



Editorial



This issue contains nine papers of which first paper on “Residential Built Form and Carbon Footprint: Quantifying Energy Consumption and Carbon Footprint for Varied Residential Typologies”, written jointly by Bhanu Mahajan and Meenakshi Singhal, tries to investigate and quantitatively compare the impact of varied residential development typologies on energy consumption and carbon footprint. Three residential development scenarios are hypothesized on a site in Ahmedabad based on differences in building heights, ground coverage and density, which impact differently upon requirements of buildings, transport infrastructure, and public amenities. Energy and carbon inventory of these scenarios are then compared in per capita values. The research concludes that reduction in carbon and energy footprint by reduced horizontal travel distance is offset by their increased use in vertical amenities and there is no significant change in the overall carbon footprint. This result can be used by policy makers to check the penetration of west influenced developmental approaches in India. While planners can acknowledge these findings and explore other methods to reduce travel distance related carbon emissions.

The second paper on “The Development in Cities of Developing Nations: A Holistic View to Developmental Approach of Cities”, authored by Dipayan Dasgupta, shows that cities in India could be divided into three typologies based on population i.e. Tier - I, Tier - II and Tier - III. Importance of Tier - I is the most effective but Tier - II cities are the “future mega cities” because Tier - I cities have almost reached saturation and level of quality of life is deteriorating since carrying capacity of these cities has been reached. This paper deals with the importance of Tier - II cities, which have gained value and importance in the recent years because the scope for development in these Tier - II cities are far better than Tier - I cities since Tier - I cities are more claustrophobic. The paper defends Tier - II cities and puts forward possible reasons to support the existence and importance of Tier - II cities.

The paper on “Urbanization, Migration and Environmental Degradation in Third World Countries - A Case Study of Indian Metropolitan Cities” is written by Siddegowda, Ph.D.; T. M. Mohan Kumar, Ph.D.; Sathish Y. A.; and Suhas K. B. The paper focuses on some of the important environmental problems caused by migration in the metropolitan cities of India. The level of urbanization of India increased from 27.81 percent in 2001 census to 31.6 percent in 2011 census. The proportion of rural population declined from 72.19 percent to 68.84 percent. India is urbanizing rapidly and about 377 million people live in 7,935 town and cities as per Census 2011 across the country, which constitutes about 31.6 percent of total population. Towns have significantly increased from 5,161 in 2001 to 7,935 in 2011. But there is high inequality in the distribution of urban population by size class categories. The authors argue that India’s urban future is grave. Therefore, there is an urgent need to tackle urban environmental problems in a rational manner giving attention to the need for improving urban strategies.

Krishna Ghosh, Suchandra Bardhan, and Souvanic Roy have jointly written a paper on “Assessing Criteria and Indicators of Sustainability: A Case of Urban and Peri - Urban Water Bodies and Wetlands in Indian Cities”, which underlines urban and peri - urban water bodies and wetlands. Although being significant element of the city’s infrastructure, lack of relevant policies for implementation are contributing to their rampant abuse and decline. The city of Kolkata and its environs are endowed with numerous water bodies and wetlands, many of which, other than performing “ecosystem services” are also additionally contributing to recreation and human well-being. This paper attempts to assess sustainability of five such case study sites from urban and peri - urban Kolkata on the basis of major criteria and indicators, and recommends relevant policies for sustainability of fragile ecosystems in urban settings.

Patel Ravi Rajendrakumar’s paper on “Impact of Chemical Industries on Agricultural Sector: Nandesari Area of Vadodara” emphasizes that in Nandesari, industries are polluting ground water and air quality of surrounding area, which is adversely affecting agriculture crop pattern and



production. According to one estimate, decline is to the tune of 30 to 80 percent for different crops. Therefore, it is necessary to control and minimize effects of pollution of chemical industries on environment so that it can create healthier environment as well as healthier life for people around chemical industries. This study focuses on the current status and assesses the impact on agricultural crops and their yields in the surrounding areas. An outcome of the studies corroborated with the initial assumption that degradation in agricultural production was indeed due to industrialization. While industrialization is an essential element of country's economy and development, certain measures like close monitoring of regulatory controls need strengthening apart from additional planning measures.

The paper on "Planning Our Future Cities" is authored by Rama Singhal, which states that as we are progressing, India is becoming increasingly urbanized. At present this growing urbanization has to be managed in such a manner that responds to growing climatic changes being wrought in our environment due to global warming. In the wake of climate change, it is becoming increasingly imperative to plan towns and cities, which are sustainable. This article explores the reasons for sustainability and how it can be achieved through changes in current urban planning practices.

S. Kumar Swami has authored a paper on "Growth of Slum Population in India". The paper highlights that urban India is undergoing a process of great transformation in the midst of economic reforms, liberalization and globalization. Many cities and towns are fast emerging as centers of growth. It is estimated that by 2025 more than 50 percent of country's population will live in cities and towns. This is likely to pose serious problems to urban planners, policy makers and managers of urban affairs in terms of increased requirement of funds for infrastructure development and management. Because of inter-regional and inter-city disparities in accessing infrastructure and basic amenities, sharp differences are noticed at the micro-level within a city between high income localities and slum and squatter settlements. As a result, the worst affected are the poorer sections of the society which form more than 40 percent of the populace on an average in the metropolitan cities living in slums and squatter settlements located at the most vulnerable spaces.

The paper on the theme "Public Art: A City Illustrated curating the Public Realm in India" is jointly written by Mitali Kedia and Parul Kapoor, brings out that in today's world very rarely an element has the power to modify the character of space into place. Public Art is one such element which not only enriches a place but also gives it meaning. Around the globe, countries have readily understood its importance and accepted Public Art as an integral part of city development. In India, however, public art is still overlooked and treated as an accessory. Urban aesthetics are still substantially limited to the installation of deities, political figures, etc. The paper discusses various possibilities and opportunities about how Public Art can boost our society. It also suggests a framework, which can be incorporated in the legal system of the country to make it a part of the city development process.

The jointly written paper on the theme "Integration of Master Plan with Economic Policies: A Review of Special Investment Regions", by Neha Bansal and Aditya Purohit tries to understand spatially inclusive economic growth parameters in urban planning. As urban development in most cities of India is envisioned and implemented through master plans, it is important to understand strategies towards inclusive economic growth within the framework of master plans. The authors observe that Special Investment Region or SIRs are based on integrated approach. A Special Investment Region (SIR) is not merely export-oriented but it is also focusing on FDI boosting strategies and it offers a range of services that compete with local and regional planning. The paper identifies the prospects under which the economic policies can comply with master plans for achieving sustainable integrated development.


Ashok Kumar, Editor



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Residential Built Form and Carbon Footprint: Quantifying Energy Consumption and Carbon Footprint for Varied Residential Typologies

Bhanu Mahajan and Meenakshi Singhal

Abstract

This study tries to investigate and quantitatively compare the impact of varied residential development typologies on energy consumption and carbon footprint. Three residential development scenarios are hypothesized on a site in Ahmedabad based on differences in building heights, ground coverage and density which impact differently upon requirements of buildings, transport infrastructure and public amenities. The energy and carbon inventory of these scenarios are then compared in per capita values. The research concludes that reduction in carbon and energy footprint by reduced horizontal travel distance is offset by their increased usage in vertical amenities and there is no significant change in the overall carbon footprint. This result can be used by policy makers to check the penetration of west influenced developmental approaches in India, while planners can acknowledge these findings and explore other methods to reduce travel distance related carbon emissions.

1. INTRODUCTION

Growing levels of urbanization and the consequent energy usage has become a global concern. The urban form, albeit other reasons, is increasingly linked with the energy consumption patterns. Urban form refers to the arrangement of the functional units of a city, reflecting both the historical development of the city and its more recent planning history (Doherty, 2012). Several past studies have attempted to investigate the sustainability of varied urban forms, by linking residential densities, building forms, configurations and layouts to their energy use and greenhouse gas emissions (Williams, 2004). Researches, mostly in the western world, emphasize on the importance of density intensification and reducing travel distances in order to reduce the energy consumption. For instance, a study done in Toronto Census Metropolitan Area suggests that the per capita and per unit area energy use in low density suburbs is higher than that in high density developments (Vande Weghe, 2007). A similar study by Norman (2006) showed higher values of energy and greenhouse gas emissions in case of low-density suburban development as compared to high-density urban core development, measured in per capita and per unit living area basis. Many of the urban design and planning movements in Europe and the USA, such as 'new urbanism', 'sustainable communities' and

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'smart growth' share elements in common with compact city thinking (Williams, 2004). While some researchers conclude that compact designs reduce driving while promoting non-motorized travel (Cervero, 2002); others find relationships to be weak and indirect (Krizek, 2003). High population densities are suggested in the compact city forms, which can reduce the overall footprint of the city, hence reducing travel distances. However, these claims have been contested in various researches (Jenks *et al*, 1996). While the energy consumption gets reduced due to reduced travel distances, as per various studies, the consequent high rise developments offset these energy reductions by increased energy consumption in the vertical services (like elevators, water pumping) and material consumption. Oldfield (2012) shows that due to higher structural requirements; the embodied energy of tall buildings is higher than low rise buildings.

The income levels greatly impact the lifestyle patterns, and hence energy consumption. The changes to urban form and density are part of wider changes to the demographic structures of cities, including decreasing household sizes, increasing numbers of households, and increasing income levels (Doherty, 2012). So, the difference in the energy consumption patterns of different neighborhoods, as observed in the above mentioned studies, can't be attributed to only the built form. The 'Compact vs Sprawl' debate is also linked with the city's land usage, as a compact city is considered less land intensive.

The present study tries to test the hypothesis that "density intensification can reduce energy consumption". Three varied residential scenarios with varying urban form and densities are premised in the outskirts of Ahmedabad city. These neighborhood level scenarios are created using the local planning norms of the city and consider identical number of dwelling units, population, floor space and unvarying socio - economic factors. The three components of the urban environment - buildings, transportation and public amenities, further split into their sub-components, are investigated to compare the three scenarios as regards their impact on annual energy usage and carbon footprint. The results may aid the policy makers in developing appropriate energy and carbon efficient residential development form for the future.

2. METHODOLOGY

2.1 Parameters of Study and Data Sources

At the neighborhood level, the literature suggests that the variation in residential densities can be achieved by manipulating three main parameters of urban form i.e. percentage of road area, ground coverage and building height. Varying the share of public areas such as parks, parking, community spaces and other common areas can further influence the densities, but is kept out of the scope of this study. Further, the impacts of existing land-market mechanisms, socio - economic variations, mutual shading between buildings, heat-island effect, etc. too are not considered, so that the difference in energy consumption patterns can be attributed mainly to the three urban form parameters.



- The primary data used for calculations and scenario building is collected from mainly three sources;
- Household surveys of 150 households - to get average dwelling size of the city and annual household electricity consumption related data;
- Stakeholder consultation - to know the relation of structural material consumption with building height; and
- Visual survey and ground truthing - to know the prevalent plot sizes, building typologies in a particular neighborhood, and residential layout patterns;

Apart from this, secondary data like Gujarat State Development Control Regulations (GDCR), transportation parameters like trip rate, modal share, average trip length; etc.; of Ahmedabad city and IPCC 2006 Guidelines for energy and carbon footprint calculations are used.

2.2 Site Selection

To test the hypothesis, an undeveloped land area was identified in the outskirts of Ahmedabad city whereby the three scenarios were created. Ahmedabad is the 7th largest metropolitan area and the 3rd fastest growing cities in India. The rapid growth rate requires spatial expansion of the city to be channelized in a preconceived manner. In Gujarat, the land is generally developed through

Fig. 1: Selected Location of Land Parcel in Ahmedabad City

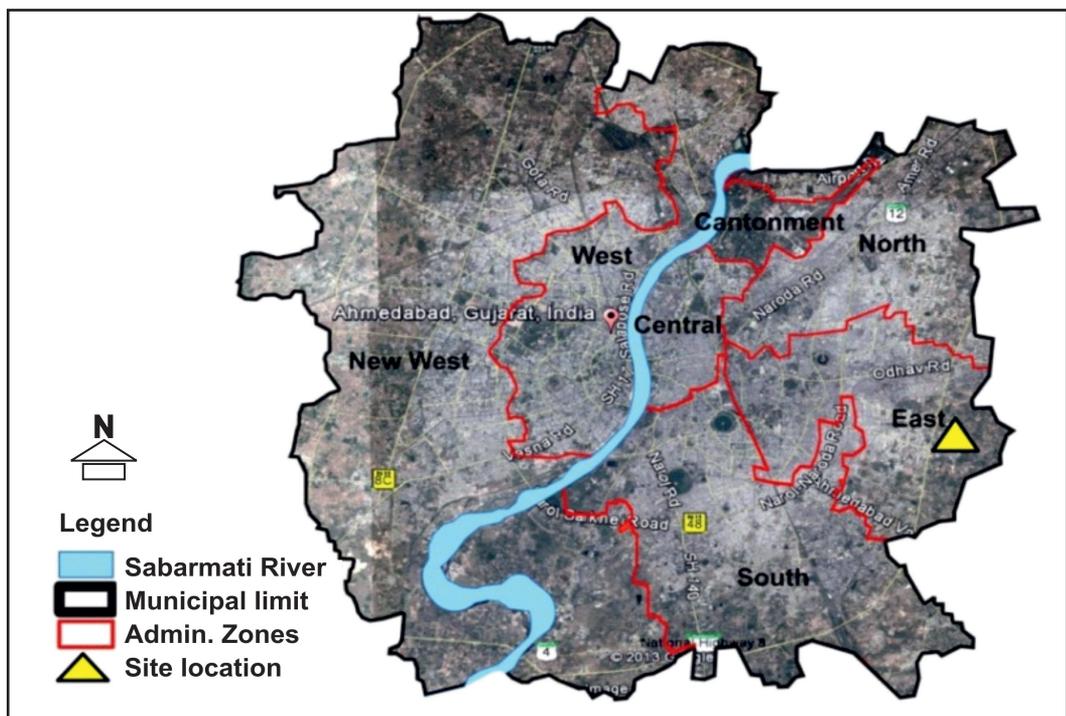
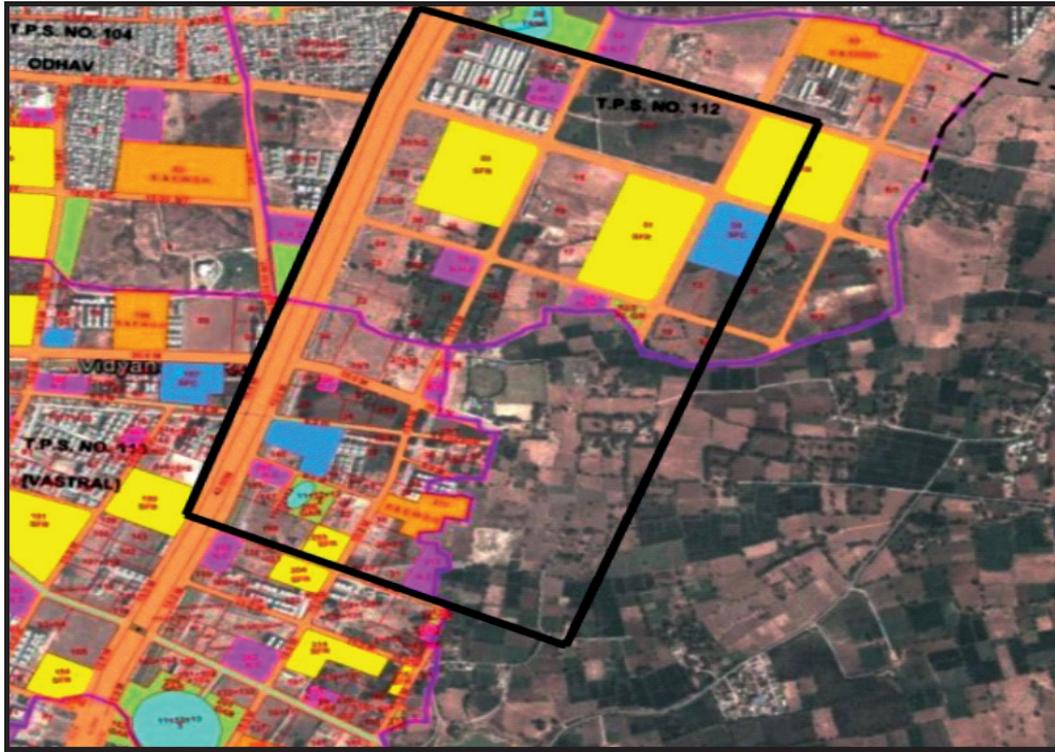


Fig. 2: Site Boundary Overlaid on the Proposed Town Planning Scheme



'town planning scheme' mechanism, wherein existing land parcels, instead of undergoing the tedious process of land acquisition, are assembled, planned and re-distributed proportionately to their respective landowners after demarcation of roads, public areas and amenities. The proposed Development Plan acquired from the Ahmedabad Urban development Authority (AUDA) was overlaid on the Google Earth satellite imagery, and, a 'yet to be developed' land parcel of 145 hectares was identified. This land parcel lies between Odhav and Vastral TP Schemes (23.006° N, 72.674° E), connecting with the Sardar Patel Ring Road (Fig. 1 and 2). While doing so, the major road network and adjoining town planning schemes were retained to ensure real life situation.

Varied layout scenarios of a neighborhood at the proposed site were developed, and compared in terms of energy usage, carbon footprint and land requirements. The study analyzes the impact of building heights, road lengths and building services on energy consumption and greenhouse gas emissions; and the overall benefits of densification measured through building footprints and travel distances. The scope of study is limited for the upcoming residential developments only.

2.3 Scenario Development

Three categories of residential development scenarios as a reflection of the present development trends of the city are selected - low rise low density,

medium rise medium density and high rise high density. Of these, medium rise medium density is a BAU (business as usual) scenario representing the currently projected futuristic development pattern of this zone. Fig. 3 depicts the layouts

Fig. 3: Three Residential Development Scenarios with Ground Coverage in each Scenario

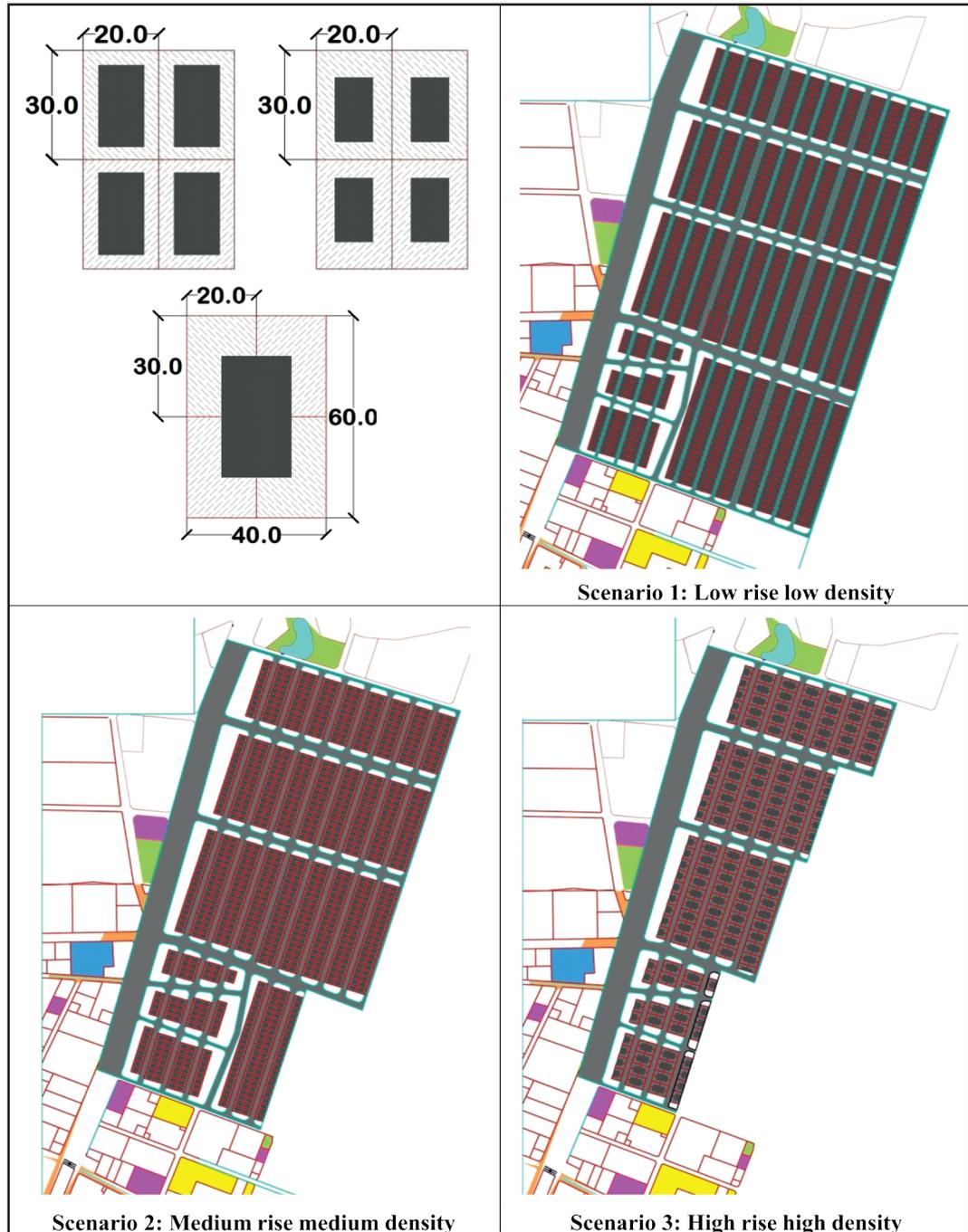




Table 1: Comparison of the Three Residential Development Scenarios

Parameters	Scenario 1: Low rise low density	Scenario 2: Medium rise medium density	Scenario 3: High rise high density	Source
Plot size	20 m x 30 m	20 m x 30 m	40 m x 60 m	Ground truthing
Building typology	Detached	Detached	Detached	
Road width	9 m	18 m	18 m	
Height	3 storey	8 storey	13 storey	Gujarat Development Control Regulations
Road side margins	3 m	0.3 H	0.3 H	
Other side margins	3 m	0.2 H	0.2 H	
Permissible ground cover	45 %	30 %	30 %	
Developed area (DA)	150 hectares	111.9 hectares	72.8 hectares	Calculated values
Road area (% of DA)	26%	36%	39%	
Total area under plots (% of DA)	56.5%	48.7%	43.7%	

of three residential development scenarios on the selected site in Ahmedabad city.

The three scenarios vary in terms of ground cover, building height, density and site area while the constants comprise total livable space in terms of floor area, demographics, dwelling area and average household size. Ground coverage or building footprint in three scenarios is governed by the setback regulations as enshrined in GDCR. The height of buildings in three scenarios is based on maximum permissible limits and permissible FSI mentioned in AUDA DP, and is three, eight and thirteen storeys respectively. The average dwelling area is 123.5 sq m as derived from household surveys. The average household size considered is 5.02 based on AUDA Development Plan, 2021. Each of the three residential scenarios provided for a population of 46,338 spread over 9231 dwelling units. Table 1; offers a candid comparison of the three scenarios.

3. ENERGY CONSUMPTION AND CARBON FOOTPRINT ASSESSMENT

The energy consumption and carbon footprint, further categorized as embodied energy, operational energy and emissions, is arranged in a matrix with the subcomponents of buildings, transportation and public amenities in Table 2.

3.1 Building Components

- Structural variation is calculated for the ‘frame structure’ utilizing a typical layout plan from the surveys, while the factors such as finishes, flooring, façade, etc which tend to vary with individual preferences are excluded;



Table 2: Matrix of Various Components and Sub-Components

Components/ sub-components Embodied energy		Energy Usage and Carbon Footprint		
		Operational energy	Emissions	
Buildings	Structural variation	Yes	-	Yes
	Lift shaft construction	Yes	-	Yes
	Electricity use	-	Yes	Yes
Transportation	Area under roads	Yes	-	Yes
	Travel fuel	-	Yes	Yes
Public amenities	Water supply and sewerage pipes	Yes	-	Yes
	Water pumping	-	Yes	Yes
	Street lighting	-	Yes	Yes

- For the lift shaft construction, based on existing studies and consultation with practicing structural engineers and architects, a thumb rule is developed to assess consumption of steel and concrete for various typologies. The size of the shafts was derived from the primary surveys;
- Life span of 50 years is considered for the buildings in the calculations of embodied energy and carbon emissions; and
- As regards electricity consumption, average values are considered based on electricity bills obtained from primary surveys of 150 households in Ahmedabad.

3.2 Transportation Category

- Area under roads in each scenario is calculated from CAD layouts and then converted into units of embodied energy and carbon emissions;
- Travel fuel related energy and emission values are directly impacted by the ‘total distance travelled by vehicles’ in each scenario, which is calculated as Population x Average trip length x Average trip rate x Vehicle occupancy rate;
- The scenarios differ in only average trip length (ATL) values which are calculated manually from CAD layouts for each household. All other factors are kept constant to negate the impact of behavioral changes on fuel consumption and the consequent transportation related emissions. The city level data is used for modal share, trip rate and occupancy rate. Average trip distance (ATL) is calculated by assuming that Ahmedabad follows the mono - centric city model, and the population in the new growth areas will travel towards the city centre, as Sridhar (2007) suggests, the mono - centric urban model is a good approximation to use for India; and
- The overall emissions for each scenario shall then be the product of ‘total distance travelled by vehicles’ and the ‘emission factor’ which is derived from the IPCC 2006 guidelines.



3.3 In the Public Amenities Category

- The lengths of water supply and sewerage pipes at plot and neighborhood level were calculated based on CAD layouts;
- The number of street lights was calculated based on the total road length and average centre to centre of lighting fixtures; and
- The household survey data was used to quantify the electricity usage in water pumping. For this, the data collected pertained to average household pumping usage, duration of pump use, pump capacity and power. As compared to low rise low density scenario, the high rise high density scenario will have

Table 3: Data Used for Energy Consumption and Carbon Footprint Assessment

Component	Data required in each Scenario	Source
Buildings		
Embodied Energy	Steel and concrete usage per unit floor area	Stakeholder consultation
	Brickwork quantity	Primary Survey
	Lift shaft size	Primary Survey
Operational Energy	Annual household electricity usage	Primary Survey
Emissions	Emissions of steel, concrete, brickwork	UN-Habitat, 1991
	EF factor of national electricity grid	CEA, 2016
Transportation		
Embodied Energy	Road Area	CAD Layout
Operational Energy	Average trip length	
	Average trip rate and modal share	
	Fuel calorific value	ADB, 2009
	Occupancy rate	Gilani, 2012
Emissions	Emission factor for road construction	ADB, 2010
	Emission factors for vehicle travel	ARAI, 2011
Public Amenities		
Embodied Energy	Total pipe length and specification	Primary Survey
Operational Energy	Annual HH water pumping electricity usage	Primary Survey
	Lighting specification and spacing	BEE, 2010
Emissions	Emission factor of water supply and sewerage pipe	Hendrickson & Horvath, 2014
	Annual household electricity consumption in water pumping	CEA, 2016 and Primary Survey
	EF factor of national electricity grid	CEA, 2016 and Primary Survey



Table 4: Scenario Comparison in Terms of Energy Consumption and Carbon Footprint

Component	Energy Consumption per Year (gigajoules)			Carbon Footprint (CO ₂ Emissions) per Year (tonnes)		
	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Buildings	106687	110513	113157	21584.4	21848.1	22038.4
Transportation	19348	18238	13146	1220.9	1185.3	853.2
Public Amenities	4063	3565	3131	922.1	806.9	709.7
Total	130098	132316	129434	23727.4	23840.3	23601.3

Fig. 4: Total Energy Use per Year (gigajoules)

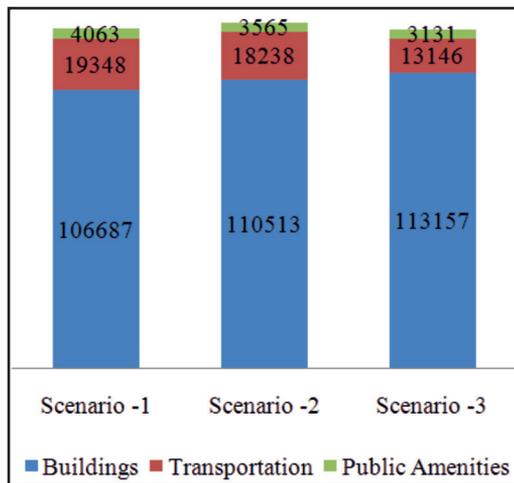
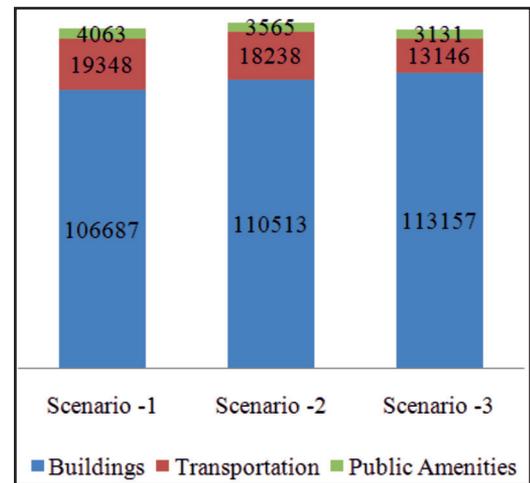


Fig. 5: Total CO₂ Emission Per Year (Tonne)



more vertical piping at plot level and a consequent higher electricity usage in water pumping, but lesser network of pipes beneath the roads as also lesser street lights.

Table 3 provides an overview of data considered for energy and carbon footprint calculations, while the results are presented in Table 4, Fig. 4 and 5.

4. CONCLUSIONS

Thus, the results show that annual energy use and emissions in each scenario varies, but the overall gap is not significant and there is no direct co-relation of built form parameters with the overall annual energy use and carbon footprint. The Scenario 2 is ahead in both the parameters i.e. overall energy and carbon footprint, which can be attributed to its high incremental percentage of road area. However, if we compare the individual components, i.e. buildings, transportation and public amenities, a clear and significant variation can be seen. With the reducing footprint of the neighborhood, the infrastructure and transport related emissions decrease,



but with increasing building height, the overall emissions increase, thereby offsetting the emission reduction achieved in other two components. Also, we can clearly see that the 'building' component is the most energy and carbon intensive component of the built environment, followed by 'transportation' and 'public amenities'. It follows that the building component is the most prominent in terms of energy intensity at neighborhood level and has a lot of potential for energy and carbon saving. In terms of carbon footprint, the building component is responsible for more than 3/4th of the emissions, which can be attributed to high carbon intensity of high rise constructions. Further, the difference in travel distance in each scenario doesn't make any significant energy or emission reduction at neighborhood level. The trade-offs are associated with every intervention that may offset the energy or carbon emission reduction achieved within a particular component and without taking into consideration all the aspects of built environment, the intervention in a particular component may not become very effective. Although the scope of the study is limited to the neighborhood level, it can be considered as a step towards developing an energy and land optimization tool for new residential development of a city.

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The Development in Cities of Developing Nations: A Holistic View to Developmental Approach of Cities

Dipayan Dasgupta

Abstract

Cities in India are divided into 3 typologies based on population, i.e., Tier - I, Tier - II and Tier - III. The importance of Tier - I is the most effective but the Tier - II cities are the “future mega cities” because the Tier - I cities have almost reached saturation and the level of life is deteriorating since the carrying capacity of those cities has been crossed. This paper deals with the importance of the Tier - II cities which have gained value and importance in the latest years because the scope for development in those Tier - II cities are far better than Tier - I cities (since Tier - I cities are more claustrophobic). The paper defends the Tier - II cities and puts forward possible reasons to support the existence and importance of Tier - II cities.

1. INTRODUCTION

Humans have been shaping and forming cities for thousands of years now but the global shift from rural to urban living has been a defining trend during the past century only. There has been a magnum increase in the number of urban centers, the then villages have transformed into towns and the once towns into cities. It is said that the world will add approximately one new city of a million every five days until 2050. In most developing countries, urban centers exist today where there were villages only a decade ago. Urban centers have been the dominant centers in the world's socio - economic, cultural, political and environmental spheres. The dependence on these urban centers has indirectly made the urban areas as big as they are today. Be it Tokyo with 30 million+ population or Dhaka by 14 million+ population, they are the most dependent-on cities in their respective places in Japan and Bangladesh respectively.

2. IMPORTANCE AND CONTRIBUTION OF URBAN CENTERS IN GLOBAL ECONOMY

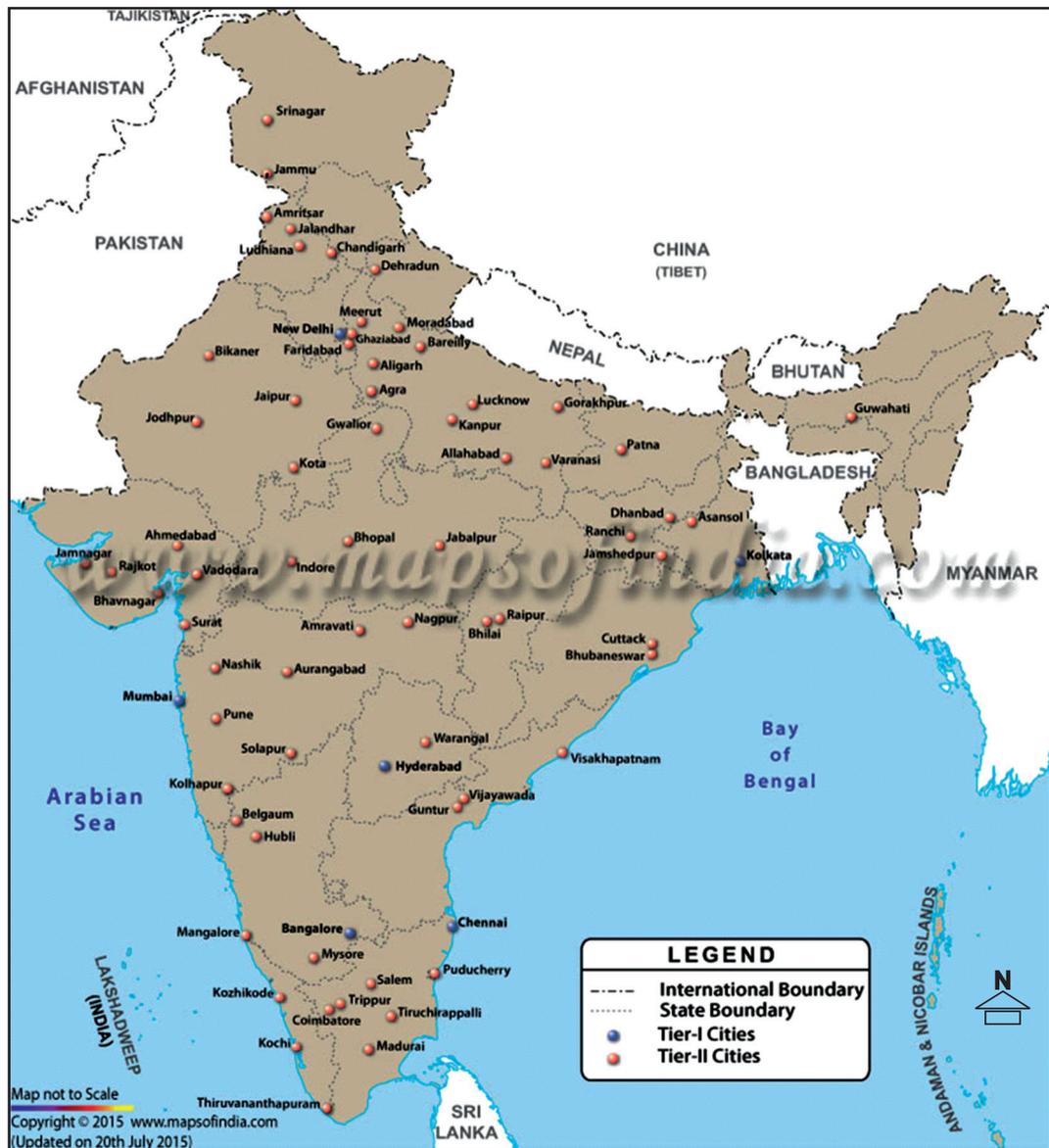
Urbanization has been an essential part of most countries development towards a stronger and more stable economy and political structure. Most of the world's largest cities are in the world's largest economies, which is an evidence of this prevailing link between economic wealth and cities. Urban centers also have important roles in social transformation. They are centers of art, science and technological innovations, of culture and education and social relief. Economic growth and urbanization are often positively linked

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with the growth of an urban area. Cities are the driving force for economic development and in return economic growth also stimulates urbanization. Such positive relationship is clear in many countries. However, urbanization may also occur in the absence of economic growth. For example, in some Sub-Saharan African countries, urbanization has occurred to a large extent independent of economic development (Zhang). Urbanization processes and patterns are also different by institutional settings and policies from nation to nation and region to region. Cities facilitate trade and commerce by providing market places. Cities serve as production and services centers since

Fig. 1: Tier - I and Tier - II Cities of India





the production of many goods and services is more efficient in a high-density urban environment.

Each of 53 Urban Agglomeration (UAs) and Towns each have a population of one million or above, each falls in this category of Million-Plus cities or urban centers. 160.7 million persons (or 42.6 percent of the urban population) live in these Million Plus UAs / Cities. 18 new UAs / Towns have been added to this list since the last Census. These cities carry the burden of bringing forward the moving population in urban areas.

Mega Cities: Among the Million plus UAs/Cities, there are three very large UAs with more than 10 million persons in the country, known as Mega Cities. These are Greater Mumbai UA (18.4 million), Delhi UA (16.3 million) and Kolkata UA (14.1 million). The largest UA in the country is Greater Mumbai UA followed by Delhi UA. Kolkata UA which held the second rank in Census 2001 has been replaced by Delhi UA. The growth in population in the Mega Cities has slowed down considerably during the last decade. Greater Mumbai UA, which had witnessed 30.47 percent growth in population during 1991-2001, has recorded 12.05 percent during 2001-2011. Similarly Delhi UA (from 52.24 percent to 26.69 percent in 2001-2011) and Kolkata UA (from 19.60 percent to 6.87 percent in 2001-2011) have also slowed down considerably.

Under the recommendation of the Sixth Central Pay Commission, the CCA classification was abolished in 2008. The earlier HRA classification of cities was changed from A-1 to X, A, B-1 and B-2 to Y and C and unclassified cities to Z. X, Y and Z are more commonly known as Tier-1 (Mumbai, Delhi, Kolkata, Chennai, Bengaluru, Hyderabad, Pune and Ahmedabad), Tier-2 (example- Indore, Kanpur, Surat, Bhubaneswar and Nagpur, etc.) and Tier-3 cities respectively. On the basis of the census 2011, two cities – Pune and Ahmedabad – have been upgraded to 'X' class from 'Y' and 21 cities to 'Y' from 'Z' for the purpose of HRA effective from 1 April 2014.

3. CITIES OF 3RD WORLD NATIONS

Half of the people live in the urban centers these days. The importance of these areas has been immense and the future has nothing but much better days in hands. When it comes as the question of 3rd World nations then these nations are the tomorrow's powerful nations be it China, India, etc. These nations have the power of competing the first class nations very soon. These nations have the perfect hunger to be the best nation any day in future. Similarly the cities of these developing nations are world-class in terms of economy but lag in a few parameters like healthy living and improper distribution of money. These cities are capable enough to be the best from where they thrive to be now. The power relies on hands of the population and the government. These cities of 3rd world nations have the immense capability of growing in every possible direction provided the willingness is on the positive side. Economy stands as an important element to withstand as a powerful urban area. The scale of economic valuation goes up, with the size of the



urban areas. For example a mega city like Delhi is far more economically stable than a metropolitan city like Nagpur, but the interesting factor of this paper is not the gaining or the prevailing importance of Delhi but the development of the importance and value of Nagpur from where it is, to where Delhi stands provided Nagpur would be an organized and better urban area than Delhi. The paper calls these Tier - 2 cities like Nagpur, Lucknow, Bhubaneswar, Kochi, Tiruchirapalli, etc., as the next generation cities because they have the power to grow as we would want them to shape since mega cities like Delhi, Mumbai and Kolkata are far more claustrophobic and heavily choked than these Tier - 2 cities.

4. TIER-I CITIES BEING STUCK FOR GROWTH

Urban areas like the mega cities of Delhi, Mumbai, Kolkata or the largest of the metropolitan cities Bangalore, Chennai, Hyderabad are almost choked and there is barely any space for more development or development activities further. These urban areas have crossed boundaries of states as in Delhi or engulfed other districts as in Mumbai or Kolkata. The population in these cities is more than 8 million and touches 20 million for Mumbai and Delhi which is the total population of many states in India or several countries in Europe or Africa. The problem arises in handling this large population and taking care of such huge areas by the Development Authorities and the functioning of the multiple Municipal Corporations and Councils gets difficult for such large urban areas. Mumbai is the sixth biggest mega city in the world with having a population about 20 million and it is heavily notorious for its chaotic traffic. There is a cacophony of honking horns and revving engines. There is no one who takes the slightest notice of road markings; there is no BRT, no Bus lanes or bike lanes. It is estimated that 15-20 percent of the total space is under all types of transport facilities for travelling within the urban area. Delhi has around 50 sq m of land under parking facilities. To maintain the rapidly growing population the requirements like food, shelter, medicine and schooling are all not at rise. Thus, this increase in population, regardless of it being a mega city, poses greater challenge as economic burdens and consequently social outrages. It is said that the Mumbai's suburban area has grown by 3555 percent in 2011 from 1911, i.e. 100 years this implies the migrated population. This is not only the problem of the City of Dreams but also a problem for the National Capital and the City of Joy. Hyderabad, Bangalore and Chennai are soon to face heavy rage of such problems or some parts are surely facing it. At the end it is the loss of identity which is outraging.

Mega cities such as Kolkata, Mumbai, Manila, Sao Paulo, Lagos and Mexico City are all a part of the largest mega cities league of the world. It's interesting to note that these cities are great as aspects for the research folks and journalists to have thrilling features of poverty and malnourished people. In Mumbai, almost half of its population is slum dwellers or homeless occupying 6 percent of its land similarly in Kolkata 33 percent approximately of the population lives in slums. There are always clashes within administration and development for instance Kolkata



metropolitan area has 4 municipal corporations, 36 municipalities collaborating to function with only one Kolkata Metropolitan Development Authority. While Tier - I cities in India struggle with overpopulation, dwindling resources and lack of space, it is the Tier - II cities that are emerging, taking forward India's economy; in shorter words they are the new lifeline of India's growth.

5. REASONS OF DEVELOPING TIER - II CITIES

By pressure on the urban area logic, one planner has to think of having a different edge in releasing pressure on Tier - I cities. This one opportunity takes us to point of working on development of Tier II cities because these cities have the opportunity of growing, as mentioned before, as per a planner's thought for the urban area. This channelized growth and development is necessary because the Tier - II cities have the potential to be formed and reformed unlikely with the Tier - I cities. This will have a pressure releasing effect on the Tier - I cities which are by far increasing by approximately 2-3 million people per decade. In the coming years the population is only to grow by numbers so today one has that opportunity to shape up the relatively smaller urban areas to have a better and defined future and not look like Mumbai, Delhi, Kolkata or Chennai does! Seamlessly the Tier - III cities are too small to focus on so the Tier - II cities grab the attention and henceforth they have become the focal point in this paper. The task of this paper is to redefine the Tier - II cities and have an empowering effect on the development and the betterment of the Tier - II cities so that they are resilient and sustainable. Tier - II cities such as Surat, Jaipur, Indore and Patna have economic growth rates exceeding 40 percent, much higher than that of Kolkata or even Mumbai. At 8.4 percent, Tamil Nadu is the second largest contributor to the national GDP. It is the playing of pivotal roles by Coimbatore, Salem, Tiruchirapalli and Madurai in the hands of economy. Some of the potential and promising Tier - II cities are focused on here.

Kochi: is such a Tier - II city which is very soon to be a Tier - I city in near future. The city offers excellent opportunities for companies looking for better infrastructure at reduced rates. Kochi has a fully functioning IT park in Kakinada and Kochi Smart City, another new trendsetter IT project for office space, excellent telecoms connectivity, national and international connectivity through broadband. Kochi has now recently launched metro rail system which is an added benefit to the ease and accessibility within the city.

Bhubaneswar: The temple city of Odisha is now to be known as an IT hub as well. The city presently looks like Bengaluru used to look in early 1990s. Several new buildings are being erected in the city and many new start-ups, both national and international, have graced the Tier - II city.

Lucknow: is a huge potential market with great future, real estate is budding and there is a high demand of the good projects by the reputed builders in Lucknow.



It also has experienced rapid urbanization and industrialization, with many steel and manufacturing industries opening up. In the serious mood of setting up an IT hub in the city soon, a high jump in GDP is expected from the city of *nawabs*.

Patna: is said to be the fifth fastest growing urban area in India with its roots steeped in agriculture and distribution. Sugarcane, grain and sesame are the three largest exports. In a 2009 report by World Bank, Patna was rated as the second best city to start a business in. it rakes in the highest GDP of Bihar with being the capital and growth rates exceeding 40 percent.

Coimbatore: it is a Tier - II city referred by industrial, infrastructure and energy players. This Tier - II city is an excellent case study for the state-of-art infrastructure with two operational SEZs and another five in the pipeline. Coimbatore is also home to an aerospace component manufacturing cluster and plans are in line to set up an electronics and software cluster spread across 157 acres.

Visakhapatnam: the coastal Tier - II city of Vizak in Andhra Pradesh is considered the third largest port on the East coast after Kolkata and Chennai. It has the oldest shipyard and a natural harbor. It is considered as the tenth urban area by GDP. The fishing industry, steel plants, shipyards, tourism, industrial parks and IT sector all turned the small hamlet into a fast growing urban area.

Guwahati: While the GDP of Guwahati in Assam sums up to be 1.5 billion dollars, it is considered the gateway to the Northeast India. It being a major retail hub of the region; it is rich in oil, has flourishing tea industries, tourism, finance, real estate, pharmaceuticals, textiles and handicrafts. The Tier - II city contributes to 80 percent of India's tea exports and 55 percent of tea production.

Raipur: India's largest iron market, Raipur in Chhattisgarh was already the second largest commercial center while it was part of Madhya Pradesh until 2000. It is now also the main hub for trading in agriculture produce in the region. This Tier - II city boasts of high numbers of steel, iron, plywood and agro - based industries and plants. Its production of formalin is distributed to all of India. It was number 6 out of 22 in a 2014 ranking of best governance in cities.

Surat: The fourth fastest growing urban area in India was marked 8th in India's highest GDP cities in 2012. Indeed a major hub for diamonds, textiles, petrol, oil, shipping, cement, IT and many more sectors. It has a decadal population growth of 50 percent in 2011.

Indore: The Madhya Pradesh government is waiting for the final approval of center to develop Indore Smart City on 300 acre non-processing area of Indore SEZ. According to the news, the smart city will be a self-dependent township with modern infrastructure and amenities including residential and commercial



properties, schools, and clinics and banking facilities. This Tier - II city is the most dependent on urban area of M.P. for commercial purposes.

6. THE HAPPENINGS FOR A BETTER TOMORROW

The prospects of Tier - II cities are immense as mentioned earlier in the paper. This is important to note that these Tier - II cities ought to have a better format of development and an organized as well as systematic growth. The paper has few of its suggestions to have an effective and systematic development as strategies and practices.

- **Building Effective Public-Private Partnerships:** The public-private partnership is important to have a more efficient and improved construction and management base for implementation and operation.
- **Encouraging Public Participation:** There is a need to have proper participation which has more public into the search of getting educated about the kind of work happening for them. Since the people are the ones, the planner works for hence it is important to let them know about the work and the format of the work, investments, etc.
- **Improving Resource Mobilization and Cost Reconciliation:** The mobility of resources from the resource provider to the proper utilization using different mechanisms to implement the pre-determined goals. The need is to have an idea of the resource location and the happenings with the resources being efficient and effective or not.
- **Public Sector Institutional Reform:** The state also is responsible for the better living standards of its people. Hence, the state has to work for its people and lend them happiness and employment by empowering in every possible way. The state is accountable for its constituents.
- **An Umbrella Organization:** An organization which will be effective, efficient and important in the hierarchy of authorities functioning in an urban area. In larger urban areas there are more than one Urban Local Bodies functioning together like in Kolkata there are 4 municipal corporations and 36 municipal councils along with almost a century of *panchayats* working together with Kolkata Metropolitan Development Authority and few others like PWD, WBEB, KMRC, Kolkata Suburban Railway, etc. It must be a chaos. This umbrella organization will have an eye on all the successful links, collaborations, work and distribution at the eagle level that is the top most level. It will take care of the Master Plan being properly implemented, distributed for work and guaranteed future development.

7. SUSTAINABLE DEVELOPMENT GOALS (GOAL - 11)

Target 11.1: By 2030, ensure access for all too adequate, safe and affordable housing and basic services and upgrade slums.



Target 11.2: By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women and children, persons with disabilities and older persons.

Target 11.3: By 2030 enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.

Target 11.4: By 2030, strengthen efforts to protect and safeguard the world's cultural and natural heritage.

Target 11.5: By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.

Target 11.6: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.

Target 11.7: By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities.

7. CONCLUSIONS

Empowering Tier - II cities and giving them the perfect direction to grow is important. The paper points out the problems of development in Tier - I cities and advocates development in Tier - II cities. The capability of Tier - II cities is immense and hence the opportunity to be an alternative to Tier - I cities should be given to those Tier - II cities. The harmony within urban areas will help in evolving towards better economy for a nation. The strategic and realistic functioning is important and the idea of viable Smart Cities is actually an idea which would be an added advantage to economy of a nation.

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Urbanization, Migration and Environmental Degradation in Third World Countries - A Case Study of Indian Metropolitan Cities

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Abstract

The study focus on some of the important environmental problems caused by migration, urbanization process in the metropolitan cities of India. The level of urbanization of India increased from 27.81% in 2001 census to 31.6% in 2011 census. The proportion of rural population declined from 72.19% to 68.84%. India is urbanizing rapidly and about 377 million people live in 7935 town/cities (census 2011) across the country which constitutes about 31.2 %. The towns have significantly increased from 5161 in 2001 to 7935 in 2011. But there is high inequality in the distribution of the urban population by size class categories. The authors argue India's urban future is grave; therefore, there is an urgent need to tackle the urban environmental problem in a rational manner giving attention to the need for improving urban strategies.

1. INTRODUCTION

Urbanization is one of the important realities of recent decades in India. Its urban system consists of 7,933 cities and towns of different population sizes, and a population of 377.16 million (Census, 2011), which is the second largest in the world. The urban system has registered an extraordinary expansion in its base over the 2001-11 decade, and this trend is expected to continue. An estimated 180 million rural people live next to India's 70 largest urban centers, a numbers that will increase to about 210 million by 2030 (McKinsey Global Institute, 2010). In recent decades, the pattern of India's urbanization has undergone an important shift, which is characterized by increasing numbers and rising population share of metropolitan cities and an unprecedented increase in the number and population of census towns whose share in urban population has risen to 14.5 percent (Census, 2011) from 7.6 percent in 2001. Metropolitan cities continue to be a collection of municipalities and other settlements, drawing powers directly from the respective statutes and presenting a monumental challenge of 'Who Governs'. Present problems of sprawl and unregulated development are fuelling fears of weakening of agglomeration economies. Due to uncontrolled urbanization in India, environmental degradation has been occurring very rapidly and causing shortage of housing, worsening water quality, excessive air pollution, noise, dust and heat problems and disposal of solid waste and hazardous wastes.

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Cosmopolitan and metropolitan cities present a particularly depressing picture today. The situation in Greater Mumbai, Delhi, Kolkata, Chennai, Bengaluru, Hyderabad, Ahmedabad, Pune, Surat, Jaipur, and Kanpur is becoming worse year after year. The problems of availability land and housing for all have been intensified. Slums have become an inevitable part of the major Indian metropolitan areas. Urbanization is not neutral in its impact an environment and climate change enters India's development strategy. The recent census data indicates that absolute housing shortages in cities and towns have declined from 1.63 million units in 2001 to 0.39 million 2011. At the same time, however, the relative shortages, measured in terms of congestion and obsolescence, are high at 18.8 million units. While urban centers act as generators of economic growth and rapid pace of urbanization creates burden on the existing natural resources, cities are more dependent an energy than rural areas and create considerable amount of ecological footprints. Accelerated urbanization creates demand for mass transportation, increment in commercial and industrial activities and program to use vacant urban land. These activities are often undertaken at the cost of natural landscapes, water bodies, increased energy consumption, etc, creating severe damages to the quality of air, water and other natural resources. Along with this climate change makes human settlements more susceptible to natural disasters, especially for the economically weaker sections of the society who are more often exposed to and affected by vagaries of extreme weather conditions. Major environmental concern with growing urbanization relates to rising levels of air, water and noise pollution, municipal solid waste and other forms of contamination relating in urban settlements.

Increase in private ownership of vehicles, growth in construction activities in urban areas without proper arrangements for disposal of construction wastes, growing mobility demands, increasing demand for power and industrial production, unplanned development of industries and hazardous industrial waste, inefficient use of energy in buildings, and expensive use of biomass for cooking and heating are some of the reasons for increase in air pollution in urban areas of India.

In the above context, using the available data both primary and secondary, the present study concentrates on some of the important aspects of India's population growth, migration and urbanization process and also highlights some of the environmental issues caused by population growth and rapid urbanization processes in the metropolitan cities of India.

2. URBANIZATION, MIGRATION AND METROPOLITAN CITIES

Urbanization is one of the important realities of resent decades in India. Its urban system of 7,933 cities and towns of different population of 377.16 million (census 2011), which is the second largest in the world. The urban system has registered an extra ordinary expansion in its base over the 2001-11 decade and



this trend is expected to continue. An estimated 180 million rural people live to India's largest urban centers (rural urban migration), a number that will increase to about 210 million by 2030 (McKinsey Global Institute). During the last three decades in India, the link between urbanization and environmental degradation, and threat to quality of life has emerged as a major issue.

2.1 Pattern and Trend of Urbanization in India, during 1901 - 2011

Pattern and trend of urban population and number of towns and cities in India during 1901 to 2011 show that (Table 1 and Fig. 1), total urban population has increased more than fifteen times from 26 million to 377.1 million. Continuous migration has been noticed in the percentage of urban population from 11 percent in 1901 to 17 percent in 1951 to further 31.15 in 2011. Similarly the number of towns and cities has also increased from 1,917 to 1901 to 3,060 in 1951 and then to 7,933 in 2011. This accelerates rapid urbanization process in India.

2.2 Rural to Urban Migration

Migration and urbanization are direct manifestations of the process of economic development in space particularly in the contemporary phase of globalization. A large part of migration and urbanization in India have been worked to stagnation and volatility of agriculture and lack of sector diversification within agrarian economy. The growth rates in agricultural production and income has been noted to be low, unstable and disparate across region over the past several decades, resulting in lack of livelihood opportunities in rural areas. A low rate of infrastructural investment in public sector in the period of structural adjustment

Table 1: Pattern and Trend of Urbanization in India during 1901 - 2011

Year	Number of Towns or Cities	Urban Population in Million	% Urban Population to Total Population	Annual Exponential Growth Rate of Urban Population
1901	1917	25.8	10.84	-
1911	1909	25.9	10.29	0.03
1921	2047	28.1	11.18	0.79
1931	2219	33.4	11.99	1.75
1941	2424	44.1	13.86	2.77
1951	3060	62.4	17.29	3.47
1961	2700	78.9	17.97	2.34
1971	3126	109.1	19.91	3.21
1981	3949	159.5	23.31	3.83
1991	4615	217.6	25.71	3.09
2001	5161	286.1	27.82	2.74
2011	7933	377.1	31.15	2.76

Sources: Compiled from various census reports registration general



necessary for keeping budgeting defects low also have affected agricultural adversely. This has led to out migration from several backward rural areas, most of the migrants being absorbed within urban informal economy.

More than twenty fold increase have been noticed in the population of Delhi in 110 years from 0.41 million in 1901 to 16.70 million in 2011, whereas there has been 2.1 fold increase in Mumbai population, from 0.81 million to 17.6 million from 1901 to 2011. However, Chennai has experienced increase of population to 10.59 million from 0.708 million in its total population during the last 110 years, whereas Kolkata has experienced the lowest increase (more than 9 fold) in its total population and Bangalore has experienced more than fifty fold (58) increases in its total population among the metropolitan cities in last or eleven decades (Table 2).

Bangalore experienced the highest decadal growth rate (cleared to 50 percent) in its total population in all census (1951 to 2011), followed by Delhi where growth rate was about 20 percent during the census years. However Mumbai experienced more than 15 percent, Kolkata about 10 percent experienced continues declining decadal growth rate from 1951 to 2011. A huge influx of migration has takes place to metropolitan cities because of job opportunities better facilities, etc.

2.3 Impact of Urbanization on the Environmental Quality in Metropolitan Cities

Environmental influence is traditionally defined as that category of forces and influences achieving upon an organism and in relation to which organism is capable of reacting and in return influencing. Environmental influence is an inseparable whole and constituted by interacting system of physical, biological

Table 2: Trend in Total Population (in 10000s) and Annual Growth Rate in the 5 Metropolitan Cities of India (1901 - 2011)

Census year	Mumbai	Growth rate	Kolkata	Growth rate	Delhi	Growth rate	Chennai	Growth rate	Bangalore	Growth rate	India	Growth rate
1901	81.3	-	151.00	-	40.6	-	59.4	-	16.3	-	2384	-
1911	101.8	25.2	174.5	15.6	41.4	2.0	60.4	1.7	18.94	8.47	252	15.7
1921	124.5	22.3	188.5	8.0	48.8	17.9	62.8	4.0	24.00	12.25	2513	0.3
1931	126.8	1.8	213.9	13.5	63.6	30.3	77.5	23.4	30.98	22.79	2786	11.0
1941	168.6	33.0	362.1	69.3	91.8	44.3	92.1	18.8	41.1	25.11	3187	14.2
1951	296.7	76.0	467.0	29.3	174.4	90.0	153.1	66.2	78.63	69.77	3611	13.3
1961	415.2	39.9	598.4	28.1	265.9	52.5	192.4	25.7	120.70	19.61	4392	21.6
1971	597.1	43.8	742.0	24.0	406.6	52.9	305.8	58.9	166.42	46.55	5482	24.8
1981	891.7	49.3	919.4	23.9	622.0	53.0	428.9	40.3	292.17	59.08	6833	24.7
1991	1259.6	41.3	1102.2	19.9	942.1	51.5	542.2	26.4	413.03	38.44	8463	23.8
2001	1636.8	29.9	1321.7	19.9	1297.1	37.7	642.5	18.5	653.71	35.09	10270	21.4
2011	1760.0	17.72	1411.254	7.6	16700.88	20.96	708.8	10.31	958.89	46.68	1210100.93	17.64
2016	-	-	-	-	-	-	823.304	-	-	-	-	-

Source: Census of India, 2011



and cultural elements. Environment is the aggregate or sum total of external conditions that influence the life of an individual or population specially the life of a man. Since urbanization is one of the main factors responsible for the deterioration of environment, towns and cities are the centers of environmental problems like air, water, soil and noise pollution is very complex in urban centers.

Deterioration of environmental quality in cities has become one of the major cause in the world. Cities all over the world face the challenges of accommodating the needs and by products of dense population which are manifested in the form of environmental hazards. Specifically growing cities of Third World Countries typically experience the double environmental health jeopardy of traditional risks from infectious diseases and the physical and chemical hazardous that accompany poorly regulated industrial development, substandard housing, traffic hazards and social violence. In India the physical environment of the metropolitan cities is degrading day by day. Air, water, land and noise experience over exploitation, slums poverty, congestions are becoming a norm. Following are the main features of urban environment.

- **Slum Situation in Metropolitan Cities:** The fast urbanization in combination with industrialization has resulted in the enlargement of slums. The explosion of slum occurs due to many factors such as the lack of developed land for housing, the high prices of land, which is beyond the reach of urban poor, a large influx of rural migrants to the metropolitan cities in search of jobs. Table 3 shows percentage of slum population in the five metropolitan cities during 1981 to 2011. A continuous increase has been found in the percentage of slum population over three decades in the five metropolitan cities of India during 1981 to 2011 was highest 41.84 percent population of Mumbai were residing in slum and 2011 nearly half of Mumbai population was living in slums. However, Kolkata and Delhi had not shown as severe condition as Mumbai. The proportion of slum population was 30 percent and 18 percent in the 1981 in Kolkata and Delhi which increased to 42 percent and 20 percent respectively in 2011. On the other hand Bangalore slum population more than doubled in a decade (1991 to 2011) and every fifth person in Bangalore metropolitan city limits lives in a slum. Although Chennai has lowest slum population among five metropolitan cities yet it has experienced continuous increases in the slum population over the four decades. There was 14 percent slum population in Chennai 1981, which increased 18 percent in 2001 and further 19 percent in 2011.

Table 3: Percentage of slum population in the five metropolitan cities of India 1981-2011

Metropolitan cities	1981	1991	2001	2011
Greater Mumbai	30.80	43.2	54.1	41.84
Kolkata	30.30	36.3	32.6	31.50
Delhi	18.00	22.5	18.7	19.63
Chennai	13.80	15.3	18.9	19.00
Bangalore	10.47	12.85	10.00	21.50

Source: Census of India, 2011



- Status of municipal solid waste generation and collection in metropolitan cities of India:** India is home to 1.2 billion people of which 377 million live in urban area. Total MSW generation in 168 cities with population over 100,000 per city was estimated at 48,134 metric tons per day (Government of India, Report of the Task Force a Waste Energy Planning Commission, 12 May 2014). Such cities had a population of 265 million in 2011. This translates to an average per capita generation of about 0.18 kg per person per day. More recent estimates put the per capita waste generation for small towns at 200 to 300 gm / capita, 300 to 400 gm / capita for medium cities and between 400 to 600 gm / capita for metropolitan cities (Government of India, Central Pollution Control Board: Status Report a Municipal Solid Waste 2010-11).

Poor status of MSW management in metropolitan cities is an indicator of the magnitude of the work required in India. Environmental pollution from smoldering unscientific dump sites and from the leachate has become a great area of concern due to burning of garbage (frequently practiced to dispose of collected garbage) is a contributor to serious air pollution. Table 4 shows that Delhi generates the largest amount of MSW in 2011 which is 8,900 tons/day followed by Mumbai (8,000 tons / day), Kolkata (6,100 tons / day), Chennai (4500 tons / day) and Bangalore (3,700 tons / day). But if we consider the per capita generation of solid waste, it is the largest in Chennai which is about 960 gram/day. But it is found that equal per capita waste generation by Mumbai, Kolkata and Bangalore which is about 430 gm / day. But as far as treatment facility concerned, they are better in Bangalore and Delhi among metropolitan cities.

2.4 Growth in Motor Vehicle in Metropolitan Cities

Urbanization has also led to rapid motorization as Table 5 shows the growth in the number of vehicles from 1951 to 2011. In fact the growth rate in the

Table 4: Status of MSW Generation and Collection in Metropolitan Cities of India.

Metropolitan City	MSW generation MT/day	Per capita generation Kg/day	Population	Treatment facility		Scientific land fill disposal
				MT/day	Type	
Mumbai	8000	0.43	18,394,912	3000	1 Bio reactor	None
Kolkata	6100	0.43	14,112,536	700	1 compost plant	None
Delhi	8900	0.54	16,349,831	6000	3 waste to energy one composting plant	Only one of 4 disposal site is proposer
Chennai	4500	0.96	4,646,732	300	1 waste to energy plant	None
Bangalore	3700	0.43	8,443,675	3300	10 composting plants	None

Source: <http://www.cpcb.nic.in>



Table 5: Growth of Motor Vehicles in India, 1951 - 2011

Year	Two wheelers	Cars, Jeep & Taxis	Buses	Goods Vehicles	Other vehicles	Total vehicles
1951	8.8	52	11.1	26.8	1.3	0.3
1961	13.2	46.6	8.6	25.3	6.3	0.7
1971	30.9	36.6	5	18.4	9.1	1.7
1981	48.6	21.5	3	10.3	16.6	5.4
1991	66.4	13.8	1.5	6.3	11.9	21.4
2001	70.1	12.8	1.2	5.4	10.5	55
2002	70.6	12.9	1.1	5	10.4	58.9
2003	70.9	12.8	1.1	5.2	10	67
2004	71.4	13	1.1	5.2	9.4	72.7
2005	72.1	12.7	1.1	4.9	9.1	81.5
2006	72.2	12.9	1.1	4.9	8.8	89.6
2007	71.5	13.1	1.4	5.3	8.7	96.7
2008	71.5	13.2	1.4	5.3	8.6	105.3
2009	71.7	13.3	1.3	5.3	8.4	115
2010	71.7	13.5	1.2	5	8.6	141.8
2011	71.8	13.6	1.1	5	8.5	159.5
2012	72.4	13.5	1.0	4.8	8.3	

Source: MoRTH. *Gol(2013) Road Transport year book 2011-12, Ministry of road transport highways , Govt. of India, Retrieved June 13, 2014 from <http://morth.nic.in/showfile.asp?lid-1131>*

number of vehicles has been much faster than in the population itself. Total number of registered motor vehicles in India increases from about 0.3 million in 1951 to nearly 142 million in 2011 (MoRTH, 2013) an increase of 7.7 percent per annum as against population increases of 3.8 percent per annum during the same period. During 2001-2011, growth was even faster at 10 percent per annum. This increase has also been accomplished by a motor vehicle fleet, with two wheelers taking over a dominant role. Share of two wheelers stood at 72.4 percent of during 2011 as compared to 8.8 percent during 1951. On the other hand the share of cars, jeeps and taxis which was 52 percent in 1951 came down to 13.5 percent in 2011. The share of buses declined from 11.1 percent in 1951 to 1.0 percent in 2011.

2.5 Air Pollution Level in Five Metropolitan Cities

Uncontrolled air pollution has adversely affected the health of people and their quality of life. For example with about 4.5 million vehicles, Delhi has acquired the dubious distinction of being the fourth most polluted city in the world. The data on air pollution (Table - 6) shows that although

**Table 6: Air Pollution Levels in Metropolitan Cities of India**

Metropolitan City	Year	Mumbai	Kolkata	Delhi	Chennai	Bangalore	NAAQS
SO ₂ Mgm / cum	1993	49.5	65.1	13.7	10.3		60
	1998	15.9	47.2	15.6	10.3	41.6	
	2003	7.7	18	12.2	6.6	10.8	
	2005	8	11	14	16	9	
NO ₂ Mgm / cum	1993	32.3	62	30.1	27.1		60
	1998	14.7	39.7	35.1	15.4	28.4	
	2003	18.7	75.5	43.3	7.5	44.9	
	2005	23	52	45	11	49	
SPM Mgm / cum	1993	475	507	362	73		140
	1998	211	283	242	131	239	
	2003	219	244	315	149	198	
	2005	223	238	268	166	155	
RSPM	2005	88	146	233 19.5	83 94	82	100

Source: <http://www.cpcb.nic.in>

SO₂ and NO₂ levels are below the National Ambient Air Quality Standard (NAAQS) in five metropolitan cities, the suspended particulate matter (both respirable and non-respirable) is disturbingly high. The above Table reveals that while SO₂ and SPM levels have been coming down, NO₂ levels have been increasing.

- Waste water generation, collection and also treatment in metropolitan cities: Discharge of untreated sewage in water comes both from surface and ground water is the most important water polluting source in India. Out of about 38,000 million liter per day of sewage is generated treatment capacity exists only for about 12,000 million liter per day. Thus, there is large gap between generation

Table 7: Sewage Generation, Collection and Treatment in Metropolitan Cities of India

Metropolitan City	Volume of waste collected in MLD	Sewage Treatment capacity in MLD	Percentage of Treatment capacity	Mode of disposal
Mumbai	2671	2130	80	Sea
Kolkata	705.86	172	24	High river fish form
Delhi	3886	2330	61	Agriculture and Yamuna coastal
Chennai	727	558	76	Agricultural area, sea
Bangalore	1400	721	100 51.5	Vrishabavathi, Koramanagala chellaghatta valleys

Source: *Status of sewage treatment in India (CUPS/61/05-06) central pollution control board 2011*



and treatment of waste water in India. Even the existing treatment capacity is also not efficiently utilized due to operations and maintenance problems. Operations and maintenance of the existing plants and sewage pumping stations is not satisfactory as hardly 39 percent plants do not conform to the general standard prescribed under environmental (protection) rules for discharge into streams as per the CPCB's survey report. There are 35 metropolitan cities, 15,644 million liters per day of sewage is generated from these metropolitan cities.

Treatment capacity exists for 8,040 MLD i.e. 51 percent is treatment capacity among the metropolitan cities. Delhi has the maximum treatment capacity that 2,330 MLD, 30 percent of the total treatment capacity of metropolitan cities. Next to Delhi, Mumbai has the capacity of 2,130 MLD, which is 26 percent of total capacity of metropolitan cities.

- **Noise Pollution in the Metropolitan Cities:** Noise pollution refers to sound in the environment that is caused by humans and that threatens the health or welfare of human in habitats. The most common source of noise pollution by far is the one that affects the most people on the planet, is motor vehicles. Air craft and industrial machinery are also major sound polluters. Additional noise pollution is contributed by office machines, sirens, power tools and other equipment. Noise health effects both health and behavioral

Table 8: Noise Level in Different Category of Area

Category of Area	Limits in dB (A) Leg	
	Day time	Night time
Industrial	75	70
Commercial	65	55
Residential	55	45
Silence zone	50	40

Source: National Ambient noise monitoring net work: NANMN/02/2015-16

Table 9: Average Noise Level in the Metropolitan Cities 2014

Metropolitan cities	Day / Night	Industrial area	Commercial area	Residential area	Silence area
Mumbai	Day	79	75	72	65
	Night	72	66	62	50
Kolkata	Day	78	85	80	75
	Night	70	65	66	66
					62
Delhi	Day	-	76	60	60
	Night	-	72	48	57
Chennai	Day	80	78	76	77
	Night	75	70	60	62
Bangalore	Day	65	68	66	50
	Night	60	60	57	49

Source: National Ambient noise monitoring net work: NANMN/02/2015-16



in nature. Unwanted sound is called noise. Noise pollution can cause annoyance and aggression, hypertension high stress level, hearing loss, sleep disturbances, and other harm full effects. Furthermore stress and also hyper tension are the leading causes of health problems whereas tinnitus can lead to forget fullness, severe depression and of times panic affects.

A national committee of experts on noise pollution control recommended that noise standard for ambient air and automobile domestic appliances and constructional equipment which were later verified under the environmental (protection) Act 1986 are high (Table 8). Table 9 shows average noise level in various metropolitan cities of India both during the day and night in the Industrial, commercial, residential area and as well as silence area during 2014. The noise pollution was noticed above than prescribed standards in all the metropolitan cities. Kolkata experienced the highest noise pollution level in all the areas during night and also in day timing. Mumbai was in better situation than Kolkata. Bangalore has observed least numbers of violations with respect to prescribed noise.

3. CONCLUSIONS

It is evident from studies that every environmental and social parameter of the metropolitan cities is very much above limits. Employment problems, extreme poverty and natural disasters are significant factors that contribute to migration to metropolitan cities. Emphasis needs to be given to rural development so as to reduce and discourage rural migration. Some of the causes of damage to the environment due to urbanization lay in legislation and regulating agencies in metropolitan cities. Failure of governance in the metropolitan cities has resulted in the growth of informal settlements and slums that constitute unhealthy living and working environment. Serious attention should be given to the need for importing urban strategies, which promote efficiency in resource use among various factors affecting the quality of life and safety in city. Transport system is among the most important. It has a direct correlation with air quality and safety. Urban transport situation in metropolitan cities in India is deteriorating. Deterioration is faster in metropolitan cities where there is an excessive concentration of vehicles. Commuters in these cities are faced with acute road congestion, energy waste, rising air pollution and a high rate of accident risk. Solid waste management in metropolitan cities makes it unsuitable for processing operations like incineration, pyrolysis, dumping, sanitary land filling, etc., due to high percentage of non-combustible and moisture in wastes. The problem of solid waste needs some holistic approaches such as reuse of solid wastes to produce energy and bio - manures.



Problems associated with waste water reuse arise from lack of treatment. Hence, for planned, strategic, state and sustainable use of waste water, there seems to be the need for policy decisions and cohesion programs encompassing low cost decentralized waste water treatment technologies bio - filter, efficient microbial strains and organic amendments and modern sewage water application methods. Concentration of ambient air quality in metropolitan cities reveals excess NAAQS. To overcome this development and planning of cities public awareness play important role to reduce the ambient air pollution. There is an urgent need to adopt suitable strategy for air quality control in urban areas. It is found that there is equal per capita waste generation by Mumbai, Kolkata and Bangalore, which is about 430 gm / day. But treatment facilities are better in Bangalore and Delhi out of these three metropolitan cities.

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Assessing Criteria and Indicators of Sustainability: A Case of Urban and Peri - Urban Water Bodies and Wetlands in Indian Cities

Krishna Ghosh, Prof. Suchandra Bardhan, Ph.D., and Prof. Souvanic Roy, Ph.D.

Abstract

Urban and peri - urban water bodies and wetlands, though being significant elements of the city's infrastructure, lack of relevant policies for implementation are contributing to their rampant abuse and decline. The city of Kolkata and its environs are endowed with numerous water bodies and wetlands, many of which, other than performing "ecosystem services" are also additionally contributing to recreation and human well-being. This paper attempts to assess the sustainability of five such case study sites from urban and peri - urban Kolkata on the basis of some major criteria and indicators and recommends relevant policies for sustainability of fragile ecosystems in urban settings.

1. INTRODUCTION

In the context of Indian cities, urban and peri - urban water bodies and wetlands are life supporting ecosystems due to the wide range of functions they perform. Maintenance of hydrological balance as source of water through storage and regulation of water table, their role as 'flood cushions,' in the cities, water purification, nutrient retention, maintaining climatic stability both at micro and macro levels, their role as carbon 'sinks' and in carbon sequestration are the plethora of functions they perform. Irrespective of the innumerable functions served by these ecosystems and though there exists an array of policies, plans and programs, acts, bills and rules for the conservation of water bodies and wetlands, yet they are found to be in a state of abuse and are declining rapidly. Notably, urban and peri - urban water bodies and wetlands in park settings also serve as popular destinations for nature - based tourism, recreation and human well -being and visitations to such parks have increased considerably during recent years, which have raised questions about the tolerance of these ecosystems. Unplanned tourism activities are identified as a major threat to these water bodies and wetlands. Moreover, city authorities often build a "garden" around lakes, with lots of flowers and trees that don't usually grow around wetlands slowly killing the natural ecosystem. Unfortunately "beautifying" or "developing"

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lakes by building parks often convert them into a swamp and breeding ground for mosquitoes. Hence, there is a pressing need to ascertain whether the present management practices will ensure their sustainability in the future. This paper assesses the existing status of five such case study sites within and around Kolkata through some significant criteria and indicators and recommends management strategies and policies for the sustainability of these ecosystems, as today there is a strong advocacy for the “Eco - city”, where the emphasis is for the city to function in harmony with the natural environment.

2. RELEVANT CRITERIA AND INDICATORS FOR ASSESSING SUSTAINABILITY OF URBAN AND PERI - URBAN WATER BODIES AND WETLANDS

Criteria and indicators for promoting sustainable management of ecosystems are tools to define, guide, monitor and assess progress towards sustainable management in a given context. Criteria define the essential elements against which sustainability is assessed, while indicators are parameters which can be measured and correspond to a particular criterion. Some of the significant criteria and indicators relevant in the context of conservation and sustainability of these fragile ecosystems in park settings, as observed from literature survey (Table 1).

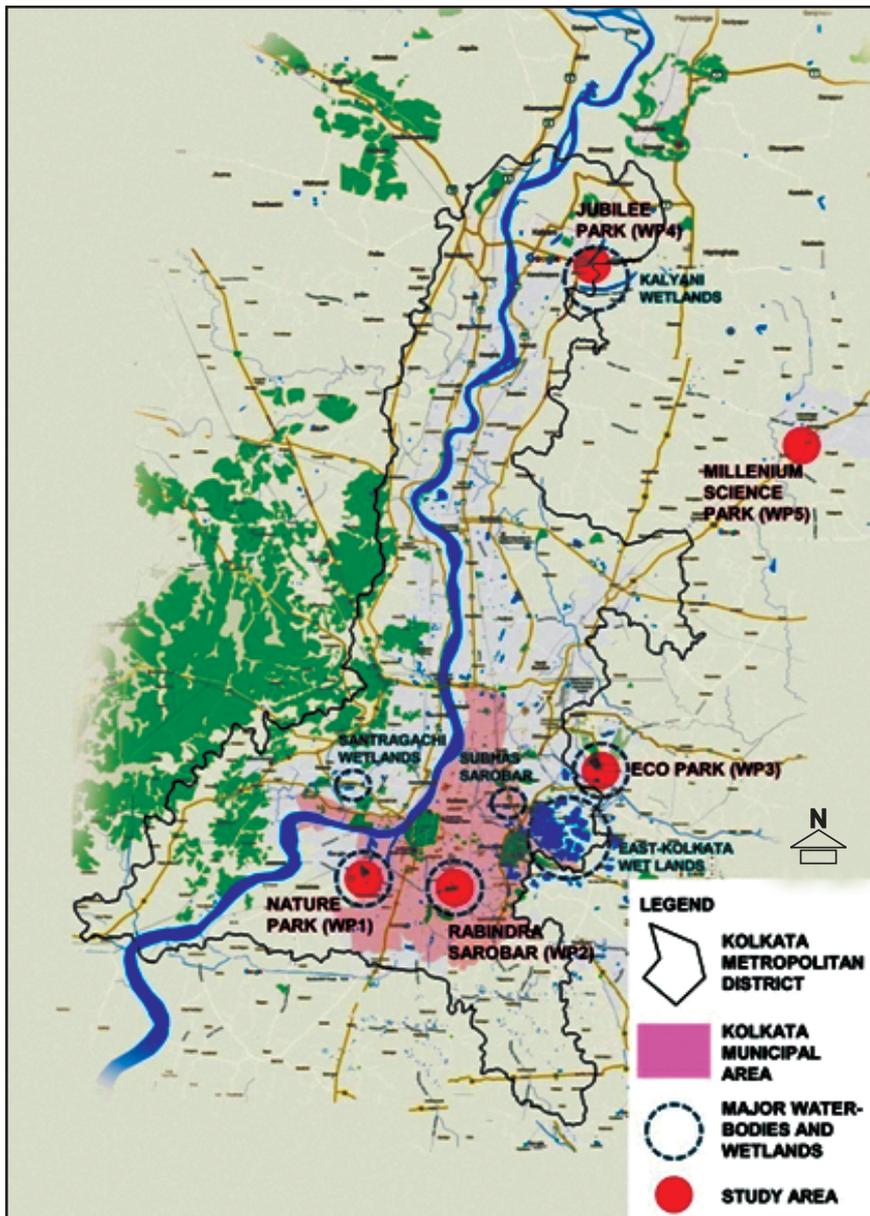
Table 1: Criteria and Indicators of Sustainability

Criteria	Indicators
Vegetation	1.1 Overall percentage of Native Species of Plants (trees, shrubs and herbs)
	1.2 Percentage of Native Trees
	1.3 Percentage of Native Shrubs
	1.4 Relative Frequency of Occurrences (%) of Native Herbs
	1.5 Percentage of Exotic/Invasive /Exotic & Invasive species having potential negative impacts on Ecosystem Services
	1.6 Simpson's Index of Diversity for Trees
	1.7 Simpson's Index of Diversity for Shrubs
Avian Diversity	2.1 Total Number of Bird Species Supported by the Ecosystem
	2.2 Number of Migrant Species Supported by the Ecosystem
	2.3 Number of Critically Endangered, Endangered, Vulnerable and Near Threatened Bird Species Supported by the Ecosystem
Water Quality	3.1 Pre-monsoon WQI
	3.2 Post-monsoon WQI
Carbon Sequestration Potential	4.1 Carbon Sequestration Potential of the Ecosystem (Water Area + Soil + Trees + Grass / Lawns)
Attitude Towards Conservation and Sustainable Development	5.1 Percentage of Visitors Willing to Pay Entry fee or Higher Entry Fee
	5.2 Difference between the Current Entry Fee and the Average Entry Fee Visitors are Willing to Pay

Source: *Compilation by Author*

Fig. 1 shows the major water bodies and wetlands within and around Kolkata including the study areas: five case study sites that are either water body or wetland based parks, selected for the research are Nature Park, Taratala, Kolkata (WP1); Rabindra Sarobar, Kolkata (WP2); Eco Park, New Town, Rajarhat (WP3); Jubilee Park, Gayeshpur, Kalyani (WP4) and Millennium Science Park, Ashoknagar, Habra (WP5). Although each of them with their environmental and ecological significance differ in terms of geographical size and area, wetland type, biodiversity, ecology, general resources and amenities and governance, notably, all of them serve as popular nature based destinations also.

Fig. 1: Major Water-bodies and Wetlands in Urban and Peri - urban Kolkata and Study Areas



Source: Google Map

of geographical size and area, wetland type, biodiversity, ecology, general resources and amenities and governance, notably, all of them serve as popular nature based destinations also.

2.1 Vegetation

Plants are excellent indicators of wetland condition as plant communities show changes in response to hydrologic alterations. Hence, the composition of the plant community reflects the biological integrity of the wetland. Besides, vegetation, an integral part of any park has significant impacts on the “ecosystem services” rendered by water bodies and wetlands (MEA, 2005), improving urban air quality while providing a habitat for selective bird communities. The exotic plants compete with the natives for light, space and nutrients thereby modifying the natural ecosystem and thus require active



and often expensive management (Pickering and Hill, 2007). Hence, the percentage of native species of trees, shrubs and herb and the number of native species of trees and shrubs have been directly observed from field survey. Exotic, invasive or both exotic and invasive species of plants having detrimental effects on ecosystem services and human health have also been identified. Moreover, species biodiversity may be used to indicate the 'biological health' of a particular habitat which is commonly measured by the Simpson's Index of Diversity (Yadav and Mishra, 2013).

Random sampling of vegetation was done using the quadrat method to capture the maximum species diversity. In the case of trees, the surveyed area in each case study site has been considered as a single quadrat while quadrats of size 5m x 5m for shrubs and quadrats of 1m x 1m for herbs were randomly chosen.

To measure the species diversity of trees and shrubs, Simpson's Diversity Index (D) has been calculated where,

$D = \sum n(n-1) / N(N-1)$, where, n = the total number of organisms of a particular species,

N = the total number of organisms of all species.

Simpson's Index of Diversity is given by (1-D). The index represents the probability that two individuals randomly selected from a sample will belong to different species (Maiti and Maiti, 2011).

Frequency = (Number of quadrats in which species occur / Total number of quadrats studied) x 100.

Relative Frequency = (Individual frequency of the species / Total of frequency of all species encountered) x 100 (Kohli, Batish and Singh, 2007).

The existing status of indicators pertaining to vegetation is evident from Table 2, while planting of further species of native trees, shrubs and herbs is strongly recommended at all the case study sites; also planting of native trees, shrubs and herbs in greater numbers is called for. The percentage of exotic, invasive and both exotic and invasive species, all taken together is negligible and is less than 20 percent at all the case study sites. Though negligible, in order to prevent their adverse impacts on ecosystem services, such as fish production, water regulation, climate regulation, soil formation, nutrient recycling, aesthetics etc., they either need to be replaced by native species or completely removed to prevent the subsequent alteration of ecosystem services derived from these ecosystems. Notably, the Simpson's Index of Diversity for both trees and shrubs



Table 2: Existing Status of Vegetation Indicators

Indicators	WP1	WP2	WP3	WP4	WP5
1. Overall percentage of Native Species (Trees, Shrubs and Herbs)	57.77%	47.05%	44.65%	60%	54.76%
2. Percentage (%) of Native Trees	45.78%	77.51%	38.28%	56.42%	17.69%
3. Percentage (%) of Native Shrubs	21.92%	32.83%	51.20%	84.97%	69.19%
4. Relative Frequency of Occurrences of Native Herbs (%)	44.22%	26.98%	35.96%	54.35%	56.34%
5. % of Exotic/Invasive/Exotic and Invasive species having potential negative impacts on Ecosystem services.	17.78%	11.76%	11.95%	17.14%	13.09%
6. Simpson's Index of Diversity of Trees	0.905340	0.934783	0.946226	0.887281	0.802397
7. Simpson's Index of Diversity of Shrubs	0.904983	0.866736	0.966766	0.657307	0.872084

Source: Compilation by Author from Primary Survey

is found to be the highest at WP3. It is fairly high in most of the other case study sites also, indicating a greater number of successful species and a stable ecosystem existing at all the case study sites.

2.2 Avian Diversity

Bird species diversity, especially migratory species is a useful indicator of a sustainable wetland ecosystem. Also Yadav and Mishra (2013) argue that an area with many endemic or rare species is generally considered to have higher conservation value than another area where species richness is similar, but all the species are common and widespread.

From Table 3 and Table 4, it is evident that the ecosystem at WP1 (Fig. 2) supports the highest number of bird species, migrant species as well as Critically Endangered / Endangered / Vulnerable / Near Threatened bird species which

Fig. 2: Bird Sightings at Nature Park (WP1)





indicates a very healthy ecosystem in comparison to the other 4 case study sites. On the contrary, the ecosystem at WP5 is not a very healthy one and hence does not support the influx of birds within or around it. The percentage of native trees is also very low (17.69 percent) at WP5, which may have adversely impacted avian diversity because exotic tree stands do not encourage bird communities as native phytophagous arthropods like caterpillars which are food sources for birds are unable to survive in exotic plantations (De La Hera et al., 2013). Again, declining bird diversity at the Okhla Bird Sanctuary located amidst urban settlements is attributed to high pollution load in the wetland (Manral and Khudsar, 2013). The Pre-monsoon and Post-monsoon WQI of WP5 (Table 7) clearly show that the water is severely polluted in both the seasons which may have adversely impacted the avian diversity.

Moreover, Xie *et al* (2016) argues that while larger parks often exhibit richer landscape types, lower edge effects, and, therefore, more bird species, human presence has a negative impact on avian species abundance and diversity. The total area of WP1, WP2, WP3, WP4 and WP5 are 82.50 ha, 77.80 ha, 194.25 ha, 12.14 ha and 3.48 ha respectively. Though WP5 is very small in size compared to the other 4 parks, yet the number of visitations /ha/day is the highest on certain days during

Table 3: Avian Diversity

Attributes	WP1	WP2	WP3	WP4	WP5
1. Species	141	80	91	77	33
2. Genera	104	63	75	67	29
3. Families	53	32	42	38	19
4. Resident species	98 (70%)	48 (60%)	67 (74%)	59 (77%)	31 (94%)
5. Migrant species	43 (30%)	32 (40%)	24 (26%)	18 (23%)	2 (6%)

Source: Compilation by Author from Secondary Sources

Table 4: Conservation Status of Birds

Conservation status (IUCN Red List Category)	WP1	WP2	WP3	WP4	WP5
Extinct	0	0	0	0	0
Extinct in the Wild	0	0	0	0	0
Critically Endangered	1	0	1	0	0
Endangered	0	0	0	0	0
Vulnerable	0	0	1	0	0
Near Threatened	2	2	0	1	0
Least Concern	137	78	88	74	33
Data deficient	0	0	0	0	0
Not Evaluated	1	0	1	2	0

Source: Compilation by Author from Secondary Sources



peak season in comparison to the other parks (229 at WP1, 208 at WP2, 440 at WP3, 443 at WP4 and 3736 at WP5) which deters avian communities from inhabiting the ecosystem. WP5 being located within a purely residential zone, increasing the size of the park may not be feasible. However, changing or introducing landscape characteristics suitable for attracting avifauna are recommended. Extremely high visitations at WP5 during the peak season are attributed to the non-existence of limits to visitors' entry at the park. Adhering to the carrying capacity estimated for WP5 may help in increasing the avifauna at the park.

3. WATER QUALITY

Visitations to urban and peri - urban water bodies and wetlands based parks are found to be intense during the winter months, which are also accompanied by various recreational activities. This often affects biodiversity by the deterioration of water quality. Hence, Post-tourism or Pre-monsoon and Pre -tourism or Post monsoon water quality analysis was done and the Water Quality Index (WQI) calculated. WQI is a single number that expresses the overall water quality at a certain location on the basis of some physicochemical parameters and is calculated from the point of view of the suitability of surface water for human consumption as shown in Table 5. The drinking water standards adopted for calculating the index are shown in Table 6.

3.1 Calculation of Water Quality Index

$Q_n = 100 \times [V_n - I_n] / [S_n - I_n]$, Where, Q_n = Quality rating for the nth water quality parameter.

V_n = Estimated value of the nth parameter at a given sampling station.

S_n = Standard permissible value of the nth parameter.

I_n = Ideal value of nth parameter in a pure water (0 for all parameters except pH and DO which is 7 and 14.6 mg/ l)

Unit weight was calculated by a value inversely proportional to the recommended standard values S_n of the corresponding parameters.

$W_n = K/S_n$, where K is a constant of proportionality and is given by

$$K = \frac{1}{\frac{1}{S_1} + \frac{1}{S_2} + \frac{1}{S_3} + \dots + \frac{1}{S_n}}$$

Table 5: Water Quality Index and Status of Water Quality

Water Quality Index Level	Water Quality Status
0 -25	Excellent
26 - 50	Good
51 - 75	Moderately polluted or Poor
76 -100	Severely polluted or Very Poor
>100	Unfit for human consumption

Source: Kalavathy et al., 2011, Jena et al., 2013

Where, W_n = Unit weight for the nth parameter.

S_n = Standard permissible value for the nth parameter.

$$WQI = \frac{\sum Q_n W_n}{\sum W_n}$$

Fig. 3: Point - Source of Pollution at Jubilee Park (WP4)



Fig. 4: Point - Sources of Pollution at Millenium Science Park (WP5)



It is evident from Table 7 that the water at WP1 and WP4 is “unfit for human consumption” in both the seasons. That it is unfit for drinking purpose at WP1 is natural, as the wetlands there comprises of 70 percent industrial and 30 percent residential

waste water brought from the adjoining areas for treatment and sewage fed aquaculture. At WP5, the pre-monsoon WQI indicates “severe pollution” while the post-monsoon WQI interprets the water quality as “unfit for human consumption”. On the contrary the water quality is found to be “good” at WP2 in both the seasons. At WP3, water is “moderately polluted” during the pre-monsoon season while it is “excellent” during the post-monsoon season. Water samples at WP2 were collected from that particular lake, which is still accessible to the public for bathing and swimming and the embankments of which are not concretized.

Table 6: Drinking Water Standards and Recommending Agencies

Parameters	Standards	Recommending Agencies
pH value	6.5-8.5	CPCB/BIS
Conductivity $\mu\text{S}/\text{cm}$	300	ICMR
Turbidity NTU	5	BIS
Total dissolved solids, mg /L	2000	BIS
Total suspended solids , mg/L	500	WHO
Chemical Oxygen Demand, mg/L	10	WHO
Biochemical Oxygen Demand, mg/L	6	WHO
Chloride (as CL), mg/L	1000	BIS
Sulphate (as SO ₄), mg/L	400	BIS
Phosphate (as PO ₄), mg/L	0.1	WHO
Nitrate (as NO ₃), mg/L	45	BIS
Nitrite (as NO ₂), mg/L	0.05	EU
Total Alkalinity	600	BIS
Total Hardness (as CaCO ₃), mg/L	600	BIS
Total coliform count, MPN /100ML	50	CPCB

Source: Compilation by author



Table 7: Water Quality Index (WQI)

Indicators	WP1	WP2	WP3	WP4	WP5
Pre - monsoon WQI	132.781	32.451	68.340	101.602	83.253
Post - monsoon WQI	261.561	35.091	11.289	182.279	124.133

Source: *Compilation by Author*

3.2 Carbon Sequestration Potential

In the context of carbon sequestration to combat climate change, inland wetlands are the largest store of terrestrial carbon as they contain 33 percent of the soil carbon pool, yet occupy a mere 6-8 percent of the land surface (Carnell et al., 2016). A wetland park primarily comprises of the water body or wetland, terrestrial soil, trees, shrubs and herbs and grasses or lawns. Under this criterion, the “Carbon Sequestration Potential of the Ecosystem” is a major indicator.

Estimated Total Carbon Sequestration Potential of an ecosystem =

$$\frac{\text{Carbon Sequestration per year (Water body + Terrestrial soil + Trees + Grass/Lawn)}}{\text{Total Area of the park}}$$

For the purpose of the research, the typology for water body or wetland followed is: wetlands at WP1 are considered as “aquaculture ponds” while the water bodies at the other four case study sites have been considered as “small lakes”. The carbon burial rate for aquaculture pond is 1.5 (Table 8) $\text{Tha}^{-1}\text{yr}^{-1}$ while that for small lakes is 0.72 $\text{Tha}^{-1}\text{yr}^{-1}$. The estimated

The case study sites are located in urban areas. Researches by Washbourne et al., (2014) prove that urban soil can sequester up to 85T CO_2 / ha annually or

Table 8: Global Areas of Inland Water Bodies and Annual Rates and Amounts of Organic Carbon Burial in these Systems

Water body	Global area (Km ²)	Carbon Burial Rate (Tha ⁻¹ yr ⁻¹)	Global Carbon Burial (MTyr ⁻¹)
Large lakes and inland seas	2,180,000	0.05	11
Small lakes	320,000	0.72	23
Large reservoirs	400,000	4.0	160
Aquaculture ponds	110,800	1.5	16.6
(Fresh water)	(87,500)	(1.5)	(13.1)
(Brackish water)	(23,330)	(1.5)	(3.5)
Agricultural impoundments	77,000	21.2	163

Source: *Boyd et al., 2010.*

**Table 9: Estimated Carbon Sequestration Potential of the Water Area and Terrestrial Soil**

Case Study Sites	Area of the water body (ha)	Carbon Burial Rate (T/ha/yr)	Estimated CSP of Water Area (TC/yr)	Total Terrestrial Area (ha)	Estimated CSP of Terrestrial Area(TC/yr)
WP1	58.50	1.5	87.75	23.99	556.08
WP2	29.54	0.72	21.26	48.15	1116.12
WP3	42.08	0.72	30.29	152.16	3527.06
WP4	3.10	0.72	2.23	9.03	209.31
WP5	0.66	0.72	0.47	2.81	65.13

Source: Compilation by Author

Table 10: Estimated Carbon Sequestration Potential of Trees

Case Study Sites	Total Terrestrial Area (ha)	Tree Density (No. of trees/ha)	Estimated No. of Trees in Total Terrestrial Area	Estimated CSP of Trees (TC/yr)	Estimated Terrestrial Area Occupied by Grass/Lawn (ha)	Estimated CSP of Grass/Lawns(TC/yr)
WP1	23.99	172	4126	35.75	19.20	21.70
WP2	48.15	53	2552	22.11	33.70	38.80
WP3	152.16	64	9738	84.37	121.73	137.55
WP4	9.03	111	1002	8.68	8.13	9.18
WP5	2.81	201	565	4.90	1.68	1.90

Source: Compilation by Author

23.18 TC / ha / yr. The carbon sequestration potential of the terrestrial soil at the case study sites have been derived assuming this as a standard.

Trees are important sinks for atmospheric carbon i.e. carbon dioxide, since 50 percent of their standing biomass is carbon itself (Ravindranath et al., 1997). The tree densities are 172 per ha; 53 per ha; 64 per ha; 111 per ha; and 201 per ha; at WP1, WP2, WP3, WP4 and WP5 respectively. Notably, the carbon sequestration rate per tree has been estimated about 7.86 Kg C/yr for the average of India (Gujarat Forest Department, 2012) which has been used for estimating the total CSPs of trees at the case study sites. It has been claimed that one acre of well managed grass or lawn stores about 920 lbs of carbon per year (Strout, 2015) or we can say one hectare of grass or lawn stores 1.13 tons of carbon per year. The estimated Carbon Sequestration Potential of trees, grass / lawns are shown in Table 10.

From Table 11, it is evident that WP5 has the highest carbon sequestration potential closely followed by WP3 and WP4, which may be attributed to a large extent to its high tree density of 201 trees per ha. Given the existing area under water and terrestrial area in all the case study sites, to increase the carbon sequestration potential of the ecosystems, further planting of trees are strongly

**Table 11: Estimated Carbon Sequestration Potential of the Ecosystems**

Case Study Sites	Total Area of Park (ha)	Estimated CSP (TC/ha/yr)
WP1	82.50	8.50
WP2	77.80	15.40
WP3	194.25	19.45
WP4	12.14	18.90
WP5	3.48	20.80

Source: Compilation by Author

recommended at all the case study sites, particularly more so at WP1 which has a low carbon sequestration potential.

The dominant tree species at WP1, WP2, WP3, WP4 and WP5 are *Cocos nucifera* (23.11 percent), *Senegalia catechu* (15.80 percent), *Casuarina equisetifolia* (13.81 percent), *Acacia auriculiformis* (23.89 percent) and *Roystonea regia* (39.46 percent) respectively. The average carbon stock of *Cocos nucifera*, *Casuarina equisetifolia*, *Acacia auriculiformis* and *Roystonea regia* were found to be 28.68 T, 34.59 T, 21.94 T and 1.24 T (Rathore, 2014) while that for *Senegalia catechu* was 0.87 T per species (Sharma and Sharma, 2016). So *Roystonea regia* and *Senegalia catechu* are found to have very low carbon stocks. However, according to observations by Rathore (2014) at the Gujrat University Campus, some native trees with relatively high carbon stocks indicating high carbon sequestration potential are: *Terminalia chebula* (76.928 T), *Limonia acidissima* (61.31 T), *Ficus benghalensis* (54.03 T), *Tamarindus indica* (52.84 T), *Ailanthus excelsa* (43.89 T), *Syzigium cumini* (43.64 T), *Embllica officinalis* (43.57 T), *Azadirachta indica* (43.11 T), *Ficus religiosa* (42.79 T), *Cassia siamea* (41.66 T), *Albizia lebbbeck* (40.58 T), *Terminalia arjuna* (38.21 T), *Magnifera indica* (35.75 T) etc. Since further planting or replacement should take into consideration the carbon sequestration rate of trees, with those having higher carbon sequestration capacities given preference, the above-mentioned trees are recommended to be planted in greater numbers. However, some of them are already present at the case study sites, though in lesser numbers.

With respect to BMPs for enhancing soil C stocks, it is opined that reduced soil disturbance, frequent fertilization, watering and scarification enhanced plant growth which along with organic manure contributes to Soil Organic Carbon accumulation while Soil Inorganic Carbon stocks may be enhanced by mineral carbonation through the addition of Ca and or Mg -bearing demolition material (Lorenz and Lal, 2015).

3.3 Attitude towards Conservation and Sustainable Development

It is a very important criterion for urban and peri - urban water bodies and wetlands, which also serve as nature-based destinations and has been measured by many researchers by the Contingent Valuation Method (CVM), which is used

to estimate the non-use values of environmental resources usually reflected by the Willingness to Pay (WTP) of local residents or visitors for conservation of natural resources. The attitude of visitors is measured through their WTP, often in the form of an entry fee. Yacob et al. (2012) used the WTP of users in marine parks of Malaysia for conservation of marine eco - tourism resources and the findings indicate that visitors were willing to pay over three times the current conservation fee. Szell and Hallett (2013) elicited the WTP for environmental protection of both visitors and local residents at Retezat National Park, Romania. Results indicated that tourists are willing to pay higher entrance fees to support conservation efforts when compared to local residents.

The first indicator under this criterion - “Willingness to pay an entry fee or higher entry fee” depending on whether there is no entry fee or whether there is an already existing entry fee at the case study sites has been derived from the questionnaire survey. The number of visitors surveyed is 150 at WP1, 162 at WP2, 166 at WP3, 154 at WP4 and 143 at WP5. Percentage of visitors both willing and unwilling at the case study sites are represented by Fig. 5a, 6a, 7a, 8a and 9a while the amounts of entry fee visitors are willing to pay are represented by Fig. 5b, 6b, 7b, 8b and 9b respectively. The Current Entry Fee at WP1, WP2, WP3, WP4 and WP5 are Rs. 20/-, Rs. 0/-, Rs. 20/-, Rs. 50/- and Rs. 15/- while from the questionnaire survey (for calculating the second indicator- “Difference

Fig. 5: (a) WTP at WP1 (Percentage of Visitors) (b) WTP Entry Fee at WP1

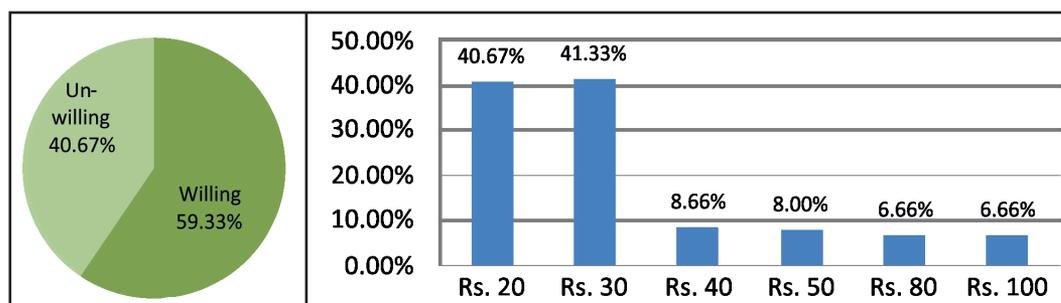


Fig. 6: (a) WTP at WP2 (Percentage of Visitors) (b) WTP Entry Fee at WP2

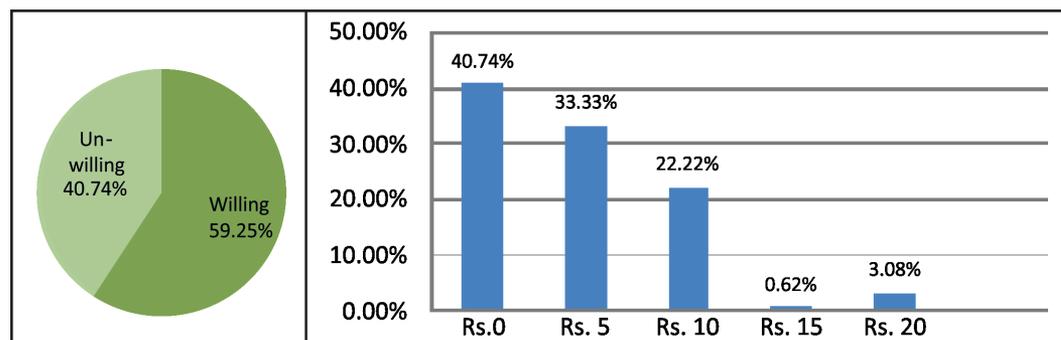




Fig. 7: (a) WTP at WP3 (Percentage of Visitors) (b) WTP Entry Fee at WP3

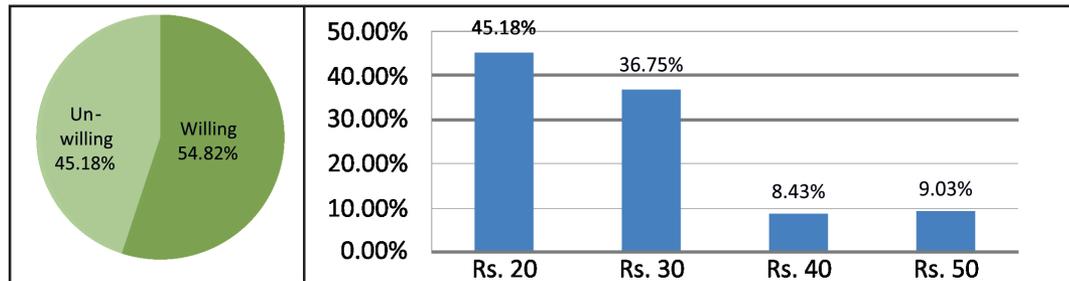


Fig. 8: (a) WTP at WP4 (Percentage of Visitors) (b) WTP Entry Fee at WP4

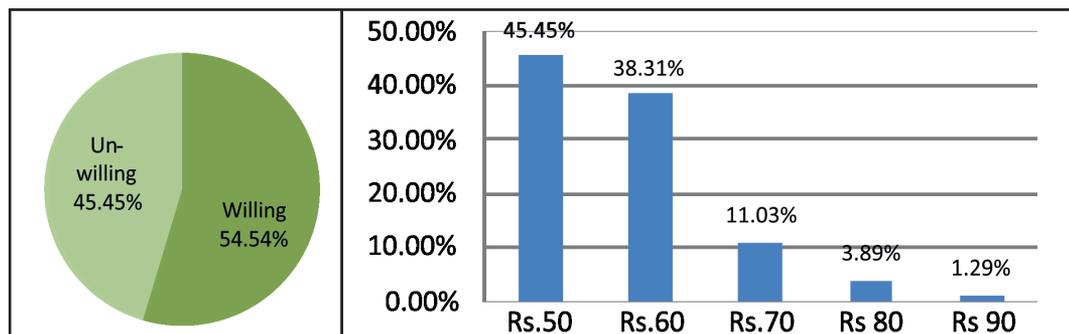
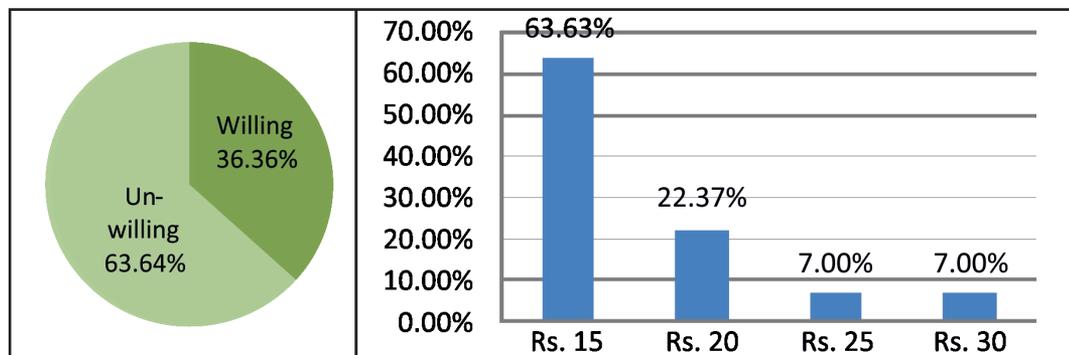


Fig. 9: (a) WTP at WP5 (Percentage of Visitors) (b) WTP Entry Fee at WP5



between the Current Entry Fee and the Average Entry Fee Visitors are Willing to Pay”), the Average Entry Fee that the visitors are willing to pay are calculated to be Rs. 29/-, Rs. 5/-, Rs. 28/-, Rs. 58/- and Rs. 18/- respectively, which is above the current entry fee at all the case study sites. Hence, the Park authorities can introduce an entry fee where absent or increase the entry fee to a realistic level where there is an existing entry fee.

Likert style scale (5 point scale where 1= Least important/Low to 5= Most important /high) was used for assessing reasons for WTP decisions. 4 statements for “Yes” decision and 4 statements for “No” decisions were tested based on a study by Szell and Hallet (2013) as shown in Table 12.



Table 12: Reasons for WTP Entry Fee / Higher Entry Fee Decisions

	Reasons	WP1		WP2		WP3		WP4		WP5	
		M	SD	M	SD	M	SD	M	SD	M	SD
Yes	To support conservation	3.921	1.201	3.438	1.337	3.495	0.999	3.880	1.196	2.90	1.39
	To enhance recreational activities	3.370	1.212	3.344	1.265	3.462	0.929	3.446	1.154	3.48	1.31
	To endow future generations with natural resources	3.820	1.097	3.813	1.253	3.615	1.056	3.145	1.506	3.67	1.12
	To show my satisfaction of my visit/visits	3.494	1.071	3.656	1.240	3.527	1.020	3.723	1.215	3.35	1.33
No	I cannot afford to pay	2.278	1.620	3.062	1.538	2.293	1.412	2.634	1.680	2.23	1.33
	I don't feel I should contribute to nature conservation	2.000	1.437	3.169	1.515	2.227	1.401	2.859	1.577	3.37	1.41
	Others (such as the state, non-government organizations should pay)	3.000	1.493	4.308	1.163	3.533	1.360	3.901	1.090	4.49	0.88
	The overall visit was not satisfactory	2.180	1.431	2.185	1.518	2.027	1.254	2.408	1.328	2.08	0.95

Source: Compilation by Author from Primary Survey

Regarding WTP decisions, from the mean values it is evident that the primary reason for “Yes” WTP decision at WP1 and WP4 was “To Support Conservation” while that at WP2, WP3 and WP5 was “To Endow Future Generations with Natural Resources.” Hence a positive attitude of the visitors, towards conservation and sustainable development is indicated at all the case study sites. Significantly, the primary reason for “No” WTP decision at all the case study sites was that the respondents felt that “Others such as State or Non-government Organizations should Pay” for the conservation and sustainable management of these water bodies and wetlands.

4. POLICY PRESCRIPTIONS

The policy implications, particularly for addressing the objective of conservation of these fragile ecosystems in urban and peri - urban areas through the criteria and indicators studied above are as shown in Table 13.

**Table 13: Recommended Policies**

Criteria	Policies
Vegetation	V1. An inventory of the existing vegetation around urban and peri - urban water bodies and wetlands should be prepared. Necessary modifications if required with respect to the proportion of native, exotic, invasive species and maintaining the desired species diversity should be done in consultation with botanists, horticulturists and landscape architects.
Avian Diversity	AD1. An inventory of the existing avifauna within and around urban and peri - urban water bodies and wetlands should be prepared. Changes in the number of resident as well as migratory bird species should be noted and appropriate measures (such as maintenance of “visitor carrying capacity”) undertaken for maintaining avian diversity.
Water Quality	WQ1. Water quality assessment should be done by the concerned authorities at regular intervals on a priority basis. WQ2. Water quality monitoring should be done through watershed management and relevant preventive measures. Removal of nutrients from the water bodies and overabundant growth of aquatic plants and algae should be prevented. Polluting activities near the water bodies (especially during the picnic season i.e. winter) or in areas that drain into the water bodies should be strictly limited. Point sources of pollution should be identified and either removed or treated accordingly. A vegetative buffer strip all around the water body should be maintained while ditches and grading should be used to divert polluted surface water away from the water body. WQ3. Water-bodies die if put to use as a drainage basin since they lose the life sustaining factor within them. Hence all sewage should be treated either through aerobic or anaerobic processes before discharging.
Carbon Sequestration Potential	CSP1. Enhancing carbon removal from the atmosphere should be initiated through the selection of appropriate vegetation, restoration of the water-body or wetland (for increased SOC stock) as required and through terrestrial soil management techniques (augmentation of SIC and SOC).
Attitude Towards Conservation and Sustainable Development	AC1. Visitors in general have a positive attitude towards the conservation of water bodies and wetlands. Hence, it should be mandatory that an appropriate entry fee be levied at all water body or wetland based parks in urban and peri - urban areas.

Indian cities face major challenges in preserving and managing their water-bodies and wetlands due to rapid urbanization. However, those within park settings are spared from the menace of encroachment. Hence, all the existing water-bodies and wetlands within and around Indian cities should be identified and clearly demarcated. The potential for their conversion to Wetland Parks should be assessed, based on their size, configuration, ecological and biodiversity significance, recreation and eco - tourism potential.

Moreover, unlike Protected Areas, which have recommended guidelines for management and planning by IUCN and emphasizes on the importance of a



Management Plan, notably, a Management Plan is often not available for the conservation and management of urban and peri - urban water bodies and wetlands in India. A pragmatic Management Plan for water bodies and wetlands based parks to be prepared by the authorities should be made mandatory and it should be prepared in collaboration with all relevant stakeholders comprising of urban planners, park authorities, wetland experts, landscape architects, botanists, zoologists, ornithologists, NGOs and representatives from the local community; etc.

Most importantly, Ecological Planning should be considered as an essential tool for Metropolitan Planning. An ecosystem based approach, through high level of coordination amongst different stakeholders needs to be adopted so that the ecological interrelationship of these ecosystems in urban areas, surrounding areas and their values and functions are understood and sustained.

5. CONCLUSIONS

All urban and peri - urban water bodies and wetlands should be considered as extremely important water management infrastructure for cities. The sustainability of these fragile ecosystems should be assessed on the basis of social, ecological and economic criteria and indicators followed by relevant wetland management strategies which should not be implemented in isolation but should be embedded in the planning policies of cities. Such an integrated approach will not only fulfill the objective of conserving these vulnerable ecosystems but will also help in the development of Eco - cities.

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Impact of Chemical Industries on Agricultural Sector: Nandesari Area of Vadodara

Patel Ravi Rajendrakumar

Abstract

In Nandesari, industries are polluting ground water and air quality of surrounding area which is adversely affecting the agriculture crop pattern and production. According to one estimate the decline is to the tune of 30 - 80% for different crops. Therefore, it is necessary to control and minimize the effects of pollution of chemical industries on environment so that it can create a healthier environment as well as healthier life for people around chemical industries. This study focuses on the current status and assess the impact on the agricultural crops and their yields in the surrounding areas. The outcome of the studies corroborated with the initial assumption that indeed the degradation in agricultural production was due to industrialization. While industrialization is an essential element of the country's economy and development, certain measures like close monitoring of regulatory controls need strengthening, additional planning measures.

1. INTRODUCTION

Chemical industries are an emerging phenomenon of economy in India. It encompasses services, goods and contributes to the economic production of the country. India is currently, the world's third largest consumer of polymers and fourth largest producer of agro - chemicals. Upcoming Petroleum, Chemicals and Petrochemicals Investment Regions (PCPIR) and Plastic Parks will provide state-of-the-art infrastructure for chemical and petrochemicals sector. The chemical industry involves the use of chemical processes such as chemical reactions and refining methods to produce a wide variety of solid, liquid, and gaseous materials. Most of these products serve to manufacture other items, although a smaller number go directly to consumers. Solvents, pesticides, lye, washing soda, and portland cement provide a few examples of product used by consumers. The industry includes manufacturers of inorganic and organic industrial chemicals, ceramic products, petrochemicals, agrochemicals, polymers and rubber, explosives, fragrances and flavors (Shah, 2010).

Second phase of chemical industry had a negative impact on the environment. The environment of the country is suffering a great deal due to this industrialization, pollution, deforestation, and the destruction of flora and fauna. The environment is increasingly placed at risk and hazards to human health. Effects of chemical industrial pollution are water pollution, soil pollution, air pollution, wildlife

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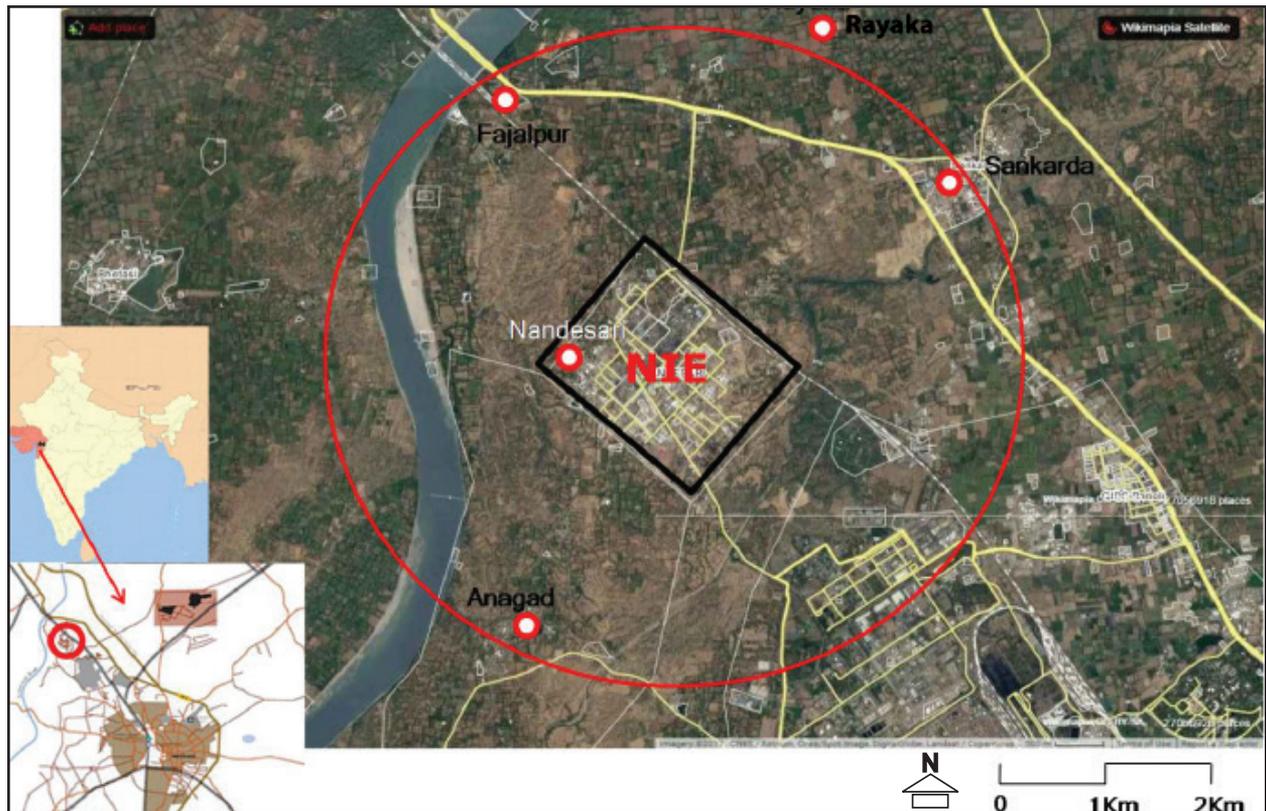
extinction, global warming; etc. The industrial effect on surrounding land use and land cover results in degeneration and also affects transportation, agricultural sector and green field areas.

2. STUDY AREA OF NANDESARI INDUSTRIAL ESTATE

Nandesari has large chemicals industries in Vadodara. It was established in 1969 and the land cover is 271.67 hectares, is located (Fig. 1) about 17 km in the northwest direction of Vadodara city. Nandesari GIDC Estate, with an area approximately 2.5 sq km, mainly comprises of chemical industries. (Fig. 2 and 3) It has common environmental infrastructure facilities like CETP, (Landfill as well as Common Hazardous Waste Incinerator). This area covers, approximately 250 industrial units that include industries producing chemical, pharmaceuticals, dyes, pesticides and plastics.

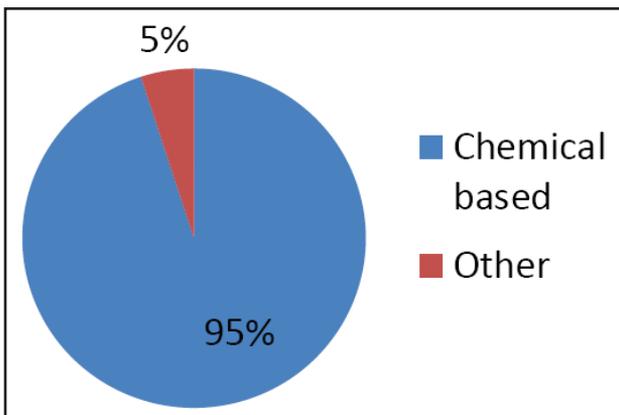
The main contributors to the total quantity of waste generated by the estate include dyes and dye intermediates manufacture (82 percent), and the production of drugs and pharmaceuticals (13 percent) (Chemical industry in Gujarat). All these industries are monitored by GPCB. CETP is established by GIDC in the year

Fig. 1: Location of Nandesari Industrial Estate



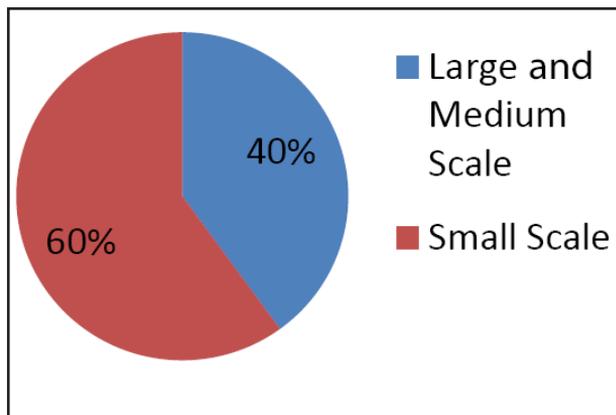
Source: Google Earth, Google map

Fig. 2: Type of Industries in NIE



Source: Head of Nandesari Industrial Association

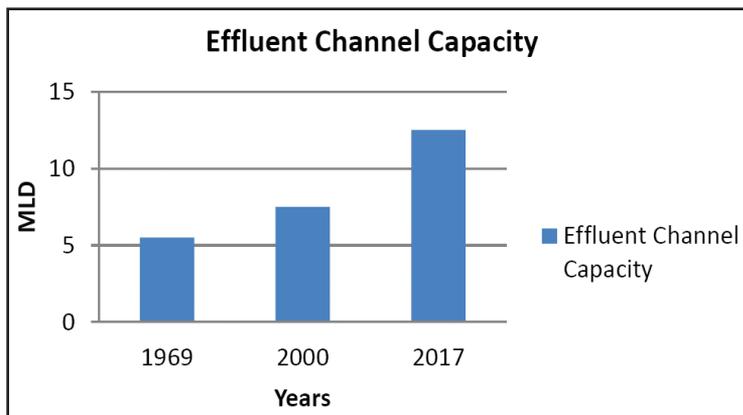
Fig. 3: Categories of Industries



1984 for the treatment of mostly small scale industries. Nandesari Industries Association (NIA) took over operation and maintenance of CETP in November 1994.

The design capacity is 5.5 MLD and average inflow is about 2.0 MLD. The effluent (Fig. 4) received through dedicated tankers from member of industries. Domestic wastewater (150 KLD) from colony is added to aeration tank. The CETP consists of primary, secondary and tertiary treatment. The treatment units are Collection Sumps, Screen Chamber, Grit Chamber, Equalization Tank, Flash Mixer, Flocculator, Primary Clarifier, Aeration Tank, Secondary Clarifier, Hypo Treatment Unit, and Pressure Sand Filter (CPCB-2010). The study area taken is located to the south east of Mahi river and at a distance of 17 kilometer from the Vadodara city as shown above. For primary survey four villages are taken that are Fajalpur, Sakarda, Anagad, and Rayka.

Fig. 4: Effluent Channel Capacity of NIE



Source: Head of Nandesari Industrial Association

3. PROBLEM STATEMENT

Currently the industrial area of Nandesari is polluting groundwater and air quality of surrounding area which is adversely affecting the agriculture crop pattern and production. According to one estimate the decline is to the tune of 30 - 80 percent for different crops (Suresh, 1999). Though the development of this industrial complex has helped the economic development of Gujarat, it



has created adverse impact on the ecology of the surrounding villages. There is noticeable adverse effect on the environment particularly regarding quality of drinking water. Also air quality has issues (Suresh, 1999). The National Highway No. 8 which passes through the industrial area with heavy vehicular traffic adds to the pollution. The vegetation is effected by water and air pollution (GPCB-2010). GPCB has been monitoring but somewhere down the line, there may have been some gaps. There is an urgent need to review the current status and assess the impact on the agricultural crops and their yields in the surrounding areas.

To understand the problem, meetings with environmental experts, visit of the institutions related to the chemical industries pollution were taken up. From the opinions of the experts and data collected from different agencies as well as local survey of people residing on surrounding area of the industries was helpful to analyze the data. These surveys divide in to two parts to know how to effect on agriculture sector due to industrial surrounding area. Inferences from the data analysis provide strong evidence for the problem statement. Solution share also been address in the last part of the paper.

4. ANALYSIS OF TEMPORAL TEST REPORTS

Agricultural crops can be injured when exposed to high concentrations of various air pollutants. Injury ranges from visible markings on the foliage, reduced growth and yield and premature death of the plant. Development and severity of the injury depends on pollutant concentration and number of other external factors. These factors include length of exposure to the pollutant, plant species and its stage of development as well as other environmental factors conducive to a build-up of the pollutant and to the preconditioning of the plant, which make it either susceptible or resistant to injury.

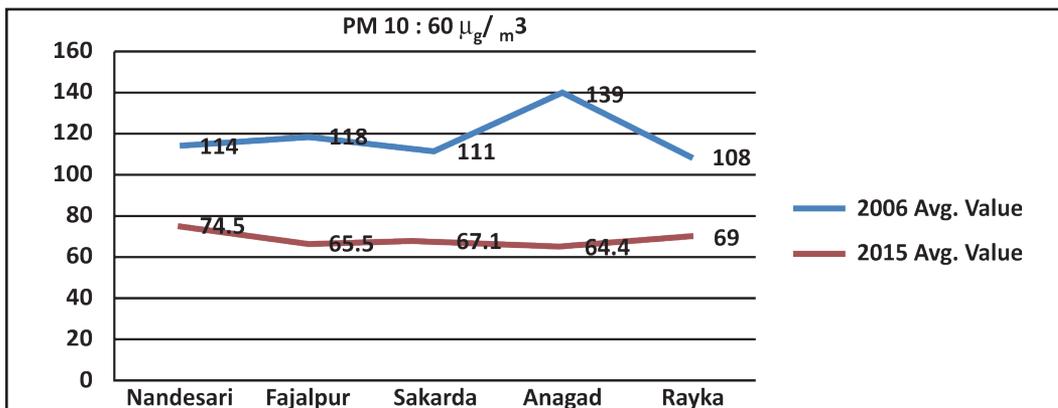
4.1 Air Quality Around Nandesari Area

Last Decades Air Quality is maintained. PM 10 is particular matter 10 micrometers or less including Organic dust, bacteria, Construction dust etc. And $PM_{2.5}$, which refers to particulate matter in air that is less than 2.5 μm in aerodynamic dia. Including organic compounds, metals, etc. $PM_{2.5}$ and PM 10 pollution is a main factor in decreasing air quality, the relationship between air pollution and land use types, such as vegetation, water, etc., the changes of landscape patterns like green space, which include the changes of composition and configuration of landscape, can influence $PM_{2.5}$ and PM 10. In this case air pollution is affect on crops also reduce its quality and life of crops.

Damage symptoms to crops caused by SO_2 ; usually result in dry, papery blotches that are generally white, tan, or straw-colored and marginal. On some species,

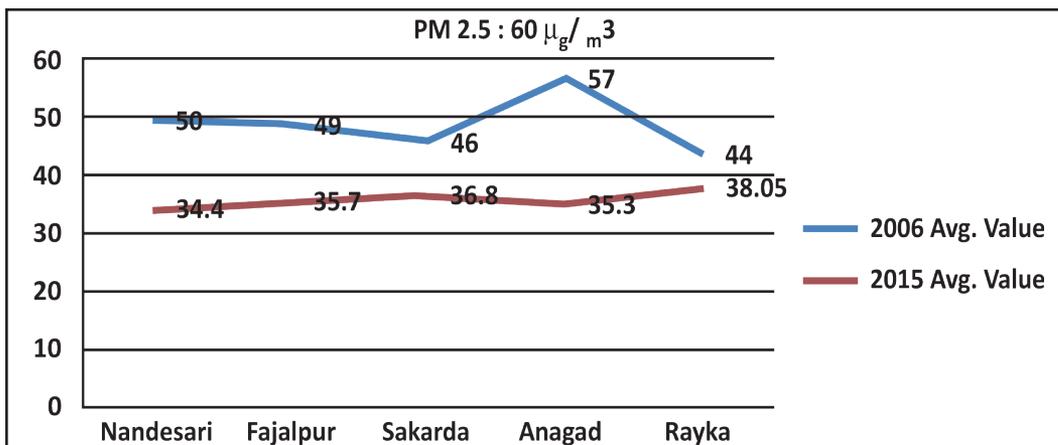


Fig. 5: Air Quality Around Nandesari at PM 10



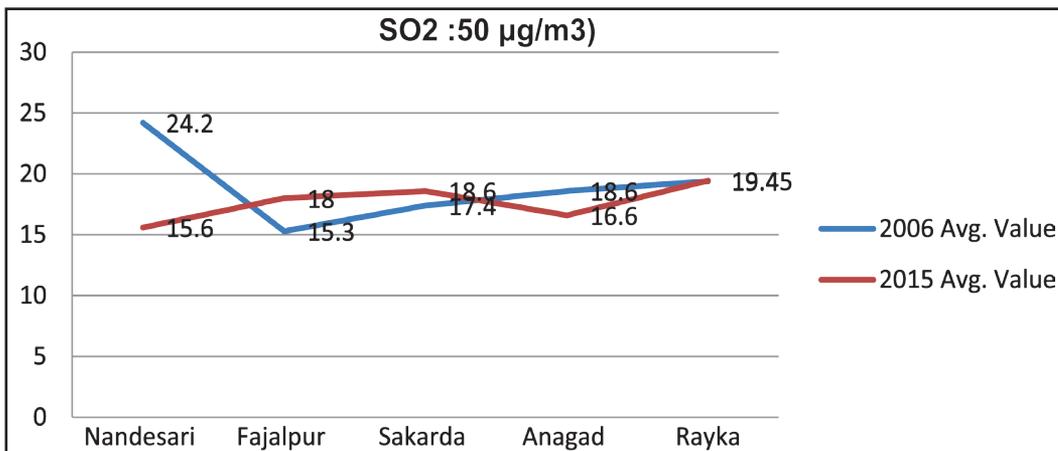
Source: Envirotech, S. (2016); CENTRE, J. O. (2007)

Fig. 6: Air Quality Around Nandesari Area at PM 2.5



Source: Envirotech, S. (2016); CENTRE, J. O. (2007)

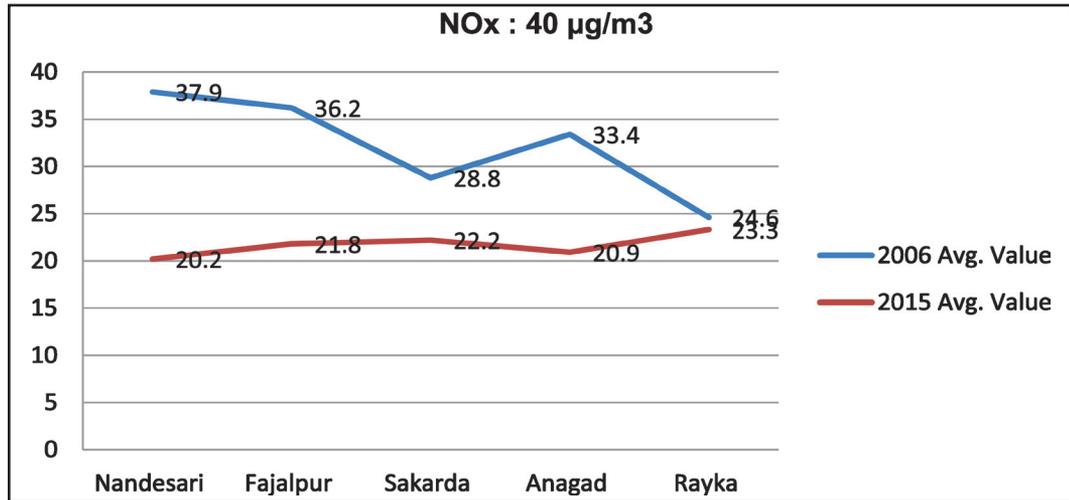
Fig. 7: SO2 of Air Quality Around Nandesari



Source: Envirotech, S. (2016); CENTRE, J. O. (2007)



Fig. 8: NOx of Air Quality Around Nandesari



Source: Envirotech, S. (2016); CENTRE, J. O. (2007)

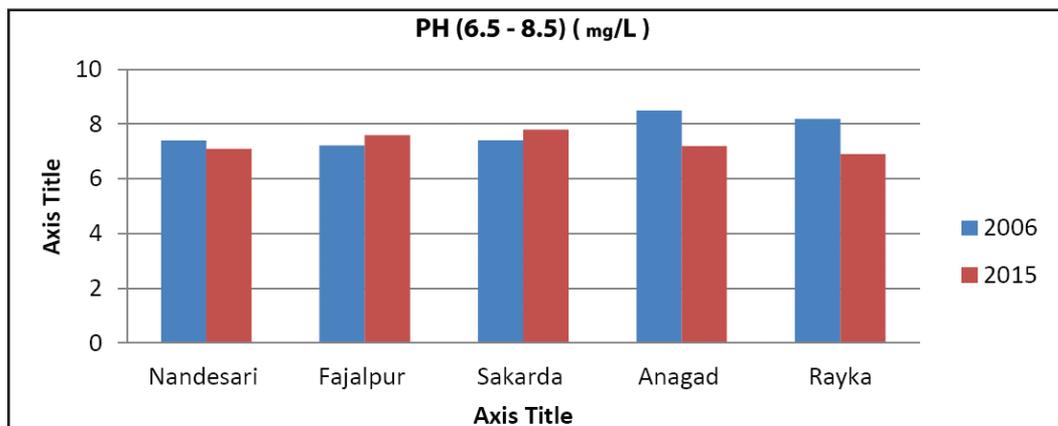
chronic injury causes brown to reddish brown or black blotches. Both the upper and lower leaf surfaces are affected. Nitrogen dioxide is part of a group of gaseous air pollutants produced as a result of road traffic and other fossil fuel combustion processes. Its presence in air contributes to the formation and modification of other air pollutants, such as ozone and particulate matter, and to acid rain.

These pollutants play a major role in the production of ozone. Eutrophication occurs when bodies of water undergo an increase in nutrients that reduce the amount of oxygen in the water. Ozone damage to crops caused the greatest yield losses (1,030 percent) in cantaloupe, grape, onion, and bean. Because of this effect seen on yields of vegetables can be reduced by 5-15 percent. Ground-level ozone causes more damage to plants than all other air pollutants combined.

4.2 Ground Water Quality Parameters

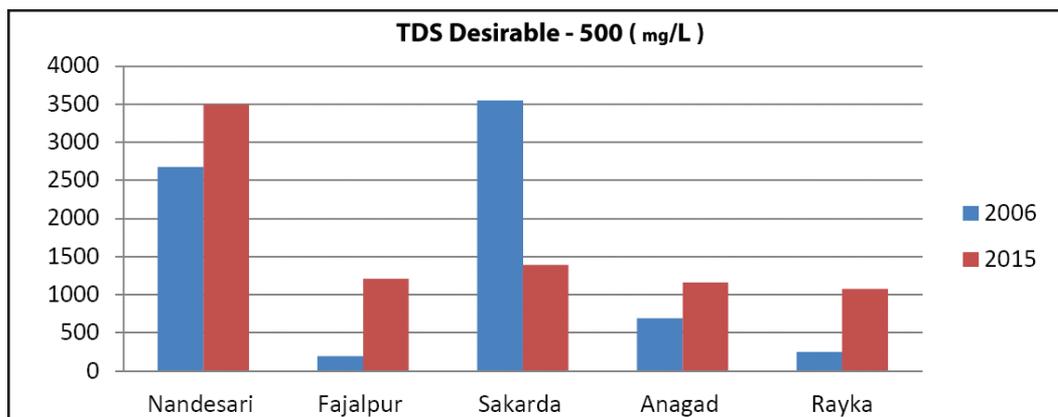
Aspect of agricultural concern is the effect of dissolved solids (TDS) in the irrigation water on the growth of plants. As a result, increased in Nandesari, Ajaipur, Angad and Rayka village last decades and reduce in Sakerda village. So the TDS are most affecting on agricultural area. Overall hardness of water is decreasing but it is still more than the standard limit of hardness for the crop. Calcium is essential element for the growth of the plant. The high COD value from the effluent of this industry is producing lots of organic substances. The level of sulfide was very high than the normal values. The heavy metals present in the effluent may come from the various metallurgical processes. The color is sharp changing.

Fig. 9: Ph of Ground Water Quality Around Nandesari



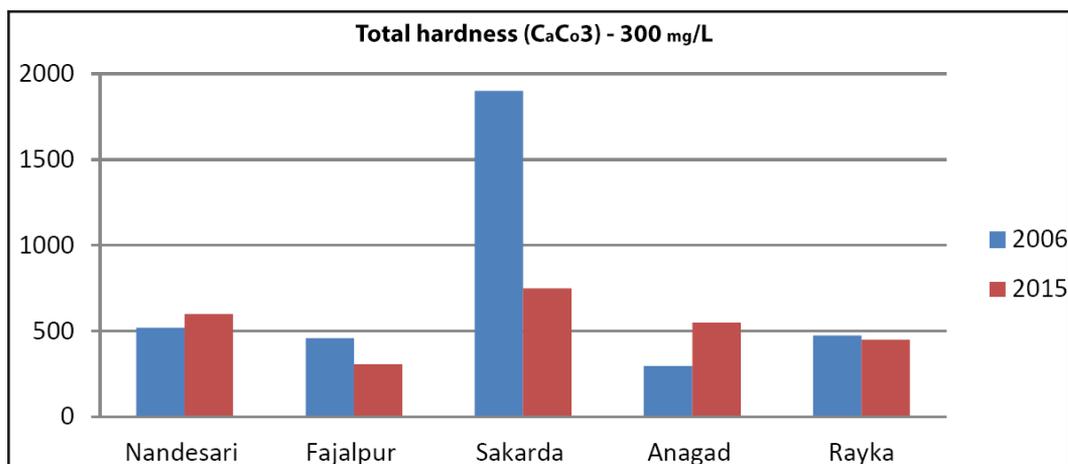
Source: Envirotech, S. (2016); Source: CENTRE, J. O. (2007)

Fig. 10: TDS of Ground Water Quality Around Nandesari



Source: Envirotech, S. (2016); Source: CENTRE, J. O. (2007)

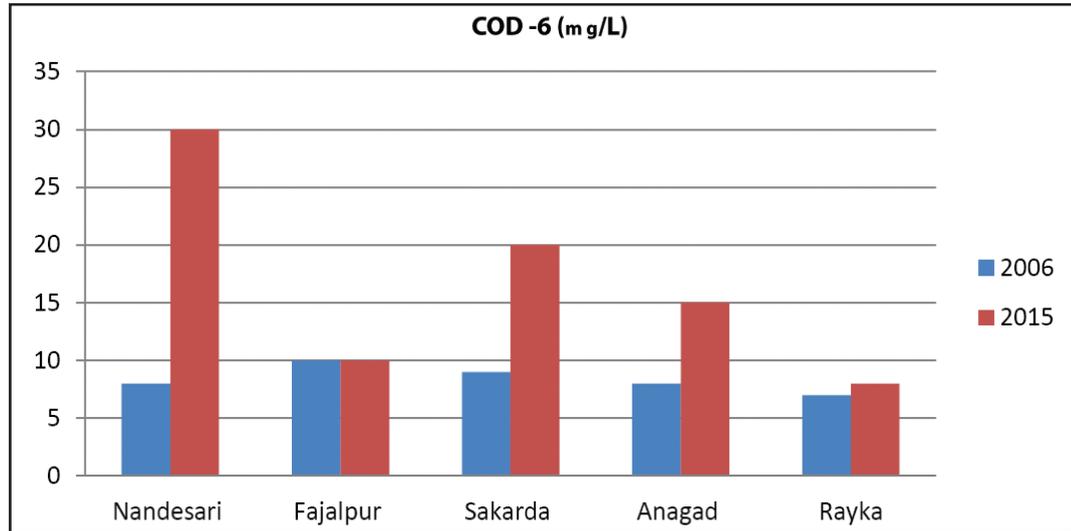
Fig. 11: CaCo₃ of Ground Water Quality Around Nandesari



Source: Envirotech, S. (2016); CENTRE, J. O. (2007)



Fig. 12: COD of Ground Water Quality Around Nandesari

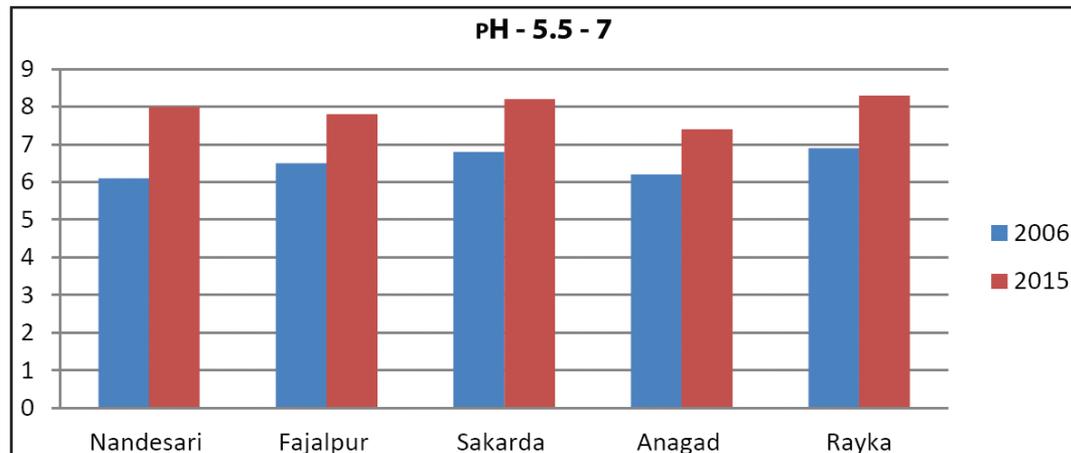


Source: *Envirotech, S. (2016); CENTRE, J. O. (2007)*

4.3 Soil Quality

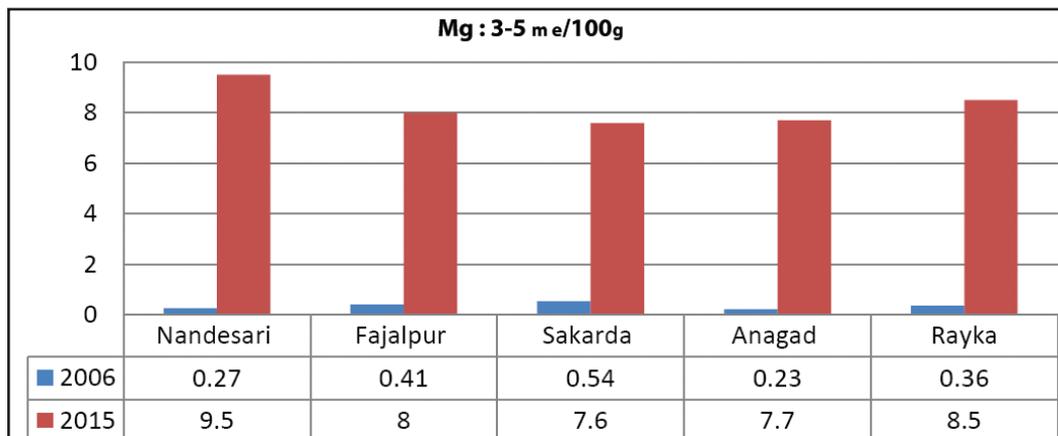
Soil pH is a measure of soil acidity or alkalinity. It is an important indicator of soil health. It affects crop yields, crop suitability, plant nutrient availability, and soil micro-organism activity, influencing key soil processes pH values are increasing that indicates the decreasing soil quality in all the villages in last decade. In the optimum range clay soils are granular and easy to work with. However, if the soil is either extremely acid or alkaline clay, soils tend to become sticky and hard to cultivate. Magnesium (Mg) is one of 18 nutrients essential for plant growth. The rock and clay particles weather over time (break down over time), minerals like Mg are released but this process is very slow. Magnesium levels in soil decline

Fig. 13: Ph of Soil Quality Around Nandesari



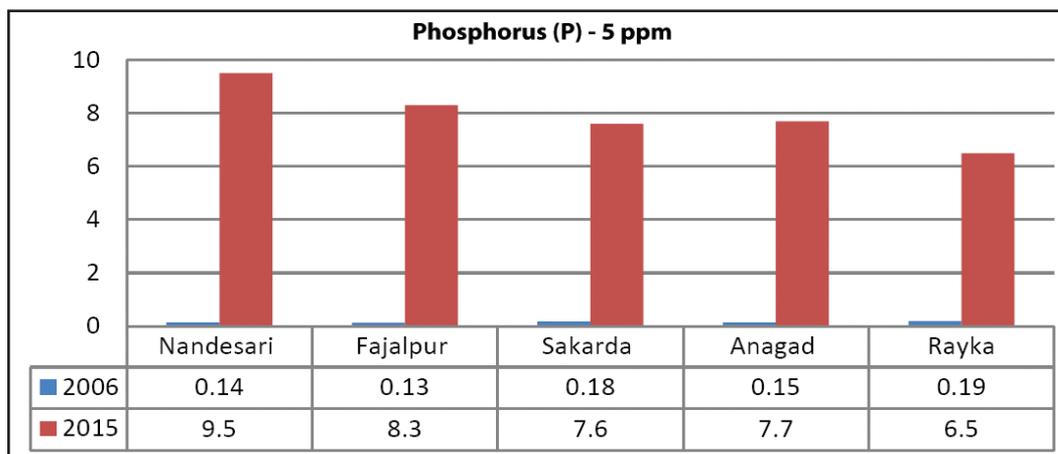
Source: *Envirotech, S. (2016); CENTRE, J. O. (2007)*

Fig. 14: Mg of Soil Quality Around Nandesari



Source: Envirotech, S. (2016); CENTRE, J. O. (2007)

Fig. 15: Phosphorus of Soil quality around Nandesari



Source: Source: Envirotech, S. (2016); CENTRE, J. O. (2007)

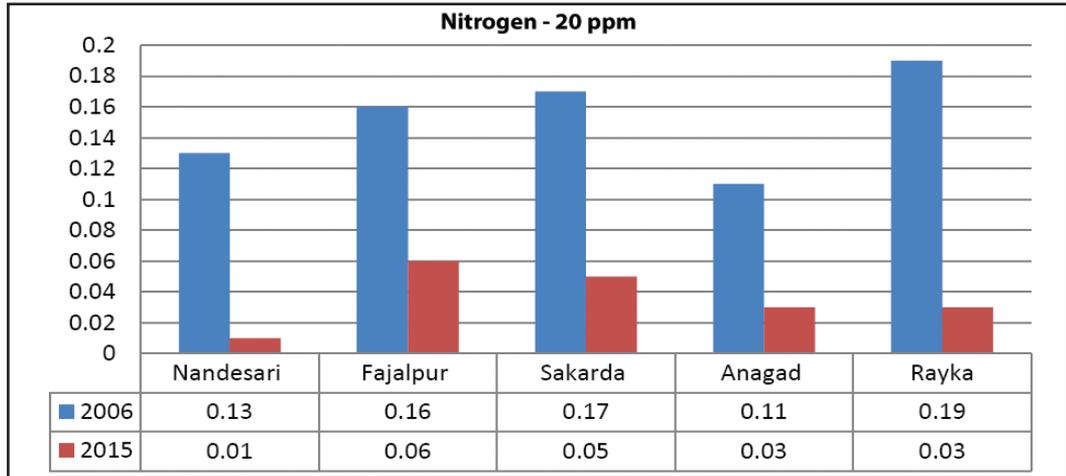
over time as a result of crop removal, soil erosion, and leaching. Negative effect is yellowing between the veins and lower leaves may also turn purple, brown and die.

The element occurs in soils in both organic and inorganic forms, the latter being usually the more important for crop nutrition. If the value of P increased 5 ppm, convert in to acid soil. Its effect is seen in plant, Dark-red and purple discoloration of older leaves and of leaf edges. Soil nitrate N is an excellent indicator of N cycling in soils. An early-season measurement of 20 parts per million (ppm) nitrate N in the surface layer (upper 6 to 8 inches) is sufficient to produce a good yield of corn.

Soil physiochemical properties are adversely affected by high concentration of pollutant, rendering contaminated soils unsuitable for crop production.

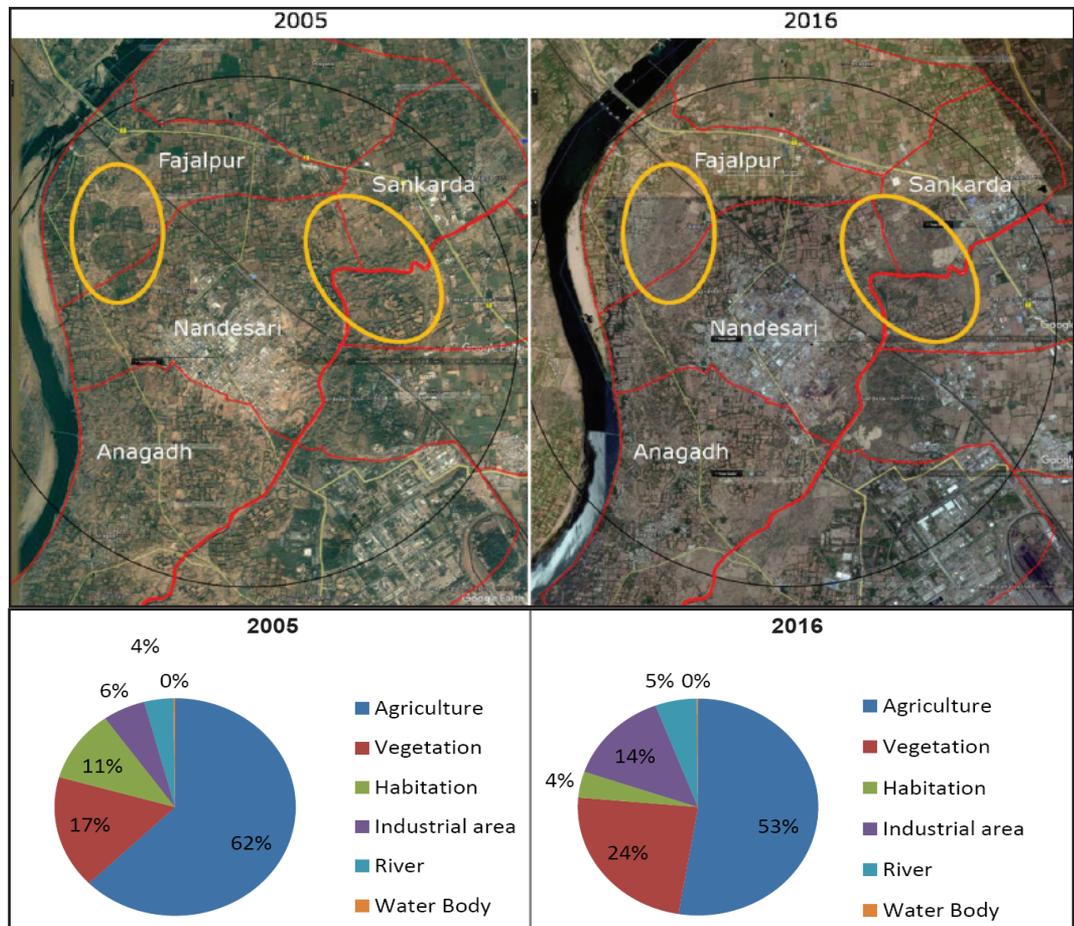


Fig. 16: Nitrogen of Soil quality around Nandesari

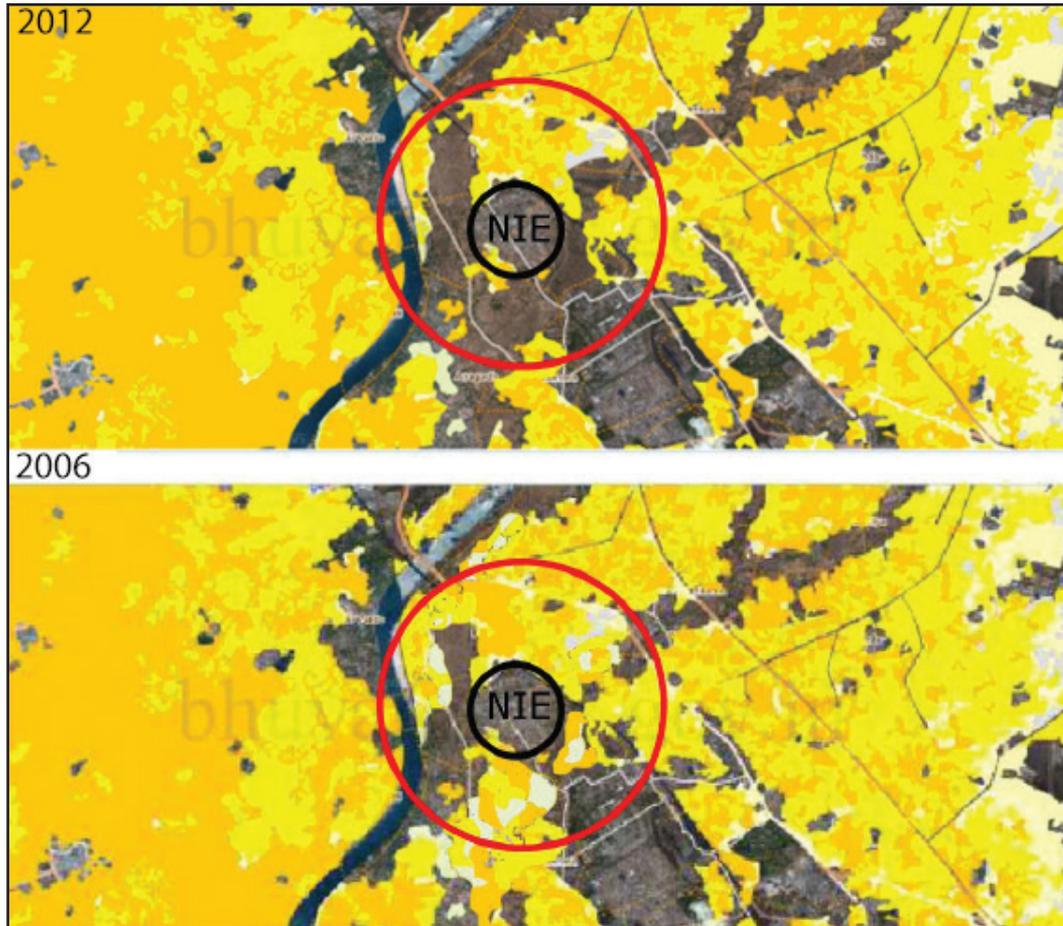


Source: Envirotech, S. (2016); CENTRE, J. O. (2007)

Fig. 17: Comaresion of Google Map 2006 and 2016



Source: Google earth

Fig. 18: Crop Land Cover Comparison

Heavy metals can also be flowing from soil into groundwater resulting in to soil contamination and decrease or problem of growth of plants. In Nandesari around villages are seen the last decades mostly soil parameters is highly affected on agriculture area. By comparison land use 2006 and 2016 of NIE. It was observed that the agriculture area has decreased by 10 percent due to industrial area has increased. That is the main factor affecting crop rotation and changing habitation. By comparing 2006 and 2012 crop land cover, we can see that, in south side of the NIE crop land cover has been decreased. Mainly Nandesari village and Angad village have been faced high effect of crop land and the reason come to know is due to the topography of the area, which is from north to south direction, all the industrial waste is highly affecting crop land in surrounding area.

5. GROUND TRUTH VERIFICATION

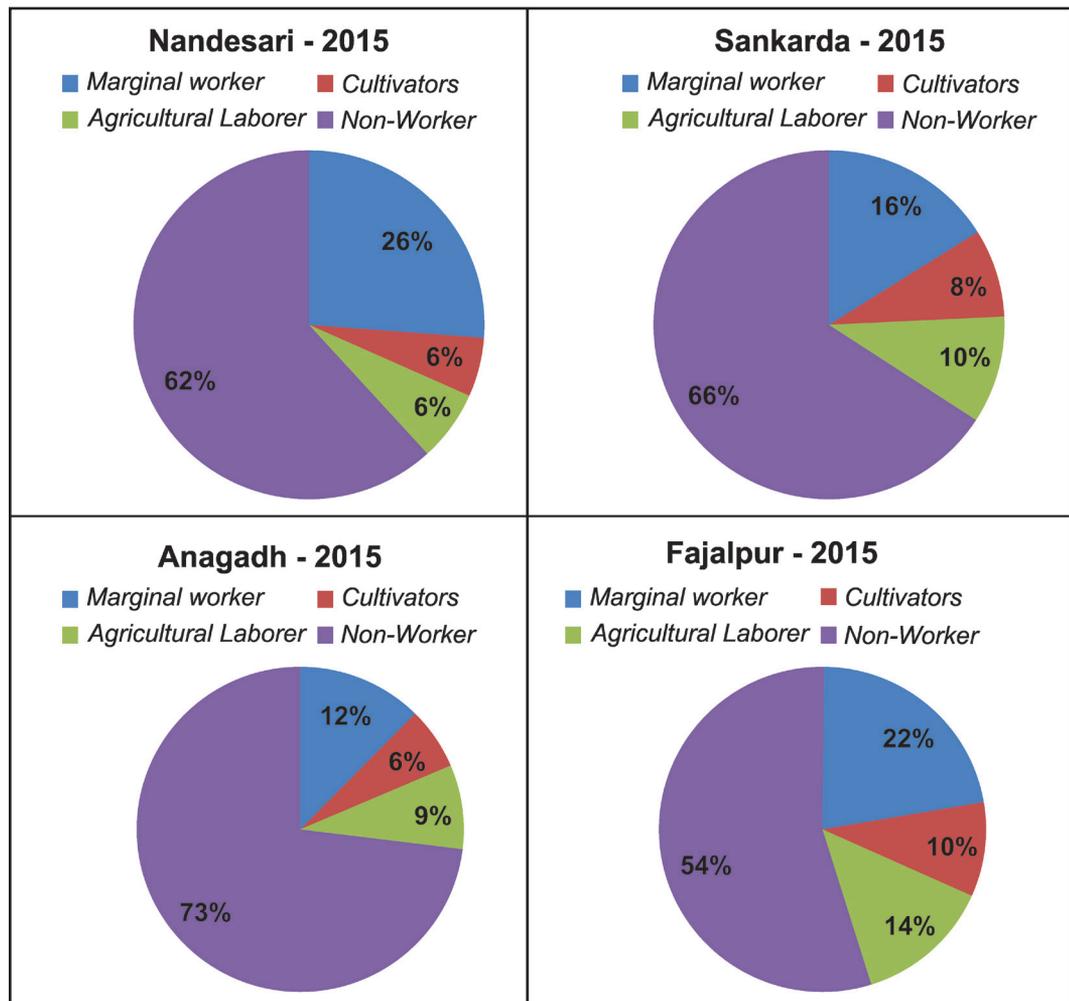
The primary survey has been carried out in four villages named Nandesari, Sankarda, Anagad and Fajalpur of Vadodara taluka which are located nearer to



the NIE. From all the villages, 55-60 farmers have been interviewed and 6 FGDs have been conducted in all the villages. Government officer in all the villages have also been interviewed. The interview is been carried out with pre-determined focus of industrial pollution effect on agriculture crops.

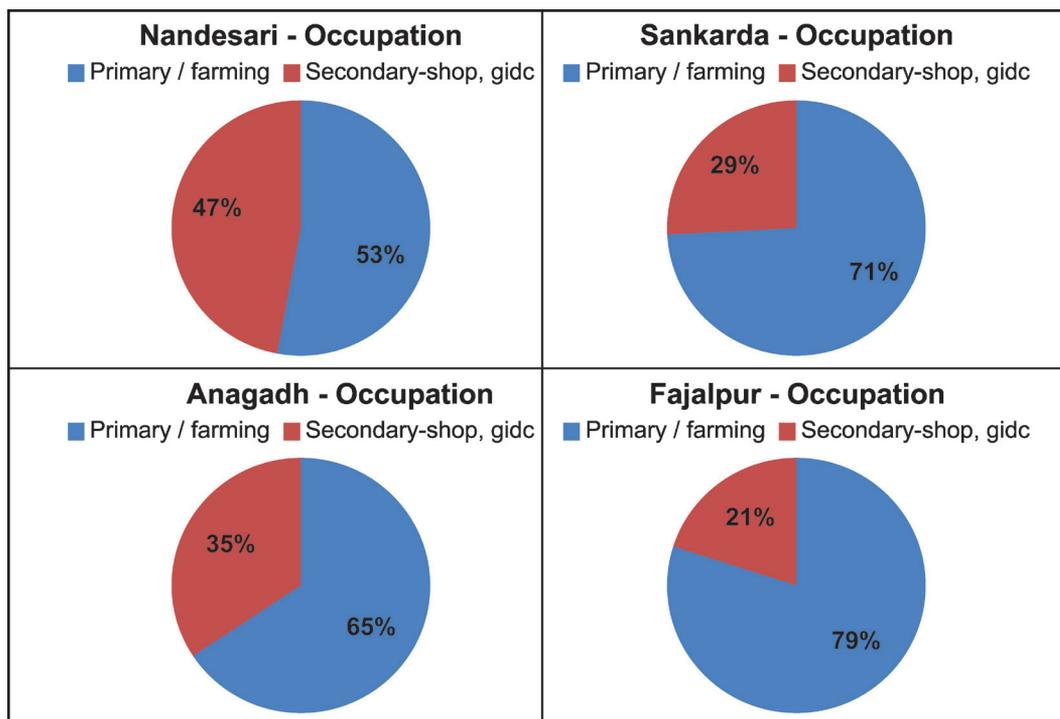
Mall four villages Agricultural related people are 5 to 10 percent, and 40 to 60 percent are non-workers, and total main workers are around 20 to 25 percent. Over all scenarios is that due to industrial development more people are attracted to work in industries. Farmers also tend to change their work area. During primary survey of farmers families from all the villages, it has been seen clearly that all the villages are affected by industries. The charts shows the change in occupation pattern of farmer’s family in all the villages, which indicates Nandesari and Anagad villages has faced high change in occupation pattern as

Fig. 19: Worke Profile of Surrounding Villages of NIE



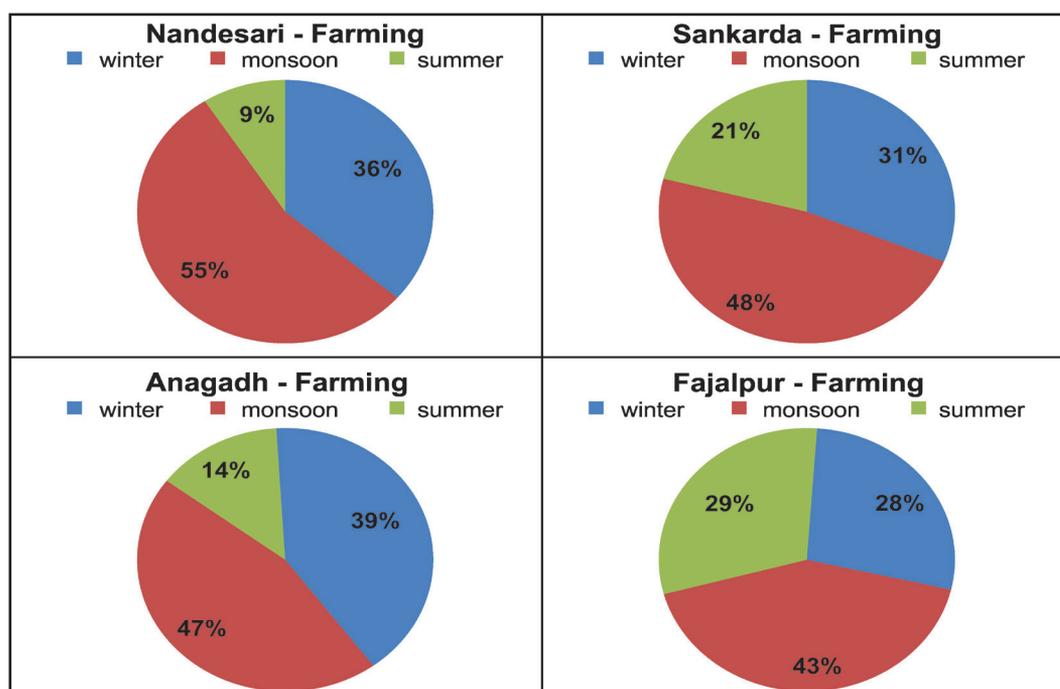
Source: Envirotech, S. (2016)

Fig. 20: Occupation of Surrounding Villages of NIE



Source: Primary survey farmers

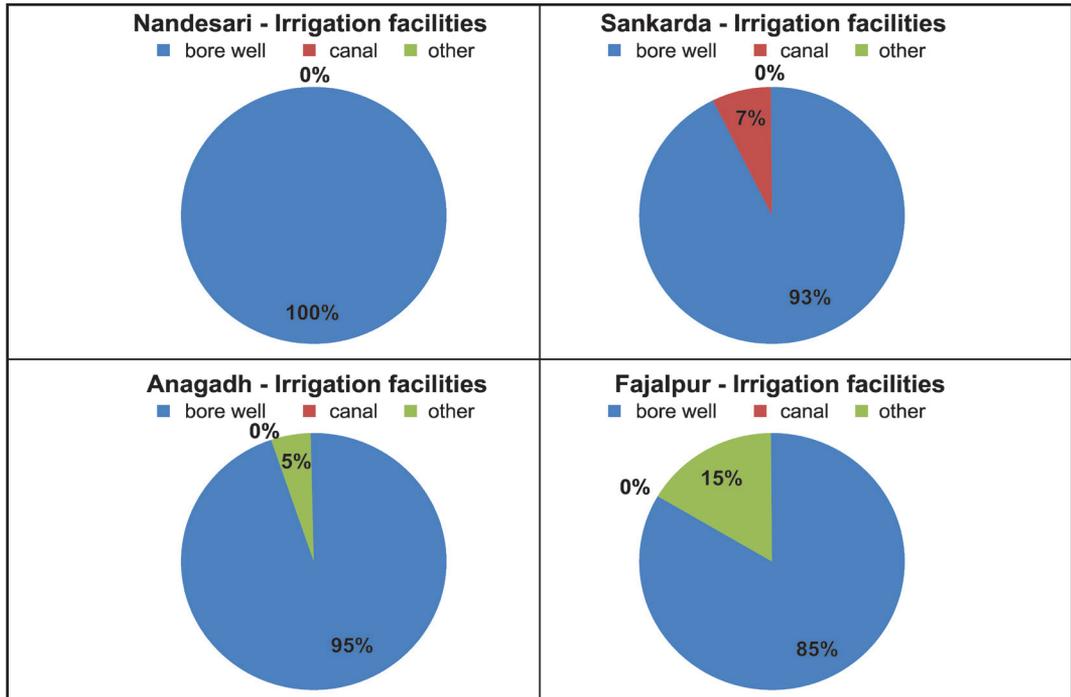
Fig. 21: Current Farming Surrounding NIE



Source: Primary survey farmers

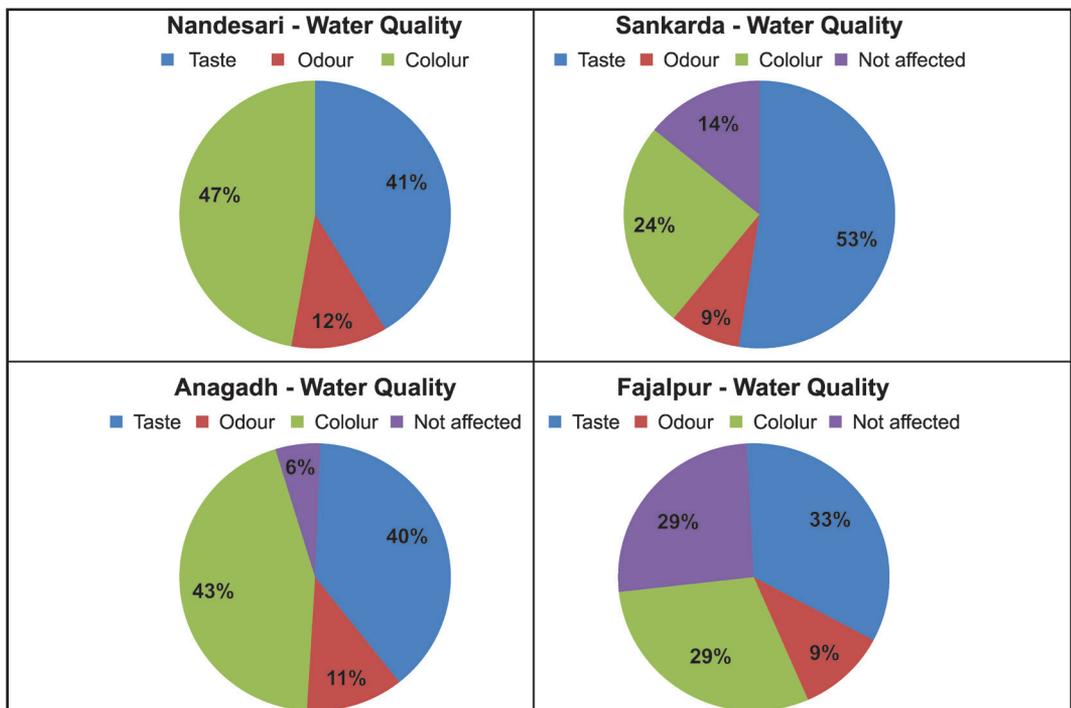


Fig. 22: Irrigation Facilities of Surrounding NIE



Source: Primary survey farmers

Fig. 23: Ground Water Quality of Surrounding NIE



Source: Primary survey farmers

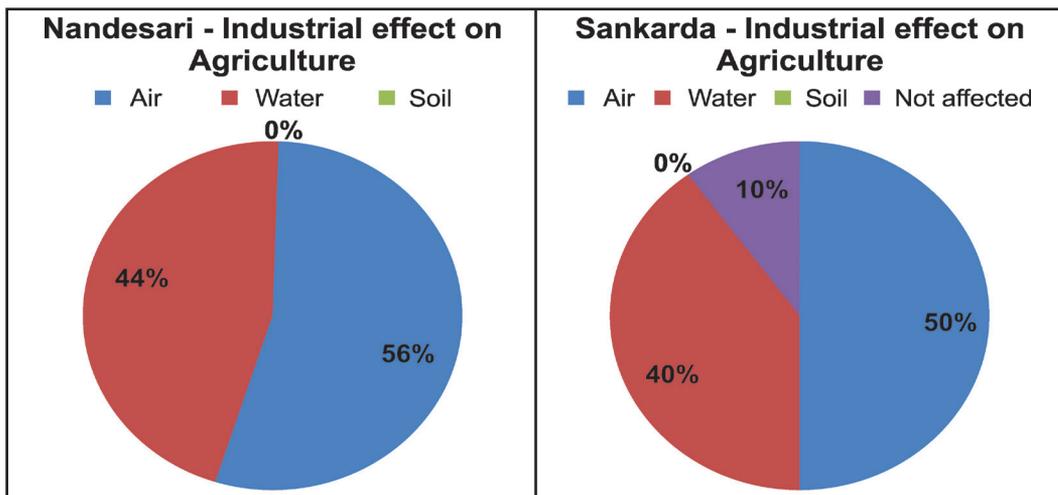
both the villages are within the proximity of industrial area. Still farming is their primary source of income, but most of the families' area now shifting to other source of income in parallel with farming.

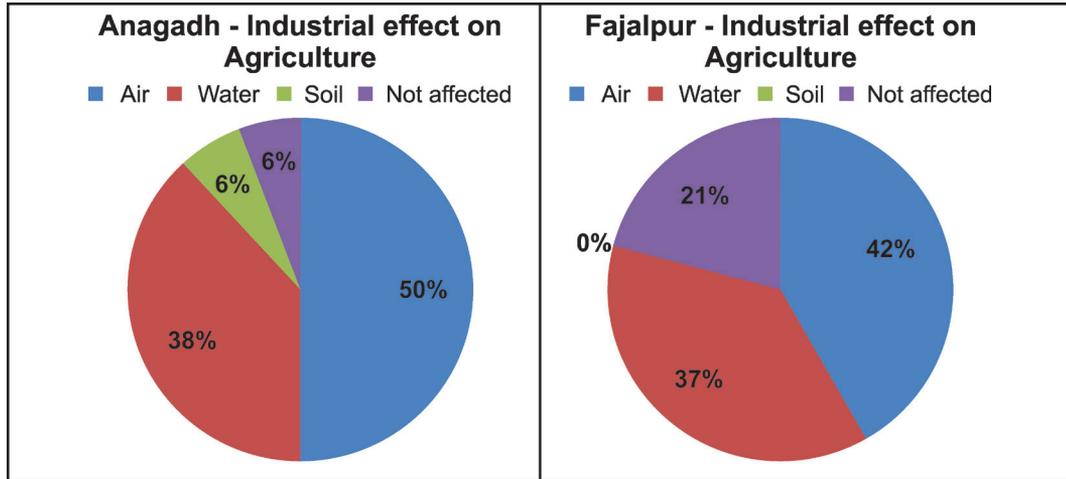
Fig. 24: Photograph of Ground Water Quality of NIE



Source: Primary survey, Local VNM News

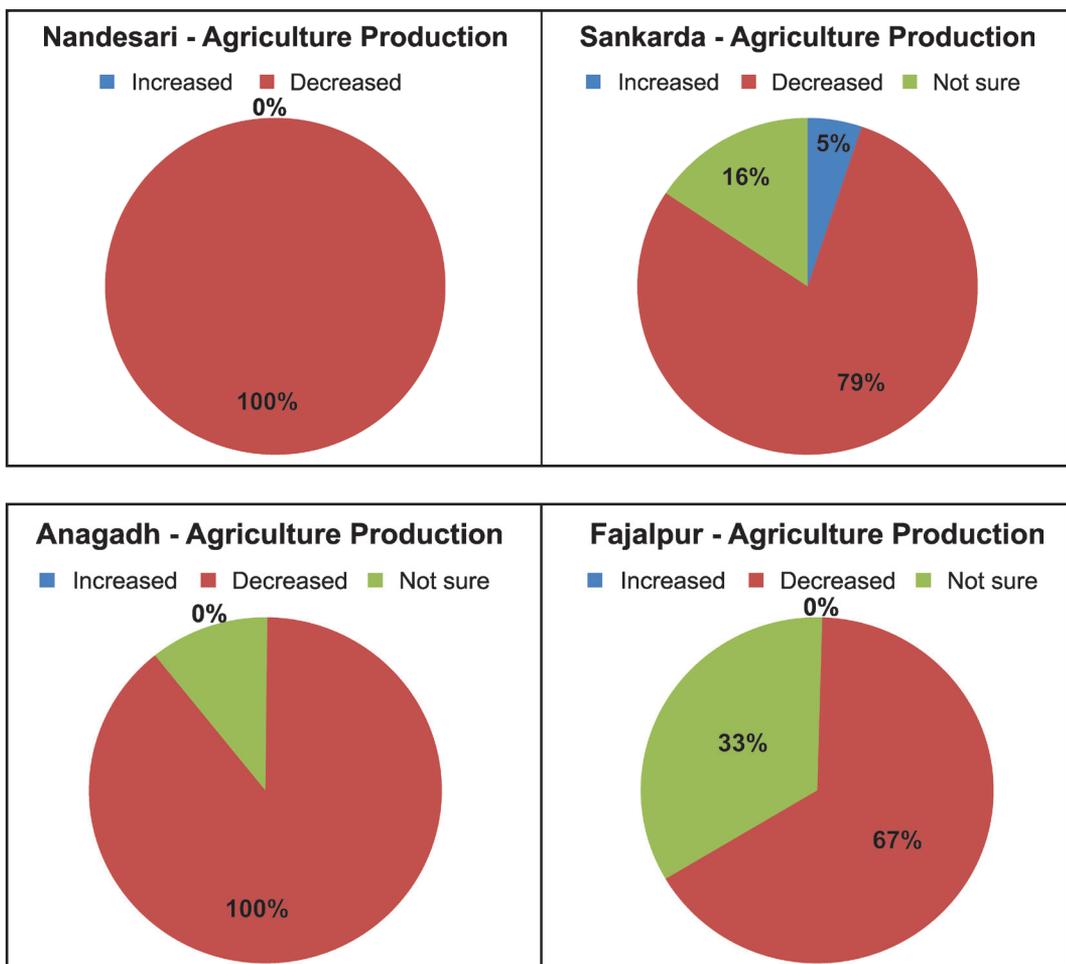
Fig. 25: Industrial Effect on Agriculture of Surrounding NIE





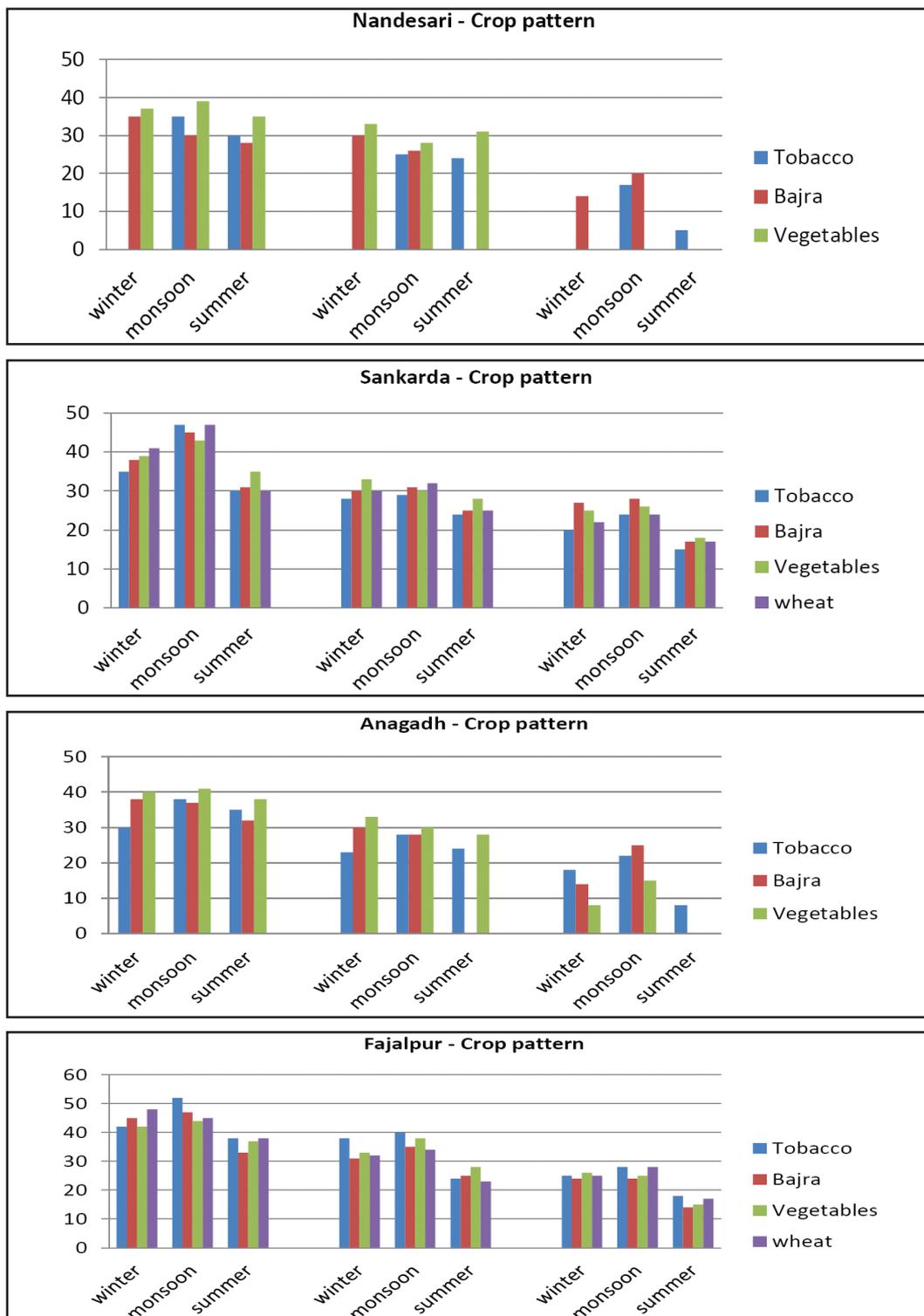
Source: Primary survey farmers

Fig. 26: Agriculture Production of Surrounding NIE



Source: Primary survey farmers

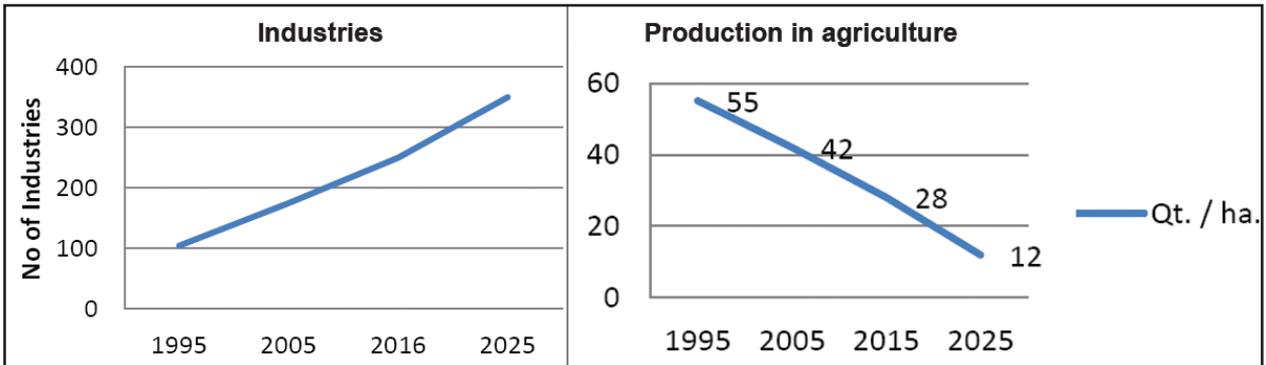
Fig. 27: Crop Pattern of Surrounding NIE



Source: Primary survey farmers



Fig. 28: ???



In Nandesari and Anagad villages mostly farming is done in monsoon season, as per the primary survey, main irrigation sources of water is bore well in all the villages but due to ground water pollution created by industries, farming is rarely done in summer season. So farmers of villages near to the NIE are mainly dependent on rain water for farming. As mentioned above all the farmers in this four villages are mainly dependent on bore well for irrigation purpose, but due to polluted ground water that decreases the quality and quantity of the crops, average 20 percent of the farmers have closed bore well and left farming, due to polluted ground water.

Ground water quality in Nandesari and Anagad villages cause a high effect on agriculture. Mainly water color and taste are visible indicators of polluted water due to industrial waste. Degradation in quality and quantity of crops is mainly because of the color in water can be caused by a number of contaminants such as iron which changes in the presence of oxygen to yellow or red sediment. From above charts it is clear that air pollution is the major component that affects the crops; another component is water, as colored water with high TDS is causing adverse effect on crops. From primary survey it is clear that cropping pattern is totally changed in Nandesari and Anagad, while Sankarda and Fajalpur are also affected. In Nandesari and Anagad villages as compared to 1995 vegetable farming is totally avoided by the village farmers due to less production in 2015.

6. CONCLUSIONS

All the chemical industries in Vadodara area, 95 percent chemical and pharmaceutical industries are situated in Nandesari Industrial Estate and around ECP. Primary survey and secondary data analysis show negative impact on surrounding crop land pattern over the years. From primary data and secondary data analysis it is clear that industrial pollution is causing hazardous effect on air, water and soil in surrounding over a last decade. Polluted air, water and soil are resulting massive change in crop land, and also livelihood of the people in



surrounding area. If industrial pollution will not be controlled it will result in demolishing in agriculture sector. Industrial pollution has changed the cropping pattern and also results in declination of crop production. Another aspect that has been come to know from primary survey is that, young generation population is willing to join as industrial worker instead of farming, their traditional occupation. This mentality and attitude of young generation will surely leads to the demolition of agriculture sector in surrounding area of industrial estate. One of the major causes of this mentality is low income from farming, low agriculture production after massive hard work, and opportunity of daily wages working opportunity. Also availability of pure water and air is a big question for the farmers.

In addition to it, Chairman of NIE has informed that numbers of industries have been increased by 100 industries in 1995 to 250 in 2016. Also NIE has extended its boundary to 125 hectares with proposal of 100 upcoming industries by 2025. And NIE has plan to increase the capacity of effluent channel by 12.5 MLD in 2016 from 7.5 MLD in 2000. As it was shown in this research that industrial pollution have reduced agriculture crop production, we can predict the future situation accordingly. Which will be the main reason for convergent of agriculture area to the barren land. What we have seen through years is farming is main primary occupancy of the people of villages is the identity of village, but what this study is showing is, if industrial pollution will be increasing, agriculture sector will obviously negatively impacted. And villages surrounding industries will lose its identity of farming.

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- Meeting with Experts and Agencies Member of Paryavaran Suraksha Samiti Chairman of Nandesari Industrial Estate Head of regional office, GBCP, Vadodara.



Growth of Slum Population in India

S. Kumar Swami

Abstract

Urban India is undergoing a process of great transformation in the midst of economic reforms, liberalization and globalization. Many cities and towns are fast emerging as center of growth. It is estimated that by 2025 more than 50 per cent of the country's population will live in cities and towns. This is likely to pose serious problems to urban planners, policy-makers and managers of urban affairs in terms of increased requirement of funds for infrastructure development and management. Because of inter-regional and inter-city disparities in access to infrastructure and basic amenities, sharp differences are noticed at the micro-level within a city between high income localities and slum / squatter settlements. As a result, the worst affected are the poorer sections of society of society in India, more than 40 percent of the populace on an average in the metropolitan cities lives in slum and squatter settlements in vulnerable locations.

1. INTRODUCTION

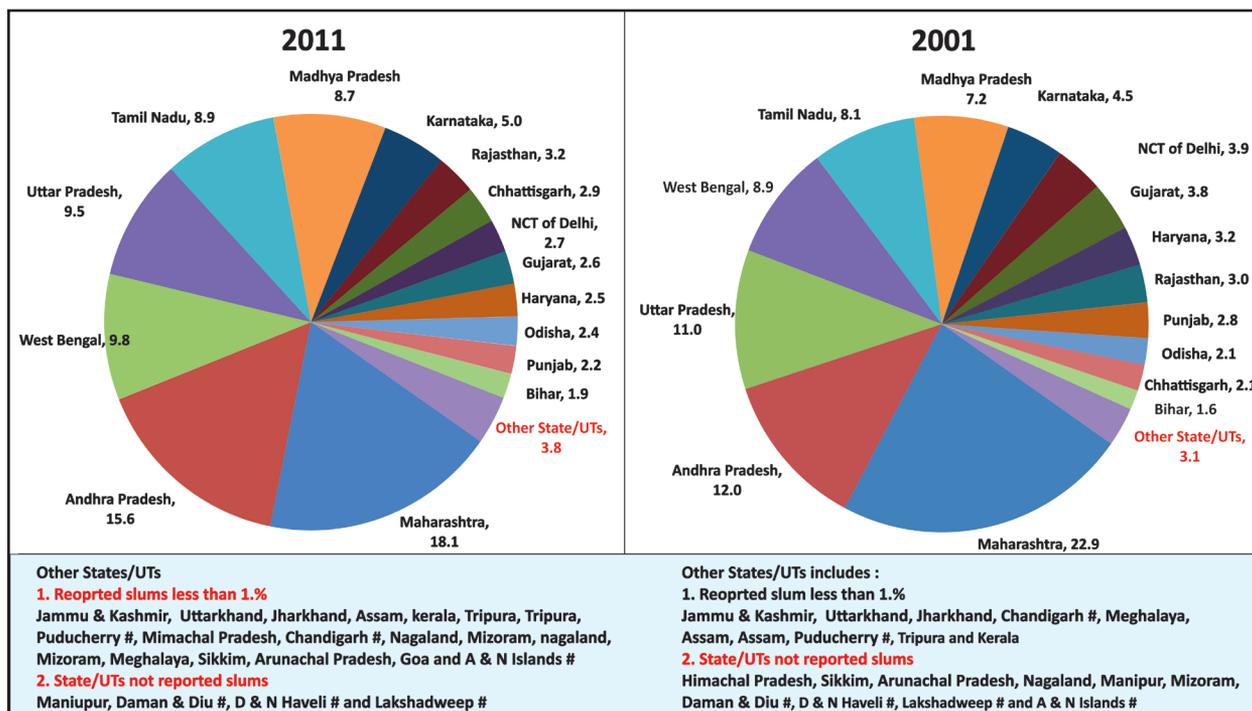
In India there has been tremendous increase in urban population. Total urban population of the country has almost doubled since 1981. By 1991 it was 84.94 million and by March 2001, it had reached 285 million. The decadal growth rate of urban population has been 31.2 percent. The percentage of urban population of the total population of the country stands at 27.8 percent. In the 1991 census it was 25.7 percent. The census of 2001 had projected the population to be more than 100 million i.e. 35 percent of the total population. The United Nations report on India's urban population has projected at 33 crore in 2001, 45.4 crore in 2010; 59.1 crore in 2020 and 65.8 crore by 2025. India has uneven distribution of urban population in various states. As per census 2011, the urban population of India is 286.11 million which constitutes 27.8 percent of the total population. The 35 million plus cities contained more than one-third (37.85 percent) of the total urban population. During 1991-2001 decade, the number of million plus cities increased from 23 to 35 and their number increased to 50 by 2011, it was estimated that there would be an increase of additional 78 million to the total urban population by 2011. Assuming that a projected increase of 39 million in the population has taken place in about 50 million plus cities (45-50 percent of total urban population by 2011), the average increase in population per million plus city would be of the order of 1.2 million during 2001-2011. India is expected to reach 600 million urban population by 2031. It is likely to have 87 metropolitan cities by 2031. From 160 million people in metropolitan cities only in 2011, the population is likely to reach 255 million. In other cities the population is

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projected to rise from 217 million in 2011 to 343 million by 2031. From a total number of 5,161 cities and towns in India in 2001, the number has increased to 7,935 cities and towns by 2011. This magnitude is bound to lead to massive problems in already overstrained mega and million plus and other cities.

Urban India is undergoing a process of great transformation in the midst of economic reform, liberalization and globalization. Many cities and towns are fast emerging as centers of growth. It is estimated that by 2025 more than 50 per cent of the country’s population will live in cities and towns. This is likely to pose serious problems to urban planners, policy-makers and managers of urban affairs in terms of increased requirement of funds for infrastructure development and management. Despite significant emphasis laid on improvement of infrastructure development in the successive five year plans, deficiencies in urban infrastructure continue with poor service delivery. A national survey of major “Public Services by Public Affairs” (2002) conducted by Central Government indicated the poor quality, reliability and effectiveness of basic services in urban local bodies. Accelerated growth of population in large urban center has been compounded by extremely limited financial resources of the developing countries. This has put a severe strain on their already weak and inadequate basic infrastructure resulting in detonation in all aspects of quality of life at the household, neighborhood and city levels. Because of limited resources and unequal access to civic needs such as shelter, sanitary facilities, safe water, sewerage, solid waste disposal, environmental situation in urban areas becomes grave.

Fig. 1: Primary Census Abstract for Slum 2001 and 2011





Because of inter-regional and inter-city disparities in access to infrastructure and basic amenities, sharp differences are noticed in the micro-level quality within a city between high income localities and slum / squatter settlements. As a result, the worst affected are the poorer sections. They lack financial resources to compete for service land and adequate housing and therefore, are compelled to occupy illegal settlements in un - serviced lands normally along railway tracks, river-beds and slopes, etc. In India, more than 40 percent of the populace on an average in the metropolitan cities lives in slum and squatter settlements in vulnerable locations.

In 2011 Census three types of slum i.e. (i) Notified slum, (ii) Recognized slum and (iii) Identified slum have been recorded. For example if the total Indian slum population is 100 then the notified slum is 34.3 percent, recognized slum 30.04 percent and identified slum 35.3 percent (as per 2011 census) The Fig. 1 gives state share of slum population.

2. INDIAN SCENARIO

For the first time in the history of the population census in the country, slum demography has been presented on the basis of actual count in census 2001. After detail analysis it is found that the pattern of growth of cities and proliferation of slums bring out the four aspects as given below:

- **Firstly**, movement of low income population into the city and its concentration and growth is an ever increasing phenomenon; estimates indicate that about one third of the population in large cities live in slum or slum like conditions and the proportion could be even higher in metros and mega cities. Further, the population in urban settlements is growing at rates between 2 to 3 per cent per annum, the population in the slum and informal settlements in urban areas is estimated to be growing at the rate of 6 to 8 per cent per annum.
- **Secondly**, the proliferation of slums in cities is a result of the inefficiency and weakness of the urban system to respond adequately to meet the shelter requirements of the economically weaker sections, which migrate to the city primarily for economic reasons. In the absence of adequate access to shelter or land, the economically weak migrant population attempts to occupy the vacant lands. The abysmal environmental quality in the slum areas is compounded by the inability and awareness among the slum dwellers to take up self-help initiatives for improvement.
- **Thirdly**, there is a substantial ignorance and insensitiveness among the city population, in general, and civic administration, in particular, on the significant contribution of the slum dwellers for the overall growth of the urban economy and their self-help initiatives are treated 'insignificant' in



the overall growth of the urban economy. Rather than citizens, the slum dwellers are considered as a “civic problem”.

3. CAUSES GROWTH OF SLUMS IN INDIA

In India, the following causes are usually attributed for the origin and growth of slums:

3.1 Industrialization and Consequent Migration of Rural Masses to Urban Areas

After the attainment of independence, the pace of industrialization has increased in our country and large as well as medium - sized industries have been established in several parts of the country. The industrial concerns have attracted the rural masses for employment. Subdivision of land owing to increase in rural population has resulted in uneconomic holdings and unprofitable agriculture. Periodic famines, floods, pestilences and other calamities have aggravated the problem.

3.2 Lack of Employment Opportunities and Livelihood Resources in Rural Areas

People in rural areas primarily depend upon agriculture which only provides limited seasonal employment. The employment potentiality in rural areas is low and it promotes migration of population from rural to urban areas in search of employment opportunities. Therefore, lack of employment opportunities in rural areas accelerates the growth of slums in the periphery of the urban conglomerate.

3.3 Absence of Adequate Facilities in the Urban Area

Most of our cities are congested and overcrowded with the lack of civic amenities when people throng into the cities to work in industries, in construction work, in Transport and Trading Corporations and they fail to find housing accommodation. If there were thousands of industrial workers without residential facilities they try to make some temporary arrangements near the place of their work. Where they find vacant Government land. Large number of unhygienic huts spring up near the factories or commercial areas. These subsequently turn into slums because the area is small, proper roads are not available, facilities like electricity; water and toilet do not exist.

3.4 Low Wages

Large number of our industrialized urban workers is unskilled laborers earning low wages. Many of them are employed on temporary basis. They cannot afford to have cement-mortar houses with proper facilities. So, they are forced to live in slums.



3.5 Ineffective Land Reforms

The age old practice of land owning and landless people creates landless labors. The landless laborers are lured and attracted by the wage labour in the Industrial Sector and thereby leave aside the traditional occupations and migrate to Industrial and urban centers to sell their labour. Such migrants no doubt contribute enormously to the growth of slum population in urban areas.

4. CONCLUSIONS

India, as a developing nation, has emphatically embraced the planned development for improving the social and economic life of its people during the post-independence period through implementation of 12 Five Year Plans and some development has been achieved. However, poverty, illiteracy, unemployment, malnutrition and such other human problems have not been eradicated and they have become major areas of concern for policy makers, planners, leaders, administrators, and development practitioners, as the achievements have not been commensurate with the expectations. It requires consistent and persistent efforts to achieve long term plan objectives. As a partial fulfillment of the requirements of the man made planning process there is need for appropriate diagnosis of problems of people in the contextual societal framework. We do not have adequate knowledge on certain vital aspects of socio - economic concerns and for that matter paths of development do not become realistic and need based. Planning for urban development remains incomplete if the problems of slum dwellers are lost sight. Although slum dwellers account for 27 percent of the population, they occupy only 5 percent of urban land area. Unimproved slums are characterized by overcrowding, dilapidated structures, unhygienic conditions, grossly inadequate basic amenities, unplanned layouts and poor accessibility. Many colonies have existed in this condition for twenty years or more, becoming progressively overcrowded.

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Planning Our Future Cities

Rama Singhal

Abstract

As we are progressing, India is becoming increasingly urbanized. At present this growing urbanization has to be managed in such a manner that responds to growing climatic changes being wrought in our environment due to global warming. In wake of this it is becoming increasingly imperative to plan towns / cities which are sustainable. This article explores the reasons for sustainability and how it can be achieved through changes in current urban planning practices.

1. INTRODUCTION

The Eleventh Urban Age Conference that took place in London on 6 and 7 December 2012 has put some interesting and thought provoking ideas about the future of cities in India. The conference titled 'The Electric City' was a detailed investigation about how combined forces of technological innovation and global environmental crisis are affecting urban society. This conference brings a number of issues home and puts them in a different light. As we move ahead and get increasingly urbanized, what have we thought about development versus climate change? If we continue to be governed by the path set by western precedents, chances of burning out are high. But have we really looked at other alternatives; more in tune with our situation like large population pressure and fewer resources and changing global trends. There is a need for some serious thought about these issues.

It is undeniable that the west has achieved more development and affords a higher standard of living for its populace. But the question arises at what costs they have achieved this standard. The direct impact of this development has resulted in greater consumption of energy which is bringing about climate changes. Cities are guzzling power - the conference has established that cities consume 60 percent of the world's energy and contribute to nearly 80 percent of global CO2 emissions. Thus Western development is at the cost of climate changes that are irreversible and affect our very existence on this planet. If India aped the West; with its staggering population, the resultant environmental impact could be devastating.

In a parallel vein, the recently released report by the Intergovernmental Panel on Climate Change (IPCC) - April 2014, focuses on the impact of climate change

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on society. Unabated climate change may raise average global temperatures by over 5 degrees Celsius thereby taking human kind into uncharted territory. Current economic activity threatens higher temperatures, heavier storms, longer droughts, more frequent floods and rising sea-levels. It has specifically warned of famine and water shortage in South Asia; especially India, if corrective steps are not taken soon to curb green house gas emissions. Therefore, some thought and action is definitely required. Ignoring this problem may prove fatal in more ways than one. Keeping all this in mind, it is becoming increasingly imperative to think about sustainable urban development in the Indian context.

India is experiencing increasing urbanization. From 31.16 percent in 2012 it is projected to grow to 40.76 percent by 2030. Now where will all these growing urbanites be accommodated? Increasing urbanization in India is making our cities sprawl - growing on the periphery in concentric circles. Very soon the numbers to be accommodated will become so voluminous, that new cities will have to be planned and planned soon. China which needs well over 300 million people to be accommodated is planning at least 20 new cities. They will be giant cities having budgets of hundreds of thousands of US dollars. India too will have to plan new cities and that too fast, but how fast?

2. SUSTAINABLE URBAN DEVELOPMENT

At present new urban development is happening in the fringes of all towns and cities. Very few new independent townships are being designed. Most of the growth that is happening is haphazard and not thought out in terms of overall land use planning or connectivity. It is governed to a large extent by availability of land and its price. It is also governed to some extent by surrounding development and the connectivity to the surrounding habitations. But can this type of urban development purely through accretion without any other thought or policy approach account for the frenzied urban growth that is being predicted? We need to start thinking more pro-actively about sustainable solutions to urban growth. The need of the hour is “planning sustainable cities” and calls for review of current urban planning practices and approaches. What is needed is a solid sustainable agenda to base further urban development.

The first step towards conscious urban planning towards sustainability is to ensure that the urban form of the city is sustainable. By urban form it is meant the spatial pattern in which the activities have been placed and the resultant form achieved. A sustainable urban form has been defined as a “city form that enables functioning of a city within its natural and man-made carrying capacities; is user-



friendly for its occupants; and promotes social equity” (Sustainable urban form for Indian cities, NIUA, 2011).

To understand sustainable urban form better one has to understand the basic elements that play a role in determining it. These are density, land use, transport infrastructure, layout, and house building type. The resultant or emerging urban form is an inter-relationship of these basic elements. Land use and the way it is organized affects transportation. House building types and layouts in turn determine type of transport requirements and energy efficiency of the built form at the micro-level. Density determines compactness of the city as a whole. World over it is now being recognized that higher densities reduce ecological footprint of the cities and is thereby used as a tool to promote sustainability.

3. TRANSPORT INFRASTRUCTURE

The type of transportation adopted for a city greatly influences the carbon footprint of the city. Transportation infrastructure is closely associated with density, land use and layout characteristics. The type of transport required for a suburban spread out development in which there are big lots would be a complete antithesis of transport for inner-city high rise development. If our cities continue to develop as they already are in a suburban manner we are losing a lot. They are given over to the automobile and are making us move towards an energy intensive lifestyle. The case in point is the new development in Gurgaon and Noida in the NCR. Fuel efficient cars are not the only answer. We need to propagate dense developments as they are more energy efficient. The ‘Electric City’ conference clearly brought out the strong association of petrol use and density of habitation, which directly impacts global warming. It also related the consumption of petrol to distance of habitation from city centre. Density of neighborhoods affect petrol usage - sparsely filled neighborhoods entail longer trip lengths be they to shops or schools.

In reality we are already living in much more denser cities as compared to Western counterparts’ e.g. New York City at 25,000 people per sq mile whereas density of Mumbai, it is >50,000 people per sq mile (Kolkata and Bangalore is >20,000 people per sq mile). These dense cities point to only one thing that if per capita income was to increase resulting in a more lavish lifestyle, then the stress on the city and its networks would be unimaginable. More mid-size new towns developed as dense habitations working well with modern public transit systems seem to be the answer, instead of further expansion of existing cities.

Suburban sprawl also results in higher use of private vehicles to commute which further raises the energy utilization. It has been found out that public transit is



a lot more energy efficient than driving vast distances in our own personal petrol burners. An example given in the 'Electric City' conference clearly points out how public transit is more energy efficient as compared to private vehicles e.g. The New York City transit system where the amount of carbon generated per trip is 0.9 pounds as compared to 9 pounds of carbon generated in an average car trip. It has also been found that in every metropolitan area city dwellers consume a lot less petrol than suburbanites. Therefore the future sustainability definitely rests with dense neighborhoods serviced through public transit; not with leafy suburbs.

According, to the 'Electric City' Conference, a number of different alternative scenarios will come forward. Personal travel would involve small, ultra-light, smart, battery based vehicles that could be hired- very much like bikes in the cities. Electric bikes, speed controlled micro-cars, mini-buses, and driverless rapid transit systems will take over the transport. As for the car it will have to be slowly phased out. In contrast let us look at the Indian scenario where car usage is growing across cities and public transit systems in most towns and cities are archaic or are practically non-existent.

Therefore, transportation infrastructure in cities needs to be reworked. This could also mean working out cities to make them more walk able or cycle able. Which in turn could mean that our cities should now not look towards Greenfield development; instead they should turn towards Redevelopment / Brown field development. In addition it could also mean that the strict zoning that is being practiced needs to be rethought and more mixing of compatible uses encouraged.

4. TECHNOLOGY TO COUNTER CLIMATE CHANGE

Today the new buzz is about building entire new cities to match the rising march towards increasing urbanization. Internationally this has taken the form of "smart cities". Smart cities are being designed with high technology input which will control the physical, economic and social aspects of urban living.

Take the example of Songdo International Business District, an intelligent city near Seoul, South Korea. Songdo City has been designed as a 'smart city' equipped with advanced sensors and monitors, devices that will be able to open and close, turn on and off, or start and stop almost everything. In this way sensing environments will be created that can adjust to human needs in myriad forms at the same time use optimal energy. Combining the use of this technology powered by energy obtained through renewable sources our urban environments will be more climate responsive. Songdo is also all about recycling and deploys



all the latest green technologies; in this way it has been hailed as a prototype community of the future designed to house the hundreds of millions who are projected to move into cities.

In this way we can see that the future of urban development is use of high - end technology to curb the effects of climate change to make it greener and planet friendly. If green energy (based on renewable resources such as sun, wind and biomass) can fuel this technological growth we can truly claim to have countered climate change through the use of technology to a large extent. But for a developing country like India the creation of these smart cities definitely does not seem a feasible option. In terms of investment required as well as educational and technical prowess of the common populace it seems farfetched. But the use of green technologies available can be adapted in our context and used advantageously. The use of passive solar techniques for building design should be made mandatory. All buildings should be made to use only environment friendly materials for construction. Use of green measures such as rainwater harvesting, recycling of waste water and use of photovoltaic cells to generate electricity for outdoor use etc. should be made mandatory in all buildings. In this manner greater energy efficiency and sustainability can be built into our environment.

In India work has already started in this direction. Builders are now coming forward to adopt green practices in their projects as specified by IGBC (Indian Green Building Council). They are realizing that although adopting green practices increases the project cost by nearly 8-10 percent, in the long run it has many benefits. Even government organizations such as CPWD and DDA have started coming up with projects receiving certification from IGBC and GRIHA respectively. But to date there is no law that mandates or promotes the construction of buildings using green practices. Some states have initiated efforts and incorporated procedures to make the installation of solar heating panels and rainwater harvesting systems mandatory for some buildings.

However, there is need to frame comprehensive legislation governing the adoption and implementation of green practices by builders and providing for penalties or sanctions in case of deviations or non-compliance. Cities such as Dubai, New York and Singapore have introduced legislations to promote the use of green practices in construction and development of buildings. Also, governments around the world are focusing on taxes and penalties to reduce energy consumption in buildings and improve water efficiency. It is high time that these are now formulated and adopted in the Indian scenario.



5. PLANNING FOR THE FUTURE

Planning is in fact predict the future and ensure that when we reach at that level the resources would have been well utilized to meet our demands. But we also know the limitations of present planning methods. Planning in the old days was based on forecasting. This has been found to work well only for short term scenarios or where present day trends are not likely to change drastically in the future. But this is no longer the case. Now we are dealing with vast changes at a fast pace. One way of dealing with this would be to go into 'back casting' instead of forecasting. In back casting one would ask what changes have to be made in the present scenario in order to arrive at a different future state. The most successful outcome in the future should be chosen and ways and means to reach there should be decided. In this way different paths can be chalked out all reaching to the same goal, which can be chosen as per circumstances. Back casting is especially relevant in the context of climate change.

6. CONCLUSIONS

In the end, it is concluded that India too should review its planning posture and decide about the future of its urban development in a new light. We should ensure that the future should be sustainable and carbon free, and to achieve that we should choose the path that leads there. Take the situation that arose due to the catastrophic floods in Uttarakhand, triggered through climatic changes, and the need for urgent futuristic urban planning in hilly terrains. Sustainability should be the key concern at all levels of planning and to ensure this all available technologies should be utilized. Thus, urban planning should also involve communities in decision making and implementation. It is only through community involvement and networking that success could be achieved.

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Public Art: A City Illustrated curating the Public Realm in India

Mitali Kedia and Parul Kapoor

Abstract

In today's world very rarely an element has the power to modify the character of space into a place. Public Art is one such element which not only enriches a place but also gives it meaning. Around the globe, countries have readily understood its importance and accepted Public Art as an integral part of city development. In India, however, art in this aspect is still overlooked and treated as an accessory. Urban aesthetics are still substantially limited to the installation of deities, political figures, etc. The paper discusses various possibilities and opportunities on how Public Art can boost a society; it also suggests a framework which can be incorporated in the legal system of the country to make it a part of the city development process.

1. INTRODUCTION

Art is a language which can stimulate different expressions, sense, and experiences using various mediums. It flirts with the morphology of a place leaving the users with moments of serendipity and surprise. Art in a public place intensifies our relation with the city and enhances our sense of community. It can transform, invigorate and energize societies and bring vibrancy to an otherwise mundane place. Public art is a reflection of how we see the world - the artist's response to our time and place combined with our own sense of who we are. Art in public spaces can be of any size and shape; it can be contextual (site specific) or stand in contrast with its surroundings, it can be created with a single medium or be an amalgamation of various mediums. It seeks to inspire the community, engage the mind and senses enhance the environment and transform the landscape. It is a powerful tool and contributes considerably to the society in general.

As an enabler of a safe and secure environment, public art alters the perception of a space and converts it into a livelier atmosphere. It imparts imageability and inspires identity. It makes art accessible - free for all - this kind of art is not enclosed within four walls and is easily accessible to the public and in most cases community participation becomes the large part of the process. As a facilitator of creative place making, it vitalizes spaces with art and encourages communities to be a part of the process. It imparts character to the public space and creates a vibrant and inclusive environment. It also connects various artists

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with different communities. Public art creatively stimulates spaces and performs under the following principles (City of Lethbridge, 2012):

- **Inclusive:** Public art is a collaborative process in which communities are engaged at various stages of planning and implementation. This process enables the community to become a stakeholder and promote a sense of ownership for the neighborhood. The outcome is a result of collaboration between various stakeholders including artists, design professionals, public and private sector.
- **Accessible:** Visual and physical accessibility is of great importance for Public Art hence it should be strategically placed with a defined access and free movement for all.
- **Sustainable:** There is a continuous need of management and maintenance for sustainability of the artwork as they can be seen mostly in open public spaces. Thus it should be ensured that the works retain the original intention of the artist and are not compromised by any lack of upkeep.
- **Diversity:** Projects for Public art consists of an array of artistic culture and expressions which reflect the diverse interests of the masses.
- **Creativity:** Public Art is a creative endeavour, open for a broader definition. It should not limit artists and foster innovation and excellence by enabling freedom of expression.
- **Quality:** Being an integral element of urban fabric requires the artwork to be of the highest quality, skill, and craftsmanship. The integrity of the installation needs to be preserved by the city to reflect its ambition and direction.

India's rich cultural heritage has always limited itself within enclosures, an absence of any art history within the public domain has led many cities to fashion very scattered efforts in creating a city-wide framework for public art. These include the Mahatma Gandhi's mural at ITO, Mudra hand gestures sculptures at IGI Airport, Chintan Upadhyay's baby head at traffic signal Nariman Point, Mumbai and colorful wall art across the Connaught Place. India has been trying to embrace this form of art and create awareness which in turn helps cities to enhance their image. Within the country, many artists have taken over the streets and public spaces to initiate a creative dimension and create the positive impact on the society, while paving the way towards making people more conscious of their surroundings.

2. COMPARATIVE ANALYSIS OF PUBLIC ART POLICIES AROUND THE WORLD

Public art originated in 1930s in the United States under the then President Franklin Roosevelt to uplift the economy from the Great Depression. 'The Federal Art Project' was one of the programs involved in relieving the economic distress by hiring unemployed artists to produce art for public buildings. Likewise, public art in urban spaces gained rapid momentum and was swiftly adopted by other

countries like France, Germany, Canada, U.K., etc., making France the first country to implement 'The Percent for Art' policy in the 1930s. The policy states that for all construction projects for public buildings, universities or schools 1 percent of total project fee should be used on the installation of the artwork' (Radišić, 2010).

There is no accepted model for public art programs available throughout the globe. Hence the best way to understand the different programs is by carrying out a comparative analysis of U.S., France, and U.K. who differ in their social, economic, historical, and ethnic identities as they have seen abundant varieties of public art projects in the past years. Since the inception of public art, these three countries have come across various issues and hurdles related to this program. The nature of the problems has been similar to each other and so has been the strategies adopted by these countries to avert them. Following are several ways in which the public bodies of these countries supported Public Art (Radišić, 2010):

- Appropriations on the project by project basis;
- Special public commission programs;
- Percent for Art legislation or ordinances; and
- Funding public art through the redevelopment process (public-private partnerships).

Differences in cultural and political systems lead to variations within the public art projects in the three countries. For instance, France has a centralized system for existing public space management whereas, U. S. and U. K. function majorly with public-private partnership models. Besides these differences, the widespread use of art within these countries is due to the development of Percent for Art as the principal policy. There is a significant shift in the role of Public Art from being a piece of ornamentation to contributing to the enhancement of society. Art in public places was introduced to decorate and enrich an urban space which mostly consisted of sculptures, frescos, murals, etc., with its focus being a cosmetic and

Fig. 1: Harry Sternberg's "Chicago: Epoch of a Great City" from 1937 placed in the Lake View Post Office in Chicago, Illinois



Source: <http://www.connectingthewindycity.com/2012/12/>

Fig. 2: The Sculpture was Placed in the Plaza at the Grant Street Entrance to their Building in 1986



Source: Photo courtesy - Office of Public Art,
Accessed from: [http://pittsburghartplaces.org/accounts/view/Chairs for Six](http://pittsburghartplaces.org/accounts/view/Chairs%20for%20Six)

Fig. 3: Sculpture installed at the U.N. Headquarters (Originally was Placed Across the Street from John Lennon’s Home)



Source: Image -Joker/ErichHhaefele/UllsteinBild/, Accessed from: <http://mashable.com/2016/09/24/public-art-social-good/#7nb2keKnkOq5>

Fig. 4: The Loss of Innocence for many Children of Iran’s Urban Lower-Strata, often Forced to Work to Supplement their Families’ Low Income.



Source: Photo courtesy -Icy & Sot, Accessed from: <https://citiesintransition.eu/cityreport/art-as-a-catalyst-iranian-graffiti-artists-transforming-public-space>

beautifying relief. In the United States of America, during the 1930’s depression many artworks were installed throughout the country representing prosperity and modernity of the nation.

As societies evolved, public art evolved with it - art became an integral part of daily life by being more site conscious and less object oriented. The artist’s collaboration with other creatively associated fields (landscape architects, architects, urban designers, city planners, etc.), helped develop socially aware and well-integrated parks, promenades, plazas and other such urban projects. Artists like Scott Burton, Siah Armajani, Mary Miss, Nancy Holt and others used art as a medium to shape and define urban spaces and the interactions that took place within them. Art in these areas was largely characterized by street furniture, temporary fixtures, lighting, paving, landscaping, etc. One such example is Scott Burton’s ‘Chairs of Six’ which consisted of six chairs facing each other with the intent of inviting strangers to start a conversation.

With the growing popularity a ‘new genre of public art’ was introduced which catered to the social issues such as women safety, violence in urban youth, etc. and aimed towards participatory and community-led initiatives focusing on the welfare of the masses. This style of Public Art helped in the display of social, economic, environmental and political issues (rather than the built environment) in urban spaces to educate individuals and create awareness within them; therefore till date this style of Public Art is practiced on a large scale. ‘Knotted



Gun simply titled 'Non - violence' installed at the U.N. headquarters is one such representation.

As a catalyst Public Art leads to social demonstration and acts as a mass communication tool. It provides a release and vent for people who cannot voice an opinion on social issues or political sentiments. This kind of Public Art brings people together regardless of their social, racial and cultural differences. The above discussion demonstrated how governments of different countries have actively supported and encouraged art in public domain which has changed the meaning of art from art in public places to art as public spaces to art in public interest.

3. PUBLIC ART IN INDIA

The previous section explained how public art has evolved over the years and how it has become an integral part of the society. India, on the other hand, is embracing public art at a much slower pace than other countries. Art within an urban space in India is unfortunately reduced to decorative and picturesque elements which do not add value to the community. Inadequate understanding and education within the people regarding the importance and benefits of public art has led to many cases of vandalism in various Indian cities.

Many pioneers in this field have expressed their views. Gautam Bhatia has described public art in India as 'an unflattering form of political deification; it rouses no spirit in the Indian consciousness, placed as it is in the leftover space of the city. As a mismatched moment in a public scene of such debilitating flux, it often goes unnoticed. Besides, its complete incompatibility with its surrounding is a sure sign that the artist and his municipal patrons have not spoken to each other. As a result, most art oscillates between the absurdly realistic to the obscurely abstract: either a full-size Nehru or a meaningless concrete or steel form'. (Times of India, 6 October 2013).

Examples of Public Art in India are visible in a haphazard manner. The capital itself holds many such instances where an attempt to integrate art with public spaces is displayed. Giant pair of spectacles with a mirror in place of the lens mounted on a stone called 'The Mirror' was installed at CP with intent to encourage people to look at their reflection. As it failed to convey the message and interact with the public, this artwork was vandalized and received extensive criticism. On the other hand street art developed by St.+Art Foundation at Lodhi Colony received universal acclamation and is now recognized as the 'Lodi Art District'. The success of this project is mainly due to its (a) extensive public participation which helped people to understand and relate to the canvases (b) central location of Lodi Colony with shaded walkways to encourage pedestrian movement (c) the liberal display of art making it accessible to all enabled a successful Public Art project within Delhi.

Fig. 5: Vandalized Public Art Initiative at Connaught Place, New Delhi



Source: Image - M Manohar, 'Times of India', May 10, 2016,

Accessed from: <http://timesofindia.indiatimes.com/city/delhi/No-place-for-public-art-CPs-Mirror-a-perch-for-vandals/articleshow/52198023.cms>

Fig. 6: Colors of the Soul by Senkoe. Inspired by the beauty of nature at Lodhi Art District



Source: (Photo courtesy - St + Art India/Facebook

Accessed from: <http://www.thebetterindia.com/47808/street-art-india-foundation-lodhi-colony/>

Similarly like Delhi, Mumbai is another important city in India where Public Art has started gaining momentum. Mumbai also lacked any history related to Public Art and the only form of Art in public spaces seen for a long time are the statues of notable men erected during British Raj. Being an exceptionally fast paced city, Mumbai does not stop or pause to appreciate any new addition within the urban space, and this has led to the failure of many Public Art endeavors. Another reason for the failure is the lack of open/public spaces. Mumbai's density being very high has caused the city to lose most of its urban fabric which is readily seen in international cities such as New York, Chicago, and London. R.K. Laxman's 'Common Man' statue showing the man standing in deep thought was vandalized and therefore was replaced by a seated statue which also became famous for photo options with the visiting public (Joshi, 2016).

There is no central mandate for uniform implementation of Public Art in India; hence different states within the country have started initiating a dialogue on Public Art at the city level. Delhi is one of the first cities to adopt strategies for Public Art and incorporate it within development policies. The Unified Building Bye Laws for Delhi (UBBL 2016) has included a chapter stating the provisions of Public Art. Following are few of the clauses extracted from the document:

- The extent of public art (measured in terms of cost) should be at least 1 percent of the cost of construction of the structure as per prevailing CPWD rates, and

Fig. 7: R. K. Laxman's Common Man at Worli Sea Face, Mumbai



Source: (a.) Accessed from: http://afternoondc.in/letters/protect-the-common-man/article_57644 (b.) Image -Balu Velachery, Flickr, January 25, 2011
 Accessed from: <https://www.flickr.com/photos/balu/5388914635/in/photostream/>

- Public art work shall be incorporated in the building sanction plans for scrutiny by Delhi Urban Art Commission' (Chaudhari, 2016).

Unified Building Byelaws 2016 document also cites the role of various local authorities to expend up to 2 percent but not less than 1 percent of the cost of building works for works of Art:

'Design proposals submitted must outline how the sum of money allocated to art is to be utilized (Unified Building Byelaws', 2016). Cities like Hyderabad and Bengaluru have also progressed in embracing Public Art, many endeavors demonstrated involvement of local and international artists to create art districts. WIP (Work in progress) by St.+Art Foundation is one such example curated to revitalize unconventional and neglected public spaces and talk about issues related to the city which affects the population at large. Air pollution being the most popular problem

Fig. 8: WIP Delhi, 2016 by St. + Art Foundation



Source: (a.) (Photo courtesy - St + Art India Foundation and Nidhi Sharma Accessed from: <http://kyoorius.com/2016/02/wip-st-art>) (b.) Accessed from: <https://www.st-artindia.org/delhi-2016>



within Delhi gained quite an attention at the exhibition. In addition to this, governments have collaborated with various artists and NGO's to use Public Art as a medium to illustrate social issues through different forms - murals, workshops, installations, screenings, talks, etc. being the most acceptable techniques.

4. CONCLUSIONS

Works of art in India are predominantly enclosed or concentrated in certain locations. The meaning and sense of what art can be and its impact on a society are unknown to the majority. The new era of development in the nation has opened gateways for a number of international collaborations. Being a fresh canvas many artists and visionaries are keen to explore various possibilities of curating public spaces with works of art. India's diversity permits her to possess a vocabulary for art which when used for the community can mould the space to accentuate the urban fabric. To encourage this local artistry and create further alliances which impart imageability, recommendations are laid in which every state sets up framework to incorporate public art as a strategy within the development/implementation process and not treat it as an appendage. The absence of awareness and acumen related to public art within local governments, there is a need to initiate a program for public art to amplify the outreach of includes these works of art and also to incorporate them into the design and building process. The program should ensure: Review, and approval of applications for public art projects after thorough scrutiny; ensure the working of the public art program; advocate for public art to enhance awareness and maximize outreach, and the program may suo-motu promote without prejudice, any proposal and project related to public art.

The program aspires to benefit the society, should take into consider the as pacts, like (i) Urban Development: as an effective tool for revival and rejuvenation of the surroundings; to open spaces for interaction; to explore various art forms; integrating public art with mobility; enhance walking and cycling experience by the inclusion of numerous art elements infused in the surroundings making them vibrant and lively; and pedestrian friendly neighborhoods creating livable cities. (ii) Preservation of Art and History: to become a tool in preserving historic culture of an area, space or site by integrating urban design with art features; it would become an instrument to display the local art and culture of that area, space or site; promote tourism; to establish a network of tourist nodes and also create new tourist destinations; and it becomes an effective tool to market tourism both domestically and internationally due to its inherent link with arts and culture - key factors in tourism.



Many cities across the globe encourage the creation of Public Art. India being one of the fastest urbanizing countries has started attaching itself to the urban aesthetics within the public spaces, yet there is a long way ahead for not as a concrete and glass jungle but to create cities with soul.

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"Development plans reflect the changes which are taking place in the country's economic and social structure as well as the directions in which the structure has to be reorganised and strengthened. In a democracy the pace of change depends to a large extent on increase in public understanding and in public response and on the growth of a scientific outlook on the part of large numbers of people. Besides the economic and social objectives, the educational aspects of planning are, therefore, of great importance".

Jawaharlal Nehru



Integration of Master Plan with Economic Policies: A Review of Special Investment Regions

Prof. Neha Bansal, Ph.D.; and Prof. Aditya Purohit

Abstract

This paper tries to understand the spatially inclusive economic growth parameters in urban planning. As the urban development in most of the cities in India is envisioned and implemented through master plans. Therefore, it is important to understand the strategies towards inclusive economic growth within the framework of master plans. The author observes that Special Investment Region SIRs are based on integrated approach. A Special Investment Region (SIR) is not merely export-oriented but it is also focusing on FDI boosting strategies and it offers a range of services that compliance with local / regional planning. The paper identifies the prospects under which the economic policies can comply with master plans for achieving sustainable integrated development.

1. INTRODUCTION

Urbanization issues and myriad of problems in India are beyond the institutional capacity of Master Plans. With rapid urbanization Urban Local Bodies face a great challenge, especially development of new areas and in the extending areas to extend urban services like water supply, sanitation, solid waste management (Ahluwalia, 2011). The projections for planning are mostly obsolete and the services fail to deliver the desired results. For instance, there has been some shortfall in institutional investment in the Sixth Plan: against the target of Rs. 1,700 Crore, the achievement was Rs. 1,544 Crore About 2230 towns have approved master plans and for another 400 towns, the master plan is under preparation at different stages against total number of 7,933 towns as per Census of India 2011 (Kshirsagar and Srinivas, 2014). Somehow, it has been observed over the years that Master plan has not been able to bear the anticipated fruits as desired which have been associated with reasons like -weak data base, financial constraints, lack of resource mobilization, over ambitious plan proposals, lack of integration between spatial planning proposals with economic development plans and inadequate legislative support, lack of flexibility in development approach; complexity, multiplicity of authorities with overlapping legislative roles, etc, It has been noted, the economic policies and master plan conflict each other during implementation especially in case of Special Economic Regions

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where only aim of the policies is to boost investment irrespective of the developmental issues in the region (Department of Land Resources, 2013). In light of these issues, the governments across the world tried to come up with some innovative solutions where they integrate the economic activities with Developmental Plans to promote harmonized development. But steps have been taken globally to integrate the development plan with economic policies. In India SIR (Special Investment Regions) are a step towards this. This paper explores and debates on the SIR policy and its implications on spatial and regional planning. We further try to identify various approaches for integrating the two parameters based on existing literature. Therefore, this paper reviews the core challenges of master plan and tries to identify key areas. The entire paper is divided into four sections, where the first section talks about the statutory status of Development Plan preparation and challenges associated with its implementation; Second section describes the case of Special Investment Region (SIR) as a prospectus to overcome the challenges faced by current development plan implementation. Third section highlights the possible areas of interventions for bringing about changes by understanding the best practices around the World. The final section concludes with these parameters in mind and looks forward to the future of master plan preparation and implementation in light of these identified aspects.

2. MASTER PLAN AND ITS KEY CHALLENGES

2.1 Master Plan: Vision and Objective

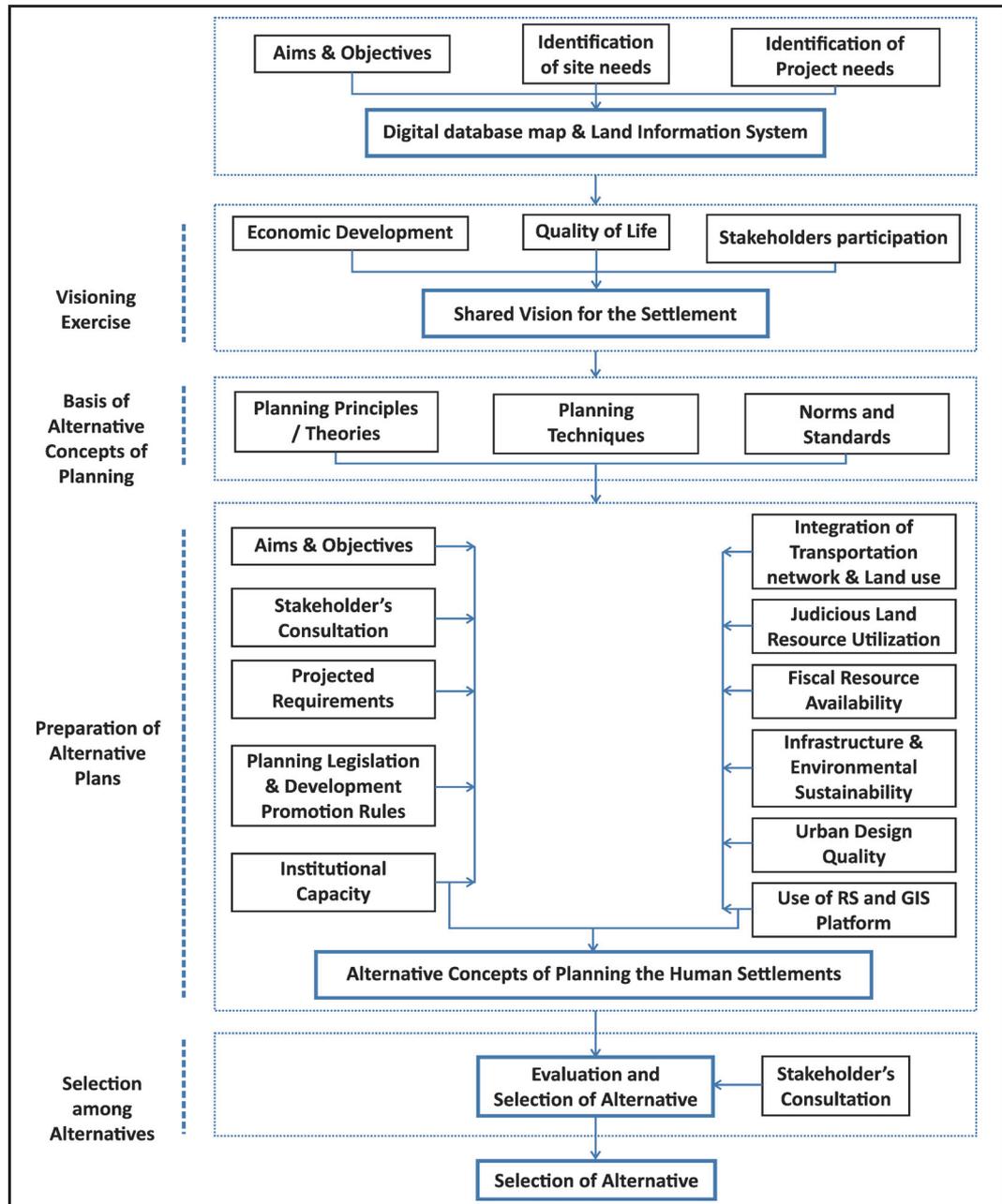
Development plans intend to formulate the blue print of the 21st century envisioned to be efficient, sustainable, adaptive and comprehensive with strong capabilities to coin the future development (Center for Good Governance, 2010). To achieve this vision, legal and statutory framework is primary for preparation and implementation. It therefore, becomes a part of mandatory governance. The Directorate of Town and Country Planning in every state is responsible for preparation of Development Plans at all levels in the State (MoUD, 2016), under State Acts such as Gujarat Town Planning and Urban Development Act, 1976, Tamil Nadu Town and Country Planning Act 1971, etc.; which are based on the country's 'Model Regional and Town Planning and Development Law, 1985' (Kshirsagar and Srinivas, 2014). Under the 74th constitution amendment act and its implication on the statutory process in town and country planning, First UDPFI Guidelines were prepared in 1996.

The statutory process of Master plan given in URDPFI includes following stages - determination of aims and objectives, Identification of Site needs, identification of projected needs, plan formulation, inclusive planning, Statutory Obligations, decentralization of Plan approval process, peoples participation, plan



modification, review and revisions of Plan (URDPFI, 2014). The process of Master Plan preparation is lengthy which can be observed from the Figure 1. The Master Plan is based on an assessment of the existing situation, and outlines a vision for development, strategies for achieving this; indicative investment requirements and operating plans, indicating how investments made are to be sustained. The plan usually includes the broad aims of the Government towards specific

Fig. 1: Plan Formulation Process (URDPFI, 2014)



areas, e.g. housing, infrastructure, community facilities, healthcare which are reinforced by more detailed policies and objectives (Kshirsagar and Srinivas, 2014). The policies and objectives can be critical in determining the appropriate strategies for development. Development Authority is the custodian of Master Plans and are entrusted the responsibilities of implementing the proposals of Master Plan. The Master Plan after the consent of government is notified and date of publication is generally the date of implementation of plan with this aim the first master plan for New Delhi came into existence in 1962 and subsequently till date approximately 1500 master plans are prepared and around 500 are under preparation.

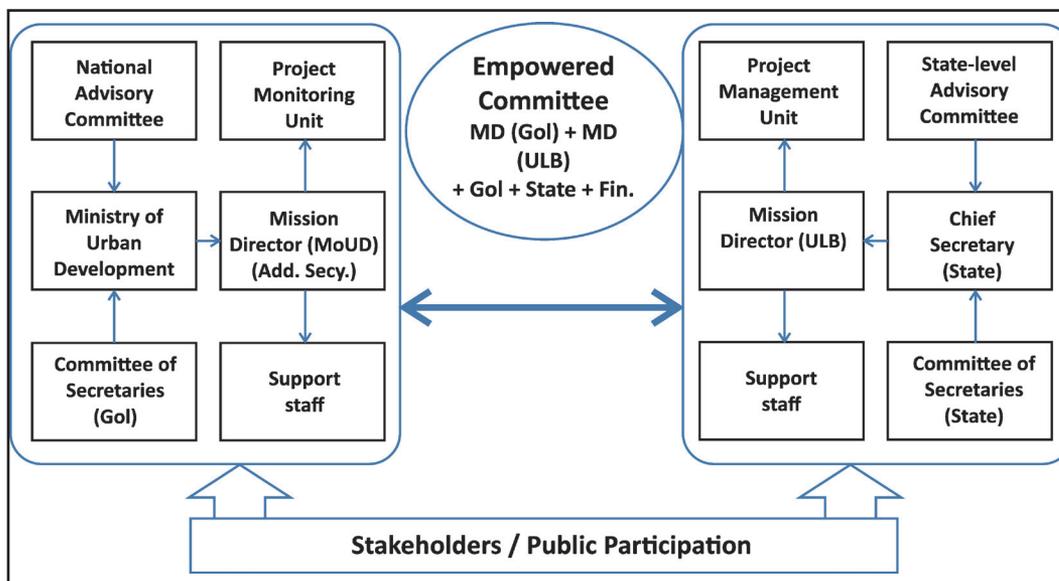
2.2 Key Challenges in Implementation

The success of a Master plan lies in its implementation framework (Fig. 2). Master plan implementation faces many hindrances ranging from political to economical, financial to institutional and from physical to socio - cultural problems. Being a statutory document, it can be implemented through planning authorities and local authorities only. It has been observed that they often failed to ensure regionalized efficient strategies needed for successful implementation of Master Plan. Similar and other key challenges have been described as follow:

2.2.1 Ineffective Policies Guiding Plan Implementation

Ineffective policies for executing Master Plans have led to improper implementation and hindrance to optimal use of available resources. Such policies sometimes cause significant harmful impact on social welfare and

Fig. 2: Plan Implementation Framework (URDPFI, 2014)





economic productivity. Understanding the case of Singur in west Bengal, land acquired from farmers for the proposed project of auto manufacturing unit was resulted in great failure where the locals raised agitation against the returns they were provided. It was further resulted in shifting of project to another state and idling of land for almost 10 years (Pandathil, 2016). Thus, an ineffective policy worse affected the local community socially and economically.

2.2.2 Time Consuming Planning Methodology for Implementation

The comprehensive master plan preparation and implementation approach adopted by the majority of practitioners is based on the traditional paradigm of “survey-analysis-evaluation-plan-Implement”. This approach involves technocratic-time-consuming-rigid procedures. As a result, due to prolongation of implementation, the envisioned results are not achieved. A noteworthy example to this is a case of Varanasi Master Plan. The Master Plan 2011 prepared in the year 2001 had proposed widening and infrastructure up gradation of 28 core city road. However, not a single road was undertaken for up gradation as result of approvals from associated departments and local community agitation. Moreover, new outer city ring road was proposed to address the issues of traffic congestion in the city. But development authority was unable to release funds and land to NHAI within stipulated time resulted worsening of traffic issue (Dikshit, 2013). Proposed Development Plan and proposals require approval by planning and local authorities and ‘No Objections’ from the city dwellers before their implementation. This has resulted in taking unnecessary long period of time, thus delaying developments in most of the local authorities. In some cases, independent developers go ahead with their developments with no regard to Development Plan and many of such developments have health and environmental consequences on the life of the society.

2.2.3 Weak Institutional Structure of Implementing Agencies

In recent years, discrepancies in implementation by developers, planning authorities, ULBs and state government have been observed due to scale and level of power of implementation. Institutional coordination problems arise between the planning agency and local government or state planning authorities and central ministry. For instance, non-coordination between various authorities responsible for waste collection and disposal, roads and utility management in urban areas has led to deceleration of development activities in respective areas. Further due to fragmented administrative powers of various intuitions, there is loss of valuable resources.

2.2.4 Inappropriate and outdated Urban Planning Regulations

Planning legislations in form of land use plans, zoning, subdivision regulations, building codes, and other public policies shape and guide development are too



static and inflexible like some existing development control codes, the building and zoning regulations (Singh, 2013). These acts and statutes are sometimes too rigid and outdated and not confronting to the countries' current social, economic and political circumstances.

2.2.5 Urban Political Instability and Interference in Implementing Development Plan Proposals

Political interference in municipal authorities has limited the local authorities' ability to fully regulate and control development. Influential government officials have been known to enforce physical Development Plan approvals that do not meet the stipulated requirements. For instance, the then Chief Minister of Uttar Pradesh, Ms. Mayawati while in power, constructed mega scale monuments across the city showcasing and advertising their party symbol (elephant). Such development was against City Master Plan provisions, sheer misuse of public money (approximately Rs. 1,000 Crore) and land, arbitrary and a sheer violation of development control regulation (Mathur, 2016).

High demand and land speculations in cities have led to overlook of development control regulations by authorities / officials. Therefore, violation in land use against the stipulated land use code especially in case of open spaces has been reported. There has been lack of adequate political support for the pursuits of the objectives and aims of town planning and development control.

2.2.6 Weak Regulatory Framework for Punishing the Defaulters

The Master Plan enlists rules and regulations to be followed by developers. But the fines levied on such offenders are, most of the time, low and affordable; hence it does not deter them from disobedience when compared to gains. In a striking case, "The Haryana government was charged with deliberately favoring and monetarily helping Vadra, by granting him a license to develop commercial properties on a 3.5 - acre plot in Sector 83 of Gurgaon in 2008. The government sold the plot to Vadra for just Rs 7.5 crore whereas its market price was much higher and so Vadra was able to sell the property to India's largest real estate developer, Delhi Land and Finance (DLF) for Rs 58 crore, just three months after buying it at a heavy discount" (Bhatnagar, 2016).

2.2.7 Inadequate Awareness of Planning Activities and Public Participation

It has been noted by practitioners that citizens are not aware of the concurrent planning activities and regulations in their cities. This results in lack of public participation in master plan preparation which in turn reduces



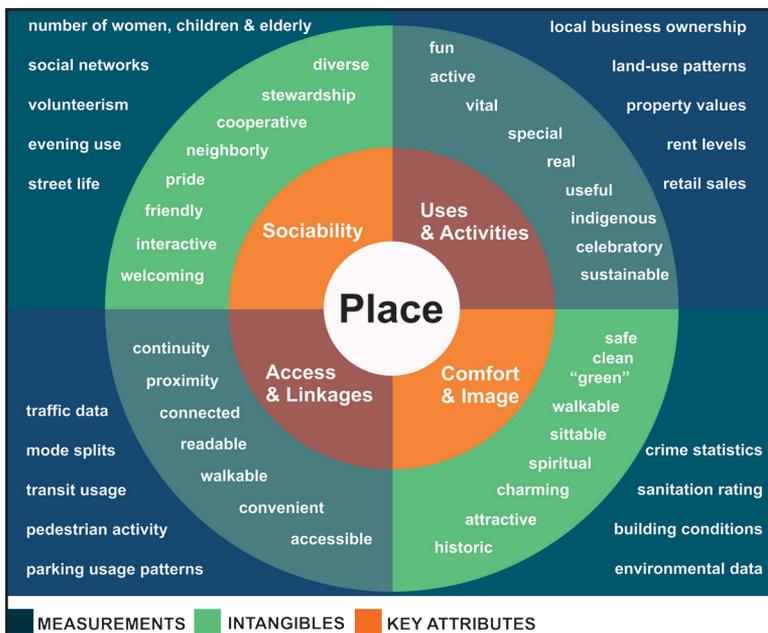
the probabilities of successful implementation and its compliance with the local issues.

In light of these issues, there is a call to go for more sustainable master plan. The next section discusses the concept of sustainable master plan and strategies in brief.

3. SUSTAINABLE MASTER PLAN

Asustainable master plan can be understood in context of two aspects one the urban planning strategies (Sustainable Urbanism) need to be sustainable and second it needs to have sustainable implementation strategies. Sustainable Urbanism is an emerging movement that combines the creation and enhancement of better livable and diverse places with the need to build high-performance infrastructure and buildings (“Sustainable Urbanism”, 2016). It is an approach that encourages cities to begin to integrate walkable, transit-based transportation systems along with high performance green buildings and associated infrastructure into their current developments and ongoing plans. The concept focuses specifically on “sustainability and livability.” Sustainable development (through master plan implementation) can be implemented in cities, towns, and neighborhoods through coordinated leadership and communication (Zhu, 2016). The strategies can be used to move a city into a more sustainable path: Increasing sustainability through density, integrating transportation and land use in an auto-dependent era, creating sustainable neighborhoods with walk-to-work neighborhood centers of locally-owned businesses, car-sharing on every block, walkable neighborhoods

Fig. 3: Sustainable Master Plan Principles



and universal accessibility. Additionally, a regional planning approach requires thinking beyond jurisdictional boundaries when designating land uses. It requires active collaboration among public entities at all levels of government to determine “larger picture” land development and preservation goals. Further, this approach highlights the cross-cutting and multi-layered nature of land use issues (Sustainable Urbanism, 2016).

A promising strategy to achieve sustainability is to work cooperatively across boundaries to protect and manage land. For



example, the impact of a cross-border green space can be much greater than attempts to protect open space in one city alone. When we talk all this with respect to planning and implementation, the regional planning authority can ensure all residents a sustainable environment, regardless of income that they can live and work near and have access to nature, areas for recreation and leisure, and public spaces that connect them to their community (Community Tool Box, 2016). Transportation Plans that connect across municipal boundaries are important in our growing metropolitan areas. In fact, in many major cities such as Atlanta, Phoenix, and Chicago they have a sustainable development plan. Even though majority of the workforce in their region commutes from outside city limits. Example - Sustainability Master Plan 2020 Acciona; Regional Plan for Sustainable Development Kansas City America (2007-17); Sustainable city Singapore (2012) (Webb, 2012); Copenhagen Implementation Plan (Nordhvan, 2014; DTU, 2014); are some successful examples where the development plan blueprints are sustainable in terms of planning and implementation. They can be referred for further details. The next section discusses one of the key aspects of sustainable master plans and that is its integration with economic policies.

4. INTRODUCING ECONOMIC POLICIES THAT INTEGRATE WITH DEVELOPMENT PLANS

Such successful examples demonstrate to be more innovative and regionalized in our strategies. But it is just not master plan in isolation but it has to be understood in relation to finances. First it should be revenue generating and second self sustaining. The master plan formulation process should incorporate the economic reforms and policies existing at that time as well as futuristic policies. Towards strong economic boost, countries and governments in particular had infested the Idea of Free trade or Special Economic Zones (SEZ) as tool to generate employment, opportunities, promote and diversify exports, increase technology transfer and attract investment flows.

4.1 Economic Policy SEZ Failed to Deliver Development Goals

SEZ is technically a geographical region that has economic laws that are more liberal than a country's typical economic laws (Menipaz and Menipaz, 2011). An SEZ is a trade capacity development tool, with the goal to promote rapid economic growth by using tax and business incentives to attract foreign investment and technology (Mishra, 2008). As per statistics of 2011, there are approximately 3,000 SEZs operating in 120 countries, which account for over US\$ 600 billion in exports and about 50 million jobs (Mishra, 2008). By offering privileged terms, SEZs attract investment and foreign exchange, spur employment and boost the development of improved technologies and infrastructure. But on a time bound process these did not pay off as intended. Recently, governments have been trying to move away from the traditional zones with the traditional set of objectives and policy tools to either more comprehensive or sector specific zones.



In addition, they are trying to incorporate other development policy instruments to their policy packages to tackle other issues such as skills development, rural development and green growth while achieving the traditional objectives. But before we try to identify the solution, we need to understand as to why the government went for makeshift from SEZ to a more rationale investment strategy called, Special Investment Region (SIR):

- SEZs have had a controversial existence. While attracting huge investments and promoting industrialization, they have been mired in protests over forced land acquisition, inadequate compensation to land-owners and trampling of citizen rights. It is essential to rework the SEZ policy and modify it to suit the Indian context (Tejas.iimb.ac.in, 2016). Current status and operational occupancy clearly state (SEZ) fell short on their aspirations and their Development Plan along with their integration. The primary goal earlier was export oriented mechanisms and working hence all other approaches took a back seat.
- Development of infrastructure without a guided, descriptive and directional approach was missing. Land use is the primary tool for Development and Infrastructure, whereas it should be an overall comprehensive development plan with a vision and approach. Environment and Ecology are not addressed. Private developers seldom attribute their proposals towards a comprehensive development plan and goals other than capital gains. Holistic development is missing.
- Integration with other large scale plans often is not thought of due to private entities focusing on business gains and not public welfare. No regulation on minimum size or area of a SEZ (Department of Commerce, 2016). In a small zone, the requisite infrastructure and services cannot be provided nor can multiple economic activities be promoted.
- Intense agriculture land is acquired and the farmers are being paid disproportionate money which is not in lieu of the current land prices (Varma, 2015). Moreover the greatest problem that seems to be emerging out is that arable land is being used for nonagricultural purpose which could lead to food crisis and loss of self-sustenance in future.

Hence a new approach and tool of SIR was introduced to overcome the shortcomings of all previous attempts of SEZs, FPZ, FTZ, etc.

4.2 Special Investment Region (SIR) is a Step towards Integrated Approach

The concept of SIR has been evolved in concurrence with Delhi-Mumbai Industrial Corridor, a high impact industrial area within 150 km distance on both side of DFC (Dedicated Freight Corridor admeasuring 1499 Km from Dadri - NCR to JN Port - Mumbai) (GIDB, 2016). To create large size Investment Regions and industrial areas and develop them as Global Hubs for economic activity supported by world

Fig. 4: Dholera SIR Transport Nodet



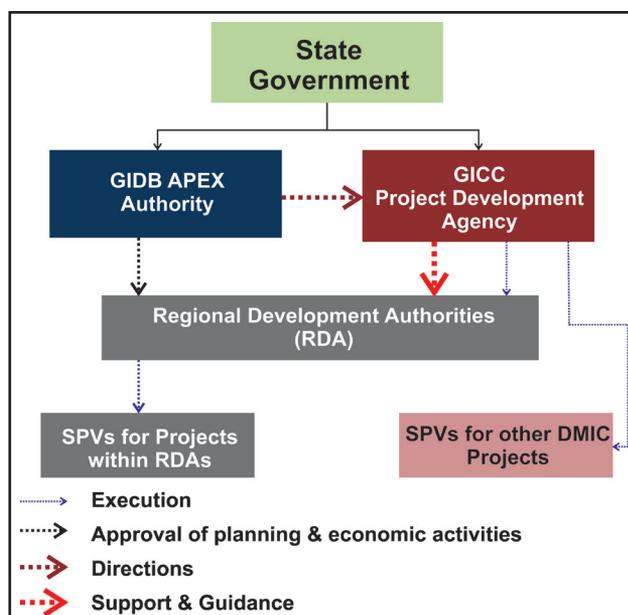
Fig. 5: Dholera CBD (“Dholera SIR”, 2016)



class infrastructure, the Government of Gujarat has enacted ‘The Gujarat Special Investment Region Act - 2009’ which came into force on 6th January, 2009 (GIDB, 2016). Thus, an SIR is different from SEZ (special economic zone) - as it is bigger and is not merely export-oriented; instead offers a range of services. In Dholera, the first SIR to be developed, a residential city is to grow vertically based on digital planning and it will coexist with industrial estates, a hub of financial and banking services and educational institutions (Aditi Phadnis, 2012). Unlike SEZ which comprises of only industrial activity, SIR also includes residential commercial and other amenities over an area of more than 100 square kilometers (Mallick and Singh, 2016). SIRs host industries across various sectors; supported by modern infrastructure, premium civic amenities; centers of excellence and proactive policy framework (Gujarat Industrial Development Corporation, 2016). Though presently only one SIR is functional, there have been 11 SIRs proposed.

The Apex body for approving SIRs is the Gujarat Industrial Development Board (GIDB) in Gujarat. Gujarat Industrial Corridor Corporation (GICC) is project coordinating agency which itself or through Regional Development Authority (RDA) identify SPVs for projects within SIR. This new approach focused on the following aspects and also tried to mitigate the shortcomings of previous efforts: A self-governed economic region enjoying full support of the government and full potential for private sector participation; Logistic support of the Freight Corridor linked with efficient rail and road network. It can be linked with metro rail system, has proximity to sea port, closeness to international airport, has premium civic amenities, and has autonomy in operations, flexibility in decisions.

Fig. 4: Organization Structure for Developing a Special Investment Region 2016





Though this was a very positive step but it still is under lot of criticism and many issues have been coming up with respect to its holistic integration. These have not been discussed in depth here and can be referred in references. But there are many other successful examples across the world which indicates that development goals have been and can be successfully integrated with economic goals to achieve a holistic sustainable development. These have been discussed in very brief in next section.

5. GLOBAL PRACTICES FOR INTEGRATING ECONOMIC AND DEVELOPMENT GOALS

It is very crucial for any region to be sustainable and successful to decrease the gap and create balance between the parameters of *spatial planning* and *economic policies*. Economists often are not equipped to integrate spatial planning factor; and urban planners often don't get a chance to go beyond the traditional mechanism of development plan making. Hence, a new breed of theory is required to assimilate the two and integrate them. The paradigm shift towards both approaches has led to various theories like Spatial Economic Planning, Geographical Economies and New Economic Geography. A review of global practices gives an insight of some of the most successful model.

5.1 South Africa's National Spatial Development Perspective (NSDP)

In 2007, South Africa launched Provincial Spatial Economic Development Strategy (PSEDS) with a principal aim to focus where government directs its investment and development. The concept of the PSEDS is a modern and a robust way of directing public sector resources to address spatial inequality in levels of development. Spatial approaches to economic development present immense benefits to policy makers such as focused investment decisions, efficient use of land resources in addressing spatial inequalities and are a tactile method of expediting employment creation. In addition, by focusing on space policy makers can think specifically about competitive attributes between economies from local municipalities to districts. Spatial economic planning helps governments to formulate policies that consider their surroundings and competitors in defining alternative scenarios for sustainable growth. This strategy ensures that the resource endowments of a regional economy are fully exploited to achieve development in that particular area (Sihle and Hamadziripi, 2010).

5.2 Middle East and North Africa Region

The MENA Region has aggressively sought new approach for their planning and implementation of various economic zones. They have focused on certain key aspects of investment climate, paradigm shift from SEZ, A zone wise approach and lastly the incentives and subsidies. These guidelines



serve as a tool to help governments maximize the success of FEZs in meeting their objective of integrating economy and spatial planning. The guidelines touch on the use of incentives; performance measures, cluster land-use strategies, linkages to the domestic economy, and an expanded role for the private sector in zone management. MENA Region has practiced following guidelines for the physical development and economy generation (Marrakech, 2009):

- Implement Land Use Planning and zoning efforts in defined areas for industrial and commercial development to attract private developers; and
- Develop Zone designation criteria in the zone law and implementing regulations to ensure that private zones are conveniently located (near population centers and transportation hubs) and minimize off-site infrastructure development costs for public authorities.

5.3 German Exclusive Economic Zone (EEZ) through Marine Spatial Planning

In the German MSP process, special effort was made to maintain the competitiveness of the shipping industry. The planning process focuses on establishing a route network under traffic separation schemes (TSS) based on the trade activities and frequently travelled routes. By minimizing barriers to shipping, this procedure contributed toward increasing the safety and efficiency of navigation (“Marine spatial Planning Initiative”, 2016). MSP in Germany is based on a set of guidelines, including:

- Strengthening economic capacity by orderly spatial development and optimization of the use of space;
- Securing and strengthening marine traffic;
- Promoting offshore wind energy use in accordance with the Federal Government’s sustainability strategy;
- Long-term safeguarding and use of special characteristics and potential in the EEZ through reversibility of uses, economic use of space, and priority for marine-specific uses; and
- Securing natural resources by avoiding disruptions to and pollution of the marine environment.

6. CONCLUSIONS

This paper shows that economic policies and development goals which can prove to be very efficient, needs to relate them through spatial planning and incorporate regional influences into them. Some best practices of sustainable development and master plan strategies indicate that steps or ways which can become base references while working on this aspect of master planning.



As it is seen that weak governance, lack of data, lack of legislative support, complexities of governance systems are key factors which influence integrated implementation of Master Plans, it is also suggested to identify reforms to first deal with these parameters. The way forward as we get to identify is that the ULB, local authorities and other sectors which are working on local levels need to bring their efforts on a common platform and then move forward to the framing of holistic framework.

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