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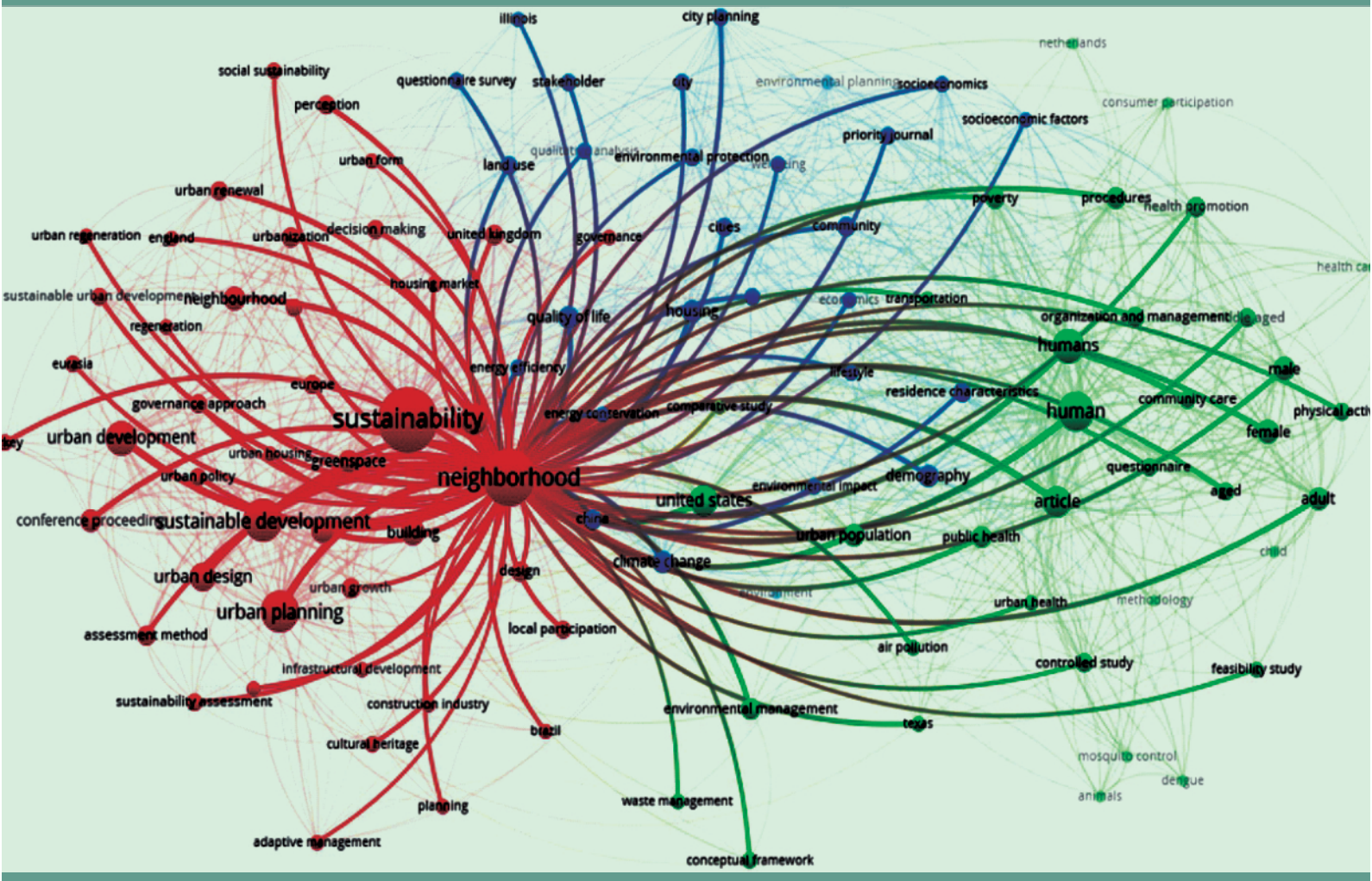

Planning for a Resilient and Low Carbon Cities;
Integrated Townships: A Spatial Planning Initiative;
A GIS based Approach for LULC Changes

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Editorial

This issue of the ITPI Journal comprises of seven papers, of which the first paper focuses on the theme 'Planning for a Resilient and Low Carbon Urban India'. The paper is authored by A. K. Jain. This paper highlights that urban India is passing through rapid socio-economic transformations leading to increasing carbon footprints, climate change, and disasters. Therefore, there is a need to re-look at the repertoire and processes of urban development which should shift from the fossil fuel era to the circular metabolisms in urban planning, renewal, recycling and conservation of natural resources.

The goal of planning interventions is to achieve socio-economic wellbeing of communities, which is the essence of democratic way of living. Identifying suitable methods to ensure community participation through information and communication technologies is the new challenge. The paper on 'Framing the Potential of E-Participation for the Implementation of Redevelopment Schemes in India' written jointly by Sanjeev Kumar, and Krishna Kumar Dhote, explores the potential of e-participation to enhance community participation for redevelopment and planning. It recognizes how e-participation approaches facilitate urban redevelopment processes. Researchers argue based on their research, planners could construct new knowledge and develop an appropriate approach in the form of a planning framework.

In the third paper written by Bageshree Yeolekar-Kadam, on the theme 'Exploring the Role of Neighborhood Habitats for Sustainability', the author underlines the intrinsic dynamics between character, design and structure of settlement impacts, as well as the identity and sustainability of a 'neighborhood-habitat'. Hence, it becomes important to explore possibilities of interventions at spatial and policy levels, leading to sustainable and people centered development against an economy - centered or people-defiant development. It becomes inevitable to understand and review neighborhood level planning approaches in the existing settlements through neighborhood regeneration approaches.

Aayushi Godse and Vijay Kapse have written their paper on 'Integrated Townships: A Spatial Planning Initiative' for studying the concept of an integrated township created by combining three separate aspects of life i.e., "Live, Leisure, and Work" - the concept of walking to school, office, and shops. An integrated township is a collection of dwellings and commercial businesses with supporting infrastructure such as schools, roads, hospitals, convenience stores, drainage, and sewerage systems. However, the basic objective of this paper is to discuss spatial planning initiatives taken in relation to integrated townships in India.

COVID-19 pandemic has significantly impacted urban life, accordingly urban planners and policy makers engaged in spatial planning and management need

to consider how a people-oriented approach could be incorporated in spatial-planning systems to reduce negative impacts of such pandemics and endemics in cities and on people. The paper is written on the theme 'Resiliency of Indian Cities' jointly authored by Sudhir Singh Chauhan and Gurpreet Kaur emphasizes to adopt effective community based spatial planning systems, and formulate guidelines and management rules in order to improve spatial planning in cities during periods of extraordinary change and challenge.

The paper on the theme 'A Methodology for the Optimum Selection of World Heritage Sites: Destination Competitiveness Approach' is authored jointly by Md. Danish and Manjari Chakraborty. They show that UNESCO, a UN Body responsible for fostering the growth of national and international tourism by designating important sites as World Heritage Sites. UNESCO upholds tangible and intangible character of regional, national and international heritage sites. This paper applies the 'Destination Competitiveness Concept' to select the most optimum destinations among the 7 Archaeological Survey of India protected UNESCO World Heritage Sites for 'Site Management and Service Enhancement', by using the concepts of 'Site Profitability', 'Site Efficiency' and "Site Sustainability", which is inextricably linked with the Destination Competitiveness model.

The last paper on 'A GIS based Approach for LULC Changes: A Case of Guwahati, India' is jointly authored by Swati Gupta and Seemi Ahmed. The paper states that each year several hectares of green cover is lost due to unplanned urban growth, particularly in the developing countries, which is resulting not only in depletion of bio - diversities but also a reason for major urban challenges like flooding, soil erosion, earthquakes, several diseases, etc. Numerous Indian cities face these issues due to unplanned developments, which result in changes of land use and land cover. The study assesses changes in land use and land cover (LULC) pattern of the Guwahati city using Landsat imageries for the year 1990, 2000, 2010 and 2020.

Prof. Dr. Prafulla Parlewar
Editor, ITPI

Prof. Dr. Ashok Kumar
Chief Editor & Secretary Publication

Content

Planning for a Resilient and Low Carbon Urban India

A. K. Jain

Abstract

Urban India is passing through rapid socio-economic transformation leading to increasing carbon footprints, climate change and disasters. There are conflicts among spatial planning and sustainability due to chronic peripheral development, increasing pollution, transport, energy, and water consumption. It needs re-looking at the repertoire and processes of urban development which should shift from fossil fuel era to the circular concepts of urban planning, renewal, recycling and conservation of natural resources. Leapfrogging in the areas of fourth industrial revolution would help in making the cities resilient, pollution free and carbon negative.

1. INTRODUCTION

Climate change has become an imminent reality with a rise in global temperatures, changes in rainfall, floods, droughts, air pollution and water shortages. With increasing traffic, wastes and stubble incineration, fossil fuel usage, carbon footprints and growing air conditioning, it is projected that the ambient temperature can increase by 3.0° C to 4.8°C, adversely affecting population's health and productivity. This may cause a 30 % decline in agriculture yield and an increase in incidences of droughts, floods, cyclones, earthquakes, pandemics, urban heat islands and changes in microclimate due to radiant energy in the earth's atmosphere. India continues to suffer from deadly air pollution in the North, while the South is inundated by catastrophic floods (November 2021). This calls for rethinking the paradigms of urban development so as to deal with the threats of climate change, pollution and disasters.

2. INDIA'S PERSPECTIVE AT THE COP 26 (2021)

In 2015, the Sustainable Development Goals (SDGs) were adopted by the United Nations, which were signed by 193 countries, including India. As a follow up, the United Nations Conference of the Parties (COP 26) in Glasgow (November 2021) resolved to limit global warming to 1.5 degree Celsius by the year 2100. Indian delegation led by Prime Minister Narendra Modi put forward the need to scale up clean technologies and formation of the International Solar Alliance (ISA). Under the ISA One Sun, One World - One Grid envisions an interconnected trans-national solar energy grid. The COP 26 agreed to reduce the use of fossil fuels and coal by new sources, such as green hydrogen, green metals, carbon capture,

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solid state batteries, electric fuels, heat pumps and next generation solar PV. Prime Minister Modi put forward his five-point agenda at the conference, and informed that India's non-fossil fuel energy will be raised to 500 GW by 2030 and 50 % of the power requirement will be met by renewable energy. This will reduce the carbon intensity of the economy to less than 45 %. India will achieve net zero emissions by 2070 by clean technologies, like electric transport, ethanol blending in gasoline, solar photovoltaic and batteries. The green and zero carbon technologies would play a critical role in India's decarbonization. India has also led the formation of a global coalition for Disaster Resilient Infrastructure (CDRI) and Clean Energy Ministerial Industrial Deep Decarbonization Initiative (IDDI). Prime Minister Modi underlined at the COP 26 that there is a need for a mindful balance between development and environment.

3. RE-IMAGINING URBAN PLANNING

Carbon footprint is the total set of greenhouse gas (GHG) emissions. According to the Indian Network for Climate Change Assessment, 58 per cent of the total emissions are caused by the energy sector, followed by the industrial sector at 22 per cent, and remaining 20 per cent by solid and liquid wastes, agriculture and forestry. Linked with it is the phenomenon of climate change and disasters, which impact infrastructure services, housing and livelihoods.

The urban and community development should be complemented by a shift in our way of life, which is resilient, sustainable and equitable. It is not just economic but aligns with the humane, environmental, cultural and socio-economic dimensions of development.

Resilience is defined as "the ability of a city as a socio-ecological infrastructural system and its components to absorb and recover from shocks whilst retaining the essential functions and adjust to stresses to re-organize, develop, and transform in order to adapt to socio-economic and environmental changes, over temporal and spatial scales".

This implies certain basic changes in the planning and urban processes, which are resilient and reduce the use of natural resources and energy. Carbon-intensive technologies can help in mitigating climate change. These should conform to net-zero energy and water standards, thrift consumption and doing more with less.

According to United Nations International Strategy for Disaster Reduction (UNISDR), the Disaster Risk Reduction (DRR) related activities comprise 10 essentials, which cover planning regulations; plans and development activities; setting up institutional structures dedicated to DRR; constructing or enhancing hazard-mitigating infrastructures; and setting up education / awareness / training programmes. (Table 1)

Table 1: UNISDR's 10 Essentials for Making Cities Resilient

Institutional and administrative framework.	Put in place organization and coordination to understand and reduce disaster risk based on participation of citizen groups and civil society; build local alliances; ensure that all departments understand their role in disaster risk reduction and preparedness.
Financing and resources.	Assign a budget for disaster risk reduction and provide incentives for homeowners, low-income families, communities, businesses and the public sector to invest in reducing the risks they face.
Multi-hazard risk assessment.	Maintain up-to-date data on hazards and vulnerabilities; prepare risk assessments and use these as the basis for urban development plans and decisions; ensure that this information and the plans tor your city's resilience are readily available to the public and fully discussed with them.
Infrastructure protection, upgrading and resilience.	Invest in and maintain critical infrastructure that reduces risk, such as flood drainage, adjusted where needed to cope with climate change.
Protect vital facilities: education and health.	Assess the safety of all schools and health facilities and upgrade these as necessary.
Building regulations and land use planning.	Apply and enforce realistic, risk-compliant building regulations and land use planning principles; identify safe land for low-income citizens and develop upgrading of informal settlements, wherever feasible.
Training, education and public awareness.	Ensure that education programs and training on disaster risk reduction are in place in schools and local communities.
Environmental protection and strengthening of ecosystems.	Protect ecosystems and natural buffers to mitigate floods, storm surges and other hazards to which your city may be vulnerable; adapt to climate change by building on good risk reduction practices.
Effective preparedness, early warning and response.	Install early warning systems and emergency management capacities in your city and hold regular public preparedness drills.
Recovery and rebuilding communities.	After any disaster, ensure that the needs of the survivors are placed at the centre of reconstruction, with support for them and their community organizations to design and help implement responses, including rebuilding homes and livelihoods.

Source: UNISDR (2013) "Toolkit for local governments – 10 essentials", http://www.unisdr.org/campaign/resilientcities/toolkit/essentials

4. INDIA'S URBAN MISSIONS

Since 2014, the Government of India has launched several new urban missions, viz. Smart Cities Mission, Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Pradhan Mantri Awas Yojana, Historic City Development and Augmentation Yojana (HRIDAY) and Swachh Bharat Mission (SBM). The SBM 2.0 and AMRUT 2.0 continue to operate with effect from October 2021.

These missions aim at low carbon urbanization and the provision of core infrastructure services like water supply, sanitation and solid waste management, efficient urban transport, affordable housing for the poor, 24x7 power supply, IT connectivity and e-governance. These missions emphasize upon participatory

planning and governance, livelihoods, connectivity and providing better education, healthcare, urban safety and smart services, which are intelligent, interconnected and instrumented. These Missions also encourage issue of Municipal Bonds, public-private partnership (PPP), Value Capture Financing, Transfer of Development Rights (TDR) and Tax Incremental Financing. Besides Town Planning Schemes and GIS based Land Pooling have been proposed for planned development and management of land.

5. RESILIENT AND LOW CARBON CITIES

The cornerstone of making a city resilient and low carbon is to adopt an integrated approach towards ecology, the conservation of the natural resources and sustainable urban development, including the services like drainage, water supply, air, sewerage, solid waste management, transportation and energy. These involve the action on following:

- Local Economic Promotion and Jobs;
- Urban Restructuring for socio-economic growth, decentralization, economy of scale, better quality of life, mixed land use, and compact urban form;
- Biodiversity and Greenery;
- Urban Heat Island Mitigation;
- Water Conservation and Management;
- Decentralised and Intelligent Services;
- Air Quality;
- Clean Transport and Transit-Oriented Development;
- Energy;
- Green and Resilient Buildings;
- Gender Equity;
- Low Carbon Lifestyle; and
- Local Economic Promotion and Jobs.

In India, the cities generate the country's 60 % of GDP and 70 % of the jobs. With Covid-19 pandemic, climate change and diminishing jobs, the factors of public health, creation of jobs, environmental sustainability and climate resilience are the emerging key issues. A target of 10 million jobs in urban areas can be achieved in next five years by development of *janta* markets, workshops / sheds, kiosks, shops, small offices, etc. At least 10 per cent of city's commercial area may be reserved for the informal sector (street vendors, kiosks, fruit and vegetable stalls, etc.). The urban areas also need a higher level of mixed use and the rationalization of FAR / FSI, height and densities.

6. URBAN RESTRUCTURING

The urban restructuring can lead to travel reduction, economy of services and conservation of agricultural areas. The Indian cities have an overall density of 100 to 240 ppha, which can be selectively doubled along public transit corridors, excluding the archaeological, heritage and conservation zones. The focus has to be on redevelopment of the brown fields, infrastructure services, transportation, public greens and facilities. The urban eco-system must be compact and dense. The urban planning, governance, businesses and industries have been transformed by fourth industrial revolution. The processes need to change which are compatible to circular economy by adoption of new technologies, such as combinatorial and discrete optimization, algorithms, complexity theory, artificial intelligence, big data, and the ubiquitous cloud. The new development strategies are essential for a green, clean, smart and emissions free urbanism.

7. BIODIVERSITY AND GREENERY

A study of the present land use pattern in India indicates shortfall of land under forests and greens, while the lands under agricultural use are being increasingly converted for the highways, airports and settlements. It is estimated that an additional 2 to 3 million hectares would be required for human settlements during next 10 years. Sacrificing agricultural land for habitation implies reduction of land for producing food. The lands that sustain agriculture, biodiversity, surface water and groundwater, fragile and sensitive areas, coastal zones, etc., need protection and conservation.

In a city an overall area of 10 sq m of greens per capita should be reserved for public greens at city, zonal and local levels. A system of landscaped linkages connecting various parts of the city, water bodies and monuments can provide a sense of oasis and shelter from oppressive climate. Peripheral green belts can act as wind breakers, filters of SPM and dust-storms. The green buffers with indigenous trees, land formations, mounds, embankments, etc., also provide effective barriers to transmission of noise.

The development of green ways can be integrated with the water bodies, drainage corridors and harvesting ponds, reservoirs and by sediment traps in the catchment zones. In water deficient, dry areas the landscape can be in form of Xeriscaping, which can reduce total water demand by as much as 50 % to 90 % by micro- just in time-irrigation. Vertical gardens and urban farming can provide relief in the dense areas.

8. URBAN HEAT MITIGATION

In a dense built up area air rises over the warmer city and settles down in the cooler environs. The hot air dome and its effect on microclimate may persist until wind or rain disperses it. Increased aerodynamics of built-up areas cause rapid deceleration of wind compared with open countryside. It has been calculated

that wind velocity within a city is half of what it is over open land. At the town edge, it is reduced by a third. The mutations and reservation of greenery and open space in windward direction and cooler surface materials (roads, parking, buildings, roofs, etc.) help in mitigating the effects of urban heat island.

9. WATER CONSERVATION AND MANAGEMENT

Water scarcity has become a persisting problem in Indian cities due to massive construction and unplanned development. The average annual per capita water availability in the country has gone down from 5,236 cubic meters in 1951 to 1800 cubic meters in 1991. Several cities in India have become water stressed. Only 18 % of the renewable water resource is being recycled, while 10 % of the annual rainfall is being harvested in India. The issues of concern are increasing coliform levels and Bio-chemical Oxygen demand (BOD) in surface waters and increased concentration of nitrates in the groundwater. To overcome these problems, water sources need to be protected by interception, recycling and treatment of wastewater. Water resources can be augmented through recharging of groundwater and by rainwater harvesting (not only in building, but also on roads, parks and parking areas) along with conservation of rivers and water bodies, water efficient taps / fittings, dual plumbing, curbing Non-Revenue Water and recycling of wastewater. Blockchain and SCADA systems can help in 24x7 water supply, which is of potable quality.

10. DECENTRALISED, INTELLIGENT SERVICES

Surveys reveal that approximately 40 % of urban population in India is not covered by sewerage, sanitation, drainage and solid waste disposal. Various alternative technologies, based on decentralized systems should be explored. The use of IT, simulation, blockchain and automation can make the services smart and intelligent. The common method of land filling for solid waste disposal is an environmental disaster. Instead, decentralized systems based on 5 R strategy of reduce, refuse, reuse, recover and recycling should be explored. Three bins provide separate bins for trash, recyclable and compost. Collection charges drop as trash drops. Biotechnology, enzyme based STP, bio-remedial treatment vessel system, sludge gas / energy recovery, vermi-culture, fossilization and compositing options can be adopted for solid and liquid waste management. Underground pneumatic conveying systems can be adopted, which are more hygienic, economical and avoid movement of trucks for transportation of wastes.

Common utility ducts or tunnels carrying electricity, water, sewerage, wastes, cables and broadband internet minimize damage from traffic, road repairs, rains, etc., be encouraged. A series of low carbon zones across the city with co-located tri-generation energy systems (combining power, cooling and heating), and automated, segregated waste collection and recycling can lead to bundling ‘green infrastructure’ together.

11. AIR QUALITY

Air quality in Indian cities is deteriorating due to indiscriminate use of fossil fuels and vehicular and industrial emissions. According to the surveys conducted by the CPCB ambient air quality in more than 20 Indian cities have reached a very critical situation. Relatively high levels of suspended particulate matter, dust, SPM, SO_2, NO_2, CO_2 and heavy metals, including lead content in the exhaust of automobiles and scooters have been observed. The recent changes in the fuel like electric and hydrogen powered vehicles, adoption of clean technologies, new emission norms, development of shared taxis, NMTs and mass rapid transport system can reduce the pollution levels due to vehicular emissions. Airshed planning, continuous ventilation, use of cooler and light shaded materials and water spray are some other methods to reduce air pollution

12. CLEAN TRANSPORT AND TRANSIT ORIENTED DEVELOPMENT

Prime Minister Narendra Modi, while inaugurating the Global Mobility Summit in September 2018, encapsulated 7 Cs of mobility i.e. common, connected, convenient, congestion free, charged, clean and cutting-edge. He underlined the need to use clean energy for transport as a powerful weapon against climate change, along with pollution-free clean drive. He championed the idea of clean kilometers which could be achieved through bio-fuels, electric charging and hybrid electric vehicles.

The MOHUA has recently issued Metro Rail Policy (2017) and Transit Oriented Development Policy (2017), which provide guidelines for preparing comprehensive proposals for promoting urban public transit with private sector participation.

As urban transport contributes nearly two-thirds of the total suspended particulate matter and 18 per cent of carbon emissions, it is time to think of sustainable modes of transit. It may be necessary to provide Integrated Transit Corridors (ITC) integrating BRT, Metro and trains together with pedestrian and cycle lanes. These can be flanked by public, semi-public, high-density developments. Metro, trains, sub-way and primary roads can run underground for easy bike and pedestrian traffic on the grade. Multi-modal integration, last mile connectivity and e-governance are the pillars of sustainable urban mobility. River / water transport and ropeways can be explored which are almost pollution free and cost-effective. Besides controlling growth of private vehicles, it is necessary to explore parking space in stilts, multi-level puzzle / skeleton structures, on roofs and in underground spaces. Seamless multi-modal public transport system comprising bus rapid transit and rail-based mass transport system would work better by adoption of single ticketing and restructuring of land uses by transit-oriented development. Subterranean garages near commuter destination reduce the need for ground parking. Digital parking meters tell mobile phone when a space opens up, reducing traffic caused by drivers trolling for space. The concept of walk to work should be the basis of urban structure and city size.

The concepts of cordon pricing, minimum occupancy vehicles, ceiling on new registration of private vehicles and establishment of a Unified Metropolitan Transport Authority can contribute towards a sustainable and clean urban transport.

13. ENERGY

Energy scenario in India is characterized by its increasing demand, which has been growing at the rate of about three times the population growth rate in the last two decades. Low carbon energy can be derived from renewable sources, such as bio-fuels, wind, tidal and solar power. The concept of energy efficiency, renewable energy and Zero-fossil Energy Development (ZED) can reduce the energy demand and consequential pollution. The renewable energy not only helps in energy generation, but also in a pollution-free environment. Smart Micro-Grids, Distributed Energy Systems (DES), Micro-Districts and Anchor Micro-grids should be linked with renewable energy network and energy efficiency.

The energy guzzling air-conditioning can be avoided by innovative methods like Net Zero Energy Design, variable refrigerant volume (VRV) system, earth air tunnel (EAT) and thermal storage. By HVAC and EAT systems inside temperature of a building can be maintained within 27 degree Celsius during summer and 19 to 24 degree Celsius during winter. Lower ambient lighting with bionic controls and integration of natural light with high performance glazing combined with light sensors can save energy use in a building. Optimum glazing design can also help to reduce glare. Synchronized lighting and bionic climate control systems can be designed to match building loads and schedules, which are segmented into multiple zones to allow intelligent controllability. Green roof, light colored finishes and insulation can help to reduce energy demand.

14. GREEN AND RESILIENT BUILDINGS

A low carbon and green building aims to be comfortable and energy efficient. The heating, lighting, cooling, ventilation and powering of buildings are responsible for approximately 40 % of the total energy use. As buildings are the largest energy users, incorporating energy storage into them will increase the resilience of the total energy distribution network and enable widespread use of renewable energy.

By passive design the building can be more climatically comfortable. It is necessary to specify building materials which are locally sourced and recycled from construction and demolition; wastes that have low embodied energy and require less energy for production and transportation to the site. Such materials include carbon-negative cements, low carbon steel, and fiber. The alternatives to steel reinforcement for bridges and buildings with low carbon emissions include basalt, fiber composite bars, bamboo, etc.

Building Information Models (BIM) can simulate the entire construction sequence beforehand addressing sustainability issues and reducing carbon emissions.

Computer-Aided Manufacturing (CAM) and Computer Integrated Manufacturing (CIM) are useful in reducing emissions, dust and GH Gases. The simulation of construction process enables better control of time, machine, expenditure and the manpower, and could reduce carbon emissions, costs and time by half to one-third.

15. GENDER EQUITY

Low carbon and resilient strategies cannot work without involving the women, who comprise nearly half of the population and use energy for everyday work, mobility, cooking, etc. However, they often face the 'gender service gap' in terms of access to energy, water and toilets. A low carbon city has to be gender sensitive with adequate, safe and affordable spaces for living, working and vending by the women.

16. LOW CARBON LIFESTYLE

Low carbon lifestyle is a cluster of habits, embedded in a social context and enabled by efficient infrastructures that minimizes the use of natural resources and generation of emissions, wastes and pollution. Creating sustainable lifestyle requires a change in social norms and rethinking the ways of living based on the principles of organicity, non-accumulation (*aparigraha*), minimalism and slowing down. It is also about caring, sharing, recycling and living in balance with the natural environment. Education, capacity building and participation of civil society, business and industry are necessary to develop pragmatic and innovative practices of sustainable lifestyles.

17. CONCLUSIONS

A resilient and low carbon city comprises smart and green transport, energy, water, sanitation, drainage and buildings with net zero carbon emissions. It produces surplus energy from renewable sources that compensates for all carbon emissions associated with the transport, construction, industries and buildings. Net zero energy development goes beyond carbon neutral and creates an environmental benefit by decarbonization. Such a city promotes creation of jobs, urban variety, gender equity, digital planning and governance, adoption of micro-climatic design approach and intelligent services. Optimum use of land and other resources and smart systems along with new partnerships are critical elements of a resilient, low carbon habitat.

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Framing the Potential of E-Participation for the Implementation of Redevelopment Schemes in India

Sanjeev Kumar, and Krishna Kumar Dhote

Abstract

The goal of planning intervention is socio-economic in nature and the community participation remains as essence of democratic approach. Identifying suitable method to ensure community participation through information and communication technology is the new challenge. Decision has to be made on procedure adopted, multilevel participation of various stakeholders and sections of community and extent during the process for participation. The research explores the potential of e-participation tool to enhance community participation for redevelopment planning. It recognizes how e-participation approaches facilitate urban redevelopment process; as a result, researchers can construct knowledge and choose the appropriate approaches to develop a framework. It highlights issues related to redevelopment, role of community participation and identification of e-participation tools, methods and process for better implementation redevelopment projects. It has been concluded in the paper that, even though challenges exist, e-participation approaches offer promising solutions for inclusive urban planning.

1. INTRODUCTION

With growing population, people are moving towards urban areas for better economic opportunities and lifestyle. The urban population will constitute 66 percent of total population by year 2050, whereas the total percentage of urban population in the year 1950 was only 30 percent (UNDESA, 2014). The rapid urbanization in developing nations created problems of housing scarcity, inadequate infrastructure leading to poor quality of life (Doorn et al., 2019) mostly affected the marginalized section of society (Chaudhuri, 2015). Urban sprawl, inequality and social conflicts have affected the connection between different sections of society and hence larger development agenda mainly lead to poor participation of pro-poor communities in states' welfare goals. If the momentum of urban development is to be maintained, urbanization will have to be addressed on priority with inclusion of urban poor in redevelopment schemes.

The goals of planning are socio-economic in nature where community participation is the essence of democratic approach (Selman, 2004). A decision has to be made on type of process, level of the citizen participation and its extent during a process. The prevailing methods of public involvement in the planning

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and implementation process are limited. Extent and effect of participation is determined by the organizational structures of local planning authority. There is a need of e-government tools for urban local bodies and other parastatal agencies to notify and engage their citizenry in planning process.

2. REVIEW OF INDIAN URBAN REDEVELOPMENT SCHEMES

The term, urban redevelopment signifies a complex phenomenon interfacing the humans with their historical, physical, environmental, and socio-economic relationships. It is a process of re-planning and comprehensive redevelopment (Stones, 1967) of land structures, physical infrastructure and social amenities, as well as protection and redevelopment of areas which have been or are being threatened by decline or are in need of preservation and conservation because of historical or cultural linkages, associated with a city or a town. Modern attempts of urban redevelopment began in the late 19th century after the World War-II in response to the destruction in the war under the rubric of reconstruction. Since then urban redevelopment has become an essential means of development (Samanta and Nallathiga, 2019). The earlier policies of World Bank recommend reshaping living conditions of urban poor settlements from focusing on upgrading slums through community participation (Mukhija, 2001). Neo-liberalism has altered development strategies in fundamental ways; its relevance to slum redevelopment is three fold through policies of decentralization, privatization, deregulation and demand-driven development (Nijman, 2008). This has increased involvement of non-governmental organizations (NGOs) and community based organizations (CBOs) in development policies (Mahadevia et al., 2018).

In India, a high proportion of the urban population lives in slums (Appadurai, 2001) that have poor quality housing, inadequate basic infrastructure and other civic services (Agarwal, 2011). The government of India has made many attempts to eradicate, regularize and redevelop slums by subsidizing programs to provide formal housing for the urban poor (Bhan, 2009). Urban redevelopment schemes in India came in light since year 1966 with the launch of Urban Community Development (UCD) Scheme. Later, urban slums got special attention through slum up-gradation and improvement schemes. Slum Redevelopment Scheme (SRS) invited government agencies, private developers and individual households together for project implementation and maintenance in late 20th century. From 2001 to 2005, most of central subsidy-based housing projects were brought under the Valmiki Ambedkar Awas Yojana (VAMBAY). VAMBAY had a provision for the “involvement of beneficiaries” in the efficient construction of new houses. Government of India (GoI) combined housing schemes under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) in 2005. Basic Services to the Urban Poor (BSUP) sub-mission of JNNURM provided subsidies to states and urban local bodies (ULBs) to construct houses and basic services. The guidelines tailored to

improve urban governance that states adopt community participation laws to ensure a participatory process. NGO and CBO participation in BSUP projects had no place in the decision-making process. Lack of technical awareness became grounds for exclusion of urban poor from influencing the course of development. It is challenging to ensure participation at the local level without an enforcement mechanism (Livengood and Kunte, 2012).

In 2009, the national administration initiated Rajiv Awas Yojana (RAY) for urban development and slum redevelopment. RAY conceived a participatory process to prepare slum free city plan of action, including slum up-gradation plan and tenure security. RAY also stipulates that agencies should identify and engage NGO / CBOs to guide and anchor community mobilization for slum survey and preparation of slum level redevelopment plans. The policy guideline recommends that decision-making should necessarily be done with the involvement of the community (Mahadevia and Datey, 2015). Slum redevelopment scheme was re-branded with convergence of old slum rehabilitation schemes in India's recent national housing program, Pradhan Mantri Awas Yojana (PMAY) Housing for All 2022 (Mahadevia et al., 2018). Table - 1 lists slum redevelopment schemes of Government of India discussing the role of stakeholders. The identified key stakeholders are government, private sector, NGO / CBO and individual Households.

Table 1: Stakeholders' Role in Indian Urban Redevelopment Schemes

Urban Schemes	Year	Stakeholders			
		Government	Private Sector	NGO / CBO	Household
Urban Community Development	1966	Scheme implementation	No Active Role	Community level services managed by CBO	No Active Role
Slum Improvement Program	1972	Scheme implementation	No Active Role	No Active Role	No Active Role
Economically Weaker Section Housing	1972	Scheme implementation	Contractors constructed DUs	No Active Role	Household share for DU
Slum Up-gradation Schemes	1976-77	Scheme implementation	No Active Role	Community organizing for upgrading	Payments for post-project maintenance
Slum Redevelopment Schemes	1995	Responsible to regulate the scheme	Implemented by private developers	No Active Role	Payments for post-project maintenance
Slum Networking Program	1997	Scheme implementation	Partial finance share	Organizing community	Share in DU cost
National Slum Development Program	1996	Scheme implementation	Contractors constructed DUs	Primary health care centres management	No Active Role

Urban Schemes	Year	Stakeholders			
		Government	Private Sector	NGO / CBO	Household
Valmiki Ambedkar Awas Yojana	2001	Scheme implementation	Contractors constructed DUs	No Active Role	Household share for DU
Basic Services to the Urban Poor under JNNURM	2006	Scheme implementation	Contractors constructed DUs	No Active Role	Household share for DU
Rajiv Awas Yojana	2009	Scheme implementation	Slum redevelopment for PPP model	Organizing community for project development and maintenance	Household share for DU
In-situ Slum Redevelopment under PMAY	2015	Regulating scheme, Providing fiscal subsidy and public lands	Implemented by private developers	No Active Role	Household bear full costs
Credit Linked Subsidy Scheme under PMAY	2015	Providing fiscal interest subsidy on home loan	No Active Role	No Active Role	Bearing DU costs with subsidized loans
Affordable Housing in Partnership under PMAY	2015	Regulating scheme and providing fiscal subsidy	Implemented by private developers	No Active Role	Bearing full subsidized DU costs
Beneficiary-led construction or enhancement under PMAY	2015	Regulating scheme and providing fiscal subsidy	No Active Role	No Active Role	Bearing DU cost after subsidy

Policies have also evolved to encourage and mandate greater inclusion in slum improvement schemes (Livengood and Kunte, 2012). Policy makers should focus on people, organizations and processes in different mode of participation (Corbett and Keller, 2006) for inclusive slum redevelopment. Public participation in India has been discussed in the town planning and development acts inviting objections and suggestions at the stage of plan preparation. Nowadays; most of the funding of the central government programs to states was linked to participation (Raisi et al., 2015). Recent initiatives have been made by the Government of India about its policy commitments towards urban development with focus on basic services to urban poor. These include such populist slogans as “slum-free cities”, “inclusive cities”, “cities without poverty”, “Housing for All”, etc. The Guidelines of Community Participation released by the Ministry of Housing and Urban Poverty Alleviation (MoHUPA) also endorses the fact that local people have enormous common sense and, consequently, are often capable of finding creative solutions to problems that are apparently technically insoluble.

E-participation may act as powerful tool and for planners it becomes relevant to use information and communication technologies (ICT) (Wallin et al., 2012). ICT improves public service delivery and also enables governments to better engage citizens, called “e-participation” (Zheng, 2017).

As the traditional methods of linking the community in development planning and implementation process, are often limited in both extent and consequence and are determined by the structure of organization in a local authority. E-participation applications in urban development aiming at better citizens engagement, propose to have well-designed tools to contact government, participate in discussions and propose their issues in a convenient way (Zheng, 2017; Coleman et al., 2008) to promote effective enhancement and involvement of citizens towards e-governance (Shofia et al., 2020). Tools such as discussion forums, online chatting, online polls and video / photo sharing could be introduced to promote public participation. The e-tool application in community participation is a nascent approach. Table - 2 presents modes of participation in current urban schemes having potential for the application of ICT.

Table 2: Modes of Participation in Government Schemes for Urban Areas

S. N.	Urban Schemes	Scheme Concerns	Modes of Participation
1	Pradhan Mantri Awas Yojana (PMAY)	Addresses housing requirement of urban poor including slum dwellers by promoting slum rehabilitation, and affordable housing for all.	Housing demand survey through MIS system, Geo-Tagging of house construction progress, Direct subsidy transfer to beneficiaries bank account.
2	Atal Mission for Rejuvenation and Urban Transformation (AMRUT)	Ensures every household with access to water and sewerage, open spaces and public transport to improve quality of life.	Citizen participation through mobile-based tools, Geo-Tagging of projects at community and HH level.
3	National Urban Livelihoods Mission (NULM)	Social mobilization and capacity building, self-employment programme to support informal sector.	Biometric smart card compatible for use in the ATMs/ Hand held Swipe Machines and capable of storing adequate information on entrepreneur’s identity, assets and credit profile etc.
4	Heritage City Development and Augmentation Yojana (HIRDAY)	Development of core heritage infrastructure projects which shall include revitalization of urban infrastructure for areas around heritage assets.	Making cities informative with use of modern ICT tools and secure with modern surveillance Increase intellectual access (i.e. digital heritage and GIS mapping of historical locations/ tourist maps and routes).
5	Swachh Bharat Mission (SBM)	Elimination of open defecation and achieving 100% scientific management of municipal solid waste. Public awareness and capacity building.	Swachh Nagar- Citizen App, Portal, & Toolkit. Google Toilet Locator search SBM Toilets on Google Map.

These schemes have potential strength and provide opportunities of information dissemination, public awareness, identification of beneficiary, feedback as well as consultation of beneficiaries, geo-tagging of construction sites, online transfer of funds, preparing inventory of services, planning plus design, monitoring of projects, linking of bank account, capacity building and maintenance with operation of services. The Indian national level e-Governance program was initiated in 2006. Government of India has approved the e-Kranti program with the vision "Transforming e-Governance for Transforming Governance". All existing, on-going and new e-Governance projects which are being revamped now follow the principles of e-Kranti namely 'Cloud by Default', 'Fast Tracking Approvals', 'ICT Infrastructure on Demand', 'Integrated Services and not Individual Services', 'Language Localization', 'Mobile First', 'Mandating Standards and Protocols', 'National GIS', 'Security and Electronic Data Preservation', 'Transformation and not Translation'. Participation mode options improve public trust, credibility and assure policy implementation (Empel, 2008). Government of India has launched the Digital India Program to transform India into a digitally empowered society and knowledge economy. 'AWAASApp', 'Collect', 'Individual Household Latrine (IHHL) Application', 'Integrated Poverty Monitoring System' (IPoMS), MIS for 'Slum/ Household/ Livelihood surveys', Mobile Application with Citizen Interface are few initiative case examples of Government of India, taken to improve the e-participation in urban planning process in India. There is paradigm shift in provision of services where conventional services are now being available online and redirecting towards digital market. Its success depends on accessibility and affordability of facilities (Demirhan and Öktem, 2011). There is a felt need for systems like e-government tools that may provide ULBs and other parastatal agencies with an alternative means to notify and engage their population. It will not only encourage citizen participation in the planning process but will also help in addressing the issues of public participation in sustainable community planning.

3. RESEARCH METHOD

Community participation has been recognized as a tool for development planning. There is a statutory requirement to involve community in the planning process but repeatedly limited to the essential level of participation. The participation process should be employed to identify the decision type, level of citizen participation and extent of participation. The research method covers literature review and experts' consultation on review finding for the selection of parameters to prepare an e-participation framework for redevelopment. The study focuses on the key factors of community participation in planning process covering its type, level and extent of participation. Based on these three aspects, an e-participation conceptual structure for public participation has been proposed. The study also reviews the existing e-tools available in public

domain. Study proposes a framework accommodating to understand enforcement of e-participation approaches in urban redevelopment planning processes.

4. EXPLORING E-PARTICIPATION INITIATIVES

Innovative mechanisms of public participation in democratic processes have been relatively well mapped in the last two decades (Bherer et al., 2020). The idea of participation first evolved in the mid-1970s. One of the main reasons for the introduction of participation was the need to overcome a crisis in the administrative system (Hague and McCourt, 1974). Public participation encompasses a group of procedures designed to consult, involve, and inform the public in the agenda-setting, decision-making, and policy-forming activities (Rowe and Frewer, 2000, 2004) that better respond to the needs of those concerned, to the decision-making process and to a greater acceptance of decisions taken (Sardinha et al., 2013). The World Bank defines participation as a process through which stakeholders' influence and share control over development initiatives and the decisions and resources which affect them. Empowerment of public through their participation is a continuous process by which citizen develop and use their ability to shared problems and to achieve expected needs in an effort to bring some changes to community (Samah and Aref,, 2009). Public participation should identify and focus on the interest and needs of all participants (Garcia-Zamor, 2012). For the large part of the 20th century, urban community planning was a field dominated by technological expert engineers. Its humanitarian visions derive their inspiration from the histories of struggles and conflicts for the promotion of a more just and humane social order across the globe. Community participation has been the main appliance to legitimate, democratize and enhance the policy making quality since 1960's (Lourenço and Costa, 2007). It encourages redistribution of power from the authority to stakeholders (Arnstein, 1969). During the 1970s, large-scale urban models started to be criticized because of their dysfunctions. As the global consensus on the importance of community participation in development projects increased, the 1990s saw rampant use of community based environmental planning. Since then, community participation has been embedded in urban development. Planners have been striving to enhance meaningful citizen involvement in planning processes for over forty years (Healey, 2013).

Many participatory modes have been developed to involve the community in societal decisions, including citizen juries, electronic forums, focus groups, web polling, workshops, and other means of consultation (French and Bayley, 2011). It is important to appreciate the key characteristics of the various available public participation methods to establish their effectiveness. Consensus conference, citizens' jury, focus groups, negotiated rule making, public advisory committee, public hearings, public opinion surveys, referenda and workshops are formalized non-digital conventional public participation methods. Influence on final policy

and transparency of process to the public 'Referenda' has highest impact while 'Negotiated rule making has lowest impact (Rowe and Frewer, 2000) for representativeness of participants. These methods are criticized consuming time and money (Irvin and Stansbury, 2004), having poor impact of participation. These have limitation of fixed location at a fixed time (Kingston, 2007) to perform. The inconvenience and associated cost of non-digit methods discourage citizens from participating in urban development.

Later online discussion forums were emphasized that could serve as virtual meeting places to communicate and share views of citizens and policy makers (Phang and Kankanhalli, 2008). The interactive cable methodology could enable the meetings to be televised and allow citizens involvement at the same time from different locations (Barnes and Williams, 2012). These modern digital tools improve the efficiency and effectiveness of citizen participation. The conventional non-digital methods of public participation had limitation with its geographical, economic and time related access barriers. Therefore, the new e-participation methods can perform better only when citizens find digital methods convenient. Online discussion forums, E-voting, E-polling and GIS based electronic methods have digital access which enables people to discuss, online voting or polling (French and Bayley, 2011). Active public involvement for unbiased responses takes effort and continual attention. Therefore, a strategy should be articulated for using appropriate modes and tools to obtain the most effective public participation (Meyer, 2016). There is a growing call for greater public involvement in policy and decision making. A variety of digital and non-digital public participation modes exist that aim to consult and involve the public. The big difference between traditional non-digital ways of participation and e-participation is the application of electronic tools (Zheng, 2017). E-participation has advantages of virtual location and could reduce the costs and time consuming (Irvin and Stansbury, 2004). The use of ICT relaxes the time, cost and geographic constraints faced by participants (Conroy and Evans-Cowley, 2006). Proficiency in using the internet and digital applications promotes the mode of e-participation in urban development.

Citizen participation is often a goal of urban development. However, in reality levels of actual participation are often low, limited to certain sets of stakeholders, and the collaboration between them often poor (Smordal, 2016). E-participation opens up innovative ways of engaging in urban planning where a combination of mobile technologies and geographical information systems are used (Astrom 2020). Besides helping governments to improve service delivery, ICT development also enables better citizen engagement. Emails and online chatting make interactions between citizens and governments more efficient. Blogs and wikis enable citizens to publish whatever content they wish to share

(Breindl and Francq, 2008). Online forums, virtual discussion rooms, electronic juries, and electronic polls (Kim and Lee, 2012) allow governments to better collect public opinions. Futurists and advocates of cyber democracy tout the Internet as a way not only to boost civic involvement but also to create a new civic utopia by promoting total democratic participation (Ferber et al., 2007). All of this brings forward a new form of citizen participation: e-participation. E-participation is used to support democratic decision making (Macintosh, 2004). It is related to the issue of enabling opportunities for consultation and dialogue between governments and citizens by using a range of digital mode (Medaglia, 2012). With the development of ICT, more and more services are being offered online, and people from different sections and classes are increasingly adopting and using e-government modes to get information and services. There is a need to explore opportunities for the efficient use of E-Participation.

4.1 E-Participatory Approach in Indian Urban Planning Process

The ICT was introduced in the mid-1990s, though it was restricted to development of information systems in India. E-governance is the first step towards online democratic participation (Walsham, 2014; Qi et al., 2018) to improve the quality of public services effectively and efficiently (Shofia et al., 2020). There are many initiatives taken to improve the e-participation in urban planning process in India. 'Integrated Poverty Monitoring System (IPoMS)' launched in December 2005 by MoHUPA covered 65 million plus JNNURM cities. 'National e-Governance' a national level program was launched in 2006. The recent e-Kranti program take cares the limitations of earlier programs with the vision of 'Transforming e-Governance for Transforming Governance'. In order to monitor the physical and financial progress in the program a web-based Management Information System (MIS) system called IPOMS was developed with the help of Centre for Good Governance (CGG), Hyderabad. MoHUPA also developed 'MIS for Slum / Household / Livelihood Surveys' system for Municipal Household Surveys in 2009 to prioritize the slum interventions in a particular city under RAY during the preparatory phase. The details of the MIS were linked to the GIS mapping of each slum parcels and the household level details of the beneficiaries, were attributed to the identified beneficiary houses mapped with the help of total station survey on the field. The MIS for surveys was developed to build a robust database of all the information collected through the survey starting from baseline information. With an understanding to reach out to the beneficiaries on real time basis the Geo-tagging application has been developed by the help of Bhuvan application.

'AWAAS App' is a mobile based application which can be directly used by any Pradhan Mantri Awaas Yojana (PMAY) beneficiary to report the physical progress of house under construction. It can also be used by designated PMAY house inspectors to inspect the houses constructed. 'Collect-Data Collection Tool' is

a mobile data collection tool that lets organizations collect data on a real-time basis using android phones. It also facilitated statistical analysis with real time data transfer facility. 'IHHL (Individual Household Latrine)' display details like applicant name, status of commences and constructed toilet photo and payment phase. 'Unified Mobile Application for New age Governance (UMANG)' is an app where people can access e-Governance services from the centre, states, local bodies and their agencies on mobile phone.

To improve the 'e-participation' understanding its application in urban development process, level, parameters and types of participation is required. E-enabling, e-engaging and e-empowerment are another set of three level of participation that correspond to information, consultation and active participation respectively (Zheng, 2017). As literature review pointed the importance of three levels of e-participation: e-enabling, e-engaging and e-empowerment that correspond to information, consultation and active participation, shall be considered for preparing framework for redevelopment.

4.2 Expert's Consultation for E-participation in Urban Planning

Effective community participation can lead to equitable and inclusive development. A variety of interactive approaches have been developed including digitally-enabled planning tools. Planning Support Systems (PSS) efforts are "loosely coupled assemblages of computer-based techniques" forming a kind of toolbox of techniques to help decision-makers in their daily tasks (Batty, 2003). Public Participation Geographic Information System (PPGIS) technologies facilitate soliciting opinion, in incorporating local knowledge and also providing increased legitimacy (Sieber, 2006). Alternative Futures Analysis (AFA) is one of the structured ways of engaging the public through PPGIS efforts (Theobald and Hobb, 2002). AFA is an environmental assessment approach for helping communities to make decisions about land. Agent–Based Modelling (ABM) is a new approach of simulating the model where the actions and interactions of autonomous agents both individual and collective entities such as organizations to assess their effects on the system as a whole (Bonabeau, 2002). Web 2.0, Crowd sourcing, and Collective Intelligence are the application that can harness the collective intelligence of people for making improved decisions (Sungkur and Rungen, 2014).

E-participation tools might be used in a multiplicity of participatory processes. These can be incorporated into existing methods to enhance the communication, education, and capacity building goals. These can also form the basis for potential new decision-making and policy processes, which meet all three goals of public participation: communication, capacity building, and access to decisions. It can assist in finding better solutions to sitting and juxtaposition issues by encouraging

understanding among and across stakeholders. There are many other e-tools for community participation which can provide a variety of mechanisms to facilitate participation but needed to improve its efficiency, accountability and transparency in public participation.

The UN scores for assessment comprise of the categories of e-Information, e-Consultation and e-Decision-Making, and the report underscores that these categories for measurement assume e-Participation at a rather rudimentary level (Shrivastava and Dhote, 2016). After discussion on crucial issues with experts degree of openness, geographical coverage and type of participation involved parameters were finalized for the conceptual e-participation framework in context to redevelopment program in India. On the issue for accessibility of data and details to all stakeholders, the experts suggested that the accessibility in each system may be decided depending on the sensitivity of data and the level of participation. They also suggested that the degree of openness or accessibility shall be defined according to the modalities of the program implementation and the extent of involvement of various stakeholders in decision making (Al-Dalou and Abu-Shanab, 2013). The framework for e-participation should consider factors (Scherer and Wimmer, 2011) like whether or not the system shall be open to public, required registration (Adhaar Card, Voter ID Card) but allowed anyone to register, shall be inviting only. The framework for e-participation must consider degree of effective command and control and multi-party engagement followed by identification of variables that are deemed important to consider before the actual slum planning exercise begins. The final degree of openness shall be to finalize who decides how many and which stakeholders get integrated into a final set for decision-making. This parameter measures the degree of accessibility, e-tool allows during community participation. This will range from None, Registered Access to Full Access.

For e-participation the participant can be identified, city at macro level, neighborhood at meso level, slum site at micro level to facilitate a wider range of consultation and knowledge sharing. The e-participation parameter measures the geographic coverage involved in the process that are directly or indirectly affected by the proposed development. It was suggested by the experts during consultation that the type of participants will affect the quality of resultant plan and thus the due consideration must be given on the level of education, the minimum number of years of education may be set as a criterion. Stage, number and reasons for participation might be considered within participation type. Pre-implementation, implementation and post implementation are three stages of participation. Community participation through e-tools must be understood as a multitude of activities and varying level of participation and must offer many access points, locations and level of participation. Community e-participation

framework requires participants who understand how to handle flexibility in community, in procedures and in practices.

5. CONCEPTUAL E-PARTICIPATION FRAMEWORK FOR SLUM REDEVELOPMENT SCHEMES

Level, parameters and type of participation have been discussed to improve the understanding of 'E-participation' for its application in urban development process. It would help to prepare a conceptual framework for E-participation in slum redevelopment schemes and urban process.

5.1 Level of Community Participation Enabling E-participation

Online E-participation has been ordered in correspondence to the ladder of citizen's participation as defined by Arnstein in 1965. The lowest step is passive supporting of information and the highest one is system supporting decisions working via the Internet. Aenstein's first step of ladder is level of non-participation, presents one-way communication. The second step corresponds to tokenism, allows citizen to have a discussion around urban planning. The third step of the ladder maps consultation level. The final step in the ladder maps to Arnstein's citizen power level, where, through an online decision support system, the citizens are given the final statement in making decisions. The citizen's role changes from the information consumer to the active decision maker when going up the e-participation levels. Macintosh's three levels of e-participation: e-enabling, e-engaging and e-empowerment explain corresponding information, consultation and active public participation (Macintosh, 2004). The purpose of the ICTs' use is also changing as per three levels of participation: (i) in the e-enabling stage ICTs are applied to obtain information concerning policy making initiatives of the government; (ii) ICTs allow citizens' opinions collection on the topic defined by the authority in the e-engaging stage; and finally (iii) e-empowerment allow citizens' for active participation.

5.2 Parameters for E-participation

A report from the UN (2005), which sets out to measure e-Participation development in the world, states: "e-participation development is still in its early stages for most of the countries of the world". The UN scores for assessment comprise of the categories of e-Information, e-Consultation and e-Decision-Making, and the report underscores that these categories for measurement assume e-Participation at a rather rudimentary level. Community participation in any Government program related to slum improvement and up-gradation has been acknowledged as a prime tool for the planning and implementation, rather it is the most primary tool to start with (Shrivastava and Dhote, 2016). These crucial issues were discussed in sessions with the

expert during consultation to identify and finalize the parameters for the e-participation framework in context to slum redevelopment schemes in India. These parameters are: Degree of Openness; Geographical Coverage; and Type of Participation Involved.

Degree of Openness: On the issue for accessibility of data and details to all stakeholders or limited access to selected stakeholders the experts suggested that the accessibility in each system may be decided depending on the sensitivity of data and the level of participation. They also suggested that the degree of openness or accessibility shall be defined according to the modalities of the program implementation and the extent of involvement of various stakeholders in decision making. The framework for e-participation in slum redevelopment schemes should consider factors like whether or not the system shall be open to public, required registration but allowed anyone to register, shall be invite only. Viewed in this light, the framework for e-participation must consider degree of effective command and control and multi-party engagement followed by identification of variables that are deemed important to consider before the actual slum planning exercise begins. The final degree of openness shall be to finalize who decides how many and which stakeholders get integrated into a final set for decision-making. This parameter measures the degree of accessibility e-tool allows during community participation. This will range from None, Registered Access to Full Access.

Geographical Coverage*:* Involvement and local knowledge to be utilized during participatory planning the experts opinioned that the geographic coverage may not be always the locations covered by the initial survey for project planning but may include all that are directly or indirectly affected by the proposed development. For e-participation in slum redevelopment schemes the participant can be identified at city at macro level, neighborhood at meso level, slum site at micro level to facilitate a wider range of consultation and knowledge sharing. This parameter measures the geographic coverage involved in the process that are directly or indirectly affected by the proposed development. This will range from Project Area, Neighborhood to city.

Participants Involved: While discussing the quality of inputs required for the physical or social planning of a slum locality, it was addressed that most participants in slum redevelopment schemes those consulted lacks knowledge on the development issues. It was suggested by the experts during consultation that the type of participants will affect the quality of resultant plan and thus the due consideration must be given on the level of education, the minimum number of years of education may be set as a criterion. Adequate numbers of participants with prudent professional experience for

years must be incorporated and ensured in the stakeholders group. These may be from various professional disciplines depending on the program features and requirements. The professionally trained volunteers serving as city cops to development process may be invited or engaged to facilitate the stakeholder group. Only adults must be allowed for formal participation with authentic identification proof such as Aadhar Identification or Voter ID Card. Stage, number and reasons for participation might be considered within participation type parameters. Pre-implementation, implementation and post implementation are three stages of participation. Number and reasons of participation might have range of any to more than 2/3rd to all and promotion, benefit to learning respectively.

5.3 Type of Participation

Community Participation through e-tools is a multitude of activities and varying level of participation which offer many access points, locations and level of participation. Community e-Participation might function as a tool for participation in slum redevelopment schemes procedures and practices. It can provide a variety of modes to facilitate enhanced participation in the slum redevelopment scheme.

The research finds participation increases along three key dimensions: 1) numerically, the absolute number of participants involved; 2) geographically, the distribution of participants, and 3) professionally, the range of disciplines and expertise able to be involved. Numerically participants were also classified as per their age, educational qualification and their access. It was suggested by the consultant that an adult (18 years and above) by age with at least completed primary education having valid ID proof like Adhaar Card, Voter Card, etc., is required for participating in slum redevelopment schemes. Types of participation ensure the involvement of adequate numbers of participants with prudent professional experience depending on the program. Anyone who has access to e-tool, including those that have been excluded in context to the minimum parameters defined for the participants. Person could be considered as Indian citizen that has proof of Indian nationality as per the standard of government of India. Regional public is other classification in the context refers to the citizen of the region which is directly or indirectly affected by the proposed development intervention in a scheme. Public representative, local representative or elected person might be indirect participant who take decision for a group. Eligible beneficiaries of a scheme would be direct participant. Consultant and technology partner might be participant for any scheme providing services in the development sector and facilitate e-services respectively. Government departments directly or indirectly involved in these schemes play role of facilitator for participation.

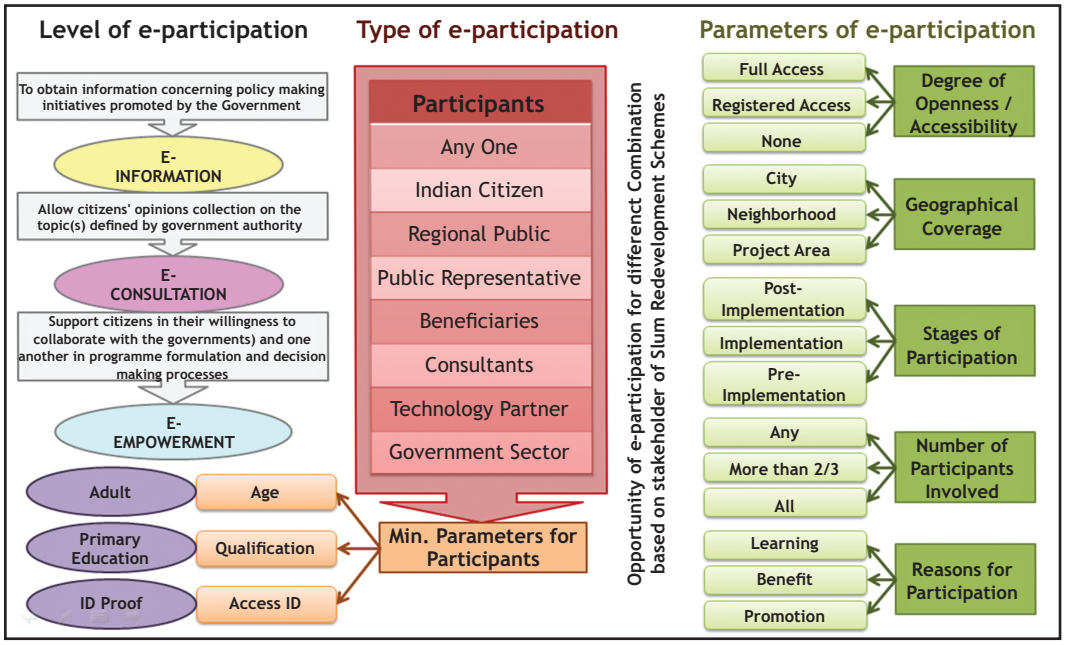
6. FINDINGS AND DISCUSSIONS

Ensuring public participation increases attention of stakeholders, opinion and experience of experts and citizens as potential victims or benefactors. Participative processes generate distinctive demands and demand tailored solutions, so different approaches can be used and have been tested over the years, such as workshops, open houses, community meetings, surveys, etc. However, despite the achievement and recognition in participation field, a long road lies ahead. The Participation Ladder (Hansen and Reinau, 2006) was originally intended as a theoretical instrument for city planners who had to handle public involvement in urban planning. The Arnstein's ladder describes the view that citizens are either manipulated by the authorities or regarded as equal participants in planning and steering activities. Three levels of e-participation: e-enabling (information), e-engaging (consultation) and e-empowerment (active participation) may be reinterpreted from the literature and further discussion with the experts in Indian context.

The identified parameters of e-participation tools can be incorporated into prevailing methods to enhance the communication, education, and capacity building goals. They form the basis for potential new decision-making and policy processes, which meet all three goals of public participation: communication, capacity building, and access to decisions. It provides assistance in analyzing and finding appropriate solutions by encouraging understanding among and across stakeholders. The research explored new dimension for participation as e-tools with review, and the discussion finally leads to the conclusion that e-participation cannot be achieved fully by simply following a model or pre-defined path to improvement rather it demands flexibility in both practice and participation. E-participation is about empowering the community's right and obligation to enact democratic participation, on their terms and in their own fashion. The upcoming e-participation is at nascent stage and will occur and grow with overlap of the old and the new cultural structures.

The approach for selection of parameters is suggested on the basis of learning from the extensive literature referred and expert consultation. Expert's opinion provided the e-participation which is useful in the preparation of framework for e-participation. The level, type and parameter discussed to build framework for e-participation in slum redevelopment in India will improve effectiveness and efficiency of the community participation and facilitate better data for futuristic planning for slum redevelopment schemes (Dhote et al., 2019). It provides a required foreground for the further development of e-tools and the proposed framework have the potential enhancing social learning and social mobilization in redevelopment schemes. The purpose of the discussion is collective learning and to facilitate enhanced accountability, transparency, involvement and awareness,

Fig. 1: Parameters of E-participation Framework



a need that translates well to the public policy sphere. The framework enables stakeholders with a platform to perceive events as per their context, consult and discuss with peer and make them available amongst themselves.

The Expert level consultation was vital in providing the parameters of e-participation framework which have been utilized in the conceptual framework for e-participation. Figure - 1 presents all dimensions of e-participation interrelating its level, parameters and type of participation. Working on framework for e-participation in slum redevelopment scheme will improve effectiveness and efficiency of the community participation. It provides a required foreground for the further development of e-tools to evaluate multidimensional aspects of participation for India. The identified parameters have potential in enhancing social learning and social mobilization in the Indian urban process. The purpose of the framework is collective learning and to facilitate enhanced accountability, transparency, involvement and awareness, a need that translates well to the public policy sphere. The framework shall be able to provide various stakeholders a platform to perceive events differently, discuss them, and make them visible to each other.

7. CONCLUSIONS

Above discussion finally leads to the conclusion that e-participation cannot completely be achieved by following an over simplified model or pre-defined path for improvement. It supports the flexibility of both practices and par-

ticipation. E-participation is about empowering the community's right and obligation to enact democratic participation, on its own terms, in its own fashion whenever it chooses to participate. New roles of e-participation are not implemented, it occurs in the confluence of the old and the new cultural structures only. Levels of participation guide to improve opportunity of information, consultation and active participation of stakeholders in e-participation. Learning from literature and the expert consultation was useful in identifying the type and parameters like degree of openness / accessibility, geographical coverage, reasons for participation, number of participants involved and type of participants involved. The expert consultation provided parameters that would be helpful to facilitate framework of e-participation for redevelopment programs in India. The discussed e-participation parameters help to improve the coverage of participation with their active response in a structured manner. ICT has brought a revolutionary change in the ways of planning. Soft Infrastructure of ICT helps us to regulate and increase the level of e-participation. It has great contribution in urban planning and development also. The future holds a success story of e-Participation through direct and indirect involvement of people.

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Exploring the Role of Neighborhood Habitats for Sustainability

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Abstract

Intrinsic dynamics between character, design and structure of settlements impacts the 'worth' of a society as well as the identity and sustainability of a 'neighborhood-habitat'. Hence, it become important to explore possibilities of interventions at 'spatial' and 'policy' levels, and 'sustainable' and 'people centred' development as against an 'economy-centred' or 'people-defiant development'. It thus, becomes inevitable to understand and review at 'neighborhood' level planning approaches in 'existing settlements' through 'neighborhood regeneration' approaches, which is the primary aim of this paper. To do this the paper analyzed scholarly literature on economically, environmentally and socially sustainable, 'neighborhood level' planning and development approaches at a global scale. It is also endeavored to explore possibilities of interventions that may aid in a 'society centred' development, aimed at nourishing an ethically sensitized society for the generations to come.

1. INTRODUCTION

Early Indian settlements flourished around rivers and thrived together as groups of communities and eventually came to be known by the cultural union based on their belief systems. These communities were known for their religious oneness and culture called for a dedicated space for the exchange of their thoughts, beliefs and emotions, and promoted a sense of belonging.

The gathering point of such communities' evolved to be the religious centre, peculiar to that community. Indian societies were especially known to carry a strong influence of their communal culture and tradition upon the overall expanse of their civilization. The benefits of having a well-defined religious centre were far reached and percolated through the psychology of the entire society and influenced the ethical upbringing of the future generations.

However, the advent of industrialization gradually revealed its side effects. The concentration of activity towards areas fostering trade and commerce that brought about alterations beyond the absorption capacities of town lands; loss of the original character and functionality of spaces; incompetent and limited land resulting to spill over and immature expansions of sprawling towns and cities; are a few sizable impacts.

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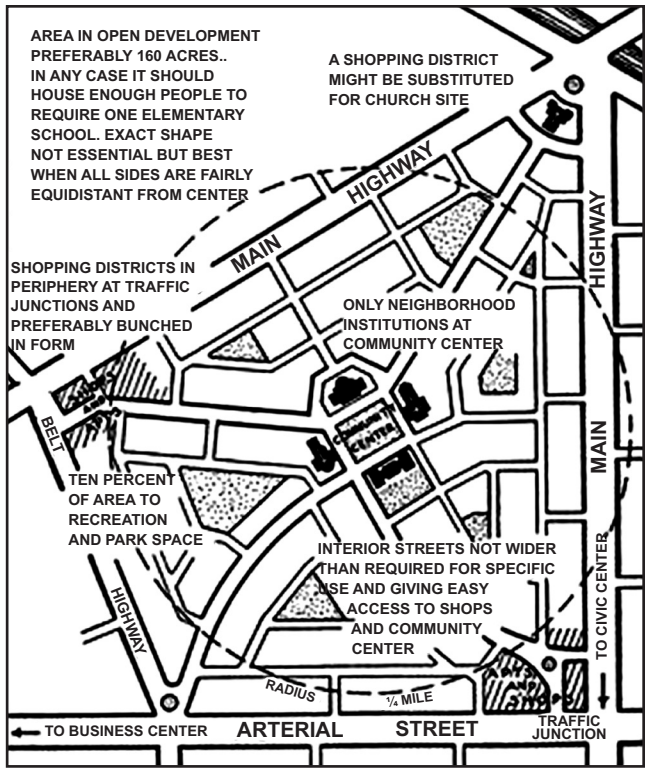
This not only prejudiced the inclusive development, but also impacted the cohesive social life forever. Development turned out to be handicapped, supportive of just an economy-centric approach, while hampering the environmental as well as social 'sustainability perspective' and impacting the advance of an ethically conscious society. Nevertheless, the intrinsic dynamics between the character, design and the structure of settlements, impacts the 'worth' of a society as well as the sustainability of a 'neighborhood-habitat'. It is to be noted here, that a neighborhood is the smallest but a complex spatial unit for studying the overall dynamics of a habitat.

2. EVOLUTION OF SUSTAINABILITY IN NEIGHBOURHOOD HABITATS

The 'neighborhood unit' notion, which appeared from the socio-cultural outlooks of the early 1900s, was created by Clarence Perry. He was an American planner and sociologist. He was also an author and educator. He worked in the New York City Planning Department where he strongly advocated the concept of the 'neighborhood unit'. He also was supportive of neighborhood community and recreation centres.

Fig. 1: A representation of Clarence Perry's 'Neighbourhood Unit', based on the Basic Principles of Town and Country Planning



Source: New York Regional Survey, Vol 7. 1929

The Neighborhood Unit was conceptualized diagrammatically, to act as a 'planning tool' for residential development in metropolises. It was diagrammatically arranged by Perry to act as a context for town planners trying to design self-sustained and appropriate neighborhoods in the beginning of the 20th century in industrializing urban areas.

Figure - 1 depicts the concept of Perry's Neighborhood Unit. It contains a community center and hierarchical road networks, shopping districts in a clustered form and at the peripheries and junctions of the roads. Interior streets are not wider than specified for a purpose and they give easy access to the community centre amenities and shops. There is an open area identified to house additional migration and an elementary school. The highways and the arterial streets connect the neighborhood to the CBD.

There are areas demarcated for religious centers as well. The overall radius does not exceed one fourth of a mile distance to primary amenities, which is

meant to be within the walking distance. Conceptually, it still continues to be a utilized resource of design and arrangement of novel residential settlements, in a manner which satisfies the contemporary "social, administrative and service requirements for a pleasing urban existence". Perry deployed an array of design principles, inclined by prevalent notions in the 1920s, such as the separation of vehicular traffic and pedestrian zones; arterial boundaries delineating the inwardly concentrated neighborhood cell from the greater urban matrix.

Eventually, the idea of "re-defining and re-planning the city on the basis of neighborhoods" came to Lewis Mumford, who considered the neighborhood as it was 'organically experienced' for development.

3. METHODOLOGY

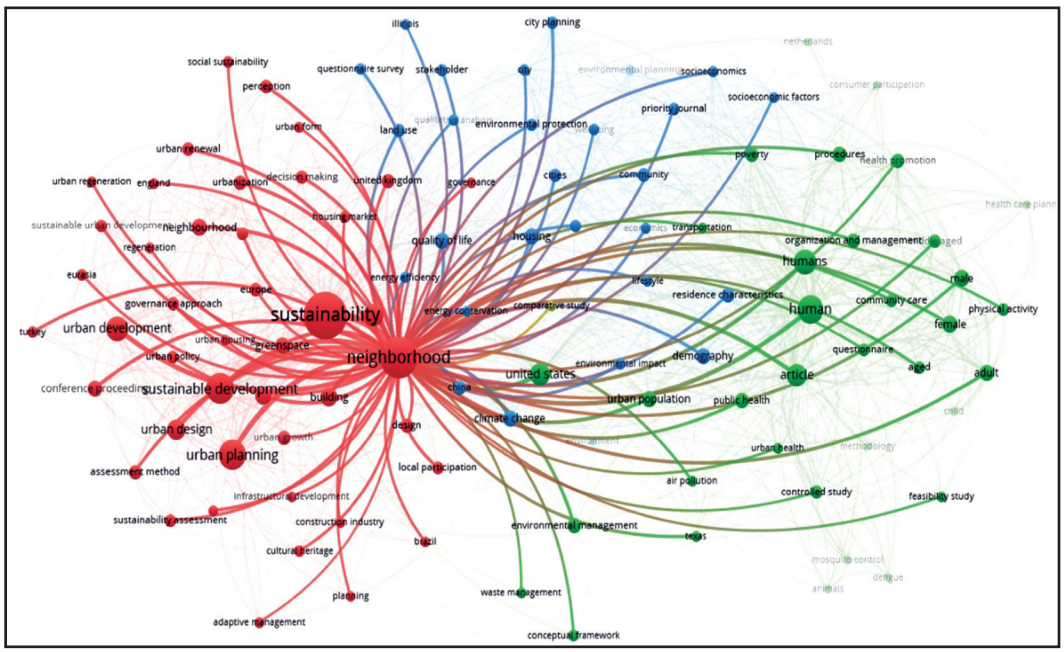
In background of the described evolution, of socially and environmentally conscious neighborhood habitats, this paper reviews literature and aims to investigate the roles of neighborhoods in urban built environment, so as to facilitate sustainability. It's approach is based on a 'Bibliometric Analysis' in the first part followed by a categorical review process in the second part of the study. Both the social and ecological parameters, along with the neighborhoods' ability to tackle sustainability matters have been considered. For the purpose of simplicity, the research papers have been categorized as per various principles of Neighborhood Planning and Design. Subject to the area of exploration, a systematic Bibliometric Analysis was conducted. In the beginning, a SCOPUS-indexed journals' search was carried out on a subscribed SCOPUS database upon 'Neighborhood Sustainability', which revealed 1658 publications; of these, there were 1245 published articles appearing in multiple high-ranked journals between 1995 and 2019. These were filtered based on relevance of the subject matter, and sorted for sub-areas in the disciplines of engineering, environmental science, social science, energy, arts and humanities etc.; these were further categorized based on the time line to arrive at a (Set A) of 195 publications. The search results were further limited to relevant keywords like neighborhood, retrofitting, social / urban housing, public policy, sustainability, sustainable development, green infrastructure, architecture, urban planning, neighborhood regeneration, urban redevelopment, land use, quality of life, urban governance and sustainable development. For the purpose of basing the study on a quantitative scientific technique, the search results were analyzed in VOS Viewer software, to identify the strengths and linkages between the major domains. A similar repeated procedure with a degree of alteration in search terms (a little more specific this time), was carried out, with a view to cross verify the obtained results from Set A. A more domain specific collection of 30 publications was achieved after short listing on relevant parameters. A repeated VOS viewer analysis was carried out for Set B, and results were further cross verified with Set A. Consequently, the selected articles were 'categorically' reviewed and the content was summarized,

based on overall orientation, field and expanse of study, intent of study and their outcomes.

3.1 Bibliometric Analysis with VOS Viewer

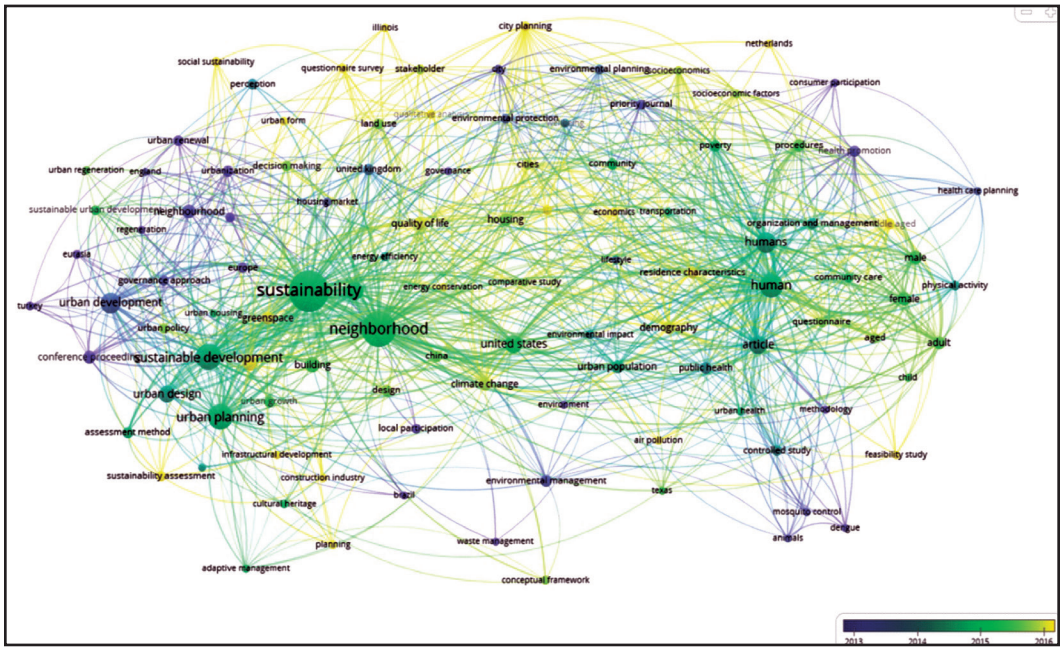
It has been observed that commendable research on the various parameters of neighborhood planning in terms of 'capability in generating sustainability', have occurred in the last decade. A systematic analysis of the SOPUS' analysis-generated keywords, through VOS Viewer software, has generated the following trends in this regard. It is to be noted that in VOS Viewer software's' terminology, a 'Network' refers to a graphical representation of the connections between domain areas. Thus, a network consists of a 'Node' or a 'Vertex', which is the prominent or central Keyword under discussion. Then, there are sub-nodes and links connecting the various sub-nodes as well. The strength of a link is representative of the degree of dependency between the domain areas (keywords). For gaining a broader perspective initially, a direct link between keywords of all 195 papers from Set A was analyzed; which helped to identify the directly dependent domains. This generated the 'Network Diagram' and an 'Overlay' as represented in Figure - 2 and Figure - 3 respectively. The findings revealed that there are strong linkages between the following domains, viz. quality of life, governance approach, urban policy, urban form, community, land use, sustainable development, urban design and planning, neighborhood, urban regeneration and renewal. It was inferred that these are areas which represent great potential for sustainable development of neighborhood habitats.

Fig. 2: Visual Network Diagram of all Linkages in Neighborhood Sustainability



Source: VOS Viewer Analysis

Fig. 3: Visual Overlay Representing all Time line based Linkages in Neighborhood Sustainability



Source: VOS Viewer Analysis

Successively, an 'Author-Keyword Analysis' was run in the software, based on a combination of 'co-occurrences' of keywords. It derived an understanding on

Table 1: Keyword Co-occurrence for 16 key words for Set A of the Scopus Search Database

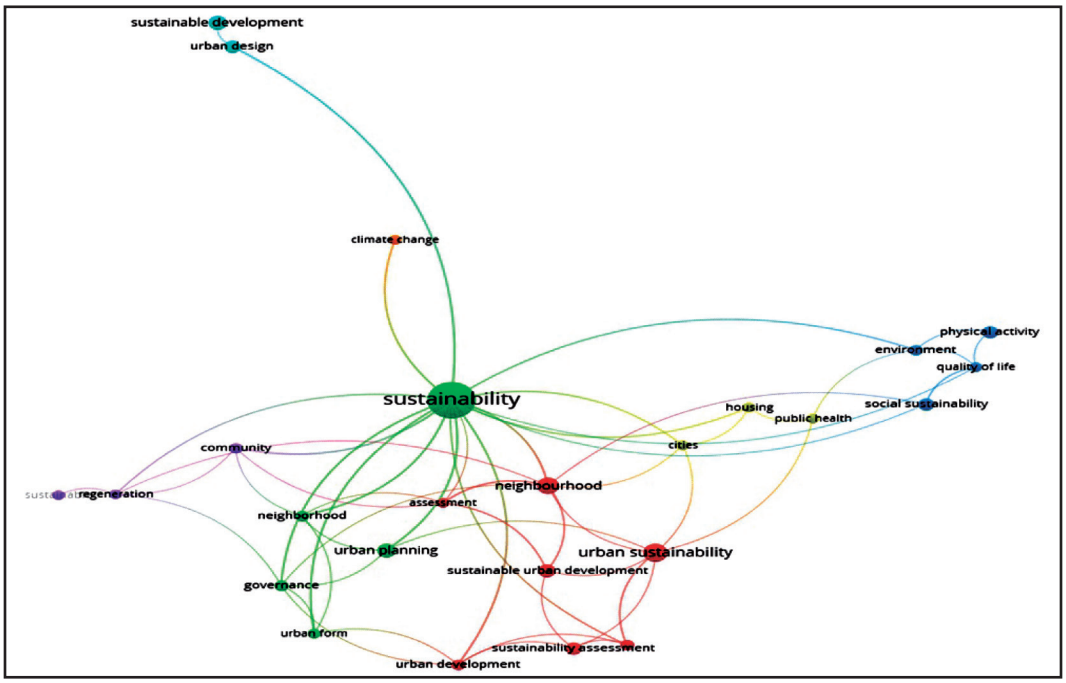
Sr. No.	Keyword	Occurrences	Total Link strength
1	Sustainability	54	27
2	Neighborhood	11	8
3	Governance	5	6
4	Urban Development	5	6
5	Urban Planning	8	6
6	Urban Regeneration	5	6
7	Urban Sustainability	14	6
8	Community	5	5
9	Neighborhood	5	5
10	Sustainability assessment	6	4
11	Sustainable Urban Development	7	4
12	Urban Design	6	4
13	Environment	5	3
14	Social Sustainability	6	2
15	Physical activity	6	1
16	Sustainable Development	8	1

the weights or significance of the linkages along a 'Time line'. It is understood here, that 'co-occurrence' as a parameter, is being perceived as a measure of significance of a specific domain; where greater the number, more significant the domain area. Thus, when a restraint of minimum X occurrences on a keyword reflected in publications was set, it means to have been a 'X*Occurrences times' prominent domain of developments. On the scale of restraint thus, the co-occurrences of keywords were analyzed with a factor of 'four co-occurrences' minimum. Out of a total of 841 keywords, 25 keywords met the criteria above; whereas, for a greater restraint i.e. a minimum of 5 co-occurrences, only around 16 terms showed evident linkages. This greater restraint has been considered for more certainty in analysis.

As evident in Table 1, the term sustainability displayed the strongest total link strength of 27 with 54 occurrences, followed and linked by neighborhood displaying 8 link strength and 6 occurrences.

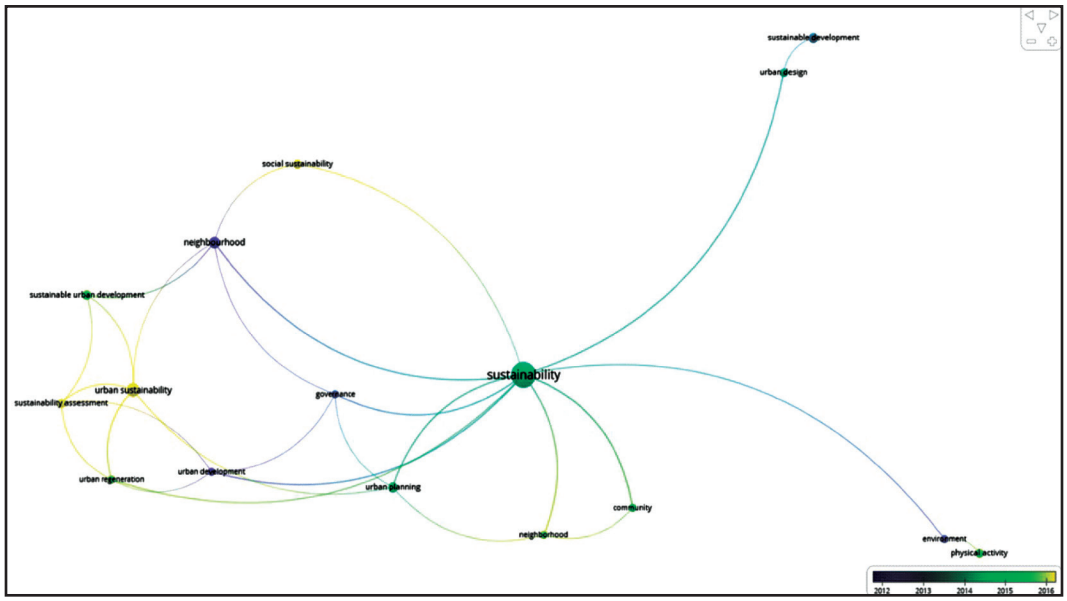
After this, a Set B of short listed database was obtained with a different selection domain and an 'author-keyword analysis. In the next stage, for each of the 120 keywords, the total strength of co-occurrence links with 'each' other keywords was calculated on the basis of the keywords having greatest total link strength being selected, which evolved into a cluster network visualization map.

Fig. 4: Visual Overlay, Set A- Scopus Database using 25 Keywords and 4 co-occurrences



Source: VOS Viewer Analysis

Fig. 5: Visual Overlay, Set A- Scopus Database using 16 Keywords and 5 Co-occurrences



Source: VOS Viewer Analysis

Further, a combination of 'co-occurrences' of keywords was derived for understanding the weights of the linkages along time lines. This was done with setting restraints on the number of occurrences. It was found that out of the 120 interlinked keywords (terms), there were just 3 keywords with minimum 4 co-occurrences among the research papers. Table - 2 highlights the major co-occurrences under this restraint. Thus 'sustainability has the strongest co-occurrence followed by Energy Efficiency' and then by 'Neighborhood'. The higher numerical value of the link strength denotes a stronger linkage and importance.

Table 2: Co-occurrence of Keywords - Minimum Four Times (Set B of Scopus Database)

Sr. No.	Selected Keyword	Occurrences	Total Link Strength
1	Sustainability	9	4
2	Energy efficiency	4	2
3	Neighborhood	4	2

Table 3: Co-occurrence of Keywords - Minimum Two Times (Set B of Scopus Database)

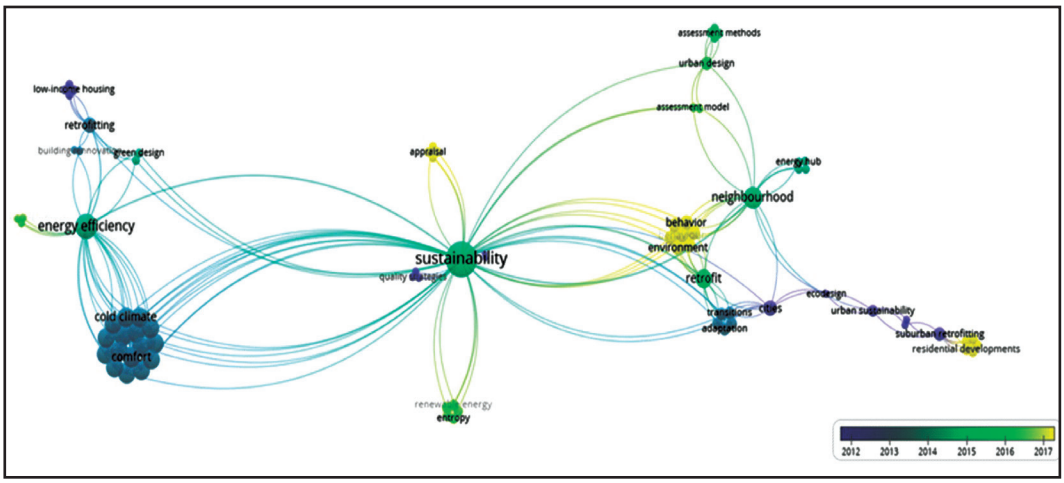
Sr. No.	Selected Keyword	Occurrences	Total Link strength
1	Sustainability	9	9
2	Neighborhood	4	6
3	Cities	2	4
4	Energy Efficiency	4	4
5	Retrofit	2	4
6	Retrofitting	3	3
7	Urban Sustainability	2	3
8	Urban Design	2	2
9	Suburban Retrofitting	2	1

Similarly, in the next combination of co-occurrences, as represented in Table - 3, it was found that there were total 9 keywords with a lower restraint of minimum 2 occurrences and they reveal that 'sustainability' is the highest occurring term (9 times) with a total link strength of 9 and is strongly linked with the immediate

following term Neighborhood' that occurred 4 times with a total link strength of 6.

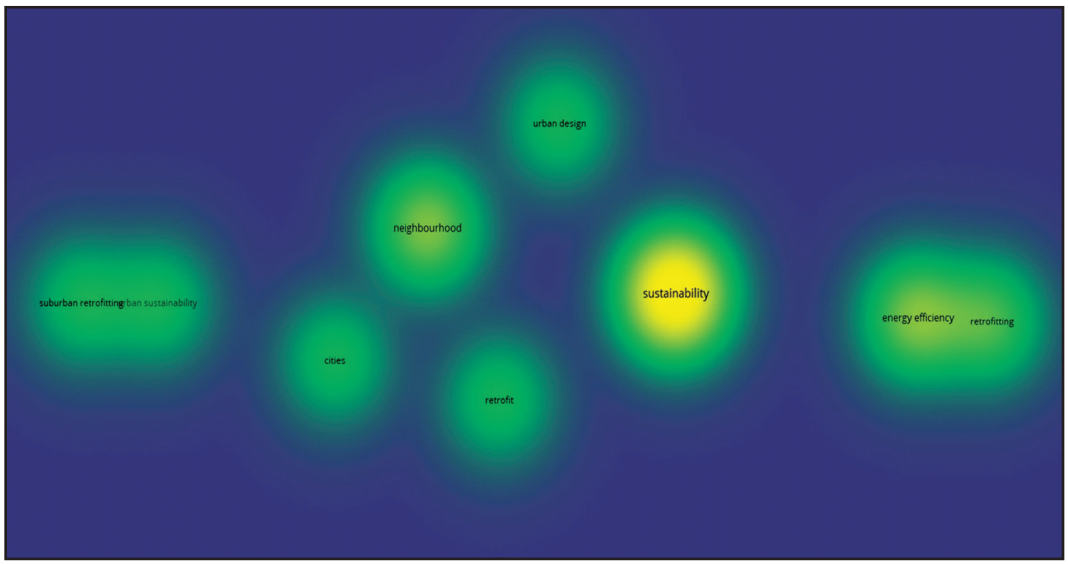
Whereas, the term 'Cities' representing a strong potential for work in urban precincts has followed with a link strength of 4 along with retrofitting / retrofit which have the same link strength with a reasonable number of occurrences. Urban sustainability, urban design and suburban retrofitting have followed with competitive occurrences, with suburban retrofitting showing the least link strength.

Fig. 6: Cluster Network Visualization, Set B SCOPUS Database, all 120 keywords (with time line)



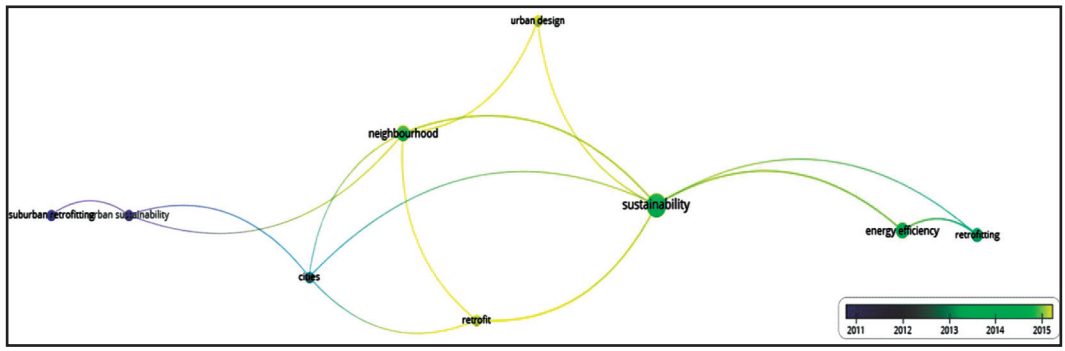
Source: VOS Viewer Analysis

Fig. 7: Density Visualization, Set B SCOPUS Database- All 120 Keywords



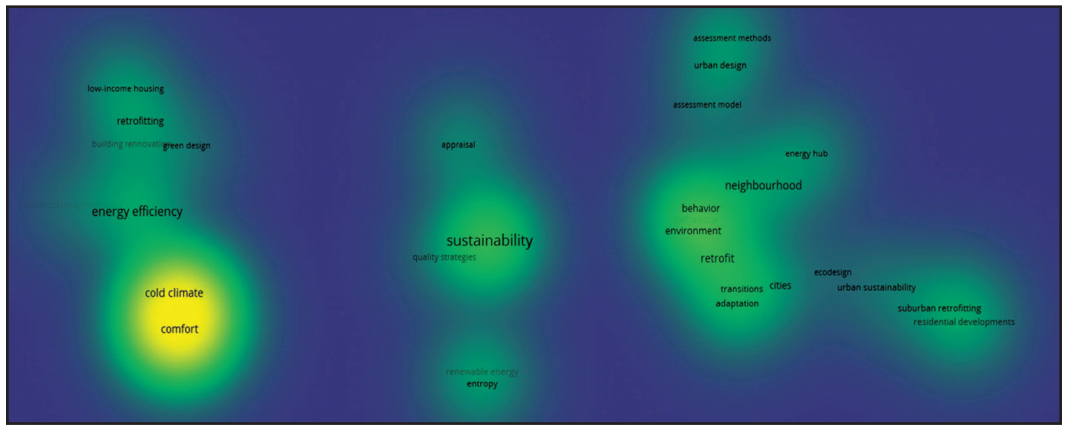
Source: VOS Viewer Analysis

Fig. 8: Network Analysis based on 9 Keywords, Set B for 2 Co-occurrences (Refer Table 3)



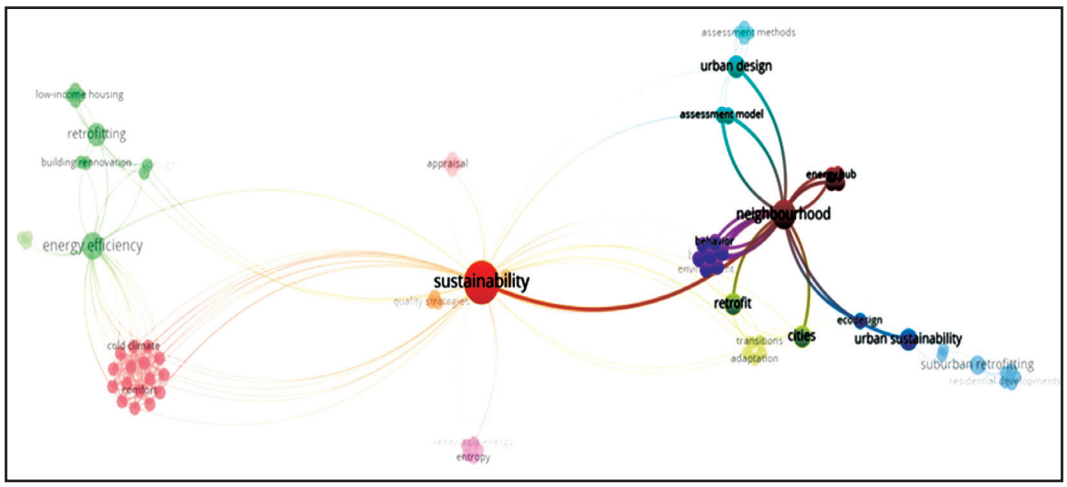
Source: VOS Viewer Analysis

Fig. 9: Density Visualization based on 9 Keywords, Set B for 2 Co-occurrences (Refer Table 3)



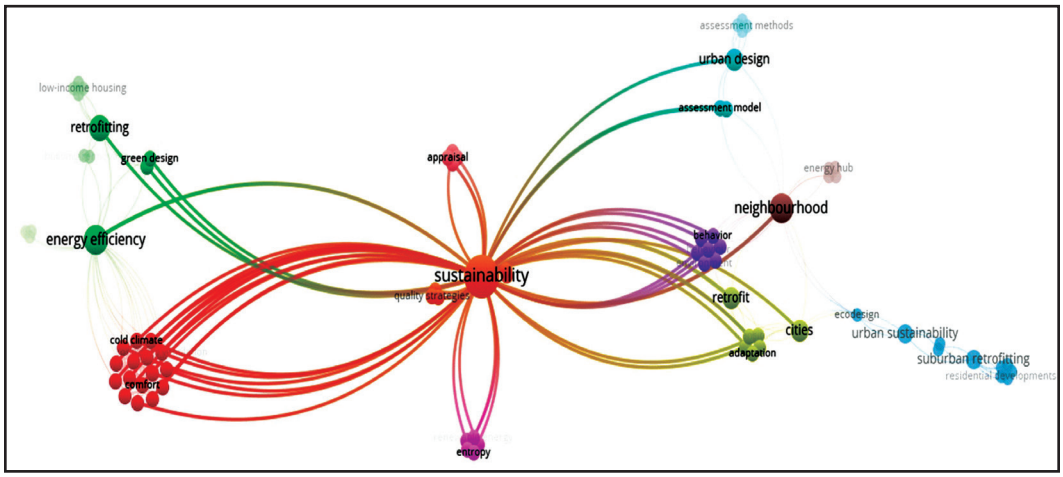
Source: VOS Viewer Analysis

Fig. 10: Direct Link Strength for 'Neighborhood', Cluster Network Visualization, Set B



Source: VOS Viewer Analysis

Fig. 11: Direct Link Strength for 'Sustainability', Cluster Network Visualization, Set B



Source: VOS Viewer Analysis

4. RESULTS FROM BIBLIOMETRIC ANALYSIS

It is evident that there are strong linkages from the perspectives of quality of life, governance approach, urban policy, urban form, community, land use, sustainable development, urban design and planning, neighborhood retrofitting, urban regeneration and renewal which are areas which represent scope for advances.

The selection parameters of Scopus database for Set A and Set B were purposefully differentiated. It helped in cross comparison of the interlinked areas to identify strongest Link strengths on quantitative as well as qualitative basis. It has been understood that Set A offers a more holistic perspective in the domain of the study and hence for the purpose of a detailed review, Set A has been preferred to Set B. Also, Set B has endorsed the previous and more relevant findings of strong connections between the domain areas.

4.1 Classification of Papers based on Ecology and Environment

(A.S. (2004)), in her work "District management in geological and social 'high-risk zones' in Medellín Colombia", has revealed that the 1990s witnessed a phase, where numerous cities in Europe regarded "District management" as an predominant instrument of 'neighborhood involvement', while making a move to motivate 'sustainable' cities.

The practice of District Management includes 'multi-sectoral coordination' of public and private agencies, as well as 'local grass roots organizations' along with citizens themselves. The aim is "to improve the conditions of life, housing, and environmental quality in segregated and conflictive neighborhoods" (2004). The objective was to "reintegrate neighborhoods into the urban fabric

and achieve social and environmental sustainability". Steinen attempted to study the role of a participatory strategy based on local rearrangement of contradictory interests and it's impact on geological and social high-risk districts in Medellin.

"The neighborhood imperative in the sustainable city" (Humber, 2006), describes the idea of the neighborhood as "more intimate local places" in the contemporary context of an urban precinct. However, it fails to provide a tangible notion. It is still depicted as one of the more noteworthy grounds for achieving equity in the dissemination of 'public resources' and 'social capital'. According to Humber, the 'neighborhood' is a place, which can support more 'indigenous economies', 'sustainable technologies' and 'infrastructure', and relevant people's participation, which are intrinsic of the 'renewal' of contemporary cities.

Özcan (2006), in his study titled "A study on the future of urban models in the third millennium: A sustainable urban model for Kirikkale, Turkey", has attempted to prepare a township model for the city, based on the 'sustainable urban development' possibilities. His model depends upon assessing ecological likelihoods which are the basis of urban open spaces. He has reorganized the neighborhoods in the city as 'clusters'. Ozacan has based his research methodology on the comparative cluster analysis of neighborhoods, further reassigning data onto overlays as per the sustainable urban development principles and its impending capabilities.

In his research titled "Waste management in the built environment on the basis of decentralization and integration strategies: The urban metabolism", he discusses "ecological and environmental conditions in and around cities which are under pressure". He states that "transportation distances grow, protection and qualities diminish, and infrastructures get more complex, less robust and less visible, which result in a decline of sustainable commitment and behavior of users" (A. V. T., 2008). It has been observed that environmental degradation has affected the quality of life in the neighborhoods since many years. He concludes on the subject that, "Resource reduction strategies and integrated waste management in close collaboration with urban planners, infrastructure developers, and representatives of key social groups are the basis to achieve environmental improvement. To do so the option of interconnection of the most important so called essential flows, especially waste related flows, energy, water and nutrients, at scales closer to users is argued to be necessary. This will be the guideline for urban planning based on the urban metabolism". This paper has highlighted the conducts for improving the sustainability of the urban areas by integrating these vital currents and thus 'closing' cycles at 'lower

scale levels' within the built-up environment through 'decentralization' (A. V. T., 2008).

(S., 2017), has conducted a primary study on "connectivity and perceived values of community green spaces". Park states that, "Green spaces in residential zones are important yet understudied features of the urban ecological system. While large urban parks and remnant wildlands in urban areas tend to receive public attention from conservation and management perspectives, less is known about the importance of spatial and ecological characteristics of the community-scale green space" (S., 2017). Park has explored four planned populations in the Phoenix municipal area of Arizona; two are conventional neighborhoods and two are community-development type of neighborhoods. These discrete communities demonstrate differences in factors like open space category, biological age, position, and housing density which are cross-compared with regard to 'landscape connectivity'. Landscape Connectivity serves as a tool of evaluating the 'ecological condition' of a community for sustainability. Through the application of GIS and 'landscape connectivity indices', the author studied community's green space features together with size, physical features and environmental potential, along with communal notions from the communities based on a primary survey. It was found that, the green spaces in the conventional communities were more 'physically connected' than their equivalents. However, the 'naturalness' and 'environmental potentials', demonstrated in the land that could aid as a possible urban desert-habitat, were found to be higher in the more 'sustainable communities'. The primary survey specified that the inhabitants of sustainable neighborhoods possessed a "higher level of satisfaction" than the individuals in conventional types of societies. The author quoted the reason behind these differences to be largely due to the "easy access to, and the perceived 'ecological values' of the green spaces in their neighborhoods and surrounding areas." The study concluded that 'careful community design' with 'ecological consideration' has the potential to generate sustainable neighborhoods which possess the potential to benefit both 'spatial' ecosystems and apparent human well-being.

4.2 Classification of Papers based on Redevelopment

(Boeri, 2012), in his study titled "High density suburbs redevelopment and social housing retrofitting for cities regeneration", has considered suburbs as key elements for changing city scenarios and redevelopment. The author has worked on a case of the 'Pilastro neighborhood', which is a significant example of a "social housing - high density settlement" which is situated in the fringes of Bologna (IT). The author high points the technical, functional and social influences based on which the 'quality of the habitat' depends, including some 'hindrances' against improvement measures. The author strongly concludes

that "Architectural quality and social quality are the two elements to be aimed for, for a correct strategy of redevelopment and regeneration of the neighborhood".

Vogt (2015) in his work "Explaining planted-tree survival and growth in urban neighborhoods: A social-ecological approach to studying recently-planted trees in Indianapolis", addresses the causes of the urban socio-ecological system, thereby forecasting subsistence and growth of foliage, in 'non-profit' as well as neighborhood plantation projects.

4.3 Classification of Papers based on Evaluation Mechanisms

(H., 2013) Conducted research on "Evaluating the sustainable performance of an urban district: Measured score or reflexive governance?" and studied how to evaluate the sustainable performance of a 'complex urban system". The author argues that "the recent tools for assessing the sustainable performance of urban neighborhoods have focused on delivering a distinct score, obviously for reasons of benchmarking, communicative impact or marketing. However, these unequivocal scores partially hide or even confuse the complex quantitative-qualitative trade-offs that are needed to arrive at a judgement" (H., 2013). His work offers a substitute method of 'quantitative analysis' and 'qualitative assessments' together. The following assessment provides a measure for 'reflexive governance'. The methodology used for this instrument comes from the 'theory of modal aspects', as framed by the Dutch philosopher Herman Dooyeweerd.

Smith (2016), has completed a research titled "Sustainable urban development? Exploring the locational attributes of LEED-ND projects in the United States through a GIS analysis of light intensity and land use'. The purpose of his paper was to explore the 'locational attributes of LEED®-ND™ projects in the United States" aimed at determining locational potentials of projects to achieve the program's specified objectives. LEED®-ND™ is noted to be the latest effort to develop more sustainable urban environs in the United States. The LEED®-ND™ program was created to provide a 'green rating system' to improve the 'quality of life' for people through the inclusion of 'sustainable development practices'. Hence, a 'premium' is placed on the 'locational attributes' of proposed projects under the 'Smart Location and Linkages' credit category. In his research work, the author has scrutinized two locational variables – 'night-time light intensity' and 'land use cover' through the use of GIS software, and has determined the effectiveness of these measures.

R.J. (2017), Having authored a research titled "Urban sustainability in an age of enduring inequalities: Advancing theory and eco-metrics for the 21st-century city", discussed that the environmental fragility of cities with radical

urbanization has brought in efforts to encourage the sustainability in urban bionet works and physical infrastructures. However, the author states that lesser attention has been given to neighborhood dissimilarities and differences in the public infrastructure. This is challenging to social sustainability and to the capability of cities to jointly address ecological challenges. The author concludes that through a backing of theoretically guided framework on neighborhood inequality and through "eco-metric" measurements along with evolving sources of urban data, the mission of sustainable cities in the United States and globally is achievable.

C. (2017), in his work titled "Assessment of sustainable neighborhoods: From standards to cultural practices" states that "the development of Neighborhood Sustainability Assessment (NSA) tools has contributed to the planning and design of better urban environments. Some of these systems aim to be universal through the use of standards, while paradoxically contributing to the certification of projects in culturally diverse contexts." Thus, this study inspects the suitability of some national NSA tools to various other countries and cultures while using 'standards as a mean of evaluation.'

Astiaso Garcia (2017) has conducted an valuation of "urban sustainability and life quality index" for the elderly through his research. The work is based on the demographic variations and the high share of population in the cities. The research aimed at defining the 'sustainability index' and 'quality of life' for the elderly at a 'suburban scale'. It outlined aspects of the local territory and also represented the neighborhood. This study delivered more relevance to the existing indicators representing the 'quality of life' for larger regions. In conclusion, the expounded index emerged to become a ready tool to be provided to the local governing body in order to become of optimal use in urban planning and management. It also helped in "prioritizing interventions" on the basis of the principles of sustainability and the individual requirements of the people, especially, of elderly.

4.4 Classification of Papers based on Participatory Governance at Neighborhood Level

J. (2013) In his paper titled 'Neighborhood facilities for sustainability' challenges the existing system of planning to deal with sustainable development. He argues that "National built environment strategies to address sustainability tend to focus on large-scale programs in areas such as renewable energy and energy efficiency. While this approach can improve national environmental indicators such as carbon emissions profiles; it appears unlikely to achieve sustainability." The author contends that further "comprehensive" as well as "local" approaches would be obligatory to address sustainability at neighborhood level. The author suggests that "interventions at a neighborhood level should be developed such

that they enable day-to-day living patterns and become more sustainable over time." The author identifies certain 'key elements' in the 'built environment' along with facilities supportive of sustainability. The author refers to them as "Neighborhood Facilities for Sustainability." Neighborhood facilities for sustainability by definition, (NFS) are "initiatives undertaken by individuals and communities to build local sustainable systems which not only improve their quality of life but also reduce environmental impacts, which are also indicative of 'people-governance'." The author states of this approach as a effective mechanism of guaranteeing that sustainability is addressed rapidly and effectively in urban settings and that the NFS approach may be more efficient and effective than national programs, in terms of its response to the 'local context' and sense of 'local ownership and capacity', ensuring good system management and maintenance.

Shirgaokar (2013) in their work titled "Integrating building energy efficiency with land use and transportation planning in Jinan, China", address the issue of sustainability using 'collective mechanisms' from one of their design venture. The project was known to integrate sustainable building design, land use, urban design, and transportation at large. The design proposal identified opportunities for improving energy efficiency. The Design proposed 'Mixed land uses' and also 'walkable neighborhoods along with highly 'differentiated street designs' which were envisioned to transmit different traffic loads and prioritize diverse travel modes. The authors state, "Street widths and building heights were adjusted to maximize the potential for passive solar heating and daylight use within buildings." The authors state that "the viability of such projects could be ensured by 'policy level framework' by 'incentivizing for developers'. This is a case that is indicative of necessity of collaborative governance and prioritization of development intentions through policy regimes and holds important learnings from researchers' perspectives."

4.5 Classification of Papers based on Inclusivity

S.M. (2014) in his research titled "Occupied by design: Evaluating performative tactics for more sustainable shared city space in private-led regeneration projects", studies substitute methods to "statutory consultations in private led regeneration projects." He discusses a case of a 'temporary legal street occupation', in Belfast in Ireland.

The author, an architect by reflective discussion, intends the necessity to deepen "public-private-government conversations" about "existing public space qualities" and "place-driven potential." His work supports an emphasis on Practice-skills as a means for architects to "re-frame their creative knowledge" and aid in "transformative practices" in complex urban systems.

H.S. (2016) has explored public spaces sustaining cultural identities in the context of China's urban developments. He discovers "what it means for a public space to embody the city within rapid urban change in contemporary urban development and how a space can accomplish this by embracing the culture of the city, its people and its places, using the particular case of Putuo, Shanghai in China."

4.5 Classification of Papers based on Socio- Environmental Sustainability

Anguelovski (2018) in their research titled "Assessing green gentrification in historically disenfranchised neighborhoods: a longitudinal and spatial analysis of Barcelona" , state that the potential of creation of municipal green spaces over an entire city to address social or racial inequalities in the distribution of environmental amenities needs to be evaluated. There is also scope to examine whether such an agenda creates and contributes to green gentrification. The authors evaluate the effects of creating 18 green spaces in neighborhoods of Barcelona that were socially vulnerable places, during the 1990s and early 2000s. Six 'socio-demographic gentrification indicators' in the areas close to green spaces were evaluated over time, in comparison with their entire districts. The authors inferred that "new parks in the old town and formerly industrialized neighborhoods seem to have experienced green gentrification. In contrast however, most 'economically depressed' areas and working-class neighborhoods with less desirable housing stock and more isolated from the city centre gained 'vulnerable residents' as they became greener, indicating a possible redistribution and greater concentration of vulnerable residents through the city."

Lai (2018) in their work titled 'Neighborhood variation of sustainable urban morphological characteristics' discusses that "Compact cities and their urban forms have implications on sustainable city development because of high density urban settlement, increased accessibility, and a balanced land use mix." The author uses "quantitative means of understanding urban morphological characteristics with reference to the differing qualities of the urban form (i.e., street patterns, building volumes, land uses and greenery). The results, based on 89 neighborhood communities of Hong Kong, show varying degrees of regional differences in the urban built form supported by numerical statistics and graphical illustrations."

Cinderby (2018), in their work titled "Exploring the co-benefits of urban green infrastructure improvements for businesses and workers wellbeing" discuss studies of the benefits for businesses through retrofitting green infrastructure (GI). The author presents a two-year "longitudinal mixed methods study" conducted in central London, while appraising the variations subsequent

after the installation of a mix of "greening schemes" in different business sectors and experiences of their staff members. The authors conclude that "Providing accessible green space in office settings led to improvements in morale, team interaction and workplace satisfaction among staff members able to access the improvements. It has been stated that retrofitting green infrastructure (GI) would add to direct and indirect returns in terms of environmental benefits improving along with good morale and overall happiness of inhabitants.

5. CONCLUSIONS

A systematic review of literature on conventional and non-conventional parameters of sustainable development researched from various prominent works of notable authors over the past few decades gives an inclusive and holistic perspective to innovate further on identified gaps based on the selected area of research. Most authors have discussed grass roots level interventions on case study basis concepts like district management, grass roots level organization's roles and citizen participation, ecological likelihoods and open spaces, decentralization and integration strategies, closing of cycles at local levels, landscape connectivity indices, reflexive governance, various green rating systems, neighborhood facilities for sustainability, green gentrification, etc. In conclusion, case study based strategies imply improvement in sustainability standards of neighborhoods. However, limited studies are conducted on the potential of policy frameworks in neighborhood sustainability and this gap presents a greater opportunity to innovate in this area.

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Integrated Townships: A Spatial Planning Initiative

Aayushi Godse, and Vijay Kapse, Ph.D.

Abstract

The concept of an Integrated Township is created by combining three separate aspects of life: "Live, Leisure, and Work" - the concept of walking to school, office, and shops. The integrated township is a collection of dwellings and commercial businesses with supporting infrastructure such as schools, roads, hospitals, convenience stores, drainage, and sewage systems. There are various Integrated Township Policies of different states which are provided to guide the development of these townships. The objective of the Integrated Township policies is to promote economic development and to facilitate the creation of efficient, equitable and sustainable new urban settlements. The objective of this paper is to highlight the spatial planning initiative taken in relation to the Integrated Townships in India. Various literature studies have been carried out on Integrated Townships and the examples of Integrated Townships including Magarpatta City and Amanora Park town have been discussed in this paper.

1. INTRODUCTION

Urbanization is increasing day by day and people are getting attracted towards the cities and urban areas where, they hope to get more and more facilities and amenities to live in better living conditions. As a result of this trend, the geographical limits of the city are increasing as the demand for housing, commercial as well as employment facilities is increasing. Increase in demand and development leads to urban sprawl which leads to improper management. The core areas of the cities are already overcrowded and vertical expansion of buildings is limited. This calls for developing pockets of livable areas in the outskirts which are self-sustaining in nature and yet are well connected to the main city. The concept of Integrated Township is developed by integrating three different aspects of life 'Live, Leisure and Work'- walk to school, walk to office and walk to shops concept (7). Integrated townships also cut down travel time, pollution and fuel. The main objective of integrated township is 'convenience' in the form of social, economic and living amenities to be given to the people within township.

Township development began with the formation of industrial towns during the early years of independence, which were built with the intention of housing

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workers near their workplace. These townships had the support of their local governments. Townships that were self-supporting developed, providing citizens with fundamental requirements and infrastructure in areas such as education, healthcare, recreation, and shopping. These townships became popular and eventually are taking the form of Integrated Townships in urban areas. (11)

The concept of an Integrated Township is created by combining three separate aspects of life: "Live, Leisure, and Work" - the concept of walking to school, office, and shops. A township is a small geographic area or a self-contained real estate property in general. The integrated township is a collection of dwellings and commercial businesses with supporting infrastructure such as schools, roads, hospitals, convenience stores, drainage, and sewage systems. It would be designed and operated with the welfare of the entire community in mind. A township project might be owned by the private sector, the government sector, or both. In an integrated township, everything is self-sustaining and eco-friendly. (7)

According to URDPFI Guidelines, "Integrated Township can be defined as clusters of planned housing and commercial businesses with associated infrastructure such as roads, schools, hospitals, convenience shopping, water treatment plants and drainage and sewage facilities. Integrated townships majorly emphasise on creating self-contained settlements with work-live-play concept by integrating selected economic activities in manufacturing / service / business categories." (12)

The definitions of Integrated Townships from some of papers are given in Table - 1.

Table 1: Definitions of Integrated Townships

S. No.	Paper	Author	Year	Highlights of Definitions of Integrated Townships
1	Self Sustainable Township	Deepali J. Chavan, Ravindra H. Sarnaik	2013	• Township is the place where not only residential facilities are provided but also recreational facilities, commercial educational and health facilities are accommodated within a walking distance in a single campus. • Convenience is the main objective in the form of economic, social, and living amenities to be given to the people within Special township. • To provide all infrastructure and residential amenities to the people which they require for living purpose. (2)
2	A Review on Self Sustainable Integrated Township	Jinal Hasmukhbhai Patel, Zarana H. Gandhi	2019	• The concept of Integrated Township is developed by integrating three different aspects of life 'Live, Leisure and Work (1) - walk to school, walk to office and walk to shops concept. • A township generally refers to a small geographic area or a self contained real estate property. • The Integrated township are clusters of housing and commercial business with associated infrastructure such as

S. No.	Paper	Author	Year	Highlights of Definitions of Integrated Townships
				schools, roads, hospitals, convenient shopping, drainage and sewage facilities. • It would be built and run to benefit the whole community. • A township project can be in a private ownership or a public ownership or both. Everything in an integrated township is self-sustainable and environment friendly. (7)
3	URDPFI guidelines	Ministry of Urban Development, Government of India	2015	• Integrated Township can be defined as clusters of planned housing and commercial businesses with associated infrastructure such as roads, schools, hospitals, convenience shopping, water treatment plants and drainage and sewage facilities. • Integrated townships majorly emphasise on creating self-contained settlements with work-live-play concept by integrating selected economic activities in manufacturing / service / business categories. (12)
4	IGBC Green Townships	Indian Green Building Council	2010	• A township is a combination of several communities; a community in turn is a combination of several sectors. Several townships form a city. • A city typically has an administrative, legal, or historical status based on local law. • A township, however, may not fall under the purview of the local government. • Township ranges in sizes and land uses. • Townships are typically mixed-use in character. (5)
5	Comparative Evaluation of Integrated Townships	Amit Ashok Hasape, Prof. Satish S. Deshmukh.	2016	• Integrated Townships can be defined as "Housing schemes in public-private partnership to provide affordable housing to various sections of the society in urban areas of the State". • An integrated township is a self sustainable township mainly initiated by private developers in order to provide, in advance, the amenities and facilities (residential, commercial, recreational, public etc) required by a fully groomed township. (1)
6	Townships for sustainable cities	Pallavi Tak Rai	2012	• Integrated Township includes housing, commercial premises, hotels, resorts, city and regional level urban infrastructure facilities such as roads and bridges and mass rapid transit systems. • Development of core and allied infrastructure forms an integrated part of township development. • Integrated Township means a self-contained township planned and developed through a licensed developer / firm / company, together with work place and places of residence with all attendant facilities and amenities in such township and in accordance with the rules. (9)

The main objective of integrated township is 'convenience' in the form of social, economic and living amenities to be given to the people within township. The objective is also to facilitate the creation of efficient, equitable, sustainable urban settlement. Residential, Infrastructure and other basic required amenities are provided within walkable distance (7) and to provide high-quality affordable housing.(2)

The benefits of Integrated Townships include walkability, connectivity, mixed use and diversity, mixed housing, quality architecture and urban design, traditional neighborhood structure, Increased density, Green transportation, Sustainability and quality of life. (6)

2. INTEGRATED TOWNSHIP POLICIES

The Integrated Township Policies are prepared to guide the development of these Integrated Townships in different states of India. The detail study of the Integrated Township Policies of four states have been done in this paper which includes Rajasthan Township Policy, 2010; Maharashtra Integrated Township Policy, 2016; Gujarat Integrated Township Policy, 2008, and Himachal Pradesh Integrated Township Scheme, 2013. The Objectives of Integrated Township Policies are:

- **To Promote Economic Development:** To assist in creating new sources of income and employment. To encourage the development of tourism, medical, and educational facilities. (9)
- **To Facilitate the Creation of Efficient, Equitable and Sustainable New Urban Settlements:** To encourage the establishment of free-standing towns, satellite towns, and other types of urban agglomerations that are well-integrated with one another, avoiding island and detached growth., to inhibit unsustainable sprawl development, to encourage the development of socially integrated and diverse communities that are sensitive to the needs of the EWS / LIG and the informal sector, to achieve "Zero Impact" in terms of the loads generated on regional physical infrastructure by pursuing self-sufficiency in infrastructure, to encourage the creation and evolution of self-sustaining pedestrian communities that thrive in a walk-to-work, walk-to-school, and walk-to-play environment. (9)
- **To Facilitate Public Private Partnerships in Urban Development:** To encourage and accelerate private sector participation in various types of infrastructure that support urban development. (9)
- **To Facilitate Capacity Building in the Private Sector and in Government for Urban Development:** To ensure that high-quality safety standards and hazard preparation are maintained in strict accordance with applicable safety codes. (9)

The policies of the Integrated Township revolve around the topics:- (i) Sustainability, (ii) equity, (iii) competitiveness, (iv) regional integration, (v) foreign investments, (vi) provision of one window clearances, (vii) land consolidation and partnership propositions, (viii) provision of trunk infrastructure, (ix) green growth and construction rating systems, (x) environmental and construction laws and bylaws' clarity, (xi) affordable housing for all, and (xii) Right mix of land use - commercial, residential, industry, etc. (9)

The Policies of the four states mentioned above are summarized below:

2.1 Maharashtra Integrated Township Policy, 2016

The objective of the Policy is to utilise the maximum development potential of land, to increase the supply of affordable houses in the market, to attract direct foreign investment in the field of Special Township Project and to develop Smart Townships through privatization without any expenditure to Government and to bring clarity /simplification in the process of approval. (8)

The minimum area required for any project in Maharashtra to qualify as an Integrated Township Project is 40 hectares. (8)

The area for the site shall be one, contiguous, unbroken and uninterrupted land. If such area is divided by one or more water courses, existing or proposed roads or by railways etc., it shall be treated as one, if the Project Proponent/s shall construct necessary connecting roads or bridges as per site requirements at his own cost with due permission from concerned authorities. The area shall have an access by means of an existing, or proposed roads having minimum width of 24 m. In case of proposed road, such area shall have an access by existing roads having width 12 m or more. (8)

The basic permissible FSI for such project shall be 1.0, to be calculated on gross plot area under Master Layout Plan without deducting any areas under the slopes. (8)

2.2 Rajasthan Township Policy, 2010

The objective of the Policy is to promote planned / integrated development of various towns by providing the basic infrastructure facilities and to safeguard the interest of the public at large by ensuring availability of residential plots / houses at affordable prices. (10)

The minimum area required for any project in Rajasthan to qualify as an Integrated Township Project is 40 hectares for Government land, 10 hectares for Mini-townships and Special Townships and 20 hectares for private land. (10)

The site should be contiguous in planning area. The Township / Mini-township scheme shall have a minimum of 15 m approach road from any National Highway, State Highway, MDR, ODR, or any other road area network / sector roads / master plan roads. The Township / Mini-Township shall not include land under the forest, water bodies, land falling within 100 m from the HFL of the major lakes, dams, land falling within 200 m from the Historical Monuments and places of archaeological importance, archaeological monuments, heritage precincts, other restricted areas. (10)

Global FAR for the entire gross area of scheme shall be 1.2. However, the individual plots can be allowed maximum FAR as per Building Regulation but not exceeding 2.4. (10)

2.3 Gujarat Integrated Township Policy, 2008

The objective of the Policy is to promote economic development, to facilitate the creation of efficient equitable sustainable urban settlements, to facilitate public private partnerships in urban development, to facilitate capacity building in the private sector and in government sector for urban development. (3)

2.4 Himachal Pradesh Integrated Township Scheme, 2013

The objective of the Policy is to promote economic development and sustainability, to facilitate the creation of efficient equitable sustainable urban settlements, to generate and provide employment opportunities to the people, to facilitate PPP in urban development, to facilitate capacity building in the private sector and in government for urban development, to provide the affordable housing and services for the EWS and LIG, Security and safety of individuals with in this living environment. (4)

The minimum area required for any project in Himachal Pradesh to qualify as an Integrated Township Project is 40 hectares for Hilly terrain and 50 hectares for plains. (4)

2.5 Compression of Integrated Township Polices of Rajasthan, Maharashtra, Gujarat and Himachal Pradesh

The land should be contiguous in planning area. New scheme should be considered in such areas where road, water supply, power line, sewerage and various infrastructure facilities can be extended without financial burden on the concerned local body and other government agencies. (4)

Global FAR for the entire gross area shall be 1.75 However, the individual plots can be allowed maximum FAR as per Building Regulation but not exceeding 2.4. (4)

The area distribution in the Integrated Townships in the four states namely: Maharashtra, Rajasthan, Gujarat, and Himachal Pradesh is given in Table - 2.

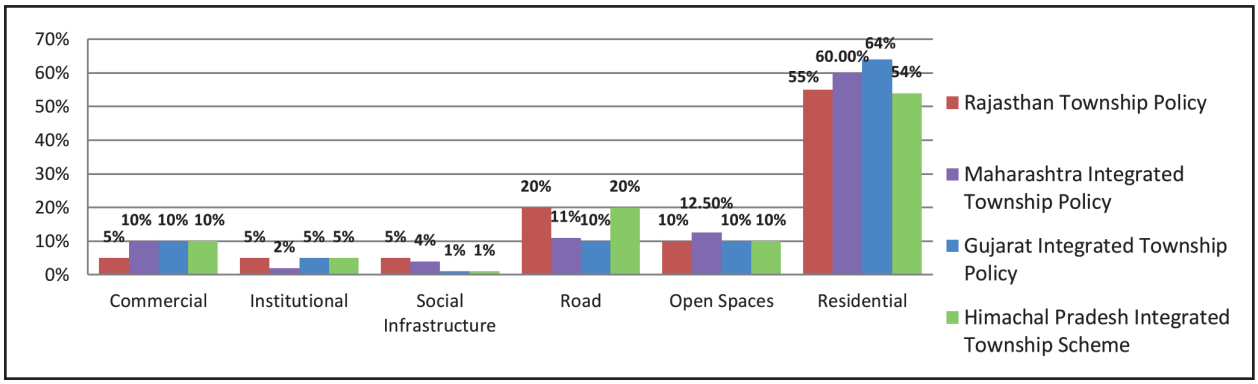
It is mandatory in the Integrated Townships to provide the basic services like continuous power supply, safe and potable drinking water, recycling of treated waste water for gardening and flushing, continuous unobstructed footpath on either sides of roads, dedicated bicycle track, provision of fire brigade, transportation, etc.

The Fig. 1 shows that 64 % of the total township area is required for Residential use in Gujarat, 60 % in Maharashtra, 55 % in Rajasthan and 54 % in Himachal

Table 2: Area Requirement for integrated Township Policies in Rajasthan, Maharashtra, Gujarat and Himachal Pradesh

State Policy		Rajasthan Township Policy	Maharashtra Integrated Township Project	Gujarat Integrated Township Policy	Himachal Pradesh Integrated Township Scheme
Area required	Commercial	5 % to 6 %	40,000 sq m	10 %	10 %
	Institutional	10 %	5,000 sq m (Primary school + High School), 1,000 sq m (Community Health Care Facilities), (up to 40 ha.), 2000 sq m(Market), 15000 sq m (Town Hall and/or Auditorium including Library), - up to 200 ha.	5 %	5 %
	Social Infrastructure			1 %	1 %
	Road	20 to 22 %		10 %	20 %
	Open Spaces	10 %	12.5% - 5% (gardens/parks), 7.5% (playgrounds)	10 %	10 %
	Residential	55% to 58 %	The land excluding the land required for above purposes.	The land excluding the land required for above purposes.	The land excluding the land required for above purposes.
	Residential for EWS / LIG	5 % of Residential area or 15 % of total No. of Plots/ dwelling units.	20 % of Residential FSI.	10 % of Residential area.	10 % of Residential area.

Fig. 1: Land Use as per Township Policies (3)(4)(8)(10)



Pradesh. Similarly, 12.5 % is required for open spaces in Maharashtra and 10 % in Rajasthan, Gujarat and Himachal Pradesh.

There are some special incentives which are given to these Townships like 100 % Foreign Direct Investment is possible in Integrated Township Projects, Non-agriculture permission is automatic, Government land falling under township area shall be leased out to the developer at current market rate, the condition that only agriculturist will be eligible to buy agriculture land shall not be

applicable in Special Township Area, there shall be no ceiling limit for holding agriculture land to be purchased by the developer for such project, there shall be floating Floor Space Index (FSI) in township - unused FSI of one plot can be used anywhere in the whole township, the stamp duty rates applicable shall be 50 % of the prevailing rates, a Special Township Project shall be partially exempted from payment of scrutiny fee for processing the development charge, development of basic infrastructure and amenities shall be an integral part of the project, minimum 100 acres of continuous and uninterrupted land parcel is required for township, minimum area for Low Income Housing has to be provided.

Some of the Integrated Townships present in India have been given in Table - 3 along with the respective cities where they are located and the site area.

Table 3: Integrated Townships in India

S. No.	Name of Township	City	Area
1	Amanora Park Town	Pune	400 acres
2	Nanded City	Pune-Sinhagad Road, Pune	700-acre
3	Magarpatta City	Hinjewadi, Pune	400-acre
4	Blue Ridge	Pune	138-acre
5	Oxford City	Pune	1000-acre
6	Life Republic	Pune	450-acre
7	Kul Nation	Manjri, Pune	102-acre
8	Megapolis	Hinjewadi, Pune	150-acre
9	DSK Dream City	Pune	300 acre
10	Pride World City	Charholi, near Pune	400 acres
11	Omaxe City	Indore	250-acre
12	Shantigram by Adani Realty	Ahmedabad	580-acre
13	Vanaha Township	Pune	150-acre
14	Forest Trails Township	Pune	170-acre
15	Xrbia Township	Hinjewadi, Pune	170-acre
16	VTP Blue Waters	Pune	200-acre

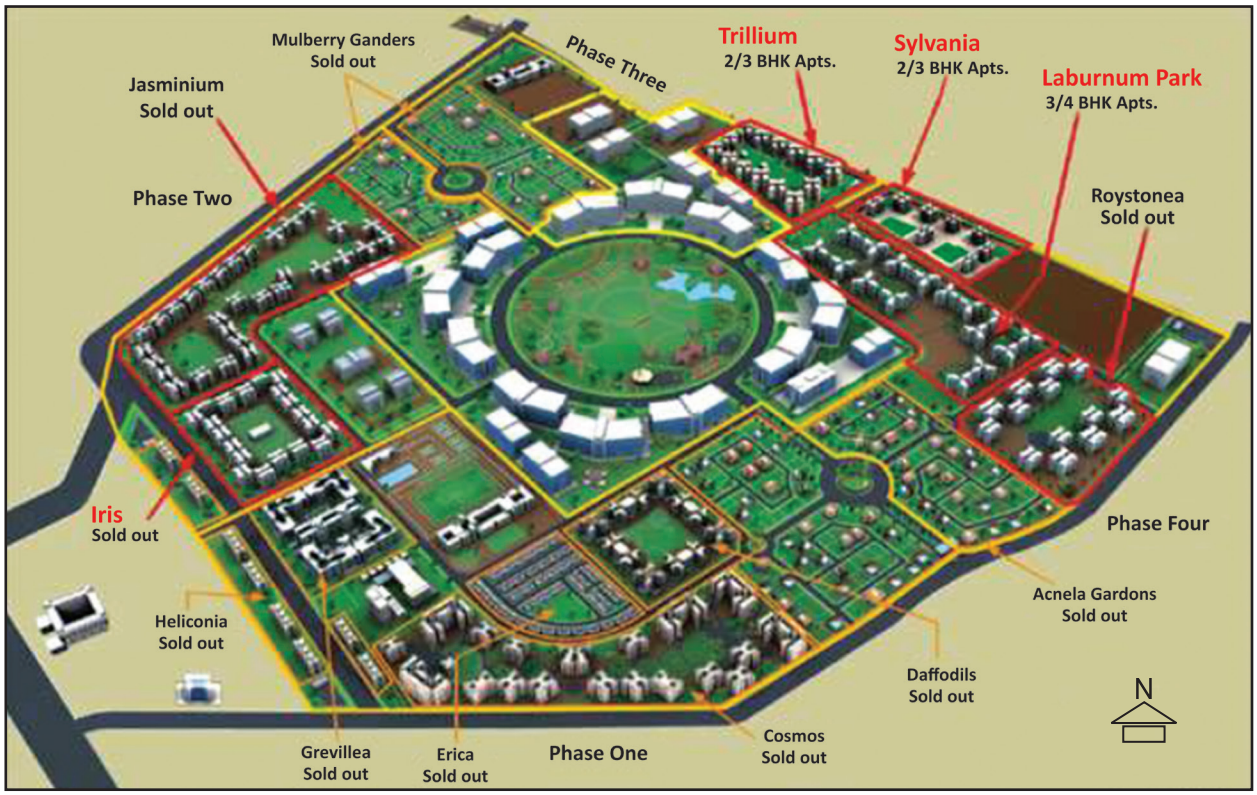
3. EXAMPLES OF INTEGRATED TOWNSHIPS

3.1 Magarpatta City, Pune

It is a proposed township on 400 acres of land located on the route to Solapur. It was created by a farmers' cooperative comprising of 120 households totaling 800 people (Fig. 2). The construction began in the year 2000. (11) The land use distribution of the township is given in Table - 4 and Fig. 3:

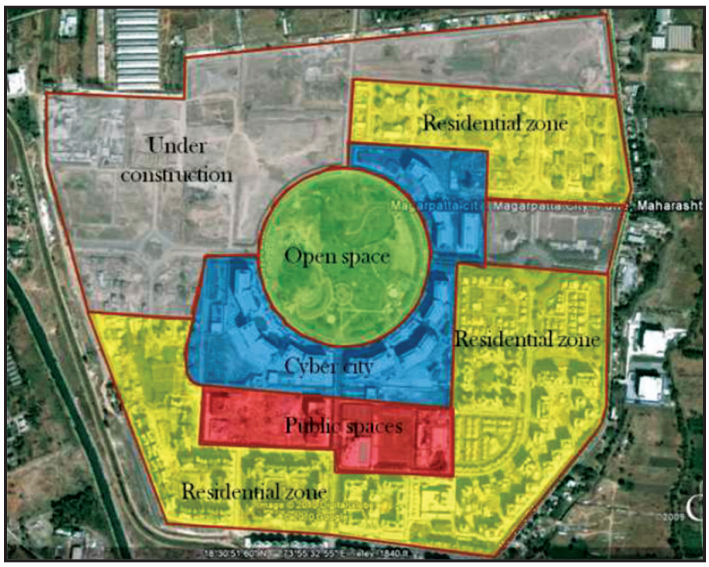
The highest land use has been provided for Open Area (30 %), followed by Residential land use (27 %), Cybercity (25 %) and Institutes (7.5 %).

Fig. 2: Master Plan of Magarpatta City



There are many eco-friendly systems installed at Magarpatta City (Fig. 3) including rainwater harvesting, garbage segregation at the source, bio-gas plants, vermi-culture, and the use of fly-ash bricks in construction and solar water heating system. Many planning features at magarpatta city include walk-to-work / walk-to-school, affordable housing, access to economic facilities (work centres), green hierarchy, road hierarchy for reducing vehicle-pedestrian conflict, places for social interaction and integrated amenities.

Fig. 3: Land Use Plan of Magarpatta City



Source: (1)

The township has Commercial offices and educational / medical institutes within the campus which, reduces the need to move out of the township and makes it self-sustainable and efficient. The land use distribution is such that

Table 4: Land Use Distribution

Land use	Area (in acres)	Percentage (%)
Open area	120	30.00
Residential	108	27.00
Cyber city	100	25.00
Institutes	30	7.50
Amenities	22	5.50
ports Complex	20	5.00
Total	400	-
FSI utilized	1	-

Source: (1)

Fig. 4: Land Use Distribution

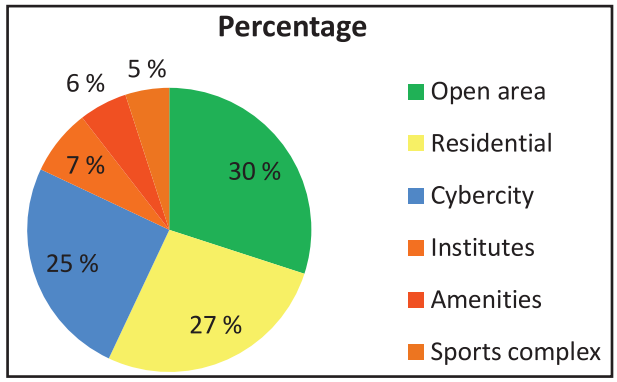


Table 5: General Amenities at Magarpatta City

Cyber City	Hi-tech commercial area for information technology enabled.
Garden city	Central garden of 25 acres along with separate internal gardens for every neighborhood ranging from 0.5 to 2 acres.
Shopping	Convenient shopping & other essential services.
Education	Educational facilities from primary school to higher education with large playgrounds.
Health Facilities	Well-equipped hospital for medical aid round-the-clock.
Jogging/ cycling tracks	Extensive network of jogging and cycling tracks throughout Magarpatta city.
Security	Round-the-clock centralized security system.
Garbage disposal	Eco-friendly sustainable garbage disposal system.
Property management	Maintenance and upkeep will be looked after by Magarpatta Property Management Division.

Source: (1)

maximum percentage is given to the open spaces followed by residential area and Cyber city. The township provides all the basic necessities within the township as per the Integrated Township Policy of Maharashtra.

3.2 Amanora Park Town, Pune

It is a 400 acre township project in Hadapsar, Pune, including 70 acres of well-designed clean and open space that was launched in 2007. It is the first township project in Maharashtra to meet all of the requirements of the state's special township policy. (11)

The township's goal is to provide comfort and convenience for residents without disrupting the region's ecosystem, which includes the *nalla*, tree clusters, slopes, and natural drainage patterns. Amanora Master Plan of Amanora Park Tow, (Fig. 5)

Fig. 5: Master Plan of Amanora Park Town

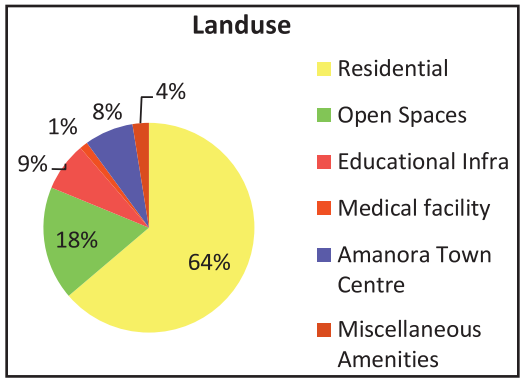
Source: (11)

is a completely developed mixed-use community (land use pattern of Amanora Park Town given in Table - 6 and Fig. 6). Rainwater Harvesting, water treatment and water filtration plant, sewage treatment plant, use of renewable resources for lighting common area, installation of smart devices such as motion sensing light, balance of green and open spaces to built spaces, walk to destination concept reduces pollution and fuel consumption by private vehicles with further reductions achieved using eco-friendly bus services, and so on are some of the sustainability features. It has all of the necessary infrastructure, such as roads, cycle tracks, tree-lined pavements, uninterrupted power, 24x7 water supply, STP,

Table 6: Land use Pattern at Amanora Park Town

Land use	Area (in acres)	Percentage (%)
Open Spaces	70	17.50
Residential	255	63.75
Educational Infra	30	7.50
Medical Facility	5	1.25
Amanora Town Centre	30	7.50
Miscellaneous Amenities	10	2.50
Total	400	100.00

Fig. 6: Land use Distribution in Amanora Park Town



Source: (11)

piped gas, healthcare, education, digital living (smart home systems, web portal to shop in the neighborhood), gardens, commercial complexes, post offices, police stations, and libraries, among other things. (11)

Amanora Park caters for all the norms of the Maharashtra Integrated Township Policy including the various land use requirements, the basic services provided and the sustainable features in the township including rainwater harvesting, water treatment plants, walkability, open spaces, etc.

4. CONCLUSIONS

The coming up Integrated Townships are innovative, sustainable and participatory forms of spatial planning strategies. They provide an opportunity for economic development and integrated form of spatial planning. They are planned according to the Integrated Township Policies of different states and are aimed at achieving sustainable form of urban settlement, which are walkable, inclusive and integrated in all respect.

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Resiliency of Indian Cities

Sudhir Singh Chauhan, and Gurpreet Kaur

Abstract

As the COVID-19 pandemic have significantly distorted urban life, in this paper an attempt has been made to incorporate the concept of resilience because cities of future needs to be resilient to meet the challenges of pandemics and endemics. Accordingly, the authors called on the urban planners and policy makers engaged in spatial planning and management to adopt "people-oriented" concepts in order to reduce the negative impacts of such disasters on both cities and people. The shift to home working has changed people's way of life, affected their subjective well-being, and significantly affected spatial planning within cities, placing greater demands on community spatial planning. Therefore, additional open public spaces and a more supportive infrastructure are required. The paper observes that an effective community-based spatial planning system has not been established, yet, something which needs to be taken into consideration in the master plan for the future.

1. INTRODUCTION

Urbanization refers to the population shift from rural to urban areas, the corresponding decrease in the proportion of people living in rural areas, and the way in which societies adapt to this change. Natural increase of population, rural to urban migration is driven by pull factors (that attract people to urban areas) and push factors (that drive people away from the rural areas), employment opportunities, educational institutions and urban lifestyle are the main pull factors and poor living conditions, lack of educational and economic opportunities and poor health care facilities are the main push factors. So, in order to sustain the increasing urbanization there is an urgent need to build sustainable infrastructure in the cities as increasing urbanization leads to acute shocks / stresses such as terrorism, disease outbreak (Covid-19), lack of physical and social infrastructure etc. So, to absorb these shocks and stresses, resilience of the cities plays a vital role. So, spatial planners need to plan the cities accordingly, to overcome such complications and problems.

The world is rapidly urbanizing, with up to 1.4 million people per week moving into urban areas. A significant portion of new urban expansion will occur in South Asia and sub-Saharan Africa. In India alone, the number of urban dwellers is expected to increase by 404 million over the next 35 years, with nearly 50 percent

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of the country's population living in cities by 2050. In sub-Saharan Africa, similar growth rates will result in 56 percent of the region's population living in urban areas by 2050, compared to 40 percent today (UN DESA 2014). As cities grow and grapple with uncertainties and challenges like climate change, it is becoming increasingly urgent for municipalities and development authorities to address urban resilience (Carmin 2012). Unprecedented urbanization has transformed the planet from 30 percent urban in 1950 to over 54 percent urban today, and this will reach an estimated 66 percent by 2050.

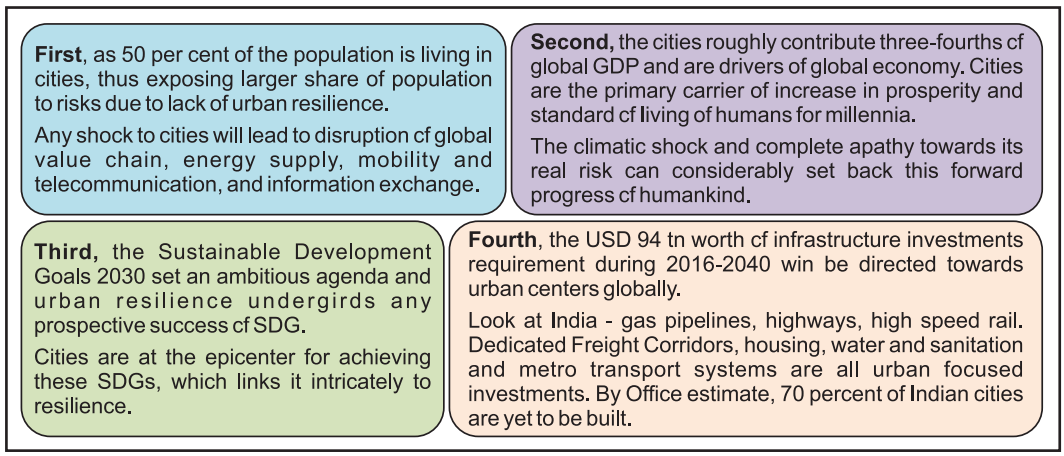
Together, India, China and Nigeria will account for 35 % of the projected growth of the world's urban population between 2018 and 2050. By 2050, it is projected that India will have added 416 million urban dwellers. Currently, India's population stood at 1210 million in 2011, with an urbanization level of 31.1 % (Census of India 2011).Cities stand at the forefront of the challenges and opportunities of the 21st century. Ever increasing population is causing humongous stress on the available resources and infrastructure, therefore, proper planning techniques needs to be adopted. Resilience is the capacity of a system to absorb disturbance and reorganize while changing to still retain essentially the same function, structure, identity, and feedbacks. It is an inherent and fundamental quality for both human and natural systems.

2. NEED FOR MAKING CITIES RESILIENT

In case of India, there is lack of planned environment with respect to resilient desired goals and strategies. Absence of socio-culture facilities tends to fail the idea of resilient city. Safe and livable cities are the prime rising focus these days, thus better and resilient planning approaches needs to be implemented to ensure the safety of all people. So, there is a critical need for a flexible and dynamic approach to building resilience that goes beyond risk mitigation. There are concrete ways to improve the decision-making process and making it more resilient.

Change in the structure of national and local economy, poor infrastructure, rising pollution levels and lack of physical safety leads to decline of cities at a glacial pace. However, climatic events can cause catastrophe to cities that can render them grounded in minutes. The floods of Mumbai and Chennai, Nepal Earthquake, Uttarakhand floods are few such instances where our cities, many hundreds of years old, became paralyzed and inhospitable. Cities are at real risks. By one estimate, every year, around 46 million people in cities are at risk from flooding, from storm surges in the East Asia region alone. Many coastal cities, particularly in Asia, are staring at the risk of submersion due to rising sea levels. More than 1,000 people died, and 45 million people suffered losses in terms of loss of livelihood, homes, and services in 2017 when severe floods hit south-east Asian cities, including Dhaka, Mumbai, and Chennai. There are four major reasons (Fig. 1) for investing in resilience contributes to long-term sustainability by ensuring current development gains are safeguarded for future generations. The need and

Fig. 1: Four Major Reasons for Investing in Resilience



Source: https://www.orfonline.org/expert-speak/urban-resilience-why-should-we-pay-more-attention-49653/

desire for urban resilience is firmly established. It is time for actual actions that can save the impending crisis which is already showing early signs. Cities are our bulwark against slipping back in time and urban resilience is a tool to ensure that no discernible harm is done to our cities.

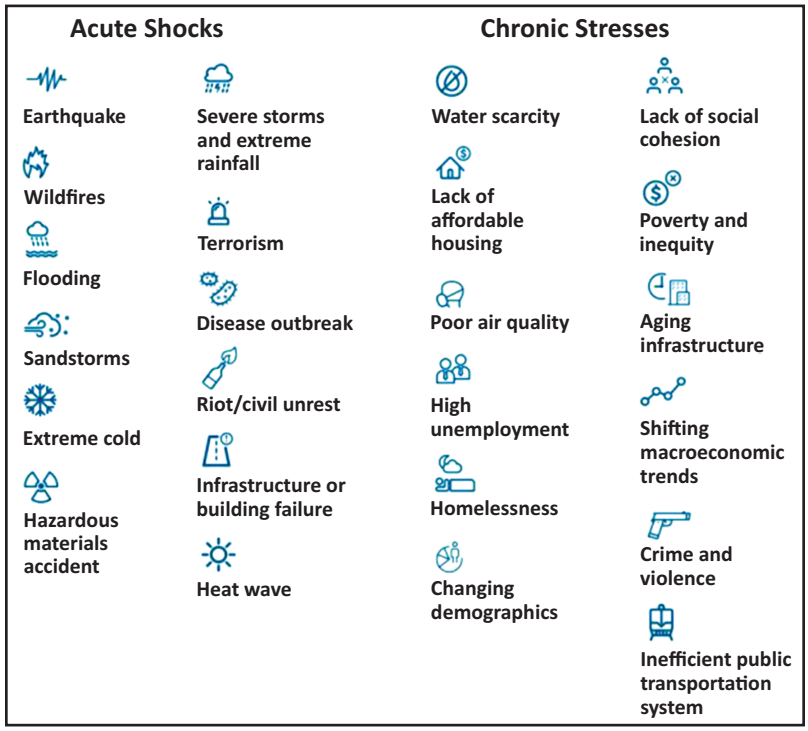
3. CONCEPT OF RESILIENT CITY

Before understanding the concept of resilient cities, it is important to understand the origin of term resilience in urban planning. The notion of resilience is rapidly gaining ground in the urban sustainability literature. The word "resilience" has been chosen as an umbrella term for the planning and design strategies needed to help our cities develop the necessary capacity to meet the challenges of the future. The term resilience is a normative concept which is not easy to be presented in quantitative terms. However, there is a broad consensus in the research community that city as a dynamic entity is not only an ecological system but also a social one. As a dynamic, socio-ecological system a city is undergoing a constant process of change and adaptation. This implies that resilience in urban areas should be considered as an adaptive process which does necessarily require the system to return to an equilibrium state after having been hit. The time scale is an important dimension of resilience. "Engle, Bremond", describe resilience as a system's ability of short-term coping and long-term adaptation. A community should be able to absorb impacts in the short term and self-organize and increase its capacity for learning in the long run.

A Resilient city is one that has developed capacities to absorb future shocks and stresses (Fig. 2). Urban resilience is "the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks (natural, socio-economic or technological) are faced by Indian Cities such as earthquakes,

wildfires, floods, sandstorms, extreme cold, terrorism, war,disease outbreak / pandemic /epidemic (Covid-19), infrastructure/building failure, heat wave, water scarcity, labor strike / unrest, poor air quality, high unemployment, lack of affordable housing, lack of social cohesion, poverty and inequality, corruption, crime and violence, civil unrest, changing demographics, inefficient public transportation system, etc.

Fig. 2: Shocks and Stresses Faced by Cities



Source: 100 Resilient Cities, 2013

Urban resilience demands that cities look holistically at their capacities and their risks, including through meaningful engagement with the most vulnerable members of a community. The focus of urban resilience is to understand the prospective stresses in the urban centers and devising strategies to cope in case these stresses become shocks.

A city can become resilient if its people are healthy and have access to basic services; if its people are safe, socially cohesive with reliable employment supporting a sustainable economy; if the city's ecosystem, infrastructure, and services are well-balanced catering to the well-being of its people; and if the city leadership and local communities work together in driving integrated planning. In the resilience literature, these are four dimensions of the City Resilience Framework (CRF), which are given bellow.

- **Health and Well-being** - of everyone living and working in the city - focus on People.
- **Economy and Society** - the systems within the society and economy that enable urban population to live peacefully and act collectively - focus on Organizations.
- **Infrastructure and Environment** - the quality of physical infrastructure and ecosystems that protect, provide, and connect us - focus on Places.
- **Leadership and Strategy** - appropriate leadership and strategy, enabling the city to learn from the past and take timely action - focus on Knowledge and Institutions.

- A resilient city is one that has developed capacities to help absorb future shocks and stresses, to maintain the same functions, structures, systems, and identity.

4. STRATEGIES FOR RESILIENCE URBAN PLANNING

Cities of future needs to be resilient as the COVID-19 pandemic have already significantly distorted urban life. By 2050, more than two thirds of the world population is projected to live in urban areas, and most of this urban growth will take place in lower and lower-middle income countries. But densely built-up urban spaces tend to come with challenges of their own. Therefore, there is a need to start ensuring today that these urban areas will be inclusive, safe, sustainable, and resilient.

4.1 Few Examples of Urban Resilience Initiatives in India

- **Urban Horticulture (Chennai):** Rooftop horticulture is also linked to waste management through segregation of waste and demand for compost, which benefits the city's waste management agency.

  Rooftops with gardens (Fig. 3) to reduce roof surface temperatures and the city's aims to scale this initiative to address heat stress in the city.

Fig. 3: Rooftop Horticulture in Chennai

Source: https://resilientchennai.com/urban-horticulture/

- **Integrated Disease Surveillance Project (Indore)**: Intends to reduce human vulnerability by detecting early warning signals of disease outbreaks to ensure appropriate response.
- **End to End Early Warning System for Ukai and Local Floods (Surat):** The objective of this project is to reduce the damage caused by floods (Fig. 4) by reducing their intensity; the project reduces human vulnerability especially of the economically weaker sections by - installing

Fig. 4: Floods in Surat

Source: Wikipedia, 2016

weather systems and data transfer mechanisms from catchment to reservoir to city.

- **Urban community based micro resilience model of ward exposed to climate and hydro meteorological risks (Gorakhpur):** Impacts of climate change were experienced by certain wards where basic services like drinking water, sanitation, solid waste were limited.

4.2 Few promising aspects and strategies for resilient urban planning in the Indian cities

- **Focus on Access to Core Services:** The spread of COVID-19 in the world's most connected urban centers has raised questions about healthy density. Density is the pre-condition for effective urban service provision, and far too many people in cities today lack access to basic services such as water, housing and health care that has exacerbated the challenge of responding effectively to COVID-19 in many cities. Poor access makes lock down orders impossible to comply with in some places. Closing this urban services divide must be a priority for cities going forward.
- **Affordable Housing and Public Spaces:** Population density without adequate public spaces or proper affordable housing provision will lead to problems. COVID-19 may prompt changes too, from temporary measures that make it feasible for people to follow social distancing guidelines to more lasting changes that should focus on improving access to affordable housing and public space like upgrading more informal settlements in place. Africa, India, and Southeast Asia face the enormous task of shaping the next generation of cities. More than 2.5 billion urban dwellers will

be added to the world by 2050, 90 % of them in Africa and Asia. It's estimated that 1.2 billion city dwellers lack access to affordable and secure housing today. As it turns, a large share of future growth is going to be unplanned, which could raise this number to as high as 1.6 billion people by just 2025. Change is needed and perhaps COVID-19 will be the wake-up call to get us there.

- **Integrated Green and Blue Spaces:** One of the few places that have seen a surge in traffic during COVID-19 lock downs (at least as long as they remain open) is urban parks. A new approach to city planning should bring open spaces, watersheds, forests, and parks into the heart of the city that is how we think about and plan our cities. A more holistic approach to planning that combines gray, green and blue infrastructure supports better health, better water management (flooding contributes to many epidemics and diseases after natural disasters), and climate adaptation and mitigation strategies. Furthermore, larger open spaces within the urban fabric can help cities implement emergency services and evacuation protocols.

Fig. 5: Copenhagen Bicycle Bridge

Fig. 6: New York City's Greened Rooftops

- **More City-Level, Granular Data:** Data is mainly now aggregated at the national level, while many decisions on containment of any epidemic or pandemic are made at the local level. To help cities harness the power of big data in response to this crisis but also other long-term sustainability and equity challenges, we need to empower cities with more granular, regularly updated data streams that can provide better evidence for decision-making.
- **Urban Transport Systems need to become more Sustainable:** Sustainable urban transport can include giving priority to bicycles over cars as done for example in Copenhagen (Fig. 5) where a bridge exclusively for bikes has been constructed, by introducing bus rapid transit (BRT) with dedicated bus routes like in Johannesburg, or cable cars as part of

urban public transport systems to link hilly and often low-income urban communities to the city like in Medellin or La Paz.

- **Nature-based solutions work for cities, too:** Increasingly nature-based solutions are considered in urban climate change adaptation and disaster risk reduction. An example would be of New York City's greened rooftops (Fig. 6) and streets that can better manage storm water runoff and improve urban climate.

  China introduced the concept of 'sponge cities', cities with open spaces that can soak up floodwater and prevent disaster in ecologically friendly ways.

There is no set road map for a resilient future, but there are varying perspectives evidently emerging from the global patterns. But if leaders and communities want to build stronger cities, the planning must begin with the fundamental unit in the city - the 'neighborhood'. The top-down ecosystem of city planning, and governance must change. There is already a growing focus towards a localized approach, becoming self-reliant and resilient. Three interrelated recommendations that could forge deeper and stronger social recovery at a local level are given in Table - 1.

Table 1: Three Interrelated Recommendations

15-minute neighborhood model	Engage the citizens in rebuilding cities	Need to accelerate the building of integrated urban systems
• This model revolves around simple forms of active mobility and ensures that everyone can easily access essential goods and services. • Such neighborhoods could be built by developing localized strategies to ensure adequate safety and well-being of the residents and growth of local businesses to make them resilient.	• It's important to engage the citizens in rebuilding cities by incorporating their needs and visions in the local agenda and the city. • Residents, businesses and the local governments / leaders could play an active role. • Hyper-local governance could transform the local economy and enable better crisis response.	• There is a need to accelerate the building of integrated urban systems by utilizing innovative digital technology for intelligent management and efficient delivery of urban services. • It would enable the regional and local government, communities, and businesses to seamlessly connect with each other and ensure inter - departmental collaboration both within the city and across territories.

Source: Prepared from article 'Building resilient cities' by Chauhan Shivanshu

5. CONCLUSIONS

The study has tried to incorporate the concept of resilience and solutions which cities of future needs to be resilient as the COVID-19 pandemic have already significantly distorted urban life. Urban planners and policy makers engaged in spatial planning and management should carefully consider how a "people-oriented" principle can be incorporated into spatial-planning systems to reduce the negative impacts on both cities and people. The shift to home working has changed people's way of life, affected their subjective well-being, and significantly affected spatial planning within cities, placing greater demands on architectural design and community spatial planning. Therefore, additional open public spaces and a more supportive infrastructure are required. It is found that

an effective community-based spatial planning system has not been established yet, something which should have been taken into consideration in the master plan for the future. In terms of policy implications, planning departments should work with public health and public safety departments to formulate guidelines and management rules in order to improve the spatial planning of cities during periods of extraordinary change and challenge.

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A Methodology for the Optimum Selection of World Heritage Sites: Destination Competitiveness Approach

Md. Danish, Ph.D., and Manjari Chakraborty

Abstract

UNESCO, a UN body try to fosters the growth of national and international tourism, by designating the sites as World Heritage Site. It upholds the regional, national and international profile of the heritage (both tangible and intangible). In tourism literature, competitiveness has been expanded into the sustainability of the destinations. This paper tends to apply the 'Destination Competitiveness Concept' to select the most optimum destinations among the 7 Archaeological Survey of India protected, UNESCO World Heritage Sites for site management and service enhancement. In this paper profitability and sustainability of the site is measured by its tourism data related to annual tourist inflow, annual revenue and expenditure. Concepts of "Site Profitability" , "Site Efficiency" and "Site Sustainability" has been inextricably linked with the Destination Competitiveness model by undertaking the "Trend Analysis" of the Tourist data using SPSS and MS-EXCEL.

1. INTRODUCTION

1.1 Site Selection and Justification: An Introduction

India, accounts for 38 numbers of UNESCO World Heritage Sites (as on 10th June, 2021 http://whc.unesco.org/en/statesparties/in) out of which, 30 are cultural sites and 7 are natural sites and 1 belongs to the mixed category. This research paper explores the Destination Competitiveness method to select the most competitive UNESCO World Heritage Site. For the purpose of study, 7 numbers of UNESCO World Heritage Sites have been identified. These Sites (Figure - 1) are among the top 15 revenue generating monuments of India as per Ministry of Culture, (Government of India, 6th August, 2014) . These Sites are namely: Red Fort Complex, Humayun's Tomb, Qutb Complex, Taj Mahal, Agra Fort, Fatehpur Sikri and group of monuments at Hampi. Maintenance and upkeep of these World Heritage Sites is under the purview of Archaeological Survey of India (ASI). ASI is the premier organization under the Ministry of Culture, Government of India, entrusted for the protection and conservation of the heritage sites across the nation. To undertake the study, decadal records between 2005 to 2015 pertaining to tourist data, revenue data and expenditure data for these 7 sites were collected and were put into analysis to establish the relationship between Tourist v/s Revenue, Tourist v/s Expenditure and Revenue v/s Expenditure. Few notable indices, viz. RPT (Revenue / Tourist), EPT (Expenditure / Tourist), Revenue Surplus

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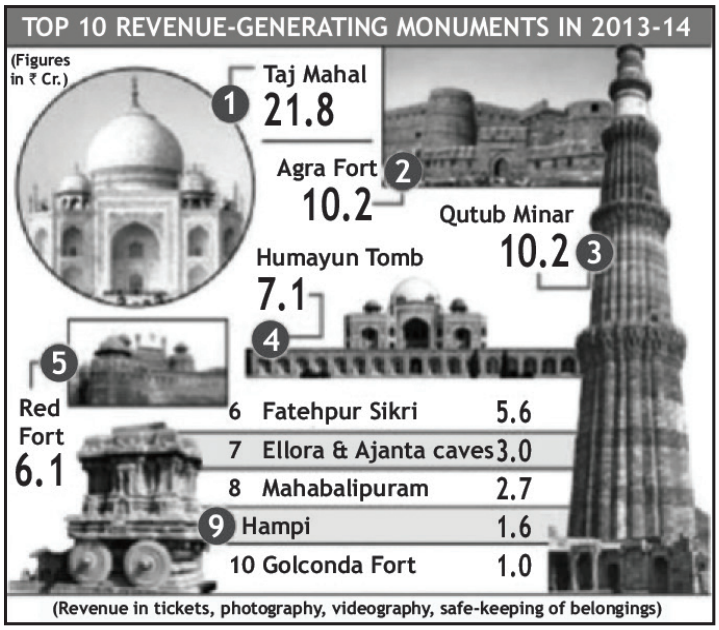
Fig. 1: Top Ten Revenue Generating Movements in India



data and R/E (Revenue / Expenditure) emerges out from this Analysis which provides a benchmark for gauging the "Site Sustainability" and "Site Profitability". In the end, Competitiveness v/s Sustainability graph is plotted to select the most optimum site for the provision of service enhancement and facilities augmentation at the given World Heritage Site.

2. OVERVIEW OF PREVIOUS RESEARCH

Various literatures have contributed towards the economic aspects of UNESCO World Heritage Sites. UNESCO World Heritage Site designation is a matter of prestige and pride for many lesser known sites in small and developing countries. In order to increase the tourist inflow and subsequent revenue, many countries spends substantial amount of time and money to prepare the World Heritage Dossier, eg: Grand Pre Site in Canada had spent close to 4 million USD for the coveted tag during the span of 4 years. Whereas, many countries lacks the necessary conservation infrastructure and technical know how to prepare the nomination dossier (Strasser, 2002:226-27). Within a region, UNESCO World Heritage Sites can be compared under the parameters of regional tourism network and tourism driven development. Regional network plays an important role in the UNESCO WHS Cities of Luang Prabang (Capital of Laos) and Baalbeck city of Lebanon. In Luang Prabang, money generated from the tourists remains within the confines of the local communities and was spend for their up gradation. On the other hand, Baalbeck's tourist revenue was channelized back by the existing central government of the country. In both the cities, local population was alienated from the economic development of the monument (Akar,Hiba Bou, January 2004). Tourism-driven activities are playing a fundamental role for the economic sustainability of Evora (Capital of Alentejo Region of Portugal) and Macao (Former Portuguese Colony in China), but not for their social and ecological sustainability (Tarrafa, Ana, Imon, Sharif Shams, Roders, Ana Periera,).

There exists a positive relationship between the WHSs and International tourist arrivals. As for WHSs poor countries, inscription of unknown sites in the list increases the number of international tourists. As per the estimated results, addition of one WHS, increases the number of international tourist by 3, 82,637.

Henceforth, possession of WHSs is a win-win situation in terms of sustainable conservation of cultural achievements and development of tourism economy (Yu-Wen Su, Hui-Lin Lin, 2013).

3. BRIEF OUTLINE OF STUDY

Research and Investigation have classified the entire paper into ten parts, for the purpose of site selection and justification among the identified 7 numbers of the UNESCO World Heritage Sites. Section - 1 discusses about the Introduction part of the paper, discussing about the modalities of study and its stated objectives. Section - 2 illustrates the overview of the previous research related to the economic dimensions of the UNESCO World Heritage Sites. Section - 4 describes the OUV of the identified 7 numbers of UNESCO World Heritage Sites. Section - 5 describes the destination competitiveness and its implications related to the travel and tourism industry. In terms of Destination Competitiveness, Section - 6 and Section - 7 list out the various factors and indicators of tourism, respectively. Section - 8 of this study describes the World Economic Forum Report of 2017, mentioning the India's performance under the TTCI (Travel and Tourism Competitiveness Index). Section - 9 of this paper discusses the Data collection and Analysis methodology part for the selection of most optimum site in terms of competitiveness and sustainability. Section - 10 discusses the results and discussion for the undertaken research. Last section of this paper, Section - 11 gives the conclusions derived from the study.

Profitability and sustainability of the site is measured by its tourism data related to annual tourist inflow, annual revenue and expenditure. Concepts of "Site Profitability", "Site Efficiency" and "Site Sustainability" has been inextricably linked with the Destination Competitiveness model by undertaking the "Trend Analysis" of the tourist data using SPSS and MS-EXCEL. Cronbach a Reliability Statistics suggests the consistency checks and reliability of the tourist data. Comparison of sustainability and competitiveness data provides a benchmark for the provision of facility augmentation and service enhancement at the Site level. Study is limited for the economic sustainability of UNESCO World Heritage Sites. Tourist income and expenditure data has been used for calculating the destination competitiveness of the World Heritage Sites.

4. ABOUT THE ASI PROTECTED UNESCO WORLD HERITAGE SITES

According to World Heritage Convention 1972, UNESCO defines the Outstanding Universal Value to designate the sites under "World heritage Sites". As stated earlier, 7 numbers of ASI protected UNESCO World Heritage Sites has been identified for the purpose of research. A brief description about these sites has been described in Figure - 1. Table - 1, describes the 'Outstanding Universal Value' (OUV) of the selected 7 sites, which are also protected by the Archaeological Survey of India (ASI).

Fig. 1: Brief Description of Identified ASI Protected UNESCO Worlds Heritage Sites (WHS)

Located in Delhi, Red Fort Complex is was inscribed in the UNESCO World Heritage List in the year 2007, fulfilling the requirement of Outstanding Universal Value under Criteria (ii), (iii), (vi).

Located in New Delhi, Humayun's Tomb spreads on an area of 21 Hectares. In the year 1993, it was inscribed in the UNESCO World Heritage List, fulfilling the requirement of Outstanding Universal Value under Criteria (ii), (iv).

Located in New Delhi, Qutb Complex comprises of Qutb Minar and its monuments. Listed as an UNESCO World Heritage Site in the year 1993, it fulfils the requirement of Outstanding Universal Value under Criteria (iv).

Located in Agra, Taj Mahal spreads in an area of 17 Hectares. Listed as an UNESCO World Heritage Site in the year 1983, it fulfils the requirement of Outstanding Universal Value under Criteria (i).

Located in the City of Agra, Agra Fort spreads on an area of 38 Hectares. Listed as an UNESCO World Heritage Site in the year 1983, it fulfils the requirement of Outstanding Universal Value under Criteria (iii).

Located in Agra, Fatehpur Sikri has property area of 60.74 Hectares with a buffer zone of 475.54 Hectares. Listed as an UNESCO World Heritage Site in the year 1983, it fulfils the requirement of Outstanding Universal Value under Criteria (ii), (iii), (iv).

Located in the Bellary district of Karnataka, Group of Monuments at Hampi was initially listed as an UNESCO World Heritage Site in the year 1986, with minor modification in the year 2012. This site bears the Outstanding Universal Value under Criteria (I), (iii), (iv).

Table 1: Outstanding Universal Value (OUV) of ASI Protected World Heritage Sites (WHS)

S. No.	Name of the Monument	Place of the Monument	Year of Inscription	Criteria of Out Standing Universal Value (OUV)
1.	Red Fort Complex	Delhi	2007	**Criteria (ii), (iii), (vi)** • Under Criteria (ii), Red Fort displays the fusion of Islamic, Persian, Timurid and Hindu traditions in terms of ideas, techniques, craftsmanship and design. • Under Criteria (iii), Red Fort influences the later buildings and gardens in Rajasthan, Delhi, Agra and others in terms of the design of the Building Components and Garden design. • Under Criteria (vi), Red Fort has witnessed the setting of events critical to the shaping of regional identity, and which have had a wide impact on the geo-cultural region.
2.	Humayun's Tomb	Delhi	1993	**Criteria (ii), (iv)** • Under Criteria (ii), Humayun's Tomb epitomizes the monumentality of scale, grandeur design.

S. No.	Name of the Monument	Place of the Monument	Year of Inscription	Criteria of Out Standing Universal Value (OUV)
				and garden setting, which is unique in itself for Islamic mausoleum. • Under Criteria (iv), Humayun's Tomb represents the unique ensemble of Mughal era- Garden Tombs.
3.	Qutb Complex	Delhi	1993	**Criteria (iv)** • Under Criteria (iv), the religious and funerary buildings in the Qutb Minar complex represent an outstanding example of the architectural and artistic achievements of early Islamic India.
4.	Taj Mahal	Agra	1983	**Criteria (i)** • Under Criteria (i), Taj Mahal represents the finest architectural and artistic achievement through perfect harmony and excellent craftsmanship in a whole range of Indo-Islamic sepulchral architecture.
5.	Agra Fort	Agra	1983	**Criteria (iii)** • Under Criteria (iii), Agra Fort creates a buffer between Red Fort and Taj Mahal and bears exceptional and contemporary testimony of the already disappeared Mughal Civilization.
6.	Fatehpur Sikri	Agra	1983	**Criteria (ii), (iii), (iv)** • Under Criteria (ii), the construction of Fatehpur Sikri exercised a definite influence on the evolution of Mughal town planning, namely, Shahjahanabad. • Under Criteria (iii), the city of Fatehpur Sikri demonstrates the most spectacular building activities which bear an exceptional testimony to the Mughal civilization at the end of 16th century AD. • Under Criteria (iv), The city as a whole is a unique example of architectural ensembles of very high quality constructed between 1571 and 1585 AD.
7.	Group of Monuments at Hampi	Bellary	1986 and 2012	**Criteria (i), (iii), (iv)** • Under Criteria (i), the city of Hampi with its exemplary temple architecture and its spectacular natural setting represent a unique artistic creation. • Under Criteria (iii), the city bears exceptional testimony to the vanished civilization of the kingdom of Vijayanagara. • Under Criteria (iv), This capital offers an outstanding example of a type of structure which illustrates a significant historical situation: ensemble of living temples and arch. remains.

5. DESTINATION COMPETITIVENESS: DEFINITIONS

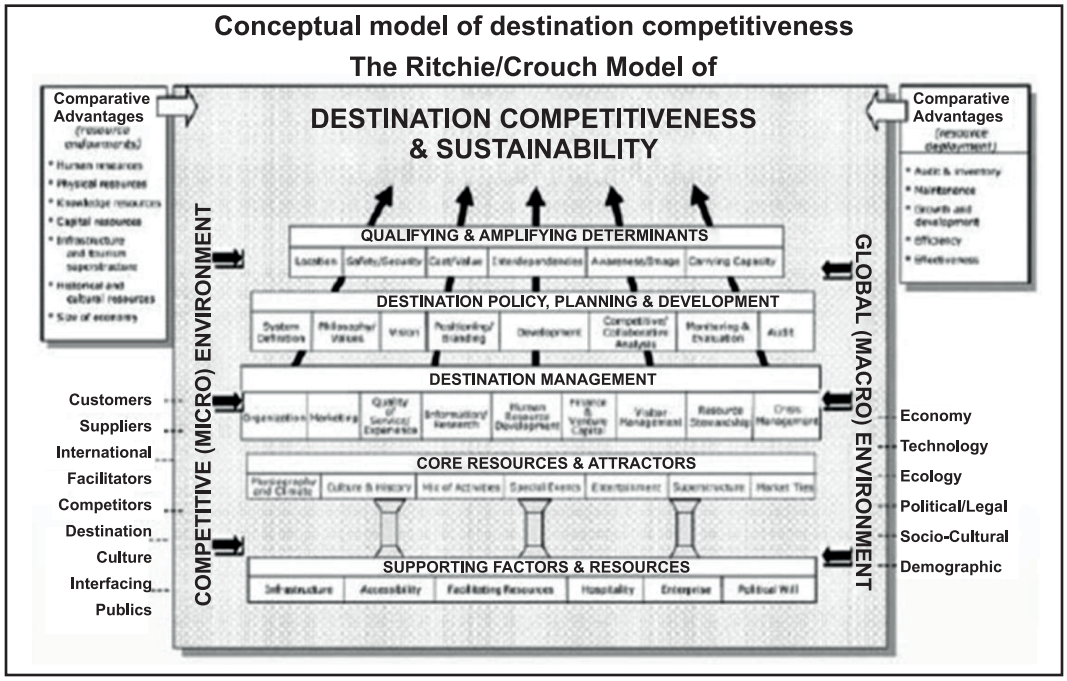
The concept of competitiveness was first enunciated by Porter (1980, 1990) and is being widely used in the industries. According to Porter, company should

find better ways to compete by continually upgrading the firms' products and processes through Cost Advantage and Differentiation Advantage. It implies that the competitiveness refers to the combination of both the assets and processes, where assets are inherited (e.g. natural resources) or created (e.g. infrastructures) and transformed into economic results (Crouch & Ritchie, 1999). During recent times, tourism has become a highly competitive. So, in order to frame the future strategies of development, destinations must identify their strengths and weaknesses. According to Murphy (1997), many tourism businesses believed to sell their destination before they can sell their individual offerings. This can be achieved by increasing the competitive advantage of the whole product mix, so that individual businesses benefit from the increased profile and trade. According to Keller and Smeral (1997), various factors have contributed towards the Competitiveness: emergence of new tourist destinations, impact of tour operators in the market, experience and Know-how of tourists and the Environmental condition of destinations. In tourism literature, competitiveness has been expanded into the sustainability of the destinations. It has incorporated the various factors of Sustainable Tourism: price, image and other qualitative attributes. According to Hassan (2000), "Competitiveness is the destination's ability to create and integrate value-added products that sustain its resources while maintaining market position relative to competitors". visitor numbers and tourist receipts are a barometer of Destination Competitiveness. Thus, a destination is said to be highly competitive, if it has high visitor numbers and increasingly destination income. A tourist destination is said to be competitive, if its market share, measured by visitor's numbers and financial returns are increasing. Destination's development for tourism must be sustainable, not just economically and ecologically, but socially, culturally and politically as well. As the competition in the tourism market increases, an identification of determinants of competitiveness is essential for the growth and vitality of the tourism destinations (Ritchie & Crouch, 1993). These mutually dependent determinants are factor condition (e.g. skilled labor, infrastructures), demand condition (e.g. basic tourism services), related and supporting industries, and firm strategy, structure, and competition (Ritchie & Crouch, 1993) (Figure - 4 and 3). According to Jacopson and O'Callaghan (1996), input and output parameters determine the competitiveness of the tourist destinations. On one hand, where physical and human capital determines the input side, output side is determined by the profitability, market share in terms of tourist arrivals, amount of tourist receipts, etc. According to Pearce (1997), destination competitiveness can be evaluated in terms of both: quantitatively and qualitatively. On one hand, quantitative indicators includes annual number of tourist arrivals, amount of yearly tourist incomes, length of overnight stays, on the other hand, the qualitative indicators refers to socio economic profile of tourists, level of satisfaction, etc. The over view of previons research is given in Table - 2.

Fig. 2: Overview of Previous Research on Destination Competitiveness

Author	Method	Type	Criteria
Pearce 1997	Secondary data	Destination competitiveness	Market, access, attractions, accommodation supply, prices, development processes.
Grabler 1997	Primary data	Destination positioning of urban destinations	Accommodation, entertainment, ambiance, cultural resources, level of prices, accessibility of amenities and destinations, location, originality, attitude, shopping facilities, food and beverage quality.
Seaton 1996	Secondary data	Destination competitiveness	Tourist arrivals, number of bed nights, tourism receipts, occupancy trends, seasonality balance of tourism payment trends, portion of tourism in GDP, market dependence trends, tourism employment trends and marketing expenditure treads.
Briguglios and Vella 1995	Secondary data	Destination competitiveness	Political factors, exchange rates, marketing, development of new products, human resources, hygiene and environmental factors, tourist services.
Bray 1996	Secondary data	Destination competitiveness	Prices exchange rates, market, access.
Edwards 1993	Secondary data	Destination competitiveness	Exchange rates, prices.
Dieke 1993	Secondary data	Destination comparison	Number of arrivals, purpose of visits, bed nights, accommodation supply, seasonality, tourism receipts, employment, tourism policies, market and tourist expenditures.
Soanne 1993	Secondary data	Destination comparison	Structural changes in demography, infrastructure and urban geography.
Javalgi, Thomas and Rao 1992	Primary data	Destination competitiveness	Tourist perceptions of several destination attributes.
Calantone, Benedetto, Hakem and Bojanic 1989	Primary data	Destination competitiveness	Tourist perceptions of several destination attributes (shopping facilities, hospitality, safety, food, culture, tourist attractions, tourist facilities, nightlife and entertainment, scenery, beaches and water sports.
Goodrich 1977	Primary data	Destination comparison	Tourist perceptions of similarities and differences between nine regions on water sports and sports, historical and cultural interests scenic beauty, hospitality, rest and relaxation, shopping facilities, cuisine, entertainment and accommodations.
Goodrich 1978	Primary data	Destination comparison	Tourist perceptions of nine regions and their intention to choose them Attributes were same as above.
Haahti and Yavas 1983; Haahti 1986	Primary data	Destination competitiveness	Tourist entertainment, of 12 European counties on value for money, accessibility, sport facilities and other activities, nightlife and entertainment, peaceful and quietness, hospitality, wilderness, tracking and camping, cultural experience, scenery, change from the usual destinations.
Driscoll, Lawson and Niven 1994	Primary data	Destination comparison	Tourist perceptions of 12 destinations on 18 attributes such as facilities, landscape, climate, culture, modern society, different experience, value for money, accessibility, shopping facilities, organized activities, cleanliness, family-oriented, exotic place, outdoor activities, religious values, hospitality, nightlife and entertainment.
Javalgi, Thomas and Rao 1992	Primary data	Destination comparison	Traveler perceptions of European destinations (as 4 major regions) about 27 attributes.
Woodside and Lysonski 1989	Primary data	Destination competitiveness	Developing a destination set where my destination is chosen among alternatives.
Faulkner, Oppermann and Fredline 1999	Primary data	Destination competitiveness	Analysis of travel agent's perceptions of core tourist attractions.
Botho, Crompton and Kim 1999	Primary data	Destination competitiveness	Tourist motivations and tourist perceptions of entertainment, physical environment and wildlife.

Fig. 3: Ritchie Crouch Model of Destination Competitiveness



6. FACTORS IN TOURISM (DESTINATION COMPETITIVENESS)

Factors which contribute towards destination competitiveness are:

- Socio-economic profile of tourism demand and changes in markets;
- Access to tourist markets (Distance);
- Mature tourist destinations and consumer psychology;
- Influences of tourist satisfaction;
- Marketing by tour operators and their perceptions of destinations;
- Prices and costs;
- Exchange rates;
- Use of information technologies;
- Safety, security and risk;
- Product differentiation (positioning);
- Adequacy and quality of tourist facilities and services;
- Quality of environmental resources; and
- Human resources.

7. INDICATORS OF TOURISM DESTINATION COMPETITIVENESS

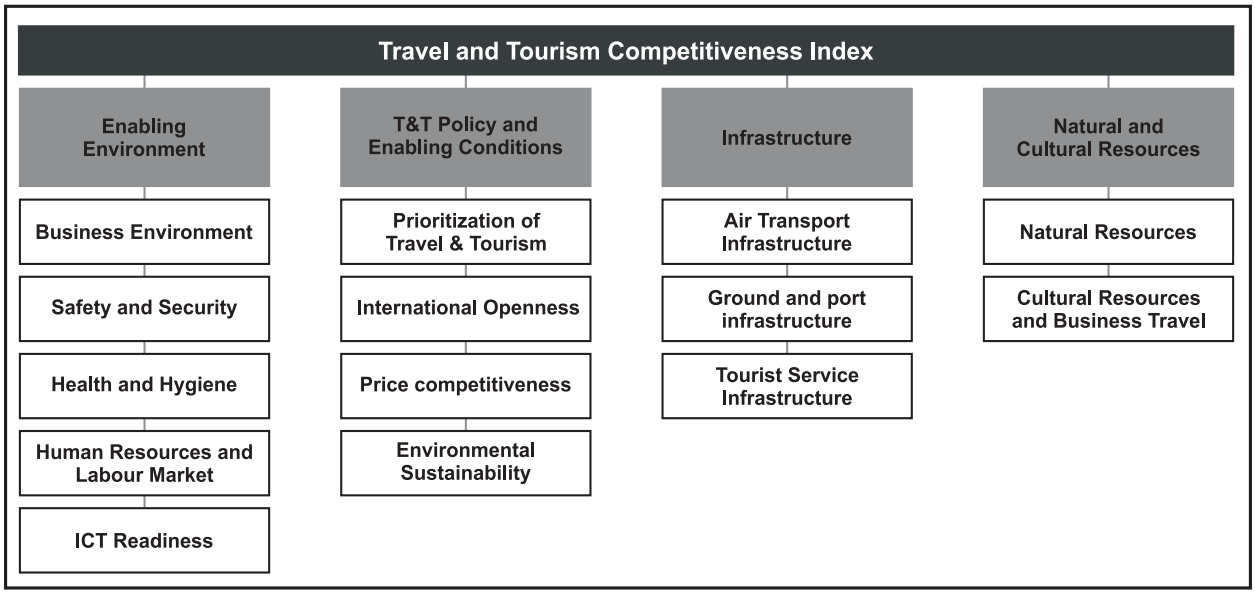
There are number of indicators to gauge the performance of tourist destinations in terms of destination competitiveness, these indicators are:

- **Volume of Tourist Arrivals:** Volume of tourist arrivals at any destination is an indicator to compare and rank it among its competitors. Higher the numbers of tourist arrivals, better will be the destination in terms of competitiveness. Destinations performance can also be evaluated by comparing the year on year change in the tourist numbers.
- **Volume of Tourist Income:** Volume of tourist receipts in terms of income is also an important indicator of destination competitiveness. Higher tourist receipts translates into stimulus effect on the local economy of the destination.
- **Volume of Repeat Tourists:** Higher the number of repeat tourists to a destination, more competitive and attractive would be the destination.
- **Share of Tourist Receipts to GNP:** Comparison of two destinations in terms of tourist receipts to GNP signifies the competitiveness factor of a destination.

8. WEF REPORT OF 2017 (TRAVEL AND TOURISM COMPETITIVENESS INDEX)

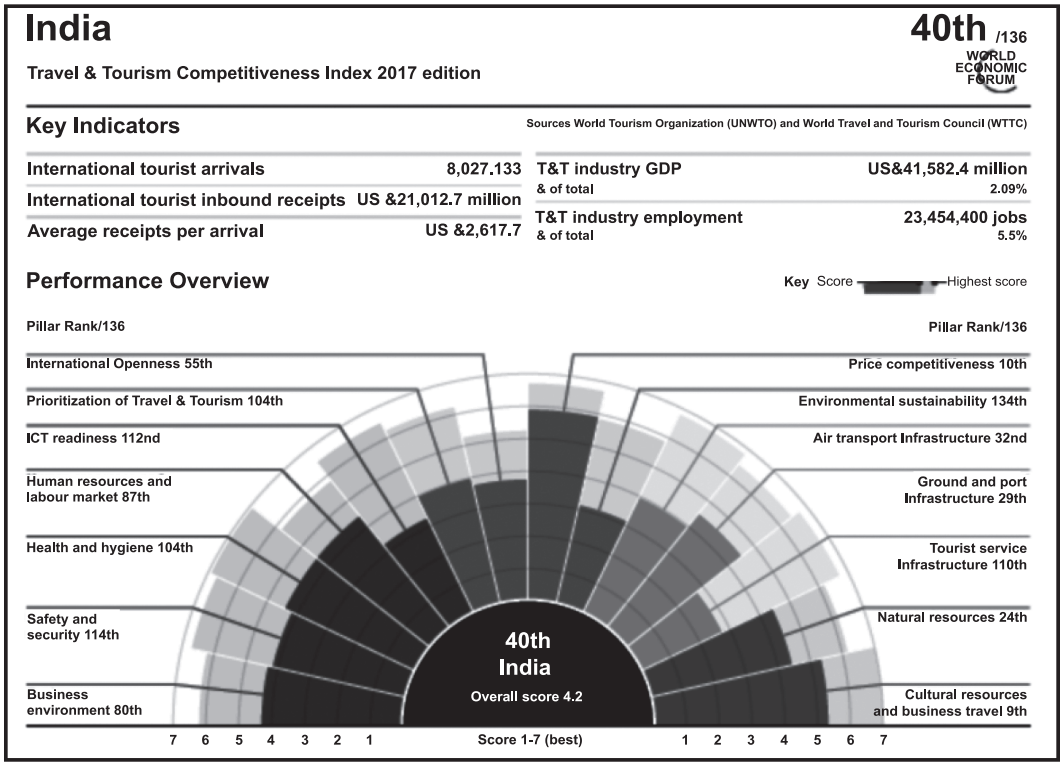
World Economic Forum (WEF) publishes the biennial report on Travel and Tourism Competitiveness Index for 136 economies across the globe. It consists of four sub-indexes, 14 pillars, and 90 individual indicators, well distributed among the different pillars, (Fig. 4).

Fig. 4: Travel and Tourism Competitiveness Framework



As per the Travel and Tourism Competitiveness Index Report for 2017, India is placed at 40th position amongst 136 countries. In terms of Pillar Ranking for Tourist Service Infrastructure, India is placed at 110th position, which gives an opportunity and challenge for further augmentation and improvement (Figure - 4 and 5).

Fig. 5: India's Performance at WEF-TTCI 2017



9. DATA COLLECTION AND ANALYSIS METHODOLOGY

Out of 30 numbers of Cultural UNESCO Sites, 7 numbers of Sites has been identified for the purpose of this study. These Sites are: Red Fort Complex, Humayun's Tomb, Qutb Complex, Taj Mahal, Agra Fort, Fatehpur Sikri and Group of Monuments at Hampi. The ten years (2005-2015) information pertaining to these sites were collected from Archaeological Survey of India, under RTI Act, 2005 under the following categories: total number of tourists (Indian and Foreign); total revenue (in Rs.) earned from ticket sales, film shooting, video-graphy, sales of publications, etc., during the period; total expenditure (in Rs.) incurred. Data entry in tabular format was made into MS-EXCEL under various heads: year wise data for tourist (Indian / Foreign) v/s revenue; year wise data for tourist (Combined) v/s expenditure; year wise data for revenue v/s expenditure (all in Rs.).

Then two-stage analysis was done, in first stage of analysis, available data was grouped under Tourist Data, Revenue Data and Expenditure Data. 'I' notation for Indian Tourist and 'F' notation for Foreign Tourist were done. Using SPSS, Reliability and Internal Consistency is being checked through the value obtained from Cronbach a and Reliability Statistics (Value must be greater than 0.5). Again Inter Class Correlation Coefficient shows the correlation between the variables and it should be positive. Anova Results and Summary Item Statistics were summarized

for Indian tourists, foreign tourists, revenue and expenditure data. These results state the Significance Value and Confidence Interval of the available data.

In Second stage of analysis, available data was grouped in tabular format under the heads tourist v/s revenue, tourist v/s expenditure and revenue v/s expenditure. Using MS-EXCEL, trend Analysis was executed.

In First Phase; Trend Analysis for the Indian tourist number v/s revenue (in Rs.) and foreign tourist number v/s revenue (in Rs.) was plotted in a graph for the selected ASI Protected UNESCO World Heritage Sites. Thereafter, revenue / tourist (RPT in Rs.) was calculated for each site and an average is being taken out. In order to measure the growth and decline from Initial to the final, % change in the RPT was also computed from the (year on year) comparative table.

In Second Phase; Trend analysis for the consolidated tourist number, (Indian and Foreign) v/s expenditure (in Rs.) was plotted in a graph for the selected ASI Protected UNESCO World Heritage Sites. Thereafter, expenditure/tourist (EPT in Rs.) was calculated for each site and an average is being taken out. In order to measure the growth and decline from initial to the final, % change in the EPT was also computed from the (year on year) comparative table.

In the Third Phase; Revenue surplus is calculated for the selected ASI protected UNESCO World Heritage Sites. In order to measure the growth and decline from initial to the final, % change in the revenue surplus (R.S.) was also computed from the (year on year) comparative table.

In the Fourth Phase; Trend analysis for the revenue (in Rs.) v/s expenditure (in Rs.) was plotted in a graph for the selected ASI Protected UNESCO World Heritage Sites. Thereafter, revenue/expenditure (R/E) was calculated for each site and in order to measure the growth and decline from initial to the final, % change in the R/E was also computed from the (year on year) comparative table.

In the Last Phase; Competitiveness v/s sustainability graph was plotted to select the most optimum World Heritage Site for the improvement in terms of facilities augmentation and provision of services.

10. RESULTS AND DISCUSSION

10.1 Reliability Statistics

Inferences: Cronbach α suggests the reliability of the data. It measures the internal consistency of the data. It refers to the extent to which it is a consistent measure of a concept. If the value of Cronbach α <0.5, then the results are not reliable. From the above results, results for the Indian and foreign tourists are closer to 1, therefore are highly reliable, and are followed by the revenue data. On the other hand, expenditure data is closer to reliability with a score of .531 (Table - 2).

Table 2: Reliability Statistics of Tourist Data

Particulars	Cronbach α	Cronbach α based on Standardized items	Number of items
Indian tourists	.997	.999	10
Foreign tourists	.988	.994	10
Revenue	.844	.936	10
Expenditure	.531	-.600	10

10.2 ANOVA Results and Summary Item Statistics

ANOVA Results and summary Item Statistics for Indian Tourists

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig
Between People	2.831E+13	2	1.415E+13	10.678	.000
within people between items	3.543E+12	3	3.936E+11		
residual	6.635E+11	18	36363052267		
Total	4.206E+12	27	1.55BE+11		
Total	3.251 E+13	29	1.121E+12		

Grand Mean = 1774599.07

	Intraclass Correlation[b]	95% Confidence Interval		F Test with True Value 0		
		Lower Bound	Upper Bound	Value	df1	df2
Single measures	.975[a]	.893	.999	383.941	2	18
Average Measures	.997[c]	.988	1.000	383.941	2	18

With a Significance Value of .000, it rejects the Null Hypothesis at 100 % C.I.

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum
Item variances	1.449E+12	9.751E+11	2.131E+12	1.156E+12	2.186

Summary Item Statistics

	Variance	N of Items
Item variances	1.590E+23	10

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig
Between people	96686779913	2	48343389957	5.440	.001
Within people between	29038432907	9	3226492545		
Items	10675429041	18	593079391.2		
Residual	39713861949	27	1470883776		
Total	1.364E+11	29	4703470409		
Total					

Grand Mean = 217665.93

Intra-class Correlation Coefficient						
	Intra-class Correlation[b]	95% Confidence Interval		F Test with True Value 0		
		Lower Bound	Upper Bound	Value	df1	df2
Single measure	.890[a]	.893	.997	81.513	2	18
Average measures	.988[c]	.988	1.000	81.513	2	18

With a Significance Value of .001, it rejects the Null Hypothesis at 99 % C.I.

	Mean	Minimum	Maximum	Range	Maximum / Minimum
Item Variances	5368110448	2588932572	10451870750	7862938178	4.037

Summary Item Statistics

	Variance	N of Items
Item Variances	6.642E+18	10

ANOVA Results and Summary Item Statistics for Revenue

Summary Item Statistics					
	Mean	Minimum	Maximum	Range	Maximum / Minimum
Item Variances	4.798E+14	7.402E+13	1.076E+15	1.002E+15	14.534

Summary Item Statistics

	Variance	N of Items
Item Variances	9.672E+28	10

With a Significance Value of .001, it rejects the Null Hypothesis at 99 % C.I.

ANOVA Results and Summary Item Statistics for Expenditure

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig
Between people	2.474E+14	2	1.237E+14	1.832	.131
Within people between items	9.570E+14	3	3.936E+14		
Residual	1.045E+15	18	5.806E+13		
Total	2.002E+15	27	7.415E+13		
Total	2.249E+15	29	7.757E+13		

Grand Mean = 16206679.00

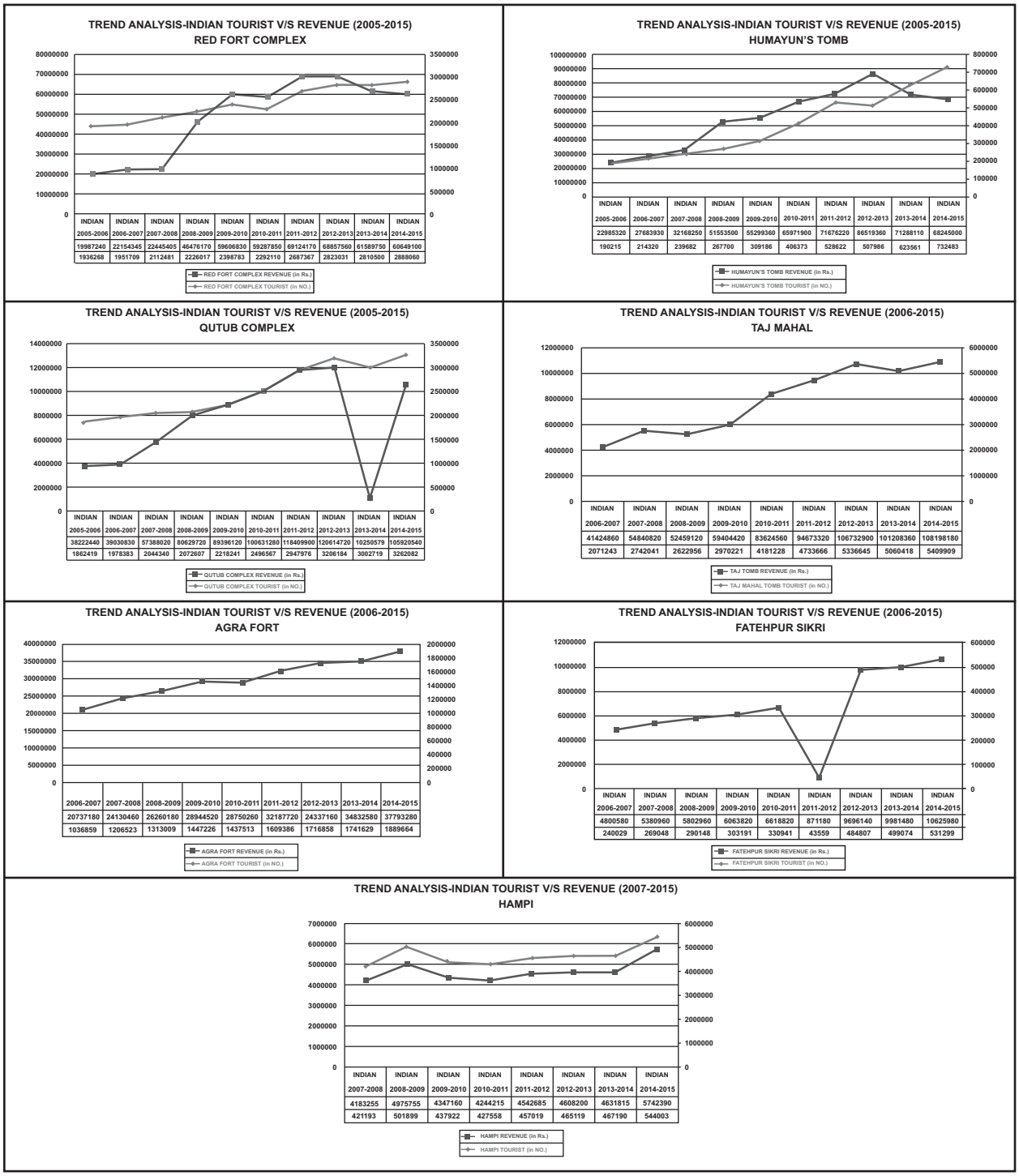
Summary Item Statistics					
	Mean	Minimum	Maximum	Range	Maximum / Minimum
Item Variances	6.462E+13	5.396E+12	2.083E+14	2.029E+14	38.610

Summary Item Statistics

	Variance	N of Items
Item Variances	3.751E+27	10

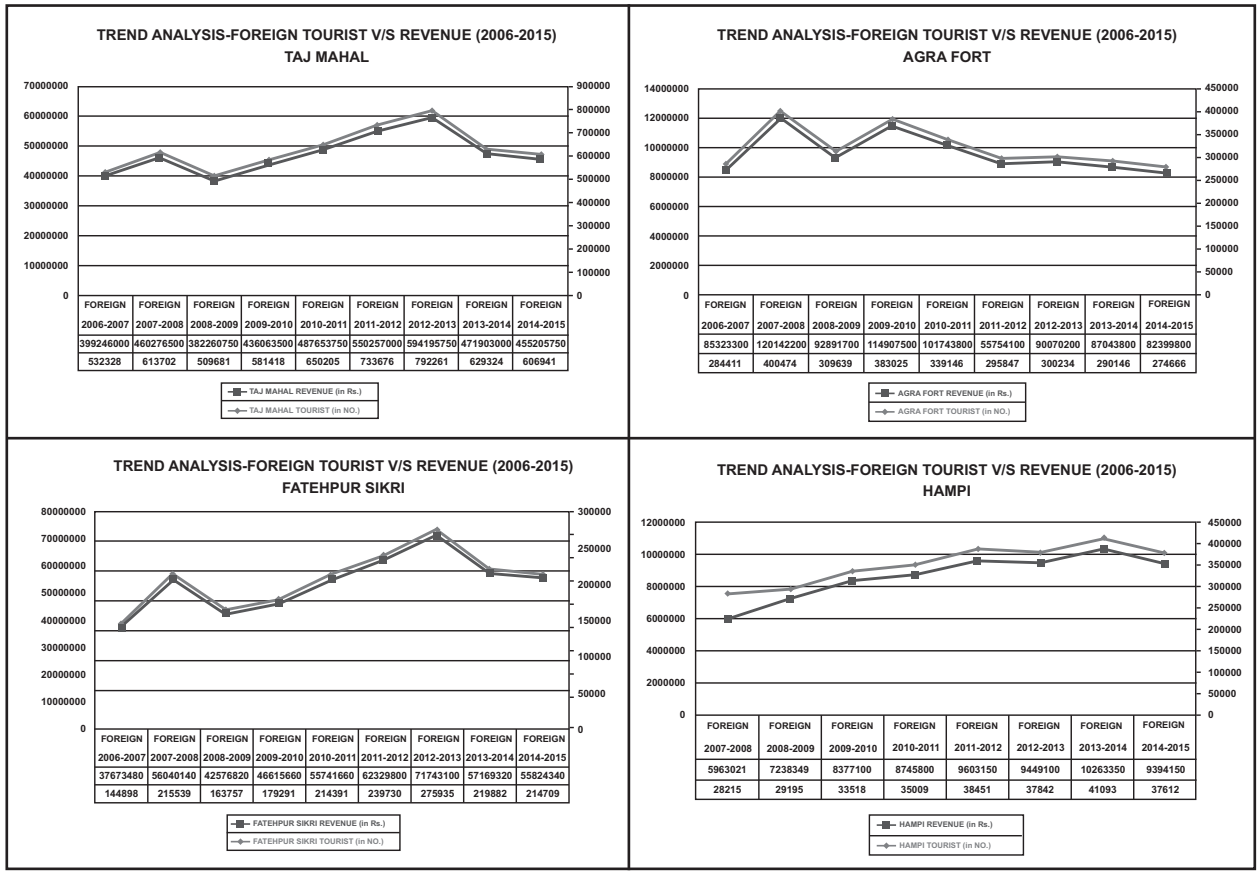
10.3 Trend Analysis: Indian Tourists v/s Revenue for ASI Protected UNESCO World Heritage Sites (WHS)

Fig. 6: Trend Analysis Charts for Indian Tourist v/s Revenue



10.4 Trend Analysis: Foreign Tourists v/s Revenue for ASI Protected UNESCO World Heritage Sites (WHS)

Fig. 7: Trend Analysis Charts for Foreign Tourists v/s Revenue



FOREIGN	FOREIGN	FOREIGN	FOREIGN	FOREIGN	FOREIGN	FOREIGN	FOREIGN	FOREIGN
2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015
399246000	460276500	382260750	436063500	487653750	550257000	594195750	471903000	455205750
532328	613702	509681	581418	650205	733676	792261	629324	606941

FOREIGN	FOREIGN	FOREIGN	FOREIGN	FOREIGN	FOREIGN	FOREIGN	FOREIGN	FOREIGN
2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015
85323300	120142200	92891700	114907500	101743800	55754100	90070200	87043800	82399800
284411	400474	309639	383025	339146	295847	300234	290146	274666

FOREIGN	FOREIGN	FOREIGN	FOREIGN	FOREIGN	FOREIGN	FOREIGN	FOREIGN	FOREIGN
2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015
37673480	56040140	42576820	46615660	55741660	62329800	71743100	57169320	55824340
144898	215539	163757	179291	214391	239730	275935	219882	214709

FOREIGN	FOREIGN	FOREIGN	FOREIGN	FOREIGN	FOREIGN	FOREIGN	FOREIGN
2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015
5963021	7238349	8377100	8745800	9603150	9449100	10263350	9394150
28215	29195	33518	35009	38451	37842	41093	37612

- **Comparison (Year on Year): Revenue / Tourist (in Rs.) for ASI protected UNESCO World Heritage Sites**

Inferences: Revenue / Tourist (RPT in Rs.) is the measurement of the revenue earned from a tourist at a designated UNESCO WHS. It is a barometer for the "Site Efficiency". RPT (in Rs.) remains constant for the three Agra based Sites (Taj Mahal, Agra Fort and Fatehpur Sikri). For Indian and foreign tourist, average RPT is highest for Humayun's Tomb and for Taj Mahal at Rs. 143.14 and Rs. 750 respectively. For Indian and foreign tourist, Average RPT is lowest for Hampi and Red Fort at Rs. 10 and Rs. 29.59 respectively. In terms of % growth in the RPT for Indian and foreign tourist, Red Fort registers the growth of 103.49 % and 53.08 % respectively. In terms of % decline in the RPT for Indian and foreign tourist, Humayun's Tomb and Qutb Complex registers the decline of 22.9 % and 21.86 % respectively.

Table 3: Revenue / Tourist for ASI protected UNESCO World Heritage Sites

Revenue Per Tourist (RPT in Rs.) for Unesco World Heritage Sites														
Monument	**Red Fort**		**Humayun's Tomb**		**Qutb Complex**		**Taj Mahal**		**Agra Fort**		**Fatehpursikri**		**Hampi**	
Year	Indian	Foreign	Indian	Foreign	Indian	Foreign	Indian	Foreign	Indian	Foreign	Indian	Foreign	Indian	Foreign
2005-2006	10.32	26.64	120.84	149.01	20.52	221.81								
2006-2007	11.35	21.34	129.17	122.21	19.73	238.96	20	750	20	300	20	260		
2007-2008	10.63	40.78	134.21	172.5	28.07	173.33	20	750	20	300	20	260	9.93	211.34
2008-2009	20.88		192.58		38.9		20	750	20	300	20	260	9.91	247.93
2009-2010	24.85		178.85		40.3		20	750	20	300	20	260	9.93	249.93
2010-2011	25.87		162.34		40.31		20	750	20	300	20	260	9.93	249.82
2011-2012	25.72		135.59		40.17		20	750	20	300	20	260	9.94	249.75
2012-2013	24.39		170.32		37.62		20	750	20	300	20	260	9.91	249.7
2013-2014	21.91		114.32		3.41		20	750	20	300	20	260	9.91	249.76
2014-2015	21		93.17		32.47			^50	20	300	20	260	10.56	249.76
AVERAGE RPT	19.69	29.59	143.14	147.91	30.15	211.37	20	750	20	300	20	260	10	244.75
% Change in RPT Initial/ Final	103.49	53.08	-22.9	15.76	58.24	-21.86	0	0	0	0	0	0	6.34	18.18

10.5 Trend Analysis: Tourists v/s Expenditure for ASI Protected UNESCO World Heritage Sites (WHS)

Fig. 8: Trend Analysis Charts for Tourist v/s Expenditure

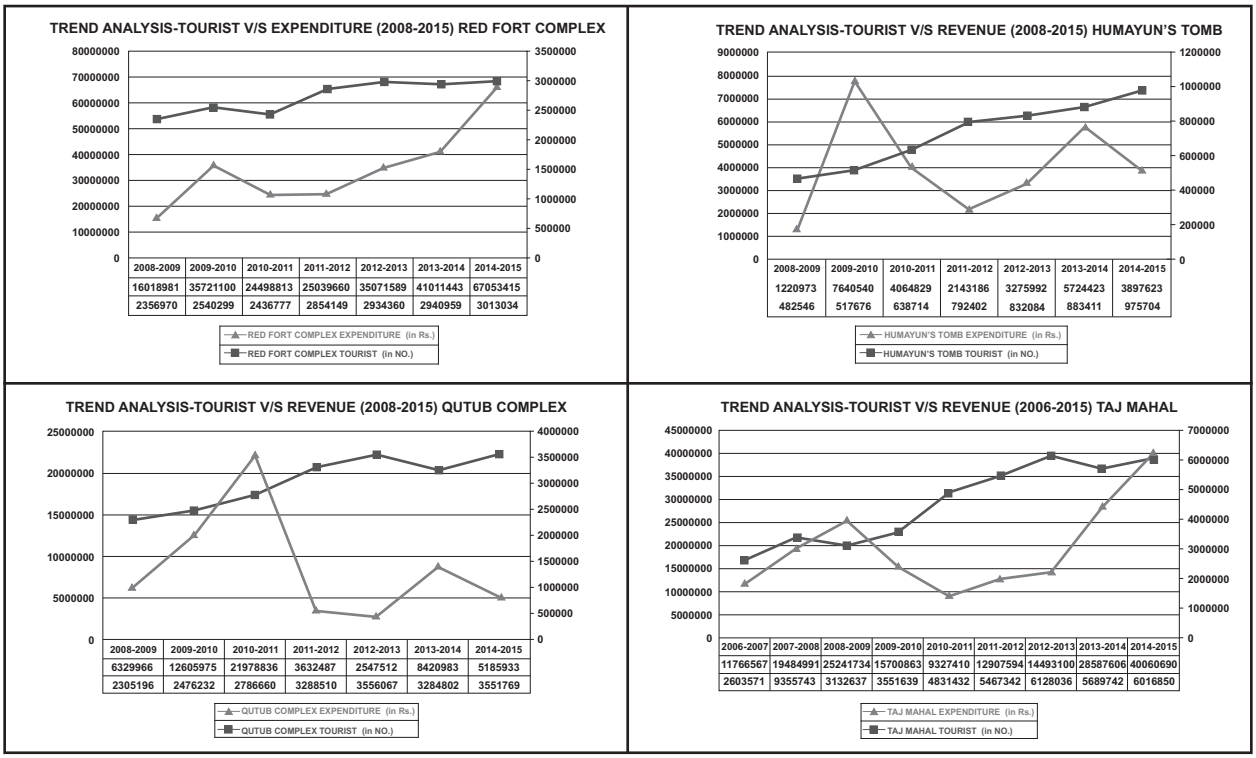
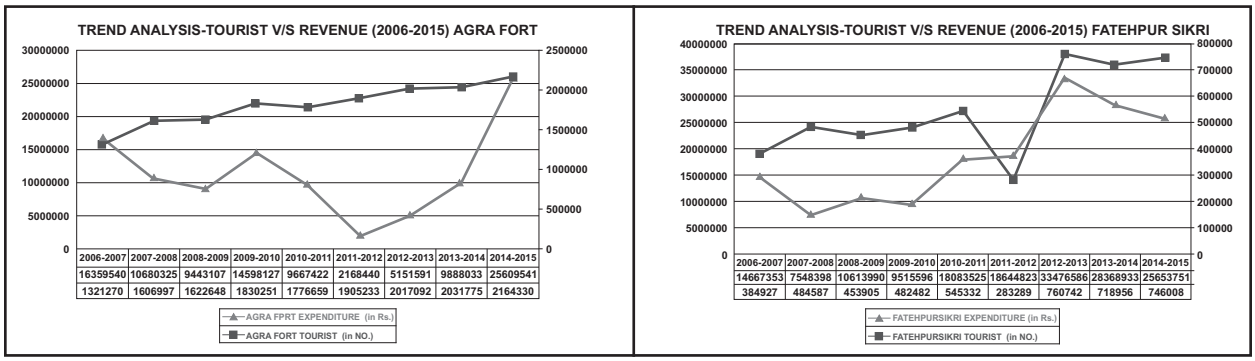


Fig. 8: Continued



Comparison (Year on Year): Expenditure / Tourist (in Rs.) for ASI protected UNESCO World Heritage Sites

Table 4: Expenditure / Tourist for ASI protected UNESCO World Heritage Sites

Expenditure Per Tourist (EPT in Rs.) for UNESCO World Heritage Sites						
Monument / Year	Red Fort	Humayun's Tomb	Outb Complex	Taj Mahal	Agra Fort	Fatehpur Sikri
2005-2006						
2006-2007				4.52	12.38	38.1
2007-2008				5.81	6.65	15.58
2008-2009	6.8	2.66	2.75	8.06	5.62	23.38
2009-2010	14.06	14.76	5.09	4.42	7.98	19.72
2010-2011	10.05	6.36	7.89	1.93	5.44	33.16
2011-2012	8.77	2.7	1.1	2.36	1.14	65.82
2012-2013	11.75	3.94	0.72	2.36	2.55	44
2013-2014	13.94	6.48	2.56	5.02	4.87	39.46
2014-2015	22.25	3.99	1.46	6.66	11.83	34.39
Average EPT	12.52	5.84	3.08	4.57	6.5	34.85
% Change in EPT Initial/Final	22.72	50	-46.91	47.35	-4.44	-9.73

Inferences: Expenditure / Tourist (EPT in Rs.) is the measurement of the expenditure incurred for providing the facility to a tourist at a designated UNESCO WHS. It helps in the provision of "Facility Augmentation" at the site level. EPT is calculated for the combined number of Indian and foreign tourists. Fatehpur Sikri records the highest average EPT at Rs. 34.85 and Qutb Complex registers the lowest EPT at Rs. 3.08. In terms of % Change in EPT, Humayun's Tomb registers the growth of 50 % and Qutb Complex registers the decline of 46.91 %.

Comparison (Year on Year basis): Revenue Surplus for ASI protected UNESCO World Heritage Sites

Table 5: Revenue Surplus for ASI Protected UNESCO World Heritage Sites

Revenue Surplus (In Rs.) For Unesco World Heritage Sites						
Monument / Year	Red Fort	Humayun's Tomb	Qutb Complex	Taj Mahal	Agra Fort	Fatehpur Sikri
2005-2006						
2006-2007				428904293	89700940	27806707
2007-2008				495632329	133592335	53872702
2008-2009	30457189	50323527	74299754	409478136	110038773	37765790
2009-2010	23885730	47658820	76790145	479767057	129253893	43153884
2010-2011	34789037	61907071	78652444	561950900	120826638	44276955
2011-2012	44084510	69533034	114777413	632022726	118773380	44556157
2012-2013	33785971	83243368	118067208	686435550	119255769	47962654
2013-2014	20578302	65563687	1829596	544613754	111988347	38781867
2014-2015	-5404315	64347457	100734607	523343240	94583539	40796569
Average R.S.	25882346	63225280	80735881	529127554	114223735	42109254
% Change in R.S. Initial/Final	-12.1	27.87	35.57	22.02	5.44	46.71

Inferences: Revenue surplus is the difference between the revenue earned and Expenditure incurred at a designated UNESCO WHS. It is an indicator to gauge the "Site Profitability". At Rs. 52.91 Crores, Taj Mahal has the highest Average Revenue Surplus and at Rs. 2.58 Crores, Red Fort registers the Lowest Average Revenue Surplus. In terms of % Change in R.S., Hampi registers growth of 46.71 % and Red Fort records decline of 12.1 %.

10.6 Trend Analysis: Revenue v/s Expenditure at ASI Protected UNESCO World Heritage Sites (WHS)

Fig. 9: Trend Analysis Charts for Revenue v/s Expenditure

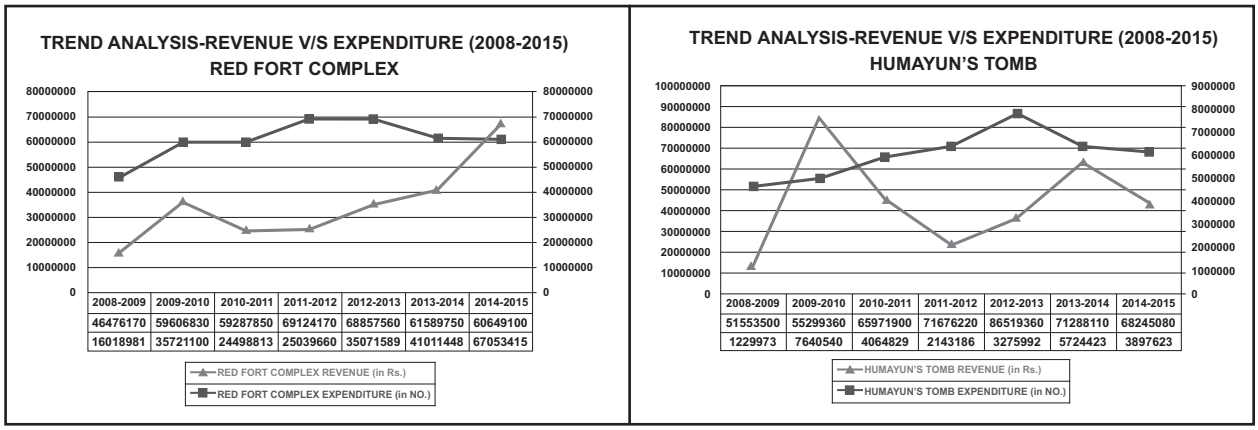
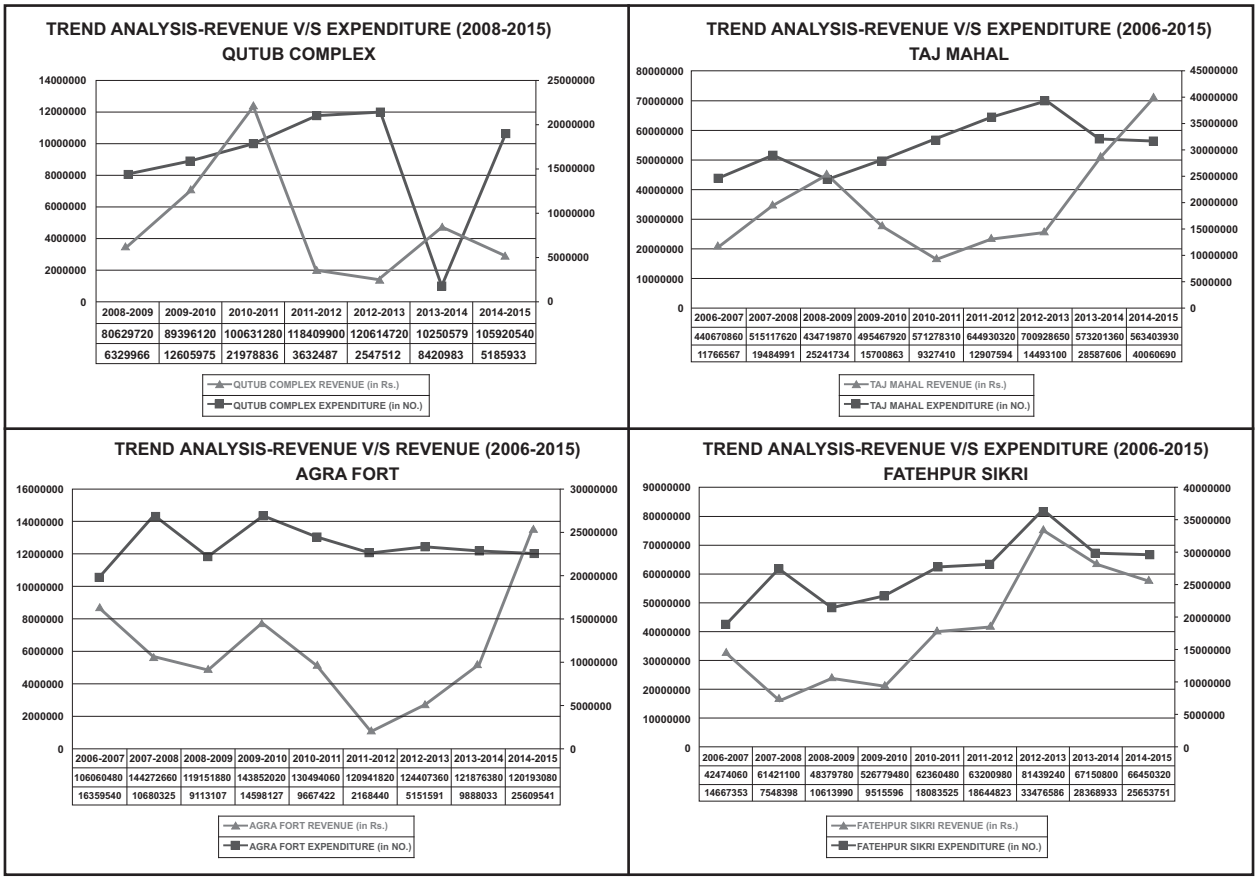


Fig. 9: Continued



Comparison (Year on Year): Revenue / Expenditure for ASI protected UNESCO World Heritage Sites

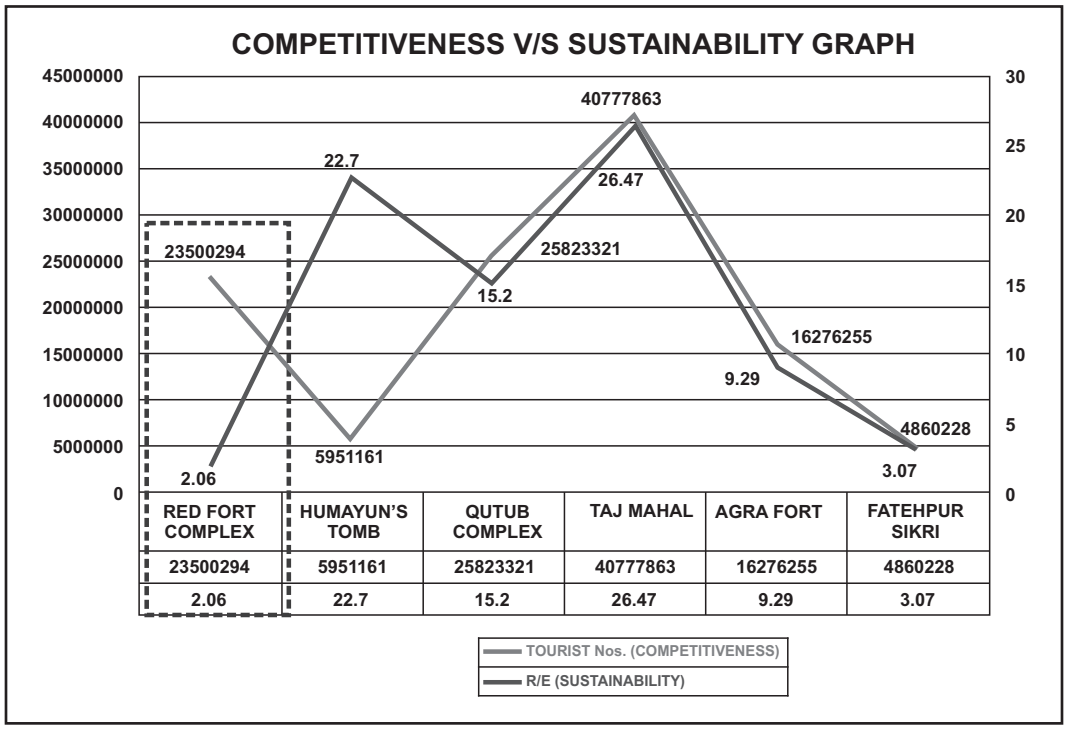
Table 6: Revenue / Expenditure for ASI protected UNESCO WHS

Revenue/Expenditure (R/E) for UNESCO World Heritage Sites						
Monument / Year	Red Fort	Humayun's Tomb	Qutb Complex	Taj Mahal	Agra Fort	Fatehpur Sikri
2005-2006						
2006-2007				37.45	6.48	2.89
2007-2008				26.44	13.51	8.14
2008-2009	2.9	41.91	12.74	17.22	13.07	4.56
2009-2010	1.67	7.24	7.09	31.56	9.85	5.53
2010-2011	2.42	16.23	4.58	61.25	13.5	3.45
2011-2012	2.76	33.44	32.6	49.97	55.73	3.39
2012-2013	1.96	26.41	47.35	48.36	24.15	2.43
2013-2014	1.5	12.45	1.22	20.05	12.32	2.37
2014-2015	0.9	17.51	20.42	14.06	4.69	2.59
% Change in R/E Initial/Final	-68.97	-58.22	60.28	-62.46	-27.62	-10.38

Inferences: Revenue / Expenditure is the ratio between the revenue earned and expenditure incurred at a designated UNESCO WHS. It is an indicator to gauge the "Site Sustainability". Higher R/E indexes more revenue earned vis-a-vis the expenditure incurred at a designated Site. In terms of % Change in R/E, Qutb Complex registers the growth of 60.28 % and Red Fort records a decline of 68.97 %.

10.7 Competitiveness v/s Sustainability

Fig. 10: Competitiveness V/s Sustainability Graph



Inferences: Tourist number is taken as an Indicator for competitiveness, whereas R/E is taken as an indicator for sustainability. World Heritage Site, with High competitiveness and comparable low sustainability score was selected for the study. Red Fort Complex is most optimum site with the tourist number of 23500294 and R/E Score of 2.06. Henceforth, compared to other sites, Red Fort Complex is the selected site with high Competitiveness vis-a-vis Low Sustainability.

11. CONCLUSIONS

This Study is based on the authentic secondary source of data. Concepts of "Site Profitability", "Site Efficiency" and "Site Sustainability" have been inextricably linked with the Destination Competitiveness Model. New Indices: Revenue / Tourist, Expenditure / Tourist, Revenue Surplus and Revenue/Expenditure suggest an overview of the intertwined relationship between the 'Economy'

and 'Sustainability' pertaining to a World Heritage Site. Cronbach a Reliability Statistics suggests the consistency checks and reliability of the data. If its value lies below 0.5, then its reliability cannot be ascertained. In terms of RPT, Humayun's Tomb (Rs. 143.14 for Indian Tourist) and Taj Mahal (Rs. 750 for Foreign Tourist) is most efficient in terms of earning revenue. At 50 % growth rate, Humayun's Tomb shows a positive trend in terms of RPT. Better Revenue generating avenues is required at Hampi (RPT for Indian Tourist at Rs. 10) and at Red Fort (RPT for foreign tourist at Rs. 29.59). EPT estimates the expenditure incurred at a designated Site. Better EPT suggests the resource-rich typology of the site, whereas poor EPT spurs Capacity Augmentation and Facilities Impoverization at the existing sites. In terms of EPT, Fatehpur Sikri (EPT of Rs. 34.85) scores the top rating, whereas Qutb Complex (EPT of Rs. 3.08) is at the lowest strata. At a decline rate of 46.91 %, Qutb Complex shows a negative trend in terms of EPT. Revenue / Expenditure is the barometer of the Site Sustainability and shows the bias towards revenue or expenditure at a given site. With an EPT of Rs. 3.08 and decline of 46.91 % in terms of EPT, lead to a growth of 60.28 % in terms of R/E for Qutb Complex. On the other hand, low RPT of Rs. 29.59 for foreign tourist and revenue surplus of Rs. 2.58 crore, with a decline rate of 12.1 % lead to the negative growth of 68.97 % to Red Fort. At an Average R.S. of Rs. 52.91 crore, Taj Mahal is most profitable and at Rs. 2.58 crore of average R.S., Red Fort is least profitable among the sites. Henceforth, Red Fort Complex is most Optimum Site selected for the provision of tourist service infrastructure and facilities augmentation (Tourist Number of 23500294 and R/E Score of 2.06). Competitiveness data suggests the economically competitive character of the destinations, whereas on the other hand the sustainability results provides an impetus for addressing the economic sustainability issues of the destinations in terms of optimization of revenues earned and expenditure incurred at the site. Comparison of sustainability and competitiveness data provides a benchmark for the provision of facility augmentation and service enhancement at the site level.

Destination Competitiveness theory is henceforth gets established as one of the most appropriate tools for the Optimum Selection among the identified ASI protected UNESCO World Heritage Sites. Travel and Tourism Competitiveness Report published by World Economic Forum details the performance of various indicators for the growth and development of tourism industry. India ranks 110th in terms of tourist service infrastructure, thus there is an immense opportunities and challenges for the development. This development can only be accomplished through the facilities augmentation and service enhancement at the heritage site. Tourist numbers and tourist revenue are the two major indicators for the Destination Competitiveness. These two indicators state the determining factors of destination competitiveness; socio economic profile of tourists, expenditure pattern of the tourists, perception level and state of satisfaction of the tourists, state of safety and security issues, etc. It also establishes the inter-operability of competitiveness and sustainability for a given heritage site.

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A GIS based Approach for LULC Changes: A Case of Guwahati, India

Swati Gupta, and Seemi Ahmed, Ph.D.

Abstract

Each year about several hectares of green cover are lost due to unplanned urban growth, particularly in the developing countries. This is resulting not only in depletion of bio diversities but also a reason for major urban issues like flooding, soil erosion, earthquake, several diseases, etc. Numerous Indian cities face this issue due to unplanned developments which result in change of land use and land cover. The study assesses the change in the land use and land cover (LULC) pattern of the Guwahati city using Landsat imageries for the year 1990, 2000, 2010 and 2020. Five broad classes were analyzed based on their spectral reflectance signature on the Arc GIS platform using image classification tool and overall accuracy was checked. As a result, it was observed that the natural and semi-natural areas, wetlands and water bodies, eco-fragile areas have decreased in the past decades while there is a huge increase in built-up areas which is responsible for problems majorly like flash floods, degradation of natural resources by excessive cutting of hills, unhealthy local environment, etc. Therefore, there is a drastic need to make the city climate resilient by efficient urban planning policy and strategies.

1. INTRODUCTION

The world has witnessed a drastic increase in the population from "5 billion in 1987 to 6 billion in 1999 and reached to 7 billion as per 2011". According to UNCTAD, the estimated growth in population is 1.1 percent every year. (UNCTAD Handbook of Statistics 2020 - Total and urban population, 2021-12-07) As a result of this, cities in developing world are turning into rapid urbanization and increasing more pressure of the natural resources due to unplanned and uncontrolled development. (Seto et al., 2002). This also puts a huge pressure on the peri-urban areas, as these cities leads to urban sprawl which results to climate change. Currently, in India out of total population, 34 % are living in urban areas of small, medium and large scale (urban population % of total population data, 2021-06-24). Cities have a vital role in the growth of economy and development of nation. But unplanned growth makes the city vulnerable to risks like disasters. Substantial change in the Land use and Land cover (LULC) are the cities that are growing fastest.

One such example is the Guwahati Metropolitan Region (GMA) in the state of Assam, India. Guwahati is the largest city of this region. This city is also called as

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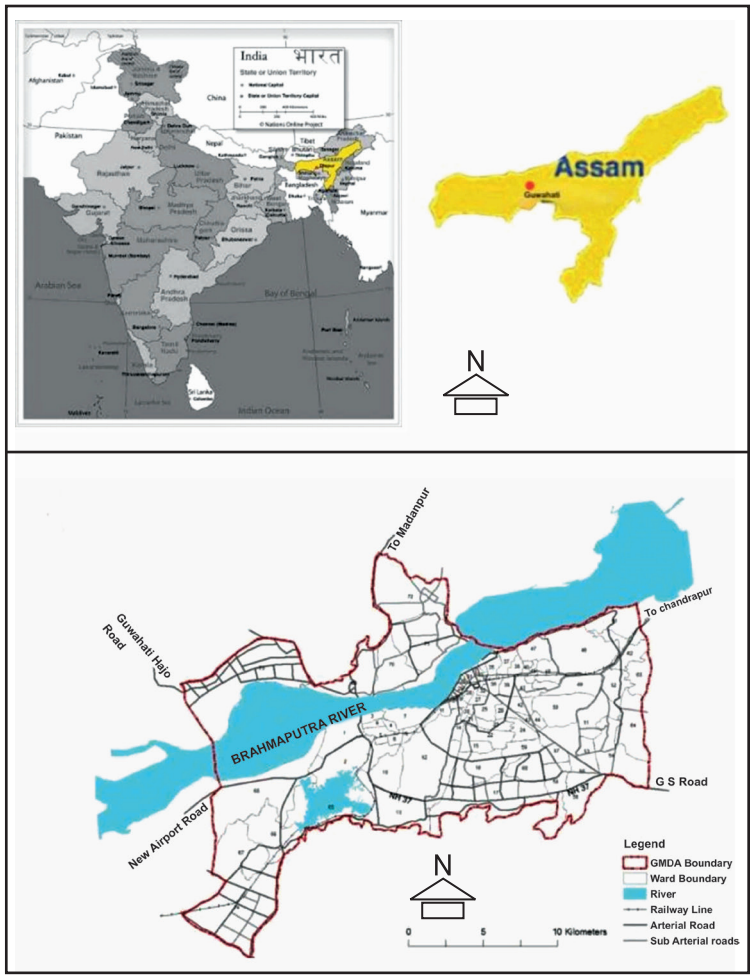
"Gateway of North - East ". The city attracted a huge inflow of people between the years 1971 to 1991 where the population rapidly increased from 2.93 lakh to 6.46 Lakh at 4 % growth rate. According to the 2011 census, the population has reached to 9.68 lakh and is currently crossing million and is expected to increase to 2.1 million by 2025 as per Master Plan report of 2025 (Plan and Area, 2009). For the strategic development of the city, it has been recognized in top 20 cities under smart city mission by Ministry of Urban Development (MoUD). It is located on the bank of a "holy river Brahmaputra", which originates from Himalayas and is the ninth largest river in the world in terms of volume. Most of its tributaries passes through the city and nourishes the natural biodiversity. Urbanization in the city is rapid and unplanned urbanization exerts pressure on the carrying capacity of the city, while rapid change in the pattern of land use results in climate change and degradation of natural environment of the city. The city majorly faces huge problem of urban flooding, soil erosion, earthquake, pollution and loss of natural biodiversity (TERI, 2013). This city has geographical and economical significance. Therefore, it needs efficient urban planning and strategic land management. The objective of this paper is to quantitatively examine the direction of Land use and Land cover change (LULC) and their impact on the urban green spaces and how these cities have overcome with the unplanned growth. The study has been done using Remote sensing (RS) data and assessment of LULC through Geographical Information System (GIS) platforms as an effective tool for mapping the change in land use pattern.

Fig. 1a: Map of India (b) State of Assam (c) Location of Study Area made using GIS platform



2. STUDY AREA

Guwahati is the capital city of Assam with the 26'10" north latitude and 92'49" east longitude under the jurisdiction of (GMDA) Guwahati Metropolitan Development Authority (Figure - 1) and known for its commercial, industrial and educational opportunities. It is surrounded by Kamrup district in

North - West, Nalbari district in the north, Darrang and Marigaon districts in the East. The city is blessed with the natural beauty, it is surrounded by the hillocks which has both forest and rocky texture in the southern and eastern side and river Brahmaputra in its north (R and A, 2016). 56 % of the population of the developing countries would be living in cities. To meet the overgrowing demand of development natural capital like forests, land and water are being converted into man made capital. The present study is of Guwahati city comprises of the areas under Guwahati Metropolitan Development Authority. Guwahati is a growing city with a population of 8,394 in 1891 and 968549 in 2011. The study focuses on the impact of the growth of the city on the forest areas within it, for which secondary data of about 100 years (from 1911 to 2015) have been used Topography of the city is undulating with the varying altitudes of 49.5 m to 55.5 m above Mean Sea Level (MSL).

The city has numerous wetlands and small water bodies, locally called as “beels”. These wetlands are know as Deepor beel, Silsako beel, Dighali Pukhuri, Borsola beel and Rangagra beel, of which Deepor beel is under the Ramsar wetland. The city has warm humid climate with the annual precipitation of 200-350 mm during the months of July to October as per the data of Regional Meteorological Centre. The average temperature varies between 11 to 15 degree in winter and 30 to 35 degree in summer and wet season. The three major geomorphic features namely- alluvial plains, residual hills, and marshy lands including water bodies makes up the city. The study area is known as Guwahati city which is an extension of Guwahati Municipal Corporation (GMC) to Guwahati Metropolitan Area (GMA) as per the Master Plan 2025. Under this the administrative area has changed from 262 sq km to 328 sq km keeping the rapid urbanization and industrial developments into consideration. Growing developmental activities have caused tremendous pressure on the land. Because of this the land cover and land use are changing at an alarming rate, and is a matter of concern that the city accounts for only 1 % of the entire region of North-East, but is responsible for extreme environmental degradation in the region. (Plan and Area, 2009)

3. METHODOLOGY

3.1 Data Sources

As the capital city, Guwahati was established in the year 1972, therefore, the spatial data of back dates have been taken from the time frame for the year 1990, 2000, 2010 and 2020 over a period of 30 years. Satellite imagery data of Landsat MSS, Landsat 4- 5 TM C2L1, Landsat 7 ETM C2L1 and Landsat 8 OLI TIRS C2L1 at an interval of 10 years are used in this analysis for study (Table 1) . The images taken are mostly of dry season ranging from October to March to avoid the excess of cloud cover during the monsoon season that lies from April to September. Other supporting maps were taken from Guwahati Metropolitan Development Authority portal.

Table 1: Satellite Data Used in the Study

Satellite	Resolution (mtr)	Path	Row	Observation Date
Landsat MSS	60	147	42	25/12/1990
Landsat-5 TM C2 L1	30	137	42	20/02/2000
Landsat 7 ETM C2 L1	30	137	42	06/11/2010
Landsat 8 OLI TIRS C2 L1	30	137	42	20/11/2020

Source: Earth Explorer (India map of India's States and Union Territories - Nations Online Project, no date b)

3.2 Pre-processing of Data

All the data was converted to digital raster images using Arc GIS 10.5 platform. It was geo referenced to WGS 1984 UTM Zone 43 North. The administrative map was digitized to obtain the municipal and ward boundaries and the area setting like road, river, and railways.

3.3 Image Classification and Accuracy Assessment

Based on the various satellite data, five broad classes were identified (Table - 2). A supervised classification was done and training samples were collected to perform using the maximum likelihood classification to extract the data based on the spectral reflectance or spectral signature for extracting Land use and Land cover data of the study area (Figure - 2). The maximum pixels have been taken for each band by avoiding overlapping (Tempfli et al., 2013). Flexibility and mapability was maintained while classification of data. Flexibility was ensured by making enough classes to match the ground reality and mapability ensures the clear division of boundaries among the classes. Taking diverse land uses of Guwahati city and spatial satellite data, four classes of LULC were identified to analyze the land fabric of the study area.

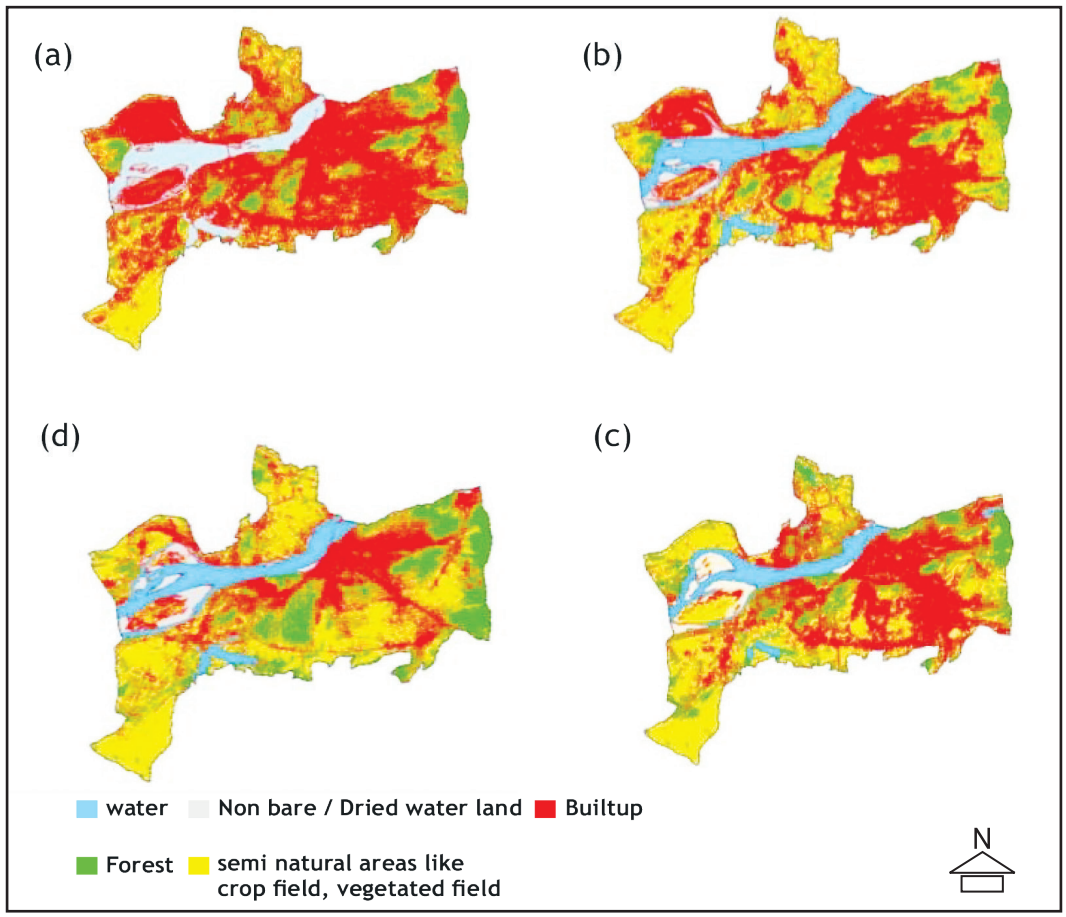
It was observed that some of the features were mis-classified due to same spectral reflectance. It was fixed by performing an accuracy assessment using 40 random points on each LULC map of year 2020, 2010, 2000 and 1990. Some testing samples were taken by creating random points then class of point was

Table 2: Land Cover Classes Used for Creating Classification Images of Guwahati

LULC Categories	
Artificial and natural water bodies.	Areas having water such as river, reservoirs, wetlands , lake etc.
Forest areas.	Area with dense vegetation like forest, shrubs.
Non bare areas dried river fields.	Areas do not have vegetation such as sandy, dried water bodies.
Semi natural areas like crop field, vegetated field.	Areas having bare vegetation, crop fields, fallow lands, plantation, that area managed.
Built up areas	Area with hard surfaces covers built units like residential, commercial, road, etc.

Source: Author

Fig. 2: (a) Classified image of 1990 (b) Classified Image of 2000 (c) Classified Image of 2010 (d) Classified Image of 2020



Source: Arc GIS 10.5

checked on classified image and random data. Using this data an error matrix was generated and overall accuracy was calculated. Where,

$$\text{Overall accuracy} = \frac{\text{Number of correctly classified site}}{\text{Total no. of reference sites}} \times 100$$

By performing this, an overall accuracy for the LULC of years 2020, 2010, 2000 and 1990 achieved as 90 %, 85.5 %, 85 % and 87.17 % respectively. It is generally taken as not less than 85 % to be acceptable accuracy for the remotely sensed data obtained from various satellites. (Anderson James, Hardy Ernest, Roach John, 2001)

4. RESULTS AND DISCUSSION

Guwahati is the largest city of North - East and therefore, the largest business, commercial, industrial, educational hub in the region. Due to this, it experiences

Table 3a: LULC Classification of Percentage Cover Obtained after Classification of Images Using GIS

	Percentage Cover			
LULC Categories / Years	**1990**	**2000**	**2010**	**2020**
Water	11	9	9	7
Forest	27	17	16	12
River fields	3	3	2	1
Crop / Vegetation	24	32	29	26
Built up areas	36	39	45	54

Source: Author

Table 3b: LULC Classification of Area Obtained after Classification of Images Using GIS

	Areas in sq km			
LULC Categories / Years	**1990**	**2000**	**2010**	**2020**
Water	37.99	36.73	35.83	27.46
Forest	94.86	72.65	66.55	48.50
River fields	11.26	13.58	7.55	5.04
Crop/Vegetation	84.57	132.2	122.97	105.27
Built up areas	126.3.9	162.2	187.27	222.56

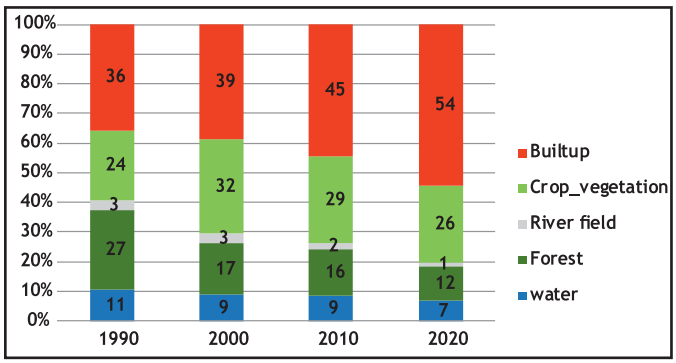
Source: Author

tremendous pressure of population. Distribution of population is uneven and is growing according the pattern of socio – economic activities. This growth of pattern has resulted in drastic change of the land use pattern, and is responsible for the degradation of green spaces. Table - 2 describes the LULC classes and categories taken for the analysis of the land cover change. It can be seen from the LULC maps (Figure 2) that dense vegetated areas like forest and shrub cover were dominant in the year 1990. These areas have experienced a huge pressure to be developed as hard surfaces into built areas. Therefore, the percentage of natural and semi natural areas has reduced from 57 % in 1990 to 33 % in 2020. Which is almost the half of what it was in 1990 (Table - 3 a and b). Reduction of green spaces at a rapid rate is leading to infinite problems majorly like water clogging.

On the other side, the increase in the hard surfaces like built areas have increased from 31 % to 59 % in the year 1990 to 2020 respectively. This is almost the double in the year 2020 as compare to 1990. This indicates a rapid rate of increase in

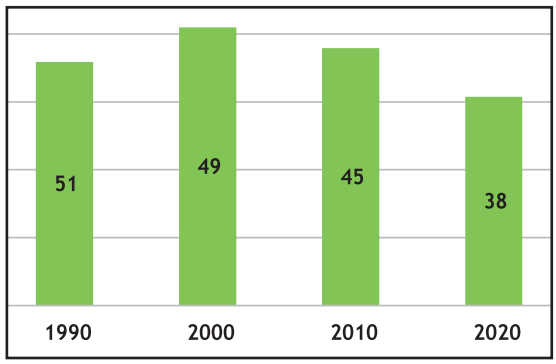
population in the city. It means various development in the city has been done at the cost of using lot of green areas, and densely vegetated areas. As per the TERI report, various construction has been done illegally by expanding into the reserved forest and cutting down hilly slopes leading to soil erosion. Illegal settlements at the bottom of the hill are prone to landslides and this has also led to the siltation in the downstream areas. According to soil statistics, 5-10 ton/ha/year soils is lost as soil erosion (TERI, 2013). Uncontrolled growth in the illegal settlements has led to the exposed, non-bared slopes; which suffers more soil erosion and soil infertility than the covered vegetated slopes. Encroachment on steep slopes illegally not only harms the soil but also impacts the lives living there which often get buried by mud slides. Past incidents have recorded a lot of accidents like 60 people lost their lives due to landslides in Guwahati. These settlements also suffer basic services like water supply, electricity, road networks, etc. Citizens stay in these places due to socio-economic factors such as employment. They can't afford to migrate to their native places (Das, Ray and Nain, 2014) . This encroachment also results in the urban flooding, flash flooding in the lower areas. As per the Master Plan of GMDA, the rules and laws is framed for the eco-sensitive zones has been demarcated and regularized. Legal or illegal expansions hinders city's "big seven": communities, transport, housing, jobs, clean water, agriculture land and natural vegetation (Forman and Wu, 2016). Guwahati city is surrounded by hills on three sides forming a valley having large area under hills and water bodies. Unplanned and uncontrolled growth has led to the major change in land use pattern resulting into major consequences on the nature and the geo-ecological environment of the city. Although, percentage for the years 24 % in 1990, 32 % in 2000, 29 % in 2010 to 26 % in 2020. For the years 1990 to 2010, crop fields have grown tremendously from 84 sq km to 132 sq km and subsequently fell down to 122 sq km in 2010 and 105 sq km in 2020.

Fig. 3: Percentage of Land Cover Change Obtained after Classification of Images Using GIS



Source: Arc GIS 10.5

Fig. 4: Percentage Change in Green Cover (Forest, Crop / Vegetation)



Source: Author

Thus, for three decade people have seem to be indulge in cultivation which has transformed rapidly into built-up areas (Figure - 3). While the precious natural cover lost due to which forest and shrubs have degraded at a rapid rate from 27 % in 1990, 17 % in 2000, 16 % in 2010, to 12 % in 2020. Geographically, the city is surrounded by hills which are densely covered with reserved forest areas but are encroached illegally and generating pressure on land. The city has seven forests within the GMDA. But these forests are overtaken due to development and construction activities (Manta and Rajbangshi, 2015). This has resulted in the more exposed surfaces of hills and soil erosion, siltation in downstream. As depicted in Figure - 4, total green cover (includes natural and semi natural vegetated areas like forest, shrub, cultivation field, managed land) in the city has left as 38 % till year 2020 and is continuously being exploited due to over construction leading to loss of permeable soft surfaces which results in storm water runoff causing flooding and clogged drains in the city. Also, this runoff carries all the unwanted waste directly into the water bodies degrading the quality of water. A lot of families directly use this river water which resulted in loss of lives. It can be seen that the pressure of the demographic changes has also led to shrinkage of water body area that is the river Brahmaputra which is passing from the city. These changes are 11 % in 1990, 9 % in 2000 and 2010 to 7 % in 2020. Urban expansion is putting pressure on the natural features of the city. The river also suffers lot of siltation during the monsoon season which causes back flow of water at slightly high elevation from the city.

4.1 Net change in Land Cover Area

Table 3 gives the clear understanding of the total change in the landuse for three decades. It shows the highest increase in built-up areas as compared to other land cover areas. It has almost doubled from the year 1990 to 2020. The study demonstrate that the past two decades have witnessed a huge amount of loss of vegetated land cover. Even the cultivated area showed increase between the years 2000 and 2010, also declined by 7 % due to rise in the built-up area (Figure - 3). This also impacted the small water bodies which shrunk completely in the last two decades. Land, currently is bearing lot of pressure due to population growth which needs to be controlled and planned efficiently.

5. CONCLUSIONS

The study thoroughly analyzed the land cover changes that occur in past three decades i.e. between 1990 to 2020, using Remote Sensing data on GIS platform. A trend of rapid urbanization took place putting pressure on the land and degrading the geo-ecological values of the city. This unplanned uncontrolled

growth resulted into many urban issues. The vegetation and green cover which was the beauty of the city increased between 1990 to 2000, however, declined after this decade. This has resulted in the generation of urban heat island (Borthakur and Nath, 2012). Since, the city holds many socio-economic opportunities, it attracts almost 10 % of total population as floating population specifically in day time. On the other side, forest that act as an absorber of pollution and hazards sometimes tend to degrade at a rapid rate. Urban forest plays vital role and functions in keeping city clean and safe. (Nesbitt et al., 2017). Therefore, proper land use planning should be adopted. The GMDA Master Plan, 2025 demarcates the regulation for the eco-sensitive areas but lack proper monitoring and implementation (Plan and Area, 2009). The study shows that the urban growth is towards south- eastern side of the city due to topography of the city. But this growth is unplanned as it has encroached several natural features. With this, it has also recorded the growth in temperature by 2 degrees due to generation of urban heat island (Borbora and Das, 2014). Furthermore, it has been seen that on the peripheral areas, cultivation and farming is practiced and has increased over the years specially on the south - west sides. The study reveals that some characters of urbanization are common in developing countries as urban sprawl. Urbanization in most of the Indian cities is haphazard and unplanned which is quite similar to that of the cities in Egypt revealed in a study (Hegazy and Kaloop, 2015). This happens due to the poor urban governance of the urban centres. LULC change of Guwahati city is a case which needs to be monitored and taken care including city's natural beauty i.e. rivers forest, wetlands, which can be restored so that it functions well with efficient planning and governance.

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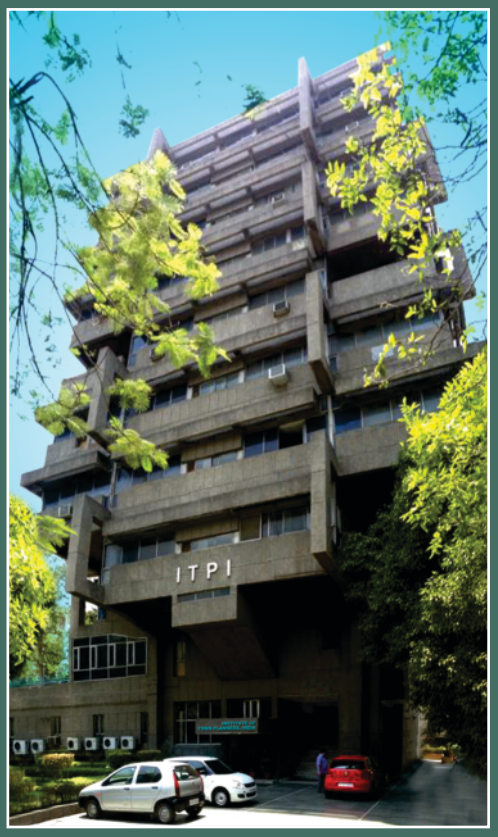

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