

Ecological Footprints of Cities in India

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Abstract

Urban expansion is almost always over the best agricultural land, because it is usually easy land to build on. This takes away the most suitable soils from agriculture. Urban and industrial developments sometimes compete with agriculture for scarce water resources, with agriculture generally being the loser. Felling and overexploitation of forests for urban and industrial development destroys natural ecological balance. Intensive agriculture destroys the natural ecology by replacing diversity with monocultures, and by the use of pesticides and herbicides. Wetland and coastal reclamation destroys an ecology that is impossible to replace, and bring harm to the sensitive ecosystems. An urban environment is complex primarily because of rapidly changing variables such as socio-economic and demographic indicators, land-use patterns, resource demand and utilization patterns, lifestyle changes etc. In the light of climate change, a new layer of uncertainty is added in terms of changes in precipitation, temperature and occurrence of extreme events. Furthermore, there are scale mismatches; in terms of the time scales over which policymakers and urban planners operate, and scales over which projected impacts of environmental decisions, degradation, climate variability and change will manifest. Also policies and developmental initiatives in cities should enable urban systems to adjust to changes as and when they happen and accordingly respond in a way that maintains their original structure and function. It is to be noted that out of 55 cities in India having population over a million, 18 are in coastal states. Major challenge for cities in the face of rapid population growth is to maintain sustainability within the social,

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economic and environmental dimensions. Urban systems are at risk to different kind of hazards. Several factors contribute to the urban risk profile. Present paper purports to examine the dynamics of urban environment, sustainability and development in the context of changing global environmental changes.

Introduction

The population growth and the demographic shift from rural to urban areas are challenging the urban governance system and for other actors to provide the basic civic services to the urban dwellers. Growing urbanization is posing serious environmental concerns in India in terms of changing land use pattern, increasing carbon emissions, solid waste generation and disposal, air and water pollution and poor sanitation amenities. A large segment of urban population in the state resides in slums, peri urban areas, squatters and informal settlements. These settlements are often located in low laying areas prone to direct and indirect risks due to environmental degradation . Moreover, over exploitation of ground water resources in urban centers for quenching the thirst of increasing urban population, changing lifestyle, and water uses for various purposes is cause of concern. Due to unregulated housing and building construction, lack of proper drainage and sewer network and also ineffective functioning of sewerage system, urban centers are at high risks .The blockage and choking in drainage sewer system leads to water logging and flash flood in urban centers. Increasing urbanization, expansion of habitat into unsuitable vulnerable areas, higher population density, higher housing density, vulnerable housing and buildings construction, non engineered unsafe construction, and aging buildings and other infrastructure are some of the factors that have increased the vulnerability of hazards and disasters in urban areas. The accelerated and uncontrolled urban growth has contributed to the ecological transformation of the cities and their immediate surroundings resulting in flash floods and water scarcity.

Urbanisation and Environment

The rapid urbanization has put pressure on the existing resources and

basic services like potable water, well laid-out drainage system, sewerage network, sanitation facilities, electricity, roads and waste disposal. It has resulted into numerous environmental and health impacts. The green cover and water bodies have been destroyed to give way to the rapidly developing urban centres. Modern buildings in cities have high levels of energy consumption in air-conditioning and lighting. Thus, unplanned and unsustainable urban development has led to severe environmental pressures. These challenges can be summarized as under (Singh and Pandey, 2012):

- *Slum Development:* The polarization of growth towards metro cities and mega cities poses a greater challenge to provide housing in urban areas, which are rapidly becoming areas of crowded habitations without basic amenities. This gets reflected in an increasing proportion of slum population which constituted 28 per cent of the urban population. Some of these areas are very dense.
- *Wastewater Generation and Water Pollution:* Adequate quantities of water are required for healthy living for drinking, cooking and washing. Because of the population growth and urbanization the gap between per capita water supply and demand is getting bigger. This is putting pressure on water resources of the area.
- *Land Resource and Vegetation Degradation and Destruction:* The higher density of housing is putting pressure on land resource and vegetation which is leading to reduction of green cover and further loss of green infrastructure.
- *Reduction in Biodiversity and Forests and Green Cover:* The rapid clearing of trees and converting parks for giving way to housing is leading to decreasing green belt.
- *Traffic Related Air and Noise Pollution:* The explosive growth in the number of vehicles is a big problem in many cities. Many cities have major difficulties in coping with the chaotic automobile traffic. The traffic jams are frequent and bad in many cities and traffic in the city area at least during the peak-hours is awfully slow. The Air pollution is high due to air

emission of pollutants and causes respiratory diseases to city inhabitants.

- ***Sewage Generation and Pollution of Urban Water Bodies:*** The lack of sanitation and sewage treatment is the biggest contributor of water pollution. Local water bodies and rivers are used as a dumping ground for untreated water from many urban areas and industrial clusters.
- ***Solid Waste Generation:*** Solid waste management means proper collection, transfer, recycling and disposal of solid wastes. In many cities the solid waste disposal is inefficient or non-existing. In such areas waste ends up to the illegal dump on streets, open spaces, ponds, lakes, wastelands, drains or rivers. Sometimes they are collected to the land sites but the protection of water bodies and groundwater is not active.
- ***Climate Change:*** Modern buildings have high levels of energy consumption because of requirements of air-conditioning and lighting. In addition, the urbanization has led to increasing vehicular density and consequent consumption of fossil fuel. This leads to increasing release of green house gases, resulting in contributions to climate change.
- ***Skirting of Planned Growth by Unplanned Settlements:*** This is a classic phenomenon present in Indian cities. It is manifested in the form of mushrooming of private housing colonies around officially planned housing projects, without any consideration to green infrastructure, civic systems or sustainable urban governance. The phenomenon is also seen in peri-urban areas in proximity to the 'ring roads' constructed in the periphery of cities.

In order to achieve the desired outcome that encompasses the above state dimensions following policy options and actions are suggested (Singh and Pandey, 2012):

- ***Creation and Management Green Infrastructure:*** Urban green infrastructure comprises of all natural, semi-natural and artificial networks of multifunctional ecological systems

within, around and between urban areas. Green infrastructure can provide numerous ecosystem services such as purification of air and water, pollution control, mitigation of floods and droughts, re-generation of soil fertility, moderation of temperature extremes, carbon sequestration, climate change mitigation and enhancing the landscape quality. Deliberately planned, developed, and maintained green infrastructure.

- ***Wastewater Treatment, Recycling and Appropriate Use:*** Urban systems create vast quantities of wastewater through inefficiencies and poor management of water systems. The wasting of water poses sustainability challenges, depletes energy reserves, and undermines human water security and ecosystem health. Approaches for reusing wastewater and minimizing its generation are urgently required. Water pollution from sewage is causing great damage to India. Urban planning has directed its efforts more towards supplying water to their citizens than about the waste water generated. The effluent often goes into streams, lakes and rivers, or seeps into the ground to contaminate drinking water. Nitrate levels in groundwater across India exceed 45 milligrams per litre which is sign of sewage contamination. Treatment of domestic wastewater, sewage and wastewater from industrial clusters is vital for balancing urban growth and environment.
- ***Waste Management:*** Managing solid waste is one of biggest challenges of the urban areas in India. In spite of heavy expenditure by civic bodies, management of municipal solid waste remains one of the most neglected issues of urban development in India. The current practices of the uncontrolled dumping of waste on the outskirts of towns/cities have created serious environmental and public health hazard. Solid waste management should lay emphasis not only on waste disposal but also on minimization, waste recycling and conversion of waste to energy.
- ***Green Transportation:*** It is not urbanization alone which affects environmental sustainability, but also how people

move about the city. Countries that rely on private transport use more energy per passenger kilometer than countries with high levels of public and non motorized transport modes. Good land use policies can also encourage the trend of using mass transportation system. Therefore, the issues which need to be considered are good quality and affordable mass transportation system, road infrastructure, fuel quality and traffic planning to make city transportation eco-friendly.

- **Affordable Housing:** With increasing concentration and growth of economic and commercial activities and influx of population in Indian cities, the demand for affordable housing delivery is intense, resulting in the proliferation of slums. Affordable housing to the poor sections of the society in ever growing cities is much needed to avoid development of slums.
- **Energy:** Buildings are highly energy intensive through their life cycle consuming about 40% of the world's primary energy supply globally. Cities pose a unique challenge to engineers in that they require concentrated energy supplies. Type of energy source will significantly affect the environmental quality of any city. In order to promote growth and also mitigate climate change, cities will need to shift energy sources, improve energy efficiency, and increase city density.

Waste Disposal & Environment

Waste generation is associated with human civilization. In India, average per capita waste generation ranges in between 400 to 700 gms. per day. However, the quantity of waste generation depends upon the life style and economic activities. Waste disposal in urban areas is the main responsibility of urban local governments. The wastes may include municipal solid waste, hazardous waste, sewage, sludge, clinical waste, agricultural and industrial waste as well as commercial waste. There has been a significant increase in the generation of municipal solid waste in India over the last decades. India generates more than 48 million tons of solid waste per year. The waste generation has been reported significantly high in the metropolitan and larger cities and low in the small cities. Out of total

waste generation in urban areas, about 25 per cent waste is reported to be hazardous. The hazardous waste is mainly generated by high polluting industries, hospitals, medical centres and nursing homes. The quality of waste generation in South Asia has been reported to be poor and thus, it cannot be converted into fuel due to its low calorific value. Most of the waste generated so far may be categorized into biodegradable and non-biodegradable. Most of the studies have highlighted the poor infrastructure and facilities for collection, segregation, transportation, handling and disposal of the waste. There are several technologies for the disposal of the waste; however, landfill is the most important technique for disposal of the waste. However, land filling in India lacks the scientific processing for disposal of the waste. Other technologies include pulverization, baling, compositing, incineration, briquetting, pyrolysis, gasification, and biogas (Singh and Khanna, 2005). When plague spread in Surat City, scientists explored that due to failure of proper handling and management of the solid waste, the problem emerged after a long time. Thus, Government is equally conscious for the proper handling and management of the solid waste. Ministry of Environment & Forest, Government of India has already formulated Municipal Solid Waste, (Management & Handling) Rules, 2000. These rules are applicable to every municipal authority that is responsible for collection, segregation, storage, transportation, processing and disposal of municipal solid waste. The rules have made provisions that waste will not be incinerated and municipal authorities will make the necessary arrangements for proper handling and management of solid waste including collection, segregation, storage, transportation, processing and disposal. Except in case of bio-medical waste which is supposed to be incinerated, the rest waste is supposed to be safely disposed off by the municipal authorities. The standard norms and practices for the safe disposal of the waste are also being given in the rules.

Waste Recovery and Recycling

Various components of MSW have an economic value and can be recovered, reused or recycled cost effectively. Currently, the

informal sector picks up part of the resources from the streets and bins to earn their living. However, a sizeable portion of organic waste as well as recyclable material goes to landfills untreated. Over 81 per cent of MSW annually is disposed at open dump sites without any treatment. With planned efforts to Reduce, Reuse, Recover, Recycle and Remanufacture and appropriate choice of technology, the country can profitably utilize about 65 per cent of the waste in producing energy and/or compost and another 10 to 15 per cent to promote recycling industry and bring down the quantity of wastes going to landfills/ dumps under 20 per cent. The percentage of wet biodegradable waste is high in Indian waste and is a source of contamination of soil, water and air, if it is disposed indiscriminately. Biodegradable waste has a good potential for generating biogas, which can serve as fuel, can also be converted to energy as well as to compost which can improve soil health and lead to increased agriculture production. This wet waste must therefore be processed either through bio-methanation or composting technology for generating biogas, electricity or compost for use as nutrient and prevent such wastes reaching the landfill. Considering that reusable and recyclable wastes form 20-25 per cent of the actual waste generated (which does not include the wastes collected by the kabadiwalas from source of generation). Plastics, paper and glass constitute 17 per cent of the recyclable wastes. Plastic wastes including composites are high calorific value material and crucial ingredient for MSW based waste to energy plants. This material also needs to be fully recovered and profitably utilized. The next step should be to strengthen segregation of the non-recyclable dry combustible MSW at secondary storage depots/transfer stations and optimally utilize this material in the form of RDF which can be fed to waste to energy plants, waste to energy plants power plants and as auxiliary fuel in cement and metallurgical industry. Setting up of small to large plastic waste to liquid fuel plants, thereby utilizing the plastic not picked up by kabadiwalas and rag pickers, also needs to be encouraged.

Management of Urban Lakes

Lakes are important part of urban ecosystem. Lakes perform significant environmental, social and economic functions as source of drinking water, recharging groundwater, controlling floods, supporting biodiversity and providing livelihoods. At present, lakes and wetlands are in extremely bad shape and are in varying degrees of environmental degradation. Despite knowing their environmental, social and economic significance, these water bodies have neglected and destroyed (CSE, 2014). Today, these water bodies are encroached, full of sewage and garbage. Due to unplanned urbanization, much of the landscape around the lakes has been covered by impervious surfaces. As a result, instead of rainwater, it is the sewage and effluents that are filling up urban water bodies. Once the sponges of urban area, today urban lakes have turned into hazards. It is the disappearance of these sponges of the city which has exacerbated floods and sharpened the pain of droughts (CSE, 2012).

Although, there are number of policies and acts for the protection and restoration of urban lakes and wetlands, urban water bodies are in extremely poor condition. Their numbers are declining rapidly. In the beginning of 1960s Bangalore had 262 lake, now only 10 hold water. Similarly, in 2001, 137 lakes were listed in Ahmadabad city, and over 65 were reported being already built over (CSE, 2012). In Delhi in 2010-11, it was found that 21 out of 44 lakes were gone dry due to rapid urbanization and falling water tables (Singh & Bhatnagar, 2012). During last 12 years, Hyderabad has lost 3245 hectares area of its water in the form of lakes and ponds (Times of India, 2012). For the last two decades, urban water bodies have been a victim to unplanned urbanization in India, because of which they face several threats. These are pollution, encroachment, illegal mining activities, ungoverned tourist activities and cultural misuse. There has been an explosive increase in the urban population without corresponding expansion of civic facilities such as adequate infrastructure for the disposal of waste and are used for disposing untreated local sewage and solid waste, and in many cases the water bodies have been ultimately turned into landfills. Encroachment is another major

threat to water bodies particularly in urban areas. As more people are migrating to cities, the availability of land is getting scarce. Today, even a small piece of land in urban areas has a high economic value. Hence, these urban water bodies are no more acknowledged for their ecosystem services but as real estate. Illegal mining for building material such as sand and stones both on the catchment and on the bed of the lake also have extremely damaging impact on the water body and one the reasons behind the destruction of many water bodies in India . Unplanned tourism activities without systematic planning and regulation proved to be another major threat to urban water bodies. Disturbance of wildlife, pollution, changes in local lifestyles and loss of cultural heritage are some of the impacts of tourism on the local environment.

Technically, in urban areas, water bodies are owned by land owning agencies. However, their survival and protection depend on the role of a number of other institutions /agencies such as Ministry of Water Resources, Ministry of Environment and Forests, Agriculture Ministry, Fisheries Ministry and other local authorities, i.e., Municipal Corporations, Development Authorities, Tourism Department, Water Supply Boards, etc. At the Central Government level, Ministry of Environment and Forests plays an important role in restoration of lakes in India under its initiative called National Lake Conservation Plan (NLCP) developed in 2001 specifically for the protection and management of lakes. The objective of NLCP is development of national level policies and actions with focus on urban lakes (CSE. 2014).

Special Purpose Vehicles (SPVs) for lake management and conservation have also been set up in many parts of the country, such as, Bhoj Wetland Authority for the restoration and management of Bhoj wetlands in Madhya Pradesh, Chilka Development Authority (CDA) in Orissa for the Chilka Lake, Loktak Development Authority (LDA) for Loktak lake in Manipur, Lake Development Authority Bangalore (Karnataka) for Bangalore lakes, J&K Lakes and Waterways Development Authority for Jammu and Kashmir Lakes, Hyderabad Urban Development Authority for Hyderabad lakes in

Andhra Pradesh, East Kolkata Wetlands Management Authority for the conservation and management of a large number of water bodies in district 24 Pargana in West Bengal and Jal Vikas Samiti in Udaipur (Rajasthan). These special Purpose Vehicle are playing an important role in the protection and management of water bodies in India. As the legislation does not give the responsibility for management of water bodies to a specific agency, these Special Purpose Vehicles are empowered to enforce provisions of the legislation. A holistic understanding and acknowledgement of a lake system should be an important part of lake management plan. A clear vision regarding the level of rejuvenation of water bodies is also recommended. In order to make a productive use of limited available resources, it is important to determine an acceptable level of restoration of lakes.

Urban Sanitation

Providing environmentally safe sanitation to the people of world's second most populous nation is a challenging task. The challenges that urban sanitation sector faces mainly relate to the low priority accorded to it by the municipal governments. This task becomes more intricate in context to the country like India where introduction of new paradigms of plans, policies or projects can challenge people's tradition and belief. Around 600 million people constituting 55 per cent of country's population do not have access to safe sanitation or any kind of toilet. Open defecation is a large global problem, but it is substantially and importantly an Indian problem. About 60 per cent of the approximately 1 billion people worldwide who defecate openly live in India. Widespread open defecation has major consequences for health and human capital in India. Inadequate sanitation has a great environmental economic and health impacts in India. In order to minimize these impacts, Government of India has under taken several measures including increased investment in urban sanitation, policy initiatives, regulations, and public campaigns to improve sanitary conditions in the country. This has resulted in raising the sanitation status during the last two decades but a marked improvement is yet to be achieved. Individual health and hygiene is largely dependent on adequate availability of

drinking water and proper sanitation. There is, therefore, a direct relationship between water, sanitation and health.

Consumption of unsafe drinking water, improper disposal of human excreta, improper environmental sanitation and lack of personal and food hygiene have been major causes of many diseases in developing countries. India is no exception to this. Prevailing high infant mortality rate is also largely attributed to poor sanitation. It was in this context that the Central Rural Sanitation Programme was launched in 1986 primarily with the objective of improving the quality of life of the rural people and also to provide privacy and dignity to women. The concept of sanitation was earlier limited to disposal of human excreta by cesspools, open ditches, pit latrines, bucket system etc. Today, it connotes a comprehensive concept, which includes liquid and solid waste disposal, food hygiene, and personal, domestic as well as environmental hygiene. Proper sanitation is important not only from the general health point of view but it has a vital role to play in our individual and social life too. Sanitation is access to, and use of, excreta and waste water facilities and services that ensure privacy and dignity, ensuring a clean and healthy living environment for all. Facilities and services should include the collection, transport, treatment and disposal of human excreta, domestic wastewater and solid waste, and associated hygiene promotion (UN Habitat and Water Aid). Sanitation is one of the basic determinants of quality of life and human development index. Good sanitary practices prevent contamination of water and soil and thereby prevent diseases. The concept of sanitation was, therefore, expanded to include personal hygiene, home sanitation, safe water, garbage disposal, excreta disposal and waste water disposal. Provision of basic services such as water supply, sewerage, sanitation, solid waste disposal and street lighting has traditionally been the responsibility of the local governments. These services are being provided through state government departments, state level boards, corporations etc. Public Health Engineering Department, Public Works Department, Urban Development Department, Housing Boards, Department of Local Self Government, Water Supply and Sewerage Boards etc. are some

of the departments of the state government which performs municipal functions.

With the passing of 74th Constitutional Amendment Act, Metropolitan Planning Committee and District Planning Committee have been formed to take up developmental activities in the concerned region in place of the parastatals (Singh, 2014). The ULB's have also been empowered to take up development functions. States have responded in diverse manner with regard to the status of parastatal agencies in the post decentralized period. Many state governments like Kerala and Karnataka have recommended the abolition of the parastatals while some have recommended for a change in their functional role like in Tamil Nadu, Uttar Pradesh, Maharashtra, West Bengal and Andhra Pradesh. The parastatal agencies have also been merged with Urban Development Department. The 74th Constitutional Amendment Act has also transferred administrative and financial process and created an enabling environment for the local bodies to undertake planning and development responsibility. Sanitation brings heavy return on investment of any development intervention, however, in India; it has been remained neglected for most of the post independence history. Millions of Indians are subjected to grave ill health, increasing threats to safety, lower spending on education and nutrition, reduced productivity and lower income earning potential resulting into a deepening cycle of poverty due to lack of sanitation facilities (Dasra, 2012). Growing slum population and lack of adequate sanitation force over 50 million persons to defecate in the open every day. The poor bear the worst consequences of inadequate sanitation in the form of ailing children, uneducated girls and unproductive people, making these populations even more vulnerable and costing India 6.4 percent of its GDP (Dasra, 2012). Inadequate sanitation is much more than just an inconvenience. As urban population increases, demand for water and sewage treatment will increase. Census data demonstrate that slum population has tripled in the last three decades, intensifying the strain on insufficient urban resources. Moreover, 7 million people continue to migrate to urban areas every year with

most of them finding their way to slums within and on the fringes of cities. Slums are typically overcrowded, lack basic services and facilities, and hence are unhygienic and unsafe. In India, only half of the 50,000 slums are notified or recognized by government. Until recently, urban local bodies were not mandated to provide non notified slums with any services. Thus, slum localities bear the worst consequences of inadequate sanitation facilities. Sanitation in urban slums is a complex and pressing issue. Existing unhygienic standards, crowded conditions and poor sanitation contribute to frequent and rapid outbreaks of diseases, lack of access to healthcare facilities compounds health problems. This also affects gender parity, education and livelihoods, making slum population more vulnerable.

Climate Change Mitigation and Adaptation

Climate change and its recent trends have a direct impact on all types of the development. Numerous agencies including National and International agencies are carrying out studies and are supporting cities to develop, adopt and implement sustainable and climate safe practices as per the National Action Plan on Climate Change, Government of India. The International Panel on Climate Change (IPCC) Working Group-II's most recent report (2013) paints a grim picture for India. Focus of the report is on food and water supply and the urgent need for our cities to be resilient. Considering this, the Regional Plans and Development Plans must incorporate the possible impact of climate change on development. The focus should be on water security, use of heat absorbing materials in construction and minimising concrete surfaces. Aspects such as urban agriculture, vertical farming, water harvesting and preservation of all environmentally fragile ecosystems including water, landscapes etcetera should be incorporated. Specific actions should be included to address, among the other mentioned components. It may be desirable to develop appropriate policies and bring about effective legal and administrative control systems to deal with the problem. City-Level Action Plans, for e.g. Kanpur and Meerut have already initiated the effort, which is supported by WWF. Green building is also one of the approaches for effectively reducing impact

of climate change. It is combination of all the best practise principle. A brief on Green Building is gin in subsection below.

Green Building

Green building concept recognises sustainable development by effective performance in the following key areas:

- **Sustainable Site Development:** the sustainable site development shall include the following:
 - Efficient land use
 - Habitat preservation and restoration
 - Efficient transportation management
 - Efficient use of locally available materials and resources
- **Water Efficiency:** It shall encourage use of water in a self-sustainable manner through reducing, recycling and reusing strategies. The methods of rainwater harvesting can be integrated to reduce load of water requirement on the urban water supply system.
- **Energy Efficiency:** It shall reduce energy consumption of infrastructural equipment through energy efficient street lighting, motor pumps etc. On site power generation using various renewable energy technologies and other clean fuels can also be integrated in the planning system.
- **Waste Management:** It shall encourage effective waste management strategies by facilitating the segregating of waste at source and promoting re-use of products and materials.
- **Indoor Environment Quality:** For development of green buildings, the norms as suggested by Ministry of Environment and Forest and various bodies such as LEED, GRIHA or IGBC may be applicable depending upon the requirements.

City Bio Diversity Index

City Biodiversity Index (CBI) is a dynamic process, being prepared for depicting the urban biodiversity status. This helps in evaluation, planning, improving and reviewing the city conditions in

biodiversity perspective. The UNEP and UN Habitat states that cities occupy 2 percent of the Earth's surface, their inhabitants use 75 per cent of the planet's natural resources. Recognising the importance of biodiversity and healthy ecosystems for their survival, cities should undertake initiatives to utilize and conserve their surroundings efficiently. These actions can reach far beyond the boundaries of the city, affecting biodiversity on a global scale. At the City level, high-resolution satellite images may be used for identifying Bio-diversity areas. As adopted by Greater Hyderabad City for formulating Greater Hyderabad Biodiversity Index, the city biodiversity index system has 92 score system with 23 indicators. International convention (Convention on Biological Diversity) and national policies/plans (National Biodiversity Action Plan (NBAP), 2008) and documents have identified Invasive Alien Species as threat to biodiversity⁸³. The 12th Five Year Plan (2012-2017) has emphasised the need for a national invasive species monitoring system to track the introduction and spread of invasive species and advised that such a system should be linked to the State Forest Departments, and field staff should be trained to collect information on invasive species. Invasive species identification should not be limited to invasion in forests— it should also include invasion in aquatic and marine ecosystems, grasslands, wetlands and so on⁸⁴. It is suggested that while implementing a plan or project and developing green areas or green buffers, local species be used and the State Forest Departments to be made stakeholders in such projects.

Environmentally Sensitive Zones: Environmental sensitive zones may be defined as areas with identified environmental resource with 'incomparable values' which require special attention for their conservation.

- Monitoring & enforcement of environmental compliance.
- Use of economic principles in environmental decision making so that costs are associated with the degradation and depletion of natural resources.
- Enhancing and conserving environmental resources through production and consumption practices with focus on

regulatory and institutional reforms. Land degradation, forests and wildlife, biodiversity, freshwater resources; ground water and wetlands are the thrust resources of concern.

- Pollution abatement: ecosystems have some natural capacities to assimilate pollution; however these vary considerably with the nature of the pollutant and the ecosystem.

Environmental Assessment Notification, 2006

To ensure that the economic growth and development in our country is in conformity with regulations for environmental conservation, the Ministry of Environment & Forests has notified the Environmental Impact Assessment Notification, 2006. The Notification 2006 has notified 39 developmental sectors, which require prior Environmental Clearance. The Ministry of Environment and Forests has prepared EIA guidelines on each sector as identified by EIA notification 2006, which elaborates the procedure and mandatory requirements of EIA with respect to the sector. For e.g. Manual on norms and standards for environment clearance of large construction projects has been issued by MoEF to assist developers to measure and quantify environmental impacts of proposed construction, and derive mitigation options to minimise impacts. The manual also enables evaluation of construction projects by the expert appraisal committee. The proponent may use mitigation options, other than the ones described in the manual to mitigate environmental impacts of respective projects.

The projects for which detailed Environment Impact Assessment may be required include the following:

- Those, which can significantly alter the landscape, land use pattern and lead to concentration of working and service pollution.
- Those which need upstream development activity like assured mineral and forest products supply or downstream population.
- Those involving manufacture, handling and use of hazardous materials.

- Those which are sited near ecologically sensitive area, urban centres, hill resorts, places of scientific and religious importance.
- Industrial estates with constituent units of various types, which could cumulatively cause significant environmental damage.
- The EIA should address to some of the basic factors listed below:
 - Meteorology and Air quality
 - Hydrology and water Quality
 - Site and its surroundings
 - Occupational safety and health
 - Details of the treatment and disposal of effluent
 - Transportation of raw materials and details of material handling
 - Impact on sensitive targets
 - Control equipment and measures proposed to be adopted
 - Land requirements
 - Rehabilitation of displaced population
 - Impact during construction

Strategic Plan for New and Renewable Energy Sector

India's substantial and sustained economic growth is placing enormous demand on its energy resources. The demand and supply imbalance in energy sources is pervasive requiring serious efforts by Government of India to augment energy supplies. India imports about 80 percent of its oil. There is a threat of its increasing further, creating serious problems for India's future energy security.

Guidelines for Rain Water Harvesting

Rainwater harvesting is the technique of collection and storage of rainwater at surface or in sub-surface aquifers, before it is lost as surface run-off. The augmented resource can be harvested in the time of need. Artificial recharge to ground water is a process by which the

ground water reservoir is augmented at rate exceeding that under natural conditions of replenishment. The functioning of ground water recharge units, various methods and techniques have already been elaborated in Infrastructure Planning section. Ministry of Water Resources, Central Ground Water Board (CGWB) has issued the 'Manual on Artificial Recharge of Ground Water⁸⁷, which can be referred for development of such projects.

Environmental Guidelines for Planning Eco-Fragile Zones

Eco-Sensitive zone

Due to rapid urbanisation and its impact on protected zone, there is a need to conserve protected areas. The Ministry of Forests and Environment, Government of India has developed guidelines for declaration of eco sensitive zones around protected areas, national parks and wildlife sanctuaries. These guidelines provide the framework to states/UTs to develop specific buffer zones around National Parks, Wildlife Sanctuaries, Sanctuaries, important migratory corridors, etc. with a view of minimizing and preferably eliminating any negative impact on protected areas and sanctuaries. The recommended procedure to be adopted by states is mentioned below:

- Prepare an inventory of the different land use patterns and the different types of activities, types and number of industries operating around each of the Protected Area (National Parks/Sanctuaries) as well as important Corridors be made with the help of range officers.
- A small committee comprising the concerned Wildlife Warden, Warden, an Ecologist and an official of the Revenue Department of the concerned area, could be formed whose function is to provide recommendation on requirement and extent of eco sensitive zone. Further, the committee can also suggest the methods of management of zone and thematic activities, which can be included in the Development Plan/ Master Plan of the region.

Urban Risks and Climate Resilience

Urbanization is a global phenomenon experienced by developed as well as developing countries. There is migration from villages to towns and cities with results in growth of metropolitan cities since they provide multiple avenues, services and amenities viz. education, health care, employment, business and entertainment options etc. People also migrate for economic opportunities and urban life styles. Though urbanization brings about development in social, economic and cultural spheres of life, it sometimes disturbs the ecological systems. Rapid and unplanned growth of urban agglomerations generates a series of negative environmental effects. Today urban India presents a very pathetic scene. Cities have become a site of rotting garbage, degrading drainage system and shocking night soil removal system. India's life line is in danger. Many Indian rivers are heading towards an environmental disaster due to discharging of untreated sewage into water bodies. Besides, poor have practically no access to sanitary toilets and in many towns and cities, the majority defecate in the open. The untreated sewage being dumped into the river and water bodies leads to health hazards. Growing urbanization is posing serious environmental concerns in India in terms of changing land use pattern, increasing carbon emissions, solid waste generation and disposal, air and water pollution and poor sanitation amenities. A large segment of urban population in India resides in slums, squatters and informal settlement. These settlements are often located in low laying areas prone to direct and indirect risks due to environmental degradation including changes in the climate and lack of basic urban services. An urban environment is complex primarily because of rapidly changing variables such as socio- economic and demographic indicators, land-use patterns, resource demand and utilization patterns, lifestyle changes etc. In the light of climate change, a new layer of uncertainty is added in terms of changes in precipitation, temperature and occurrence of extreme events. Furthermore, there are scale mismatches; in terms of the timescales over which policymakers and urban planners operate, and scales over which projected impacts of environmental decisions,

degradation, climate variability and change will manifest. Also policies and developmental initiatives in cities should enable urban systems to adjust to changes as and when they happen and accordingly respond in a way that maintains their original structure and function. It is to be noted that out of 35 cities in India having population over a million, 18 are in coastal states. Major challenge for cities in the face of rapid population growth is to maintain sustainability within the social, economic and environmental dimensions. Urban systems are at risk to different kind of hazards. Several factors contribute to the urban risk profile.

Increasing urbanization, expansion of habitat into unsuitable vulnerable areas, higher population density, higher housing density, vulnerable housing and buildings construction, non engineered unsafe construction, and aging buildings and other infrastructure are some of the factors that have increased the vulnerability of hazards and disasters in urban areas. Growing urbanization is posing serious environmental concerns in India in terms of changing land use pattern, increasing carbon emissions, solid waste generation and its disposal, air and water pollution and poor sanitation amenities. Major challenge for cities in the face of rapid population growth is to maintain sustainability within the social, economic and environmental dimensions. The accelerated and uncontrolled urban growth has contributed to the ecological transformation of the cities and their immediate surroundings resulting in flash floods and water scarcity. Furthermore other factors depending on the local circumstances contribute to the urban vulnerability, hazards and risks (Singh, et.al. 2014). Cities may be viewed as hubs of the intensive resource demand, environmental degradation and greenhouse gas emissions. However, cities may play a critical role in promoting low carbon development through use of renewable energy, energy efficiency, green buildings and mitigating emissions from urban transport. The immediate problems of states' cities relate to inadequate institutional arrangements for solid waste management, drainage, sewage treatment and disposal and sanitation services. Thus, it is imperative to improve the municipal

services, particularly sanitation services and urban local governments adopt the integrated urban planning for climate resilience and addressing the environmental problems (Singh, 2014). Policymakers and developmental planners have increasingly become interested in understanding the concepts of resilience, vulnerability, and adaptation to enable proactive and better informed responses to urban disasters. (Dayton and Johnson, 2004). Urban Resilience" is the capacity of an urban center to absorb the shock of a sudden or unforeseen disaster provoked by an event without necessitating massive extra territorial aids and resources to maintain its urban performance quality. These shocks could be of manmade origin or of natural causes such as tsunami, flood, cyclone, earthquake, landslides, etc. The quality of urban resilience or in other words its absorbing capacity depends upon the management quality of its governance system, its resources availability, its infrastructural facilities and manoeuvrability, the participative dynamics of its citizens and most importantly its visions and preparedness mechanism at all levels to counteract the disasters and emergencies. In fact, an urban center is a complex entity of a total system composed of innumerable sub-systems representing different urban elements and parameters. A good number of scientific means and knowhow's such as GIS, forecasting, simulation of scenarios and magnitude of disasters' effects, etc. are available to understand, to envision and to modelise these risks and minimize their impacts on settlements. In order to encounter the disasters and improve the resilient capacity of the settlement centers, three basic strategies are needed to be developed: 1) Anticipation and envisioning of the "causes & effects chain" that constitute the total urban system of the settlement centre; 2) Improve the early warning and preparedness capacity, infrastructural mobility and governance system; and 3) Incorporating necessary measures in the development program to rectify the planning errors (Baral, 2014).

Growing urbanization would result in an increase in dependency on urban services, economic opportunities, resources, and infrastructure. In India, while cities such as Mumbai, Bangalore,

Ahmadabad, and Chennai have substantial developmental investments, medium and small towns are grappling to deal with population growth and competition for resources due to inadequate infrastructure and financial resources. (Mc Grahnan et al., 2007). A major challenge for cities facing rapid population growth is to maintain environmental sustainability. The nature of inter-linkages of services within an urban environment and consequently the highly connected nature of risks, policies relating to urban resilience and sustainability essentially need to address multiple sectors and dimensions (Nijkamp and Finco, 2000). This includes land use planning, energy management, ecosystem services, housing and transport, water supply and sanitation, health services, and waste management, inter alia.

Aggregating the findings from the extensive review of literature on climate adaptation, resilience efforts, urban risks, and development, we find (Teri, 2011):

- Resilience is multi-sectoral: Policies need to be integrated within on-going decision-making and planning processes in critical sectors;
- Resilience is an incremental process: Planning should emphasize mechanisms for on-going learning, evaluation, and adjustment of strategies based on observed impacts of climate changes
- Resilience includes not only “hard infrastructural investments” but also “soft” actions to strengthen the adaptive capacity of populations and sectors
- Resilience should be framed in line with local and regional developmental priorities, and focus on the most vulnerable sectors
- Resilience planning should involve stakeholder groups in a collaborative way. It is a multi-sectoral approach, operating at various levels of institutional set-up
- Mainstreaming resilience planning needs to be guided by policies and legislative framework or by the rules of law to

help integration with development activities at each level.

- Resilience planning should be based on detailed region-specific vulnerability analysis to capture vulnerability in its varied dimensions (for example biophysical, social, and technological, etc.)

Project planning for infrastructure needs early risk audit in its formative stages of estimating investments. Hazard and vulnerability assessment need to be more focused on risk of disaster and climate change in these estimates. In local level project planning the focus on process that captures risk concerns, risk reduction to build resilience in infrastructure is lacking (Bhatt, 2014). Resilience is proving to be a helpful way of furthering our understanding of how to improve efforts in disaster management, both in reducing the scale of impact beforehand and in providing a better response afterwards (Sanderson, 2014). There is an urgent need to look for alternatives to produce greener and cleaner building materials, which consume fewer resources, produce lesser pollution and are environment friendly besides focusing on disaster resistance capability of construction materials. In India, town planning is an important entry point for mainstreaming urban resilience. Review of several planning documents is required in order to identify options and strategies towards urban resilience. These include:

- Town and country planning act and zoning regulations
- Development control rules and building bye-laws
- District planning manual of the Planning Commission
- National building codes
- Urban Development Plan Formulation and Implementation (UDPFI) guidelines
- City master plans

At the city level, budgetary challenges and lack of fiscal autonomy still exist as bulk of the finances still rest with the Central and state governments and not with city governments. The method of mainstreaming risk reduction and resilience planning is through climate risk screening. It is an approach for reducing climatic risks to

developmental objectives and integrating adaptation options within developmental programmes at the national and sub-national levels (Tanner et al., 2007). The steps involved in a climate risk screening include:

- Assessment of current and future impacts of climate change on developmental objectives of a project/ policy;
- Assess the ways in which the developmental project/policy already contributes towards vulnerability reduction and risk reduction Identify potential entry points to integrate climate risk management strategies into the developmental project/policy ambit;
- Prioritization of the selected strategies based on multiple established criteria
- Conducting cost-benefit analyses of the selected strategies.

Strong urban planning can promote resilience by ensuring optimal use of space, energy and natural resources. Flexible and adaptable climate change planning processes are crucial. Engagement, education and awareness raising campaigns are a useful element within planning for development because each activity can contribute to climate change – wasting electricity, driving cars, not recycling or reusing. Decentralized and improved urban governance is important for practical implementation of resilience and sustainability strategies. Public-private partnerships are an important and effective means of leveraging stakeholder expertise and forming partnerships for greater community benefits. Municipal bodies often do not have appropriate data to address planning needs and development. Advanced mapping, visual and spatial technologies can promote effective resource allocation and resilience strategies in cities. In order to ensure disaster resilient development in cities, there is a need for *better inter—agency coordination* across ministries and departments such as urban development , housing, water resources, environment, transport, home/internal affairs, power, communications, municipal governance amongst others at national, state and local levels along with many non- governmental

organizations and civil society.

Conclusion

Cities may be viewed as hubs of the intensive resource demand, environmental degradation and greenhouse gas emissions. However, cities may play a critical role in promoting low carbon development through use of renewable energy, energy efficiency, green buildings and mitigating emissions from urban transport. Mainstreaming climate resilience into urban development is essential because climate risks may only be one of the several factors defining poverty level, well-being, economic growth and development in an urban environment. Strategic urban planning directly supports urban resilience as a tool for sustainable development. Urban local governments must actively coordinate and mainstream mitigation, adaption and resilience into urban planning process to prepare cities to deal with climatic risks and impacts. The Supreme Court of India has played a catalytic role for greening cities in the country. The court identified critically polluted cities and suggested an action plan to reduce the level of pollution in these cities. The immediate problems of India's cities relate to inadequate institutional arrangements for solid waste management, drainage, sewage treatment and disposal and sanitation services. Thus, it is imperative to improve the municipal services, particularly sanitation services and urban local governments adopt the integrated urban planning for climate resilience and addressing the environmental problems.

Suggestions

- There is a need to prepare a comprehensive, flexible and user friendly framework for planning and policy analysis under climate variability and uncertainty scenario.
- It is imperative to establish and strengthen ground water monitoring network through construction of observation wells, sanctuary wells for coastal aquifer management and water quality monitoring.
- It is high time to review the National Water Policy with a view to ensure integrated water resource management in the context

of climate change challenges in water sector.

- It is imperative to develop inter-ministerial and inter-departmental coordination for vulnerability analysis, mitigation and addressing of climate change challenges both at the state and centre level.
- Integrated Energy Policy, introduced in 2006, should be effectively enforced to promote energy efficiency in all sectors with emphasis on mass transport, renewable energy resources development and clean energy technologies.
- Promotion of cleaner technologies, strengthening of emission standards, introducing economic incentives and strengthening of monitoring and reporting system is imperative in order to control the industrial pollution.
- State specific water policies need to be prepared. Ground water legislation needs to be promulgated in all states to promote sustainable water uses and water development. Emphasis should be given to developing surface water use and taking measures for rainwater harvesting to increase water resource availability.
- It must be made mandatory to install rainwater harvesting systems in both public and private buildings, including industrial and commercial establishments. Buildings having a courtyard should allocate a prescribed proportional area for rainwater harvesting and recharging. The ULBs should make ensure such provisions before approving building plans.
- Environmental taxes can potentially be levied in a wide range of settings for effluent/emission charges for industrial pollution, and user fees for municipal solid waste, to taxes on the use of agricultural inputs such as fertilizers and pesticides and carbon taxes. The small scale industries may also be imposed taxes in accordance with polluter pays principle.
- It is imperative to develop and evaluate adaptation strategies in all the major hydro geological environments to mitigate negative impacts of climate change and variability.

- Integrating climate change adaptation considerations into policy process and decision making across a range of sectors and skills is critical in managing the impacts of climate change. There is need to develop, disseminate and implement the knowledge, tools and technologies required to effectively engaging in an integrated approach.
- Technological intervention is required to enhance effective treatment of waste water. Strengthening of waste water and sewerage/effluent treatment plants should be undertaken on priority basis.
- There should be effective enforcement of user charges on sanitation services particularly door to door collection of garbage and refuse, cleaning and maintenance of public toilets, sweeping of roads and streets, cleaning and maintenance of drainage, etc.
- There should be more incentives for the urban local bodies to mobilize the communities and making the cities open defecation free as well as dust bin free. The community, particularly urban poor should be provided adequate subsidy and loan facility for construction of toilets.
- The capacity of existing sewerage treatment plant should be fully utilized through addressing the prevailing problems, constraints and challenges in effective functioning of the sewerage treatment plants. There should be effective ban on disposal of human excreta into open drains and water bodies.
- There should be proper policy of septage management as a large urban population is depending on conventional septic tanks technology for disposal of human excreta. The policy should also address the issues of appropriate technologies, regular cleaning of septic tanks, disposal of solid waste from septic tanks and provision of training and capacity building of sanitary workers engaged in cleaning of septic tanks.
- Urban planning urgently begs a fundamental conceptual change, with a need for locating urban disaster management strategies in a holistic frame work. In order to reduce the

pressure on land in hazard prone areas, the emphasis should be given on construction of buildings and infrastructure in the outskirts of the core area of the city. The satellite towns should be developed with greater emphasis on financing and creation of infrastructure in order to reduce the population stress on mega cities.

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