

Environmental Impacts of Urban Growth From an Integrated Dynamic Perspective: A Study of Hyderabad, Telangana State, India

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Abstract - India is home to one-fifth of the world's population and that population is increasingly urban. The landscape is also urbanizing. Although there are studies that focus on specific elements of urban growth, there is very little empirical work that incorporates feedbacks and linkages to assess the interactions between the dynamics of urban growth and their environmental impacts. In this study, we develop a system dynamics simulation model of the drivers and environmental impacts of urban growth, using Shenzhen, South China, as a case study. We identify three phases of urban growth and develop scenarios to evaluate the impact of urban growth on several environmental indicators: land use, air quality, and demand for water and energy. The results show that all developable land will be urban by 2020 and the increase in the number of vehicles will be a major source of air pollution. Demand for water and electricity will rise, and the city will become increasingly vulnerable to shortages of either. The scenarios also show that there will be improvements in local environmental quality as a result of increasing affluence and economic growth. However, the environmental impacts outside of Hyderabad may increase as demands for natural resources increase and Hyderabad pushes its manufacturing industries out of the municipality. The findings may also portend to change other cities in India and elsewhere in the developing world may experience as they continue to industrialize.

Keywords: Land use change, Air quality, Integrated assessment, Feedback mechanism, Dynamic simulation modeling.

I. INTRODUCTION

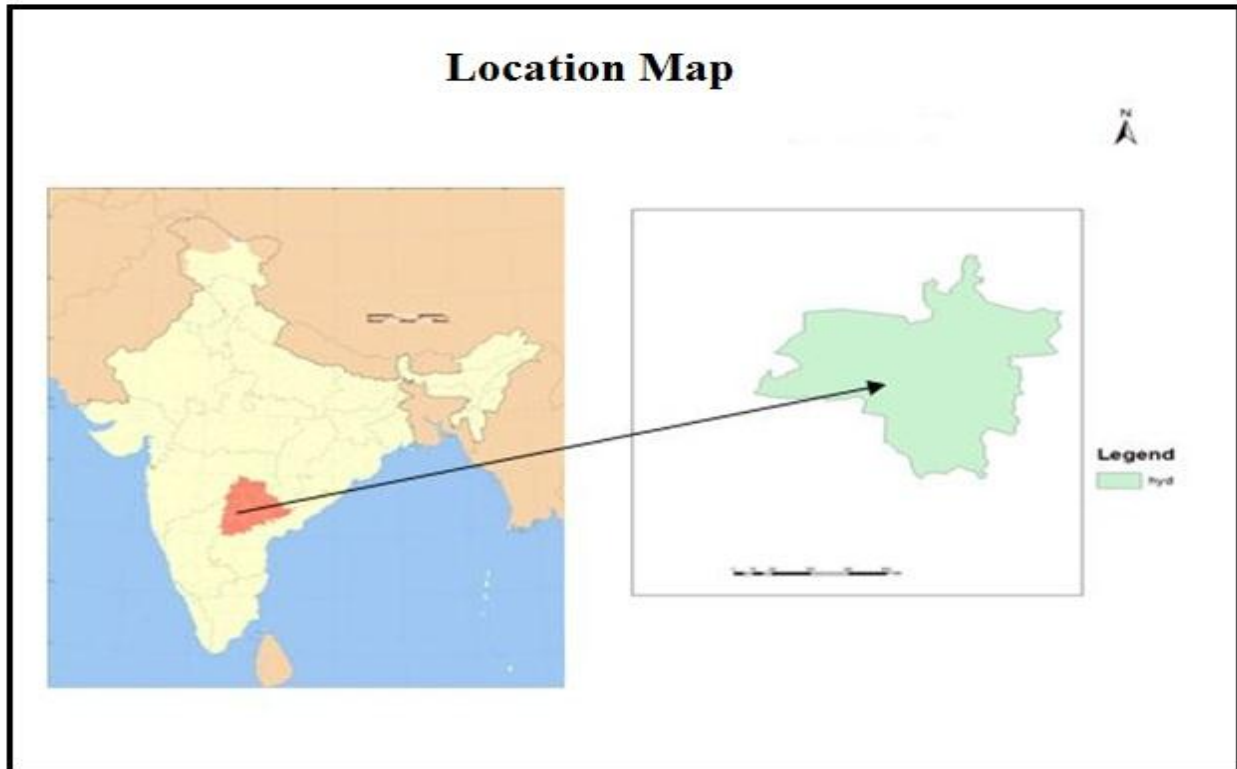
An overall idea about urban growth and sprawl has been provided in this paper it aims to list the causes and consequences of urban growth and sprawl. The causes that force growth in urban areas and the causes that are responsible for undesirable pattern or process of urban growth are also essentially important for the analysis of urban growth. The consequences or the impacts of urban growth, whether ill or good, are also necessary to be understood and evaluated towards achieving a sustainable urban growth. Galster et al. (2001) argue that sprawl as a pattern or a process is to be distinguished from the causes that bring such a pattern about, or from the consequences of such patterns. This statement clearly says that analysis of pattern and process should be differentiated from the analysis of causes and consequences. Remote sensing data are more widely used for the analysis of pattern and process rather than causes or consequences.¹ However, some of the researchers (e.g., Ewing 1994) argue that impacts of development present a specific development patterns as undesirable, not the patterns themselves. Therefore, whether a pattern is good or bad should be analyzed from the perspective of its consequences. Causes are also similarly important to know the factors that are responsible to bring such pattern. Indeed remote sensing data are not enough to analyze the causes or consequences in many instances; one should have clear understanding of causes and consequences of urban growth and sprawl to encounter the associated problems.

Study area

Hyderabad is a creation of the first twin city of Golconda-Hyderabad, and then come Golconda, Hyderabad – Secunderabad concept, followed by the huge cantonments of the Nizam and the British. The general land- use of the old Hyderabad is confined largely in South, East and a vast North East with Osmania University, Railways, NGRI, NFC, E.C.I.L., and several small and medium sized industries and institutions. The latitude and longitude for the study of area of Hyderabad city and environs extends from (17° 15' 30'', 78° 15' 00'') to (17° 40' 15'', 78° 40' 15''). The Hyderabad Urban Development Area

¹ Galster G, Hanson R, Wolman H et al (2000) Wrestling sprawl to the ground: defining and measuring an elusive concept. Working paper of Fannie Mae, pp 1–38

(HUDA) is around 1865 sq.km. The HUDA area is divided into 29 planning zones (11 Zones inside municipal limits and 18 zones in the non-municipal limits or peripheral areas).



II. OBJECTIVES

- To study the environmental impact of urban growth in Hyderabad
- Problems related to urban sprawl in study area

III. METHODOLOGY

In this research we have used mostly Secondary data such as profile of GHMC (greater Hyderabad municipal corporation), climatic details, population data, number of lakes, rate of urbanization has been collected from GHMC, various websites, journals, books, articles of newspapers (The Hindu, Indian express, Frontline) and geography department library of Osmania university.

Only for ground truthing we visited the area to confirm the actual location of the study.

Maps have been prepared with the help of ArcGis software 10.2 version. Toposheets of the study area have been taken (56K7, 56K11, 56K12, 56K8) for further analysis, Land Sat Images.

IV. BRIEF LITERATURE REVIEW

A number of studies have been carried out on urbanization in many countries. In India too, works or studies have been done on urbanization. Some of the prominent studies on urbanization in India were done by Ashish Bose, Rao.V.L.S.P., B.K.Roy., Sinha A.K., Alam & Pokshivishky etc. Coming to Andhra Pradesh, the major studies on urban growth and urbanization were done by Pothana (1979),

Markandey (1980), Rao and Simhadri (1981), Jyothirmayi (1981), and Subba Rao (1984).

An insight into the study conducted by Rao and Simhadri (1981) "Growth Trends of Cities and Large towns of Andhra Pradesh: A Temporal study (1908-81)" clearly brings an idea forwarded by them, that India's rate of urbanization is more and there is a relatively lower degree of urban growth. This is observed in Andhra Pradesh too. The phenomenal increase of urban population has taken place mostly in the case of cities and large towns. Further they say that a characteristic feature of the growth pattern of the class-I towns in Andhra Pradesh leads to the trend of decreasing primacy of Hyderabad city especially after the formation of linguistic state.

Prakash Rao (1983) has studied certain aspects to bring out the significance of spatial dimensions. The urbanization process and patterns at the national, state, regional, city regional, and intra city levels are studied. He states that within the overall characteristics of sharp breaks in urban-rural profiles, an urban interface between urban and rural is emerging, particularly in the metropolitan regions and in the developed regions with aero-industrial and commercial base. This is mainly due to improvements in transport and communications to metropolitan centers and urban industrialization and commercialization of the rural areas, and consequent improvement in the incomes of the people.

Pothana makes an economic analysis of urban growth in Andhra Pradesh. He says no single definition of

"urbanization" is acceptable generally or applicable in all situations, for him it is a complex process encompassing all round changes in the socio-economic and cultural parameters and relationships. He further says that distinction can sometimes be made between definitions on the basis of emphasis on purely sociological and demographic factors such as the concept of "urbanism" as distinct from "urbanization".

Jyothirmayi's (1981) work on "Spatial and Temporal Pattern of Urban Growth in Telangana (1901-71)" clearly puts an idea of increase in number of towns from 1901-71 and growth of population in towns too as well as spatial extension of towns. She studied the Spatial and Temporal aspects of urban growth by Rank Size rule of George.K.Zipf's (1949) method. She says the urban pattern in Telangana recorded a marked change over several decades. The hierarchical pattern of the Telangana towns is one of primate city pattern. According to her metropolitan Hyderabad, the biggest of the urban centers of the region with polarized pattern of urbanization, industrialization and concentration of commercial and other important central functions is the cause of the uneven development of economic space in the region. She expresses further that there is a trend of diversification of activities than specialization in small towns, with a change in economic and functional activities of the individual towns.

Physical factors play an important role in developing and shaping of urban places. Social and Economic factors also play an important role in the growth of urban places. Urban places are the mirror images in which one can see the images of social, economic and political conditions of the region. In examining the factors promoting urban growth and growth of urbanization, physical factors such as site and situation, environmental conditions, provision of water-bodies and climate play an important role" (Atmaram, 1989)

Berry says "the study of increasing numbers of cities in a nation, changes in the shapes and size distributions give some rather aggregate indications of the way in which the set of places are growing over time" (B.T.Robson) 1973.

V. V ANALYSIS AND DISCUSSION

Population Growth

The first and foremost reason of urban growth is increase in urban population. Rapid growth of urban areas is the result of two population growth factors:

1. natural increase in population, and
2. Migration to urban areas.

Migration is defined as the long-term relocation of an individual, household or group to a new location outside the community of origin. In the recent time, the movement of people from rural to urban areas within the country (internal migration) is most significant. Although very insignificant comparing the movement of people within the country; international migration is also increasing. International

migration includes labor migration, refugees and undocumented migrants. Both internal and international migrations contribute to urban growth. Internal migration is often explained in terms of either push factors—conditions in the place of origin which are perceived by migrants as detrimental to their wellbeing or economic security, and pull factors—the circumstances in new places that attract individuals to move there. Examples of push factors include high unemployment and political persecution; examples of pull factors include job opportunities or better living facilities. Typically, a pull factor initiates migration that can be sustained by push and other factors that facilitate or make possible the change. According to the United Nations report (UNFPA 2007), the number and proportion of urban dwellers will continue to rise quickly. Urban global population will grow to 4.9 billion by 2030. In comparison, the world's rural population is expected to decrease by some 28 million between 2005 and 2030. At the global level, all future population growth will thus be in towns and cities; most of which will be in developing countries. The urban population of Africa and Asia is expected to be doubled between 2000 and 2030. This huge growth in urban population may force to cause uncontrolled urban growth resulting in sprawl. The rapid growth of cities strains their capacity to provide services such as energy, education, health care, transportation, sanitation, and physical security. Since governments have less revenue to spend on the basic upkeep of cities and the provision of services, cities become areas of massive sprawl and serious environmental problems.

Table: 1- Extraction of Dynamic Changes of the Hyderabad in 1981 – 1991

Year	Urban Sprawl Area	Population
1981	93.81 sq.km	2545836
1991	250.51 sq.km	4344437
Progression Rate	167.03	70.64

Source: Land Sat Image

Table: 2 - Extraction of Dynamic Changes of the Hyderabad in 1991 – 2001

Year	Urban Sprawl Area	Population
1991	250.51 sq.km	4344437
2001	579.65 sq.km	5751780
Progression Rate	131.38	32.39

Source: Land Sat Image

Table: 3 - Extraction of Dynamic Changes of the Hyderabad in 2001 – 2011

Year	Urban Sprawl Area	Population
2001	579.65 sq.km	5751780
2011	824.36 sq.km	6809970
Progression Rate	42.21	18.39

Source: Land Sat Image

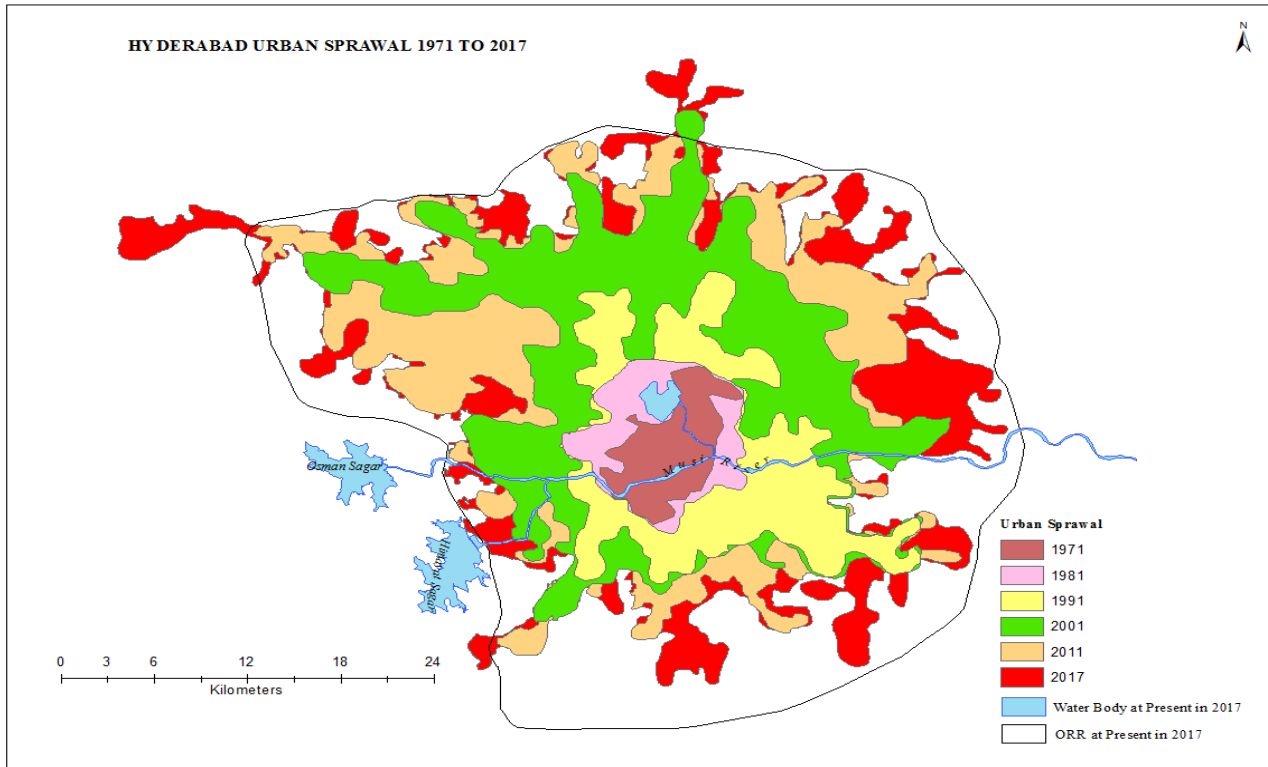


Fig: showing urban sprawl in Hyderabad

Consequences of Urban Growth and Sprawl

Consequences of urban growth may have both positive and negative impacts; however, negative impacts are generally more highlighted because this growth is often uncontrolled or uncoordinated and therefore the negative impacts override the positive sides. Positive implications of urban growth include higher economic production, opportunities for the underemployed and unemployed, better life because of better opportunities and better services, and better lifestyles. Urban growth can extend better basic services (such as transportation, sewer, and water) as well as other specialist services (such as better educational facilities, health care facilities) to more peoples. However, in many instances, urban growth is uncontrolled and uncoordinated resulting in sprawl. As a result, the upside impacts vanish inviting the downsides. In the developed countries, during the nineteenth and early twentieth century's, urbanization resulted from and contributed to industrialization. New job opportunities in the cities motivated the mass movement of surplus population away from the villages. At the same time, migrants provided cheap, plentiful labour for the emerging factories. Currently, due to movements such as globalization, the circumstances are similar in developing countries. The concentration of investments in cities attracts large number of migrants looking for employment, thereby creating a large surplus labour force, which keeps wages low. This situation is attractive to foreign investment companies from developed countries who can produce goods for far less than if the goods were produced where wages are higher. Thus, one might wonder if urban poverty

serves a distinct function for the benefit of global capital. Developed and developing countries of the world differ not only in the number of people living in cities, but also in the way in which urbanization is occurring. In many megacities of developing world, urban sprawl is a common problem and a substantial amount of city dwellers live in slums within the city or in urban periphery in poverty and degraded environment. These high-density settlements are often highly polluted owing to the lack of urban services, including running water, sewer, trash pickup, electricity or paved roads. Nevertheless, cities provide poor people with more opportunities and greater access to resources to transform their situation than rural areas. One of the major effects of rapid urban growth is sprawl that increases traffic, saps local resources, and destroys open space. Urban sprawl is responsible for changes in the physical environment, and in the form and spatial structure of cities. However, major consequences of urban sprawl can be summarized as follows.

Impacts on Wildlife and Ecosystem

In areas where sprawl is not controlled, the concentration of human presence in residential and industrial settings may lead to an alteration of ecosystems patterns and processes (Grimm et al. 2000). Development associated with sprawl not only decreases the amount of forest area (Macie and Moll 1989; MacDonald and Rudel 2005), farmland (Harvey and Clark 1965), woodland (Hedblom and Soderstrom 2008), and open space but also breaks up what is left into

small chunks that disrupt ecosystems² and fragment habitats (Lassila 1999; McArthur and Wilson 1967; O'Connor et al. 1990)³. The reach of urban sprawl into rural natural areas such as woodlands and wetlands ranks as one of the primary forms of wildlife habitat loss. Roads, power lines, subdivisions and pipelines often cut through natural areas, thereby fragmenting wildlife habitat and altering wildlife movement patterns the fragmentation of a large forest into smaller patches disrupts ecological processes and reduces the availability of habitat for some species. Some forest fragments are too small to maintain viable breeding populations of certain wildlife species.

Loss of Farmland

Urbanisation generally, and sprawl in particular, contribute to loss of farmlands and open spaces (Berry and Plaut 1978; Fischel 1982; Nelson 1990; Zhang et al. 2007)⁴. Urban growth, only in the United States, is predicted to consume 7 million acres of farmland, 7 million acres of environmentally sensitive land, and 5 million acres of other lands during the period 2000–2025 (Burchell et al. 2005)⁵. This case is enough to visualize the world scenario. Provincial tax and land-use policies combine to create financial pressures that propel farmers to sell land to speculators. Low prices of farm commodity in global markets often mean it is far more profitable in the long term for farmers to sell their land than to continue farming it. In addition, thousands of relatively small parcels of farmland are being severed off to create rural residential development. Collectively, these small lots contribute to the loss of hundreds of hectares of productive agricultural land per year. The loss of agricultural land to urban sprawl means not only the loss of fresh local food sources but also the loss of habitat and species diversity, since farms include plant and animal habitat in woodlots and hedgerows. The presence of farms on the rural landscape provides benefits such as green space, rural economic stability, and preservation of the traditional rural lifestyle

Increase in Temperature

Positive correlation between land surface temperature and impervious surface clearly indicates temperature increase in the sprawled area (Weng et al. 2007; Wang et al. 2003)⁶. On warm days, urban areas can be 6–8°F (3.5–4.5°C)

warmer than surrounding areas, an effect known as an urban heat island (Frumkin 2002). The heat island effect is caused by two factors. First, dark surfaces such as roadways and rooftops efficiently absorb heat from sunlight and reradiate it as thermal infrared radiation; these surfaces can reach temperatures of 50–70°F (28–39°C) higher than surrounding air. Second, urban areas are relatively devoid of vegetation, especially trees; that would provide shade and cool the air through evapo-transpiration. As cities sprawl outward, the heat island effect expands, both in geographic extent and in intensity. This is especially true if the pattern of development features extensive tree-cutting and road construction. Furthermore, dispersed metropolitan expansion involves a positive feedback loop that may aggravate the heat island effect. Sprawling metropolitan areas, with greater travel distances, generate a large amount of automobile travel. This, in turn, results in more fuel combustion, with more production of carbon dioxide, and consequent contributions to global climate change. Global climate change, in turn, may intensify the heat island effect in metropolitan areas. Thus, not only does the morphology of metropolitan areas contribute to warming, but so may the greenhouse gas production that results from increased driving.

Impacts on Water Quality and Quantity Sprawl also have serious impacts on water quality and quantity. With miles of roads, parking lots and houses having paved over the countryside, rainwater and snowmelt are unable to soak into the ground and replenish the groundwater aquifers. Urban growth and sprawl lead to an increasing imperviousness, which in turn induces more total runoff volume. In the urban area, water runs off into storm sewers and ultimately into rivers and lakes. Extra water during heavy rain can dramatically increase the rate of flow through wetlands and rivers, stripping vegetation and destroying habitats along riverbanks. It can also cause damaging floods downstream and lead to an increase in water pollution from runoff contaminated with lawn and garden chemicals, motor oil and road salt. These pollutants can be absorbed by humans when they eat contaminated fish from affected water-bodies and when they drink from contaminated surface water or groundwater sources. In addition, heavy rainstorms occurring in cities and towns with inadequate systems for managing storm water can cause untreated human sewage to enter waterways (combined sewer overflow). Impacts on Public and Social Health One of the original motivations for migration to the suburbs were access to nature. People generally prefer to live with trees, birds, and flowers; and these are more accessible in the suburbs than in denser urban areas. Air pollution causes severe breathing problems, skin diseases, and other health problems. The effects of air pollution on the health of human and other living species are perhaps known to everyone. Sprawl results waste in time of passing vacant land enroute from central city to the sprawled suburb (Harvey and Clark

² Hedblom M, Soderstrom B (2008) Woodlands across Swedish urban gradients: status, structure and management implications. *Landsc Urban Plan* 84:62–73

³ Wilson EH, Hurd JD, Civco DL, Prisloe S, Arnold C (2003) Development of a geospatial model to quantify, describe and map urban growth. *Remote Sens Environ* 86(3):275–285

⁴ Nelson AC (1999) Comparing states with and without growth management: analysis based on indicators with policy implications. *Land Use Policy* 16:121–127

⁵ Burchell RW, Shad NA, Lisotkin D, Phillips H, Downs A, Seskin S et al (1998) The costs of sprawl revisited. National Academy Press, Washington, DC

⁶ Wang W, Zhu L, Wang R, Shi Y (2003) Analysis on the spatial distribution variation characteristic of urban heat environmental quality and its mechanism—a case study of Hangzhou city. *Chin Geogr Sci* 13(1):39–47

1965)⁷, giving rise to more traffic congestion (Brueckner 2000; Ewing 1997; Pedersen et al. 1999; Wasserman 2000)⁸ and reduced social interaction. Since sprawl is so car-dependent, walking or cycling opportunities (and the chances they bring for social interaction) diminish, while driving distances tend to lengthen dramatically. Long commutes to and from work heighten psychological stress. As people spend more time on more crowded roads, an increase in these psychological health-outcomes might be expected. Longer travel-time also reduces time available for work, leisure, and family (Wilson et al. 2003)⁹. Families who cannot afford housing to live within the city may suffer from distress that may cause negative impacts on a community's overall health. Rates of automobile fatalities and injuries per driver and per mile driven have fallen thanks to safer cars and roads, seat belt use, laws that discourage drunk driving, and other measures, but the absolute toll of automobile crashes remains high. The relationship between sprawl and motor vehicle crashes is complex. At the simplest level, more driving means greater exposure to the dangers of the road, translating to a higher probability of a motor vehicle crash. The most dangerous stretches of road were those built in the style that typifies sprawl: multiple lanes, high speeds, no sidewalks, long distances between intersections or crosswalks, and roadways lined with large commercial establishments and apartments blocks. Walking offers important public health benefits, but safe and attractive sidewalks and footpaths are needed to attract walkers and assure their safety that is often suffered by sprawled development. Urban areas are warmer than rural. Heat is of concern because it is a health hazard. Relatively benign disorders include heat syncope, or fainting; heat edema, or swelling, usually of dependent parts such as the legs; and heat tetany, a result of heat-induced hyperventilation. Other effects include heat cramps, heat exhaustion vomiting, weakness, and mental status changes. From the perspective of social health, low-density development is blamed for reducing social interaction and threatening the ways that people live together (Ewing 1997; Putnam 2000)¹⁰. Residents may also lose their sense of community as their town's population swells dramatically. Other Impacts Exurban development can place additional burdens on rural economic/land-use activities such as forestry, mining, and farming, since the values of exurbanites may clash with those of traditional users regarding the most suitable uses of rural lands. Sprawl also includes aesthetic impacts such as more ugly and monotonous suburban landscapes. For other several indirect

impacts of sprawl please refer Barnes et al. (2001) and Squires (2002).

Urban Growth and its effect on Water Supply-Demand in Hyderabad

Hyderabad city is growing day by day with the alarming rate. The twin cities of Hyderabad-Secunderabad (herein referred to as "Hyderabad"), is one of the fastest-growing urban agglomerations in India, with an annual population growth rate of more than 5% (UN, 2009). The city population, currently 6.8 million, is expected to exceed 10 million in 2015. At this rate, Hyderabad will rise from its current global rank of 31st to 22nd of the biggest urban agglomerations, overtaking Bangkok, Lima and Hong Kong (UN, 2009). The change in land use over last 20 years is studied using the LANDSAT satellite images. For this purpose, satellite images of the year 1989, 2000, 2005 and 2010 were used for identification and classification of the urban area into five classes as: Water, High Density Urban Area, Low Density Urban Area, Vegetation (including agriculture) and Fallow Land. Due to defect in SLC (Scan Line Corrector) instrument of Land sat satellites after 2003, there were data gaps in the images of 2005 and 2010. These data gaps were successfully filled with the other images of the year 2004 and 2009 of the same season for this study.

⁷ Harvey RO, Clark WAV (1965) The nature and economics of urban sprawl. *Land Econ* 41(1):1-9

⁸ Ewing R (1997) Is Los Angeles-style sprawl desirable? *J Am Plan Assoc* 63(1):107-126

⁹ Wilson EH, Hurd JD, Civco DL, Prisloe S, Arnold C (2003) Development of a geospatial model to quantify, describe and map urban growth. *Remote Sens Environ* 86(3):275-285

¹⁰ Ewing R, Pendall R, Chen DDT (2002) Measuring sprawl and its impact. *Smart Growth America*, Washington, DC

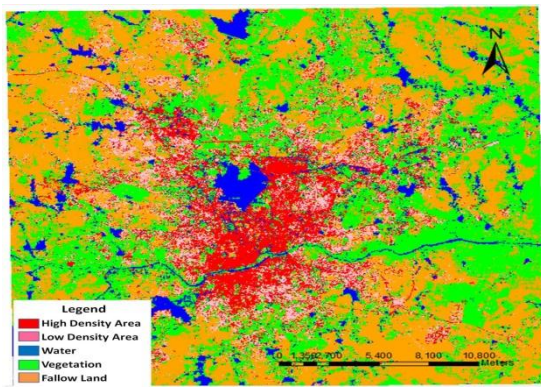


Fig.1a) Land Use Classification result for 1989

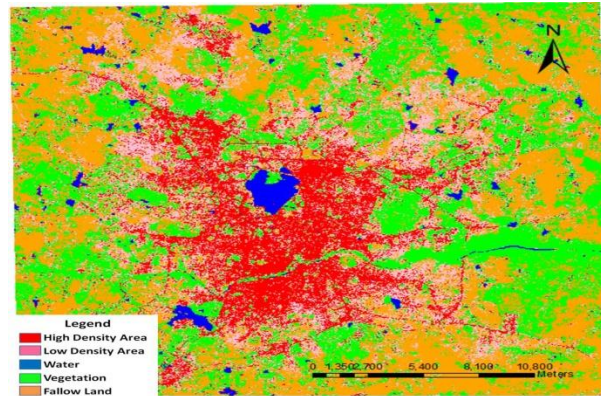


Fig.1b) Land Use Classification result for 2000

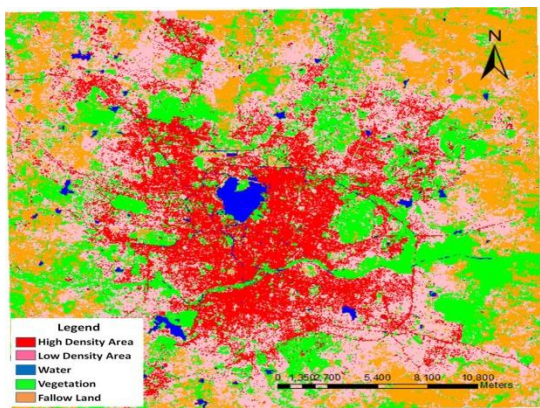


Fig.1c) Land Use Classification result for 2005

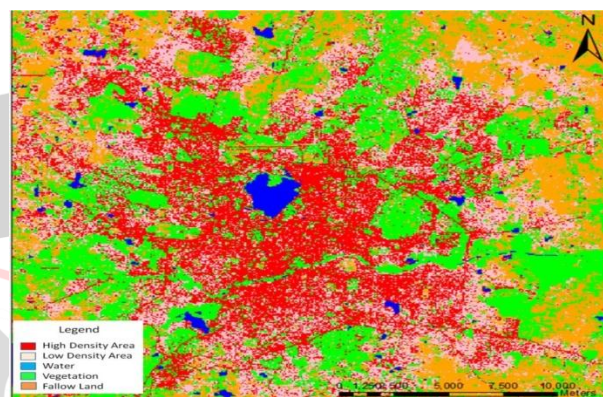


Fig.1d) Land Use Classification result for 2010

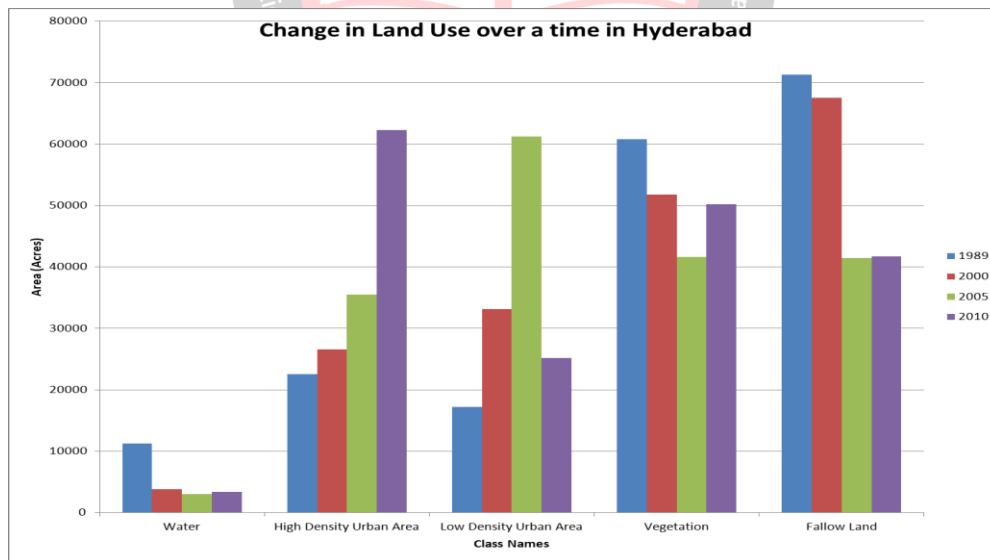


Fig. 2 Change in Land Use over last 20 years in Hyderabad

The results shows that, considerable decrease in the area of water through the period due to Non-implementation of the environmental laws and haphazard planning and growth of Hyderabad city, which also have reduced the Musi river and the different lakes in the city area. Also from the results, high population density area shows the trend of fast growth. In case of Low population density area, it was increasing from 1989 to 2005 but in 2010 it has decreased due to its conversion into high population density area. The Vegetation shows the decreasing trend up to 2005 but after that it has increased slightly because of government's policy of conversion of some areas in new parks. The area under fallow land includes most of the play

grounds and open area. The fallow land is also showing the steep decreasing trend until 2005 but after that it is near about stable in the included study area.

The effect of this population growth can be seen on the water supply to Hyderabad. It has grown rapidly over the period 1950–2010 and is projected to increase further with the completion of additional projects by 2030 (Figures 3(a) and (b)). In 1950, when Hyderabad had a population of 1.1 million people, water supply was secured by two nearby reservoirs, providing the city with roughly 3.5 million cubic meters per month (MCM month⁻¹).

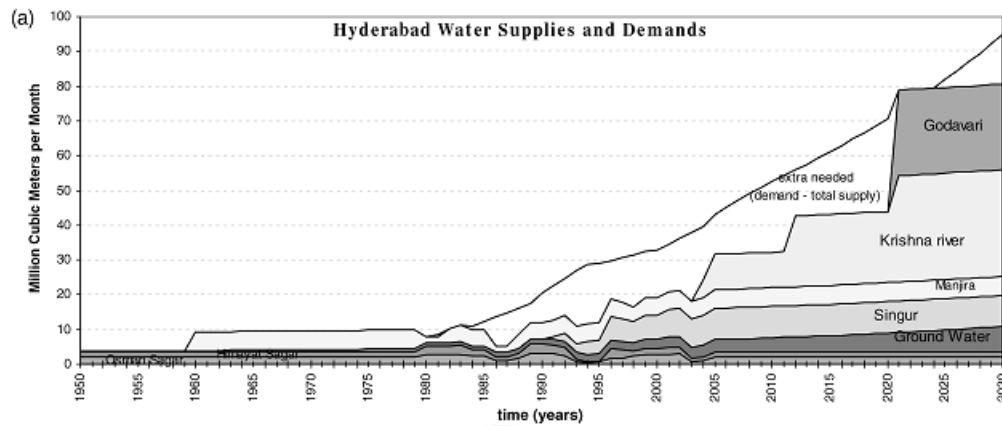


Figure 3(a) Hyderabad urban water supply patterns.

Water delivery rates from the different water sources for urban water supply in Hyderabad in the period 1950–2030. For the period 1980–2003 more detailed water delivery data were used

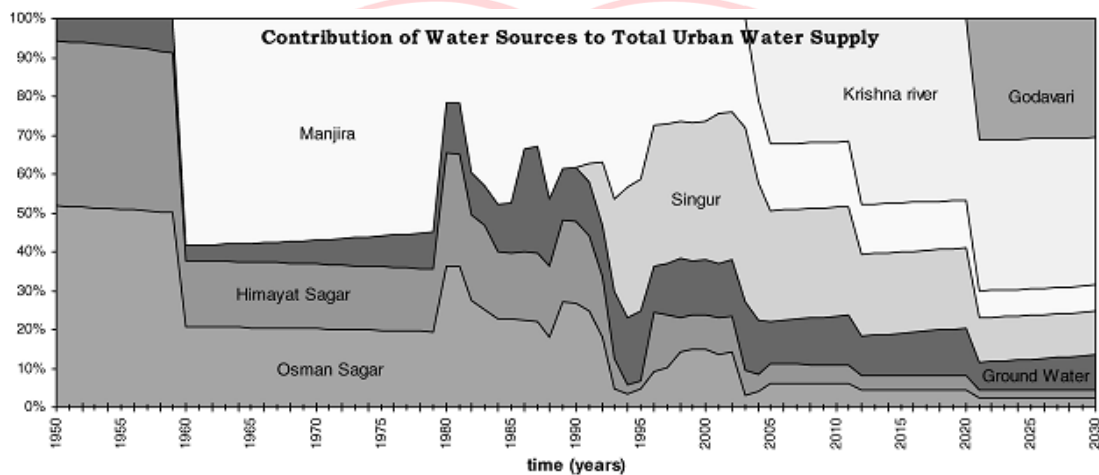


Figure 3(b) Hyderabad urban water supply patterns.

Relative contribution of the water sources for urban water supply in Hyderabad in the period 1950–2030. Absolute values were converted to percentages of total water deliveries to Hyderabad city. The percentage of each source is called “contribution to total supply”, showing its relative importance. In the 1960s, water began to be diverted from sources outside the local catchment area, and those sources now dominate the total urban water balance. In 1991, when the Singur reservoir started operating, water supply doubled in volume, rising to about 18 MCM per month in the late 1990s. In March 2003, Krishna river water from the Nagarjuna Sagar reservoir began to be pumped from a distance of more than 120 km, giving an enormous boost to water supply and already accounting for one-third of water supply in 2004, with 10 MCM per month. This is the first

stage of a multi-stage project which will provide Hyderabad with an additional 10 MCM in 2011 and a similar extra water supply in 2021. For 2020, plans exist to launch an ambitious inter-basin transfer project that will take another 25 MCM from the Godavari River. The extent of groundwater withdrawal for urban use is estimated to be 3.3 MCM per month, which has clearly caused drops in the groundwater table. Water supply is governed by the Hyderabad Metropolitan Water Supply and Sewerage Board (HMWSSB). Total water losses with treatment and transportation can amount to one-third of net delivery (HMWSSB, 1995). Hyderabad Metropolitan Water Supply and Sewerage Board (HMWSSB) is trying to conquer this increasing demand of growing urban population in very short period. In some cases they have achieved their target

but still there are lots of people who do not have enough water to fulfill their all the water needs.

VI. SUGGESTION

- Relocation of certain amenities and facilities to relieve traffic and maintain balanced location and distribution.
- Expand arterial roads along with the main roads, plan for MMTS along with roads wherever possible and provide multilevel parking using open spaces to free congestion on roads.
- Flyovers / Foot over bridge up to a certain limit can reduce congestion which in return can reduce pollution. Smooth flow of traffic without abstracters could reduce air pollution.
- Encroachments on either side of the roads in the city should be removed immediately.
- The concept of Public-Private Participation (PPP) in any development plan would lead to sustainable growth and development of the city.
- Encourage social forestry, gardens, greenery in and around the Hyderabad.
- Encourage private investment for urban infrastructure / amenities and facilities and collect user charges whenever necessary.

VII. CONCLUSION

It is understandable that, the population growth rate in different wards differs a lot in different time periods from 1981 to 2001 in Hyderabad. As a result of this the area is growing at a faster rate. In conclusion the changing negative growth is due to already existing congestion, and with the improved facilities and free availability of land with better infrastructure in the surroundings of Hyderabad. The MCH core city of Hyderabad had high density of people rather its surrounding urban agglomerations. The scope of vast open area facilities even people of MCH area to shift into suburbs for various reasons. The rapid development of the city is due to availability of safe drinking water facility and good climate condition all over the year and employment opportunity in the city which is attracting more number of people of surrounding regions. In one way, it is a big commercial centre in the state where by the city is becoming congested day by day hence; the municipality authority has lot of responsibilities to overcome the problem.

REFERENCES

- [1] Alam S.M. and Pokshishevsky, V.V. (eds), 1976, "Urbanization in Developing Countries", Osmania University, Hyderabad.
- [2] Burchell RW, Shad NA, Lisotkin D, Phillips H, Downs A, Seskin S et al (1998) The costs of sprawl revisited. National Academy Press, Washington, DC
- [3] Ewing R (1997) Is Los Angeles-style sprawl desirable? J Am Plan Assoc 63(1):107-126
- [4] Ewing R, Pendall R, Chen DDT (2002) Measuring sprawl and its impact. Smart Growth America, Washington, DC
- [5] Galster G, Hanson R, Wolman H et al (2000) Wrestling sprawl to the ground: defining and measuring an elusive concept. Working paper of Fannie Mae, pp 1-38
- [6] Harvey RO, Clark WAV (1965) The nature and economics of urban sprawl. Land Econ 41(1):1-9
- [7] Hedblom M, Soderstrom B (2008) Woodlands across Swedish urban gradients: status, structure and management implications. Landsc Urban Plan 84:62-73
- [8] Hyderabad 2020, 2003, A Plan for Sustainable Development, Hyderabad Urban Development Authority.
- [9] Kamalakar Reddy, A. & Vijaya Bhole, 2001, Studies in Land use Planning and Environmental Management, Dept., of Geography, O.U, Hyderabad.
- [10] Kamraju, M., and M. Kamraju. "Changing Pattern of Urban Growth in Hyderabad City: A Study." Jai Maa Saraswati Gyanadayani 3 (2018): 483-503.
- [11] Kamraju, M., M. Kamraju, and M. Vani. "Geotechnical Study for Groundwater Management a Case Study of Peddavagu Mini Watershed in Telangana State." International Journal of Innovative Research in Science, Engineering and Technology 6: 11780-93.
- [12] Kamraju, M., and Siva Prathaap. "HOW TO AVOID REJECTION OF RESEARCH PAPER BY JOURNALS." International Journal of Research and Analytical Reviews (IJRAR) (2019).
- [13] Neeraja, B., M. Kamraju, and K. Nagarani. "A COMPREHENSIVE STUDY OF FACTS AND FIGURES IN HYDERABAD FOREST DIVISION."
- [14] Kamraju, M, Siva Prathaap, and Mohd Akhter Ali. "HOW TO WRITE AN ACADEMIC RESEARCH PAPER." Journal of Emerging Technologies and Innovative Research , 2019.
- [15] Kamraju, M. "Evolution of Administrative Reforms in Hyderabad State." International Journal of Creative Research Thoughts (IJCRT) , 2018.
- [16] Kamraju, M. "URBAN SPRAWL AND SUSTAINABLE DEVELOPMENT IN HYDERABAD: A GEOINFORMATIC APPROACH." IJCRT, 2018.
- [17] Kamraju, M. "IMPACT OF URBAN GROWTH ON LAND USE- LAND COVER IN HYDERABAD CITY." Journal of Emerging Technologies and Innovative Research (JETIR) , 2019.
- [18] Lata, K.M., Shankar Rao, C.H., Krishna Prasad, B. Badrinath, B.S. & V.Raghav Swamy, 2001, Measuring urban sprawl – a case study of Hyderabad, GIS development, 5 (12), June 2001, Hyderabad.
- [19] Markandey, Kalpana, 2005, Urban Squalor as a Facet of Urban Landscape: Environmental Issues from Hyderabad, ISRO RESPOND Project Report
- [20] Nelson AC (1999) Comparing states with and without growth management: analysis based on indicators with policy implications. Land Use Policy 16:121-127
- [21] Rao D.S. and Reddy N.B.K., 1982, "Spatial Variation of Social Amenities within the City Regions of Andhra Pradesh", The Indian Geographical Journal, Vol.57, No.2, December 1982.
- [22] Wang W, Zhu L, Wang R, Shi Y (2003) Analysis on the spatial distribution variation characteristic of urban heat environmental quality and its mechanism—a case study of Hangzhou city. Chin Geogr Sci 13(1):39-47
- [23] Wilson EH, Hurd JD, Civco DL, Prisloe S, Arnold C (2003) Development of a geospatial model to quantify, describe and map urban growth. Remote Sens Environ 86(3):275-285