

Brief for GSDR 2015

Sustainable Urban Environment in Delhi Mega City: Emerging Problems and Prospects for Innovative Solutions

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Introduction

Cities are the engines of growth and indicators of progress. Besides, they have widespread implications on environment and human society. There is large scale incidence of urban poverty and slums in cities of developing countries. This has resulted in mismatch between infrastructure, resources and population, leading to degraded and unsustainable urban environments. The unprecedented urban growth is also referred as pseudo-urbanization for the reason that this growth is exceptionally unbalanced. The footprints of urbanization, concretization and land use conversion are visible in the form of urban heat island (UHI) formation that poses threat to human health and wellbeing. The study addresses above issues in national capital - Delhi.

Population Increase and Urban Growth: Vice or Virtue

The total population in Delhi has witnessed steep rise from 1.74 million in 1951, which was 0.48% of total population of India, to 16.75 million in 2011 (Directorate of Census Operations, 2011). The density of population was 4,194 in 1981 and rose to 11,297 in 2011 (Directorate of Census Operations, 2011). The urban population was 82.4% in 1951 and 97.5% in 2011. The number of villages reduced from 300 in 1961 to 165 in 2001. Area wise, the rural areas have shrunk from 797.66 km² in 1991 to 369.35 km² in 2001. In 1991 rural-urban share was 53.79%-46.21%, which in 2011

became 24.91%-75%. Two of the nine districts, i.e., Central and New Delhi are presently 100% urban. Large scale migration from the neighboring states of Uttar Pradesh (46%), Bihar (13%) and Haryana (10%) is observed. Nearly 44% of the total population resided with 4-5 members per household and 25.6% in 6-8 persons per household (2011). The 7.7% of total rural population and 14.4% of the urban population is below poverty line (Directorate of Economics and Statistics, 2012).

Land Use and Environmental Changes

Forest: The Breathers

The vegetation cover is imperative for balanced atmospheric temperature and sustenance of life. As per the reports of Forests Survey of India (2011), total area of forest and tree cover was 40 and 111 km² respectively in 2001 that increased to 120 and 176.2 km² in 2011 (Forest Survey of India, 2011). Total vegetative cover doubled in a decade from 10% to 19.97% on account of substantial increase in tree cover under the Green Action Plan of Delhi Government. Open forests have coverage share of 119.96 km² and dense forests are merely 6 km² (Forest Survey of India, 2011). The central and south eastern region is greener than western half of the city.

Water Bodies: Elixir of life

Water bodies are crucial for sustainable urban eco-hydrology. Total area under water bodies has considerably declined from 14.41 km² (1970) to 8.51 km² (2008), mainly lost to urban

growth (Singh; Gahlot & Singh, 2013a). In addition, the groundwater level declines for 2m every year. Diminishing water bodies has deep impact on environmental health (Singh; Gahlot & Singh, 2013b). Pollution load in the river Yamuna added from various sources like industries and domestic and long dry season, has virtually converted it into a *nala*. Najafgarh drain along with its 70 sub-drains is the biggest polluter of the river. The BOD load increased 2.5 times (1980-2005) with total of 276 tonnes per day (Central Pollution Control Board, 2006).

Air Quality: Menace to Human Health

The air pollution levels in Delhi are strikingly high and the transport sector is major contributor. Nearly 421.84 tonnes of CO, 110.45 tonnes NO_x, 184.37 tonnes HC and 12.77 tonnes particulate matter is released in Delhi's atmosphere per day (Department of Environment and Forests, 2010). The CO has dipped drastically post-CNG use (i.e. 1999); SPM and RSPM have increased, SO₂ has declined marginally and NO₂ is still high over 1997-2011 (Department of Planning, 2013). The composition of pollutants have changed with the introduction of CNG, new pollution standards and phasing out of old vehicles. The concentration of CO, SO₂ and PAHs has declined, while NO_x and SPM increased (Chelani & Devotta, 2007; Ravindra, Wauters, Tyagi, Mor, & Grieken, 2006; Sindhwani, & Goyal, 2014). The rise in NO_x is attributed to CNG use and SPM to the diesel vehicles' growth.

Vehicular Growth: Regulate, Restrict, Restrain

The vehicles in Delhi have doubled from 1999-2000 to 2011-12 (Chelani & Devotta, 2007). The highest growth rate is 707.08% for taxis, whereas private cars and jeeps experienced an increase of 168.74%. Over 90% vehicular population of the city comprise of private

vehicles (cars, jeeps, motor cycles and scooters) (Chelani & Devotta, 2007). In 1980-81, the total road length was 14,316 kms that doubled to 28,508 kms in 2000-01 and increased to 32,663 kms by 2011.

Urban Built-up Land: Moving Towards Global City

The urban land use has increased tremendously with 4.17 km² till 2003 and further 66.33 km² added from 2003 to 2011 at the cost of fallow land, agricultural area; shallow water bodies and scrub land (Sharma & Joshi, 2013; Mohan, Pathan, Narendrareddy, Kandya & Pandey, 2011). The built up area increased by about 17% from 1997 to 2008.

UHI: Localized 'Global Warming'

The land surface temperature (LST) is a critical indicator of UHI assessment. UHI is a phenomenon, whereby city experiences elevated temperature in comparison to the surrounding hinterland due to trapping of insolation by atmospheric gases, high rise buildings and concrete surfaces of asphalt, metal, tiles and bricks. It causes heat waves in summers and leads to heat stress and mortality. It changes the micro climate, hence, changes in transmission and life cycle of many diseases (McGeehin & Mirabelli, 2001).

The satellite data is widely used for understanding urban micro-climatology and UHI (Singh & Grover, 2014). The LST, in October, range between 23 to 46°C with lowest value for water bodies and highest for fallow land (Mallick, Kant & Bharath, 2008) and UHI was intense in dense commercial areas (Mohan, Kikegawa, Gurjar, Bhati & Kolli, 2013). There are seasonal and diurnal variations in LST and UHI (Singh, Grover & Zhan, 2014). It is less intense on summer owing to aerosol distribution and

presence of river Yamuna (Pandey, Kumar, Prakash, Kumar & Jain, 2009). However, the UHI formation is weak in Delhi due to healthy tree-cover and low rise building (Singh & Grover, 2015). The higher temperatures are associated with fallow agricultural land, industrial and concrete surfaces. There is formation of urban heat belts corresponding to high density areas across the city. Increased LST coupled with atmospheric pollutants is menace to human health.

Human Health at Stake

The modifications in atmospheric composition, surface geometry and characteristics, UHI creation, increased pollution, land use alterations have global impacts as the scale of urbanization is widespread in the developing countries. The changing city environment has implications on ecology, human morbidity and mortality. In all, there are 815 medical institutions having a meager capacity of 42,598 beds. In a span of past 7 years, till 2011, only 4 hospitals, 1 PHC, and 2 medical colleges have been added to the existing infrastructure. The growth of dispensaries (246), maternity, nursing homes (120) and sub-centres (50) is much higher.⁸ The health infrastructure is sparse in proportion to demand.

Mortality from respiratory infection is 43%, of which 16% are infant deaths (Department of Planning, 2011). Most vulnerable groups are below 5 and 55+ age groups. Over 30% of the children suffer from respiratory problems (Siddique, Banerjee, Ranjan Ray & Lahiri, 2010). In 2006, 161 deaths from respiratory cancer took place that increased to 420 in 2012. Nearly 40,000 Indians experience early death due to air pollution every year where 7,500 are from Delhi (Brandon & Homman, 1995; Ravindra, Wauters, Tyagi, Mor & Grieken, 2006).

Solutions: Quest for Innovation

There is wide array of problems faced by urban centers. Therefore, there is need for creating efficient sustainable plans to overcome the challenges. There is encouragement on public private partnership (Bhagidari Scheme) like for river cleaning and *Swachh Bharat Abhiyan* (Clean India Campaign). The industries were relocated to the periphery and need widespread implementation. Further, green buildings and eco-roofs along with wall gardens need to be promoted.

The improvements in living conditions like improved transportation, sanitation, clean drinking water, improved sewage and solid waste management and well-managed infrastructure lead to preventive measures. These preventive measures are also proposed under Jawaharlal Nehru National Renewal Mission. In addition, super specialty government aided hospitals that provide treatment at low cost need to be established in every town for better coverage.

Suggestions: Delhi as Model Smart City

To maintain the resources for use of future generations, strict policy and planning implementation is required. The 3R's- reuse, recycle, reduce need to be asserted and reflected in all policy plans. Corporate social responsibility should be integral service condition. Plastic should be banned with the provision of availability of low cost substitutes of plastic. The general public should be involved in urban sustainable development. This can be done by asking youth and children to list the problems with solutions. The behavioral changes and a sense of belonging to the city need to be inculcated. Public transportation shall be made more affordable, efficient and safe. Car pooling and training of drivers on air

pollution and fuel use may be promoted. Besides this, strict policy control measures like polluters pay and firm inspection of vehicles and industries needs stringent implementation. It is important to abolish the burning of garbage and biomass and focus on less-polluting better ventilated kitchens. The indigenous pollutant tolerant tree species like *Mangifera indica* (Mango), *Ficus religiosa* (Peepal), *Azadiracta indica* (Neem), *Acacia Arabica* (Babool) etc should be planted (Firdaus, 2010). This will help maintain green cover, control pollution and also lead to health, happiness, wellbeing and sustainable city.

Urban sustainable development is a collective concept that underpins within it the individual wellbeing. It is important to meet the needs of present generation, especially poor, keeping in mind the environment's ability to meet the needs of future. Along with it, the personal goals and freedom shall not be compromised. Three perspectives of sustainable urban planning: resource and consumption, good environment and social capital shall be incorporated in planning process. Wellbeing and happiness can be achieved only when the urban environment is socially, ecologically, economically and politically sustainable.

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List of abbreviations

BOD	-	Biochemical oxygen demand
CNG	-	Compressed Natural Gas
CO	-	Carbon Monoxide
HC	-	Hydro Carbons
Km ²	-	Kilometer Square
LST	-	Land Surface Temperature
m	-	meter
NO _x	-	Oxides of Nitrogen
PAH	-	Polycyclic Aromatic Hydrocarbons
SO ₂	-	Sulpher Dioxide
SPM	-	Suspended Particulate Matter
UHI	-	Urban Heat Island