

Sustainable Urban Development in India: Challenge & Approaches

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Abstract--- India's contribution towards unsustainability is very low as compared to other major contributor countries. But the challenges persistent to the rapid urbanization in India and the huge share of global population can threaten the global sustainability. So there is a need to ingrain sustainability in India. The paper tries to put forth the need of the sustainable urban development in India. The urbanization in India has led to (un)sustainable situation. It provides the proven benefits of economic growth and development, but it also brings the social and environmental challenges. Various challenges associated with sustainability, spatial planning, governance, deficiencies and execution has been discussed in this paper. As challenges lie in the ability to cope, the later part of the paper confers the sustainable development approaches in India. It has been studied under the antecedent of legal provisioning, various policies and programs, institutional arrangements, technological solutions, frameworks and measurement systems for a better present and future.

Keywords--- India, Urbanization, (Un) sustainable

I. INTRODUCTION

INDIA has seen a great transformation after independence and the pace of the development increased in last two decades. There is shift from the traditional rural community to the modern urban community resulting in the urban drift. This rising urbanization comes with the benefits of economic development. Urbanization is closely related with industrialization; modernization and rationalization (Urbanization). Urban centers are the places of opportunities, knowledge banks, innovations, creativities and their commercialization. They pull the human capital and talent for the economic sustenance. Beyond economic growth, urbanization can also give rise to social equity by eroding the distinctions between caste and creed which is strongly present in rural society (Ramanathan). 1990's sectoral reforms across various sectors (industries, agriculture, investment, trade, infrastructure, banking and finance) opened up India's market to international competitions. This expanded domestic capital markets, eliminated barrier to trades resulting to 5.7% growth rates during 1991-2000 and 7.2% during 2001-2010.

However, rapid urbanization is unsustainable as it brings

social and environmental challenges. Urban areas are exploiting resources at high par. Unplanned urban growth causes strained infrastructure, growth of slums, environmental degradation, traffic problems and high cost of living. India's huge population, vast and diverse land mass and poverty induced rural-urban migration has put up burden on the administrative leaders, policy makers and planners, which in turn leads to the inadequate governance.

To overcome the challenges, the path of intelligent and sustainable urban development will drive the economic growth which is socially inclusive and environment friendly. India has already stepped in evolving a framework for sustainable development. The latter part of the paper highlights legal provisioning, various policies and programs, institutional arrangements, technological solutions and measurement systems for a better present and future.

II. NEED OF THE SUSTAINABLE URBAN DEVELOPMENT IN INDIA

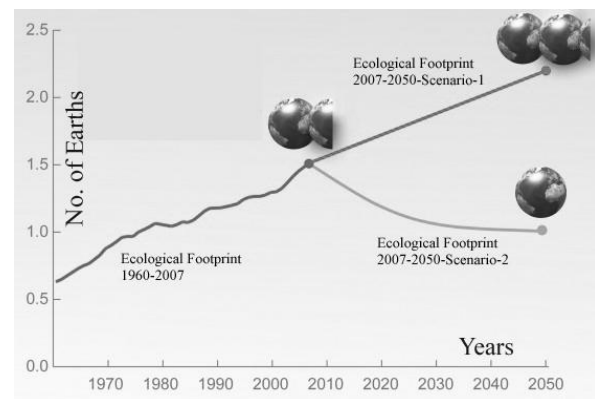


Figure 1: Ecological Footprint Scenario

Source: 2003-2012 Global Footprint Network

India's current population is with over 1.22 billion people (2011 census), more than a sixth of the world's population. India is projected to be the world's most populous country by 2050 reaching 1.6 billion, surpassing China (BBC News, 2004). The land mass and resources available to sustain this gigantic population is scarce. In the last few decades due to globalization, liberalization and privatization there is an economic boom but it has also increased the burden on the resources. There is a concern to safeguard the resources.

If we consider the ecological foot print of India as against the world's or other developed or developing countries, India's' share is less. Current global consumption pattern demands 1.5 planets to provide the resources and absorb our

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waste. If current population and consumption trends continue then, by 2030, two Earths will be required to support the human race (fig 1). This global ecological footprint overshoot also contributes to resource conflicts, wars, mass migrations, famine, diseases and other socio-economic problems. (2003-2012 Global Footprint Network).

Table 1(Refer Annexure-1) represents the population, density, ecological foot print, bio-capacity and carbon dioxide emissions (CO₂) of some countries. The upper and lower limits (two each) are highlighted to understand the contribution of various countries. Selection criteria for countries in comparison below is based on the representation from- higher to lower range; all continents; and developed, developing and less developed countries.

The study shows that even though India's contribution towards un-sustainability is very low, but due to huge population and increasing demand to fulfill the needs of the current and future generations it's necessary to espouse sustainability path at early stage. Also issues like poverty, health, education, expanding economy and diversity (both physical and social) needs to be addressed for India. Indigenous practices in India are sustainable, but due to the rapid economic development the urge to continue or preserve these knowledge systems is declining. In the long run India too may end up being consumptive society like the developed nations. Thus there is a need to adopt sustainability measures at this initial stage of development.

III. ISSUES AND CHALLENGES IN INDIAN CONTEXT

Urbanization has led to varying challenges in India. Common challenges can be classified in following categories

IV. CLIMATE CHANGE LEADING TO ENVIRONMENTAL DISTRESS

India's carbon dioxide emissions have increased by 78 percent since 1990. Annual coal consumption has tripled since 1980. Indian national energy consumption is expected to be more than double from 2002 to 2020, increasing from 116 to 252 gigawatts (Wish, 2010). Developed nations are primary contributors to emission of Green House Gases (GHG) which has led to Climate Change. Main contributors of GHGs are the combustion of fossil fuels, landuse change and other human activities. Large countries like China and India, also can match GHG emissions of developed nations within two to three decades. India's population (mostly rural) directly depends on the climate sensitive sectors (agriculture, fisheries and forests) and natural resources for their livelihoods and subsistence (S. Jayant et al, 2006). The people involved in these sectors are highly vulnerable due to low adaptive capacity.

Impacts of climate change will be on hydrological cycle resulting to droughts and floods, increase in the frequency of tropical cyclones, increase flooding in low-lying coastal areas, retreat of glaciers, human health and desertification (India's Initial National Communications to the United Nations Framework Convention on Climate Change, 2004). Extreme weather due to climate change can be quoted by few examples. In July 2005, widespread, devastating flooding caused by extremely heavy rainfall, 100 cm in 24 hours in

Mumbai killed at least 1,000 people and caused approximately US\$3.5 billion in damage. In early January 2010, temperature in Himachal Pradesh and the Kashmir valley dip below normal and snowfall happened for consecutive four days resulted in disturbed normal life and killed over 125 people (List of extreme weather events, 2012). The cloudburst at Leh on 6th August 2010 killed 113 people (Cloudbursts ravage Leh, 2010).

V. SPATIAL PLANNING

Unprecedented Scale: Huge urban population and less and diverse landmass has put up challenges for the development and planning authority to take urban planning decision. Multiple models of urbanization have evolved simultaneously, like Kolkata is the only metropolitan city in the eastern region; while state of Gujarat, Maharashtra and Kerala have multiple growth centers. Capital city of Delhi has to tackle a huge area of National Capital Region (NCR) so a common solution is unfeasible in India (Booz & Company and CII, 2010).

Metropolization: Metropolization means migration of people from small urban centers to metro cities. It is a post independence phenomenon, a product of centralization of administrative, political and economic forces in the country at national and state capital. Three out of fifteen high density cities in world are Indian (Richard F. et al, 2004). High density results in pressure on resources and its planning. The growth of small towns in India is comparatively stagnant.

Planning Policies: More than sixty percent of the urban growth in India is natural, spontaneous and not planned. There is lack of research based scientific planning process. There are no defined standard metrics for socio-economic or environmental concerns. Many urban administrations adopt non-inclusive planning process. There is no comprehensive data on urban components which can give the details of actual scenario to plan for current and future. Planning is undertaken in isolation without overlapping the socio-political-cultural-economic-legal aspects. Politics is the key driver in budget allocation (Ramanathan).

Significant challenge is to revitalize the urban core which has a typical feature of mushrooming slums, overburdened infrastructure, inadequate open spaces and poor quality of life. Also the effort to conserve the heritage and maintain social and cultural history is missing. In Nagpur, the slums which were two decades old especially in core city were declared as notified slums to make them legal and provide infrastructure with no tax recovery. Currently, these areas in core are dominated by middle and higher income groups but taxes are still not collected as these areas still enjoy the status of notified slums and are not de-notified. Policies like this put direct debt on the municipal bodies.

Another challenge is to deal with the fringe areas, the expanding city and the sprawl. The issues in these areas are multiple administrative bodies (rural, urban or special planning areas) with lack of physical and social infrastructure, loss of farmlands, poor neighborhood quality and unauthorized layouts especially in green zones.

Infrastructure Deficiency: There is a remarkable pressure

on the urban local authorities for providing physical infrastructure like safe drinking water, sanitation facility, adequate power supply, storm water drains, roads and transport and social amenities like health services, education facilities. There is huge gap between demand and supply of services. In 2001, 69% of Household had access to safe drinking water, 35% has closed drainage facility and 88% households had electricity but only 0.2% relied on solar energy.

Social Issues: Globalization and economic development has endangered the existing culture and social identity. In the race of modernization, the indigenous knowledge system is getting vanished. India has significant 8% increase in (Gross domestic product) GDP but there is proportionate increase in urban poor. Rich is becoming richer and poor is becoming poorer. The Slum Population of India has exceeded the population of Britain. In Mumbai, the financial city, 55% of population lives in slum areas (Slum Population in India). Even though the decentralization has been introduced and an attempt is made to empower the local bodies, they face lack of skills and self initiatives. Also, there is less public participation in planning process resulting in irrelevant and unsuitable solutions.

Governance: Governance is the process of decision-making and its implementation. It focuses on the stakeholders (government, political parties and leaders, cooperatives, NGOs, research and finance institutions, etc.) involved in decision-making and implementing the decisions. Due to the economic boom spatial expansion has occurred in urban areas, but the government policies remained unchanged. In many urban areas there is a lack of coordination and participation among various stakeholders resulting in a default design instead of planned approach. Challenges in governance is due to policy limitations and administrative problems (Booz & Company and CII, 2010). All the challenges mentioned earlier can be improved by good governance.

Policy Limitations: The development plans still stick to the colonial methodology of segregated landuse pattern as against the mixed land use. There is a lack of enforceable policies for landuse, building bylaws and protecting the environment (Ramanathan). Most initiatives are focused on developing new infrastructure, rather than revitalizing the existing.

74th Constitution Amendment Act (CAA) came in force in 1993, with a vision of decentralization and to have grass-root level planning by strengthening the position of urban governance in a more organized manner. It expects that Urban Local Bodies (ULBs) will assume responsibilities for urban planning and infrastructure. However, CAA did not lay down revenue base for ULBs and the power to determine the revenue base continues to remain with state governments. Some states performed better but many urban local bodies became weak and were not able to perform effectively (Vaidya, 2009). A study on Chandigarh states that CAA has shown benefits, but there are serious issues of mal-administration, corruption, and conflict among governing institutions of urban governance (Sharma, 2011).

Administrative Problems: Gigantic urban population made

the municipalities overburdened thus resulting in inadequate infrastructure provision. Most urban administrations have no skills in planning; neither have they brought public-private-partnership (PPP). Limited transparency and fragmented accountability also adds to the problem. There are many departments and agencies working on similar or overlapping issues resulting in conflict in implementation. There are issues of overlapping jurisdictional authority and quality of the local elected representatives (Ramanathan), (Booz & Company and CII, 2010).

Nagpur has two local civic bodies, Nagpur Municipal Corporation (NMC) and Nagpur Improvement Trust (NIT). NMC (elected body of city representatives) is responsible for administering and maintaining basic infrastructure to the city and NIT deals with developing new areas within city limits and providing new infrastructure. There is a confusion among the citizens whom to approach during infrastructure problem.

Financing: High cost is involved in providing and maintaining infrastructure and services. Cities have constricted financial resource base thus local bodies have high dependency on State Government and the latter on Central Government. Aggregate revenue of all ULBs is very low at around 0.75% of the country's GDP as against 5% for Poland, 5% for Brazil and 6% for South Africa (Monanty P.K. et al, 2007). The major source of the revenue generation in cities is by tax (property, octroi, entertainment, profession, advertisement, stamp duties, cess tax, etc.). In many cities due to non comprehensive database, rational taxes cannot be collected. Many "public service" institutions, public sector land & buildings and government properties are exempt from paying property tax causing huge losses for the exchequer. Economic rationale invariably plays second fiddle to political rationale (Ramanathan).

VI. SUSTAINABLE DEVELOPMENT FRAME WORK IN INDIA

India's effort for sustainable development can be traced back since ancient period. Emperor Ashoka (269 to 232 BC) believed that a king's duty is not just to protect citizens and punish wrong-doers but also to preserve animals and trees. His governance method and regulations for environment protection are noteworthy. Our ancestors established prosperous settlements, grew crops and lived within the limits of the nature. Nature was considered divine and worshiped and the balance were tried to maintain. With the advent of globalization and high resource consumption there is a need to regard nature as sacred and preserve it for the humankind.

In the contemporary context India's participation to safeguard the world can be quoted since the 1972 at the United Nations Conference on 'Human Environment'. Mrs. Indira Gandhi, former Prime Minister of India was the only head of state to address this conference. She emphasized on concern for the environment, poverty removal, equity in consumption pattern of developed and developing nations, understanding the common concerns and share responsibility (Speech by Indira Gandhi). After 1992 'Earth Summit' at Rio, India tried to evolve a framework to strengthen its role in Sustainable Development through various policies and programs, legal provisioning, institutional arrangements, technological

solutions and measurement systems for a better present and future. These are formulated to eradicate poverty, promote financial inclusion, focus on human development and protect the environment.

VII. POLICIES AND PROGRAMS

Policies and programs are formulated focusing socio-economic up-liftment and environment protection. The framework here has been segregated under three pillars of sustainability as economic, social and environment.

Economic: Severe economic crisis led to liberalization in 1990's where several policy measures have been taken with regard to regulation, fiscal policy, export-import, taxation, interest rate control, export promotion and incentives to high priority industries (Agenda 21-India). Food processing and agro industries have been accorded high priority to increase productivity and profitability. Industry policy framework encouraged entrepreneurship, develops indigenous technology through investment in research and development, bring in new technology, develop the capital markets for small and medium sector enterprises and increase competitiveness for the benefit. Technology up-gradation policies are introduced to be compatible with foreign trade. The banking sector reforms consisted of a shift in banking sector supervision from intrusive micro-level intervention over credit decisions toward prudential regulations and supervision; inter-state and entry deregulation; adoption of prudential norms; and use of other monetary policy instruments. Policy measures were made to facilitate private sector participation in key infrastructure projects (Meera Mehrishi et al, 2011).

Social: Policies are made to address the issues of social inequity and the social impacts due to urbanization. Twenty Point Programme was launched by the Government of India in 1975 and revised in 1982, 1986 and 2006. Its thrust is on eradicating poverty, raising productivity, reducing income inequalities, improving the quality of life of the poor and removing social and economic disparities. Many of the items of the program are at par with the United Nation's (UN) Millennium Development Goals (MDGs) and the South Asian Association for Regional Cooperation (SAARC) Social Charter. The program covers various aspects like poverty, employment, education, housing, health, agriculture, land reforms, irrigation, drinking water, protection and empowerment of weaker sections, consumer protection, environment, e-Governance, etc (TPP, 2008). National Urban Housing and Habitat Policy goals at affordable housing for all and mandates 10-15% housing for EWS and LIG in all new housing projects. Policies are made for women empowerment, health, population control, inclusion of weaker sections, education for all and safeguarding the traditional knowledge systems. Information and communication technologies (ICT) tools are used to provide smart governance.

Jawaharlal Nehru National Urban Renewal Mission (JNNURM) aims at making economically productive, efficient, equitable and responsive cities by upgrading the socio-economic infrastructure in cities, and strengthens the municipal governance in accordance with the 74th Constitution Amendment Act, 1992. It focuses on water supply and

sanitation, solid waste management, road network, urban transport and redevelopment of old city areas and integrated development of slums. JNNURM provides financial support for infrastructure projects under a cost sharing arrangement with the states and local governments, which is linked to a carefully structured governance model (JNNURM, 2011).

Environment: In 1972 steps were initiated with the formation of the National Committee on Environmental Planning and Coordination that gradually evolved as a separate department of Environment and reached the full-fledged stage of Ministry of Environment and Forests in 1985. The institutional framework took shape with the Central and State Pollution Control Boards (CPCB and SPCBs) to monitor, enforce, advice, research and generate awareness about the pollution (air, land, water and noise) (M.Mishra & N.Chandra). Environment policies are made for the protection of environmental features like forest, biodiversity, marine and coastal environment, wetlands, pollution, land conversion, water management and clean energy. Joint forest management involves community participation for protection, regeneration and development of degraded forest land. National Mission for a Green India, The National Action Plan on Climate Change aims at enhancing carbon sinks in sustainably managed forests and other ecosystems, and conserves vulnerable species, ecosystems and forest dependent communities (National mission for a Green India, 2010)

Clean energy policies and programs are targeted towards promotion of energy efficiency and renewable energy. It deals with using renewable energy (solar) especially for power generations, enhancing current mechanism to save energy, labeling program for appliances, sustainable building codes, energy audits (Meera Mehrishi et al, 2011) and including environmental externalities in development projects

VIII. LEGAL PROVISIONING

The United Nations Conference on Environment and Development in Rio de Janeiro in 1992 'Earth Summit' resulted in documents a) '*Rio Declaration on Environment and Development*' which consisted of 27 principles intended to guide future sustainable development around the world, b) '*Agenda 21*' an action to be taken globally, nationally, and locally by organizations of the UN, governments, and major groups in every area in which humans directly affect the environment, c) '*Forest Principles*', a non-legally binding document that makes several recommendations for forestry and legally binding agreements a) '*Convention on Biological Diversity (CBD)*' (conservation of biological diversity (or biodiversity); sustainable use of its components; and fair and equitable sharing of benefits arising from genetic resources), b) '*Framework Convention on Climate Change*' (to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system) (UNCED).

This became the central to the legal provision pertaining to the three pillars of the sustainable development in India. In the early phase (1970's and early 80's), policy focus was largely on environment and its protection. The 42nd amendment of the constitution in 1977 added some important clauses that

entrusting the responsibility of providing a clean and well-protected environment like Wildlife (Protection) Act, Water and Air (Prevention and Control of Pollution) Act, provides protection of environment and prevention, control and abatement of pollution.

Post Bhopal disaster, 1984 was a landmark evolution of jurisprudence. Legal reforms and initiative for prevention and preparedness adds the dimension of social justice and equity. Approaches like polluters pay (environmental and social costs fall on those who impose them), precautionary principles (taking into account scientific uncertainty, public attitudes and values) and Public Liability Insurance Act safeguarded the direct or indirect suffers. Amendments were done in the earlier act to address social issues. Environment (Protection) Act included protection and improvement of environment and prevention of hazards to human beings and other creatures. Environment Impact assessment, Motor Vehicle Act, Biomedical Waste Rules were enacted to arrest pollution.

India's integration with World Trade organization led to economic unification with environment and social factors. Trade related aspects of Intellectual Property Rights have sought to incorporate CBD such as conservation of bio-resources, equity, access and benefit of sharing, right to indigenous communities, local knowledge systems and economics. Foreign Trade (Development and Regulation) Act, 1992 regulate and develop foreign trade in India.

In 1990's secondary legislation was framed under Environment Protection Act for Municipal Solid Wastes Management and Handling, Recycled Plastics Manufacture and Usage Rules, the Manufacture, Storage and Import of Hazardous Chemical Rules, Ozone Depleting Substances (Regulation and Control) Rules and a series of notifications delegating power to states under River Conservation and Noise Pollution acts to deal with pollution.

Post 2005 approach is more inclusive and considered issues of social welfare, justice and equity. Conventional piecemeal approach was replaced by linked approach by integrating the three pillars of sustainable development. Right to information Act unlocks the opaqueness of the system and became transparent and accountable. Enactments of legal right are provided for the marginalized societies, children, senior citizens and barrier free environment (Meera Mehrishi et al, 2011).

IX. INSTITUTIONAL ARRANGEMENT

There has been remarkable progress in legal provisioning on sustainable development, but challenges still exist in implementation. These can be tackled by capacity building, improved financial and technical resourcing and evolving institutional framework to work in more harmonized and integrated manner. Institutions involved have to perform administrative, policy framing, monitoring and evaluation, guiding, training (capacity building), research and conservation role. They need to work in coordinated manner rather than in isolation. There has to be defined roles and responsibility at different levels (national, state and local). To successfully address the interconnected challenges, it's crucial

to have cross sectoral and multi level coordination, like collaborative mechanism involving formal and informal groups (civil society and knowledge institutions).

X. TECHNOLOGICAL SOLUTIONS

India should look forward to use latest technologies for better governance, monitoring projects, up keeping and sharing data, etc. Telecommunication revolution has already taken place and projects like Unique Identification Number (Adhar) will definitely prove beneficial for varied purposes (like planning project proposals, infrastructure and facility provisions, resource mobilization, identifying target groups, etc.). Still, India needs to take a giant leap in utilizing technology in channelizing its growth. Remote sensing, GIS, high-tech monitoring systems (for urban traffic, infrastructure, disaster mitigation, etc.) for a real time data, computerized land records and other data related to land mass (with centralized access), promoting cashless transactions for transparent and fair economy thus generating more revenue through taxes, using information technology for e-governance, etc. Complete data on urbanization, linked to GIS should be made mandatory in preparing City Development Plans (CDPs). The list of technological applications for a better and sustainable future is endless.

XI. SUSTAINABILITY MEASUREMENT AND RATING SYSTEM INITIATIVE IN INDIA

Measurement and Assessment tools help to address the evaluation of sustainability. It helps to address the past trends, current practices and future projections for the human well-being. Most of the research work on the measurability has happened in developed nations. In India, though late, the efforts for assessing sustainability have already initiated and research is being done to augment the same. Refer Table 2 in Annexure-2)

XII. CONCLUSIONS

Instead of above mentioned mechanisms, we are leading towards a unsustainable future. Social, economic and environment well-being is an obligatory parameter for the sustenance of any city. But if the efforts and approaches for the development are not evident then it leads to failure. Rapid urbanization is happening in India but the challenges like vast population; shortage of resources; scale and state of planning; stakeholder's non-participation, etc. has put up pressure on the government. The magnitude of the problems needs solution which is people centric and practical. All stakeholders including citizen, policy-maker, designer, planner, activist, administrator, politician, etc. should know their share of responsibility towards safeguarding our future. They should understand the constraints that prevent success and take a value based action.

To cope up with the challenges, to improve the quality of urban life, it's essential to prioritize the sustainability issue. India has evolved strong framework of policies and programs, legal provisioning, structured institutional arrangement, technological advancement and measurability measures for sustainable development. But this seems to be only a stepping

stone and there is a need to evolve research, generate transparency and technological inputs and put effort for good comprehensive and cohesive database, bring more governance.

Annexure-1

Table 1: Countries with their Ecological Footprint and CO₂ Emission (Brad E.et al, 2010)

| Sr. No | Name of the Country | Population (Million) | Population Density Km ² | Ecological Foot Print | Bio-Capacity | Ecological Remainder | CO ₂ Emission / Capita (Metric Tons) | |
|--------|----------------------|----------------------|------------------------------------|-------------------------|--------------|----------------------|---|------|
| | | | | (global hector/ person) | | | 1990 | 2007 |
| 1 | United Arab Emirates | 6.25 | 30 | 10.68 | 0.85 | -9.83 | 29.4 | 31.6 |
| 2 | Qatar | 1.14 | 123 | 10.51 | 2.51 | -8 | 25.2 | 55.4 |
| 3 | Denmark | 5.45 | 126 | 8.26 | 4.85 | -3.41 | 9.8 | 9.2 |
| 4 | United States | 308.67 | 30 | 8 | 3.87 | -4.13 | 19.1 | 18.1 |
| 5 | Canada | 32.95 | 3 | 7.01 | 14.92 | 7.91 | 16.2 | 16.5 |
| 6 | Australia | 20.85 | 2 | 6.84 | 14.71 | 7.87 | 17.2 | 17.9 |
| 7 | Singapore | 4.49 | 6389 | 5.34 | 0.02 | -5.32 | 15.6 | 8 |
| 8 | France | 61.71 | 110 | 5.01 | 3 | -2.01 | 7 | 6.1 |
| 10 | New Zealand | 4.19 | 15 | 4.89 | 10.77 | 5.88 | 7.1 | 7.8 |
| 11 | United Kingdom | 61.13 | 243 | 4.89 | 1.34 | -3.55 | 10 | 8.9 |
| 12 | Japan | 127.4 | 337 | 4.73 | 0.6 | -4.13 | 9.4 | 9.8 |
| 13 | Russia | 141.94 | 8 | 4.41 | 5.75 | 1.34 | | 11.8 |
| 14 | Chile | 16.64 | 23 | 3.24 | 3.83 | 0.59 | 2.6 | 4.3 |
| 15 | Brazil | 190.12 | 21 | 2.91 | 8.98 | 6.07 | 1.4 | 1.9 |
| 16 | South Africa | 49.17 | 36 | 2.32 | 1.14 | -1.18 | 9.1 | 8.8 |
| 17 | China | 1336.6 | 140 | 2.21 | 0.98 | -1.23 | 2.2 | 4.9 |
| 18 | Ghana | 22.87 | 87 | 1.75 | 1.19 | -0.56 | 0.3 | 0.4 |
| 19 | India | 1164.7 | 328 | 0.91 | 0.51 | -0.4 | 0.8 | 1.8 |
| 20 | Bangladesh | 157.75 | 1002 | 0.62 | 0.38 | -0.24 | 0.1 | 0.3 |

Annexure-2

Table 2: Measurement Systems, Credit Systems and Guidelines for Sustainable Development in India

| Tools/ Indicator | Comments Feature/Spatial level or Context | Environmental/ Economic/ Social Sustainability | Unit of measurement |
|---|---|---|---|
| Environmental Sustainability Index for Indian States 2009 Informing Environmental Action (Dash) | Percentile Comparative analysis of environmental achievements, challenges and priorities among Indian states | Air, Water, Land use, Forest & Biodiversity, Waste & Energy Environmental Budget | DPSIR, 40 indicators capture the present state of the environment (State), depletion and pollution (Pressure), resulting impact on ecosystem and human health (Impact), policy and societal efforts to reduce such impacts (Response) and the driving forces (Drivers). Three steps: i) Selecting the indicators based on DPSIR framework, ii) Grouping of indicators into nine policy areas and iii) adding the equally weighted nine sub-indices to form a composite index |
| | State Level | Health, Natural Disaster & Population Pressure | |
| LEED India Green Building Rating System (IGBC) | Provide tools to design, construct and operate green buildings and promotes a whole-building approach to sustainability | Site development Water savings Energy efficiency Materials selection and Indoor environmental quality | Voluntary rating system based on point credits Four level rating: Certified (26-32, 23-27); Silver (33-38, 28-33); Gold (39-51, 34-44); and Platinum (52-69, 45-61) for new construction and core-shell respectively |
| | Green Factory Buildings, Homes, Townships & SEZ, New Construction Core and Shell | Innovation and Accredited Professional points | |
| 'GRIHA' Green Rating for Integrated Habitat Assessment (GRIHA, 2010) | Evaluation tool to help design, build, operate and maintain a resource efficient built environment for buildings in different climatic zones | Preserve and protect landscape, renewable energy, water and waste management, lighting efficiency, reduce energy demand, low energy material, pollution level | Voluntary rating system developed on a point based scoring system 100 point system consisting of core and optional points. Five levels of certification: one star (50-60); two star (61-70); three star (71-80); four star (81-90); and five star (91-100) |
| | | Efficient onsite circulation health well being, safety and sanitation of workers, accessibility for all | |
| | | Reduce volume, weight and time, operation and maintenance | |
| Sustainability Reporting Framework (by corporate sector) (Telang, 2011) | Sustainable global economy disclosure of organization's recital incredible way and to identify business risks and opportunities to the organization | Manage their economic, environmental, social and governance performance and impacts responsibly and report transparently | i) Sustainability Reporting Guidelines; ii) Sector Supplements; and iii) The Technical Protocol |
| Energy Labeling Program for appliances (Energy Conservation Act of 2001) | electricity-consuming appliances: refrigerators, fluorescent tube lamps pumps, motors, air conditioners, televisions | Energy saving and Indoor Quality | The rating grades models on their energy efficiency, starting from one star, implying low energy efficiency, to a five star grade for the most energy efficient model. |
| Clean Development Mechanism (CDM) Credits (K.Singh) | Assist parties included in Annex I ¹ in achieving compliance with their quantified emission limitation and reduction commitments | Energy efficiency, Transport, Methane recovery, Industrial process changes | Certified Emission Reductions (CO ₂ and GHG) and Carbon Credits |
| Energy Conservation Building Code (ECBC) 2007 | Provide minimum requirements for the energy-efficient design and construction. Commercial buildings or building complexes with connected load > 500 kW or a contract demand > 600 kVA or buildings with a conditioned floor area > 1,000 m ² | Building Envelopes, Heating, Ventilating, and Air Conditioning (HVAC), Service hot water & Pumping, Interior and exterior lighting, Electrical power | Development of compliance procedures & capacity building of stakeholders. Three options for compliance: i) performance requirements for each subsystem and system; ii) performance requirements of each system, but with tradeoffs between subsystems; and iii) Building-level performance. Use 40 to 60% less energy than similar |

¹ List of parties to the Kyoto Protocol

| | | | |
|--|--|---|--|
| | | | buildings being designed and constructed at that time |
| SuBAH Framework (Booz & Company and CII, 2010) | Framework for Sustainable Urbanization | Environmentally sustainable, socially equitable and economically viable | Three mandates are required, i)governance, ii) business model, and iii) infrastructure |

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