A Sustainable Vision for Urban India

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Abstract

The author observes that the cornerstone of making sustainable is to adopt an integrated approach towards ecology and the conservation of the natural resources which should form the basis of city planning and development. It should strike a balance between conflicting demands - citizen freedom versus safeguarding community interests, commercial opportunity versus environmental sustainability, public service versus mandatory procedures. Most important is to develop a vision and ideas as the basis of urban planning.

1. INTRODUCTION

Today, more than half the world’s population of over six billion people lives in towns and cities. Everyday they are joined by another 180,000 city dwellers. It is projected that two out of three children born today in developing countries will grow up in towns and cities, and by 2030 there will be two billion new city dwellers. In 2030, sixty percent of the world’s population will live in cities and urban agglomerations, most of them (3.9 billion) in developing countries. In 2030 there will be about 500 cities with a population of one million or more around the globe - more than half of them will be in Asia. By 2015, 18 of the 27 megacities will be in Asia. Today more than 900 million people live in slums worldwide. They account for about half of all city dwellers in developing countries.

This poses an unprecedented challenge to re-establish the uterine relationship between nature and man, between human consumption and production. The ecological cycle, which has been disrupted by indiscriminate economic and physical demands of development needs to be revived. Looking at the damage which our cities and development have inflicted upon the environment, one of the prime agenda is to explore the possibility of creating a living environment which is self sufficient, ecologically balanced and culturally stimulating. We need to relook at the fundamentals of human settlements and evolve a sustainable system whereby harmony and interrelationship between nature and life can be re-established.

What is Sustainability? The first question that needs to be asked is what is meant by sustainability? Why sustainability? What are the attributes of sustainable human settlements? The report ‘Our Common Future’ states that the basis of...
sustainable development is to promote harmony among human beings and between humanity and nature. The pursuit of sustainable development requires striving for a balance between economic goals, human (social, cultural, livability and health) and environmental needs. This involves a process of effective citizen participation in decision-making. An economic system that is self reliant and securing ecological basis for development are the prerequisites of sustainable development.

To translate sustainability principles in terms of city planning, the following six critical areas can be identified:

- **Jobs**: Job sites located within communities reduce time spent traveling to work.
- **Corridors**: High density commercial and residential corridors focus growth along transit routes.
- **Workability**: Interconnected street systems link residents with the services they need.
- **Green Space**: Green spaces provide recreation opportunities and connect people with natural systems.
- **Infrastructure**: Integrating natural systems reduces infrastructure costs and environmental impact.
- **Housing**: A range of housing types allows residents of differing economic situations to live in the same neighborhood and have access to the same services.

Sustainable Development requires a holistic approach. As stated by Allen and You of the DPU, London, there are five aspects of sustainability that impinge on the development of human settlements:

Economic Sustainability relates to the capacity to put local and regional resources to productive use for the long-term benefit of the community without damaging or depleting the natural resource base on which it depends and without increasing the city’s ecological footprint. This implies taking into consideration the full impact of production cycles.

Social sustainability refers to the fairness, inclusiveness and cultural adequacy of an intervention to promote equitable rights over the natural, physical and economic capital that support the livelihoods of communities, with particular emphasis on the poor and traditionally marginalized groups. Cultural adequacy means the extent to which a practice respects cultural heritage and cultural diversity.
Ecological sustainability pertains to the impact of urban production and consumption on the integrity and health of the city region and global carrying capacity. This demands long term consideration between the state, dynamics of environmental resources and services, and the demands exerted over them.

Physical sustainability concerns the capacity of an intervention to enhance the livability of buildings and urban infrastructures for all city dwellers, without damaging or disrupting the urban region environment. It also includes a concern for the efficiency of the built environment in supporting the local economy.

Political sustainability is concerned with the quality of governance systems guiding the relationship and actions of different actors among the previous four dimensions. It implies the democratization and participation of local civil society in all areas of decision making.

Physical planning attempts to bind together all these facets of sustainable development. However, as has been practiced for last few decades, planning has to undergo mutations including advocacy planning, participatory planning and budgeting, and community design. Planning in a myriad of ways has to respond to the challenge of and the quest for sustainable urbanization. These initiatives have to share a common ethical commitment to participatory governance and social inclusion, for reducing the poverty and promoting environmental justice. Effective participatory planning among all the stakeholders, mediation between competing or conflicting interests would help in bringing about change and lasting improvements to the living environment.

2. SUSTAINABLE CITY

The cornerstone of making sustainable is to adopt an integrated approach towards ecology and the conservation of the natural resources which should form the basis of city planning and development. The composite built environment includes the environmental infrastructure – water supply, sewerage, solid waste disposal and transportation network. Planning attempts to interface the regional, physical, environmental, transport, social, legal, management, financial and other aspects into a composite whole. It should strike a balance between conflicting demands - citizen freedom versus safeguarding community interests, commercial opportunity versus environmental sustainability, public service versus mandatory procedures. Most important is to develop a vision and ideas as the basis of urban planning. The vision for the future requires a radical transformation of infrastructure systems. Energy, water, waste management, sanitation, mobility and information should be the basis of future growth patterns along with price based signals enabled investment and technology choice. The extensive use of IT and biotechnology would enable the city to evolve and adapt with its metabolism networked to the surrounding ecosystems. This requires a
widespread application of eco-technology and changes in institutions, management and governing regulations.

Natural resource saving is the starting point for environmentally responsive planning. For eco-efficiency provides a valuable tool. As a rule of thumb, if a certain level of resource use is defined as a baseline, reduction of use by a factor \( x \) (say half) implies a reduction of the load on ecosystems by the same factor. At the same time enhancing the efficiency factor for technology and operations (say twice) gives ‘Factor-4’ efficiency. A specific efficiency factor may be an abstract target, but successfully increasing efficiency requires knowledge of local ecology on which to base the technologies and processes used. Planning along the lines of Factor-4 produces tangible results and improves the limited carrying capacity of urban land and conservation of natural resources. It is essential that the services and utilities are planned with flexibility to keep with fast changing technology. These should incorporate intelligent controls, and ‘state of art’ maintenance systems.

3. SMART AND COMPACT CITY FORM

The spatial model impacts the sustainability (less travel time and thus energy saving). A compact city structure should be developed to achieve the following:

- **Urban Form:** (i) High dense settlements (ii) Less dependence on automobile (high density) (iii) Clear boundary from surrounding areas;
- **Spatial Characteristics:** (i) Social fairness (high dense settlements) (ii) Self-sufficiency of daily life (iii) Independence of government (clear boundary); and
- **Social Functions:** There is close relationship between compact urban form and the sustainability by: reduction of automobile dependence, efficient supply of social infrastructure and public services, active community relationship by high-dense habitation, and revitalization of inner city.

Compact cities can have significant implications to climate change and environment. Critical instruments for this policy option include coordination with public transport, infrastructure development, mixed land use, urban boundary, and coordination of different levels of government. Data from international cities indicates correlation of urban density with less transport energy use and car use per capita.

Smart growth land use practices aim to create more accessible land use patterns, which reduce the amount of travel needed to reach goods and services. The objective of smart growth city should be:
To control urban sprawl and reduce kilometers driven by influencing the spatial structure of locations in the urban environment;

To support a high transit share; and

To keep walking and cycling (the most environmentally friendly transport modes) attractive

A successful compact and smart city should be developed around public transport and transit oriented development. Examples include: Singapore’s integration with radial and circumferential mass rapid transit, Curitiba’s integration with bus rapid transit on the linear main roads, Freiburg’s integration with light rail transit and environmental commuter pass, and Holland’s land use policy based on the categorization of locations according to accessibility to public transport called ABC Policy.

3.1 Energy and Environment

For worsening urban crisis, there is an urgent need to focus upon the improvement in energy services. Besides the containment of user demand, decentralized generation, alternative and renewable energy sources, such as a solar energy, offshore wind turbines, biomass-based energy generation, gas and clean coal for thermal power, the grid and hydrogen as the major energy carriers, need to be explored. The concept of energy efficiency begins with Zero-fossil Energy Development, which should be incorporated in city planning.

3.2 Water

In the Indian cities water is emerging as the most critical sustainability constraint. A range of technical and institutional options ranging from centralized surface storage to decentralized rainwater harvesting and recycling, together with design and water management options should be explored. As a mandate, urban planning should address management of watersheds on community basis; surface and sub-surface storage; rationalization of land and water use, recycling, re-use and local biological treatment of urban and industrial process water. A vision plan for water supply focusing upon local, unexploited opportunities should be the basic component of any city plan.

3.3 Transportation

Integrated public transportation should be the basis of design of the future city. Networked just-in-time public transportation systems, such as hyper trams and guided hyper-buses could be the least cost and low ecological footprint solutions. High speed intercity rail line, air transport and the containerization with radio tagging of goods enable automated rapid movement across different levels of aggregation. Piggybacking on the passenger network should be integral
component of transport planning. Transport systems are intimately linked to pollution control, including noise, which should be a major determinant of urban planning.

A least-cost life cycle analysis of transportation systems across a range of carriage ways and modes (pedestrians, road, light rail, rail, water, and air) should be able to establish an optimum long term mix. A mix of bicycles, people movers, hyper trams, hyper buses and ferries generally provide safer, faster and cheaper services than the inefficient personal car. Data shows that the number of vehicles in urban India increased by 80 times, but road area has gone up by only five percent. This calls for proportionate development of roads and parking areas, grade separated corridors, multi-level parking and options to explore subterranean space for circulation and planning. Transport policy intimately linked to pollution control including noise, should be part of city transport plans. Providing a barrier free environment is mandatory requirement for planning and design of outdoor and indoor environment.

Rapidly increasing demand for transport and the resulting traffic congestion have led to pressures to build new transport infrastructure. Although, as a long term measure many of these capital intensive transport systems are justified, the fact remains that most of the cities can ill-afford the expenses of these solutions. Thus, there is an inescapable need to consider the other alternatives.

It is time to think of Public Private Rapid Transport or PPRT, which enables to travel in automated, electricity propelled personal cabin. This will reduce the demand of ground space and avoid gridlocks, exhausts, accidents and noise. This would change the whole concept of present transportation and traffic system with the following advantages:

- A ground free from cars and congestion;
- More time for rest and work during journeys;
- Traffic silence;
- Clear air, more greenery, pedestrian precincts and boulevards;
- Less expensive transport;
- Transport safety assurance;
- Climate stability, normalized ozone layer and no fossil fuels;
- Up-to-date technology & energy efficiency;
- A choice of public or private cabins;
- High level of comfort and air conditioning; and
- No parking hassles.
Guide ways can be built either as ordinary roads or as cableways over the existing corridors. These can be book - one-way or bi-directional. A one-way beam in the lowest price class would have the same capacity as a 3-lane road. This is because computer controlled vehicles, on a dry weather protected surface, can run closer than ordinary cars. Even at moderate speeds, the beam vehicles run faster than the road traffic. They will not be impeded by traffic lights, pedestrian crossings and cross-roads. Public Private Rapid Transit will take only half the time of that with an ordinary motorcar. If the guide way would be moved with large vehicles, as beam buses, a capacity twice that of a subway can be achieved.

A variety of vehicles from beam-cars with a varying number of seats, up to the largest beam-buses with 32 seats, can go directly to their destination, while the buses stop for arriving and departing passengers. Cabins traveling on the ground like ordinary motorcars are possible to include within the system. It is possible for a person to use one specific environmentally friendly car during several journeys through a system of car renting. For security, automatic surveillance can be included in the cabins and stations. The cabins can be cleaned automatically by cleaning machines. Such a transport system will change the way the city is designed. The city can afford much higher buildings, higher densities and higher land efficiency. The reduction in ground level transport will relieve large areas for greenery, pedestrians and non-motorized vehicles. The multi-storied and super tall buildings can be directly served by the Public Private Rapid Transport System reaching right up to their vertical elevators, helipads and other transit transfers.

3.4 Design with Nature

Sustainable development is basically a concern of ‘design with nature’. It means development and human interventions in natural system to the extent of carrying capacity of an area. The carrying capacity of an area is the population or level of activity that can be sustained for a given length of time without depletion of the resources or breakdown of the biological natural systems. In order to address the needs of the majority of the people, that is poor, a major focus area has to be local economic promotion and poverty reduction. Among young people there is a widespread perception that the future holds nothing for them, as a result, a large number of the unemployed are forced to take on informal, illegal or uncertain jobs. While entrepreneurial potential and development opportunities lie untapped, the cities and municipalities lose out on tax revenue. This sort of situation is not attractive for investors, and the economic development stagnates, while the vicious circle of poverty perpetuates. As such, there is an urgent need to focus on the promotion of small and medium-sized enterprises and the local and regional economy of the city. The
growth opportunities of existing enterprises, value added chains that are labor intensive, facilitating business start-ups and attracting new businesses will enhance the competitiveness of the city.

3.5 Key Elements and Concerns
For sustainable human settlements, the following ten key elements have been identified by the building and social housing foundations:

- Resource budgeting;
- Energy conservation and efficiency;
- Renewable energy technology;
- Long lasting built structures;
- Proximity between home and work;
- Efficient public transport systems;
- Waste reduction and recycling;
- Organic waste composting;
- A circular city metabolism; and
- Supply of staple foods from local sources.

Sustainability is a subject which concerns everyone and cuts across various activities, disciplines and levels. It is thus an all embracing and complex agenda to plan for. Some of the emerging environmental concerns are the following:

- Developing environment laws, framework and standards;
- Environment Impact Analysis;
- Circular Metabolism for infrastructure services;
- Blue network planning, recover and conserve rivers and water bodies;
- Waste Management and Recycling;
- Services upgradation;
- Urban Renewal;
- Urban form and ecological compatibility;
- Energy saving, adoption of non-conventional sources of energy;
- Rainwater harvesting;
- Industrial zoning, typology and locational decision;
- Public transport, fuels, technology, streets as boulevards catering to pedestrians and non-motorized vehicles;
- Health concerns, housing, services sanitation;
• Micro-climate, pollution, dust and noise minimization;
• Conservation of heritage;
• Green Building Standards, guidelines and Bye-laws;
• Employment generation and poverty reduction; and
• Conservation of Heritage and Cultural Resources.

For the sake of conceptualizing an action oriented approach, there is a need to disaggregate the agenda and focus upon the key elements at various levels, such as policy at national/state and local level, planning and development level and building level.

Policy and State Level
• Policy and Legal framework and processes;
• Organizational and management structure;
• Environmental performances;
• Standards Allocative sustainability;
• Climate change;
• Key principles - intra and inter-generational equity, Pollution prevention principles, Biodiversity, etc;
• Public policy goals and commercial imperatives - triple bottom line approaches, green dividends;
• Inter-governmental models;
• Governance issues;
• Sustainable land use and development;
• Development and building controls;
• Performance setting, management and monitoring tools;
• Incentive systems;
• R&D;
• Change management; and
• Incentive Schemes, such as, tax, development rights, green power, demonstration projects, pricing policies, one off subsidies, emissions trading and carbon credits.

Planning and Development
• Planning strategies and public participation;
• Statutory planning instruments;
• Development assessment and controls;
• Greenhouse abatement strategies;
• Urban transport;
• Water resources management, water use;
• Waste resource strategies incorporating the principles of recycling, reuse, reduce and recover;
• Biodiversity and vegetation strategies;
• Coastal and water bodies protection;
• Air quality, emissions control;
• Landscape diversity;
• Storm water runoff, sanitation and sewage;
• Energy efficient and alternative sources of energy;
• Conservation of heritage and culture;
• R&D, Factor 4 Technologies;
• Professional Development and Capacity Building;
• Public Policy Performance;
• Benchmarking process and outcomes;
• Review process; and
• Change leadership and Management

**Architecture and Building Design:** At the level of architectural design, the ecological factors are to be considered in a holistic perspective at the following stages and areas:

• Building lifecycle;
• Project Initiation and Feasibility;
• Design;
• Procurement;
• Construction
• Commissioning;
• Ownership;
• Operation and Maintenance;
• Refurbishment;
• Demolition;
• Eco-efficiency benchmarks (energy / greenhouse, water, waste, air quality and particulate levels);
• Mandated performance;
• Treatment of embodied energy;
• Plumbing, sanitation;
• Integrated methodologies, design, retrofitting and management;
• Rating of materials;
• Building quality matrix;
• Landscape and Site ecology;
• Storm water and drainage;
• Water;
• Energy;
• Thermal comfort / micro-climate;
• Indoor air quality;
• Occupant satisfaction;
• Transport / circulation;
• Waste Management / recycling;
• Materials; and
• Management / Operation and Maintenance.

A habitat is not just its physical attributes, but also its cultural, mythical and metaphysical contents, which include the following:

• Mythical and metaphysical aspects;
• Sense of pride, faith and image, dreams and aspirations;
• Cultural, educational and intellectual development;
• Multiculturalism;
• Sense of belonging, social interaction;
• Spatial experience;
• Environmental compatibility;
• Equity, participation and affordability;
• Physical infrastructure, networks and communications;
• Incrementality;
• Personal, social and economic opportunities, employment generation;
• Pluralism, change and renewal;
• Safety and security;
• Meeting functional needs; and
• Health, physical comfort, and privacy

The starting point of organizing the space should be ecology and environment. Environmental guidelines, norms, standards and codes should form the backbone of planning and design. The organization and hierarchy of the following should determine the physical form and community module:

• Transportation and Circulation (including parking, cycle ways and pedestrian precincts);
• Open spaces, parks, playgrounds;
• Community facilities;
• Neighborhood module, housing; and
• Decentralized and local infrastructure services.

Management and maintenance aspects need to be given serious attention at the design stage. Not only the buildings, but the cities need to be intelligent and should be visualized to cater to the needs of the next generation.

For environmental and micro-climate focus, the concepts of site planning, building design technology and materials have to be re-examined. It is at the design stage, that the environmental efficiency and compatibility of a building are largely determined, which is popularly called ‘green architecture’. The building should incorporate flexible systems which respond to the changing micro-climatic needs and varying conditions of natural ventilation and light. The design should obviate outdoor and indoor pollution. It should provide for rooftop rainwater harvesting and recycling of wastewater and exploitation of non-conventional sources of energy (such as photo-voltaic system). The design of openings and glazing should allow flexibility. In large public buildings, the use of intelligent systems can be employed.

The following checklist may be useful aid for design with nature:

• Natural Eco-system;
• Water supply and quality;
• Air quality;
• Noise reduction;
• Erosion Control;
• Flooding Prevention;
• Landscape features;
• Flora and fauna; and
• Open space integrity.

Site Planning and Development: The essence of ecology oriented site planning should include the following:

• Seek the most suitable site;
• Let the site suggest plan and built form;
• Extract the full site potential. The building and open space should adapt to the land forms, micro-climate and appropriately oriented;
• Diminish landscape disruption, minimize excavation and grading;
• Minimize amount and cost of earth work;
• Prevent the wastage of topsoil;
• Preclude the need for erosion control and replanting;
• Make use of existing drainage ways and contours; and
• Blend new development into the natural scene.

Natural ground forms are best accepted as given. They are the resolutions of myriad forces at work over a long span of time. To adapt to them is to harmonies with the forces and conditions by which they have evolved. By means of site reconnaissance and soil surveys the most productive land can be designated for lawns, gardens or crop production or can be preserved in its natural state. Areas of thin soil, poor or excessive drainage, or underlying rock are the prime candidates for projected development.

The rudimentary principles of planning include the following considerations:

• Confine development to the uplands;
• Protect the wetlands, streams and water bodies by leaving adequate fringes of vegetation;
• Preserve and utilize the natural drain-ways;
• Preclude soil erosion by providing sheet flow and well knit ground cover;
• Detain heavy surface run off in swells or ponds to provide regulated flow, filtering and ground water recharge; and
• Return to the earth or its receptor water of quality and quantity equal to that withdrawn.

The preservation of the natural drain ways requires the following:

• Avoid concentrated surface runoff to downgrade properties;
• Avoid trapped water pockets;
• Provide under-drains at road edges and low points;
• Conduct surface water by swell gutter or buried pipe to storm-sewer mains or out fall; and
• If storm inlets and lateral sewer are needed, compute the required capacity and then use the next larger size.

Layout and Design for Micro-Climate:
• Provide maximum shade in summer and adequate heat gain in winter;
• Minimize reflection (indirect solar radiation) in streets and open spaces;
• Moderate the effects of undesired winds, by plantation, opening design and water bodies;
• Adopt compact forms and layout. Plan narrow winding alleys and pathways which are shaded, relatively cool and break stormy winds, but allow through ventilation and adequate natural lighting;
• Plan close proximity of urban services and daily functions within walking distance; wide roads can thus be omitted or at least reduced;
• Avoid large open spaces where hot air can collect during the day and which are conducive to dust storms;
• Provide ample shaded public space. A vegetal cover of the ground keeps it comparatively cool and contributes to a cooler outdoor micro-climate. Unshaded pavement should be avoided as far as possible and air should not be allowed to pass over such hot surfaces before reaching a building;
• Select light colors for open spaces and exposed surfaces;
• Include green areas of plants around and within the buildings to provide shade and cool air and to stabilize the soil; and
• Integrate water bodies which reduce the temperature and improve micro-climate.

Architectural and Building Design: Architectural design for climatically comfortable environment should carefully consider the following factors:

Orientation, water, shade, channeling of cooling breeze as prime elements for a comfortable micro-climate, minimum exterior surface to maximum internal volume, natural ventilation, atriums and internal courtyards to reduce glare and dissipate heat, compact grouping and clustering of buildings to minimize expose of wall surface, use of open spaces, platforms, chowks, etc; for social intensity and climatic comfort.
The following checklist is helpful at design stage:

- Provide courtyards, wind shafts/tunnels, reduce need of artificial light during daytime;
- Provide vestibules for entrances;
- Locate entrances on downwind side of building;
- Reduce building height and avoid need of providing lifts and sophisticated fire fighting systems;
- Use impermeable exterior surface materials;
- Seal all vertical shafts, vertically offset or stagger stairwells, elevator shafts, and mechanical shafts to avoid chimney effect;
- Articulate surface with fins, recesses;
- Explore using subterranean space and basements;
- Consider below-grade location;
- Use water, fountains to decrease heat buildup;
- Employ highly textured surface, recessed openings, chajjas, drip course, damp proof course, etc;
- Reduce paved areas in the vicinity of building;
- Plant deciduous trees adjacent to building to moderate surface temperature;
- Capturing as much winter sun as possible and keeping out solar radiation in summer;
- Using a thermal buffer zone toward the north and west, insulation of roof walls, etc;
- Use low energy, recoverable and recycled building materials. Avoid over design;
- Specify insulation standards; avoid use of CFC blown insulation; and
- Provide a user friendly manual for efficient operation and maintenance.

It is not only the discipline, civic sense and enforcement that help in reduction of average noise levels, but it is also an aspect of design and land use planning. Landscape and green buffers can help in the reduction of noise levels. It is not desirable to locate residential land use facing major roads. Wall buffers and projections between two apartments can curtail noise. Landscape, earthen embankments, mounds, hedges, plantation, etc; act as the buffers to noise. Green buffer with thin leave trees, land formations, etc. provide effective barriers to transmission of noise.

**Planted Landscape:** Landscape planning of a site should be based upon the following principles:

- Preserve the existing vegetation;
- Select each plant to serve its intended function;
- Group trees to simulate natural stands;
- Use canopy trees to unify the site;
- Install intermediate trees for under-story screening, windbreak and visual interest;
- Install ground covers on the base plane to retain soil and soil moisture, define paths and use area and provide turf where required;
- Utilize shrubs for supplementary baffles and screens;
- Choose as a dominant theme tree a type that is indigenous, moderately fast growing, and able to thrive with little care;
- Use secondary species to complement the primary planting installation and define the spaces of lesser magnitude;
- Use trees to sheathe the traffic ways, but keep the sight line clear;
- Use planting to reinforce the alignment of paths and roadways;
- Install screen planting to hide unpleasant views, eliminate glare, and reduce noise level;
- Provide evolving sequence of spaces to enclose and link the various uses;
- Keep the planting simple;
- Consider climate control in all landscape planting;
- Complement the topographical forms; and
- Use plants as space definers and dividers.

It should be carefully assessed how much area can be made available for plantation after meeting the requirements of buildings, parking, and driveways. By skillful planning, the landscape area and building can be merged together.

4. CONCLUSIONS

The idea of sustainable development means dreaming design with nature. It is an art of striking a balance between economic goals, human (social, cultural livability and health) and environmental needs. This can be achieved only by a comprehensive understanding of the complex issues involved and creative design as Mark Twain once said ‘... do not part with your dreams, you may exist but cease to live’.