGLOMERATION
1971-2001
Scale
5 km
0
5 km
1971
1981
1991
2001

Figure 8


URBAN SPRAWL MAP
HYDERABAD URBAN AGGLOMERATION
1971-2001
Scale
5 km
0
5 km
N
1971
1981
1991
2001

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