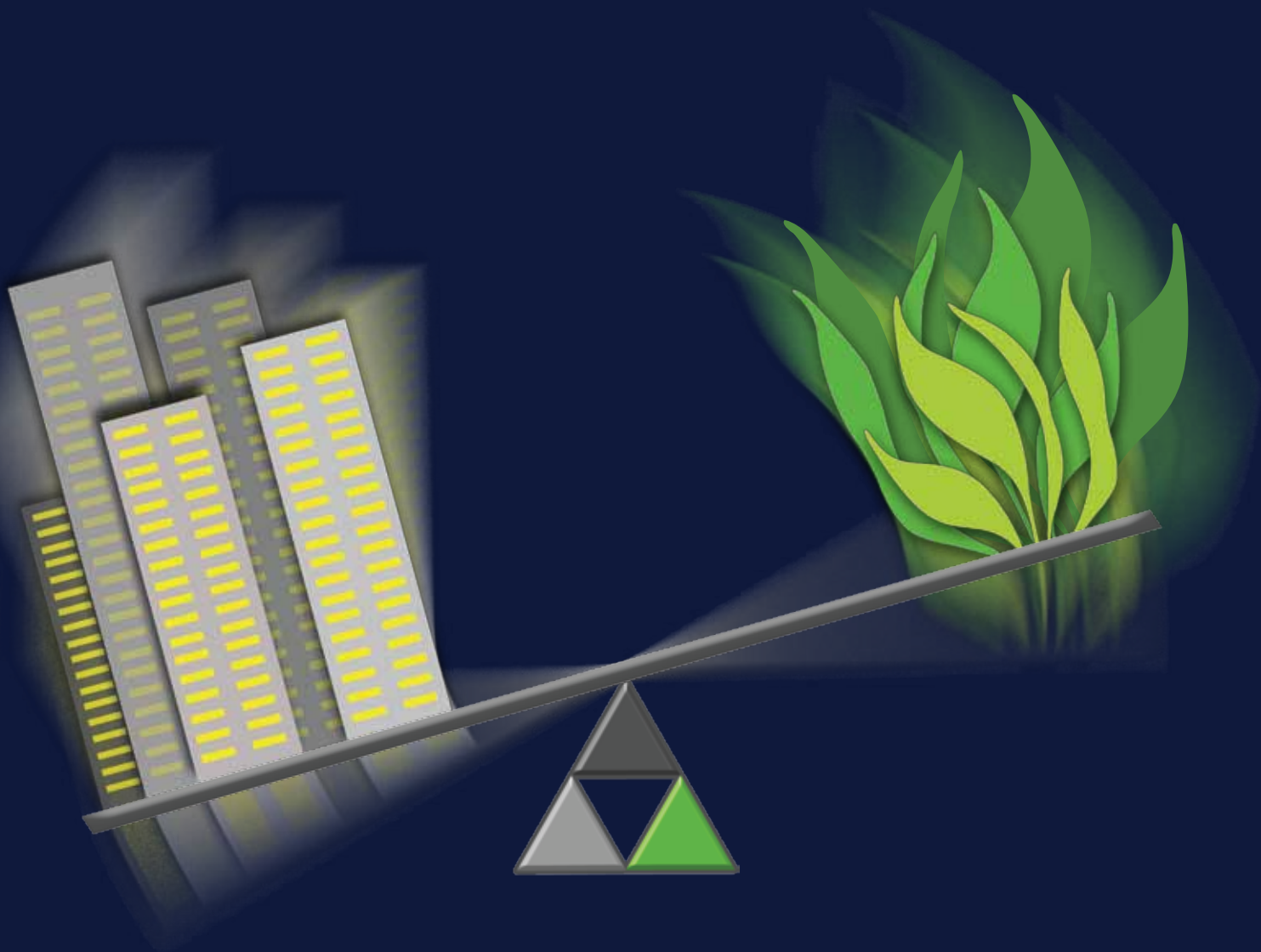


Sustainable Housing: Balancing Environment with Urban Growth in India



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The Rajasthan State Pollution Control Board is a body corporate constituted under section 4 of the Water (Prevention and Control of Pollution) Act, 1974. It was first constituted on February 7, 1975, with the objectives of prevention, and control of water pollution and maintaining or restoring of wholesomeness of water. Later, it was also entrusted with the responsibilities of prevention, control and abatement of air pollution under the provisions of Air (Prevention and Control of Pollution) Act, 1981. Water (Prevention and Control of Pollution) Cess Act, 1977 has been enacted to make the State Board financially independent. Under this act the State Board has been given powers to collect cess on the basis of water consumed by the industries and others. Besides, the State Board is also implementing the provisions of the Public (Liability) Insurance Act, 1991. Enactment of the Environment (Protection) Act, 1986 has further widened the scope of the activities of the Board. This act being umbrella legislation, different rules for addressing the problems of various sectors have been enacted under this act. Currently, the State Board is engaged in implementation of the following rules under EPA, 1986:

- Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008.
- Manufacture, Storage & Import of Hazardous Chemical Rules, 1989.
- Public (Liability) Insurance Act, 1991.
- Public (Liability) Insurance Rules, 1991.
- Environmental Impact Assessment (Aravali) Notification Dated 7.5.1992.
- Environmental Impact Assessment Notification dated 14.09.06.
- Bio Medical Waste (Management & Handling) Rules, 1998.
- Plastic Waste (Management & Handling) Rules, 2011.
- Noise (Pollution Control & Regulation) Rules, 2000.
- Municipal Solid Waste (Management & Handling) Rules, 2000.
- Batteries (Management & Handling) Rules, 2001.

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Summary

By 2030, according to the projections of the United Nations (UN) Population Division, each of the major regions of the developing world will hold more urban than rural dwellers; by 2050 fully two-thirds of their inhabitants are likely to live in urban areas. By 2050, India is likely to be the most populous country with a projected population of 1.69 billion. It is estimated that over 70 million new urban housing units will be needed over the next 20 years in India. This unprecedented urbanization has implication for ecological, economic and social sustainability. Here we argue that to balance environment with urban growth, we shall have to draw on multiple branches of knowledge and concepts including Sustainable communities, sustainable cities, livable cities, green cities, prosperous cities, eco-cities, healthy cities and resilient cities. These concepts provide us networked and intricately linked action points that would need to be integrated to achieve a balance between urbanization and environment. Accordingly, we provide evidence-based suggestions on creation and management of green infrastructure, wastewater treatment, recycling and appropriate use, waste management, green transportation, affordable housing, energy, and finally, recovery of full costs of, and reinvestment in, urban services. The Analysis we have provided in this review offers a workable and practical philosophy that can be translated in the field from the perspective of balancing urban growth and environment in India. All these actions need to be incorporated for implementation in the master plan of the individual cities or regional master plan of the area to achieve ecological, economic and social sustainability.

1. The context

The world's population on the eve of the emergence of agriculture is estimated to have been around 6 million individuals as against almost 7 billion today, multiplying by 1200 in just 11,000 years [1]. This shift from forager to producer societies is known as The Neolithic Revolution [2]. By 2030, according to the projections of the United Nations (UN) Population Division, each of the major regions of the developing world will hold more urban than rural dwellers; by 2050 fully two-thirds of their inhabitants are likely to live in urban areas [3]. During the period 2000–2024, the world's total population is projected to grow by 1.76 billion persons, with some 86% of

this growth expected to take place in the cities and towns of developing countries [3]. In 2050, India will be the most populous country, with a projected population of 1.69 billion, compared with China's 1.30 billion [4, 5]. The ultimate size of India's population when the population stabilization is achieved will be about 1.72 billion around 2060, according to the population projection by the United Nations Population Division (UNPD) [6].

Urbanization and urban expansion is happening even faster. Although cities are estimated to occupy less than 0.5% of the Earth's total land area [7], satellite-based efforts at mapping global urban extents fail to agree on the size and pattern of urban land use, with estimates ranging from 0.24% to 2.74% (i.e., 0.3 to 3.5 million km²) of terrestrial land surface circa 2000 [7-9].

For centuries, cities were compact with high population densities, and the physical extent of cities grew slowly [10]. This trend has been reversed over the last 3 decades and urban areas around the world are expanding on average twice as fast than their populations [11, 12]. The model results for India shows on average a 4.84% urban land expansion growth rate with 30% from population growth and around 23% from growth in GDP per capita for the period 1970 to 2000 [12]. If current trends continue globally, more than 5.87 million km² of land have a positive probability (>0%) of being converted to urban areas by 2030, and 20% of this (1.2 million km²) have high probabilities (>75%) of urban expansion [13]. Nearly half of the increase in high-probability urban expansion globally is forecasted to occur in Asia, with China and India absorbing 55% of the regional total [13].

Although urban land cover is a relatively small fraction of the total Earth surface, urban areas drive global environmental change [14, 15]. Urban expansion and associated land-cover change drives habitat loss [16-18], threatens biodiversity [17, 19], and results in the loss of terrestrial carbon stored in vegetation. Within the pan-tropics, loss in vegetation biomass from areas with high probability of urban expansion is estimated to be 1.38 PgC (thus, 0.05 petagram of carbon per year), equal to approximately 5% of emissions from tropical deforestation and land-use change [13].

In the light of these realities of urbanization and its consequences, with 17% of current global population in India, it is necessary to design policies for sustainable housing in a manner that provide balance between environment and urban growth. This not only involves developing sustainable building technologies applicable to various climate regions, economic conditions, and residential customs in India, it also involves the management innovations for urban governance. In the sections that follow we describe the environmental challenges associated with urban growth. We assembled a large and comprehensive database of published research and present here science-based policy options to guide planners and policy-makers for achieving trade-off between urban growth and environment. Our analysis not only has practical utility for urbanization, it also offers evidence-based insights on green buildings, sustainable housing,

green infrastructure, climate change resilience, waste and wastewater management, and urban industrial symbiosis.

2. Sustainable housing

The sustainability can be defined as meeting the needs of today without compromising the needs of future generations. Sustainable housing has the potential to produce good quality housing at a price that is affordable both in the short and long term. Thus, sustainable housing must aim at economic, social and environmental sustainability from planning to implementation phase and at the same time result in housing that is affordable, accessible and environmentally less damaging [20]. The National Urban Housing and Habitat Policy-2007 intends to promote sustainable development of habitat in India with a view to ensuring equitable supply of land, shelter and services at affordable prices to all sections of society [21]. Notwithstanding numerous attempts, sustainable housing has remained difficult to define, yet it should be coherent to certain characteristics of sustainable development [22]:

- (1) help for the very poor because they are left with no option other than to destroy their environment,
- (2) the idea of self-reliant development, within natural resource constraints,
- (3) the idea of cost-effective development, meaning thereby that development should not degrade environmental quality, nor should it reduce productivity in the long run,
- (4) the issues of disease control, appropriate technologies, food security, clean water and shelter for all,
- (5) the notion that people-centred participatory initiatives are needed; human beings in other words, are the resources in the concept.

From this perspective the sustainable housing policy should incorporate three objectives [22]: The first of these is that future policies must provide the basis for household improvement. The second objective of the policies which could result in sustainable housing improvement is concerned with the empowerment of poor people. The third objective of such policies must be to psychologically give the lower segment of the urban society a feeling of self-worth. Thus, in order to be sustainable, housing initiatives must be economically viable, socially acceptable and affordable, technically feasible and environmentally-friendly.

3. Potential contribution of housing to sustainability

It is pertinent to note that housing sector can significantly contribute to sustainability because of its close association with environmental aspects:

1. Buildings consume large amounts of natural and man-made resource in construction, maintenance and continued use by society.
2. Buildings are a fixed asset with a long operational lifespan.

3. Buildings are among the fundamental necessity for a good quality of life, and thus have implications beyond housing affecting transport, health, employment and community.
4. Buildings are amenable to numerous ways in which recycled materials can be reused for construction.
5. Large number of innovations are available for efficiently operating the buildings including use of recycled material for construction, wastewater treatment and use, energy efficiency, solar heating, passive solar heating, creating urban green spaces in proximity to compact housing.

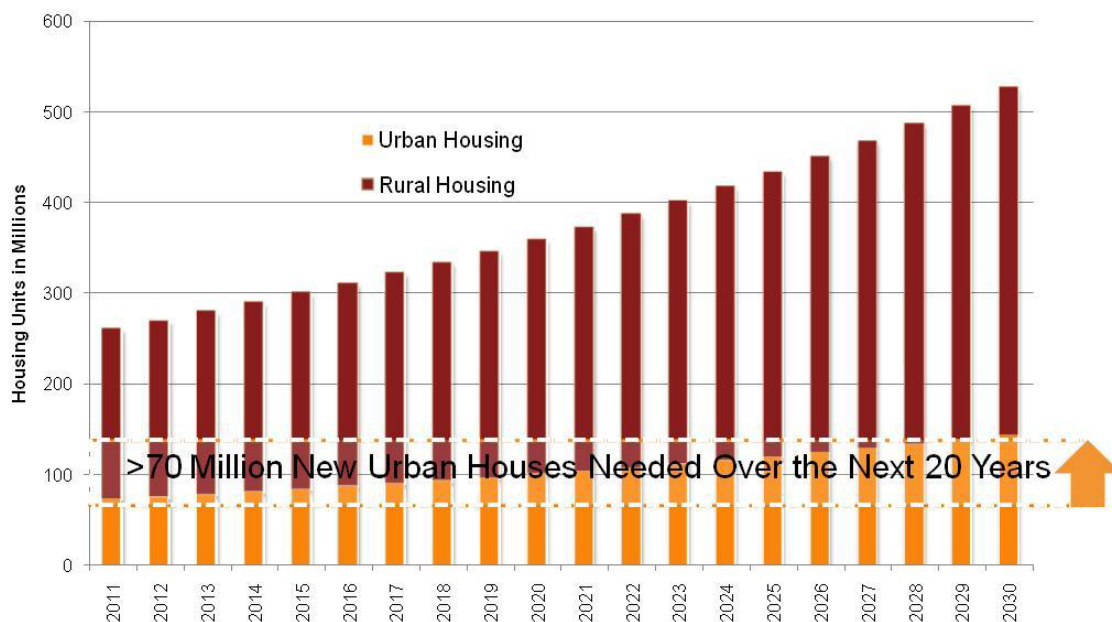
Rightly then, the National Urban Housing and Habitat Policy-2007 takes note of several aspects related to environmental sustainability. A paragraph is particularly instructive [21]:

“Development of sustainable habitat is closely related to the adoption of ‘the Regional Planning approach’ while preparing Master Plans of towns/ cities, District Plans and Regional/Sub-Regional Plans. It involves maintenance of the ecological balance in terms of a symbiotic perspective on rural and urban development while developing urban extensions of existing towns as well as new integrated townships. Promotion of sustainable habitat is closely linked with reserving a significant proportion of the total Master Plan area as ‘green lungs of the city’ (e.g. Master Plan for Delhi 2021 provides 20% of green areas), protecting water bodies with special emphasis on the flood plains of our rivers and developing green belts around our cities. It will be desirable to pursue a goal of 20-25% recreational land use area (excluding water bodies) which has been prescribed for Metro-cities by the Urban Development Plan Formulation and Implementation Guidelines (UDPFI) in order to enhance the sustainability of human settlements. Recreational land use refers to parks, playfields and other open space such as specified park, amusement park, maidan, a multipurpose open space, botanical garden, zoological parks, traffic parks, etc. It is also necessary to estimate the Gross Geographic Product (GGP) of a given sub-region and endeavour to enhance it while developing new urban settlements. The new Habitat Policy recognizes the sustainability limits of existing urban settlements. It also seeks to emphasize the mutual inter-dependence between towns and villages”.

4. Urbanization scenarios

In 1950, developing nations accounted for less than 40% of the world’s urban population. By 2005 that figure reached 70%. It is projected that urban population in developing nations will continue to grow reaching 80% by 2030. By 2050, 93% of the urban population growth will occur in developing countries [23]. One of the major challenges faced by cities today is the growing number of urban dwellers living in slum conditions. About one third of the world urban population live in these conditions and if populations continue to grow it is estimated that 889 million people will live in slums by 2020 [23].

In India, the share of urban population to total population has been increasing from 20 per cent in 1950s to about 30 per cent by now. During 1992 to 2000 India experienced higher rates of urbanization than China, but 2000 to 2008 China experienced higher rates of urbanization than India [24]. The polarisation 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. The slum population faces challenges ranging from insecure tenure and poor shelter conditions to the lack of access to basic infrastructure facilities like water supply, sanitation and solid waste disposal [25]. This is likely to intensify as over 70 million new urban housing units will be needed over the next 20 years in India (see figure 1) [26, 27].



Source: Planning Commission 11th Plan Report & EDS Analysis

5. Urbanization and environmental challenges

The rapid urbanization has put pressure on the finite resources and is characterized by severe shortage of basic services like potable water, well laid-out drainage system, sewerage network, sanitation facilities, electricity, roads and waste disposal. These in turn result in to numerous environmental and health impacts that must be addressed. 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 lead to severe environmental pressures. These challenges are many, but can be summarized as under [10, 13, 28-42]:

1. *Slum development*: The polarisation 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. For example, around 85,000 households live on a 110-hectare (275 acres) site next to Mumbai's international airport, on land that belongs to the national airport authority [43].
2. *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.
3. *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.
4. *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.
5. *Traffic related air and noise pollution*: This 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 awafully slow. The Air pollution is high due to air emission of pollutants and causes respiratory diseases to city habitants

6. *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.
7. *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.
8. *Climate change:* Modern buildings have high levels of energy consumption because of requirements of air-conditioning and lighting. In addition, the urbanization has lead to increasing vehicular density and consequent consumption of fossil fuel. This leads increasing release of green house gases, resulting in to contributions to climate change.
9. *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.

6. Balancing environment with urban growth

To balance environment with urban growth—or at a minimum, to arrive at trade-offs—we have to draw on several concepts which often have overlapping ideas. These concepts provide us networked and intricately linked action points that would need to be integrated to achieve a balance between urbanization and environment. These include:

1. *Sustainable communities:* Sustainable communities are defined as places where people want to live and work, now and in the future. They meet the diverse needs of existing and future residents, are sensitive to their environment, and contribute to a high quality of life. They are safe and inclusive, well planned, built and run and offer equality of opportunity, good and services for all [44-49].

2. ***Sustainable cities***: Sustainable city means one that is able to provide basic needs for the population without discrimination, along with the necessary infrastructures of civic amenities, health and medical care, housing, education, transportation, employment, good governance, social justice, and yet is able to sustain green infrastructure [50-55].
3. ***Liveable cities***: Liveability relates to those attributes of a place—including dwelling, neighborhood, city and region—that contribute to quality of life and well-being of residents. Thus, the concept encompasses measures of residential amenity, human capital, social capital, human health, personal satisfaction and happiness. The major challenge is to arrive at trade-off strategies leading to liveability–sustainability nexus [56, 57].
4. ***Green cities***: Green Cities are defined as having clean air and water, beautiful avenues, public parks, community gardens, domestic gardens, urban forests and urban water-bodies, and where human population has succeeded in minimizing the negative ecological impacts on urban green infrastructure and life-support systems [58-62].
5. ***Prosperous cities***: UN Habitat recently suggested that cities are the home of prosperity where human beings find satisfaction of basic needs and access to essential public goods. The city is also a place where ambitions, aspirations of life are realized, providing contentment and happiness. The State of the World's Cities report [63] notes that prosperity for all has been compromised by a narrow focus on economic growth, and thus, suggests a fresh approach to prosperity, the Wheel of Prosperity, beyond the solely economic emphasis, including other vital dimensions such as quality of life, adequate infrastructures, equity and environmental sustainability.
6. ***Eco-cities***: Eco-cities are defined as cities that create economic opportunities for their citizens in an inclusive, sustainable, and resource-efficient way, while also protecting and nurturing the local ecology and global public goods, such as the environment, for future generations [64-66].
7. ***Healthy cities***: A healthy city is defined in terms of both process and outcome. It is not the one that has achieved a particular level of health; it is one that is conscious of health and striving to improve it. A healthy city continuously creates, improves and sustains the physical, social and environmental infrastructure and expands community resources for enabling the mutual support among population groups for living [67-73].

8. **Resilient cities:** A resilient city is characterized by its capacity to withstand or absorb the impact of a hazards including climate change through resistance or adaptation, which enable it to maintain certain basic functions and structures during a crisis, and bounce back or recover from an event. The United Nation's International strategy for Disaster Reductions defines resilience as "the capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase this capacity for learning from past disasters for better future protection and to improve risk reduction measures" [76]. The focus on resilience reflects a mounting recognition that disaster risk reduction, climate change adaptation and sustainable development are inextricably linked. These issues present mutually dependant challenges, which require collaborative, integrated strategies, strong governance, and innovative technological and financial solutions [74]. Urban resilience is often the outcome of both infrastructure and governance. In terms of governance these characteristics have been used as basis for a climate resilient urban governance assessment framework, and include (1) decentralisation and autonomy, (2) accountability and transparency, (3) responsiveness and flexibility, (4) participation and inclusion and (5) experience and support [75]. Urban resilience is a growing area of interest and concern that must be taken into account in sustainable urban development [75, 77-83].

In order to achieve the desired outcome that encompasses the above stated dimensions, following policy options and actions are suggested:

1. **Creation and management green infrastructure:** Urban green infrastructure comprise of all natural, semi-natural and artificial networks of multifunctional ecological systems within, around and between urban areas, at all spatial scales [84-87]. 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

has the potential to guide urban development by providing a framework for economic growth and nature conservation across urban systems. Planned approach is essential for integration between urban development, nature conservation and public health promotion. Thus, creation and maintenance of green infrastructure for ecosystem service and human well-being is an important component of sustainable urban systems. This will include protection to already existing structures such as ponds, lakes, rivers, vegetation, forests and other components of natural systems. It will also entail creation of urban green spaces, gardens, constructed wetlands, permeable pavement, and integrated rainwater harvesting systems. An important consideration that is now emerging is that we need to move towards multifunctional urban green spaces, such as "edible landscapes" that provide both goods and services to society [86, 89, 90]. For example, construction of parks, urban green spaces, urban forests, domestic/home gardens, plantations on vacant lands and peri-urban agriculture and agro forestry can immensely contribute in creation of green infrastructure [78, 91].

2. ***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. If applied in combination, these options make the most of scarce freshwater resources, serve the varying water needs, and confer a variety of environmental benefits. However, their widespread adoption will require changing how freshwater is sourced, used, managed, and priced [92]. 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 a sure sign of sewage contamination [93, 94]. Treatment of domestic wastewater, sewage and wastewater from industrial clusters is vital for balancing urban growth and environment. CPCB estimates suggest that of the 35,254 million liters per day (MLD) of sewage generated in urban areas, only 11,777 MLD receives secondary-level treatment [94, 95]. Other estimates suggest that in practice

only 20% wastewater is processed [93]. Thus innovative and decentralized solutions for wastewater treatment and reuse are urgently required. Treated water should be recycled for appropriate end use. It will check contamination of soil, land and water resources as well as partly address the problem of water scarcity which most of the Indian cities are facing. Interestingly, if every municipal body starts recycling every drop of wastewater, it has the potential to become the model of urban industrial symbiosis and at least partly fulfil the water requirements of per-urban farmers as well as industrial clusters.

3. **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 [38, 96]. The quality of waste management services is a good indicator of a city's governance. Rapid urbanization, increasing industrialization, rising incomes and a more sophisticated form of consumerism are leading to an increase in the amount and toxicity of waste in middle-income Asian countries, especially in the cities. Solid waste management should lay emphasis not only on waste disposal but also on minimization, waste recycling and conversion of waste to energy [36, 38, 96-98]. A good example is of metals. Metals are infinitely recyclable in principle, but in practice, recycling is often inefficient or essentially nonexistent because of limits imposed by social behavior, product design, recycling technologies, and the thermodynamics of separation. The most beneficial actions that could improve recycling rates are increased collection rates of discarded products, improved design for recycling, and the enhanced deployment of modern recycling methodology [99]. Another stream of waste is bio-medical waste that needs serious attention in India [100-117]. Particularly, in smaller hospitals most biomedical wastes are often collected without segregation into infectious and noninfectious categories [100].
4. **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. Compact cities, such as Vienna and Madrid, have significantly higher population density and higher public transport use than more sprawling cities. 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.

5. **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 [118]. Affordable housing to the poor sections of the society in ever growing cities is much needed to avoid development of slums. Amelioration of affordable housing delivery and control in growth of slums is likely to depend on policies that ensure the satisfaction of certain core economic principles such as the household stock and flow principle [118]. It must be understood, however, that housing affordability is a complex issue that should not be assessed in terms of financial attributes and economic viability alone. In order to increase quality of life and community sustainability the environmental and social sustainability of housing must also be taken into consideration along with provisioning of civic amenities [119, 120].
6. **Energy:** Buildings are highly energy intensive through their life cycle consuming about 40% of the world's primary energy supply globally [121]. Cities pose a unique challenge to engineers in that they require concentrated energy supplies. Type of energy source, whether renewal or fossil fuel based, will significantly affect the environmental quality of any city. We need to avoid a focus on mere target such as physical coverage, and move to an outcome-oriented energy provision that takes into consideration demand-side parameters such as availability, reliability and efficient consumption [122]. To promote growth and also mitigate climate change, cities will need to shift energy sources, improve energy efficiency, and increase city density [123-126]. Energy combined with other interventions has another dimension. There are clear opportunities for simultaneously improving health and cutting green house gas emissions through coherent policies on transport systems, urban planning, building regulations and household energy supply. These are the issues that influence some of the largest current global health burdens, including approximately 800,000 annual deaths from ambient urban air pollution, 1.2

million from road-traffic accidents, 1.9 million from physical inactivity, and 1.5 million per year from indoor air pollution [127].

- 7. *Recovery of full costs of, and reinvestment in, urban services:*** In order to ensure the continuous functioning and sustainability of urban systems, we need to recover the costs of services from residents, and the money so recovered be used for the proper functioning and maintenance of these systems [128]. Transition to a green urban economy now requires a fundamental transition in the design of policy and institutions and in the organization of economic activities so as to enhance efficiency and reduce unsustainable practices. Financial, economic, and market instruments need to be aligned to provide incentives to enhance energy efficiency, encourage recycling and reuse, and greening the urban economy. This necessitates a new role for the governments, moving from its traditional command and control approach towards a market-based economic approach by creating a conducive environment for the proper functioning and interactions of markets, the private sector and other stakeholders [129].

6. Conclusions

The Analysis we have provided in this paper shall hopefully provide a workable and practical philosophy that can be translated in the field from the perspective of balancing urban growth and environment in India. Based on the various field listed above, a coherent proposal for action can be drawn at the level of individual buildings, communities, cities and at the level of regional city network. All these actions need to be incorporated in the master plan of the individual cities or regional master plan of the area. Finally, we need policy actions in terms of ecology, economy and society to achieve sustainability.

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