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Addressing the Key Issues in Emerging World with the Promotion of Smart and Sustainable Practices: A Case of Sarabha Nagar, Ludhiana

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Abstract: ***Sustainable Development Goals by United Nations, 2015 provided a mandate to all government and all the people to make cities inclusive, resilient and Sustainable. This study attempts to know how to achieve those goals by 2030 by working on Goal 11: Sustainable cities & communities and Goal 13: Climate change. Goal 11 is a stand-alone goal for sustainable cities within the Sustainable Development Goals or SDGs that define what all countries of the world seek to achieve for their citizens and the planet by 2030. While the Smart city mission at the national level is the link which helps to achieve these goals in a much better and holistic manner. It comes up with the smart and sustainable solutions for those emerging issues by using bottom-up approach in planning by taking the case study of Sarabha Nagar, Ludhiana.***

1. Introduction

Cities are emerging as the hubs of new technologies, new investments, social and cultural development etc. due to which cities have enabled people to change them in terms of their lifestyle and with the coming up of new advancements. However, there are many challenges which are being faced by cities in the today's world like 60-80 per cent of energy is consumed and 75 per cent of carbon emissions come from cities, rapid urbanization is pressurizing on portable and fresh water supplies, good sewage connections, healthy living environment, public health and much more (UN's Sustainable development goals, 2015) due to which Goal 11 and Goal 13 of SDGs has come into the picture which focuses on making cities inclusive, safe, resilient and sustainable and to fight the climate change. Whatever global changes are happening they affect the local conditions and one cannot separate what happens locally from global change.

On the national level, the smart city mission focuses on creating walkable localities by reducing traffic congestion, air and noise pollution etc. by working on strategies of retrofitting, redevelopment, Greenfield development and Pan-city development and with the introduction of smart and sustainable solutions. It emphasises not only on the city development while area-based development too by implementing the smart and sustainable strategies for the neighborhoods which is bottom-up approach.

The reason why cities are to be focused because half of the world live in Urban areas which will grow by 60% in 2030s and two-thirds of the world's economy comes from cities which will rise by three-fourth in 2030. In India, 590 million people will live in cities, nearly twice the population of United States today **(Institute, India's Urban awakening: building inclusive cities, sustainable economic growth, April, 2010)**. Along with that two-thirds of the futuristic demand for infrastructure and buildings is still to be met in continents of Asia and Africa. So there is a need to come with the practices which will not only shape our cities but also make it more liveable.

Accordingly, this paper makes an attempt by raising the key issues in the city neighborhoods and the smart and sustainable strategies which could be implemented to make them a living entity. These strategies can be implemented on the macro level to achieve the Goal 11 and Goal 13 of SDGs which are to be achieved by 2030 as well as will help to build the smart cities.

2. Criteria for selecting the Ludhiana under Smart City project

Government of India has selected 100 Smart cities in 2015 with the objective to promote the cities which could provide core infrastructure and give decent quality of life to all of its citizens, a clean and sustainable environment and application of 'Smart' solutions (Affairs, 2015)

Figure 1: 100 Smart Cities selected in Smart Cities Mission

Ludhiana has been selected as the first smart city of Punjab. It is the first metropolitan city and largest city in Punjab, both in terms of area and population. It is the called as Heart of Punjab and the biggest trade business hub of Punjab. It is the manufacturing hub of agriculture equipment , hosiery and biggest Cycle manufacturing & parts in India and 2nd largest in the world. As per Census 2011, it has the highest population density of 975 per square km against India's 382 persons per square kilometre. Ludhiana is administered by Ludhiana Municipal Corporation which has been established in 1977. Also, it is the only city which is selected under the first phase of smart city mission in Punjab. Ludhiana is well connected through railways and roads by Amritsar-Kolkata (NH-1) and Chandigarh- Ferozepur (NH -95) pass through the city .

Table 1: City selection Criterion

S. No	City	Area (sq. km)	Population: As per 2011 Census	Level of Urbanization	Cities under Smart cities	First phase selection under Smart cities
1	Amritsar	5,094	11,83,705	53.58%	✓	
2	Bathinda	3,382	2,85,813	-		
3	Jalandhar	2,634	8,73,725	52.93	✓	
4	Ludhiana	3,767	16,13,878	59.16%	✓	✓✓
5	Patiala	3,627	4,45,196	35%		
6	Mohali	1,098	1,76,152	54.76%		

Source: Census of India, 2011

The city has good scope for retrofitting and redevelopment which is an important criterion for smart cities to make it efficient and liveable. The city made the extensive use of social media to connect with citizens, especially youth and students to seek feedback and suggestions on problem areas like traffic and pollution. The city scores high on e-governance and city participation, the two major parameters for smart cities. They had 99,687 Number of survey respondents (IBM, 2016) through which they came to know which areas to be developed for Pan-city, retrofitting, Greenfield development etc.

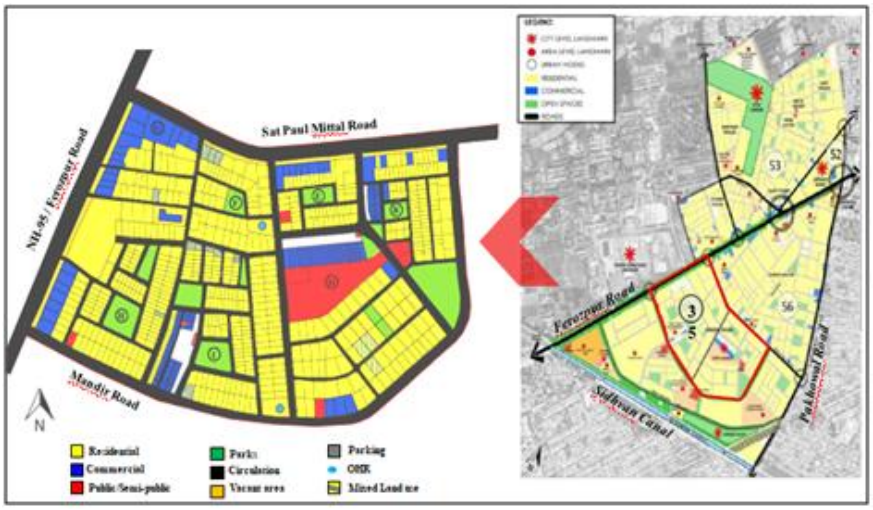

Figure 2: Location and Landuse Map of Sarabha Nagar

With the smart city funding, the Municipal Corporation of Ludhiana has undertaken to retrofit old areas like Sarabha Nagar for area-based development. This is due to the reason the area is planned while still it faces the problems related to infrastructure which can be solved by incorporating sustainable and smart infrastructure. Along with that, the participation of public was much more in this area. The total area of Sarabha Nagar comprises of 300 acres while for the study only 125.5 acres has been taken into consideration.

3. Study Area - Sarabha Nagar, Ludhiana

Sarabha Nagar was established under the Punjab Improvement Act, 1922 under the Development Scheme of Improvement Trust of Ludhiana in 1963 and is one of the oldest areas of Ludhiana. The area is planned residential neighborhood which has all the necessary amenities and services and the home for rich and high class. The site of Sarabha Nagar has been selected for the retrofitting for the Smart City mission to make the existing area more efficient and liveable by more intensive infrastructure service levels and with the smart and sustainable solutions. The study area lies in High- density residential zone with 150-200 persons per gross acre (GLADA, 2011-2031)and falls in D-zone of Municipal Corporation.

Table 2: Site Details

Feature	Detail
North	Sat Paul Mittal Road
East	Sacred Heart Convent school, Pakhowal Road
South	Mandir Road
West	NH-95, Ferozpur Road
Area	125.51 acres
Ward included	35
Block included	B, D, E, F, G, H ,I
Population:	2813 approx.
Number of Households	625 approx.
Zone	Middle Zone

Source: Site Visit (September/2016)

The site is well connected to NH- 1, NH-95, Ludhiana Railway Station and Interstate bus terminal, Ludhiana.

4. Issues and observations identified in the Study area

Sarabha Nagar is quite an old area which is planned and it experiences the problems same as any neighborhood of an Indian city. These issues are common these days related to the approach we are using in our cities. By resolving the issues at the local level, it is easy to resolve the issues of the whole city as every locality is having a different character of its own and requires special attention. Then only we can fight with the climate change and only then we can achieve the sustainability. The issues within the study area are observed as on which it could be worked to achieve environmental sustainability:

- Air and Noise pollution levels are high due to which the micro-climatic conditions of the site are getting affected
- The Rate of ground-water depletion is high.
- Lack of availability of rainwater harvesting systems and poor drainage system due to which there is water logging problem during the monsoon period,

As per the public opinion survey conducted in September, 2016 54% of the old people are concerned with the problem of noise and air pollution and want to eradicate such problem from environment.

4.1 Air Pollution

Over 80% of the residents of Ludhiana city is unprotected to the poor air quality that exceeds WHO limits. Outdoor air pollution has grown by 8% from 2011-2015 globally especially the impact is much wider on the Middle East, Southeast Asia and the Western Pacific as these are fast-growing cities. The pollution levels in these cities are 5 to 10 times above than the WHO suggested levels. Air pollution is now the biggest single killer which is causing more than 3 million deaths annually than any other major diseases like that of malaria and HIV/AIDS combined in the world. This figure is expected to get doubled with the increase in the urban population and vehicular ownership by 2 billion in 2050s. (WHO, 2015). Globally, India has its 16 most polluted cities falling in the list of world's 30 most polluted cities. Sarabha Nagar is also not less in emissions of air pollution. The data depicted are as follows:

Table 3: Ambient Air Quality , 2004

Emissions of	SPM µg/m3	SO2 µg/m3	NOx µg/m
Levels	175	11.7	29.2

Source: Ludhiana Master Plan (2011-2031)

The Permissible Levels for Residential and commercial area should be SPM = 120 µg/m3 , SO2 = 80 µg/m3 and NOx = 80 µg/m3. It is depicted from the data that the content of SPM µg/m3 is more while **SO2 µg/m3 and NOx µg/m** is less than the permissible limit. So air contains a large volume of suspended particles due to smoke which has been emitted by the diesel generators, absence of efficient and effective IPT and mass transport system, vehicular emissions due to more privately owned vehicles etc. The exposure to PM10 affect the human health as it damages the lung tissue, respiratory problems etc. while PM2.5 has the greater impact than PM10 as it along with affecting the human health it impacts the environment. So, actions should be taken against it. As per the socio-economic survey conducted on September 11th , 2016, the average distance of people from their workplace is 1-5 km and they use 81% cars and 19% bikes. Therefore, the carbon emissions are more due to which urban heat island effect is created.

Table 4: Air Pollution levels in Ludhiana by WHO, May 2017

Particulate matter	Levels
$PM_{2.5}$	108
PM_{10}	201

Also, as per Air pollution data from World Health Organization, 2017, Ludhiana is having extremely high pollution level and air quality is low. Therefore, with the lowering of air quality, the micro-climatic conditions are getting affected.

4.2 Noise Pollution

Table 5: Noise Pollution in Sarabha Nagar, 2007

Date	Day		Night	
	dB (A) Leq	dB (C) Leq	dB (A) Leq	dB (C) Leq
8.11.2007	70.3	91.8	67.8	98.7
9.11.2007	74.6	99.0	78.9	98.9
10.11.2007	65.9	76.9	80.3	80.3

Source: Ludhiana Master Plan (2011-2031), PPCB

The Permissible Levels for a day should be under 55dB and night should be under 45dB. While the level of noise is higher than the permissible limits in both the cases of day and night so attention is required. So the noise levels are not only affecting the environment but also disturbing the population.

4.3 Ground-Water Depletion

More than 50% of India faces severe water- stress, and this is only likely to increase as cities and populations grow (World Resources Institute (WRI)).

The groundwater table of 90% of Punjab is depleting in which depletion is more in the central part of state. Ludhiana being falling into the central part, it has groundwater table beyond 30 ft depth which has been increased from 3% in 1973 to 95% in 2005. The groundwater is overexploited in Ludhiana. So there is dire need to come up with the strategies to reduce the same (Gupta).

Figure 3: Water Logging, Ferozpur road, Sarabha Nagar

4.4 Water Logging due to poor infrastructure

During the monsoon period, there is a major problem of water logging. As per the Public Opinion survey conducted, 9% of people face the problem of water logging. As by Ludhiana Building Byelaws, 2015, It is mandatory to harvest water by means of percolation pits, rainwater harvesting systems, water storage sumps in all buildings above 200 sq. yards while on the ground there is very less implementation of the system has been observed due to which there is water logging problem. No serious action has been taken for non-compliance of installation of rain-water harvesting systems in buildings Also, the amount of rainfall experienced by Ludhiana is 649.9 mm (GLADA, 2011-2031) which is quite high. Therefore, to come up with the strategy which can eradicate the problem of waterlogging is mandatory.

5. Strategies and Recommendations

To overcome the issues of the water logging and pollution problems in the site area and to achieve the Goal 11 of Sustainable cities & communities and Goal 13 of Climate change certain sustainable and smart strategies are suggested. Instead of using the conventional methods, the new techniques are to be adopted.

Green roof: Green roof has been suggested as it could be the alternative to conventional rainwater harvesting system and is cost efficient because a lot of capital is required to construct conventional rainwater harvesting systems. Along with that, the problem of low air quality can be reduced by working on micro-climatic conditions. The Green roof is the landscaped space which includes all kind of vegetation. This concept is already applicable in other parts of the world. These roofs are alternative to conventional roofs across many parts of the world. For instance, to encourage its usage among people density bonus, Cash incentives, storm-water tax relief is being given in ULBs of Portland and Chicago. As a result, the green roof industry has seen a 16% spike in growth and conventional roofing methods have remained statistically flat. The vegetation used is drought tolerant and don't require any water for the maintenance.

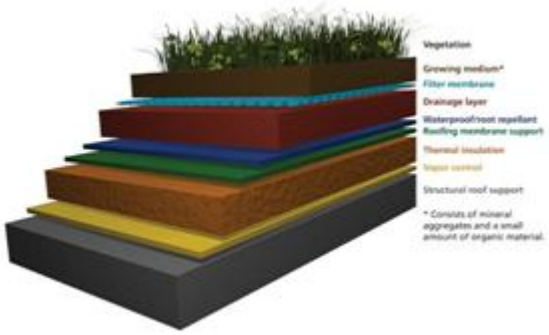

Figure 4: Cross-section of Green roof

The **Environmental Benefits** of Green roof is that it will manage Storm water, habitat filter pollutants, reduce urban heat island effect, improved air quality , save energy by reducing energy demand by 5-15% of a building and along with that it will buffer noise as the vegetation which is being used absorbs pollution particles. The **economic benefits** are can double Lifespan of roof , lower Heating and Cooling Costs LEED Credit. **Social benefits** like to reduce cost of Storm water Infrastructure and System management, create green spaces, increase in more community participation, connect the community with the natural environment. The building which installed green roof can expect of the lifespan of 40 years or Greater due to Protection of Waterproof Membrane from UV Radiation, Rain, Pollution, and Extreme Temperatures. Also, the vegetation used require no water for their growth and functioning. Hence, it will not have any impact on groundwater.

Table 6: Types of Vegetation for Green roof

GRASS	HEIGHT
Bermuda grass	3ft
Kentucky blue grass	2-3ft
Cochin grass	3ft
SHRUBS	
Golden dew drop	-
Hibiscus	-
Junipers	-

So, in case of Sarabha Nagar it could be used to eradicate the problem of rooftop run-off during monsoon and by reducing the pollution levels along with other benefits listed above. This helps in achieving the Goal 11 and Goal 13 of SDG and Smart city objectives.

For the implementation on the site the policy could be made which can include:

- Mandatory for coverage of at least 30% roof top for all residential areas with an area of 200 sq. yards
- Mandatory for coverage of the whole roof-top area for all kind of commercial and Public/Semi-public buildings.

Bioswales: Bioswales are xeriscaping elements which along with beautifying the road are an alternative to the Stormwater infrastructure or storm sewers. Bioswales are placed alongside the parking lots and roads to help in percolating the runoff. The cost of implementation is quite less than traditional curb , Stormwater infrastructure and gutter systems. They consist of a drainage course with gently sloped sides and filled with vegetation which removes the pollution particles from run-off water. The concept is successfully implemented in Boston.

Figure 5: Bioswales along the curb-side

In Sarabha Nagar, the bioswales are proposed along all the roadsides which would accompany the pedestrian paths and

cycle track. The width of the Bioswale would be 1.5-2.5 mts or as per the availability of road width. The vegetation to be used in the Bioswale is salt tolerant, drought and flood tolerant.

Plants like Ophiopogon planiscapus, Nigrescens, Vaccinium ovatum, Cornus sericea 'Kelseyi, Spireax bumalda, vegetative filter Strips etc. will be used. It need less water and no fertilizer for the maintenance. Therefore, to eradicate the problem of surface run-off , the Bioswale would be an effective option which will improve air quality.

Instead of spending too much in providing the conventional infrastructure which requires much of investment and maintenance cost , one could rely on such methods which not only saves money but also beneficial for the environment. This not only will help in making cities beautiful along with that helps in achieving the objectives of Sustainable Development Goals.

6. Conclusion

The concepts like Green Roof and Bioswales are smart and sustainable which helps in changing the micro-climatic conditions as well as helps in reducing the water logging problem without much investing into Storm water Infrastructure and System management. By executing all such solutions on a micro level and by later on covering the entire city can easily help to achieve the Goal 11 and Goal 13 of SDGs by 2030. For the implementation of such practices, the policy framework and development regulations has to be strong enough. It is not only the responsibility of population to help us achieve all those objectives but also the government has the key role to play in initiating such practices. That is the only way to achieve smart city objectives and will help in making the cities inclusive, resilient and Sustainable.

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