JOURNAL OF ITPI

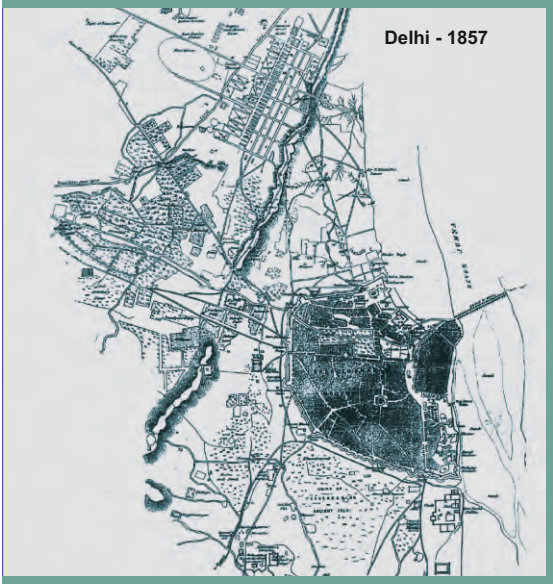
Journal of the Institute of Town Planners, India

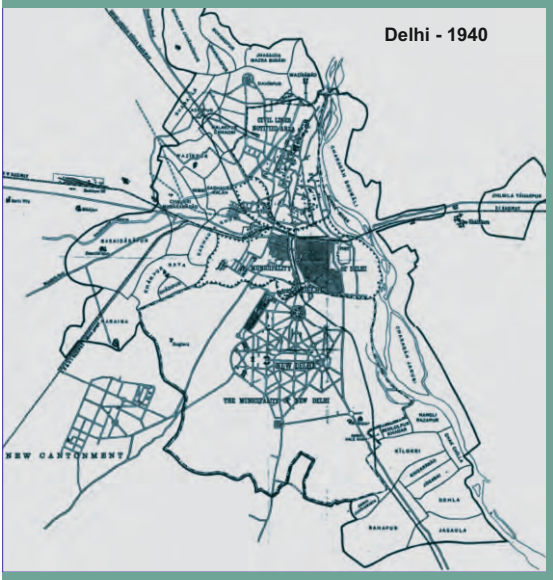
ISSN : 0537 - 9679

RNI : DELENG/2004/12725

Volume : 18, Number : 3

July - September 2021





Participatory Local Area Planning, Geo Spatial Tools for Land Pooling, City Planning by using Geo-informatics, etc.

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A Quarterly (Refereed) Journal of the
Institute of Town Planners, India

Volume : 18, Number : 3, July - September, 2021

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Subscription (Including Postage)

- Annual ₹ 1,500.00 (In India) & US$ 135.00 (Outside India)
- Per copy ₹ 400.00 (In India) & US$ 35.00 (Outside India)

Editorial

This third issue of 18th volume of the ITPI Journal presents a mixed bouquet of papers on city planning and development matters.

Sanjukkta Bhaduri, in her paper 'Innovative Approaches to Participatory Local Area Planning', highlights that participatory planning is a consensus-building approach that helps a community to join together in indicating views, on future development of their area, to the city planners. She further says that the present process of planning, in India, follows a top down approach which does not incorporate public participation making plans incoherent with the needs and aspirations of the local population. Introduction of participatory local area plans, as the third tier of plans in the city planning process, is desirable. A lot of efforts are being made in this direction. The Smart Cities Mission has initiated a scheme on formulation of local area plan and town planning schemes for selected 25 smart cities. School of Planning and Architecture, New Delhi, has developed an innovative smart toolkit - Urban STeP - for e-participatory local area planning. Bhaduri shares, in her paper, the details of this tool kit.

Revival of Kancharapalem, the decaying residential colony, situated in the old core area of Visakhapatnam and occupied by people engaged in performing arts, especially drama, is the focus of the joint paper by Gaurab Das Mahapatra and Sanand Maddipati. They observe that the cause of blight is a heavy loss of income of artists due to a general lack of interest of people in drama because of the advent of cinema and web-based entertainment. Based upon a comprehensive survey, the authors provide various strategies for revival of the area and provide employment opportunities through promotion of drama.

Vistasp Jal Mehta and Rekha S. Nair, in their paper, attempt at finding the correlation between vegetation and day time land surface temperature, using remote sensing data, in the case study of Mumbai Metropolitan Region. They conclude that vegetation and land surface temperature have an inverse correlation. Un-planned and densely packed areas with dense tree-cover almost always result in lower temperatures; however, relative lack of tree-cover does not always lead to significantly higher temperatures.

Meenakshi Pawar in her paper 'Industrial Development after Independence Case Study of Durg - Bhilai, Chhattisgarh', observes that, agriculture, development of steel Industry was given top priority in the First Five-Year Plan which resulted in the development of steel plants including Bhilai Steel Plant in Chhattisgarh, Rourkela in northern Odisha and Bokaro in Jharkhand. She highlights that Bhilai is an early prototype of corporate urbanization that encouraged a patterns of unplanned and under–provisioned growth around the core. It also promoted development of four main industrial pockets: Bhilai Steel Plant (BSP), light industrial area, Bhilai industrial area and Hathkhoj industrial area providing 40,000 jobs in BSP and about 38,000 jobs in ancillary industries.

A.K. Jain, in his paper 'Geo Spatial Tools for Land Pooling', observes that land pooling policy involves radical changes in land transactions and administration; and therefore, to provide a sound legal back-up, the Land Pooling Policy and the Delhi Development Act 1957 should be consistent with the LARR Act 2013, Transfer of Property Act 1882, Revenue Act 1963 and Registration Act 1908. He discusses the Land Pooling Policy of the Draft Master Plan for Delhi - 2041 and recommends that the geo - spatial tools including land rights mapping, digital ledgers, and block chain, should be used for land transactions and administration.

There are two papers on social issues - crime and open defecation. The paper on 'Crime Prevention, through Urban Design and City Planning in Delhi using Geo-Informatics', by Rupesh Kumar Gupta, observes that crime is not evenly distributed and there are pockets that are crime-prone. Based upon primary survey, using GIS and GPS, during two different time periods, at 10 selected major crime-prone areas in Delhi, he finds that the places occupied by low-income people, having low level of infrastructure, and less police patrolling, generally, have a high incidence of crime. Both the crowded as well as isolated and unoccupied areas are hot spots for crime. The paper finds that the incidence of crime, at a hot spot, is limited within 500 metre radius and reduces after that distance.

'Provisioning Urban Toilets: Perspectives from Smaller Cities', is the theme of the paper by Vivekanand Gupta. This article presents an analysis of challenges in augmenting toilets and improving accessibility based upon the study of three mid-sized north Indian cities, during 2018-2020, under the 'Engaged Citizens Responsive City Program'. He finds that some of the accessibility challenges of toilets include insufficient coverage, unavailability of facilities to women, and poor maintenance. Augmentation of individual toilets requires a major fix through a citizen owned data and some programmatic interventions for both open defecation-free (ODF) and non-ODF cities. Engaging citizens, through the participatory methods of learning, is a must to bring a behavioral change contextual to safe management of septage. He advocates that the statutory spatial plans of smaller cities need to incorporate on-site systems and septage management infrastructure.

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Content

Institute of Town Planners, India Journal 18 x 3, July - September 2021 ISSN:L0537-9679

Innovative Approaches to Participatory Local Area Planning

Sanjukkta Bhaduri, Ph.D.

Abstract

Participatory planning is an urban planning paradigm that emphasizes involving the local community from the very beginning of the strategic and management processes of urban planning; or, community- level planning processes. The Participatory Strategic Planning process is a consensus-building approach that helps a community to join together in explaining how they would like their community or organization to develop over the next few years. The participatory planning method has its roots in the United States, influencing western European countries in the subsequent years. The present process of Planning in India follows a top down approach which does not allow or encourage public participation in all the stages thereby making planning process and the plans themself not in coherence with the needs and aspirations of the local population. The paper spells out an innovative and an effective approach for Participatory Local Area Planning through E-Participation.

1. INTRODUCTION

A city is diverse in its nature, the diversity of the city gets manifested through various units that have unique characteristics and features which requires guidance for planning and further development. Local Area comprises of these primary units which can be a municipal ward, a neighborhood or an area having similar physical and socio-economic characteristics as well as development features. The local area plan framework entails identification, assessment of the provision, adequacy and / or deficiency and estimation of the requirements of the area in terms of provision, up gradation, protection, conservation and management. Local area planning sets out a strategy for planning so as to achieve sustainable inclusive development of a specific area governed by a local authority and for a defined duration of time.

The term “Local” has different connotations between different countries and cities. Local area planning is perceived to offset the top down approach in planning as master plans / development plans / perspective plans fails to effectively involve the citizen in the process of development planning. Local area planning includes a participatory, collaborative, bottom up approach to city growth and development. Balcatta, suburb of Perth, Western Australia initiated the Local Area Planning project in early 2006 followed by Australia and UK. According to Master Plan of Delhi 2021, Local Area Plan is the third tier of plans with Master

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Plan and Zonal Plan being the first two tiers respectively and the Layout Plan being the fourth tier. The Local Area Plan is thus slated to be a legal document as the Master Plan and the Zonal Plan.

Participatory local area planning is an urban planning paradigm that facilitates involvement of local community from the initial stage of local area plan preparation for efficient and responsive urban planning or community-level planning processes. The Participatory Strategic Planning process is a consensus-building approach that enables community to voice their opinions of how they want their local area to develop over the next few years. Under the Smart Cities Mission of Ministry of Housing and Urban Affairs, Government of India has initiated a scheme on Formulation of Local Area Plan and Town Planning Schemes for selected 25 smart cities.

The present planning system in India is a top down approach with regional plans, master plans and zonal plans. These plans are perceived to be rigid, static and regulatory in nature with planning period of 20-25 years making them long term strategy plans. The current conventional process is considered to be time consuming and do not generate a strong database which is the requirement for today's digital era. Implementation and monitoring of the plans is also a great challenge; the plans also lack in monitoring mechanisms, implementation strategies and cooperation and coordination among implementing agencies. Moreover, the process of planning and also the level / scale do not leave much scope for local participation as a result of which ground realities many times are not incorporated in the plan, neither is public participation considered for assessment of requirements, development and improvement of the local areas. Thus, there is a need of a more dynamic, realistic and effective planning system which allows maximum citizen participation at all stages of planning and development.

2. PARTICIPATORY APPROACH TO LOCAL AREA PLANNING

The present planning process relies greatly on assumptions and estimates which might not present the ground realities at all times. Citizen participation offers a new way of thinking about development. It embodies the idea that citizens can help themselves; that they can articulate their own needs, aspirations and concerns about their neighborhoods. People know the neighborhoods they live in the best and thus are in the best position to not only identify the issues and problems of those particular neighborhoods but also to find the solutions and / or to address the challenges. Citizens can be active participants rather than mere recipients of development processes; that development works better for them if done "bottom-up" rather than from the "top-down".

Participatory approach in plan making is more effective at the Ward / Local level. Participatory planning and decision making is powerful, but an under utilized

tool, for engaging the community in the holistic development of the community. The methodology of participatory planning has been created in order to solve complex interdisciplinary problems which require both local skills and scientific knowledge.

This approach is driven bottom-up by local needs and priorities, and top-down by regulatory responsibilities. The approach is considered to be adaptive, and evolving dynamically with changing conditions. Local area plans involve participatory planning initiatives through stakeholder inputs. Popular participation can be viewed as a basic democratic right that should be promoted in all development projects (Cornwall). Effective participation means that citizens deepen involvement to the extent that demands are translated into tangible outputs and outcomes (e.g. improved service delivery, redress of grievances, new policies). This helps in effective implementation and monitoring of local plans.

Participatory approach in plan making is the key for:

- Planned development;
- Improvement in urban governance;
- Better decisions; and
- Incorporation of stakeholders' opinions, views and suggestions.

Though the concept of participation is widely researched and written, agreed to and easily understood, there are challenges to ensure participatory approach and processes in planning. To overcome the challenge of limited to lack of and ineffective citizen participation in the development planning process in India, it is required to adopt a more inclusive approach in all the stages of planning process.

2.1 Challenges in Participatory Local Area Planning

While the approach is desired for the most effective way for inclusive planning, the task is easier said than done with the following key challenges:

- Identification of stakeholders at ward level and to get all stakeholders together;
- Ensuring all sections of the community are able to participate;
- Generation of information base that needs to be disseminated to people in a people friendly format i.e. through maps depicting the status of areas in terms of its characteristics and issues;
- Resolution of conflict and arriving at a consensus;
- Assessment of requirements of all sections of the society in the ward; and
- Stakeholders' input at various stages of local area plan preparation.

With respect to the local area planning, the challenge is that there is no mandate for preparing the same. Municipalities as institutions of urban local governance have been given 18 responsibilities as the functional domain of the municipality including town planning as per the Constitution (74th Amendment) Act. It specifies that Urban Local Bodies (ULBs) would be responsible for preparing comprehensive development plans and their effective implementation through people's participation. However, it is left to the states to decide on the provision of the participatory approach; people's participation not being a mandatory exercise, limits its application even more.

Local area planning itself has lot of challenges like the delimitation of local area planning boundaries. There is a large gap for the data required for local area plan preparation. The urban local bodies lack the data in accessible, accurate and understandable formats. Particularly there is a data gap in land use, housing and land ownership sectors which are crucial for local area planning. Another challenge is also to conduct surveys in dynamic neighborhoods in order to update the data in real time. Database generation through surveys often takes considerable time / many months in the plan making process, in many cases further reducing the citizen consultation phase in order to remain on the schedule.

Identification of stakeholders itself is a challenge in heterogeneous neighborhood and the interests of the same often are conflicting / competing. In many cases of local area planning attempts in India, it was found that even though the citizens were consulted in the entire process of planning, however many sections of the society were not included and their voices were not heard, people like tenants, low-income communities, workers to name a few. The purpose of participatory planning thus gets defeated, so as the application of the approach in local area planning.

3. GOVERNMENT INITIATIVES

In order to adopt the approach of citizen participation and partnership, the government of India has formulated many policies which support the concept. The Smart City Mission, launched in 2015, is an urban renewal and retrofitting program by the Government of India with the mission to develop 100 cities across the country making them citizen friendly and sustainable. The purpose of the Smart Cities Mission is to drive economic growth and improve the quality of life of people by enabling local area development and harnessing technology, especially technology that leads to Smart outcomes. The objective of Area-based development is to transform existing areas (retrofit and redevelop). The focus is on sustainable and inclusive development and the idea is to look at compact areas and create replicable models.

The National Urban Policy Framework (NUPF) 2018 outlines an integrated and coherent approach towards the future of urban planning in India. Participatory

approach is mentioned in National Urban Policy Framework (NUPF) 2018, prepared by Ministry of Housing and Urban Affairs, Government of India. Citizen Participation is a necessary aspect pertaining to urban planning and development in the current scenario. NUPF mentions this in various aspects like city planning, physical infrastructure, urban information systems and urban governance, etc., The NUPF 2018 focusses on stakeholder participation, citizen awareness building, citizen grievance redressal systems and feedback mechanism. Thus, the policy propagates a platform for practicing participatory approach of planning in India i.e. e-participation. The policy framework suggests a digital platform for delivery of the citizen centric e-governance services along with mobile app and use of local language in accessing and transacting on citizen service portal.

3.1 E-Participation

E-participation is the term referring to "ICT-supported participation in processes involved in government and governance"; processes may concern administration, service delivery, decision making and policy making. The above-mentioned policies and missions encourage e-participation for all sectors of cities. E-participation is intended to promote the inclusive and conscious participation of citizens in decision making. The Internet creates new forms of social life, giving new opportunities for citizen involvement and strongly influences public decision-making systems. There is a need for a technology-based platform that is both stakeholder centric and stakeholder led, so as to facilitate local area plan preparation. In the recent times there is an increase in e-participation portals both globally as well as in India.

3.2 Global Platforms of E-Participation

For the last twenty years, a dynamic development of information and communication technologies (ICT), followed by a constant increase in the number of internet users has been witnessed. There are multiple e-participation platforms in various parts of the world. For example, Pittsburg, U.K- Department of City Planning has a e-participation platform specifically for land sector. The portal has interactive web maps of various categories giving an idea of the entire city, neighborhoods, wards, environment, etc. Urban Reviewer – NYC is another such platform for dissemination of information about land and related data. This website documents all publicly owned vacant land in the city. Change by US - New York is a platform dedicated to development projects; it enables to follow and track projects, provide insight and ideas about them and turn ideas into action through the formation of project teams. Accidental Skyline - New York City is another platform which addresses the FAR in New York City. This offers tools to help demystify the city planning process and bring the public into the conversation and a mapping tool that shows where by right development is allowed by the zoning code of NYC. ABCD- Z – IDO Zoning conversion map, City of Albuquerque, New Mexico is also a portal which deals with Land use Zone

Change; the interactive maps show zonal use and proposed use and the user is free to give his / her ideas and suggestions.

3.3 National Platforms of E-Participation

In coherence with the NUFP 2018 and the Smart City Mission, India also has seen many such e-platforms in the recent times. My Gov. in the Government of India initiated database portal, which mainly focus on the dissemination of data and policy and governance. Interface for healthy exchange of ideas and views involving the common citizen and experts, engages citizens on important policy issues and governance. The web application; SDMC Third Eye: APP focusses on sanitation, health and education, and roads. Citizens can take photos and videos of their concerned wards and zones under various categories such as sanitation, parks, roads, etc. Corruption related issues can also be raised through this app. Another app named Safe City - Pin the Creeps, is dedicated to the sector of crime. Mobile application of Clean India: Mobile App, focusses on Sanitation. Users can take pictures to report, geo - locate and timestamp streets that need cleaning or problems to be fixed by the local authorities and tag their reports. This App empowers people to become the eyes and ears of municipalities on the ground. Surat is dedicated to the sector of employment. The application named SAFAL App, acts as a bridge between service seeker and service provider. It also provides an employment opportunity to people possessing various skills especially from unorganized sector. Public Eye, Bangalore is an application dedicated to transport sector. Enables to capture and report traffic violations. Typical violations like defective number plate, illegal U turns, illegal one way, illegal parking, etc., can be reported. Users can also check the status of their complaints in the app itself. *Hawa Badlo*, Delhi is another such portal dedicated to the issue of air pollution That allows citizens to report the presence of construction dust or the burning of leaves and garbage in public parks to authorities.

From the above examples, both globally and nationally it is evident that the existing platforms of e-participation are sector based and not area / ward based thus do not provide a holistic mechanism for the citizen participation in local area planning. Also having multiple platforms dedicated to different sub section of various sectors of neighborhood creates a divide amongst citizens who have selective accessibility and usability of such portals.

Multipurpose web platform is essential to bridge the gap between all stakeholders related to local area planning and development, thus would result in improved governance and plan making. The platform should have the following:

- Create technical database (including spatial and non-spatial data) on communities, their local environment and development projects;
- Help the communities and other local area stakeholders to see, upload and validate information regarding various resources; and

- Bring all the concerned agencies and authorities on a single platform and increase their accountability, coordination and enable transparency.

4. URBAN STEP

School of Planning and Architecture, New Delhi has developed the innovative E-Participation project, "Urban Step - Smart Toolkit for e-Participatory in Local Area Planning," under Design Innovation Centre (DIC), a National Initiative of Design Innovation (NIDI), set up by Department of Higher Education, Ministry of Human Resource Development, Government of India. This is an innovative mechanism for engagement of stakeholders for ward level planning and this project has also been granted patent.

The project "Urban SteP: Urban Smart Toolkit for e- Participation in Local Area Planning" has two parts,

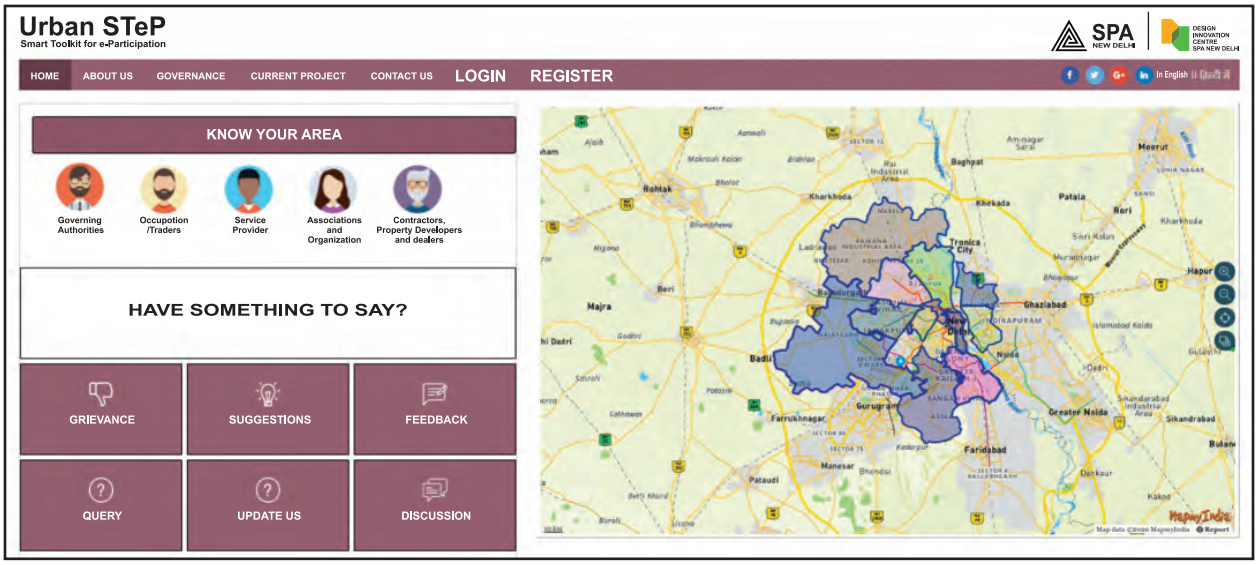
- Smart Toolkit to aid in preparation of Local Area Plan; and
- Web based bilingual platform and Applications both iOS and android for interaction of local area stakeholders.

The invention is an innovative technology based participatory process for local area planning i.e. a smart toolkit. The Smart Toolkit enables effective participation of stakeholders in local area planning and development. It provides a technology based platform to bridge the gap between the ward level stakeholders and the administrative authorities. The smart toolkit is a step by step process wherein engagement of local area stakeholders at various steps has been integrated so as to facilitate the development of a ward level plan.

The web portal facilitates inclusion of opinions and feedback of citizens and authorities at all stages of local area planning. The portal would also help in updating ward information and facilitate dissemination of the same, obtaining requirements, suggestions and feedback. It would also help in grievance redressal. The platform would also allow the stakeholders to post their queries to various administrative authorities. The multipurpose web platform would bridge the gap between all stakeholders related to local area planning and development, thus would result in improved governance and plan making. The platform would create a technical database of the ward including spatial (GIS based) as well as non-spatial data of the ward. This would help in creation of detailed information at the ward level through easy to understand interactive maps.

Participation of local area stakeholders in various capacities has been ensured in the local area planning process through a web portal which acts as a platform for various purposes and through various steps. Participation of local area stakeholders are solicited for database generation of the ward, feedback on the status of upcoming projects, registering complaints, providing suggestions and

Fig. 1: Urban STeP Portal Home page with 7 Tabs



identifying requirements for the same. Participation is also sought for achieving consensus pertaining to conflicting interests in the development of the ward.

The interactive web based platform and applications would be useful to various stakeholders. It would help in regular updating of the ward information. The web portal and applications would enable Urban Local Bodies to obtain suggestions from local stakeholders and help in communication and coordination with various other government departments and help the communities and other Stakeholders to see, upload and validate information regarding various resources. It would enable them to raise their issues or grievance and identify priorities for the Local Area Development. The communities can give suggestions and feedback on development of the ward and ongoing and upcoming projects; they would become aware about the facilities in the area and also would be able to resolve conflicting interests and arrive at a consensus on ongoing issues in the ward.

The web portal and application has been designed in such a way that any stakeholder can file a grievance which would get directed to the concerned authority for redressal. A person who registers a grievance would get intimated regarding status of the complaint. This platform endeavours to bring all the concerned agencies and authorities on a single platform and increase their accountability, coordination and enable transparency. It is an innovative project under DIC so as to ensure citizens engagement in the Local Area Plan. The portal has various attributes which would contribute improved performance and monitoring of the various development organizations there in the city.

4.1 System and Method for Local Area Planning

The framework has the following components:

4.1.1 Data Source (DS)

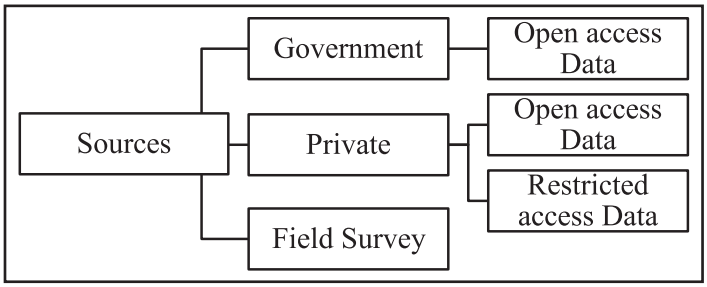
The input to system is the data extracted from multiple sources via Application Programming Interface (API) in various formats including shape files, excel files, etc. This would include government source such as API's from data.gov.in, census, Bhuvan, etc., as well as private sources such as API's through MapmyIndia, Open Street Maps, Google, etc. The data can be open data (freely accessible to all) or restricted access data (limited/paid). DS-A 1 (Data source to Admin) and DS-A 2 illustrates the data through sources suggested in Figure - 1 as an input to the admin where the data would be processed in suitable formats such as maps, pie charts, graphs, tables, etc.

4.1.2 Tabs

The portal has 7 tabs as follows:

- **Know Your Area** tab **-** The generated base map would be available on a web portal and application that would be integrated with any web application or website and application through Know Your Area Tab;
- **Suggestion** tab – Suggestions from Local area stakeholders pertaining to categories such as housing, market areas, industrial areas, open / green area, monument, infrastructure and facilities can be given through this tab;
- **Update us** tab - Updating of ward level data by local area stakeholders' with reference to new constructions and developments in the local area can be given through this tab;
- **Feedback** tab - Feedback of local area stakeholders on ongoing and proposed projects in the local area and authorities can be given through this tab;
- **Query** tab - Questions about certain aspects related to the mentioned categories can be put through this tab;
- **Grievance** tab – This tab enables local area stakeholders to submit grievances regarding aspects related to the mentioned categories; and

Fig. 2: Data Sources



- **Discussion Forum** tab - This tab enables the local area stakeholders to discuss and debate on various topics proposed by the admin on issues and projects pertaining to the local area. In case of any conflict of opinions arising among the local area stakeholders, the admin may resolve the conflict.

4.1.3 Admin (A)

Admin is the main processing system of the portal which would perform sequentially the following actions:

- Digital database generation;
- Base map generation;
- Status analysis at various levels i.e. city, zone, ward and plot level;
- Gap analysis; and
- Issue identification.

4.1.4 Local Area Stakeholders (LAS)

The local area stakeholders (LAS) comprises of the following:

Table 1: Local Area Stakeholders

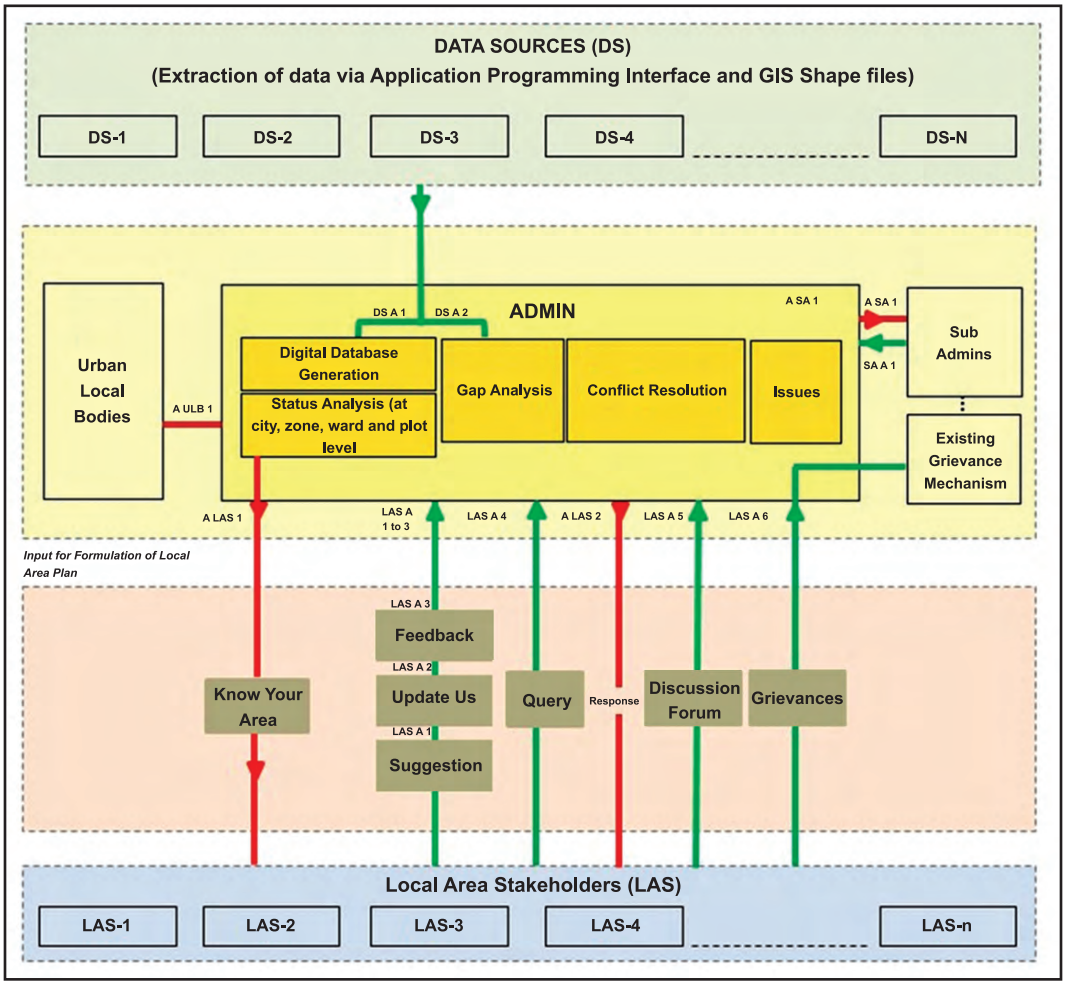
S No	Head	Sub Head
1	**Governing Authorities**	Municipal Corporation/ Urban Local Body
		Planning and Development Authority
		National / State Board and Trusts
		Member of Legislative Assembly (MLA)
		Mayor
		Councillor
		Other Religious Trusts / Boards
2	**Associations and Organizations**	Resident Welfare Association (RWA)
		Industrial Association
		Retail Market Association
		Labour Union
		Wholesale Market Vendors' Association
		Non-Government Organization (NGO)
		Community Based Organization (CBO)
		Street Vendors' Association
		Others
3	**Service Providers**	Cable Operators
		Internet Providers
		Water Supply
		Waste Water Management
		Gas Supply
		Electricity Supply
		Solid Waste Collection
		Police

S No	Head	Sub Head
		Fire fighting
		Education (Schools, Colleges, Universities, Kindergarten)
		Health care (Hospital, Clinic, Health Care centers, Dispensaries)
		Petrol Pumps/ Gas filling stations
		Distributive Facilities
		Banking
		Horticulture
		Inter-Para Transit Mode (Cycle Rikshaw Pullers, E-rickshaw pullers, etc.)
		Street and road maintenance
		Hotels, restaurants and café
		Others
4	**Residents**	Owners
		Tenants
5	**Occupation / Traders**	Salaried, Business, Daily wage
6	Contractors, Property Developers and Dealers	
7	Others	

The local area stakeholder (LAS) is connected to the Admin through LAS-A 1 to LAS–A 5 (Local area stakeholder to admin) which illustrates the feedback that the local area stakeholder would enter by the various tabs: Suggestion tab, Update us tab, Feedback tab Query tab, and Discussion Forum tab. Admin is connected to the local area stakeholders via A-LAS 1 (Admin to local area stakeholders) which illustrates the display of the processed data to the local area stakeholders by the *Know Your Area* tab. Admin is connected to the local area stakeholder through A-LAS 2 (Admin to local area stakeholders) which illustrates the feed forward i.e. response generated in the admin of the feedback given via *Query* tab by the local area stakeholder.

The Admin would also resolve the various conflicts received from the local area stakeholders through the *Discussion Forum* tab. The Admin is linked to the urban local body through A-ULB 1 (Admin to urban local body) which illustrates the forwarding of data generated in the admin to the urban local body as an input for the local area plan. Admin is connected to the sub-admins via A-SA 1 (Admin to Sub admin) which illustrates the sending of feedbacks from tabs i.e. *Suggestion* tab, *Update us* tab, *Feedback* tab and *Query* tab.

Fig. 3: System and Method for Local Area Planning



The Admin is linked to the Sub Admin through SA-A 1 (Sub admin to Admin), which illustrates the forwarding of data generated in the Admin to the Sub Admin. The feedback thus received is directed to the Sub Admins through A-SA 1. The local area stakeholder would register his / her grievance through the grievance tab through LAS–A 6. Admin upon receiving the grievance would direct it to the existing grievance mechanism in place in the city.

4.2 Benefits of Urban STeP

The portal and web application has the following benefits for the community and the urban local bodies.

4.2.1 Benefit to Urban Local Bodies and Planners

The toolkit designed would ensure generation of real time updated data through sourcing and extracting the same from multiple sources like Map My India, ESRI,

Fig 4: Land Use Map on Urban SteP

etc., and that can be collated, analyzed and updated. Thus, the urban local bodies would be benefitted through saving of time to generate database. Moreover dissemination of data is also a challenge. The hurdle in data dissemination can be overcome by knowledge sharing / creating awareness / sensitisation through the Urban STeP portal and web application. Thus, maximum utilization of data that would be collected for various purposes could be achieved. Urban StეP would help in achieving improved governance and plan making. Government Organizations can act on / incorporate the ideas and requirements of the citizens in planning and development of local areas / wards.

Urban STeP would contribute to city planning and development through database generation at the ward that can be scaled up at the city level in terms of land use, activities, facilities and services that would facilitate preparation of plans at the ward level, zonal level, and Master Plan level.

4.2.2 Benefit to Local Area Stakeholders

Urban STeP would bridge the gap between all stakeholders related to local area planning and development. The platform would help in community engagement for the development of wards. It would also benefit people by providing information on a platter and by giving a platform to raise their voices by giving suggestions and ideas.

Urban step enables the local area stakeholder to:

- See, upload and validate information regarding various resources;
- Raise their issues and identify priorities for the local area development;
- Give their feedback and suggestions on ongoing and proposed projects in the ward; and
- Discuss on ongoing issues among other local area stakeholders.

5. CONCLUSIONS

The process of planning has to be more inclusive in its nature starting from the very first phase to the last stage of implementation. To achieve the same participatory approach, is the best possible and most effective mechanism. E-Participation is the ICT and IOT based methodology which is largely un-explored and under utilized and thus needs to be integrated in the planning profession and practice. Local area planning can be done through e-participation using tools like Urban SteP, the technological framework of which can be scaled up from local level to city level, widening the scope of public participation in the entire scale of planning for a city. The portal allows people to voice suggestions, discussions, grievances and feedbacks which can be direct inputs for the planners and decision makers for the preparation of local area plans.

ACKNOWLEDGEMENT

The project was funded by Design Innovation Centre (DIC), set up by Department of Higher Education, Ministry of Human Resource Development, Government of India, under the umbrella of National Initiative of Design Innovation (NIDI) Scheme.

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Kancharapalem – A Putrefying Cultural Urban Core

Gaurab Das Mahapatra and Sanand Maddipati

Abstract

Kancharapalem is a locality situated in the old core area of Visakhapatnam, Andhra Pradesh. For nearly a century, Kancharapalem was a culturally thriving residential locality with artists and professionals involved in the drama industry. However, now, Kancharapalem is mere ruins of its initial glory and often makes headlines only for its antisocial activities. Advent of movies and 'web-based' entertainment has taken away the glory of drama and made the people of Kancharapalem suffer. The artists were forced to change profession or embrace the wrong paths for earning daily livelihood. After getting the Central Smart City status, public administrators of Visakhapatnam are focusing on "Smart Infrastructure" and "ICT" and are likely to ignore the rich past of this decaying Kancharapalem making its past glory disappear in a decade or so. The aim of this research is to identify the strategies which would help revive the degraded "drama-focused" cultural significance of Kancharapalem through architectural interventions; involving urban planning based surveys and analysis.

1. INTRODUCTION

From being a prosperous settlement of approximately 130-150 years ago, Kancharapalem today remains nothing more than a putrefying urban core in the city of Visakhapatnam. Initially Kancharapalem gained fame as a hub for puppet shows; also serving as the residential areas of artists and craftsmen. Over the years, the puppet shows were slowing losing its glory and Kancharapalem became a bustling hub for 'Drama'. The entire cast and crew related to drama either began to live there or were converted from the initial business of puppet shows. People from surrounding villages, districts and even states used to visit Kancharapalem regularly to hire the services of Drama companies which were at the helm of fame in the creative industry of drama and street plays. The backbone of the economy in Kancharapalem during this period was solely based in and around the Drama business. The interaction amongst the residents of Kancharapalem and with the people outside locality was extremely healthy in terms of social life. Being located near the railway station gave an edge to Kancharapalem over other hubs for drama in the entire region. Railway station made the people from all over the region to drop in during the early hours, followed by spending the whole day negotiating with the desired drama group and finally leave Kancharapalem in the late hours; leading to mitigating the need to spend an extra day for business purposes.

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However, things started changing since the late 1960s due to the popularization of mainstream cinema in Andhra Pradesh. Popular stars like Senior Nandamuri Taraka Rama Rao, Akkineni Nageswara Rao, SV Ranga Rao and Rajan Ala became a household name; and in spite of their background from drama, they were popularizing movies and feature films. People of Kancharapalem were losing their livelihood and were finding it difficult to cope up with the changing trend. The shift from puppet shows to drama was manageable and had smooth transition. However, this change from drama to movies was huge in terms of the capacity to cope up economically. Puppet and Drama businesses were handled at household level since the main component of these two art forms was people themselves. However, movies had a substantial technical component which made them expensive and a matter of skilled workforce. The residents of Kancharapalem were not prepared for this drastic change in livelihood pattern caused due to the advent of movies. Another side of this change was the impact it had on the social setting of Kancharapalem. A nominal number of residents had still clung on to their drama business; however, most of them changed profession. The remaining residents found it difficult to either continue drama or move on to a different profession; or choose the wrong paths of society. In fact, Kancharapalem gradually started becoming a hub for antisocial activities since then. Since the last 5-10 years, Kancharapalem regularly features in leading newspapers like Hindu, The Times of India, Eenadu, etc., but only for the wrong reasons.

In the year 2018, a movie titled "% Kancharapalem" was released. This movie went on to be selected in New York Film Festival and was the first movie from Tollywood (regional movie fraternity) to do so. This movie directed by Mahaa featured real characters from Kancharapalem giving it an edge over typical movies. This movie depicted the life of a typical resident of Kancharapalem. The shooting was also done in Kancharapalem itself. This movie made Kancharapalem again come to the limelight and people got awareness about the lost glory of Kancharapalem. It is in this year that a number of research institutions, including Gitam School of Architecture started a survey based study of the same.

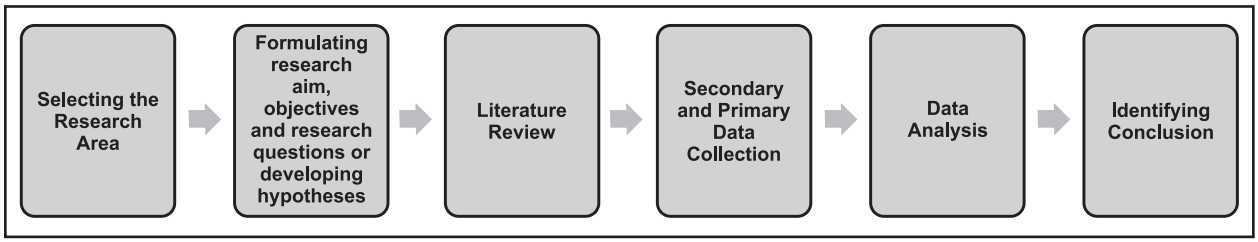
In 2015, Visakhapatnam was selected in the Smart City Mission launched by Government of India. Kancharapalem, in this context can serve as a part of cultural loop in this mission. However, this idea can only be realized and people can be re-attracted to Kancharapalem if its soul i.e. drama culture, is revived. Otherwise, it will be difficult for Kancharapalem to find its place in 21st century Visakhapatnam.

2. RESEARCH METHODOLOGY

For research of such genre, framing the research methodology becomes specific in terms of the intended output. This is primarily because a hoard of complex activities are related to the study area involved and it is important for the researcher to prioritize on the 'more' relevant issues.

The research design started with selection of the research area. This was followed by formulating the aim, objectives and hypotheses development. The next stage was conducting secondary and primary data collection. Data Analysis was to be undertaken after the relevant data was collected, sorted and summarized. The second last stage was identifying conclusion or identifying the path towards which the inferences of the research were leading to. The last and most important step was to draw a limitation to the study and ensure that the conclusion of the paper creates a base for further research work; which should be continued as a follow-up of this paper since there are a lot of other aspects which could have been studied in the same research area. The following diagram shows the basic outline of this research design (process) that was adopted for this research:

Fig. 1: Stages of the Research



Source: Author

The research process as mentioned in the last section is elaborated with reasons and understandings in this segment:

2.1 Determining the Research Method: 'Critical Instance' Case Study Type

Out of the varied range of research methods (like Experimental Research, correlational research, etc.), the research method that was initially intended after studying the delineated study area was 'Case Study Research Method'. Case study research methods are usually used at instances where the requisite research involves elaborate study of a definite spatial extent or specified user groups, often leading to a relatively narrative explanation of the findings. This type of research methods combines both objective and subjective data, but with detailed approach to some narrowed down objectives. Moreover, case study research method helped in framing the hypotheses for this research i.e. an ideal platform for interaction through "Drama" is the best fit solution to bring back the society to its unique charm and revive Kancharapalem.

There are multiple ways in which case study research methods can be adopted like Illustrative type, Exploratory type, cumulative type and critical instance type. For this research, 'Critical Instance Type' was the apt method. Critical Instance type refers to the type of case study research methods in which a researcher

creates analysis platform which in turn questions or modifies previously held notions regarding a particular aspect.

In this case of Kancharapalem, the focus of the research was to seek a way which would foster the livability and increase the awareness of people towards the losing 'Drama' culture. Now, drama being an intangible (cultural) aspect required a balance of qualitative and quantitative approach providing 'Critical Instance Case Study Type' for research. After determining the research method, there was the need of delineating the exact research area in terms of spatial extent.

2.2 Selecting the Research Area

Geographically, Kancharapalem might not have a character which is distinct to its immediate vicinity. However, culturally, it is often considered poles apart from most parts of Visakhapatnam. Even within Kancharapalem, the old Kancharapalem and the new one (developed post-independence) differ starkly. The difference which is being discussed here is primarily based on street width, building typology, social strata and amenities.

Eventually after studying the area, a part of Kancharapalem was delineated for this research. The primary reasons behind this delineation was the distinct visual character of Kancharapalem. Besides, this part, it still had reminiscence of the charm in its heyday in terms of social bonding and public realm. Moreover, this part had certain physical attributes which would foster the course of this research, e.g. presence of old buildings which belonged to people related to the

Fig. 2: Kancharapalem Now

Source: Author

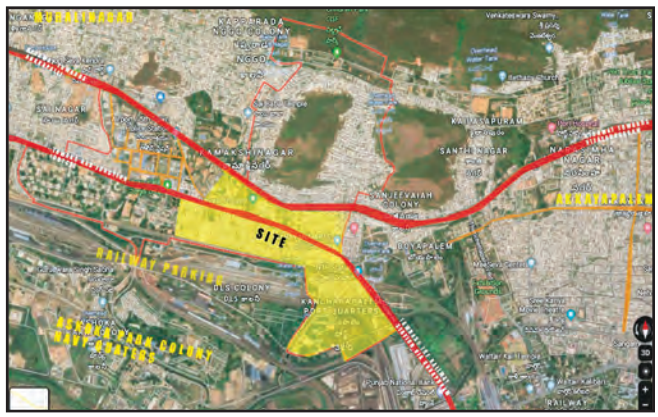
Fig. 3: % Kancharapalem Movie

Source: Official Facebook page of % Kancharapalem)

profession of drama. The delineated study area is falling in Ward No. 34 within Greater Visakhapatnam Municipal Corporation limits with an area of nearly 70 acres and having a population of 24,265 persons as per Census 2011 report.

Fig. 4: Study Area in Kancharapalem

Fig. 5: Location of Kancharapalem



Source: Author

2.3 Formulating Research Aim, Objectives and Research Questions and Developing Hypotheses

After the study area was delineated, the aim, objectives and hypotheses were developed. The aim of the research of this research is to identify the strategies which would help revive the degraded "drama-focused" cultural significance of Kancharapalem through architectural interventions; involving urban planning based surveys and analysis. It should be stated in this stage that the paper seeks the direction towards the intervention strategies and not the details of the intervention strategies itself. The objectives that were finalized to strengthen the aim were:

- Survey (primary study) of the existing street scape;
- Identification of aspirations of people;
- Understanding the orientation of the present residents towards the "Drama' culture; and
- Linking the first two objectives to identify social and/ or spatial intervention strategies which would eventually help in revival of this old core city.

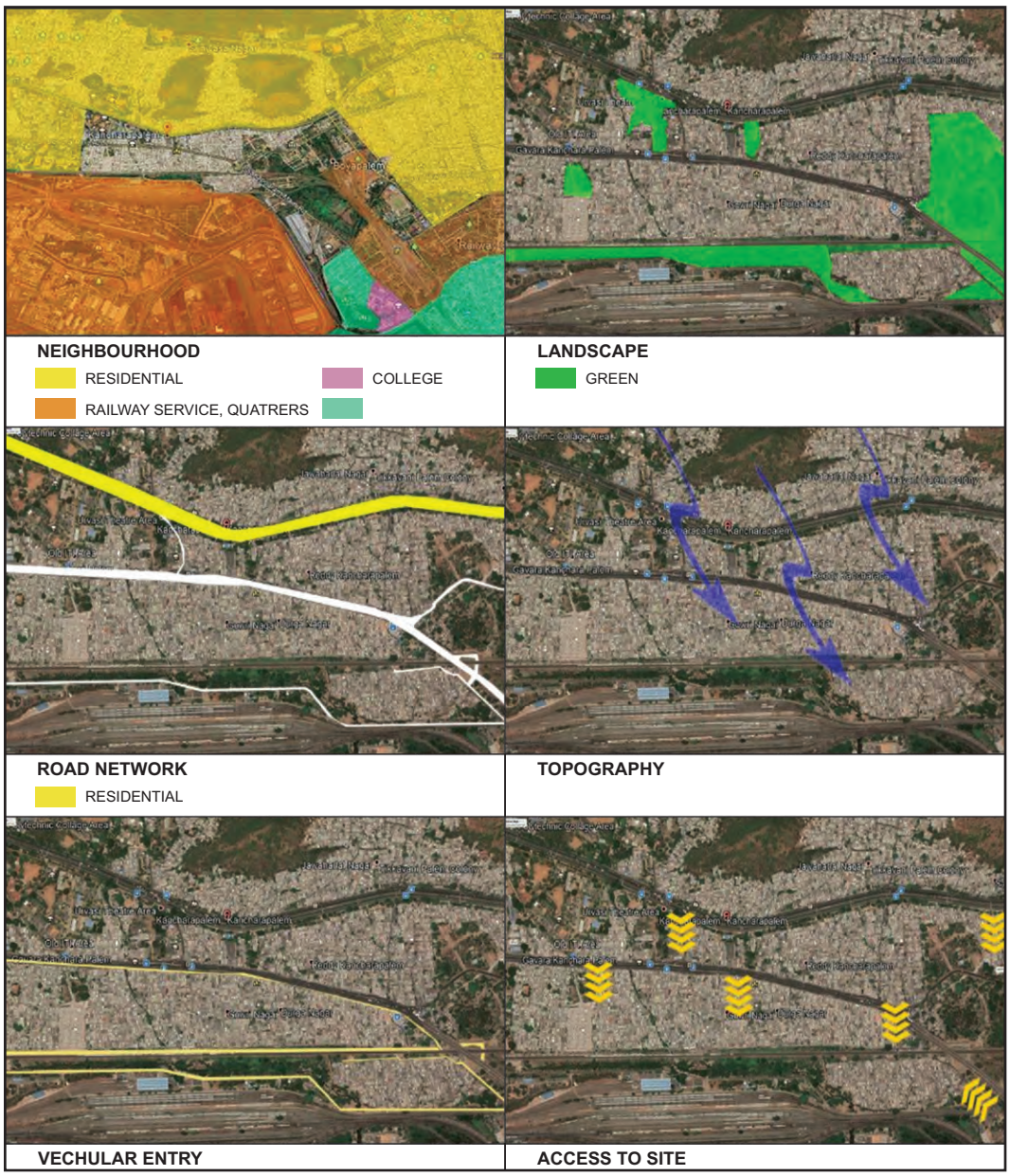
The hypothesis formulated in this stage was that an ideal platform for interaction through "Drama" is the best fit solution to bring back the society to its unique charm and revive Kancharapalem.

2.4 Secondary Data Collection (including Sampling and Survey)

Secondary data collection for Kancharapalem involved documents from the old library building present within Kancharapalem itself. These documents gave

information related to the history of kancharapalem with respect to the spatial and social character. Newspaper reports provided a fruitful insight of present day Kancharapalem which, over the past few years, has made news primarily for activities like murder, robbery, flesh trade, smuggling, etc., giving a notion of skewed social setting in place of a culturally thriving society. The movie c/o. Kancharapalem also provided a deep understanding of the people's perspective. However, it should be mentioned that due to a limited number of documents

Fig. 6: Baseline Study for Kancharapalem



Source: Author

available online, the data collection was more inclined towards primary study. Baseline study was a component of this part of the study. Morphological factors like neighborhood, landscape, road network, topography, vehicular circulation and access to the site were observed.

2.5 Primary Data Collection

Primary Data Collection involved a continuous involvement of nearly a year where 14 streets along with 102 residents were undertaken in Kancharapalem. There were two components that were surveyed in this research i.e. streets and residents. Out of the two major type of sampling i.e. probability and non-probability, the one used for this research is 'Non-Probability' type since each unit of the sample did not have the probability to get selected in the sample. Moreover, there was a certain deliberation from the research angle to select the samples selectively due to the fact that neither all streets contained the original essence of 'Old' Kancharapalem and nor all residents were acquainted with the 'Old' Kancharapalem. So, a Probability type sampling would have rendered a skewed survey result. Once the sampling type was finalized, there was a further need to specify the exact type of 'Non-Probability' sampling that should be used to survey streets and residents respectively.

Since this research needed to understand the essence of the streets which are having reminiscence of 'Old' Kancharapalem, the streets were selected specifically thus leading to 'Purposive' type of Non-Probability Sampling. A total of 14 streets were selected for the survey. The names of the streets are given in Table - 1.

Table 1: List of the Streets Surveyed in Kancharapalem

S. No.	Name of the Street
1	Gavara Kancharapalem Main Street
2	Sarakam Kasi Street
3	Pydi Thallama Street
4	Quarters Street
5	Railway Service Street 1
6	Railway Service Street 2
7	Bridge Street
8	Main Railway Street
9	Gavara Street 1
10	Gavara Street 2
11	Kaluvu Street
12	Service Street Connecting Main Kancharapalem Street and Railway Street 2
13	Kotha Kancharapalem Street 1
14	Kotha Kancharapalem Street 2

Source: Author

The photographs of these streets are given below to understand the existing urban fabric.

- Street Survey: structured questionnaire based
- The Table - 2 shows how the questions were framed in the questionnaire for street survey and what were the type of structured questionnaire that were used in the survey format.
- Sampling for residents: 'Quota' type of Non-Probability sampling (Table - 3).
- This research needed testimony of the people who had some kind of acquaintance with the 'Old' Kancharapalem, 'Quota' type of Non-Probability sampling was apt for this

Table 2: Questions Included in the Survey Format for Street Survey

S. No.	Question	Options	Type of Questionnaire
1	Name of the Street	N/A	Open Ended
2	Width of the Street	Less than 3 m 3 - 6 m 6 - 9 m 9 -12 m 12 - 18 m More than 18 m	Multiple choice questions
3	Predominant Building Usage in the Street	Mixed Use Residential Educational Institutional Assembly Business Mercantile Industrial Storage Hazardous	Multiple choice questions
4	Major Problem in the Street (Like Water logging, etc.)	N/A	Open Ended
5	Predominant Building Height (in terms of Floors)	Ground Floor G+1 – G+ 2 G+3 - G+5 G+5 – G+8 G+8 – G+10 More than G+10	Multiple choice questions
6	Predominant Condition of the Buildings (as per Census of India, 2011)	Good Livable Dilapidated	Multiple choice questions
7	Informal Vendors Present?	Yes No	Dichotomous Questions
8	Street Lights Present?	Yes No	Dichotomous Questions
9	Is it Accident Prone	Yes No	Multiple choice questions
10	Open Spaces Present?	Yes No	Multiple choice questions

Source: Mr. Adarsh Sai

research, since, Quota type focuses on the selection of sample based on certain characteristics determined during the preliminary (pilot) survey of Kancharapalem. A total of 102 people were surveyed.

Table 3: List of Questions Included in the Survey Format for Resident Survey

S. No.	Question	Options	Type of Questionnaire
1	Name	N/A	Open Ended
2	Gender	Male Female Transgendered	Multiple choice questions
3	Age (in years)	<20 20-30 30-50 50-70 >70	Multiple choice questions
4	Period of Stay in Kancharapalem (in years)	≤10 10-25 ≥25	Multiple choice questions
5	Occupation	Drama Service Business Unemployed Other Arts Retired	Multiple choice questions
6	Is Kancharapalem same as before (in societal terms) ?	Yes No	Dichotomous Questions
7	If NO, then WHY?	Lack of general interest towards Drama Lack of resident (especially youth) interest towards Drama Lack of Basic Urban Services Political Ignorance *Any other	Multiple choice questions
8	Is there a need to revive Kancharapalem (in societal terms) ?	Yes No	Dichotomous Questions
9	If YES, then HOW?	Generating employment through Drama Generating interest of Youth towards Drama Improving Basic Urban Services Improving Streetscapes * Any other	Multiple choice questions
10	In case of Street Based Urban Development in Kancharapalem, WHAT do you need most?	Open Spaces (for relaxation) Informal gathering spaces Performance Area Organised Food Stalls Regularised Street Vendors Exhibition Spaces * Any Other	Multiple choice questions

11	If Open Spaces are inserted in Kancharapalem, WHICH type would you prefer?	Open Air Theatre Practice Zones Performance Theatre (Formal) Theatrical Exhibition Regularized Street Vendors * Any Other	Multiple choice questions
12	In case of Redeveloping the Buit Volume in Kancharapalem, WHICH strategy would you prefer?	Demolition for open space/ performance area Demolition and Modern (Apartment Style) Construction Demolition and Traditional (Old Kancharapalem Style) Construction Retrofitting Only (Keeping Old Kancharapalem Style) * Any other	Multiple choice questions
13	If the Above buildings belong to Artists/ ex-Artists, WHICH option would you prefer?	Renovated/ Retrofitted Buildings Sold/ Rented/ Leased for Other Purposes (like Commercial, Apartment, etc.) Renovated/ Retrofitted Buildings to keep its original owners * Any other	Multiple choice questions
Note: For all questions whose option was 'Any Other', a suggestion was requested; which was an 'Open Ended' Question			

3. SURVEY RESULTS

In this section, the results of the surveys are discussed.

3.1 Resident Specific

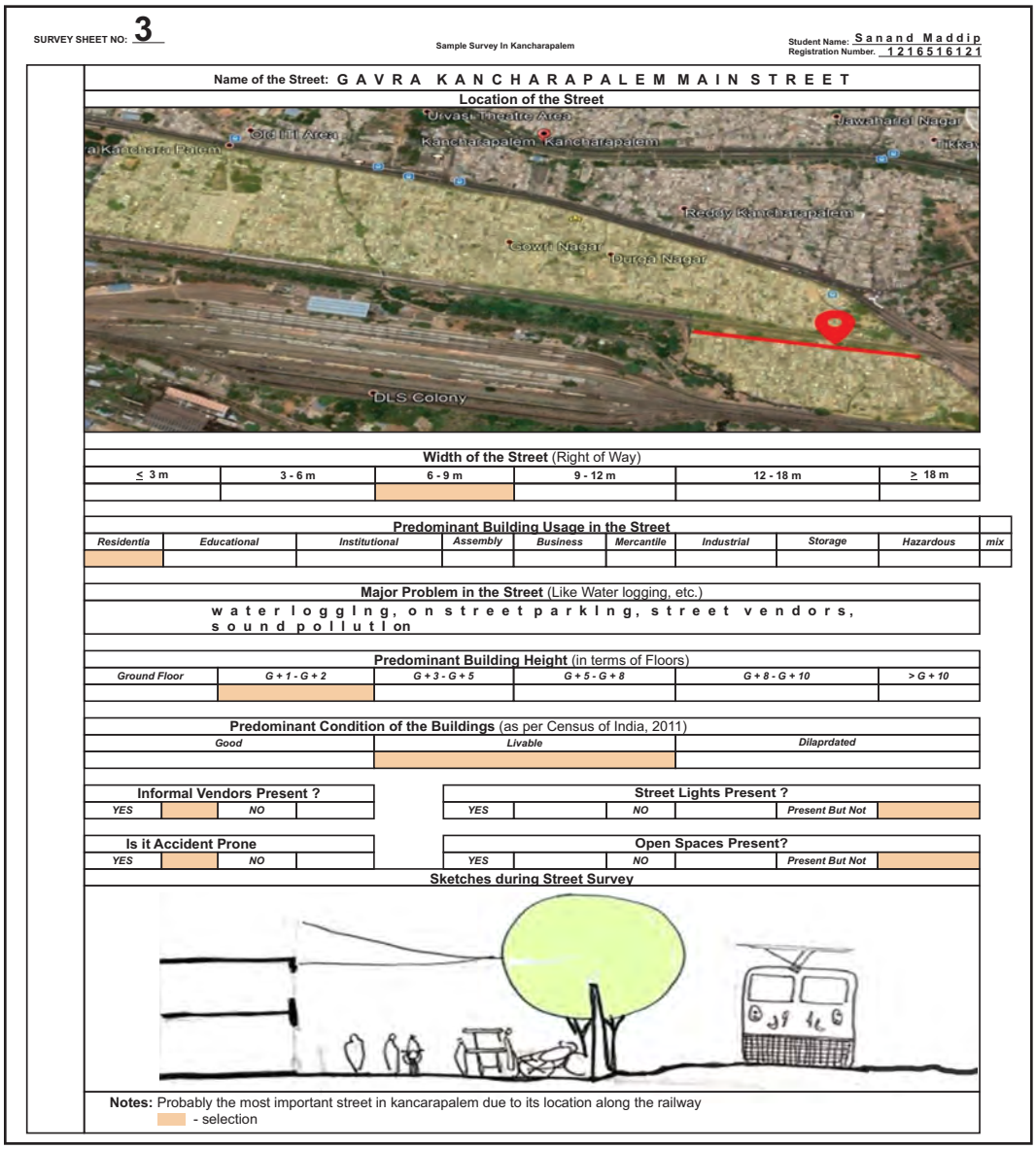
Following are the results of resident specific survey conducted on 102 individuals:

- Out of the total 102 people surveyed, there were 71.6 % (73 numbers) male respondents and 28.4 % (23 numbers) female. No transgendered respondents were willing to communicate.
- Out of the total 102 people surveyed, 1.9 % (2 numbers) were from the age group >20 years, 23.5 % (24 numbers) were from the age group 20-30 years, 41.2 % (42 numbers) were from the age group 30-50, 28.5 % (29 numbers) were from the age group 50-70 years and 4.9 % (5 numbers) were from the age group >70 years.
- In the question regarding their stay in Kancharapalem, 85.30 % (87 numbers) were staying in Kancharapalem for >25 years, 7.85 % (8 numbers) were residing there for 10-25 years and 6.85 % (7 numbers) were for <10 years.
- 12.8 % (13 numbers) of the respondents were still having drama related occupation, 41.2 % (42 numbers) of the respondents were in other service (like jobs, etc.), 21.6 % (22 numbers) were in businesses, 3.9 % (4 numbers) were unemployed and 20.5 % (21 numbers) of the respondents were retired.

Fig. 7: Surveyed Streets of Kancharapalem; From left to right row wise: Gavara Kancharapalem Main Street, Sarakam Kasi Street, Pydi Thallama Street, Quarters Street, Railway Service Street 1, Railway Service Street 2, Bridge Street, Main Railway Street, Gavara Street 1, Gavara Street 2, Kaluvu Street, Service Street Connecting Main Kancharapalem Street and Railway Street 2, Kotha Kancharapalem Street 1, Kotha Kancharapalem Street 2

Source: Mr. Adarsh Sai

Fig. 8: A Sample of Filled Survey Format intended for Street Survey



SURVEY SHEET NO: 3

Sample Survey In Kancharapalem

Student Name: Sanand Maddip
Registration Number. 121651612 1

Name of the Street: GAVRA KANCHARAPALEM MAIN STREET

Location of the Street

Width of the Street (Right of Way)

≤ 3 m	3 - 6 m	6 - 9 m	9 - 12 m	12 - 18 m	≥ 18 m
		■			

Predominant Building Usage in the Street

Residentia	Educational	Institutional	Assembly	Business	Mercantile	Industrial	Storage	Hazardous	mix
■									

Major Problem in the Street (Like Water logging, etc.)

water logging, on street parking, street vendors, sound pollution

Predominant Building Height (in terms of Floors)

Ground Floor	G + 1 - G + 2	G + 3 - G + 5	G + 5 - G + 8	G + 8 - G + 10	> G + 10
	■				

Predominant Condition of the Buildings (as per Census of India, 2011)

Good	Livable	Dilaprdated
	■	

Informal Vendors Present ?

YES		NO	

Street Lights Present ?

YES		NO		Present But Not	

Is it Accident Prone

YES		NO	

Open Spaces Present?

YES		NO		Present But Not	

Sketches during Street Survey

Notes: Probably the most important street in kancarapalem due to its location along the railway
■ - selection

Source: Author

- 100 % (102 numbers) of the respondents agreed that Kancharapalem is not the same as before.
- 54.9 % (56 numbers) of the respondents stated that lack of basic urban services is the primary reason behind the change in Kancharapalem. 15.7 % (16 numbers) of respondents stated lack of general interest towards drama as the primary reason and 12.7 % (13 numbers) stated lack of resident (especially youth) towards drama. Moreover, 10.8 % (11 numbers) of respondents blamed political ignorance and 5.9 % (6 numbers) stated other reasons like advent

Fig. 9: A Filled Survey Format Intended for Resident Survey

SURVEY SHEET NO: 26

Sample Survey In Kancharapalem

Student Name: Sanand Maddipat
Registration Number.

Name	Rambabu.K		Gender	Male		Female		Transgendered		
Age	< 20		20-30		30-50		50-70		>70	
Since WEHN In Kancharapalam?			≤ 10 yrs		10 - 25 yrs		≥ 25 yrs			
Occupation	Drama		Service		Business		Unemployed			
	Other Arts						Retired			

Is Kancharapalem same as before (In societal terms) ?		YES		NO	
If NO, then WHY?					
Lack of general interest towards Drama	Lack of resident (especially youth) interest towards Drama	Lack of Basic Urban Services	Political Ignorance	*Any other	
*Any other	Intro of motion picture				

Is there a need to revive Kancharapalem (in societal terms) ?		YES		NO	
If YES, then HOW?					
Generating employment through Drama	Generating Interest of Youth through Drama	Improving Basic Urban Services	Improving Streetscapes	Any other	
*Any other					

In case of Street Based Urban Development in Kancharapalem, WHAT do you need most?						
Open Spaces (for relaxation)	Informal gathering spaces	Performance Area	Organised Food Stalls	Regularised Street Vendors	Exhibition Spaces	Any Other
*Any other						

If Open Spaces are Inserted in Kancharapalem, WHICH type would you prefer?					
Open Air Theatre	Practice Zones	Performance Theatre (Formal)	Theatrical Exhibition	Regularised Street Vendors	Any Other
*Any other					

In case of Redeveloping the Buit Volume in Kancharapalem, WHICH strategy would you prefer?				
Demolition for open space/ performance area	Demolition and Modern (Apartment Style)	Demolition and Traditional (Old Kancharapalem	Retrofliting Only (Keeping) Old Kancharapalem Style)	Any Other
*Any other	Improve urban facilities			

In the Above buildings belong to Artists/ ex-Artists, WHICH option would you prefer?		
Renovated/ Retrofitted Buildings Sold/ Rented/ Leased for Other Purposes (like Commercial, Apartment, etc.)	**Renovated/ Retrofitted** Buildings to keep its original owners	Any Other
*Any other	used for the exhibition of the old style of that place	

Photographs of the Survey

Notes: The residents are especting intervention from government of prlvate bodies for upgradation of quality of life

- selection

Source: Author

of movies, etc., as the primary reason behind the changed (not for good) of Kancharapalem.

- Regarding the need of reviving Kancharapalem, 99.2 % (101 numbers) respondents were in favour of the revival. Only 0.9 % (1 numbers) expressed desire to not to revive Kancharapalem.
- 51 % (52 numbers) stated improving basic urban services of the respondents stated that general employment through drama will be the best way to revive Kancharapalem. 18.6 % (19 numbers) of the respondents said creating employment through drama should be helpful. 13.7 % (14 numbers) stated that creating general interest of youth towards drama will be the way, 12.8 % (13 people) said improving street scapes will be important and finally 3.9 % (4 numbers) of the respondents stated that publicity of drama and interaction with others shall be the primary way to revive Kancharapalem.
- When asked about street based Urban Development in Kancharapalem, 40.3 % (41 numbers) wanted performance area, 22.5 % (23 numbers) wanted organized food stalls, 15.7 % (16 numbers) expressed need of exhibition spaces, 10.8 % (11 numbers) wanted regularised street vendors, 7.8 % (8 numbers) mentioned open spaces for relaxation and 2.9 % (3 numbers) told that informal gathering spaces will be the necessity.
- Regarding the type of open spaces (if inserted) in Kancharapalem, 48 % (49 numbers) of the respondents wanted performance areas to be accommodated on those new inserted spaces. 20.6 % (21 numbers) wanted open air theatres,16.7 % (17 numbers) wanted theatrical exhibition, 11.8 % (12 numbers) went in favour of cultural practice zones and 2.9 % (3 numbers) of the respondents wanted regularised street vendors as the activity to be accommodated in the open spaces that will be inserted or identified.
- When asked regarding the preferred strategy for redeveloping the built volume in Kancharapalem, 66.7 % (68 numbers) of the respondents preferred the option of retrofitting (only) by keeping the old Kancharapalem style intact. 13.7 % (14 numbers) of the respondents preferred demolition and traditional (old Kancharapalem style) construction. 10.8 % (11 numbers) preferred demolition for creating open spaces / performance areas. 8.8 % (9 numbers) of the respondents stated that demolition and modern (apartment style) construction as the preferred strategy.
- The respondents were asked if the above buildings (the ones to be intervened during redevelopment programme) belonged to the artists/ ex-artists which strategy should they prefer to be adopted. 53.9 % (55 numbers) preferred the option of renovated/ retrofitted buildings in order to keep its original ownership and usage and 46.1 % (47 numbers) preferred the option of renovated/ retrofitted buildings to be sold/ rented/ leased for other modified purposes (like Commercial Usage, Apartment construction, etc.).

3.2 Street Specific Surveys

The street specific survey conducted in 14 streets had the following results:

- Out of the 14 streets that were surveyed, 21.4 % (3 numbers) were in the range of 3-6 m, 50 % (7 numbers) were in the range 6-9 m and 28.6 % (4 numbers) were in the range of 9-12 m.
- In the category of predominant building usage, 57.1 % (8 numbers) of the streets had predominant residential usage, 28.6 % (4 numbers) had predominant mixed use and 14.3 % (2 numbers) had predominant mercantile usage.
- In the category of predominant building height (in terms of floors) in the street, 57.1 % (8 numbers) of the streets had predominance of G+1 – G+2 category, 28.6 % (4 numbers) had predominance of G+3 – G+5 category and 14.3 % (2 numbers) of the streets had predominance of only Ground Floor category.
- In the category of predominant condition of the buildings in the street, 85.7 % (12 numbers) of the street had predominantly livable conditions and 14.3 % (2 numbers) had predominantly dilapidated conditions.
- Out of the 14 surveyed streets, 78.6 % (11 numbers) of the streets had presence of informal vendors and remaining 21.4 % (3 numbers) of the streets did not have presence of informal vendors.
- All the 14 streets were accident prone.
- In 42.85 % (6 numbers) of the streets, street lights were present and working. Again, in 42.85 % (6 numbers) of the streets, street lights were present but not in working condition. Remaining 14.3 % (2 numbers) of the streets, street lights were not installed.
- In the category of open spaces present, 85.7 % (12 numbers) of the streets had open spaces but were in a formal usable state. 14.3 % (2 numbers) of the streets do not have identifiable open spaces.

4. CONCLUSIONS

Kancharapalem cannot be revived with a single development focus in mind. The initial consideration that advent of movies is the only reason behind the decay of Kancharapalem identified to a large extent during the survey. Respondents had multiple other reasons like urban services, political ignorance, etc., as the reason behind the decaying core of Kancharapalem. Moreover, the changed genre of the streets also makes it challenging for decision makers to intervene in Kancharapalem at a large scale. The conservative surgery approach complemented by the aspirations of the people would be an ideal way to interpret the real development paradigm of Kancharapalem. However, no one (respondents) could deny that revival of drama would be beneficial for this area.

Presently, the authors are working on creating a framework to strengthen the lost drama culture by inspiring local youth to take part in drama in coordination with the few existing families who are still related to the field. Authors are working in the domain of identifying the vacant spaces in the existing streets where this kind of informal activities could take place. A full length drama related to the life of a youth in Kancharapalem is also being planned by the local residents who were helpful during the survey and research since 2018.

So, the strategies which would help revive the degraded "drama-focused" cultural significance of Kancharapalem through architectural interventions; involving urban planning based surveys and analysis are:

- Up gradation of basic services;
- Improving street scape;
- Identification of open spaces for drama; and
- Planning framework for conducting drama activities as a part of the economy and including Kancharapalem in the cultural / heritage loop of Visakhapatnam.

Probably by the year 2022, this proposal comprising of the above mentioned points shall be completed; and submitted to the local authority (Greater Visakhapatnam Municipal Corporation).

Acknowledgements

We express our heartfelt thanks to Prof. Dr. K. Mohan (Director, Gitam School of Architecture) for his support and encouragement while framing this research. Special thanks to Adarsh (Student of our school and a resident of Kancharapalem) for helping with photographs. We are also thankful to Xavier School of Human Settlements for acknowledging this research as one of the best in their 4th Annual research on Cities Summit, 2020.

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The Correlation between Vegetation and Surface Temperature in Mumbai Metropolitan Region

Vistasp Jal Mehta and Rekha S. Nair, Ph.D.

Abstract

This study attempts to identify hot spots in the Mumbai Metropolitan region and to assess its relationship with vegetation. Remote sensing data is used to investigate the relation and contrary to the general perception of downtown areas having higher temperature compared to its suburbs, it was found that although much of the island city is densely urbanized, the Land Surface Temperature was not as high as it was in some of the Sahyadri hills to the East, a peri-urban area. This is likely to be due to the strong cooling effect of the surrounding Arabian Sea and the fact that when the hills get denuded, their black basaltic rock is often exposed. It was seen that when the hilly terrain was well vegetated and showed good Normalized Difference Vegetation Index (NDVI), such as in Tungareshwar Wildlife Sanctuary, Matheran and Prabalgad, the LST was very low. Most of the remaining mountains, both of Navi Mumbai and further north towards Kalyan, having very low or minimal vegetation, and were very hot. Of the built-up areas, it was noticed that informal settlements and places that had sheds / factories with very little gap between buildings were exceptionally warmer. However, even among informal settlements, the older ones showed less heat than the newer ones. This study has only considered daytime LST.

1. INTRODUCTION

The land surface temperature of urban areas, is generally perceived to be significantly more than its rural suburban areas. There are a number of factors that cause such variations. One of the most important of these is that the land surface temperature (LST) is inversely related to a decrease in area under vegetation.

When solar energy falls on surfaces, depending on their physical properties, the surfaces reflect, absorb, and radiate heat to different extend. Surfaces with high albedo will reflect a greater amount of solar energy back into the atmosphere; whereas those will lower albedo will absorb and store a larger part as heat, which they will subsequently release later – usually at night. This thermal lag causes urban areas to have a near-zero or more commonly, a positive heat flux at all times. (Oleson *et al.*, 2011) In addition, higher temperatures lead to increased usage of air conditioning which, in turn, leads to higher levels of smog and still warmer temperatures from the heat-exchange with condenser units (Williamson,

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Erell and Campus, 2001). In the United States, it was found that this increase in urban heating was responsible for 5-10 % addition to the peak electric demand. (Akbari, 2005). Tree cover, on the other hand, helps mitigate this heating effect. (Akbari, Pomerantz and Taha, 2001), (McPherson and Rowntree, 1993) by providing shade to hard and due to evapotranspiration which cools the land due to latent heat from change of state.

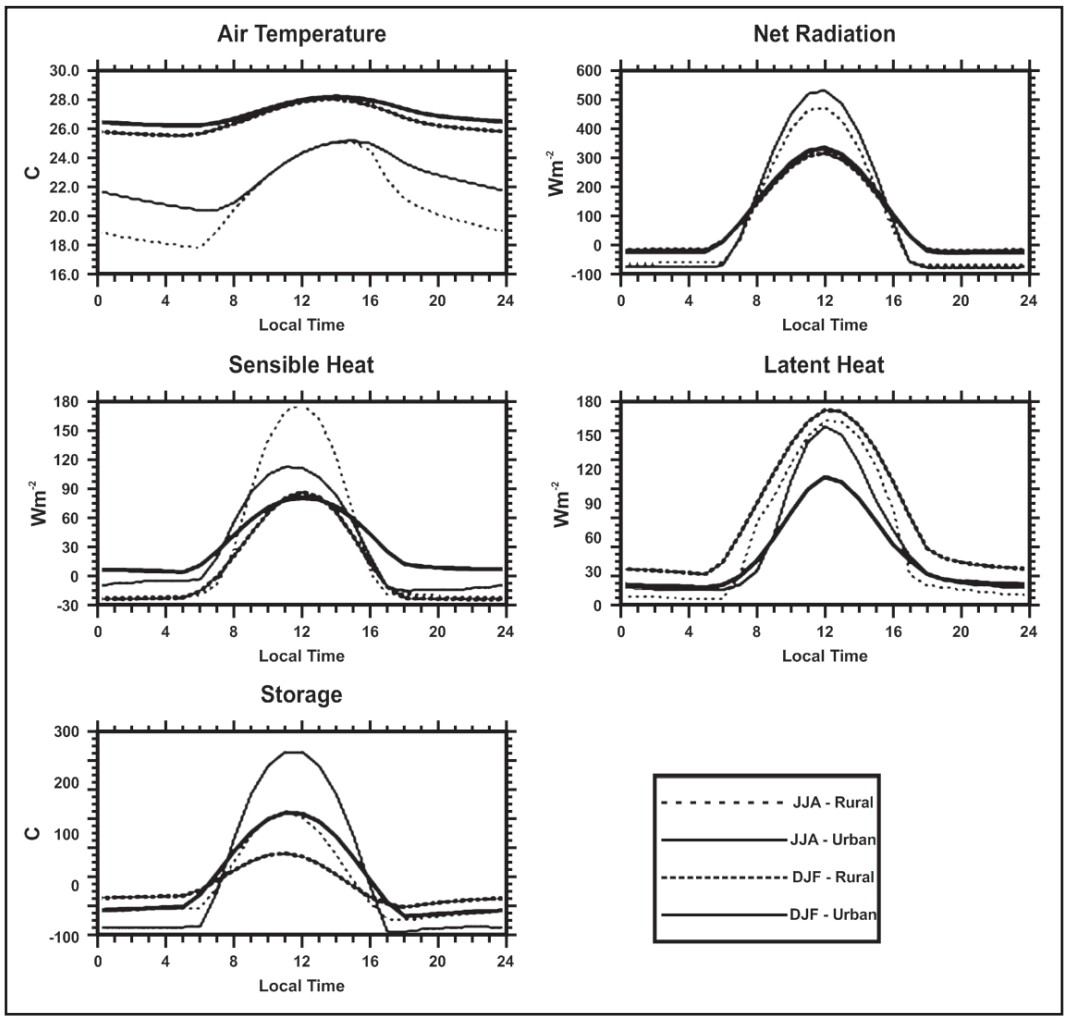
As urban areas get increasingly paved and the area under vegetative cover decreases, temperatures within the city rise compared to the surrounding countryside. This is known as Urban Heat Island (UHI). Pavements, on average, make up 30-45 % of land area in major cities and are significant contributors to UHI as they have low reflectivity and high thermal storage. (Kaloush, 2007)

Many studies have been conducted at the city-wide scale to demonstrate the connection between surfaces and urban temperatures. These studies have typically employed remote-sensing data from Landsat or ASTER (Advanced Space borne Thermal Emission and Reflection Radiometer) (Kaloush, 2007); (Liu and Zhang, 2011); (Zhang *et al.*, 2012) while others have used global or regional climate models (Oleson *et al.*, 2011). Studies such as these are good for identifying macro causes, trends, and effects.

Zhang et al. in their study of Wuhan city in China using Landsat remote sensing data noted a direct inverse correlation between vegetative index and surface radiation temperature, and found that, while water bodies and green spaces have a remarkable influence on thermal intensity, they also have an edge effect on ambient temperature. Liu and Zhang used Landsat as well as ASTER data, concentrated on three specific areas – Kowloon, the North Hong Kong Island, and the International Airport. They reached similar conclusions about the correlation between LST (Land Surface Temperature) and NDVI (Normalised Difference Vegetation Index).

Oleson et al., ran a global simulation which showed that during the daytime urban areas are sometimes actually cooler than rural areas due to higher albedo and increased long-wave radiation loss due to warmer surface temperatures. However, the "partitioning of this radiation into turbulent and storage heat fluxes is quite different between urban and rural surfaces and is the cause of the differences in air temperature". Further "urban area stores more heat during the day and releases it later in the day and at night, thereby maintaining a near-zero or positive sensible heat flux at all times". (Oleson *et al.*, 2009). Their paper also make an analysis for a grid cell of India located in Mumbai (Fig. 1). In this, it was found that, although urban and rural temperatures are similar during the day in both seasons, they contrast higher at night. It is particularly noted that rural areas warm up and cool down much quicker in winter than in summer.

Fig. 1: December January February and June, July August Climatological (1980-1999) Diurnal cycle of Urban and Rural Air Temperature and Energy Balance for a Grid Cell in India (19.9 °N, 72.5 °E) for the NWHF simulation.



Source: https://rmets.onlinelibrary.wiley.com/doi/full/10.1002/joc.2201

Remote sensing based studies are hampered by limited spatial resolution and affected by atmospheric conditions at the time the satellite passes over the area. The latest Landsat 8 has a resolution of 15 m for the panchromatic band but only 30 m for most of the others. The thermal band, on the other hand is a low 100 m which is resampled to 30 m, and therefore, much less accurate. Simulations, on the other hand, are synthetic studies, and while they can be good indicators, their values need to be verified with evidence on the ground.

The study by Valsson and Bharat, 2013 for Nagpur city was entirely based on field measurements. But Joshi *et al.*, 2015 have in their study, combined remote sensing data with on-ground surface temperature measurements using thermal

infrared guns to arrive at isotherm maps for Gandhinagar, Gujarat. Authors found that UHI was highest in the industrial areas, new developments, the dense, old part of Ahmedabad city.

This study attempts to identify hot spots (highest land surface temperature) in Mumbai and its surrounding region and to assess the role of vegetation in mitigating hotspots.

2. RESEARCH DESIGN AND METHODOLOGY

The research design and methodology include:

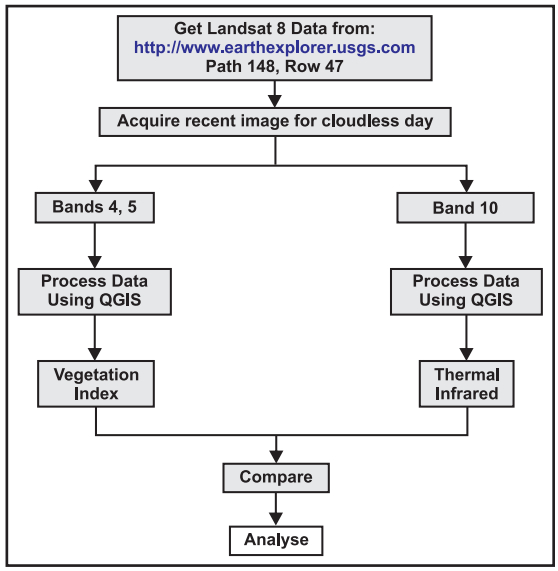
- Generate a regional LST map using Landsat remote sensing images;
- Generate a regional NDVI map using Landsat remote sensing images;
- Compare LST with NDVI to see correlations and anomalies;
- Analyze factors contributing to correlations and anomalies; and
- Suggest measures to mitigate high LST in the context of Mumbai Region.

Table 1: Descriptions of Landsat - 8 Bands

Landsat-8 Bands (Descriptions)		Wavelength (µm)		Resolution (m)
1	Ultra Blue (coastal/aerosol)	0.43	0.45	30
2	Blue	0.45	0.51	30
3	Green	0.53	0.59	30
4	Red	0.64	0.67	30
5	Near Infrared (NIR)	0.85	0.88	30
6	Shortwave Infrared (SWIR) 1	1.57	1.65	30
7	Shortwave Infrared (SWIR) 2	2.11	2.29	30
8	Panchromatic	0.50	0.68	15
9	Cirrus	1.36	1.38	30
10	Thermal Infrared (TIRS) 1	10.60	11.19	30* (100)
11	Thermal Infrared (TIRS) 2	11.50	12.51	30* (100)

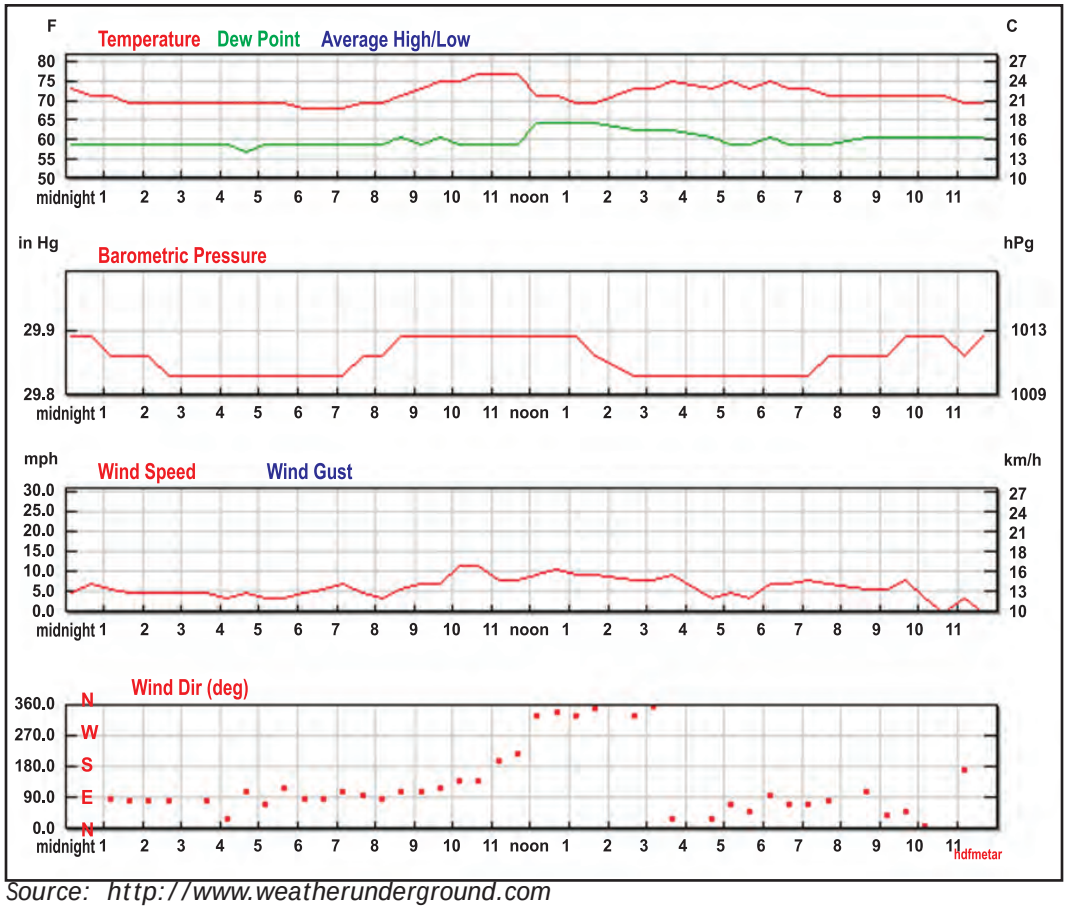
The Indian Space Research Organization (ISRO) is currently in the planning phase for thermal imaging[1] which can be used to study urban heat island effect not yet available. For this study, Landsat TM data, which is freely available, has been used. Landsat is a joint project of the U.S. Geological Survey (USGS) and NASA. Landsat 8 is the latest in a series of satellites that have provided remote sensing data over the last forty years. It registers eleven frequency bands of which two are in the thermal infrared spectrum. The flow chart which describes the process followed is given in Fig. 2.

Fig. 2: Framework of Research



1 *Live Mint (news article), "ISRO may get a thermal imager to detect urban heat islands"* 24th November 2015.

Fig. 3: Weather Chart for 15th February 2017



Source: http://www.weatherunderground.com

* *TIRS bands are acquired at 100 m resolution but are resampled to 30 m before being made available for download. Landsat data were obtained from https://earthexplorer.usgs.gov/. The path/row numbers for Mumbai Metropolitan Region, are 148/47. Data were downloaded for the days with no significant cloud cover, the timestamp for which was 15th February 2017 at 14:00 hrs. As per the weather report for that day (Fig. 3), temperature at that time was approximately 22°C.*

The data were processed using QGIS (Quantum GIS). Thus, types of maps were generated for comparison which, when seen side by side show distinct correlations:

- Thermal Infrared which shows land surface temperatures (LST); and
- Normalized Difference Vegetation Index (NDVI).

2.1 LST Map Using Landsat Remote Sensing Images

For generating a regional LST map, the infrared bands 10 was used. As this band is of a lower resolution than the others, the resulting image is not very sharp. However, it is sufficient to accurately pick out the hotter and cooler areas. To

make it visually clearer, the grey scale image was converted to a false - color image with blue as the cool end of the spectrum and red at the hot end of the spectrum.

Things noticeable on the thermal map are given in Fig. 4.

- Surface temperatures range from about 23°C over water to more than 36°C; in some places. As noted earlier, ambient temperature at the time was 22°C;
- Surface temperatures within built-up areas of the island city, Salsette, and Navi Mumbai (from Vashi to Belapur) ranged from 29°C to 34°C. Only a few parts crossed 36°C;
- Many of the absolute hottest areas are in places where there are no urban settlements; and
- Nhava Sheva Port area is expectedly hot as it has large treeless expanses of concrete and there are some areas where steel containers are stacked.

2.2 Regional NDVI Map Using Landsat Remote Sensing Images

To know the extent of vegetative cover over an area, it is necessary to measure the biomass. Chlorophyll, which is leaf pigment, absorbs red and blue parts of the visible spectrum and strongly reflects green. Near-infrared (NIR), on the other hand, penetrates the leaf

Fig. 4: Image with False Colors Indicate Surface Temperatures in °C taken from TIRS 1 Band of Landsat 8 i.e. Band-10

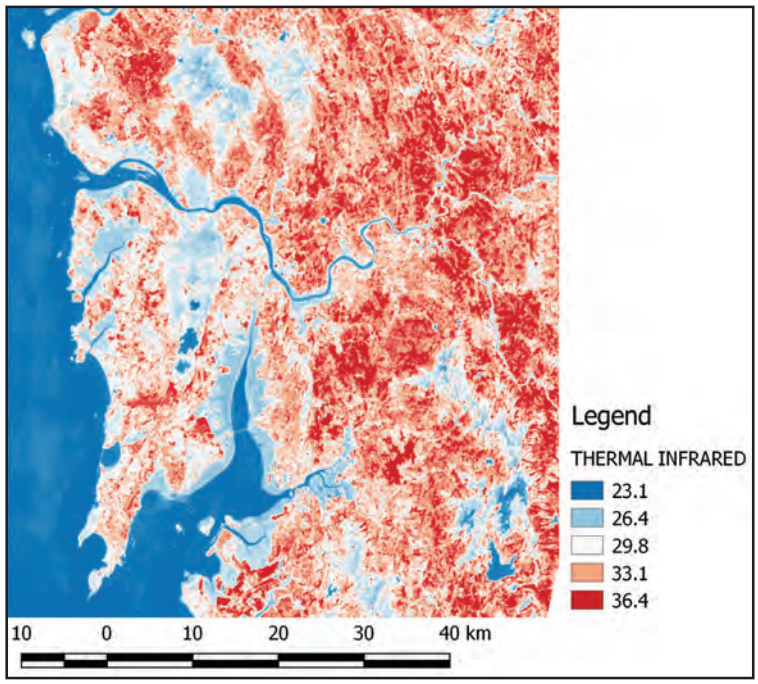
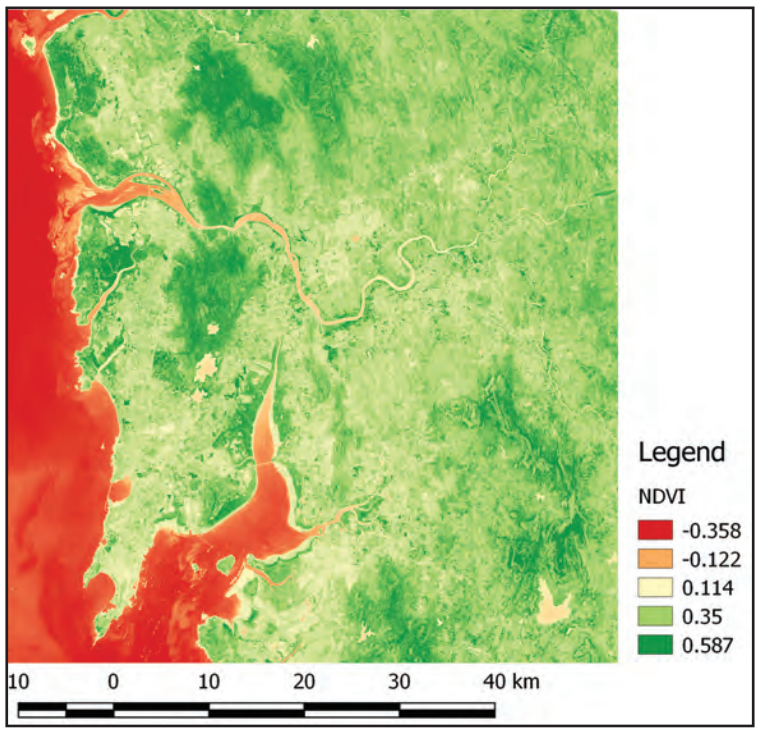


Fig. 5: NDVI Image Derived from NIR (band 5) and Red (Band 4)



surface and is scattered when reflected. The difference between the reflectance of NIR and red spectrum is the basis on which most vegetation indices are based. NDVI is the most widely used vegetation index. It is the ratio of the difference and sum of the near-infrared (NIR) and red bands. Essentially:

NDVI = (NIR – RED) / (NIR + RED)

To arrive at this, it is essential to add the relevant images to separate layers in the graphics editor and perform the operations as per the formula. The colorized result is shown in Fig. 5.

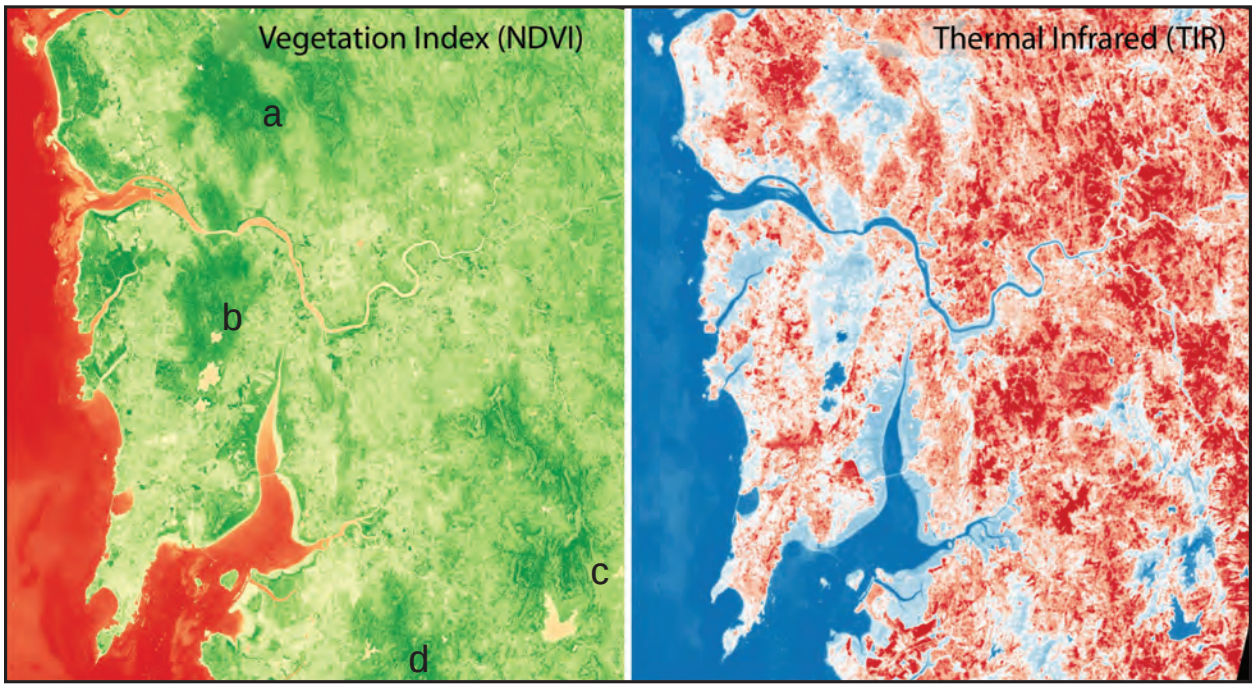
In this map, the forested areas of Tungareshwar Sanctuary, Sanjay Gandhi National Park, Matheran and Karnala Wildlife sanctuary are prominently seen as dark green patches. The built-up developments of Mumbai city and suburbs show clearly as contiguous patches with barely any vegetation.

3. COMPARISONS AND OBSERVATIONS

Looking at the two maps alongside each other, some direct correlation especially for the cooler areas became immediately visible (Fig. 6):

- Tungareshwar Wildlife Sanctuary;
- Sanjay Gandhi National Park;
- Matheran; and

Fig. 6: Comparison of NDVI and TIR Maps for Mumbai Metropolitan Region



- Karnala Wildlife Sanctuary.

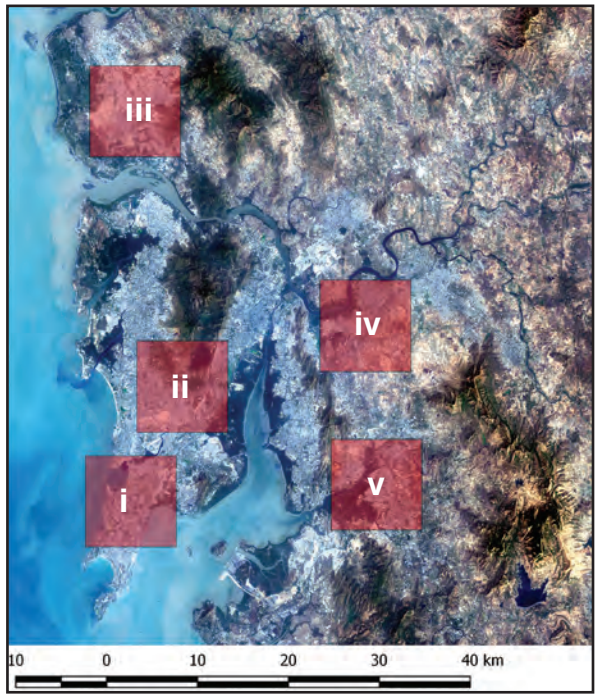
Detailed analysis was done by selecting five locations of 10 km x 10 km each shown in Fig. 7.

3.1 Island City

First the island city was analyzed in detail. This is the oldest inhabited part of the city and unique in a number of ways.

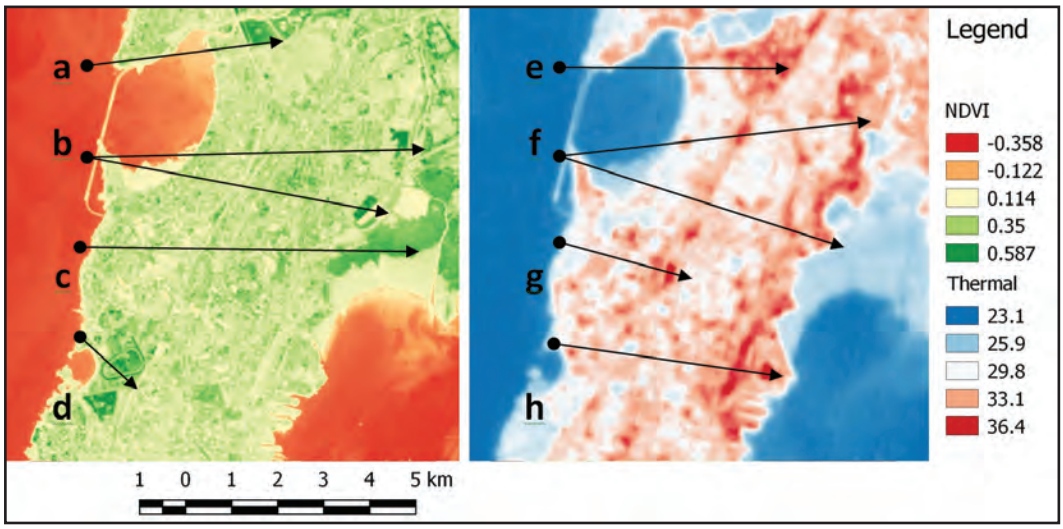
It was noticed that, despite the main part of the island city being almost uniformly built-up, and there being very few areas with high NDVI. There were also relatively few spots that showed a distinct hot or cold character as listed below.

Fig. 7: Locations Clockwise from bottom left; (i) Island City – South Mumbai; (ii) Mumbai Airport to Goregaon and informal settlements stretching from Vikhroli to Mulund; (iii) Western Suburbs – Vasai and Nalasopara; (iv) Central Suburbs – Diva to Kalyan; (v) Navi Mumbai – Kharghar-Kalamboli.



- **Mangroves of Mithi River along with Maharashtra Nature Park:** It was seen that some patches within the mangrove area are either denuded or slightly elevated leading to less dense green cover;
- **Marshy land in the Wadala-Siwri:** These areas have tree cover along the periphery. But it is not significant;
- **Mangroves in the Siwri-Chembur Zone:** These are fairly widespread and protected by virtue of having limited access;
- **Race Course and Willingdon Club:** Here, although NDVI was generally high, there were areas of the racecourse that were completely devoid of even grass and these actually showed up as a yellow spot on the thermal map. Willingdon club, however, has many mature trees, and was found to be uniformly cool;
- **Dharavi:** It is known as Asia's largest informal settlement. It is distinctly less hot than most of the others which we shall look at in the next section. Being an older settlement, there is a possibility that a greater number of dwellers have improved on their corrugated galvanized sheet roofing with better materials as and when they could afford to do so;
- **Settlements of Sion-Wadala:** These are also fairly old and, like Dharavi possibly have buildings built with better materials to combat extreme heat;

Fig. 8: NDVI and TIR Images for the Island City



- **Railway Workshop and yard at Parel:** This area is a large treeless patch of land with sheds that are covered by metal and asbestos roofing. It was distinctly hotter than most other parts of the island city; and
- **Hay Bunder and the BPT Sheds at Sewri:** This area is adjacent to the ship-breaking yards of Darukhana and was the hottest in the island city, despite being on the shore. It is also surrounded on the landward side by a number of sheds and godowns.

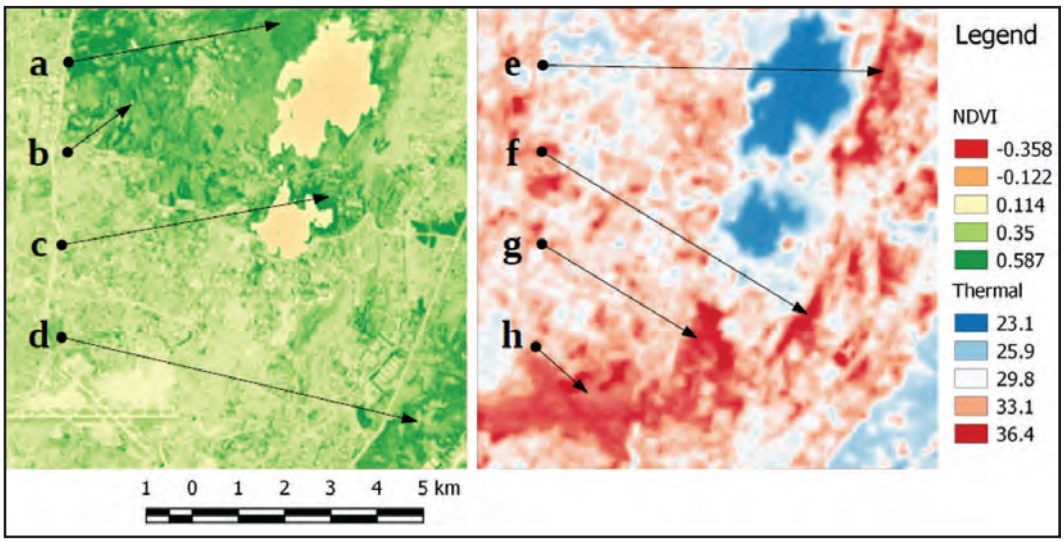
Within the island city, almost all the hot spots were in commercial areas or informal settlements and most residential areas in the island city were relatively cooler with almost no exceptions. It was noted that since the island city is almost completely surrounded by sea this is possibly one of the reasons it does not get as hot as it might otherwise have done.

3.2 Mumbai Airport to Goregaon and Vikhroli to Mulund

In this part of the city it was seen, again, that NDVI is inversely correlated to LST:

- **Sanjay Gandhi National Park:** It is, in theory, a 103 sq km. Forest but has been encroached from almost all sides. However, it plays a vital role as a green lung for Mumbai City;
- **Goregaon:** It is mostly Aarey Milk Colony. This is currently controversial as the Metro Corporation wants to build a shed in this locality and is being opposed by environmental activists. It displays fairly good NDVI indicating that the green cover is better than average;
- **IIT Bombay:** It is located on the edge of Powai lake, this is a well-wooded campus with many large and mature trees;

Fig. 9: NDVI and TIR Images for the Area Covering Mumbai Airport



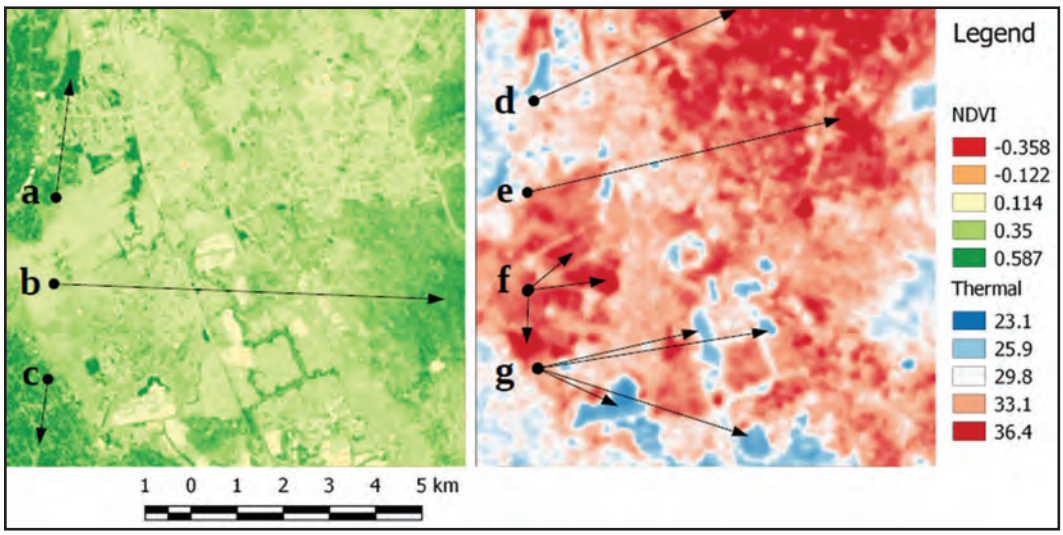
- **Vikhroli Mangroves:** As can be expected, this mangrove area shows good vegetation. Most of this belongs to Godrej group of companies, making it the largest patches of mangrove land belonging to a private party;
- **Informal settlements of Bhandup and Mulund:** Compared to Dharavi and Sion-Wadala, they display slightly higher temperatures by about 2°C despite being very close to, or even encroaching into, Sanjay Gandhi National Park;
- **Informal settlements of Vikhroli:** Like those of Bhandup and Mulund, these settlements display about 2°C higher temperatures than Dharavi and Sion-Wadala;
- **Informal settlements of Saki Naka, Chandivali and Ghatkopar:** These, too, exhibited temperatures at the upper end of the scale; and
- **Mumbai Airport:** Both the runways were seen very clearly on the thermal map while the new building known as T2, as well as the cargo terminal, showed extreme heat. There is some amount of grass cover alongside the runway but it does not seem sufficient to have any mitigating effect.

3.3 Vasai and Nala Sopara

The observation on Vasai and Nala Sopara are given below:

- **Green zone, Umralae, Nala Sopara (West):** This is an unbuilt area with agricultural fields. NDVI ranged from 0.6 - 0.75 and temperature averages 26.5°C;
- **Periphery of Tungareshwar Wildlife Sanctuary:** This forest has recently been declared a sanctuary and has areas within it that have an NDVI as high as 0.75 and temperatures show a correct inverse relationship, going as low as 24.9°C;

Fig. 10: NDVI and TIR Images for Vasai and Nala Sopara



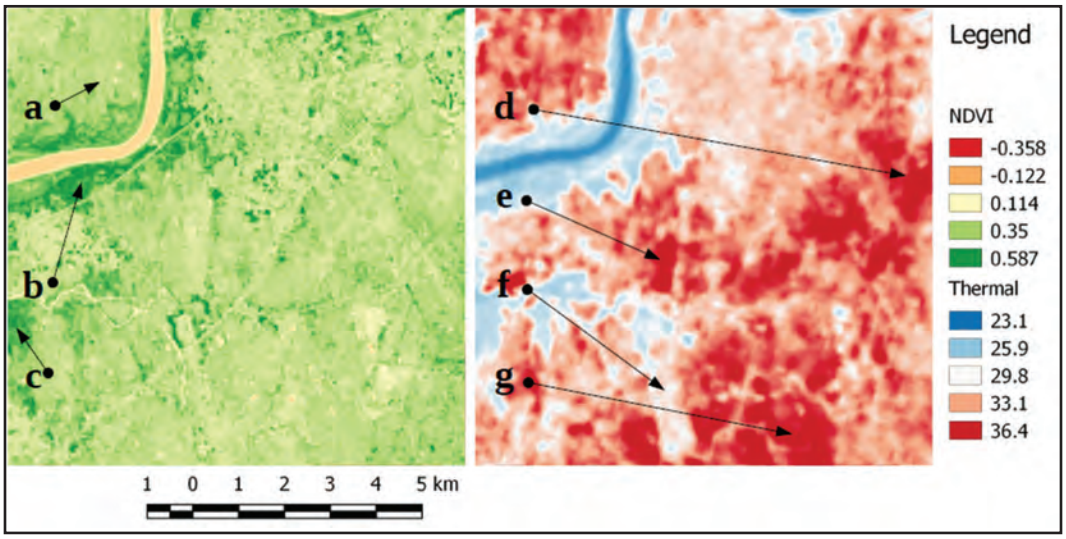
- **Vasai (West):** This is a fairly green, residential zone in Vasai with low-rise bungalows and many trees, mostly coconut. NDVI is usually between 0.5 - 0.6 where there is no building footprint. Temperatures are in the range of 28-30°C. This 3 - 5°C warmer than Tungareshwar;
- **Bujadpada Hill:** This 250 m high hill is severely denuded. The lack of protected status has left its NDVI averaging 0.25 with only some parts near the summit displaying around 0.5. Temperatures range from 31°C to as high as 38°C;
- **Industrial Estates, Nalasopara (East):** There are large areas of only industrial and storage buildings. There is no planning and little or no space between buildings. NDVI was 0.15 – 0.2 and temperatures ranged from 23 – 37.5°C;
- **NSP Salt Plant:** This is possibly a disused salt plant as there is little or no direct access to sea water. As the soil must now be saline, there is little or no vegetation there. NDVI is around 0.2 and temperatures range from 35 – 37°C; and
- **Salt Pans:** Compared to the disused salt pans above, these are actively being used. Even though the NDVI is the same at around 0.2 but the temperatures range from 25 – 27°C which is a full 10°C cooler. Only the sections where the salt was stacked were slightly higher at around 28.5°C.

3.4 Central Suburbs – Diva to Kalyan

This was by far the area with the greatest density of hotspots but not all of them were, necessarily, built-up.

- **Bharodi Gaon, Diva:** Just north of the Ulhas river, this is a traditional village with clustered huts and surrounding fields. NDVI ranges from 0.25 - 0.32 and temperature ranges from 32 – 34°C;

Fig. 11: NDVI and TIR Images for Dombivali – Diva Area

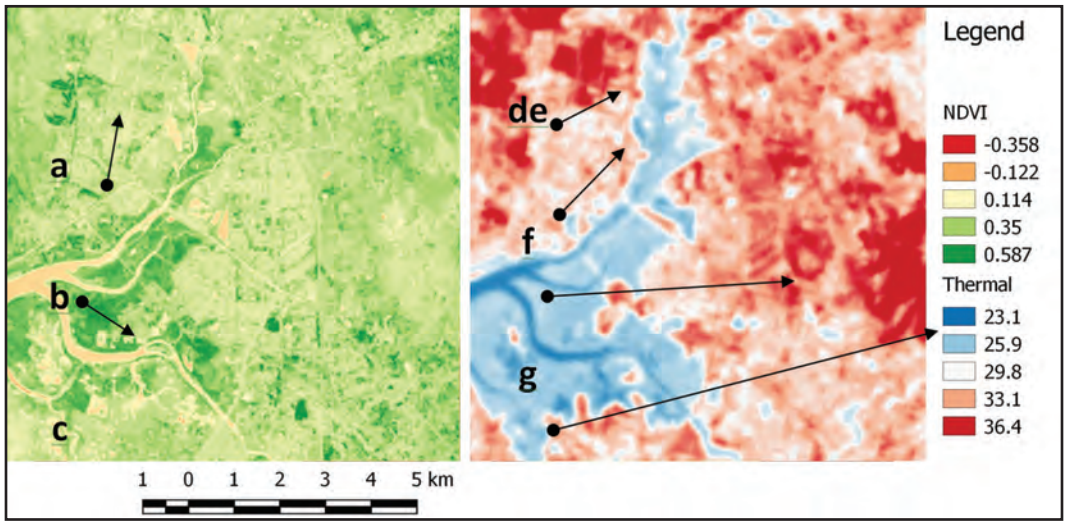


- **Flood Plains of Ulhas River:** Whereas the river itself is at 24°C, the green zone along the banks is 26 – 28°C. NDVI on the other hand ranges from 0.35 – 0.6;
- **Desai Khadi:** This zone has meandering tributaries of the Ulhas and patches of dense trees are seen. The only anthropomorphic activity seems to be limited agriculture leading to the assumption that this is also part of the Ulhas river's flood plain. NDVI ranges from a 0.45 – 0.7. Temperatures range from 26 – 27.5°C;
- Diva (East): This zone is farther from the station than most of the housing clusters. It is mostly open land with some sheds and factories. NDVI ranges from 0.2–0.3 and temperatures range from 36.5–38°C;
- **Open Land on Diva-Manpada Road:** This open land seems to have lost its topsoil to brick-makers and is completely denuded of trees. It has a recently built factory shed in the centre. NDVI averages 0.21 and temperature ranges from 36 – 38°C; and
- **Pallava City:** This is a large development by a private developer. NDVI is 0.5 - 0.65 on the golf course where temperatures are around 28 - 29°C. The remainder is largely built-up and, NDVI is 0.2 - 0.3 and temperature ranges from 29 - 31°C.

3.5 Navi Mumbai – Kharghar – Kalamboli

- **Kharghar Golf Course:** This course was inaugurated in 2012. Therefore any large trees that may or may not have been planted would not yet have reached maturity. Currently, the NDVI ranges from 0.45 - 0.65. Despite that, temperatures range from 31 - 33°C;
- **Mangroves near Mansarovar:** Falling within the Panvel-Taloje creek area, this area is somewhat denuded along the edges. The south edge of this mangrove

Fig. 12: NDVI and TIR images for Kharghar – Kalamboli area



forest touches the proposed Navi Mumbai International Airport (NMIA). NDVI ranges from 0.35 - 0.56 and temperatures range from 25 - 27.5°C;

- **Waghivali Island:** Most of this island has been notified[2] to be taken over by the NMIA although the coastal parts are proposed to be converted into a mangrove park although it is earmarked for future conversion to a Special Economic Zone (SEZ)[3]. Currently, the NDVI ranges from 0.15 in the settlement to 0.5 in the mangrove areas. Temperatures range from 24 - 27°C except for the village itself where the temperature is 32.5°C;
- **Kharghar Sectors 24, 26, 29, 31:** This part of Kharghar has not yet been built-up. However, NDVI is low at 0.2 and temperatures range from 36.5 - 37°C;
- **Kharghar Sectors 19, 20, 21:** These sectors are completely developed and adjoin the ones in (d) above. Here, NDVI is a similar 0.2 but temperatures range from 29.5 - 32.5°C;
- **Kalamboli:** This is an industrial area with a large number of factories / sheds interspersed with small villages. NDVI is about 0.18 and temperatures 35 - 36°C; and
- **Kewale Hill:** About 500 m high, this hill to the east of Kamothe is severely denuded. There is poor growth of any kind of vegetation other than grass or monsoon flora. The rock, often exposed, is almost black, made more because pastoralists frequently burn the dried grass in an effort to force new growth for their goats. The heat it radiates was found to be far greater than that of Taloja MIDC which lies to its immediate Northwest. NDVI is 0.15 - 0.25 and temperatures range from 36 - 39°C.

2 *http://www.cidcoindia.com:1009/site/LandNotification.aspx?Type=PLOT&Village=Waghivali*

3 *http://www.cidcoindia.com:1009/homeimg/main_plan.jpg*

4. ANALYSIS

There were a number of things realized from the study:

- The inverse correlation between NDVI and TIR is mostly accurate but there are some notable exceptions.
  - Water is the most significant and most natural exception to this correlation. Temperature of water was always significantly lower than even the densest forested land, and
  - Whereas dense tree cover almost always resulted in lower temperatures, relative lack of tree cover did not always lead to significantly higher temperatures. In such cases, surface temperature depended more on the albedo of the surface with concrete of cities being much cooler than rock and soil of exposed hillsides and open land;
- Areas that were unplanned and densely packed were much more likely to exhibit signs of heat buildup;
- Concrete roofs were found to be significantly cooler than metal roofs of structures like godowns, sheds, workshops, factories, and informal settlements;
- Concrete roadways were not seen as significantly hot but the two runways of the airport. This could be attributed to the extreme thickness of the concrete on runways which is often about 1 m thick and so stores a much larger amount of heat; and
- Salt pans sometimes showed as hotter. But sometimes cooler than surroundings. This is probably dependent on the current status of that particular pan. This was starkly visible in Vasai-Nalasopara where disused salt pans showed extreme heat whereas existing ones were significantly cooler than their surroundings.

5. CONCLUSIONS

While it can be said that the inverse correlation between NDVI and TIR generally stands, it would be preferable to verify the data using physical measurements and direct observations instead of relying entirely on remote sensing.

Further, the thermal bands on Landsat 8 have a much lower resolution (100 m) than the remaining ones (15 m for panchromatic and 30 m for all others), so accuracy is not too good.

It has been seen that, among settlements, metal roofs are the biggest contributors to heat, while concrete roofs are much less so. It must be remembered, however, that metal roofs will also cool of rapidly at night while concrete roofs will retain heat and release is more slow, thereby preventing the area from cooling off completely.

Given the effect that NDVI has on surface temperatures, there is a good case to be made for green roofs. Even if some parts of the roofs can be shaded with vegetation, the overall effect should be substantial especially as the concrete roofs will absorb less heat through the day and therefore have less to release at night.

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Institute of Town Planners, India Journal 18 x 3, July - September 2021 ISSN:L0537-9679

Industrial Development after Independence: Case Study of Durg - Bhilai, Chhattisgarh

Meenakshi Pawar

Abstract

The steel Industry was given top priority in the first five-year plan besides agriculture because that was the need for the hour. The Bhilai steel plant came into being during the second plan in 1955 and was directly under the control of the Ministry of Iron and Steel plants. Under a unified company management Durgapur and Bhilai were transferred to Hindustan Steel Limited (HSL) in April 1957 and Bhilai steel plant was set up. However, Steel Authority of India Limited (SAIL) was formed on 24th January 1973 and the final merger took place in 1978.

After the formation of SAIL steel plants at Bhilai, Rourkela and Bokaro were made separate entities with integrated steel plants. Bhilai city was completely dependent for its economic sustenance on Bhillai Steel Plant established in 1959, but with time it is undergoing the transition, wherein it is witnessing the shift in economy from secondary to tertiary / service sector. Undoubtedly Bhillai Steel Plant and the related ancillary industries still play a significant role in the city economy. But the other sectors are also witnessing a fast growth trend in the scenario of changing demographic profile.

1. INTRODUCTION

Bhilai town developed as an industrial town in 1955 after commissioning of Bhilai steel plant. From a conglomeration of villages, it changed into a planned area in 1959 when the Bhilai planned area came into existence. Prior to 1955, Bhilai was basically a rural village with population of 350 persons. Central government acquired 96 villages to locate the steel plant and related mining activities.

In 1965 ACC plant was set up due to available limestone at Nandini and waste slag from BSP. Some retail commercial activities and later some wholesale activities started in Khursipur and Supela. In 1966 master plan prepared by IIT Kharagpur recognized Khursipur as CBD. In 1973 under MPTCP act a special development board was set up for Bhilai Durg region. The village pockets adjoining Bhilai Nagar absorbed immigrants, industrial and other workers of rapidly growing ancillary industries.

SADA, a development authority worked for planning of land in Bhilai. In 1998 SADA was dissolved and 4 administrative regions were formed - Bhilai Municipal

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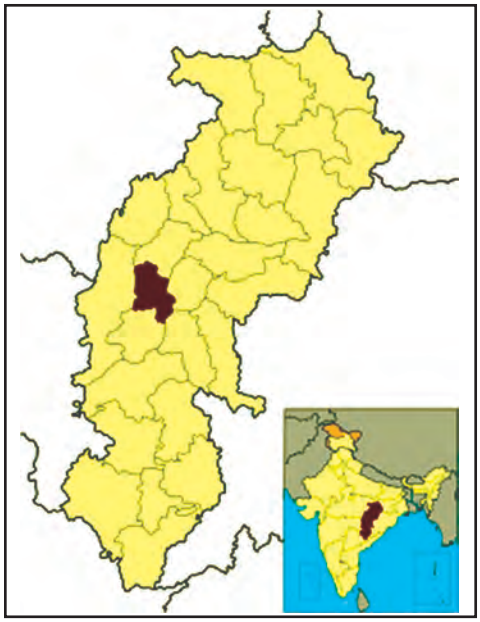
Fig. 1: Bhilai Plant

Source: India TV News Desk, New Delhi [Published on: June 13, 2018 17:22 IST]

Corporation, Bhilai Charoda, Kumhari and Jamul. Hathkhoj industrial estate as proposed in the development plan is established with light and heavy industries.

2. LOCATION AND REGIONAL SETTING

Fig. 2: Location of Study Area



Source: Maps of India

Durg district is almost centrally located in Chhattisgarh State. It extends from 20 23" E latitude to 22 23" E longitudes and 80 46" n longitudes to 81 58" N longitudes respectively. Total area of the district is 8537 sq km. Total population of the district is 28, 05,576 according to the 2001 census. The district is 210 km in its north to south extent whereas is 95 km in its east west extent. The district shares its boundaries with Bilaspur in the north, Raipur in the east, Dhamtari in the south-east, Kawardha in the north-west, Rajnandgaon in the south-west and Kanker in the south respectively.

3. ADMINISTRATIVE SETUP

Durg district is divided into 11 *tehsils* and 12 sub-divisions. Ten *tehsils* have one sub division each and 2 sub-divisions in Balod.

The district gets its name from its District headquarters. Durg was a part of Koshala kingdom. It was one of the fort

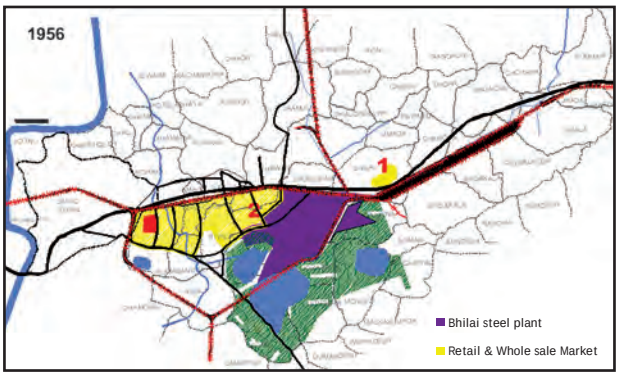
districts captured by the kulcharis. The total name of the district was Shiv Durg which means fort of Shiv or city located on Shivnath. History reveals that Durg was established in the 10th century by Jag pal who was rewarded 700 villages. During the colonial rule, Durg had 3 *tehsils* namely Durg, Balod and Bemitara. They were a part of Raipur District and on 1st January 1901 it was constituted as a district. On 1st January 1948 the kingdoms of Kheragadh, Rajnandgaon, Kawardha and Chuikhadan were brought under Durg district.

The urban sprawl has been started primarily by the establishment of B.S.P and the residential colonies for its workers. The industrial estate was developed in phases depending upon the availability of funds for establishing developed plots for various types of industries.

Prior 1955 Bhilai village, with population of 350 persons and 96 other villages were acquired by the Central Government to locate the steel plant and related mining activities. The chronology of development that followed is as under:

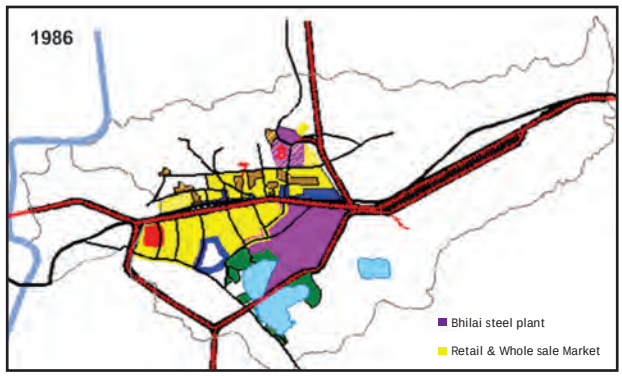
- 1956 - Bhilai steel plant established and the township was planned;
- 1956 - Five large labour camps at Khursipar, Supela and Bhilai were setup;
- 1959 - Later on some retail and wholesale markets started in Khursipar and Supela 1962 - TCPO proposed a Development Plan that was not implemented;
- 1965 - ACC plant setup in Jamul due to available limestone (Nandini) and waste slag from BSP;
- 1966 - Master plan prepared by IIT Kharagpur in which Khursipar was recognized as CBD;
- 1973 – Under MPTCP act a special Development Board setup for Durg – Bhilai region saw growth of ancillary industries;
- 1986 - Development Plan proposed by TCPO for 2011
- 2001 - SADA was dissolved and four municipalities were formed, namely Bhilai Nagar, Charoda, Jamul and Kumhari.

Fig. 3: Land Use Map, 1956



Source: Author

Fig. 4: Land Use Map, 1986



Source: Author

4. PHYSICAL SETTING

4.1 Physiography

The district occupies the south-western part of the upper Shivnath - Mahanadi valley and the bordering hills in the south and southwest. Physiographical the district can be divided into 2 divisions namely the Chhattisgarh plain and the southern plateau. The Chhattisgarh plain occupies the largest area in the district. The areas in the south have an altitude of more than 300 m above mean sea level.

4.2 Slope

The general slope of the district is towards the north and north-east and is locally in some places towards east. The northern part is less than 200 m in relief.

The major rivers of the region are Kharkhara, Tandula, Kharun and Shivnath rivers which flow from the hills in the south towards the plains in the east. In the south, rain water drains into river Indravati. Shivnath and Kharun Rivers contribute most to the drainage system of the district. Shivnath River flows near the western border of the district whereas Kharun forms the eastern border of the district and ultimately joins Shivnath River. River Shivnath itself forms the part of the larger Mahanadi basin.

4.3 Geology

In the geological section limestone is overlaid by shale. The thickness is more than 50 m in the area. Hydro-geologically the ground water occurs in unconfined condition in the weathered mantle and in the semi-confined conditions in joints, fractures, etc.

4.4 Forest

The district has forest cover only in the southern part in the hills. Major species found are Sal, Tendu, mango, Sirsa, Bois etc. Major forest produce are timber and firewood.

4.5 Climate

The Climate is of humid. The district experiences hot summers and warm winters. The mean minimum temperature in December is 16 degree Celsius and the mean maximum temperature from April to June is 47 degree Celsius. The average annual rainfall is 1277 mm and the district comprises of laterite soils.

4.6 Soil

Soil in Durg district comprises of black soil and sandy loam soils. Few patches of Durg district comprises of laterite soils. The black soil in the area facilitates good paddy cultivation.

4.7 General Cropping Pattern and Land Use

Most part of the district is covered by arable irrigated land, while some portions of the district fall under arable un-irrigated type of land use. Main crop grown in the

district is paddy followed by pulses. Rice is mainly grown in the un-irrigated parts of the district as these areas get high rainfall. The district is known as the "rice bowl" in the State. Around 200 variety of paddy are grown, over an area of 490 hectares.

5. FUNCTIONAL LINKAGES

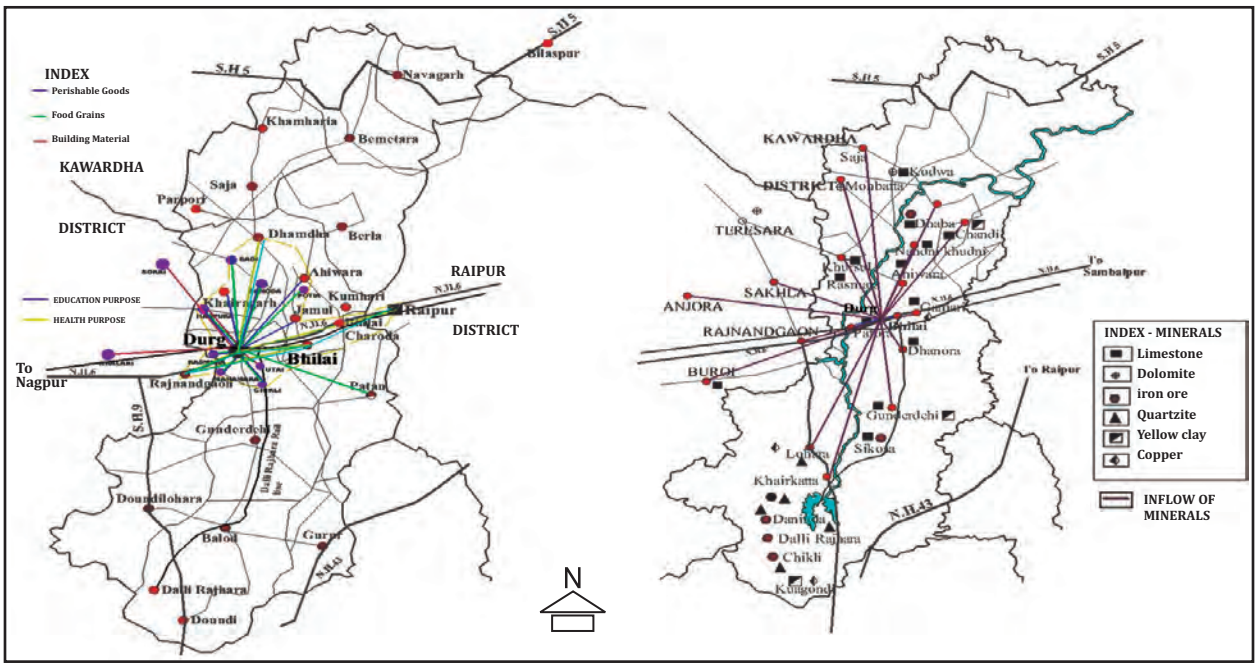
5.1 Rail Network

The District is well connected by railways to different parts of the country as well as the state. The railway link is provided by south-eastern railway line which runs between Bombay and Kolkata. There is also a separate branch line from Durg to Dallirajhara for transportation of iron-ore.

5.2 Road Network

National Highway 6 also known as Great Eastern Road connects Mumbai, Raipur to Kolkata and runs through the district. Durg town lies at a distance of 37

Fig. 4: Influence Zone of Durg - Bhilai



km from Raipur, 150 km from Bilaspur, 27 km from Rajnandgoan, 283 km from korba, 327 km from Jagdalpur. The State Highway No. 9 also passes through the district.

6. INFLUENCE ZONE OF THE REGION

The influence zone of Durg-Bhilai spreads upto Dhamdha, Patan, Ahiwara, Gunderdehi, Rajnandgoan, Chikli and Khalari, from where the perishable goods and other commodities come to Durg. The raw materials for industries to Durg and

Bhilai, comes from far flung areas like Saja, Nandini, Dhaba, Dallirajhara, Lohara, Kharkatta. Thus, we can say that the influence of the district is immense, although the development of the city is taking place in the east–west axis towards Raipur.

6.1 Commodity Flow

Durg is rich in mineral deposits like iron–ore, limestone, dolomite, quartzite, runner sand, white clay and soap stone. Other minor minerals are clay, sand, stone, flag stone and murum. Many industries are based on basic mines such as steel and cement products which are running in the district. This gives a substantial part of mine revenue to the state government. Durg has got its importance after the establishment of Bhilai Steel Plant. It has mostly light engineering and other household industries that have developed as ancillary industries. The district is also known for textiles like Tasar and Rosa silk.

Durg indicates that the district is comparable with other districts of Chhattisgarh as well as other neighboring States. With regard to the demographic parameters, it can be said that Durg fairs a little higher with the other districts in terms of sex ratio, growth-rate, working population, literacy rate and rural and urban population. When compared with the *tehsils* of Durg district, it has been observed that Durg has similar characteristics like that of its other *tehsils* within the district. However, by observing the influence zone of Durg that affects and is affected by Durg, it can be concluded that the district is almost growing at a rapid pace, and that in near future can overshadow the adjacent order centers in terms of population and services.

7. BHILAI ECONOMY

Bhilai city was completely dependent for its economic sustenance on Bhillai Steel Plant established in 1959, but with time it is undergoing the transition, wherein it is witnessing the shift in economy from secondary to tertiary / service sector. Undoubtedly Bhillai Steel Plant and the related ancillary industries still play a significant role in the city economy. But the other sectors are also witnessing a fast growth trend in the scenario of changing demographic profile.

7.1 Economic Resources

Bhilai city is in close vicinity to mineral resources which feed the industries. Various types of mineral resources are limestone (Nandini Mines, Pitharia), Iron-Ore (Merasara, Dalli Rajhara, Semaria), dolomite (Kodwa Mohbhatta) and quartzite (Danitola). Along with sufficient power supply, the location of the city is very conducive for the sustenance and growth of industries. Large units of BSP and ACC cement plant are functioning in the city which has encouraged the setting up of ancillaries.

The main objective of the new industrial policy is to add umpteen values to State's abundant natural resources within the state itself, and create maximum employment opportunities by setting up industries in all its districts across the state. In order to attract industrial investment in the state, the policy attempts at providing necessary infrastructure for investment, reducing the cost of production for the investor and ensuring an investor friendly administration. Towards this end, special importance has been given to private sector participation.

7.2 Industry

There are four main industrial pockets in Bhilai namely Bhilai Steel Plant, Light Industrial Area, Bhilai Industrial Area and Hathkhoj Industrial Area spread over Bhilai Nagar, Jamul, Charoda and some in Kumhari.

Area occupied by industries is	-	222.43 ha
Bhilai steel plant	-	78.00 ha
Jamul	-	50.00 ha
Charoda	-	81.80 ha
Vacant land (Charoda)	-	19.50 ha

8. DETAILS OF INDUSTRIAL AREAS IN BHILAI

Industries are classified as small, medium - large and mega projects on the basis of investments and according to the industrial policy as follows:

- **Medium-large industries** - total capital investment up to Rs. 100 crore except small scale industries.
- **Mega Projects** Large Scale Industries - with capital investment between Rs. 100 crore and Rs 1000 crore.
- **Very large scale Industries** - with investments over Rs. 1000 crore.

Table 1: Industrial Areas in Bhilai

Industrial area	Area (in acres)	Allocatable land	Allotted land	No. of units
Industrial Area, Bhilai	221.51	179.94	133.94**	208
Light Industrial Area, Bhilai	716.14	468.04	379.16	473
Hathkhoj, Heavy *industrial area	1360.50	505.45	229.61	196

** 46 acres land handed over to CSIDC

* 300 acres land under CSIDC

Table 2: Large and Medium Scale Industries - Investment, Product and Employment

No.	Name of the Industry	Investment	Product	Employment
1	Bhilai steel plant	60057 crore	Iron and steel production	42561
2	Refractory plant	530	Re-factories	1584

No.	Name of the Industry	Investment	Product	Employment
3	M/s associated cement company limited, Jamul	112	Cement	2000
4	M/s simplex casting ltd	153	Iron industrial casting	600
5	M/s simplex engineering and foundry works	200	Steel and equipment iron and Chemical Plant	308
6	M/s engineering and casting units	74	Ferrous and nonferrous casting	417
7	M/s BK engineering corporation	3.3	Grade iron casting, structural fabrication, equipment and spare parts and steel plant.	700
8	M/s engineering and casting units	6.7	Technological equipment engineering production structural fabrication.	50
9	M/s engineering corporation limited	70	CGI casting fabrication	593
10	M/s Raipur milk cooperative association	32	Milk production	206
11	M/s caston industries ltd	25	Sodium, caromic acid sodium sulphate	95
12	M/s bharat industrial works	10	Microwave tower	245
13	M/s ferroscrap nigam equipment	643	Iron and scrap work	95
14	M/s ABA steel pvt ltd	406	Hb wire binding wires	70
15	M/s bhilai wires ltd	1	All types odf steel wirse ,iron wirse and strip, pc wires, standing wires	35
16	M/s neros ispat pvt ltd	3.1	Sponge iron	90
17	M/s top worth steel pvt ltd	35	Sponge iron	155

9. EMPLOYMENT DENSITY

Registered workers in BSP - 40,000

Employment density in BSP - 179.83 pph

Registered workers in ancillary industries - 37,968

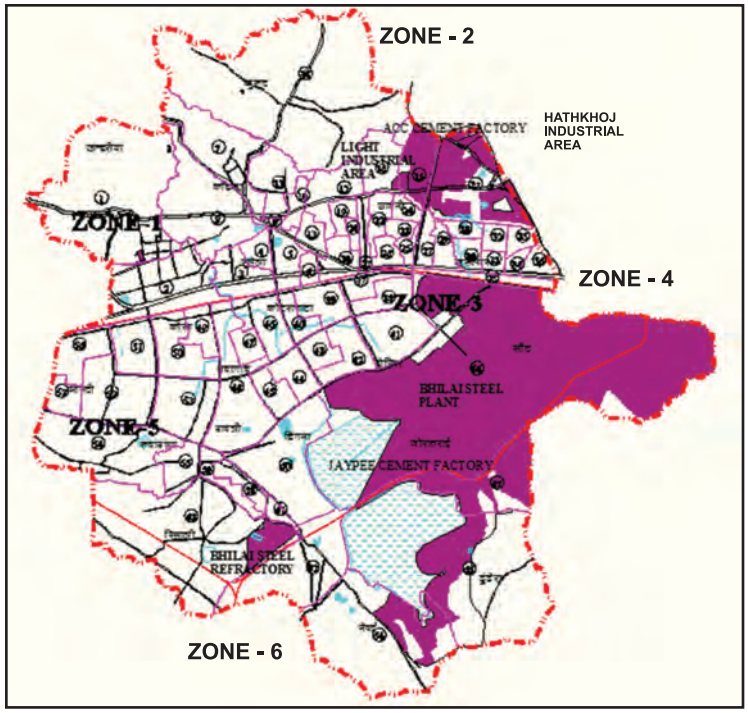
Employment density in ancillary industries - 180.97 pph

On an average Small-Scale Industry employ 6-25 persons, Medium Scale Industries employ 50-200 persons, and Large-Scale Units employ more than 400 persons. Annual turnover of small-scale industries is 1 crore approximately and annual turnover of medium scale industries is approximately 5 crore. In the changing economic profile of the city the new industries that are coming up are diverting from engineering and mechanical based industries to finish and consumer products.

Before 2000, 12 % industries were mechanical based, and 34 % were engineering based. Whereas after 2000, out of new industries that were set up 60 % are steel wires and

10% are fabrication based. The district industrial policy also encourages the consumer products and finished product-based industries.

Fig. 5: Location of Major Industries in Bhilai City.



According to industrial policy the special thrust industries are:

- Processing of medicinal, aromatic and dye plants;
- Automobiles, auto components, spares and cyclic industries;
- Manufacturing of plant, machinery and engineering parts;
- Food processing industries;
- Milk chilling plant and branded dairy products;
- Pharmaceuticals industries;
- White goods and electronics consumer products;
- Power generation from non-convention sources; and
- Information technology, biotechnology and advanced technology industry.

10. TRADE AND COMMERCE

Shopping and commercial areas reflect the economy and image of the city. At present the city does not have planned commercial areas except in the Bhilai township. The unplanned areas have Supela Chowk, Powerhouse Chowk, Hathkhoj and Kumhari as the main wholesale and retail markets. These markets generally have unorganized and haphazard growth. As the town grew, the demand for goods grew and the old areas were available at low rates leading to formation of market areas on the fringe of the township. With growth of industrial areas in the north east of Bhilai township, service shops and restaurants and *dhabas* grew along Nandini road. Meanwhile, Kumhari also emerged as a market fulfilling the needs of the people in that area.

11. INFORMAL SECTOR

Large sections of unemployed and under employed population in the rural areas flock to nearby big cities in search of employment. Lack of employment in formal sector and sufficient informal markets leads the enterprising ones to set small enterprises and petty trading activities to supplement their income. Thus, informal sector generates income and employment but exhausts resources while creating congestion problems that need to be regulated.

The informal sector has come up because of unemployment, increase in population, self-earning tendencies and low investment. But this sector faces problems and creates problems because of poor physical infrastructure, poor access to finances, and no policies for this sector. There is an urgent need to regulate it, and incorporate informal sector in policies, and inter-weave it with formal sector. Presently, 14 types of activities are predominant in the city namely - flowers, business, spices and jaggery, vegetables, pottery, bangles, tea stall, clothes, pan shop, toy shop, lemon-water, meat shop, fruit, food, leather shoes repair.

12. CONCLUSIONS

The city remained a part of the British Empire until India gained independence. Post-Independence, the city shot into prominence following the establishment of the Bhilai Steel Plant. Bhilai Steel Plant is the main producer of wide steel plates and other steel products and is the ten times winner of the Prime minister's trophy for best integrated steel plant in the country.

The plant is the sole supplier of the country's longest rail tracks, which measure 260 metres (850 ft). The plant also produces products such as wire rods and merchant products. Bhilai Steel Plant has been the flagship integrated steel plant unit of the Public Sector Steel Company, the Steel Authority of India Limited and is its largest and most profitable production facility. In the 2004 - 05 fiscal year, it was the Authority's most profitable plant. It is the flagship plant of SAIL, contributing the largest percentage of profit. Bhilai have many other industries like cement, power, fabrication and others.

On 14th June 2018, Prime Minister Narender Modi dedicated Steel Authority of India Limited (SAIL), recently modernized Bhilai Steel Plant to the nation, marking the completion of the state-owned steel major's costing Rs. 70,000 crore for modernization and expansion program (MODEX) and to raise its total steel- making capacity across five integrated plants to 21 million tons per annum.

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Institute of Town Planners, India Journal 18 x 3, July - September 2021 ISSN:L0537-9679

Geo Spatial Tools for Land Pooling

A.K. Jain

Abstract

The Master Plan of Delhi-2021 (MPD-2021) has envisaged the land pooling policy. This involves radical changes in land transactions and administration by land rights mapping, digital ledgers, block chain land administration domain model, new partnerships and innovative planning and management systems.

1. INTRODUCTION

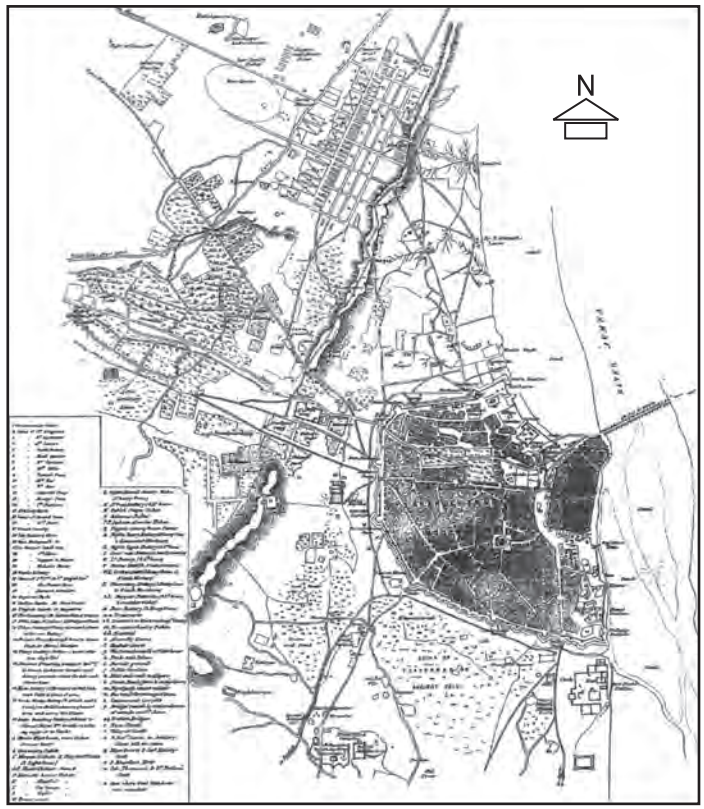
Land is the basis of planned urban development, which often entails large scale appropriation of rural lands. The agitations and frequent court cases highlight the widespread discontentment against coercive land acquisition.

The Government of India in 2013 replaced the Land Acquisition Act, 1894 by Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act. As a result, Private Sector Participation (PSP) and Public-Private Partnerships (PPP) in land assembly and development are being increasingly adopted.

2. COMPULSORY LAND ACQUISITION

The Capital of India was shifted from Kolkata to Delhi in 1911. The Land Acquisition Act, 1894 was invoked for compulsory acquisition of 43,187 acres (including 9371 acres for Imperial Delhi). The Report of H.C. Beadon, the Land Acquisition Collector, became the template for land acquisition.

Fig. 1: Delhi in 1857



Source: Brown J.L., (1861) The Punjab and Delhi in 1857

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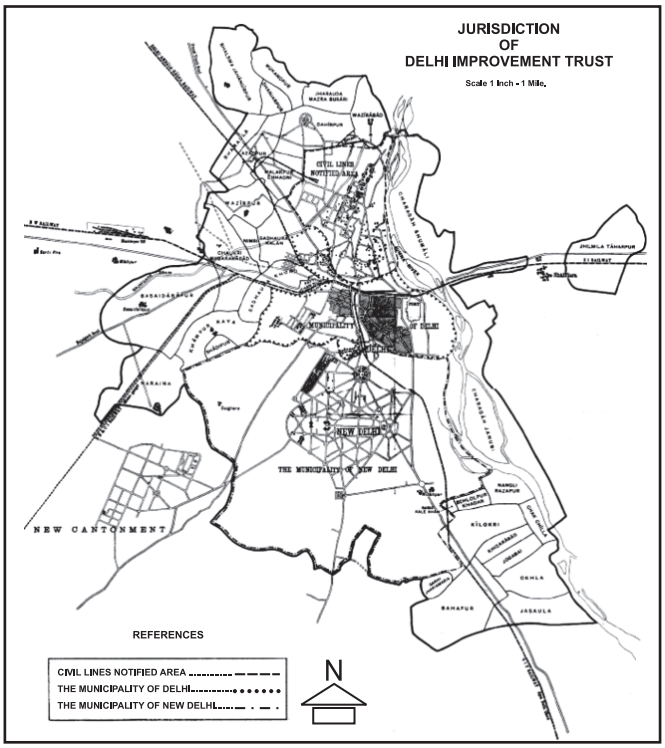
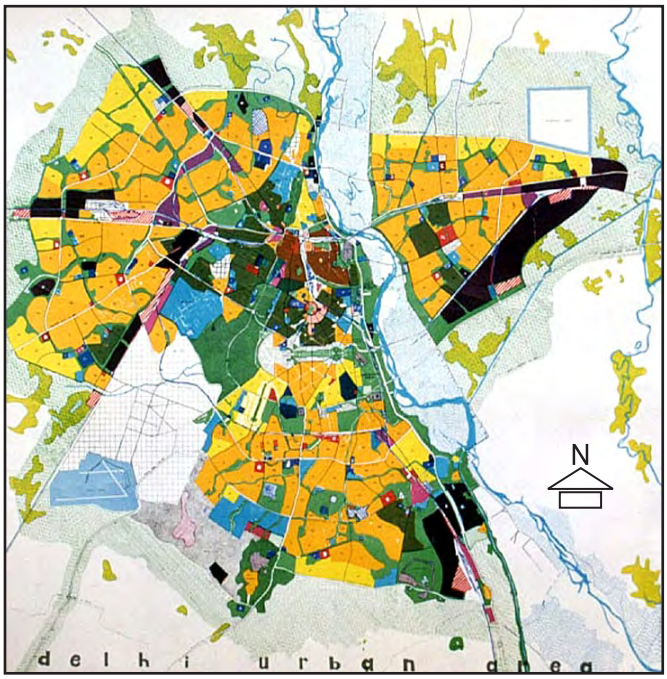
Fig. 2: Delhi Urban Area (1940)



Source: DIT Report, 1940

Fig. 3: Delhi-1962



Source: DDA

Five million refugees came to India after partition in 1947, for which the Ministry of Refugees, (later Ministry of Rehabilitation) took up the housing schemes (36 rehabilitation colonies), markets and industrial areas in Delhi. Licensing and renting system were adopted which made these accessible to the poor refugees with low / no investment. The Delhi Development Authority was established in 1957 as Delhi's apex planning and development agency. Initially, it adopted the system of leasehold tenure, licensing of sites and services, and auction of shops, commercial and bigger residential plots.

To accommodate the increase of population from 2.3 m in 1961 to 5.7 million in 1981, the urban area of Delhi was projected, by the Master Plan for Delhi – 1962 (MPD 1962), to increase from 20,000 ha to 44,000 ha. For this, the policy of large-scale land acquisition, development and disposal was framed, under which 90,111 acres of land was acquired.

As per the DDA surveys the total urban area of Delhi in 1981 was 48,777 ha which was quite close to the projection of the MPD 1962. This was added by about 20,000 ha during 1981-2001, making a total urban area of 68,777 ha. These comprised mainly Rohini, Narela and Dwarka sub-cities.

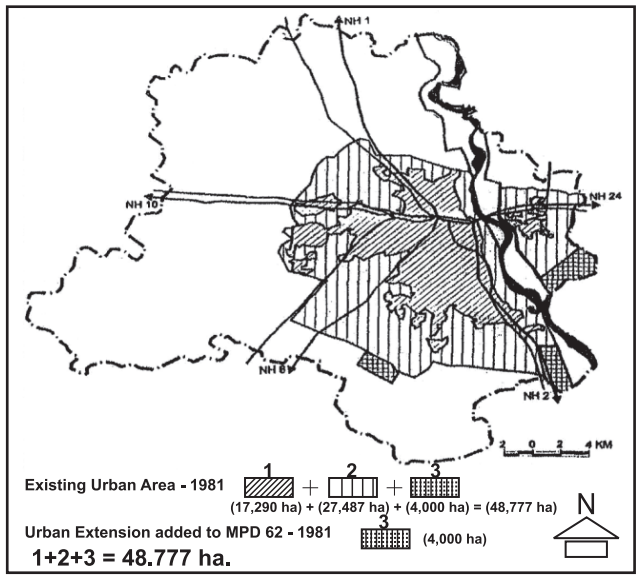
2.1 Issues in Compulsory Land Acquisition

The compulsory acquisition of land has raised various issues:

- Poor, obsolete land records, and lack of digitized property transactions;

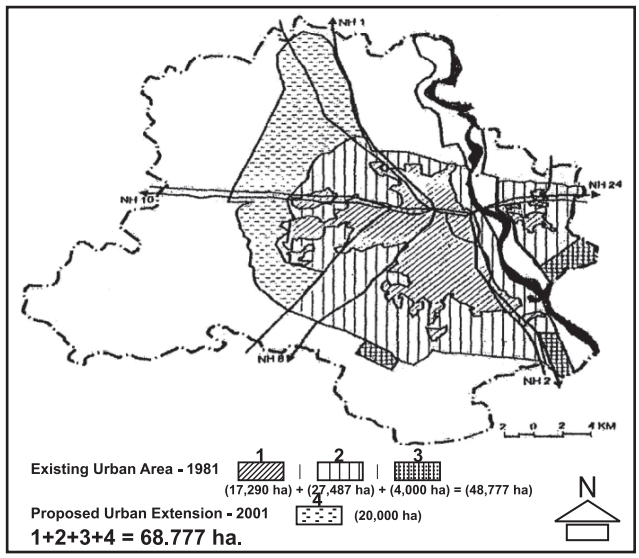
- Dissatisfaction of the land owners regarding compensation;
- Delays in land acquisition;
- Litigations with respect to acquisition, encroachments and compensation;
- Huge public investments for land acquisition and development;
- Encroachments on acquired public lands, and lack of enforcement against unauthorized colonization and squatting;
- Lack of adequate land for social housing, infrastructure services, work centres, public-semi-public facilities, etc.;
- Huge administrative work;
- Problems of equity, transparency, and the poor lacking right to the city;
- Political - bureaucratic tussles; and
- Tenure and legal issues.

Fig. 4: Urban Delhi (1981)



Source: DDA

Fig. 5: Urban Delhi (2001)

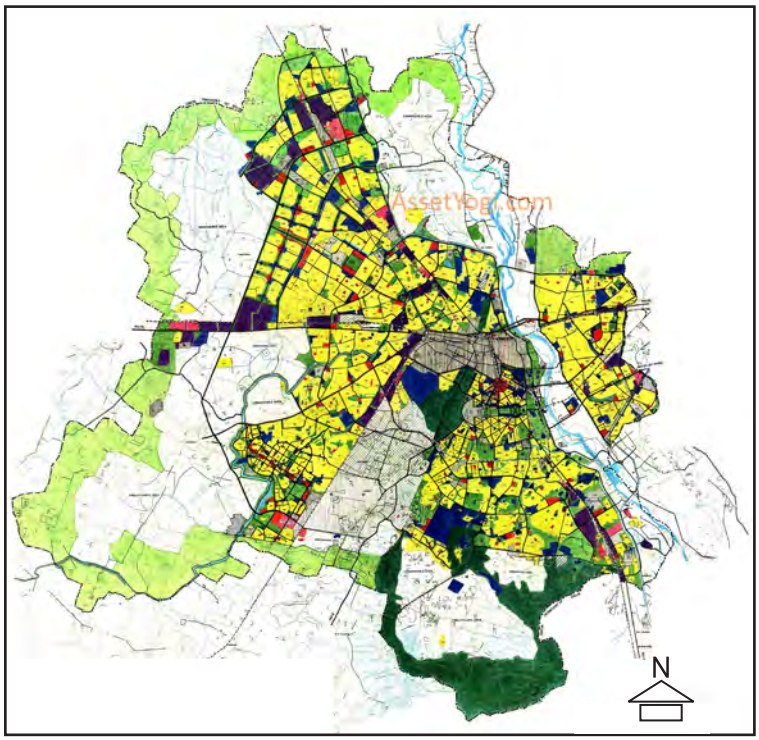


Source: DDA

The liberalization of the Indian economy (1992) gave a thrust to urban development and the private sector entered in a big way in real estate, housing and infrastructure projects, including ports and airports, rail freight corridors and Special Economic Zones (SEZs). The emergence of transport corridors with industrial zones and urban centres have been the significant features of spatial planning. The privatization of urban development is being increasingly adopted, which aims at:

- Land value, capture by conversion of agricultural land for urban uses, Transportation Reinvestment Zones (TRZ), etc.;
- Obtaining the gains of private sector efficiency;
- Introducing competition in the supply of housing and other developments;
- Opening up new areas of business and creating jobs; and
- Better use of lands for improving the overall economy.

Fig. 6: Master Plan for Delhi - 2021



Source: Delhi Development Authority (2007)

Fig. 7: Urban Extension / Sub -Cities for Delhi 2021

2.2 Property Titles and Tenure Rights

As a result of centuries of land administration, Delhi witnesses various forms of land rights-both formal (deed, title, license, etc.) and informal (street vendors, slums, squatters, *teh-bazari*, etc.). *Benami, pagdi* and power of attorney are quite common, which are something between formal and informal tenures. *Chulah tax* was imposed by the British rulers in certain villages in Delhi mainly to exert political pressures on the locals. Overall, the system of land tenure / rights is quite complex and vulnerable to fraud. The most vulnerable are the properties in 2000 odd unauthorized colonies, where the land largely belongs to the government is disputed or under acquisition. The Government in 2019 issued NCTD (Regularization of Property Rights in Unauthorized Colonies) Regulations.

3. GAPS IN LAND RECORDS AND SERVICES

According to NCAER (2020), Delhi has poor / very poor land records:

- Records of Rights - Poor, Obsolete
- Spatial Records - Very Poor, Manual
- Digitised Cadastral Maps - 53 % of Villages
- Digital Registration Process - Very Poor
- Quality of Land Records, Updation and Land Use - Very Poor

Fig. 8: Illegal Colonies Land Market

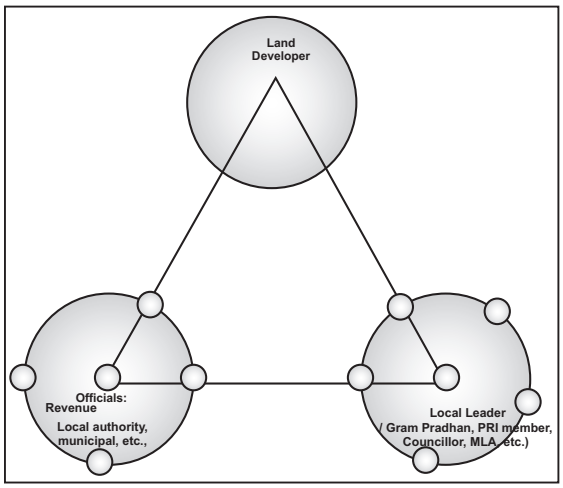
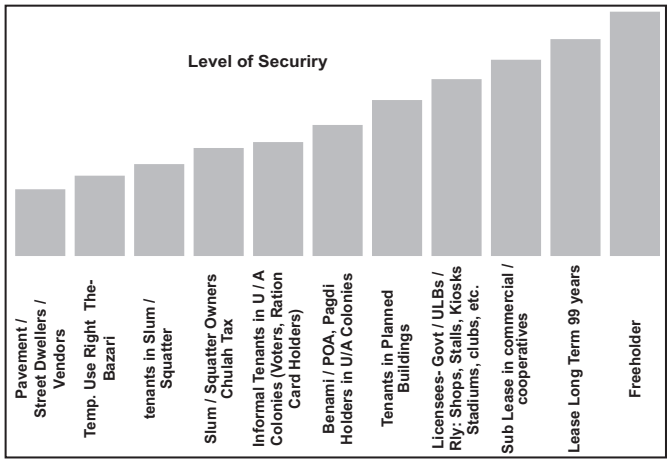


Fig. 9: Property Titles and Tenure Rights



Source: NCAER (2020) Land Records and Services Index

Lack of digital Land Information System and practice of power of attorney are the major hurdles in implementation of the Land Pooling Model. This needs the adoption of digital ledgers for data management, Land Admin Domain Model (LADM), and Satellite / Total Station/Drone surveys.

4. LAND ADMINISTRATION REFORMS

The World Bank supported land administration reforms and programs aim at increased availability of serviced urban land for planned development. There are summarized in the Table - 1:

Table 1: Summary of World Bank Supported Land Administration Projects, East Asia

Thailand: 1984-2002 - Three phase-Land Titling Projects I, II and III	
Program focus	Tenure security and building a sustainable land administration system. Support provided for land titling, valuation, capacity building, training, education strengthening
Achievements	9 million titles were distributed to land owners (no gender disaggregated data). Strong land and property market. High public awareness, sustainability programme still running. Annual operating costs of Thai department of Land about strong, sustainable education programs.
Laos Peoples Democratic Republic: 1997-2009; Two Phases-Land Titling Projects I and II	
Program focus	Tenure security and building a sustainable land administration system. Support provided for land titling, valuation, capacity building, training, education, institutional, strengthening
Achievements	Approximately 400,00 land titles issued (77.5 % of titles issued to women-compared to 22.5 % to men) strong public awareness High gender mainstreaming Sustainable land administration education programmes.
Indonesia: 1994-2001 and 2004-09; Two Phases-Land Administration Project; Land Management and Policy Development Project	

Program focus	Institutional strengthening and capacity building, policy development, titling local government land management.
Achievements	Approximately 4.3 million titles distributed (no gender disaggregated data for phase 1, 20% of the 32 million titles under phase 2 issued to women)
	Training, capacity building and education, 3 X LAM education programs, Institutional strengthening and policy development approximate 1,000 local government personnel trained in LAM.
Indonesia (Disaster Response) 2005-2009: Reconstruction and Land Administration Project	
Program Focus	Tenure security in the reconstruction of Aceh after the tsunami and civil war-titling, institutional development and capacity building, policy.
Achievements	222,268 land titles distributed (28 % distributed to women or joint owners) More than 300,000 newly constructed houses, Joint Land Titling
	Policy adopted: RALAS was designed to be the first programme to systematically formalize women's customary land rights. Institutional strengthening and policy development Very high civil society engagement
Philippines: 1999-Present Two Phase Land Administration and Management Project I and II	
Program Focus	Land administration reform including policy development, institutional strengthening and capacity building and taxation.
Achievements	Key legislation for titling and valuation introduced. Strong land administration service delivery. Modest titling outputs. Land sector development framework, endorsed as the approach to reform and the national medium development plan, includes NSDI. Valuation standards fully operational after extensive development and testing. Fiscal reform progress. Strong partnerships with LGUs. Key agreement with indigenous people established.
Cambodia: 2002-10 Land Management and Administration Project	
Programme Focus	Land policy development, institutional strengthening and capacity building, land titling, land dispute resolution and land management.
Achievements	1.2 million titles distributed. Strong systematic land titling capacity developed in project provinces. Dispute resolution procedures under cadastral commissions. Strong land administration and surveying education programmes established.
	Note: A further programme of land allocation for social and economic development is under implementation since 2008.
Vietnam: 2008-Present Vietnam Land Administration Project	
Program Focus	Tenure security (issue of land use rights certificates - LURC), institutional strengthening, service delivery.
Achievements	Tenure of 5.1 million LURC issued (72 per cent to be in joint ownership). Joint ownership introduced. Single certificate covering land and building introduced. Outsourcing of surveying and land certification. All land offices modernized, services standards, capacity building.

Source: Bell, Keith Clifford, Experiences from World Bank Support to Land Reforms, Coordinates, October 2011, p. 7-9

5. LAND POOLING MODEL

Land Pooling model envisages that an equal portion of land is deducted from every agricultural plot as contribution of land for physical and social infrastructure. This involves:

- Land Pooling and Return without payment of compensation for land retrieved for common infrastructure;
- Relaying of pooled land;
- Carrying out infrastructure work and subdivision of land;
- Re-allotted part of developed land back to the owners; and
- Selling part of developed land to meet the cost of development.

The process brings public and private investments in infrastructure development and obviates financial transactions which are typically difficult.

The Master Plan of Delhi, 2021 (MPD-2021) has envisaged a paradigm shift in land management, which stipulates optimum use of brown field land and land pooling policy for the proposed five new sub-cities. These sub-cities would accommodate a total population of 95 lakh, which includes about 33 lakh existing population. The total area under five sub-cities is 66,657 ha, which includes regional park / forests / water bodies, mandatory agricultural green belt (54 border villages measuring, about 11,000 ha), existing built-up areas / villages / unauthorised colonies, etc. (about 7681 ha) and land reservations for power plants, services, utilities, solid waste, sewerage, etc. Out of total urbanisable area of 42,334 ha, an area of about 27,628 ha is estimated to be available for new developments. Of this about 50 per cent would be available for residential development, 15-20 per cent for greens, 10 - 12 per cent for transportation and 7 to 9 per cent for commercial and industrial uses. About one-fourth of the proposed urban area comprises facility corridors, mainly having integrated

Table 2: Sub-Cities Planned for Delhi-2021

Zone / Sub-city	Zonal Area	Urban Area	Proposed Population	Existing Population
	ha	ha	(Lakh)	(Lakh)
Zone J (South Delhi-1I)	15178 ha	8268 ha	20	8
Zone K-1 (Nangloi Area)	6515 ha	6515 ha	12	5
Zone L (West Delhi III- Najafgarh Area)	22840 ha	11611 ha	20	9
Zone N (NW Delhi III)	13975 ha	9670 ha	24	6
Zone P-II (North Delhi)	8149 ha	6270 ha	19	5
Total	**66,657 ha**	**42,334 ha**	**95**	**33**

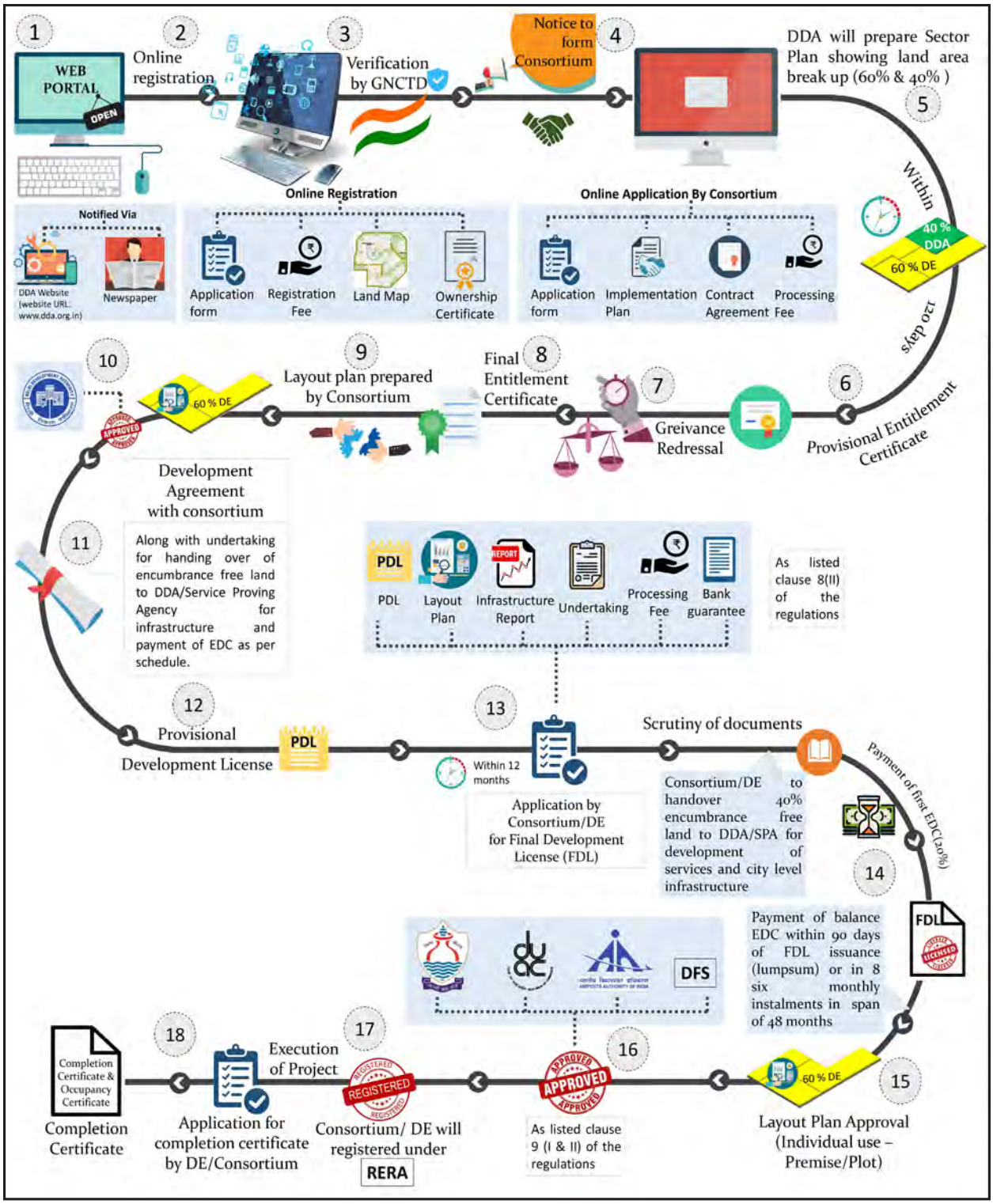
transit corridors, commercial, public and semi-public facilities, government and institutional uses. The Zonal Plans of all five zones in urban extensions of Delhi have been notified.

The Land Pooling Policy of the DDA was notified by the MoHUA in Gazette of India dated 11th October 2018 under section 11A of the DD Act and the Regulations were notified on 24th October 2018 by the DDA under section 57 of the DD Act. The Land Pooling Model of the DDA is based on the following principles:

- **Basis of Pooling:** Pooling of land will be done on the basis of sectors as delineated in the Zonal Development Plan;
- **Minimum Area Requirement:** Minimum 70 % contiguous land of the developable area within the sector, free of encroachment, is required to be pooled to make the sector eligible for development;
- **Land Holding Break-up:** Of the pooled land, landowner / consortium will retain 60% and hold remaining 40 % to be surrendered as and when required to the DDA/service agencies;
- **Development by Consortium:** 60 % land to be utilized by consortium/land owners for development of residential, commercial, public and semi-public facilities as per the policy;
- **Implementation Plan:** Consortium will mutually decide a formula among land owners for redistribution of developed land / build space as part of implementation plan and convey the same to the DDA;
- **External Development Charges:** External Development Charges (EDC) shall be applicable on entire area of pooled land to cover the actual cost of providing city-level infrastructure;
- **Separate Developer Entity:** Landowners / group of landowners with minimum 2 hectare of pooled land can choose to work as separate Developer Entities (DEs; and
- **FAR for Group Housing and City Level Commercial and PSP** shall be as per as MPD 2021 norms. 15 % of FAR for EWS housing shall be given over and above the permissible FAR.

It is necessary that the land pooling and return transactions are digital and on the spot. This will save the landowners and developers from anxiety and will reduce administrative work, court cases, land transfer hassles, land security and vigilance. It will be necessary to create Zonal Land Banks for return of land to *poolers* and also to develop Master Plan Roads (30 m and above), trunk services and facility corridors. This would enable the service agencies to plan

Fig. 10: Land Pooling Procedure (DDA)

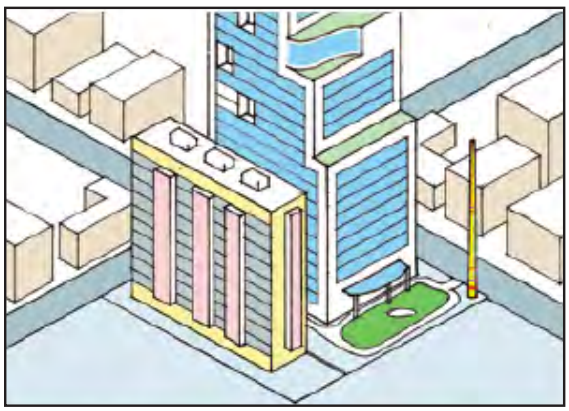


Source: Delhi Development Authority

Fig 11: Existing Land Profile

Fig 12: Plan-for Land Pooling and Readjustment

Fig 13: Joint Development - Infrastructure Services by the Government / ULBs, Construction by Developers



Source: Matthews, R. et al (2018) State Led Alternative Mechanism to Acquire, Plan and Service Land for Urbanization in India, WRI India

Sustainable and pragmatic land pooling involves the following initiatives:

essential public infrastructure services, such as roads, utilities, power, ESS, water works, main sewers and drains, which are developed by different agencies / departments. For integrated development, it is necessary to bring them on a common blockchain platform.

5. LAND RIGHTS MAPPING

A new generation of geo-spatial land tenure tools can be applied for land rights mapping. These comprise four geo-spatial technologies: smart sketch maps, Unmanned Aerial Vehicles (UAVs), automated feature extraction, and sharing and publishing the maps through geo-cloud services. Land data acquisition is done by the delineation of cadastral boundaries through UAV data. The tool delineates physical objects demarcating all cadastral boundaries.

The Land Administration Domain Model (LADM) forms the basis for organizing and integrating geo-spatial data. The algorithm shapes and integrates land data on a shared platform. The focus is on knowledge sharing and social and environmental impact by image and data processing using the Land Administration Domain Model (LADM) and development of a business model.

Digital Ledgers and Blockchain

A digital ledger is a geographically distributed database that is shared and synchronized across a network of the participants. It has a blockchain structure where the data is stored in blocks, linked and secured by cryptography for handling identities, contracts and assets. The blockchain is an electronic transactions system. It is based on a hash algorithm that converts data into a block. There are three types of blockchains:

- Public, consortium and private blockchain.

- A public blockchain allows anyone in a network to be involved in the process of adding blocks.
- A consortium blockchain requires participants to be from an organization.
- A private blockchain is operated by a particular organization. Every user receives a unique public key and a unique private key. These two keys can be used for privacy and authentication.

Thus, a blockchain is a chain of digital signatures that are joined together in clusters with a specific block.

Broadly, land registrations are title based and deed-based systems. In the deed-based system of registration, a deed or a transaction of land is registered. This deed is proof of a land transaction but with no the legal right. As such, a transferee must trace the ownership of the land back to its root and establish if the transferor is a rightful claimant. The title-based system is the legal land right; the rightful claimant for the spatial extent of the property right are registered. Deed and title-based systems of land registration are the result of centuries of optimizing land administration systems. The deed-based system is vulnerable to fraud where the chain of transactions is broken. The title-based system aims to curb such frauds.

Digital Blockchain system for land registration is indispensable for land pooling schemes in order to curb the frauds and power of attorney transactions, which are very common in urban and rural zones.

6. LAND ADMINISTRATION DOMAIN MODEL (LADM) FRAMEWORK

The Land Administration Domain Model (LADM) is an International Standard (IS) of the International Organization for Standardization, as ISO 19152. It covers basic information related to components of land administration and includes agreements on administrative and spatial data, land rights and source documents (e.g. deeds or survey plans), and forms of tenures- customary tenure, government land, and privately held land.

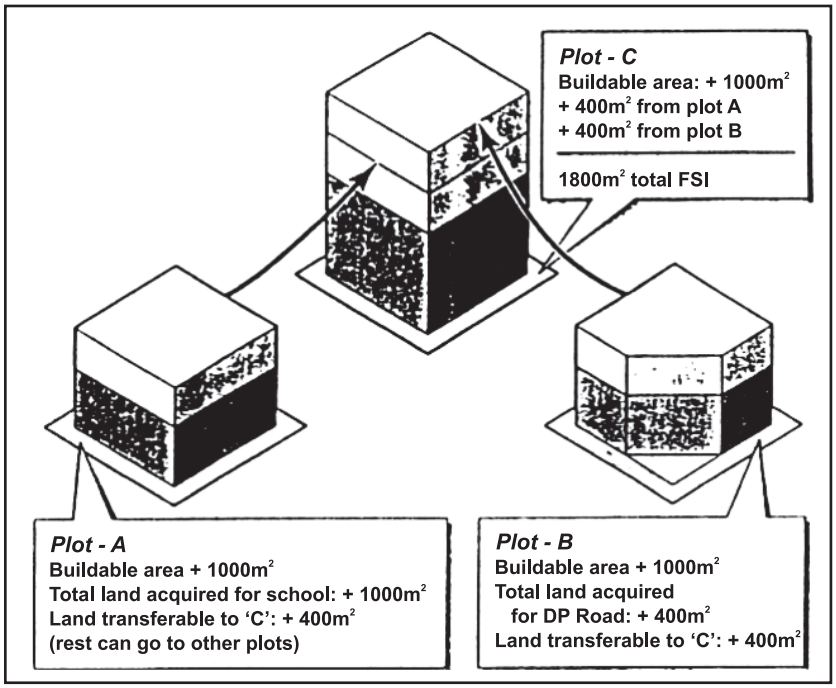
As such, LADM is capable of depicting the Land Administration System and different forms of land grabbing. The LADM defines the Spatial Units and different forms of property (commonly held, public or private). The differentiation is valid for converting private lands for public use (roads, infra services, facilities, parks, etc.) by taking over contiguous parcels of lands and readjustment of ownerships of remaining private lands (say 60 % of original extent). The LADM, assigns the class and contains the Rights, Restrictions and Responsibilities. (Annex F of ISO 2012), which can be the basis of land adjustment and registration. For land pooling, two specialised classes, one for public based regulation (AL_ Infrastructure Reserve), and the other for Land Registration, where the ownership rights and the publicly imposed restrictions are registered for each case.

Integrated and inclusive development aims at addressing the issues of environmental sustainability, urban retrofitting, infrastructure upgrading and optimum use of land. The poor and informal sectors have a claim on equitable access to resource- land, housing, services, jobs, etc. Redevelopment of old, unplanned areas, unauthorized colonies and slum rehabilitation can be ensured by incentivized development rights and upgradation of infrastructure services, such as water, power and drainage, transportation. The variety of urban developments in Delhi roughly covers the following residential areas:

- 36,000 acres - planned residential area;
- 12,000 acres - unauthorized / regularized colonies;
- 1,000 acres - government land available for social housing;
- 2,390 acres - slums & JJ clusters; and
- 6,000 acres - resettlement colonies.

These areas offer scope for densification of built-up areas and amalgamation of small plots for Group Housing (minimum 1670 sq m) with common greens and parking and enhanced FAR (400 or 1.5 times the plotted development). This involves upgradation of infrastructure services, facilities and open spaces. The redevelopment strategy cannot work without simplifying approval process. Mixed land use, incentives of higher density, extra FAR and Transferable Development Rights are necessary in these tasks.

Fig 14: The Concept of Transferable Development Right



Digital property titles and transactions can facilitate the process since many properties do not bear clear titles, informally leased or sold. The development process involves several stakeholders, public and private institutions which require horizontal and vertical coordination. This can be achieved by digital platform, i.e. blockchain. In the context of heterogeneous urban character, it is necessary to adopt a hybrid approach for land pooling and redevelopment. The strategy of sustainable development focuses upon public greens,

social facilities and utilities with minimum consumption of land. The concepts of Excess Condemnation and Facility Corridors can be employed to serve the twin objectives of providing a public road, highway or such facility and generate revenue by the acquisition of additional lands which are directly affected by such provision. The adjacent area is developed by the local body, the land value of which increases as a result of facility / road, and it accrues to the local body, rather than to individuals. The concept of property development along major public transport corridors / MRTS has been adopted in Delhi with grant of 50 % additional FAR. This also helps in building up of a land bank of the local body.

The Concept of White Zoning

Planning norms, density, FAR and flexible land use zoning can open up new avenues for using the land as a resource for urban turn around. It is essential to optimize utilization of urban land vis-a-vis Floor Area Ratio and residential density, along with mixed land use and flexible zoning, known as white zoning in Singapore. It allows flexibility in land use. Depending upon the feasibility of land use and floor area permissibility, the developer pays the land use and FAR charges. This strengthens the financial base of urban local body to provide services and amenities. The Special Area, i.e. the Old City, unplanned areas and major corridors can be taken up for white zoning. This way the old, dilapidated areas are renewed and upgraded with a wider participation of the owners, and reduces the need for acquisition of virgin, unserviced lands.

Transit Oriented Development

Relatively low and uniform Floor Area Ratios (FAR) have distorted urban land market by promoting sprawl, increasing transportation and infrastructure overheads. It is necessary that the FARs are rationalized to permit higher density development in the areas with adequate infrastructure and public transportation capacities, both existing and future. Gains in property values can be recouped for infrastructure development. Land Value Capture, Land Based Transportation by Transit Oriented Development are the new frontiers of infrastructure financing. These tools can be effectively used for infrastructure development.

Transferable Development Right

Transferable Development Right enables the land acquisition for public purpose without monetary compensation, but by way of grant of additional FAR / FSI. This helps in obtaining lands for road widening, new roads, development of parks, playgrounds, civic amenities, etc.

Accommodation Reservation

The Accommodation Reservation is a form of *in-situ* TDR which allows the land owners to develop the sites reserved for road widening or an amenity in the development plan using full permissible FSI / FAR on the plot. This way the

reservations for social housing, parks, utilities, retail markets, dispensaries, etc., are implemented on private lands without the need to acquire the land by payment of compensation.

Spatial, Financial and Infrastructure Integration

Land management involves coordination among the local, state and central governments with horizontal and vertical linkages among planning, engineering, finance, legal, housing and management departments. Coordinated spatial, financial and infrastructure integration can be achieved by Capital Investment Folio (CIF). This helps in coordinating the spatial plans with infrastructure investment strategies and sustainability factors, e.g. form of urban expansion, which minimizes energy use, minimize development on high value agricultural land, avoid vulnerable groundwater resources and optimize use of land by mixed use areas, redevelopment and redensification, multiple uses of buildings etc. Infrastructure Bundling: Urban projects, such as slum redevelopment, roads, and airports are being increasingly financed through award of land for market to partly compensate the cost of development. Slum Rehabilitation at Kathputli Colony, Delhi, IGI Airport, New Delhi, Redevelopment of the New Delhi Railway Station, Sports City / F-1 Racing Track, Yamuna Expressway (UP) and Ganga Expressway in Uttar Pradesh are some of the examples of such projects where the cost of infrastructure development has been part-funded by the award of land rights.

Betterment Levy and Land Value Capture

For the sake of equity and fair distribution of public resources, the concept of betterment levy obliges the land owners to return a part of land value addition or profit that results from public investments. Betterment levies help to finance urban development and public services by the ULB and service agencies. The infrastructure development can be financed through the recovery of EDC, conversion charges, FAR charges, Betterment levy, etc. However, to ensure the availability of infrastructure and corridors prior to real estate development it is necessary to separate the surrender/ return of land and payment of EDC, Betterment levy, Conversion Charges, FAR Charges, etc., vis-a-vis grant of development right and change of land use. The land owners can be given a choice or a combination of cash and development right.

7. REGULATORY PROCESS

The land pooling and its development involve various regulatory functions, such as given below:

- Working out the rules, regulations, procedures and guidelines, grant of licenses, for private sector participation in real estate, land assembly, planning, infrastructure development, redevelopment, housing, etc.;
- Spatial Data Infrastructure (SDI) / computerization of land records, on-line, one window approval of plans;

Table 3: Land Assembly and Development Management Tasks

Tasks	Specific Actions
a) Advanced and coordinated development of the transport networks, main roads, infrastructure services, etc.	Availability of land for transport and services networks / corridors. • Service agencies should prepare plans of land requirement and Service Plans; • Preparation of detailed sector plans; • Preparation of DPR for PPP projects; • Work programming of agencies responsible for land management, engineering, planning, and utilities; • Preparation of a land information system, digitise land data/ ownership details land management program, land regulation and transfer, etc.; • Working out External and Internal development cost estimates and financing structure / sources; and • Action Plan and programmes combining Land Value Capture, Plan Funds, EDC, Betterment Levy, etc.
b) Availability of land for development of public, social and government uses / facilities.	Availability of land for utilities / grids / roads / service corridors • Funding-development charges, EDC, Betterment levy. • Planning and development of Facilities Corridors and public open spaces. • Launching land pooling projects.
c) Immediate transfer / return of land holdings to the land pool participants and its registration	Publication of area-wise plans and program for land pooling • Government land bank for spot exchange / adjustment of land with land *poolers*; • Notification of lands under LARR Act (2013) for facility corridors / Master Plan Roads and of those not participating in land pooling; • Promotion, persuasion and information sharing on web (planning, land infrastructure, finances, etc.); • Land management / acquisition option under TDR and Reservations; and • Land Pooling projects.
d) Timely and orderly planning of land into roads, facilities, open space and building plots (with title documents) and grant of planning permission	Monitoring of demand, supply and use of housing plots. • Subdivision regulations linked to the land use zoning; • Efficient administration of development regulations, planning permission, TDR / AR, and Land Banking; • SDI/digitised land / property information; and • Online / one window planning permission.
e) Increased supply of low-cost housing and redevelopment & re-densification of existing urban zones	Implementing Redevelopment Guidelines, promoting TOD, taking up pilot projects. • Grant of ownership to eligible / repolarized households in slums, unauthorized colonies, etc.; on the basis of clusters (a minimum composite area of 1670 sq m) which can be taken up for redevelopment into group housing with enhanced FAR of 400 with one-third as soft parking / common greens, and 10% of FAR for commercial activities; • Encouraging private lands to redevelop and infill development; • Allocating share of land from land pooling projects for social housing; and • In-situ upgrading of slums and squatter settlements.

f)	Coordinated and speedy development	Time-lines, Action programmes, quality control and monitoring. • Streamlining approval procedures; • Financing Plan and management; • Building Materials, Codes and Specifications; • Category-wise pre-selection of the experts/ consultants and contractors for award of work on pre-determined rates, without the need of time-consuming tendering, EOI, etc., for each project; • Timely recovery of EDC / development, conversion, FAR, Betterment, Levy, Service charges, etc.; and • To assist PPP / Cooperatives / Community to take up land pooling, Redevelopment, Regularization of illegal settlements, conferring land titles / registration / licenses.

Source: Jain A.K. (2014) Revisiting Land Acquisition and Urban Process, Readworthy Publishers, New Delhi

- Compulsory acquisition of land which effect the composite land pooling, and infrastructure development;
- Procedures for grant / revoke of licenses, approvals and planning permissions;
- Model agreement and MOU with land owners for land pooling, preparation and approval of the plans of land pooling;
- Issue of Transfer of Development Right and Accommodation Reservation Certificates;
- Enforcement and monitoring of progress of work and financial transactions of private / PPP developer, housing and service agencies, etc.;
- Regulations / procedures to oversee the compliance of the legal, administrative and financial commitments;
- Financing and accounting procedures; and
- Procedures to deal with appeals, grievances and complaints.

The land policy needs simultaneous process reforms for better control over time, bridging the gap between demand and supply, overcoming delays and cost overruns, time-bound planning and effective monitoring. Technological interface vis-a-vis energy, water and environment with reference to standards and specifications, infrastructure, construction, maintenance is a major consideration. There is a need to adopt new contracting procedures for efficiency, quality of service, delivery and transparency. The Table - 3 gives a list of the actionable tasks.

This needs evolving a hybrid regulatory framework that integrates the physical, economic, and social development. This may need the revamping of Land Management Department as a Regulatory Authority to steer and regulate the process of land pooling, and to oversee the compliance of the legal, administrative and financial commitments.

8. CONCLUSIONS

The land pooling process needs the adoption of land rights mapping, digital ledgers, and blockchain based land administration domain models. These should aims at providing the right to the city, social equity, jobs and transparency. It involves reviving the property licensing for small shelter, shops, kiosks, social and health facilities. For optimum use of the available urban land, it is necessary to take up the Transit Oriented Development (TOD), redevelopment and land recycling projects. A composite and compact urban pattern with safe buildings, public greens, transport corridors, physical and social infrastructure are crucial. These require a participatory approach, and new partnerships. For a sound legal back-up, the Land Pooling Policy and the Delhi Development Act 1957 should be consistent with the LARR Act 2013, Transfer of Property Act 1882, Revenue Act 1963 and Registration Act 1908.

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Institute of Town Planners, India Journal 18 x 3, July - September 2021 ISSN:L0537-9679

Crime Prevention, through Urban Design and City Planning in Delhi using Geo-Informatics

Rupesh Kumar Gupta

Abstract

Crime it differs from one community to another, even within one community it doesn't occur equally in all places and nor by the same way The observation from the study showed that places like JJ Clusters, low-class residential colonies, low-income group, low literacy, and poor infrastructure, less police patrolled areas have a high incidence of crime. The study found that crowded areas, isolated places, parks, shades and vacant plots are most vulnerable for the crime. In numerical terms, the results revealed the crime rate was highest within 500 meters distance from the aforementioned places and then reduced beyond that.

1. INTRODUCTION

Urbanization is the process of growth in urban areas; industrialization, specialization, and economic development are considered as related to the theories of urbanization. In other words, urbanization is an indicator of industrial development in the economy. Labour market pooling, trade of goods and services, knowledge spillover, high level of income and economic relations are the basic pillars of urbanization. A basic feature of urbanization is the shifting in employment from rural to the urban or industrial sector. This type of development is helpful for employment creation, poverty reduction and local business development in the urban regions. In agreement to most of the theories, it can be propounded that urbanization is good for promoting the growth of industries and development in the economy, however, another face of this urbanization may be the encouragement of crimes since crimes normally occur in large cities; high density and high mobility in urbanized areas. In rural areas, due to lower population density, criminals have less chance of hiding themselves because people know each other. The opposite is true for urban areas.

2. MEANING OF CRIME: LITERATURE SURVEY

Crime is an activity which is against the law. The relationship between the crime and the evolution of mankind may also be considered a historical one as Cain (first son of Adam and Eve) committed the first crime when he murdered his brother Able because of jealousy. The linkage between criminal activities and the socio-economic development of society is undeniable. Due to the complex

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nature of the subject of crime, its varied causes and consequences, various academic disciplines such as criminology, sociology, geography, psychology and demography study it from their own perspective. Clark and Marshall (1952) wrote: "A crime is any act or omission prohibited by public law for the protection of the public and punishable by the State in a judicial proceeding in its own name". Similarly, Tappan (1960) defined that "A crime is an instrumental act or omission in violation of criminal law, committed without justification and sanctioned by the State as felony or misdemeanor". At the turn of the millennium, the fear of crime has received significantly more attention in the academic literature, general media and in national and local politics. Similarly, debates over its nature, significance and resolution and most recently, even its very existence, have multiplied. Increasingly, fear of crime is seen as inseparable not only from crime and disorder in western cities but also from a range of other social and economic problems concerned with housing, employment, environmental planning and social exclusion (relating to poverty, gender, race and so on). Clear distinctions in the level of fear of crime have commonly been cited as higher in larger towns and cities (Hough, 1995) and lower in rural areas (Kennedy and Krahn, 1984). The relationship between urbanization and crime rates has long been recognized by criminologists. Another perspective in criminology emphasized the opportunity that the structure of cities offers to potential offenders (Glaeser and Sacerdote, 1996). Urban environments are more suitable targets, and people are more tempted in cities to commit crimes. Criminologists have discussed the urban tendency towards crime for decades. Wirth (1938) discussed the observed connection between crime and urbanization and argued that this connection is the evidence for his theory, urbanism as a way of life. According to Wirth (1964), special urban characteristics such as size, density, heterogeneity and impersonality are responsible for a mode of living that generates more crime. Clinard (1942, p. 203) elaborated this view by arguing that there is more crime in densely populated areas than in scarcely populated rural areas because of the urban characteristics such as mobility, impersonal relations, differential association, limited participation in community organizations, organized crime cultures, and a criminal type in the life experience of offenders.

At present, there is no single term to denote the study of crime and place. Mike Davis explores crime and control in Los Angeles as an extreme example of the 'ecology of fear' (1999). Others refer to 'socio-spatial criminology' (Bottoms, 2007) or 'crime and community' (Hughes, 2007). On the more quantitative cartographic side, 'geo-criminology' and 'crime mapping' (Vann and Garson, 2001) are more frequently used. Park and Burgess's (1967) work in Chicago in the early twentieth century foregrounded the relationship between urban environment, actions and values. They saw social science as a form of 'human ecology' (1925). Burgess's 'zonal theory of urban development' suggested that Chicago and other large cities was structured around five concentric circles. The non-residential 'central

business district' was surrounded by the 'zone in transition', an area of cheap rented housing attracting different generations of migrants. Next came three residential areas of increasing affluence. Other scholars built on this model. Shaw and McKay's (1942) studied juvenile delinquency showed that a very high proportion of young offenders had grown up in the 'zone in transition'. They explained this as an effect of the 'social disorganization' which is characteristic of this area. A churning migrant population with shifting moral values, high levels of poverty and low levels of community cohesion produced teenagers prone to commit a crime.

Shaw and McKay (1942) emphasized the process of social disorganization that leads to concentrations of crime. Poverty, residential mobility, ethnic heterogeneity, bad housing, and weak social relations indicate disorganization that did not allow stable communities in neighborhoods. After several years of decline, they suggested, a greater number of offenders would settle in such neighborhoods, and this would, in turn, explain that neighborhood's higher crime rates.

Sampson and Groves (1989) concentrated on the behavioral mechanisms caused by social disorganization. They argued that social disorganization is related to the capacity of a community to carry out informal social control on criminal behavior (for instance, the capacity to supervise adolescents in peer groups and to exercise better guardianship, such as by recognizing strangers in the neighborhood).

Gerban J.N. (2007), propounded that the residents in the rural areas are less confronted with a crime because of higher levels of social cohesion and informal social control and lower offender rates in a well-ordered physical surrounding. Criminals live more frequently in cities in which their crimes are concentrated in city centres and their surroundings. The greater the distance to the city centre, the less crime occurs (Gupta, 2020a, b, Gupta, 2021).

Myers (1983) took a random sample of offenders released by federal prisons in 1972. He studied that punishment is not an effective tool for preventing crime. It was better to create opportunities for employment which would lead to a reduction in crime. Further, the empirical investigation of crimes and its determinants in urban areas was done by Gumus (2004). He used two types of crime data of large cities of the US. First was the total numbers of property crimes and second were serious crimes like murder, forcible rape and robbery as a dependent variable. Using cross-sectional data of large cities of the US, he found that urbanization and income inequality are important factors of urban crime.

Shaw and McKay concluded that the high levels of crime were not a function of the personal attributes of the groups living in the neighborhoods but rather

argued that "the structural factors of poverty, high heterogeneity, and high mobility created 'social disorganization', and it was community-level social disorganization that was presumed to cause crime" (Wilcox, Land, Hunt 2003, p.28).

In the mid-1990s, there was a revival of Shaw and McKay's approach in the form of the "New Chicago School" which adopted computerized mapping and spatial analysis techniques, particularly through the use of Geographic Information Systems (GIS) (Ainsworth Working within the framework of the ecology of crime) American criminologist Rodney Stark (1987) asked how neighborhoods can remain areas of high crime and deviance despite a complete turnover of their populations. He concluded that there must be something about these places that sustain crime. Stark developed a theory of deviant neighborhoods and proposed five characteristics, or essential factors, that distinguish high crime areas having high population density, poverty, mixed-use of buildings for residential and commercial purposes, transience and dilapidation. While a small number of offenders may choose targets far from their home, the large majority will "stake-out" local areas with which they were familiar. Offenders tend to operate in areas that they have come to know, possibly while engaging in non-criminal activities (Ainsworth 2001, p.86). Furthermore, Felson (2002, pp.62-63) contends that rates of residential burglary are higher in lower-density cities and suburban communities where physical layout and design features offer greater opportunity. It is assumed that opportunity is the necessary condition for crime and that the growing number of consumer goods in stores and homes and the sharp rise in personal affluence has provided increasing opportunities for criminal activity. Closely associated with this concept is the routine activities theory of crime, in which demographic or social class factors contribute to particular activity routines that merge three prerequisites for a crime: (1) the presence of a motivated offender (such as an unemployed teenager), (2) a suitable target (such as a home containing goods which could be easily resold), and, (3) the absence of a capable guardian (homeowner, watchful neighbor, friend or relative) (Clarke and Felson, 1993, p.9; Knox 1995, p.256; Hackler 2000, p.169).

Crime rates are not evenly distributed over geographical areas in urban settings. Some neighborhoods are more troubled by crime, and even within neighborhoods, there are considerable differences between areas as a result of subtle interplays between physical characteristics and people's behaviors (Gupta, 2020a, and Gupta, 2021). The early Chicago School of Sociology stimulated the study of concentrations of crimes in cities all over the world (Park and Burgess 1967). Burgess (1967) introduced the idea that a city can be ecologically divided into concentric zones with varying crime rates. The highest crime rates were in the transitional zones surrounding business centres.

In the above literature, it is clear that the rate of crime is higher in the city and lowers in a rural village. This is also observed that along with the distance to the city the crime decreasing. So urbanization is also are a major factor of crime due to heterogeneous, disparity in income, employment etc. There hasn't been a body of work that discussed the local based or micro-level of crime and reason behind this. The present work tried to investigate the socio-economics status as well as the design of the micro-level of crime in the capital city. In this paper we tried to shows the macro as well as the micro picture of crime. The study tries to explore the relationship between different types of heinous and non-heinous crimes and their micro-environment. The role of urban mobility in crimes has also been assessed. The micro-environment of the different locations of crime has been mapped and monitored through GIS, and GPS technology. Such kinds of work are helpful to understand the complex urban problem and given a long term plan for future sustainable urban development. The role of crimes on urban mobility has also been assessed. This kind of work will be very relevant for administrators, planners, and policy makers for the future course of action.

3. RESEARCH OBJECTIVES

The main objective of this study is to analyze the spatial pattern of crime in different areas of Delhi and select the most vulnerable (top ten) crime prone places for further study of its layout design and micro environment. Next to prepare a detailed inventory map of land uses and security arrangement existing crime prone places for each hotspot for prevention of crimes. Geographical Information System (GIS) and Global Poisoning System (GPS) techniques have been used for this purpose.

4. LOCATION OF STUDY AREA

National Capital Territory is spread over an area of 1483 sq km between $28^0$23'17"N and $28^0$53'00"N latitudes and between $76^0$50'24"E and $77^0$20'37"E longitudes. The demographic changes in NCT Delhi occurred more rapidly in last hundred years and more than forty-fold (1911 - 0.41 to 2011 - 18.45 million) increase in its population has been noticed, but it was not uniform during the past century.

5. METHODOLOGY

The government offices published data like National Crime Research Bureau (NCRB), Delhi Police website, different report, policies papers, document, research thesis, observational data of projects, magazine, articles, daily newspaper as well as primary field information of last 20 years, have been studied, and then a list of crime-prone area of Delhi have been prepared. It is observed that some of the areas where the frequency of crime is much more, so according to the frequency of crime the list of the area was revised. For the time constraints and resource limitation, we selected the top ten (high-frequency

crime area in the last 10 years) crime-prone areas from that list for further study. After that, we visited all ten most vulnerable areas and interacted with local people, municipal bodies, local police, government and private official, as well as a small shopkeeper, to know about the exact location (hotspots) of the crime and reason behind it. Then we came to know that entire area or locality is not crime-prone, but the particular location (hotspots) of that area are crime-prone, where the crime occurred frequently in last 10 years. These are Anand Vihar Metro Terminal, Seemapuri Bus Stop, Gokalpuri Bus stop and Metro station, Old Delhi Railway and Metro Station, New Delhi Railway and Metro Station, Sarai Kale Kha Bus Terminal and Nizamuddin Railway Station, Kashmiri Gate Bus and Metro Terminal, Vishvidyalaya Metro station, Jahangirpuri Metro station and Vasant Vihar Bus stop.

Once we came to know about the ten major hotspot locations of crime then we prepared a structured questionnaire and randomly interviewed 250 individuals in each crime hotspot i.e. total 10x250 questionnaire in 2014. To bring out the effect more clearly, a separate interview of 250 people each from the same 10 hotspots was undertaken in 2018 through random sample method. We tried to investigate the surrounding of the hotspot, layout design of the building, and types of crime occurred in each place. The data for the micro physical environment was also collected by making inventory map of dark/isolated places, open / close parking, forest, bushy patches, crowed area and installation of surveillance devices etc. for each identified stations / stands. An inventory map was prepared in the dimensions of 500 meters from the centre of all hotspot places. Finally for preventing and minimizing crimes a planned and re-designed map for each surveyed place was prepared. Geographical Information System (ESRI Arc GIS-Arc Map) and Global Poisoning System (Trimble-Juno 3B Handheld GPS) techniques have been used for mapping of micro-environment in and around the selected crime hotspot places. To understand the pattern of crimes at ten different hotspot places the opinion of the people were obtained.

6. CRIME IN INDIA: AN OVERVIEW

In India, studies of rural communities have found fear of crime to be lower than the urban areas and focused on a certain vulnerable part of urban areas like dark and lonely places, unattractive and uncared places, poor design of subway, housing, bus stand or bus terminal, railway station, street light and so on is often implicated directly (Gupta, 2020a, 2020 b, & Gupta, 2021). If one goes by the direct proportionality of crime with urbanization, statistical data shows the highest degree of crime in Uttar Pradesh, West Bengal, Bihar, Madhya Pradesh, Andhra Pradesh with least crime rate for Mizoram, Nagaland, Goa (Table 1). However, the universality in proportionality can't be applied here, which also means it is not necessary that the crime rate increases with the degree of urbanization and urban population. As per the crime statistics (Table 1, Fig. 1)

Table 1: Status of Crimes Rate during 2011

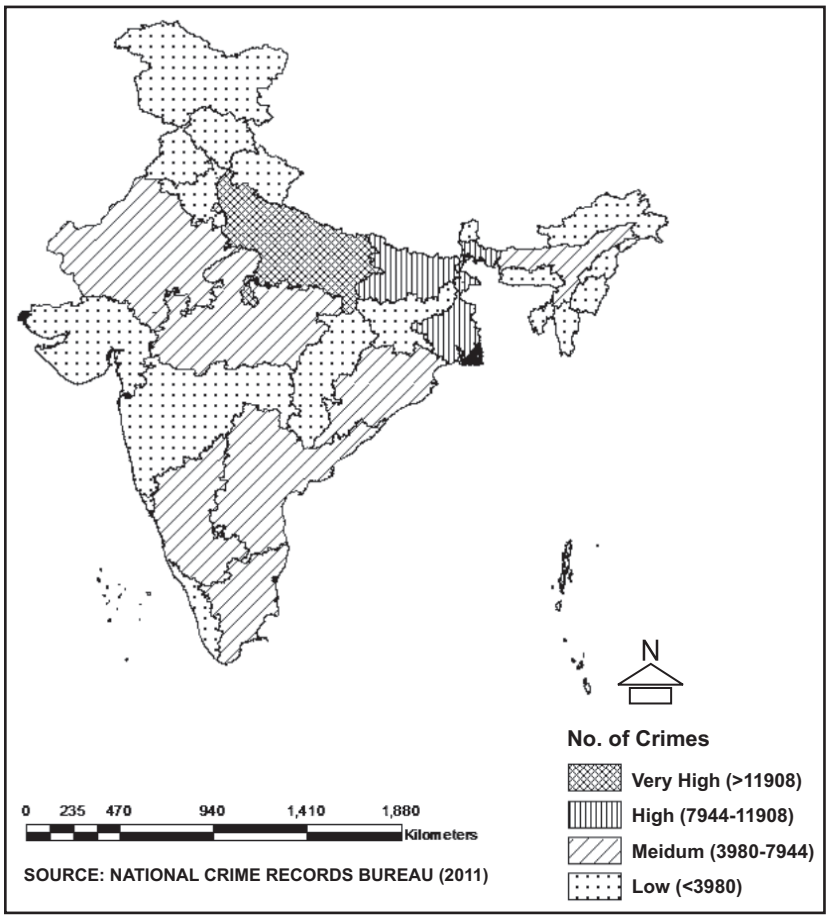
	States	Murder	Rape	Kidnapping and Abduction	Dacoity	Total / Rank
1	Andhra Pradesh	**2808**	**1442**	**2154**	**126**	**6530 (5)**
2	Arunachal Pradesh	65	42	93	13	213 (25)
3	Assam	1303	110	3764	305	**5482 (7)**
4	Bihar	**3198**	**934**	**4268**	**556**	**8956 (3)**
5	Chhatisgarh	1110	1053	472	68	2703 (16)
6	Goa	48	29	28	2	107 (28)
7	Gujrat	1126	439	1214	221	3000 (14)
8	Haryana	1062	733	959	167	2921 (15)
9	Himachal Pradesh	130	168	212	1	511 (22)
10	Jammu and Kashmir	110	277	1077	14	1478 (19)
11	Jharkhand	1747	784	941	309	3781 (13)
12	Karnataka	1820	636	1395	214	**4065 (11)**
13	Kerla	365	1132	299	71	1861 (18)
14	Madhya Pradesh	**2511**	**3406**	**1288**	**118**	**7323 (4)**
15	Maharashtra	**2818**	**110**	**110**	**773**	**3811 (12)**
16	Manipur	78	53	110	1	242 (24)
17	Meghalaya	110	130	87	49	376 (23)
18	Mizoram	26	77	6	1	110 (27)
19	Nagaland	46	23	34	7	104 (29)
20	Odisha	1477	1112	1139	417	**4145 (10)**
21	Punjab	842	479	681	28	2030 (17)
22	Rajasthan	1461	1800	3204	28	**6493 (6)**
23	Sikkim	14	16	10	0	40 (32)
24	Tamil Nadu	1877	677	1984	101	**4639 (9)**
25	Tripura	163	205	154	11	533 (21)
26	Uttar Pradesh	**4951**	**2042**	**8500**	**379**	**15872 (1)**
27	Uttarakhand	178	129	314	13	634 (20)
28	West Bengal	2109	2363	4285	236	**8993 (2)**
29	A & N Islands	14	13	15	1	43 (31)
30	Chandigarh	24	27	58	6	115 (26)
31	D & N Haveli	14	4	9	7	34 (33)
32	Daman & Diu	6	1	3	4	14 (34)
33	Delhi	**543**	**572**	**3767**	**33**	**4915 (8)**
34	Lakshadweep	0	0	0	0	0 (35)
35	Puducherry	32	7	12	5	56 (30)
	Total UT's	633	624	3864	56	5177
	All India Total	34305	24206	44664	4285	107460

Sources: ncrb.nic.in

issued by the National Crime Records Bureau, Ministry of Home Affairs, for the year 2011, the recent spate of murders, kidnappings and rapes in the States is often met with the refrain, and people are of the view that India has become unsafe.

Given the slow rate of growth of urbanization but a high rate of crime can be a reason for people to call India unsafe. If one goes by the urbanization-crime nexus then the rate of crime should not have been on the rising trend in India, but the statistics present a different picture which clearly depicts that urbanization alone is not the factor for rising crime in a State, even in the urbanized centre. However, one cannot rule out that crime is not related to urbanization at all. It is proper to say that there is no direct proportionality between the two, that is if one increases the other will also, but the two are associated to each other in such a way that in common parlance the two seems to be the tipping point for one each other. No doubt, as per the statistics the direct proportionality of crime with urbanization in Indian context has nullified and as such does not follow the common trends of western countries. It may be due to the values and customs that are unique to the Indian culture that in spite of rapid urbanization and subsequent increase in crime, the proportionality between the two is not yet exponential.

Fig. 1: Spatial Pattern of Crime in Urban India, 2011



Source: NCRB, Govt. of India

According to the National Crime Records Bureau, Ministry of Home Affairs, GOI's compendium "Crime in India", 2011, a total of 4,75,369 cognizable crimes under the IPC were reported in 53 mega cities during the year 2011 as compared to 3,68,883 crimes in 35 mega cities during the year 2010. The cities of Delhi, Kanpur, Mumbai and Bengaluru have accounted for 9.9 per cent, 7.3 per cent, 6.7 per cent and 6.3 per cent respectively of the total crimes reported from 53 mega cit-

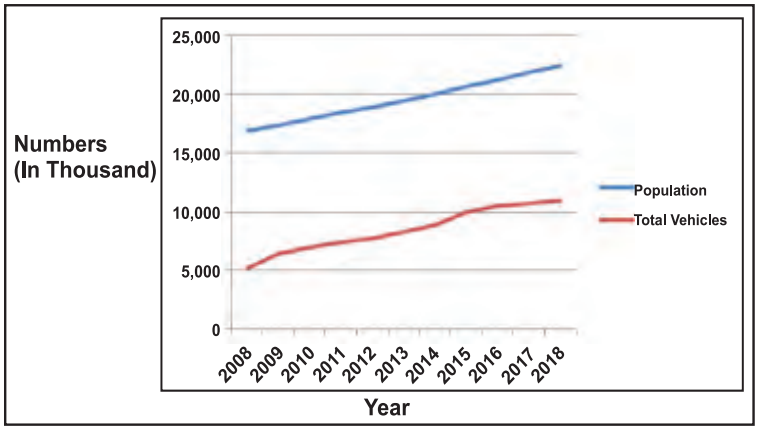
ies. Asansol (West Bengal) has reported a significant increase of 83.7 per cent of IPC crimes as compared to the previous year (2010) while in 13 cities; the decline of IPC crime is reported. The average rate of crime in urban agglomeration centers was at 295.1 which were much higher than the national crime rate of 192.2. Kochi reported the highest crime rate of 1636.4 among the mega cities in the country followed by Gwalior (709.3) and Durg - Bhilainagar (683.0). The crime rate for each city is compared with the corresponding crime rate of the domain state in the crime rate (IPC) in cities was generally higher than the corresponding crime rate of domain state. The crime rate was lower than that of the respective domain state in case of Chandigarh, Chennai, Coimbatore, Delhi (city), Hyderabad, Kannur, Kolkata, Kozhikode, Madurai, Malappuram, Mumbai, Surat, Thiruvananthapuram, Thrissur and Vasai Virar. The crime rate at national level increased by 2.5 per cent (from 187.6 in the year 2010 to 192.2 in the year 2011), however, the crime rate in cities has decreased by 13.7 per cent (from 341.9 in the year 2010 to 295.1 in the year 2011). According to the census of India, 2011, Maharashtra is the most populated urban state in India followed by Uttar Pradesh and Tamil Nadu.

The capital city of India has been blatantly termed many times as the crime capital of India based on the reports depicting the sharp rise of crimes (Table - 2) on various occasions throughout the city. But crimes in Delhi are no more limited to scattered incidents caused by outsiders / terrorists; instead, it is more about the city's socio-economic imbalances, lack of education, urban anonymity, disproportionate gender ratio, overpopulation, unemployment, poverty, corruption, inadequate policing, lack of police patrolling, deteriorating moral values, loopholes in legal systems, etc., and rapid urbanization too has led to certain factors which certainly have a bearing on the crime rate in the city.

Table 2: Data Related to Population, Vehicles and Total Number of Crimes

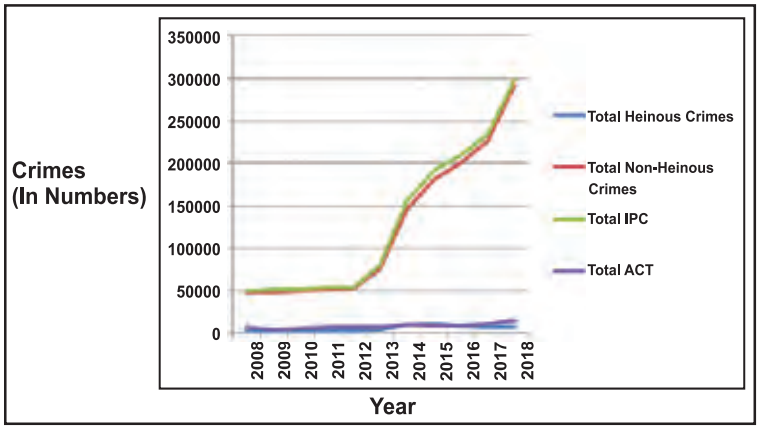
Years	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Population	16,955	17,437	17,935	18,451	18,983	19,529	20,092	20,676	21,285	21,896	22,523
Total Vehicles	5190	6450	6930	7440	7770	8290	8810	9970	10480	10750	10980
Total Heinous crimes	2069	2027	2085	2171	2402	4159	10266	11187	8238	6527	6925
Total Non-Heinous	47281	48224	49207	51182	51885	76025	145388	180190	201281	227053	291745
Total IPC	**49350**	**50251**	**51292**	**53353**	**54287**	**80184**	**155654**	**191377**	**209519**	**233580**	**298670**
Total ACT	6754	4053	4667	5896	6080	6616	9908	8599	7401	11134	14134
Grand Total	56104	54304	55959	59249	60367	86800	165562	199976	216920	244714	312804

Fig. 2: Population and Total Number of Vehicles



Sources: Census of India, NCRB, Govt. of India, Transport Department, Govt. NCT Delhi

Fig. 3: Total Number of Heinous and Non-Heinous Crimes



Sources: NCRB, Govt. of India

Figure 2, gives the total population and the total number of vehicles are showing an upward trend during the period of study. Looking at figure 3, it depicts that total crimes under non-heinous category and IPC has been steady till 2012 but suddenly there has been an Exponential jump in these crime rate graph till 2018 (Fig. - 3). But looking at total heinous crime and ACT, it has been seen that they are at a very lower rate than the other counterpart. This can also be observed in Table 1.

Apart from this, the regression equations have been applied in order to trace the relationship among the increase in population and number of vehicles with a total number of crimes.

Total Number of Crimes = a + b_1Population + e 1

Total Number of Crimes = a + b_1Vehicles + e 2

Total Number of Crimes = a + b_1 Population + b_2Vehicles + e 3

As per Table 3, it is very evident that the three models which have been framed considering a total number of crimes as dependent variable and population and vehicles as an independent variable. It has been reported in Table 3 that as per

Table 3: Three Regression Models Results

Equation No. (Model)	1	2	3
R-Square	0.8989	0.844163	0.91072
Adjusted R-Square	0.8877	0.826848	0.88845
Constant	-806101*	-243251*	-119470*
Population	48.1081*	-----	82.3722*
Vehicles	-----	45.0089*	33.5063*

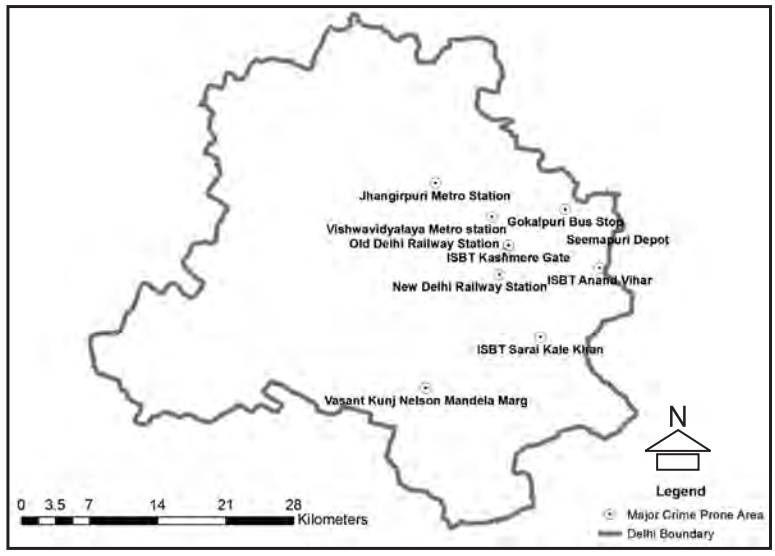
** P-values are found to be Significant at 1per cent significance level*

equation 1, 2 and 3, the r-square and adjusted r-square is coming out to be more than 0.80 and indicates that the model is a good fit. Further, the beta coefficient in model - 1 for the population is 48.1081, indicating that the population is actually contributing to increment in a total number of crimes. As per model - 2, the beta coefficient of vehicles is 45.0089, indicating that an increase in the number of vehicles is actually contributing to increment in a total number of crimes. Further, taking into account the model - 3, the beta coefficients of the population is 82.3722 and for vehicles it is 33.5063, indicating that increase in a number of vehicles, as well as a population, are actually contributing in increment in the total number of crimes. These coefficients are found to be statistically significant at a 5 per cent significance value.

The capital city, Delhi has been grappling with the problem of a variety of crimes - murders, rape, kidnapping, abduction, street crime, hate crime, honour killing etc. In this context, for detailed study, we selected top ten hotspots, on the basis of available literature, people perception, NCRB report, newspapers, research work, articles published and unpublished data and information. A list of major hotspots which witnessed severe crimes in last 5-10 years was selected are - Anand Vihar ISBT / MS / RS, Seemapuri BS, Gokalpur BS, Old Delhi RS, New Delhi RS, Nizamuddin RS and Saraikalekhan ISBT, Kashmiri Gate ISBT / MS, Vishvidyalaya MS, Jahangirpuri MS and Vasantkunj (Nelson Shopping Centre) BS (Fig. 4). A detailed study of the micro environment, location, layout, design, people perception, people income, police mobility, employment structure, literacy, gender, caste and religion, infrastructure, etc., were carried out and discussed in the context of spatial, temporal and multi-layer analysis.

This study was based on field survey as there was hardly any reliable secondary data available at the micro spatial level on crime. The available secondary data can't be claimed reliable, as it is seen that not all of the victims report crimes. However, to understand the general trend and pattern of crimes in Delhi, the secondary data was collected from the reports of the National Crime Record Bureau, police records and other agencies. Apart from under-reporting on crimes and distortion in official crime statistics, it was very difficult

Fig. 4: Transit Places for Major Hotspots of Crime



Source: based on primary and secondary published data

to get crime data for a particular place from police records. To overcome this challenge detailed questionnaire along with verbal information were given to the participants explaining them the meaning of crimes before filling up the questionnaire. Only those respondents were approached who were familiar with the place for at least 10 years and their ages is 18 years and above. With the help of this data, a list of crime-prone area for different locations of Delhi was prepared, and top ten major crime-prone areas or hotspot were selected. These transit places are either highly busy or were in news recently for heinous crimes. Total of 250 respondents from every 10 places was interviewed based on a structured questionnaire. The data for the micro physical environment was also collected by making inventory map of dark / isolated places, open / close parking, forest, bushy patches, crowed area and installation of surveillance devices, etc., for each identified stations / stands. An inventory was prepared in the dimensions of 500 meters from the centre of all transit places. Finally for preventing or minimizing crimes a planned and re-designed map for each surveyed place was prepared. The GPS, Satellite imagery and GIS technique were used for mapping of micro-environment in and around the selected transit places. To understand the patterns of crimes at ten different hotspot / stands the opinion of the people were taken.

6. MICRO-ENVIRONMENT OF THE HOTSPOT

To plan and design a place, it is necessary to understand the land use pattern, its management, surveillance mechanism (natural and digital) and social organizational structure. With this perspective, an inventory of each of the selected hotspots was prepared. A brief account is as under:

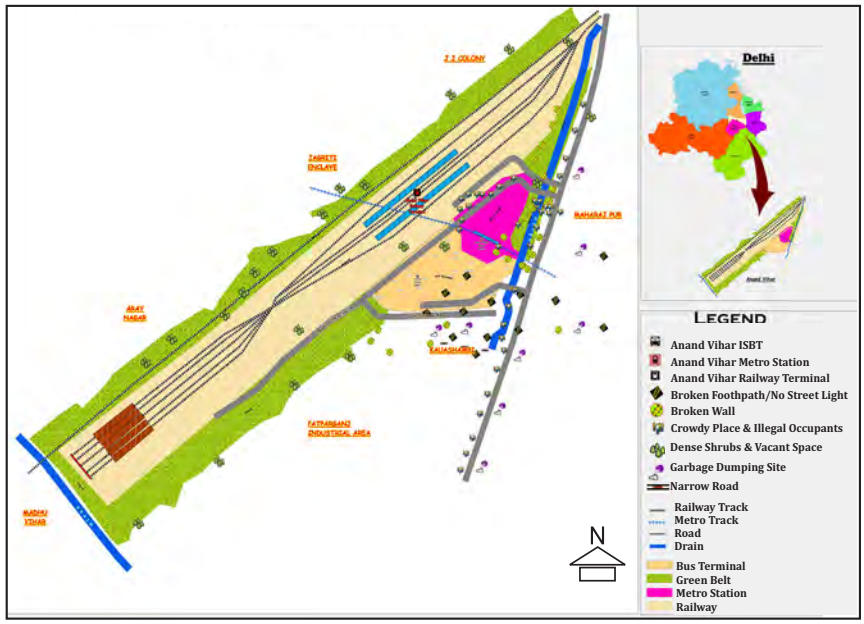
6.1 Anand Vihar (Bus, Rail and Metro Terminal)

It is located in East Delhi district near Uttar Pradesh border. Inter-State Bus Terminal, Metro and Railway Station are located here. It is amongst the busiest transit place in Delhi surrounded by bushy / forest area in the south and west, an open unmaintained plot in the north and Outer Ring Road (ORR) and Sahibabad industrial area in the east. There are many unmaintained patches and vacant plots in the Sahibabad Industrial Area. Buses are parked in the Inter-State Bus Terminal (ISBT) without security arrangement and surveillance devices. Parking near Rail and Metro terminal looks like a temporary arrangement without fencing and security arrangement. There are many uncared dark areas and abandoned buildings within the terminal boundary with no proper electric lights and digital surveillance devices. Wide-open unmaintained sewers drain with small tree / bushes alongside it is running between the terminal and outer ring road (Fig.-5). Crowding at ORR is a common feature during peak hours. It is a high crime-prone place where pick-pocketing and snatching are the most prevalent.

6.2 Seemapuri Bus Terminal

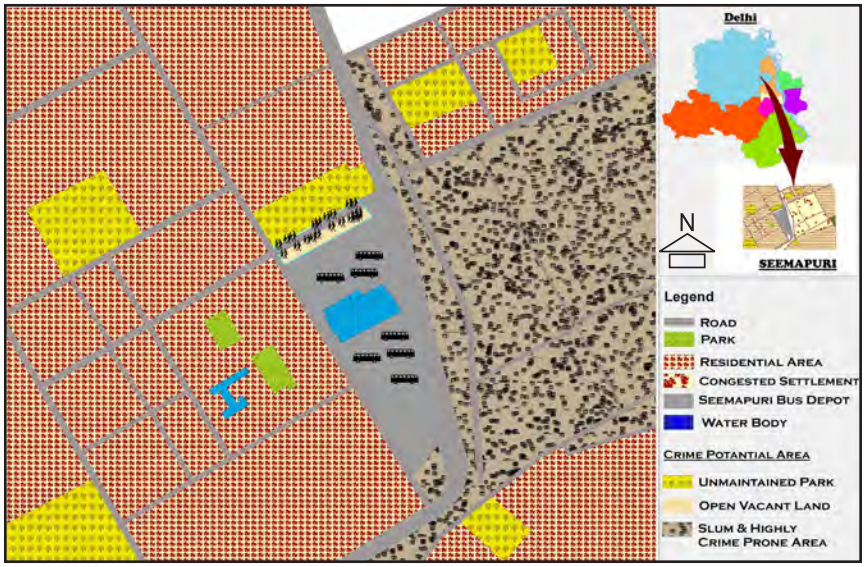
It is located in north-east district on the outer ring road and is close to UP border. On both sides of the ORR, there are unauthorized colonies. Many unplanned Jhuggi Jhopri (JJ) clusters have come up along the western side of the road. A dense economically low-class residential colony is present in the east. With the poor arrangement of lights, no surveillance devices, dark patches and crowding at the bus stop, pick-pocketing and snatching incidents (53 per cent) are high here. Relocation of JJ from parks, and public places and provision of CCTV Cameras, proper maintenance of encroached parks, illumination of the whole area and police surveillance are necessary to prevent / control crimes at this place (Fig. 6).

Fig. 5: Transit Place for Crimes at Anand Vihar ISBT / Railway Station



Sources: Google Earth, 2018 and GPS Survey

Fig. 6: Transit Places for Crimes at Seemapuri Bus Depot

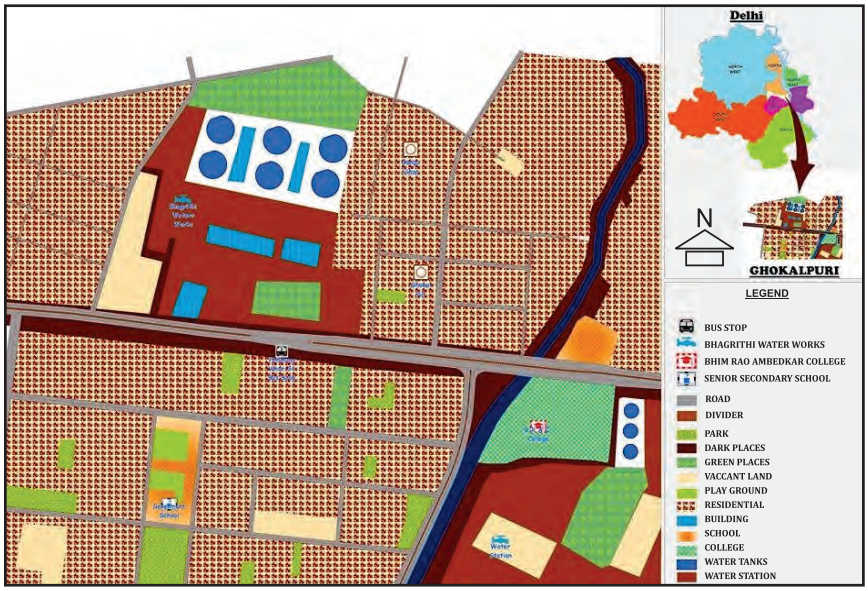


Sources: Google Earth, 2018 and GPS Survey

6.3 Gokalpur Bus Stand

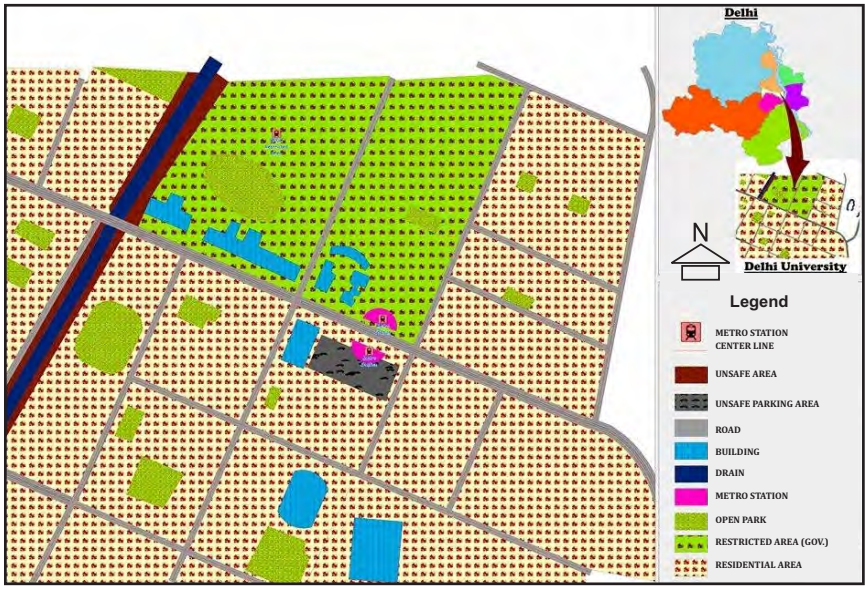
This bus stand is located near Gokalpur urban village and is close to Dr. Bhim Rao Ambedkar College, Sarvodaya School and a newly established Gokalpur Metro Station. An economically low class dense residential colony is present in the north. Within 500 m in the south many vacant plots, unmaintained graveyards, open drains alongside the road are present. Faulty design of fly-over on the roundabout blocks the visibility on both sides. Such features create fear of crimes particularly in the college students and school children. This area needs

Fig. 7: Transit Places for Crime at Ghokalpur



Sources: Google Earth, 2018 and GPS Survey

Fig. 8: Transit Places of Crime at Delhi Unvesity



Sources: Google Earth, 2018 and GPS Survey

proper monitoring of graveyards along with illumination, digital surveillance and creating visibility across the flyover (Fig. 7).

6.4 Vishwavidyalaya Metro Station

It is established in a well-planned and maintained area in comparison to the other transit places. There are few bushy patches and vacant, unmaintained and abandoned parking area here which creates fear of crime at this place. The area along the Nazafgarh drain is not maintained properly, darkness at night creates fear of crime to the visitors. It needs a proper arrangement of electric lights and regular digital surveillance. Here non-serious crimes like snatching, abuse, pick pocketing, smoking and drinking are prevalent; this is as per the perception of the people. (Fig. 8).

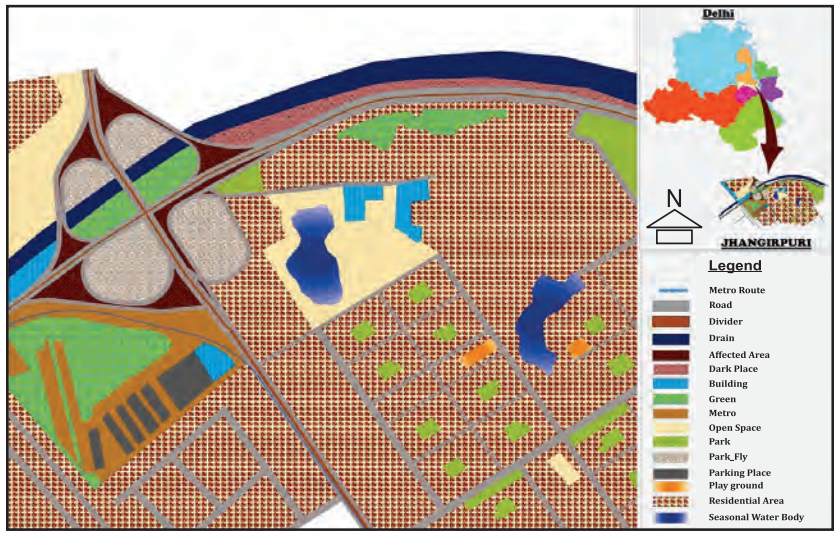
6.5 Jahangirpuri Metro Station

Located in north Delhi, this place is surrounded by the economically low-class residential colony and JJ cluster in the north-east. In the south, there is a vacant plot and a major transport corridor. The unmaintained vacant plots, lonely bushy area and situated near Haryana makes it a suitable hotspot for crime. Areas under major trilateral fly-over called outer Circle Bypass require proper digital surveillance and police monitoring. (Fig. 9).

6.6 Old Delhi Railway Station

This is a very busy transit place and people from diverse socio-economic background arrive here. Presence of tea corner near parking, crowding outside the station and area near foot-over Bridge is considered to be crime-prone in the night. Although railway platform is well under surveillance, however areas along rail tracks need proper maintenance, fencing and installation of digital devices.

Fig. 9: Transit Places for Crime at Jhangirpuri

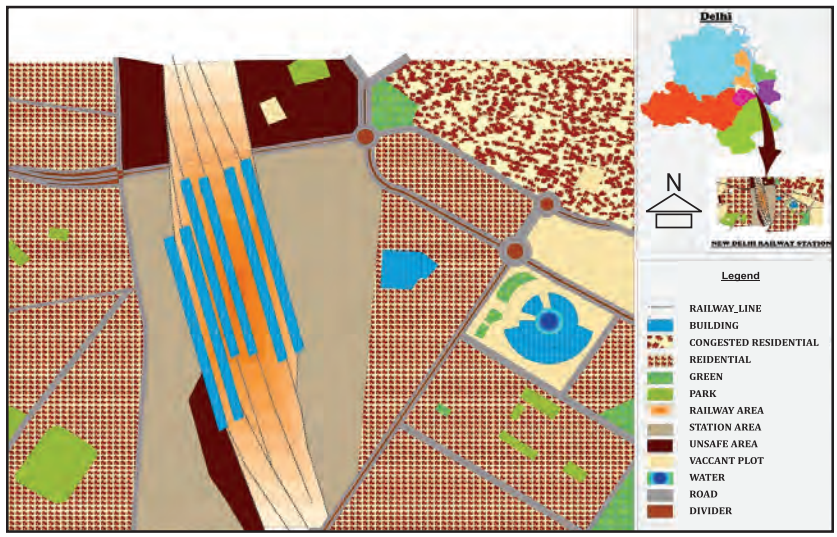


Sources: Google Earth, 2018 and GPS Survey

6.7 New Delhi Railway Station

The entrance at New Delhi is from two sides; Paharganj and Ajmeri Gate. The area in front of railway station towards Paharganj is perceived to be more fear-full due to un-monitored crowding of the general public, auto and manual rickshaw, a shelter for diversified people like *matkawala*, rail hawker, etc. The platform is considered safe by the respondents but the areas along the railway line attract crime due to unmaintained and abandoned railway boogies. Therefore, areas along the railway line should be cleaned and maintained with proper illumination and installation of the CCTV cameras and proper fencing (Fig. 10).

Fig. 10: Transit Places of Crime at New Delhi Railway Station

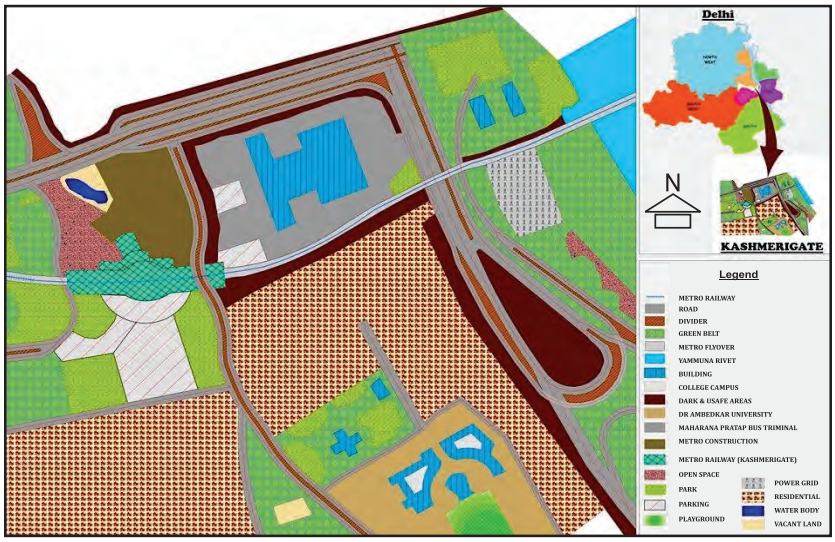


Sources: Google Earth, 2018 and GPS Survey

6.8 Kashmiri Gate Terminal ISBT / Metro Terminal Station

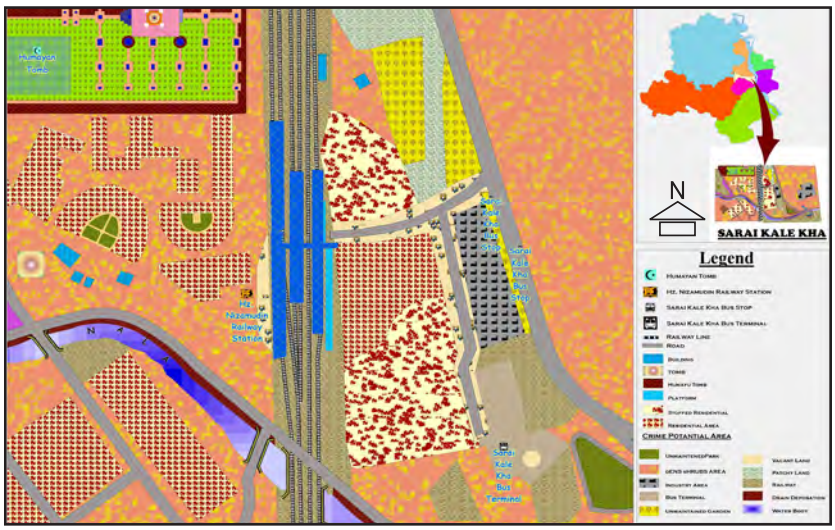
In a diameter of 500 m, the highest crime hotspot is the places under the flyover and the parking lots. There are many dark places which create fear in public due to improper lighting and poor maintenance. It is a crowded place due to the interchange point of commuters of bus, metro and rail. The bus parking has

Fig. 11: Transit Places of Crime at Kashmerigate



Sources: Google Earth, 2018 and GPS Survey

Fig. 12: Transit Places of Crime at HZ. Nizammudin R.S. and Sarai Kale Kha ISBT



Sources: Google Earth, 2018 and GPS Survey

many dark corners, which requires monitoring through the digital device with a camera. The area under and along the flyover should be maintained through the clearing of bushes and trees and installation of digital devices along with the high density of police patrolling in the night (Fig. 11).

6.8 Nizamuddin Railway Station and Sarai kale Khan Bus Terminal ISBT

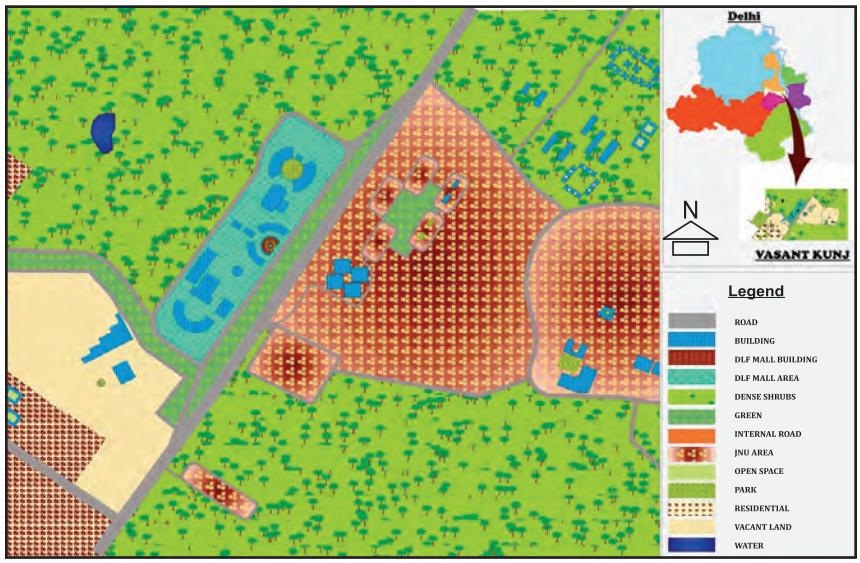
The entrance area of the station is very crowded without proper monitoring by the traffic police. There are bushy and dark places behind the industrial site, which needs to be pruned so that the area can be lighted up and the visibility can be maintained. CCTV cameras should be installed. The belt along the Yamuna River is highly crime-prone and the road leading to Nizamuddin Railway Station from ring road is prone to snatching and pick-pocketing. Crowded streets should be monitored properly by CCTV cameras. Parks and streets should use surveillance devices to prevent crime (Fig. 12).

6.9 Vasant Kunj (Nelson Shopping Center) Bus Stand

This place has wide un-landscaped patches along the roads without surveillance devices and proper light at night. The divider is wide and rough. At night the whole area gives a deserted look which is favorable for criminals to commit crimes. Within 500 m from this place, there are open wide areas with bushes and tree without fencing and surveillance device. Therefore, there is a need for proper

fencing, the arrangement of lights, pruning of trees and bushes to enhance visibility and landscaping of patches along both sides of the road. This will prevent criminals from committing crimes and will remove fear from the mind of the general public. (Fig. 13).

Fig. 13: Transit Place of Crime Vasant Kunj



Sources: Google Earth, 2018 and GPS Survey

It is observed that the major crime-prone area in perused then in north-east: Seemapuri, Usmanpur, Mustafabad, New Usmanpur, Kalyanpuri, in western part; Najafgarh, Dabri, southern: Vasant Vihar, Najafgarh and northern part Jahangirpuri, Bhalswa Dairy, Wazirpur, etc., comes out as prominent. It is seen that the areas lying on the borders are most prone to crime. These are places where criminals from Uttar Pradesh and Haryana find a safe haven. It is easy to move from Anand Vihar, Kalyanpuri to Noida and Ghaziabad and from Jahangirpuri, Sultanpuri to Jhajjar or Sonepat. It is found that there are no changes in the ascription of offenders during two time periods. The detail ascription of criminal in relation to crime hotspots of the city are given in Table - 1.

7. CRIMES AT THE PLACES

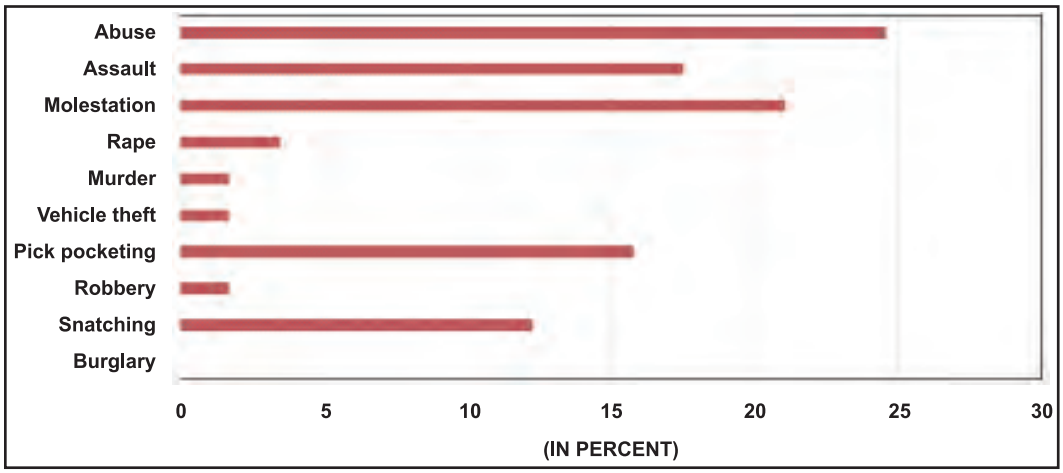
On the basis of the primary data based on the perception of respondents, the types of crimes frequented in the hotspot areas are - Burglary, Snatching, Robbery, Pick pocketing, Vehicle theft, Murder, Rape, Molestation, Assault and Abuse. However, about 85 per cent of respondents perceives that crimes which took place in the transit places are less serious in nature i.e., pick pocketing, assault, abuse, etc. Only about 13 per cent of the respondents observed that murder, rape, molestation are serious crime but have comparatively less presence. It has been recorded that the incidents of crime vary from place to place as per neighboring conditions of the transit places. The majority of the incidents represent non-serious crimes.

Anand Vihar Transit place stands first among all of the above-mentioned crime spots and it could be due to the floating population, vacant plots / isolated places, bushy areas nearby the transit place and being adjacent to the Uttar Pradesh border. Less of surveillance and patrolling of cops were also observed to be the reason for the high level of crime. As per the perception of the respondents pick

pocketing, snatching, assault and abuse are the incidences which are recorded at higher side. Among all the transit places the presence of all sorts of crime was recorded at a low percentage in Old Delhi and Nizamuddin. The reason for less crime was because of well-illuminated roads, public awareness, electronic surveillance and lack of vacant place and dark spaces, well-maintained parks and less blind corners. Rape, murder, robbery and burglary were recorded lowest among all of the crime cutting across all the transit places, the reason for this could be that there is no easy way of escaping due to the crowded area, police post, and vigilance, etc.

These are the crime like Abuse (24 per cent), pick pocketing (17 per cent) followed by snatching (13 per cent), assault (18 per cent), while burglary is the lowest (0.14 per cent) were very familiar in most of the crime hotspots (Fig. 14). The spatial pattern of crimes at hotspot places, like pick pocketing

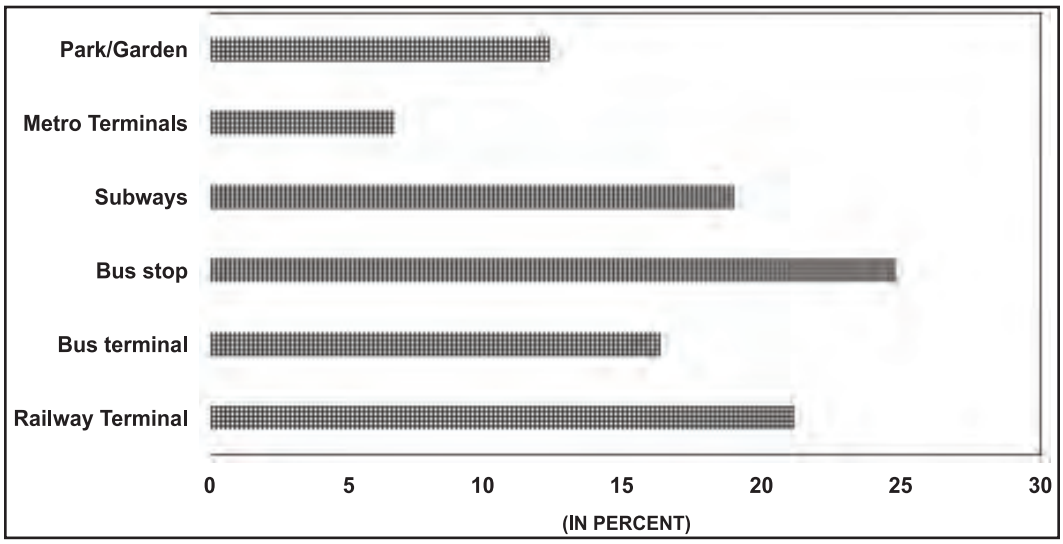
Fig. 14: Average of Different Types of Crime



(27 per cent) has been reported highest followed by snatching (26 per cent) at Seemapuri Bus terminal, whereas snatching is lowest at Vishwavidyalaya Metro Station as well as New Delhi Railway Station (12 per cent each). Among all, the highest incidence of molestation was recorded at Vishwavidyalaya Metro Station (21 per cent) followed by Vasant Kunj (NSC) Bus Stand, both come under posh areas.

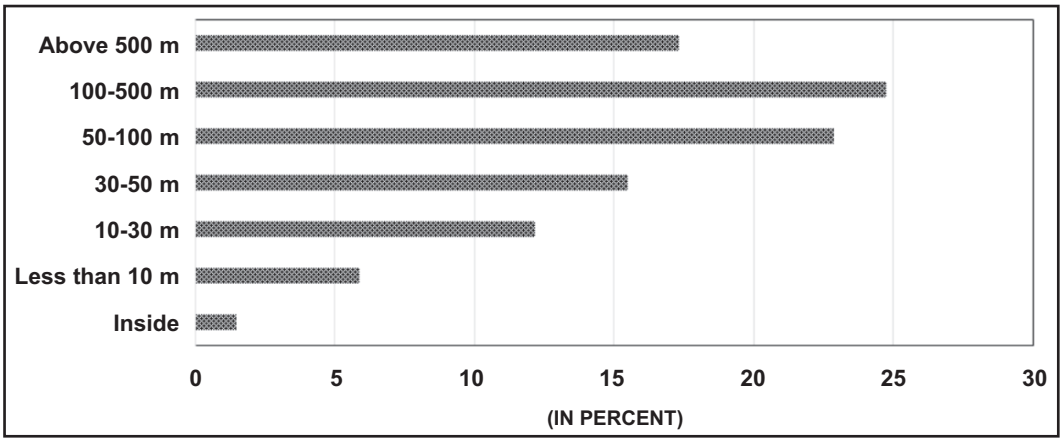
The overall study shows that Bus Stands are most vulnerable to crime (25 per cent) as they are neither patrolled by police nor have well-maintained surveillance devices. Next is Railway Station (21 per cent), followed by bus terminal-ISBT (16 per cent) because it is under surveillance by the terminal authorities and covered by boundary walls, whereas the Metro Stations (7 per cent) had less crime due to availability proper special security personal and monitoring through digital Surveillance devices (Figure 15).

Fig. 15: Major Hot Spot of Crime (Potential Area for Crime)



Above discussions reveals that most of the crime (24.72 per cent) occurred in 100 to 500 meter from the railway / bus / metro station. The 22.88 per cent crime occurred in 50 - 100 meter, and very less crime occurred inside the bus stand, railway station and metro station (Figure 16). The Table - 1 shows that maximum (83 per cent) crimes occurred within 500 meters from the major hotspots after that crime decreased.

Fig. 16: Proximity of Crime (Crime with Distance)



Anand Vihar stands first among all of the above-mentioned crime hotspots and it could be due to the tri-junction of railway-metro and buses terminal. Due to tri-junction the area known as the high mobility of people, the floating population from the different direction and vacant plots / isolated places, bushy areas nearby the hotspot and being adjacent to the Uttar Pradesh border are the features, which make it crime-prone and hotspot of this region. Less

of surveillance and patrolling of cops were also observed to be the reason for the high level of crime. This is observed that pick pocketing, snatching, assault and abuse are the frequent incidences which are recorded at a higher rate in this places, whereas the hotspot like Old Delhi and Nizamuddin recorded less crime compared to other places. The reason for less crime was because of well-illuminated roads, public awareness, electronic surveillance and lack of vacant place and dark spaces, well-maintained parks and less blind corners. Rape, murder, robbery and burglary were recorded lowest among all of the crime cutting across all the hotspot places, the reason for this could be that there is no easy way of escaping due to the crowded area. Through the above discussions, it can be said that the modification of the built environment can reduce the incidence of crime and promote community responsibility. The planning and design of a place play an important role in choosing a place to commit a crime by the offender.

8. CONCLUSIONS

It is observed that physical micro-environment and layout designs of transit places have an impact on the incidences of crime. The places surrounded by economically low-class residential colonies, JJ clusters, low-income group, low literacy, poor infrastructure, less police patrolling have a high incidence of crimes. As per the assessment of responses, non-serious crimes like pick-pocketing, snatching, assault, abuse, etc., are more prevalent than serious crimes like murder, rape etc. Crowded areas, isolated places / shades and vacant plots are crime hot-spots. Crime increases with distance from the location to up to 500 m after that it decreases. People believe that most of the crime occurs within 500 meters from the bus / railway station. The incident of crimes is high in the first half of the night. Crowding, isolated places and vacant plots are potential areas of the crimes.

Thus, to tighten the noose on crimes happening across the city, a smart solution to monitor the city-wide crime situations via a real-time intuitive crime map which can pinpoint the crime hotspots in areas across the city are recommended. Therefore, enabling the policy makers, security officials to get a firm grip on the crime scenarios, to take strategic governance initiatives and as well as raise awareness among the citizens on the where abouts of the crime that took place. It is true that police and authorities of transit places should cooperate to control crimes, however proper planning, designing and surveillance provisions in and around hotspots play an important role to prevent or minimize the incidence of crimes. The socio-economic conditions are equally important, but the goal should not be just to reduce crime but to improve the quality of life of the people which only makes society crimeless.

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Institute of Town Planners, India Journal 18 x 3, July - September 2021 ISSN:L0537-9679

Provisioning Urban Toilets: Perspectives from Smaller Cities

Vivekanand Gupta

Abstract

The efforts of augmenting toilets in urban areas have seen a major spurt in recent years. This article presents an analysis of challenges in augmenting toilets and improve accessibility closely observed in three mid-sized north Indian cities during 2018-2020 under 'Engaged Citizens Responsive City Program', good practices and the ways forward. Some of the accessibility challenges include insufficient coverage and unavailability of facilities to women and maintenance issues. Planning for city-wide public and community need a more scientific approach using geographic information systems. Augmentation of individual toilets requires a major fix through a citizen owned data and some programmatic interventions for both ODF and non-ODF cities. Engaging citizens is a must to bring a behavioral change contextual to safe management of septage, for which participatory methods of learning may prove to be a boon.

1. INTRODUCTION

In past few years 'toilets' have precipitously become a topic of common discussion as well as policy discourse. As per November 2020 data of Swachh Bharat Mission (SBM) Urban, the number of completed Individual Household Latrines (IHHL) has crossed 62 Lakh, while over 5.9 Lakh public and community toilet seats have been completed. 4,327 cities have been declared open defecation free. Number of Open Defication Free Plus (ODF+) certified urban local bodies stands at 1,632 across country whereas ODF++ certified towns are 489 (SBM Urban 2020). With commencement of Pink Toilets, a resound realization have emerged towards sanitation needs of women. The whole sanitation ecosystem is witnessing a new sense of urgency to keep cities clean (clear) of human waste. An exploratory observation of this journey of cities towards clean cities, which still seems to be walking beginning miles, identifies many nuances requiring a multifaceted thrust. Engaging citizens, creation of citizen owned data, capacity building are some of the emerging themes along with the policy and program oriented fine-tuning and an altered approach. Under European Union supported 'Engaged Citizens Responsive City' program many nuances from cities of Ajmer, Jhansi and Muzaffarpur have been captured. These nuances are further co-related to the planning, programmatic and policy elements for provisioning of urban toilets and presented in this article.

2. ACCESS TO PUBLIC TOILETS

Public toilets have a great role to play in making cities free of open defecation (and urination) in the true sense. Additionally, public toilets should also be

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credited for their contribution to public-health by preventing ill-effects that could have been caused in their absence. Availability of public toilets should be looked from two dimensions i.e. one, availability of facility blocks at all necessary places, like markets, major roads, transport nodes; two, accessibility of facilities for women, children and differently-abled persons. The coverage of whole city with public toilets seems to be an unfulfilled wish with many wards still remaining to be covered. In the front of accessibility, a completely paradoxical supply scenario is observable in cities of Jhansi, Ajmer and Muzaffarpur. Women, whose sanitation needs, are different than men; find that the facilities are grossly inadequate. For example, in cities of Ajmer and Muzaffarpur, 90% of the urinals are only for men. There is a need to add construction of seats for women in the SBM's national monitoring framework. Only 6 % of the public and community toilets have enabling features for differently abled persons. Most operational facilities in cities need to be equipped with enabling features for differently abled adults and children.

3. COMMUNITY TOILETS

It was revealed in NSSO's *Swachhta Status Report 2016* that community toilets are used by only 46 percent persons of households not having sanitary toilets. In states like Rajasthan and Bihar this was found below 10 percent. There are two major reasons behind low usage of community toilets. One is the lack of facilities and other is poor condition of maintenance of existing facilities. For planning of community toilets, the most practiced approach has been augmenting one community toilet block for each informal settlement, which may be disregarding the geographic aspect of proximity. Whereas, a geographic analysis based approach by using GIS can suggest the optimum numbers and locations of community toilets. Under Engaged Citizens Responsive City (ECRC) program, Participatory Research in Asia (PRIA) attempted to support urban local bodies through preparing indicative plans for locating public and community toilets in a rational manner in the three cities.

For sustainability of sanitation facilities created the most critical requirement is the sense of ownership among users (Dasra and Forbes Marshall 2012). In the initiative lead by Gramalaya in Tiruchirappalli, the ownership was created through mobilising community members for taking care of community toilets they used (Bedoshruti, S. Ritu, T and Soumya, C. 2012). As a result of continued engagement under ECRC program, community members took the initiative to renovate and maintain a defunct community toilet in Muzaffarpur. A policy provision at local government or state level can pave the path of a systematic change in this regard.

4. INDIVIDUAL HOUSEHOLD LATRINES (IHHL)

The survey in Ajmer, Jhansi and Muzaffarpur shows that for over 70, 80 and 90 % households respectively the insufficiency of funds is a major reason for not having

toilets. Another major finding revealed low instances of application by needy households and very high instances of rejection of applications by the urban local bodies (Participatory Research in Asia, 2018). Such findings hint towards need of a robust system of identifying and providing hand-holding support to the households and provision of alternate mechanism of funding the gap. In Ajmer, an example of pooling finances from local affluent persons was witnessed. The implementation approach for IHHL should now shift to a pro-active one from a reactive one. The ULBs should search and locate the houses not having individual toilets where construction is feasible to build the IHHL and register them for the desludging service in future. The issue of households of ODF declared towns which are still lacking an individual toilet; need to be addressed through a program centered approach.

5. CREATION OF CITY LEVEL DATA BASE

An urban observatory at Ministry of Housing and Urban Affairs was launched in the month of March this year (Press Information Bureau, 2019) to promote the data driven governance. Its contribution in improving basic urban amenities like toilets is yet to be seen. In the meanwhile, the potential of citizens to collect the authentic data should be acknowledged by the policy focusing on augmentation of toilets. The 'citizen owned data' has many advantages, with appreciation of issues being first of them. Localized mechanisms of 'citizen owned data' (collected by citizens themselves) covering critical aspects of program like number of toilet-less houses, need of new public and community toilets based on their geographic analysis would provide a concrete data on the real time standing of mission vis-à-vis targets. For such an atmosphere, a two-fold push will be required - one, capacity enhancement of citizen groups of community and two, setting up a system of aggregating data to feed into the national level observatory.

At a macro level, a spatial data base of informal settlements is required to effectively deliver social protection programs and basic amenities covering toilets. This will help in customizing program elements like benefits, target definition and targeting methods as per the settlement characteristics. Nonetheless, the basic structure of programs should lay a foundation for practicing this approach at the ground. In El Salvador, informal settlements (named as precarious settlements) have been classified as per the vulnerability (World Bank, 2012).

6. REGULAR DESLUDGING THROUGH EFFECTIVE CITIZEN ENGAGEMENT AND BEHAVIORAL CHANGE

The surveys conducted in Ajmer, Jhansi and Muzaffarpur brought to light that 48-86% households never emptied their septic tanks (Participatory Research in Asia 2018). This indicates an enormous intervention to protect soil and water of cities from being polluted by the unsafe disposal of untreated faecal matter. Many interventions on Feacal Sludge and Septage Management (FSSM) have

been undertaken in recent years through multiple resources including Bill and Melinda Gates Foundation (BMGF) funds. The element of citizen engagement in such initiatives seems to have substantial potential of strengthening. Discussions at multi-stakeholder forums in Jhansi revealed that mere notifications of compliance are not enough to ensure regular emptying of septic tanks. In the present scenario, citizens are not convinced about the need of emptying septic tanks in 2-3 years horizon if it is not full. The concepts like 'efficiency of septic tank', 'poor quality of effluent', 'faecal matter impacts health' seem to be beyond understanding of a common urban citizen including urban poor. Therefore, all programs on faecal sludge management should be informed that without citizens being convinced that quality of water flowing in the drain outside their homes affects their health and they should de-sludge the septic tank even when it is not full, it is not possible to have the actual buy-in of urban citizen.

The change in behavior of a large portion of households of cities partially or fully dependent on on-site systems is required to make regular de-sludging of septic tanks happen. The need of inducing behavior change at a large scale calls for educating citizens on the above-mentioned aspects. This can be effectively achieved through collective learning using participatory approaches. A mechanism to incentivise citizens for scheduled emptying of septic tanks can also be tried at ULB level. List of properties from the property tax data base may be a starting point to prepare a comprehensive data base of toilets and their scheduled cleaning. Incentives through property tax or discounts on next desludging may attract people for a regular desludging. Some cities in Maharashtra, like Wai have already rolled in scheduled desludging services and are financing it through sanitation tax (CWAS CEPT University 2019).

7. CAPACITY BUILDING NEEDS

Capacity building is one of the six mission components of SBM (urban), which mainly talks about ULB officials' capacity building. Sanitation Capacity Building Platform (SCBP) recommended ULB, parastatal and sanitation agency's staff, senior ULB officials and elected representatives as targets for capacity building towards faecal sludge and septage management (NIUA 2017). However, a broader outlook at stakeholders' landscape, suggests that there are many others, who have a major role to play in improvement of sanitation situation in urban areas. Therefore, the programs on toilet provisioning should have a provision of capacity building of all stakeholders of the service delivery chain catering to its important nodes in entirety. Some of the stakeholders whose capacity building is very critical to the success of toilet oriented programs are masons, contractors, community based organizations, councillors, etc. It has also been experienced in cities like Jhansi and Ajmer that to aim such set of stakeholders an especially designed training pedagogy is needed.

8. CONCLUSIONS

Looking at the present status of provisioning of toilets and facilities of safe management of septage, it can be concluded that cities, especially smaller ones have a long way to go. Effective citizen engagement, citizen education, robust data systems and multi-stakeholder capacity building are needed to make the programmatic delivery more efficient. In addition to the program oriented thrust, a plan driven push is also necessary using statutory provisions of spatial planning.

Toilets, considering their role in city, should be made an integral part of cities' spatial plans (Master Plans or Development Plans). Location of public and community toilets are directly linked with the land use types like - slums and commercial areas. Locations of community toilets and public toilets can be identified using GIS platform of the spatial plans. Spatial plans need to incorporate analysis of off-site vs on-site systems based on factors like affordability for local governments, willingness to have and pay for such systems etc., Based on the suitability analysis, on-site systems or mix systems (off-site and on-site) with faecal sludge management and treatment infrastructure should be included in the plans.

Acknowledgement

Some of the findings presented in this paper have also been presented in 'Status Paper on Urban Toilets' written by the same author published by Participatory Research in Asia (PRIA).

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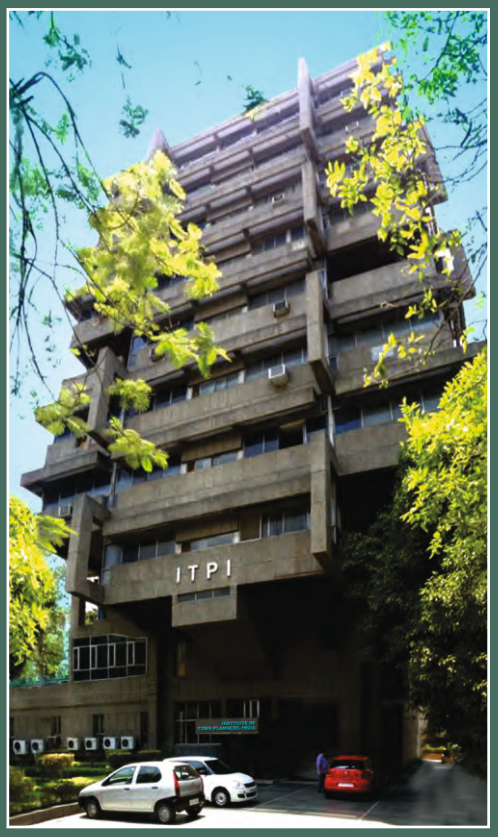

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Printed and Published by Pradeep Kapoor; Secretary General, ITPI on behalf of Institute of Town Planners, India, and Printed by Manav Enterprises, 455, Patparganj Industrial Area, Delhi-110092, Telephone - 011-42508488 and Published from 4-A, Ring Road, IP. Estate, New Delhi-110002, Telephone - 23702454, 23702457, 23702452
Editor Prof. Dr. Ashok Kumar, Secretary (Publication), ITPI