



Editorial

In this issue there are nine papers out of which the paper on “A Review of Affordable Housing Policies of State Governments in India” is written by Arunika Sharma and Ruchi Prasad. This paper explains that the shortage of housing has assumed alarming proportions particularly for low income households who have been compelled to live in slums and squatter settlements. Lack of developed land and unavailability of funds have become major causes for shortage of affordable and adequate housing. Government of India has recently embarked upon a journey of addressing housing shortage by initiating a massive campaign under the Pradhan Mantri Awas Yojana (PMAY), encouraging states to come up with their own State Housing Policies. This paper discusses India’s housing shortage scenario, provides a snapshot of housing policies of various States, and highlights various provisions made in these policies.

The second paper written by Pratik Jayprakash Patel on the theme “Rain Gardens: A Case Study of City of Cullman, Alabama; USA” is based on a proposal prepared by the author for the city which was in transition before the adoption of its new Comprehensive Plan. Rain Gardens are an effective technique through which surface runoff water is collected, decontaminated and given back to the nature using renewable energy sources and not relying on any mechanical or electrical equipment. Rain Gardens are considered as one of the cheapest and most effective ways to recharge ground water and also beautify the area. The excess water collected can be given back to natural streams or lakes bringing down contaminant levels. Rain Gardens are effective with water from impervious surfaces like roads, parking lots, all paved areas, compacted garden areas, terraces, etc.

Continuing with the broad theme of environment, Alok Kumar Tripathi and Anshuman Singh’s paper on “Regional Approach for Integrated Disaster Risk Management and Vulnerability Reduction: A Case of Diu Region” focuses disaster risk management and vulnerability reduction. Disaster is a major concern for all countries, and its impact has been more devastating in recent years due to interaction between human activities and environment. This paper describes how regional approach for disaster risk management and vulnerability reduction can help in making a region disaster resilient through physical planning interventions, Innovative technologies, administrative reforms, structural measures, capacity building and raising awareness could help address these issues. Regional hazard vulnerability and risk analysis has been done for the Diu Region and disaster specific plans have been integrated to prepare a composite risk zoning plan for the Region with the use of geographic information system.

Still continuing with the theme of environment with a focus on disasters, Neha Bansal and Aditya Purohit written a paper on “Urban Resilience Approaches and its Challenges”. With rapid urbanization, risk of disasters is increasing as more people and assets locate in areas of high risk. For instance, more than half of the world’s large cities, with populations ranging from 2 to 15 million, are located in areas of high earthquake risk. The impact of disasters is even more compounding in these high risk areas. Disasters not only erode and destroy years of development gains, they also destroy assets, kill people and increase poverty and adversely impact GDP especially in vulnerable urban areas. Accordingly this paper aims at discussing resilience to combat long term disaster management in urban areas by taking some best practices for study and ends by identifying disaster resilience methods, which have adapted to smart techniques.

Anita Shyam’s paper on “Impact of Development on Mangrove Cover in the Mumbai Metropolitan Region” underlines that Mumbai Metropolitan Region (MMR) having the largest coastal area in India is experiencing tremendous growth over the years due to rapid industrialization and urbanization. High population density and uneven growth rate have resulted in serious environmental problems in the MMR coastal region. Pressure on land due to increased development has led to scarcity of land causing scarcity of open areas, mangroves, and areas under water bodies have been filled for creating built up spaces. This study attempts to



understand the impact that development pressures have had on mangrove cover by mapping changes in the mangrove area of the MMR region.

Environment has assumed such critical proportions in our lives that the sixth paper on “Sustainable and Resilient Water Management Practices for Residential Areas” continues the debate and discussion with a particular focus on water. This paper is jointly written by Anchal Choudhary and Jagdish Singh. Urban population in India has been increasing at rapid rate. It is expected to increase at growth rate of 2.54 population per annum in the near future. Water resources are facing immense pressure in all urban settlements. Urbanization in India has resulted in an increase in constructed or built-up area. Total constructed or built up area taken as a whole measured nearly two million sq meters in 2005 which is anticipated to rise to 10 billion sq meters by 2030. As the built-up area increases, natural ground water recharging decreases, and leads to increase in urban flooding and water logging problems in the monsoon season. This paper provides a discussion on sustainable and resilient water management practices for residential areas.

In their joint paper Arpan Paul, Prerna Mandal, Ankhi Banerjee, Arkopal Goswami and Joy Sen discusses “Factors Affecting Innovation Driven Livability: A Case of Kolkata Metropolitan Area”. In this paper an attempt has been made to arrive at preliminary set of factors responsible for innovation driven livability. Causes responsible for livability of a metropolitan area as an effect of development of an innovation zone based on economic activity are considered. Firstly, an understanding of the concept of innovation and livability is developed before moving to developing an approach for identifying factors enabling innovation driven livability. This paper contributes to the development of an approach of innovation in a metropolitan area, which leads to enhanced livability. The results provide factors responsible for innovation driven livability and puts forward possibilities of finding more factors according to needs of development in a specific metropolitan context.

Richa Rathi Thakkar writes on “Emergence of New Planning Perspectives and Data Sets”. New ideas, developments and approaches are taking shape with the emerging importance of social responsibilities to reach harmony and due to turning events in the global economy. Contemporary situations demand the discipline of planning to be more interactive with the civil society’s decisions regimes by creating perspectives and facilitating sustainable developments. In order to meet the upcoming demands from the planning profession, Richa Rathi Thakkar focuses on active participation in sessions on contemporary agendas; encourage new solutions and technical alternatives; and active adoption of changing nature of data sets and parameters that need to be embraced for analysis. The paper broadly covers need for a newer perspective, its reflection on government initiatives and enlists some of the new data sets for consideration.

The last paper by S. Kumar Swami once again revisits much haunted issue of “Growth of Slum Population in India”. This is likely to pose serious problems to urban planners, policy makers and managers of urban affairs in terms of increased requirements of funds for infrastructure development and management. Because of inter-regional and inter-city disparities in access to infrastructure and basic amenities, sharp differences are noticed at micro-level quality within a city between high income localities and slum and squatter settlements. As a result, the worst affected people are the poorer sections of our society. In India, more than 40 percent of the population on an average in metropolitan cities lives in slum and squatter settlements in vulnerable locations.

While critical commentaries on current issues such as disasters, housing and slums is crucially important, strategic planning pathways for bettering future policies would certainly help practicing planners and planning students. Enhanced focus by authors of various persuasions on making the future of the Indian cities, bright is encouraged by the ITPI.


Prof. Ashok Kumar, Ph.D.
Editor



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A Review of Affordable Housing Policies of States in India

Arunika Sharma and Ruchi Prasad

Abstract

The growing concentration of people in urban areas has led to problems of land shortage, housing shortfall, congested transit and has also severely stressed the existing basic amenities such as water, power and open spaces of the town and cities. The problem has assumed alarming proportion particularly for the weaker sections, low income and disadvantaged groups who have been compelled to live in slum and squatter settlements further deteriorating the housing conditions in the country. Lack of developed land and unavailability of funds have been major causes for shortage of affordable and adequate housing. Government of India has more recently addressed the housing shortage by initiating a massive campaign by way of Pradhan Mantri Awas Yojana (PMAY) and encouraging states to come up, with their own state housing policies. This paper discusses the housing shortage scenario, provides a snapshot of housing policies of various states and highlights the provisions made.

1. INTRODUCTION

India is a nation with large population and ever growing urbanization. Rapid pace of urbanization due to the urban-rural migration is putting pressure on the urban infrastructure in cities. India faced shortage of 18.78 million in its urban areas in 2012 of which 56.18% pertained to economically weaker sections (EWS), another 39.44% to lower income groups (LIG) and remaining 4.38% pertained to MIG and HIG groups (source: Twelfth Five Year Plan: 2012-17, Planning Commission, India). The report also highlights that nearly one million households are living in non-serviceable *katcha* houses, while over half a million households are in homeless conditions and are in need of new houses. Further, out of the total urban housing shortage, nearly 62 percent houses are self-owned, while 38 percent families live in rented homes.

Considering the gigantic magnitude of housing problem, for a large developing nation like India, there is a need to constantly find innovative solutions and best practices. The Pradhan Mantri Awas Yojana (PMAY) - Housing for All - scheme launched in June 2015, aims at addressing the housing requirements of the urban poor including slum dwellers. The PMAY proposes to build 2 crore houses for urban poor by the year 2022 through a financial assistance of Rs. 2 trillion from central government. This Mission has four verticals viz. in-situ slum redevelopment with

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private sector participation using land as resource, affordable housing through credit linked subsidy, affordable housing in partnership with private and public sector and beneficiary led house construction/enhancement. Under these components, central assistance will be in the range of Rs. 1 lakh to Rs. 2.20 lakh per family. The houses thus provided will be either in the name of female of the household or in the joint name of husband and wife. As of 25 April 2016, government has identified 2,508 cities and towns in 26 states for taking up construction of houses for urban poor.

The challenge in India is not just increasing the supply of housing stock but also to improve planning and designing of these houses with added technological advancements for faster and cost effective construction. Acknowledging this the Technology Submission under the PMAY - HFA Mission lays emphasis on construction of affordable houses for urban poor with focus on both engineering, planning and design aspects. Also government has come up with the 'Template for State Housing Policy for Urban Areas (2016)' with guidance note for states for formulation of respective housing policies.

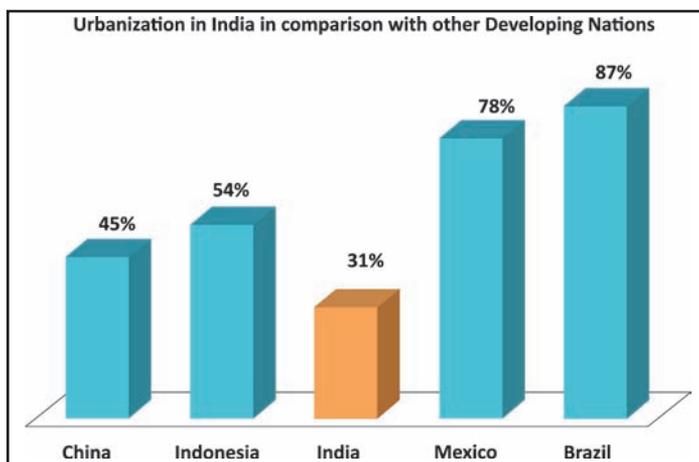
Various states, have come up with their own housing policies (some in draft format) under the PMAY- HFA in an attempt to address the housing problem.

1. STATE HOUSING POLICIES: VARIOUS MODELS AT A GLANCE

2.1 Gujarat Model

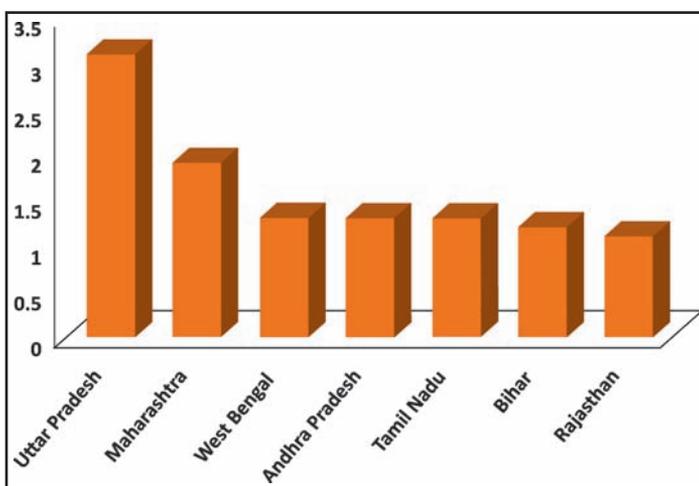
Gujarat Affordable Housing Policy - 2014 under Mukhya Mantri Gruh Yojana (MMGY) announced in January 2014 envisages slum free cities and aims at

Fig. 1: Urbanization in India in Comparison with Other Developing Nations



Source: 12th Planning Commission

Fig. 2: Housing Shortage of Top Seven Indian States



Source: Ministry of Housing and Urban Poverty Alleviation (MoHUPA), 2012



providing housing at reasonable price to poor through three development models.

The first model: Public Agency on Public Land is implemented by urban local bodies, urban authorities and housing boards. This model is for the Greenfield Development and the project can have a mixed scheme of affordable houses in which EWS, LIG and MIG - I, can be developed with other categories of houses like MIG - II and HIG. However, in such mixed schemes built up area for affordable houses should be at least 60 percent of total built up area. In addition, the built-up area of EWS and LIG type houses should be at least 35 percent of total built up or 15 percent of total number of houses whichever is higher. Selection of developer shall be made through an open online tendering process and developer quoting the lowest bid is selected.

The second Model: Private Developer on Public Land, mode of implementation of the project is through Public Private Partnership (PPP). LIG and MIG units are constructed on public land by private developers on a PPP mode. Developer can construct affordable units and free-sale units on same plot. Selection of developer is made through open online tendering process and developer who offers to build maximum built-up for LIG-I, LIG-II and MIG-I type affordable houses gets selected.

The third model: Private Developer on Private Land incentivizes private developers to develop affordable housing scheme on their private land. Private developers willing to participate and develop housing schemes under this policy can construct EWS, LIG-I and II or MIG-I category houses. For other residential zone built up area of affordable houses should be at least 60 percent of the total area. In addition, the built-up area of EWS and LIG type houses should be 15 percent of total number of houses or 35 percent of total built up whichever is higher.

Other incentives for private developers' participation include initiatives such as permissible FSI of 3 will be given on entire plot of affordable housing scheme (i.e. AH component + free sale component). This FSI can be utilized only on plots where affordable houses are built and cannot be transferred to some other place. The developer is free to undertake any kind of construction as per local General Development Control Rules (GDCR) provision for free sale component. The developer can be given exemption from municipal charges only for sub-plots that are used for construction of EWS and LIG category houses, and is entitled to receive tax benefits announced for such projects by central government which can be obtained from authorized department. Important initiative of the state includes the reservation of affordable housing zones in development plan and socially and economically weaker section housing in town planning schemes.



2.2 Rajasthan Model

Rajasthan Affordable Housing Policy was initially launched in December 2009 and more recently a new policy has been prepared incorporating learnings from the past experiences, feedback from various stakeholders and new policy initiatives by the Government of India. The new policy “Chief Minister’s Jan Awas Yojana - 2015” has attempted well-defined provisions for all possible situation of land. Following provisions of Jan Awas Yojana for Low Cost Affordable Housing have been framed, incorporating various incentives for developers and subsidies for beneficiaries by Government of Rajasthan and Government of India.

Provision - 1A: Mandatory Provisions for Residential Schemes of ULBs, UITs, development authorities, RHB and private developers. As per the provision, minimum area for plotted development is 2 hectares whereas, for flatted development schemes area should not be less than 5,000 sq m.

The provision mandates Rajasthan Housing Board to construct 50 percent houses in case of plotted development and 10 percent of the FAR to be reserved in case of flatted development for EWS and LIG houses. It also mandates the UITs, Development Authorities and Urban Local Bodies to construct 25 percent of the flats as well as plots for EWS and LIG categories and the private developers to earmark at least 7.5 percent of the proposed residential FAR in case of flatted construction and 10 percent of the residential saleable area in case of plotted development for EWS and LIG. Local Authority would take up allotment of houses whereas in case of private schemes, the developer shall make the allotment.

For successful implementation of the above development provision the state government has initiated various incentives to the developer like 100 percent waiver on land conversion charges on EWS and LIG component, 100 percent waiver on building plan approval charges for EWS and LIG, FAR proposed for EWS and LIG shall not be counted in the FAR calculation of main project even if EWS and LIG units are provided on split location, provision of split location is allowed within the same urban area, permissible commercial use.

Provision - 1B: Mandatory Provisions for the proposed industrial Areas of RIICO and Private Developers. As per the provision 5 percent of saleable area in new industrial schemes shall be reserved for EWS / LIG Housing. Saleable area is to be reserved for EWS and LIG plots at the rate of 30 to 45 sq m for EWS and 45 to 75 sq m for LIG, with plot areas of 30-45 and 45-75 sq m respectively. In the schemes of area less than 2 hectare a fee of 5 percent of saleable area shall be levied. The Rajasthan State Industrial Development and Investment Corporation (RIICO), developer will invite applications within 60 days of approval of maps,



and carry out scrutiny of applications. Provision is made for 10 percent reserve list, to cater to any subsequent cancellations. In allotment process by developer the advertisement for the allotment of EWS and LIG plots, income criteria shall be fixed as per this Policy by the developer and final list of allottee shall be submitted to concerned authority, municipality and UIT with relevant documents. RIICO and developer would also collect cost of plot from the allottee directly.

Incentives offered to the developer include exemption from land conversion and change of land use charges for area proposed under EWS / LIG and 100 percent waiver on approval charges of EWS and LIG component.

Provision - 2: Development of Affordable Houses by Private Developer on Private Land in Partnership. As per the provision, the private developers are supposed to construct houses for the EWS / LIG categories on the land owned by them. The developer constructs EWS / LIG flats on 50 percent of the land owned by him and remaining is used for residential development. Allotment of EWS and LIG houses is by local authorities to the eligible beneficiaries.

The developer gets 100 percent waiver on land conversion and change of land use charges, 100 percent waiver on building plan approval charges for EWS and LIG category and maximum permissible 2.25 FAR at present is allowed without betterment levy for the complete project area.

Provision - 3A: Development of EWS and LIG flats by Private Developer on whole of Private Land (flatted development, above G+ 3 formats). The private developers are supposed to construct houses for the EWS and LIG categories on the land owned by them.

As an incentive the developer gets 100 percent waiver on land conversion / change of land use charges, 100 percent waiver on building plan approval charges and maximum 2.25 FAR plus incentive FAR on additional height is allowed for the developer.

Provision - 3B: Development of EWS / LIG houses by Private Developer on whole of Private Land (Plotted development with G+3 format). The provision mandates 100 percent of the total land area to be reserved for EWS and LIG. A minimum 5 percent of the scheme area shall be reserved for park and green spaces and 5 percent for facilities. Up to 70 percent of the area is allowed as saleable area and setback for individual blocks are relaxed under this provision. Sale price of houses is to be decided by the developer or on fixed price if subsidy as per HFA Mission guidelines is to be availed and as an incentive the developer gets 100 percent waiver on land conversion / change of land use charges and 100 percent waiver on building plan approval charges.



Provision - 4A (i) and (ii): Private Developer on Government Land on Land of Local Authority. Provision 4A (i) and (ii) are for construction of Housing on Government Land in the ratio of 75:25 in which minimum of 75 percent area shall be used for EWS and LIG and remaining 25 percent area of land can be used for other categories of houses, flats and plots. While in 4A (i) EWS and LIG houses are to be constructed in G + 3 format and 4A (ii) would have EWS and LIG houses constructed in multi - storied format.

As per the prevailing rules building plan approval is to be paid by the developer on 25 percent remaining land area of developer and maximum up to 2.25 FAR (without betterment levy) shall be constructed on EWS and LIG component of scheme.

Provision - 4B (i), (ii) and (iii): Private Developer on Government Land or Land of Local Authority. Provision 4B is construction of EWS and LIG units in the ratio prescribed on the basis of population of the city. In this provision component of land other than EWS / LIG would be auctioned through open bidding. Provision 4B (i) is applicable for the cities with population of 3 lakh and above, Provision 4B (ii) is applicable for then cities with population 1 lakh and up to 3 lakh and Provision 4B (iii) is for the cities below 1 lakh population. Local Authority shall allot housing units of EWS and LIG segment to the eligible beneficiaries as prescribed by government.

Cost of external development will be borne by the local authorities on EWS and LIG components and developer shall pay cost of external development on land other than EWS and LIG segment. Other than EWS and LIG component developer is free to construct residential units as per his choice including commercial area. The policy has indicative building plans of EWS and LIG flats.

2.3 Odisha Model

Odisha Urban Housing Mission 2015 has a vision to ensure that all residents of urban areas in Odisha have access to a range of housing options within their affordability limits by putting a system in place that will deliver results consistently over a period of time. Under Odisha Urban Housing Mission 2015, there are total of 7 Development Models. Model - 1 has provision for mandatory development of EWS housing by both private developers and Project Development Agencies (PDAs). Model - 2, talks about incentives for market based development of EWS and LIG housing. Model - 3 focuses on development of affordable housing projects and has provision for cross-subsidization. Model - 4 focuses on in-situ redevelopment through PPP mode. Relocation and redevelopment of slums is part of Model - 5. Model - 6 lays emphasis on



beneficiary - led individual house construction or enhancement while Model - 7 focuses on rental housing for EWS. The policy launched in August 2015 offers models in convergence with PMAY.

For successful implementation of all the above development models the state government has provided various incentives to the developer in form of fast track approval process, exemption from land use conversion charges, exemption from building plan sanction fee and exemption from external and periphery development Charges.

2.4 Haryana Model

Affordable Group Housing Policy, 2013 of Haryana considers 5 to 10 acres of land per project with a maximum of 2 projects per residential sector reserved for affordable housing projects.

Permissible areas in cities earmarked for affordable housing is 300 acres each for Gurgaon, Faridabad, Panchkula, Pinjore - Kalka, 150 acres each for Sonapat, Panipat, Karnal, Dharuhera, Bahadurgarh and Sohna and 75 acres each for rest of the cities. With the permission of Development Authority the land is acquired by the Private Developers from the farmers directly at the negotiated market prices. Government acts as a facilitator and the models require the developer to provide 20 percent of the plots to EWS/LIG categories at predetermined rates. The projects are to be completed within its 4 years of commencement.

2.5 Uttar Pradesh Model

Uttar Pradesh Affordable Housing Policy, 2014 stipulates provision of minimum 20 percent houses for EWS and LIG (10 percent each) in all upcoming public and private sectors new housing schemes of an area of 10 acres and more. Scheme where area is less than 10 acres the private developers shall pay shelter fee in lieu of EWS and LIG houses. As incentive FAR equivalent to total floor area of EWS and LIG houses is provided to the developers.

The state's approach to affordable housing focuses on minimizing the unit cost by providing incentives to private developers, easy access to cheap land, liberal and flexible planning norms and by use of cost effective materials and technology. Uttar Pradesh Affordable Housing Policy, 2014 is being implemented under the banner of Samajwadi Awas Yojana in the urban as well as rural areas. The norms set for the Affordable housing scheme include:

- Minimum area of the scheme should be 5 acres; maximum being 100 acres;
- Minimum 60 percent area shall be used for affordable housing and carpet area of dwelling unit shall not exceed 75 sq m. Remaining 40 percent area may



be utilized for HIG, commercial, institutional, recreational and community facilities; and

- Ceiling cost of affordable house on super built-up area (to be revised annually based on cost index) is for NCR-Rs. 3,000, Metro Cities-Rs. 2,800 and other towns - Rs. 2,500 per sq ft.

Incentives provided to the developer include exemption from external development charges, exemption from stamp duty on purchase of raw land, exemption from change of land use from agriculture to residential charges, single window clearance for DPR through *Awas Bandhu*, permissible FAR of 2.5 and density of 450 DUs per hectares. Provision of land Pooling is under the scheme and annual award has also been instituted for the best performing developer to encourage developer to come forward and take up affordable housing projects, besides the incentives.

2.6 Maharashtra Model

Maharashtra State New Housing Policy and Action Plan, 2015 aims to build 1.1 million houses in the Mumbai Metropolitan Region (MMR) and another 800,000 across the rest of the state by 2022.

The draft of the state government's new housing policy and action plan, 2015, has proposed that unused and underutilized land resources of the state and state-owned organizations, such as Maharashtra Industrial Development Corporation, Mahasagar Dairy, Urban Local Bodies (ULBs), the City and Industrial Development Corporation of Maharashtra (CIDCO), Maharashtra Housing and Area Development Authority (MHADA) and the Mumbai Metropolitan Regional Development Authority (MMRDA), municipal bodies, among others, be pooled together. This will ensure efficient land use and such surplus land will be beneficially used for affordable housing. This pooled land would be used to build houses for the economically weaker sections (EWS), low-income groups (LIG) and middle-income groups (MIG) in the ratio of 30, 30, and 30. The remaining land would be used to create open spaces, parks and recreation facilities.

With a view to make EWS, LIG and MIG housing affordable, the stamp duty and registration charges are to be rationalized. The draft also focuses on reducing stamp duty for affordable homes from the present 5 percent of transaction value to 1 percent, 2 percent and 3 percent for EWS, LIG and MIG houses, respectively.

The proposed policy, while emphasizing the role of government agencies, also has a role for the private sector and rolls out a series of incentives to encourage private participation in building affordable houses on government land. It offers additional floor space index (FSI) to builders. Private landowners lease their land



to MHADA in exchange for an FSI incentive of 2.5 of which landowners utilize 1.75 FSI to build flats or commercial complexes and on remaining FSI they build tenements for MHADA. Besides, 10 percent of the total apartments in a private builder's project can be of large sizes. The policy fixes the size of EWS, LIG and MIG flats at 250 sq ft., 500 sq ft. and 700 sq ft., respectively. Another incentive to the private sector is the permission to redevelop dilapidated *chawls* (also known as cess buildings) and 105 MHADA colonies in Mumbai. Besides these developers with 25 hectares of contiguous land will be eligible to participate in township projects in MMR - covering eight municipal corporations, nine municipal councils and 1,000 villages.

As per the new policy, the state government's role will be that of an interventionist i.e. to introduce supply periodically and also as a facilitator by putting in place the necessary regulatory framework to encourage supply through the private sector participation. This is a complete departure from the 2007 policy, which focused more on the private sector to create affordable housing stock.

2.7 West Bengal Model

Public private partnership has been widely recognized as a natural response to meet the colossal demand for housing in the context of government's dwindling budgetary capacity. Urban land has been a principal tool for West Bengal government's policy to maximize real estate activities and an incentive to encourage the private enterprises.

The state administrated land release has basically two parallel approaches. Firstly, 40 percent of the land has been reserved for bulk residential to be used by Joint Venture companies and other organizations, and secondly, remaining 60 percent of the total land has been released to the individuals, cooperatives for subsidized housing. The state seeks to confer equal priority to individual buyers and housing cooperatives so as to avoid a private sector monopoly. The involvement of the government as an equal shareholder in the joint sector companies has facilitated the process of obtaining of permits, clearances and registration of property.

2.8 Telangana Model

The Government of Telangana has launched Housing policy to provide 2 BHK house to all eligible beneficiaries in both rural and urban areas. It is proposed to construct 60000 houses in the year 2015-16 out of which 24000 houses will be in urban areas. Each 2 BHK house with two toilets (bath-cum-WC) shall have plinth area of 560 sq ft. In urban areas houses shall be taken in G + pattern and District Collectors and Commissioner, GHMC (Greater Hyderabad Municipal Corporation)



would further consider land availability and decide on the number of floors to be taken up. Proposed funding for new 2 BHK Program includes:

- Gol subsidy of Rs. 1.0 lakh of unit cost of Rs. 5.30 lakh under HFA; and
- Loan of Rs. 4.30 lakh from financial institutions as state subsidy

The state envisages preparation of an inventory of land holdings in cities to constitute a land bank and also an asset management plans for better management of the available land targeting its supply to create affordable housing dwelling units. As per the policy mandate, affordable housing in Telangana will be sanctioned in the name of the female member of the household.

2.9 Sikkim Model

Sikkim Urban Affordable Housing and Habitat Policy, 2015 aims at ensuring direction and basis for the planning and development of the housing sector by all relevant State level and local level departments and agencies as well as the private sector.

Sikkim has three key institutions for Housing Delivery namely Urban Development and Housing Department, Sikkim Housing Development Board, Building and Housing Department and the roles and responsibilities of various stakeholders are defined. The policy has four models for affordable housing encouraging private sector participation with some mandatory conditions for earmarking housing for urban poor.

Private developer on private land: The first mode refers to the mandatory provision of ear-marking either 10 percent of the total built up area or 25 percent of total number of units, in all Group Housing and Group Development Scheme Projects, whose land extent is more than 5 acres. The second mode of private development refers to group housing schemes aligned to requirements of the AHP Scheme of Gol, with minimum 250 dwelling units. The DUs would be a mix of EWS, LIG and higher categories of commercial of which at least 60 percent of the FAR or FSI will be used for dwelling units of carpet area of not more than 60 sq m or 35 percent of the total number of dwelling units constructed should be for EWS and LIG - I category. The third mode of private development refers to construction of affordable housing units by the private developer as a stand-alone project or with other MIG and HIG units with no conditions on number of units, pricing, size specifications, etc.

Private Developer on Government Land: As per this model, government land and ULB land would be identified for allotment to developers for construction of EWS, LIG, MIG and HIG flats through an open bidding process.

Government led development: All government led housing schemes for affordable housing shall earmark at least 60 percent of the FAR or FSI for affordable housing



units of carpet area of not more than 60 sq m, or 35 percent of the total number of dwelling units constructed should be for EWS and LIG category.

Rental housing projects: In projects for rental housing and dormitories, rent would be fixed by states and UTs either on no profit-no loss basis or through open and transparent procedure, as the case may be.

2.10 Andhra Pradesh Model

Government of Andhra Pradesh endeavors to implement a series of specific proactive measures and incentives to encourage maximum private sector participation in the affordable housing segment in Andhra Pradesh. Andhra Pradesh has proposed four models for Andhra Pradesh State Affordable Housing Policy, 2015 with some mandatory conditions for earmarking housing for the urban poor.

The First Model: Private Developer on Private Land aims at incentivizing private developers to develop affordable housing scheme on their own private land. Under this model, three modes of private development are proposed. The first mode refers to the mandatory provision of ear-marking either 10 percent of the total built up area or 25 percent of total number of units, in all Group Housing and Group Development Scheme Projects, whose land extent is more than 5 acres.

The Second Model: Private development refers to the group housing schemes aligned to requirements of the AHP Scheme of Government of India, with minimum 250 dwelling units. The DUs would be a mix of EWS, LIG, higher categories of commercial of which at least 60 percent of the FAR will be used for dwelling units of carpet area of not more than 60 sq m, in addition 35 percent of the total number of dwelling units constructed should be for EWS and LIG - I category.

The Third Model: Private development refers to construction of affordable housing units by the private developer as a stand- alone affordable housing project or as a mix with other MIG and HIG units with no conditions on number of units, pricing, size specifications, and income eligibility, etc., aligned to open market. As per the second model Private Developer on Government Land, Government land and ULB land would be identified for allotment to developers for construction of EWS, LIG, MIG and HIG flats who would be selected through an open and transparent bidding process and the developer offering maximum built-up for EWS, LIG-I, LIG-II type of affordable houses to be surrendered free of cost to the concerned authority will be selected. Government land shall be allotted free of cost to the selected developer for construction of the housing scheme on a 99 years transferrable lease basis with all relevant clearances in place such as land use conversion, etc. The expenditure on all internal development works shall be borne by the



developer and will not be allowed to charge the internal development cost to EWS and LIG flats.

As per the third Model Government Led Development, all APHB, UDA, MC, municipalities and other statutory bodies housing schemes for affordable housing shall earmark at least 60 percent of the FAR for affordable housing units of carpet area of not more than 60 sq m in addition 35 percent of the total number of dwelling units constructed should be for EWS and LIG - I category and another 20 percent of the houses to be constructed for MIG category. Selection process of contractor or developer shall be done on basis of lowest-quoted tender bid and the entire process shall be open and transparent.

The fourth model focuses on Rental Housing, which may be the preferred choice to accommodate tenants of slums, laborers, floating population and urban homeless. In projects for rental housing and dormitories, rent would be fixed by states and UTs either on no profit-no loss basis or through open and transparent procedure, as the case may be. The state government provides benefits such as exemption in service tax, trade license fees, stamp duty for affordable rental housing units.

Incentives provided to the developer include tax benefits, grievance redressal system to address issues raised by developers, TDR facility, no FSI capping and height restrictions for the non-affordable component of group development scheme and 100 percent waiver on levy of development charges for the affordable housing component, zero building plan approval fee for the affordable housing component etc.

3. CONCLUSIONS

Given housing shortages, demand-supply gap, budgetary constraints and unavailability of developed land; it is interesting to see how state governments have taken measures to create an enabling framework to address the problem of housing. However, there is no denying that urbanization as one of the powerful, irreversible forces, coupled with the market forces, may make it difficult to eliminate urban housing shortage completely; leaving at any given point of time a certain percentage of the population with housing that is either inadequate or unaffordable.

Several States have so far, notified their affordable housing policies to address the housing shortage. State and Central government policies are addressing shortage in housing by providing incentives to private developers in order to create an affordable housing stock and are in convergence with the Pradhan Mantri Awas Yojana, which provides for a strong public-private partnership (PPP) component in its models of redevelopment and construction of new affordable housing units.



The present documentation through its select cases of State Housing Policies brings out how PPP takes varied forms and States are turning to PPP as possible financing option for provision of affordable housing, easing out the budgetary constraints. The level of, and feedback on PPP is beyond the scope of this paper but none the less it brings out the anticipated contribution of PPP in lowering the unit costs, promoting risk sharing between the public and private sectors and increasing the operating efficiencies. The emphasis on ceiling cost of units predetermined rates for EWS and LIG will encourage innovation by motivating private partners to develop methods for project delivery that meets the requirement at lower cost besides ensuring that projects are delivered on time to avoid cost overruns. Incentives provided by the State Governments in the form of TDR facility, 100 percent waiver on building plan approval charges, 100 percent waiver on land use change charges, exemption from municipal charges, tax benefits, etc., serve as key drivers to encourage PPP.

The governments have shown that it is possible to ensure formulation of policies and programs that can eliminate the housing shortage to some extent and provide for housing at reduced rates. Earlier experiences, however, show that, availability of housing at reduced cost does not automatically get translated into affordability. Affordability as a concept is very generic and has different connotation for different people. Specifically for the urban poor, to make the house affordable and accessible, housing finance solutions for informal sector urban population have to be strengthened with small Micro Finance Housing Corporations offering customized processes and products for the informal sector population to help bridge the housing finance gap. Land availability for housing the urban poor requires improvements in the planning systems to ensure inclusive development. An exercise to identify and reserve zones for affordable projects based on locational preferences of the targeted population is required.

Further, given that India is a diverse nation with varied geo-climatic zones, cultures, practices, etc., there is a need to develop housing solutions in local contexts combining design, technology and peoples' preferences, cultural needs for overall improved quality of life. The PMAY and its Technology Sub-Mission are a step in this direction. Housing strategies to deal with the dynamic trends shall require a re look at these from time to time. The present initiative of Government of India shall, however, form the basis to innovate further and facilitate several other states in formulation of affordable housing policies and action plan.

REFERENCES

Andhra Pradesh Model: Andhra Pradesh State Affordable Housing Policy - 2015 by Municipal Administration and Urban Development Department, Government of Andhra Pradesh



[http://urban.ap.gov.in/MAUD/Downloads/Andhra percent20Pradesh percent20State percent20Affordable percent20Housing percent20Policy, percent202015.pdf](http://urban.ap.gov.in/MAUD/Downloads/Andhra%20Pradesh%20State%20Affordable%20Housing%20Policy,%202015.pdf)

Gujarat Model: Mukhya Mantri GRUH Yojana, Affordable Housing Mission Gujarat, Urban Development and Urban housing Department

<http://www.udd.gujarat.gov.in/GRUHYojna.php>

<http://municipalika.com/wp-content/uploads/2014/Presentations/CS08-Mona-Khandher-Presentation.pdf>

Haryana Model: Affordable Housing Policy - 2013, Town and Country Planning Department Haryana

[https://tcp.haryana.gov.in/Notifications_Judgements/Notification_AFFORDABLE_HOUSING_POLICY_2013_Finalised percent2018.08.2013.pdf](https://tcp.haryana.gov.in/Notifications_Judgements/Notification_AFFORDABLE_HOUSING_POLICY_2013_Finalised%2018.08.2013.pdf)

Maharashtra Model: Final Draft Maharashtra State new Housing Policy and Action Plan - April 2015 by Government of Maharashtra

<http://www.credaimaharashtra.org/download/new-housing-policy-and-action-plan-2015.pdf>

Odisha Model: Odisha Urban Housing Mission & Policy for Housing for All in Urban Areas - 2015 by Housing and Urban Development Department Odisha

http://bdabbsr.in/website/pdf/Policy_for_Housing_for_All_in_Urban_Areas_Odisha_2015.pdf

Planning Commission (2012) Twelfth Five Year Plan (2012-17), Planning Commission India, New Delhi.

Pradhan Mantri Awas Yojana - Housing For All(Urban)Scheme Guideline, Ministry of Housing and Urban Poverty Alleviation, Government of India, New Delhi.

Presentations made by Housing Departments of State Governments at various forums.

Challenges and opportunities for Housing Sector in Urban India: A Cushman and Wakefield Publication, 2014.

Rajasthan Model: Chief Minister's Jan Awas Yojana - 2015, Department of Urban Development and Housing Department of Local Self Government

<http://resurgent.rajasthan.gov.in/uploads/media-centre/publication/chief-minister-Jan-awas-yojana-2015.pdf>

Sikkim Model: Draft Sikkim Urban Affordable Housing and Habitat Policy - August 2015 by Urban Development and Housing Department, Government of Sikkim [http://hfasikkim.org/doc/Sikkim percent20Urban percent20Affordable percent20Housing percent20Habitat percent20Policy percent20DRAFT_190815.pdf](http://hfasikkim.org/doc/Sikkim%20Urban%20Affordable%20Housing%20Habitat%20Policy%20DRAFT_190815.pdf)

Uttar Pradesh Model: Uttar Pradesh Affordable Housing Policy - 2014, Housing and Urban Planning Department, Government of Uttar Pradesh

[http://awas.up.nic.in/policies/Affordable percent20Housing percent20Policy percent202014 percent20\(12.12.2014\).pdf](http://awas.up.nic.in/policies/Affordable%20Housing%20Policy%202014%20(12.12.2014).pdf)

[http://awas.up.nic.in/Housing percent20Policy-2014/Housing percent20Policy percent20-2014.pdf](http://awas.up.nic.in/Housing%20Policy-2014/Housing%20Policy%20-2014.pdf)



Rain Gardens: A Case Study of City of Cullman, Alabama; USA

Pratik Jayprakash Patel

Abstract

Rain Gardens are an effective technique through which surface runoff water is collected, decontaminated and given back to the nature using renewable energy resources and not relying on any mechanical or electrical equipment. Rain Gardens are considered one of the cheapest and most effective ways to recharge ground water and also beautify the area. The excess water collected can be given back to the natural streams or lakes bringing down the contaminant levels. Rain gardens are effective with water from impervious surfaces like roads, parking lots, all paved areas, compacted garden areas, terraces, etc. Native and adaptive plants are recommended for rain gardens because they can survive in the local climate, soil and water conditions.

1. INTRODUCTION

Rain gardens are interchangeably also termed as bio - retention areas and are part of bioswales depending upon their designs and intentional use. Bio - retention is the process in which contaminants and sedimentation are removed from storm water runoff. Storm water is collected into the treatment area which consists of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. Bioswales are landscape elements designed to remove silt and pollution from surface runoff water. They consist of a swelled drainage course with gently sloped sides (less than 6 percent) and filled with vegetation, compost and rubble. Bioswales often result and end in a rain garden.

When an area's soils are not permeable enough to allow water to drain and filter properly, the soil should be replaced and an under drain or French Drain installed. The water thus collected can either be stored in underground reservoir to be reused or simply given back to a natural stream, lake, river or sea. A rain garden requires an area where water can collect and infiltrate, and plants to maintain infiltration rates, diverse microbe communities, and water holding capacity. Transpiration by growing plants accelerates soil drying between storms. This includes any plant extending roots to the garden area.

Simply adjusting the landscape so that downspouts and paved surfaces drain into existing gardens may be all that is needed because the soil has been well

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Fig. 1: A Basic Working of Rain Garden.

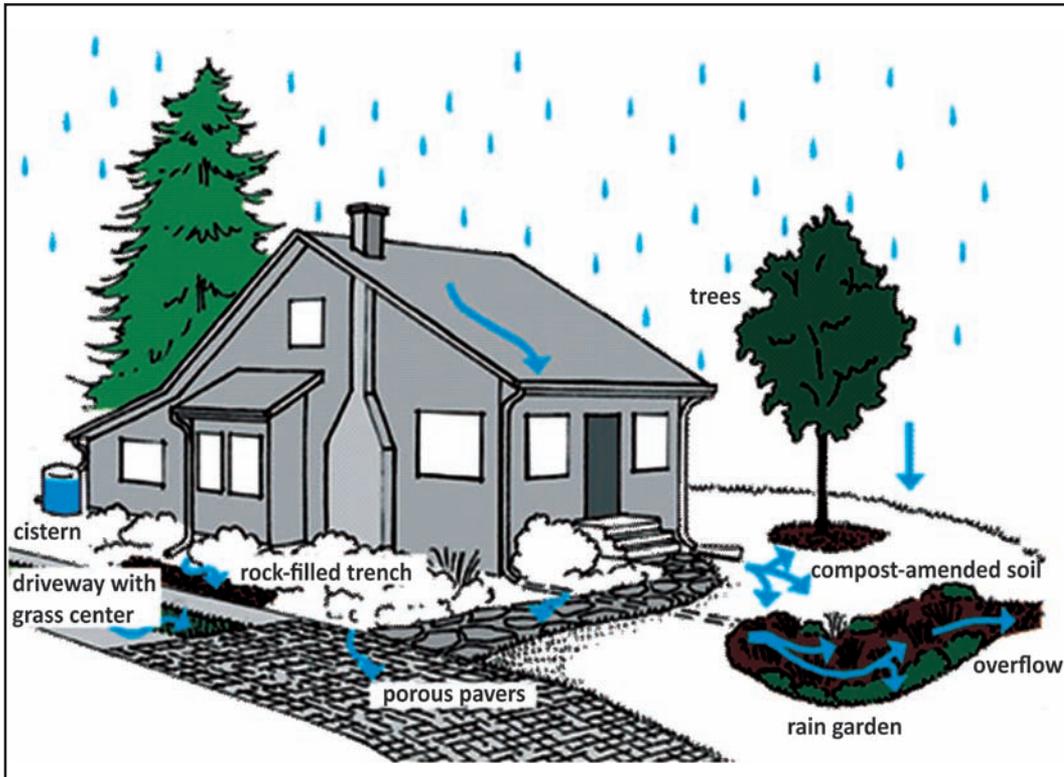
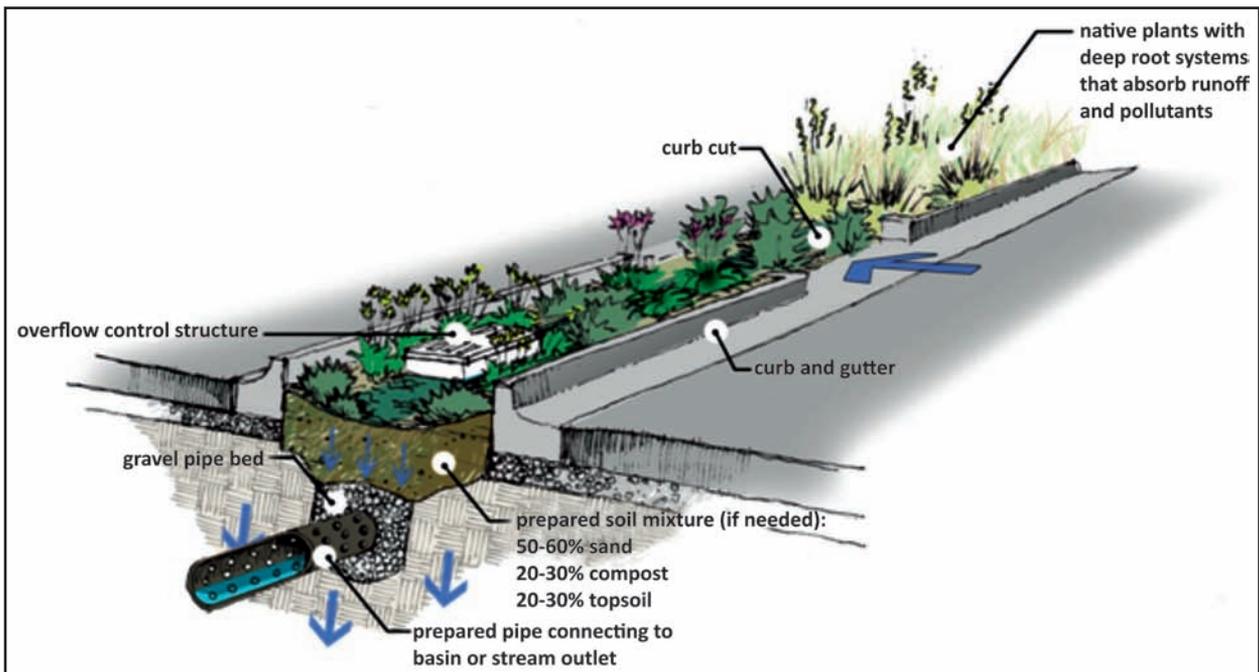


Fig 2 - A Basic Curbside Rain Garden



loosened and plants are well established. However, many plants do not tolerate saturated roots for long and often more water runs off one’s roof than people realize. Often the required location and storage capacity of the garden area must be determined first. Rain garden plants are then selected to match the situation, not the other way around.

2. STUDY AREA PROFILE

City of Cullman, Alabama USA was founded in the year 1873. “Cullman is a thriving 21st Century community fueled by its quaint heritage and indelible Southern charm”. With a 4.8 percent unemployment rate, a 9.00 percent sales tax and an extremely low crime rate, the community is an ideal environment

to start a family, own a business, work, play, worship, shop, live. Cullman was voted the #1 best place to raise children in Alabama by Bloomberg Business Week in 2013. Cullman has an excellent year - round climate with short mild winters and long warm summers. The City of Cullman is also a very “green,” city - having been named a Tree City USA for 28 consecutive years due to our commitment to preserving and planting trees and shrubbery throughout the City of Cullman (City of Cullman website www.cullmancity.org).

Fig. 3: Aerial View of Cullman, AL



Image Source: www.cullmancity.org

Fig. 4: Aerial View of Downtown Cullman



Image Source: www.cullmantoday.com



3. PROJECT DETAILS

The scope consisted of a small part of downtown Cullman that needed design interventions. The site was between 1st Avenue and 4th Street covering an area of 6 City Blocks. The elements used were dust bins, light poles, public furniture and landscape. Concepts of Rain Gardens were introduced to make the area sustainable too. Parking infrastructure and Right of Way adjustments were also key features of

Fig. 5: Location of the City



Fig. 6: Zoning Map for City of Cullman

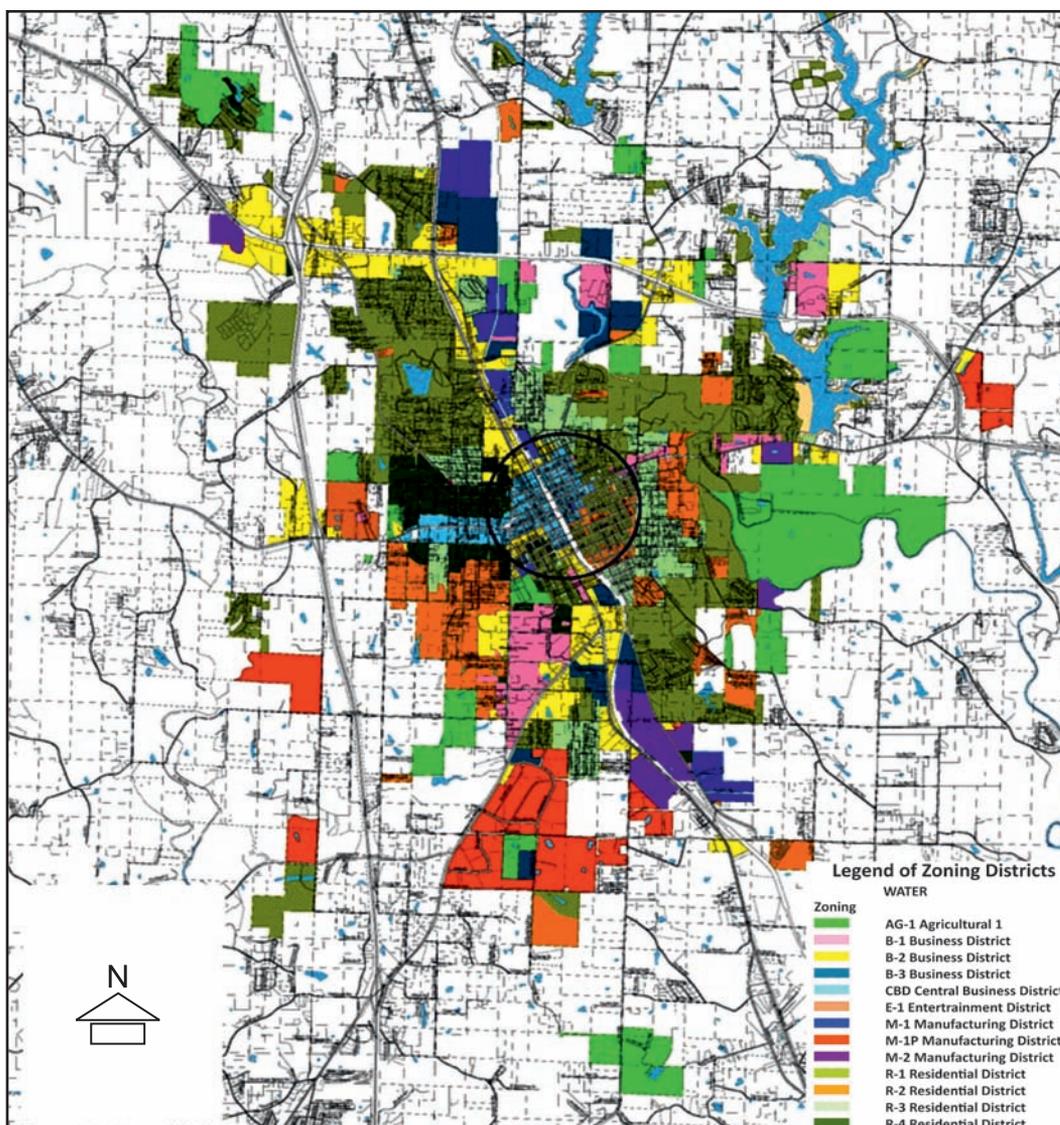


Image Source: www.cityofcullman.org

the proposal. The design also intervened in services and all major services were buried so that they do not disturb the street or interfere with the look of the area. Landscape species proposed were Red Maple, Strawberry bush and Elder Berry to give an attractive look to the area. Storm water runoff was treated in the rain gardens for pollutant removal through microbes that live in soil and plant roots.

City of Cullman receives on an average 59 inches of rainfall annually which is almost double the average rainfall in United States. Rain Gardens hence are very feasible and effective here than any place else. Average precipitation days are 100 and sunny days on an average are 202 in an entire year. Cullman receives snow only two days on an average per year.

Fig. 7: Master Plan of the Proposal

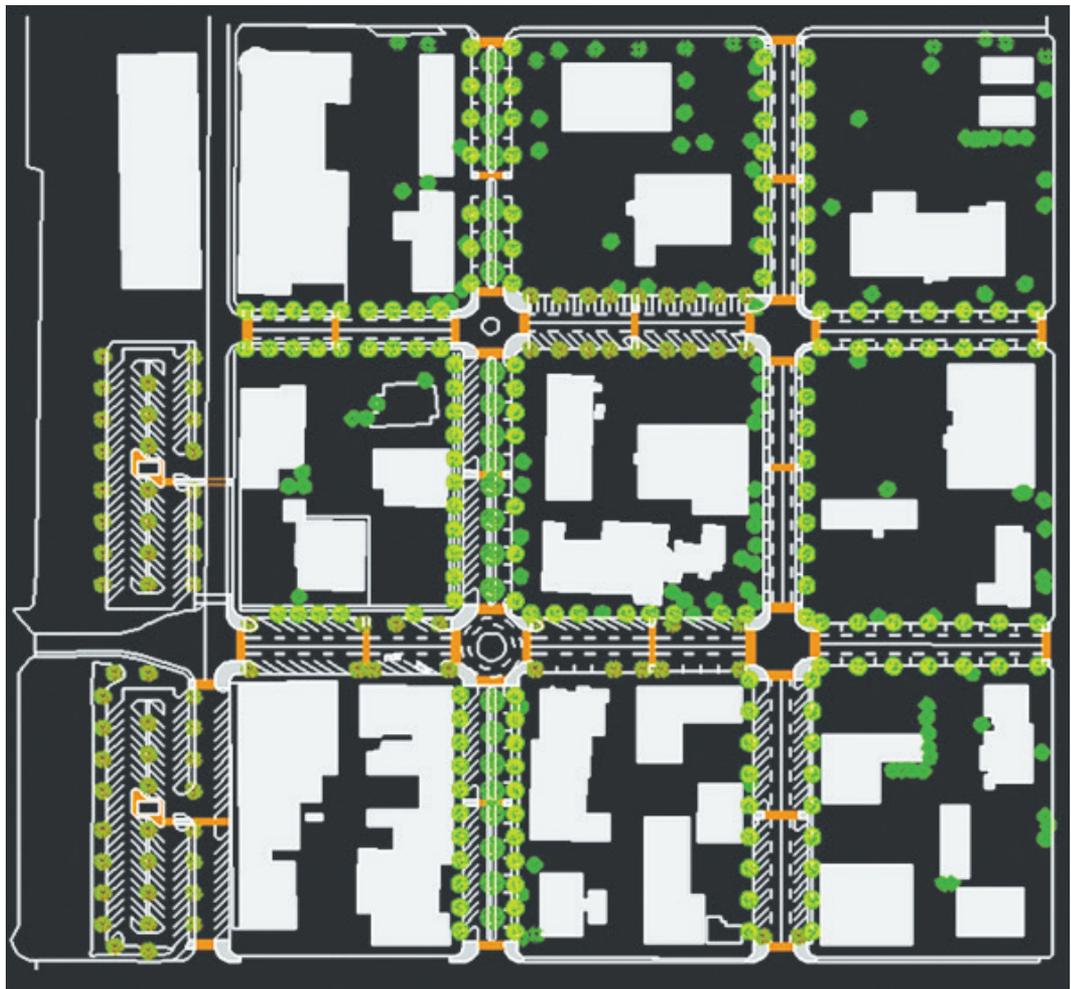


Fig. 8: Parking Lot Design Proposal

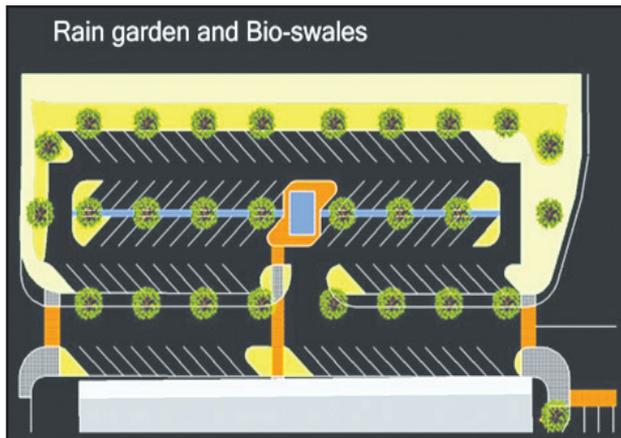


Fig. 9: Rain Garden Details

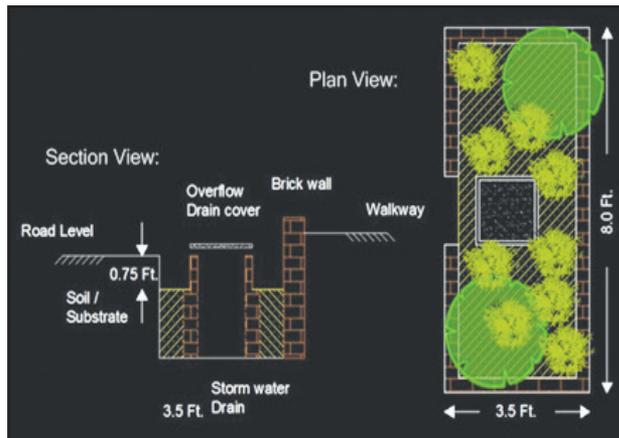


Fig. 10: and 11 Streetscape before and after

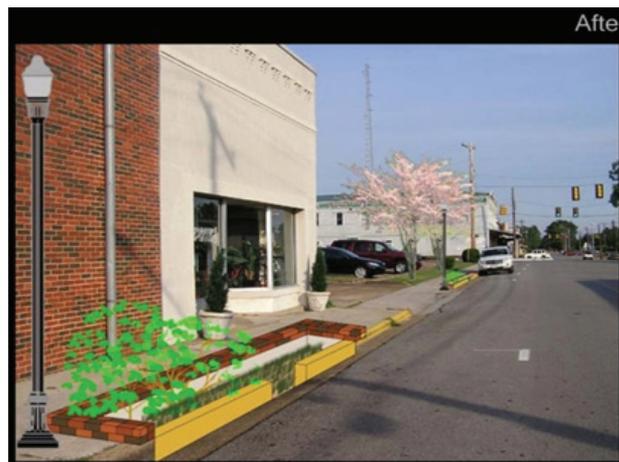


Fig. 12: Intersection of Roads before and after

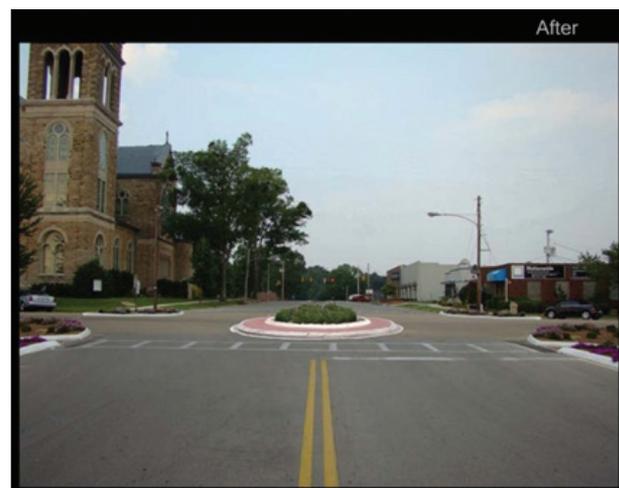
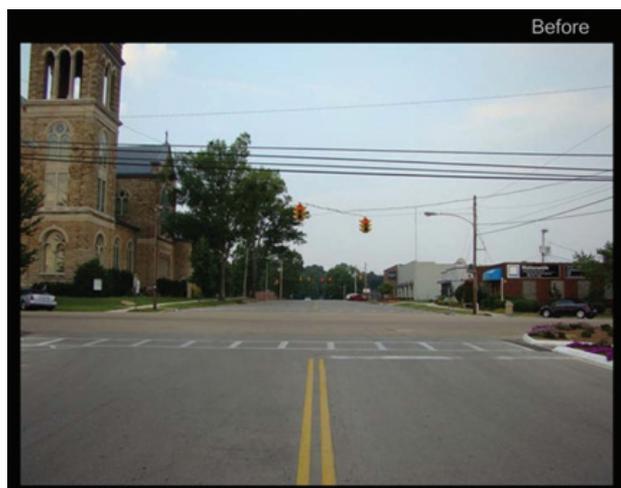


Fig. 14: Streetscape before and after



Rain Gardens were used as a tool to collect and treat water from roof tops and surface runoffs mainly from parking and streets. Entire proposal consisted of downtown revitalization guidelines along with street scape improvements and business incubation schemes. The following images show at a glance some details about street scape and rain gardens.

5. CONCLUSIONS

The author and project coordinator for city of Cullman USA, and was actively involved in its downtown redevelopment and other key development projects for the Mayor's office. Rain gardens have since become a planner's and urban designers intervention for small communities throughout the world. Project is under implementation in phases currently. Other proposals simultaneously going on are way finding Signage and Identity for Cullman along with Downtown Revitalization. Rain Gardens play a dual role of ornamenting the street scape and also are efficient enough to treat surface runoff and make it decontaminated so as to give the water back to nature without using any additional resources or energy. Selection and use of local and indigenous species of plants meant that the operating cost of the rain gardens was almost nil, other than the usual maintenance of plants. The construction cost of the rain gardens was a trade off against the resources the city had to pay to Storm water treatment plants.

Change of strategy can be adopted by places whose annual rainfall is less so as to collect the decontaminated water from rain gardens to storage tanks which can be reused later when the rainfall gets scarce in summer months. This makes them self reliant and non - dependable on artificial sources of water.



Rain gardens are adopted widely as the most cost effective and reliable way to treat surface runoff water and are part of city ordinances across USA. In India they can be used best in rural settings around the lakes which collect the rain water. To maintain the water quality of water a sloped rain garden which ends in a bio - swale can be used. Techniques of root zoning and phytoremediation are effective at such places so as to decontaminate the water thoroughly of all harmful matter. In residences too rain gardens work efficiently to help conserve water and decrease the cost of operation and maintenance of landscaped gardens. Ideally 60 percent of the rain garden is sand, 30 percent compost and bottom consists of top soil mix and gravel. French drains can be used to collect water or divert it to specific location. Rain gardens should be placed in place that is away from built area and preferably near driveways and hard landscaped areas to collect water from both. Urban development or townships can collectively propose a rain garden in their master plan itself near the entrances or on road edges as all storm water is eventually diverted in city's storm water line. In rural areas or areas without city services rain gardens can be proposed at places on the lowest part of the site or naturally sloped areas.

REFERENCES

www.Cullmancity.org, City of Cullman's official website.

www.Cullmantimes.com, Local newspaper

www.census.gov, U.S. Census Bureau

www.cullmantoday.com

All drawings and details are copyrighted and produced from the design portfolio of the Author with the consent of City of Cullman, AL USA.

The author acknowledges City of Cullman, AL, ex- Mayor Donald Green and Chief Town Planner James Fisher AICP for support and accepting the vision.



Regional Approach for Integrated Disaster Risk Management and Vulnerability Reduction: A Case of Diu Region

Alok Kumar Tripathi and Anshuman Singh

Abstract

Disaster is a major concern for all countries, as its impact has been more devastated in the recent years due to interaction between human activities and environment. As risk is the result of hazard and vulnerability, the disaster has become a frequent phenomenon, resulting in to food crisis and droughts. Therefore, it is necessary to have a disaster risk management and vulnerability reduction mechanism. This paper describes how regional approach for disaster risk management and vulnerability reduction can help in making a Region disaster resilient through physical planning interventions, innovative technologies, administrative reforms, structural measures, capacity building and raising awareness. Regional hazard vulnerability and risk analysis has been done for the Diu Region and disaster specific plans have been integrated to prepare a Composite Risk Zonation Map for the region with the use of Geographic Information system.

1. INTRODUCTION

Diu region is a part of South Gujarat State and the Union Territory of Daman and Diu in India, which consists of Diu district along with 5 districts of Gujarat namely Porbandar, Gir Somnath, Amreli, Bhavnagar and Junagarh. Diu is an island, while other five districts are situated in southern part of Gujarat and covers mainly coastal areas. The area of the Region is approximately 16,860 sq km and the total number of *talukas* in the Region are 27. The disaster management process in the Region is regulated under Disaster Management Act, 2005 and Gujarat State Disaster Management Act, 2003. Geographical location, climatic conditions and high urbanization rate in the Region are major responsible factors for its vulnerability to disasters, both natural disasters like earthquake, cyclone, flood, drought, and Tsunami and man-made disasters like fire, collapse of houses, road accident hazard, chemical or industrial accidents, environmental pollution, etc.

Earthquake and cyclones are most predominant catastrophes as recurring annual phenomena, and brings destruction in the Region, disrupts its functioning physically, socially and economically. Environmental concerns also endangers due to vast impact of disasters over flora and fauna in the Region.

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Development in the Region need to be planned for taking care of the above hazards.

The Report of Disaster Management in India, Ministry of Home Affairs, Government of India mentioned that on an average, natural disasters took a toll of over 2,198 human lives, damaged 15 lakh houses and affected 42.47 lakh hectares cropped area during the period 2001-2011. Statistics also revealed that about 80 percent of human lives were lost due to collapse of houses and buildings. This makes it necessary to have a comprehensive planning of building construction practices and natural disaster management framework for both post disaster management and pre-disaster mitigation planning. While Tsunami is not frequent phenomena but it can unleash devastation instantaneously in large areas. Drought being a frequent phenomenon in Gujarat state, it also have its impact in the Region therefore, special measures are required to be taken to tackle these disasters. The aim of the study is to discuss development of a Region which encourages resilience of it's urban and natural landscape safeguarding the identity and heritage from potential threat of hazards and disasters through preparedness and well integrated response systems.

2. PAST DISASTERS IN THE REGION

2.1 Hazard, Vulnerability, Capacity and Risk Analysis

Owing to its geo-climatic, geological and physical features, Region is vulnerable to all major natural hazards (Table - 1) namely, drought, flood, cyclone, earthquake, and Tsunami. The Region is also under constant threat of various human made hazards like that of industrial (chemical) hazards, transportation accidents, terror attacks, epidemic, road accidents, etc.

Gujarat State Disaster Management Authority (GSDMA) has developed Gujarat Hazard Risk and Vulnerability Atlas. This is the first geographically explicit Level - 1, assessment of its kind outside that integrates six hazards viz. earthquake, flood, cyclone, tsunami, drought and industrial (chemical) accidents, covering the whole State of Gujarat. Following are the major hazards in the state.

2.1.1 Earthquake

As per Indian Seismic Zone Map, Diu Region lies in Zone - III. The estimated mean *taluka* earthquake peak ground acceleration (PGA) zonation for a 100-year return period is presented in the (Fig. 1). The cities of Una, Mahuva, Gir-Gadadha and certain parts of Bhavnagar district fall into the severe intensity zone, while Amreli, Junagarh and Porbandar fall in the very severe intensity zone over this time frame. The rest of the region comes under low risk zone.

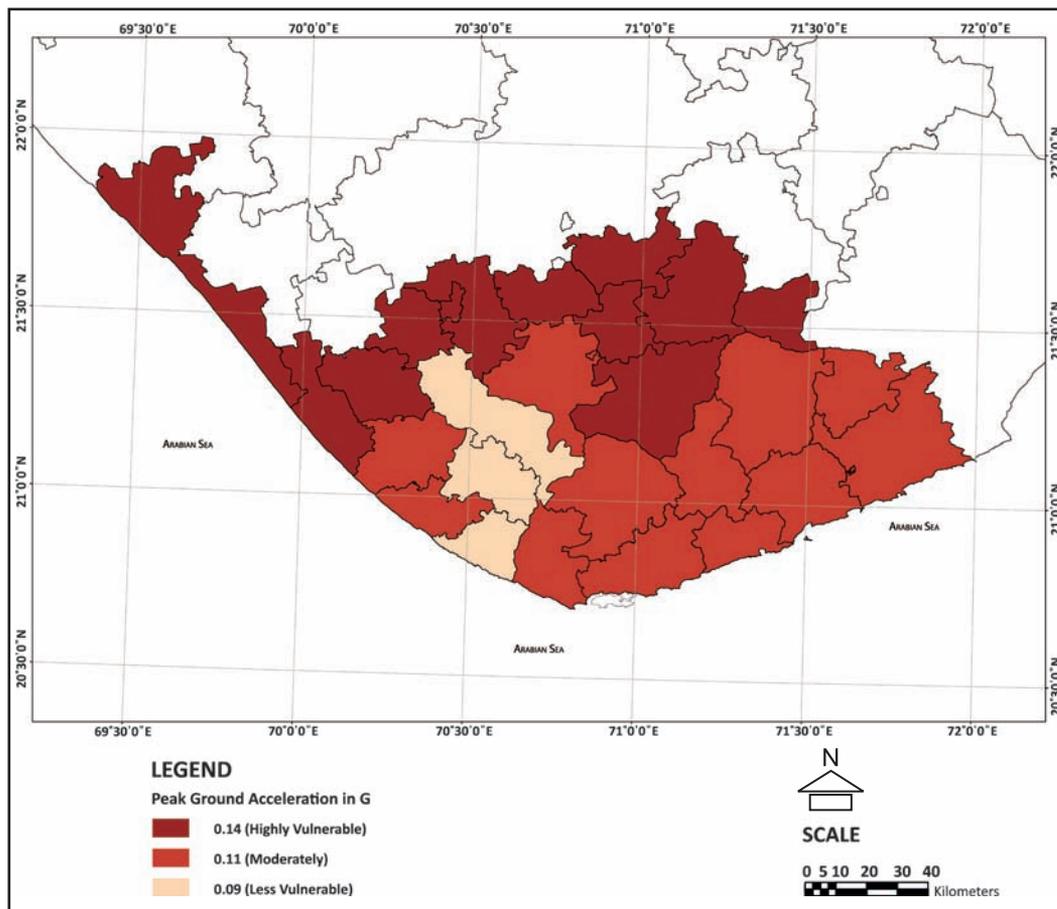
**Table 1: Occurance of Disasters during 1964 - 2010 in Diu Region**

Date	Type of Disaster	Intensity	Location and Details
June 1964	Cyclone	Severe	Coast just west of Naliya Loss: 27 people killed
Oct 1975	Cyclone	Very Severe	15 km northwest of Porbandar Loss: 85 people killed, property damage worth INR 75 crore
June 1976	Cyclone	Severe	Saurashtra coast near Bhavnagar Loss: 70 people killed, property damage worth INR 3 crore
Nov 1982	Cyclone	Very Severe	Saurashtra coast 45 km east of Veraval Affected areas: Veraval, Sutrapada, Kodinar, Una, Diu Loss: 507 people killed, 1.5 lakh livestock perished
June 1983	Cyclone	Medium	Affected areas: Diu
June 1996	Cyclone	Severe	South Gujarat Coast between Veraval and Diu Loss: 47 people killed, property damage worth INR 18.05 crore
Oct 1996	Cyclone	Medium	Diu Loss: property damage worth INR 2.07 crore
June 1998	Cyclone	Very Severe	Gujarat coast near Porbandar Loss: 1173 people killed, 1774 missing, property damage worth INR 1865.38 crore
Dec 1998	Cyclone	Medium	Diu
May 1999	Cyclone	Severe	Diu Loss: 141 people killed
1999	Drought	Medium	Entire Gir Somnath district
Jan 2001	Earthquake	Medium	Kodinar, Una, Sutrapada, Veraval, Talala, Diu
Feb 2002	Civil Unrest	Light	Una, Sutrapada, Kodinar, Veraval
June 2005	Flood	Severe	Una, Veraval, Talala, Kodinar
July 2009	Rains	Severe	Veraval
Nov 2009	Fire	Light	Talala
Jan 2010	Food Poisoning	Medium	Veraval, Una

2.1.2 Drought

Daily temperature of the Region ranges from a minimum 13°C to 27°C in January to 27°C to 41°C in the summer during May. The South-West winds mostly bring rain between June to September and approximately 90 to 95 percent of precipitation is registered in these three months. From the Northwest areas to South Gujarat areas, the rainfall varies from 300 mm to 2000 mm per annum.

In the Region, 60 percent of rainfall is uncertain, unprecedented and unequal and the Regions of Saurashtra, face famine every third year. Since 1900, the

Fig. 1: Earthquake Hazard Risk Zonation


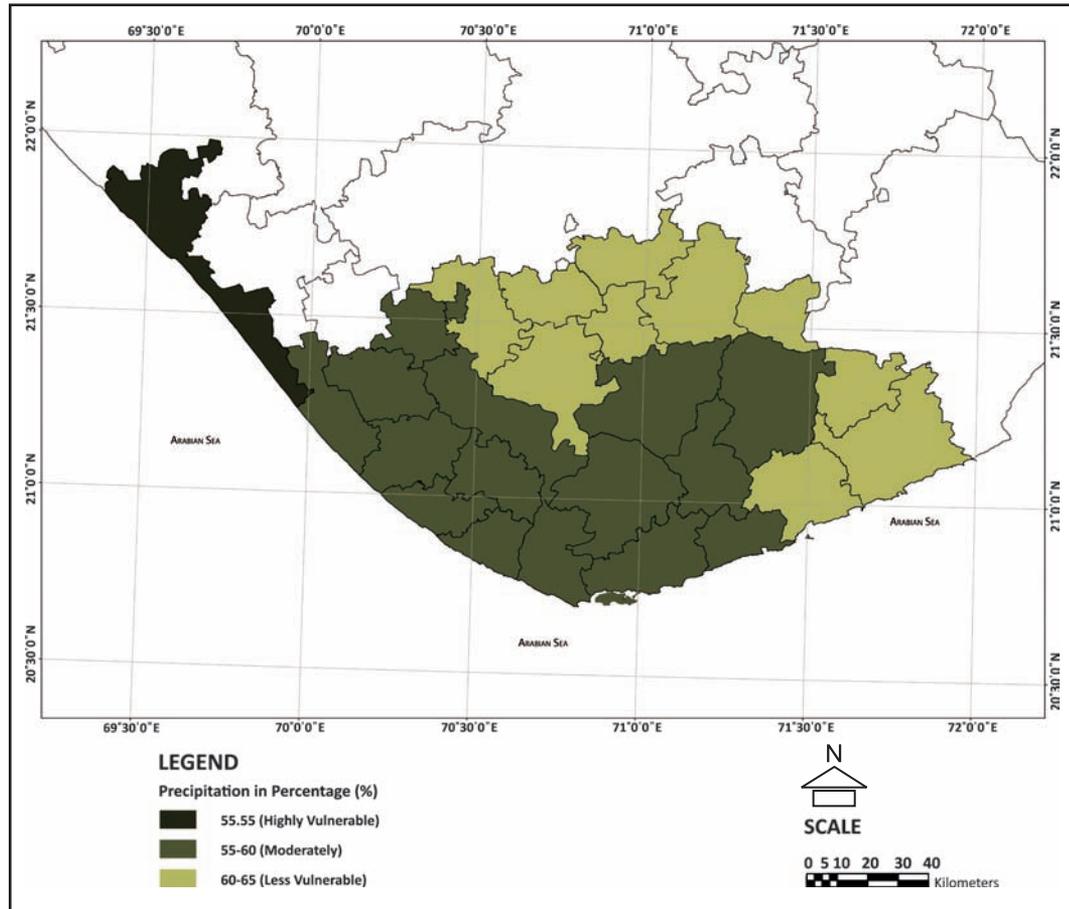
region has faced scarcity of water and food almost 30 times. Gujarat is one the chronic drought prone state of India, with an average annual rainfall about only 700 mm with more than half of the *Talukas* of Gujarat receiving rainfall within the range of 200-400 mm. Substantial portions of the Region are arid to semiarid. With large parts of Porbandar and Southern coastline having no source of alternate irrigation, groundwater exploitation is leading increased threats of droughts (Fig. 2). Falling water tables have added stress on crops and water supplies.

2.1.3 Cyclone

Gujarat falls in the Region of tropical cyclone. With the longest coast line of 1600 km in the country, it is highly vulnerable to cyclone and its associated hazards such as floods, storm surges, etc. Most of the cyclones affecting the state are generated in the Arabian Sea. They move Northeast and hit the coast particularly the Southern Kutch and Southern Saurashtra and the Western part of Gujarat. So, the Region is highly vulnerable to cyclones. Two cyclonic storm seasons are



Fig. 2: Drought Hazard Risk Zonation



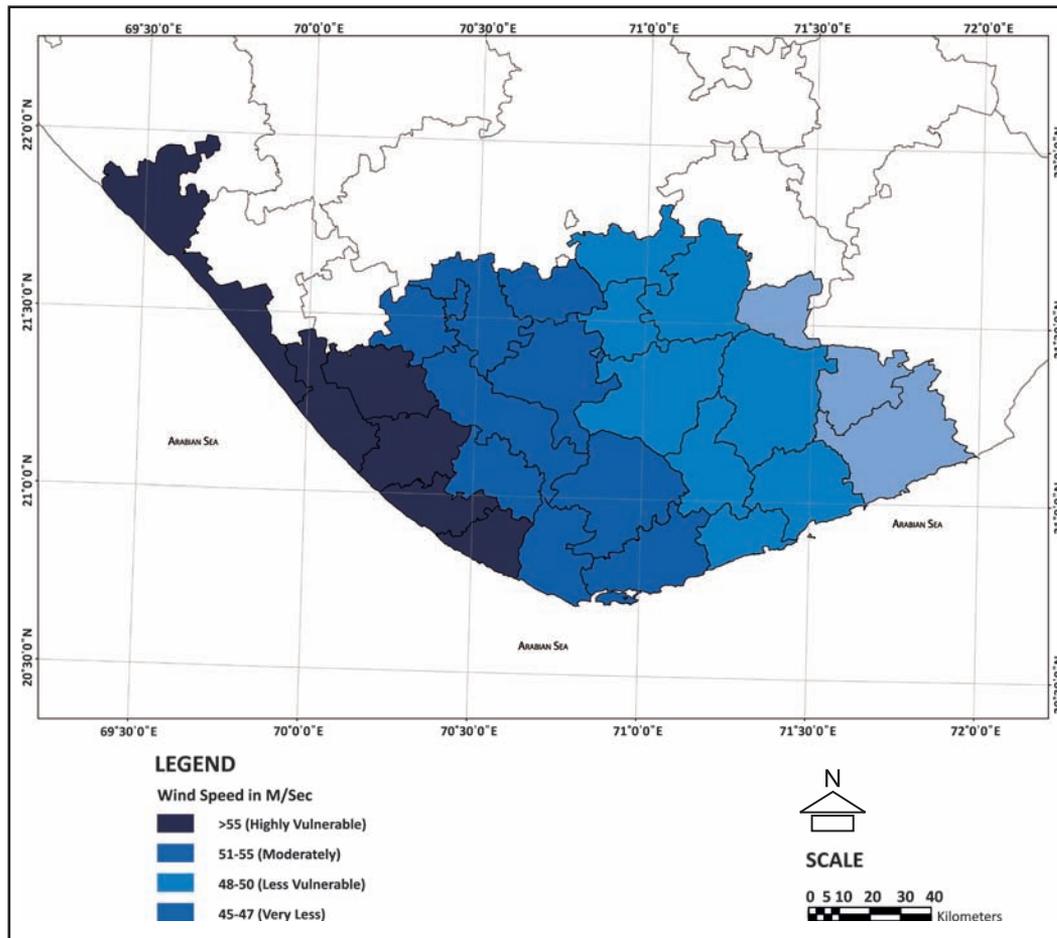
experienced in the Region: May to June (advancing southwest monsoon) and September to November (retreating monsoon).

Over 120 cyclones originating in the Arabian Sea had passed through Region over a period of 100 years. Figure -3 shows a maximum wind speed class of more than 55 m/sec along the Saurashtra coast, specifically in Porbandar, and Junagadh districts, which are exposed to high intensity cyclonic and storm impact. The 51 to 55 m per sec class extends further inland to cover much part of Junagadh and Gir-Somnath districts. The 48 to 50 m per sec class extends to most of Amreli districts including parts of Gir-Somnath. The 45 to 47 m/sec class covers much of Bhavnagar district.

2.1.4 Floods

The climatology of Region is influenced by the Arabian Sea in the south. A long coastline makes parts of arid Saurashtra and Region occasionally experience

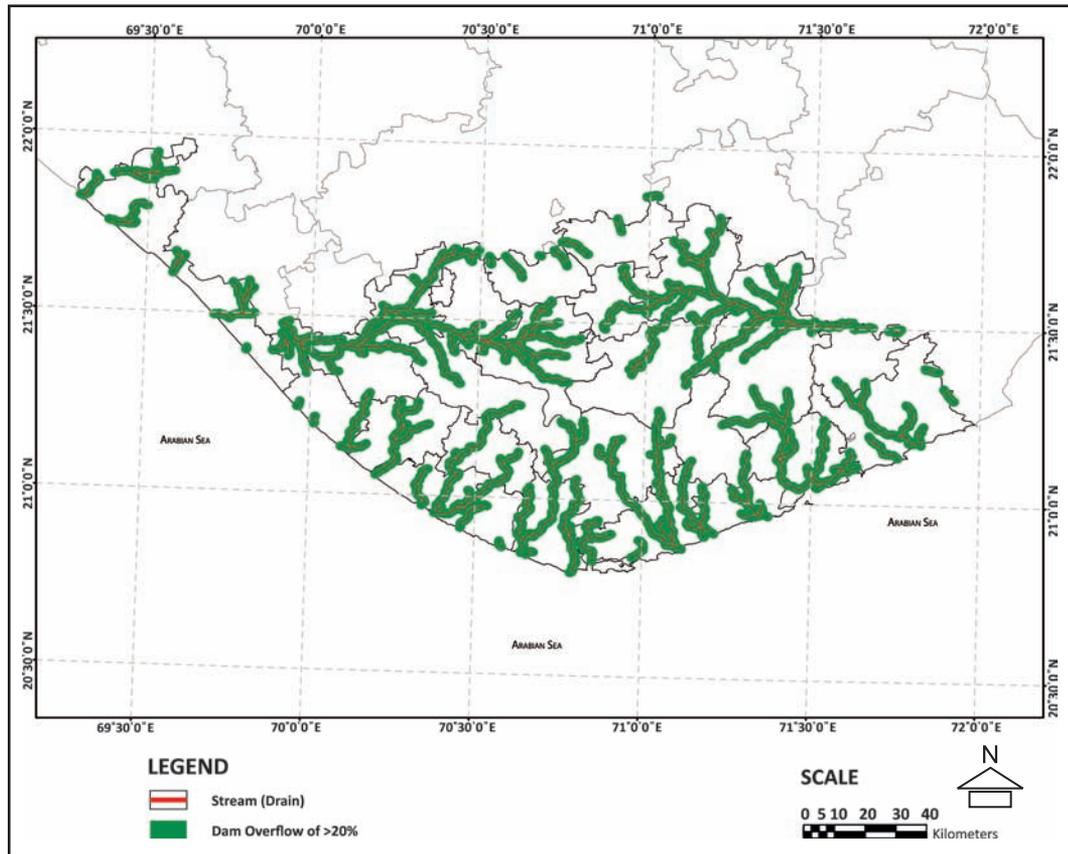
Fig. 3: Cyclone Hazard Risk Zonation



very high rainfall. These occasional heavy rainstorms are responsible for most of the floods in the region. While the Northern part of the Gujrat State is mostly arid and semi-arid, the Southern part is humid to sub-humid. Extremes of climate, be it rainfall or temperatures are quite common in this region. All major rivers in the region pass through a wide stretch of the very flat terrain before reaching the sea. These flat lowlands of lower river basins are prone to flooding.

The flood prone river sections were identified from settlement level analysis. Flood prone river sections in region extend to the upper basins due to the presence of dams which have to resort to emergency discharge during heavy rainstorms. Even small valleys in Region are used for agriculture. Hence flooding in these zones impacts both residents and settlements. Figure - 4 shows the majority of the area of Gujarat is flood prone, irrespective of the size of the catchment. The flood risk in the Region is higher in the South Gujarat plains. The

Fig. 4: Flood Hazard Risk Zonation



relatively flat plains in the lower basic areas with hilly catchments in upper parts of South Gujarat accentuate flood risks.

2.1.5 Man Made Disasters

The Region has faced some incident of man-made disasters, also. The various type of man-made disasters in the region include:

- Fire;
- Industrial and Chemicals Disasters;
- Accidents;
- Epidemic; and
- Stampede

Albeit not so prominent in the Region, areas of Talala, Sutrapada, Una, Kodinar and Veraval have been subjected to man-made disasters in the past.



Table 2: Seasonality of Hazards

Hazards	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Cyclone	Low	Low	Low	Low	High	High	Low	Low	High	High	High	Low
Drought	High	High	High	High	High	High	High	Low	High	High	High	High
Earthquake	High	High	High	High	High	High	High	High	High	High	High	High
Epidemic	High	High	High	High	High	High	High	High	High	High	High	High
Fire	High	High	High	High	High	High	High	High	High	High	High	High
Flood	High	High	High	High	High	High	High	Low	Low	Low	High	High
Heat Wave	Low	Low	Low	High	High	High	High	Low	Low	Low	Low	Low
Industrial/ Chemical	High	High	High	High	High	High	High	High	High	High	High	High
Road/Train Accident	High	High	High	High	High	High	High	High	High	High	High	High
Stampede	High	High	High	High	High	High	High	High	High	High	High	High
Tsunami	High	High	High	High	High	High	High	High	High	High	High	High
Legend	High Occurrence				Moderate Occurrence				Low Occurrence			

2.2 Seasonality of Hazards

By understanding the approximate occurrence of hazard, the Region may remain prepared for the respective hazards by activating the relevant departments for the same.

The Table - 2 is only indicative of the occurrence. The results are based on the occurrence period of past disasters and it can be used as a suggestive tool only.

3. VULNERABILITY ANALYSIS

3.1 Social Vulnerability

There are total 40, 74,447 schedule caste persons and a total of 8,917,174 tribal population in the Gujarat State as per Census, 2011. The socially vulnerable tribal groups or primitive tribes in the Diu Region are identified as Siddi: Junagadh, Bhavnagar, Amreli, and Porbandar. This tribe is most vulnerable to social risk in the Region as per the State Disaster Management Plan, Gujarat.

3.2 Structural Vulnerability

As per Census 2011, the material of roof and walls of housing also varies widely all over the Region and include grass, *thatch*, bamboo, mud or un-burnt bricks, wood, stone, burnt bricks, concrete, etc. The locally available materials are mainly given preference for the construction of roof and walls. Absence of proper building codes and safety guidelines are responsible for the formation of these



type of structures, which further results into structural vulnerability. These type of practices would increase the damage and loss during any disaster particularly earthquake, cyclone, floods, etc.

3.3 Economical Vulnerability

There are various economic vulnerable groups in the Region. These groups include BPL and *Antoadhya* households, having limited resources for their daily use. The houses they live in are not capable to face any kind of hazards. The limited resources are also prone to loss and damage in case of any disaster. Economical vulnerability is further multiplied by their limited financial capacity to recover from disaster loss.

The Region being a hub of important commercial houses, factories, corporate, etc., has high rate of development and industrialization and constitutes significantly to State GDP from manufacturing sector. Many fuel pipelines also cross the Region, increasing the hazard vulnerability of the Region. Any significant damage to the infrastructure will result into economical loss to the Region and would take its development many year back. Hazard profile of the State is the main reason for the economic vulnerability of the different sectors of the society, and any damage to these sectors or any part of supply chain can have significant impacts on economy of the State.

3.4 Environmental Vulnerability

Around 42 percent of State's population lives in towns and cities and the state has a decadal growth rate of urban population as 5.24 percent (2001-2011). High rate of urbanization directly or indirectly results into deforestation, pollution, land use change, seasonal variations, and various global issues like sea level rise, global warming, etc. Chemical and pharmaceuticals companies discharge effluents to rivers and air, causing loss of biodiversity, damage to mangroves and coastlines, etc., which severely affects local communities and wider ecological systems. Such environmentally degraded area compromises a community's ability to respond to and recover from a hazard event. Also the Region is comprised of eco-sensitive areas like Girnar in Junagarh and Gir National Park. Hence it becomes highly vulnerable to environmental risks.

4. CAPACITY ANALYSIS

Capacity means all type of resources including human, equipment, infrastructure, etc.; integrating all these together will help in efficient and effective response in all phases of disaster management cycle. A Comprehensive database of disaster management related inventory is an integral part of a structured response. Timely response at the time of disaster is influenced by lack of proper and adequate disaster management information.



State Disaster Resource Network (SDRN) is the web portal of Gujarat State created by GSDMA, containing database of resources at the village, *taluka*, city and district level. This information act as an important tool in disaster mitigation. SDRN, a decision support tool, is layered using the existing IT Wide Area Network (WAN) of the State - GSWAN. Gujarat based organization Bhaskaracharya Institute for Space Applications and Geo-Informatics (BISAG) has upgraded SDRN into a map based geo spatial information systems and currently this network is being integrated with the GIS based Decision Support System.

4.1 Human Resources

Staff and officials of various line departments form a huge human resource for various critical functions in both pre and post disaster phase. Trainings are regularly conducted at State level by GSDMA, GIDM and SPIPA. Disaster Risk Management Program also delivers trainings at district level. Trainings on search and rescue, first responders, EOC management, architects and engineers training for safe construction, flood rescue and many other training of trainers are part of these. Large human resource at district and *taluka* level has gained advantage from these in the Region.

4.2 Equipment

Various type of fire - fighting equipment have been provided by Fire - fighting Department to all the public buildings and guidelines have been issued to private owners by GSDMA over the years. Other emergency equipment required for search and rescue operations are available in collectorate, ULBs and other co-ordinating agencies.

4.3 Infrastructure

Logistics and supply chain management of responding agencies, relief material and evacuated masses, etc.; is a critical part of disaster phase for which infrastructure act as a great resource.

4.4 Risk Analysis

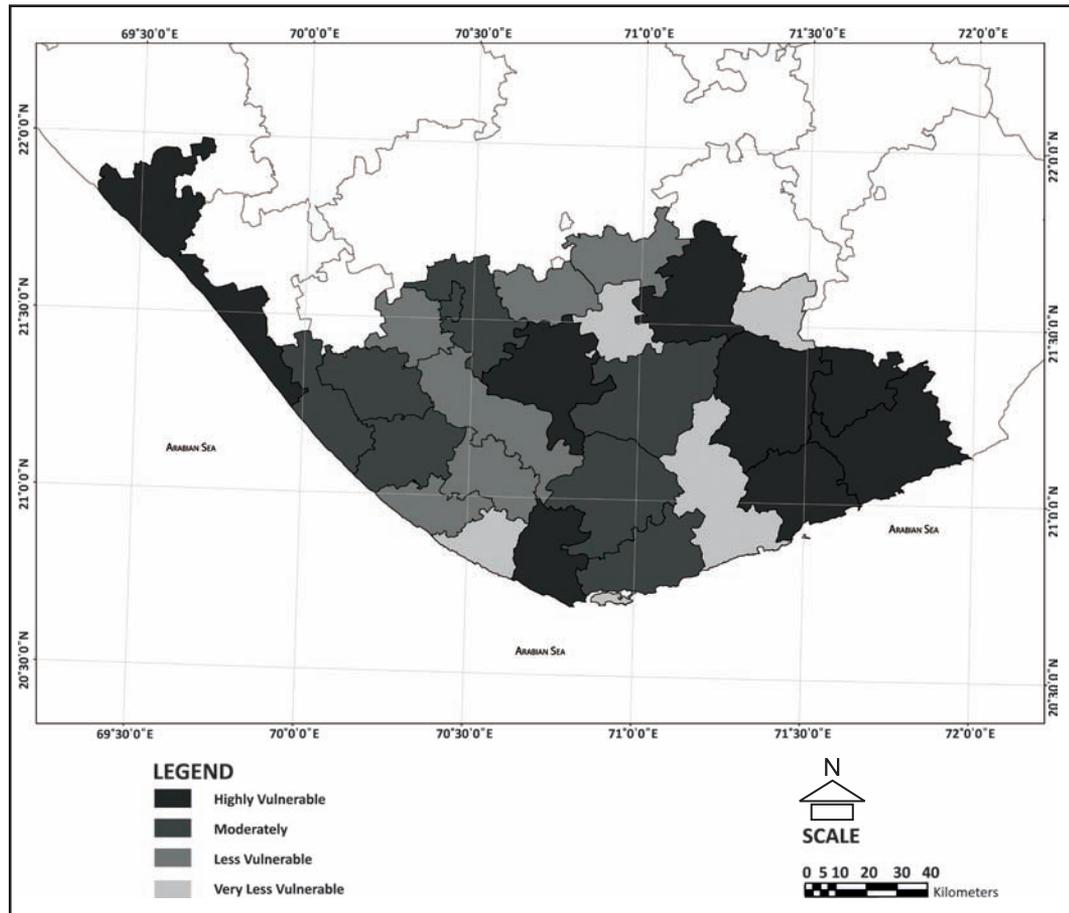
An overall Composite Risk Index (Fig. 5) for all hazards on a *taluka*-wise basis has been estimated for prioritization of overall investments, disaster mitigation and related development interventions. The risk index has been computed by stratifying annualized risk estimates by two deciles classes to generate a five point scale (very high, high, moderate, low and very low).

5. INSTITUTIONAL MECHANISM AND OTHER STAKEHOLDERS

Disaster management structure exists from the national to local level. This institutional mechanism provides a framework for all the activities of Disaster management cycle from policy formulation, implementation and monitoring.



Fig. 5: Composite Risk Zonation



5.1 District and Local Level

There are District and Local Crisis Groups, which cater to major disaster accidents in the district and at local levels. The various committees exist for the effective functioning of the disaster management process as discussed below.

5.1.1 District Disaster Management Committee (DDMC)

According to Disaster Management Act, 2003 the District Collector will have the authority for coordinating all disaster management related activities in the district. District Disaster Management Authority will also be headed by Collector and shall formulate the guidelines for carrying disaster management work in the district and monitor all measures relating to preparedness and response to various hazards. The District Disaster Management Committee will constitute members from *Zila Panchayat*, various line departments, NGOs and others. These shall be notified by the Department of Disaster Management from time to time. District Relief committee shall be



constituted by District Collector during Disaster situation in order to monitor management of relief.

5.1.2 Taluka Disaster Management Committee (TDMC)

Block / *Taluka* level Disaster Management Committees will include the members from different department and representatives of local *panchayat* body. The *Mamlatdar* will have the authority for co-ordinating all disaster management related activities in the Block / *Taluka* level. The committee will monitor all phases of disaster management including mitigation preparedness, response and relief.

5.1.3 City Disaster Management Committee (CDMC)

Disaster Management Committee will be part of city, *Nagarpalika* and overlook all the matters related to disaster management. City Disaster Management Team will be constituted by ULBs consisting officials and non-officials. They will also organize training for them for effective functioning of the Disaster Management System.

5.1.4 Village Disaster Management Committee (VDMC)

There shall be a Disaster Management Committee in each village which consists of officials and non-officials. *Gram Sabha* will supervise the matters related thereto. The responsibility of the Committee will include generating awareness, dissemination of warnings during disasters, community preparedness programs and strategies, adoption of resilient housing practices, organizing and coordinating relief during post disaster situations.

5.1.5 Other Stakeholders in Disaster Management

Various agencies, organizations, departments and authorities constitute a core network for initiating various disaster management related functions and activities. These also includes academic, scientific and technical organizations, media, community, etc.; that play important role in various situation of disaster management.

6. NOTABLE DISASTER MANAGEMENT INITIATIVES

These are some notable initiatives which have been initiated at regional level, district levels and *talukas*.

- Allocation of Satellite Remote Sensing GPS, Satellite Radio Phones, Cell Broadcasting and safety equipment to the fishermen;
- Creation of 'cyclone cells' in component villages, establishment of cyclone shelters and provision of training to rural populace;


Table 3: Incident Response System in the Region

Incident Response Taskforce	Unit	Incident Response Functions and Co-Ordination With Control Rooms
Coordination and Planning	Planning	Coordinate early warning. Response and Recovery Operations
Administration and Protocol	Finance and Admin;	Support disaster operations completing Administrative task for relief assistance
Warning	Planning	Collection and dissemination of warnings of potential disasters.
Law and Order	Operation	Provide resources to support local evacuation, search and rescue
Search and Rescue	Logistics	Provide resources to support local evacuation, search and rescue
Public Works	Public Information	Provide resources to re-establish normally operating infrastructure
Water	Logistics	Assure provision of potable water and water for industrial and agricultural uses
Food and Relief Supplies	Law and Order	Assure provision of basic food and other relief needs in affected communities
Power	Operation	Provide resources to re-establish power supplies in affected communities
Public Health and Sanitation	Operation	Provide personnel and resources to address public health problems
Animal Health and Welfare	Operation	Provision of health and other care to animals affected by a disaster.
Shelter	Operation	Provide supplies to ensure temporary shelter for disaster hit populations.
Logistics	Operation	Provide air, water, land transport for evacuation, storage and delivery of supplies
Survey (Damage Assessment)	Operation	Collect and analyze data on impact of disaster and develop estimates of resource needs and relief plans
Telecommunications	Operation	Assure operation of communication systems to support early warning or post disaster operations
Media (Public Information)	Operation	Provide assistance to print and electronic media on early warning and post-disaster reporting

- Formation of committees at village and *taluka* level, and creation of awareness through public campaigns;
- Monitoring of the sea coast by coast - guards through specialized vessels assisting in navigation and security;
- Creation of Incident Control Room in the District Disaster Management Authority for hazard mapping and planning;
- Updating the disaster related data over state disaster resource network (SDRN) and India Disaster Resource Network (IDRN); and
- Insurance and disaster resistant construction, pre-monsoon meetings, interdepartmental coordination conduction of mock drills.



7. GAPS IN DISASTER RESPONSE SYSTEM

7.1 Absence of 'Disaster-specific' Action Plans

- Disaster Management Act 2005 clearly mentions that action plans need to be formulated within the District Disaster Plan; and
- The Disaster Management Plan 2016 of Diu elucidates regarding action plan for cyclones solely, and does not detail about that for floods, earthquakes, and other disasters

7.2 Absence of Co-ordination Among Component Districts

- Each component district of 'Diu region' works in a isolated manner towards disaster management activities;
- The Disaster Response Systems are entirely dependent over head offices situated far off, and lack in support systems from the adjacent districts;
- There is no integration of Disaster Management and Land Use Planning;
- Although the districts have been successful in preparation of District Disaster Management Plan, however, the same has not been integrated with Development Plan preparation process.
- Integration of disaster management activities is essential with planning process, as it projects the future land use;
- Absence of Emergency Operation and Response Centers;
- The Disaster Management Plan of Diu, does not mention about the emergency operation and response centers;
- Contrastingly albeit the plan of Gir - Somnath mentions about emergency task forces and states that a single emergency response center exists in the neighboring Rajkot district;
- Disaster Management System needs to be incorporated in Byelaws;
- Building Regulations / Byelaws provide the mandatory techno-legal framework for regulating building activity from planning, design to completion of construction; and
- Not only do the rural, but urban municipalities in the Diu Region disregard disaster management initiatives.

7.3 Absence of Micro-zonation Maps

- The seismic catastrophe of Bhuj and its consequences in 2001 are known to every Indian national. Diu Region being just about 300 km from it lies under potential threat as well; and
- Micro-zonation would provide as a tool for qualitative assessment of seismic hazards in different parts of the region.



8. RECOMMENDATIONS AND SUGGESTIVE MEASURES

Following policies and proposals have been formulated on the basis of above discussions:

- Establish Regional Disaster Co-ordination Center (RDCC) and Regional Disaster Rehabilitation Center (RDRC);
- Establish Emergency Operation and Response Centers in each and every district;
- Disaster Management Centers should be established at strategic locations for sensitizing public and creating awareness;
- Prepare 'Disaster - specific' Action Plans;
- Prepare Prevention cum Preparedness Plan as a part of Regional Plan
- Prepare Seismic Micro - Zonation Map for the entire Diu Region;
- Constitute Disaster Management Committee at the regional level and District Disaster Management Committee at the district level in order to assure multi-sectoral and multi-disciplinary approach to disaster management;
- Include Separate Chapter of Disaster Management Plan in Development and Zonal Plans;
- Establish Passive solar Energy Substations for communication backup;
- Active Vertical and Horizontal Coordination (State to District and District to District coordination);
- Use official Wireless Grids (police, army, etc.);
- Strategies like carbon emission reduction promoting alternative green technologies be given priority;
- Amend existing Byelaws and Regulations to involve disaster preparedness initiatives;
- Strengthen the public buildings like schools, hospitals to disaster resilient structures, so as to accommodate people in case of emergency;
- Retrofitting and strengthening of structures identified as vulnerable and reinforcement of innovative construction technologies be taken up on priority;
- Strengthen Communication Systems;
- Identify Administrative Training Institutes for capacity building and strengthen institutionalized mechanism system; and
- Community awareness be created through education and research, public sensitization and awareness.



9. CONCLUSIONS

Disaster management should be considered as an integral part of a Regional Plan. The first section describes various techniques and existing disaster management mechanisms adopted in the region, which have been formulated on the basis of State Disaster Management Act, 2003 and have been modified according to National Disaster Management Act, 2005. The later sections have made an attempt to analyze these trends to identify various gaps and issues and mechanisms both in the system as well as in the approach on the basis of which objectives for the Diu Region have been decided with a 20 year time frame. In the last section various policies and proposals have been suggested to improve and strengthen the disaster management mechanisms in the Region. Since, disaster management does not work in isolation, these should also be incorporated in Development and Zonal Plans.

REFERENCES

- Anna Serra, J. D. (2011) *Assessing the role of vertical and horizontal communication in disaster risk reduction learning and planning: The case of the Spanish Tous dam-break, 1982*, Autonomous University of Barcelona, Spain, Chalmers University of Technology, Gothenburg, Sweden.
- Authority, D.D. (2016) *District Disaster Management Plan, Junagadh*, District Disaster Management Authority, Junagadh.
- Authority, D.D. (2016) *District Disaster Management Plan, Amreli*, District Disaster Management Authority, Amreli
- Authority, D.D. (2016) *District Disaster Management Plan, Diu*, District Disaster Management Authority, Diu.
- Authority, D.D. (2016) *District Disaster Management Plan, Gir Somnath*, District Disaster Management Authority, Gir Somnath.
- Authority, G.S. (2016) *State Disaster Management Plan, Gujarat*, Gujarat State Disaster Management Authority, Gandhinagar:
- Authority, N.D. (2016) *National Disaster Management Plan*, National Disaster Management Authority, New Delhi.
- BOARD, N. C. (2013) *Draft Revised Regional Plan 2021*, National Capital Region, National Capital Region Planning Board. New Delhi.
- Japan, C.O. (2015) *White Paper Disaster Management in Japan*, Cabinet Office Japan.



Urban Resilience Approaches and its Challenges

Neha Bansal, Ph.D., and Aditya Purohit

Abstract

With rapid urbanization, the risk of disasters is increasing as more people and assets are located in areas of high risk. For instance, more than half of the world's large cities, with populations ranging from 2 to 15 million are located in areas of high earthquake risk. The impact of disasters is even more pounding in these high risk areas. Disasters not only erode and destroy years of development gains but destroy assets, kills people and increase poverty and also impact GDP directly especially in more vulnerable urban areas. Therefore, there is a need for long term strategy for disaster management than merely emergency management. This paper aims at identifying the concept of urban resilience to combat long term disaster management in urban areas.

1. INTRODUCTION

Building disaster resilience into urban planning will be increasingly crucial as cities continue to grow worldwide, say members in the panel hosted by the United Nations Office for Disaster Risk Reduction (UNISDR) as part of a week's Global Platform for Disaster Risk Reduction (UN, 2013). With rapid urbanization, the risk of disasters is increasing as cities or urban areas concentrate risk due to huge concentration of people and physical and financial assets. More to this, more than half of the world's large cities, with populations ranging from 2 to 15 million, are located in areas of high earthquake risk zones (Gu, 2015) where the impact of disasters is even more pounding. Disasters cause huge economic losses. It has been noted that since 1980 the risk of economic loss due to floods has increased by over 160 per cent and to tropical cyclones by 265% in OECD countries (UN Water, 2014). As per the disaster analysts the impact of disasters on developing countries and least developed countries (LDC) is perhaps the most challenging. The earthquake in Haiti (2010) is estimated to have exceeded 15 per cent of GDP or 120 per cent of GDP when total damages and losses are included (UNISDR, WMO, 2012). In larger LDC economies, such as Bangladesh or Mozambique, the loss of 3 to 5 per cent of GDP due to disasters in every five to ten years has a cumulative impact on development (UNISDR, WMO, 2012). The situation is worse in large cities which concentrate and magnify risk. An example to this is Great Kobe urban

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quake which destroyed much of Kobe, Japan (January 1995), killing more than 6,000 people and bringing losses that exceeded US \$100 Billion (Mitchell, 1999). Researchers have indicated that urban resilience is most significant and impactful method for reducing growing levels of disaster risk in long run. It is also directly linked with sustainability. This paper aims at identifying the concept of urban resilience to combat long term disaster management in urban areas. The subsequent section discusses the impacts of disasters in urban areas and their long term potential threats.

2. URBAN DISASTER RISKS

A disaster occurs when an extreme event exceeds a community's ability to cope with that event. For city governments, uncontrolled rapid urbanization complimented with increased climate variability and disasters imposes great challenges to effective urban management and the delivery of key services. Disasters impact and cause many types of challenges listed below:

- **Challenge on sustainable urban development:** Fig. 1 shows that disasters erode years of development gains and result in loss of vision of sustainable development. City authorities are increasingly finding ways to include adaptation strategies although related knowledge and expertise are still scarce and fragmented. Current approaches are limited and generally do not consider local adaptation capacities of individuals and households.
- **Ever Evolving Disasters and Unpredictable Nature of Disasters:** results in low capacity of the governmental institutions for disaster management. In fact, climate change is undermining the effectiveness of institutional responses which were designed to be applied in the event of known 'common' and more 'predictable' hazards and associated impacts (Wamsler, 2012).

Fig. 1: Flood Disaster Eroded Development (Koksal, 2012)





- **Lack of Urban Transformation in Light of Increasing Disasters:** Since natural hazards threaten large metropolitan areas, urban transformation is needed to together mitigate disasters along with development. This approach of urban transformation includes land use decisions related to hazard, risk and vulnerability analysis and to enhance the implementation of building codes respecting the current standards with application of urban transformation methodologies (Turkoglu, 2011).
- **Social and Physical Impact of Disasters:** The physical impacts of disasters include casualties (deaths and injuries) and property damage. These are usually the most obvious, easily measured, and first reported by the news media. According to Noji (1997), Earthquakes produced 28 of the greatest disasters and 450,000 deaths, whereas floods produced four of the greatest disasters and 194,000 deaths (Al-Aawah and Boukhair, 2010).
- **Disasters Impact Differentially due to Differential Development:** Figure 2 shows that there is significant variation by country, with developing countries in Asia, Africa, and South America accounting for the top 20 positions in terms of number of deaths from 1966-1990 (Hazard, Vulnerability, and Risk Analysis, 2011). Low-income countries suffer approximately 3,000 deaths per disaster, whereas the corresponding figure for high-income countries is approximately 500 deaths per disaster. Figure 3- indicates the levels of natural disaster risk- based on the United Nations University World Risk Index 2014
- **Damage:** Losses of structures, animals, and crops also are important measures of physical impacts, and these are rising exponentially in the

Fig. 2: Total Life Years Lost by Regions (Noy, 2015)

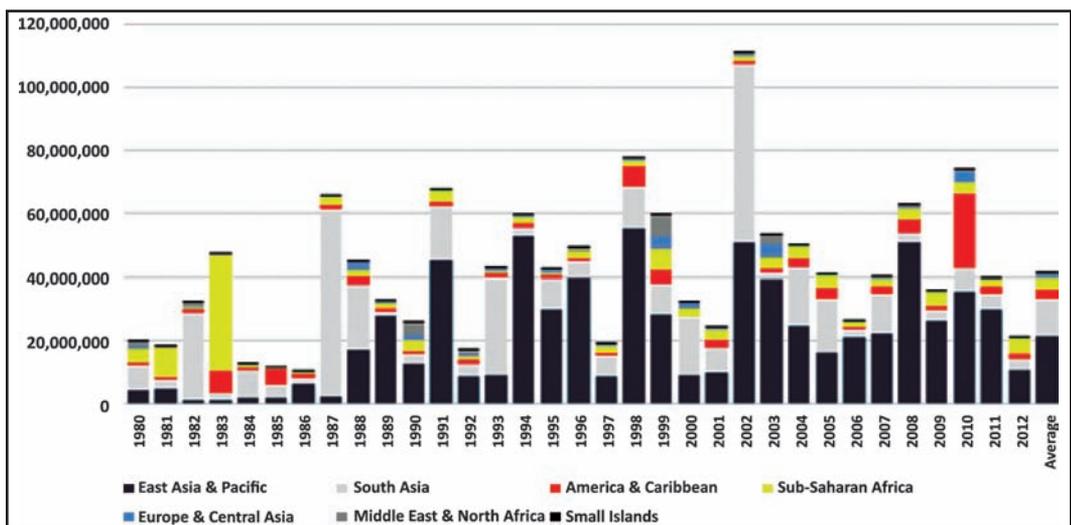
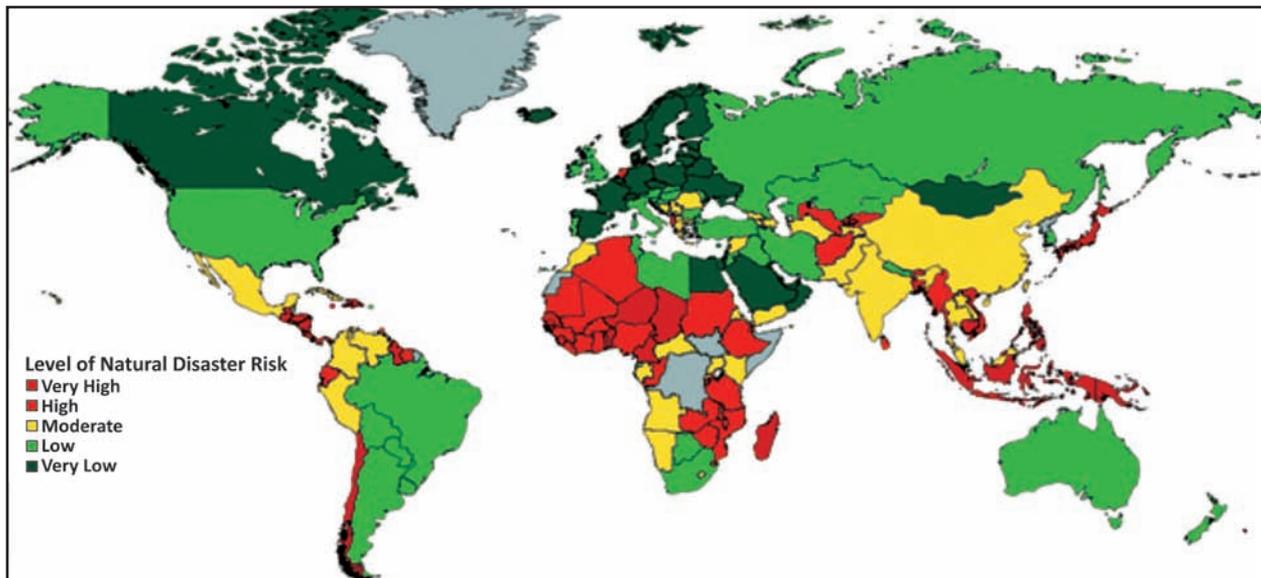


Fig. 3: Levels of Natural Disaster Risk - Based on the United Nations University World Risk Index 2014 (Child Fund, 2013)



United States (Mileti, 1999). However, it is also evident in Fig. 3 that the rate of increase is even greater in developing countries such as India and Kenya (Pearson, 2001).

- **Environmental Damage Impacts Include Damage or Contamination:** to cropland, rangeland, and woodlands. For example, ash fall from the 1980 Mt. St. Helens eruption was initially expected to devastate crops and livestock in downwind areas, but no significant losses materialized (Cook *et al*, 1981).
- **Psychosocial Impacts:** Research reviews conducted over a period of 25 years have concluded that disasters can cause a wide range of negative psychological responses (Lindell, 2013). These include psycho-physiological effects such as fatigue, gastrointestinal upset, and tics, as well as cognitive signs such as confusion, impaired concentration, and attention deficits. Psychological impacts include emotional signs such as anxiety, depression, and grief. They also include behavioral effects such as sleep and appetite changes, ritualistic behavior, and substance abuse (CDRSS, 2006). Fig. 4 indicates different types of losses due to disasters taken from various events.
- **Economic impacts:** Property damage caused by disaster impact creates losses in asset values that can be measured by the cost of repair or replacement (Committee on Assessing the Costs of Natural Disasters, 1999). Economic losses in Asia and Pacific region remained high owing to natural disasters in 2014, amounting to some \$59.6 billion (UN ESCAPE,

Fig. 4: Different Types of Losses Due to Disasters (Vaticana, 2015 and Martinez, 2015)



Destruction by Typhoon Haiyan in Tacloban City, in Central Philippines on November 14, 2013. - AFP and loss of Life and Health Implications

2015). This highlighted the lack of economic resilience in the region, as per the review report on ‘Natural Disasters in Asia and the Pacific: 2014’ by the UN Economic and Social Commission for Asia and the Pacific (Vaticana, 2015).

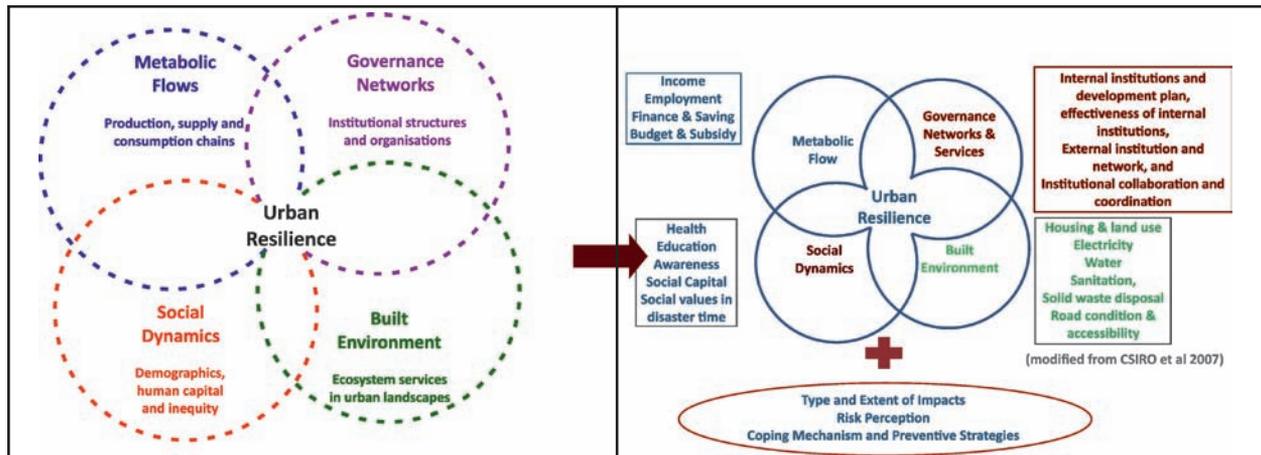
- **Political impacts:** There is substantial evidence that disaster impacts can cause social activism resulting in political disruption, especially during the seemingly interminable period of disaster recovery (Hazard, Vulnerability, and Risk Analysis, 2016).

Thus, urban transformations in light of rapid urbanization and increasing disaster risks necessitate the need for urban resilience to be incorporated in urban development, which can be seen as a long term strategy for disaster management. Next section discusses the concept of urban resilience.

3. WHAT IS URBAN RESILIENCE?

The concept of resilience is used in the disasters field as a way of understanding the ability of a system to avoid damage as a result of a natural hazard impact (Johnson and Blackburn, 2014). With the increase in disaster events and inefficient disaster management systems, resilience has emerged as an attractive perspective with respect to cities, often theorized as highly complex, adaptive systems (Peters *et al*, 2015). With the increasingly complex urban systems, dimensions of urban resilience are also adapting and evolving. Though there is no clear definition of urban resilience, but the concept has gained momentum and significance with various disaster management organizations. The most commonly referred concept given by “100 Resilient Cities” project Pioneered by the Rockefeller Foundation (Rockefeller, 2016) has been referred here. “Urban Resilience is the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience. Thus an urban resilient citizen is disaster resilient and more sustainable over the others.” Another

Fig. 5 : Urban Resilience Conceptual Model (Razafindrabe, Shaw and Arima, 2016)



Urban Resilience - The four interconnected research themes for prioritizing urban resilience research. (CSIRO et al., 2007; Rose, 2007)

Further Modified - Resilience of Urban Communities in a Changing Climate and Environment-Focus on Water-Related Issues in Central Vietnam (Razafindrabe, Shaw and Arima, 2016)

theoretically referred definition by (CSIRO *et al*, 2007; Rose, 2007) says “urban resilience is the ability of an interdependent social and ecological system to absorb disturbances and maintain the same structure and function.” Here the urban system is divided into four quadrants and the resilience passes through all the four and thereby interconnects them (Fig. 5). These have been modified by researchers to understand the components of the four quadrants connecting each other (Fig. 5).

3.1 Key Aspects in Resilience

One of the researchers in her blog clearly identifies the key aspects of urban resilience (Carter *et al*, 2015). It says “A resilient system copes well with shock. Resilience shifts management focus from growth and efficiency to adaptability. An overemphasis on growth and efficiency leads to a dangerous rigidity and fragility. Based on this ideology, the key elements of sound resilient system have been listed below (Carter *et al*, 2015). A system can shift dramatically into an undesirable regime from a small change if a threshold is crossed, however attention to thresholds is critical.

- **Adaptive Cycles:** A metaphor of systematic change that proposes that systems cycle through four phases: growth and conservation (resources committed, stable, slow change, predictable), release and reorganization (resources freed up, chaos, fast change, opportunity).
- **Panarchy - Multiple Scales and Cross - Scale Effects:** function at multiple scales of space, time and social organization. You must understand the cross-scale interactions to manage effectively at a specific scale.



- **Transformability:** If a SES is pushed into an undesirable context and can't be returned to its former state, the capacity to create a fundamentally new systems with new variables, new livelihoods, and different scales of organization.
- **General Versus Specific Resilience:** Specific Resilience is a system to a specific shock. Specific resilience occurs at the expense of other parts. Focus on resilience of one part of the system can come at the expense of the other. Balance between the two parts is important.
- **Social - Ecological System:** an integrated system in which the dynamics of the social and ecosystem domains are strongly linked and of equal weight.
- **Assessment:** understanding the regime the system is in, where it is in the adaptive cycle, where the system thresholds are, what the key variables are, and how the cross-scale interactions either increase or decrease resilience
- **Management:** how to avoid an undesirable state or get from an undesirable state to a desirable one, and how to transform a system when that's the only option.

After a clear understanding of the concept, some best practices taken up for understanding the urban resilience methods. We also tried to identify the challenges in urban resilience and its further scope of development. With time, the disaster resilience methods have also adapted to smart techniques. We have also tried to identify some of these which are discussed in next section.

4. URBAN RESILIENCE - BEST PRACTICES

As resilience primarily increases coping capacity, it has been observed that some practices have already incorporated it in present system of disaster management. This at initial stage can be attributed to the development of effective early warning systems, based on advancements in monitoring and forecasting of weather-related hazards, combined with effective coordination, communication and emergency preparedness at national to local levels in several countries (WMO, 2016). These countries having high-impact weather-related hazards include countries like Cuba, Bangladesh, France, and the United States (Golnaraghi, 2016) Whereas some other practices have been listed below-

- **Twigg's (2009) 'Characteristics of Resilience' Framework:** (Twigg's, 2007) Based on five dimensions of resilience identified in the Hyogo Framework for Action (governance, risk assessment, knowledge and education, risk management and vulnerability reduction, disaster preparedness and response), provides an extensive inventory of 28 components and 167 characteristics or indicators.
- **DFID's Multi-Hazard Risk Assessment Framework:** The framework is primarily based on five components: magnitude and likelihood of hazards, vulnerability



analysis, in-country capacity to address disaster risk, overall impact assessment and role of DFID. These components are evaluated based on set of indicators. A varied range of data and methodology (Interviews with key stakeholders, historical data, - evaluations, understanding early warning systems, poverty assessments, humanitarian evaluations, post - disaster needs assessments, external analysis, country assistance strategies, poverty reduction strategy, risk matrix is used based on available components of resilience derived which include - DRR policy, planning, priorities, and political commitment, legal and regulatory systems, Integration with development policies and planning, emergency response and recovery, Hazards and risk data and assessment.

- **A Multidimensional Approach for Measuring Resilience (Oxfam GB, 2013):** is based on five dimensions affecting the ability of households and communities to minimize risks from shocks and adapt to emerging trends and uncertainty. These are - (i) Livelihood viability: the extent to which livelihood strategies can thrive in spite of shocks, stresses and uncertainty; (ii) Innovation potential: the ability to take appropriate risks and positively adjust to change; (iii) Contingency resources and support access-access to back-up resources and appropriate assistance in times of crisis; (iv) Integrity of natural and built environment-health of local ecosystems, soundness of natural resource management practices, and robustness of essential physical infrastructure; (v) Social and institutional capability- extent formal and informal institutions are able to reduce risk, support positive adaptation, and ensure equitable access to essential services in times of shock / stress (Oddsdóttir, Lucas and Combaz, 2013).
- **Toward Resilience : A Guide to Disaster Risk Reduction and Climate Change Adaptation (Emergency Capacity Building Project, 2013)** is a resource for staff of development and humanitarian organizations, providing principles of effective practice, guidelines for action, case studies, and tools and resources for the application of an integrated, rights-based approach to disaster risk reduction and climate change adaptation. It provides advice on the design, implementation, monitoring and evaluation of programs that build disaster and climate resilience, following a simplified program cycle with three phases: analysis, design, and implementation (Oddsdóttir, Lucas and Combaz, 2013).
- **Community Based Disaster Preparedness (Catholic Relief Services, 2009):** This guide was developed to support a community led disaster preparedness process. It does not provide specific indicators for measuring resilience, but recommends participatory methods to collect information for monitoring progress and highlights the value of qualitative information. It provides participatory strategies and tools for a three phase approach to developing disaster preparedness, the first two phases of which involve assessing resilience in the community (Dummett, 2009).



- **Participatory Capacity and Vulnerability Assessment (Oxfam GB, 2012):** is a framework based on two social development methodologies. First, it indicates the Capacity and Vulnerability Analysis (CVA) methodology which enables program design based on a community's capacities as well as its vulnerabilities. Secondly, it gives the belief about enabling communities to genuinely participate in program design, planning, and its management that leads to increased ownership, accountability and impact, and is the best way to bring about change. PCVA draws on a range of participatory learning and action (PLA) techniques and tools designed to channel participants' ideas and efforts into a structured process of analysis, learning, and action planning (Oddsdóttir, Lucas and Combaz, 2013).
- **Participatory Assessment of Disaster Risk (Tearfund, 2011):** This framework is based on a tool known as Participatory Assessment of Disaster Risk (PADR). The purpose of the tool is to enable a community to assess the factors that contribute to the size and scale of any potential disaster and to develop a locally owned plan to address these factors and reduce the risk of disaster. It also enables the community to identify and address the social, political and economic structures which contribute to their vulnerability (Oddsdóttir, Lucas and Combaz, 2013).
- **The Yokohama Strategy Based on the Hyogo Framework for Action 2005:** 2015 has gained recognition in addressing the multidimensional aspects of disaster risk from a development perspective. Hyogo Framework for Action 2005-2015- Building the Resilience of Nations and Communities to Disasters was adopted at the World Conference on Disaster Reduction in Kobe, Hyogo, Japan in 2005. The Framework serves as the guiding instrument for international cooperation, disaster risk reduction and resilience building. The multi-stakeholder and multi-sector nature of the Hyogo Framework for Action provides guidance on how disaster risk reduction contributes to sustainable development and provides the solutions for clearly defined, agreed and monitored goals and targets around disaster risk reduction and resilience (UNISDR, 2013).
- **Sendai Framework - 2015:** is the successor instrument to HFA-2005-2015. The Sendai Framework was adopted by UN Member States on 18 March 2015 at the Third UN World Conference on Disaster Risk Reduction in Sendai City, Miyagi Prefecture, Japan. It has seven targets and four priorities for action which include: (Priority - 1) Understanding disaster risk; (Priority - 2) Strengthening disaster risk governance to manage disaster risk; (Priority - 3) Investing in disaster risk reduction for resilience and (Priority - 4) Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction (UNISDR, 2012).



- **Other Initiatives:** A number of initiatives have been undertaken to build consensus on measuring results at the regional and sub-regional. These include- six high level regional strategies or plans of action on disaster risk reduction were adopted in Africa, Americas, Arab States, Asia, Europe and the Pacific (United Nations System, 2013); the Incheon Roadmap for Asia (AMCDDR, 2010); National or community targets seen in Bangladesh (Sixth Five-Year Plan 2011-15), Mozambique (Five Year Government Plan 2010-14 and Master Plan for Disaster Prevention and Mitigation 2006), Peru (State Policy 32) and Philippines (Philippine Development Plan 2010-14) (National Economic and Development Authority, 2011); Disaster resilient construction techniques in Western Sumatra (JITI Foundation, 2015). These can be referred in detail in respective literatures.

5. CHALLENGES IN URBAN RESILIENCE

- Problems at global scale in resilience building- Global goals and targets for disaster risk reduction and resilience raises a particular concern for implementation and accountability (UNISDR, 2012). These global targets need to relate as closely as possible to human development indexes, especially as vulnerability increases.
- The speed and pace of changes, and the high degree of uncertainty in many domains today pose a challenge to many decision-making processes. Over the last several decades, progress with hazard monitoring, predictions and forecasting is leading to forward-looking information, assisting decision makers to reduce risks of extreme events. But still the predictability is changing at a faster pace in most cases due to rapidly unpredictable changes in climate (Reeves and Deimler, 2011).
- The application of scientific evidence, supported by technology transfer and capacity development is critical in disaster risk reduction and resilience building. Further investment is therefore needed to make science and climate information and evidences more available to support policies around investment and planning (Bosher and Dainty, 2011).
- Although many cities have started including resilient programs in their master plans, they lack a holistic vision of the systemic relation between different urban parameters and an effective operational mechanism for timely signalization and modus-operandi to face these disaster situations (Gupta, 2015).

6. CONCLUSIONS

The best way of managing urban disasters are through mechanisms of resilience. There is growing evidence of the intensity and frequency of climate related extreme events highlighting the criticality of their impact on nature and humans. Thus, time to see disasters through the lens of reducing risks of and building resilience to disasters, rather than just a response to a one-off disaster event. The



incorporation of disaster risk reduction and resilience into development process for integrated approach is needed. These need to be done through public and private sector strategies and planning for development and growth. In addition, more explicit recognition of the importance of reducing disaster risk and building resilience - with measurable goals and targets would be a major step in meeting the challenges of resilient sustainable development.

REFERENCES

- Al-Aawah, M. and Boukhair, R. (2010) *Towards improved public awareness for climate related disaster risk reduction and management in the Arab region*, United Nations Educational, Scientific and Cultural Organization, Cairo.
- AMCDDR (2010) *Climate Change Response Division*, Seoul.
- Bacani, B. (2015) *INSURANCE 2030 - Harnessing Insurance for Sustainable Development*, UNEP.
- Bosher, L. and Dainty, A. (2011) Disaster risk reduction and 'built-in' resilience: towards overarching principles for construction practice, *Disasters*, Vol. 35, No. 1, pp.1-18.
- Carter, J., Cavan, G., Connelly, A., Guy, S., Handley, J. and Kazmierczak, A. (2015) *Climate change and the city: Building capacity for urban adaptation*, Elsevier, London. pp. 1-66.
- CDRSS, (2006) *Facing hazards and disasters*, National Academies Press, Washington, D.C.
- Child Fund, I. (2013) *The Effects of Natural Disasters*, ChildFund. [online] Childfund.org.
- Cook, R., Barron, J., Papendick, R. and Williams, G. (1981) Impact on Agriculture of the Mount St. Helens Eruptions, *Science*, Vol. 211, No. 4477, pp.16-22.
- Department for International Development (2012) 'Multi - Hazard Disaster Risk Assessment (v2)', in Dummett, C. (ed.) (2009) *Community Based Disaster Preparedness - A How-To Guide*, European Commission, Brussels.
- Few, R., McAvoy, D., Tarazona, M. and Walden, V. (2013) *An approach to evaluating the role of intervention in disaster recovery*, *Contribution to Change*, Practical Action Publishing Ltd, pp.1-107.
- Golnaraghi, M. (2016) 'An Overview: Building a Global Knowledge Base of Lessons Learned from Good Practices', in *Multi-Hazard Early Warning Systems*. In: First Edition.
- Gupta, K. (2015) Challenges of Urban Resilience in India, *South Asia Disasters*, Vol. 128, p.12.
- Gu, D. (2015) *Risks of Exposure and Vulnerability to Natural Disasters at the City Level: A Global Overview*, Department of Economic and Social Affairs, United Nations.
- JITI Foundation (2015) *Disaster resilient construction techniques in Western Sumatra Because better bricks make better homes*, [online] Jtifoundation.org.
- Johnson, C. and Blackburn, S. (2014) Advocacy for urban resilience: UNISDR's Making Cities Resilient Campaign, *Environment and Urbanization*, Vol. 26, No. 1, pp.29-52.
- Koksal, G. (2012) Economic Cost of Natural Disasters. [online]. More than Shipping.
- Lindell, M. (2013) *Recovery and Reconstruction after Disaster*, Springer, pp.819-821.
- Lucini, B. (2014) *Disaster resilience from a sociological perspective: exploring three Italian earthquakes as models for disaster resilience planning*, Springer Science and Business.
- Martinez, J. (2015) *Health Implications of Disasters in the Philippines*.



- Mitchell, J. (1999) Megacities and natural disasters: a comparative analysis, *Geo Journal*, Vol. 49, pp. 137-142.
- National Economic and Development Authority (2011) *Philippine Development Plan 2011-2016*.
- Noy, I. (2015) *A DALY Measure of the Direct Impact of Natural Disasters*, VOX CEPR's Policy Portal, Wellington.
- Oddsóttir, F., Lucas, B. and Combaz, É. (2013) *Measuring disaster resilience*, Helpdesk Research Report, GSDRC.
- Pearson, E. (2001) *Challenges Facing the Developing Countries*, Pearson Education Canada.
- Peters, G., Butsch C., Krachten, F., Kraas, F., Sridharan, N. and Marfai, M. (2015) Analyzing Risk and Disaster in Megaurban Systems - Experiences from Mumbai and Jakarta, *Planet@Risk*, Vol. 3, No. 1, pp. 107-117.
- Reeves, M. and Deimler, M. (2011) Adaptability: The New Competitive Advantage, *Harvard Business Review*.
- Razafindrabe, B., Shaw, R. and Arima, M. (2016) *Resilience of Urban Communities in a Changing Climate and Environment-Focus on Water-Related Issues in Central Vietnam*.
- Reducing Urban Crime and Violence (2010) *Towards Safer and More Secure Cities*, 5th ed.
- Rockefeller, F. (2016) *City Resilience*, [online] 100resilientcities.org.
- Twigg, J. (2007) *Characteristics of a Disaster Resilient Community - A Guidance Note*.
- Turkoglu, H. and Kundak, S. (2011) *Urban Transformation as a tool for Disaster Mitigation*, ERSA conference papers, European Regional Science Association,
- UNCSD (2012) *United Nations Conference on Sustainable Development, Rio+20: Sustainable Development Knowledge Platform*, [online] Sustainabledevelopment.un.org.
- UNISDR (2012) *Sendai Framework for Disaster Risk Reduction - UNISDR*, [online] Unisdr.org.
- United Nations System (2013) *United Nations Plan of Action on Disaster Risk Reduction for Resilience*.
- UN Habitat (2016) *Global Report on Human Settlements 2007*, UN Habitat, Kenya.
- UN, I. (2013) *Disaster Risk Reduction Must Keep Pace with Rapid Urbanization, Say Urban Planners*, Meetings Coverage and Press Releases, [online] Un.org.
- UNISDR (2016) *Hyogo Framework for Action (HFA)*, UNISDR.ORG.
- UN-ESCAPE (2015) *Enhanced regional cooperation key to building resilience to floods and landslides*.
- UNISDR-WMO (2012) *Disaster Risk and Resilience, UN System Task Team on post-2015 UN development agenda*.
- Vaticana, R. (2015) *Natural disasters in Asia and Pacific impact some 80 million people*, [online] En.radiovaticana.va.
- Wamsler, C. (2012) *Sustainable Urban Transformation for Climate Change Adaptation. Urban Transformation*, Lund University Centre for Sustainability Studies.
- Water, U. (2014) *A Post 2015 Global Goal for Water: Synthesis of key findings and recommendations from UN*, First Edition.
- WMO (2016) *Multi-Hazard Early Warning Systems (MHEWS)*, [online] Wmo.int.



Impact of Development on Mangrove Cover in the Mumbai Metropolitan Region

Anita Shyam

Abstract

Mumbai Metropolitan Region (MMR), the largest coastal city in India, is experiencing tremendous growth over the years due to rapid industrialization and urbanization. The pressure on land for development has increased tremendously due to scarcity of land and fast pace of development, open areas, mangroves and areas under water bodies have become susceptible to developmental pressures. Mumbai has lost many of its natural features due to uncontrolled development. This study is to understand the impact that the development pressures have had on the mangrove cover by mapping the change in the mangrove area in the MMR region. The mangrove area and the adjoining areas are divided into smaller zones to do an assessment of the change in mangrove cover and identify the areas of high development pressures.

1. INTRODUCTION

Coastal Resources constitute an important component of natural resources, particularly in a country like India, which is surrounded by sea on all three sides. Coastal regions, where land and water meet are unique ecological regions which attract large number of economic activities like trade and ports development, ship building activities, defense, fisheries, industries and human settlements. These economic activities appear to promote economic growth but in turn cause loss in terms of coastal and marine resources. Mumbai is a reclaimed island along its entire shoreline. The wave action has increased in the North Western area and has eroded 16 km long coastline by about 500 m in the past 35 years. Only mangroves can provide natural control for eroding shoreline. Coastal biodiversity including the million migratory birds that visit Mumbai are housed by the mangroves.

Large demographic pressure is exerting tremendous stress on the coastal environment. The major causes of mangroves degradation are land reclamations and industrial effluents. Systematic dumping of all kinds of waste and debris in the mangrove area destroy them. This waste and debris creates a barrier preventing the sea water from entering the mangroves and eventually killing the mangroves. In many instances this is done intentionally to reclaim land for construction activity. Hence, it is important to control and finally stop this systematic degradation of mangroves.

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Most industrial houses, developers and builders are reclaiming the mangrove lands illegally. There are over 200 non - point sources of industrial and domestic waste discharges that pollute entire water around the city, 6 times more than the assimilation capacity. Under the name of “development” creeks, rivers and other water bodies are altered in shape, size and course. Every year, over 1,000 tons of mangrove wood is cut for fuel wood and to meet other timber demands. Other threats to mangrove cover are port development, dumping of all kinds of waste and debris, over harvesting of marine resources and reduced natural regeneration. Total length of the coast in Maharashtra is 720 km. The Maharashtra Coastal Zone falls under five districts from south to north namely, Thane district, Sindhudurg district, Ratnagiri district, Raigad district and Bombay district.

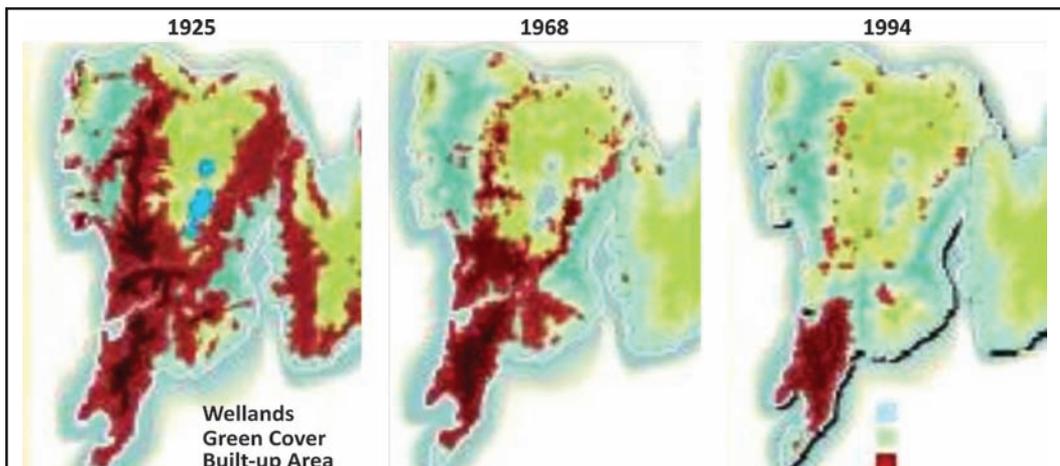
2. CHANGE IN MANGROVE COVER IN MUMBAI

From the time of evolution of the city, the area under mangroves has decreased and it is taken over by built up areas. Fig. 1 show clearly that as the city grew, the wetlands have slowly been replaced by built up area. The mangroves are categorized into dense, sparse and mud flats.

Mangrove cover change analysis for MMR has been done for the Creek Areas (i) Manori Creek; (ii) Malad Creek; and (iii) Thane Creek. This study has taken place mainly around the Manori and Malad creek Area

The mangrove cover map 2005 (Fig. 2 and 3) shows that dense mangrove areas near Thane Creek which have been converted to mud flats. Detailed analysis of the cover change for each creek is given in Table - 2 shows that there has been an overall decrease in the mangrove area in MMR. The decrease in the dense and sparse mangrove has been maximum in Thane Creek area west side followed by Manori, Malad respectively.

Fig. 1: Built Up Area Against Wet Land Area



Source- Times of India, Aug 04 2005



Fig. 2: Mangrove Cover - 1997

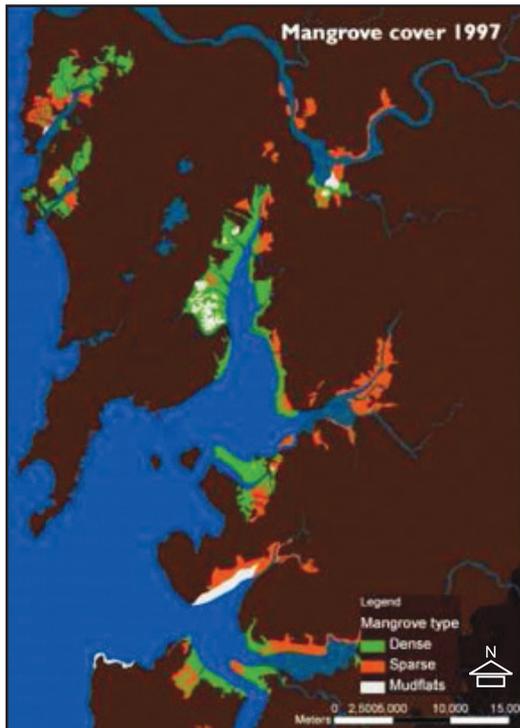


Fig. 3: Mangrove Cover - 2005

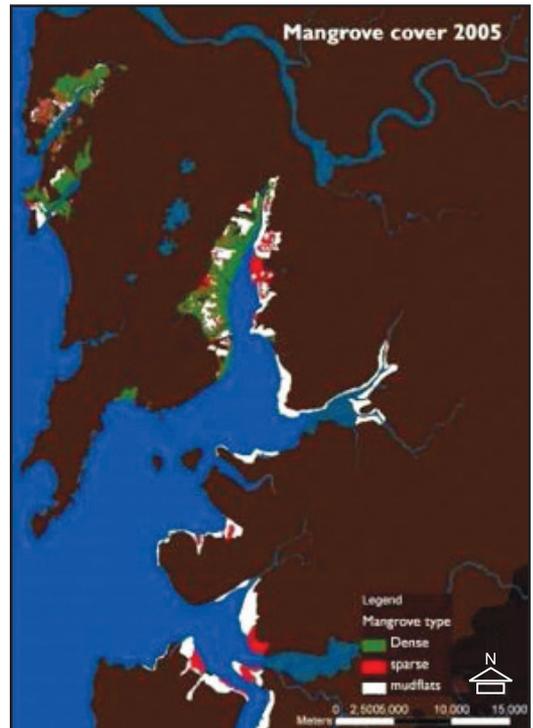


Fig. 4: Manori Creek - Zones

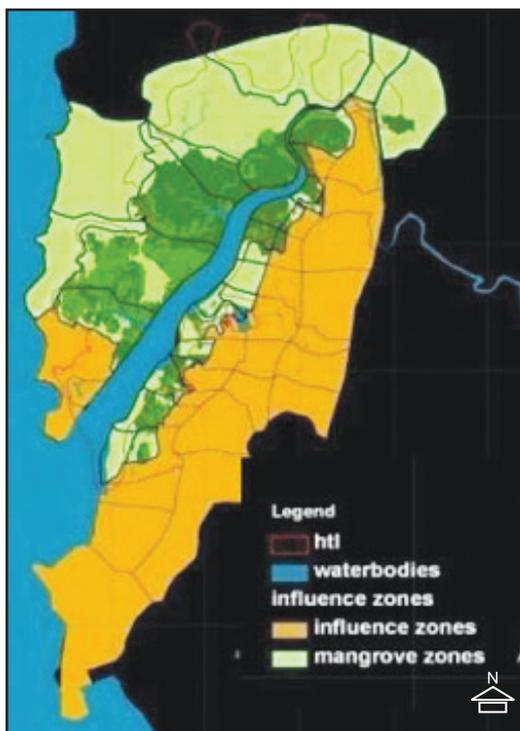


Fig. 5: Manori Creek Subdivision of Zones

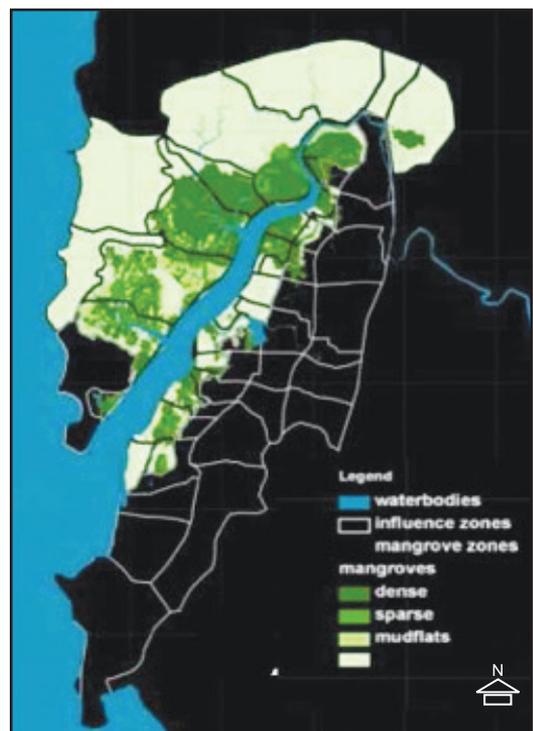
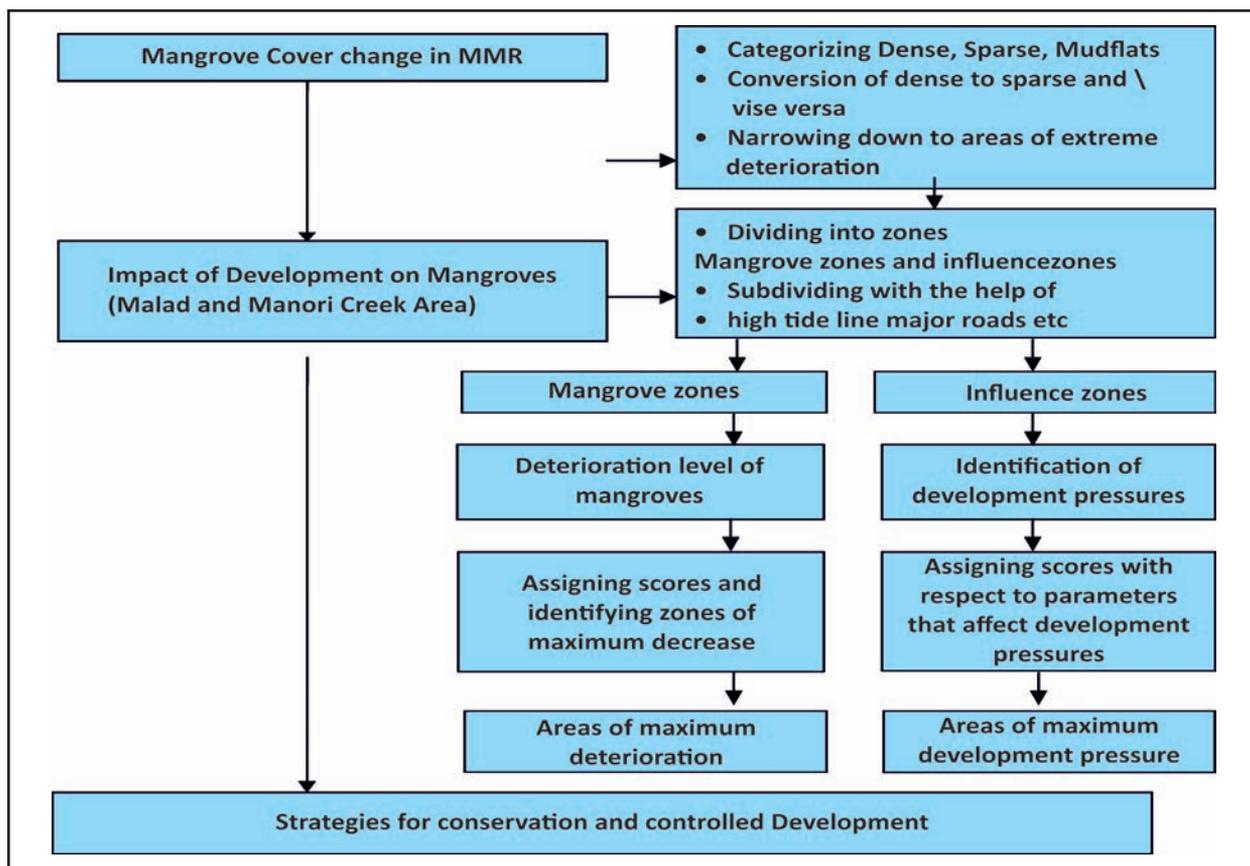


Table 1: Built Up Against Wet Land


3. ASSESSMENT OF IMPACT OF DEVELOPMENT ON MANORI CREEK AREA

Manori Creek (Fig. 4 and 5) area is divided into two zones Mangrove zones and Influence zones i.e. area around the mangrove that impacts the mangrove zones. These are further divided into smaller zones with respect to ward boundary, high tide lines, and the major roads in the area for assessment and to identify. Table - 2 also shows the deterioration levels of mangroves to identify zones where mangrove deterioration is maximum. Areas of high development pressure are zones where development pressure is maximum which in turn affects the mangroves. Fig. 6 shows the extent of deterioration of mangroves in each zone. Fig. 7 gives the final output map showing the zones in which maximum mangrove deterioration has taken place with respect to the above parameters. The areas highlighted are the ones with maximum deterioration.

3.1 Development Pressures Around Manori Creek

Development pressures around Manori Creek are tremendous. The analysis for development pressures are identified with respect to the parameters given below.



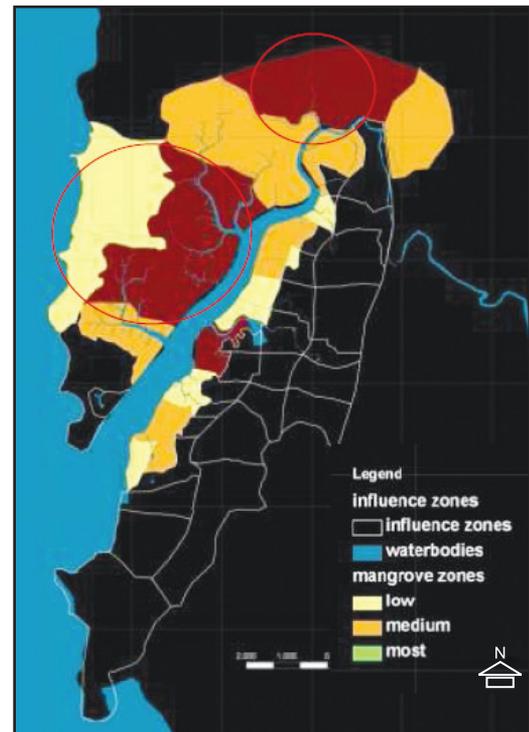
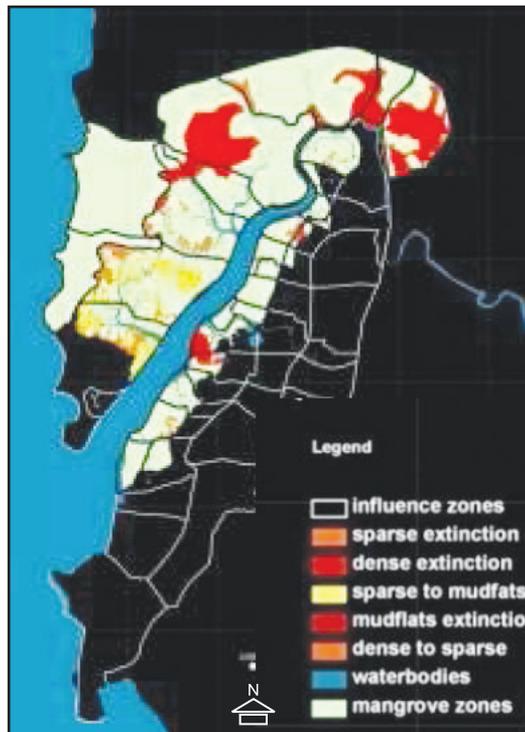
Table 2: Categories of Mangrove Deterioration

TYPE	Area (Sq km)
Dense to extinction	5.73
Dense to sparse	0.48
Dense to mud flats	0.14
Sparse to extinction	2.4
Sparse to mud flats	3.39

The parameters considered were selected as these parameters have an effect on the development pressures which in turn would have an impact on the mangroves.

- Population Density
- Population growth rate
- Accessibility
- Proximity to main roads.
- Land use Characteristics
 - Residential;
 - Slums;
 - Commercial; and
 - Amenities
- Activity pattern (Human Impact)
 - Solid waste dumping;
 - Upcoming projects (conversion of mangrove cover to another land use); and

Fig. 6: Deterioration Levels of Mangrove Cover- Manori Creek Area **Fig. 7: Most Affected Mangrove Areas**



- Pumping stations
- High tide and low tide levels

With the help of assigning scores depending upon the impact of development pressure in each zone for each parameter, the maps are generated for each parameter.

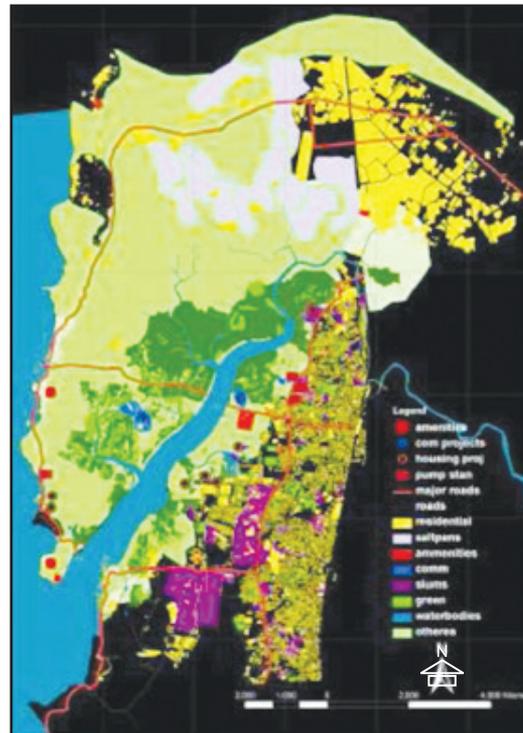
3.2 Existing Scenrio at Manori Creek Area

Accessibility: Manori is well connected to the other part of the city by major roads shown in the *Error! Reference source not found.*. Swami Vivekanand Link road cuts across vertically this area. Madh Marve Road runs almost parallel to Link road on the other side of the Manori Creek on the extreme left, connecting the Gorai area with the city. Gorai - Borivili Road cuts across the Madh Marve Road running perpendicular to it (Fig. 8).

Activity Pattern: The mangrove area is flanked by residential area on one side and vacant land on the other side. The residential area has green pockets in between. Various activities related to human impact take place in the area. There are four pumping stations and two discharge out falls, in this area. Essel World and Water Kingdom, famous amenity centres of Mumbai, are on the east side. Parking of Essel World has destroyed a chunk of mangroves (Fig. 9).

Fig. 8: Manori Creek- Accessibility

Fig. 9: Manori Creek Area - Activity Pattern





CRZ: CRZ - I, II AND III are present in the area. The entire mangrove area falls under CRZ - I where a buffer of 500 m is to be maintained (Fig. 10).

Land Use: The mangrove area is flanked by residential on one side and vacant land on the other side. The residential area has green pockets in between. There are irregular slum pockets along the stretch of different sizes. Salt Pans are there on the northern end of the area next to which there is high density residential development (Fig. 11).

3.3 Method of Analysis

The influence zones were given rankings for each parameter and maps for each parameter were generated. The final map was generated overlaying all the maps of each parameter.

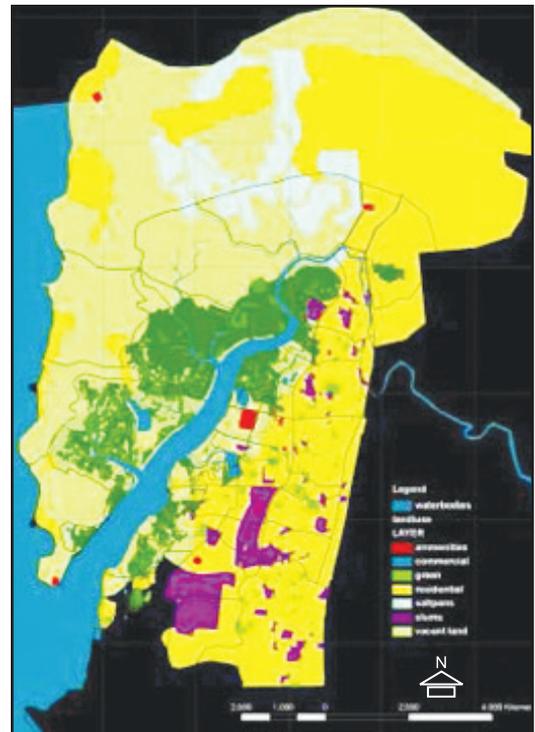
Analysis of Each Parameter: The Figures 12 to 17 indicates the development pressures in the area for each parameter respectively.

Error! Reference source not found. indicates the high impact of development pressure on the mangrove areas with respect to population density (Fig.12). The zone which has more population density has more development pressure so is given higher score. The population density is more in PN ward which is the

Fig. 10: Manori Creek Area - CRZ



Fig. 11: Manori Creek Land Use



southern most tip of Manori Creek area. RC ward has the least population density followed by RN and RS wards respectively.

Fig 13 indicates the high impact of development pressures areas related to land use characteristics of the area, the pressure is more if the land use is residential

Fig. 12: Population Density

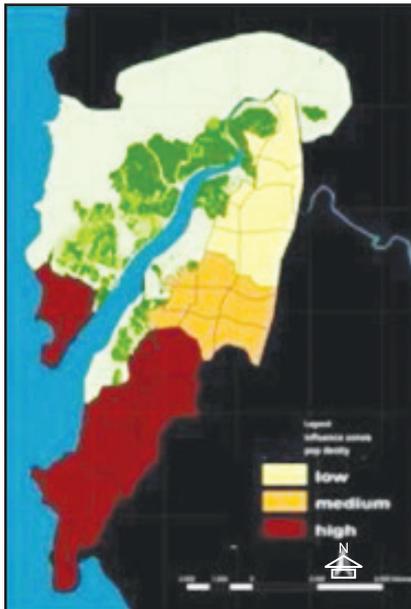


Fig. 13: Land Use

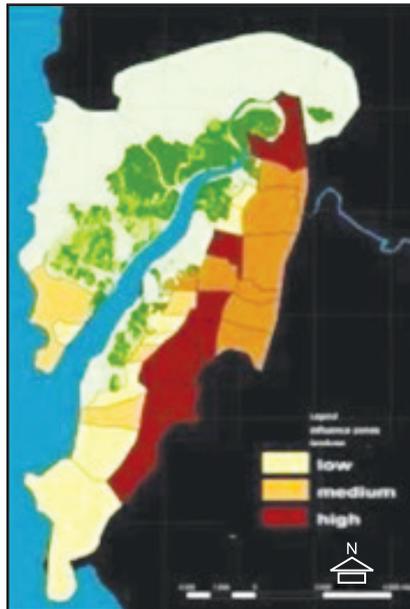


Fig. 14: Growth Rate

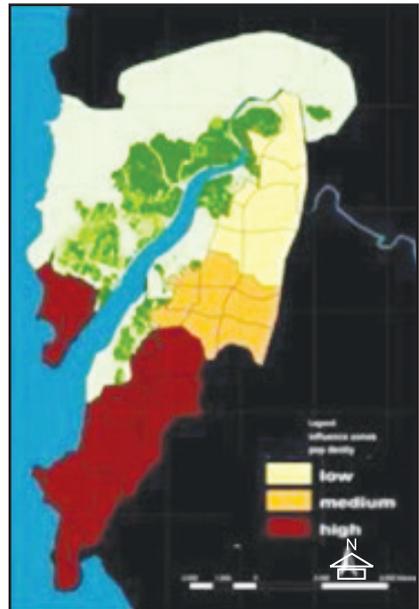


Fig. 15: Proximity

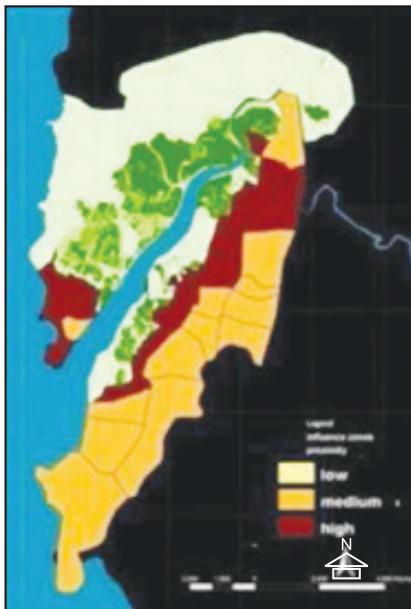


Fig. 16: Accessibility

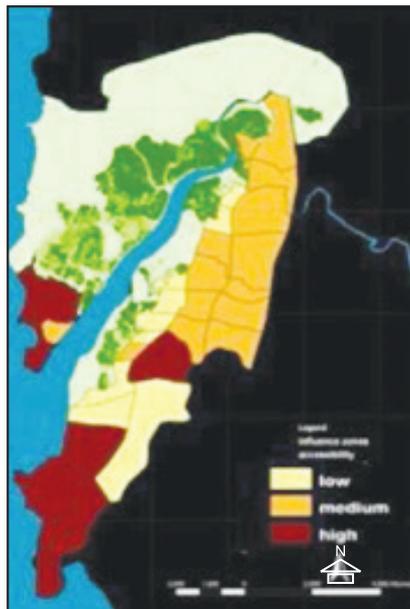
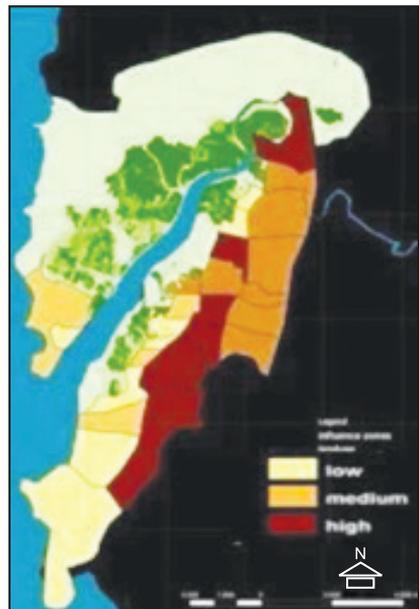
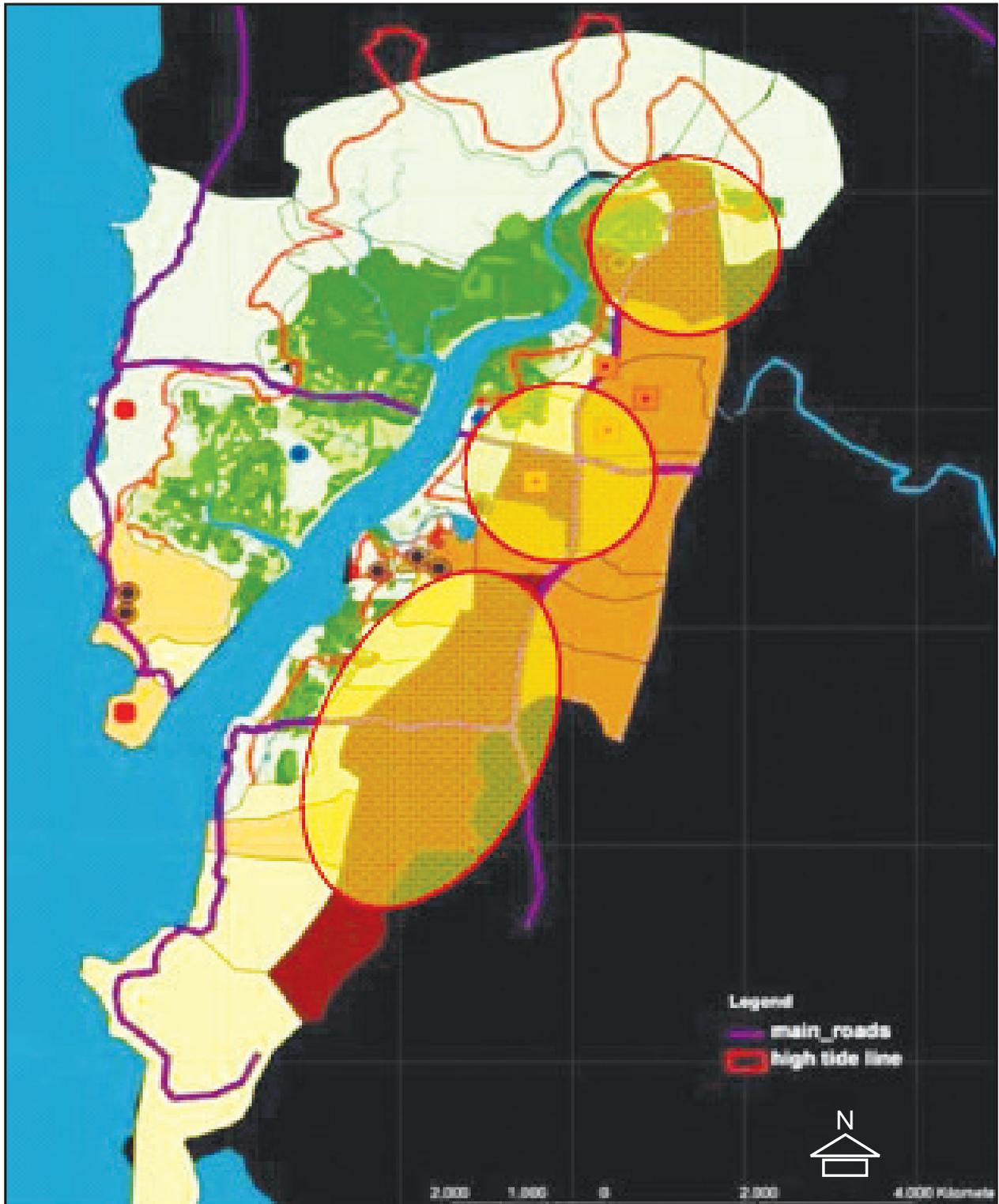


Fig. 17: High Tide Line



(These Figures are generated after assigning scores to the various development pressures)

Fig. 18: Areas Indicating High Development Pressures





or commercial, which is more susceptible to development than if the area is vacant or is used for recreation.

Error! Reference source not found. indicates the impact of development pressures in the area with respect to growth rate (Fig. 14). The zone with more growth rate is given higher score as it has more development pressure. The growth rate is maximum in PN ward.

Error! Reference source not found. indicates the impact of development pressures related to proximity (Fig. 15) to the mangrove areas. The zones adjacent to the mangrove area will be more hazardous to development. The zone which is nearer to the mangrove has more susceptibility to development pressure hence is given higher score. The level of proximity will decrease as one move away from the mangroves near the creek towards the city.

Error! Reference source not found. indicates the level of concern depending upon the accessibility (Fig. 16) of the zones in relation to the major roads passing through the area. The zones have more connectivity will be more susceptible to development.

Error! Reference source not found. indicates the zones closer to the HTL (Fig. 17) which will be the most critical if development pressure is more in those zones. The zones closer to HTL will have higher score. Development should not take place in the area inside the HTL or adjacent to the HTL. Almost all the mangrove areas come inside the HTL.

Fig. 18 is the final output map generated by summing up all the scores of individual parameters, which shows that there are three patches where the impact of development pressures will be high. The map also shows areas of high development pressures. The analysis of Manori Creek shows that the zones identified have high development pressures which can have an impact on the mangrove area. The area all around the creek shows high development pressures is due to all the above parameters. Hence the development pressures are due to the high impact of development and human interference.

4. ASSESSMENT OF IMPACT OF DEVELOPMENT ON MALAD CREEK AREA

Error! Reference source not found. shows the area is divided into mangrove zones and influence zones (Fig. 19 and 20) same as the Manori Creek in the previous section. These are further divided into smaller zones with respect to (i) ward boundary, (ii) high tide lines, and (iii) the major roads in the area. These zones are analyzed further to identify deterioration levels of mangroves (mangrove deterioration is maximum) and areas where development pressure is maximum.

Fig. 19: Division of Zones- Malad Creek

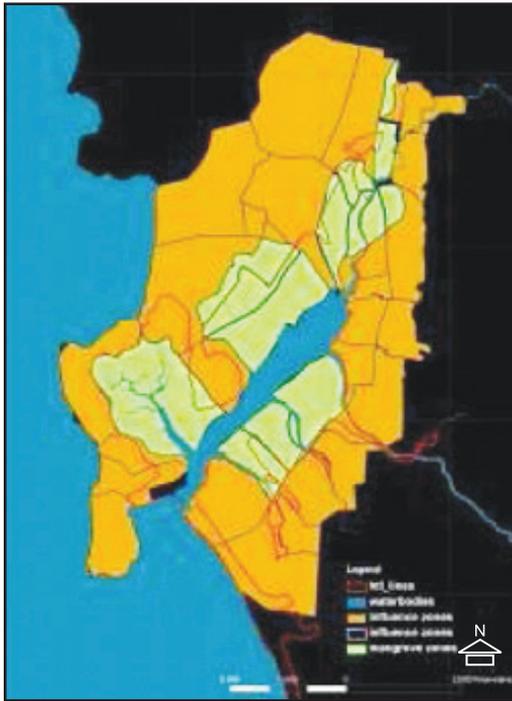


Fig. 20: Mangrove Zones, Malad Creek Area

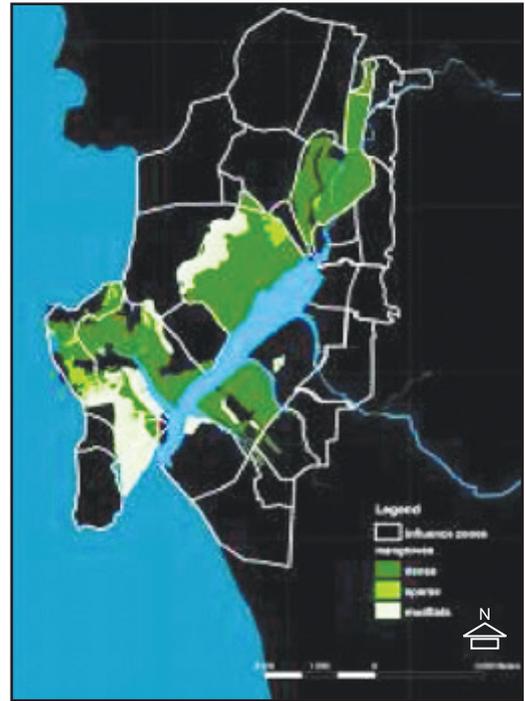


Fig. 21: Mangrove Deterioration - Malad Creek

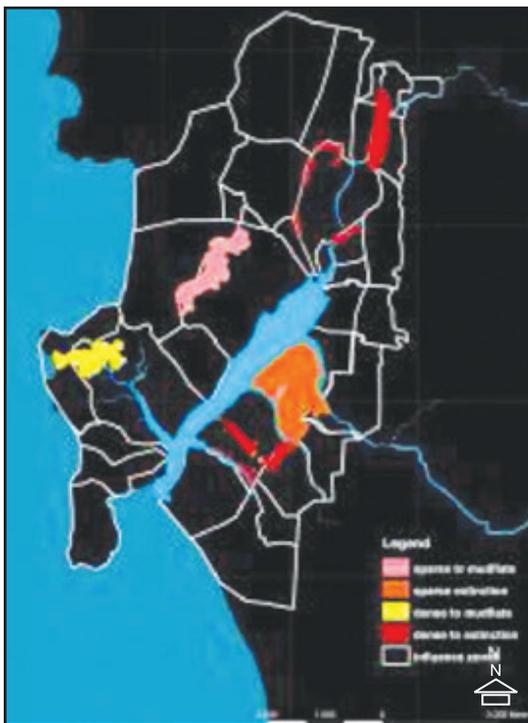
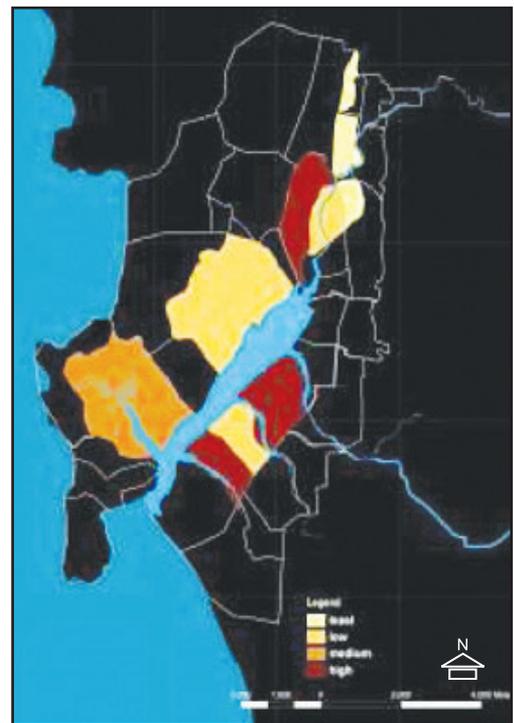


Fig. 22: Area of Maximum Deterioration - Malad Creek



4.1 Deterioration Levels of Mangroves and Development Pressure along Malad Creek

The level of deterioration (Fig. 21 and 22) of mangroves involves:

- Conversion of one type to another
 - Dense to mud flats; and
 - Sparse to mud flats
- Extinction of a particular type
 - Dense to Extinction; and
 - Sparse to extinction
- Land use changes over time
 - Conversion of mangrove cover for another purpose

Table 3: Subdivision of Mangroves in Malad Creek

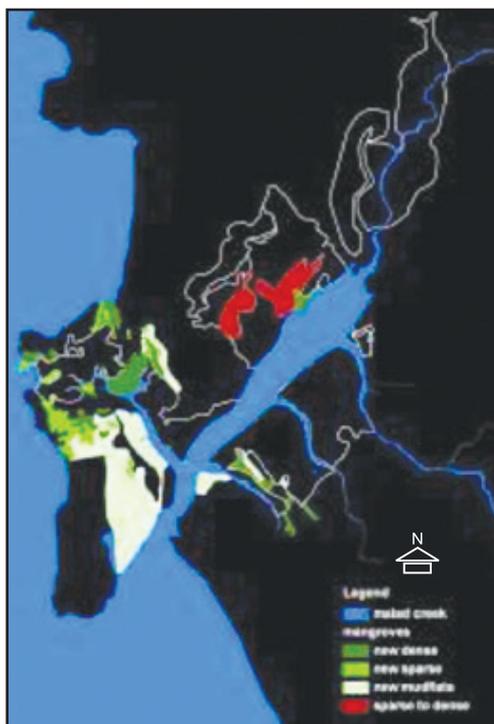
Subdivision of Mangroves	Area (Sq km)
Dense to Extinction	0.821
Dense to Sparse	-
Dense to Mudflats	0.555
Sparse to Extinction	1.2
Sparse to Mudflats	0.64

Error! Reference source not found. shows the extent of deterioration in each zone. There has been a conversion of dense to mud flats and sparse to mud flats and sparse to extinction. Table 3 indicates that there is more extinction of sparse mangroves than dense mangroves.

The zones identified which have high development pressures which can have an impact on the mangrove area. The zone towards the central area which shows high development pressure is due to the conversion of mangrove area into other land use. Hence the development pressures are due to the high impact of development and human interference.

Fig. 23 shows that there has been some increase in the dense mangroves and more increase in the mud flats in the southern part of the creek. The sparse have been converted to dense along the central part of the creek. This indicates that along with deterioration of the mangroves new mangroves have sprouted in some areas.

Fig. 23: Increase in Mangrove - Malad Creek



4.2 The Existing Scenario

Accessibility: Swami Vivekanand Road cuts across the area. Goregaon Link Road runs parallel to SV Road adjacent to the mangrove area. Madh Marve Road also runs almost parallel to SV Road on the western side (Fig. 24).

Land Use: Land use conversion has taken place all along the creek. A huge patch of mangrove is taken over to be converted into a golf course in the centre of the creek area. Slum encroachments have taken place along the Malad Creek. Dumping ground is located on the southern end of the creek which takes the waste temporarily of that area till it is taken from there to the main dumping ground of the city (Fig. 25).

CRZ: CRZ - I, II and III are present in the area. The entire mangrove area falls under CRZ - I., where a buffer of 500 m is to be maintained (Fig. 26).

The high tide line covers almost all the mangroves in the area and more. The entire CRZ comes within the high tide line.

Activity Pattern: The mangrove area is flanked by residential on one side and fairly less developed area on the other side. The residential area has green pockets and in between various activities related to human impact take place in

Fig. 24: Malad Creek - Accessibility



Fig. 25: Malad Creek - Land Use

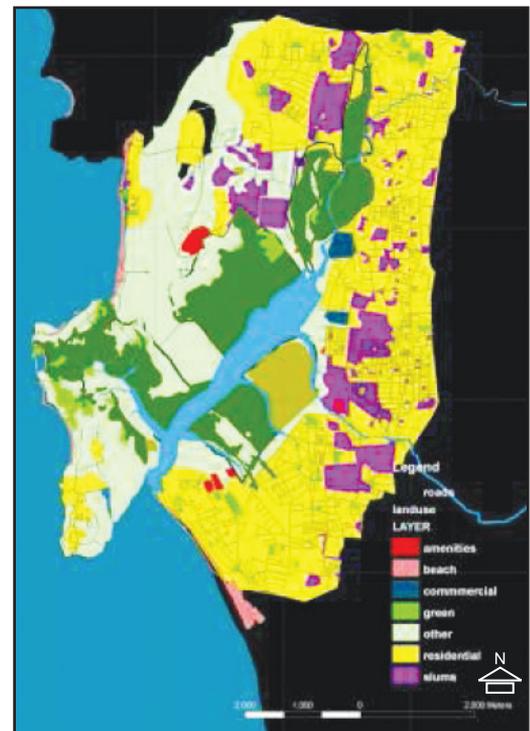


Fig. 26: Malad Creek - CRZ

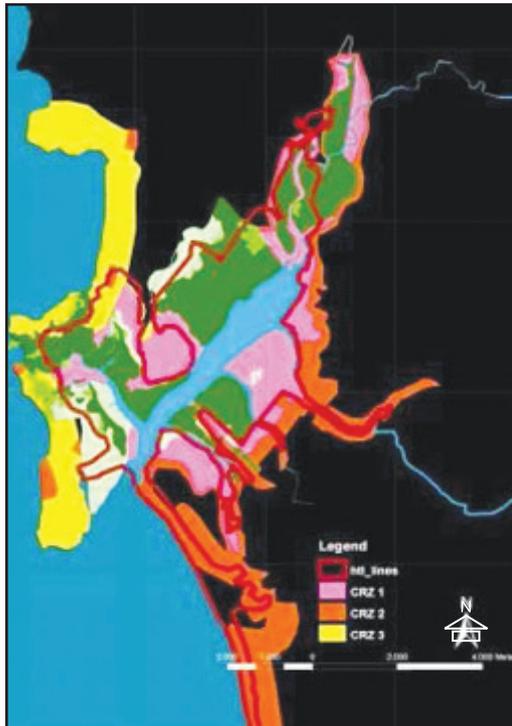
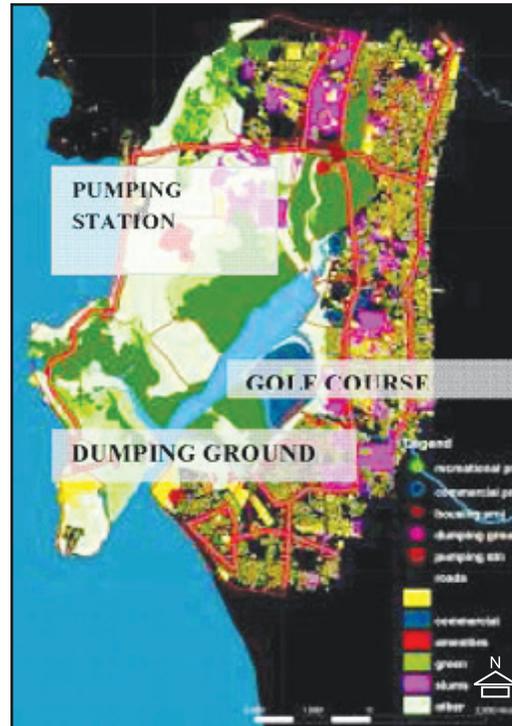


Fig. 27: Malad Creek - Activity Pattern



the area. There are three pumping station and one discharge outfall in this area. There is also a temporary dumping ground in the area where the waste of the area is dumped before it is taken to the main dumping ground (Fig. 27).

4.3 Method of Analyses

These zones were given weightages for each parameter and maps for each parameter were generated. The final map was generated overlaying all the maps of each parameter.

Analyses of Each Parameter: The Figures 28 to 33 indicates the development pressures in the area for each parameter respectively.

Error! Reference source not found. Fig. 28 indicates the impact of the development pressure with respect to the growth rate. Growth rate is maximum in R South ward which is the northern part of the Malad creek area. The growth rate is more on the western side of the creek than the eastern side.

Error! Reference source not found. indicates the impact of the development pressure with respect to the population density. The zone with higher population density is given a higher score. The population density is higher in the western part of the region compared to any other part (Fig. 29).

Fig. 28: Growth Rate

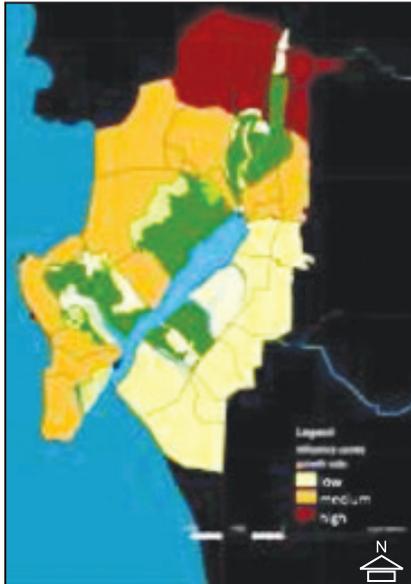


Fig. 29: Population Density

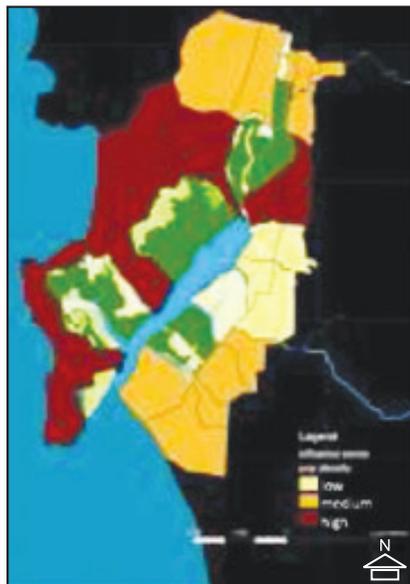


Fig. 30: Land Use



Fig. 31: Proximity

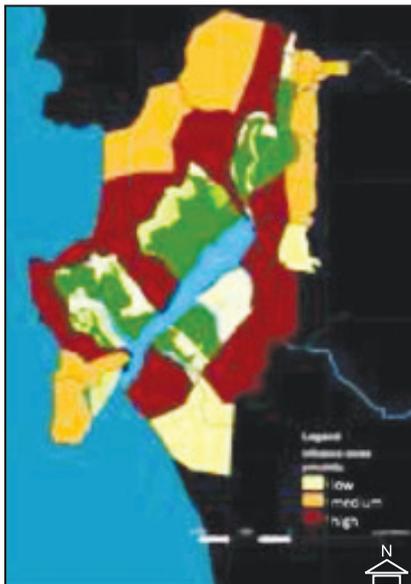
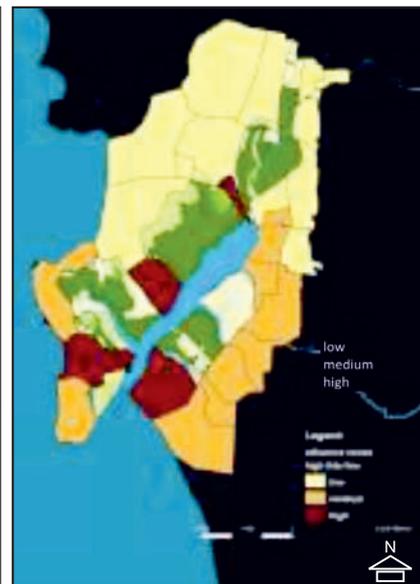


Fig. 32: Accessibility



Fig. 33: High Tide Line



Error! Reference source not found. Fig. 30 indicates the impact of the development pressure with respect to the land use. The impact of development pressure on the mangrove is higher in the north western part of the area.

Error! Reference source not found. indicates the impact of the development pressure with respect to the proximity (Fig. 31) to mangroves. The proximity to the mangroves decreases as the distance from the mangrove increases.



In contrast with the growth rate the proximity is high on the eastern and the western side adjacent to the mangrove area.

Error! Reference source not found. Fig. 32 indicates the impact of development pressure with respect to the accessibility. The impact of development pressure is higher where the Swami Vivekanand Road and the Madh Marve Road cuts across. The zone which is more accessible will have more impact of development pressure on the mangrove area.

Error! Reference source not found. Fig. 33 indicates the impact of the development pressure with respect to the high tide line. All the mangrove area falls inside the high tide line which also falls under the CRZ - 1.

Summing up all the score of each parameter, final maps showing the zones which have high development pressures are identified. There are three zones showing highest development pressure. These zones are the ones which has the most human impact.

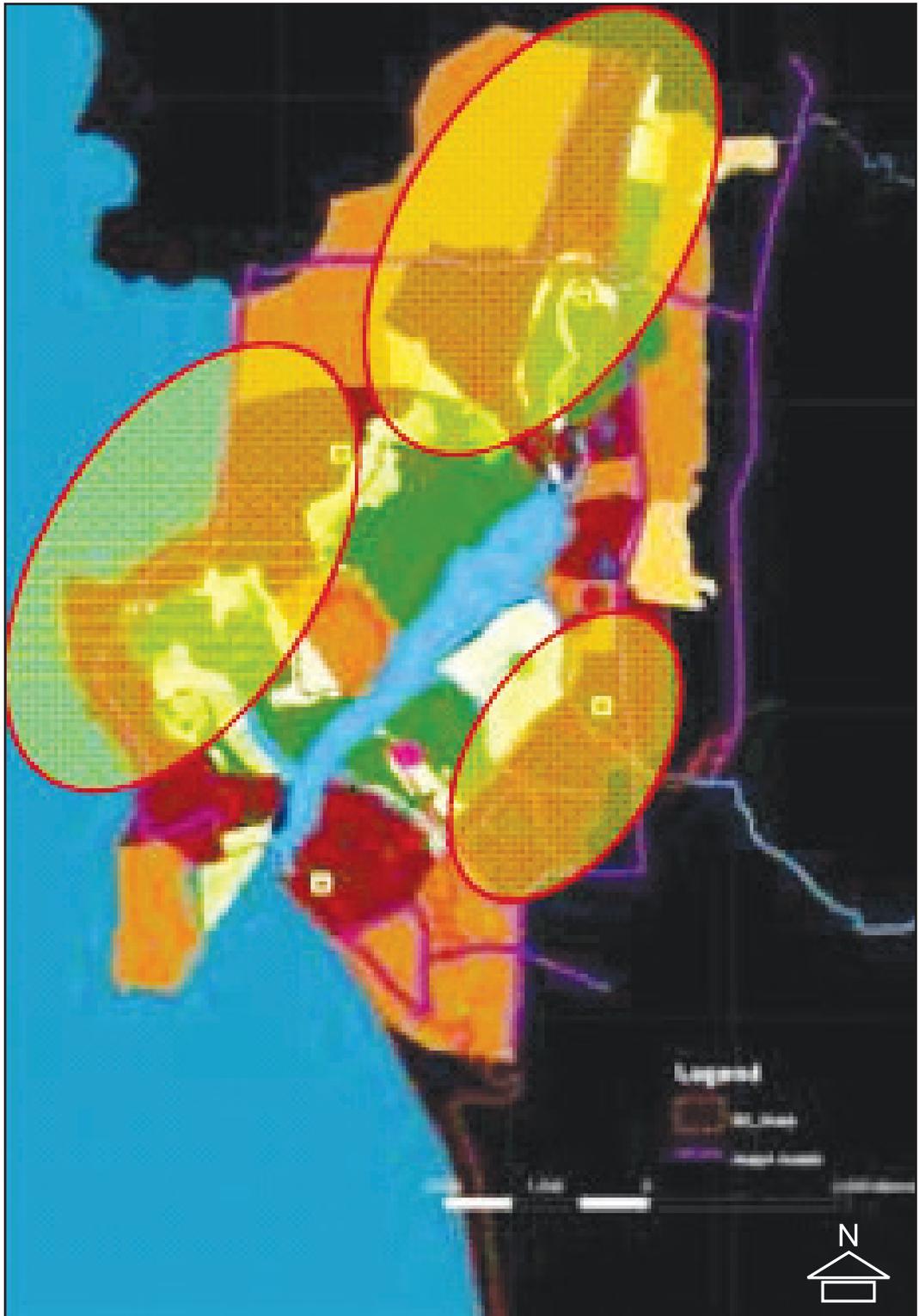
5. INFERENCES DERIVED

- The rapid and haphazard trend of urbanization in Mumbai and its suburbs has extended relentlessly beyond its administrative boundaries. This explosive growth of urban areas has brought about fundamental changes to the physical landscape.
- The analysis of the mangrove cover change in MMR clearly shows that the mangrove cover has deteriorated on the whole. Development could be one of the main reasons for it. The dense and sparse mangroves have decreased whereas the mud flats have increased.
- The mangroves have decreased either due to environmental conditions or due to human impact on them. Mangroves have been classified as a Coastal Regulation Zone-I (CRZ), which means that construction cannot take place without the express permission of the CRZ Authority. This makes all construction activity in mangrove areas a violation of CRZ rules.
- The development pressures (Fig. 34) around the Malad Creek is more compared Manori creek area. The reason for this may be that Malad area is much more developed and inhabited by people compared to Manori creek.

6. RECOMMENDATIONS

The conservation of mangroves has not been completely successful and they are fast disappearing owing to rampant construction and lack of government will for their protection. Hence, the measures to be taken should be of two kinds one which is at policy level and the other is setting up guidelines in terms of physical planning intervention, as given below:

Fig. 34: Development Pressures at Malad Creek





Physical Planning: Intervention can be done by giving 500 m buffers adjoining the mangrove area so that there is clear demarcation of mangrove area and the adjoining area. Network of roads should be provided so that there is a physical delineation after the buffer so that the development does not penetrate into the mangrove areas. High density commercial development should be restricted near the mangrove area and the density of development should decrease as the distance from the city and the mangrove area increases.

Policy Recommendations include detail separate plans for the individual areas, i.e. Specific Plans showing the physical attributes in detail so that planning for such environmentally fragile land is easier. The CRZ regulations should be strengthened by detailing the regulations with respect to the area and Transfer of Development Rights (TDR) can be given for mangrove area so that if any mangrove land is privately owned the ownership can be transferred to the government.

7. CONCLUSIONS

Mumbai can boast of some very unique and varied environments, ranging from coastal belts, creeks and mangroves, to many hills, forests, streams, lakes and ponds, all of them in a state of intense stress and marginalization today. Analysis of the mangrove cover change in MMR clearly shows that the mangrove cover has deteriorated on the whole. Development could be one of the main reasons for it. The dense and sparse mangroves have decreased whereas the mud flats have increased. The mangroves have decreased either due to environmental conditions or due to human impact on them.

The mismatch between supply and demand of land is one of the main reasons for the disappearance of environmentally fragile land like mangroves. The rapid and haphazard trend of urbanization in Mumbai and its suburbs has extended relentlessly beyond its administrative boundaries. This explosive growth of urban areas has brought about fundamental changes, to the physical landscape.

The pressures of rapid haphazard developments are: high and growing population density, relaxation of the building restrictions of no-development zones, along with the growth of pollution, encroachments, deforestation for fuel for economic gains, and destruction of natural landforms for real estate development which lead to the catastrophic depletion of the largest and most precious of the vanishing green zones of the city.

Over the years, excessive built up area intentionally strangulated the city's open spaces, wetlands, mangroves and salt - pan lands for commercial purpose. This loss and subsequent commercialization and concretization of open spaces has resulted into non-percolation of water, which previously could seep into the soil has now practically nowhere to go, ultimately leading to flooding.



Conservation of the mangroves which is still existing in the city and an initiative to safeguard them with the help of controlled development in the areas around the mangrove is one of the possible measures to help preserve them.

REFERENCES

- Acharya, A.K. and Nangia, P. "Population growth and changing land use pattern in Mumbai metropolitan Area"
- Godrej (2009) Godrej Mangroves in Mumbai, [Online] Available: <http://www.mangroves.godrej.com/MangrovesinMumbai.htm> [29 December 2009]
- Hirway, I. and Goswami, S. (2008) *Valuation of Coastal Resources: The Case of Mangroves in Gujarat*, Academic Foundation in association with Centre for Development Alternatives, Ahmedabad.
- Katiresan, K. "Threats to Mangroves", Centre for advanced studies in Marine Biology, Annamalai University.
- Kulkarni, V. Sustaining a coastal city: Approach to Save Mumbai Mangroves
- Kumar, R. (2010) Conservation and management of mangroves in India, with special reference to the State of Goa and the Middle Andaman Islands, [Online], Available: <http://www.fao.org/docrep/x8080e/x8080e07.htm> [05 January 2010]
- Latkar, P. Ecologically Integrated Spatial Planning Concepts
- Marpakwar, P. (2010) Easier CRZ norms to boost slum rehab, Times of India, March 18, Pg 13
- Mehta, M.K. (2009) Debris dumped on BKC mangroves, Times of India, November 11, Pg 13
- MMRDA, *Regional Plan for Mumbai Metropolitan Region 1996-2011*, MMRDA, Mumbai
- Sekhar, V. (2004) From Wetlands to Badlands, Times of India, 03 August.
- Singh, H.S. (2000) *Mangroves in Gujarat*, Gujarat Ecological Education and Research Foundation, Gandhinagar.
- TERI (2003) *Environmental Threats, Vulnerability, and Adaptation: Case Studies from India*, Teri Press: New Delhi.
- Unknown, "Unplanned Development may put city lakes at risk", Times of India, Mumbai.
- Urban Development Department, Government of Maharashtra (1977) Coastal Zone Management Plan for Maharashtra, Mumbai.
- Vijay, V. (2008) Mangrove mapping and change detection, Central Institute of Fisheries Education, Mumbai
- Viju, B. (2009) "Greens fear opening road to violation" Times of India, June 03, page 7
- Simit Bhagat, (2009), "Where is the fish on my plate" Times of India.



Sustainable and Resilient Water Management Practices for Residential Areas

Anchal Choudhary and Prof. Jagdish Singh, Ph.D.

Abstract

Urban population in India has been increasing at rapid rate. It is expected to increase at growth rate of 2.54 per annum. Water resources are facing an immense pressure from all the cities today. The urbanization in India has resulted into increase in constructed / built-up area. The total constructed / built up area taken as a whole in 2005 was near about 2.0 million sq meters which is anticipated to rise to 10 billion sq meters by 2030, which is out of the blue (CSE, 2014). As the built-up area increases, the natural ground water recharging decreases, and leads to increase in the urban flooding and the water logging problem in the monsoon season. Now, the other side of the face is that increase in urban areas has led to the over extraction of water resources that has resulted in the groundwater depletion. The situation is further deteriorated by increase of unplanned built-up areas resulting in land reclamation of water bodies, which are in particular prominent in cities.

1. INTRODUCTION

Water is life. From microorganisms till the most evolved creature humans need it for their survival. A day will be a larger unit to describe if a person is thirsty and if water is not given to him. So the water is as basic as air. Water is the most basic element for any settlement. India is a land that has always valued water and this is a reason that it has overcome all ups and downs and still a very fast emerging economy on the world map. In the present time urban centers are serving as the engines of economic growth. Today urban areas are the fast and upcoming centers of large internal and external investment. Cities are providers of large employment emerged as the hubs around which the Indian economy gravitates. Accordingly, it becomes essential that appropriate sustainable and resilient environment is created within these urban centers which would help them to be a magnet for investment, to offer employment, to guarantee a quality of life and to make them more dynamic.

Table 1: Contribution to Indian Economy by Urban Sector

Year	Urbanization	Share of GNP
1951	17.29%	29%
1971	19.91%	37%
1991	25.75%	50%
2001	27.75%	60%
2011	35-40%	72-75%

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2. UNDERSTANDING SUSTAINABILITY AND RESILIENCY

The concept of sustainability has emerged in 1986 when International Union for the Conservation of Nature showed its concern for the natural resources. Over a period of time it has been explained by various agencies and authors (Table - 2).

Table 2: Concept of Sustainability

S no.	Definition of Sustainability	Year	Author / source
1	Sustainability seeks to respond to five broad requirements: 1) integration of conservation & development, 2) satisfaction of basic human needs, 3) achievement of equity & social justice 4) provision of social self-determination & cultural diversity 5) maintenance of ecological integrity.	1986	International Union for the Conservation of nature.
2	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.	1987	Brundtland Commission
3	Sustainability requires at least a constant stock of natural capital, construed as the set of all environmental assets.	1988	David Pearce
4	Any form of positive change which does not erode the ecological, social, or political systems upon which society is dependent.	1988	William Rees
5	Sustainability implies that the overall level of diversity and overall productivity of components and relations in systems are maintained or enhanced.	1988	Richard Norgaard
6	Means "improving the quality of human life while living within the carrying capacity of supporting ecosystems".	1991	World Conservation Union
7	Sustainability is the ability of system to sustain the livelihood of the people who depend on the system for indefinite period.		Otto Soemrwoto
8	Sustainability equals conservation plus stewardship plus restoration.	1994	Sim Van der Ryn.
9	Sustainability is the fundamental root metaphor that can oppose the notion of continued exponential material growth.-	1992	Ernest Callenbach
10	Sustainability is to maximize simultaneously the biological system goals (genetic diversity, resilience, biological productivity), economic system goals (satisfaction of basic needs, enhancement of equity, increasing useful goods & service) & social system goals (cultural diversity, institutional sustainability, social justice, participation).	2012	Barbier, as cited in Juwana, Muttill, & Perera
11	Sustainability is meeting human needs while conserving the Earth's life support systems and reducing hunger and poverty.	2012	Palmer, as cited in Juwana, Muttill, & Perera, 2012)
12	Is the ability to provide and manage water quantity so as to meet the present needs of humans and environmental ecosystems, while not impairing the needs of future generations to do the same.	2012	Mays, as cited in Juwana, Muttill, & Perera.
13	Is the ability to use water in sufficient quantities and quality from the local to the global scale, to meet the needs of humans and ecosystems for the present and the future to sustain life, and to protect humans from the damages brought about by natural and human-caused disasters that affect sustaining life.	2012	Mays, as cited in Juwana, Muttill, & Perera
14	Is the process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystem.	2012	GWP-TAC, as cited in Juwana, Muttill, & Perera, 2012



From Table - 2 it can also be concluded in the simple terms that “Sustainability is the one in which the system remains in the limits of its carrying capacity, utilizes its resource in a way that actions does not impair the system for the future generations development”. The term resiliency was introduced later in 21st century, to define the state of any city or any area after been faced wide array of shocks and stresses including natural hazards.

Resiliency when defined (Table - 3) in the urban context it would be, “Resiliency is the elasticity of a dynamic system in the constant change under which it is able to face disturbance and does not lose its substance”. These disturbances are called as stresses and are categorized as natural, technological, economic and human.(Choudhary and Singh, 2015). Climate change and environmental change has occurred due to massive urbanization which has led to increase of natural disturbances for a city. Flood and drought are the result of natural stresses that is seen in urban Indian context. Technological stresses are those which are occur due to the technical failure in an urban system. The economic stresses are the ones that are the result of disturbances in the economic aspect of a city. Economic aspects of a city are effected by various factors as government policy, fund allocation, urban local government and citizen contribution. As the word suggests human stresses are those which result due to the human errors. These may be at any level varying, from operational errors of water supply to the over extraction of ground water resource.

Table 3: Concept of Resiliency

SNo.	Definition of Resiliency	Year	Author/ Source
1	“Urban resilience generally refers to the ability of a city or urban system to withstand a wide array of shocks and stresses”.	2012	(Leichenko, as cited in Agudelo-Veraa, Leducb, Melsa and Rijnaartsa, 2012).
2	“Resilience is a measure of robustness and buffering capacity of the system to changing conditions”.	2012	(Berkes and Folke, as cited in Agudelo-Veraa, Leducb, Melsa and Rijnaartsa , 2012)
3	A simple definition of resilience is the ability of a city to absorb disturbance while maintaining its functions and structures.	2013	(Holling & White, as cited in Lu and Stead, 2013)
4	Scholars considered resilience as the ability of a social system to withstand disturbances and to re-organize it-self following disturbance-driven changes.	2013	(Walker et al., as cited in Lu and Stead, 2013)
5	“Resiliency is actually strength to absorb disturbances by stressors and achieve a new stable state which has overcome the disturbances. This new state of city is not always the same as previous state, in fact most of the time it is a new state since all the urban settlements are in a dynamic state of constant change.”	2015	(Choudhary and Singh, 2015)



The concept of sustainable and resilient water management practices dates back to ancient time. Two parameters were important and recognized at that time by the civilizations, which includes - to provide clean water and to provide plentiful water.

3. GLIMPSES FROM ANCIENT INDIA

Bharat (Ancient India) is a land that has preserved and valued its water resources since ages due to its culture and tradition. This is the main reason for the development we see today and the country hold very fast developing economies of the world. The sages and ancient scripts say that water has a very enormous power it can cut a mountain when a river originates and can destroy a whole settlement when the deluge comes. As observed that if a raindrop goes in the mouth of snake it becomes poison and if it goes inside shell it transforms to a precious pearl which is very valuable and everyone in the world is fond of it. So the water is extremely valuable resource which is losing its importance day by day due to various human interventions.

Table 4: Water Management System in Ancient India

Timeline	Benchmarking Water Management Systems From Ancient India	Characteristic Feature of Water Management.	Contribution to the Sustainability and Resiliency
3rd millennium B.C.	Studies in Baluchistan and Kutch gives evidence of - Dams built of stone rubble	Water storage at the community level	Social Sustainability Resiliency
3000-1500 B.C.	Indus - Saraswati Civilization (Harappa and Mohenjodaro) gives evidence of - Probably the earliest tanks (that were deep and rectangular) built in India. An individual well has been found in each house. Several reservoirs have been found to collect rainwater runoff.	Water storage at the community level. Source of water at individual level. Water conservation	1. Environmental & Social Sustainability 2. Resiliency
321 - 291 B.C.	Chandragupta Maurya's rule gives evidence of - Dams, lakes & irrigation systems	Water storage at community level. Water source at community level.	1. Social sustainability 2. Resiliency
3rd Century B.C.	Kautilya's Arthashastra refer to -Water harvesting systems used for irrigation.	Water conservation for community use.	1. Social and environmental
1st Century B.C.	Sringaverapura near Allahabad tells that - It had a system to use floodwaters of the Ganges through a well refined water harvesting system.	Harvesting and utilization of flood water of river Ganges.	1. Environmental sustainability 2. Resiliency

Source: Compiled by the author from various sources



The glimpses from the history are enough for anyone to know about the India's rich tradition of water management systems. Table - 4 sums up the benchmarking water systems from ancient India which made the water resource sustainable and resilient and led the way for the growth and flourishing the civilizations. These splendid water systems of ancient India were:

From above Table - 4, it can also be observed that sustainability and resiliency are of major concern for a civilization to develop and flourish since long.

3.1 Historical Water Systems in Madhya Pradesh

Valuable historical water systems that helped to achieve sustainability and resiliency of water and catered to the needs of people (Table - 5):

The water management systems made the culture flourish and develop and bring them to the present state.

4. WATER MANAGEMENT SYSTEMS IN URBAN RESIDENTIAL AREAS

Learning from the past various initiatives have been taken in different urban pockets of cities to manage their water resource in sustainable and resilient manner. This helps to reduce the load of urbanization over natural water resources and also helps to retain in its viable state. The various executed examples are tabulated in two different tables. Table - 6, highlighting the issues being resolved by using the water management systems, and Table - 7, shows the design and the economic aspect.

Table 5: Water Management System in Madhya Pradesh

S. No	Timeline	Present City	Historical Place	Name of structure	Importance of structure.
1	5 th century	Gwalior	Gwalior Fort	Suraj kund	This is the original tank where the army of Suraj Sen and he (Commander) himself got rid of the dangerous epidemic. This tank is older than the fort and is located inside the walls of fort
2	9 th to 16 th century	Areas of Damoh, Sagar District	Bundelkhand	Network of several hundred tanks. Later used lime mortar masonry to build tanks.	To ensure satisfactory level of groundwater Chandela Kings established a network of several hundred tanks. Construction was done by stopping flow of water (rivulet) running between two nearby hills with a massive earthen embankment. Hills have quartz reefs running under them which helped to confine water. Later Bundela Kings came who build tanks bordered by steps, pavilions and royal gardens using lime mortar masonry. Use of tanks was



Table 5 Continued...

					<p>by all though they were build close to places and temples. Till present day these wells in the vicinity of these tanks yield water and also recharge ground water.</p>
3	11 th Century (1005-1055 A.D)	Bhopal	Old City of Bhopal	Upper lake and lower lake	<p>Parmara Raja Bhoj during his tenure as a king of Malwa (also established Bhopal) built the largest artificial lake (65,000 acres) in India fed by 365 streams and springs.</p>
4	13 th century	Delawadi	Ginnorgadh Fort	Chor Bawadi	<p>Located on the Vindhya ranges this fort is at a height of 1775 feet above MSL. Being at this height it's amazing that this fort has 25 wells and 4 ponds.</p>
					<p>There are 64 bawadis around this fort. Chor Bawadi is a 05 storied structure & is on western side of the fort. It is supposed that there was a hidden escape route from fort to Bawadi for survival during emergency situations.</p>
5	15 th century	Chanderi	Chanderi city	Battis Bawadi	<p>City of Chenderi was urbanized in 11th century by Kirti Pal Kumrudev which had 7 fortification. The city had a spread of 30 miles. Sultan Gayasuuddin Khilji order to construct this Bawadi so as to cater the water demands of city. Its specialty of the Bawadi is that water level at every ghat is equal. It is of unique importance in 1200 Bawadis in Chanderi.</p>
6	16 th century	Mandu	Castle of Bajbhadur	Reva Kund	<p>Bajbhadur constructed this pond in the form of a lake. This had rainwater harvesting structure which catered the water demands of Castle of Queen Rupmati.</p>
7	17 th century	Khandwa district	Burhanpur town	Old water works of Burhanpur town	<p>Abdul Rahim Khan (ruler) had frequent battles with Mughals. Apprehension that river Tapti could is poisoned if a war broke out, and so the water could be suicidal. Under his reign in 1615, a Persian geologist, Tabkutul Arz investigated the valley and devised underground tunnels and infiltration galleries to supply the town with water. Gradient and gravity are parameters on which the whole system is based upon.</p>

Source: Discussions with Madhya Pradesh Tourism Department and Madhya Pradesh govt.



Table 6: Issues Resolved by Using Water Management Practices

Sr. No.	Residential zone (base on spatial planning)	Areas typology	Annual Ave. Rainfall / Rainy days.	Case study	Issue Solved
1	High density	Residential Colony	797.3/ 39.1	Residential Colony, Nizamuddin (EAST), New Delhi.	Problem of water logging- Natural recharge is difficult because sub soil is a mix of sandy and clayed soils.
		Residential Colony	797.3/ 39.1	Defence Colony, New Delhi.	Ground water decline especially in summers.
2	Medium Density	Multi-Story Apartments	1146.7/51.4	Multi-Story Apartments, Priyadarshini Heights, Bhopal, M.P.	No municipal supply till 2009 Recharge bore wells End tanker supply especially during summers
		Housing Society	740.6/33.3	Housing Society, Bimanagar Cooperative, Housing Society, Ahmadabad ,Gujarat.	Drought prone area Erratic water supply from municipality Dry bore wells
		Residential Colony	974.5/58.4	Residential Colony Rainbow Drive Colony, Bangalore, Karnataka.	No water supply from the Bangalore Water Supply and Sewage Board. Fast declining ground water yield.
3	Low Density	Independent Residences	857.8/58.4	Residence of H Ramesha Bogadi, Mysore, Karnataka	Saline municipal water High TDS in municipal water
			837.9/45.2	Residence of N Arunachalam Kadachenandal, Madurai, Tamilnadu	No municipal supply Entire dependency on ground water
			1933.9/86.2	Residence of Stephen Alter Landour, Mussoorie, Uttarakhand	Erratic municipal supply Once in two days normally. Once in three or four days in summer.
			1008.3/48	Residence of O P Sharma, Pipliyakumar, Indore, M.P.	Water Scarce region Decline of ground water levels. No municipal supply.
			2167.4/112.7	Deputy Chief Minister's Residence Barik Point, Shillong, Meghalaya	Water shortage during summer months. Rugged Terrain , limits possibility of ground water

(Source: Compiled by Author)


Table 7: Design and the Economic Aspect of Water Management System.

Sr. No.	Case study	Roof Area	Storage System	Recharge System	Year	Cost	Designed and implemented by
1	2	3	4	5	6	7	8
1	Residential Colony, Nizamuddin (EAST), New Delhi.	Roof Top & surface area - 2.01 lakh sq m.	Ground water recharge	Collection Chamber (1 per recharge structure): 0.45 m* 0.45 m* 0.5 m Recharge pits(11): 1m*1m*2m Recharge bore: 10 m deep with 150 mm dia	2004	1.79 lakh	Designed by : Center for Science and Environment, New Delhi Implemented by: Resident Welfare Association, Nizamuddin (East).
2	Defence Colony, New Delhi.	Total roof top - 26,087	Ground water recharge	Dim - 1.5 m*1 m* 2 m, 150 mm dia, 17 m deep.	2003	2.58 lakh	Design- CSE, New Delhi, Implemented by - Defence Colony, C-Block, Resident's Welfare Association.
3	Multi-Story Apartments, Priyadarshini Ht., Bhopal, M.P	Total rooftop area: 540 sq m	Ground water recharge.	- In use bore well As the area lies on Deccan Basaltic Rock, drilling a recharge well would have been expensive.	2002	6500	Designed by: Brijesh Namdeo, Association for Motivation of Biosphere and Environmental Revolution (AMBER) society, Bhopal. Implemented by - Priyadarshini Heights Resident's Association.
4	Housing Society, Bimanagar Cooperative Housing Society,	Total rooftop area: 16,635 sq m	Ground water recharge.	Recharge through percolation well.	2002	1.6 lakh	Designed by- PRAVAH & Center for Integrated



Table 7 Continued...

1	2	3	4	5	6	7	8
	Ahmadabad, Gujarat.			Dim of well: 6 m dia, 10.7 m depth			Development, Ahmedabad. Implemented by - Bimanagar Cooperative Housing Society.
5	Residential Colony Rainbow Drive Colony, Bangalore, Karnataka.	Total area: 137,593 sqm (34 acres) Area of unpaved surfaces (15 % of total area): 20,639 No. of Units:240	Ground water recharge	Recharge wells in Strom water Drains Recharge wells 20 in strom water drains 51 in homes 71(3ft dia, 20 ft deep)	2008	NA	Designed by: Biome Enviromental Solutions Pvt Ltd. Bengaluru Implemented by: Rainbow Drive Residents' Welfare Association
6	Residence of H Ramesha Bogadi, Mysore, Karnataka.	Roof Area: 125 Sq m.	Storage System: 3 tanks Kitchen Tank- 1000 liters Bathroom Tank- 5000 liters Underground Sump- 6000 liters	Recharge System:1 Recharge Pit: 4ft*3ft*3ft	2003	12000 Excluding cost of sump	Designed and Implemented by: H Ramesha
7	Residence of N Arunachalam Kadachenandal, Madurai, Tamilnadu	Roof Area: 174 sq m	Storage system : 1 storage tank: 3.66m*1.22m* 2.44m (stores10 895 liters)	Recharge system: 1 recharge pit (90 cm dia, 3m depth)	2006	44000	Designed and Implemented by: N Arunachalam
8	Residence of Stephen Alter Landour, Mussoorie, Uttarakhand	Total Roof Area: 644sqm Roof for RWH: ¼ th of total roof area:161 sqm	Storage system:2 underground sumps (40,000 20.000 litre capacity)	Settling tank: 2(1,000 and 400- litre capacity) Sedimentation tank: 2.5ft*2.5ft*2ft	1998	80,000	Designed and Implemented by: Stephen Alter



Table 7 Continued...

1	2	3	4	5	6	7	8
9	Residence of O P Sharma, Pipliyakumar, Indore, M.P.	Total rooftop area:120 sqm	Volume of storage tank:100,000 litres	NA	2000	2.5 lakh	Designed and Implemented by: O P Sharma
10	Deputy Chief Minister's Residence Barik Point, Shillong, Meghalaya	Total roof top area:186.2sq m	Storage system: 3 tank (each 1000 litres)	NA	2001	NA	Designed and Implemented by: WAPCOS Ltd, New Delhi and Central Ground Water Board, Shillong.

Table 8: Assessment of Water Management Practices

Sr. No.	Issue Solved	Case study	Contribution to Sustainability			Contribution to Resiliency (reduction in stress)			
			4	5	6	7	8	9	10
1	2	3	Env.S	Eco.S	Soc.S	N	T	E	H
1	Problem of water logging.	Residential Colony, Nizamuddin (EAST), New Delhi.	2	1	2	2	0	2	2
2	Natural recharge is difficult because sub soil is a mix of sandy and clayed soils		2	2	1	2	0	1	2
3	Ground water decline especially in summers.	Defence Colony, New Delhi.	2	2	1	2	0	2	2
4	No municipal supply till 2009	Multi-Story Apartments, Priyadarshini Hts, Bhopal, MP(India).	0	2	1	0	0	2	2
5	Recharge bore wells		2	2	1	2	0	2	2
6	End tanker supply especially during summers		0	2	1	0	0	2	2
7	Drought prone area	Housing Society, Bimanagar Cooperative, Gujarat.	2	2	1	2	0	2	2
8	Erratic water supply from municipality		0	2	1	0	0	2	2
9	Dry bore wells	Housing Society, Ahmadabad, Gujarat.	2	2	1	2	0	2	2
10	No water supply from the Bangalore Water Supply and Sewage Board.	Residential Colony Rainbow Drive Colony, Bangalore, Karnataka.	0	2	1	0	0	2	2
11	Fast declining ground water yield.		2	2	1	2	0	2	2



Table 8 Continued...

1	2	3	4	5	6	7	8	9	10
12	Saline municipal water	Residence of H Ramesha Bogadi, Mysore, Karnataka.	2	2	1	0	2	1	0
13	High TDS in municipal water		0	2	0	0	2	1	0
14	No municipal supply	House of NArunachalam Kadachenandal, Madurai, TN	0	2	1	0	0	2	2
15	Entire dependency on ground water		2	1	0	2	0	2	2
16	Erratic municipal supply. Once in two days normally.	Residence of Stephen Alter, Landour, Mussoorie, Uttarakhand	0	2	2	0	0	2	2
17	Once in three or four days in summer.		0	2	2	0	0	2	2
18	Water Scarce region	Residence of O. P. Sharma, Pipliyakumar, Indore, M.P.	2	2	1	2	0	2	2
19	Decline of ground water levels.		2	2	0	2	0	2	2
20	No municipal supply		0	2	1	0	0	2	2
21	Water shortage during summer months.	Deputy Chief Minister's Residence, Barik Point, Shillong, Meghalaya.	0	2	1	2	0	2	2
22	Rugged Terrain, limits possibility of ground water		0	2	0	0	0	2	2
	Total (44)		22	42	21	22	4	41	40
	Percentage		50%	95.45%	47.72%	50%	0.09%	93.18%	90.90%

5. ASSESSMENT OF WATER MANAGEMENT PRACTICES

Assessment has been done for the validation of these practices, (Table - 8), however, there are issues which were solved related to the various case studies. These components are evaluated on 0-2 ordinal scale. These components receive a score of 0 if the issue solved do not contribute to the sustainability and resiliency component; scored as 1 if the issue is solved contributes partly to sustainability and resiliency; and scored as 2 if the issue solved fully contribute to the sustainability and resiliency. So there are a total of 44 credits for each component of sustainability and resiliency. Evaluation criteria have been adopted from Fu and Tang (2013).

6. CONCLUSIONS

Water management practices were used to solve various issues in different urban residential areas. When assessed it was found that these practices contributes 50 percent of environmental sustainability, around 95 percent of economic sustainability, and 48 percent of social sustainability. The resiliency



part shows that reduction in natural stress is 50 percent, technological stress is negligible, economic stress is 93 percent and human stress is 91 percent. These water management practices highly endorse sustainability and resiliency. Issues pertaining to economic aspects get solved nearly entirely whereas social and environmental aspects in a moderate way. It is clear from the above examples that water management practices serve two extremes in the case of water resources namely - floods and droughts. So it will be better to say that it is a key to achieve water resource sustainability and resiliency in residential areas. For a developing nation like India these practices are very useful and fruitful.

REFERENCES

- Agudelo-Vera, C.M., Leduc, W.R., Mels, A.R. and Rijnaarts, H.H. (2012) Harvesting urban resources towards more resilient cities, *Resources, Conservation and Recycling*, pp. 3-12.
- Choudhary, A. and Singh, J. (2015) *Technical Papers - High Growth Inclusive Urban Settlements* (pp. 153-157), Sixty Third National Town and Country Planners Congress, ITPI, Chennai.
- Desouza, K.C. and Flanery, T.H. (2013). Designing, planning, and managing resilient cities: A conceptual framework, *Cities*, pp. 89-99.
- Dieleman, H. (2013) Organizational learning for resilient cities, through realizing eco-cultural innovations, *Journal of Cleaner Production*, pp. 171-180.
- Fu, X., and Tang, Z. (2013) Planning for drought-resilient communities: An evaluation of local comprehensive plans in the fastest growing counties in the US, *Cities*, pp. 60-69.
- Jyothiprakash, V. (2012) Water resource scenario and management techniques, *National workshop on recent advances in water resources management*, Maulana Azad National Institute of Technology, Bhopal.
- Lu, P. and Stead, D. (2013) Understanding the notion of resilience in spatial planning: A case study of Rotterdam, The Netherlands, *Cities*, pp. 200-212.
- Miller, G.T. (2000) *Living in the environment: Principles, Connections, and Solutions*, Brooks/Cole Publishing Company, Belmont, CA.
- Pickett, S.T. Cadenasso, M.L. and Grove, J.M. (2004) Resilient Cities: meaning, models, and metaphor for integrating the ecological, socio-economic, and planning realms, *Landscape and Urban planning*, pp. 369-384.



Factors Effecting Innovation Driven Livability: Case of Kolkata Metropolitan Area

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Abstract

In this paper an attempt to arrive at the initial factors responsible for innovation driven livability has been made. The cause responsible for the livability of the metropolitan area as an effect of development of an innovation zone based on economic activity is considered. Firstly, the understanding of the concept of innovation and livability is developed and then moving to the approach for the identifying factors enabling innovation driven livability is discussed. The paper contributes to the approach of the innovation in metropolitan area which leads to livability. The result provides factors extracted as being primary components for the study of innovation driven livability and puts forward the possibilities of finding more factors according to the needs of the development.

1. INTRODUCTION

In the fast growing world, development process has been catalyzed by various factors influencing the economic, physical and social life of the people in metropolitan areas. The level of inclusion of factors ensures the success or failure of different schemes targeting development of urban and rural areas. Since metropolitan areas are striving for more and more opportunities for growth to become increasingly livable, there is a need to address livability from different angles and identify issues related to quality of life. Research emphasizes that for the achievement of a more productive use of the potential, in terms of traditional competence and skills, tacit knowledge, and specific innovation processes of each region and these potential can be reinforced corresponding to each region's innovation profile through investments in human capital and research (Camagni and Capello, 2013). Thus, the inherent strength of each area can be utilized to improve future economic opportunities establishing its identity. Inherent strength of an area can be attributed to factors such as heritage and historical background, economic activities including creative products and services.

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Normally development strategies propose solutions addressing multiple issues in order to optimize resource and time. However, there is a need for further reforms in drafting developmental strategies to encourage innovation with the existing potentials in required sectors.

Generally the success of Development Plans depend on how integrated it is with the demands of the people. In light of this, the fulfilment of policies by researchers and decision makers starts with assessment of symbiosis between people and surrounding environment in creating livable space, satisfying triad objectives of work, place and folk. Moreover, to ensure healthy growth in the metropolitan areas proper implementation of the Development Plans considering future requirement is need of the hour. Development Plans are intended to augment urban space, encouraging people to thrive and grow in a livable environment. Integrated policies formulated in development plans facilitating a range of employment opportunities as well as basic infrastructure provision catering to all sections of a society, ensures livable environment. However, absence of integrated policies, have created hindered development of infrastructure (physical, social and economic) further limiting employment opportunities thus aggravating the living conditions of urban poor. This study examines the factors which are responsible for making an area livable through the development of innovation zones. The association between innovation zones and livability potential of an area is further explored in the study.

2. COMPREHENDING INNOVATION DRIVEN LIVABILITY WITHIN A METROPOLIS

In this section, firstly the concept of innovation is reviewed through literature discussing about their typology and their relevance. Based on research and studies done innovation is perceived as omni present phenomenon in the modern economy. Till date in all sections of economy it is evident that there is an urge for on-going processes of learning, searching and exploring. This expectation for the creating and learning new results in the evolution of new products, new techniques, and new forms of organization and markets (Zone, 2009).

Apart from organizations and institutions, as major components, there are variety of components which reflects on the Innovation System (Edquist, 2008). Here by organizations it refers to firms, banks, universities, research institutes, and government agencies, and institutions. Different studies have defined innovation according to their, study context, requirement, and data availability. Since there is no universally accepted definition of innovation, therefore few concepts have been considered for better understanding the idea. Innovation can be expressed as the application of commercial or industrial to



achieve something new such as a new goods, a new method of production, the introducing a new market, the conquest of a new supply source or the carrying out of a new organization of any industry (Zhou, 2012). The following shows few classified types of innovation (Zhou. Y, 2012) which are not restricted to these:

- Product and process innovation;
- Radical and incremental innovation; and
- Technical and administrative innovation.

Taking example of China's Regional Innovation System (RIS) which contains three main components; *innovation actors*, which include higher education institutes (HEI) and large and medium sized enterprises (LME); *innovation inputs*, which include GDP per capita, funding for science and technology (S&T) activities, skilled labour involved in S&T activities, and employment rate; and interactions between innovation actors, which include FDI, international trade, domestic technology transfer, and the *interactive effects* between S&T investment and innovation actors.

In order to quantify *innovation actors* and financial and human capital for innovation, the number of higher education institutions (HEI) and the number of large and medium sized enterprises (LME) are utilized (Lundberg, 2011). There are number of studies which establishes the role of factors and there interactions showing different results and impacts on the region and its development. The presence of educational and professional institutes attracts potential human resources which enables the region to create employment opportunities. Hence, areas providing employment and educational facilities become more livable and sustainable. Moving to livability, it can be understood through studies as the need of people for public services and facilities, and is recognized as a major factor to generate social welfare (Kennedy and Buys, 2009).

The urge to become fast growing economy and obtaining a sustainable global position is growing higher and higher in India. According to the economists, India's working age population (between 15 to 64 years) is expected to increase by 125 million in the next 10 years, and by another 103 million in the following decade. Generally, a surplus of youth is equal not only with an increase in productive labour but also with a flow in creativity and innovation. This shows the potential of India in the coming future to make its position more visible and stronger, globally. The policy encouraging innovation in India has just been formulated as The Science, Technology and Innovation Policy - 2013, which underlines the need for a science, technology and innovation policy in India's present context, and



to ensure successful implementation of 2010-2020 as the “Decade of Innovation” for future prosperity.

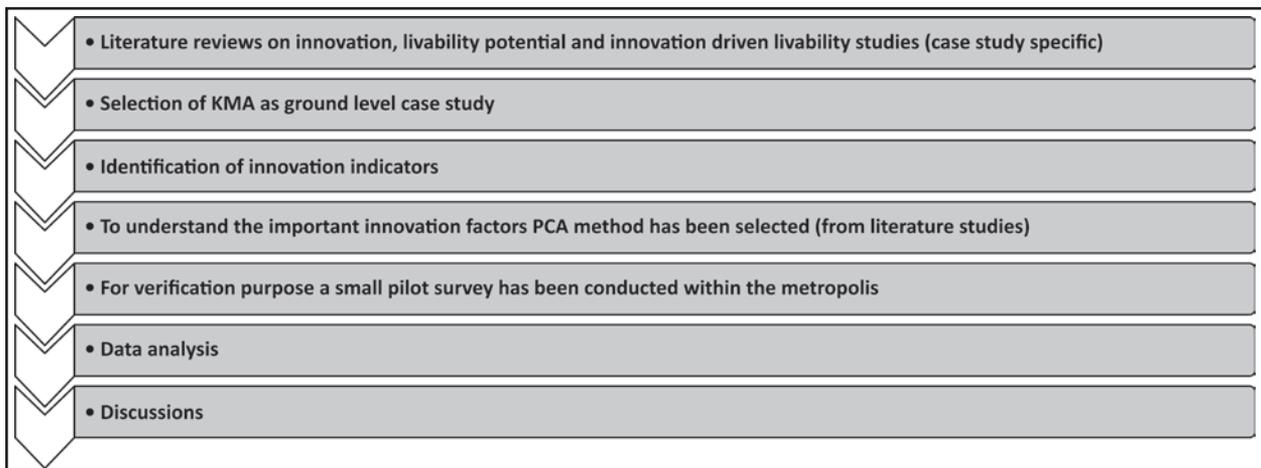
Government of India has also stressed the need to enunciate a policy to synergize science, technology and innovation and has also established the National Innovation Council in 2013. In light of the above discussion we understand the role of different innovation actors, inputs and factors and the need of further detailed research to be undertaken for better explaining the significant role of innovation and its impact on livability. The next section forwards a methodology to identify factors for innovation driven livability in India’s context.

3. METHODOLOGICAL APPROACH

In this section the approach (Fig. 1) for the analysis and interpretation of the significant factors resulting in innovation driven livability are discussed. This study is based on detail literature review and case study analysis on innovation driven livability within a metropolitan area.

From various literature components, this study has identified few factors of innovation approach through which livability within a place can be appraised. These factors are, population density (PD), housing density (HD), literacy rate within the domain (LT), existing work participation rate (WPR), general institutions mainly schools and colleges (GI), Technical and professional institutions (TI), health care (HL) and existing length of road (RD) for better connectivity’s and accessibilities. Table 1 gives the selected factors and their source literature review to carry forward the research. After identifying these factors, all data have been compiled from Census of India 2011 and District Census handbook. For evaluating

Fig. 1: Methodological Approach



**Table 1: Factors for Innovation Driven Livability Assessment**

Factors	Studies
Population density (PD)	(Woolcock, 2009) (Kennedy & Buys, 2009) (Badland et al., 2014)
Housing density (HD)	(Serrano & McMurrin, 2016) (Owens, 2009) (Woolcock, 2009)
(Literacy rate within the domain (LT)	(Owens, 2009) (Lazzeretti, Boix, & Capone, 2009)
Existing work participation rate (WPR)	(Lazzeretti et al., 2009) (Ronita Bardhan, H. Kurisu, Kiyoo & Hanaki, 2011) (Zanella, Camanho, & Dias, 2014), Y. (2012)
Technical and professional institutions (TI)	(Zanella et al., 2014) (Ronita Bardhan, H. Kurisu, Kiyoo & Hanaki, 2011)
Health care (HL)	(Lazzeretti et al., 2009) (Centre for Liveable Cities & Urban Land Institute, 2013) (Badland et al., 2014)
Existing length of road (RD)	(Shamsuddin, Hassan, & Bilyamin, 2012) (Javad, Tilaki, Abdullah, Bahauddin, & Marzbali, 2014) Aziz & Abdul Samad Had (2007) (Zanella et al., 2014)

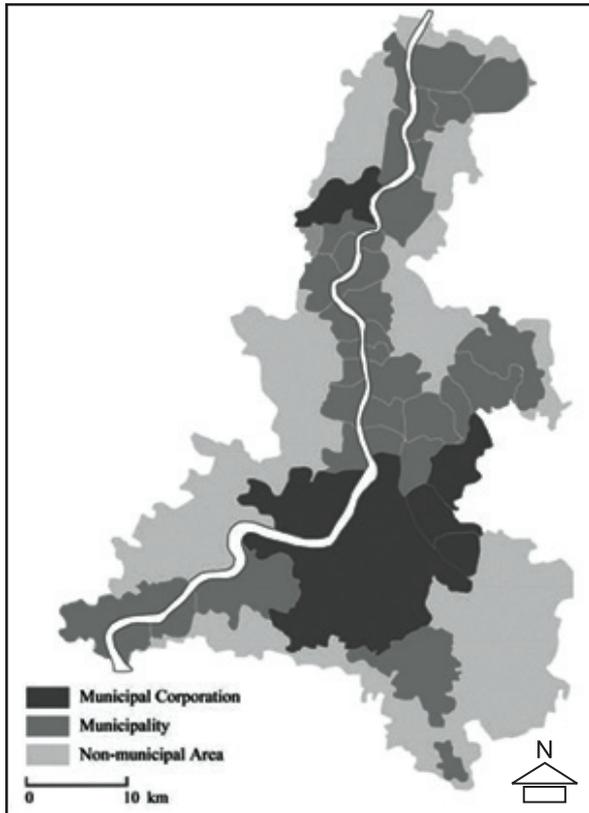
a perception based pilot survey has been done on some selected areas within KMA.

To identify the most important factor within the selected pool of factors, Principal Component Analysis (PCA) have been identified (Economics, 2008). PCA is a statistical technique which use to transmute a set of observations into possibly correlated variables known as principal components (Spss and Analysis, 2012). The first principal component accounts for as much of the variability in the data as possible, and each succeeding component accounts for as much of the remaining variability as possible (Olaleye, 2013) state and private. Reconnaissance survey revealed there are 8, 19 and 12 residential neighborhoods respectively for federal, state and private. The main aim of this stage is to identify the meaningful underlying innovation factors which drive livability within a metropolis. For this study innovation driven livability factors have been identified from the literature; and pilot survey have been conducted to understand the impact of innovation factors on the livability approach.

After identifying the prime factors to assess innovation driven livability, this study has taken Kolkata Metropolitan Area (KMA) as a case study (Fig. 2) to identify the prime innovation factors which has a direct and indirect impact on



Fig. 2: Kolkata Metropolitan Area



metropolitan livability. The reasons to choose KMA are:

- KMA is the third largest urban agglomeration in India, after Delhi and Mumbai;
- KMA is the agglomeration of 4 Municipal corporations, 37 Municipalities with huge rural conurbations; and
- It subsists of many towns and villages around the core city of Kolkata. The Kolkata Metropolitan Development Authority (KMDA) governed and taking care of KMA, which is developing in a rapid way in terms of new innovation approach, sustainable infrastructures, mixed used development, riverside region developments, etc.

4. RESULTS AND DISCUSSIONS

The paper discusses the primary drivers among initially selected factors from the literature which are responsible for the development of innovations. In order to examine the effects of the factors, PCA has been carried on the census data for each factor. Moreover, the effect of

these factors is seen with respect of other case studies taken for the study from literature. In this stage the research tries to identify the principal components within the set of factors which improve the innovation driven livability within a metropolis.

From the Table - 2, the correlation among the selected variables has been discussed. The correlation values come more than 0.300 represent a positive

Table 2: Correlation matrix

	PD	HD	LT	WPR	GI	TI	HL	RD
PD	1.000	.961	.409	.733	.370	.456	.580	.378
HD	.961	1.000	.096	.407	.414	.355	.673	.526
LT	.409	.096	1.000	.705	.688	.596	.239	.177
WPR	.733	.407	.705	1.000	.728	.684	.359	.184
GI	.370	.414	.688	.728	1.000	.599	.426	.239
TI	.456	.355	.596	.684	.599	1.000	.097	.285
HL	.580	.673	.239	.359	.426	.097	1.000	.655
RD	.378	.526	.177	.184	.239	.285	.655	1.000

interactive relationship among those two variables. The correlation values below 0.300 represents that, these variable are not correlate at all. To measure how suited the above selected data for this test, Kaiser-Meyer-Olkin Measure have been done. This test measures the sampling effectiveness for each variable within the data portal. The



statistic is a measure of the proportion of variance among variables that might be common variance. In this case the Kaiser-Meyer-Olkin Measure of Sampling Adequacy value of these variables is .771, which represents the sampling is adequate.

Table 3 represents the Eigen values and percentage of variance explained by the selected variable. From the analysis, it has noticed that the first three variables namely, population density, work participation rate and technical institutions have Eigen values more than 1 and these variables explained 72.877% of the total variance. So these three variables are the principal components through which this study can assess innovation driven livability.

Table 3: Total Variance Explained

	Total	% of Variance	Cumulative %
PD	2.815	35.19	35.19
WPR	1.814	22.673	57.864
TI	1.201	15.013	72.877
GI	0.918	11.478	84.355
HD	0.605	7.56	91.914
RD	0.388	4.856	96.77
LT	0.237	2.967	99.737
HL	0.021	0.263	100

5. CONCLUSIONS

The study contributes an approach to research on innovation driven livability and their impact. Since innovation zones are relatively unexplored field globally, there is a need to conduct more study based on it as it has immense impact on developing economies. The above discussion based results show that innovations could enhance livability of an area. It also shows how the consideration for the factors of innovations in the preparation of development plans and planning policies can bring the much needed break through in terms of solutions for metropolitan development. The main aim of the study was to bring into light the significance of the factors which play crucial role in bringing livability in the urban local bodies of metropolitan area through innovations. There is a huge scope for studies on innovation and its effect on livability by interacting different factors and studying there correlation and significance on the development. Hence, there is a large scope in utilizing these factors considering their significance in making a city livable by providing working opportunities, better housing and infrastructure facilities in order to work, live and recreate in a healthy environment.

REFERENCES

- Badland, H., Whitzman, C., Lowe, M., Davern, M., Aye, L., Butterworth, I. and Giles-Corti, B. (2014) Urban Livability: Emerging lessons from Australia for exploring the potential for indicators to measure the social determinants of health, *Social Science and Medicine*, Vol. 111, pp. 64-73.
- Camagni, R. and Capello, R. (2013) Regional innovation patterns and the eu regional policy reform: Toward smart innovation policies, *Growth and Change*, Vol. 44, No. 2, pp. 355-389.
- Centre for Livable Cities and Urban Land Institute (2013) *10 Principles for Livable High - Density Cities. Lessons from Singapore*. Retrieved from <http://www.clc.gov>.



sg/documents/books/10PrinciplesforLiveableHighDensityCitiesLessonsfromSingapore.pdf

Economics, C. (2008) *The Innovation Driven Economic Development Model. The Bay Area Council Economic Institute*. Retrieved from <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:THE+INNOVATION+DRIVEN+ECONOMIC+DEVELOPMENT+MODEL#0>

Edquist, C. (2008) Identification of Policy Problems in Systems of Innovation through Diagnostic Analysis. *Cas.Uio.No*, (SEPTEMBER 2008), 1-25. Retrieved from http://www.cas.uio.no/research/0708innovation/Edquist_100608.pdf

Javad, M., Tilaki, M., Abdullah, A., Bahauddin, A. and Marzbali, M. H. (2014) The Necessity of Increasing Livability for George Town World Heritage Site : An Analytical Review, *Modern Applied Science*, Vol. 8, No. 1, 123-133.

Kennedy, R., and Buys, L. (2009) Dimensions of Livability : A Tool for Sustainable Cities, in *Sustainable building conference* (pp. 1-11).

Lazzeretti, L., Boix, R. and Capone, F. (2009) *Why do creative industries cluster? An analysis of the determinants of clustering of creative industries, DRUID Summer Conference*, 1-34. <http://doi.org/10.4324/9780203112571>

Li, G. and Weng, Q. (2007) Measuring the quality of life in city of Indianapolis by integration of remote sensing and census data, *International Journal of Remote Sensing*, Vol. 28, No. 2, pp. 249-267.

Lundberg, E. (2011) *Evaluation of Tourism Impacts - A Sustainable Development Perspective*, Department of Business Administration, School of Business, Economics and Law, Licentiate.

Olaleye D.O, A.O. and O. E. (2013) A Multivariate Analysis of Factors Influencing Green Space Provision in Residential Neighbourhood of Sub-Saharan African Cities, *Journal of Environment and Earth Science*, Vol. 3, No. 5, pp. 138-146.

Owens, C. (2009) *Challenges in Evaluating Livability in Vancouver, Canada*.

Ronita Bardhan, H. Kurisu, Kiyo and Hanaki, K. (2011) Linking Urban Form and Quality of Life in Kolkata , India. *ISOCARP Congress*, Vol. 47, No. 2, pp. 1-12.

Serrano, K. J. and Mcmurrin, G. (2016) GIS for Livable Communities : Examination of Community Perceptions of Assets , Liabilities and Transportation.

Shamsuddin, S., Hassan, N.R.A. and Bilyamin, S.F.I. (2012) Walkable Environment in Increasing the Livability of a City, *Procedia - Social and Behavioral Sciences*, Vol. 50, pp. 167-178.

Spss, A. and Analysis, O.F. (2012) An SPSS R -Menu for Ordinal Factor Analysis, *Journal of Statistical Software*, Vol. 46, No. 4, pp. 1-29.

Woolcock, G. (2009). Measuring Up?: Assessing the Livability of Australian Cities. *State of Australian Cities: National Conference*. Retrieved from [http://soac.fbe.unsw.edu.au/2009/PDF/Woolcock Geoffrey.pdf](http://soac.fbe.unsw.edu.au/2009/PDF/Woolcock%20Geoffrey.pdf)

Zanella, A., Camanho, A.S. and Dias, T.G. (2014) The assessment of cities' livability integrating human wellbeing and environmental impact, *Annals of Operations Research*, Vol. 226, No. 1, pp. 695-726.

Zhou, Y. (2012) *Determinants of Regional Innovation Capacity in China*, (August).

Zone, N.I. (2009) *The Role of Innovation Zones in Regional Development*, (May).



Emergence of New Planning Perspectives and Data Sets

Richa Rathi Thakkar

Abstract

New ideas, developments and approaches are taking shape with the emerging importance of social responsibilities to reach harmony and due to turning events in the global economy. Contemporary situations demand the discipline of planning to be more interactive and induced into the civil society's decisions by creating perspectives and facilitating sustainable developments. In order to meet the upcoming demands from the planning profession, practitioners need to actively participate in sessions on contemporary agendas; encourage new solutions and technical alternatives and actively adopt the changing nature of data sets and parameters that need to be embraced for analysis. The paper highlights the need for a newer perspective, its reflection in the government initiatives and enlists some of the new data sets for adoption.

1. INTRODUCTION

The pressing need in planning is to make development free from shortcomings and discrepancies. This effort necessitates appraisal of approaches in planning, new schemes, their execution and success stories. Amidst aims of excellence and fundamental aspirations lies the pertinent role of focused planning, analytic perspective and revised data-sets. More often than not, excellences like emerging as global-power or supreme-economy and aspirations like thorough equality or freedom, coincide with contrarities and gaps in achievement. And because aims of excellence and fundamental aspirations both are duly affected by implementation of planning, the appraisal of either brings back 'planning' also in question. This on-going research necessitates rethinking approaches towards planning.

Further, in system-run social-economies, the structural band of planning, schemes, and analytic data-sets is precisely for success of aims and aspirations while minimizing failures. Especially, grids of data-sets are the central concern for improvement and revision in achieving goals; at least, to combat contrarities in plan-execution and aimed-results. An interdisciplinary approach can bring out results, where planning is not limited to land-development concerns but also addresses social issues.

2. CONVENTIONAL APPROACHES REVISITED

The statutory planning system (s), program driven plans and special purpose plans have considered the following key elements for analysis, which may vary

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**Table 1: Significant Focal Points for Approval**

Plan Type	Data Groups
Master Plan/ Development Plan	Demographic profile, Economic profile, Land uses, Transportation, Infrastructure, Housing, Environmental analysis
Zonal Development Plan	Site background & analysis, Proposals & Development strategy, Compliance to Government policies, Zoning regulation, Development regulations, Implementation framework
Comprehensive Development Plan	City profile, Demographic profile, Land management & urban growth, Economic profile, Infrastructure, Environmental analysis, Housing analysis

from scale to scale. The Plans and references are oriented towards land uses and its regulation, while there are only few attempts to expand into Policy intervention, vision or perspective development and, in incorporating social aspirations.

The is list of focal points which are significant for appraisal and further holistic planning is given Table - 1. The need for critical evaluation predetermines demand for new data sets to evaluate parameters with increasing exactitude.

For India to emerge as one of the global powers, it needs to gauge its successes as well as failures in order to assess direction of its growth in future in order to emerge as a global power. Such efforts are reflected in new government programs and policies. Government schemes, namely Smart Cities Mission, Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Heritage City Development and Augmentation Yojana (HRIDAY) by Ministry of Urban Development, Pradhan Mantri Kaushal Vikas Yojana (Skill Development Program) and *Beti Bachao, Beti Padhao* Scheme (BBBP), Female Child Protection are all new approaches in respective fields. The Twelfth Five Year Plan (2012-17) had initially pressed urgency of economic recovery and was titled 'Faster, More Inclusive and Sustainable Growth'. It is clear from the above that development has taken priority not only for immediate efforts, but for faster results also.

An added factor for development is 'inclusive planning', which has become a necessity for planners to consider and reflect in the current government's approach to development through its slogan '*Sabka Saath, Sabka Vikas*'. A paradigm shift to prioritize, develop vision for cities through citizen's engagement and feedback at later stages of planning is paving way to interactive and stronger planning methods as well as preparing newer e-platforms.

Denser developments, faster lifestyles and the pressure on micro-economic set-ups have altered the recent Indian lifestyle and so has its implications. Women safety has been questioned in recent times and has undoubtedly become a serious concern. With increase in urban female work participation



rate from 15 percent to 18 percent over the decade (Census of India, 2001 and 2011) and expected to increase further, there is a need for safer cities. Similarly, increasing crime rates and road safety issues have got critical attention. To achieve a balance in community development; health concerns and environmental safeguards, there is a demand to evaluate and plan from these perspectives.

The rapid changes are taking place in the country (rural) areas have an influence on the economic and social profile of India. Socio - cultural changes due to exposure of the youth and shift in employment pattern from primary economic activities to service sector activities has created parallel situations. Hence a changed viewpoint is emerging to modernize rural settlements or villages and smaller towns as per its need. Government's initiatives have been through 'Swachh Bharat Abhiyan' and 'Adarsh Gram', lately. But since population densities in rural and peri - urban areas are sparse, alternative solutions are to be sought, for which, newer parameters need to be considered while planning.

The revolutionary change to digitalization has its impact on all aspects of development, i.e. economic, social and environmental and it is emerging as a promising tool. Both public and private sector are transforming to this platform to seek solutions and to integrate and deliver value-added services. New data sets are much needed in this field and are significant for integration as 'layers' and for interfacing through applications. However, it has its own inherited challenges, some of which are cyber crime, loss of privacy and mass-control-loss.

Contrary to development, terrorism is an international turmoil which is unpredictable in time and space. This situation, unless resolved at global level, will still hold high pressure on city design where key elements of transportation network and urban design are crucial. Pro-development sectors as listed, demand specific attention in terms of status quo for areas of investment:

- **Infrastructure:** India needs Rs. 31 trillion (US\$ 454.83 billion) to be spent on infrastructure development over the next five years, with 70 per cent of funds needed for power, roads and urban infrastructure segments. Major developments are targeted towards building new greenfield expressways across the country, metro rail lines in urban centres.
- **Energy:** The Ministry of New and Renewable Energy (MNRE) has signed an agreement with Germany-based KfW Development Bank to fund the Rs. 300 crore (US\$ 44.47 million) floating solar projects in Maharashtra and Kerala, which is expected to generate over 310 GW of green energy. Around 293 global and domestic companies have committed to generate 266 GW of solar, wind, mini-hydel and biomass-based power in India over the next 5-10 years. The initiative would entail an investment of about US\$ 310-350 billion. Cleaner



source of energy and waste to energy are the two prime focuses which need attention by planners, hence it is crucial to understand both, international practices and local situations.

- **Tourism:** Tourism and Hospitality sector across India is picking-up as International aid is being directed towards this sector and is among the top 10 sectors to attract Foreign Direct Investment (FDI).

To implement the project, especially large infrastructure projects, the shift is towards a coordinated Public-Private-Partnership (PPP). Due to this added factor, it is essential that decision making is to be rightly stated for earmarking the project cost and benefits at an initial stage or for its success at the later implementation stage. Hence the role of planners becomes more crucial to provide an unbiased, well researched and a feasible plan. Since new approaches are coming up (such as best practices in road construction, waste management) and there are only handful implemented cases, it is desirable that the new indicators need to be thoroughly verified by different data sets which have not been commonly used before.

3. REFLECTION ON NEW APPROACHES AND DATA GROUPS

For analysis, emphasis is on processed data sets to be used which shall be statistically quick to study and in the form of hard matrix for further usage and for monitoring. Therefore, these data sets are to be converted as indicators to pass or fail in the targeted attempt. The change is being reflected in Government programs and planning approaches as pointed below:

3.1 Smart City Challenge

- The challenge evaluated city's baseline founded on hard matrix to understand the preparedness of a city to advance as a smart city;
- New and clear Key Parameter Indicators (KPI) laid (such as livability, administrative efficiency) and stiff percentages defined by MoUD for minimum baseline improvement such as in renewable energy, energy efficiency etc.;
- Achievable targets (as hard matrix and percentages) were to be set by the cities for future references and monitoring;
- Specific sector preference to be laid by cities, especially taking into consideration the public opinion (use of portals: <http://www.smartcitieschallenge.in/>, <https://www.mygov.in/>);
- Innovative citizen engagement approaches adopted by participant cities; and
- The result of the challenge is in a ranking order of the cities by MoUD.

3.2 Atal Mission for Rejuvenation and Urban Transformation (AMRUT)

- Outlay for AMRUT is INR 50,000 crore for the five years from FY 2015-16 to FY 2019-20.



- Baseline infrastructure levels to be evaluated versus the service level benchmarks as hard matrix, including household level coverage, per capita consumption as well as efficiency;
- Again, achievable targets as hard matrix and percentages (financial and physical) vis-a-vis the given time frame - to be set by the cities to evaluate variance in future;
- Specific targets in terms of percentages for particular milestones (such as Municipal tax and fee improvement, User charges) set by MoUD;
- Checklist considered new areas for appraisal including citizen consultations for prioritizing projects, assessment of low cost or no cost improvements; and consideration of management improvements and PPP, inclusion of National level priorities and inclusive development.

3.3 Swachh Bharat Abhiyan

- This mission has completely different approach; i.e. proactive approach including focus on behavioral change strategy, single target of 100 percent coverage, enabling environment for private sector participation and the mission covers both rural and urban areas;
- Planned Waste to Energy Production (Mega Watts) - 493.7 and Total Waste to Compost Production for the year 2016 (Metric Tons) - 65,047 as per Swachh Bharat Urban;
- Swachh Bharat Urban recognizes best case studies in different areas and Municipal Solid Waste Management, challenging conventional waste collection and management systems and inviting techno-economic innovations;
- City Sanitation Plan is comprehensively integrated with the mission, bringing out achievable targets and transparency;
- Campaign promotion through social media and electronic media, for universal coverage among many other activities included under the broad umbrella of 'Swachh Bharat'; and
- Under this mission, Government of India released "Cleanliness Ranking" for 73 cities based on cleanliness and sanitation.

3.4 Heritage City Development and Augmentation Yojana (HRIDAY)

- HRIDAY guides recording and documentation of tangible and intangible heritage assets such as areas of social importance, livelihood dependence on assets;
- Concept development of interlink between disaster management and heritage;
- The Plan is proposed to consider improvement of 'Imagability of the area' as a factor of opportunity; and



- Pallet creation for specific components has been considered as a part of the Plan.

3.5 Urban Green Growth Strategies for Indian Cities

- Urban Green Growth Strategies for Indian Cities considers “favouring examples which included aspects of economic viability, environmental sustainability, social sustainability and improved governance” for good practices;
- The Report (Volume - 1) takes into account parameters which reflect relationship with the planning indicators like residential use of traditional energy sources, RE-regulation in Bylaws or D.C. Rules / Green building schemes and even presence of energy / solar cells within ULBs for evaluating Urban Energy Sector and Green Growth;
- It considers simple yet effective parameters like availability of skilled labour, proximity to trade corridors, availability of power/ clean fuel for business to evaluate Urban Economy and Business and Green Growth; and
- Co-ordination among agencies and adequate cost recovery to evaluate Urban Transport Sector and Green Growth and GIS based property mapping among others.

3.6 United Nation Women Flagship Program

- Safe Cities and Safe Public Spaces is one of UN Women’s Flagship Programing Initiatives designed to ensure that UN Women can deliver on the Sustainable Development Goals (SDGs);
- Some of the successful cases achieved by innovative approaches are: ‘(i) Egypt’s Ministry of Housing, Utilities and Urban Development adopted women’s safety audits to ensure a gender approach to urban planning. (ii) Port Moresby (Papua New Guinea) established vendors associations in their safe market programme, with 50 percent representation of women in executive positions; and
- New approaches highlighted above are in the direction of innovative social accountability tools, inclusiveness, based on public aspirations, where else new data sets are systematically converting to objective parameters than subjective outputs. These data sets used are simple indicators and effective co-relations between various factors of planning, analysis of which can bring out better understanding of the subject and critical aspects of interdependency.

4. ENLISTING NEW IDEAS

Some sections of data sets are elaborated and brought to light for reference. One more important aspect, i.e. public opinion and inclusion of citizen’s aspirations has been considered to understand citizen’s opinion on specific inputs (Table - 2).



Table 2: Consideration of Data Sets and Citizen's Opinion

Health and Safety	Consideration of Data Sets	Consideration in Citizen's Opinion
Fire safety	Fire accidents typology; Analysis of origin of fires, Fire regime analysis and regime wise power supply analysis; Hydrant capacity; Rescue missions; Robust fire detection system(s); Burned area restoration and rehabilitation	Citizen's opinion to understand public awareness of fire alarming systems in Public, Semi-public and Commercial areas; Willingness to participate in fire safety drills; Emergency responses and awareness among public
Disaster planning	Proximity to hazardous elements; Exposure of service lines; Escape routes; Transport and communication facilities; Regional level data sets	Preparedness for disaster; Disaster shelter planning; Adaptability to mitigation options
Women safety	Dark space mapping; Pedestrian facilities, Recorded criminal activities and incident mapping; Nearest emergency aids; Clear sight lines around major landmarks, Analysis of existing surveillance system	Identifying vulnerable areas in the neighborhood and city; Safety issues concerning transportation, (e.g. preference to one-way roads, Separate provision in Mass public transportation system etc.)
Crime rates	Analysis of crime by typology; Surveillance system; Unemployment rate pattern and Immigration pattern; Recreational activity analysis	Access to defensible spaces; Discussion on Crime Prevention Through Environmental Design (CPTED); Need for IT solutions
Health infrastructure	Health infrastructure mapping, Capacity analysis, Analysis of rapid response system ; Analysis of public green spaces , centres related to health and overall well being	Accessibility to and quality of health facilities; Preference to public verses private services; Development of a rating system
Resilience towards terrorism	Observation of global terrorism Index; Analysis of transport entry and exit points; Surveillance system; Identification of critical city centres and monuments; Analysis of (portable)external barriers and street furniture (cluttered/ uncluttered)	Public opinion on surveillance options; Aspects of multidimensional security and planning; Balance between security and aesthetics
Inclusive Planning		
Education	Permanent and mobile schools; Rate of school drop-outs; Low school attendance, Student-Teacher ratio ; Private higher education institutes and tuition centres; Transition from one education level to higher level	Need for Institutional improvements; Related infrastructure for curriculum activities
Facilities for dependents	(1) Elderly - old age centres, health infrastructure, recreational activities; (2) Infants and Toddlers - creche, day-care centres, health infrastructure, dedicated open spaces; (3) Institutes for differently-abled; (4) Barrier free environment for elderly and differently-abled	Specific community infrastructure; Willingness for common infrastructure and institutional households; Design needs for dedicated spaces
Gender oriented infrastructure	Woman hospitals, Institutes and hostels; Dedicated public transportation or feeder services; Toilets for women	Social security and safeguards; Gender oriented economic opportunities; Specific community infrastructure
Economically Weaker Section	Employment ratio; Employment duration; Comparison of wages as per economic indicators; Coverage of infrastructure in slums	Economic opportunities sector wise; Mapping the major centres for work and live to understand mobility; Infrastructure needs



Table 2: Continued

Road Safety		
Road Accidents	Accident typology (minor accidents - major accidents); Accident mapping; Accessibility for public transport and emergency vehicles	Common areas of incidents and accidents; Need for public transport users been considered; Assess the impacts of various tools used in road design for vehicle & pedestrians (such as use of colors, lights, signages etc.)
Pedestrian Safety	Pedestrian accidents; Pedestrian facilities -overhead bridges & subways, signals, lighting poles; provision of climbing lanes in hilly areas	
Road design	Road levels; Design of cross-section, junctions, interchanges; Horizontal and vertical alignment and visibility	
Improved Governance and Accountability		
Governance	Administrative efficiency, E-Governance, Citizen charters & Grievance system,	Feedback on grievances; Rating the functional ability of the administration
Public Accountability	Transparency in Budget, Adoption of double entry accrual accounting, Web enabled public information system	Use of existing IT applications, Need for other IT solutions

4.1 Health and Safety

One of the most critical issues for concern for social balance is the health and overall safety, which now needs a dedicated section in planning. These aspects may capture the changing civil society's aspiration and may touch some of the unturned stones.

4.2 Urbanization in Peri - Urban Areas

The changing characteristics of Indian population and its lifestyle are immensely affected by the interplay of socio - economic factors in rural and urban areas and henceforth its developmental needs. Within the urban-influenced areas, i.e. Peri - urban, the sparse population density makes decentralized infrastructure as a feasible option. Here unique cultural and social as well as environmental parameters need to be considered to understand its planning desires. Points noted for consideration are listed below;

- Population density and build-up density to comprehend the settlement composition;
- Percentage and ratio of male and female workers in various sectors, literacy rate, male-female ratio to analyze the level of development in peri - urban area;
- Availability of public transportation, solid waste generation per capita, and property ownership sizes as socio - economic indicators;
 - Sources of water and dependence of household and economic uses on it, disposal and handling of solid and liquid waste, influence of industrial land uses and *mandi* towns to maintain the balance between environmental and economic systems; and



- Here, public opinion is critical and largely useful for planners as it can be considered at the initial stages of greenfield site plan formulation and for DCRs formulation;
- Public opinion on surveillance options is needed to discuss the prospects and consequences of the various types of surveillances. Selected options shall be considered in planning proposals and thrust for investment by Government.

4.3 Inclusive Planning

Inclusive planning is the solution to overcome clashes between classes, castes, genders, age groups. Development planned with consideration to vulnerable sectors of society can reduce gaps, improve economic productivity and help India to emerge as a global power.

4.4 Infrastructure

Since the focus of development is infrastructure, its analysis should not be limited merely to infrastructure 'coverage' but also consider the following aspects:

- Comparison of city infrastructure baseline with Service level benchmarks;
- Sustainability indicators: waste to energy, green energy in the city;
- Checklist for areas of improvement: unscheduled failures, leakages, irregularities in supply;
- Mass transportation (from urban planning point of view): besides population density, built-up density can also be analyzed to understand vertical growth to co-relate with the shifting Transit Oriented Development (TOD) module; and
- Public opinion is vital to identify gaps in infrastructure, to understand adaptability of public at large and to induce public awareness but public education is equally significant, specifically while handling waste management aspects, fuel management aspects and to encourage use of public transportation.

4.5 Road Safety

To decrease road accidents and incidents, road safety has become a commitment in regional, urban and transport planning. Detail guidelines are available for road safety checklist(s), out of which few indicators are enlisted below:

4.5.1 Cultural Indicators

It is difficult to measure cultural changes, however, indicators such as digitalization, education, literacy rate, male-female ratio, power consumption



can be used to measure modernization. While from infrastructure point of view, quantity and quality of malls, stadiums, auditorium, museums and other cultural public spaces shall be analyzed. Analysis of household industries (such as food related, handicraft, handloom, etc.) can bring out culture influenced economic activities.

4.5.2 Urban Environment Indicators

From health point of view, the following indicators can be used to analyze environment:

- Indicators as per CBCP and SBCP for Natural Resource Analysis;
- Green fuel use;
- Eco - system compatible urban design (Eco - urban design analysis);
- Non-confirming uses: mapping of city land utilization and analysis of incompatibility;
- Micro-Climate impacts by Thermal Mapping: Thermal modelling shall be increasingly used in analysis of city morphology and its climatic impacts to help reduce greenhouse gas emission; and
- Mapping Radiations: Radiations, such as from telecommunication instruments and equipment, laboratories using radioactive materials, large electromagnetic devices must be critically charted to invigilate justified usage of technology.

4.5.3 Improved Governance and Accountability

Apart from the scheme mandates, statutory city planning shall cover administrative efficiency and good governance aspects.

5. CONCLUSIONS

There is a pressing need for 'out of box' solutions in all aspects of planning. Specifically in project consultancy, such approaches may add value and analysis may provide creative solutions. A holistic approach is now a pre-requisite for urbanization and especially for smart city development of brown field sites to ensure involvement of various departments such as police, electricity board, fire safety departments, education departments, health service providers, and disciplines like demography, sociology, architecture, engineering, economics, public administration for appraisal and implementation. Hence, an integrated perspective is imperative for sustainable development, execution and success. The new perspectives and data sets suggested above, among others, may come as a challenge for planning discipline. But indulgence in the new data sets may overcome the conventional and shall be revisited occasionally and treated as an



opportunity to manifest for a better future of planning. Therefore, it is time to 'recheck our ways of doing planning.

REFERENCES

Bhandari, L. (2006) *Social Infrastructure: Urban Health and Education Infrastructure Report*, New Delhi.

Ministry of Urban Development (2014) *Urban and Regional Plan Formulation and Implementation Guidelines (URDPFI)*, Vol. I and 11, 2013, Ministry of Urban Development, New Delhi.

Ministry of Urban Development (2014) *Guidelines for Swachh Bharat Mission*, Ministry of Urban Development (MoUD), New Delhi.

Ministry of Urban Development (2015) *Atal Mission for Rejuvenation and Urban Transformation (AMRUT)*, Mission Statement and Guidelines, Ministry of Urban Development (MoUD), Government of India, 2015, Pp. 8, 28-30, 50- 59.

Ministry of Urban Development (2015) *Guidelines for Heritage City Development and Augmentation Yojana (HRIDAY)*, Ministry of Urban Development, Government of India, New Delhi.

National Crime Prevention Council (2000) *Crime Prevention through Environmental Design Guidebook*, National Crime Prevention Council, Singapore, 2003. Source: <http://www.popcenter.org/tools/cpted/PDFs/NCPC.pdf>

National Institute of Urban Affairs (2015) *Heritage City Development and Augmentation Yojana (HRIDAY) Template for Preparation of City HRIDAY Plan including Civil Infrastructure Development Plan*, Ministry of Urban Development, New Delhi.

National Institute of Urban Affairs and Global Green Growth Institute (2015) *Urban Green Growth Strategies for Indian Cities*, Vol. 1, ICLEI Local Governments for Sustainability, South Asia (Publisher), National Institute of Urban Affairs, and Global Green Growth Institute, New Delhi.

Usip, E., Edem, T.E. and Etuk, U. (2015) Urban planning, architecture, and global terrorism: The Nigerian perspective, *European Scientific Journal*, Vol. 11, No. 23, pp. 4-13.

United Nation (2016) *Safe Cities and Safe Public Spaces*, June 2016. Source: <http://www.unwomen.org/en/what-we-do/ending-violence-against-women/creating-safe-public-spaces>

WEB

<http://www.ibef.org/industry.aspx> (as on 05.11.2016)

<http://www.swachhbharaturban.in/> (as on 05.11.2016)

<http://swachhbharaturban.gov.in> (as on 05.11.2016)