



Editorial



This special issue carries 8 papers on the theme of ‘Urban Environmental Planning: Consequences and Challenges’, invited for the 66th National Town and Country Planners’ Congress held at Hyderabad from 2 to 4 February 2018. The first paper on the theme “Urban Environmental Planning: Issues and Consequences”, written by D. S. Meshram, Ph.D., highlights that consequences of inadequate attention to environment issues can be seen through intense rainfall in Chennai and Mumbai, air quality issues of Delhi, droughts in Maharashtra, floods of Bihar and Orissa and so on. The author underlines the fact that environmental issues like air, water, noise are being discussed in master plans in the chapter on “environment” while the other chapters address industry, trade and commerce and physical and social infrastructure, etc., which also has great bearing on environment. Therefore, these chapters also need to address environmental issues. With reference to “Urban flooding” the author mentions that the same is discussed in the Master Plan in the Chapter “Drainage” and suggests to discuss and deliberate the same in the separate Chapter in detail at least for the towns which are ceased with frequent urban flooding.

Ashok Kumar, Ph.D., the author of the paper on the theme “Three Narratives about Climate Change Policies in India” argues that several attempts made by Government of India since the last three decades, place India at the forefront of global climate change regime. India is one of the fourth major emitters of total annual emissions but nonetheless is one of the smaller contributors to global cumulative emissions of 3 percent only. India’s per capita contribution to emissions was only 2.44 metric ton, emissions per person in 2012. But India also remains one of the most vulnerable countries due to changes in patterns of rainfall, and increasing frequency and intensity of extreme events such as cyclones, droughts and floods. At the same time India is confidently riding on its high economic growth rate. The paper shows that economic policies and climate change policies have moved forward with a centre of gravity always remaining on the side of economic policies. This location of climate change policies is inequitable as they do not address needs of the most vulnerable sections of society. Another important aspect is that mostly the Indian climate change policies have not yet arrived in the city as largely they remain delinked from national climate change policy endeavors.

The paper on “Urban - Rural Water Nexus: Issues in Environmental Planning” jointly written by R. Parthasarathy and Soumini Raja describes that increasing level of urbanization and population growth has put immense pressure on basic services in urban centres. With increasing economic growth rates and urban immigration, there has been a considerable demand for domestic and industrial water use. An increase in water demand in both rural and urban areas would require a comprehensive understanding of the rural-urban water nexus. Urban water demands are likely to grow over the next decade. The paper argues that there is a need to address water supply policies at a micro level instead of the current pan-macro approach.

Utpal Sharma in his paper on “Integration of Environmental Concerns in Development Plans: A Case of Hyderabad Metropolitan Region” shows that the number of metropolitan cities in India and the developing world are increasing. City planners are increasingly faced with challenges of enhancing economic growth potential of cities and their regions. He argues that the very real concerns of environmentally sustainable development, climate change, rural-urban dynamics in city regions, issues of peri - urban areas and inclusive development needs to be addressed adequately. Land use and mobility planning, delineation of urban growth boundaries, provision of social amenities and physical infrastructure and policy and institutional frameworks need to be increasingly geared to achieve desired economic, social and environmental outcomes. The paper takes the Structure Plan for Hyderabad Metropolitan



Region as a case study to understand how these issues can be addressed and what insights can be distilled for metropolitan cities in developing countries.

A paper on “A Perspective on Environmental Challenges of Urbanization” is written by R. Shankar, Ph.D.; shows that urbanization in Indian in recent years has brought a host of problems to urban areas, which are generally characterized by arbitrary and inefficient land use developments, deteriorating living conditions and growing environmental degradation. Negative effects of rapid suburban growth are evidenced in the haphazard development of suburban land and resultant infrastructure problems. Lack of planning that characterizes most suburban growth has resulted in higher transportation costs in terms of money, time and inconvenience for suburban residents, in higher public sector costs, undesirable land use patterns and in the inadequate supply of open spaces, recreational facilities and other amenities. However, alarming the present urban growth situation may be, it is possible to put it on a track of sustainability. What may be lacking is the initiative and resolve for bold action and innovative ideas to deal urgently with a set of complex challenges we have created.

“Dealing with Environmental Challenges: New Approaches Advocating Green Growth in the Indian Cities” is written by Somnath Sen, Ph.D., who explains that the increasing proportion of world’s population living in urban areas has been driven by the growing concentration of new investments and employment opportunities. In general, nations with the most rapid and sustained economic growth have the highest level of urbanization. He further argues that green growth strategies are needed to promote sustainable growth and to break the pattern of environmental degradation and natural resource depletion. He argues that emission reductions can be achieved with minimal cost to GDP. It is the only way to reconcile rapid growth required to bring developing countries to the level of prosperity to which they aspire with the needs of more than 1 billion people remaining unmet, who still continue to live in poverty and the imperative of a better managed environment. Indeed, green growth is a vital tool for achieving sustainable development.

The paper written by R. Srinivas on the theme “Climate Resilient Construction and It’s Integration of Environmental Clearance with Building Plan Sanction” attempts to discuss the efforts of Ministry of Environment, Forests and Climate Change to delegate the power of Environment Clearances to urban local bodies vide notification dated 9 December, 2016 which was challenged in the National Green Tribunal. The NGTs order dated 8 December, 2017 has directed MoEF and CC to revisit the notification dated 9 December, 2016

The paper on “Srinagar and Urban Flooding: Lessons for Urban Planners” is written by Iftikhar A. Hakim describes that urban flooding poses a serious challenge to development and lives of people, particularly residents of the rapidly expanding towns and cities in developing countries and emphasizes that planning of Srinagar has to take into account the complexities of the Kashmir region, its fragile ecology, vulnerability to floods, existing settlement pattern, affordable transportation so that economic development and future growth of the city is ensured without compromising on its fragile ecology. Further, a healthy trend of growth of medium towns needs to be supported and reinforced by public policy, which may include policy level impetus to growth of satellite towns involving consciously planned cities in addition to the existing satellite towns in the city region of Srinagar. This will not only help to deter urbanization of ecologically fragile areas but will also go a long way in job creation and economic development of the region.


Dr. Ashok Kumar, Editor



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Urban Environmental Planning: Issues and Consequences

D. S. Meshram, Ph.D.

Abstract

Consequences of inadequate attention to environment issues can be seen through intense rainfall in Chennai and Mumbai, air quality issues of Delhi, droughts in Maharashtra, floods of Bihar and Orissa and many more. The author underlines the fact that environmental issues like air, water, noise are being discussed in master plans in the chapter on “environment” while the other chapters address industry, trade and commerce and physical and social infrastructure, etc., which also has great bearing on environment. Therefore, these chapters also need to address environmental issues. With reference to “Urban flooding” the author mentions that the same is discussed in the Master Plan in the Chapter “Drainage” and suggests to discuss and deliberate the same in the separate Chapter in detail at least for the towns which are ceased with frequent urban flooding.

1. INTRODUCTION

As per State of the Asia Report 2010-11 on current Issues and Challenges faced by Cities in Asia - Pacific Region; Asia has emerged as “one of the main engines of global economy” and the contribution of cities to the GDP of this Region is as high as 86 percent. The Report also highlights that the level of urbanization in the Asia - Pacific Region was 42 percent in 2010, and is not likely to cross 50 percent mark before 2026. Fifty percent of world’s urban population lives in Asia - Pacific. The Asian cities are characterized by demographic expansion, high density (10,000 to 20,000 persons per sq km) and mixed land uses. Spatially there is emergence of mega cities, mega - urban regions and urban corridors as a by-product of “combined dynamics of international economy and urbanization”. There are 10 mega - cities (more than 10 million population) which accommodate 11 percent urban population of the Region and include Tokyo, Delhi, Mumbai, Shanghai, Kolkata, Dhaka, Nagoya - Osaka - Kolbe - Kyoto, ‘bullet train’ urban corridor, acts as a back bone of Japans economies growth. The Beijing - Tianjin - Tangshan - Qinhuangdao Transportation corridor, North-East China, is another example of urban corridors in the region. Cities of all population sizes are, generally, well distributed in most of the countries over their respective geographic expanse. Urban scenario in India is dominated by the population growth of 6 major mega cities (UAs). The population of these cities namely Mumbai, Delhi, Kolkata, Chennai,

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Bangalore and Hyderabad as per United Nations, Department of Economic and Social Affairs (UNESA), Population Division Projection (2014) is given in Table 1.

The main problems faced by Asian cities are urban poverty, inequality, affordable housing, safe drinking water, sanitation, transportation and livelihood and accordingly, some countries in the Region have begun to understand the need for inclusive and sustainable urban development.

The 20 largest cities consume 80 percent of the World's energy, besides urban areas generate 80 percent of greenhouse gas emissions worldwide (International Federation of Surveyors 2010). Accordingly, the main focus of this paper is on the "Consequences and Challenges of Urban Environmental Planning" with specific emphasis on "Environmental Challenges of Urbanization"; "Environment and Development Plans" and "Urban Flooding".

2. ENVIRONMENTAL CHALLENGES OF URBANIZATION

Indian cities contribute more than 62 percent of the national GDP as per United Nation World Urbanization Prospects Report - 2014. The level of urbanization which was 17 percent in 1950; 26 percent in 1990; and 31.16 percent in 2011; however, the recent data reveals that level of urbanization is more than 32 percent (UN-Habitat 2015). While the Census of India, 2011 data reveals that, 377 million people lived in urban area which constitutes about 31.80 percent of the total population in India, and more than half of the population is expected to live in urban areas by 2050, due to increase in level of urbanization from 31 percent in 2011, to over 50 percent by 2050, which will open up opportunities as well as challenges for the country.

Earlier, the Census of India also projected that the urban population by 2011 would be 358 million and urban growth rate would decline from 2.75 percent per annum (1991-2001) to 2.3 during 2001-2011 to 2.23. However, the growth rate has not declined but was almost constant i.e. 2.76 percent while during the same period level of urbanization has increased 3.3 percent (2001-2011) compared to 2.1 percent during 1991-2001. During the same period the economy has grown from 6 percent per annum (1990) to 8 percent in 2000. This indicates that economic growth encourages faster urbanization. It is therefore, not possible to stop the

Table 1: Population Growth of Selected Metropolitan Cities in India

Sl. No.	Cities	2001	2011	2030**	Annual Growth rate	
					2001-2011	2016-2030
1	Delhi UA	12.90	16.35	36.06	2.68	2.2
2	Mumbai UA	16.43	18.39	27.80	1.19	1.9
3	Kolkata UA	13.25	14.06	19.09	0.61	1.7
4	Chennai UA	6.69	8.65	13.92	2.94	2.2
5	Bangalore UA	5.70	8.52	14.76	4.94	2.5
6	Hyderabad UA	5.76	7.68	12.77	3.34	2.3

Source: United Nations - Department of Economic and Social Affairs (2014).



wave of urbanization and it should not also be, at least on the pretext that urbanization degrades the environment, because negative externalities emerging from the urbanization especially of the large cities such as urban sprawl leading to acquisition of agricultural lands, pollution, congestion, loss of open spaces, paucity of infrastructure, poor housing, etc., will have to be suitably addressed by taking proper measures to curve these negative externalities. However, the consequences of inadequate environmental approach to urban planning can be seen through intense rainfall in Chennai and Mumbai, air quality issues of Delhi, droughts in Maharashtra, floods of Bihar, Orissa and Tamil Nadu, and so on.

From the modern history of city planning and development, it is not difficult to trace that rapid urbanization and industrial development leads to environmental degradation. In spite of inclusion of sustainability in plans, planning guidelines and persistently talking about climate change, risk and resilience, we are observing constant environment degradation. The UN Conference on Sustainable Development with focus on “future we want” held at Rio de Janeiro where about 50,000 participants from 193 countries assembled and discussed the various issues including climate change, disastrous consequences of rise in level of oceans and ways to create green economies. Brundtland, the former Norwegian Prime Minister and the then Chairman of UN Commission, that evolved the concept of “Sustainable Development” gave globally acceptable definition of sustainability, and 25 - year ago, said in a statement that the “Rio + 20 declaration does not do, enough to set humanity on a sustainable path, decades after it was agreed that this is essential for both people and the planet”. And many activists raised sentiments and said that the Summit did not advance beyond what was agreed at the original Earth Summit at Rio in 1992. There being no political will to move forward and commit further support to sustainable development.

Increasing rate of urbanization with migration to urban areas, urban sprawl leading to acquisition of agricultural lands, deficiency of infrastructure, lack of open spaces and parks, pose serious environmental challenges. Due to continuous building activities, debris are dumped in water bodies and low laying areas, eventually, these spill over choke waterways causing floods during monsoons, the gravity of which is being felt in metropolitan cities like Delhi, Mumbai, Hyderabad and Chennai. Temperature in cities is increasing drastically due to paving on the vegetated land, increasing number of residents, beyond the bearing capacity of our town and cities, construction of high rise apartments, commercial places, malls, besides industrial activities, foundries, factories and use of lifts in multi storied building in addition to air conditioners, coolers, heaters, generators, etc., which not only generate heat but also create air pollution. In addition to industries, factories, and foundries power plants, furnaces, release harmful emission of gases and smokes besides release their liquid waste in water bodies.



To accommodate ever increasing urbanization, forests are cut and denuded, which decreases the vegetation cover. To house the high population growth, cities demand more infrastructure and services, creating scarcities which will be difficult to meet. Infrastructure scarcities also cause pollution as unplanned resource management depletes natural resources and creates unhealthy environment. However, after filling these gaps, more people are attracted to cities causing overcrowding, beyond the bearing capacity of town / city, haphazard and unintended development manifested in the form of unauthorized construction and slums. Solid wastes production and sewage wastes increase disproportionately with population growth without adequate management capacities. The excess of water in urban areas, specifically during rainy season creates havoc. Coastal cities such as Mumbai and Kolkata are poised to face some of the most severe impacts. In addition, inland and coastal cities located in areas next to rivers will also have to face impacts of flooding, as is already being felt for example in Delhi, in areas around the Yamuna river.

Cities in semi-arid areas and dry lands such as Bangalore are already facing the problems of water flooding due to unpredictable rainfall, compounded by the pressures of urbanization. The most vulnerable are residents who are socio - economically deprived because they live in informal or traditional settlements that are located in areas at greatest risk of flooding, in addition to greater risk of eviction during hazards. The intensity of these challenges will be magnified as climate change accelerates. For mitigation, sustainability measures are being implemented in several cities ranging from public transportation to solid waste management and rainwater harvesting. However, these measures need to be intensified. Ecosystem restoration also requires to be focused, urban forests have a potential to reduce air pollution and decrease urban heat island effects.

3. ENVIRONMENT AND DEVELOPMENT PLANS

This section of the paper narrates the present trends of dealing with environmental issues in master plans by taking the case study of Master Plan Delhi - 2021; Master Plan Chennai Metropolitan Region - 2026; and Regional Plan - 2021, National Capital Region because it is observed that a separate Chapter is incorporated in all these Plans on “Environment”.

3.1 Master Plan Delhi - 2021

Master Plan Delhi - 2021 underscores that creation of a sustainable physical and social environment for improving quality of life is one of the major objectives of the plan because almost unprecedented scale and speed of urbanization in Delhi has resulted in enormous pressure on the physical environment with a severe impact in terms of pollution, and today Delhi is considered to be amongst the most polluted cities in the World. The city environment needs to be seen in terms of two components namely the environment per se or the habitat



and services management. The former pertains to the natural features and resources including the elements of air and noise, water (water bodies - river, lakes, drains and ponds and ground water) and land with reference to open spaces, green areas and other surface and sub-surface conditions. The latter is related to the built environment and includes the environmental infrastructure - water supply, sewerage, solid waste disposal, and the transportation network. Accordingly, three fold approach and strategy has been adopted in MPD - 2021, i.e. management of natural resources and related environment infrastructure and services in a manner that would lead to optimization of use of natural resources, and reduction and abatement of pollution; conservation and development of the natural features with a view to enhancing their environmental value and development; and preservation of open spaces, greens landscape or recreational areas. Natural resource conservation includes management of water (surface and ground), air and noise which is elaborated below:

3.1.1 Water (Surface and Ground) Pollution

The sources of water resources in Delhi are basically comprised of the river Yamuna, drains and the lakes / ponds. The ground water in Delhi occurs, in confined and semi-confined conditions, which is also one of the major sources for water supply in many parts of the city and contributes substantially to water supply, especially in new developed areas groundwater is largely being used as drinking water. However, recharge of ground water gets limited due to decreased availability of permeable surfaces owing to urbanization, and the runoff getting diverted into the sewers or storm water drains that convey the water into the river Yamuna. While, the surface water resources in Delhi are: the Yamuna River and the drains which are highly polluted; and a large number of the traditional water bodies in the form of ponds, etc.

The annual rainwater harvesting potentials of Delhi has been assessed at 900 billion liters or 2500 million liters per day. If even 25 percent of this could be harvested it would imply availability of 625 MLD, which would be nearly equivalent to the presently estimated deficiency. This is in addition to the potential for roof water harvesting assessed at around 27 MLD.

Development of parks and green corridors along the *Nallahs*, should incorporate conservation of ground water and water bodies. To recharge the ground water, conservation of water bodies and rainwater shall be essential. And to increase sub-surface soil water through seepage of rain water, porous paving tiles should be used in the pavements and soft parking areas.

3.1.2 Air Pollution

Despite various initiatives and measures taken over the past few years, like introduction of CNG and EURO - II norms, etc., the air quality in the city, in terms of pollution levels, has continued to be a matter of concern. The three



main sources of air pollution in Delhi are vehicular emission (around 70 percent); industrial emissions (around 20 percent) with a major element of this coming from the three thermal power plants; and from other sources such as diesel generator sets, and domestic cooking, burning of biomass, etc. With the phenomenal growth in the number of vehicles, almost 8 - 10 times in the last two decades in absolute terms, the most significant aspect in the context of congestion and pollution, relates to the growth in personalized transport as compared to the availability of public transport. Such a huge share of private vehicles in Delhi, while serving a relatively limited purpose in terms of the transportation modal split, obviously creates tremendous pressure on road space, parking, and pollution directly and through congestion. The other elements being operation of existing power plants which needs to significantly reduce the pollution arising from them, and industries, both in terms of pollution control in designated industrial areas, and relocation of non-conforming industries. All Thermal Power plants located in the NCT of Delhi needs to be gradually converted to gas based plants.

3.1.3 Noise Pollution

Noise is emerging as a major pollutant and irritant as well as a constant source of disturbance and health hazards. Against a permissible level of 50 - 60 dB, the sound level in Indian cities often exceeds 80 dB. Faulty and leaking silencers, over-use of horns and vehicles plying on roads accentuate noise level, besides the noise from construction activity, commercial, and industrial activities, unabated use of sound amplifiers, generator sets and fire-crackers, etc. However, by proper land use planning, such as location of public, semi-public and commercial activities along major transport arteries, a buffer can be created for residential zones. Green buffer through thin leaved trees, land formations, mounds, embankments, etc., along major roads could also provide effective barriers to transmission of noise. It would be advisable to notify certain areas as 'No Horn Zone'. The design and surface material of roads and pavements should also ensure reduction of noise.

3.1.4 Natural Features

The major natural features and eco - systems of Delhi are the river Yamuna, together with a network of streams / drains that empty into the river, and the Aravalli Range. But both of these are in a state of considerable degradation, and it is of vital importance to conserve and rejuvenate these ecosystems. This has regional bearing; therefore, surrounding states also have to contribute towards their conservation and rejuvenation.

3.1.5 River Yamuna

Once the lifeline, which spawned the many civilizations, the River Yamuna today suffers from inadequate flow and quantum of water and an extremely high degree of pollution. Over the years, rapid urbanization, encroachments on the river



banks, over exploitation of natural resources / water, and serious deficiencies and backlog in sanitation and waste water management services, have resulted in the dwindling of water flow in the river and extremely high levels of pollution in the form of BoD and Coliforms, etc. The major source of pollution in the river to the extent of about 80 percent is the discharge of treated and untreated waste water through the 22 major drains. The concerned agencies must, therefore, should ensure that people are discouraged from throwing garbage into the river or the drains and measures are taken to prevent throwing of garbage by the habitations alongside. Regular de-silting of the drains should also be undertaken.

3.1.6 Regional Park

The Aravalli Range in the NCT of Delhi comprises of the rocky outcrop stretching from the University in the North to the NCT Border in the South and beyond, and sizeable areas of the same have been designated as the Ridge. This is not a continuum as various intervening stretches have, over a period of time, been brought under urbanization - for example the Central Ridge area was planned as an integral part of New Delhi, at the time of the development of New Delhi as the Capital in the early part of the twentieth century. The Master Plan of Delhi - 2001 identified the Regional Park into four parts as Northern Ridge - 87 ha.; Central Ridge - 864 ha.; South Central Ridge (Mehrauli) - 626 ha.; Southern Ridge - 6200 ha.

3.1.7 Green and Recreational Areas

Delhi has a much larger green cover than any of the other metropolitan city in the country, and could well be called a "Green City". The green / recreational use constitutes 8,722 ha, of land as per MPD 2001, which is around 19 percent of the total urban land area of 44,777 ha. In the Urban Extension the green cover is to be provided at the rate of 15 percent of the total land, excluding the Ridge / Regional Park. Out of this, some area shall be developed in the form of formal parks for the community and the rest shall be developed as woodlands and incidental greens for balancing the environment. This will be in addition to the development of specialized parks like Bio - Diversity Parks, plantation along the roads, drains, riverbank, etc.

3.1.8 Green Belt

The MPD - 2021 provides for agricultural land as Green Belt along the border of NCT of Delhi, in synergy with the provisions of Regional Plan 2021 of NCR. The belt extends from the NCTD boundary up to a depth of one peripheral revenue village boundary, wherever possible.

3.2 Master Plan Chennai Metropolitan Area - 2026

The Master Plan of Chennai Metropolitan Area - 2026 underlines that for a better world to live in, we need good air, pure water, nutritious food, healthy



environment and greenery around us. Without sustainability, environmental deterioration and economic decline will be feeding on each other leading to poverty, pollution, poor health, political upheaval and unrest. The environment is not to be seen as a stand-alone concern, as it cuts across all sectors of development. Therefore, there is a need to improve our economic growth rate, provide basic minimum life support services to large section of our population and deal with the problems of poverty and unemployment. At the same time, we have to pay attention to conserving our natural resources and also improving the status of our environment.

Environmental deterioration is not a necessary or inescapable result of urbanization; what needs to be done is striking a right balance in making, development in such a way that they are more effectively attuned to environmental opportunities and constraints. The metropolitan environment of Chennai comprises mainly of two components viz. (i) environment per se, and (ii) the habitat. The environment per se relates to natural features and resources including the air, noise, water and land (open spaces, forests, etc.). The habitat is related to built environment and infrastructures such as water supply, sewerage, and solid waste disposal. The conservation of natural resources includes management of air, noise, water and land. The Plan addressed the various environmental issues as given below:

3.2.1 Pollution of Waterways

In Chennai, the most visible manifestation is the severe pollution of the six major waterways and drains, viz. Cooum, Adyar, Buckingham Canal, Captain Cotton Canal, Otteri Nallah and Mambalam drain. The sewage carried by them is of the order of 532 MLD, which is more than the quantity of sewage collected from the city for treatment, by the Metro Water Treatment Plants. The waterways of Chennai are not perennial in nature and receive flood discharge only during monsoon season; in the rest of the year they act as carriers of wastewater from sewage treatment plants and sewage from defective storm water outlets.

3.2.2 Air Pollution

The invisible part yet the more dangerous one is the air pollution load. The major contribution is by the vehicular sector (71.28 percent) followed by industrial sector (19.70 percent). According, to TNPCB at major traffic intersections the TSPM and RSPM values are exceeding the standard values. Pollution by industries is widely prevalent in the Manali industrial complex and surrounding areas. The annual average pollution load for industrial areas Sulphur-di-oxide, oxides of nitrogen, RSPM TSPM are way above the acceptable levels.

3.2.3 Pollution by Solid Waste

The disposal of wastes - solid waste, bio-medical waste, hazardous industrial wastes is a major problem at the municipal dumping yards at Kodungaiyur and



Perungudi are the generators of greenhouse gases and smoke due to burning of waste and have degraded the environment severely around them. In the recent past, one of the major pollution problems identified is non-degradable plastic wastes. The preventive, promotional and mitigating aspects considered to tackle this problem by the authorities concerned, include source segregation of municipal wastes, raising consumer and public awareness, specifying plastics for recycling, penalties for littering besides specifying minimum thickness of plastic carry bags.

3.2.4 Noise Pollution

The noise level survey conducted by the TNPCB reveals that noise level exceeded the limits mostly in commercial areas, mainly due to vehicular movement. During festive seasons in Chennai, the noise levels were noted high and particularly during Deepavali it exceeded 120 dB.

3.2.5 Environmental Hotspots

Chennai is blessed with diverse types of environmental areas natural as well as manmade, which is rare for urban areas. The long coastline, with wide sandy beaches, Marina being the foremost; wetlands and estuaries, hillocks with forest cover are the few. The Guindy National Park and the Vandalur Zoo area are unique to urban areas. Manmade reservoirs designed for urban water supply and irrigation, patches of productive agricultural land, good aquifer recharge areas add to the value of CMA. The environs of CMA are equally well bestowed in this respect with the Pulicat Lake in the north, the Nagari hill range in the northwest and Muttukadu in the south. Many of these features are home to local and migrating birds, turtles and other wild life.

3.2.6 Green Cover

Chennai city has only about 2 percent of the area as declared parks, while in Chennai Metropolitan Area the declared forest cover is about 24 sq km which is also about 2 percent of the CMA area. However, satellite imageries show that green cover over the city due to trees along roadside and within the sites is of considerable extent. There is ample scope for further development of this green cover within the city and also in the rest of CMA, particularly along roads, drains, riverbanks, etc.

3.2.7 Climate Change

It is recognized now that climate change due to global warming is going to be an important threat to safety of millions of people not only living near the coastline but also in the interior because of its impact on changing rainfall patterns and cyclones. Chennai is a flat coastal city subject to regular cyclonic storms and extensive inundation during the northeast monsoon period. Hence, it is necessary to take into account ways and means of tackling the effects of climate change in a planned manner. Knowledge on this subject is only gaining ground in recent



times. We need to absorb latest information and technology in this discipline not only to cut down greenhouse gas emissions from urban activities but also anticipate the effects of climate change on the economy and life of people to take timely remedial measures.

3.2.8 Cremation Grounds

Chennai Corporation is maintaining 29 conventional burial and cremation grounds and 4 electrical crematoriums. The conventional burial and cremation grounds require more space and firewood to burn the bodies and conventional burning has the element of air pollution in the vicinity apart from adding to the depletion of tree cover.

3.3 Regional Plan 2021, National Capital Region

Regional Plan 2021, National Capital Region, a dynamic urban region with more than 100 urban centres, is endowed with ecologically sensitive natural features such as ridge, wetlands, sanctuaries, etc., which needs to be planned in a way to achieve an environmentally sustainable pattern of urban development through a rational land use pattern and conservation. The conversion of agricultural land into non-agricultural and abiotic uses in order to realize the land value potential is so severe that it would require a very consistent and deterministic policy to achieve this. The environment plays a crucial role in establishing the paradigm of future development. Environmental concerns need to be viewed holistically and concerns of both natural as well as built environment not only need to be conserved but also protected from various forms of natural hazards. Accordingly, the Regional Plan - 2001 envisaged the following policies and proposals for the environment and eco - development in NCR.

3.3.1 Air Pollution

The pollution impacts have to be identified through appropriate field research studies so that the levels and types of industrialization can be established for different Sub-regions.

3.3.2 Water Pollution

No untreated domestic and industrial waste should be permitted to be discharged over land or into water bodies before treating it to the specified discharge standards under Environmental Protection Act, 1986. As far as possible, new industries be developed in identified and classified industrial areas / estates which should have proper effluent treatment facilities in-situ before effluents are discharged into natural areas. The settlements where regular sewerage schemes are not available, low cost sanitation system for individual family or community may be adopted as a short-term measure. Controlled environmentally protected zones for hazardous and polluting industries should be created.



3.3.3 Solid Waste

Scientific approach should be adopted for the solid waste management and its re-use in all urban and agricultural areas.

3.3.4 Afforestation Programs

The afforestation should be undertaken on all barren and uncultivable land by the concerned agencies. Care should be taken by the local planning and plan implementing authorities at the time of preparing and implementing the development plans of the urban areas in their Sub-regions to contain the unplanned and uncontrolled spread of corridor developments all along the major transport arteries of the region.

The Ministry of Environment and Forests under Section 3 (2) (v) of the Environment Protect Act, 1986 and Rule 5 (3) of the Environment (Protection) Rules, 1986 restricts certain activities in specified area of Aravalli Range which are causing environmental degradation in the region and prohibits process and operations, such as: location of any new industry including expansion / modernization; all new mining operations including renewals of mining leases; existing mining leases in sanctuaries or national parks and areas covered under Project Tiger; and / or Mining is being done without permission of the competent authority; cutting of trees; construction of any clusters of dwelling units, farms houses, sheds, community centres, information centres and any other activity connected with such construction (including roads and part of any infrastructure relating thereto); and electrification (laying of new transmission lines).

Thus, it is evident that, invariably not only the master or development plans but Regional Plans also contains exclusive Chapter on “Environment” and it may not be correct to say that master or development plan do not take into consideration, the environmental Issues. It not only considers the water, air and noise pollution aspects but gives safeguards to mitigate the pollution which downgrades the environments.

However, there are two schools of thoughts among the professionals i.e. whether inclusion of a separate chapter on environment in a development plan is enough, environment being such a crucial part of city planning practice. If there is a separate chapter on environment in a development plan, it shows the seriousness with which planning agencies take environmental concerns into account. While others who are having contrarian view stress that instead of one dedicated chapter for environment in a development plan, various facets of environment should be embedded in all planning policies of the plan, making environment as an overarching principle for guiding development. It needs no emphasis that, in MPD - 2021 there are separate chapters on shelter, trade and commerce, industry, transportation, social infrastructure, physical infrastructure (water, sewerage, drainage, power, solid waste management and



mixed land use regulations, these factors are also responsible for deteriorating the environment. Therefore, environmental concerns need to be embedded in all policies of the plan. For example, we find that sanitation is discussed in the Master Plan under “Physical Infrastructure” chapter and very little mention is made in the Environment chapter. Thus, it would be more appropriate if sanitation and environment issues are also discussed together, reinforcing environmental concerns in more details through sanitation policies. Similarly discussing pollutions i.e. land, water, air in the environment chapter and not in the industry, transportation, physical infrastructure, social infrastructure, commercial and trade chapters may not be appropriate because these are also the main sources of environmental pollution.

4. URBAN FLOODING

A flood is excess of water or mud on land that is normally dry and is a situation whereby inundation is caused by high flow or overflow of water in an established water course. Urban floods can occur anywhere without warning and when a large volume of rainfall is experienced within a short period of time it becomes devastating. However, it is well known fact that human activities are more responsible rather than meteorological factors for urban flooding. Overgrazing, over cultivation, soil erosion and deforestation were traditionally considered causes of flooding which block natural drainage systems. In addition storm water drains which are essentially created to let the flood waters pass freely, but due to increasing levels of urbanization and lack of enforcement of planning laws, low laying areas gets encroached by haphazard development blocking the access to run off, of the rain water. Thus, so called development overtakes natural drainage systems. Besides the urbanization reduces surface run-off due to paved surfaces which decrease ground absorption and increase speed and amount of surface water flow. Urban flooding not only affects environment but also has economic costs and infrastructure losses as well. The causes of urban flooding are: (i) natural causes; and (ii) man made cause. Natural Causes include heavy rains / flash floods; depleting lakes and wetlands; and siltation, while man made causes include; population pressure; impervious surfaces; unplanned urbanization; trespassing on water storm drains; unauthorized colonies; and poor water and sewerage management.

The environmental risk is further aggravated due to the fact that 50 per cent of the urban population of Asia-Pacific lives in low-lying coastal areas and flood plains that are vulnerable to climate-related disasters which “wipe-off years of development in a matter of days”. The Report on State of Asian 2010 / 2011, identifies that Bangkok, Dhaka, Guangzhou, Hai Phong, Ho Chi Minh city, Jakarta, Kolkata, Mumbai, Shanghai and Yangon are the world’s most exposed cities to increased flooding due to climate change. Accordingly, in this section of the paper efforts have been made to examine as to how the issues of urban



flooding have been addressed in the Master Plans. It is observed that the issues of urban flooding are dealt with; in the Master Plan under the “drainage” Chapter. Accordingly, provisions of Master Plan Delhi - 2021; Master Plan Chennai Metropolitan Area - 2026; and Regional Plan - 2021, National Capital Region have been studied.

4.1 Master Plan Delhi - 2021

The Master Plan Delhi - 2021, highlights that drainage has two aspects i.e. flood protection and storm water discharge, which are interrelated. The storm water and flood protection in Delhi are not local but have regional bearing including areas of Uttar Pradesh, Haryana and Rajasthan. The main drainage system of Delhi is such that all water collected through main drains, link drains and small rivulets is discharged into Yamuna river. On the basis of topographical characteristics and existing drainage network, National Capital Territory (NCT) of Delhi has been divided into five drainage basins namely Najafgarh, Alipur, Shahadra, Khushak nallah and Mehrauli. The blockage of natural channel is a matter of concern. It is mainly because of the encroachment by slum dwellers along the drains which causes choking of drains and flooding in the upstream areas due to reduced carrying capacity. The other major reason is dumping of solid waste in the drains causing blockage.

To improve the drainage system of Delhi, effluent treatment plants needs to be provided at outfall of drains and aeration units at interceptions with advanced techniques for maintenance of drains. A time bound action program for augmentation and capacity revision of existing and new drains (due to increase in runoff from urban extensions) is also vital. Check dams and depression / lakes be designed for increasing ground water table, as storm water holding points wherever need. The designs shall preserve the natural drainage pattern after the development of an area. Drainage should be linked with the ecology and green networks, by adopting the concept of “bio - drainage”.

Regular desilting of drains and control of dumping of solid waste into the drains be taken up on priority. Public awareness program be taken up in association with NGOs and RWAs to make the people aware about the consequence of dumping waste in the drains. Other measures suggested in Master Plans for proper drainage are: drainage be treated as integral part of Road Development Plans / Grade Separators; a proper database be prepared and GIS based drainage mapping and planning be promoted; sub-wells be developed under flyovers for trapping rainwater; pump houses in low lying areas be provided with back-up power; and remodeling of selected drains may also be required considering the upstream flow in the region.

4.2 Master Plan Chennai Metropolitan Area - 2026

The Master Plan of Chennai Metropolitan Area - 2026, observes that Chennai city and environs are very flat with contours ranging from 2 m to 10 m above MSL with a few



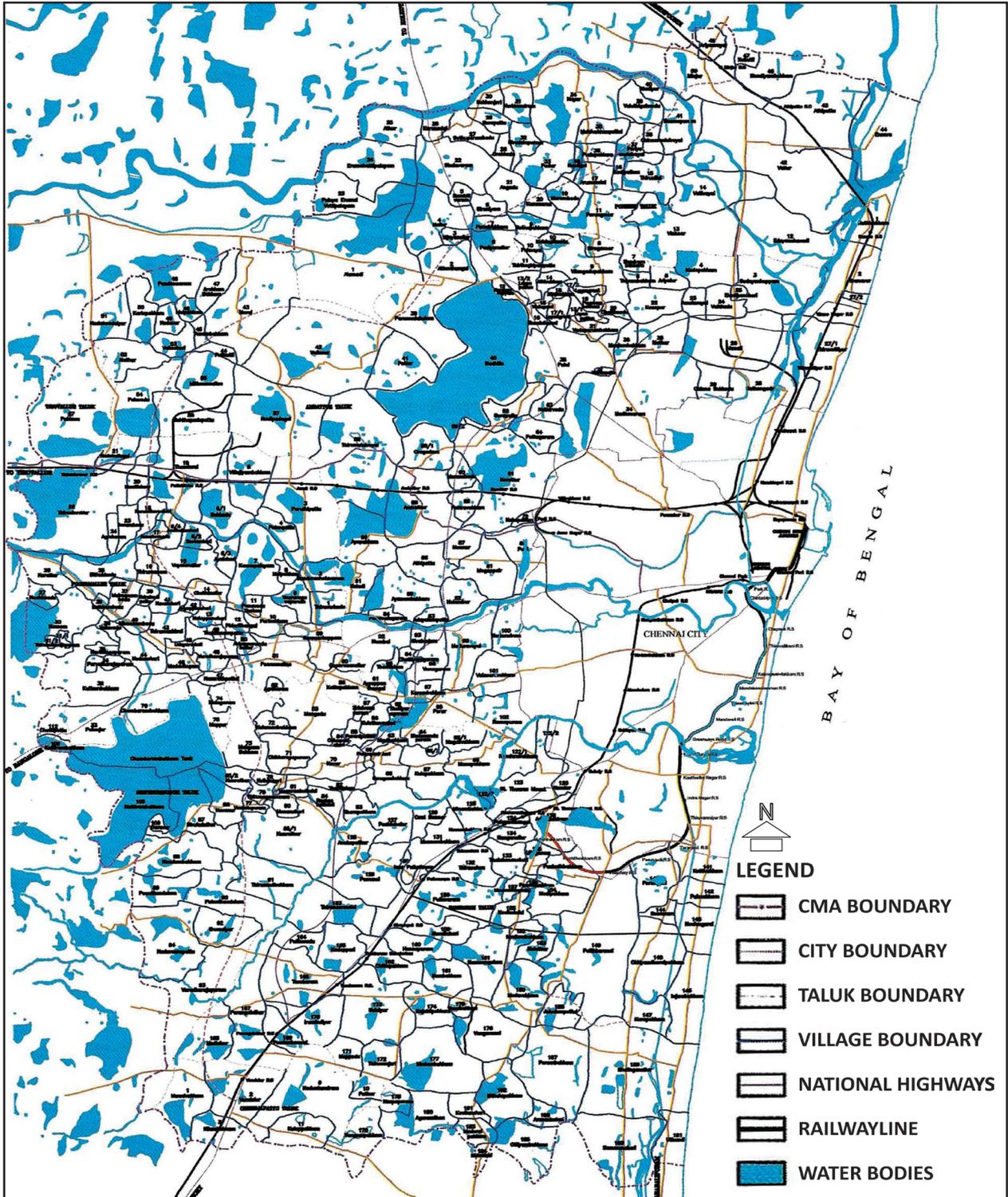
isolated hillocks in the southwest at St. Thomas Mount, Pallavaram and Tambaram. It is traversed by three major rivers namely Kosasthalaiyar River, Cooum River and Adyar River. The climate of the region is dominated by the monsoons, which are caused by thermal contrast between land and sea. Most of the rainfall is associated with clear synoptic systems of depressions and cyclones in night time, rains are most common. River Nagari which has a large catchment area in the Chittoor District (Andhra Pradesh) region and the Nandi River, which has catchment area in the Vellore District, join and enter Poondi Reservoir. Kosasthalaiyar River, which has its origin near Kaveripakkam, has a branch near Kesavaram Anicut and flows to the City as Cooum River and the main Kosasthalaiyar river flows to Poondi reservoir. From Poondi reservoir, Kosasthalaiyar River flows through the Tiruvallur District, enters CMA, and joins the Sea at Ennore. Cooum River from the Kesavaram Anicut flows through the Kancheepuram district enters CMA and finally reaches Sea near Fort St. George. Adyar River having its catchment area in the Kancheepuram District and originating from the Pillaipakkam Tank Group and Kavanur Tank Group flows through the CMA enters the city and reaches sea near Adyar (Fig. 1). Sholavaram Tank, Red Hills Tank and Chembarambakkam Tank are the major water bodies in the CMA. Sholavaram tank receives water from the Poondi Reservoir via Poondi Feeder Canal to supply Red Hills Tank. Red Hills Tank is the main source of water supply to the Chennai city and during storm events water is released to Red Hills Surplus Channel, which enters the Kosasthalaiyar River and discharges into the Sea.

In spite of the fact that the region has such large lengths of drainage (158 km) and extensive water storage systems of tanks and reservoirs the region especially the city suffers from regular annual flooding of developed and settled areas. The last century records have shown that there were several catastrophic flooding in Chennai; in 1943, 1978, 1985, 2002 and 2005 caused by heavy rain associated with cyclonic activity. These events of catastrophic flooding were found to be attributable to failure of the major rivers and other drainage systems. Flooding of less catastrophic nature occurs regularly in low-lying areas of the city and its suburbs because of inadequacy or inoperativeness of the local drainage infrastructure. The reasons for this state of affairs are three-fold firstly, most of the existing waterways are silted and their flow channels and banks are obstructed with encroachments and structures, similar is the case with the reservoirs and tanks. Secondly several of the areas under tanks and their anicuts have been developed as residential neighborhoods over the years, for example T. Nagar, Nungambakkam, Vyasarpadi. While Taramani area has been developed as an institutional area. Thirdly the geological structure particularly in the southwest is not conducive to water infiltration.

Annual flooding of low-lying areas has besides causing loss of property, is disrupting the life of many slum dwellers through displacement and heavy expenditure on their relief, loss of manpower in industry and business and



Fig. 1: CMA - Major Waterways and Waterbodies



Source: Master Plan Chennai Metropolitan Area - 2026



damage to infrastructure. More importantly it impinges on the health of the citizens through epidemics like dysentery, typhoid and cholera, malarial as well as other types of mosquitoes has returned to Chennai in full force.

The Master Plan, however, aims to convert the present constraints in disposal of flood waters as an opportunity to manage and use the excess water for augmenting urban water supply through creation of additional storage capacity; developing a network of open spaces to provide green environment would enable them to be used as flood moderators during critical months of the year.

4.3 Regional Plan 2021, National Capital Region

Regional Plan 2021, National Capital Region underlines that drainage is an important element of physical infrastructure and constitutes removal and disposal of surplus rain / irrigation water from the land. It has two aspects namely flood protection and removal of storm water. National Capital Region in general, is a part of well integrated drainage system of the Ganga basin. The extremely gentle gradient that spreads almost all over the region restricts degradation activities of the streams or drains. The storm water discharge in any basin or sub-basin of NCR is not local but has regional bearing covering areas of Haryana, Rajasthan, Uttar Pradesh and NCT of Delhi. It is, therefore, necessary to plan the drainage system at regional level in an integrated manner with adjoining states. Topography, rainfall intensity, soil characteristics, irrigation methods, crops and vegetative cover are important factors for deciding the type and design of drainage system. Since urban expansion is inevitable, increased run off would require remodeling of the existing drains as well as provisions of new and supplementary drains, implementation of appropriate flood protection measure, protection of natural drainage course, improved ground water recharge, and other environmental improvement measures such as prevention of sewer flows into the storm drains, pollution of river Yamuna, etc. Provision of appropriate drainage in marginal settlements consisting of JJ clusters, resettlement colonies, informal and unauthorized colonies, etc., also requires due attention.

Regional Plan - 2021 proposed that open drains, which are by and large the sources of pollutions, should be discouraged and discontinued. Areas where the annual rainfall exceeds 75 cm, separate systems for sewage and storm water are recommended. A combined sewerage system including drainage may be economical if the average annual rainfall is less than 75 cm. During the review of Regional Plan 2001 in the year 1991, it was observed that nearly 60 percent towns, in NCR are partially covered with the storm water drainage system and only two towns are fully covered. In all the cases, drains are open and in some of the towns there is combined system. The disposal of storm



water is invariably unplanned and takes natural course on land, depressions, ponds, etc.

Studies of existing situation have revealed that there is lack of integrated planning in the drainage for storm water which is not local but has got regional bearing covering areas in Haryana, Rajasthan, Uttar Pradesh and NCT - Delhi Sub-regions. Untreated sewage continues to flow in most of the drains in the region and ultimately falls into the rivers Ganga and Yamuna. Encroachment by slum dwellers along the drains causes choking of drains and flooding in the upstream areas due to reduced carrying capacity. Dumping of solid waste in the drains also continue causing blockage. Master Plans have not been prepared district wise. Even the hydraulic survey has not been carried out regularly to assess the conditions of the drains.

There is a need to adopt integrated regional approach for drainage planning and critically examine each major drainage system under basins / sub-basins of NCR at micro level by each constituents State Government to assess the deficiencies in planning, design, maintenance and to suggest remedial measures including remodeling / improvement work wherever necessary.

Therefore, integrated Regional Drainage Plan at the regional level and Drainage Master Plan at the district level should be prepared after critically examining each major drainage system under basins or sub-basin of NCR at micro level by the State Governments incorporating the improvement proposals for enhancing the quality of regional and local drains taking into account the present / future development and settlement pattern in the region. There is a need to conceptualize a drainage system before any area development program is taken up. No area development project / new town / colonies / industrial complex should be sanctioned / allowed to be started or implemented unless Integrated Drainage Plan is conceptualized and cleared by the designated authority. Measures be taken to prevent the use of storm water drains for conveying sewage and dumping of solid wastes and sludge in open drains. Unauthorized development / encroachment / slum dwellings in the drainage system should be prohibited.

Thus, it can be observed that, the issues of urban flooding are generally addressed in the Master Plans, but offcourse not in detail; without carrying out proper studies regarding the causes and consequences of the urban flooding and mitigation measures be adopted accordingly, before and after floods occur.

It would be interesting to note the observations of Nambi Appardurai, India's Adaptation Strategy Head for World Resources Institute (WRI), who observed that "Chennai has seen 17 days straight of rain, precisely the kind of extreme weather event that experts say will only become more common in a warming world". The



state of water bodies, in Chennai, highlights the issue that encroachment of water bodies, flood plains, and wetlands by unauthorized construction. According, to Times of India (Delhi, 02-12-2015) 300 water bodies have disappeared; 5,500 ha of swampland has been converted to IT corridor; and there are no storm water drains in suburbs of Chennai which include Tambaram, Sriperumbudur and Ambattur. There are over 1.5 lakh illegal structures in the city covering tanks, lakes, canal or riversides. According, to ASSOCHAM; Chennai came to a virtual standstill which caused financial loss of about Rs 15,000 crore. General Insurance Companies estimate that the insurance claims for damage to property, automobiles and other goods could be well over Rs 1,000 crore.

Chennai also faced heavy rains, in late November and early December 2015, which was followed by unprecedented floods that devastated the city, buildings were inundated, roads converted into canals and airport flooded. More than a lakh people were affected and they had to be accommodated in relief camps.

Similarly, Hyderabad which is dominated by hills, tanks and forests, in recent rainy season several colonies around the Ramanthapur were inundated due to which hundreds of families stranded in their homes, besides, 200 households and 10 apartments in Ravindra Nagar Colony, Laxmi Nagar Colony and Sai Chitra Nagar Colony were also completely inundated, which generally occurs in every monsoon. The encroachment on the Turka Cheruvu and Papayya Kunta canals has actually obstructed the water flow, leaving the area to get inundated. People residing in houses near by these lakes were unable to move out of their homes due to water stagnation in the area. The floods also occurred in IT belt of the city where 6.1 cm rainfall that lashed Madhapur, and it was not possible for residents to come out of their homes because of the waterlogged roads and overflowing drains.

Uttarakhand, *dev bhumi* (land of god), faced one of the most severe devastation, on the night of June 16-17, caused by a combination of very heavy rain, in short period of time, cloudburst and landslide. Rudraprayag, Chamoli and Uttarkashi were most affected districts where about 78,000 (Rudraprayag: 26,000; Chamoli: 35,000; and Uttarkashi 17,000) tourists and pilgrims on Chardhamyatra, covering Badrinath, Kedarnath, Gangotry and Yamnotry, were stranded. In all, according to media reports, more than 1,00,000 people were affected out of which about 90,000 persons were rescued (by 25th June) and sent to safe places by the efforts of about 10,000 officers and men from army, air force, and paramilitary force. The rest about 10,000 persons were missing.

In fact, what caused these catastrophes? There are two schools of thoughts. One group says it is the result of global warming while the other attributes it to man-made causes. However, it is more important to take adequate measures at two stages i.e. pre-disaster and post-disaster so as to mitigate the intensity and loss of life and damage to property. In fact, environmental issues of urbanization are



very critical and need to be addressed with sensitivity. Sustainable approaches are required to be adopted and environmental impact assessment needs to be done very carefully without damaging the prospect of economic development.

5. CONCLUSIONS

Cities, as places of concentration of people and most of the non-farm economic activities, provide opportunities but they are also the centre of environmental pollution. However, the environment should not be seen as standalone concern, as it cuts across all sectors of development. It also needs to understand that environmental deterioration is not a necessary or inescapable result of urbanization, what needs to be done is striking a right balance in making development in such a way that they are more effectively attuned to environmental opportunities and constraints.

As for as addressing the environmental aspects in Master Plan is concerned, it is a fact that not only the Master Plan but even Regional Plan takes into account the issues of environment in a separate Chapter by detailing air, water, and noise pollution. While there are separate Chapters on industry, commerce, physical and social infrastructure, which also has direct bearing on the environment and therefore, environmental impact of these aspects are required to be detailed out in these chapters as well so that environmental concerns are addressed adequately.

Urban flooding which is assuming alarming magnitude having devastating impact on the cities and towns is also generally addressed in Master Plan and also in Regional Plans; under the Chapter titled as "Drainage". In Master Plan Delhi - 2021 causes of flooding has been addressed but not in detail as observed in the Section - 4 of this paper. While in Regional Plan 2021, National Capital Region, efforts have been made to address these concerns at regional level. The NCR Plan also underlines that in some of the towns in NCR, even the hydraulic survey has not been carried out regularly to assess the conditions of drains. Master Plans also recommend adoption of integrated approach for drainage planning and critically examine drainage system at micro level. Therefore, taking into consideration the gravity of problem, it would be more appropriate to discuss and deliberate urban flooding in detail, in separate Chapter at least for the towns which are ceased with frequent floods.

Master Plans and Regional Plans therefore, should aim to convert the present and emerging constraints in disposal of flood water as an opportunity to manage and use the access water for augmenting urban water supply through creation of additional storage capacity and using it during critical months of summer to meet the deficiency of the water instead of donating it to the sea god. Beside strict measures be taken to prevent the use of storm water drain for conveying sewage dumping of solid waste in open drains. Unauthorized



development, encroachments and setting of slums in drainage systems and low lying areas be removed and appropriate steps be taken to stop occurring of such incidence in future by providing adequate and decent housing to the poor.

The Economic Survey 2016-17, Volume 2 has been tabled in the Lok Sabha on 11 August 2017, which presents the state of the nation's economy and performance of various sectors. As far as urban Infrastructure sector is concerned, the survey recognizes the cities as "the confluence of capital, people and space" which creates a "fertile environment for innovation of ideas, technologies and processes" resulting in huge economic returns. Indian cities with just a-third of the country's population generate two-third of national GDP, 90 percent of tax revenues and the majority of formal-sector jobs. However, the quality of life of urban masses is poor and therefore, the government has introduced several mission programs like Swachh Bharat Mission, Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Heritage City Development and Augmentation Yojana (HRIDAY) and Smart Cities Mission (SCM); however, it is too early to assess the impact of these schemes, because urban development schemes, requires long gestation period.

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Three Narratives about Climate Change Policies in India

Ashok Kumar, Ph.D.

Abstract

In this paper the author argues that several attempts made by Government of India since the last three decades, place India at the forefront of global climate change regime. India is one of the fourth major emitters of total annual emissions but nonetheless is one of the smaller contributors to global cumulative emissions of 3 percent only, with per capita contribution to emissions was 2.44 metric ton, emissions per person in 2012. But also remains one of the most vulnerable countries due to changes in patterns of rainfall, and increasing frequency and intensity of extreme events such as cyclones, droughts and floods, at the same time India is confidently riding on its high economic growth rate. The paper shows that economic policies and climate change policies have moved forward with a centre of gravity always remaining on the side of economic policies. This location of climate change policies is inequitable as they do not address needs of the most vulnerable sections of society, and mostly the Indian climate change policies have not yet arrived in the city as largely they remain delinked from national climate change policy endeavors.

1. INTRODUCTION

Most often reiterated assertion is that more than half of India's population is expected to live in urban areas by 2050. Most of the wealth producing class, and a large percent of the consuming class would also live in towns and cities. Added to this is the fact that cities already produce nearly two third of greenhouse gases. On 30 October 2007, the Executive Director of the United Nations Centre for Human Settlements stated that cities are "responsible for 75 percent of global energy consumption and 80 percent of greenhouse gas emissions". Cities have thus, become the most significant nodes of climate change in Indian society and economy. Due to the rising levels of urbanization and freeing up of the economy, most noticeably after the steady launch of 1991 economic reforms, the Indian cities are likely to become even more prone to environmental risks than any time in the recorded human history.

India along with the entire world has been facing extreme climatic conditions like intense variations in rainfall, air pollution, droughts, heat waves, flooding, etc. An important issue is that cities are mostly missing from Indian climate change discourse and policy makers generally shroud the climate change deliberations

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with the rhetoric of its negative implications on economic policies. At the same time it has become abundantly clear that since the last three decades city planning has taken a decidedly market friendly turn whereby economic growth policies have directly influenced urban planning and development policies. What is less discussed is that economic policies in a free market create uneven urban development. In India like anywhere else in the world, uneven development appears to have protected the wealthy and provided unevenly for different economic and social sections of the society. It is an established fact that poor have suffered disproportionately high adverse impacts of environmental risks emerging out of climate change. Consequences of lack of environment centered approach to urban planning can be seen in the form of losses of human lives and property through flooding due to intense rainfall in Chennai and Mumbai. Worsening air quality in Delhi, droughts in Maharashtra, floods in Bihar and Orissa and many more cases point to the fact that city planning and development policies remain delinked from India's climate change policies. Lack of sustainable city planning and government's inability to provide for the poor with adequate housing, and basic services particularly water, sanitation and solid waste management has placed huge pressure on cities beyond their carrying capacities. One of the major threats for achieving an environmental friendly urban planning is inadequate governance i.e. weak institutional capacity, poor inter - sectoral coordination, lack of effective public accountability, inadequate regulatory policies, market friendly economic policies, and insufficient knowledge and information.

Compact city development and production of green buildings remain two most prominent policy mechanisms for creating sustainable and resilient cities in India. It is often contended that compactness of a city would contribute to environmental sustainability due to energy efficiency resulting from lesser use of fossil fuels, completely ignoring the fact that more energy is required to use high rise built environments, making the idea of energy savings from compactness very ambivalent and even doubtful. Population in the Indian cities faces three direct vulnerabilities. First, several large cities are located along the vast coastline and these areas are environmentally hazardous. Second, cities have generally located in and near low lying areas for survival reasons. Historically, cities have located alongside rivers (in river valleys and in flood plains). Third, Indian cities not only have underdeveloped infrastructure but also lack resources for climate adaptation leading to less effective planning in the event of occurrence of a natural or human made disaster.

Several perspectives place India at the forefront of global climate regimes. For instance, India is one of the fourth major emitters of total annual emissions. It is one of the smaller contributors to global cumulative emissions of 3 percent only. India's per capita contribution to emissions was only 2.44 metric ton emissions per person in 2012. However, India also remains one of the most vulnerable countries due to changes in patterns of rainfall, and increasing frequency and



intensity of extreme events such as cyclones, droughts, and floods. At the same time India is riding on its high economic growth rate, making the country the fourth largest economy of the world. All these factors pose critical challenges for policy makers and city planners for dealing with climate change in urban India.

After introduction, this paper presents a critical analysis of India's climate change policy since the last four decades. It shows that economic policies and climate change policies have moved forward with a tilt towards economic policies. In the second section, the paper identifies predominance of two narratives, one focused on environment and the other on the economy. The third section provides few illustrative examples of battle between the economic policies and climate change policies, at the end defeating the climate change policies. The paper ends with the recapitulation of the main conclusions.

2. CLIMATE CHANGE POLICIES OF INDIA

With the release of the National Action Plan on Climate Change (NAPCC) on 30 June 2008, Government of India has launched eight national missions to combat climate change (Prime Minister's Council on Climate Change, 2008). Since then several state governments have also begun the task of preparing climate change action plans. National Environment Policy was released in 2006 (approved by the Cabinet on 18 May 2006), which laid out a broad framework on environment and climate change, making sustainable development premised on environmental limits and social justice, its central features. Prior to the release of the National Environment Policy 2006, National Forest Policy, 1988; National Conservation Strategy and Policy Statement on Environment and Development, 1992; Policy Statement on Abatement of Pollution, 1992; and National Water Policy, 2002 mainly focused on environmental management. The National Environment Policy, 2006 builds on three chief aspirations. "First, that human beings should be able to enjoy a decent quality of life; second, that humanity should become capable of respecting the finiteness of the biosphere; and third, that neither the aspiration for the good life, nor the recognition of biophysical limits should preclude the search for greater justice in the world" (Government of India, 2006: 2). All the three aspirations indicate economic priorities. These aspirations could be viewed as two forms of economic rhetoric hidden beneath terms like 'a decent quality of life', and 'search for greater justice in the world' because quality of life directly depends on economic growth in an industrializing developing nation. Context of the idea of 'search for greater justice in the world' is that developed countries should take more responsibility for abatement and mitigation of climate changes because they continue to be some of the biggest emitters of greenhouse gases. It also implies that developed countries should bear financial costs for abatement and mitigation of climate changes in developing countries like India.

Nonetheless, the climate change policies of India could be divided into three time periods: pre-2007; 2007 to 2009 and 2010 to 2017 (Dubash and Joseph,



2016). The first period could be characterized as the institution building phase. The period from 2007 to 2009 began with India gesturing to the world that the country is serious about climate change abatement and mitigation. In the third period from 2009 to the present India presents itself as one of the major global champions of climate change as demonstrated through the signing of the Paris Agreement.

2.1 Climate Change Policy Prior to 2007

Disputing the emission estimates of the World Resources Institute (WRI), Anil Aggarwal and Sunita Narain in their classic report 'Global Warming in an Unequal World: A case of Environmental Colonialism' showed how developed countries, which produced significantly more emissions than developing countries including India, wanted imposition of stiffer environment conditions on developing countries. The authors viewed the earth as 'global commons' with a limited capacity to absorb emissions (carbon dioxide and methane) and argued that these global commons should be justly distributed among all countries. Those producing more emissions should start reducing their emissions faster than those who are either not great emitters or are making small emissions contributions on a per capita basis. Unlike WRI estimates, these scholars made a clear case in favour of India, which made small contribution of emissions on a per capita basis to global warming (Aggarwal and Narain, 1991; Table 1), the authors underscored. But compared to its population - 16.2 per cent of the world's in 1990 - India's total production of carbon dioxide and methane amounted to only six per cent and 14.4 per cent, respectively, of the amount that is absorbed by the earth's ecological systems. How can, therefore, India and other such countries be blamed even for a single kg of the filth that is accumulating in the atmosphere on a global scale and threatening the world's people with a climatic cataclysm? In fact, India can double its total carbon dioxide emissions without threatening the world's climate. And if it controls its deforestation, then it can increase its carbon dioxide emissions from fossil fuels several times (Aggarwal and Narain, 1991: 10).

Three crucial points were made by the Centre for Science and Environment, an influential environmental NGO located in Delhi. First, we should focus on

Table 1: Share in Global Emissions and Change from the Previous Year

S. No.	Name of the Country	Share in global emissions	Change from previous year
1.	China	26	-0.3
2.	United States of America	13	-2.0
3.	India	7	+4.7
4.	Russian Federation	5	-2.1
5.	European Union	9	+0.2

Source: Netherlands Environmental Assessment Agency (2017: 32).



cumulative contribution made by different countries to greenhouse gases rather than annual emissions. This meant countries like the USA and other advanced industrialized countries would be required to do more on climate change because they have pumped more greenhouse gases into global commons and it also meant that they should start reducing their greenhouse gas emissions in future as it is to be equitably shared among all countries. Second, 'a per capita allocation of global sinks is the only morally defensible metric'. Third and most important issue highlighted by the CES was that 'a distinction should appropriately be made between 'survival emissions' of the poor and 'luxury emissions' of the rich' (Dubash, 2013: 192).

While Government of India was aware of its equity concerns in relation to global politics of climate change, CES's insightful analysis and critique contributed to firming up 'equity position' in Government of India's climate change policies including in the National Action Plan on Climate Change (NAPCC). In the NAPCC this policy was labeled as 'co-benefits'. Co-benefits from transport projects, for example, could include enhanced productivity through time savings, improved equity, improved safety, reduced health costs, reduced use of fossil fuels, etc.

Nonetheless, before 2007 climate change policies were treated as "diplomatic rather than developmental problem. Based on this construction, climate change is presented as a problem of allocating a global commons - the earth's ability to absorb greenhouse gases - equitably across nations" (Dubash and Joseph, 2016: 46; also see Dubash, 2013). This meant climate change policy became synonymous with foreign policy and climate change negotiations became synonymous diplomatic maneuvering by few experienced officers from the Ministry of External Affairs and Ministry of Environment and Forests. As Indian government officers engaged with other governments at the global stage, participation by other ministries was minimal, only to the extent that technical inputs were provided by sector specific ministries. For example, Ministry of Power provided technical inputs about improving coal efficiency and Department of Science and Technology provided inputs to the Intergovernmental Panel on Climate Change (IPCC). It is well documented that there was little oversight by Parliament, the cabinet and the Prime Minister's Office in climate change policy framing (Jakobsen, 1998 as quoted in Dubash and Joseph: 46). In this kind of policy environment, imagining participation of city governments in climate change policy matters, appeared unthinkable.

Apart from playing a predominant role at the world stage, Government of India also made considerable movement at the domestic front in making and implementing policies in related areas. For instance, policies on energy efficiency and electricity reforms were formulated and implemented. But very little attempt was made to link these policies to climate change policies.



In order to evaluate and approve clean development mechanism projects, the National Clean Development Mechanism Authority was established in 2003 by the Ministry of Environment and Forests. The basic purpose was to protect and improve the quality of environment in terms of the Kyoto Protocol to which Government of India is a signatory. From 2003 to 2011, a total of 2,295 projects - around one-quarter of the global total have been registered with India's designated National Authority for the Clean Development Mechanism.

The period prior to 2007 could be characterized as a period of institution building for climate change where Government of India created a number of organizations under different acts and also framed crucial policies. However, very little was achieved to link these policies, to policies being implemented in towns and cities. This period could be viewed as presenting a challenge to municipalities.

2.2 Climate Change Policy from 2007 to 2009

Two high level policy making institutions on climate were set up during this period. First, the Prime Minister's Council on Climate Change (PMCCC) was set up in mid - 2007 and was tasked with the important work of preparation of national strategy on climate change, which was released in 2008 in the form of the National Action Plan on Climate Change (NAPCC). With Prime Minister as its chairperson, the PMCCC was made up of 26 members including a number of central ministers, influential non-governmental organizations and other experts. By the end of 2009, PMCCC approved four national missions including National Solar Mission, National Mission on Enhanced Energy Efficiency, National Himalayan Mission. Second, appointment of the Special Envoy on Climate Change was made in January 2008, which started India's journey in earnest towards making climate change policies. Special Envoy on Climate Change produced much crisper summary of the NAPCC report. However, after two years the position of the Special Envoy on Climate Change was abolished in March 2010 in order to give greater responsibility to the Ministry of Environment and Forest, now known as the Ministry of Environment and Forest, and Climate Change.

Arising out of Kyoto Protocol, the year 2007 became a point of contention between developed and developing countries. Developed countries had placed great pressure on large developing countries like India to enhance their climate change commitments for undertaking mitigation measures. Climate change became a regular agenda at G20 and G8 plus 5 meetings. In order to deal with the pressure of developed countries, India forged a negotiating alliance among large emerging economies including Brazil, China and South Africa, the alliance popularly known as BASIC (Dubash and Joseph, 2016). This was also the time when greater attention was being paid to the subject of climate change in India



after the Copenhagen Conference of the Parties (COP) in 2009. Making it one of the most crucial political events about climate change, nearly 115 world leaders participated in the Copenhagen Climate Change Conference. It was during this conference that some firm climate change commitments were made by all participating governments including India.

In India at about the same time in mid - 2009 Jairam Ramesh was appointed as the Minister for Environment and Forests who led the country for “vigorous engagement with the subject” (Dubash and Joseph, 2016: 46). This serious engagement was reflected through parliamentary debates, media articles, and journal papers. Even business associations developed dedicated climate change platforms. Impact of continuous international and national pressure became visible through the release of National Action Plan on Climate Change (NAPCC) in 2008 (Ministry of Environment and Forests, 2008). This action plan was prepared by the Prime Minister’s Council on Climate Change, which proposed 8 national missions:

- National Solar Mission;
- National Mission on Enhanced Energy Efficiency;
- National Mission on Sustainable Habitat;
- National Water Mission;
- National mission for Sustaining the Himalayan Ecosystem;
- National Mission for a “Green India”;
- National Mission for Sustainable Agriculture; and
- National Mission on Strategic Knowledge for Climate Change.

What is significant is the fact that the NAPCC paved the way for framing and implementation of national missions, some of which at least would directly impact climate change policies in cities in future. While most of these national missions were directly or indirectly related with city planning; but the National Mission on Sustainable Habitat, National Water Mission, and National Solar Mission are directly related to city planning, affecting built environment, water management and energy requirements. Habitats, water and energy are evidently critical to city sustainability. Some of these national missions have been launched, the largest of them being the National Solar Mission aimed at promoting ‘ecologically sustainable growth while addressing India’s energy security challenge. This is the clearest manifestation of the cobenefits approach. Apart from international pressure, there were several motivations of Government of India to invest so much energy in this national mission.

One of the key drivers of the National Solar Mission was Indian policy makers’ aspiration to become a major global solar player by establishing a domestic



solar manufacturing base. While energy security also played a role, it was the sector's industrialization potential (with associated economic growth and job creation possibilities) that was the more important consideration for central policy makers. State-level policies were mostly aimed at deployment of solar technologies rather than making them. The most vigorous implementation of solar policies occurred in the state of Gujarat where ... an alliance of government and business interests ... was determined to accelerate economic development. More generally, political leaders and policy makers sought to enhance their re-election prospects and careers. Business leaders, in particular developers, supported the policies because they saw opportunities for high returns on investments, as did financial institutions (Schmitz, 2016a: 15). Government of India has never hidden its ambitions about economic wellbeing of the country even under great pressure from international players. As is evident from the statement of Prime Minister Manmohan Singh during the launch of the National Solar Mission on 30 June 2008:

Our vision is to make India's economic development energy-efficient. Over a period of time, we must pioneer a graduated shift from economic activity based on fossil fuels to one based on non-fossil fuels and from reliance on non-renewable and depleting sources of energy to renewable sources of energy. In this strategy, the sun occupies centre-stage, as it should, being literally the original source of all energy. We will pool our scientific, technical and managerial talents, with sufficient financial resources, to develop solar energy as a source of abundant energy to power our economy and to transform the lives of our people. Our success in this endeavour will change the face of India. It would also enable India to help change the destinies of people around the world (Government of India, 2008: 1).

According to Ministry of New and Renewable Energy, India has achieved grid connected solar power generation capacity of over 5,000 MW by the end of 2017. Unwavering commitment of Government of India to the National Solar Mission is further evident in 17 June 2015 press release when Union Cabinet approved the plan to upscale the National Solar Mission aimed at commutatively producing 100,000 MW by 2022, which is five times higher than when the mission was originally launched. Out of the proposed total 100 GW solar energy generation 40 GW will be generated on rooftops and 60 GW through large and medium scale grid connected solar power projects. Government of India expects that the new solar target of 100 GW will result in abating over 170 million tons of CO₂ over its life cycle. National Solar Mission has clear implications for the cities and towns. For example, ministry of Railways has set up a solar power plant at Hazrat Nizamuddin railway station in Delhi with a total capacity of 5 MW. Another policy to achieve energy security was focused on wind energy where the states of Maharashtra, Gujarat and Tamilnadu played crucial role.



This period therefore continued to focus on policies of ‘cobenefits’ and ‘common but differentiated responsibilities’ approaches as summarized in a recent research: “the articulation of a co-benefits approach has enabled stakeholders to engage in the climate change debate without conceding on their priority of accelerating economic development. The pursuit of energy security has been the most powerful driver of domestic action” (Schmitz, 2016a: 16; also see Schmitz, 2016b).

2.3 From 2010 to the Present

Beginning of this period is marked by a rise in the climate change activities, most of which could be attributed to the leadership provided by the then Minister of Environment and Forests, Jairam Ramesh. Attempts were made by the Ministry of Environment and Forests to encourage states to prepare State Action Plans. As the minister departed in the middle of 2011, this momentum could not be sustained. Nevertheless, four sets of institutional shifts have been identified till 2014 by Dubash and Joseph (2016: 49). First, the abolition of the position of the Special Envoy on Climate Change from the office of the Prime Minister left a gaping institutional hole due to absence of an organization for coordination and strategic thinking at the national level. Second, adhoc institutional attempts were made to generate new knowledge and strategic thinking, which were hardly successful. Third, relevant scale was not selected to implement the NAPCC, instead sectoral ministries were chosen. Fourth, dedicated state level institutions were established to prepare and implement state climate plans. Although most states have already prepared action plans on climate change we are unsure about their implementation. Delhi, for example, is one of the first states to prepare its climate action plan in 2009 could not implement even its basic policy in the transport sector.

Fallout of these four shortcomings was clear. First, due to absence of a central coordinating agency with the capacity to think strategically, climate change policy again became diplomatic policy where international coordinating role shifted back to the Ministry of External Affairs with inputs from the Ministry of Environment and Forests along with some retired bureaucrats acting as external advisors. Second, at domestic level, being at the same level as other ministries, the Ministry of Environment and Forests could not effectively play the coordinating role. This role was performed better by the Special Envoy on Climate Change who drew on the authority of the Prime Minister’s office. In order to address the coordination challenge at domestic level, an empowered Executive Committee on Climate Change was formed in 2013 where secretaries of the concerned ministries became its members. But this committee also could not overcome the challenge of inter-ministerial competition. With about two years of disengagement on climate change issues, Government of India set up the National Institute for Climate Change Studies and Action in 2013.



3. TWO OR THREE NARRATIVES OF CLIMATE CHANGE IN INDIA

Recent scholarship on sustainable urbanism identifies two primary narratives, one global, the other local. Kirsten Hackenbroch and Christoph Woiwode (2016: 2) argue that the first narrative is focused on ‘economic growth, future-proofing and infrastructure investments’, which presents the Indian city to global entrepreneurs as an attractive investment destination. This narrative submits to the demands of the global capital where addressing local interests becomes a political compulsion.

The city government seized the momentum generated by climate change discussions to push its own development agenda. In this regard, it is interesting to see how pressing development needs—such as the need to provide basic infrastructure for water, sanitation, waste management and transportation—are bundled in the Plan with a “climate friendly agenda (Aggarwal 2013: 1913). While the economic growth agenda remains at the forefront, climate change arguments remain weak or even absent. Advancing economic agenda remains the priority:

This bundling of the climate agenda with development needs is leveraged for a variety of purposes by the Delhi Government. First, it is used to mobilize broader support for its development agenda. In a city that is deeply fragmented along economic, social and political lines, the Plan evokes common external threats to garner support from different interest groups and push long pending initiatives through the complex web of administrative hurdles and overlapping jurisdictions. Second, this bundling is used as an opportunity to procure greater funding from both domestic and international sources particularly, through the Clean Development Mechanism (CDM). CDM projects are generally associated with a steep learning curve and so moving early has provided the Delhi government the strategic advantage of ‘learning by doing’ and staying ahead of the race relative to its competitors. Third, the Delhi Government has used the Plan to showcase its most innovative green projects (such as restoration of old water bodies) and those based on cutting edge technology (such as the Yamuna cleaning project). This has helped develop its image as a ‘national exemplar’ of an innovative and green city. This reputation, in turn, has been leveraged to seek further funding and generate other indirect benefits, such as from tourism (Aggarwal, 2013: 1913).

Second narrative is about quietly sensitizing the public about climate change at a local level. This is termed by Kirsten Hackenbroch and Christoph Woiwode (2016: 2) as “glocalisation through people’s initiatives from below”. This form of climate change narrative pursues socially and spatially inclusive urban development agenda. Chennai Climate Change Action Plan, 2011 is cited as an example of this form of climate change narrative. The Chennai Climate Change Action Plan was prepared collaboratively by Corporation of Chennai, University



of Madras and Kyoto University, Japan. This plan addresses the critical aspects of integration of physical infrastructure like water supply, sewerage treatment and storm water drainage in order to reduce disaster risk. Local collaborations have made Chennai “the first Indian city to adopt a Non-Motorized Transport (NMT) Policy in 2014 (Hackenbroch and Woiwode, 2016: 11).

On similar lines three narratives on climate change policy are developed by Navroz K. Dubash (2013: 197). These include the growth first realist, the sustainable realist, and the sustainable development internationalists narrative. The growth first realist narrative also focuses on economic growth and climate change policies are viewed as a threat to economic growth. International commitments to abate climate changes are generally avoided. Equity concerns lead climate change negotiations at international level. The sustainable development realist agenda pursues the cobenefits approach and delinks climate change from international processes. “While commitment to equity, including to domestic distributional questions, is likely to be genuine, this is framed as a domestic debate alone. This stance can lead to a somewhat schizophrenic stance - contention with growth-first realists at home and making common cause overseas (Dubash, 2013: 197). The sustainable development internationalists narrative differs from the second narrative in that it advocates more effective climate change regime and moves partly away from the cobenefits approach to international regime of climate change. India has pursued the second narrative of sustainable development realist which is based on the cobenefits approach and equity principle.

Kari-Anne Isaksen and Kristian Stokke (2016) have also analysed changing climate discourse in India. Three narratives of climate change have been identified: the third world discourse; the win-win discourse; and the radical green discourse (Table 2).

Fig. 2: Discourses on Climate Politics in India

Aspects of Climate Change Analysis	The Third World Discourse	The Win-Win Discourse	The Radical Green Discourse
India’s National Interest	Primacy of economic growth	Primacy of economic growth	Social equity and ecological balance
Relevance of climate change for India	International climate politics as a threat to economic growth	Climate change as a threat and possibility for development and diplomacy	Climate change as a threat for vulnerable groups
Climate policy at the national scale	Growth as a precondition for sustainability, no domestic climate action	Greening of economic growth, national action plan on climate change	Alternative development strategies, but exclusion from policy making
Climate policy at the international scale	Protecting India’s space for growth, principles of common but differentiated responsibilities and per capita emission levels	Proactive climate diplomacy in pursuit of India’s international interests, emission intensity targets	Proactive climate diplomacy, but exclusion of concerns and actors from foreign policy

Source: Isaksen and Stokke (2014: 114).



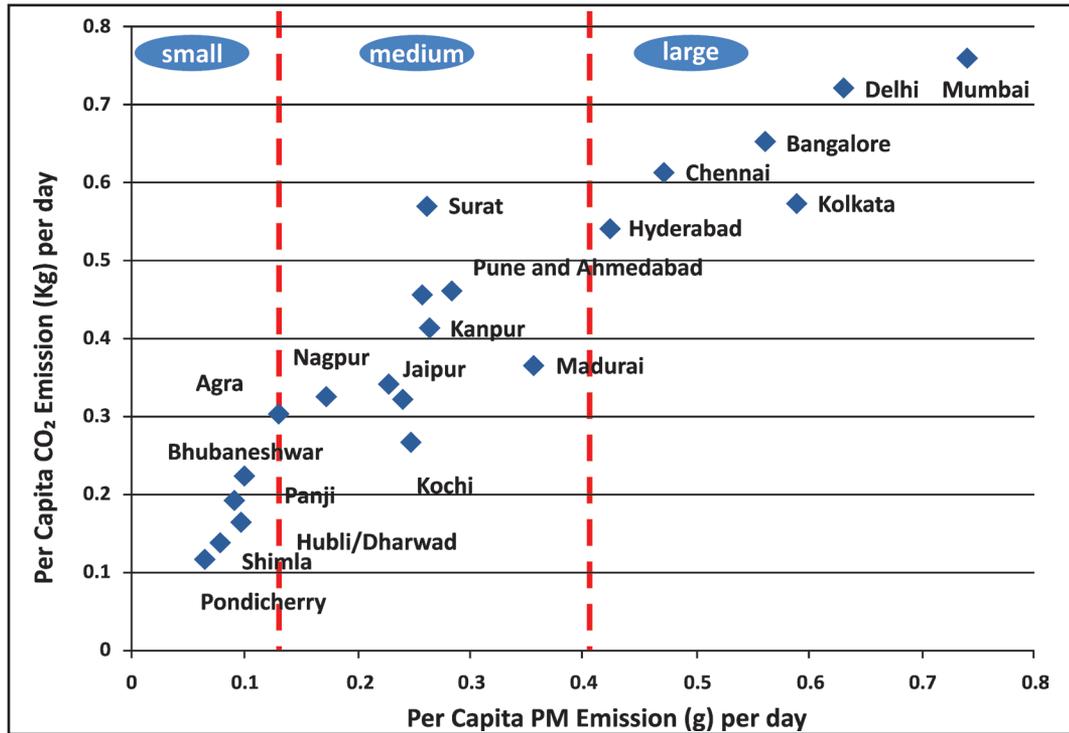
The first narrative i.e. 'the third world discourse' on climate politics focuses on economic growth and views global talk about climate change as a threat to economic growth. This discourse is based on the belief that the principles of common but differentiated responsibilities and per capita emissions could only safeguard India's economic interests (for a radical critique see Swyngedouw, 2010, 2011). The core argument of the win-win discourse is: "India's primary interest is economic growth, but since climate change constitutes a threat to growth, India should adopt a pro-active climate policy that includes 'greening' of growth and pro-active participation in international climate negotiations. Growth and climate actions are thus, seen as compatible, in contrast to the focus on trade-offs in the Third World discourse" (Isaksen and Stokke, 2014: 114). The win-win discourse is also rooted in India's aspiration as a global power that should accept global responsibilities including climate change commitments, linked with occupying a seat as a permanent member of the United Nations Security Council in near future. This exuberance particularly stems from sustained economic growth over the last two decades. The third narrative is the radical green discourse, which is generally excluded from the climate discourse of India. The radical green discourse counters other two narratives. It is argued that "the Radical Green discourse foregrounds poor people's need for social justice and ecological sustainability. The line of reasoning is that there is great disparity in wealth and emissions within India and the current growth strategy cannot provide justice or ecological sustainability. India therefore needs a different development strategy altogether" (Isaksen and Stokke, 2014: 116). Alternative growth strategy should focus on 'equity and redistribution' rather than economic growth alone, which is unhelpful for bringing a significant section of Indian population out of poverty. Here climate change is perceived as a threat to India's poor rather than Indian economy, indicating multiplicity of public interests. Per capita emissions theory of Aggarwal and Narain is also rejected because "it hides the vast differences that exist between the rich and the poor and their emissions" (Isaksen and Stokke, 2014: 116). Richer people and richer sections of the Indian economy should take more burden for the abatement of climate changes because they cause more harm to the Indian and global commons.

4. URBAN SETTLEMENTS AND THE CLIMATE CHANGE

Climate change is a global concern and cities are considered major emitters of greenhouse gas emissions (for example, see United Nations, 2007). Although emissions in each city and town are context dependent, generally speaking we could argue that the larger the population of a city, greater the emissions of greenhouse gases. There appears to be a strong correlation between emissions of air pollutants and GHGs. As cities grow in size particularly transport related emissions also increase (Fig. 1). Similar results are obtained globally. A recent study shows that large cities in Asia like Shanghai emit more greenhouse gases per capita than per capita emissions in China. A number of factors are responsible for



Fig. 1: Per Capita Carbon Dioxide and PM Emissions, 2009



Source: Clear India Initiative for Asian Cities (2009).

high per capita greenhouse gas emissions in large cities of Asia. A study points out that “patterns of mobility, the design and distribution of houses, the organization of food and water systems, and individual lifestyle choices affect emissions in Manila, Jakarta, Ho Chi Minh City, New Delhi and Chiang Mai” (Dodman 2009: 191 after Label et al, 2007). Per capita Carbon Dioxide and PM Emissions in large cities in India are higher than smaller cities (Fig. 1). Contributing factors are a large number of automobile, polluting industries, etc.

4.1 The Energy Conservation Building Code

Bureau of Indian Standards and Ministry of Power continued to work in their own spheres without desired coordination. One illustration is particularly relevant here. National Building Code, 2005 did not contain provisions about energy efficiency in spite of the fact that the Bureau of Energy Efficiency (BEE) was set up in March 2002 under the Energy Conservation Act of 2001, expressly mandating energy savings in the built environment. The Energy Conservation Building Code was launched by the Ministry of Power, Government of India in May 2007. It was indeed linked with built environment but ECBC was only meant for commercial buildings having a connected load of 100 KW or contract demand of 120 KVA. Government expected that application of this building code would reduce energy consumption between 25-30 percent. Municipalities and State



Governments are encouraged to adopt these energy saving building codes with appropriate amendments. Although 23 State Governments have adopted the Energy Conservation Building Code, no municipality has come forward for their implementation till the end of 2017. The updated version of ECBC was launched on 19 June 2017.

The National Building Code, 2016 makes considerable improvements upon the previous code. Importantly it recommends codes for producing sustainable buildings and built environments. For example, Part 11 of the National Building Code, 2016 deals with promotion of sustainability of buildings and built environment. The Code also makes provisions for earthquake resistant design of buildings; use of solar energy in buildings; rainwater harvesting; disaster resilient buildings; and norms for energy saving. Largely the Code appears to be in line with ECBC 2017.

4.2 Green Urban Mobility and Transit Oriented Development

Another aspect of climate change in the Indian city is that municipalities and planning agencies are largely dependent on central and state government schemes and funds. Flagship projects such as Green Urban Mobility and Transit Oriented Development clearly promote low carbon public transport systems. Under the Green Urban Mobility scheme, a focus on non-motorized transport like cycle, and use of electric vehicles is expected to reduce emissions and improve environment. The idea of Pooled Green Mobility Funds drawing on resources from green climate fund, multilateral and bilateral agencies, and Government of India and State Governments would open a regular stream of funds. Government of India is expected to select cities through the Green Mobility Challenge after cities submit their Green Mobility Plans. However, implementation of these projects has not yet begun. For competing under the Green Mobility Challenge, cities would be placed in three groups. Group-1 cities would include urban settlements from

Table 3: Dimensions of the Green Urban Mobility Scheme

S. No.	Dimension	Detailed Features
1.	Pedestrian and cycling facilities	8,000 plus kilometers of footpath and cycle tracks across 103 cities. 73,000 plus public cycles across 58 cities.
2	Public Transport Facilities: Improved and cleaner public transport across 106 cities	1,000 plus kilometers of BRT network across 28 cities. 20,000 para transit and 6,000 buses on alternate (electric) fuels across 103 cities. 550 depots across 103 cities. Real time PIS, AVLS, cashless ticketing across 103 cities.
3.	UT financing and institutional strengthening	Setting up of UMTA across 53 cities. Permanent funding for UT financing and operations and maintenance.

Source: Ministry of Housing and Urban Affairs (2018).



hilly and North Eastern states and union territories. Group - 2 cities are those having population below 1 million, and cities with population more than 1 million including NCT Delhi and Chandigarh would be placed in Group - 3. If successfully implemented, Government of India expects to provide sustainable transport accessibility to nearly 58 percent of urban population within seven years (Table 3).

Transit Oriented Development may have co-benefits for climate change, but very little credible research exists to support large investments on TOD projects in Indian cities.

4.3 Smart Cities Mission

Smart Cities Mission, another flagship project of Government of India was launched in 2015. It is being implemented in 99 cities of various sizes throughout India. Among other things, each smart city proposal focuses on alternative and clean energy sources such as rooftop solar energy that could be tapped at the scale of a building. Promotion of large scale LED street lighting, creation of more and more green buildings, and use of environment friendly solid waste management techniques are some of the other initiatives being undertaken under the Smart Cities Mission. A composite index known as Livability Index has been prepared by Ministry of Urban Development, Government of India. The Livability Index encourages cities to evaluate their programs across environmental, social, economic and physical criteria rather than singular or sectorally - specific norms.

5. CONCLUSIONS

Climate change adaptation and mitigation policies in India face a paradox. It is eloquently described by Anthony Giddens: “The politics of climate change has to cope with what I call ‘Giddens’s paradox’. It states that, since dangers posed by global warming aren’t tangible, immediate or visible in the course of day-to-day life, however awesome they appear, many will sit on their hands and do nothing of a concrete nature about them. Yet waiting until they become visible and acute before being stirred to serious action will, definition, be too late” (Giddens, 2009: 2). Writing a year later, the prominent German scholar wrote: “In the name of indisputable facts portraying a bleak future for humanity, green politics has succeeded in de-politicizing political passions to the point of leaving citizens nothing but gloomy asceticism, a terror of violating nature and an indifference towards the modernization of modernity” (Beck, 2010: 263).

The reality of climate change could be no longer denied. Cities in India not only produce large amounts of greenhouse gases but they also make large populations vulnerable to climate induced risks because of high densities. Giddens Paradox sadly becomes evidently real as governments and planning agencies at all levels have been reluctant to follow the Radical Green discourse in spite of large scale environmental risks experienced by citizens in large agglomerations in Mumbai, Chennai, Delhi, Hyderabad and Bengaluru.



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Urban – Rural Water Nexus: Issues in Environmental Planning

R. Parthasarathy and Soumini Raja

Abstract

The paper narrates that increasing level of urbanization and population growth has put immense pressure on basic services in urban centres. With increasing economic growth rates and urban immigration, there has been a considerable demand for domestic and industrial water use. An increase in water demand in both rural and urban areas would require a comprehensive understanding of the rural-urban water nexus. Urban water demands are likely to grow over the next decade. The paper argues that there is a need to address water supply policies at a micro level instead of the current pan-macro approach.

1. INTRODUCTION

Environment as a subject has gained immense value to planning studies and practices. This is partly due to the fact that environmental studies are no longer limited to appraisals with respect to environmental impacts. Increasingly, tools and techniques used in integrating environmental parameters to urban issues have come to dominate policy formulation. All these however, call for an inter-disciplinary approach. Often the most important elements in urban planning relating to environment are primarily land and water. For the sake of convenience, this paper takes the case of two cities namely Ahmedabad and Surat and in Gujarat to highlight the importance of focusing on environmental issues in urban planning practice.

The state of Gujarat is divided into six agro - climatic zones, namely North Gujarat, South Gujarat, Central Gujarat, Saurashtra and Kachch. A large variation in the availability of water across the state has a direct correlation with geography, rainfall pattern, changing land use and management practices. In terms of the total quantum of rainfall, Southern and central Gujarat received the highest rainfall. Gujarat's total water resource potential is 50,000 MCM of which surface water is about 38,000 MCM (76 percent) and groundwater is about 12,000 MCM (24 percent).

A major part of surface water is available through 185 river basins. River basin waters are used mainly for irrigation, drinking as well as industrial purposes. Of the 185 river basins, major basins of Sabarmati, Mahi, Narmada and Tapi drain central and

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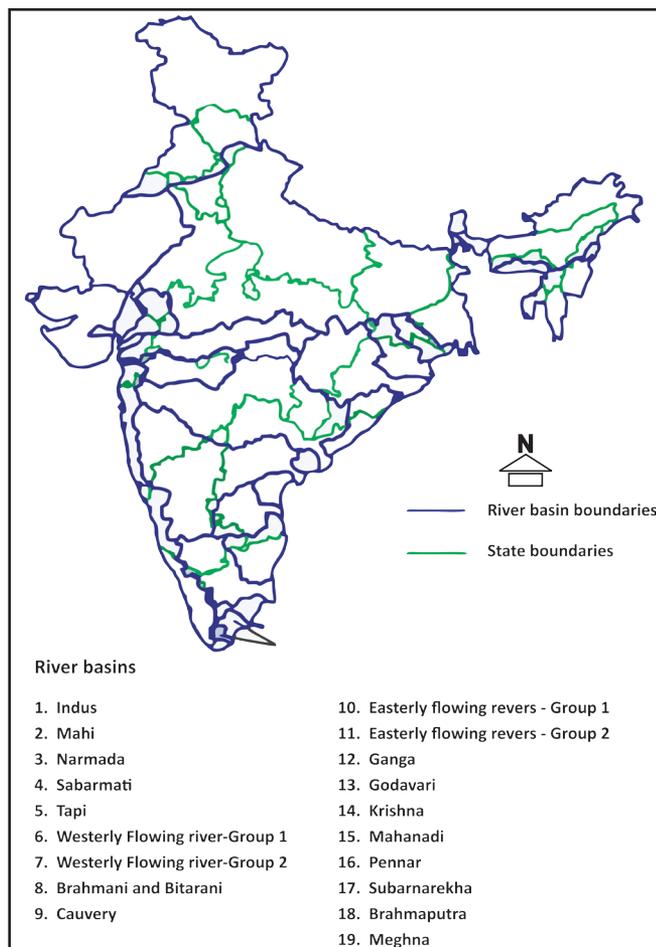
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southern parts of the state while the minor basins (grouped as westerly flowing rivers group 1) are concentrated in the Kachchh and Saurashtra regions (Fig. 1). Over the years Gujarat has become one of the most rapidly growing states in industrial investment and economic development causing stress on the resources, especially water.

In Gujarat there are about 150 urban centres¹ of which seven are under municipal corporations and the rest are under municipal councils. Approximately 38 percent of the population lives in the urban areas. An analysis of the literature on river basin studies in Gujarat (Parthasarathy, 2009) shows that the key challenge faced by the state today is to bring about a balance between water demand and consumption in urban and rural areas. There has been a constant deterioration of surface water reported from especially Sabarmati and Tapi river basins owing to the large scale investment in industries and rapid urbanization trends.

There has been a visible deterioration in both surface water and ground water quality in various parts of the state. The major reasons attributed to this phenomenon are the increasing density and deepening of tube wells, dumping of wastewater by the local authorities and discharge of untreated or partially treated effluents by the industries into the rivers and other water bodies.

Fig. 1: River Basins in India



(source: Amarasinghe, 2004)

1 In the Census of India 2001, the definition of urban area adopted is as follows: (a) All statutory places with a municipality, corporation, cantonment board or notified town area committee, etc. (b) A place satisfying the following three criteria simultaneously: i) a minimum population of 5,000; ii) at least 75 percent of male working population engaged in non-agricultural pursuits; and iii) a density of population of at least 400 per sq. km. (1,000 per sq. mile).

An Urban Agglomeration is a continuous urban spread constituting a town and its adjoining urban outgrowths (OGs) or two or more physically contiguous towns together and any adjoining urban outgrowths of such towns. An urban Agglomeration would be constituted as: (i) a city or town with one or more contiguous outgrowths; (ii) two or more adjoining towns with their outgrowths; and (iii) a city and one or more adjoining towns with their outgrowths all of which form a continuous spread (Census of India, 2001). Towns with population of 1,00,000 and above are called cities (Census of India 2001).



The agricultural run-off and disposal of hazardous waste in different forms in landfills near the urban areas and industrial zones have also affected the quality of surface and groundwater. The polluted water reduces the net utilizable safe water and aggravates the problem of water scarcity mostly in the rural areas of Gujarat, especially those at close proximity to the urban and industrial centres. The study investigates this urban-rural water nexus in the Sabarmati and Tapi basins which account for some of the most important urban and industrial centres in the state.

The Golden Corridor, a major driver of economic development, passes through the central and lower reaches of Sabarmati and Tapi river basins. The basins comprise some of the most important urban centres, industrial clusters and productive agricultural lands that contribute to the State's Domestic Product. However, a large scale deterioration of the waters in the basins has been attributed mainly to the careless and insensitive management of these urban and industrial centres. Domestic withdrawals consist of mainly two components i.e. (i) water withdrawals for human consumption plus domestic services, and (ii) water withdrawals for livestock. According to the CWC estimates in 2002 the human demand for drinking, cooking, bathing, recreation and other purposes accounts for 79 percent of domestic withdrawals (Amarasinghe, 2004). Water demand in urban areas is higher due to water use for flushing latrines, gardening, fire-fighting and other purposes.

An increasing consumption of water by the domestic and industrial sectors over the years has subsequently led to the increasing release of untreated waste water into the natural water courses. The most noticeable implication of this process is the severe damage caused to natural resources and to a large extent to the agricultural areas. Although waste water acts as a substitute for chemicals in agriculture it has often proved fatal not only to the productivity of crops but also to the health of the producers (Drechsel et al, 2009). More importantly, with the increasing consumption of water (surface and ground sources) by urban centres, the demands of the rural areas are often un-met, increasing the rural areas' dependence on polluted sources to meet their demands.

River basin based studies may help in bringing out this overarching issue of urban-rural water nexus especially in the context of Gujarat. With more than 54 to 63 percent of the population classified as rural in the Sabarmati and Tapi basins respectively, it would be important to take a closer look through an assessment of the prevailing conditions in the major urban centres like Ahmedabad (Sabarmati River basin) and Surat (Tapi River basin) and their rural peripheries.

2. SABARMATI RIVER BASIN AND TAPI RIVER BASIN

2.1 Sabarmati River Basin:

Sabarmati River Basin (figure 2) is categorized as a water deficit basin which lies on the west coast of India between latitudes 22 degree N to 25 degree N and

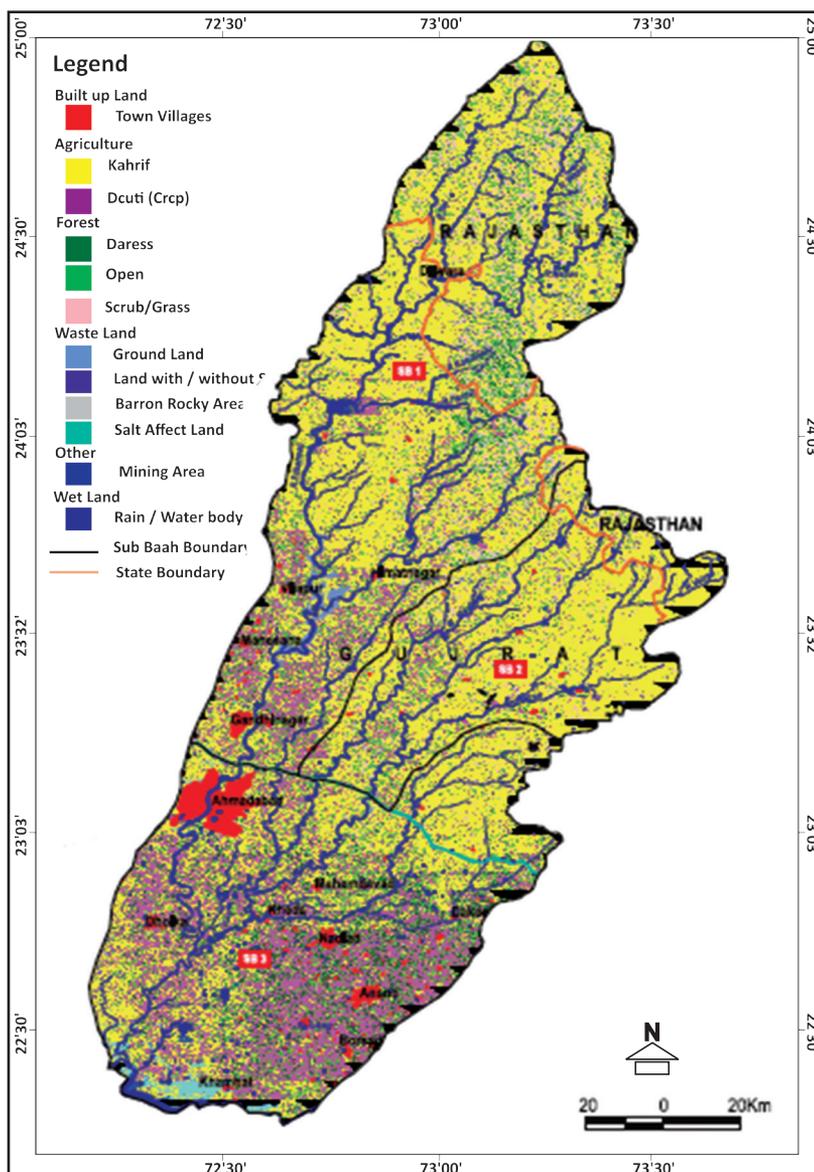
longitudes 71 degree E to 73 degree 30' E, and is spread across the States of Rajasthan and Gujarat. Sabarmati River originates at an altitude of 782 m in the Aravalli Hills in Udaipur in the Rajasthan State, and flows for a length of 371 km in the south-west direction, of which 48 km lie in the Rajasthan State and 323 km lie in the Gujarat State. The river joins the Gulf of Khambat in the Arabian Sea.

The major characteristics of Sabarmati basin are given in Table 1. The basin has a total drainage area of 21,565 sq km of which 17,441 sq km is in Gujarat and 4,124 sq km is in Rajasthan (Gopalakrishnan et al. undated). Approximately 57 percent of the total land use is under agriculture and about 20 per cent of the land is not under cultivation. The Sabarmati basin covers parts of the districts of Banaskantha, Sabarkantha, Mehsana, Gandhinagar, Ahmedabad and Kheda. There are around 20 industrial estates located within the river basin and of the many urban centers; the city of Ahmedabad and Gandhinagar are located along its central reaches.

2.1.1 Ahmedabad

Ahmedabad is located in the south-western part of Sabarmati basin occupying 27.3 percent of the total basin area. Sabarmati River comprises three sub basins - Dharoi, Watrak and Hathmati (WinrockIndia, 2006). Ahmedabad Urban Agglomeration spreads over 1,330.08 sq km of which 190.84 sq km area falls within the jurisdiction of Ahmedabad Municipal Corporation (AMC) and 150 villages under the jurisdiction of Ahmedabad Urban Development Authority (AUDA). River Sabarmati

Fig. 2: Land Use Map of Sabarmati River Basin



(Source: CEPT, 2009)

**Table 1: Characteristics of Sabarmati and Tapi River Basins**

Sl No	Attributes	Sabarmati	Tapi
1	Catchment Area (Sq km)	22	65
2	Length of the river (km)	371	724
3	Total Population (millions)	6	17.9
4	Density of Population (No/Sq km)	521	245
5	% Rural Population (%)	54	63
6	Total Renewable water resource (cu km)	3.8	14.9
7	Potentially utilizable water resources (Surface water) (cu km)	1.9	14.5
8	Potentially utilizable water resources (Ground water) (cu km)	2.9	6.7
9	Potentially utilizable water resources (Total water) (cu km)	4.8	21.2
10	Total Renewable water resource available per capita (cum)	631	831
11	Potentially utilizable water resources available per capita (cum)	797	1183

Source: *Amarasinghe et al., 2004*

divides the city into the old city and its periphery on the eastern bank and the new city on the western bank.

In 2001 AMC accounted for a population of 35,20,085 with a density of 184 persons per hectare and AUDA accounted for 47,09,180 with a density of 77 persons per hectare. According to 2001 census the city accounts for seven per cent of the state's population and 20 per cent of its urban population. Also Ahmedabad city accounts for 21.5 per cent of factories in the state employing 18 per cent of workers. Currently there are around 4859 factories in Ahmedabad city of which chemical and petro - chemical industries have the largest share of 29 per cent and textile industries constituting 13 per cent are considered to fall within the highly polluting category. However approximately 20 per cent of the land use in AUDA (including AMC) is put under agricultural use while industries account for approximately 17 per cent (14.3 in AMC and 3 in AUDA excluding AMC) (CEPT, 2006a). The water supply needs of the urban area are met from three sources: surface water from Raska pipeline, French well in Sabarmati River and by intake well-constructed in River Sabarmati. Narmada canal that passes through the North of the city releases water which is pumped through the intake wells. The AMC also draws water from 363 bore-wells installed in various parts of the city.

Earlier studies have shown that though the average daily supply of water per capita has increased from 20.24 Million Gallons in 1951 to 104.83 Million Gallons in 2001, the gross per capita per day has reduced over the years (Winrock India, 2006). According to Ahmedabad Municipal Corporation, in 2005, of the total 590 MLD supplied, 492 MLD is for domestic purposes, 66 MLD for commercial and industrial purposes and 30 MLD to public stand posts. However, in the peripheral areas outside the jurisdiction of AMC, organized water supply is limited largely to Gamtal (village



settlement) areas that cover less than 10 percent of the population. With increasing urbanization pressures and demand on infrastructure within the city limits, the peripheral areas are not catered to and subsequently are forced to depend on bore-wells. The villages face problems that are dual in nature - one, associated with excessive withdrawal of ground water and deterioration of water quality due to fluoride intrusion and two, use of surface water that is often contaminated with pollutants from industries affecting agriculture and live stock productivity.

Currently there are twenty industrial estates in the Sabarmati basin of which three are located within the Ahmedabad district boundary. They are Odhav, Naroda and Vatva. Vatva has 1,750 industries, Naroda has 850 industries and Odhav has 765 industries (Winrock India, 2006). There are three CETP that have been installed in the industrial estates. The treated sewage is discharged into river Sabarmati. The less and non - polluting industries in GIDC are presently not treating the waste and the effluent is discharged either in open or in the Khari canal. The other industries in AMC and Behrampura which are highly toxic are connected to the main sewer line and the effluents from these are being discharged into the River Sabarmati without any treatment (CEPT, 2006 a). Currently there are 27 storm water drain outlets into the river Sabarmati within the Ahmedabad Urban Agglomeration. Within the Ahmedabad urban area, domestic sewage of 500 MLD is generated of which about 168 MLD is discharged into River Sabarmati without treatment through storm water outlets (CEPT, 2006 a). An analysis of the land use within the river basin shows that in approximately 13 per cent of the river basin area double cropping is practiced and this patch of agricultural land lies within the lower reaches of the basin (CEPT, 2009).

Annual mean water resource in the basin is estimated as 3,810 million cu m. Total demand for the year 2001 was of the order of 5,744 million cu m. Consumption of surface water for irrigation is estimated to be 3,465 million cu m per year including the Mahi command within the Sabarmati basin (1,663 million cu m). Ground water contribution for agricultural use is estimated at 2,279 million cu m. Water requirement for humans and livestock in 2001 was 510 million cu m (Gopalakrishnan et al, undated). A sample study of villages lying in the south of Ahmedabad Urban Agglomeration such as Vautha, Sahij and Navagam Karna by CEPT University and Asamli, Bakrol, Chitrasar and a few others by Winrock International have pointed out that these villages use the polluted river water for irrigation and for livestock. The quality assessment of water samples has shown a large concentration of lead, cadmium, chromium and other metals; their concentrations were well above permissible limits (CEPT, 2009; Winrock India, 2006).

A recent study (CEPT 2009; Winrock India 2006) revealed that the impact could be classified based on the agricultural productivity and practices, human and livestock health and impact on fauna and flora. Some of the common observations from both the studies have been the high TDS content in the bore-wells. CPCB in 2007 rated



Sabarmati river water into the category ‘E’² with some of the downstream stretch (Ahmedabad to Vautha) as below ‘E’. It was observed that many of the villagers depend on the waste water for irrigation purposes, which to a large extent has resulted in contamination of chemicals in fruits and grains and has also led to lower yield of certain crops. There are various health implications such as intestinal problems, skin irritations and joint pains that have mainly affected the agricultural laborers and lower caste members of villagers who are in direct contact with the river water. Various livestock disorders have also been reported due to drinking of polluted water. Animals showing weakness at a very early age, frothing at the mouth, swelling of throat, foot rot, etc.; have been reported from these villages. Moreover, milk production has dropped drastically (Rural Component Lab Report, 2009).

2.2 Case 2: Tapi River Basin:

South Gujarat region is drained by three major west flowing perennial rivers namely, Mahi, Narmada and Tapi. The region covers 24 percent of state’s geographical area and it receives 40 percent of state’s precipitation. The Tapi (Fig. 4) is one of the major rivers flowing westward through the States of Madhya Pradesh (9,804 sq km), Maharashtra (51,504 sq km) and Gujarat (3,837 sq km), draining into the Gulf of Khambat in the Arabian Sea. Tapi river basin extends up to 65,145 sq km and is the ninth largest in the country. The basin can be classified into two parts, namely, the upper region that is predominantly agricultural land, falling within the state of Madhya Pradesh, and the central and lower reaches flanked by heavy industries in the states of Maharashtra and Gujarat. Some of the major urban centres such as Burhanpur in Madhya Pradesh; Akola, Bhusawal, Jalgaon, Malegaon and Dhule in Maharashtra; and Surat in Gujarat are located within the Tapi basin area.

Fig. 3: Water Quality Test Result in Sabarmati Basin (Winrock, India, 2006)

Village/Source	Cadmium	Chromium	Copper	Lead	Zinc	Arsenic
Permissible Limits For heavy metals in water (ISI)	0.01	0.05	1.5	0.10	15.00	0.00
Galiyana River Water	0.02	0.46	0.16	0.00	0.07	0.00
Sahij River Water	0.02	0.49	0.28	0.16	0.08	0.00
Gyaspur river Water	0.007	0.92	1.57	0.17	0.65	0.00
Vautha Borewell	0.01	0.61	0.22	0.40	0.56	0.00
Sahij Soil	0.15	25.04	19.4	0.98	36.59	0.00
Vautha Wheat	0.00	0.00	0.00	2.675	0.00	0.00

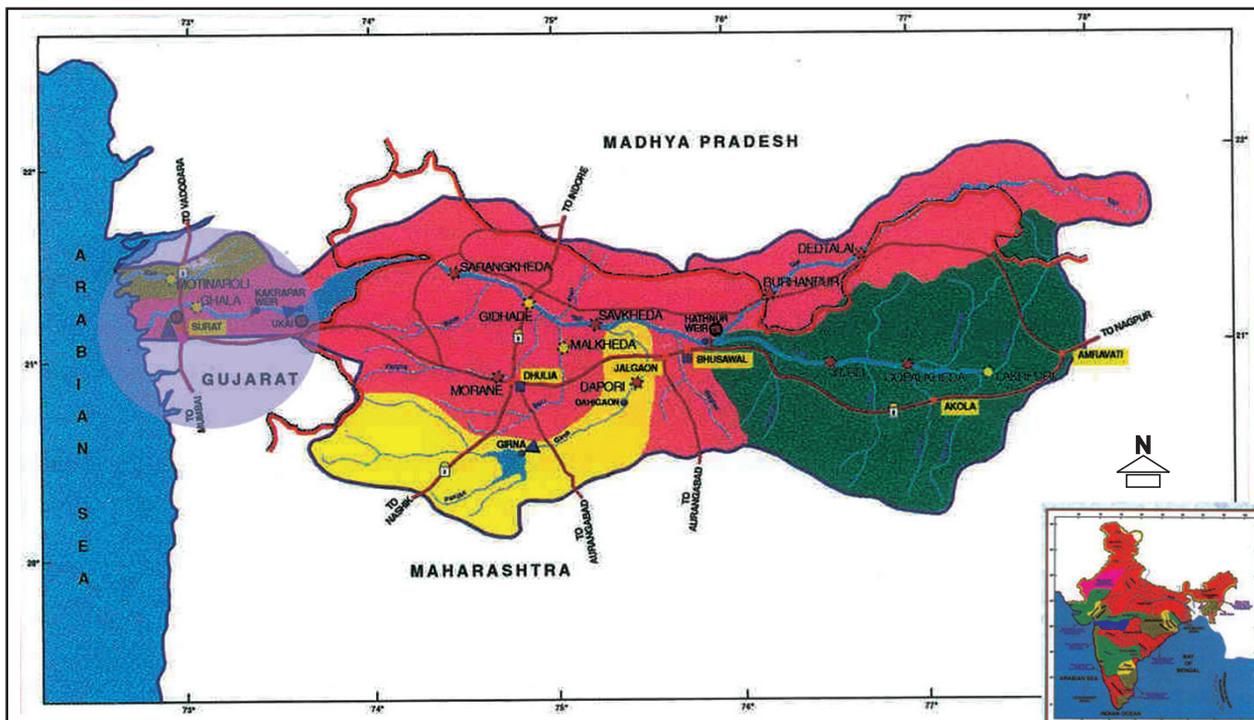
² Designated best use of water : ‘A’ - Drinking water source without treatment but after disinfection, ‘B’ - Outdoor bathing, ‘C’ - Drinking water source after conventional treatment and disinfection, ‘D’ - Propagation of wildlife and fisheries, ‘E’ - Irrigation, Industrial cooling, controlled waste disposal, Below ‘E’

2.2.1 Surat Urban Center

Unlike the urban agglomeration of Ahmedabad located in the south western reaches of Sabarmati basin, Surat urban agglomeration is located along the mouth of river Tapi. However, the increasing urbanization trends, migration and heavy industries have put an immense pressure on the neighboring villages located on the immediate periphery of the urban centre and especially those located along the coast. Surat urban agglomeration under SUDA consists of Surat city and 148 villages. Surat city is governed by SMC covering an area of 326.52 sq km extending up to the Arabian Sea coast and SUDA that covers an area of 722 sq km (Fig. 5). Surat urban agglomeration extends over Surat city, Olpad, Chorasi, Kamrej and Palsana talukas as well as the Hazira Industrial Area making a total area of 168 sq km. Surat is India's twelfth and Gujarat's second most populous city. In the year 2001 Surat city within the jurisdiction of Surat Municipal Corporation (SMC) had a population of 24,33,785 with a density of 217 persons per hectare (before expansion of city limits from 112.27 Sq km in 2001 to 326.52 Sq km with density 88 persons per hectare in 2006) and Surat Urban Development Authority (SUDA) with a total population of 30,90,686.

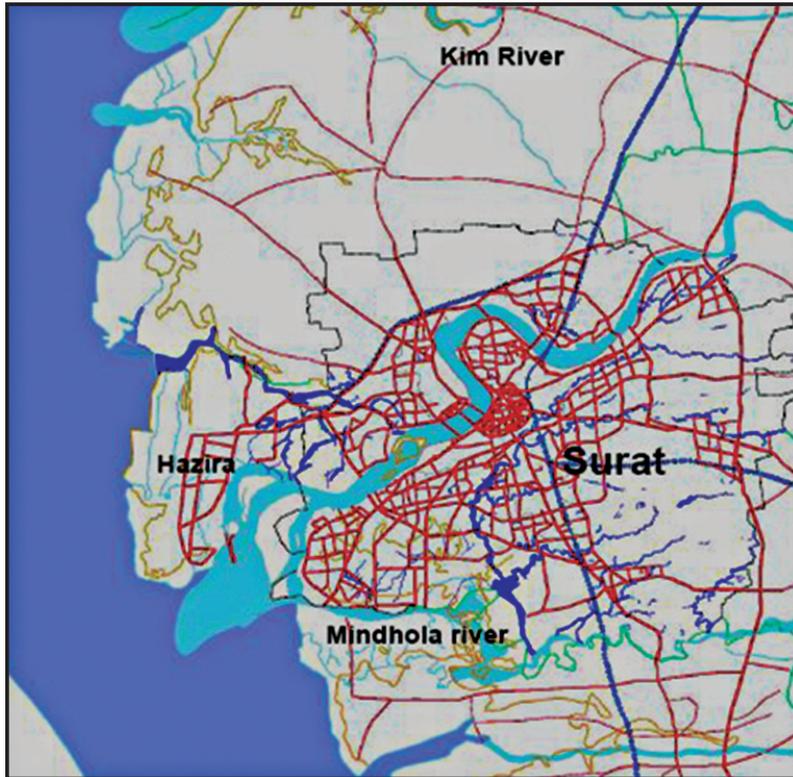
Surat is known for its industrial base, which plays an important role in the economy of the state. It is known for its textile manufacturing, trade, diamond cut-

Fig. 4: Tapi River Basin



Source: Ministry of Water Resources, www.wrmin.nic.in

Fig. 5: Surat Urban Centre



Source: CEPT, 2006b

ting and polishing industries, intricate *zari* works, chemical industries and gas based industries at Hazira established by ONGC, Reliance, ESSAR, and Shell. There are more than half a million industrial units mainly consisting of textile industries. Textile units depend on ground water for textile processing and withdraw about 700 to 1,000 cubic meters of water every day. There are six main industrial estates located within the city in Pandesara, Khatodara, Udhana, Katargam, Sachin and Bhestan, which have more than 30,000 industrial units (CEPT, 2006b).

The Surat Urban Centre has seen a consistent growth in its population and this has been mainly attributed to the employment opportunities in the field of manufacturing and other sectors (CEPT, 2006b). Increasing demand for residential, commercial and industrial use has put enormous pressure on its natural resources especially the water supply. Main source of water for the city has been the River Tapi since centuries. The contribution of ground water is only about 10 percent of the daily total water supply to the city. At present SMC supplies water to 95 percent of its population. Total water supplied including ground and surface sources within the city is 580 MLD (supply capacity is 6,732 MLD). 502 MLD is supplied for domestic purposes, 20 MLD for commercial purposes and 55 MLD for industrial purposes.



However, the area which is not served is mostly made up of agricultural land within SMC. The same is the case with the rural areas in the urban periphery. Most of the villages located along the periphery depend for their livelihoods on agriculture and fishing (Parthasarathy and Soumini, 2009). The SUDA except the SMC area has no water supply system of its own. The main source of water for various villages in SUDA area is the ground water that is tapped through bore-wells or the water supply schemes supported by Gujarat Water Supply and Sewerage Board.

According to the Gujarat Pollution Control Board the quality of Tapi River has been classified based on parameters like BOD, DO and PH data and shows signs of pollution. Deterioration of the surface water quality also affects groundwater quality, which can be attributed to dumping of waste water by local authorities and discharge of untreated or partially treated effluents by industries into the rivers and other water bodies. Agricultural run-off and disposal of hazardous wastes in different forms in landfills, near urban areas and industrial zones, also affects the quality of surface and groundwater. Polluted water reduces net utilizable safe water and aggravates the problem of water scarcity. Unregulated lifting of ground water through bore-wells coupled with close proximity to coastal areas has increased the salinity of ground water. Surat District is affected partially by salinity, fluoride and nitrate contents in ground water. Percent of villages affected by salinity is the highest in South Gujarat (6.5 percent) followed by Middle Gujarat (6.0 percent), which is mainly attributed, to the proximity, to the sea.

A survey in the coastal villages of Surat district has shown that irrigation plays a major role in the agriculture of this region (Parthasarathy and Soumini, 2009). In this district, 60 percent of total irrigated area is under canal irrigation, which channelizes water from local perennial streams and rivers to agriculture fields. The district has 54 percent of irrigated land to net sown area as compared to 32 percent for the state as whole. Industrial and urban development in the lower Tapi River basin has posed various challenges not only to the livelihood in agriculture and fishing in the neighboring villages but also to the fauna at the mouth of the river. Site visits to coastal villages of Chorasi and Olpad talukas have revealed that with the increasing threats from future changes in climate, these unplanned developments aggravate the vulnerability of coastal rural livelihoods (Parthasarathy and Soumini, 2009).

A field study was conducted in 75 households spread across 10 coastal villages. Villagers complained about the impact of the existing industrial cluster at Hazira on the annual productivity of crops. It has been observed that there is a reduction in size of fruits and vegetables over the past decade mainly attributed to the increasing chemical content in soil and air and other direct pollutions from the industries. There is a visible increase in salinity in many fields especially in villages of Olpad Taluka. There has also been an expansion of city boundaries over a period of five years, which has led to conversion of large tracts of agricultural land to non-agricultural use. Many agricultural workers are shifting to non-agricultural work such as industries in the nearby areas. Many of these villages are located on the tail



end of canal irrigation systems. This has in turn further affected the availability of water for irrigation. A large number of farmers depend on wells for irrigation purposes. Salinity ingress has affected the availability of water for irrigation.

Location of Industries on the mouth of River Tapi has affected the livelihood of fishermen's community drastically. Fishermen reported that in the past decades catch of varieties such as Pomphret and Chilia has reduced tremendously. Industries located along the coast and rivers have been reported to be polluting water bodies harming fish breeding and rearing. In 2008 there were repeated dead fish incidences along Dumas Beach. Moreover conversion of mangrove patches and denotifying them for industrial and port activities have also affected fish breeding in the area. Large scale dredging in the Tapi river mouth has also affected aquatic ecosystem (Parthasarathy and Soumini, 2009).

3. CONCLUSIONS

River Basin studies have helped in bringing out the over arching issue of urban-rural water nexus especially in Gujarat, which is currently the most industrialized state in India. With more than 54 and 63 percent of population classified as rural in the Sabarmati and Tapi basins respectively, this analysis attempted an assessment of the prevailing conditions in the major urban centres like Ahmedabad (Sabarmati River Basin) and Surat (Tapi River Basin) and their rural peripheries. A case of the River Sabarmati in Ahmedabad city has revealed that the discharge of treated and untreated waste and toxic effluents into the river has impacted various villages located in the down-stream areas. In addition, the domestic sewage amounting to about 168 MLD from Ahmedabad city is also discharged into the River Sabarmati without treatment. With approximately 13 percent of the river basin area under double cropping - mainly in the lower reaches - impacts of industrial and urban domestic waste have turned critical in the rural areas. Rural areas have been affected not only by decreasing productivity but also by the contamination of crops and land further impacting the health of humans and livestock. Although both showed similar trends in the deterioration of the surface water quality, the groundwater was influenced by the release of waste water by urban authorities and the discharge of untreated or partially treated effluents by the industries into the rivers. The case of Tapi river basin revealed a different pattern of the urban-rural nexus. Surat being in close proximity to the Arabian Sea, water resources have been affected by both anthropogenic activities in urban and industrial centres as well as increasing salinity. The impact of increasing industrial and urban density has not only affected agricultural sector but other primary sectors also such as livestock rearing and fishing. These two cases have revealed a strong evidence of an urban - rural nexus, which often remains unidentified and is overlooked as the existing planning processes are piecemeal in nature and approach. This emphasises the need to bring about a regional planning perspective in the overall planning processes.

Evidently, domestic and industrial water needs are a priority as enunciated in the Water Policy. In the course of making provisions for these sectors, there seems



to be a lack of provisioning for handling of waste water. How do we dispose of waste waters to lower reaches, especially if cities are also industrial centres? The quantity as well as quality of water supplied to these areas is of great concern and therefore, it is important to discover whether any improvements could be made in the existing arrangements that determine the use of resources. In fact, this paper has presented an analysis through studies of river basins that connect urban and industrial areas and those of adjoining rural areas. Instead of piecemeal plans of urban and rural needs, it is better that a wholistic plan that addresses planning components on a regional scale is considered. For land use planning, environmental management and natural resource planning and management appears to be natural correlates. Therefore, to address the issue of sustainable development and inclusion of environmental planning tools appears to be a necessary condition to urban planning.

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Integration of Environmental Concerns in Development Plans: A Case of Hyderabad Metropolitan Region

Utpal Sharma

Abstract

The number of metropolitan cities in India and the developing world are increasing, and city planners are increasingly faced with challenges of enhancing economic growth potential of cities and their regions. The author argues that the very real concerns of environmentally sustainable development, climate change, rural-urban dynamics in city regions, issues of peri - urban areas and inclusive development needs to be addressed adequately. Land use and mobility planning, delineation of urban growth boundaries, provision of social amenities and physical infrastructure and policy and institutional frameworks need to be increasingly geared to achieve desired economic, social and environmental outcomes. The paper takes the Structure Plan for Hyderabad Metropolitan Region as a case study to understand, how these issues can be addressed and what insights can be distilled for metropolitan cities in developing countries.

1. INTRODUCTION

Metropolitan cities in the developing world are increasingly poised to play a larger role in the global economy. A recent research report by McKinsey (McKinsey Global Institute, 2011) clearly points towards the imminent shift from cities in the developed world to those in the developing world in terms of contribution to global GDP. The report indicates that 600 urban centers presently account for 60 percent of global GDP. While the number of cities contributing 60 percent to global GDP is expected to remain the same, the composition is likely to change. The report indicates, "By 2025, we expect 136 new cities to enter the top 600, all of them from the developing world and overwhelmingly (100 new cities) from China, India will contribute 13 newcomers, including Hyderabad and Surat. Latin America will be the source of 8 cities".

In India, the trend of concentration of urban population in large cities and agglomerations is getting stronger. The number of million-plus cities in India has grown from 5 in 1951 to 35 in 2001 and 53 in 2011, and their population share from 18.9 percent in 1951 to 42.6 percent in 2011 (Census of India, 1951, 2001, 2011). By 2026, the number of million-plus cities in India is expected to be 61 (Registrar General and Census Commissioner of India, 2006). A major challenge is the complexity that increase in scale is likely to bring up. Large metros like Bangalore and Hyderabad as well as smaller, million-plus cities have witnessed peripheral expansion. A major challenge of urbanization in India is that over one-

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fourth (25.7 percent) of the urban population is estimated to live below poverty line (Planning Commission of India, 2009 and Himanshu, 2009).

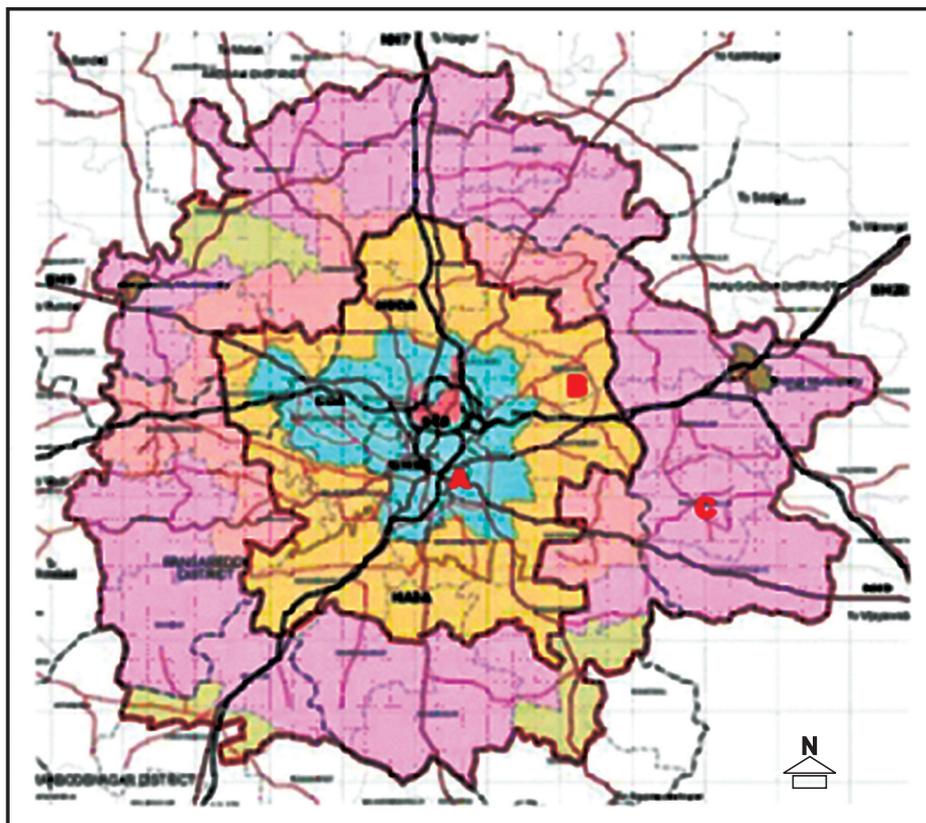
2. THE STRUCTURE PLAN FOR HYDERABAD METROPOLITAN REGION

The city of Hyderabad represents India's rich history, culture and civilization, while also standing for modern day, economically vibrant urban India. The City of Nizams and Pearls is today one of the fastest developing cities in India and has in the last decade, emerged as a leader in the Information Technology (IT) industry. The multiplicity of local bodies and parastatal agencies with different roles and responsibilities related to service provision in the Hyderabad Metropolitan Region (HMR), the vast areal extent of the region and the enormity of the urban and environmental issues involved, was recipe for an incredible degree of complexity in planning.

The jurisdiction of Hyderabad Metropolitan Development Authority (HMDA) extends over 55 *mandals* spread across five districts, making it the second largest in India after the National Capital Region of Delhi. The total area of Hyderabad Metropolitan Region (HMR) is 7,247.29 sq km in a circular form with a radius of 84.53 km; of this, the area of urban settlements is 13 percent, while that of rural settlements is 87 percent.

The total population of the HMR in 2001 is estimated to be 7.65 million, of which 5.96 million (77.93 percent is urban and 1.69 million 22.07 percent is rural). The slum population living in HMR is estimated at 1.95 million, and is found only in the Hyderabad Urban Agglomeration (HUA). Secondary data analysis allowed a division of the HMR into three distinct sub-regions based on level of urbanization, industrialization and non-farm employment:

Fig. 1: Hyderabad Metropolitan Region





2.1 Hyderabad Urban Agglomeration (HUA)

The core area of HMDA and the economic base of HMR, comprising 11.64 percent of the total HMR area. It hosts a population of 5.74 million (75 percent of HMR population) spread over the districts of Hyderabad (in its entirety), Rangareddy (12 mandals) and Medak (2 mandals). HUA area consists of 12 municipalities, 3 census towns and 13 out growths (Census of India, 2001). The Hyderabad Urban Agglomeration (HUA) is dynamic, having registered an increase in area from 298.5 sq km in 1971 to 832 sq km in 2001, registering an increase of 3.48 percent per annum. Similarly, the population of HUA increased from 1.79 million in 1971 to 5.74 million at a compounded annual growth rate of 3.95 percent per annum. This growth of population is attributed to natural increase, net rural urban migration and reclassification of rural settlements to urban. This trend is likely to continue in the future, albeit at a declining rate.

2.2 Rest of HUDA and HADA

Which includes 210 rural settlements including 18 uninhabited villages and 3 urban settlements. Also circular in shape, it has a radius of 47.22 km. The total population in this area is 0.57 million (7.49 percent of HMR), mainly rural (Census of India, 2001). The economic base of this part is predominantly rural and relatively poor, in comparison with HUA.

2.3 Extended Area of HMDA

Comprising 635 settlements, including 26 uninhabited villages and 7 urban settlements. The total area of extended area of HMDA is 5017.90 sq. km. It is predominantly rural, with a population of 1.34 million. This area also has a relatively poor economic base in comparison with HUA.

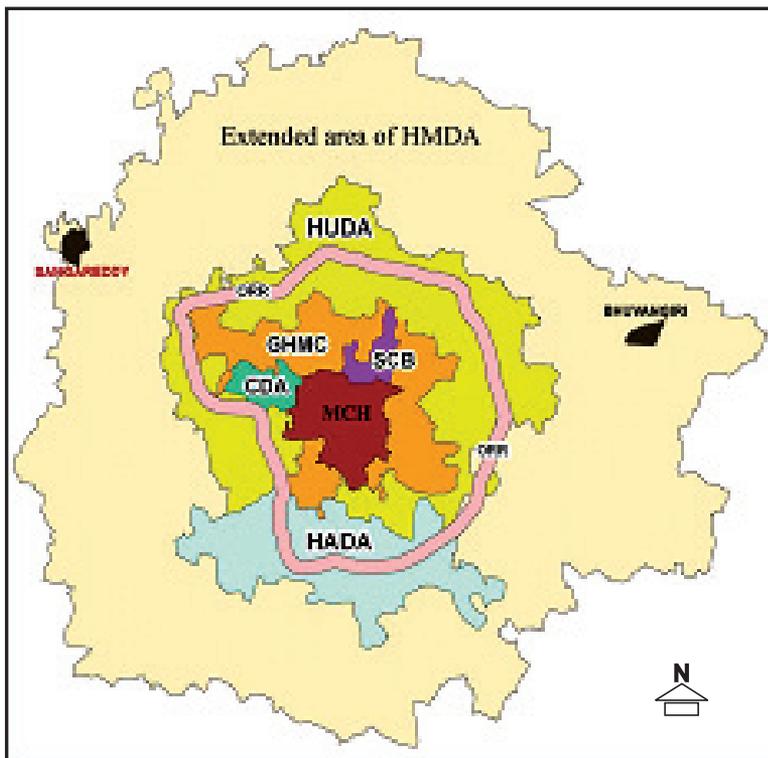
The Structure Plan for Hyderabad Metro Region (HMR) projects the population of HMR in 2031 as 18.4 million, of which the estimated urban population shall be around 16.1 million (CEPT University, 2010).

3. PLANNING CHALLENGES

It was evident from the initial analysis that the two outer regions, i.e., 'rest of HUDA and HADA' and the newly extended area of HMDA needed to be developed in a manner consistent with the character and potential of the areas. It was also evident that the three sub-regions of HMR are heterogeneous, with varying levels of development. While HUA and the core is the most developed region, the remaining areas have a predominantly rural economy, where agriculture is the mainstay. In order to derive scale economies, they needed to be integrated in a manner that inequalities between them are reduced to a minimum or eliminated. A significant challenge was to develop a Structure Plan for the HMR, while taking into account the existing Master Plans for HUA, HADA, HUDA and

other jurisdictions that were/are already in force (Fig. 2), suggest changes if required in those plans and achieve a seamless integration. This required a definition of the Structure Plan area or project area, which was possible After GIS maps were available and a concept plan alternative selected. The project area spreads over 35 mandals (Fig. 3) (of which 15 are partially included), covering 798 settlements. Of these, 163 settlements fall in erstwhile HUDA and HADA area (946.33 sq. km) and 635 settlements in the extended area of HMDA. In 2001, the project area had a population of 1.78 million (Census of India, 2001) and an area of 5,964.23 sq km.

Fig. 2: Existing Master Plans in HMR

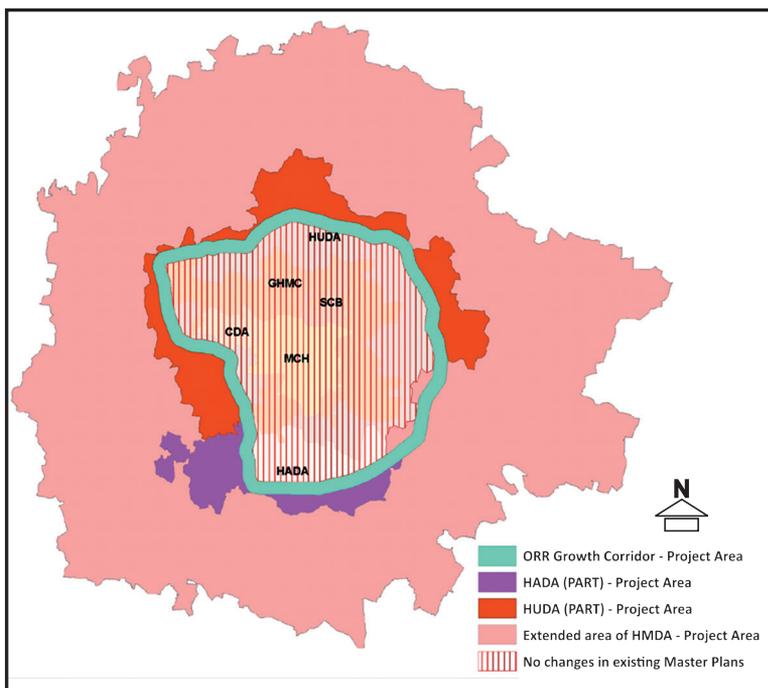


4. THE PLANNING PROCESS

4.1 Defining the Vision a Participatory Approach

Participation and ownership of the plan by local level stakeholders was envisaged as a key factor to the success of the Plan. A series of workshops, discussions and meetings were held with senior officials of various departments, academicians and the general public, including the poor. These interactive and collaborative exchanges helped understand the perceptions and needs of the local populace, which together with studies of the existing situation and examination of growth potential and opportunities, helped define the vision for the

Fig. 3: Schematic Depiction of Structure Plan Area





city and its region: “To develop Hyderabad Metropolitan Region as a modern economic region with world class infrastructure and social amenities to address future requirements in harmony with its ecological resources”. Economic development and environmental protection thus, emerged as the key priorities / objectives. Again, after the Draft Structure Plan was prepared, the general public was invited to give suggestions and objections if any, enabling a public review and endorsement of the proposals.

4.2 Analytical Approach

The analytical approach adopted by the Structure Plan was to examine the differentials between each of the three sub-regions in the HMR and identify issues to be addressed to fully integrate the entire region, so as to derive all the benefits of scale economies. Existing situation analysis as well as projections of population, employment, land use and land area requirements were therefore undertaken for each of the three sub-regions.

4.3 Economic and Policy - Oriented Thinking

Discussions with stakeholders helped identify that Hyderabad needed to address its economic priorities with investment in physical infrastructure, while conserving the environment and addressing diseconomies such as congestion and pollution. Key economic drivers in each of the three sub-regions were identified, including existing and proposed investments in townships, industries, Special Economic Zones, IT/BT parks etc. All such investment projects were found to be distributed along the National Highways, State Highways and the Outer Ring Road. Employment projection (4.65 million urban worker population in HMR at an overall level in 2031) was undertaken and probable locations of employment centres identified for each of the sub-regions as well.

4.4 Strategic Orientation

The following development strategies were identified, which guided preparation of the Hyderabad Structure Plan 2031: (1) Creation of a compact city to achieve sustainable development; (2) Proposing multi-nuclei centers to help reduce pressure on the core area, with each Center acting as a self-contained zone providing economic opportunity and higher order social facilities to the surrounding areas; (3) Transit Oriented Development (TOD) along major corridors, emphasizing movement through public transport. The above-mentioned Centers were to be well-linked to the core city; and (4) Integration of the peripheral areas with the core and intermediate areas, so that the entire HMR acts as one entity (through TOD).

4.5 Research and Training Orientation

The planning process triggered parallel research and training functions at CEPT University, Ahmedabad which are expected to diffuse to other cities in future.

4.6 Balancing Environment and Economics

Typically, land-use development decisions in India in the past have been guided by one-dimensional criteria, most commonly short-term economic gain, and not ecological, social, or even economic advantages over the long run. The Structure Plan for HMR, 2031 used Environment Suitability Analysis as a tool/process to determine the fitness of a specific land parcel to support a well-defined activity or land use. Systematic, multi-factor analysis of the different

conditions of the landscape resulted in identification of two broad zones viz., Conservation, and Development zones. Conservation zones are ecologically sensitive areas and are categorized on the basis of presence of critical environmental features. The remaining area, other than Conservation Zone in the suitability analysis was demarcated as suitable for development activities (Fig. 4).

Superimposition of the environmental suitability analysis and the land potential analysis resulted in the Composite Land Suitability Analysis (Fig. 6).

Out of 3321 sq km of developable area, around 733.31 sq km of area was proposed for development in the extended area of HMDA.

4.7 Assessment of Concept Plan Alternatives

Three alternative Concept Plan proposals were drawn up. The main goal of each was to create an efficient road network, while integrating the environmental and land suitability features. The alternatives were useful in verifying feasibility of high-rise development; land designated for roads and open spaces, plot typology and built form character, for the proposals. The selected alternative (Alternative III), combines the merits of Alternative I and II and addresses gaps in the same through additional conceptual proposals (Fig. 7).

Fig. 4: Environmental Suitability Analysis

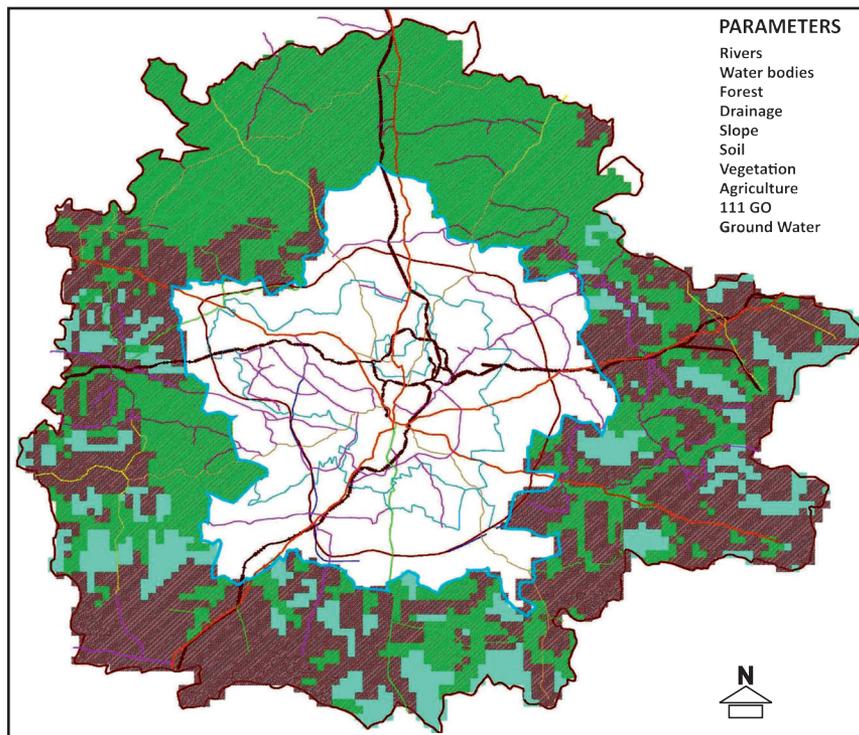




Fig. 5: Schematic depiction of Structure Plan Area

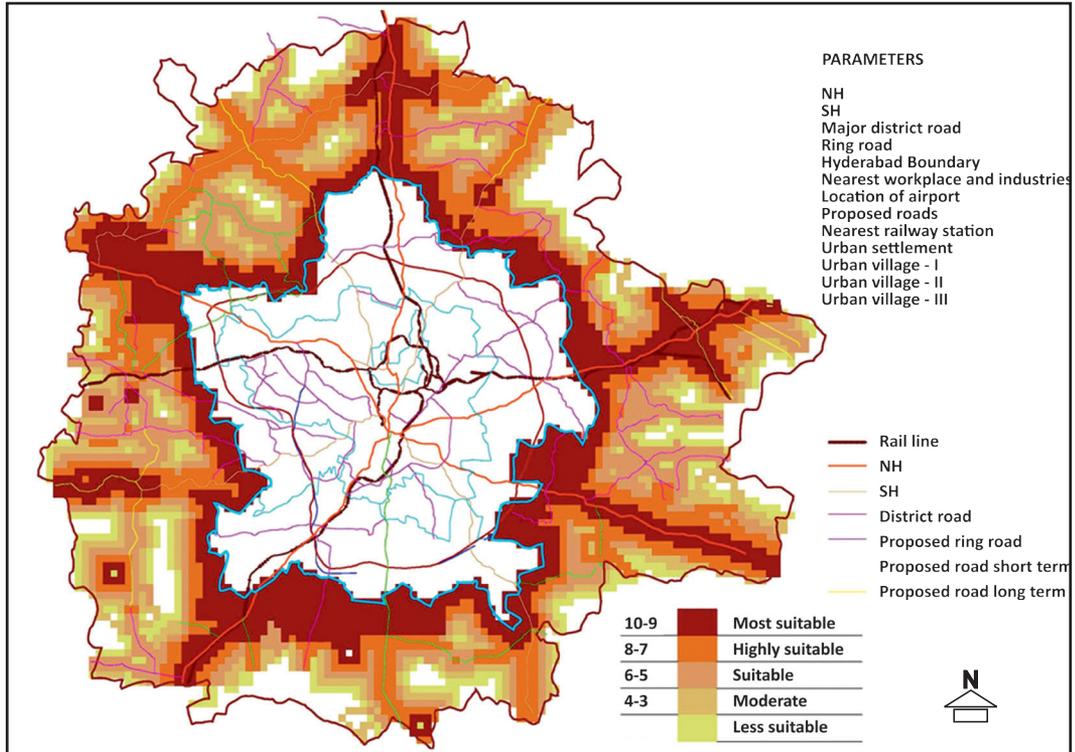


Fig. 6: Composite Land Suitability Analysis

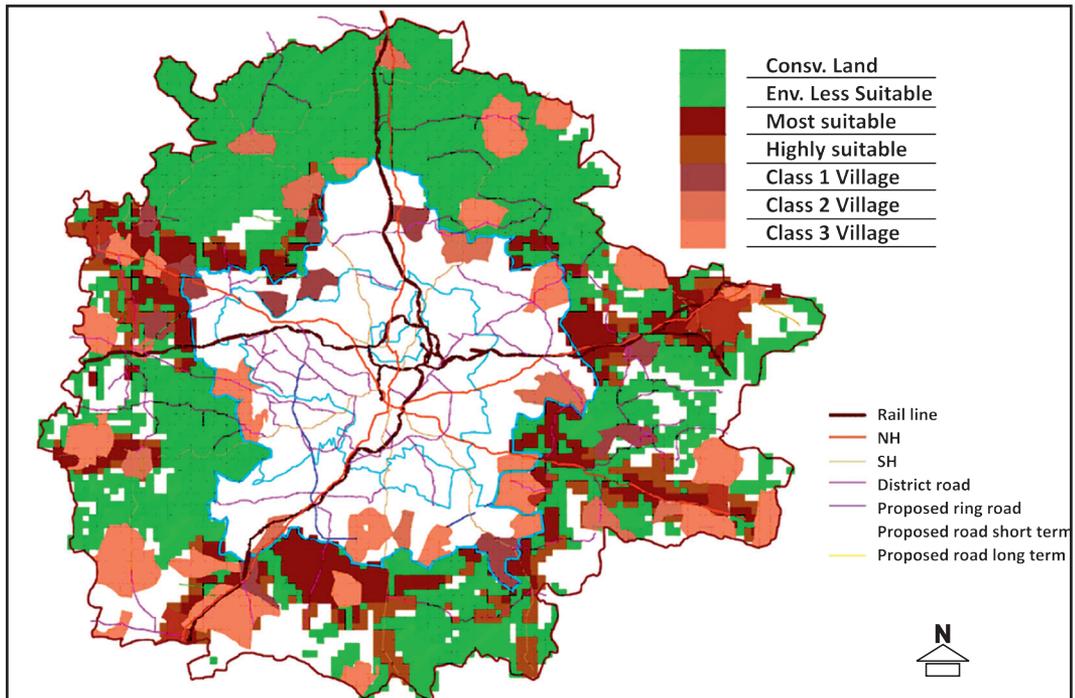
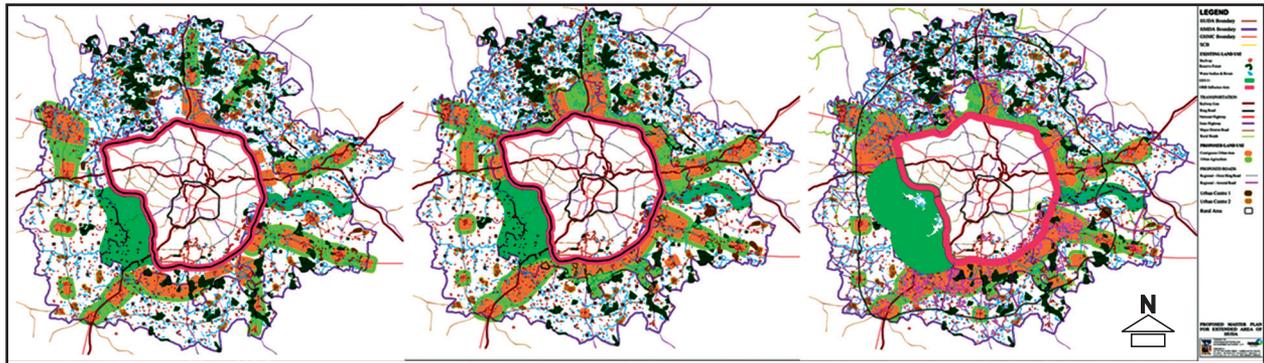


Fig. 7: Evolution of the Concept Plan



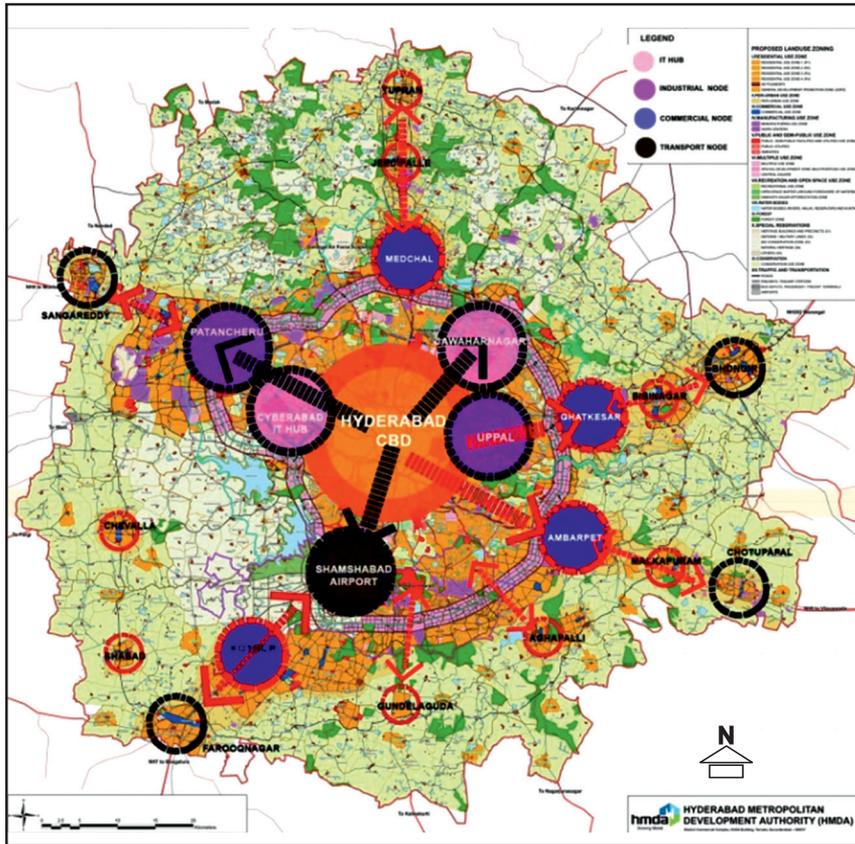
4.8 Guiding Principles of the Structure Plan

The guiding Principle of the Structure Plan Includes:

- **Transit Oriented Development:** Several growth pockets are identified in the extended area of HMDA, along the major highways. According to the land potential analysis, most of the future growth pockets are along the linear corridors. Recent developments like the International Airport, Outer Ring Road, radial roads, Multi Modal Transport System, Hardware Development Park, Special Economic Zones, etc., are molding the travel pattern. Transit Oriented Development is expected to help integrate at regional level, the Outer Ring Road with the radial roads and the proposed Regional Ring Road. Higher order facilities like commercial activities, IT parks generating employment may be proposed in areas around the intersections of outer ring road and radial roads. Proposals for passenger terminals and goods terminals along the railway corridor are already in place. Transit Oriented Development is expected to facilitate better connectivity of the city center of Hyderabad with the peripheral area of HMDA, taking the pressure off the city center of Hyderabad and providing strong connectivity in the region. The Structure Plan envisages that Hyderabad city will act as a primary nucleus to the other multiple sub-nuclei centres (identified as growth centers). These centers are inter-related and integrated in a strong relationship through the network, to be achieved through Transit Oriented Development.
- **Multiple Nuclei Concept:** The concept is used to create alternative centres and sub-centres to help take the overload from the center or core nuclei (Figure 8). The projected urban population of the HMR will be around 18 million in 2031. Based on the multiple-nuclei concept, a hierarchy of centers serving different sizes of population are envisioned for the HMR:
- **5 million-**The Core city of Hyderabad, characterized by mixed land use will serve as the main Central Business District (CBD) and will act as a center for the entire urban population.

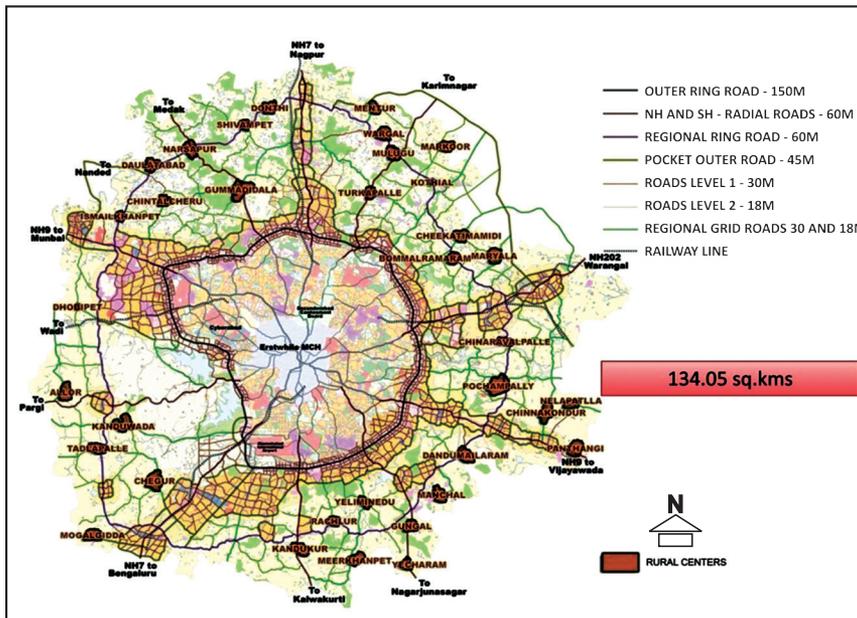


Fig. 8: Application of Multiple Nuclei Concept to HMR



- 2.5 million : Shamshabad (airport), Cyberabad, Jawaharnagar, Uppal and Patancheru along with the core city will serve HMR urban population as sub-city level centers.
- Similarly, 16 lower order sub-centres are identified to serve a total of 16.1 million urban population in the HMR.
- Urban nodes proposed in the Structure Plan include commercial, transportation and industrial nodes, identified as an accumulation of a cluster of activities.
- Rural-urban Continuum: Lack of a regional planning approach in Indian and Asian cities has often led to a rural-urban divide rather than creation of a continuum for development (Planning Commission of India, 2001, Asian Development Bank, 2008). The Structure Plan for HMR seeks to understand the hierarchy of settlements in the metropolitan region and proposes integration of rural centres through their development and network linkages (Fig. 9).

Fig. 9: Rural Centres Proposed for Development





- **Urban Services Boundary:** Provision of urban infrastructure such as water supply, sanitation, sewage, solid waste management, etc., within a defined area to enable clustering of development activities, is proposed. The proposed growth pockets / multiple nuclei centres will help control urban sprawl. The growth pockets proposed to be developed in a phased manner, will act as self-sustained zones and will help define the urban service boundary. These small urban systems are likely to lower the cost of service provision. Transport costs will be lower and people's productive time will be saved.
- **Peri-urban Development:** The term 'peri-urban' is defined as an activity that produces, processes and markets food and other products, on land and water in peri-urban areas, applying intensive production methods and reusing natural resources and urban wastes to yield a diversity of crops and livestock (UNDP, 1996). Peri-urban development acts as a transition / buffer zone between intense urban areas to rural areas.
- **Provision of Social Amenities:** The Structure Plan proposes social amenities at village level as per UDPFI guidelines for the years 2021 and 2031, respectively. Scalogram Analysis was undertaken at village level to understand the spatial parity and presence of mega centres for allocating facilities. Higher level of amenities for education, health and finance are proposed and identified spatially at *mandal* level for the extended area of HMDA and notified area of erstwhile HUDA and HADA (rural).
- **Environmentally Suitable Development:** It is increasingly evident in cities across the world that poor urban planning and management can adversely impact the urban economy, environment and society. The Structure Plan for HMR proposes development in harmony with the environment. It identifies "no development zones" to protect the lakes, water bodies and forests in the region. Segregation of residential, commercial and industrial areas with buffer zones is undertaken. Green buffers are proposed for major corridors of movement already existing or proposed, to protect the resident population from air and noise pollution. Clustering of industries is given priority based on the type of waste generation. Decentralized and specialized treatment plants are proposed in local clusters, to reduce the cost of infrastructure development.

In addition to the guiding principles, the Structure Plan for HMR addresses lacunae in past planning exercises through specific policy provisions.

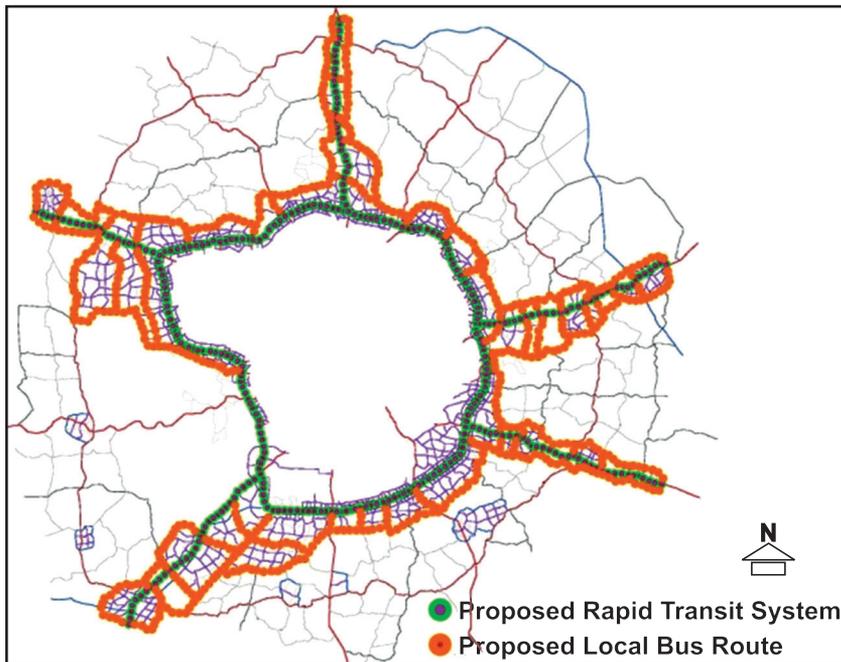
- **Policy Framework:** The Structure Plan delineates a Policy Framework for focus areas such as economic growth, conservation of lakes and water bodies, heritage conservation, mining and quarrying, climate change and energy efficiency, urban poverty and social equity, industrial development, transportation, infrastructure development, and provision of housing and community facilities, with a pro-poor focus for the HMR. A seven-point charter for inclusion of the urban poor in the development process and policy provisions



related to housing and community facilities, developed land reservations for the poor to the tune of 20-25 percent in all housing projects, basic municipal service provision, and access to social services are provided for.

- **Integrated Land Use and Transport Planning:** The need to integrate land use planning with transport planning has been one of the most common refrains in reviews of land use plans in India. The Structure Plan for the HMR takes into account the existing road hierarchy and proposes a Regional Ring Road in the extended area of HMDA. Arterial roads such as state and national highways connect the outer ring road to the regional ring road. More arterial roads have been proposed in the extended area so that connectivity improves and urban, rural and peri - urban areas in extended area are connected to the core area. Out of the 33 radial roads proposed by HMDA, 26 radial roads intersect Outer Ring Road Growth Corridor (ORRGC) and further extend to the Regional Ring Road in the extended area of HMDA. Various sub-centers/centers are identified at the intersection of the major radial roads to Outer Ring Road (ORR) and Regional Ring Road. The proposed grid roads are integrated with the existing village roads (24m to 30 m width) in the ORRGC. The Structure Plan provides the framework for road network development, including regional road network and urban road network development and proposes public transport routes in the region (Figure 10). A rail network, freight cargo terminals, passenger terminals and logistic hubs are proposed in the HMR. Detailing of the traffic and transportation aspects would be carried out in the Comprehensive Traffic and Transportation study being carried out by HMDA.

Fig. 10: Proposed Public Transport Routes in HMR



- **Serviced Development:** Much has been written on the need for convergence between different sectoral plans (ADB, 2008 and HPEC, 2011, Planning Commission of India, 2011) and the need for integrated land use, transport and infrastructure planning. Unserviced development particularly in the peripheries has been found to lead to a number of problems in Asian cities; in particular, less efficient networks and delays in providing services due to issues in ac-



quiring right of way (ADB, 2008). The Structure Plan for HMR provides the framework for such integration. The assessed demand for physical infrastructure (water supply, sewerage, solid and hazardous waste management and storm water drainage) and social amenities and related land requirements are incorporated into the Plan.

- **Land use Zoning to ‘Promote’ Development:** Planners in India have long recognized the merits of mixed land use in the Indian context (DDA, 1990 and HPEC, 2011); this is likely to hold good in the context of cities in the developing world. Past plan implementation effort in India has often been criticized for having failed to enforce Development Control Regulations. Typically, zoning and development control regulations in Indian cities have limited the supply of land for urban use, increased the cost of expanding built spaces in peripheral areas and opened up rent-seeking opportunities (HPEC, 2011).

The Structure Plan for HMR recognizes the need for “Development Promotion Regulations” as opposed to “Development Control Regulations” and clearly identifies / defines “Developable Urban Space”. The Development Promotion Regulations drafted for the Structure Plan seek to promote and regulate development activities in the urbanizable limits and other areas identified as suitable for development by way of zoning regulations, land development regulations and building regulations.

Land use zones provided for in the Structure Plan for HMR include zones for residential use, commercial use, peri - urban use, manufacturing use, public, semi-public facilities and utilities use, multiple use (including areas earmarked as multiple use zones and those identified for transit oriented development), recreation and open space use (in areas earmarked as open space buffers around water bodies), water bodies and reserve forests, special reservations (heritage buildings and precincts, defense lands, bio - conservation zone, natural heritage and others), conservation use, and traffic and transportation use.

The Development Promotion Regulations for HMR do not address the issue of state policy allowing regularization of unauthorized construction or illegal development, which has made planning exercises irrelevant in the past in most cities/states in India, as this is beyond the mandate of the Structure Plan. This issue needs to be addressed by the State Government.

Implementation Mechanism: In India and in several other Asian countries, the most common method of acquiring land for urban use / public purposes is through the process of land acquisition, a cumbersome and time-consuming process that is often fraught with litigation and political interference. Constraints to availability of land for development due to issues of land acquisition have been



a problem with several Master Plans in India, relegating them to plans on paper alone.

5. THE CHALLENGE OF METROPOLITAN GOVERNANCE

Metropolitan urban governance is a complex issue, as typically, a metropolitan area is spread over a large area and cuts across a number of municipalities, rural and transition areas. As more and more cities join the league of metropolitan cities, it is increasingly evident that appropriate institutional structures that maintain the functional integrity of a metropolitan region, with a unified approach to coordination and planning are created. Hyderabad Metropolitan Region is a case in point, encompassing several municipalities, villages and districts, as indicated above.

The HMDA Governing Board and Executive Committee are constituted of representatives of several of State Departments. The Board is chaired by the Chief Minister of Andhra Pradesh; the Metropolitan Commissioner is the Vice Chairperson, while the Mayor of the Greater Hyderabad Municipal Corporation is a member. Other members include elected representatives from the Urban Local Bodies and the Legislative Assembly / Council in the metropolitan region and officials or nominees of the State Government. The Act provides for a representative of the Metropolitan Planning Committee (MPC) to be included in the Board. HMDA has emerged as the dominant body in the metropolis, with a highly visible and powerful mandate. The Metropolitan Planning Committee has a representative character but lacks a mandate of significance (Sivaramakrishnan and Maiti, 2009).

There are numerous, existing institutional players in the HMR including urban and rural local bodies and parastatals. Under the HMDA Act, HMDA has the power to issue directions to urban local bodies and other agencies on matters concerned with planning and provision of services in the metropolitan area. However, it cannot interfere in the obligatory and discretionary duties of local bodies, except for integrated efforts with them. Though the structure of HMDA's Governing Body shows that the need for co-ordination is recognized, the Structure Plan for HMR recognizes that the "process" aspects of co-ordination need attention, especially those that involve co-ordination with local bodies / entities other than those at state level. Given the above institutional dynamics, the arrangements proposed for implementation of the Draft Structure Plan included:

- A Plan Monitoring and Surveillance Cell: The Structure Plan for Hyderabad recommends creation of a Plan Monitoring and Surveillance Cell within HMDA. Its primary tasks would be to review and monitor Plan implementation on a regular basis based on a review of data and regular ground verification. This is meant to ensure effective implementation of the Plan. It is also meant to



ensure that the Plan does not remain static, is reviewed continuously and is able to respond to changes if any, in the socio - economic development scenario in the region. The proposed Cell would report to the Commissioner, HMDA and have Zonal Officers responsible for monitoring and surveillance, reporting to the Chief Planner, HMDA. Bi-annual reviews of the Plan by the Cell, and annual reviews are recommended to be placed before the High Level Committee of HMDA.

Sectoral Committees: The Structure Plan recommends creation of Sectoral Committees to plan, co-ordinate and implement the Plan as envisaged, and develop guidelines and implementable Action Plans in consultation with stakeholders, in the nature of advisory, working groups: (a) Land and Infrastructure; (b) Transport; (c) Environment, Climate Change and Energy Efficiency; and (d) Urban Poverty and Social Equity. It recommends involvement of academicians, eminent citizens and civil society in the Committees.

6. CONCLUSIONS

Planners in India and the rest of the developing world will increasingly face challenges of planning for metropolitan cities. Balancing economic growth potential with concerns related to environmentally sustainable development and addressing issues such as climate change, rural-urban dynamics in city regions, issues of peri - urban areas and inclusive development will be the key to sustainable growth of cities. The strategic approach and methodology adopted in the preparation of the Structure Plan for Hyderabad Metropolitan Region offers insights into how such issues can be addressed by planners in developing countries. It also explores the issue of multiplicity of agencies, typical of metropolitan regions, and examines how the Development Authority framework can be made to work in such situations.

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A Perspective on Environmental Challenges of Urbanization

R. Shankar

Abstract

In India, recent years has brought a host of problems to urban areas, which are generally characterized by arbitrary and inefficient land use developments, deteriorating living conditions and growing environmental degradation. Negative effects of rapid suburban growth are evidenced in the haphazard development of suburban land and resultant infrastructure problems. Lack of planning that characterizes most suburban growth has resulted in higher transportation costs in terms of money, time and inconvenience for suburban residents, in higher public sector costs, undesirable land use patterns and in the inadequate supply of open spaces, recreational facilities and other amenities. However, alarming the present urban growth situation may be, it is possible to put it on a track of sustainability. What may be lacking is the initiative and resolve for bold action and innovative ideas to deal urgently with a set of complex challenges we have created.

1. INTRODUCTION

Indian urbanization, in recent years has brought in a host of problems to urban areas which are now generally characterized by arbitrary and inefficient land use development, deteriorating living conditions and growing environmental degradation. Negative effect of the rapid suburban growth is evidenced in the haphazard development of suburban land and the resultant infrastructure problems. The lack of planning that characterizes most suburban growth has resulted in higher transportation costs in terms of money, time and inconvenience for suburban residents, in higher public sector costs, undesirable land use patterns and inadequate supply of open spaces, recreational facilities and other amenities. According to Aparna (2006), the most striking common feature in the fringe area development is the haphazard growth of slums, unauthorized colonies, piecemeal commercial and residential development, intermixing of confirming and non-confirming uses of land coupled with inadequate services and facilities. According to Ahmedabad Municipal Corporation (AMC) and Ahmedabad Urban Development Authority (AUDA), the population growth in the peripheral areas is more rapid than the areas within city limits. A study on urban sprawl (by Iyer et al.) shows that conversion of open land into non-agricultural land after 1991 is much faster in Bangalore urban agglomeration than in Hyderabad urban agglomeration.

In Bangalore Urban Agglomeration Area, during the last decade, the percentage share of high density built up area has drastically reduced from 23.98% to 15.65%,

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whereas that of low density area has gone up. On the contrary the real estate investment in Hyderabad Urban Agglomeration (HUA) had taken place in the outer areas resulting into the development of scattered built up area leaving behind vacant spaces in between. As the city sprawl increased in dispersed low density pattern, the built-up land devoured the agricultural lands and water bodies. In Hyderabad, the residential land use of fringe area has increased from 147.03 sq km (8.69%) in 1993 to 214.17 sq km (12.66%) in 2000. On the contrary the agricultural and vacant land use has declined from 1209.17 sq km (71.45%) in 1993 to 1117.73 sq km (66.05%) in 2000. Between 1974 to 1999, Delhi has experienced a sprawl development with an increase in population of 4.2 Million. It was able to accommodate this population by losing 60,000 hectares of agricultural land. On the other hand, during the same period, Chennai Metropolitan Area (CMA) along with other urban settlements in the hinterland has experienced a rapid pace of urbanization. In the process, CMA has lost agricultural land from 40991 hectares in 1991 to 22130 hectares in 2004. Another satellite data based recent study shows that between 2007 and 2014, that is within a span of only 7 years, some 447 sq km of agricultural and other lands have been lost to urban growth within Bangalore Metropolitan Fringe Area.

2. HOUSING SHORTAGE AND GROWTH OF SLUMS

The Private and Government Agencies Approved townships, mainly target high end users and depending on individual state policies, a very small percentage ranging between 10-20 % is reserved for EWS and LIG households. It is a well known fact that, most of the middle and high income consumers are looking at housing sector as an investment option. As a result of this, the newly added housing stock, in terms of plots and flats, remain vacant. On the other hand, over the decades, the urban housing shortage at national level has increased from 3.6 million in 1961 to 10.6 million in 2001 and to 18.78 million in 2012, more than 95% of which is in the EWS and LIG categories. According to the Census of India 2011, out of the 90 million residential units, 11 million units are vacant. This is about 12 % of the total housing stock. As against this vacant houses, all the government housing schemes altogether only provided 1.1 million units in the last 12 years. This paradox of growing housing shortage and growing vacant houses is the symptom of the distorted functioning of real estate market.

The increasing housing shortage, in turn, has contributed to the rapid growth of slum population across metropolitan cities. Growth of slums in India has been at least three times higher than the growth of urban population, leading to sizeable number of urban population living in slums. As per TCPO estimate 2001, 21.7 percent urban population lived in slums. Nearly 45 % of Mumbai population lives in slums and the percentage of slum dwelling population is increasing steadily increasing particularly in all metropolitan cities.



3. LOSS OF AGRICULTURE LAND FOR URBAN DEVELOPMENT

The per capita availability of arable land in India has decreased from 0.5 ha in 1950-51 to 0.15 ha in 1999-2000 owing to population escalation and it is further expected to come down to 0.09 ha by 2031. In recent years, land use has become highly competitive as a result of tremendous population stress and the narrowing man land ratio. The multi - sectoral conflicting demands led to abuses, giving rise to serious problems of land degradation and diminishing production potential. According to Financial Express the country's cultivable land has marginally fallen in 2005-06, mainly due to diversion of farm land for non-agricultural purposes. Total cultivable land has declined to 182.57 million hectares in 2005-06 from 185.09 million hectares in 1980-81. During the same period, land under non-agricultural purpose went up to 24.94 million hectares from 19.66 million hectares, resulting in a marginal fall in cultivable land.

As per Nagdeve the land for non-agricultural uses mainly housing, industry and others (in short for human settlements) has increased from 9.36 million hectares in 1951 to 22.97 million hectares in 2001, an increase of 2.5 times. It is a paradoxical situation that on the one hand more production is required from the scarce soil resources for meeting the demand of ever expanding population and on the other hand vast areas are either going out of cultivation or showing reduction in productivity due to land degradation at an alarming rate. Therefore, reclamation of the degraded lands and prevention of any further loss of arable land, are among the serious national challenges.

The situations pertaining to loss of agricultural land in urban agglomerations of Bangalore and Hyderabad has already been mentioned earlier. In 1971, 50% of Bangalore urban agglomeration (BUA) land was crop land and 8% was scrub land and grasses. On the other hand the situation was reverse in Hyderabad Urban Agglomeration (HUA) that is scrub land constituted 56% and 6% crop land. In BUA the proportion of crop land has declined to 47%, 11% and 8% in 1981, 91 and 2001 respectively. On the contrary in HUA the scrub land declined to 46%, 4% and 2% in 1981, 91 and 2001 respectively. The real estate investment on the peripheral areas of HUA has resulted in the development of scattered built up area leaving behind vacant spaces in between. Across 25 'mandals' in and around Hyderabad, 90,000 hectares of agriculture land has been diverted during the last five years. To sustain the high rate of economic growth, major infrastructure development projects such as construction of new airports, roads, power generation plants etc. are coming up. All this and more through large-scale diversion of fertile agriculture land.

As per CMDA the share of residential land use in Chennai city has increased from 48.57% in 1975 to 52.94% in 2001. On the contrary the percentage of agricultural land use in Chennai metropolitan area excluding Chennai city has declined from 48.91% in 1975 to 11.72% in 2001. As per PMC the share of residential land use in Pune municipal corporation area has increased from 36.55% in 1987 to 42.52% in 2001.



4. URBAN TRANSPORT PROBLEMS

4.1 Road Accidents

The number of persons killed in road accidents in India has been increasing. The number of road accidents has increased, from about 161,000 in 1981 to over 400,000 in 2001. The number of fatalities has gone up from 28,400 to almost 80,000 during this period. In India, government statistics report 342,000 traffic injuries, but academic studies criticize this as a severe underestimate and indicate much higher levels: 1.2 million serious injuries and 5.6 million minor injuries in 2002. The latest figures of road accident deaths show an increase from 1,46,133 in 2015 to 1,50,785 in 2016 as per *savelifefoundation.org*.

The fatalities per 10,000 vehicles in India are 21 as against one to two in high-income countries and four to six in some lower income countries. About 65 per cent of the casualties occur on the National Highways and State Highways, which constitute 7 per cent of the total road length in the country. There is a direct relationship between the average speed of vehicles and the rate of accidents. About 83 per cent of road accidents occur because of the fault of drivers. Many Indian cities are plagued by roads that are unsafe, narrow, crowded, unpaved encroached footpaths without the provision of universal accessibility and obstructed by stationary uses such as street vendors, parked vehicles, and stray animals.

Moreover, most Indian cities lack even the most basic infrastructure for pedestrians, cyclists, children and elders. Walking is especially dangerous in Indian cities, where over half of all traffic fatalities are pedestrians. The most vulnerable group consists of pedestrians and users of non-motorized transport, the majority of whom are poor. The economic cost of road traffic accidents in India is estimated to be Rs. 55,000 crore in 1999-2000. About 57 per cent of the persons killed in road accidents in Delhi during 1981-2001 period were pedestrians and cyclists. Another 21 per cent were scooter/motorcycle users.

4.2 Public Transport Problems and Challenges

The sharply rising demands for public transport have overwhelmed the existing public transport systems in India. In recent years, public transport has not grown nearly as rapidly as private transport. Over the long term, however, the demand for public transport services has increased considerably, mainly due to the burgeoning growth of India's cities, both in population and land area. That has increased both the number and length of public transport trips. Buses carry more than 90 percent of public transport in Indian cities. Yet, a large number of cities do not have adequate public transport services.

Only eight of the 35 cities that have a population of more than one million have dedicated bus services, or have formed city bus undertakings. Buses themselves are seriously overcrowded, with some passengers forced to ride on the outsides of vehicles. In addition, however, buses need to negotiate extremely congested,



narrow streets, with no separate rights-of-way at all, having to fight with a mixed array of animal-drawn carts, minivans, cars, taxis, motorized two-wheelers, auto rickshaws, pedestrians, cyclists, and street vendors.

Severe roadway congestion has slowed down most buses to a crawl during much of the day—as slow as 6 to 10 km per hour in many large cities. Dissatisfied public transport passengers are increasingly turning to the private car, and even more dramatically, to the relatively low-cost motorized two-wheelers, which have experienced a boom in ownership and use in the past 10 years. The deteriorating quality of public transport service reinforces the impact of the rapid sub-urbanization of Indian cities. Both trends encourage a shift away from space-saving public transport toward individual motorized transport. That has greatly increased roadway congestion, further reduced travel speeds, and aggravated traffic safety problems.

5. SUMMARIZING IMPACTS

The impacts of urbanization being witnessed in the post economic reforms era can be summarized as given below:

- Occurrence of dispersed and low-density sprawl along transport corridors leading to inadequate and costly infrastructure;
- Alarming rate of loss of cultivable agricultural land for urban expansion;
- New urban extensions occurring at low densities and in such patterns making it unviable for public transport;
- Increasing ownership of private motorized vehicles causing traffic congestion, delay and pollution; and
- Prescription of low FARs and other housing policies making adequate housing unaffordable to large sections of metropolitan households.

The above mentioned impacts clearly indicate that, the present pattern of urban development, nay unplanned growth, is likely to lead to more adverse and far-reaching impacts in the near future. In order to contain, the loss of fertile agricultural land and to make available, affordable housing units with efficient public transport accessibility and to make urban environment more liveable, it is the need of the hour to explore and adopt an alternative urban development form which is sustainable and relevant.

6. IMPLICATIONS OF IMPACTS OF PRESENT GROWTH PATTERN

There is a growing concern among the more serious planners about the implications of the impacts of the present urbanization pattern. What do these impacts add up to in quantifiable terms? What do these trends mean on consumption of our scarce resources? An attempt is made here to project the likely impacts in terms of urban land consumption, motor vehicle growth, fuel demand and road accidents



scenario in metropolitan India. For each of the attributes, projection and scenario building work is carried out for the year 2051. Two scenarios are developed, one on the basis of existing growth trends with 'do-nothing' and the other with planned intervention by modifying legal provisions and adopting improved technology. The outcome of the projections and calculations are further used as a basis for formulating an alternative sustainable urban development model.

7. PROJECTED LAND CONSUMPTION FOR URBAN DEVELOPMENT

7.1 Basis for Projections and Analysis

- The existing average gross density for metropolitan cities vary from 195 and 25 persons / hectare within and outside municipal limits respectively;
- Average population of million plus cities is 3.2 million. According, to Ribeiro, E.F.N, the projected population in India in 2051 will be 1732 million out of which 47.5% will be urban, that is 820 million. As per straight line projection method, the total population percentage of million plus cities to total urban population in 2051 will be 68%;
- Existing percentage of urban population living in million plus cities is 38.6%. Therefore, total number of population residing in million plus cities in 2051 will be $68 \times 820 / 100 = 558$ million;
Total number of million plus cities = $558 / 3.2 = 174$ million plus cities; and
- Thus, the total no. of new million plus cities expected by 2051 having an average population size of 3.2 million will be $174 - 35 = 139$ cities.

The existing population percentage share of Municipal and outside Municipal limit areas to the total metropolitan population is 54 and 46 per cent respectively. The present pace of urban development in the fringe areas of the metro cities indicates that in the coming decades, they are going to accommodate a major share of the metropolitan area; whereas the capacity of city area to attract population will get saturated. With this assumption, the future land area needs are projected with a reverse scenario considering the population share of city and outside limits as 40 and 60 per cent respectively.

8. CALCULATION OF FUTURE LAND AREA REQUIREMENT

- Based on the existing gross average density pattern within Municipal limit i.e. @ 195 persons / hectare.

Assuming that, the population of 139 million cities will grow based on the existing density pattern that is @ 195 persons / hectare, and the future population share within municipal area will be 40 per cent. Therefore, the effective population that needs to be accommodated within municipal limit will be 40% of 558 million: $40 \times 558 / 100 = 223$ million

- In order to accommodate 223 million population @ 195 persons / hectare, the total land area required for settlement will be,



- $D = P / A$, $195 = 223 \text{ (million)} / A \text{ (Ha)}$
- $\text{Area} = 223 / 195 = 1.14 \text{ million hectares} = 1140000 \text{ hectares}$
- Additional land area required to accommodate 223 million population will be
- $1140000 - 298974 = 841026 \text{ hectares.}$
- This additional land area will be made available within the existing municipal limits by following means:
 - Extension of municipal limits wherever possible in all the directions.
 - Redevelopment of existing buildings by increasing FAR.
 - Productive utilization of pockets of vacant land.
- If, on the other hand the gross average density within municipal limit is planned at different higher densities of 400, 600 and 800 Persons/hectare, the additional land area requirement will be:
 - In order to accommodate 223 million population @ 400 persons / hectare, the total land area required for settlement will be, 557500 hectares
 - To accommodate 223 million population @ 600 persons / hectare, the total land area required for settlement will be, 371666 hectares
 - To accommodate 223 million population @ 800 persons / hectare, the total land area required for settlement will be, 278750 hectares

In other words, if the development is allowed to take place @ 400, 600 and 800 P / Ha (gross density), there will be saving of 33.4, 56 and 67 per cent of land respectively as against the present growth pattern.

- Based on the existing gross average density pattern outside municipal limit i.e. @ 25 persons / Hectare.
 - Assuming that, the population of 139 million cities will grow based on the existing density pattern that is @ 25 persons / hectare and the effective population that needs to be accommodated outside municipal limit will be 60% of 558 million= 335 million.
 - In order to accommodate 335 million population @ 25 persons / hectare, the total land area required for settlement will be, = 13400000 hectares.
 - The existing percentage share of population residing outside municipal limits is 46% and therefore, the total population share of 35 million plus cities residing outside municipal limits will be $46 \times 108 / 100 = 49.7$ million. Existing area of 35 million plus cities outside municipal limits will be = 1988000 hectares.
 - Therefore, additional land area required to accommodate 335 million population will be: $13400000 - 1988000 = 11412000 \text{ hectares.}$



- If the present pattern of development is allowed to continue without proper planning, this additional area of 1141 million hectares will be consumed from prime agricultural lands.
- If, on the other hand the gross average density outside municipal limit is planned at different densities of 200, 300 and 400 Persons/hectare, the additional area requirement will be:
 - In order to accommodate 335 million population @ 200 persons / hectare, the total land area required for settlement will be, 1675000 hectares.
 - To accommodate 335 million population @ 300 persons / hectare, the total land area required for settlement will be, 1116666 hectares.
 - To accommodate 335 million population @ 400 persons / hectare, the total land area required for settlement will be, 837500 hectares.

Therefore, it is evident from the above analysis that if the future development outside municipal limit is allowed to occur @ 200, 300 and 400 P/H (gross density), it will consume only 1.67, 1.11 and 0.83 million hectares of land respectively, as against consumption of 11.4 million hectares (additional land area) in case of 25 P / H. In other words, there will be saving of 85.4, 90.3 and 93 per cent of land respectively as against the present growth pattern. If the projected development is allowed to occur @ 800 P/Ha within municipal limits, the entire projected population for the year 2051 within municipal limit can be accommodated in the existing area only. However, in case of outside municipal limits, the entire projected population for the year 2051 can be accommodated in an area of 1.67 million hectares which is less than the existing developed area of 1.98 million hectares, at a density of 200 p/ha. In other words, there will be net saving of 9.5 million ha. of additional agricultural land requirement within the metropolitan area of India.

9. PROJECTED INCREASE IN SLUM POPULATION

As per the Government of India estimate, the present growth of slum population is at least three times higher than the growth of urban population. On the other hand, the projected urban population of India for the year 2051 is 820 million, closely 3 times more than the existing urban population of 285 million (Ribeiro, 2003). Therefore, if the present trend is allowed to continue 'with do nothing', the projected growth of slum population will be six times more than the existing. The existing percentage of urban population living in slums is 21.7: 21.7×285 million (existing urban population) / 100 = 61.8 million.

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



10. INCREASE IN URBAN HOUSING SHORTAGE

As per the NBO (2006) estimate, the urban housing shortage has increased from 10.6 million in 2001 to 24.71 million in 2007 (more than twice). Assuming that the housing shortage grows in the same manner with a decadal increase of more than double from the existing. The total housing shortage in the year 2051 will be almost 8 times more than the existing: $24.7 \times 8 = 198$ million (shortage in 2051).

It is seen from the above-discussed projections that, if the present pattern of urban development is allowed to continue in the same manner with do-nothing, it will consume 11.4 million hectares of agricultural land outside municipal limits, there will be an increase of 329 million vehicle population on roads, demand for car parking space in metropolitan cities will be 102272 hectares, the annual crude oil demand will be 158 million tons which will cost Government Rs. 4,44,266 crores, road traffic fatalities will increase to 360000 per annum, and the magnitude of urban slum population and housing shortage will be 371 and 198 million respectively. All these projections clearly indicate that, the present growth pattern is most likely to lead to more complex, adverse environmental implications and this raises several questions relating to our planning and development approach at local, regional and national levels.

11. HOW DO WE MAKE OUR CITIES ENVIRONMENTALLY SUSTAINABLE ?

In order to preserve our fertile agricultural land and to make available, affordable housing units to all with efficient, reliable public transport accessibility, it is the need of the hour to explore and adopt an alternative sustainable urban development pattern. The sustainable urban development concepts like Compact city, New Urbanism, Transport Oriented Development (TOD) and Smart Growth which have evolved in response to the increasing need for a resource-conserving, sustainable, and people-centric city, have already found enthusiastic supporters among governments, urban development agencies, planners and urban designers in many parts of the world outside India. These diverse approaches share the important characteristics of compact, mixed use development, pedestrian and bicycle friendly environment, walkable communities and transit-based development. An integrated sustainable city model for India could be evolved combining and suitably modifying the underlying principles of sustainable urban development:

- Adopt, with suitable modifications for Indian situations, "Traditional Neighborhood Design" that provides more livable and walkable neighborhoods' in a more pedestrian friendly environment. Create and maintain aesthetically appealing, functionally efficient and healthy built environment, which is designed to the last possible detail ---- "New Urbanism"
- Create a "mixed-use community that encourages people to live near transit services in sufficient density to make public transport viable and attractive to decrease their dependence on driving. Provide high capacity, high speed,



multi-modal and multi-level transport corridors connecting cities ---- “Transit Oriented Development” (TOD).

- Adopt appropriate, innovative planning and development strategies, and urban design techniques to make cities conserving and efficient in resource use. Develop a variety of housing types which will provide affordable choices for families and individuals, of diverse socio - economic strata. Enforce conservation of agricultural land by containing urban expansion through appropriate development controls and zoning regulations. - “Smart Growth”.
- Plan compact, high density, mixed land use development in terms of walkable, bicycle-oriented and anthropo - centric communities which are safe, secure and universally accessible and where all community facilities are available within easy accessibility----- “Compact City”.
- Maximize the accessibility of an area to people of different sexes, age groups, abilities and economic class. Create economic opportunities particularly for the people of Economically Weaker Section (EWS) and Low Income Group (LIG) strata by facilitating and integrating informal sector activities at neighborhood, zonal and city levels. - “Inclusive Design” or “Universal Design”.
- Use indigenous resources and technological mixes that respect and emulate the natural ecosystems and respect local social and cultural patterns in achieving self - sustainability. Develop a city of human scale, slow intra-city and rapid inter-city transportation, multi-functional economic base, self - sustainability in basic and other needs, and integration of resource conservation measures in settlement development at all levels. Decentralize infrastructural development and maintenance functions of the city making the best possible use of resources and technology options available and involving community participation -- - “Eco - Development”.
- Design streets to accommodate variety of transport modes and activity patterns and sustainable transport management. Facilitate use diverse modes of slow and medium speed transport with in and between communities including walking, cycling, and other environment friendly para- transports, Light Rapid Transit System (LRTS) and Bus Rapid Transit System (BRTS) ----- “Traffic Calming” and “Sustainable Transport Management”.
- Integrate urban and rural lifestyles into a symbiotic, inter-dependant and holistic system through integration of land use and transportation, planning and design, and functional efficiency and aesthetic appeal.- - “Synergic Development”.
- Encourage urban development and life style incorporating and utilizing the benefits of Information, Communication and Entertainment (ICE) technologies and e-governance and replacing and reducing dependence on transport-based lifestyles and development---- “ICET and e-Governance Based Development” or “Connected Urban Development”. (CUD)



12. CONCLUSIONS

However, alarming the present urban growth situation may be, it is possible to put it on a track of sustainability and we have the expertise. What may be lacking is the initiative and resolve for bold action and innovative ideas to deal urgently with a set of complex challenges we have created.

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Dealing with Environmental Challenges: New Approaches Advocating Green Growth in the Indian Cities

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Abstract

The increasing proportion of world's population living in urban areas has been driven by the growing concentration of new investments and employment opportunities. In general, nations with the most rapid and sustained economic growth have the highest level of urbanization. The author further argues that green growth strategies are needed to promote sustainable growth and to break the pattern of environmental degradation and natural resource depletion. He also argues that emission reductions can be achieved with minimal cost to GDP. It is the only way to reconcile rapid growth required to bring developing countries to the level of prosperity to which they aspire with the needs of more than 1 billion people remaining unmet, who still continue to live in poverty and the imperative of a better managed environment. Indeed, green growth is a vital tool for achieving sustainable development.

1. INTRODUCTION

Urbanization is not just an outcome due to shift from agriculture and to an economy dominated by industrial services, but it is part of what makes this shift more economically viable. Municipal governments, which once focused almost exclusively on the delivery of urban services, have become increasingly involved in seeking external investment and developing city economies. The increasing proportion of the world's population living in urban areas has been driven by the growing concentration of new investment and employment opportunities. In general, nations with the most rapid and sustained economic growth have highest urbanization (Satterthwaite, 2007). Urban centres provide opportunities for a range of social and cultural activities as well as being critical for innovations in science, technology and education. Indeed, urban areas are of critical importance for social and economic development as the Cities Alliance recognizes “only sustained urban growth has the capacity to lift both rural and urban populations out of poverty” (Cities Alliance/ICLEI/UNEP, 2007). This means that integrating the environment in city government activities must engage both with the service delivery and the economic development components of their work. Integrating greenhouse gas emissions reduction strategies in urban planning and management can reduce the impact, which cities have on the global environment while improving the quality of life for urban residents. Activities in several specific sectors, viz. transportation,

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shelter, infrastructure, urban natural environment etc; may lend themselves to both of these goals.

The United Nations estimates that India's population will reach 1.7 billion by 2050. In that case, the country is likely to face a widening ecological deficit even if its current per-capita levels of resource-consumption remain the same. Therefore, for Indian society to continue to prosper in an increasingly resource-constrained world, business and government leaders must work actively to protect the natural capital on which India's economy, and all human life, depends. Today, the country's total demand on bio - capacity is exceeded only by the United States and China. "India is depleting its ecological assets in support of its current economic boom and the growth of its population," says Jamshed N Godrej, erstwhile Chairman of the CII Sohrabji Godrej Green Business Centre. "This suggests that business and government intervention are needed to reverse this risky trend, and ensure a sustainable future in which India remains economically competitive and its people may live satisfying lives."

World Bank (2007) in a paper entitled Principles and Practice of Ecologically Sensitive Urban Planning and Design, case of Vietnam says that the forms that urbanization is taking in the developing countries, however, are problematic. Towns and cities that were never planned to have large populations, are suffering from overloaded infrastructure. Development of the fringes is proceeding with little or no planning, resulting in even worse problems. Scattered developments, gradually increasing in density, are producing intense land-use conflicts and environmental pollution. Once development has occurred, these areas are difficult to service with efficient infrastructure. In order to make Indian cities livable from the perspective of inclusion, resilience and authenticity, which are intricately interconnected, and cannot be achieved independently of one another, therefore, there is a need for a fundamental shift in the way planners and policy-makers approach urban development. Learning from the success stories as well as many failed initiatives, a few factors emerge as central to making Indian cities livable. In this regard Muthukumara Mani, Senior Environmental Economist, World Bank have remarked "While the overall policy focus should be on meeting basic needs and expanding opportunities for growth, they should not be at the expense of unsustainable environmental degradation".

2. URBANIZATION VS ENVIRONMENT

The report of OECD (2016), Urban Green Growth in Dynamic Asia, OECD Publishing, Paris summarizes that Southeast Asia has experienced one of the most dynamic urbanization processes in the world, and within the Southeast Asian region, the Asean - 5 countries - Malaysia, Thailand, Indonesia, the Philippines and Viet Nam - are major drivers of such trends. The combined urbanization level of these 5 countries increased from 29.5% in 1980 to 51.4% in 2015 and is expected to reach



67.7% in 2050 (UN DESA, 2014). Further it narrates that urban sprawl is one of the most visible consequences of fast urbanization in Southeast Asia. Much of the urban expansion has taken place in peri - urban areas. Public services have not been able to keep up with the pace of urbanization and economic growth, leading to enormous infrastructural and environmental challenges. The sprawl of many cities has been accompanied by fast motorization, India is no exception. Another challenge is fast-rising amounts of solid waste generated by its residents. Many Southeast Asian cities have also experienced increasing water demand and situations of water stress and scarcity, aggravated by the poor coverage and quality of water supply infrastructure. Asian cities are prone to high vulnerability to the impacts of climate change. The annual number of natural disasters in Southeast Asia has increased from 13 in 1970 to 41 in 2014, resulting in a surge of both economic damages and the number of persons affected. Floods, typhoons, hurricanes and earthquakes are the most frequent types of disasters occurring in the region, sometimes bearing severe human and economic losses. The frequency and impacts of such disasters are expected to increase in the future, as a result of a combination of climate change impacts (such as sea-level rise), urbanization and socio - economic changes. A general trend towards the reduction of poverty is observable but urban inequalities are rising: the Gini coefficient in the main Indonesian cities has increased at a faster rate than in Indonesia overall since 2008. In addition, cities in all countries of the region still host significant numbers of slum dwellers with poor access to urban services such as solid waste collection and high vulnerability to natural disasters.

The trends of urbanization, economic growth and the associated challenges of Southeast Asian cities demonstrates that urban green growth priorities may lay in investing in urban infrastructure and in mitigating negative environmental impacts. There is more need to decouple environmental impacts and economic performance to ensure robust long-term economic growth and tackle development challenges, rather than to revitalize economic growth. In Southeast Asian cities, strong opportunities for urban green growth exist in six sectors: land use and transport, housing and buildings, energy, solid waste, water resource management; and green industries and services.

3. WHAT IS URBAN GREEN GROWTH

Urban activities (including policies and programmes) that reduce either

- Negative environmental externalities, such as air pollution and CO₂ emissions; or
- The consumption of natural resources and environmental services, including water, energy and undeveloped land. World Bank in its feature article on March, 2014 on India: Green Growth - Overcoming Environment Challenges to Promote Development expressed three striking findings in the review:



First, Environmental sustainability could become the next major challenge as India surges along its projected growth trajectory. Second, a low-emission, resource-efficient greening of the economy should be possible at a very low cost in terms of GDP growth. While a more aggressive low-emission strategy comes at a slightly higher price tag for the economy it promises to deliver greater benefit. Third, for an environmentally sustainable future, India needs to value its natural resources, and ecosystem services to better inform policy and decision-making.

Although the past decade of rapid economic growth has brought many benefits to India, the environment has suffered, exposing the population to serious air and water pollution. A new report finds that environmental degradation costs India \$80 billion per year or 5.7% of its economy. Green growth strategies are needed to promote sustainable growth and to break the pattern of environmental degradation and natural resource depletion. Emission reductions can be achieved with minimal cost to GDP.

It is the only way to reconcile the rapid growth required to bring developing countries to the level of prosperity to which they aspire with the needs of the more than 1 billion people still living in poverty and the imperative of a better managed environment. Indeed, green growth is a vital tool for achieving sustainable development. Findings of the World Bank further suggest that:

- Green Growth is Necessary: With cost of environmental degradation at US \$80 billion annually, or equivalent to 5.7% of GDP in 2009, environment could become a major constraint in sustaining future economic growth. Further, it may be impossible or prohibitively expensive to clean up later;
- Green Growth is Affordable: Model simulations suggest that policy interventions such as environmental taxes could potentially be used to yield positive net environmental and health benefits with minimal economic costs for India;
- Green Growth is Desirable: For an environmentally sustainable future, India needs to value its natural resources, and ecosystem services to better inform policy and decision - maker especially since India is a hotspot of unique biodiversity and ecosystems; and
- Green Growth is Measurable: Conventional measures of growth do not adequately capture the environmental costs, Therefore, it is imperative to calculate green Gross Domestic Product (Green GDP) as an index of economic growth with the environmental consequences factored in.

Obstacles to Greening Growth are political and behavioral inertia and a lack of financing instruments - not the cost of green policies as commonly thought. Green Growth should focus on what needs to be done in the next five to 10 years to avoid getting locked into unsustainable paths and to generate immediate,



local benefits. There is no single Green Growth Model. Green Growth Strategies will vary across countries, reflecting local contexts and preferences - but all countries, rich and poor, have opportunities to make their growth greener and more inclusive without slowing it, as said by Vice President, Sustainable Development Network of the World Bank in Washington.

The OECD defines green growth as “fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies” (OECD 2011). The United Nations Environment Programme (UNEP) defines a Green Economy as “one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities” (UNEP 2011). These definitions are consistent with sustainable development as an ultimate objective and with Green Growth or a Green Economy as a means to reconcile its economic and environmental pillars, without ignoring social aspects.

4. WHAT IS GREEN ECONOMY

The Green Economy is defined as an economy that aims at reducing environmental risks and ecological scarcities, and that aims for sustainable development without degrading the environment (Wikipedia). Adopting a Green Economy approach could provide a framework for India. Some of the specific areas in which urban actions are important to achieving a Green Economy include: taking advantage of the environmental and social opportunities of density; investing in green urban infrastructure; greening the urban economy with taxes and subsidies; fostering urban social and environmental innovation and competition; and green urban governance for a green urban economy. Local conditions and priorities vary enormously around the world.

5. KEY STRATEGIES TO PROMOTE GREEN GROWTH IN CITIES

5.1 Placing Urban Transport Much Higher on the Agenda and Integrating it with Land Use

There is an urgent need for a long-term land-use vision and an effective mechanism to implement the vision in Indian cities, in which transport networks must be integrated (e.g. through transit-oriented development). Cases from Hyderabad-metro and G-Auto Rickshaw in Ahmedabad are good examples in India.

5.2 Addressing Housing Conditions and Living Environment

Insufficient quantity or quality of housing supply can be a major obstacle to urban green growth. It also directly affects the vulnerability of urban dwellers: housing factors such as construction materials, access to safe drinking water and hygienic toilet facilities are the most critical determinants of human health in urban areas. Tokyo Green Building Program is designed to require building



owners to care about the environment in newly constructing or expanding large buildings.

5.3 Promoting Urban Wastewater Treatment

Promoting urban wastewater treatment is pivotal to building sustainability and urban resilience. In order to increase treatment capacity, appropriate financing policies and mechanisms should be developed for users to pay for the cost of wastewater treatment and policy complementarities with the energy sector should be explored. Dewats decentralized system of bio - remediation became a successful example at Kachhpura, Agra, India.

5.4 Managing Hazardous, Medical and Industrial Wastes

Promoting effective hazardous and medical waste collection has mostly been overlooked in the waste management stream although it is essential for ecological conservation, public health and safety. A centralized bio - medical waste treatment facility has not only improved the quality of environment but has also turned bio - medical waste into a source of revenue and employment by opening avenues for private sector investment in waste management sector, in Surat Municipal Corporation.

5.5 Developing Housing and Buildings to Meet Green Standards

Building standards and energy regulations need to be developed so as to include green growth. In order to accelerate such actions, it will be important for national and sub-national governments to discuss the various building codes which are implementable at a local level and sufficiently contribute to green growth. Agra Nagar Nigam achieved one such example through the Cross Cutting Agra housing Program, indeed a paradigm shift in approach to slum up-gradation adopted in Indian cities.

5.6 Promoting Cleaner Energy and Efficiency to Meet Rising Demand

Demand for energy in the case study cities has been escalating due to a burgeoning population and rapidly expanding economy driven by manufacturing industries. Thane Solar City Program through Roof top photo voltaic power system is a good example of how Local energy governance can play a key role in responding to the joint challenges of environmental management and local economic development. This raises concerns about energy security as well as environmental sustainability.

5.7 Greening Industries and Services for Effective Resource Management

While industries are the backbone of the economy of the cities, they also pose environmental challenges, as they are the one of the major sources of CO2 emissions. Governments can use regulations and financial tools to encourage industries to be more resource and energy efficient, bringing benefits to the



city as well as the business itself. Surat Municipal Corporation, is generating electricity by establishing sewage gas based power plant through sewage gas based engine generator technology. This has resulted in reduction in electricity consumption of grid power and also reduced the emissions of greenhouse gases.

5.8 Enhancing Skills for Green Buildings

It is also crucial for city governments to strengthen local clusters by enhancing skills to respond to green building demand. With demand for green buildings increasing, cities can enhance skills of workers related to building design and construction to deliver on efficient green buildings.

5.9 Managing Water Resources to Ensure Sustained Access

The lack of abundant water resources in some cities is leading to situations of water stress and scarcity. Along with concerns about the quality of drinking water, cities also suffer from huge losses in the water distribution networks, intermittent supply, and misuse of water sources. Decentralizing water resource management through rain water harvesting has not only reduced the financial burden on Thane Municipal Corporation for creation of infrastructure for water supply but also secured the water resource for the city by recharging the groundwater and prevented urban flooding by reducing surface runoff.

5.10 Transforming Solid Waste Management by Promoting the “3Rs”

A fundamental problem for Southeast Asian cities is a lack of policies to reduce the increasing volume of urban waste. The “3Rs” (reduce, reuse and recycle) principle must be embedded into their municipal solid waste management strategies. Ahmedabad Municipal Corporation’s effort of converting waste to wealth by efficient collection, transportation and treatment of solid waste has not only created business and employment opportunity in the city; it has additionally created a source of revenue.

6. CONCLUSIONS

In fact Indian urban planning needs major overhaul, because it is overly top down and controlling. It does not provide much needed guidance, coordination and integration where it should. Planning legislation needs to be amended in conjunction with legal framework relating to urban land. Land management needs to be made more efficient and transparent with a role for both the State as well as private developers. Creation of extensive infrastructure, addressing urban poverty, lack of decent shelter and urban services, and the challenges of slums and homelessness need to be accorded the highest priority. Safety and security in cities cannot be viewed as an optional extra, but is a central concern of livability. This will in turn contribute significantly to making cities



resilient as well as inclusive. Finally, better and more reliable spatial as well as socio - economic data is needed in order to make policy decisions that are suitable to different stakeholders in Indian towns and cities. This requires not only technological solutions but a change in mindset, and needs to be built into planning education systems and curricula.

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Climate Resilient Construction and It's Integration of Environmental Clearance with Building Plan Sanction

R. Srinivas

Abstract

The paper attempts discuss the efforts of Ministry of Environment, Forests and Climate Change to delegate the power of Environment Clearances to urban local bodies vide notification dated 9th December,2016 which was challenged in the National Green Tribunal. The NGTs order dated 8th December, 2017 has directed MoEF and CC to revisit the notification dated 9th December, 2016

1. INTRODUCTION

The building construction sector is a major contributor towards carbon footprints, which invariably impacts the overall climatic conditions. India is committed towards mitigating the effects of climate change and moving towards internationally accepted norms for environment friendly building construction. Currently, the objective of environmental safeguard is being achieved through obtaining a specific environmental clearance (EC) for any construction project having a size of more than 20,000 sq m. With rapid urbanization and growth of Indian economy, it is anticipated that the construction activity will experience a proportionate growth. Government is also committed towards streamlining clearances for buildings and real estate sector and empowering urban local bodies with an objective of Ease of Doing Business. The delegation to urban local bodies shall facilitate hastening the process of environment clearances.

2. ENVIRONMENTAL CONDITIONS FOR COMPLIANCE DURING BUILDING APPROVALS

The Ministry of Environment, Forest and Climate Change notification of 9 December 2016, decided to integrate the environmental concerns into building plan approval process and empowering the concerned local body / development authority to approve and certify compliance of stipulated requirements. The new building construction proposals are classified into the following three categories:

- Conditions for Category 'A' Buildings: Built-up Area 5000 sq m - 20000 sq m
- Conditions for Category 'B' Buildings: Built-up Area 20000 sq m - 50000 sq m
- Conditions for Category 'C' Buildings: Built-up Area 50000 sq mt - 150000 sq m

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Table 1: Environmental Conditions for Building and Construction (Category “A”: 5000 sq mt - 20000 sq mt)

Sl. No.	Medium	Environmental conditions
1	Natural Drainage	The inlet and outlet point of natural drain system should be maintained with adequate size of channel for ensuring unrestricted flow of water.
2	Water conservations - Rain Water Harvesting and Ground Water Recharge	A rain water harvesting plan needs to be designed where the recharge bores (minimum one per 5000 sq m of built-up area) shall be provided. The rain water harvested should be stored in a tank for reuse in household through a provision of separate water tank and pipeline to avoid mixing with potable municipal water supply. The excess rain water harvested be linked to the tube well bore in the premise through a pipeline after filtration in the installed filters.
2(a)		The unpaved area shall be more than or equal to 20% of the recreational open spaces.
3	Solid Waste Management	Separate wet and dry bins must be provided at the ground level for facilitating segregation of waste.
4	Energy	In common areas, LED/ solar lights must be provided.
5	Air Quality and Noise	Dust, smoke and debris prevention measures such as screens, barricading shall be installed at the site during construction. Plastic/ tarpaulin sheet covers must be used for trucks bringing in sand and material at the site.
5(a)		The exhaust pipe of the D G set, if installed, must be minimum 10 m away from the building. In case it is less than 10 m away, the exhaust pipe shall be taken up to 3 m above the building.
6	Green cover	A minimum of 1 tree for every 80 sq m of land shall be planted and maintained. The existing trees will be counted for this purpose. Preference should be given to planting native species.
6(a)		Where the trees need to be cut, compensatory plantation in the ratio of 1:3 (i.e. planting of 3 trees for every 1 tree that is cut) shall be done with the obligation to provide continued maintenance for such plantations.

A local authority, i.e. ULB, development authority or any other body authorized to sanction building plans shall approve the building plans by ensuring the stipulated conditions for the respective categories of buildings. These environmental conditions can be suitably integrated in the building permission conditions so that their effective implementation could be ensured by the local authority while sanctioning building plans in their respective urban areas. However, in order to empower the Local Authority, the State / UT Governments will be required to amend their building by-laws to incorporate a specific set of conditions as given in Tables - 1.

3. PROCESS OF DELEGATION OF ENVIRONMENTAL CLEARANCES FOR BUILT UP AREAS RANGING FROM 20,000 SQ MT TO 1,50,000 SQ MT OF

Once these conditions are incorporated through due process adopted by States and UTs into the Building Bye-Laws and made applicable and enforced by their local authority, States and UTs will be required to approach M/o Environment, Forest and Climate Change along with the Draft notification for seeking clearance that the requirements have been met and after getting the clearance from



Table 2: Environmental Conditions for Building and Construction (Category “B”: 20000 sq mt - 50000 sq mt)

Sl. No.	Medium	Environmental Conditions
1	Natural Drainage	The inlet and outlet point of natural drain system should be maintained with adequate size of channel for ensuring unrestricted flow of water.
2	Water conservations - Rain Water Harvesting and Ground Water Recharge	A rain water harvesting plan needs to be designed where the recharge bores (minimum one per 5000 sq m of built-up area) shall be provided. The rain water harvested should be stored in a tank for reuse in household through a provision of separate water tank and pipeline to avoid mixing with potable municipal water supply. The excess rain water harvested be linked to the tube well bore in the premise through a pipeline after filtration in the installed filters.
2(a)		The unpaved area shall be more than or equal to 20% of the recreational open spaces.
3	Solid Waste Management	Separate wet and dry bins must be provided at the ground level for facilitating segregation of waste.
4	Energy	In common areas, LED/ solar lights must be provided.
4(a)		At least 1% of connected applied load generated from renewable energy source such as photovoltaic cells or wind mills or hybrid should be provided.
4(b)		As per the provisions of the Ministry of New and Renewable energy solar water heater of minimum capacity 10 liters / 4 persons (2.5 liters per capita) shall be installed.
4(c)		Use of flyash bricks: Fly ash should be used as building material in the construction as per the provisions of Fly Ash Notification of September, 1999 and as amended from time to time.
5	Air Quality and Noise	Dust, smoke and debris prevention measures such as screens, barricading shall be installed at the site during construction. Plastic/ tarpaulin sheet covers must be used for trucks bringing in sand and material at the site.
5(a)		The exhaust pipe of the D G set, if installed, must be minimum 10 m away from the building. In case it is less than 10 m away, the exhaust pipe shall be taken up to 3 m above the building.
6	Green cover	A minimum of 1 tree for every 80 sq m of land shall be planted and maintained. The existing trees will be counted for this purpose. Preference should be given to planting native species.
6(a)		Where the trees need to be cut, compensatory plantation in the ratio of 1:3 (i.e. planting of 3 trees for every 1 tree that is cut) shall be done with the obligation to provide continued maintenance for such plantations.


Table 3: Environmental Conditions for Building and Construction (Category “C”: 50000 sq mt - 150000 sq mt)

Sl. No.	Medium	Environmental conditions
1	Natural Drainage	The inlet and outlet point of natural drain system should be maintained with adequate size of channel for ensuring unrestricted flow of water.
2	Water conservations - Rain Water Harvesting and Ground Water Recharge	A rain water harvesting plan needs to be designed where the recharge bores (minimum one per 5000 sq m of built-up area) shall be provided. The rain water harvested should be stored in a tank for reuse in household through a provision of separate water tank and pipeline to avoid mixing with potable municipal water supply. The excess rain water harvested is to be linked to the tube well bore in the premise through a pipeline after filtration in the installed filters.
2(a)		The unpaved area shall be more than or equal to 20% of the recreational open spaces.
2(b)		The ground water shall not be withdrawn without approval from the competent authority
2(c)		Use of potable water in construction should be minimized.
2(d)		Low flow fixtures and sensors must be used to promote water conservation.
2(e)		Separation of grey and black water should be done by the use of dual plumbing system.
3	Solid Waste Management	Separate wet and dry bins must be provided at the ground level for facilitating segregation of waste.
3(a)		All non-biodegradable waste shall be handed over to authorized recyclers for which a written tie-up must be done with the authorized recyclers.
3(b)		Organic waste composter / vermiculture pit with a minimum capacity of 0.3 Kg/tenement/day must be installed wherein the STP sludge may be used to be converted to manure which could be used at the site or handed over to authorized recyclers for which a written tie-up must be done with the authorized recyclers.
4	Energy	In common areas, LED/ solar lights must be provided.
4(a)		At least 1% of connected applied load generated from renewable energy source such as photovoltaic cells or wind mills or hybrid should be provided.
4(b)		As per the provisions of the Ministry of New and Renewable energy solar water heater of minimum capacity 10 liters / 4 persons (2.5 liters per capita) shall be installed.
4(c)		Use of flyash bricks: Fly ash should be used as building material in the construction as per the provisions of Fly Ash Notification of September, 1999 and as amended from time to time.
4(d)		Use of concept of passive solar design of buildings using architectural design approaches that minimize energy consumption in buildings by integrating conventional energy-efficient devices, such as mechanical and electric pumps, fans, lighting fixtures and other equipment, with the passive design elements, such as building orientation, landscaping, efficient building envelope, appropriate fenestration, increased day lighting design and thermal mass.
4(e)		Optimize use of energy systems in buildings that should maintain a specific indoor environment conducive to the functional requirements of the building by following mandatory compliance measures (for all applicable buildings) as recommended in the Energy Conservation Building Code (ECBC) 2007 of the Bureau of Energy Efficiency, Government of India.
5	Air Quality and Noise	Dust, smoke and debris prevention measures such as screens, barricading shall be installed at the site during construction. Plastic/ tarpaulin sheet covers must be used for trucks bringing in sand and material at the site.
5(a)		The exhaust pipe of the D G set, if installed, must be minimum 10 m away from the building. In case it is less than 10 m away, the exhaust pipe shall be taken up to 3 m above the building.
6	Green cover	A minimum of 1 tree for every 80 sq m of land shall be planted and maintained. The existing trees will be counted for this purpose. Preference should be given to planting native species.
6(a)		Where the trees need to be cut, compensatory plantation in the ratio of 1:3 (i.e. planting of 3 trees for every 1 tree that is cut) shall be done with the obligation to provide continued maintenance for such plantations.
7	Sewage Treatment Plant	Sewage treatment plant with capacity of treating 100% waste water shall be installed. Treated water must be recycled for gardening and flushing.
8	Environment Management Plan	The environment infrastructure like Sewage Treatment Plant, Landscaping, Rain Water Harvesting, Power backup for environment, Infrastructure, Environment Monitoring, Solid Waste Management and Solar and Energy conservation, should be kept operational through Environment Monitoring Committee with defined functions and responsibility.

Source: Model Building Bye Laws, 2016



The Ministry of Environment, Forest and Climate Change, State / UT shall issue notification of Building Bye-laws along with stipulated conditions. Copy of the notification shall be forwarded to Ministry of Environment, Forest and Climate Change so that they may notify the particular State or part thereof for which conditions have been suitably integrated to delegate the powers to the Local Authority. Thereafter, for such notified area no separate prior Environmental Clearance will be required. However, for those States and UTs or part of the States and UTs, where these conditions have not been incorporated in the Building Bye-Laws, the existing arrangement of mandatory prior Environment Clearance by State Environment Impact Assessment Authority shall continue to hold.

States have been advised to amend their Building Bye-laws by incorporating the set of conditions for each category A, B and C as mentioned above either for the entire State and UT or clearly identified part thereof, where they would like to integrate the Environmental Clearance conditions with building permissions and empower the local authority to examine, stipulate and ensure compliance of conditions required to address environmental concerns. The State / UT will have to submit such proposal / notification at draft stage as well as a copy of the final notification to the Ministry of Environment, Forest and Climate Change.

For building plans with a total built-up area between 5,000 sq m and 1,50,000 sq m, environment clearance will be required to be synchronized with the bye-laws. The concerned Urban Local Body, authorized to sanction building plans, shall ensure at the time of sanctioning a building plan that the environmental requirements stipulated in Table - 1 (for above 5,000 sq m and up to 20,000 sq m), Table - 2 (for above 20,000 sq m and up to 50,000 sq m) and Table - 3 (for above 50,000 sq m and up to 1,50,000 sq m), as the case may be, are complied with.

4. NATIONAL GREEN TRIBUNAL ORDERS

4.1 Original Application NO. 677 OF 2016 (M.A. NO. 148/2017) in NGT

The applicant filed against the Ministry of Environment, Forest and Climate Change notification dated 9.12.2016 on the grounds that there is pathetic condition of urban local bodies in the area under their jurisdiction more particularly in Ghaziabad. The exemption granted from Environmental Clearance for building and construction projects would be a huge retrograde step in the area of environment conservation. The applicant believed that such a step will have a disastrous effect on the environment and would cause irreversible damage to the environment. The magnitude of the environmental footprint would be immense and unregulated building and construction activity would cause immense environmental damage.



Further, the applicant also in his petition stated that In exercise of subordinate legislative power, a delegate cannot affect the application of another legislation enacted by the Parliament. In other words, while amending the Ministry of Environment, Forest and Climate Change notification of 2006 in exercise of subordinate legislation, the delegated authority cannot render the provisions of Water Act, 1974 and Air Act, 1981 as inapplicable and also take away the powers of the Pollution Control Boards under the said Acts, to grant / refuse consent to establish and/or operate to a project.

"Ease of doing responsible business" cannot be in fact and in law, the ground for making amendment to the environmental laws, as it primarily falls beyond the scope of the object and purposes of the environmental laws in force. It is only a ploy to circumvent the provisions of the environmental assessment. The comprehensive process for evaluating the impact on environment due to various projects has been negated by the said amendment. The petitioner expressed his concern that the notification though claims to serve social cause of providing housing for the poor but, in fact, result of its enforcement would be contrary. It would permit construction of huge buildings and apartments without strictly complying with the environmental norms.

5. NATIONAL GREEN TRIBUNAL ORDER DATED 8TH DECEMBER, 2017

National Green Tribunal explained vide 8 December, 2017 order that it has the jurisdiction to examine the legality, validity and correctness of a Notification issued by the competent forum in exercise of its power of subordinate legislation with regard to acts stated in Schedule I to the National Green Tribunal Act, 2010. The Tribunal declared that (i) clause 14(8), (ii) the provisions relating to exclusion of Consent to Operate and Consent to Establish under Water (Prevention and Control of Pollution) 52 Act, 1974 and the Air (Prevention and Control of Pollution) Act, 1981 in clause 14 of the impugned Notification; relating to constitution and functioning of Environmental Cell, cannot be sustained and are liable to be quashed for the reasons afore-stated. NGT directs the Ministry of Environment, Forest and Climate Change to re-examine its Notification dated 9 December, 2016 and take appropriate steps to delete, amend and rectify the clauses of the said Notification in light of this judgment .

The Unified Building Bye Laws of NCT Delhi amended by the Delhi Development Authority (DDA) vide its Notification dated 22 March, 2016 can also not be given effect to, unless the Notification dated 9 December, 2016 is amended in terms of this judgment.

Till the time the Ministry of Environment Forest and Climate Change comply with the above directions and notify the amended provisions of Regulations of 2006,



it will not implement the impugned Notifications. However, once the amended regulations are notified, The Ministry of Environment, Forest and Climate Change, State Environment Impact Assessment Agency (SEIAA) and local authorities can give effect to that, without any further reference to the Tribunal.

The Ministry of Environment, Forest and Climate Change shall, particularly take care that the laudable social cause of providing “Housing to the poor” does not get defeated by business, economic profitability with reference to “ease of doing business”, while particularly protecting the environment.

6. CONCLUSIONS

The delegation of the environmental clearance to Urban Local Bodies by integrating with the Building Bye Laws was done after detailed discussions together Ministry of Environment, Forests and Climate Change and Ministry of Housing and Urban Affairs. It is an attempt to bring more objectivity in the environmental parameters and make the environmental clearance more stringent. The delegation shall also facilitate strengthening of the urban local bodies to constitute environment cell, which can employ competent environmental professionals like environmental planners and environmental engineers and environmental scientists. However, With the NGT orders, the revision of building bye laws of the States will get delayed and environmental clearance will be subjected to more delays due to lengthy process at the State Level Environment Impact Assessment Authority. Now, Ministry of Environment, Forests and Climate Change is preparing grounds to file the petition against the said NGT order.

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- National Green Tribunal Order dated 8 December 2017 on Petition (Original Application NO. 677 OF 2016, New Delhi.



Srinagar and Urban Flooding: Lessons for Urban Planners

Iftikhar A Hakim

Abstract

Urban flooding poses a serious challenge to development and lives of people, particularly residents of the rapidly expanding towns and cities in developing countries and the author emphasizes that planning of Srinagar has to take into account the complexities of the Kashmir region, its fragile ecology, vulnerability to floods, existing settlement pattern, affordable transportation so that economic development and future growth of the city is ensured without compromising on its fragile ecology. Further, a healthy trend of growth of medium towns needs to be supported and reinforced by public policy, which may include policy level impetus to growth of satellite towns involving consciously planned cities in addition to the existing satellite towns in the city region of Srinagar. This will not only help to deter urbanization of ecologically fragile areas but will also go a long way in job creation and economic development of the region.

1. INTRODUCTION

Urban flooding poses a serious challenge to development and the lives of people, particularly the residents of the rapidly expanding towns and cities in developing countries. Over a period of eighteen months - August 2010 to November 2011 - destructive floods occurred along the Indus River basin in Pakistan in August 2010; in Queensland, Australia, South Africa, Sri Lanka and the Philippines in late 2010 and early 2011; along with mud slides, in the Serrana region of Brazil in January 2011; following the earthquake-induced tsunami on the north-east coast of Japan in March 2011; along the Mississippi River in mid - 2011; as a consequence of Hurricane Irene on the US East Coast in August 2011; in Pakistan's southern Sindh province in September 2011; and in large areas of Thailand, including Bangkok, in October and November 2011 (Jha et al, 2012).

It's likely that cities will only become further prone to frequent flooding owing to challenges posed by global climate change. There is an emerging pattern of unprecedented localized heavy rainfall in some Indian cities, notably Hyderabad in 2000, Ahmedabad in 2001, Delhi in 2002, 2003, 2009, 2010, Chennai in 2004 and 2015, Mumbai in 2005 and 2017, Surat in 2006, Kolkata in 2007, Jamshedpur in 2008, Guwahati in 2010, and Srinagar in 2014 (Anon, 2017).

Urban flooding is becoming more dangerous and more costly to manage because of the sheer size of the population exposed within urban settlements, affecting

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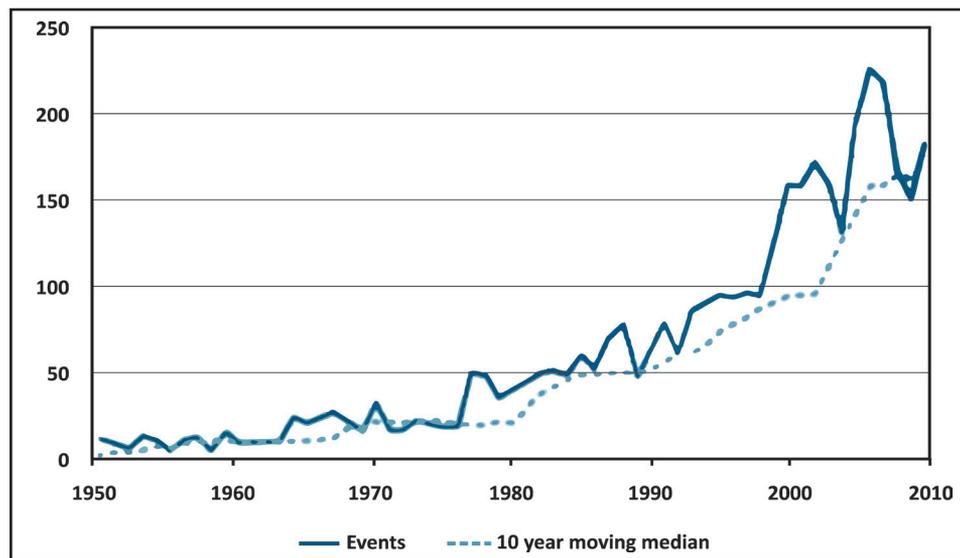
all settlement sizes. The World Bank report projects that by 2030, there will be 75 agglomerations of over five million inhabitants with urban populations in all size classes are also expected to continue to grow. By 2030 the majority of urban dwellers, in fact, will live in towns and cities with populations of less than one million where urban infrastructure and institutions are least able to cope (Jha et al, 2012).

The occurrence of floods is the most frequent among all natural disasters. In

the past twenty years in particular, the number of reported flood events has been increasing significantly. The number of people affected by floods and financial, economic and insured damages have all increased too. In 2010 alone, 178 million people were affected by floods. The total losses in exceptional years such as 1998 and 2010 exceeded \$40 billion (Jha et al, 2012: also Fig. 1 and 2).

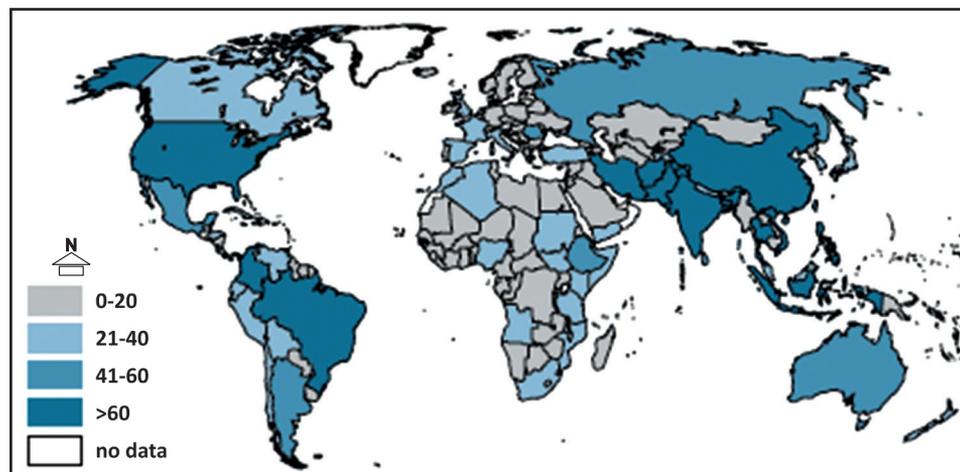
The current and projected levels of flood impacts give urgency to the need to make flood risk management in urban settlements a high priority on the political and policy agenda. Understanding the causes and effects

Fig. 1: Number of Reported Flood Events



Source: EM-DAT/CRED cited in Jha et al, 2012

Fig. 2: Flood Events, 1971-2011



Source: EM-DAT: The OFDA/CRED International Disaster Database www.emdat.be Universite Catholique de Louvain Brussels -Belgium cited in Jha et al, 2012.



of flood impacts and designing, investing in and implementing measures which minimize them must become part of mainstream development thinking and be embedded into wider development goals.

2. SRINAGAR: HISTORY AND LOCATION

Srinagar City Region is an agglomeration of the mother city surrounded by 10 urban areas - 4 statutory towns, 5 census towns and the Cantonment Board - and 162 villages proposed to be urbanized as per the notification issued for the extension of local area under as per SRO 429 dated 21-10-2014. Spreading over an area of 766 sq km. Srinagar Metropolitan Region is spread over six districts inhabited by a population of 17.27 lac persons as of 2011 (Census of India 2011) excluding the estimated overhead population of around 3.0 lac which includes the Defence forces, Service population and Darbar Move population (Draft Revised Master Plan 2015-35). The population of the local area was about 0.9 million in 1981 which increased to 1.45 million in 2001 and subsequently to 1.72 million as per the census 2011. The population for the local area is projected at 1.9 million in 2015 and projected at 3.34 million by 2035. The first written account of the spatial history of Srinagar states that the city of Srinagari was founded by Ashoka in 250 BC in the east of Takht-i-Sulaiman Hill or Shanker Acharya Hill as given in Kalhan's Rajatarangini. The city has continued to thrive for the last 2500 years with the history embedded in distinct layers of different periods. Srinagar city being equidistant from two main commercial towns of the Valley - Anantnag and Baramulla - acts as the distributing Centre for incoming merchandize from different parts of the Valley.

Srinagar is presently exposed to constant danger from floods - being itself the cause of floods checking the drainage. Emperor Akbar selected the slopes of the Kohi-Maran / Hari-Parbat for his City Nagar whereas his successors closed the Dal Lake to the floods of the Jhelum, thereby robbing the river of one of the escapes for its flood-water. Pathans built their palace on the left bank of the Jhelum preventing the river from escaping to the west and now all the flood-water from the south of the Valley must pass through the narrow waterway of Srinagar - through the channel of the river narrowed by stone embankments.

3. URBAN SETTLEMENT PATTERN OF THE STATE AND THE KEY URBAN CENTRES

As per Census 2011, the urban population of Jammu and Kashmir is 3.34 million in a total population of 12.55 million. At present Srinagar is the only city with more than one million population with the 'City Region' having 1.9 million population whereas three urban areas - Anantnag, Baramulla and Sopore - are class - I towns with more than 100,000 population. Most of the cities and towns in Kashmir region are located on River Jhelum and its tributaries. The projected urban population of different classes of towns is indicative that Srinagar will



continue to be the primate city in the region; however, the share of Class - I and Class II towns - above 50,000 populations - is projected to increase significantly during the next 20 years. This trend of urbanization is healthy for the reasons as it shows impetus to the growth of the medium towns addressing the existing skew in the distribution of population.

In the first six days of September 2014, leading to devastating floods, south and central Kashmir received abnormally massive rainfall due to rare climatic occurrence with the rainfall exponentially higher than the normal. The rainfall had direct impact on the discharge in the South Kashmir Region which directly affects Srinagar as given below:

- The rainfall in Qazigund in South Kashmir and Srinagar was exponentially higher than the normal;
- Anantnag (Islamabad) received 490 mm of rain as compared to 10.3 mm witnessed during the period normally;
- Pahalgam received 230 mm against the normal 12.3 mm;
- Kokernag witnessed 426.3 mm rain against 9.8 mm normal;
- Qazigund had 561.3 mm rain against 6.2 mm and Srinagar received 157.7 mm rain against the normal of 6.5mm (Zargar, 2014); and
- This is 4600 percent, 17770 percent, 4250 percent, 8900 percent and 2300 percent higher than the normal respectively for these places.

4. CLIMATE CHANGE

“The Kashmir floods are a grim reminder that climate change is now hitting India harder. In the last 10 years, several extreme rainfall events have rocked the country, and this is the latest calamity in that series,” said Chandra Bhushan, deputy director general of the Centre for Science and Environment (CSE) and

Table 1: Rainfall Data of Preceding Floods in Srinagar

Date	Event of the Day	Rainfall on the day (mm)	Normal rainfall (mm)
04 September 2014	Anantnag receives highest rainfall in 24 hr period	180	1.8
	Pahalgam receives highest rainfall in 24 hr period	58.6	2.7
05 September 2005	Kokernag receive highest rainfall in 24 hr period	149.5	3.4
	Qazigund receive highest rainfall in 24 hr period	206	0.7
	Srinagar receive highest rainfall in 24 hr period	52.4	0.4

Fig. 3: Bemina Institutional Area (Floods 2014)



Fig. 4: Bemina Housing Colony After 10 Days (Floods 2014)



the head of its climate change team (Chaudhary, 2014). A 2006 study by B. N. Goswami of the Pune based Indian Institute of Tropical Meteorology showed that from 1950 to 2000, the incidents of heavy rainfall events (over 100 mm / day) and very heavy rainfall events (over 150 mm/day) increased while the moderate events (below 100 mm / day) decreased (Chaudhary, 2014).

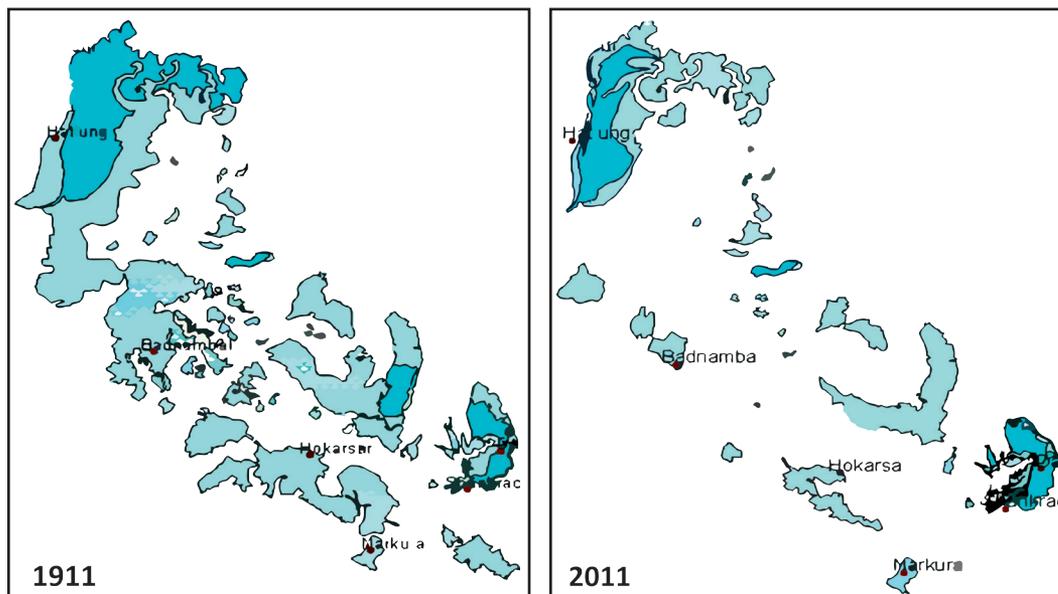
The Kashmir disaster was caused by an event that fell in the ‘very heavy rainfall’ category. The fear is that due to climate change, this can become the new normal. The recently released Fifth Assessment Report of the Intergovernmental Panel on Climate Change projects shows that India will get more intense rainfall even as the number of rainy days decreases due to changing weather patterns (Chaudhary, 2014).

“India should start internalizing climate change adaptation in all developmental policies and programmes. From building of city infrastructure to agriculture and from water supply to energy infrastructure, we will have to make changes to incorporate climate change impacts.” (Chaudhary, 2014). In the case of Kashmir, extreme events coupled with bad development and poor preparedness has worsened the impacts. For instance, despite the fact that the area is highly flood-prone, the state didn’t have a single flood forecasting station, though India has 175 stations (Chaudhary, 2014).

5. FRAGILE ECOSYSTEMS AND URBANIZATION

Kashmir often called heaven on the earth, is also a major tourist attraction. But this has also become a bane for the State leading to unchecked, ill-planned constructions which are choking the floodplains of the rivers. As concrete structures take over wetlands, rivers and streams have lost the ability to carry extra water when it rains heavily.

Fig. 5: Geographical Status of Greater Srinagar Vis-à-vis Wetlands and Water Bodies



Source: Chugh and Farooq (2015)

Wetlands in Kashmir Valley have lost their water absorption capacity due to excessive siltation and encroachments, thus decreasing the chances to provide assistance during floods. Wetlands including Hokersar, Haigam and Shalabugh, considered as natural sponges in times of floods have been converted into “agriculture and built-up” over the past two decades which worsens the flood susceptibility. A research by Humayan Rashid and Gowhar Naseem of Jammu and Kashmir Remote Sensing Centre reveals the loss of nearly 50 percent of the wetlands over the period of 100 years (Fig. 5). In 1911 the total extent of water bodies with marshy areas was 356.85 sq km, however it has reduced to 158.54 sq km in 2011. Also it was revealed that the city of Srinagar was facing problem of drainage as these lakes used to act as sponges for floods. With most of them vanishing, the city was facing problems of floods from rainfall for three or four days because of excess water flow in river Jhelum (Chugh and Farooq 2014). Kashmir Region has recorded a huge loss of forest since 1992. Comparison of forest survey reports show that the valley lost about 10 percent of its dense forest cover during the period (1992-2012) indicating that ability of forests to retain water has been reduced. It meant more rain water flowed directly into Jhelum River causing flooding (Chugh and Farooq 2014). “The flood channels that used to take the excess water away have been destroyed. The posh areas in Srinagar that have been affected badly by floods are the ones that have come up on the floodplains,” said Narain.

On the basis of the Google Earth maps, the data received from NRSC and after ground truthing with the support of Irrigation and Flood Control Department, flood



Fig. 6: Inundation Map of Srinagar 2014

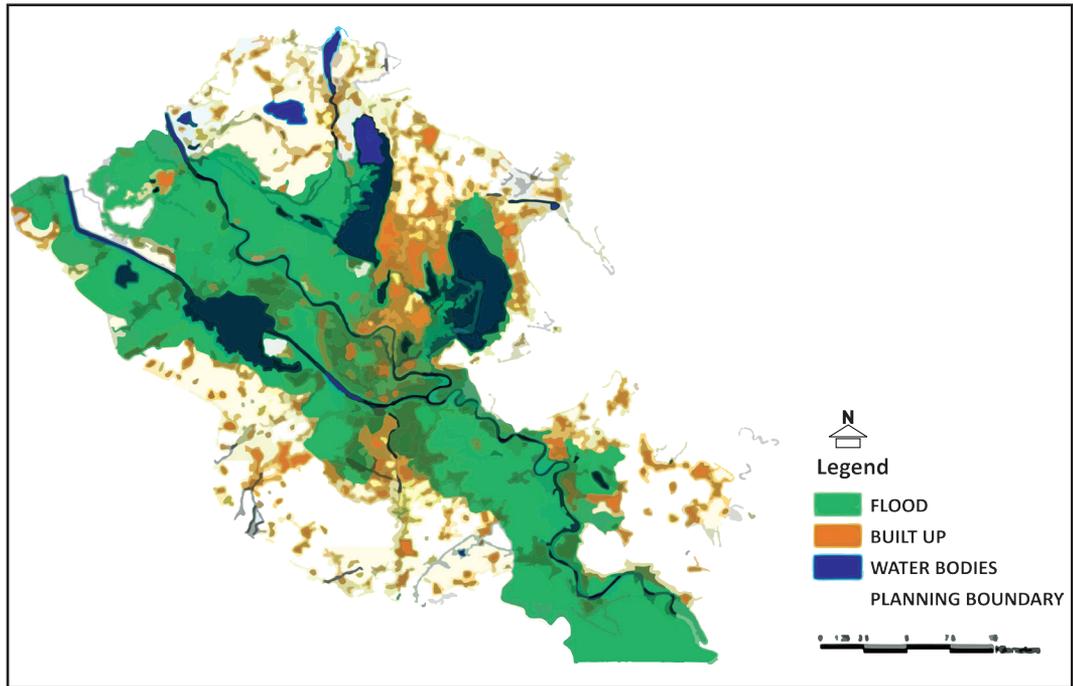
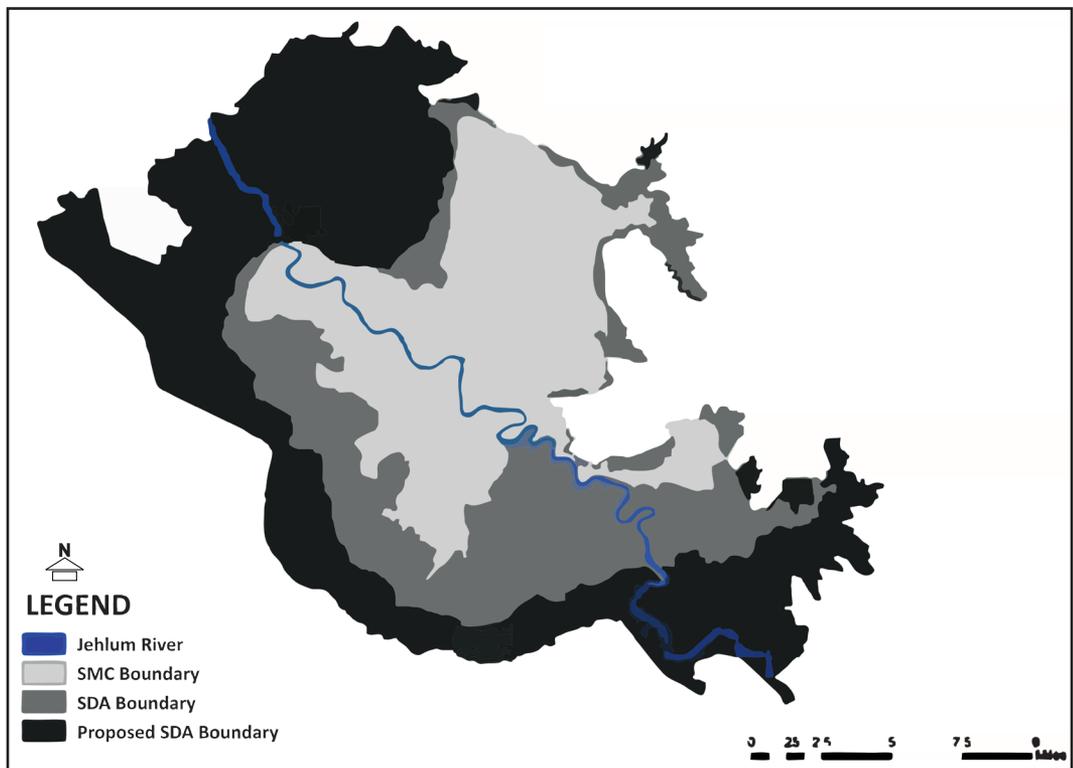


Fig. 7: Spatial Expansion of Srinagar Functional Boundaries



maps of 2014 (Fig. 6) were prepared by Town Planning organization in early 2016. These maps are indicative of the extensive spatial vulnerability of the historic city and the need to scientifically look into the issue. Juxtaposing the flood vulnerability map of the city with the expansion of the city during last decades (the changing urban area limits of the city) one can easily conclude that there is absolute mismatch between the boundaries with the actual vulnerability of the city. The boundaries of the city (Fig. 7) have been extended from 1971 onwards to the latest one in 2015 to increase the urbanizable areas for accommodating the increasing population. However, the extensions especially the recent one is clear example of the extension being divorced of the scientific urban planning foundation.

6. SRINAGAR PLANNING IN RETROSPECT

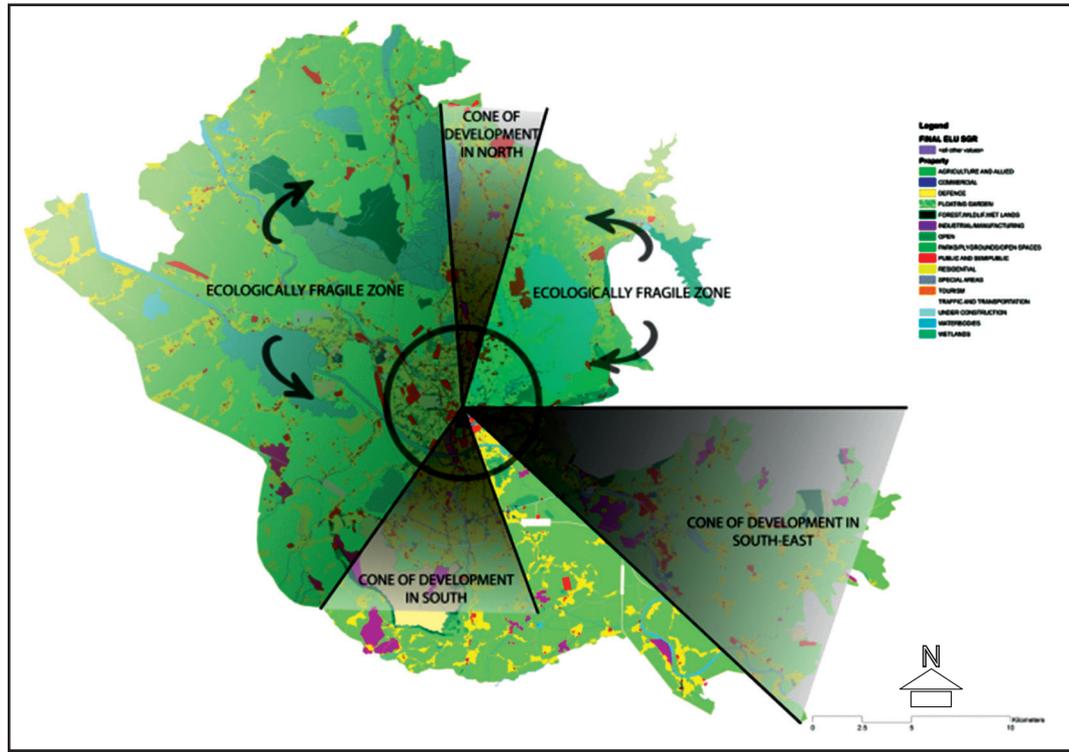
The city has many constrains to its expansion. Srinagar Master Plan 1971-91 while acknowledging the existence of flood absorption basins and water bodies in its east, west and south sides and the constraint of seismography in the southwest direction, proposed the addition of 5.36 sq miles in north, 2.15 sq miles on North West and on south west 4.89 sq miles low lying land added to the city, up to Flood Spill Channel with the expansion expected to accommodate population of 5,00,000. The Master Plan also proposed the development of three satellite townships for a population of about 1,65,000. The Master Plan termed the expansion of further south across flood (Fig. 8 and 9) spill channel faulty but indispensable. It recommended the protection of the population between eastern and western roads on the southern sides because of the already settled population in the housing colonies and was proposed to accommodate 1,00,000 population.

In order to mitigate the problems arising out of development on the west side due to higher water tables - till recently part of flood absorption basins - the

Fig. 8: Proposed Growth (Master Plan 1971-91) Fig. 9: Proposed Growth (Master Plan 2000-21)



Fig. 10: Actual Growth of Srinagar in last 4 - 5 Decades



Master Plan proposed the creation of three artificial lakes of 11, 22 and 12 acres. The whole belt between New Airport Road and Parimpora Narabal Road got developed into large residential, Governmental and institutional areas which get flooded and water logged frequently. A major part of this belt despite being planned development has slum like conditions with plethora of urban ills. Major public buildings remained submerged for more than two weeks in September 2014 floods and these areas face persistent waterlogging in rains.

In the Master Plan 2000-21, the issues of the expansion of Srinagar in the lateral direction and the constraints on the growth have been discussed - on the east and north sides, the city is bound by Zabarwan mountains extending from Nagabal to Gagribal, on its south east lie the uplands of Pampore Karewa and Damodar Karewa. Former is mostly under saffron plantation while the latter is occupied for most of its part by airport and defence up to Humhama and beyond Humhama there are uplands which have been seriously affected by tectonic earthquakes in the past. On the west side are small Karewas of Khushipora and Zainakote, beyond which lies the flood absorption basin named Hokersar. In the north lies the vast water body of Anchar Lake and Khushalsar. Land area available between Hokersar and Anchar Lake is agricultural, and under persistent pressure of urban expansion along Srinagar-Baramulla Road and Srinagar - Wayil Road.



Both the Master Plans have failed in giving Srinagar a safe direction and an urban policy for its growth and economic development because the land use planning was not based on layered and scientific land suitability analysis. The revision of the Master Plan is under process and the document which is in public domain is not strategically difficult from the previous documents. It may have further compromised on lake buffers despite the scientific, environmental and flood related, evidence increasing buffers in the aftermath of the floods 2014 and change of HFL.

Despite acknowledging the constraints to the expansion of the city in the Master Plans, the planners have failed in giving Srinagar a safe direction through a sound land use and urban development policy for its growth and economic development. The failure may also be attributed to persistent political interference on urban land use policy and the archaic institutional structure of the urban local bodies and the local authority - Srinagar Municipal Corporation and Srinagar Development Authority as Lakes and Waterways Development Authority, entrusted with the implementation of the Master Plans. Over the years, Srinagar Municipal Corporation and Srinagar Development Authority shut their eyes to construction of illegal colonies, right from Nowgam to once-marshy land, Bemina. SMC and SDA may even have issued permissions in most cases. In a period of 100 years and particularly after the approval of first master plan, Srinagar lost major part of the wetlands and water bodies to urbanization.

7. FROM SMART GROWTH TO REDUCED DENSITIES

The core city or the oldest part of the city has historically been high density development which unfortunately was equated to slum like situation in the plan documents. The city like any other city with such a long history was not planned for car but was a pedestrian city with high density (Table - 2) of development and mixed land use. The city had unique work - home relationship. Plans were prepared in 1960s and 1970s to decongest the city, and widen the pedestrian streets into motorable streets. Hence the historic city with extraordinary street

Table 2: Density Pattern through Master Plans

Source	Description	Year	Residential Area	Unit	Residential Density (pph)
Master Plan 1971-91	EXISTING	1971	2052	Acres	562
	PROPOSED	1991	10494	Acres	191
Master Plan 2000-21 (under revision)	Base Year	2000	8772	Hectares	103
	Existing	2015	8686	Hectares	158
	PROPOSED	2021	15112	Hectares	149
Master Plan 2015-35 (Revised)	EXISTING	2015	12675	Hectares	149
	PROPOSED	2035	19398	Hectares	174

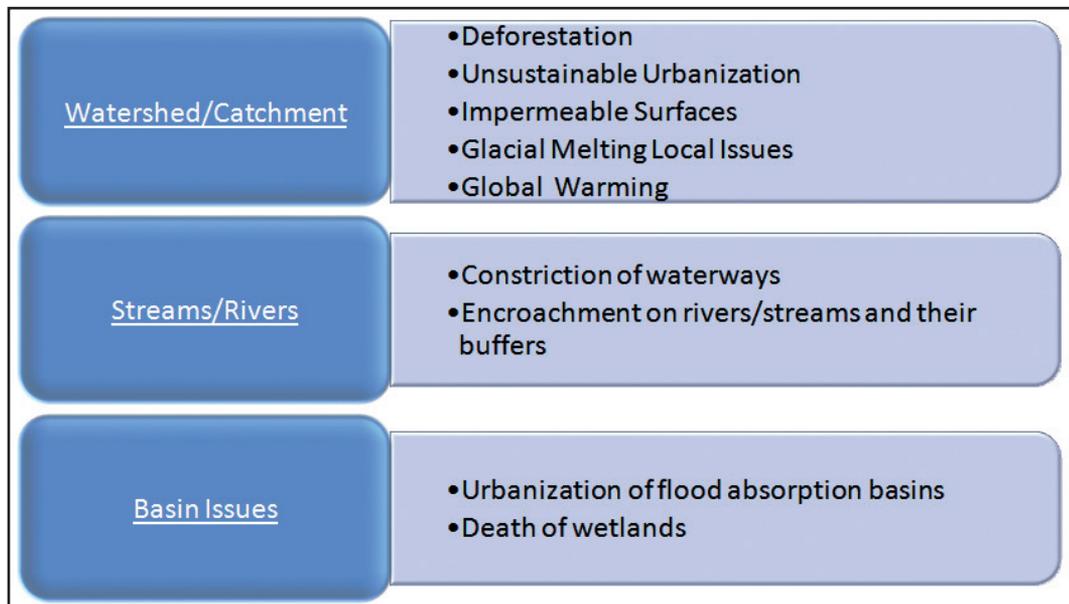


scape started converting into eclectic architecture destroying the invaluable heritage.

The limited availability of land for urbanization and other sound scientific and historic reasons explaining the extraordinarily high density of the city of Srinagar, the ‘planners’ of the Master Plan of the city inspired by Western principles of urban planning, introduced the concepts of limited ground coverage urbanized the flood sponges and prime agricultural lands. In the process gross residential density got drastically reduced from 560 pph to 150 pph (Table - 2) compromising on the critical flood security as well as the flood infrastructure. In a region of fragile ecology this has led to urban sprawl and increased vulnerability by devouring the wetlands and other flood sponges.

Srinagar has fragile ecology surrounded by hills or wetlands. Flood absorption basins and water bodies in east, west and south sides of Srinagar limit the possibilities of its growth. Rather than facing the challenge and giving right direction to the spatial growth of Srinagar, planners have found these water bodies as soft targets for urbanization. Francois Bernier - who visited Srinagar during Aurengzeb’s reign, reported that there were only two wooden bridges over the Jhelum. George Foster - who visited Srinagar in 1783 AD, mentions the city having developed about three miles on either side of the Jhelum with four or five bridges (Khan, 2013). However Srinagar in the recent past has been known as the city of seven bridges. Srinagar now has fifteen bridges in a distance of 7.77 km, excluding the three bridges under construction at Convent School, third Zaina Kadal Bridge and second Noor Jehan Bridge at Noor Bagh which will

Fig. 11: Genesis of the Urbanization of Critical Resources



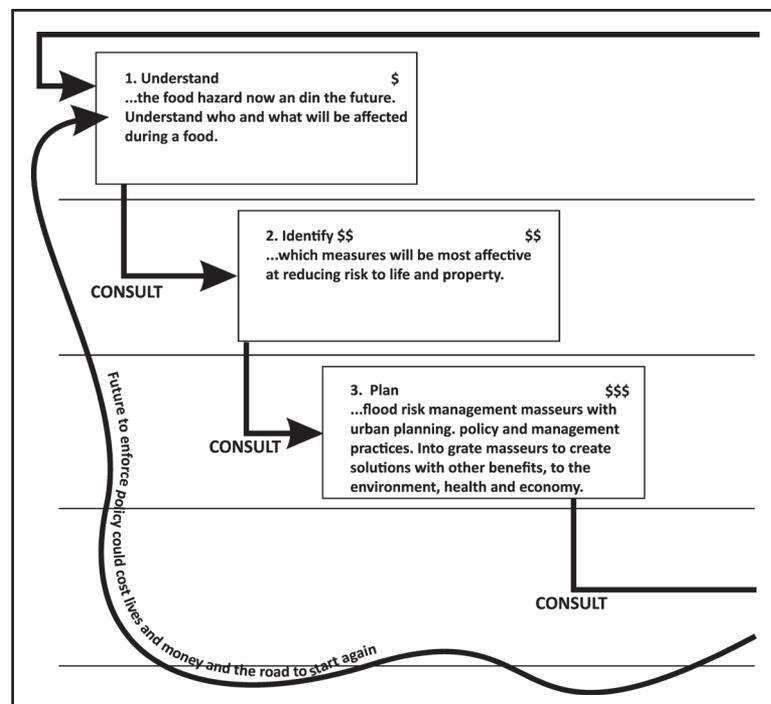
take the total to 18. There were plans for a fourth Zaina Kadal Bridge which was scuttled by Archaeological Survey of India.

8. PLANNING FOR SUSTAINABLE AND RESILIENT SRINAGAR

Urbanization is accompanied by increasingly larger-scale urban spatial expansion as cities and towns swell and grow outwards in order to accommodate population increases. Urban expansion alters the natural landscape, land uses and land cover, for example by changing water flows and increasing impermeable areas, thereby adding to the flood hazard problem (Satterthwaite 2011 cited in Jha et al, 2012). High levels of urbanization in river flood plains and other areas of catchments might also change the frequency of occurrence of flooding. In the mid - 1970s, when urbanization was just starting to accelerate, a study by Hollis (1975) showed that the occurrence of small floods might increase up to 10 times with rapid urbanization, whilst more severe floods, with return periods 100 years or over, might double in size if 30 per cent of roads were paved. The changes in land use associated with urbanization affect soil conditions and the nature of run-off in an area. Increased development of impermeable surfaces leads to enhanced overland flow and reduced infiltration. It also affects the natural storage of water and causes modification of run-off streams (Wheater and Evans, 2009 cited in Jha et al, 2012). In view of this it may be advisable that the urban planning process factors in the integrated flood management ensuring that the flood absorption basins are preserved and environmental management issues are addressed. The five stage process given in Fig - 12 is seminal to an urban or regional planning exercise.

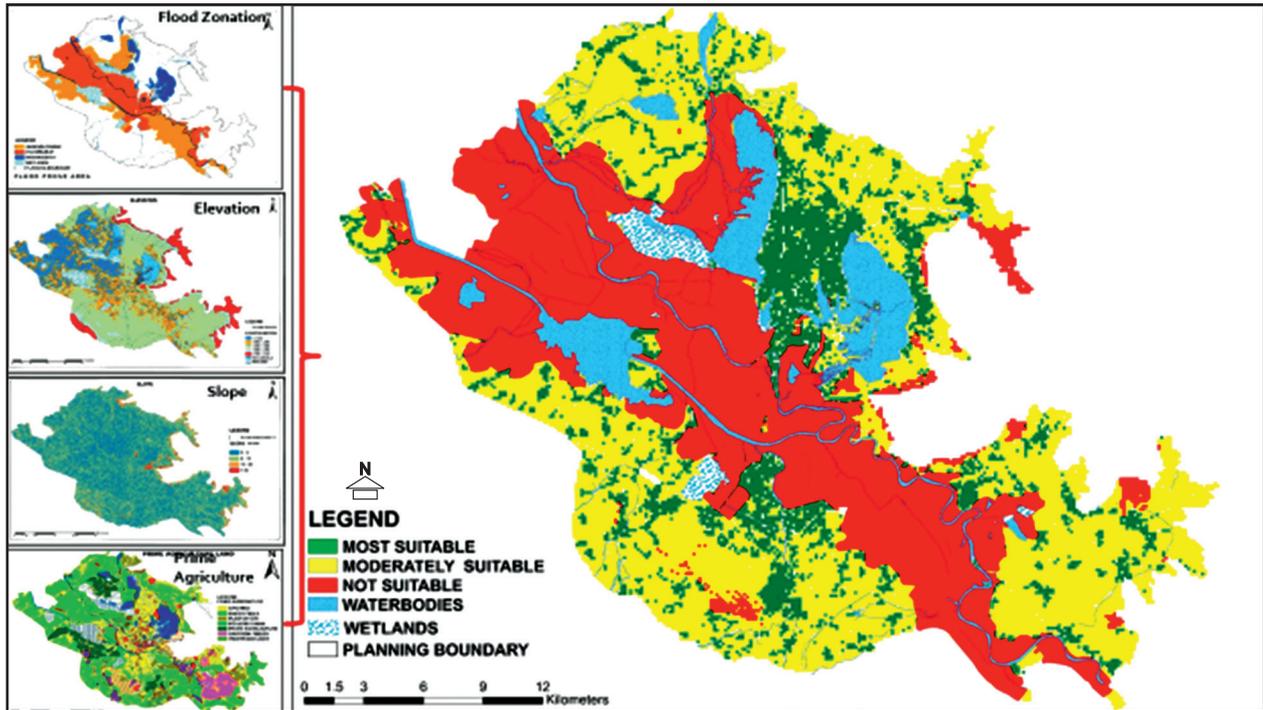
Land use planning and the regulation of new development is a key aspect of integrated urban flood risk management. In developing countries in particular, the opportunity to better plan, the formation of new urban areas is central to prevent the predicted increase in future flood impacts from being realized. The need to integrate

Fig. 12: Five Stage Diagram of Integrated Flood Risk Management



Source: GHK Consulting and Baca Architects cited in Jha et al 2012

Fig. 13: Land Suitability Analyses



flood risk management into land use planning and management is therefore important in order to minimize risk and manage the impacts of flooding. In growing urban settlements in particular, flood risk may be seen to be of lesser importance than other social and economic concerns. It is hence likely that floodplain development will continue, due to pressure on land resources and other political and economic considerations. However, where new urban environments are better planned within areas at risk from flooding, flood-receptive design can be employed at a potentially lower cost and disruption during the build or reconstruction phase than to attempt to later retrofit. This allows the building in of resilient design, with potential payoff well into the future.

Layered GIS based land suitability analysis provides a structured approach to the land use policy for a city region. A comprehensive land suitability analysis (Fig - 13) was performed for Srinagar city region which warrants major restructuring of the land use and strategic shift of urban development for the city. The land suitability determines the areas that are suitable for urban development, the areas that are moderately suitable and the areas that are not suitable at all. The outcome of the analysis was that the city has very limited land available for urban development and most of the land is not suitable for urbanization. Similar work will need to be done for other cities in the State.



9. CONCLUSIONS

The planning of Srinagar has to take into account the complexities of the Kashmir region, its fragile ecology, vulnerability to floods, existing settlement pattern, affordable transportation so that the economic development and future growth of the city is ensured without compromising on its fragile ecology. The structured land suitability analysis involving successive elimination of the high slopes, flood absorption basins, vulnerable areas, prime agricultural lands, ecologically fragile areas, wetlands, forests and water bodies leaves very limited availability of land for development purposes. Out of the total local area of 758 sq km 215 sq km is already developed, 120 sq km is ecologically fragile; 46 sq km are prime agriculture with about 30 sq km under saffron cultivation. In the local area, 140 sq km is vulnerable and 146 sq km are undevelopable leaving only about 70 sq km in the whole local area which is developable. This will warrant two pronged strategy of in fill development and the development of satellite townships including the towns that fall in the city region of Srinagar. Hence, the future urban development strategy should focus on:

- Increased densities
- Development of Satellite townships as counter magnets to Srinagar
- Combination of the two

Further the healthy trend of the growth of medium towns needs to be supported and reinforced by public policy which *inter alia* may include the policy level impetus to the growth of satellite towns involving consciously planned cities in addition to the existing satellite towns in the city region of Srinagar. This will not only help to deter the urbanization of ecologically fragile areas but will also go a long way in job creation and economic development of the region.

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