Analysis and Action for Sustainable Development of Hyderabad

Hyderabad as a Megacity of Tomorrow: Sustainable Urban Food and Health Security and Environmental Resource Management

Project funded by Federal Ministry of Education and Research (BMBF), Germany:
"Research for the Sustainable Development of the Megacities of Tomorrow"

ASSESSMENT OF URBAN CARRYING CAPACITY

A CASE STUDY OF ENVIRONMENTAL AND INSTITUTIONAL IMPLICATIONS FOR WATER RESOURCE MANAGEMENT IN HYDERABAD

RAMESH CHENNAMANENI AND SUBBA RAO

Research Report 8

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Research Reports are outcomes of the Pilot Projects implemented jointly in Hyderabad by the Pilot Project Groups of the Megacity Project of Hyderabad. These reports for analysis and action focus on *knowledge generation and application* as well as on *institutions and governance structures* concerning the core issues of poverty, food, nutrition, health, transport, environment and resource degradation. This has been possible through joint research efforts, involving institutions of urban governance, integration of organisations of civil society in communication, participation, co-operation and network linking. Views and opinions expressed in the reports do not necessarily represent those of the Project Consortium.

Assessment of Urban Carrying Capacity

A Case Study of Environmental and Institutional Implications for Water Resource Management in Hyderabad

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1 Introduction

Urbanization to a large extent is the result of a host of changes in the socio-economic policies of the governments. With the national economy gradually shifting from predominantly agriculture based to industrial, the resultant socio-economic stresses and strains necessitated people to shift from rural areas to urban areas. Urban areas have a key role to play as facilitating centers for different economic functions, other than farming. They are understood as vital cogs in economic development and expected to offer quality of life. However, today the characteristics of a city are understood by the degree of pollution, health hazards, traffic congestion, number of street children and the stress & strain of living, flash floods & frequent inundations, law and order problems. Further, the cities suffer from shattered socio-cultural life, environmental and aesthetic deterioration and ever escalating cost of living.

The city of Hyderabad has come a long way from a historical city to the present day's hub for IT industry and multinationals. The city also hosts a number of corporate hospitals, educational institutions and research organizations. With the booming economic and commercial activity, the city's infrastructure has also been given importance to support the fast changing phase of the city.

On the other hand, issues such as traffic congestion, water shortage, inflation, increasing resident population, escalating land values and environmental concerns, are on the rise at an alarming rate. To accommodate the radial and multi-dimensional activities, the city has also grown in physicality. Today, the city has also come a long way from a 174 Sq. Kms radius to 2000 Sq. Kms and the projection suggests a rise to app 6000 Sq. Kms. Haphazard growth of Hyderabad has degraded natural resources like water, air, and soil.

It is observed and understood that problems are interrelated as if there is a network of problems, balancing and perpetuating each other. Yet, the urban planning and management lacks comprehensive approach to address these issues. Most of the time, these issues are looked in isolation and their integration in the overall urban development process has not taken into shape yet. In fact, the urban development process in India has been reduced to mere physical development of the city.

Further, it is well understood that as the city grows in physical and social stature; we not only bring in more land and natural resources into the built-in areas, but also integrate the complexities of that respective area into the city. Moreover, the sustainability of the natural resources that the urban ecosystem can hold to meet the growing linear and horizontal

dynamics is also a question to ponder over. On parallel lines, there are on-going efforts to make the city of Hyderabad a Mega City.

At this juncture, it is important to understand that unless the City is made self-reliant in managing its own resources and wastes, the idea of sustainable city will be limited to concept itself. This effort requires a careful understanding and analysis of urban planning and development process and its impact on the various natural, social and economic factors that determine the nature and status of the urban ecosystem. One needs to assess the carrying capacity of the natural system in context of urban development

Contemporary challenges that we face are:

- Can we sustain the present rate of physical development?
- To what extent urban development be limited??
- Is there a better way to regulate urban development?

1.1 Can we identify the threshold limit of urban growth? Further, understand the carrying capacity of the natural system.

In this regard, it is very important to follow study and analyze the changes to understand and reorient the direction of the change towards sustainability. Such study and understanding has greater relevance in the area of urban development, particularly with reference to carrying capacity of natural system in the context of urban physical growth.

Over a period of time, there have been efforts in extending the principles of natural ecosystems to the built-in areas, in order to understand their functionality on the lines of ecology and ecosystem. The role of Carrying capacity as a decision making tool has been studied in order to understand the viability of resources that an urban ecosystem holds in order to support its population and its respective economic activity.

Presently, the on-going efforts to orient the urban development process in Hyderabad on the lines of sustainable development makes it conducive to study, extend and integrate the principle of carrying capacity as a decision making tool in the on-going urban planning and development process.

The relevance of integrating the principle of carrying capacity to the built-in areas can be well understood from one of its definition which states that it is ‘the maximum rate of resource consumption and waste generation that can be sustained indefinitely without

progressively impairing the productivity and functional integrity of relevant ecosystems wherever the latter may be located.' Since, the urban areas are primarily dominant by the diversified human activities, this definition holds relevance.

2 Carrying Capacity

Diverse urban problems occur in cities due to over development and over concentration, which cumulatively exceeds the region's carrying capacity. Particularly, water and air pollution have become critical central issues for urban planners and decision makers.

Traditional approaches focus on providing physical facilities, which are based on demand and supply principle, often complicate environmental issues. During the year 1996 UNCSD established certain indicators in this direction, which are – social, economic, environmental and institutional dimensions. However, carrying capacity is defined with a specific context and the parameters may vary from one case from another.

Ecologists generally consider carrying capacity to be the maximum no of individuals that cane be supported in an environment without the area experiencing decreased ability to support future generations within that area [Chang 1988]

Planers define carrying capacity as the ability of natural or man made system that can absorb the population growth or physical development without considerable degradation [Schneider et a l1978]

Carrying capacity is the ability of natural or man made system to support diversified needs beyond which considerable irreversible damage or degradation, instability occurs [Godscahalk and Parker 1975]

Carrying capacity can be defined as scale of economy that the natural system can sustain [Seoul Development Institute 1999]

Carrying capacity as concept can be defined as maximum levels of human activities that can sustained by the urban environment without causing irreversible damage and serious degradation. This concept is based on assumption [Kozlowski 1990] that there is certain thresholds which when exceeds can cause serious damage to environment.

Agenda 21 emphasizes need to look beyond conventional ways of addressing approaches for economic development, which has been instrumental in many of changes in society.

2.1 Urban carrying capacity can be understood in four dimensions

1. 1. Environment & Ecology - the degree of human activities that environment & ecology within an area can support without causing serious degradation or damage on maintenance of quality of life
2. 2. Urban Facilities - degree of human activity facilities and services within an area that can support without causing serious degradation or damage on maintenance of quality of life
3. 3. Public Perception - The amount of activity or degree of change that can appear before recognizing the visual quality of environment differently than previously perceived.
4. And
5. 4. Institutional Perspectives - - the administrative or financial condition of city fro maintaining optimal scale of urban development towards public goal

To enable to understand and assess the limits of carrying capacity, it is very important to identify the critical determining factors. The following factors are generally accepted and used in assessing the urban carrying capacity -

Determining factors:

- Energy
- Water Supply
- Open Green Areas
- Roads Traffic
- Sewage Treatment
- Solid Waste Treatment and Management
- Subway System

Many more parameters are considered viz; slope, topographic details, population density etc. criteria fro selection of specific parameters depends on the purpose or the objective of the study.

Carrying capacity should be maintained as fundamental base while economic growth progresses. This holds broad framework for sustainable development, which aims at harmony between economy and environment. Further, environment has certain limits after which the development cannot be sustained. Therefore, such activities need to be controlled and regulated within carrying capacity of natural system.

Carrying capacity refers to the number of individuals who can be supported without degrading the physical, social, and cultural environment; i.e., without reducing the ability of the environment to sustain the desired quality of life over the long term.

3 Hyderabad: Carrying Capacity

India, witnessed rapid urbanization during the last two decades and state of Andhra Pradesh, is no exception to this phenomenon. Presently, urban population in Andhra Pradesh has reached 38 percent of the total state population. And, it is estimated that in coming 20 years period, it will reach anywhere around 50 percent of the total state population, whereas the urban population at National level is 31 percent and may likely reach 40 percent by the year 2021. The situation is alarming.

Historical city of Hyderabad celebrated its 400 years of establishment during 1993 and its origin may be traced back to the Quli Qutub Shahi Kings of the 16th century when the city was built. The city of Hyderabad was established as a civil capital in 1591 on the south bank of river Musi, about six kilometers East of Golconda.

Hyderabad topped the list of cities in terms of its ‘growth rate’. Population in capital city increased in leaps and bounds, in the past four decades. In the year 1927, this city had a population of half million and steadily increased to 2 millions in 1970’s, later in 1980’s it touched 3 million and in 1990’s it was 4.2 million. Today, the city population might have reached anywhere around 5.5 million.

3.1 Land use

Initially, area under urban management was 176 sq. km., and today it expanded over an area of more than 1990 sq. km., in and around Hyderabad. Population of people below poverty

line is estimated to be 38% of the total urban population. **The available urban open space per person in Hyderabad city is 0.3 sq. m. as against the national recommendation of 3 sq. m. per person in city.**

The recently issued draft Master Plan of Hyderabad by HUDA for 2020, states as – ''In any layout and sub division of land or an undivided parcel of land having a net plot area [after leaving said master plan roads etc] admeasuring 2500 sq m or more 25% of the and plot area shall be reserved as recreational open space. This shall be provided in one place for plots less than 3200 Sq M for layouts exceeding 3200 in areas the total open space may be located in more than one place provided that none of such spaces is less than 800 Sq M. The minimum dimension of such recreational space shall in no case be less than 7.5 m if the average width of such recreation space is less than 24 m the length thereof shall exceed two and half times the average.

The guideline indicates the poor understanding regarding the relevance and importance of open green / recreational spaces by the planners and needs intensive & extensive public debate. More so, environmental and social perspectives needs to be promoted, integrated and ensured in the planning process.

This city witnessed dramatic and drastic changes in terms of land use pattern over centuries. Significant changes were noticed from the 1974 onwards. Population increased about two fifty percent over forty years from 1951 to 1991. The built up area, which was about 99 Sq. Km. in 1927, increased to 522.49 Sq. Km. in 1991 - a period of 64 years with a growth rate of 1.97% to 4.95%. The built-up area in 1971 was 245 Sq. Km. By 1991, it reached 522 Sq. Km; the growth in built up area had almost doubled during this period.

The population density per Sq. Km. increased from 2,537 to 24,291 within the city. Impact of increase in urban sprawl in towns of built up area resulted in the decrease in agricultural and other open space. Decrease in agricultural land suggested both conversion of land to urban land use or discontinuation of agriculture activities in anticipation of conversion to urban areas.

The loss of agricultural lands and water bodies due to urban growth have been estimated. It is observed that the agricultural land which was 785.14 Sq. Km. in 1973 reduced to 684.71 Sq. Km. in 1991 registering a reduction of 12.7%. The water bodies, which were 117.98% Sq. Km. in 1973 reduced to 112.01 Sq.Km. in 1991 registering a net loss of 5.06% in eighteen years. [Refer – tables – 1,2,3,4,5,and7].

The cumulative loss under open spaces, agricultural lands, water bodies and increased area under built up area has a direct impact on the ground water resources. The increase in the area

under impervious structure/material causes in reduction of surface water percolating into the ground. Such situation not only reduces the percentage of percolation but, also, aggravates the percentage of surface runoff, flash flooding and inundations. Today, Hyderabad experiences these typical problems.

3.2 Automobile Pollution

Automobile density has increased tremendously in the past five years along with the unplanned growth of the city. In addition to public transport and surpassing its growth rate, every other type of personalized vehicle number rose sharply. Linear growth along the main roads is one of the major factors for this exponential increase in automobiles. Estimates show that there are nearly 6 lakhs of different categories of vehicles out of which nearly four lakhs are two wheelers and one-lakh cars. On an average daily 11-lakh liters of petrol is consumed. If the diesel consumption of other vehicles is added to the above, it is beyond one's imagination as to how much amount of carbon monoxide, nitrogen dioxide, ozone (indirectly), lead and mono carbons are released into the atmosphere due to this consumption. Narrow roads, while reducing the traffic speed, cause more emissions due to idling of the engine. Of these emissions, carbon monoxide is the most hazardous. Most have the respiratory and heart diseases can safely be attributed to this foul urban air. The most vulnerable sections are: children, the elderly. Asthmatic, Policemen, Roadside vendors, Mechanics, etc. The Pollution Control Board and the recently amended Motor Vehicles Act has failed to check this urban menace.

[Refer –table no’s 8 & 9].

Noise pollution is more insidious than easily recognized air and water pollution and is invisibly undermining the physical and psychological well being of millions of people. Noise affects rational thinking of human being, as it is stressful on the nervous system. In Hyderabad, lesser attention is paid to sources of noise pollution and as such is not curbed.

4 Drinking Water

Hyderabad faces water shortage, very frequently. This situation arises despite three phases of Singur project. Reasons for such a situation are not limited merely to industrial and urban growth. They include lack of coherent water policy and neglect of sources like River Musi, Hussein sagar, Osmansagar, Mir Alam Tank and various other lessen-known tanks. [Refer Table no – 6 & 11].

Hyderabad is perched on the Deccan plateau, 1776 feet above the sea level. Realizing this limitation, previously, a series of tanks were created in and around the city to augment rainwater and other water sources. Hussein Shah Wali dug Hussainsagar during the time of Ibrahim Quli Qutab Shah in 1562, to meet the drinking water needs of the residents. Now it is nothing but a pool of industrial effluents and solid wastage. Zealous real estate developers have reclaimed most of the other upstream tanks, some are in the process of being reclaimed and the remaining few serve as cesspools of sewage.

Mir Ali tank, which serves most of the old city water needs is in the process of becoming extinct due to land grabbers. Some houses are built on the upstream of this lake. This is alarming, considering that raw domestic sewage from these houses is let directly into the tank, which serves the drinking water needs of residents in old city. Trucks are washed here, thus contaminating the water with oil and grease.

River Musi is another neglected water resource. Its existence itself is threatened not solely from private interests but from the government also. A bus complex was constructed in the midst of the river opposite Gowliguda - the place is called as Imliban. Initially, government announced its intention of restricting itself to the natural island, but later on lot of land filling was done. Within a few years, the river may not be visible at all. The river hardly receives any fresh water except city sewerage. In the catchment area of this river, near Vikarabad, government has allotted Pattahs for agriculture purposes against all norms of watershed management.

The Hyderabad Metropolitan Water Supply and Sewerage Board (HMWSSB) is statutory in charge of providing and maintaining water supply and sewerage systems within MCH limits and supplies bulk quantities of water in the service area of about 792.86 Sq. Kms, which covers the ten adjoining municipalities, Osmania University Campus and Secunderabad Cantonment and ten enroute villages along National Highway No. 9(NH-9) upto Sangareddy. The water supply systems in 10 adjoining municipalities are being maintained by the respective municipalities. The Board in the 9th Board Meeting decided to take over the water

supply distribution system in the nine surrounding municipalities by HMWSSB, to ensure proper and equitable distribution of water in the said municipalities. The HMWSSB has so far taken over the water supply system in L.B Nagar, Kukatpally and Qutbullapur municipalities and the taking over of water supply functions in the balance municipalities would be done n phased manner. The Osmania University and Secunderabd Cantonment Board are looking after the water supply and sewerage system in their areas. The water supply systems in the Panchayat areas are being maintained buy the respective local bodies. The HMWWS is also supplying bulk quantities of water to many industries outside MCH limits.

It is to be noted that while the jurisdiction of HUDA is 1864.87 Sq. km, the present service area of HMWSSB is 792.86Sq.km. This is nearly equivalent to the 2001 Census Urban Agglomeration of 778 Sq.km. In the long run metropolitan water supply system will need to be extended to more areas.

The second Master Plan for Delhi (August, 1990) worked out domestic water requirement at 135 liter (30 Gallon) per capita per day (lpcd). But including industrial & commercial uses, gardens & floating population, an upper limit of 363 litres (89 gallons) per capita per day was fixed. For Kolkata (Plan for Metropolitan Development 1990-2015) KMDA adopted a per capita norm ranging from 80 lpcd t 180 lpcd (including all categories of demand). In 1994 the Hyderabad Metro Water Supply and Sewerage Board projected future water demand based on standards between 180 lpcd t 280 lpcd including industrial & commercial needs (284 lpcd for all categories).

At that rte for the entire HUDA area, and for the projected populations of 136 lakhs, the 2020 requirement would be nearly 3870 MLD. In recent times the demand calculations were pegged at 150 lpcd. The UDPFI Guidelines suggest for large metropolitan cities a domestic stands rod 135 lpcd as the minimum and 150-200 as the desirable norm. In addition a non-domestic demand 30-35 lpcd is prescribed. In the light of these standards the 150 lpcd assumption is acceptable. At this rate the 2020 water requirement for 136.43 lakhs population would be nearly 2050 MLD.

The present sources of water for Hyderabad are the Osmansagar, Himayatsagar, Manjira and Singur reservoirs. As in 2002 the total availability of water is 735 including the enhancement of 55 MLD made possible from Singur.

This leaves a shortfall of 1315 MLD (2050-735) to be met from new sources. For 2021 the HMWSSB has projected a water demand for their service area at 1817 MLD, which will have a population of nearly 100 lakhs. The total HUDA area demand as earlier stated will be 2050 lakhs. This is proposed to be obtained form the Krishna Water Supply Project over the next

tow decades. It has been estimated that the Krishna Reservoir is capable of supporting the balance demand of nearly 1300 MLD.

4.1 Salient features of the KRISHNA WATER SUPPLY PROJECT

- To tap raw water from Akkampally Balancing Reservoir and to convey to the Water Treatment Plant at Kodandapur.
- To treat and transmit 45 Mgd (204 MLD) of water to Hyderabad City.
- The MS pipelines of 2200 mm dia 115 Km long along Hyderabad – Nagarjuna Sagar State Highway (the pipeline designed to convey 90 Mgd. (410 Mld) capacity.
- Water Treatment Plant of 45 Mgd (Mld) capacity at Kodandapur.
- Enroute balancing reservoir at 5 places of 90 ML capacity.
- 3 Stage clear water pumping with Pumping Stations and Pumping equipment to pump 45 Mgd (205 Mld) at Kodandapur, Nasarlapally and Godakondla (lift involved 405.5 M with 15 MW power requirement)
- Extending Power lines and providing Electrical Sub-Stations to the pump house.
- Feasibility to add at a future date additional WTP of 45 Mgd. (205Mld) capacity at Kodandapur with additional pumping units to pump 45 Mgd. (205Mld) t add at Kodandapur, Nasarlapally and Godakondla as stage – II
- Feasibility to add raw water pipeline with and independent intake structure in the foreshore of Nagarjunasagar Reservoir and raw water pump house on onshore at Sunkishala at a future date.
- With each phase bringing in 410 Mld, the three phase project will add 1230 Mld water to Hyderabad city in addition to 730 Mld now available.

It is however natural that the cost of making Krishna Water available at Hyderabad after treatment and distribution will be very high.

4.2 Municipal Waste Waters

Total discharge of untreated municipal waters into Musi River, Hyderabad is around 500 million liters per day. The estimated air pollution emitted due to vehicular emissions in Hyderabad city is 488 tonnes per day. And, loss due to impact on human health is estimated around 360 crores per annum. (1997). Impact of water and soil pollution on environment and human health in terms of financial estimations is not done so far.

4.3 Sewerage System for Hyderabad Development Area

Even for the MCH area, which occupies only 9% of HUDA area, the coverage with underground sewerage system is less than 70% of the area.

Of the 10 adjoining municipalities, only parts of Lal Bahadur Nagar, Uppal, Qutbullapur, Gaddiannaram and Kukatpally have underground sewers. All other areas in HUDA depend on septic tanks. The present capacity of STPs in the city is 113 Mld at Amberpet and 20 Mld at Khairatabad, Hussainsagar: total 133 MLD. The proposed National River Conservation Plan for Musi River with 5 new STPs will add a capacity of 592 MLD. Salient features of the Musi River Conservation Project are as follows:

6. A pre-feasibility Project Report was prepared for Rs. 295.00 Crores for the abatement of pollution pf River Musi and forwarded by the state government to the Ministry of Environment and Forests, Government of India.
7. The project envisages to intercept and diver the dry weather flows from storm water drains flowing to the River Musi, in the stretches of the Music River flowing within the city limits and to transmit the same by conveying mains of 33 kms. Long to the Sewage Treatment Plants at 5 places, and let out the treated effluents in to the River Musi either directly or by applying on land. [Refer table no -7].

However if the water demand by 2020 is 2050 MLD then the sewage load would be 80 % of that i.e nearly 1640MLD. It is estimated that the sewerage system for the HUDA area would cost Rs. 4000 Crores.

It is also very important to note that the HMWSSB system will cater to all the Municipalities. The topographical features and slopes of the HUDA area will require that the 10 Municipalities such as Serilingampally have their decentralized sewerage systems and won STPs in addition to the areas covered by HMWSSB.

4.4 Storm Water Drainage

Within the MCH area the storm water drainage system is managed by the MCH. The MCH has taken up task of covering and canalizing nearly 117 kms of drains. Similarly in the 10 municipalities 63 storm water drains with a total length of 102.34 km area to be developed.

Issues related with storm waters management is totally neglected for reasons not known. The existing system is transformed as sewage carrier in all most all the localities, which reduces its capacity to facilitate storm waters during the monsoon period.

City is experiencing increased frequency in flash floods and inundations for short duration intensive rainfall. [Refer – news clippings]. Further details are discussed under watershed case study.

4.5 Solid Waste Disposal

The present per capita garbage generation in the city is around 500 gms. Assuming an increased garbage generation of 100 gms with economic development, the 2020 garbage generation for 136.43 lakhs population would be 13643 metric tones per day. [Refer table no –10 [.

At present the MCH area generates around 2500 tonnes of garbage per day. The disposal sites are located at Nagole, Amberpet, Jeedimetla, Hasmatpet and Gandamguda.

The Ministry of Environment Government of India has issues guidelines for locating landfill and garbage disposal sites while laying down norms for minimum distances to be maintained form existing habitations, drinking water sources, airports and several other sensitive locations. If all the distances strictly adhered to then it may be necessary to go to a distance of 60 km from Hyderabad to find safe sites.

Concerned authorities struggle to develop viable solutions in addressing municipal solid waste issues, even after 7 years of notification. No serious attempts have been made in promoting citizens active participation.

Seldom we recognize the vital services provided by poor. It is estimated about 15,000 poor people are engaged in collection of recyclable material from municipal garbage in twin cities of Hyderabad and Secunderabad. About seventy percent constitute street children and the rest are women and men from slum dwellings.

It is estimated that each individual rag picker earns an amount of Rs.20 per day. The total earning capacity of this informal sector is to the tune of Rs.3,00,000 per day.

In spite of their valuable contribution in keeping the city garbage free, we refuse to offer any ‘social status’ to them as part of urban green brigade.

4.6 Power

For a projected population of 136.43 lakhs in 2020 for the Hyderabad Metro Area, the demand for electric power is expected to be nearly 2500 megawatts. The Master Plan for Delhi computed consumption of power for domestic, commercial, industrial and other requirements at about 2 KW per household. The UDPFI guidelines have recommended one 11 KV substation for population of 15000 as general standard. Going by Delhi Master Plan standards, 2020 power requirement will be more than 5000 MW.

High-rise buildings are now dotting the skyline of Hyderabad city. A large number of high-rise buildings, predominantly for residential purposes, have sprung up in the city in recent years. Many more are in planning or actual construction stages. But now it is the time to start watching over the indiscriminate construction of high-rise buildings.

There is every need to ensure that high-rise constructions are carried out under a comprehensive urban policy that meets all the requirements of the environment and utility services. Many attractive apartments today are found with unhappy occupants because they do not get adequate water, as the area's water supply cannot cope with the huge need of the users. On the other hand ordinary dwellings in the same area are experiencing dwindling water supply because the heavy pumps of the high-rise buildings nearby draw much of the supplied water. Multi-storied buildings nearby draw much of the supplied water. Multi-storied buildings have cropped up in many places filling up water channels and water bodies that formed a part of the city's useful natural drainage of flood and rainwater. Experts say that many of these multi-storied buildings were set up without the proper reinforcements to withstand even moderate earthquakes.

Then there are also serious concerns about the environment. Multi-storied structures blocking natural drainage create water logging problems and problems of sanitation. The sewerage system is inadequate in most parts of the city or do not even exist in some areas. The high-rise buildings, therefore, stress the system further or add to environmental hazards.

Rules are there in paper for the builders of high-rise buildings to take the permission from different government bodies, to the effect that the buildings would be sustainable from the perspective of utility services and not conflict with other broader goals. Most of the time, these certifications are too easily and undeservedly obtained with bribery.

The imperative, therefore, is a comprehensive policy and ways for its scrupulous execution to take care of the planned urbanization needs of Hyderabad. After the collapse of about 70 multi-storied buildings in Ahmedabad, which claimed nearly 700 lives, there is widespread concern in the state for overlooking the politician-builder-bureaucrat nexus.

Over the years, dearth of planning and law enforcement failure in the capital city snowball this problem into a crisis. There have been plenty of high-level meetings, seminars and symposia, reports and editorials in the news media on the issue; however, these, unfortunately, failed to produce any effective means to bring our real estate development to an order. Participants at every meeting would be unanimous on one observation - any one agency cannot possibly come up with an efficient and effective solution. *This multidimensional problem requires multidisciplinary engagement for a redressal.*

Reportedly, on 29th January, 2001, the Municipal Corporation of Hyderabad (MCH) has requested all the builders in the Twin Cities to verify the buildings constructed by them in the last 10 years and give reports to the Corporation regarding their structural stability and safety within a week. The builders were also urged to immediately take corrective action through competent structural engineers if any structural defect was noticed. They were also told to examine the escape and rescue routes in the buildings constructed by them as per the Bureau of Standards specifications.

This request was made in a meeting held with the representatives of the Builders Forum, Builders Association and members of the Building Committee regarding precautionary measures to be taken in view of the earthquake in Gujarat. But nothing happened afterwards and the ‘constructions’ continued.

The problems of land use and urban development are not addressed at all in Hyderabad, with authorities taking up short-term measures ignoring the long term implications of haphazard development on city and the quality of living in this city

The quantitative structure of land use in this city indicates the most striking problems in the urban development. There is improper land usage as a result of the high percentage of land used for concrete structures. The figure is as high as 80 per cent, and it is not easy to imagine how much this growth contributes to the urban environmental pollution problem. As a

consequence, the evolution of the city's function has been hindered, and severe pollution has degraded the urban environment. There is slow development of urban infrastructure.

Public facilities cover 8 per cent of the area. So it is not difficult to identify the main reason causing heavy traffic jams. The residential environment needs urgent improvement.

Town planners from round the country met in Hyderabad during the Silver jubilee Celebrations of ITPI (Town & Country Planning) in February, 2001, to discuss various efficient methods in building better plans for the future. Reportedly, experts felt the use of technologies such as Information Technology, GIS and Remote Sensing are of great use to them, than the people- and environment-friendly green building approach.

In Hyderabad, three principal approaches are made for building regulation:

8. Floor Space Index
9. Certificates and Permissions
10. Legislations and government orders

All these approaches are implemented in violation, and have led to high-levels of corruption. There is now high-degree of nexus between politicians, bureaucrats and real estate developers. The impact of such a unholy nexus can be seen in terms of wall and building collapses, degradation of water resources, congestion in all forms and at all levels, pollution and ultimately impacting on the quality of life affecting the health of not only the present generation but also that of next generation.

In this scenario, it is heartening to see that associations have come forward to ensure ‘voluntary code of conduct’. It is our belief this can be further strengthened by the promotion of the concept of green buildings through education and awareness campaigns among the people, residents and the real estate sector. There is need for initiation of reforms in the real estate sector, which help and promote the growth of sustainable cities.

4.7 Impact of High-Rise Buildings

It is our understanding that the design, construction, and maintenance of buildings have a tremendous impact on the environment and natural resources. There are more than 15,000 residential buildings and nearly 2,000 commercial buildings in Hyderabad today. These buildings together use one-third of all the energy consumed in the State, and two-thirds of all electricity. By the year 2010, another 5,000 buildings are expected to be constructed. The

challenge will be to build them efficiently, so they use a minimum of nonrenewable energy, produce a minimum of pollution, and cost a minimum of energy dollars, while increasing the comfort, health, and safety of the people who live and work in them.

Further, buildings are a major source of the pollution that causes urban air quality problems, and the pollutants that cause climate change. They account for sulfur dioxide emissions, nitrous oxide emissions, and particulate emissions, all of which damage urban air quality. Buildings also produce carbon dioxide emissions, the chief pollutant blamed for climate change.

Traditional building practices often overlook the interrelationships between a building, its components, its surroundings, and its occupants. "Typical" buildings consume more of our resources than necessary, negatively impact the environment, and generate a large amount of waste. Often, these buildings are costly to operate in terms of energy and water consumption. And they can result in poor indoor air quality, which can lead to health problems.

5 Water Resources – Relevance of Urban Watersheds

Watershed is a network natural streams contributing the / canalizing the stream waters to common destiny. Health and performance of watershed ensures the quality of fresh waters. Importance in irrigation and multipurpose dams. River valley conservation and dry land agriculture and did not receive any serious attention in the area of drinking schemes in the country.

Carrying capacity of the watershed is its inherent ability to assimilate the generated impacts induced due to land use changes and continue to retain its functional efficiency. Also, as a natural system, watershed has certain threshold limits in terms of its carrying capacity. It looses its resilience and may collapse if the impact of induced changes crosses the threshold limits. More so, when the man made changes are rapid and unscientific in nature. Loss in carrying capacity not only has direct bearing on environmental conditions but also has its cumulative impact on well being of the society – in terms of economy, human health etc.

Urban development trends in most of the developing countries do indicate the increased environmental degradation. Growing metropolitan cities in India are no exception this phenomenon.

Initial studies focused in understanding the carrying capacity of natural system due to population pressure, in the area of wildlife management and alter extended in the other interrelated branches of biological sciences. During last decade, attempts have been made in applying these basic principles in the context of urban development by several institutions in Europe and North America. Case studies conducted in parts of Asia in this direction could bring out qualitative analysis and expressed limitations in assessing the quantitative in puts due to lack of adequate authentic data.

Preliminary pilot studies are conducted at Durgam Cheruvu [lake] watershed, Hyderabad, India. The qualitative analysis of this study emphasizes the urgency in reorienting the urban planning and development and monitoring process, strategies and approaches towards sustainable urban development. Studies facilitated to identify gaps in the institutional mechanisms and further, the need for long term action research studies through specific recommendations.

5.1 Watershed

A watershed is an area of landform, which all water drains, running downhill, to a shared destination - a river, pond, stream, lake, or estuary. A watershed is a catchment basin that is bounded by defined topographic features, such as ridge tops. The aerial extent of watershed varies from few hectares to hundreds of Square kilometers. They exist on all the landforms on the earth. This implies that every human being and living form is part of watershed and does not matter how far one live from the stream or lake.

Watershed has two distinct functions in nature

11. To regulate physical dynamics of hydrology and
12. To filter the surface waters and ensure cleanly freshwater flows into the lake. The subcomponents of these two major functions are as following:

- Receive Rain waters
- Regulate the Rain waters towards common destiny, which could be lake / stream / river
- Vegetation intercepts Rain waters & retards its force before reaching the ground
- Ground cover grass filters facilitates infiltration into ground & retains soil moisture

- Marshy fore shore area, further slows down surface run off and filters the fresh waters before joining lake.
- Regulates atmospheric temperature & keeps surrounding cool
- Lake waters allow further settlement of sediments & regulates flood waters to down stream areas
- Returns the water as water vapor through direct evaporation from lake waters and as evapo - transpiration through vegetation & ground grass.

Thus watershed regulates entire dynamics of water / hydrological cycle. This process one can be observed irrespective of scale & magnitude. These hydrological dynamics in the watershed depends or controlled by relief, gradients, soils, underlying geological formations [Rocks] and intensity of rainfall and climatic conditions [Temperature, wind, humidity etc]. Further, shape and size of watershed.

5.2 Carrying Capacity

Carrying capacity of watershed is assessed on its natural ability to assimilate generated impacts brought due to land use changes on the watershed and continue to efficiently deliver its natural functions. Every natural system has the threshold limits system from the other.

Watershed looses its carrying capacity once the generated impacts surpasses the threshold limits of natural functions, which varies from one unit from other. Man induced changes under urban development have direct bearing on threshold limits. And, ultimately reflect on carrying capacity of the watershed. *Generally smaller watersheds have limited assimilating abilities and the corresponding impact will be many folds greater when compared to large-scale watersheds.*

6 Environmental Implications

Any significant change in the assimilation capacity has direct bearing on environmental conditions and reflects both in quantitative and qualitative functional behavior of the watershed. The assessment can be done at two levels –

- Physical impact in terms of quantitative changes hydrological parameters and
- Qualitative changes – generally assessed in terms of water, ambient air quality and changes in local atmospheric temperatures.

Measurable benchmarks needs to be established to asses the threshold parameters / limits as part of carrying capacity studies. To enable to establish such benchmarks, the data inventory covers three vital sectors

13. Hydrological parameters
14. Land use [pre and post urban] and
15. Information on storm water drains and sewer lines.

Primary objective of data compilation, interpretation and analysis is to identify specific man made land use changes which have direct bearing to alter the natural functions of the watershed. Keeping the primary objective in mind and also the time factor and resources the following important parameters are considered for the present study –

16. Location and geographical extent of Watershed
17. Nature of the Underlying parent rock and soils
18. Relief and Natural Gradients [i.e. topographical features] and run off coefficients.
19. Pre urban land use
20. Post urban land use
21. Rainfall
22. Percentage of area covered under storm water drains and sewer lines
23. Loss in original rainwater retention capacity of lake.

7 Urban Watersheds – case studies

7.1 Hussainsagar Lake: Case Study 1

Hussainsagar is a 400-year-old lake connecting the twin cities of Hyderabad and Secunderabad. It was originally built to serve the purpose of public water supply and irrigation. Irrigation was abandoned when urbanization took place early in this century and since the 1930's the lake is no longer used for public water supply, due to inadequate yield and heavy pollution. The total catchment area of the lake is 240.56 sq. kms while the lake surface area is estimated to be 6.50 sq. kms. It receives inflows from the following streams; Kukatpally Nala, Yousufguda stream, Banjara Hill Nala, Balkampet channel and Picket Nala.

The glory of the lake ended the day industries came up in the catchment area. Industrial estates were established in Jeedimetla, Balanagar, Sanathnagar and Kukatpally, which fall in the catchment zone of the lake. Due to haphazard industrialization, unplanned growth and gross negligence, Hussainsagar is now a toxic reservoir. Gradually, Hussainsagar became a reservoir of industrial effluents and sewage. About 25 years ago, an industrial pipeline known as Kukatpally Main (K-Main) was laid for the purpose of transferring industrial effluents to the downstream of the lake. Over years, due to lack of maintenance, the pipeline got corroded and developed huge leaking points. Thus, the K-Main and the purpose became redundant. Added to this situation, government permitted at one time industries in Patancheru to dump their effluents into K-Main for considerable period.

Most of these upstream industries are chemical related and generally lack pollution treatment facilities. Dangerous chemical effluents are let into the streams that feed the lake. Solid wastes are washed into the streams during the rains. There are now tons of toxics deposited in the lake. Industrial inflows into the lake through Kukatpally Nala are estimated to be 9540 CMD.

On a daily average, 18,650 CMD of sewer water join Hussainsagar from all the channels. The average population density of phytoplankton is estimated at 5.40x10.7 organisms/litre. Total species identified are 110. Blue green algae dominate other algal groups.

It has become the dead water body. Studies have shown that fish have got a very high content of heavy metals in their body especially in their brain.

In addition, the annual ritual of Ganesh Nimmajjanam (Immersion of Ganesh Idols) is done on a massive scale. Some thousands of idols are immersed, which are made from different materials; with paints et al. Mercury levels (probably from paints) in Hussainsagar in 1986 were 152 mg per Kg of sediment and 16 mg/l of water. Visibility under the water is barely 6 cm.

Apart from the pollution, sedimentation of the lake decreasing its storage capacity. The lake itself has been shrinking owing to illegal occupations along its bed, and road construction. Two roads, Buddha Purnima Road and Necklace Road and Lumbini Park today stand on the lakebed. Ground water in down stream areas is absolutely polluted though studies have not been done to analyze them.

Flows from Hussainsagar join River Musi. Fodder plots along this riverbed cater to the needs of the Milch animals. This link confirms the pollution of food chain itself. Even the beds of streams, which feed the lake, have these fodder plots. So far, a dozen studies have been made on this lake. There were a few initiatives from France and Australia to restore the lake. A comprehensive plan is supposed to have been chalked out, though nothing is in concrete shape.

7.2 Durgam Lake Watershed – case study 2

Durgam Lake watershed is located in the North West section of the Musi river basin and the Geographical Coordinates of Watershed are Latitudes 17^0 25’ 00” (S), and 17^0 27’ 00” (N) and Longitudes 78^0 22’ 30” (W), 78^0 24’ 30”(E), approximately. Watershed is in an elongated shape running from southeast to Northwest, covering a total area of 11.17 square kilometers.

Location of Durgam lake watershed carries prime importance by virtue of its critical position in the upper reaches [top ridge] of macro watershed covering 5 chain link tanks in the down stream [Malkam, Ibrahim, Kotha, Sathm and Langer houz lakes]. The environmental impacts in terms of physical conditions in the Durgam Lake watershed has direct bearing on in situ situations but also has potential to create chain reactions in the entire macro watershed.

7.2.1 Durgam Cheruvu [lake]

The received rain waters drain into Durgam Cheruvu, located in a valley section surrounded and the geographical coordinates are Longitudes 78^0 23’ 30” (W), 78^0 23’ 46” (E) and Latitudes 17^0 26’ 9” (N), 17^0 25’ 30” (S), approximately. This man made lake is popularly

referred as ‘secret lake’, since its location is camouflaged under the folds of surrounding hillocks. *It is one of the lakes having high potential for water storage. It was constructed with lot of vision and technical perfection deserves all the praise. A very big lake of about 250 acres in extent with substantial storage capacity was brought into existence by bridging a small gap of a few hundred meters between two hillocks. Most of the water gets stored within the folds of hillocks Madhapur in the close vicinity of Hi- Tec cit.*

This man made lake was constructed in 15th centaury by Qutub Shahi dynasty and speaks volumes about its technical perfection and engineering marvel and foresighted vision of then rulers. The surplus water from this water body joins the down stream lake and the limited availability of flat terrain supported 20 acres of wetland agriculture under this lake.

The lake waters were meeting the water needs of the Golconda fort and had concealed pipe systems to supply waters through natural gravity flow. Water distribution to fort was abandoned over a period of time. Primary objective of constructing lake to control and regulate surplus floodwaters and also to supply waters for the fort.

7.2.2 Nature of the Underlying parent rock and soils

The granite rock formations constitute underlying bedrocks and the out crops can be seen as elevated ridges in all three directions of the area. Out crops of the granite formations can be seen in all the three sections of the watershed, occupying from W to NNW and SE to parts of NE of Durgam Lake. Controlled nature of natural streams indicate deep seated fracture system. Soils are predominately red morrum in nature. The thickness of the soils and weather sections can be seen in the valley sections of the watershed. The thickness varies from few inches to 15 feet in the valley zone.

7.2.3 Relief and Natural Gradients [i.e. Topographical features]

Topography is undulating in the valley section and varies from moderately steep to very steep. Highest elevation is 620 meters above sea level and lowest elevation at the lake level is 540 meters above sea level. It has gentle gradient from northwest to south and north to south .The gradients from west to lake wards is steep and similar is the gradient from northeast to south. Lake is located in the valley section and is in elongated shape running from north to south.

Close observations indicate that the drainage is structurally controlled in nature i.e. drainage coming from east to west joining the lake. Durgam lake is connected with artificial

man made flood control canal coming from north to south, joining at the fore shore zone. This structure was facilitating the diversion of harvested rainwaters from the watershed located northwest Durgam watershed [north of hi-tech city phase 2]. This canal is abandoned and is no more use. Consequent the flows into the lake is drastically reduced to the tune of 1.44 M Cu.m.

Based on nature of relief, gradient watershed can classified into five distinct zones [Refer M**ap 1**]

24. Occupies west and northwest and north-northwest sections and forms the topographic ridge of watershed. This zone covers 21 percent of the total area [232 hectares app] and has gradient of 7 degrees.

25. Occupies northwest, north and northeast sections and forms a crescent shape valley. Natural gradient fallow towards Durgam Lake. Undulating in nature becomes flat as slope reaches lake. Covers 24 percent of the total area [270 hectares] and has a gradient of 0.80 degrees.

26. Occupies southwest section and covers 6 percent of total area [75 hectares]. Exposed granite formations and the natural gradient is 8 degrees gradient.

27. This section of watershed occupies 40 percent of total area and has two distinct development zones. [Refer D1 & D2 M**ap 2**]. D1 has gentle slope 0.90 and D2 with 6 degrees gradient. Located towards NE and E parts of the area.

28. Occupied by highly impervious granite formations and occupies 9 percent of the total area [95 hectares] located south west of Durgam lake. Has steep slope of 11 degrees running towards lake.

The watershed is an ecologically sensitive and any unscientific developments have the potential to change the hydrological system in a drastic manner.

7.3 Pre urban land use pattern

Prior to the urbanization the area dry land crops and wet crops are seen beyond the watershed near HI TECH city in the form of small patches. The land utilization as per revenue records is 6% under Barren Un Cultivable Land; 8% is under forests; 11% is under Non Agricultural Use; 3% is Cultivable waste; 4% is Post pasture land; 26% Cultivable Fallow; 9% is other

Fallow land; 1% is under Miscellaneous use; only 32% is Urban Sprawl. This information covers entire serilingampally Municipality.

7.4 Post Urban Land Use

The development activities in Durgam Lake Watershed can broadly classified into three broad categories based on the nature of the land use –

29. Institutional Area

30. Mixed Land Use development and

31. Residential.

Micro unit 'A' has planned growth and is exclusively allotted IT sector under hi – tech city. The HITEC City [Hyderabad Information Technology Engineering Consultancy City], is a joint venture of APIIC Limited and M/s Larsen and Turbo Limited for providing State of the Art integrated infrastructure of IT industry which can just move in, plug in and start working.

Entire HI TECH City is located in the micro –unit – 1, of the Durgam lake watershed. The phase II of the Hi-Tech city is located all along the topographical ridge, spreading from west to northwest zone of the watershed. This zone has distinctly massive structures occupying the highest contour of 600 meters and the work at the foot region of the hillocks is under progress. Extensive excavations in this region are in progress.

This new venture is located in the parts of Serilingampally municipality. To promote it sector in the state government provided grant exemption of Stamp Duty, transfer of Property Tax and Registration charges on the space purchased by User IT companies with HITECH City premises. The first phase was completed in the year 1998, providing space of 5.8-lakh Sq. ft spaces with world - class art of technology. The Honorable Prime Minister of India inaugurated the Phase I of HITEC City on 22nd Nov 1998 and foundation stone was laid for Phase II on the same day.

The entire project is aims to provide built environment covering around 6 million square feet area. Total area of about 158 acres is allocated by the Government for phase I and II with expected investment of 1500 crores.

HITEC City on integrated Techno Township designed to serve the business and social needs of business organizations. The Township's architecture and Engineering enable easy adaptation to the changes in Technology and the growth in business. HITEC City offers an earth Station, thus putting the world within easy reach. Add to this the township is in close

proximity to schools, colleges and hospitals. Phase I of the project offers companies a ready-to-run business complex from day one. Companies can also construct buildings of their own design in the main city area. Truly, HITEC City will serve as a one-stop-shop solution, catering to the business activities as well as the social needs of the corporate community.

Software companies such as Microsoft, Metamor, Oracle, Apple Soft and Toshiba etc have purchased space in HITEC City, besides service sector firms like ICICI, Andhra Bank, Thomas Cook, Tata Consultative Services, DOT, STPI etc have also purchased space and developed their own premises under the second phase. And many more are expected to join the venture and the work is in progress.

7.5 Mixed Land Use Development

Mixed land use development pattern is observed in ‘B’ ‘D1’ ‘D2’ micro units. Micro unit ‘B’ has relatively high-density development. Unplanned & unregulated growth in this zone resulted in encroachments of fore shore and part of lakebed area. Area has high degree of mixed development. Patches of marshy wetland sections are under developmental pressure. Micro unit D1& D2 has planned growth of residential units and is transforming into mixed land use, giving way to commercial development. No developmental activities are initiated in micro unit ‘C’. Information on proposed land use development is not available. Micro unit ‘E’ witnesses complete residential growth and developmental activities are in progress. This section of watershed is located in the southwest section. Illegal encroachment of lakebed is in progress.

Physical growth under concrete structures and paved roads occupies more than 50 percent of watershed. And, the area is not covered by storm water and sewer line systems. The planning process is under progress.

8 Rainfall and its Interpretation

Area enjoys semi arid conditions and receives rains from southwest monsoons. The average annual rainfall is around 780 mm and receives maximum rainfall during, the months of July August, September and October. Number of effective rainy days range between 18 to 30. and area experiences high intensity precipitation, also. Information on rainfall is very important to assess not only the total hydrological system but also changed hydrological dynamics due to land use changes.

Sources –

1. I M D (Indian Meteorological Department), Government of India – station located at Airport, Begumpet, Hyderabad.

Procured data – Day wise rainfall for the period between – 2000 to 2006. Data is collected, compiled and documented by IMD. Monitors data from January to December, months falling under single / one calendar year.

2. A.P. State Bureau of Economics and Statistics :

The rain gauge station is located at the revenue office of serlingampally Mandal.

Procured data – Average annual rainfall data for the period between 1993– 2000. Revenue department monitors, collects, compiles and documents data on seasonal basis for instance data starts from June 2001 and ends in May 2002. This method of data collection covers parts of two consecutive calendar years. Also, collected month wise data for the year 2004 -05 from Serlingampally Mandal Revenue Office.

Due to non availability of day wise rainfall data from revenue department, no attempt has been made towards comparative analysis from two different sources. However, there is marked difference in total volume of rainfall received from these two different stations. The observation for a period of more than 10 years clearly indicate changes in rainfall trend over distances of 30 km and challenges the age old conventional theory of IMD, that the rainfall station has potential to monitor over an area of 150 Sq.Km.

8.1 Data Interpretation

Data collected from revenue authorities indicate that rainfall exceeded the normal between 1997 to 2000. Area received excess rainfall during this period and recorded maximum in 2000 [1133 mm]. And rest of years in this period recorded below average trend and recorded lowest in the year 2005.

Data procured from IMD indicate good rainfall between 2000 – 06. During the years received precipitation is above average [2K - 894, 2001-817, 2005-1131, 2006-920 and below average years are – 2002 -662, 2003 -747, 2004 -684 all in Milli meters only].

9 Impact on Hydrological System

Estimated volume of rain waters during pre urban conditions is 3.90 M cum, considering an average run coefficient of 0.45. Where as the estimated total volume of rain waters under post urban condition is 5.22 M.Cu.m. An average run off coefficient of 0.60 is taken into account to estimate the volume of received rainwaters under post urban situation. Factors for considering the run off coefficient are - mixed development pattern, nature & percentage of impervious surfaces in post urban and also the gradients. Considered coefficients for the micro units are – A -0.60, B – 0.80, C- 0.50, D1 – 0.55, D2 – 0.60 and E – 0.80. However, the average coefficient value of 0.60 is taken for the post urban conditions. Run off coefficients are taken as per the international norms. [Ref 25].

It is observed that there is a marked increase in total annual runoff volume in the area from 3.92 M.Cu.m to 5.22 M.Cum under pre and post urban conditions, i.e an incremental increase of 1.10 M.Cu.m. Incremental increase for 10mm rainfall will be around 16,750 Cu.m.

Durgam lake watershed is not covered with storm water drains and also by sewer lines. Further, encroachments and constructions in the fore shore and lakebed area not only created obstructions for natural flow of storm waters into lake but also reduced drastically the original rainwater storage capacity of Durgam Lake to the tune of 40 percent [1.56 M Cu.m].

More than 55 percent of the area is covered with artificial impervious ground surface and concrete structures. Loss of water retention capacity, absence of storm water and sewer systems, increased impervious surface area cumulatively poses threat in occurrence of frequent flooding.

The studies carried out by L.B. Leopard [US Geological Survey Circular 569, 1968], revealed that an urban area with 40 percent impervious surface and 40 percent served by storm sewers can expect to have about three times as many over bank flows as before urbanization. The studies in this direction showed that urban runoff is 1.1 to 4.6 times pre urban runoff. Floods are a function of rainfall – runoff relations, and urbanization causes a

tremendous number of changes in these relations. Further, enhances frequency in occurrence of flash floods and inundations of low-lying zones. Its impact is greater in small watershed basins of few square kilometers.

Absence of storm water drains, increased impervious cemented structures & pavements, reduced infiltration capacity, accelerated surface storm water run off, loss in rain water storage capacity of water body and disturbed natural drainage, changed natural gradients, loss of tree & ground cover cumulatively undermined the carrying capacity of Durgam lake watershed in terms its ability to assimilate generated physical impacts due to unplanned and rapid urban development. Unfortunately all this happened over a very short span of six years.

The original rainwater storage capacity of Durgam Lake is 3.925 M.Cum. However, the land reclamation, constructions in foreshore and lakebed cumulatively reduced water storage capacity to the tune of 40 percent, [i.e. 1.56 M Cu.m app]. Intensive short duration rainfall of 60 mm over this watershed has great potential to trigger off sudden flash floods and economic losses.

This watershed experienced heavy rains and consequent floods during the last week of august 2000. This area received more than 200 mm of rainfall within a short span of 72 hours. Sudden gush of storm waters from all three sections of watershed had devastating impact – development activities in the fore shore obstructing in flows into lake further aggravated the flood situation.

Breach in the Durgam Lake Bund was a cause of concern the water gushing out of crack/ breach potential to flood Manikonda, Raidurg people living in down stream areas do not have idea on the impact of such natural calamities. People living in the university employees colony in this area, lacked the knowledge of the threat that could cause due to the above mentioned calamity and this proves to be the pitiful condition of the environmental awareness among the well educated people.

Without proper measures to regulate the upstream waters and developmental activities, proposals to develop micro soft and other developments including world trade centre twin towers have been made that would place the proposed developments in this area into “environmentally high risk zone”. The estimated impact of due to Durgam lake watershed has potential to create economic and environmental losses over an area of more than 60 Sq.Km.

9.1 Identified Gaps

Rainfall monitoring station is located at the Begumpet airport and is under the control of Indian meteorological department. Department claims that data collected has its relevance over an area of 150 Sq.km. however the data collected from the state revenue authorities clearly indicates variations in the data. The rain gauge station monitored by state authorities is located 30 Km. West of IMD's station. The changing micro climatic conditions in and around urban areas, demand high density and closed network of rain gauge stations.

Monitored and documented data do not record the duration of the rainfall and time of rainfall (night, day, time etc.,). Rainfall intensity cannot be estimated in the absence of such information. *Intensity of the rainfall is very important while computing the hydrological parameters, and also in quantifying the environmental impacts.*

9.2 Water Quality

Watershed area discharges one million gallons of untreated waste waters per day, directly into the natural streams and which in turn ultimately join Durgam Lake. Disturbances brought in the natural drainage system and total absence of sewer systems created marshy stagnant sewage water pools in the low lying areas. Micro unit 'B' transformed into potential mosquito-breeding site. Local clinics in this area continue to receive large number of patients with malaria and other water borne diseases, including Chickun guinea during last two years. Several illegal garbage dumping sites and collection points are located in parts of Kalyan Nagar colony without any scientific facilities. The rainwater passing through these sites carry pollutants to the lake. Loss of marshy fore shore wetlands undermined the natural ability of watershed to arrest the siltation and filtering of rainwaters joining the lake.

No proper safe disposal facilities are created fro the safe disposal of municipal solid waste in hi tech city zone. One can find dumps of municipal solid waste on slopes of Hi Tech city.

The tertiary employees in this region use the open areas of this zone to attend the nature call, which also happens to be a major cause of concern as no proper public facilities have been provided. The growth of informal food stalls along the roadside also indicate the loop sided planning of the HITECH city by APIIC.

BOD of untreated waste waters entering lake range from – 250 to 300 mg /l total absence of the sewage system not only contaminated the surface waters but also polluted ground water sources.

Quality of groundwater and surface water sources deteriorated. The BOD & COD, Total Nitrogen and Total Phosphorous content is very high and made the fresh waters unfit for human consumption. Luxuriant growth of water hyacinth in Durgam Lake during the November and December months of 2006 confirms the fact.

10 Institutional Mechanisms

Urban planning and development demands the services and in puts from several departments and constitutionally elected local governing bodies. Also, calls for high degree of planned and systematic coordination among the concerned institutions and active citizens' participation.

Urban Development Authority - Urban governance for Hyderabad city was initiated in the year 1869 and subsequently the city was given the status of corporation in 1933. Responding to the need fro a systematic development plan and to regulate growth of Hyderabad. Government of Andhra Pradesh on October 2nd 1985 constituted Hyderabad urban development authority [HUDA] under the provisions of the A P Urban Areas [Development] Act of 1975.The jurisdiction of HUDA comprises all the adjoining municipalities and 106 Grampanchayats.

There are other urban development authorities even within the jurisdiction of HUDA: Quli Qutubshah Urban Development Authority (for old city), Buddha Purnima Urban Development Authority (for the area near and inclusive of Hussainsagar) and Cyberabad Urban Development Authority. Coupled with the town planning section within Municipal Corporation of Hyderabad, the respective objectives and activities of these governmental organizations creates hazy picture for functions related to urban environment management.

Municipal Corporation of Hyderabad – functions of MCH is restricted to Hydearbad i.e 174 Sq.km core area, only.

Hyderabad metro water supply and sewage board – HMWSS&B (Hyderabad Metro Water Supply and Sewage Board) is responsible for supply of potable water supplies not only for area falling under Municipal Corporation of Hyderabad but also to all the municipalities falling under HUDA. And also responsible for developing basic infrastructure to address the sewage system.

A.P. Pollution Control Board - Andhra Pradesh Pollution Control Board, is responsible in addressing the pollution related issues through proper regulation and controlling mechanisms. Functioning of the board still continues to operate on conventional strategies and struggles to enforce regulating mechanisms effectively in the controlled industrial estates. Further, it's in puts towards proposed urban projects do not address adequately, right from conducting public hearings.

An attempt was made in exploring and developing viable strategies in addressing the non point source pollution, which is a major concern in urban environmental management. Board conducted one-day consultative workshop and involved important stakeholders on 19th October 2004. Interestingly, feed back in the workshop provided encouraging in puts, focusing on the need to empower local governing bodies in addressing urban environmental issues – particularly in regulating water pollution compliances from non point sources.

APIIC (Andhra Pradesh Industrial Infrastructure Corporation) provides basic infrastructure facilities, allocates land for developmental activities. Review of the functioning style of this corporation indicates that the corporation is yet integrate the lessons learnt through past experiences and build required institutional capacities in addressing the issues related with cluster development through scientific and system's approaches.

Irrigation department - Irrigation Department is responsible for the operation and management of water bodies located in and around Hyderabad. Efforts to transfer these responsibilities continue to create confusion among the departments.

Tourism Department – functions as a user agency and utilizes the infrastructure and other facilities created by urban development authority or Municipal Corporation of Hyderabad. Often, out sources its operations to private sector.

Local governing body – there 12 municipalities located adjoining the Hyderabad municipal area. Local bodies such as village panchayats and municipalities are vital cogs in a democratic system. The strength, spirit and sustainability of municipal local bodies– largely depends on the effective participation and cooperation of elected bodies– bureaucrats and civil society. Above all, it equally depends on the 'Leadership' qualities of the elected members.

In the light of the 74th Amendment of the constitution, which has come to effect from June 1993, the subject assumed special significance "Protection of the environment, promotion of ecological aspects and environmental conservation are now listed specifically as functions of municipalities, district planning committees and metropolitan planning committees".

Municipal functions, including water supply, sanitation, solid waste management, urban growth planning and protection of community health, are important aspects of the living

environment and have been the responsibility of local government all along. The challenge is how to strengthen the municipal management for an effective urban environment management.

The departments and institutions directly or indirectly responsible for urban planning, development and management include -revenue department, local governing bodies and human resources training and development institute, department of science & technology and environment, department of municipal administration and urban development and Andhra Pradesh Urban Infrastructure Finance and Development Corporation and State Tourism Department.

11 Conclusions

- Watersheds covering 2000 sq km falling under HUDA jurisdiction have lost their carrying capacity resulting in the drastic changes in hydrological parameters.
- 30 mm intensive short duration rainfall stands as thresh old limit and causes flash floods and inundations in the areas falling in core zone of Hyderabad Municipal Corporation.
- The rainfall data collected two different sources show wide variation and challenges the conventional practice of endorsing rainfall data from single source, covering 150 Sq. Km.
- Absence of wastewater treatment facilities resulted in contamination of all the surface water bodies and also contaminated 30 percent of ground water sources.
- Existing Fresh water based infrastructure is totally neglected. Consequent economic loss of 2000 crores.
- Urban planning and development is not in tune with the natural systems. And, the pollution regulating authorities have no control over non point sources of pollution.
- Local governing bodies do not ascertain their constitutional rights to protect environment.
- General awareness on legal instruments and public policies is very poor among majority of citizens, elected municipal representatives officials.
- Conflicts are increasing among the stakeholders and also among concerned departments and institutions.
- There is need to reorient present urban development plans in tune with natural systems for the watersheds falling in the proposed greater Hyderabad area, covering an additional area of 4000 sq .km.
- Attempts towards promoting supplement sources water supplies viz, rainwater harvesting and ground water recharging are being implemented on casual and ad hoc approaches.
- Efforts towards promoting wastewater treatment, recycling and re use are not effective and calls for political commitment to strengthen the implementation process.
- Perceptions and perspectives towards natural systems and resources have undergone a metamorphic change in the minds of city dwellers. Many think of natural areas in a wilderness context and resists to understand the interdependent relation between natural

systems with city development – see no role of water bodies in city environs – unfortunately mindset among urban planners, developers including policy makers and administrators is no different.

- Lack of coordination and territorial behavior undermines the system in developing integrated and system's approach to develop and implement urban planning and development. Isolated approaches often not only create bottlenecks in the process but also places cities in perpetual dependants on far off catchments for natural resources mobilization.
- System lacks management perspective in the area of urban water resources and institutions responsible for urban water supply continue to function on principle of ' **Demand and Supply**'. Also, do not have any control over the catchments of the respective drinking water sources.
- No attempt is being made in developing mechanisms / a strategy towards protection and conservation of catchments of drinking water sources. Also, in developing strategic integrated approaches towards sustainable urban water resources management.
- Cumulative impact of unplanned, rapid and unscientific urban development activities in and around Hyderabad city not only undermined the functional ability of natural watersheds but also posing threat to the urban carrying capacity, particularly in sustaining the potable water supply system.
- Deteriorated watersheds resulted in drastic environmental changes not only in the physical dynamics of hydrological cycle but also on the quality of fresh water sources. Further, resulting on human health.
- Increased frequency of flash floods and inundations is causing huge economic losses.
- Absence of effective implementation of pollution regulating mechanisms contributing to contamination of surface and ground water resources.
- Radiation from the massive concrete structures, hot air disbursal from air conditioning systems and vehicular pollution is already showing its impact on increased atmospheric day temperatures in this area. And further physical growth and absence of tree cover may result in the formation of urban heat pocket.
- However, the national policies could not focus on issues related with watersheds in the context of urban planning, development and management. Fact is '**Urban populations**

consume more natural resources than rural population. As the urban areas grow, proportionately urban population draw on larger catchment areas for food, energy, water, minerals and materials, and human resources. This massive demand for resources leads to degradation of immediate surroundings and distant areas, impacting on the carrying capacity of the natural systems in the region'.

- The environmental impact due to present urban development has direct bearing on the watersheds both at micro and macro level of any given river basin. Cumulative impact of these changes not only disturbing the dynamics of hydrological but also contributing to large-scale river pollution.
- Reality is the rate of developmental activities keep pushing increased water demands further. One needs to review and assess the water needs of city in view of proposed greater Hyderabad and other industrial developmental activities. Also, in terms environmental, economic implications, including system's efficiency in managing and sustaining urban water supplies. Also, to integrate issues related with equity in the area of water supply keeping the needs of poor and changing over consumption patterns among the effluent sections of society.
- Different institutions and government have been focusing on urban environmental problems. However, most of the administrative actions are disjointed, fragmented and function in isolation. There is a wide gap between the management, planning and implementation. The rapid urbanization did not provide enough gestation periods to municipal authorities and local bodies to equip themselves in terms of administration, scientific temperament and financial management to tackle new challenges and escalating urban problems.
- Need is felt in reorienting and developing concrete guidelines on the urban planning and development in tune with the natural watershed. And further the need to recognize and integrate the environmental services offered by the natural systems [**Watersheds**] as an integral component of urban planning with national perspective.
- Present situation calls for a fresh approach and appropriate methods to tackle the growing problems of management of urban environment tasks. This requires the development of a new line of thinking, which integrates the advancement in science and technology, and the knowledge and skills embedded therein.

12 Recommendations

Following action research studies are suggested for the next coming phases of the project :-

- Prepare land use spatial maps for all the watersheds units falling under the greater Hyderabad, including the existing areas under HUDA.
- Establish rain gauge monitoring stations on selected watersheds and conduct carrying capacity studies to establish complete scientific parameters in relation with proposed urban development activities.
- Also, establish monitoring stations to Asses the variations in atmospheric temperatures to enable to correlate with urban development impact, including Temperature Rising due to vehicle pollution.
- Integrate principles and practices of carrying capacity in other studies of the mega city project viz –Traffic Management.
- Conduct simulation studies considering other water related issues like – Rainwater Harvesting, Groundwater Recharging, Wastewater treatment, Recycling and Re-use components, which will minimize the impacts due to flash floods and inundations. Such studies may conducted in proposed development zones under greater Hyderabad.
- Conduct studies to establish economic value of environmental services offered by natural systems, including the existing water resources infrastructure.
- Also, expected environmental and economic losses due to generated impact due to unplanned urban development.
- To implement similar studies and pilot projects in already developed areas as part of urban renewal strategy.
- Conduct consultative workshops involving all the major stakeholders to explore and identify management practices with specific focus on sustainable water resources management.
- Design and develop education and awareness literature on urban watersheds to sensitize citizen groups and other stakeholders and also develop training manuals on principles and practices on applied urban ecology.

- Proposed studies should review the national and state policies in the context of water resource protection, conservation and sustainable usage within the broad frame work of urban planning and development.
- Review the existing acts and other legal instruments in relation with foreshore area encroachments and validity of legal status and explore possibilities in developing strategic approaches in building trust and confidence among the stakeholders. And also mechanisms to ensure the active participation of these stakeholders and partners in lake conservation projects.
- Recent initiatives on issues concerned with urban water resources could throw adequate light on alternate mechanisms, like rainwater harvesting from rooftops and ground water recharging techniques to improve supplement water sources. However, there is need felt in promoting science and technology interventions in transforming the present concrete human settlements into livable ECO –CITIES.