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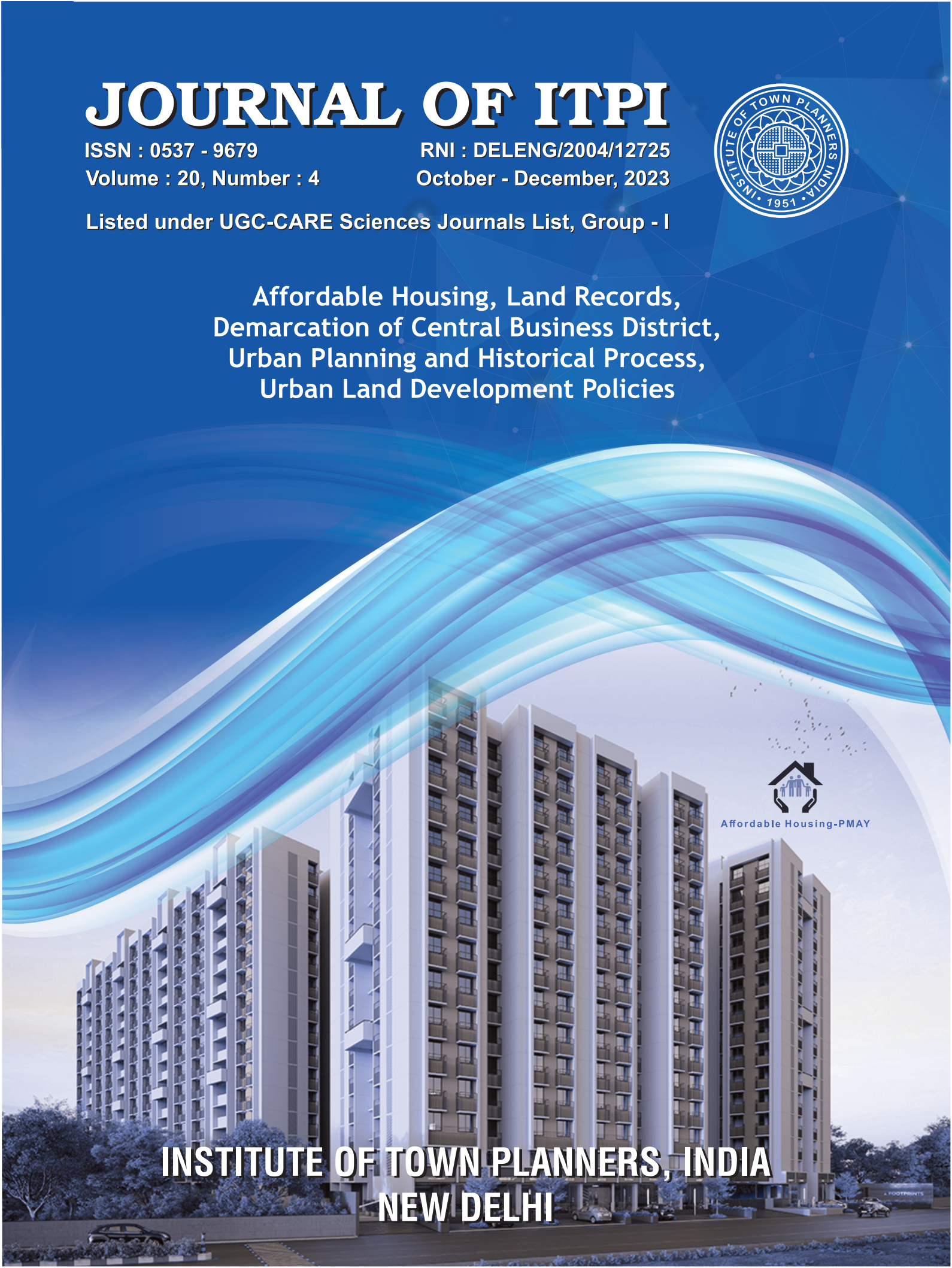
Affordable Housing, Land Records, Demarcation of Central Business District, Urban Planning and Historical Process, Urban Land Development Policies



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Editorial

Historically, land has remained a crucial component in the planning and development process in the cities and communities. Housing, transportation, and other infrastructure comes on it to serve the needs of different sections of the society viz., HIG, MIG, LIG, or EWS. Their requirements are so vivid that uniformity in provisions can not be even expected. Therefore, careful attention and thinking needs to be exercised while planning the human settlements. The present issue of Journal of ITPI addresses the concerns of affordable housing, land records, historical process of urban planning, sustainable urban form, central business district, eco-tourism, and environment.

The first paper by N. K. Patel on "Overview of Affordable Housing with Focus on Middle Class Housing" raises the issues and challenges associated with affordable housing. The author has unambiguously explained how the affordability of MIG Class for owning a house is worked out in normal and real conditions by taking account of his income Vis-à-Vis the project costing including the taxation and planning interventions.

The second paper by Ramakrishna Nallathiga on "Land Records and their Modernization in India: Status and Way Forward" highlights the importance of land records in the development and their management in urban and rural areas. The author lays down the evolution, structure and shortfalls of colonial land records system and significant changes occurring in the ICT enabled National Land Records Modernization Programme to facilitate the present-day land and real estate transactions.

The third paper by Tarisha Desai on "Urban Planning and Historical Process" attempts to understand the historical process in response to growing cities with specific reference to Coimbatore city. The paper highlights the incorporation/ non-incorporation of these processes in the current planning practice while looking at various Development Plan Reports.

Monica Kashkari and Tejwant Singh Brar in their paper on "An Overview of Sustainable Urban Form in Historic Cities" have stressed that the sustainability of the built form in a historic settlement encompasses the regeneration and conservation of the overall built environment. The paper addresses how various case studies, policies and programs to make a broad understanding of the sustainable urban form, current policy directives, and best practices and derive a road map of better planning of historic cities.

The fifth paper by Saurabh Jindal and Veruval Devadas on "Urban Land Development Policies in India: A Comparative Analysis" compares the land development laws, rules, and policies of Indian cities to reveal that existing land policies share common approaches, but their mechanisms and frameworks differ, leading to the selection of different development models. The paper recommends to develop an integrated approach to land development to achieve the objectives of the Sustainable Development Goals (SDGs). The authors stress that urban land development policies must foster resilience, inclusiveness, and a sustainable built and natural

environment to address the urban vulnerabilities to frequent disasters, disease outbreak events, and ecological sensitivity.

Kumud Dhanwantri, K. K. Yadav, Meenakshi Dhote, Kushagra Rajendra, and Ila Gupta in their paper on "Contextualizing Environmental Regulations for Improving Public Health and Community Wellbeing in Urban India", while investigating the effectiveness of green space zoning regulations, air quality standards, environmental and public health policies, and their impact on public health in Gurugram, highlight the critical need for adaptive environmental regulations that transcend a generic, one-size-fits-all approach. India's urban centres, characterized by heterogeneity in environmental stressors and socio-economic dynamics, demand tailored strategies to safeguard public health and enhance the overall wellbeing of their communities. Community engagement, awareness, education programs, socio-economic disparities, vulnerable communities, require targeted support and inclusive policies. The paper points that urban planning policies must prioritize creating and maintaining accessible green areas, conserve biodiversity and recognize the mental and physical health benefits of green spaces for urban dwellers.

The seventh paper by V. S. Sanjay Kumar, Shabana Yoonus and M. V. L. R. Anjaneyulu on "Demarcation of Central Business District of an Indian City: A Case Study of Thiruvananthapuram" have identified land price, number of establishments, and distance to the nearest railway station as the key parameters to demarcate the central business district of Thiruvananthapuram, the capital city of Kerala.

The eighth paper by Dr. Ritu raj and Dr. Ashwani Luthra on "Factors attributing to Crop Residue Burning and their contribution to GHG Emissions - A Case of Amritsar" have opined that the incomplete and open farm combustion of crop residues has resulted in pollution in the area and the entire region. The paper estimates the total residue burnt and reviews various reasons why the farmers burn the residues by taking the case of the Amritsar district of Punjab state. It also assesses the GHG contribution because of the residue burning. Further, it attempts to identify various reasons the farmers take these steps besides the national ban on residue burning.

Ashwani Luthra, Ph.D.
Editor & Secretary (Publication)

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161	Institute of Town Planners, India Journal	Institute of Town Planners	0537-9679	NA	from January - 2023 to Present	View
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From the Desk of President, ITPI, New Delhi

Overview of Affordable Housing with Focus on Middle Class Housing

Shri N. K. Patel

1. INTRODUCTION

Affordable housing is a term which has no defined meaning that is accepted universally. The definition changes from one entity to another. According to a report from RBI, "The ratio of housing expenditure to household income is used to measure affordability. Housing units can be classified as affordable if the ratio is less than some cut-off value. The choice of this cut-off is judgmental; however, as a thumb rule, it is taken to be 30 per cent". On the other hand, an article from Economic Times says that, "Affordable housing refers to housing units that are affordable by that section of society whose income is below the median household income".

The World Bank classifies the countries of the world Annually based on income levels. The Gross Net Income (GNI) per capita in USD is considered for the comparison. In comparison between South Asian countries, Maldives has the highest per capita GNI and was the first country to upgrade from lower, to lower-middle income group and Afghanistan has the least GNI and yet is in lower income classification. As per the stats of World Bank, India has paddled up form lower, to lower middle class in 2007, FY09. However, India has just surpassed the low-income threshold line in 2019-20.

In India, as per 'Confederation of Real Estate Developers' Association of India (CREDAI), affordable housing is provided for three sections of the society which are the Economically Weaker, Lower Income and Middle-Income Segment (table 1). The government of Gujarat considers parameters on the basis of income criteria for affordable housing. These include parameters like carpet area, layout, maximum selling price per unit (that includes all costs of construction but will not include maintenance deposit, registration, and insurance) and annual family income.

To buy a home, the said bands should not spend more than 30-40 percent of their gross monthly income as EMI.

The rapid urbanization rates in India not only boost the economy, but also lead to challenges that come along with it. The urban population has grown at a Compound annual growth rate CAGR of 2.8 percent over 2001-2011, resulting in an increase in the urbanization rate from 27.8 percent to 31.2 percent. Out of India's 1.21 billion population, 377 million people are urban dwellers. If a similar trend continues, 33.75 percent of the total population of India will be urbanized by the year 2020-21. Also, the Federation of Indian Chambers of Commerce (FICCI) estimates that by 2050, the country's cities would witness a net increase of 900 million people. Furthermore, over 2012-2050, the pace of urbanization is likely to increase at a CAGR of 2.1 percent- double than that of China.

***Shri N. K. Patel**; Urban Planner & Housing Expert*

Table 1: Parameters for Affordable Housing for Different income Groups

Parameter	EWS	LIG	MIG-I	MIG-II
Carpet area (sq. mtr.)	25-30	31-40	41-50	51-65
Layout	2 room, kitchen, bathroom, toilet	1 bedroom, 1 hall, kitchen, bathroom, toilet	1 bedroom, 1 hall, kitchen, (study room, children room/ dining area optional) bathroom, toilet	2 bedroom, 1 hall kitchen, bathroom, toilet, (study room, children room/dining area optional)
Maximum selling price per unit (that includes all costs of construction but will not include maintenance deposit, registration and insurance)	Up to Rs 3,00,000/-	Up to Rs. 7,50,000/-	Up to Rs. 11,00,000/- (if specifications are better or jantri rate is more than Rs. 12000/- sq. mtr.	Up to Rs. 22,50,000/-
Annual Family Income	Less than Rs. 1,00,000/-	Rs. 1,00,000/- to 2,50,000/-	Rs. 1,00,000/- to 2,50,000/-	Rs. 2,50,000/- to 5,00,000/-

This rapid urbanization leads to a shortage in the housing stock. As per the report submitted by a technical committee to the Ministry of Housing and Urban Poverty Alleviation (MHUPA), India's urban housing shortage is estimated at nearly 18.78 million households in 2012. Besides those 12 percent living in obsolescent houses, 80 percent of the households are living in congested houses and are in requirement of new houses. The report also stated that around 1 million people are living in non-serviceable/kutcha (houses made of local materials like bamboo, mud etc.) housing and over half a million are homeless. It is observed that the major problems in the housing sector are faced in the category of affordable housing, due to the income factor.

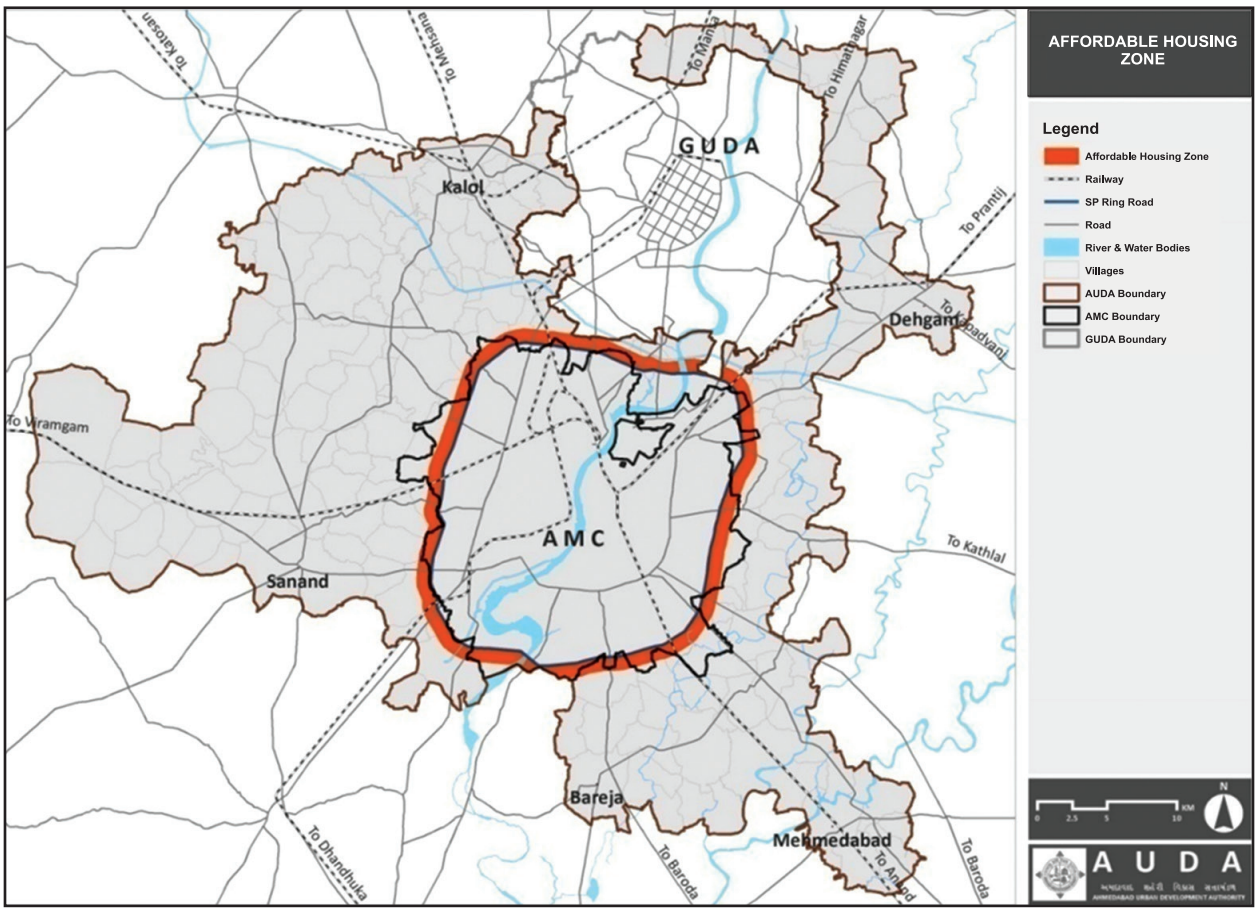
2. BUDGET 2021-22 ON AFFORDABLE HOUSING

Affordable housing was also a major topic in the budget 2021-22. The Finance Minister stated that the advantages of enhanced interest deduction on availing home loans catering the affordable housing scheme were extended till 31st March 2022. Due to this the MIG first-time home buyers will be benefited. Adding to it, income tax deduction of ₹ 1.5 Lakhs is availed for 2021-22 and this even led to tax deductible of ₹ 3.5 Lakhs/annum for one more year. One of the agenda behind these decisions is to provide affordable MIG Housing.

Map 1 reveals the delineated RAH (Residential-Affordable Housing Zone) of Ahmedabad which is identified within 1km wide stretch on the outer side of SP Ring Road covering around 75 sq.km of land area. As per GDR, the base FSI for this affordable patch shall be 1.8 with chargeable FSI of 0.9 at reduced rates.

In real-estate scenario, Ahmedabad is sublated into 6 parts: Central, North, South, West, West Peripheral and East. In y-o-y basis, 17,331 units were launched in 2020, quarter 1. Noticeable thing was that, that in quatre 1, 79.6 percent and 51.1 percent in quarter 4 of new launches were under affordable sector. The drop observed in quatre 4 in affordable housing was in the interest of COVID-19 cases following the relaxation of lockdown restrictions and festivities

during the holiday season. Government imposed weekend lockdown and night curfews to detain coverage of COVID-19 and address the health emergency. Eventually, due to pandemic the under-construction residential projects de-escalated. But, in comparison between all housing typologies affordable housing was dominating in 2020 quarterly.



3. MIDDLE INCOME CASE STUDY

India's economy is projected to grow at a base rate of 7.5 percent annually to 2030 according to an analysis from Bain & Company, with 500 million people moving into the middle- and high-income bracket over the period. In order of varied implications for the evolution of democracy and economic choices, the middle classes may comprise nearly 40 percent of the country. As India is a developing country it grows initially and parallelly so middle-class population does. Depending on the measures used, the estimated size of this middle-class ranges between 78 million (Economist, Jan 2018) to 604 million (Krishnan and Hatekar, EPW June 2017). MIG is the social mainstay of India's turn towards globalization and internal economic liberalization.

There are actually five middle classes in India: Rural Middle Class, Public Sector Middle Class, Urban Private Sector Middle Class, Trader Middle Class and Rising Middle Class. As per calculations of National Electoral Survey (NES) conducted by CSDS/ Lokniti for the years 1999, 2004, 2009

and 2014, middle class population are accounted for around 33 percent of India's population in 2014. The Urban Private Middle Class is the fastest growing category among the middle classes, increasing seven-fold from 0.4 percent to 2.7 percent, and while this is still a small proportion, this class has a disproportionately large agenda-setting capacity.

Public Middle Class are those who are employed across all tiers of government – post the 1999 NES survey, when it formed 3 percent of the overall population. The Rising Middle Class is a large and fast-growing group, growing from under 5 percent in 2004 to close to 12 percent in 2014 (table 2). A greater share of urban middle class wants the government to spend more on infrastructure over subsidies – perhaps a reflection of the disproportionate share of subsidy benefits that the rural middle classes receive compared to their urban counterparts.

Table 2: Characteristics of Middle Classes in India

	2004 (Population)	2014 (Population)	2021 (Population)
Total Population of India	**1129.6 Million**	**1295.6 Million**	**1380 Million**
Middle Class	-	33 percent	42 percent
	-	427.55 mn	585 mn
Urban Private Middle Class	0.40 percent	2.70 percent	5.00 percent
	4.52 mn	34.98 mn	69.00 mn
Rising Middle Class	5 percent	12 percent	19 percent
	56.48 mn	155.47 mn	262.20 mn

Since independence there are various housing schemes/programs for EWS & LIG with various models and strategies is carried out with land. FAR, financial supports are still there. However, there are no such special schemes/programs focusing on MIG section.

So, the main focus of the article leans towards MIG housing. India in 2016 had 120 million MIG households with 450 million population residing into it. It is predicted that in 2025 there will be approximately 140 million households with population of 630 million. By past and future figures and predictions it stated that in 2021 there are 130 million households with 585 million MIG population.

Table 3: Projections of MIG Population in India

Year	MIG Households		MIG Population	
2016	120	Million	450	Million
2021	130	Million	585	Million
2025	140	Million	630	Million

Source: satista.com

As per the statistics, the housing backlog for MIG in the year 2012 was 8 million households, with 30 percent of affordability gap. With the given figures, we can assume that if the MIG population in the year 2021 is 585 million with 140 million households, the housing gap will be about 10-12 million.

4. MIG INCOME

To enhance MIG housing statics, it is necessary to understand the character of MIG in India. "Income" is the primary factor of any income group, as our focus was on MIG, exercise for finding out current average income of MIG people was done (table 4).

Table 4: MIG Income in India

Year	USD Rate	Avg. MIG Income in USD	Avg. MIG Income in INR (Annual)
2016	68	7,700	5,23,600
2021	72	8,162	5,87,664
2025	76	8,162	6,20,312

Source: satista.com

To understand what happens if a MIG person buys a house, analysis was done which end results that what an MIG individual need to pay monthly if they buy a house. For calculating the affordability, 30 percent of the household income is considered. Hence, the main aim of analysis is that whether the current market scenario is compatible for MIG person or not. Adding to it, one more question arose is that how the person will arrange the 20 percent of capital (table 5). So, it is assumed that the MIG individual will arrange it through savings and take loan from the relative which turns to be five lakh rupees.

Table 5: Affordability of MIG Class

A	House Cost (as per analysis done in the paper)	26,00,000 INR
B	20 percent Capital @A*20 percent	5,20,000 INR
C	80 percent Loan @A*80 percent	20,80,000 INR
D	Tax @8 percent @C*8 percent	1,66,400 INR
E	Total Amount @C+D	22,46,400 INR
F	Installment/ month (Loan for 10 Years/120 months) @E/120	18,720 INR
G	Installment/ month (adding the maintenance) @F+1500	20,220 INR

5. MIG INCOME VS. HOUSE COST

The MIG Income Vs. the MIG House Cost is compared in order to get the insight of the relationship. In the year 2000 the cost of a house of 54 Sq. Yards was 4 lakhs, when the home buyer's annual income was about INR 72,000. The installment factor for the year 2000 was 5.61 based on the above-mentioned figures (table 6). Similarly, in the year 2010 the installment factor increased to 6.1. If a similar trend continues, the installment factor for the year 2020 should be 8.6.

Table 6: MIG Income Vs. Housing Cost

MIG Income Vs. Housing Cost			
Year	2000	2010	2020
Cost of house (54 Sq. Yard)	4,00,000	14,00,000	30,00,000
Percent of Government Tax	3 percent	9 percent	21 percent
MIG Income/annum	72,000	2,28,000	3,48,000
Installment Factor	5.61	6.1	8.6

If we consider only income of middle-class people, it increases 2.1 times in the span of 2000-2010 whereas, the cost of the house increases 2.5 times. Similarly, in the span of 2000-2020 the income only increases 3.8 times whereas the house cost has increased 6.5 times as compared to the year 2000.

6. MIG NON-AFFORDABILITY

The following constraints lead to the non-affordability of Middle-Class population.

- Income is not increasing at the same pace as the prices of the houses.
- The installment affordability factor has increased in the year 2020.
- Most of the MIG beneficiaries cannot avail the PMAY subsidies of INR 1.65 Lakhs.
- The current MIG population of 585 million is likely to increase over the years as per various economic surveys.

7. REAL LIFE MIG SCENARIO

7.1 Normal Scenario

To understand the on-ground reality of housing a real-life scenario analysis is practiced in this paper of South Bopal Ext. Village-Ghuma (Western Ahmedabad). The analysis is executed by various interventions.

In order to find out the actual price of the house, the study is carried out using various local data, actual survey and government data. Actual market prices are considered for cost and prevailing charges. Also, this normal scenario is real time situation in most of the Tier-II cities of India (table 7).

Table 7: On Ground Reality of Housing - Normal Scenerio

Plot Parameters	
Size of Plot	4,000 Sq. Yard
Development Zone	R1
FSI	2.7
Base FSI Without Premium	1.8
Payment FSI	0.9
Built Up as per 2.7 FSI	10,800
Land Market Cost (40,000/Size of Plot)	16,00,00,000 INR
Stamp Duty (5.8 percent) Including Registration	92,80,000 INR
Plan Approval Fees Like Betterment, Development (INR 575/Sq. Yard of land Area)	23,00,000 INR
Government Land Rate (Jantri Price) (for premium FSI Calculation)	20,000
Payment FSI Cost as per GDCR (0.9 FSI, which is 20 percent as <60 Sq. Yard)	20 percent
Total Cost on Payment FSI	1,44,00,000 INR

Construction Cost & Sales	
Total Built Up (Size of Plot*FSI)	10,800 Sq. Yard
Total Number of Flats (Each 54 Sq. Yard i.e. 486 Sq. Ft)	200 Units
Total Super Built Up (54*200*1.54*9)	1,49,688 Sq. Ft
Construction Cost (1300/1,49,688)	19,45,94,400 INR
Total Cost of GST (16 percent of Const. Cost)	3,11,35,104 INR
Total Miscellaneous Cost- Marketing, Admin., Etc.	1,40,00,000 INR
Total Selling Price (Basic) (1,49,688*2960)	44,30,76,480 INR
Selling Price Extra (Legal + Premium + Parking + Electricity)	250 INR/Sq. Ft
Total Selling Price (Extra) (1.49.688*250)	3,74,22,000 INR
Total Selling Price	48,04,98,480 INR
GST @ 8 percent	3,84,39,878 INR
Project Costing	
Total Cost (Land Cost + Stamp Duty + Plan Approval Fees + Total Payment FSI Cost + Construction Cost + Total Miscellaneous Cost) ----B	39,45,74,400 INR
Total Income [Total Selling Price (Basic) + Selling Price Extra] ----A	48,04,98,480 INR
GST Cost (Total Cost of GST on Super Built up + GST on Total Selling Price)	6,95,74,982 INR
Builder's Profit (A – B)	8,59,24,080
	18 percent
Stamp Duty of 5.8 percent (Borne by Purchaser)	2,56,98,436 INR
Government's Total Revenue Collection	12,12,53,418 INR
Summary of Normal Scenario	
Cost of 1 unit (54 Sq. Yard)	24,02,492 INR
GST on 1 Unit	3,47,875 INR
Stamp Duty on 1 Unit	1,28,492 INR
Total Cost of 1 Unit for Buyer (54 Sq. Yard)	28,78,859 INR
Builder's Profit on 1 Unit	4,29,620 INR
	18 percent
Government Revenue on 1 Unit	6,06,267 INR
	21 percent

The normal scenario stated that the builder achieves 18 percent of profit on 1 house of 54 Sq. Yard whereas government is benefited with three percent more which is 21 percent on a single MIG house. One more thing to be looked upon was that the price of steel and cement are hiked up bit that is not considered in this study. Adding to it the jantri rate was also going to increase in February, 2021 but that factor is also not used under this analysis. The exercise is to just limited to normal scenario.

8. TAX INTERVENTION (50 PERCENT TAX REDUCTION)

Intervention of 50 percent tax deduction was also examined to find out what does the builder and government gets at the end. The results are mentioned in table 8.

Table 8: Tax Intervention in Affordable Housing

Plot Parameters	
Size of Plot	4,000 Sq. Yard
Development Zone	R1
FSI	2.7
Base FSI Without Premium	1.8
Payment FSI	0.9
Built Up as Per Payment FSI (4,000*0.9)	3,600 Sq. Yard
Land Market Cost (40,000/Size of Plot)	16,00,00,000 INR
Stamp Duty (2.9 percent) Including Registration	46,40,000 INR
Plan Approval Fees Like Betterment, Development (INR 285/Sq. Yard of Land Area)	11,40,000 INR
Government Land Rate (Jantri Price) (for premium FSI Calculation)	10,000 INR
Payment FSI Cost as per GDCR (0.9 FSI, which is 20 percent as <60 Sq. Yard)	10 percent
Total Cost on payment FSI	36,00,000 INR
Construction Cost & Sales	
Total Built Up (Size of Plot*FSI)	10,800 Sq. Yard
Total Number of Flats (Each 54 Sq. Yard i.e. 486 Sq. Ft)	200 Units
Total Super Built Up (54*200*1.54*9)	1,49,688 Sq. Ft
Construction Cost (1300/1,49,688)	19,45,94,400 INR
Total Cost of GST (8 percent of Const. Cost)	1,55,67,552 INR
Total Miscellaneous Cost- Marketing, Admin., Etc.	1,40,00,000 INR
Total Selling Price (Basic) (1,49,688*2960)	44,30,76,480 INR
Selling Price Extra (Legal + Premium + Parking + Electricity)	250 INR/Sq. Ft
Total Selling Price (Extra) (1.49.688*250)	3,74,22,000 INR
Total Selling Price	48,04,98,480 INR
GST @ 4 percent	1,92,19,939 INR
Project Costing	
Total Cost (Land Cost + Stamp Duty + Plan Approval Fees + Total Payment FSI Cost + Construction Cost + Total Miscellaneous Cost) ----B	37,79,74,400 INR
Total Income (Total Selling Price (Basic) + Selling Price Extra) ----A	48,04,98,480 INR
GST Cost (Total Cost of GST on Super Built up + GST on Total Selling Price)	3,47,87,491 INR
Builder's Profit (A – B)	10,25,24,080 INR
Stamp Duty of 2.9 percent (Borne by Purchaser)	1,28,49,218 INR
Government's Total Revenue Collection	5,70,16,709 INR

Summary of 50 percent Tax Reduction Intervention	
Cost of 1 unit (54 Sq. Yard)	24,02,492 INR
GST on 1 Unit	1,73,937 INR
Stamp Duty on 1 Unit	64,246 INR
Total Cost of 1 Unit for Buyer (54 Sq. Yard)	25,67,444 INR
Builder's Profit on 1 Unit	5,12,620 INR
	21 percent
Builder's Profit on 1 Unit After Cost Reduction due to Market Equalization of 18 percent Profit/Deduction	4,39,389
	18 percent
Government Revenue on 1 Unit	2,85,084 INR
	11 percent

Due to the factor of market equalization, it was mandatory to deduct the cost. However, due to 50 percent cost reduction the governments revenue amount dropped.

9. PLANNING INTERVENTION (ADDITIONAL 0.9 FSI)

One more intervention related to planning was considered. The intervention stated to provide 0.9 additional FSI (means 2.7+0.9= 3.6 FSI). The end result of this intervention is pictured in table 9.

Table 9: Tax Intervention in Affordable Housing

Plot Parameters	
Size of Plot	4,000 Sq. Yard
Development Zone	R1
FSI	3.6
Base FSI Without Premium	1.8
Payment FSI	1.8
Built Up as Per Payment FSI (4,000*1.8)	7,200 Sq. Yard
Land Market Cost (40,000/4,000)	16,00,00,000 INR
Stamp Duty (5.8 percent) Including Registration	92,80,000 INR
Plan Approval Fees Like Betterment, Development (575/Sq. Yard. Yard of Land Area)	23,00,000 INR
Government Land Rate (Jantri Price) (for premium FSI Calculation)	20,000 INR
Payment FSI Cost as per GDCR (0.9 FSI, which is 20 percent as <60 Sq. Yard)	20 percent
Total Tax on Payment FSI Area (7,200*20,000*20 percent)	2,88,00,000 INR
Construction Cost & Sales	
Total Built Up (4,000*3.6)	14,400 Sq. Yard
Total Number of Flats (Each 54 Sq. Yard i.e. 486 Sq. Ft)	270
Total Super Built Up (53*270*1.54*9)	1,98,337 Sq. Ft
Construction Cost (1,300/2,04,776)	25,78,37,580 INR
Total Cost of GST (16 percent of Construction Cost)	4,12,54,013 INR
Total Miscellaneous Cost- Marketing, Admin., Etc.	1,40,00,000 INR

Total Selling Price (Basic) (1,98,337*2,960)	58,70,76,336 INR
Selling Price Extra (Legal + Premium + Parking + Electricity)	250 INR/Sq. Ft
Total Selling Price (Extra) (1,98,337*250)	4,95,84,150 INR
Total Selling Price	63,66,60,486 INR
GST @ 8 percent	5,09,32,839 INR
Project Costing	
Total Cost (Land Cost + Stamp Duty + Plan Approval Fees + Total Payment FSI Cost + Construction Cost + Total Miscellaneous Cost) ----B	47,22,17,580 INR
Total Income (Total Selling Price (Basic) + Selling Price Extra) ----A	63,66,60,486 INR
GST Cost (Total Cost of GST on Super Built up + GST on Total Selling Price)	9,21,86,852 INR
Builder's Profit (A – B)	16,44,42,906 INR
Stamp Duty of 5.8 percent (Borne By Purchaser)	3,40,50,427 INR
Government's Total Revenue Collection	16,66,17,279 INR
Summary of Planning Intervention (Additional 0.9 FSI)	
Cost of 1 unit (53 Sq. Yard)	23,58,002 INR
GST on 1 Unit	3,41,433 INR
Stamp Duty on 1 Unit	1,26,113 INR
Total Cost of 1 Unit for Buyer (54 Sq. Yard)	26,07,347 INR
Builder's Profit on 1 Unit	6,09,048 INR
	26 percent
Builder's Profit on 1 Unit After Cost Reduction due to Market Equalization of 18 percent Profit/Deduction	3,90,848 INR
	18 percent
Government Revenue on 1 Unit	6,17,101 INR
	24 percent

The provision of additional 0.9 FSI eventually was fruitful for government as the profit score raised up. Such interventions are kind of win-win situation for both builder and government as well. Moreover, 70 housing units were added as a result due to additional 0.9 FSI.

10. BOTH INTERVENTIONS

After conducting calculations of both the interventions, idea implementing both the intervention together came up. The outcome of that is mentioned in table 10.

Table 10: Combined Tax and Planning Interventions and Affordable Housing

Plot Parameters	
Size of Plot	4,000 Sq. Yard
Development Zone	R1
FSI	3.6
Base FSI Without Premium	1.8
Payment FSI	1.8

Built Up as Per Payment FSI (4,000*1.8)	7,200 Sq. Yard
Land Market Cost (40,000/4,000)	16,00,00,000 INR
Stamp Duty (2.9 percent) Including Registration	46,40,000
Plan Approval Fees Like Betterment, Development (285/Sq. Yard. Yard of Land Area)	11,40,000
Government Land Rate (Jantri Price) (for premium FSI Calculation)	10,000 INR
Payment FSI Cost as per GDCR (0.9 FSI, which is 10 percent as <60 Sq. Yard)	10 percent
Total Tax on Payment FSI Area (7,200*10,000*10 percent)	72,00,000
Construction Cost & Sales	
Total Built Up (4,000*3.6)	14,400 Sq. Yard
Total Number of Flats (Each 54 Sq. Yard i.e. 486 Sq. Ft)	270
Total Super Built Up (53*270*1.54*9)	1,98,337 Sq. Ft
Construction Cost (1,300/1,98,337)	25,78,37,580 INR
Total Cost of GST (8 percent of Construction Cost)	2,06,27,006 INR
Total Miscellaneous Cost- Marketing, Admin., Etc.	1,40,00,000 INR
Total Selling Price (Basic) (1,98,337*2,960)	58,70,76,336 INR
Selling Price Extra (Legal + Premium + Parking + Electricity)	250 INR/Sq. Ft
Total Selling Price (Extra) (1,98,337*250)	4,95,84,150 INR
Total Selling Price	63,66,60,486 INR
GST @ 4 percent	2,54,66,419 INR
Project Costing	
Total Cost (Land Cost + Stamp Duty + Plan Approval Fees + Total Payment FSI Cost + Construction Cost +Total Miscellaneous Cost) ----B	44,48,17,580 INR
Total Income (Total Selling Price (Basic) + Selling Price Extra) ----A	63,66,60,486 INR
GST Cost (Total Cost of GST on Super Built up + GST on Total Selling Price)	4,60,93,426 INR
Builder's Profit (A – B)	19,18,42,906 INR
Stamp Duty of 5.8 percent (Borne By Purchaser)	3,40,50,427 INR
Government's Total Revenue Collection	9,31,23,853 INR
Summary of Both Interventions Together	
Cost of 1 unit (53 Sq. Yard)	23,58,002 INR
GST on 1 Unit	1,70,716 INR
Stamp Duty on 1 Unit	1,70,252 INR
Total Cost of 1 Unit for Buyer (54 Sq. Yard)	24,14,758 INR
Builder's Profit on 1 Unit	7,10,529 INR
	30 percent
Builder's Profit on 1 Unit After Cost Reduction due to Market Equalization of 18 percent Profit/Deduction	4,26,317 INR
	18 percent
Government Revenue on 1 Unit	3,44,903 INR
	14 percent

So, here one can conclude with the table 11.

Table 11: Combined Assessment for Affordable Housing

	Normal Scenario	50 percent Tax Reduction	Planning Intervention (Additional 0.9 FSI)	Both Intervention
Cost of 1 unit	28,78,859 INR	23,29,261 INR	22,16,360 INR	20,73,790 INR
Percent Decrease in Terms of Normal Scenario	-	19 percent	23 percent	28 percent
MIG Income Vs. Housing Cost				
Year	2000	2010	2020	
Cost of house (54 Sq. Yard)	4,00,000	14,00,000	20,73,790	
Percent of Government Tax	3 percent	9 percent	14 percent	
MIG Income/Annum	72,000	2,28,000	3,48,000	
Installment Factor	5.61	6.1	5.95	

Finally, to combine up it is observed that in the normal scenario the developer holds 18 percent profit and government has 21 percent of revenue collection which was about 3 percent to 5 percent revenue collection before decade. By reducing 50 percent of tax with special mechanism will reduce sizeable cost compare to the normal scenario. And the Planning intervention is tool without pouring finance, it helps in gaining percentage in the revenue collection and a drop in the house price.

11. CONCLUSION

There is a sharp increase in the cost of middle-class housing. One of the key factors is the increase in the Payment FSI, GST and other costs which have increased by 18 percent from 2000-2020. These costs are 3.5 times higher than PMAY subsidies of INR 1.65 Lakhs.

Only by a small planning intervention of increasing 25 percent FSI, a decrease of 23 percent is observed in the cost of the house. Similarly, if tax intervention is done, and all the taxes are reduced by 50 percent there is 19 percent decrease in the cost of the house.

Hence, if both the interventions are applied to real market scenario, the price of individual house decreases by 28 percent.

Reduced price will generate or bring middle class population in the housing economic cycle.

Also, given the sheer gap in demand-supply, one can assume that every private player would want to venture into this sector. However, high land costs, archaic building bye-laws, stringent licensing norms, delay in project approvals and unfavorable banking policies make affordable housing projects uneconomical for private developers.

Land Records and their Modernization in India: Status and Way Forward

Ramakrishna Nallathiga

Abstract

Land records hold a lot of importance in the development as well as exchange of land and real property, in both urban and rural areas. Land records and their management began to assume importance in the post-industrial era; they were amplified by the expansion of services sector. Like several other nations, India got the legacy of colonial land records system, which served the past regime well, but it required significant changes to meet with the manifold increase of land and real estate transactions in modern times. Land record modernization, with focus on digitalization, is a step in that direction. This paper first lays down the evolution, structure and shortfalls of land records systems in India using secondary literature and data; it then discusses the need for as well as the key features of national land records modernisation programme, which is based on the ICTs and digital technologies. Finally, it discusses the way forward.

1. INTRODUCTION

Land records hold a lot of importance in the development as well as exchange of land and real estate/property, particularly in the urban and semi-urban areas (including urban fringe) wherein such transactions like land exchanges as well as real estate development and transfer take place the most. Rural land records also hold importance when the demand for rural land is on rise for the production of food crops, particularly, when land is becoming increasingly scarce in the rural areas under the shadow of existing urban areas i.e., urban fringe. The demand for land for various uses has in fact evolved over time with the advent of new uses (as well as users) that came into the scenario after the industrialisation of economy in the 19th century; it accentuated after the tertiarization of economy that led to the proliferation of services sector in the 20th century. Figure 1 shows the evolution of land markets and land administration systems in Western countries, which also happened in India albeit with some time lag of few decades.

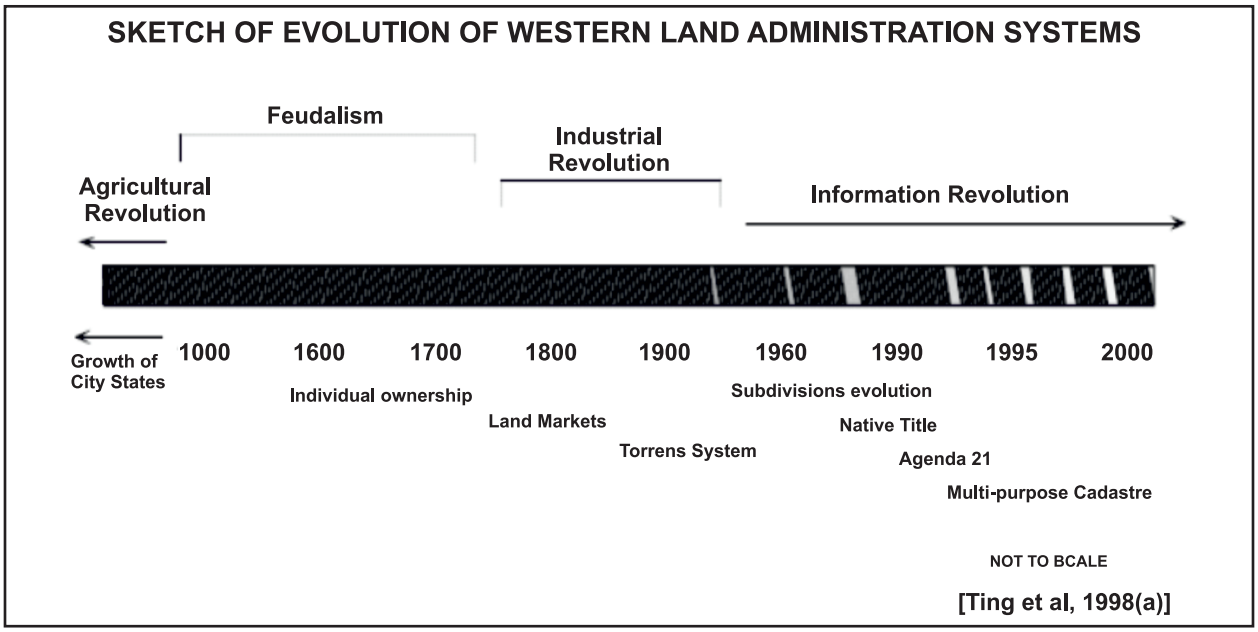
Land ownership began to assume importance in the developed nations after the agrarian reforms aimed at the distribution of farm land to peasants, thereby forming hereditaments. Subsequently, land became an asset for individual holders, who could use it, develop it as well as use it as collateral for raising finance. In the post-industrial era, large tracts of land were sub-divided and exchanged for establishing industrial units; it was amplified with the expansion of services sector economy, which led to a more intensive use of land through its development and the formation of real estate/property. Land records and their management assumed importance after this period across the world and countries have established their land records management systems. A large number of countries also upgraded and modernized their land records and their management so that they continue to serve the modern needs.

***Ramakrishna Nallathiga**; Ph.D., FITP, Faculty Member, School of Architecture, Planning and Real Estate, NICMAR University, Pune*

1.1 Land Revenue and Administration System in India

Land records and their management formed an important constituent of administration for a very long time in India, even before the British rulers arrived, with the village administrators maintaining land ownership records (figure 1). Taxation of land, especially agriculture land, was an important means of revenue mobilization for the prevalent kingdoms throughout the history, which required some record keeping system; tax revenue was collected by the administration by taking away a share of agricultural crop produce (which was set arbitrarily). India's land records and management systems evolved during the medieval era led by Mughal rule under Akbar led by Todar Mal, who brought in better land record keeping practices and devised taxation system on the basis of presumptive crop yield and defined tax rate. This has led to a high integration of land and revenue administration (Rao 2012).

Figure 1: Evolution of Land Markets and Land Administration Systems

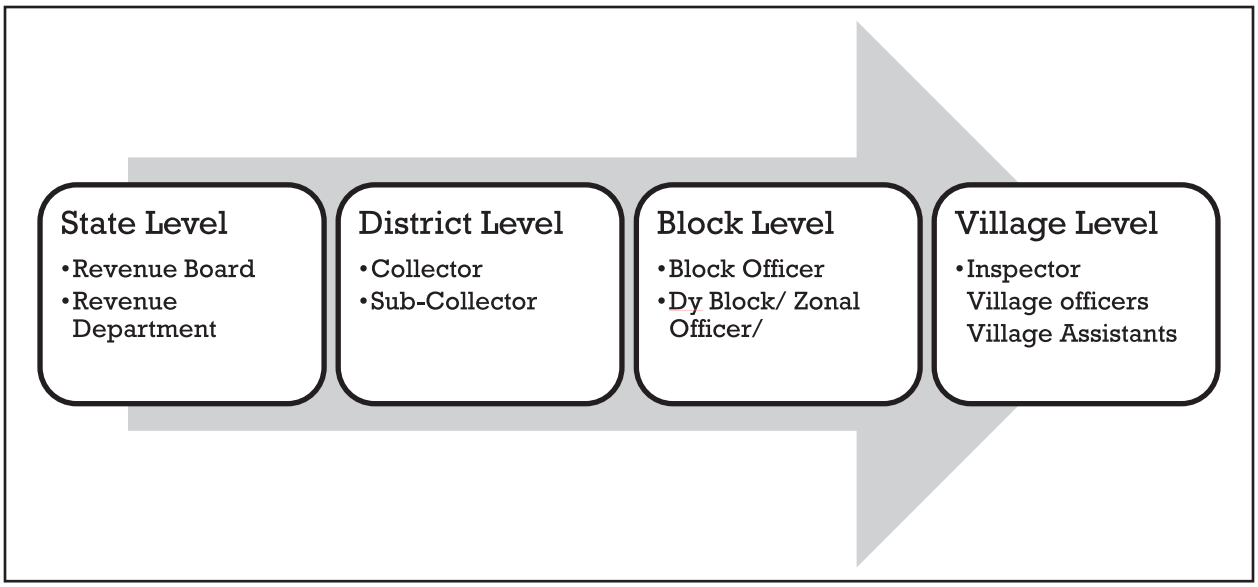


Land and revenue administration has evolved over time but they were subject to several changes in history. The ancient kingdoms that prevailed before Mughal empires used markedly different measuring instruments for measuring agriculture land and crop produce, which led to a lot of non-uniformity; the medieval kingdoms, comprising both Muslim and Hindu rulers, brought-in some amount of standardization of land measurement, establishment of land revenue (tax) units and the rationalization of tax levy; the modern kingdom under British empire also deployed them, but they also subjected it to significant changes that paved way for modern land records. The British rulers made some significant changes to land and revenue administration system through several reforms (Rao 2012).

They introduced a common uniform measurement system (or, metric system which was further changed to SI system later), developed land survey systems that use new standardized

instruments and developed formal land records administration systems. The administration of land and revenue records was done at different levels by land and revenue administration department that would perform these functions at (i) State Level, (ii) District Level, (iii) Block Level (iv) Village Level (figure 2). Government appointed officers were in charge of operations that lead to the creation, maintenance and management of land records and revenue collection thereof. Post-independence, India has adopted the colonial land record administration system without many changes, perhaps to ensure a continuity of land records and record keeping systems. Figure 2 shows the broad organisation of land and revenue administration in India.

Figure 2: Land Revenue Administration in India



Source: Author's Own

Prior to independence, India had the following land tenure systems prevalent during the British rule (Mearns 1999): (i) *Zamindari System* (Ownership by Intermediaries) (ii) *Ryotwari System* (Ownership by Individuals) (iii) *Mahalvari System* (Collective Ownership). Post-independence, the Government of India undertook several land and agrarian reforms with an objective of addressing the issue of concentration of land in the hands of few individuals, which included: (a) Abolishment of intermediaries (or, Zamindari system) (b) Tenancy reforms aimed at recognising the tenurial rights of tenant farmers or sharecroppers (c) Fixing a ceiling on individual land holdings through urban and rural land ceiling acts (d) Assignment of government land and surplus land to landless farmers. However, the reforms gave mixed results – there was a reduction in the number and size of large land holdings and tenurial rights got established but surplus land was not effectively distributed by the bureaucracy and political system (Pethe and Nallathiga 2017). Further, land and revenue administration followed more or less the same organisation structure created by the British with lesser effectiveness.

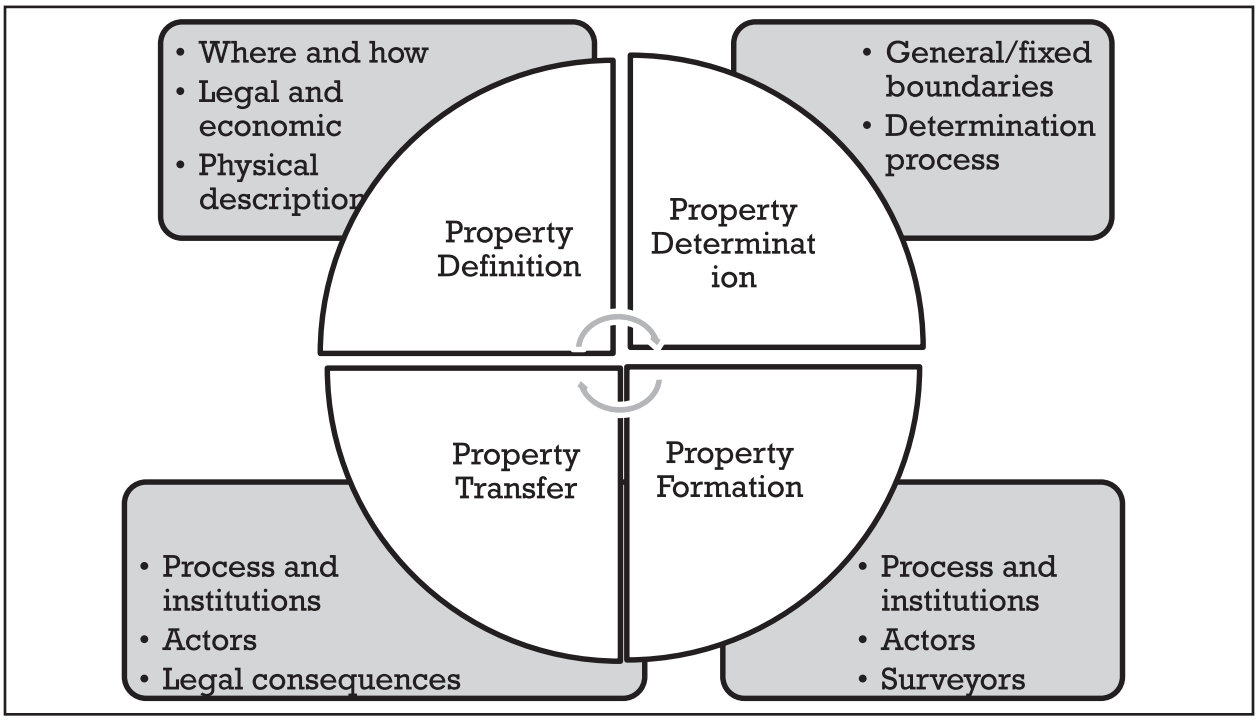
Land became a State subject after the independence, with the Central government playing role in legislative/ policy reforms (Sonar and Patel 2018); therefore, though some States came

out with changes in land and revenue administration, they had to largely rely upon the land and revenue records available from past colonial land record systems. Land and revenue record management was again geared towards land tax (of agricultural land) and record keeping (Record of Rights or RoR) so as to collect land tax revenue. However, with the abolition of agricultural land tax, the incentives for maintaining records and record keeping has reduced over time i.e., they were mostly used to settle land and property disputes. As a result, land records were neglected and some of them were even subject to destruction due to natural and man-made calamities like floods, earthquakes and fire accidents.

2. SYSTEM OF LAND RECORDS IN INDIA

Across the world, with increasing population and liberalisation of economic sectors, private ownership (title) of land has been on rise and so also associated tenancies. Legislations were made on inheritance/ succession as per prevailing Law/Code, assignment/lease of land, transfer of land (sale/lease/inheritance/mortgage/pledging), and development of property/structure on land. With rapid changes in population and economy, the transfer of land and property has been on the rise and, therefore, the need to scrutinise, securitise and record such exchanges. Similarly, the demarcation of land and property through surveys and record verification also assumes importance so that any disputes on plot size, boundaries, extent and features can be addressed. Governments have also evolved systems for recording the exchange of land and property titles and their exchanges through the registration/ recordation of such transactions. Figure 3 shows land and property records cycle involving the various elements at each stage.

Figure 3: Land and Property Records Cycle



Source: Author's Own

There are three major constituents of land records (Sonar and Patel 2018):

- Textual record, which refers to the Record of Rights (RoR) with the land owner name, size and limits, tenure, land class, nature of rights etc. Any change in ownership due to inheritance, gift, partition and will etc needs to get reflected through the 'mutation' of record. The RoR is also expected reflect any encumbrances (such as mortgage or loans taken on land) and the extent of private and public rights prevalent on the land/ property.
- Spatial record, which refers to location and extent of property in a mapped format. The maps have to clearly reflect individual plot area, demarcate boundary as well as reflect land features such as roads, water bodies, land use, neighbouring properties and so on.
- Transaction record, which refers to sale or purchase or any other such transaction on land and/or real property registered on a non-judicial stamp paper. The sale or purchase transaction are expected to lead to mutation of title details in RoR but not mandatory.

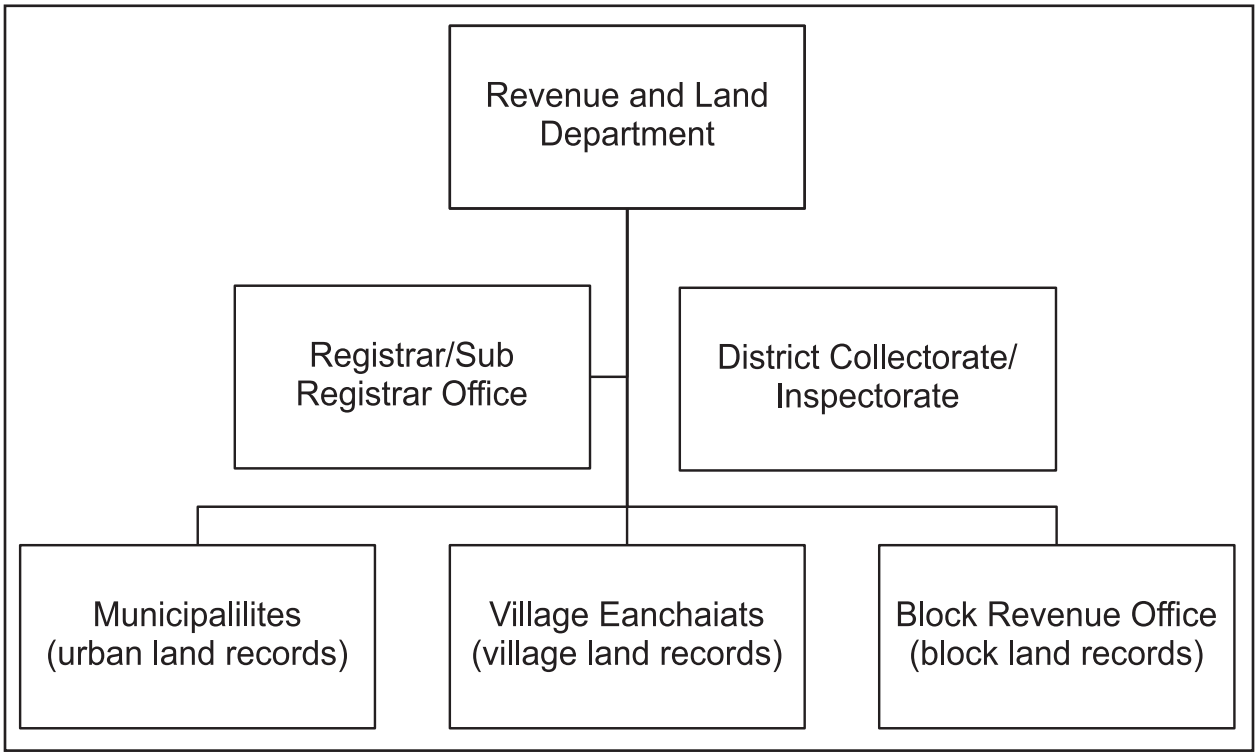
The broad system of land records in India consists of (Sonar and Patel 2018):

- Survey of Land Departments to deal with:
  - Demarcation of boundary of individual holdings
  - Survey and Measurement of land
  - Classification of land and its use
  - Preparation of cadastral maps
- Revenue Departments concerned with:
  - Levy of tax and collection of revenue
  - Allocation of land and property as per Government policy
  - Maintenance of original records of ownership/titles (RoR)
  - Settle disputes on land and its transfer
- Registration Departments to undertake:
  - Registration of all transactions of immovable property (land, structure etc)
  - Collection of registration charges and stamp duty fees
  - Issue of certificates required by land owners/ buyers/ lessors/ lessees/ mortgagers/ financiers

Figure 4 shows the broad organization structure of land records management system in India. The land and revenue department oversees the allocation, coordination and policy making with regard to land resources in the State. Revenue department maintains the Record of Rights (RoR), mutations register and tax registers for land revenue collection with the help of village level machinery (Sonar and Patel 2018). The registration departments register the formation of new properties and transaction on existing properties through offices of registrar/sub-registrar; it collects stamp duty and registration charges. It is the district collector who acts as a custodian of land records held at district level. Block level officer helps in the procurement and updation

of land records coming from local level. Land records are maintained at local level by the village panchayats in the rural areas and municipal offices in urban areas.

Figure 4: Land Records Maintenance Organisation System



Source: Author's Own

3. NEED FOR LAND RECORD MODERNIZATION

There are several issues associated with the current system of land records in India, especially with its organisation and administrative structure:

- The focus of land and revenue department on revenue raising (which was lost due to agricultural tax reforms) led to the neglect of land records maintenance as evident from poor maintenance and updation of title records (especially mutation records). Further, the transfer of land title records has not been smooth where there were some structural changes e.g., administrative structure change in Andhra Pradesh in 1980s.
- After the abolition of agriculture tax, registration of land and property has become an important means of revenue for the States through the levy of registration charges and stamp duty on such exchange transactions of land and/or immovable property. However, as property registrations are not linked to actual title records, but based on the evidences shown on property acquisition and development in present form,it raises some questions, sometimes after the registration of purchase transaction (IIHS 2015).
- Lastly, land survey and land records management did not receive due attention that should have been paid from time and again. As a result, cadastral maps either do not exist or

not updated in terms of subdivision, amalgamation and development. Land records do not reflect the actual title condition and status prevalent on the ground.

Land is increasingly becoming important in the developing nations like India, which have been experiencing rapid population rise, urbanization and tertiary sector development. Land records and their effective management leads to meeting with these development challenges efficiently. Further, with land becoming more and more scarce resource in developing societies, land value has been on the rise, which leads to more intensive use of it through sub-division, use change and development. This in turn will manifest into broader land and property markets. Here, efficient land records are essential for well-functioning land markets, improved tax revenue mobilization by sub-national governments, addressing dispute resolutions and court litigations. Land record modernization, with focus on digitization, is a step in that direction.

Like most other developing nations, India also has a legacy of colonial land record and administration system, formally developed by the British rulers. The colonial land records system served the past regime well (for taxing agriculture land/ estate) but it required an upgradation to the modern times with the use expansion (Zasloff 2011). The colonial land record system also facilitated the land acquisition plans of then government as well as promoted its interest through intermediaries. Further, the colonial land administration did not recognise the tenurial rights of farmers as well as the ownership rights of tribes/ forest dwellers (Babu and Nautiyal 2003). Therefore, there is a need for a better land record management system that overcomes some of the shortcomings in the current system (Mearns 1999).

Multiplicity of agencies in land record management only compounds the issues and renders difficulty to citizens in accessing the services (Mishra and Suhag 2017). The retrieval of land records information is difficult as current land record system is fraught with information gaps, delays, manipulation and corruption because of the bureaucratic structure ridden with manual processes for storage, maintenance and retrieval of land records data. Land records at village level are currently maintained by the village administrator (patwari) in a non-uniform and non-standardized manner peculiar to each state (also, records in vernacular language with illegible writing also render difficulty in comprehending them). Village administrator maintains and updates land record books, which are known differently in various vernacular languages e.g., Khasra, Girdavari, Khatauni and Jamabandi etc (Chakraborty and Singh 2009). As these books are being used in land acquisition, it leads to huge litigation problems and projects get stalled due to this (Mishra and Suhag 2017). Further, as these are physical records maintained in paper form, they are prone to destruction during natural disasters and by rodents or termites. Therefore, there is a strong need for Land Record Modernization (LRM) for not only better records and record keeping but also to make them easily accessible to citizens and stakeholders.

4. NATIONAL LAND RECORDS MODERNIZATION PROGRAMME

The Government of India has recognized the problems associated with current land record management system and has mooted projects to improve it. The National Land Records Modernization Programme (NLRMP) is one such initiative aimed at achieving modernization of land records with the following objectives (GoI 2013):

- To build a transparent and integrated system of online and real time land records (including maintenance and updating of textual records, maps, survey and settlement operations and registration)
- To ensure that the cadastral records mirror the ground reality and also to ensure automatic mutation of the Record of Rights
- To make necessary legal changes/ amendments to facilitate the modernization of land records process
- To facilitate long term goals of achieving conclusive titling system in order to minimize land/ property disputes

The NLRMP is an ambitious programme of the Government of India to improve and modernize land records in India by making use of the Information and Communication Technology (ICT). It was started with pilots in eight districts of Indian states (Chakraborty and Singh 2009): Rangareddy (AP), Sonitpur (Assam), Singhbhum (Bihar), Gandhinagar (gujarat), Morena (MP), Wardha (Maharashtra), Mayurbhanj (Orissa) and Dungarpur (Rajasthan). The objective of the NLRMS is to remove the problems pertaining to manual systems and to maintain and update land records so that they meet the needs of various user groups. Computerization of Land Records (CoLRM) is an important means to achieve plot-wise land ownership and Record of Rights (RoR) and create an archival system from which they can be retrieved easily. Several State Governments also recognized the need for and importance of updating land records and modernizing their systems in order to cope up with ever increasing transactions associated with land and immovable property. Some such initiatives include:

- Dharitree (NIC)
- Bhoomi (Karnataka)
- Bhubharati (Andhra Pradesh)
- Mahabhulekh (Maharashtra)
- E-Dhara (Gujarat)
- CARD (Andhra Pradesh)

As Land is a State subject under the Constitution, the NLRMP was initiated as a Central Sponsored Scheme that provided funding support to the States towards modernizing their land records. Table 1 shows the cost sharing structure of the major components of NLRMP. The Government

Table 1: Cost Sharing under NLRMP

Programme Component	Central Govt Share (%)	State Govt Share (%)
Computerization of Land records	100	-
Survey/ resurvey	50	50
Modern record rooms	50	50
Registration	25	75

Source: GoI (2013)

of India sought to implement land record modernization in a phased manner covering target districts spread across different States over time. While the Central Government provides for funding share and technical support (capacity building), the initiation and efforts were to be made by the State governments. The programme covered 379 districts in 32 States in the phase 1, which would improve to cover all districts in the course of time (GoI 2013).

After 2017, the NRLMP has been nomenclated as Digitalization of Land Records Management (DLRM) Programme and it aims at improving land records through (GoI 2013):

- Scanning, digitization, updation of mussavies/ cadastral maps
- Geo-linking of (Record of Rights) RoR data with updated digitized maps
- Scanning of old Revenue documents for virtual record room
- Survey/Resurvey using Electronic Total Station Survey
- Digital Geo-Position Systems (DGPS) Survey
- Aerial photography and remote sensing satellite data processing

4.1 Computerization of Land Records Management

The evolution of personal computers has paved the way for the creation of electronic records that can be created, stored, retrieved, archived digitally and in more secure manner. The subsequent developments and improvements in computer hardware, software, networking and accessories has led to their universal adoption and utilization. The widening of electronic data exchange through internet has further increased the penetration of computers into every sphere of activity. In this context, computerization of land records management holds a lot promise in the organization, storage, retrieval and management of land records using ICTs, which have been revolutionizing the world. Technological advances in computers and ICTs have several advantages like (i) Linking various data bases in different forms (ii) Generating field data with hand held instruments (ii) Generating spatial / mapped data (iv) Linking spatial data with the non-spatial data. The various ICTs used in Land record Modernization include:

- Database Management Systems (DBMS)

  DBMS software like Foxpro, Visual Basic, Oracle SQL Server etc can be used for storing and retrieving large volumes of data such as that of textual and mapped data. Such software applications have wider storage capacity and faster processing power and also suit to the dynamic updation of land records.

- Geographic Information Systems (GIS)

  GIS software like Arc GIS and Map Info can be used to create, store and retrieve geographical data in digital form. GIS allows data storage in both raster and vector formats and also allows linking with Remote sensing (RS)/Global Positioning Systems (GPS). GIS Maps are versatile in creation of maps and provide a lot of advantages of use, storage, updation and retrieval of spatial presentation.

- Cadastral Mapping

  It involves preparing a cadastral map, which is a map showing boundaries and ownership of land parcels. A cadastral map shows features such as Survey District Name, Block Number and Subdivisions, Certificate of Title Numbers, Plot / Site and position of building, Section and lot numbers, Street names, Boundary dimensions, References to prior maps
- Electronic Total Station (ETS) and Global Positioning Systems (GPS).

  ETS makes land holder able to retrieve a complete record of his land holdings from record room. GPS gives advantage of geo-referencing of plot boundaries on a map and it gives more accurate location of land parcels with the help of navigation satellites. GPS can also help in three-dimensional positioning of land in terms of meter and geodetic positioning
- Remote Sensing (RS) and Image Processing (IP)

  Remote sensing technology has advanced a lot to give high resolution images that can be used to identify the current land use and cover as well as the development on land. High resolution RS products enable locationing of plot and determination of its use as well as other features so that cadastral records can be updated. Image processing software aid in the interpretation of images and formation/updation of electronic land records by using GIS tools.

4.3 GIS Based Land Information and Management System

The concept of web-based Land Information and Management System (LI&MS) is to create a single window system for a GIS based multi-purpose cadastre framework which supports continuous, readily available, comprehensive land related information at land parcel level. The major components of the LI&MS are (Rawat 2013):

- Reference framework consisting of geodetic network
- Series of current, accurate large scale maps
- Raster data showing the latest scenario: Color Ortho Images (Digital Aerial Photographs/ High Resolution Satellite Imagery, Lidar data in special Cases)
- Cadastral overlay delineating all cadastral parcels
- A unique identifying survey number assigned to each parcel used for indexing of all land records in information system
- Geodatabase of all cadastre integrated with the cadastral maps for information retrieval and updating on mutation.

5. LAND RECORDS MODERNIZATION: COMPONENTS AND IMPLEMENTATION

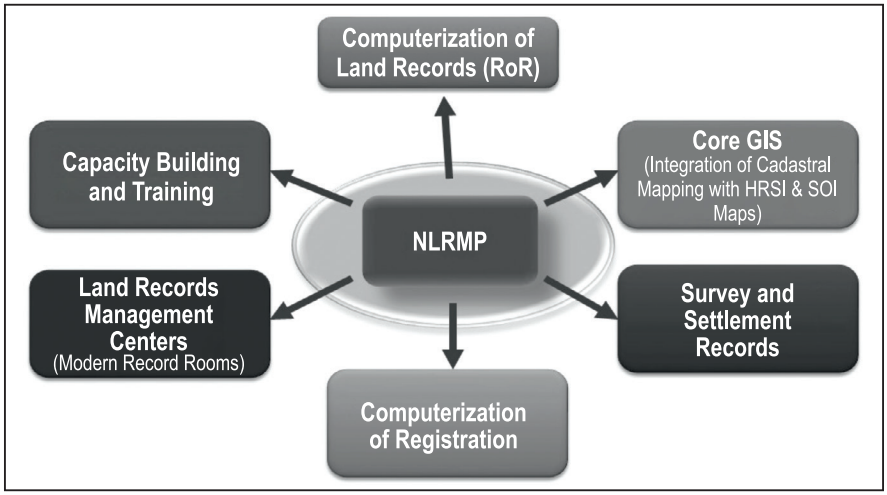
The Government of India has identified some major elements/ components of land records modernization and seeks to implement it through fund allocations and technical support while monitoring the progress made towards implementation, which are discussed below.

5.1 LRM Components

Figure 5 shows the various elements/components of NLRMP that are integral to its implementation. Computerization of Land Records is central to the programme. It is supported by Core GIS solutions that provide cadastral maps in association with existing agencies like the Survey of India. Land

records management centres (or, data centres/ modern record rooms) serve as hubs for storing the virtual/ digital records of land and property as well as their transactions for their retrieval. Survey and settlement records data have to be integrated with land records (RoR) data to make the process complete. The computerisation of registration process has also been made integral to the process, as such transactions leave a signature of real estate/ property exchanges. It is here that the electronic registration of land/ real property transaction should lead to an automatic updation of RoR. The revenue department staff capacity building through training and skill development is expected to help in better implementation.

Figure 5: Components of Land Records Modernization Programme



Source: Rawat (2013)

The Government of India, which is a major stakeholder, has been providing funding support for undertaking the implementation of above components. Table 2 shows the funds allocated by the Government of India towards the implementation of Land Record Modernization. It is evident that much of allocation is made towards generating records through survey/ resurvey of land as well as creation of infrastructure like the master record room development.

Table 2: Funds Allocation for Various Components of LRM

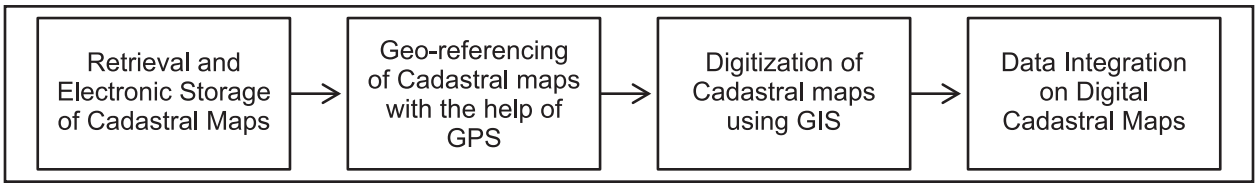
S. No.	Component of LRM	Amount (Rs Lakhs)
1.	Establishment of PMU / NLRMP Cell	7,287
2	Computerization of Land Records	26,992
3	Survey/Resurvey	99,935
4	Computerisation of Registration	5,495
5	Modern Record Rooms	50,475
	Total Central Government Share	190,184
	Total Amount Released	118,158

N.B. Figures as on January 31, 2023
Source: DLRM website

5.2 LRM Implementation

Figure 6 shows the broader implementation process of NLRMP. The implementation process begins with data development, which involves the conversion of old physical (hard copy) data of maps and other records into digital (soft copy) data, creation of new data base by updating or generating new data and the integration of data bases into inter-operable formats. In order to

Figure 6: Land Records Modernization Process



Source: Author's Own

achieve it, surveys and re-surveys are needed to be carried out and the existing data bases need to be synchronised with the land records (RoR) to make a firm database. Software development involves developing land information systems with data organization in different modules with interfacing between various data sets and integration with services.

Table 3 shows the progress status of the implementation of various components under LRM. Most of the components have been reportedly achieved progress close to targets. Survey/ resurvey is the component where progress is yet to reach good levels.

Table 3: Progress Status of Various Components of LRM

S No.	Component of LRM	Implementation Progress Status
1.	Computerization of Land Records	94.63%
2	Digitization of Maps	79.84%
3	Modern Record Rooms	84.08%
4	Survey-Resurvey	49.58%
5	Computerization of SROs	93.34%
6	Integration of Registration with Land Records	75.98%

N.B. Figures as on January 31, 2023
Source: DLRM website

Table 4 shows the physical implementation status of the various components of LRM in the 36 States and UTs of India. It can be seen that the computerization of land records, property registrations and digitization of maps have been progressing well but the integration/linking of land records (RoRs) with maps and other databases is a long way to go.

Table 4: Implementation Status of Various Components of LRM

S. No.	Component of LRM	Completed (>95%)	Ongoing (>0% & <95%)	Not Started (<10%)
1.	Computerization of Land Records	22	12	2
2	Digitization of Cadastral Maps	19	13	4
3	Integration of Cadastral Maps with RoRs	7	19	10
4	Computerization of Property Registration	24	9	3
5	Integration of Land Records and Property Registration	17	13	6
6	RoR Linkage with Aadhaar		21	15
7	Issuance of Digitally Signed RoR	10	16	10

N.B. Figures as on January 31, 2023
Source: DLRM website

6. DISCUSSION AND WAY FORWARD

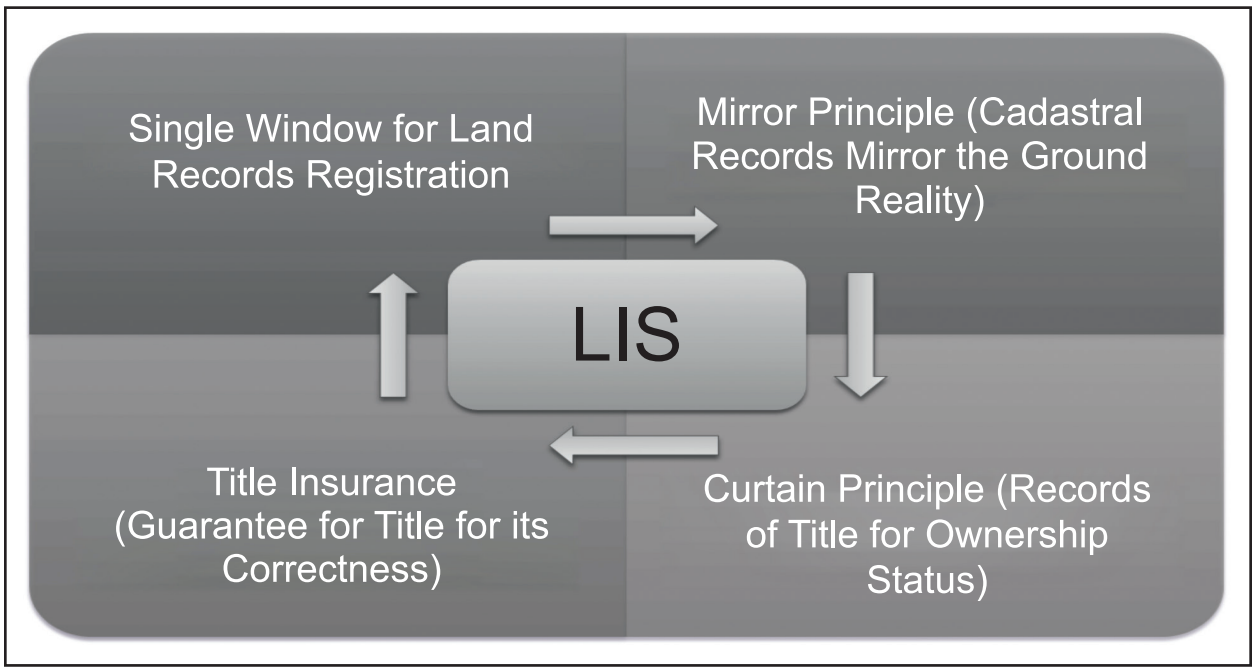
The current system of land record management, which is based on the template given by the colonial land record system, has several limitations in the modern era, when land and real property are subject to intensive use, development and exchange. With the advancements in ICT, it is very much possible to restructure and refine the existing land records data through improvisation, upgradation, computerisation and automation, which are being attempted through land records modernization programme. This programme is undertaken through partnership/ collaboration between the central and state governments with a major support coming from the central government, which is also providing technical support.

The current system of land records only gives information on land parcel and the presumed title holder of it. The deed registration process is more a facility run by the government for the facilitating the exchange of land and/or property systems. Being a presumptive title based system of exchange, it does not confer a definite title to deed holder after the registration, which is criticised by the citizens and civil society for keeping the property title uncertain. Uncertainty on land title becomes a hurdle for investments, development and financing, leaving it possible perhaps for a only handful large firms to be able to overcome the legal issues with some remedial measures. The non-linking of land/ property titles and registration transactions led to a rise in fraudulent transactions and are subject to long expensive litigation process. Moreover, land acquisition by the government also faces challenges due to title issues.

The Government of India (GoI) would like to move towards the conclusive title award after completing the implementation of NLRMP, which is expected to generate such comprehensive land records data at the village/settlement level. While the survey/resurvey would establish the mapped record of land/ property ownership, the mutation process will be made automatic so that the land records are updated after it. The GoI would like the States move towards universal property card that would replace the old records to move towards certainty of land/ property records (Manasi and Smitha 2018). There will be data exchange and interface between the various stakeholders of land records so that land titles reflect/ mirror ground condition. Figure 7 shows the conceptual framework of moving towards such Land Information System (LIS).

The Government of India came out with a draft model land titling bill (GoI 2019), which will serve as a model for the States to come out with similar bill based on the assessment of their own legal and rights framework. However, the States are yet to move towards making their legislations and much of the data is still in the hands of bureaucracy. Computerization of land records and their management will slowly change the gears and more and more land/ property information will become available in future. When accomplished, it will lead to ushering of land and property markets and empowerment of citizens in terms of property rights.

Figure 7: Conceptual Framework of Migration to Definite Property Title



Source: Rawat (2013)

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Urban Planning and Historical Process

Tarisha Desai

Abstract

According to Lewis Mumford cities are the places where the highest needs of the men are put in the center. (Mumford, 1961). Thus, our cities strive to provide for all sorts of needs of humans i.e., the mobility network, water supply, drainage, electricity supply, virtual connections, physical infrastructure, social and religious infrastructure, etc. But will these efforts make our cities the most liveable ones or they will produce a 'post-historic man' - as defined by Lewis Mumford who will progressively lose their feeling, emotion, creative audacity, and finally consciousness? (Mumford, 1961) Being a British colony for a long time; India inherited planning as a problem-solving tool from the British Empire. Even after Independence, it continued to use planning as a crisis management tool to face challenges like Housing for refugees as well as planning for an economic boost. (Spodek, 2013) Thus, India observes a sudden jump in terms of planning the cities instead of gradual evolution. This is because, within such orderly disorder, we have missed seeing our cities as a historical process. According to many scholars, it is essential to understand the history of the city before planning for it. Legislation and Guidelines for planning in India have also given provision for the same but is it truly happening? It is now time to pause and revisit our intentions of planning as India bears a great diversity in varied fields. With such inquiry, the focus of this literature study is to discuss what is meant by the historical process in response to growing cities, how such processes are observed/ not while planning for the cities through a literature case study of Coimbatore city, and how these processes are incorporated/not as part of the current planning practice while looking at various Development plan reports.

1. INTRODUCTION

According to Patrick Geddes city evolution is a continuous process, subsequent of a human effort to build liveable surroundings. Further, a city with deep historical roots always exhibits a series of changes, particularly in terms of its physical existence. Therefore, the process of change impacted by place, people, and time, results in the urban expansion of cities. Within such a situation, urban planning acts as an essential instrument to realize the rational goals of present-day cities. (1949; Geddes) Numerous researchers have noted that the population increase in the city changes the goal of the cities from the original functions to the provision of housing and other facilities. Thus, somewhere the growing cities fail to utilize the present potential of the place due to its past and try to achieve things that are missing. (Dr. M. Ramachandran, 2014)

Benedetto Croce (1921) claimed that historical accounts of events are merely an undifferentiated list; hence, considering history in terms of events or chronology is more like reading a chronicle than a history. Therefore, it is crucial to identify effective historical uses and a strategy for planners to use historical knowledge actively and continually rather than as a piecemeal source of data. (Carl Abbott, 1989) As planners try to establish a new foundation of Urban life through the tool of planning in this urbanizing world; it is important to recognize the city's historical roots and make a distinction between its original purposes and those that have developed from it to create the liveable cities. (Mumford, 1961)

***Tarisha Desai**, Ph.D. Scholar, School of Planning and Architecture, Delhi*

However, it has been challenging to incorporate historical information into urban planning. This is because humans are less proficient at handling the complex aspects of experience, meaning, and logical change. For historical knowledge to be meaningful in planning, it is essential to recognize the meaning that man has assigned to historical actions rather than merely knowing what they were. (Cunningham, 1972)

Currently, finding a way to balance the contemporary with the historical in our cities is becoming difficult. Understanding the challenges and issues of today requires knowledge of history. History may not provide the answers to all of today's problems, but it can help us understand how people have responded to earlier situations and what the results were, helping us to deal with similar difficulties in the present. (Nasson, 2002-2019)

In India, the historic urban settlements can be traced back to the Indus Valley civilization. This settlement seems to be paralleled with Mesopotamian civilization. This civilization observed a sudden end around 1750 B.C. and there are two opinions of archaeologists about its end, either it could be some natural cause like long-term flooding or it could be some human-oriented process like the Aryan invasion to India. (Morris, 2013) Since then invasion has been part of Indian history.

As a result, with time India became a vast country having a lot of geographic, climatic, ethnic, religious, and linguistic diversity. With this one can observe that various cities of India have undergone numerous social, cultural, religious, political, and economic changes brought by the invading society and transformed all those new ideas into to more localized manner. Therefore, it showcases multiple and pluralistic manifestations resulting in multi-layered built environments. (Desai, 2007)

Presently small and medium-scale Indian cities are also observing the trend of urban growth along with all mega cities because of rapid urbanization that is taking place in the country. (Cuthbert, 2003) Hence it is important to identify methods to achieve indigenous planning for the growing cities. This is also because currently our planning practices are established from the British town planning experiences gained before independence with a belief that these ideas of planning are universal. It has been observed that there is a constant absence of historical understanding to derive indigenous planning for cities and solve the specific urban problems of the city. There is a need for planners to identify an image for the city that can represent the individuality of the cities as well as break the colonial influence. (Sanyal, 2001)

J.E. Brush (1974) has examined the morphology of Indian cities regarding the current street plan, the arrangement and characteristics of buildings, and associated patterns of land use. (Brush, 1974) While discussing the foregoing viewpoints, R.L. Singh (1961) made clear that they should be followed not just to discover new categories and patterns or to create new classifications, but also for the light they shed on historical processes and functional relationships. Our cities are constantly evolving; therefore, it makes sense to view history as a process rather than as a series of discrete occurrences.

India has always remained a unique country in terms of planning its cities. The individual thinkers/rulers have showcased the best possible planning strategies for residents of the cities. Even though India has faced two major historical processes i.e., invasion and colonization; the Cities of India have adopted many of the new ideas for better growth and have transformed them into local forms for the community. But during the later stage of colonization under the British influence on planning the pace of transforming new ideas into local format reduced and we adopted practices and planning solution as it is. Thus, planning in India changed its focus from community-oriented planning to economy and infrastructure-oriented planning. Hence our cities are becoming places for the fulfillment of various wishes of humans. As a result, even though India holds a huge cultural diversity, Indian cities do not show traces or evolution of theirs in reference to the glorious past. Therefore, there is a need to wait, look back at the past, and understand our cities to achieve indigenous planning.

With such background present study with the help of Narrative literature review method focuses on three aspects firstly it tries to understand what is the meaning of Historical process in the context of urban cities and planning, secondly study looks at the approaches to look at history and tries to identify components of history that are valuable to utilize historical understanding in to planning process. Thirdly study tries to understand the present status of utilization of Historical understanding in the plan-making process.

2. DEFINING THE HISTORICAL PROCESS

The act of defining any term is a significant task. While defining a term; it is important to comprehend the chosen term's purpose and justification in full. By its name, historical process is a history-related topic. It contains the key phrases – history, and Process. Understanding the distinctions between history, historic, and historical is essential to comprehend the meaning of historical. Even though all three nouns are related, they have separate functions.

History is used for the volume of information and knowledge of the past. It specifically tries to investigate the changes that have occurred over the time with help of numerous evidences. At the same time, history offers multiple interpretations to acquire an understanding of how and why certain changes must have occurred. (Nasson, 2002-2019) The word historic is applied as a term to events, things, and people having significant and long-term impacts on human society. This can be understood by the example that the writing of Bhagavat Geeta is a historic work.[1]

The literal dictionary meaning of historical is to connect the study and representation of things from the past.[2] It is used for things, events, and, people related to past not necessarily having great importance in the past. Thus, we can infer that historic things are also historical but it is not necessary that every historical matter is historic. This can be understood with an example that there are many historical writings available in India but *Bhagavat Geeta* is one of the historic writings. Hence, we can utilize the word historical for all the things, matters, people, event, etc. which belongs to the past.

1 *https://dictionary.cambridge.org/grammar/british-grammar/historic-or-historical Date: 10-02-2023*
2 *https://dictionary.cambridge.org/dictionary/english/historical, Date: 10-02-2023*

Word process indicates something that is ongoing. In simple words, process indicates a series of transformations that must have happened to a particular scenario in a considered timeframe. The dictionary meaning of the same is a series of changes that happen naturally.[3] Thus the historical process can be defined as a sequence of change taking place naturally or due to the occurrence of various events that must have taken place in the past.

With this fundamental knowledge of historical processes, the question arises: Can evolution be seen as a historical process? Leslie A. White writes about this. He recognized the similarities between the processes of history and evolution, both of which display temporal sequence. However, historical processes are influenced by the particulars of a given time and place, but evolutionary processes are not confined by space and time. (Bock, 1952) After understanding this one can look at how various scholars have defined historical process.

According to Max Adler, "Knowledge and tenacity of historical process is topic of autonomous reflection." (Czerwińska-Schupp, 2017) This focuses our attention on the reality that there are various ways to view the historical process. These interpretations vary depending on the setting and field of study used to define the term.

"People make their own history"

- Karl Marx.

Karl Marx believed that changes in the production process, which is essential to all aspects of social existence in human society, are the cause of all kinds of historical processes. He emphasizes that the creation of material life was the first historical act of humans. During the period of Second International, many scholars tried to define the historical process in the line of theories given by Karl Marx.

Karl Kautsky one of the Marxist theoreticians has defined Historical process as an extension of the process happening in the natural world. It is considered that the definition given by him was influenced by naturalism, scientism, and positivism. This definition was given with a background that facts of life i.e., morals, custom, art, value, etc. to a particular society are subject to their own independent and unavoidable laws of development. These laws were treated as extensions of the laws of nature. But his explanation was limited or it eliminated the significance of purposeful human action. (Czerwińska-Schupp, 2017) Thus this point of view does not consider the political or economic changes but explains the historical process as an ongoing phenomenon of the development of human society advancing out of the natural process.

Another definition examines the social and political changes that are taking place in human society. This definition refers to the historical process as a measure of the development or decline of human society. This point of view was regarded as a humanist and activist interpretation. (Rohbeck, 2018) Even while this perspective considered social and political changes as well as historical developments, it was unrelated to the notion of economic structure. Thus, this

3 *https://dictionary.cambridge.org/dictionary/english/process, Date: 10-02-2023*

approach sees the historical process as a constant change in the social and political conditions of human society but it is incomplete and falls short of providing a more thorough explanation of the historical process.

These two definitions do not consider one of the major concerns of the economic perspective as a result it was not satisfactorily accepted by all the theorists of the period of Second International. Otto Bauer was one of the historians who gave a new interpretation of the historical processes during this period. This is because Bauer considered an economic factor as the predominant factor in the historical process. Otto Bauer was a historian, inspired by Marxism and he changed the method of history writing from explaining history in terms of dynasties, wars, ideas, and 'great men', i.e., the traditional way of history writing. He expressed the history of humankind as not more than a class struggle. (Czerwińska-Schupp, 2017)

Having such background Bauer explained that, with a change in the scientific and social living condition of human; thoughts, morals, custom, values, art, religion, etc. also changes. Further, he explains that these can be determined by changes observed in production and exchange of goods considering relations of the production as a base. Hence Bauer defined the historical process as a permanent and progressive development of forces of production and related economic conditions that developed during our conscious struggle to dominate nature for the sake of satisfying our needs. (Czerwińska-Schupp, 2017) This definition includes the political economic and socio-economic factors in consideration. This also expresses the mutual dependency of socioeconomic processes.

Only a select few, in Bauer's opinion, were capable of directing historical events using acquired knowledge. Marx added to this explanation by stating that those who control the means of production will have an impact on society. Therefore, the role of powerful people is to inspire mass movements, although historically, the masses have always been the focus. (Czerwińska-Schupp, 2017) As a result, although certain individuals guide or direct events like wars and some revolutions, etc., they happen due to mass movements. This historical act of society supports Bauer's notion that the people who are the subjects of historical processes are the masses. History cannot proceed without mass approval or rejection of a certain event.

As said by Karl Marx growth of any human settlement towards becoming a city depends upon the way the cycle of surplus production is managed by the human society at a particular place and time. Hence one cannot avoid the socio-economic aspect while studying the growth of a city. This is further emphasized by Lewis Mumford while explaining how the use of agricultural surpluses for commerce, as well as for diverse occupations and the development of new occupations before agriculture, led to cities becoming the center of attention. (Mumford, 1961) Hence, the definition of the Historical process provided by Otto Bauer is more appropriate in the context of studying cities.

Thus, the Historical Process is a subject area under the umbrella of History. While trying to understand cities through the lens of the Historical Process, one needs to understand which approach of history writing can provide a fresh perspective for the historical interpretation

of the cities to plan them in the contemporary time. Moreover, to identify an appropriate historical process, understanding the elements of History is equally important.

3. APPROACHES AND ELEMENTS OF HISTORY

History is a story about how man has interacted with changing times based on evidence. It thus involves investigating historical events, shifts in human civilization over time, and their effects on current social norms. There are two predominant approaches of historical study. They are the idealistic approach and the materialistic approach.

Idealism is the pursuit of knowledge about the universe within a particular framework, set of presumptions, or set of guidelines. The idealist approach to history thus focuses on examining the character of history as a method of study and application. Dilthey, Croce, Hegel, Collingwood, and Oakeshott have made significant contributions to the idealist view of history.

Even though idealism provides a detailed understanding of history, it contains some gaps. Many philosophers and historians have criticized this method of studying history since it makes the subject matter difficult for many people to understand because it is invisible. In addition, because this theory enables the creation of history from mental constructs, the same material can be interpreted in a variety of ways. Hence, the history of the same location can be elaborated in many ways depending on the historian's perspective, comprehension, and context. This may also result in inaccurate and incorrect history writing. (Hutchison, 2010) Thus, the idealist approach to history portrays a certain level of limitation, and in contrast to this approach, materialism expanded its region and was accepted by many thinkers and historians.

In recent times materialist conception of history became an important methodology used by some communist and Marxist historiographers, thinkers, and planners that focuses on human societies and their development through history, contending that history is an outcome of material conditions rather than ideals. Thus during 20th century many planners, critiques of urban planning and writers noted the idea of Marxist materialism. (Paden, 2003)

The ability of Marxist theory to examine changes in work, the built environment, and daily urban life via the categories of political economy is its primary contribution to the study of cities. This entails figuring out how capitalist social interactions are woven into the fabric of urban life, as well as the organizing principles and underlying patterns of accumulation and investment. (Hutchison, 2010)

Peter Hall in his famous book Cities of Tomorrow, p.339 explains that Marxist planners are caught up in a dilemma. It is difficult to identify that either the theory is about unrevealing the historical logic of capitalism or it is a prescription for action. (Holgersen, 2020) Although the basic association between industrial expansion and rural-urban migration established by Marx and Engels seems to apply to modern urbanization, the dynamics of urbanization have grown progressively distanced from processes of economic development. (Hutchison, 2010) Thus, the Study of the Historical Process from only a materialist perspective may not help to understand cities in a rightful manner. Hence both approaches to history (Idealist and Materialist) have many

leads for planners but at the same time, both approaches have their own limitations. To identify the methodology of utilizing historical understanding in present-day planning; utilization of the positives of both approaches can be turned out as a fruitful tactic.

Furthermore, historical perspectives introduce us to the key elements that enable the analysis of historical processes. Time, geography, and production process are the three main elements of historical studies. Most of our recent research on urban history views cities through the prisms of geography and time. The element of time enables viewing history in chronological order. It helps to recognize numerous events and identification of significant monuments in relation to time. Thus, when planning for our cities, the element of time can be most easily suited to describe history. Geography is another element, which covers data on Physical, Human, and Environmental geography. Planning can also be seen using information about location with respect to this component, as it is simple to understand. While the third component of the production process provides information on the shifting relationships between capital, labor, and land. It is a relatively new field of study. Very few scholars have begun to approach history from this angle. One can observe the partial existence of the first and second components within the current planning procedures of different Indian cities, and the third component has room to develop in the future.

4. CONTEMPORARY PLANNING AND HISTORY

India being one of the British colonies, has inherited a planning system from the U.K., After Independence India had two major challenges related to Housing for refugees as well as planning for economic boost and development. Thus, the situation offered the planning profession to plan for crisis management rather than the living environments of the city. (Ansari, 1977)

After 1950s many amendments and legislations have been made and implemented in India to shape and enhance the process of planning to achieve better envisioned urban cities of India. Amongst the steps taken to improve planning process in India; a national workshop on *master plan approach: Its efficacies and alternatives* was held in 1995. Various scholars together gave thought to the entire process of urban planning and its implementation. As a result, the Institute of Town Planners India prepared a planning guideline 'Urban Development plan Formulation and Implementation' in 1996 with help of recommendations given during this workshop. This was the first national-level guideline on urban planning. It provided framework for plan preparation and implementation. With changing times and increasing urban challenges having a need for new directions this guideline had gone through a revision and in 2014 it was renamed as the 'Urban and Regional Plan Formulation and Implementation' guideline. (URDPFI, 2014)

As this guideline provides content for plan preparation it includes the provision of a brief history of the city as well as a segment on natural and built heritage as part of data collection before preparing for the development plan. The process of plan preparation starts with population projection and an approximation of typical household size, along with the economic status of various household units; to determine the demand for residential space. Similarly based on economic trends and future funds requirements of industry, office, and retail spaces are projected; then transportation pattern is decided based on land use distribution. In addition to this basic

process, many cities identify the concentrated area for natural and built heritage and provide an identification of areas important for conservation or preservation within the city. Moreover, cities also plan for sustainability and smart city standards as part of the development plan. (Ahluwalia, 2015) Thus process of plan preparation has become very technical and meticulous. As the National Guideline has provided space for historical data collection; Development plan reports compile data of history but utilization of its understanding shows limited traces within the plan formation process.

Table 1: Comparative Reading of the Status of History and its Utilization in Development Plan Reports of Selected Cities

Development Plan - City	History is Part of Report?	Where Information of History is Provided?	Is history Utilized as a Part of Planning /How?	What Type of Information is Utilized as History?
Delhi Master Plan 2041	Y	Section 3: Heritage, Culture and Public Spaces	Heritage Conservation and Tourism Planning	Very brief history along with identification of Various Heritage sites and monuments are identified.
Ayodhya Master Plan 2031	Y	Ch.1.2 Brief History of Development of the Town	Tourism Planning	Mythological associations, important heritage monuments and locations, and important personalities are described
Hampi Master Plan 2021	Y	Ch.2D Cultural Heritage	Heritage Tourism	Very brief description of various heritage monuments is given.
Bhopal Master Plan 2031	Y	Ch.11 Old city and Heritage	N	Brief description of various heritage monuments and zones is given.
Surat Development Plan 2035	Y	Ch.1.2 Historical Background of Surat, Ch.14 Heritage and Conservation	N	Brief information on tangible and intangible heritage along with mythological stories and timeline-based events are described.
Rajkot Development Plan 2031	Y	Ch.13 Heritage and Tourism	Tourism – Partially	Brief identification and a few line description of various monuments and timeline-based events are explained.
Vadodara Development Plan 2031	Y	Ch.1.2 Brief History of Vadodara	N	A spatial-temporal growth of the city since the past is explained and a brief of various monuments with timeline-based events is explained.

Source: Table created by Author based on reading DP Reports of selected cities.

Table 1 shows a study of development plan report of selected cities. The cities are selected based on their current scale and historical importance to look in to diversity that Indian cities

carry. Through this study it has been identified that DP reports include the History of a place but it is a very small segment and very briefly written which does not help in the identification of the aspects/ elements of history important to be planned for any city. Majority of reports do not infer anything from the written History. There is a very minor inclusion of history in physical plans; it is limited to heritage planning and tourism planning. It can also be observed that in some places chapters of history are included only to support the preconceived idea of promoting tourism.

Such a planning strategy reveals a gap in historical context, as implied by R.G. Collingwood's description. He clarifies that every historical event has two sides: an internal face and an external face. The external one reflects the event's consequence, which is primarily physical, while the internal one represents the event's cause, which is primarily immaterial. He continues by saying that since the outward face is simple to recognize, people just pay attention to it. (R.G. Collingwood, 1994) Thus, precincts or monuments are also simply mentioned and not included because they fall in the purview of conservation. The internal aspect of historical events is utterly disregarded at the same time. Thus, one can observe that history is just listed in the city planning report and has a limited use.

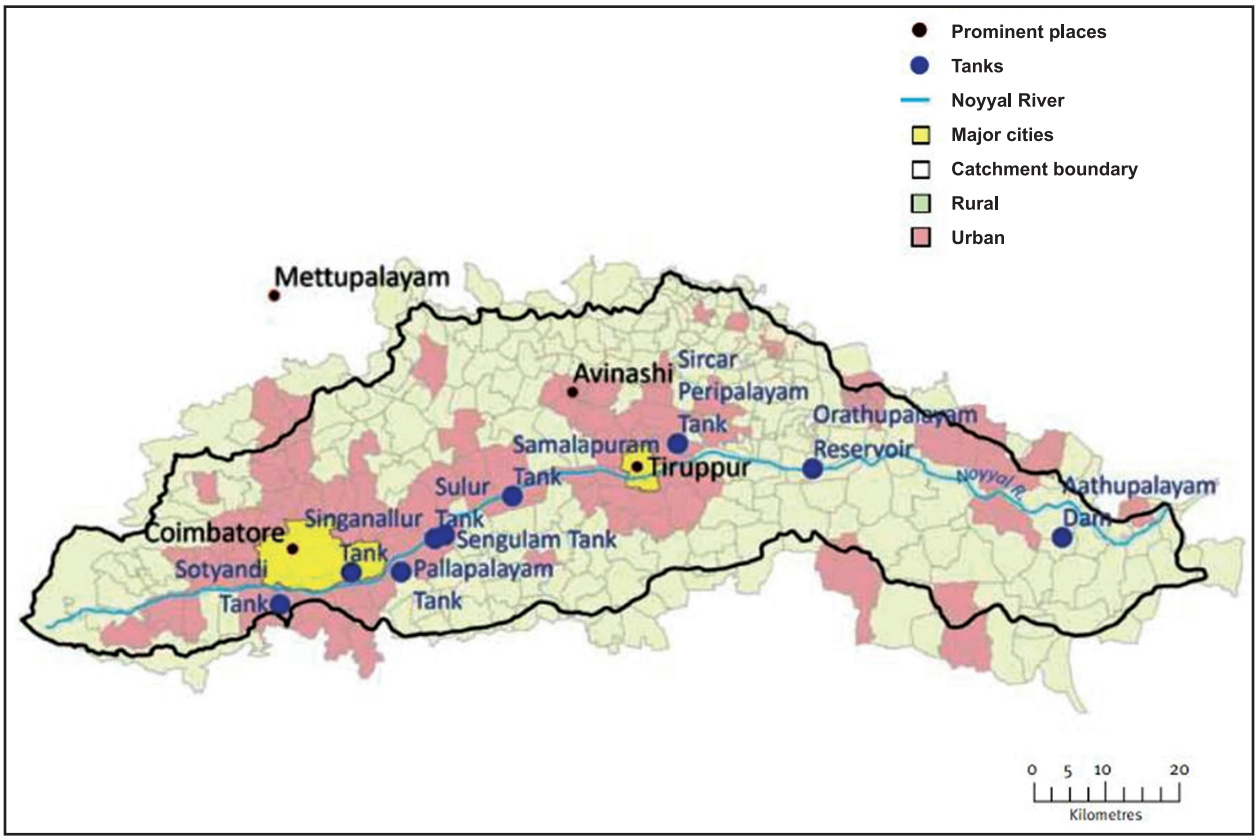
5. LITERATURE CASE STUDY – COIMBATORE, INDIA

The City of Coimbatore also known as the "Manchester of Tamil Nadu" has a very important and strategic location in terms of geography and biodiversity. In terms of population, it is the second-largest city in Tamil Nadu. The city corporation, having an area of 105 sq. km., is surrounded by the Nilgiri Biosphere Reserve in the North and the Anaimalai and Munnar mountain ranges in the East, all of which is part of the Western Ghats: one of the ten "hottest" biodiversity hotspot regions of the world (figure 1). According to the provisional reports of the Census of India (2011), the urban agglomeration of Coimbatore comprises a population of over two million. (Rajshekariah, 2011)

Historically city of Coimbatore developed as a settlement on the banks of River Noyyal. Major labor of the settlement was involved in Agriculture as a production activity. Moreover, there was a network of tanks developed through the time. Hence the area historically was characterized as a network of lakes surrounded by agricultural lands. Along with Agriculture, the settlement was involved in the activities of the trade as due to its importance of geographical location, settlement falls on the trade route between the coastal areas of Kerala and Tamil Nadu. (Directorate of Census Operations, 2011)

Due to the rich Agricultural activities, abundance of water availability due to the existence of a river and network of lakes, and important geographical location on the coastal route, attracted development of many industries to develop near this settlement by the late nineteenth century. Thus, a land use transformation took place where Agricultural lands were reduced and the Industrial land use developed. A transformation of Agrarian settlement to Industrial settlement can be observed.

Figure 1: Map of Urban and Rural Settlements in the Noyal Sub Basin



Source: Map prepared by Ecoinformatics Lab, ATREE based on data from Primary Census Abstract Coimbatore 2011.

Thus, the growth of Coimbatore is observed with the development of Industries, which also resulted in the larger rural-urban migration to the city. While looking at the growth pattern of the city one can observe initial radial growth that changed to the ribbon development along the roads, which resulted in a larger footprint spread over the biodiversity-sensitive areas. (Rajshekariah, 2011)

It is also observed that the importance of the river and network of tanks was ignored due to the influx of population and development of the industries. Geographically Noyyal River (180 KM long) acts as a tributary to the Kaveri River and it is considered as a holly river that provides the most portable water. During the 8th and 9th centuries around 30-32 tanks were built by the ruler to maintain the water table of the region, storing maximum water during monsoon, and reducing the flooding of the river. Out of which presently only 11 tanks exist. (Rajshekariah, 2011)

While reading the Development Plan of the city one can observe that importance is given to the economic growth of the city and land use is provided to boost the industrial growth through diversifying the types of Industries but importance to the existing Agricultural activities,

manmade lakes, and water retention in the river throughout the year is not taken into the mainstream consideration. As a result, the city is observing draught during summer and sudden floods during monsoon season. (Rajshekariah, 2011)

Thus, the Ignorance of the historical response of human settlement toward the topographic and ecological situation can create new challenges for Planning.

6. CONCLUSIONS

Through this study we can understand that today in India we are standing at a place where we can take pause, go back to our historical roots, and plan our cities with a new direction which is away from the colonial influence.

This does not mean that there is a need to return to the past. Nevertheless, there is a need to first develop a different perspective to look at the history of a city and help to extract meaning from the unique past of the city. As we know that every city is sole in its own way and so they cannot be understood in the same fashion but common aspects or ways in which planners can utilize the understanding of history while planning needs to be identified.

As cities are always growing it is logical to see history of our cities as a process. This study shows that historical process in context to Urban cities can be defined best through the definition given by Otto Bauer “as a permanent and progressive development of forces of production and related economic conditions that developed in the course of our conscious struggle to dominate nature for the sake of satisfying our needs”. (Czerwińska-Schupp, 2017)

To build a method of city planning while utilizing historical process a mix approach of idealist and materialist can help us, as one allows to create history through mind construct based on evidences found and the other approach allows to see the changes in terms of work, built environment and daily life via categories of political economy.

Further the study helps to understand the scope to see history of our cities through the components of the production process. As many scholars have seen history in terms of chronology and geography which is limiting us from seeing the history of our cities in terms of events, locations, built fabric, etc. reflection of the same can be observed in current plans where historically important places are identified and left aside as scope of conservation. All these are tangible aspects but intangibles are ignored and the component of production process shows scope to utilize intangible history to be utilized as a planning process.

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An Overview of Sustainable Urban Form in Historic Cities

Monica Kashkari and Tejwant Singh Brar

Abstract

The sustainability of the built form in a historic settlement encompasses the regeneration and conservation of the overall built environment. Understanding how the study of urban form is relevant and useful in planning historic cities is a cornerstone of the current study. This study has been attempted using documentary analysis, literature review and understanding of various case studies, policies and programs to make a broad understanding of the Sustainable urban form, current policy directives, and best practices and derive a road map of better planning of Historic cities.

1. INTRODUCTION

"Historic towns" is a compound word that combines the definitions of "historic" and "towns," where "historic" refers to a thing or event that is significant when studied as part of the past (Cambridge Dictionary) and "town" is a place where people live and work that is typically larger than a village but smaller than a city. The notion that a historic city, or part of one, needs to respond to the elements that necessitate its contact with the rest of the city and link to the greater urban setting surrounding it is what is seen as significant. However, a historic district must be able to demand a special status from the rest of the city (Jain, 1990).

The concept known as Historic Urban Landscape is a means of managing cultural resources in dynamic, ever-changing landscapes. The World Heritage Committee uses the Historic Urban Landscape concept to provide an all-encompassing management strategy for historic urban areas. Its foundation is understanding the layers and connections between every city's tangible and intangible, local and global, and natural and cultural values. By combining social and economic development objectives with preserving urban history, UNESCO holistically manages historic urban landscapes. Urban legacy is viewed under this approach as a social, cultural, and economic asset for city growth. The Historic Urban Landscape method considers the complete human context, including both tangible and intangible aspects, rather than just the preservation of the physical environment. It tries to promote the sustainability of planning and design interventions by addressing the existing built environment, intangible heritage, cultural variety, socio-economic and environmental concerns, and local community values. Built or urban form has a significant role in maintaining and improving the area's character and quality in historic settings.

Urban form is a term that describes the physical characteristics of a city, such as its size, shape, and configuration. Urban structure is a term that refers to the pattern or arrangement of development blocks, streets, buildings, open spaces, and landscapes that make up urban areas. Urban function is a term that describes the activities and roles in a town concerning its society,

Monica Kashkari; *Research Scholar, School of Art and Architecture, Sushant University, Gurgaon*

Tejwant Singh Brar; *Senior Professor, School of Art and Architecture, Sushant University, Gurgaon*

hinterland, or other settlements. Urban functions are the relation between urban (social) needs and urban (spatial) forms. Urban functions shape the morphological characteristics of urban space, such as the location, size, and shape of urban areas. As society evolves and the economy changes, urban functions can also vary; hence, form and functions are correlated. Urban form can be analyzed at different scales, from the individual building to the metropolitan area (Živković, 2019). Urban form can also be classified into two major variations: organic, i.e., the structure that develops without any effort of standardized or regulated planning and planned form, set up by a designed and coordinated action. Urban form can affect the built environment as well as can impact the natural environment in various ways. Different urban forms can influence the amount and type of energy used. Compact and mixed-use urban structures tend to reduce the need for private car use and promote public transport, walking, and cycling, which can lower the energy demand. Compact urban forms can also reduce the energy demand for heating and cooling by increasing the share of attached buildings and reducing the exposed surface area per unit of floor space. However, some studies suggest that compact urban forms may upsurge the energy demand for lighting due to higher building density and shading effects (Dempsey, 2010).

Further, different urban forms can affect the exposure of urban residents to air pollutants from various sources, such as traffic, industry, and power plants. Compact and mixed-use urban structures can reduce the vehicle kilometres travelled and the emissions of air pollutants from the transport sector. However, compact urban forms can also increase the concentration of air pollutants in densely populated areas due to reduced ventilation and dispersion. Moreover, compact urban forms may increase the exposure of urban residents to noise pollution from traffic and other sources. Therefore, the impacts of urban form on air quality and health depend on the trade-offs between emission reduction and exposure increase (Rezaei, 2023). Different urban forms can also affect the amount and quality of land used for urban development and the impacts on natural habitats and biodiversity. Compact and mixed-use urban forms can reduce land consumption per capita and limit the urban sprawl into rural areas, preserving more natural land and ecosystem services. However, compact urban forms can also increase the fragmentation and degradation of natural habitats within urban areas due to higher building density and impervious surface coverage (Hui Wu,2022). The availability of green spaces may also be reduced when propagating compact urban form; hence, the impacts of urban form on land use and biodiversity depend on the balance between quality and quantity. Therefore, the aspects of Urban form have to be imbibed with the principles of sustainability, especially when dealing with historic towns.

Sustainable urban form designs and manages cities to minimize environmental impact and enhance social and economic well-being. Historic cities have a rich cultural heritage and a distinctive urban character that reflects their history and identity. Planning historic cities involves balancing the need for conservation and regeneration while respecting the values and preferences of the local communities. Various kinds of research have looked into the details of historic towns, like in the Research paper, ‘Historic Cities in India -Overview’, which examines the issues in planning for historic cities in India and how the changing social and economic scenarios have introduced a fused culture collage of the traditional and contemporary era. The Research paper, ‘History Of Urban Design: From Ancient To Modern Cities’, provides an overview of the history of urban design and how different civilizations and periods have influenced cities’

urban form and environmental performance. The UNESCO Recommendation on the Historic Urban Landscape is a key tool to help cities tackle climate action and sustainable development by presenting an integrated, people-centred landscape approach to urban management.

Historic landscapes are characterized by their local and global significance and tangible and intangible cultural and ecological values. Historic landscapes should have built forms that respect these ideals and are flexible enough to accommodate necessary innovation or change. The architectural form must also be consistent with the surrounding built environment and landscape setting to create a cohesive and harmonious whole. These days, most Indian cities are very similar to one another, no matter where they are. The mix of high population density in the central regions and relatively low density in the more recent developments is one of the most distinctive characteristics of Indian cities. The old core sections of the city are under a lot of duress from the recent expansions to the ancient settlement, which seem incompatible with the city's overall structure and viability(Kumari, 2020). The substantial population of the old town is a significant feature of the contemporary Indian environment. Even though it is not located in the city's developable area, it affects adjacent areas and the entire city. Therefore, it is imperative to emphasize that "Unlike individual constructions, historic portions of Indian cities cannot be detached for planning and conservation." Furthermore, these spaces cannot be walled off and turned into living museums without a proper roadmap for sustaining the built form and its inhabitants. Some of the problems being faced in historic urban landscapes in India are listed below:

- Lack of appreciation of the cultural and historical worth of the heritage resources among the public and the authorities. The importance of the built form, the materials, and the construction methods utilized in old urban districts are not often recognized or appreciated. They could also see them as impediments to progress or modernization.
- Inadequate funding, knowledge, and institutional support have resulted in inadequate preservation and upkeep of the historical assets. Historically significant buildings and structures are destroyed, damaged, or neglected for various causes, including natural disasters, vandalism, unauthorized intrusion, or inadequate management.
- Loss of authenticity and integrity of the heritage resources owing to inappropriate interventions or alterations. Without the necessary permission or consultation from the appropriate authorities, certain initiatives may change or modify the original characteristics or purposes of the buildings or structures. They might also include components that go against the area's historical character or are unsuitable for the setting.
- Conflict between the objectives of development and conservation. The values of heritage must be enhanced and preserved in a way that allows for suitable innovation or change to satisfy the needs and ambitions of both the present and future generations. Involving all relevant parties in the planning and decision-making processes, including local communities, governmental institutions, the commercial sector, civil society, and international organizations, is necessary.

Thus, there is a need to study this in detail. The preservation and revitalization of the entire built environment are included in the sustainable built form of a historic settlement. One of

the main goals of the current study is to comprehend the relevance and use of studying urban form in the planning of ancient cities. This study attempts to gain a broad understanding of the Sustainable urban form, current policy directives, and best practices, as well as a road map for better planning of Historic cities, through documentary analysis, literature review, and an understanding of various case studies, policies, and programs.

2. CASE STUDIES

Historic towns are often characterized by their compact, mixed-use, and walkable urban form, which can offer some advantages for sustainability, such as reducing energy consumption, land use, and transport emissions. Sustainable urban form in historic towns explores how to balance the preservation of historic towns' cultural and architectural heritage with the demands of modern development and sustainability (Buitelaar, Moroni, De Franco, 2021). Looking at historic cities of India like Hyderabad, Ahmedabad, etc., part of this study noted that historic towns also face some **unique challenges**, such as:

- **The deterioration and obsolescence of the historic buildings and infrastructure**. For example, historic buildings may not meet the standards of safety, comfort, accessibility, and efficiency that contemporary users require. Moreover, historic infrastructure may not be able to cope with the increased demand for services, such as water, sanitation, electricity, and communication (Wang, 2012).
- **The loss of identity and authenticity of the historic towns**. For example, historic towns may be subject to inappropriate interventions that alter or destroy their original character and value. Moreover, historic towns may be affected by the homogenization and globalization of culture, economy, and lifestyle, eroding their distinctiveness and diversity (Saleh El-Basha, 2021).
- **The marginalization and exclusion of the historic town**. For example, historical towns may be isolated from the mainstream development and opportunities that are offered by larger or newer urban areas. Moreover, historic towns may be dominated by tourism or gentrification that displace or exclude the residents of the communities (Kiruthiga, Thirumaran, 2019).

There are also many examples of successful heritage conservation projects and strategies. Overall, the built-form has been improved by overcoming the issues of heritage conservation.

- The restoration of Sri Ranganathaswamy Temple in Tiruchirappalli, Tamil Nadu, involved conserving the 12th-century temple complex, one of India's largest and most sacred Hindu temples. The project addressed the issues of structural stability, water seepage, deterioration of paintings and sculptures, and environmental pollution. The project also enhanced the visitor facilities and management and revived the traditional rituals and festivals. The project received the UNESCO Asia-Pacific Award for Cultural Heritage Conservation in 2017.
- The revitalization of the historic precinct of Ka Duhvaan in Aizawl, Mizoram, involved the regeneration of a historic neighbourhood that was once the seat of power and culture of the

Mizo people. Using traditional materials and techniques, the project restored the historic buildings and structures, such as the chief's house, the assembly hall, the watchtower, and the granary. The project also created a public park, a museum, and a cultural centre and engaged the local community and stakeholders in the conservation process. The project received the UNESCO Asia-Pacific Award for Cultural Heritage Conservation in 2019.

- Conservation of the Qutb Shahi Heritage Park in Hyderabad, Telangana, is another project that received the UNESCO Asia-Pacific Award. This project involved the conservation of a 16th-17th century necropolis that contains the tombs of the Qutb Shahi dynasty, along with mosques, gardens, pavilions, and water structures. The project addressed the issues of structural damage, waterlogging, vandalism, and encroachment. The project also improved the landscape, drainage, lighting, and signage, enhancing the visitor experience and interpretation. The project received the UNESCO Asia-Pacific Award for Cultural Heritage Conservation in 2019.
- Incentives for residents have been used to conserve historic urban form in Ahmedabad, which has a rich heritage of historic buildings and precincts, especially in the walled city area. The city has implemented a Transferable Development Rights (TDR) scheme, which allows the owners of heritage properties to transfer their development rights to other sites in exchange for financial compensation or additional floor space index. This scheme aims to incentivize the conservation and maintenance of heritage properties and prevent demolition or alteration (Routh & Shah, 2013). Telangana has enacted the Telangana Heritage (Protection, Preservation, Conservation and Maintenance) Act, 2017, which first provides an inclusive definition of heritage, including both built and natural heritage, and also includes management of protected sites. A similar strategy is proposed in the Bhopal Master Plan.
- Hyderabad has a diverse and distinctive heritage of historic monuments, buildings, and neighbourhoods. The city has introduced a Heritage Conservation Fund, which provides grants to the owners of heritage properties for restoration and preservation. The fund also supports awareness and education programs on heritage conservation. The fund aims to incentivize the participation and involvement of owners and communities in heritage conservation.
- Pondicherry has a unique heritage of colonial architecture and urban form, influenced by French, Portuguese, Dutch, and British cultures. The government of Pondicherry notified regulations for heritage in 2018, and the city has launched a Heritage Awards scheme, which recognizes and rewards the owners of heritage properties for their conservation efforts. The awards are given in different categories, such as best restored building, best-maintained building, best adaptive reuse, etc. The scheme aims to incentivize the appreciation and the enhancement of heritage value and character.
- Luang Prabang, Laos, is a UNESCO World Heritage Site that preserves the fusion of traditional Lao architecture and French colonial influence (Fumagalli, 2020). The town has implemented a participatory approach to urban conservation and development, involving local communities, authorities, and stakeholders in the planning and managing of the

historic area. The town has also promoted using local materials, skills, and techniques to restore and maintain historic buildings (Dearborn, Stallmeyer,2009).

- Amsterdam, Netherlands, is famous for its historic canals, bridges, and buildings that date back to the 17th century. The city has adopted a comprehensive strategy for sustainable urban development, focusing on mobility, energy, waste, water, green spaces, and social inclusion. The city has also encouraged the use of bicycles, public transport, and electric vehicles as the preferred modes of transportation, reducing car dependency and emissions (Sannah, Ouboter, Lugt, Koop, and Leeuwen, 2021).
- Helsinki, Finland, is Finland's capital and largest city, with a history of over 450 years. The city has pursued a vision of becoming **carbon-neutral by 2035** by implementing measures such as increasing renewable energy sources, improving energy efficiency, enhancing public transport and cycling infrastructure, and **promoting circular economy** and green innovation (Jaakkola, 2012). The city has also preserved and revitalized its historic buildings and districts, such as the Suomenlinna sea fortress and the Tori Quarters.

Therefore, sustainable urban form in historic towns requires a holistic and participatory approach that respects and enhances the heritage values of the historic towns while addressing their current and future needs and challenges. Based on the examples and reviewing of their policies and plans, the possible strategies for achieving sustainable urban form in these historic towns can be attributed to the reasons as tabulated in Table 1:

Table 1: Strategies for Achieving Sustainable Urban Form

S. No.	Strategies	Remarks
1.	Adopting adaptive reuse and retrofitting of the historic buildings and infrastructure.	For example, historic buildings can be renovated or converted to accommodate new functions or users without compromising their heritage significance. Moreover, historic infrastructure can be upgraded or integrated with modern technologies to improve performance and efficiency.
2.	Promoting context-sensitive and compatible development in and around historic towns	For example, new development can be designed and located to respect and complement the existing urban form, scale, style, and materials of the historic towns. Moreover, further development can be oriented to enhance the connectivity and accessibility of the historic towns to the wider urban network.
3.	Fostering community involvement and empowerment in the management and development of the historic towns.	For example, residents and stakeholders can be engaged in the planning and decision-making processes that affect the future of the historic towns. Moreover, residents and stakeholders can be supported to develop their capacities and opportunities to benefit from the heritage assets of the historic towns.

Source: Current Study

3. ISSUES AND CONCERNS

Policies at all levels promote sustainable urban form; developing national and local policies that support compact, mixed-use, and transit-oriented urban development is important; for example, India's National Urban Policy Framework (NUPF) provides a set of principles and outcomes for guiding urban planning and governance at different levels of government. The NUPF advocates for a compact city model that optimizes land use, reduces travel distances, and enhances livability. The historic town's perspective must be integrated while developing policies at all levels. Using planning tools and instruments that regulate urban areas' shape, size, and density will ensure historic cores' systematic and practical development. For example, urban growth boundaries, floor area ratios, transferable development rights, and town planning schemes are tools that can be used to control urban sprawl and promote compact urban forms. Applying value-capture financing mechanisms that capture the increase in land value due to public investments or policy changes, For example, betterment levies, tax increment financing, business improvement districts, and land readjustment are some of the mechanisms that can be used to finance urban infrastructure and services that support compact urban form. Implementing integrated transport and land use planning that promotes public transport, walking, and cycling as the preferred modes of mobility. For example, transit-oriented development, mobility as a service, non-motorized transport infrastructure, and parking management can reduce car dependency and encourage sustainable transport modes in historic towns. Enhancing the quality and quantity of green spaces and natural habitats within urban areas, for example, urban forestry, green roofs and walls, urban agriculture, and ecological corridors, can improve compact urban form's environmental vibrancy and livability. Most historic cities lack comprehensive plans and policies in all the above respects.

There are gaps and sometimes conflicts between the national, state, and local laws and norms that govern heritage conservation and incentives. Thus, the challenges of conserving historic urban form in India may be summarised as follows:

- Different states and cities have different definitions, criteria, and procedures for identifying and protecting heritage properties and providing incentives to owners and residents. *Lack of clear and consistent policies and regulations on heritage conservation and incentives.*
- Many heritage properties may not be properly documented, surveyed, or registered, making assessing their condition, value, and significance difficult. *Lack of adequate and reliable data and information on heritage properties and incentives.*
- Moreover, there may be limited or outdated data on the availability, demand, and impact of incentives for heritage conservation, making it difficult to monitor and evaluate their effectiveness. Many heritage properties may require high costs for restoration, maintenance, or adaptation, which may exceed the benefits or affordability of owners and residents. *Lack of sufficient financial resources and capacities for heritage conservation and incentives.*
- Shortage of skilled professionals, institutions, or organizations that provide quality services or guidance for heritage conservation and incentives. *Lack of sufficient technical resources and capacities for heritage conservation and incentives.*

- Many owners and residents may not be fully informed or aware of the heritage value and significance of their properties or the availability and benefits of incentives for conservation.
- Lack of consultation or collaboration among stakeholders, such as government agencies, the private sector, civil society, or community groups, on planning and implementing heritage conservation and incentives.

4. CONCLUSIONS

Based on the various case studies and understanding of the best practices employed in multiple cities, the possible steps which form a mechanism to maintain sustainable urban form are as detailed below:

Identifying and protecting the historic buildings and structures that have heritage value and significance. For example, using tools such as heritage inventories, surveys, registers, and designations to document and recognize the town's historic assets and apply appropriate standards and guidelines for the conservation, restoration, and rehabilitation of historic buildings and structures.

Adapting and reusing historic buildings and structures for new functions and users that are compatible with their heritage character. For example, historic buildings can be converted into museums, cultural centres, hotels, offices, or residences that respect and enhance their original features and materials. Moreover, retrofitting historic buildings with modern technologies and systems improves their performance and efficiency without compromising their heritage significance.

Integrating historic buildings and structures with the surrounding urban context and landscape. For example, designing and locating new development that respects and complements the historic town's existing urban form, scale, style, and materials. Moreover, it enhances the connectivity and accessibility of the historic town to the wider urban network by improving the transport and mobility infrastructure.

Engaging and empowering the local community and stakeholders in the conservation and development of the historic town. For example, involving residents, authorities, businesses, NGOs, and experts in the planning and decision-making processes that affect the future of the historic town. Moreover, it supports residents and stakeholders in developing their capacities and opportunities to benefit from the heritage assets of the historic city.

Incentivizing residents can impact conserving historic urban forms, depending on the type and level of incentives offered and the willingness and capacity of residents to participate. Some of the possible incentives for residents to conserve historic urban forms are:

Financial incentives. These are monetary rewards or subsidies that reduce the cost or increase the benefit of conserving historic buildings and structures. For example, grants, loans, tax credits or exemptions for restoration and maintenance of historic properties. Other incentives may be revenue-sharing or benefit-sharing schemes that allow residents to receive

a portion of the income generated by heritage tourism or other commercial activities around historic sites.

Regulatory incentives. These are legal or administrative measures that facilitate or encourage the conservation of historic buildings and structures. For example, zoning regulations, building codes, or design guidelines that protect the historic character and value of the urban area. Other incentives are transferable development rights or easements that allow residents to sell or donate their development rights or property rights, and the conservation agencies or organizations get to fulfil their objectives.

Educational incentives. These are informational or awareness-raising activities that increase the knowledge and appreciation of residents for the historic buildings and structures. For example, training programs, workshops, or publications that provide technical guidance and best practices for conservation. Other incentives are cultural events, festivals, or exhibitions that showcase the history and heritage of the urban area.

Social incentives. These motivational or participatory mechanisms enhance structures like recognitions, certificates, etc.

Thus, to sustainably maintain historic towns' urban form, it is necessary to ensure that regulatory support is available in the form of policy interventions, regulatory plans, etc. However, to have these interventions, it is required that the historic towns are studied and analyzed in detail, with possible detailed surveys and documentation, existing situation analysis and intervention areas.

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Urban Land Development Policies in India: A Comparative Analysis

Saurabh Jindal and Veruval Devadas

Abstract

The Indian urban development landscape has become increasingly complex due to the expansion of cities and the "Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act of 2013". This has led to the need for optimal land development mechanisms that provide land-owners with valuation gains and funding without relying on government tax resources. Currently, several mechanisms exist for urban land development in India, but the number of studies is low in India. This study compares and evaluates these mechanisms, analyzing land development laws, rules, and policies of Indian cities. The findings reveal that existing land policies share common approaches, but their mechanisms and frameworks differ, leading to the selection of different development models. The study also highlights the lack of an integrated approach to land development, which is crucial for achieving the Sustainable Development Goals (SDGs). The findings of this study could assist urban planning consultants and development authorities in structuring their land development policies.

1. INTRODUCTION

The land market of urban peripheral areas is the primary institution for allocating land for the urbanization of an expanding city. Urban infrastructure and basic services are lacking in these outlying areas, where affordable property is available but commute costs are high. High-income households are willing to pay more for real estate to encourage the separation of lower- income groups and fund urban infrastructure and services. As a result, social exclusion occurs, and land markets can no longer distribute land fairly and effectively to all users. Furthermore, higher-value neighborhoods with higher property taxes benefit from government investments in urban infrastructure and services. It resulted in some well-served and enjoyable communities, leaving others without the most basic facilities and amenities. The causes of this bias are the high land cost and the market's inability to ensure an adequate supply of serviced land at reasonable rates.

The rising expenses of urban infrastructure and services constitute a burden on poorly designed and neglected private urban sprawl expansions. Additionally, it can result in increased environmental issues. Maintaining the institution of the land market and related land property rights for socially fair land use is a critical concern for development authorities. There is a significant financial burden and potential for corruption associated with public land acquisition and publicly administered land allocation procedures. For development authorities, maintaining the institution of the land market and related land property rights is a crucial problem. They must increase their financial capability to better direct urban growth, particularly the supply of affordable housing.

Saurabh Jindal; *Assistant Professor, National Institute of Construction Management and Research (NICMAR) Hyderabad, Shamirpet, Hyderabad, Telangana*

Veruval Devadas; *Professor, Department of Architecture and Planning, Indian Institute of Technology Roorkee, Roorkee, Uttarakhand*

The equitable allocation of resources, particularly those related to land, infrastructure, and housing, depends on appropriate land policy. The land policy involves planning, acquiring, assembling, financing, developing, maintaining, and regulating land and floor space. Spatial planning could be a component of land policy. In addition, several linked systems, including those related to demography, land use, infrastructure, the economy, and the environment, must be considered when formulating policy for land development.

2. OBJECTIVES

The study aims to evaluate the various land development policies being implemented for urbanization in India. The following are the study's objectives:

- To analyze the provisions of various tools of land development policy.
- To appraise the different models of urban land development policy in India.
- To make a comparative analysis between the different models of urban land development policy in India.

3. LITERATURE REVIEW

A municipality's land policy consists of the political and legal steps it takes to address the issue of urban land scarcity. By altering land use, distribution, and value, it seeks to put into practice spatial development goals that have been collectively set. The most often used tool in land policy is a land use plan. For development authorities, upholding the institution of the land market and associated land property rights for socially fair land use is a crucial concern. Local governments' financial capabilities must be addressed to control urban expansion properly. To facilitate the long-term integration of geographical, financial, economic, and institutional activities, spatial planning can be a part of land policy. The "reference land value system," which uses data on urban land use planning together with purchase transactions in the regions or zones to calculate land values (Voß & Bannert, 2018), is one of the strategies that govern land-uses without affecting property rights. According to Viallon (2018), the "added value capturing" method is the tax on higher land value brought on by zoning changes. To address issues of land scarcity, equality, and ecology, "land taxation" is a practical method of influencing the behavior of particular groups of people.

Many policy instruments are used in various countries to impact property rights through land-use regulations, including 'Negotiated land use plans,' in which the development authority negotiates land-use plans with private developers and sells serviced, zoned building land back to the developers at an agreed-upon price (Tennekes, 2018). Spot zoning is the rezone of land parcels when the current zone does not comply with the allocated zone following the case-by-case negotiation of developer contributions (Mandelker, 2016). According to Zhao et al. (2012), the joint development model enables the local government to provide private developers a license to purchase or assemble parcels of land directly from land-owners and develop them following the existing land use plans. The use of urban growth boundaries is another method of preventing urban sprawl by ensuring a sufficient amount of land that may be developed while leaving the region outside the boundary in its natural form (Sullivan,

2018). Land readjustment is the process of combining small land parcels that various land-owners have voluntarily given up into a larger tract that is then scheduled for development by the development authority. Along with providing infrastructure, social amenities, and land for public use, it also covers the costs associated with development. The degrees of involvement, financial calculations, zoning standards development, and land redistribution are crucial components in land readjustment so that original land-owners can get fair development advantages in re-allocating land parcels (Condessa et al., 2018). The building obligation is a tool the development authority uses to compel land-owners into timely compliance with the land use plan (Hengstermann, 2018).

The policy redefining property rights includes the authority to pre-empt a property that an owner wishes to sell for the government to obtain significant land parcels for infrastructure development, housing policy, or the creation of land reserves. (Melot, 2018). A market framework for redistributing development rights is being created using the transfer of development rights (TDR) concept that protects historical, artistic, agricultural, and environmental resources (Skuzinski & Linkous, 2018). Sometimes, Development Authorities use the tool of Long-term land leases to reduce occupation costs by renting land previously bought at a reasonable price (Guelton & Le Rouzic, 2018).

The policy that redistributes property rights is based on strategically purchasing land on the open market for development authorities to execute future planning efforts (Spit, 2018) quickly. One of the common land policy strategies is the "expropriation" of the parcels required to carry out planned public projects (Albrecht, 2018). Nationalizing the land might be a government approach if private land use practices lead to resource over-exploitation (Lloyd, 2018).

4. DATABASE AND METHODOLOGY

Presently, in India, there are various mechanisms for urban land development as state governments in the country are responsible for land development and management. This study examines and evaluates the opportunities and problems of different urban land development techniques used across the country. Land development laws, rules, and policies of selected Indian cities have been reviewed and analyzed in this research.

4.1 The Legislative Framework for Land Development Policy in India

The state governments in India are tasked with administering land, assessing and collecting taxes, maintaining land records, and other activities linked to land under the Seventh Schedule (the State List) of the Indian Constitution. The Union Government develops plans and strategies for the Union Territories' development. Rising urbanization prompted the creation of regional development plans, and National Urban Land Use Policy formulated in 2013 emphasized the need to make the greatest use of available land resources. The Urban and Regional Development Plans Formulation and Implementation (URDPFI) guidelines issued in 2015 by the Government of India advise a complex planning framework, including investment planning and planning for important areas. Planning for urban land development in India occurs concurrently with the procedure for requesting recommendations and objections from the public about draft plans. In

2018, the National Urban Policy Framework outlined guiding principles for urban planning to spur sustainable growth and job creation while creating more inclusive cities through socioeconomic mobility, mixed uses, open spaces, and public transportation.

4.2 Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (RFCTLARR) Act, 2013

Governments can acquire private property for public purposes by using eminent domain. The doctrine of 'eminent domain,' according to which the welfare of the people is the most important law. List III of the seventh schedule gives the central and state governments the authority to initiate land acquisition laws. A public purpose that can only be met by a specific piece of property and for which no substitute exists justifies using eminent domain to acquire land. Governments in India may acquire private property to construct public infrastructure or urbanize undeveloped land. Under the RFCTLARR Act of 2013, which entered into force on January 1, 2014, it pays impacted land-owners and offers rehabilitation and relocation. The Land Acquisition Act of 1894 governed the acquisition of land in India until 2013, when the government's compensation was judged insufficient by the land-owner. However, following the passing of the RFCTLARR legislation in 2013, land acquisition for urban development has become time-consuming for government entities.

4.3 Development of Land by Private Sector

Other than government land acquisition, alternative development options and private sector involvement in land assembly and development exist. The developer buys land and compensates farmers/owners based on the rising market price. It is a type of collaboration between private developers and the government system that has led to the evolution of the housing industry. Developers construct houses, roads, utilities, and other infrastructure on their land. The government provides regulatory support as well as connecting infrastructure. The government imposes external development/ betterment levies to cover infrastructure construction costs. However, some governments reserve land for sale to cover costs. Various mechanisms and instruments are used by various states in India for land development. Considering that administering land is a state-list subject in India, several land development mechanisms, such as town planning schemes, joint development models, joint ventures, land pooling, TDR, long-term leases, and hybrid models, are developed by various Indian states.

- **Maharashtra Model**

  The Town Planning Scheme (TPS) of Maharashtra enables municipalities to acquire property from private land-owners for public uses like roads, open spaces, low-income housing, utility infrastructure, and other health, education, and community services. These projects entail land pooling, boundary readjustment, and land redistribution to allow planned development and infrastructural improvements. Land policy in Maharashtra is determined following the framework and procedures outlined in the Maharashtra Regional and Town Planning Act of 1966. Regional planning boards/development authorities establish regional plans, while local bodies develop development plans. The state government of Maharashtra establishes regional planning organizations and divides the state into regions.

These organizations develop regional plans that outline how the land in the region should be used. The development plan specifies how land within a planning authority's control will be used and developed. Urban renewal, housing, commercial centers, industrial districts, civic centers, educational and cultural institutions, and recreational spaces are all part of it. A planning authority develops one or more town planning schemes for the area under its jurisdiction, which include information on who owns each original plot, the property that has been reserved, purchased, or allocated, the extent to which the borders of the original plots will be changed, and an estimate of the overall cost. Nonetheless, the TPS technique has been criticized owing to considerable delays and land distribution that culminates in litigation. Authorities may only recuperate their expenditures by charging land-owners betterment fees, although the delays have raised implementation costs. To account for the greater expenditures, the cost of adopting a TPS is therefore paid by the yearly budget of the urban local authority, thus further delaying its implementation. Furthermore, the law makes no provision for acquiring property to resell it to offset the scheme's cost (Deuskar, 2011).

- **Gujarat Model**

  Gujarat State's land policy is developed in line with the Gujarat Town Planning and Urban Development Act (GTPUDA) of 1976. For planning purposes, the GTPUDA of 1976 stipulates the formation of a development area encircling a city or town. Each designated Development Area is assigned an Urban Development Authority responsible for developing development plans, town planning schemes, and local area plans. Gujarat's urban planning process consists of two steps. Following the creation of a Development Plan (DP), Town Planning Schemes (TPSs) are executed for 100 to 200 hectares of land.

  The DP suggests possible land-use classifications for residential, industrial, commercial, educational, agricultural, and recreational uses. It also describes how development will take place and how long it will take. It also describes how development will occur, and the process for its publishing includes participation from the public. Reorganizing property segments, giving access to each land parcel, reserving land for public use, and determining the requisite increments in land values for infrastructure development are all part of the Gujarat town planning process. The legislation requires 10% of land for housing for socially backward and economically weak, 15% for roads, 5% for parks, and 15% for social infrastructure. The remaining land is utilized to rearrange plots for the original owners, although the size of the individual plots is reduced. Following the strategy's adoption, the plots' market value increases. Given that there was no acquisition or transfer of ownership, the development authority is not required to compensate. The land-owners are charged a betterment fee based on the cost of the proposed infrastructure. However, while calculating finance for urban planning schemes, it is critical to keep the time dimension. Furthermore, development authorities utilize their finances to cover development and acquisition costs for city-level Infrastructure (Nallathiga et al., 2015).

- **Uttar Pradesh (UP) Model**

  According to the Integrated Township Policy-2014 of the state of Uttar Pradesh, the Joint Venture (JV) model for project development envisions a partnership between the

development authority and builders, developers, and cooperative societies depending on their technical and financial capacity. If discussions with the land-owners fail, the development authority purchases the land following the RFCTLARR Act's requirements. A developer costs out and distributes social facilities following government standards and sets aside 20% of built plots for the Economically Weaker Section (EWS). The developer will make a profit when selling the remaining land. The development authority serves as a facilitator for the entire process. The JV agreement specifies the project term, and a penalty is assessed if the developer requests a time extension. It ensures that the land is utilized within the allotted time frame. However, only residential zones with a minimum continuous land size of 50 Ha. may use the concept. In terms of coordinated development with real estate, public-private partnership (PPP) models have been used under the various policies of the UP Government's Department of Infrastructure and Industrial Development to fund, design, construct, and operationalize city-level infrastructure projects such as expressways, energy, transportation, education, urban revitalization, and service sector, among others (Chahar & Gangal, 2019). The JV and PPP models lessen the government's financial strain and enable speedier growth. However, some of these arrangements might lead to issues. Benefits could not be distributed fairly, as in the case of property that is bought from land-owners at a set price but does not get the full value of a planned shift in land use or commercial development.

- **Haryana Models**

  In Haryana, both Joint Development Model and a land readjustment mechanism are being put into effect simultaneously.

  The Joint Development Model has been implemented under the terms of the Haryana Development and Regulation of Urban Areas Act, 1975, wherein, private developers can purchase land directly from land-owners and convert it into a colony. The zoning laws, infrastructural growth, land use patterns, and general development framework are all outlined in the development plans created by the development authority. The Haryana Department of Town and Country Planning issues licenses to private colonizers for the development of Residential, Commercial, Industrial, and IT Park/Cyber Park Colonies following the provisions of this act to involve the private sector in the urban development process. In this strategy, private developers that act as colonizers buy land directly from the proprietors. The state has been divided into several zones based on its growth potential for establishing licensed colonies, including hyper, high potential, medium potential, and low potential. The land a colony needs to start depends on how quickly it can expand. The development authorities impose development charges, taxes, and other levies on colonizers to pay for the construction and upkeep of city-level infrastructure. A 20% flat/plot reserve for EWS housing is also included in the model's provisions for penalties to guarantee timely construction. However, failure to purchase particular parcels of land earmarked for planned development frequently caused problems with continuing services, roads, etc.

  The "Land Pooling policy," a land readjustment technique, was notified in the gazette by the Haryana government in 2022. The development of residential, commercial, institutional, industrial, and infrastructural needs in Haryana is the responsibility of Haryana Shehri Vikas

Pradhikarn (HSVP) and Haryana State Industrial and Infrastructural Development Corporation Ltd. (HSIIDC) under this policy. The state government's Development department determines the project area, performs viability and feasibility studies, and publishes the results under this policy. Then, either directly or through an aggregator, land-owners willingly apply to a project on the Development organization's website. The relevant Development agency reviews applications, confirms ownership, and approves the project, among other things, before publishing the area's layout plan. The reassembled plots are proportionate to the project's saleable land area according to the authorized layout design, and they are available for distribution to land owners offering land under this policy. The value of the undeveloped property, the cost of development, stamp duty, conversion fees, scrutiny fees, registration fees, and other administrative costs are all deducted from the value of the developed land before it is returned to the original land-owner. However, persuading current owners to participate under this strategy voluntarily could be difficult.

- **Delhi Model**

  The Master Plan for Delhi (MPD), which governs the city's future growth and development over twenty years, is created by the Delhi Development Authority (DDA) under the Delhi Development Act 1957 requirements. It contains an analysis and proposals for environmental, infrastructure, and land use improvements. Delhi's land policy is centered on "land pooling" for Greenfield development of urbanizable lands in urban expansions as part of the MPD. Even though it was notified in 2013, it was changed in 2018, and as of 2023, implementation is still ongoing without any indication of progress in the proposed greenfield sectors. The DDA developed a sector demarcation plan to designate Land Pooling zones to enable the DDA to carry out the planned construction of urban expansions and to absorb an extra 48 lakh people at an average city-level density of 250–300 per hectare. The Delhi Land Policy is a hybrid instrument for urban development that primarily uses the "joint development model" and "land readjustment" mechanisms. The policy stipulates that the sector can only be eligible for pooling if at least 70% of adjacent property is acquired by participating land-owners to enable coordinated planning and services. Land-owners with a minimum of 2 ha. of land in a sector must create a consortium to participate in the scheme. The consortium is a single organization that brings together land-owners for coordinated planning, maintenance, property division into shares, and sector development. Under this policy, the DDA creates a sector plan that identifies the locations of the roads, industrial, recreational, public, and semi-public facilities, and a city's physical infrastructure. The consortium would next produce a layout design in line with the sector plan and development control guidelines, and DDA would issue an Entitlement certificate. While DDA would get 40% of the land for the development of city-level physical infrastructure, recreational facilities, and public/semi-public amenities to support the development, the consortium would retain 60% of the land for the development of residential land, commercial property, and neighborhood level infrastructure and amenities. However, the consortium must pay the DDA External Development Charges to cover the cost of delivering city-level infrastructure. Moreover, the development of the Land Pooling areas would be subject to Delhi's prevailing development control norms as per MPD. Additionally, housing for EWS would be built by a consortium for which a floor area ratio (FAR) of 15% more than

the maximum residential FAR would be granted and sold equally by the consortium and DDA. To ensure time-bound development, penalties have been added to the regulations. If service provider organizations cannot complete the external development activities by the Consortium-specified deadline, they would also be penalized. Even though the policy creates a new framework for rapid and regulated growth, with the government acting as a facilitator, there are still obstacles. Delay in policy implementation following the first policy notification, lack of trust between land-owners and the development authority, conflict in the marketable title of joint holdings, complex process, achieving consensus within the consortium, and farmers' lack of access to credit all contributed to delays in implementation, potentially increasing the chances of unauthorized development (Jain et al., 2022).

- **Amaravati Model**

  The state of Andhra Pradesh was reorganized by the Andhra Pradesh Reorganization Act of 2014, which designated 8352 square kilometers as the Capital Region and 216 square kilometers as the Capital City Area (Amaravati). The land policy of Amaravati comprises land development for economic growth, housing, institutions, infrastructure, and recreation to improve quality of life. The mechanism and framework are based on the land pooling model, which offers land-owners a return for every acre (4046.86 sq.m.) of agricultural land pooled of 800 to 1,000 sq yards (669 to 836 sq.m. approx.) of residential land and 100 to 450 sq yards (84 to 376 sq.m. approx.) of commercial property. A draw procedure would be used to distribute the reassembled plots to nearby land-owners within a five-kilometer radius of the pooled property. Under the policy's requirements, land-owners are excluded from initial stamp duty, registration fees, non-agricultural land assessment, and development fees. Additionally, the government would provide low-income families with interest-free credit up to Rs. 25 lahks and offer accommodation for people without housing. In Amarawati's capital city, the zoning regulations apply to several zones, including residential, commercial, industrial, infrastructural, open spaces, and protected places. The RFCTLARR legislation of 2013 or a negotiated agreement may be used to acquire unpooled land. However, according to the study by Menon (2022), this strategy made things worse for landless farmers, which resulted in the loss of their source of income. Moreover, its timely implementation has been delayed due to environmental concerns, farmer protests, budgetary limitations, and the government's decision to establish two additional capitals.

5. RESULTS AND DISCUSSION

This study compares India's prevalent land development models with the conventional approach to land acquisition under the new law of RFCTLARR 2013. This paper considers four major cities in India: Ahmedabad, Gurugram, Amaravati, and Delhi which are based on their typicality of land development policy mechanism. As a result, these land policies may directly and considerably influence the planning of other cities in India. Furthermore, Ahmedabad is one of the earliest municipalities where land policy was first adopted and later became a model for development in most Indian cities. Gurugram is one of India's greatest IT, financial, and economic centres, with

several start-ups and Fortune 500 firms based there. Amarawati, with an area of approximately 20,000 hectares, is the newly built capital of Andhra Pradesh state, which has adopted land policy on large scale for the first time in India. Delhi is India's largest urban agglomeration and political center. The case study examines the legal framework, development regulations, policy attributes, and financial gains to land-owners and developers in various cities with varying land policy mechanisms. Land development policy mechanisms in India were evaluated using the legal frameworks of respective cities, and development regulations were obtained from their current development plans. Table 1 compares typical land development policies models and conventional land acquisition model in India.

Table 1: The Comparison of Typical Land Policy Models in India

Land development policy mechanisms in India	Town Planning Scheme	Joint Development	Land Pooling Policy	Hybrid model	Land acquisition model
Scope of development	Redevelopment/ Greenfield	Greenfield	Greenfield	Greenfield	Redevelopment/ Greenfield
Case study	Ahmedabad, Gujarat	Gurugram, Haryana	Amaravati, Andhra Pradesh	Delhi	-NA-
Legal framework	Gujarat Town Planning and Urban Development Act, 1976	The Haryana Development and Regulation of Urban Areas Act, 1975	The Andhra Pradesh Capital Region Development Authority Act, 2014	Land Policy notified on 11/10/2018 under the provisions of the Delhi Development Act, 1957	RFCTLARR Act, 2013
Prevailing Development Plan in 2023	AUDA revised Development Plan 2021	Final Development Plan 2031 for Gurgaon-Manesar Urban Complex	Detailed Master Plan of Capital City - Amaravati notified in 2016	Master plan for Delhi - 2021	-NA-
Scale of development	Several schemes for Community development		A single policy for City development		
Minimum land required by individual/group of land-owner	Any size	5 acres (20234 sq.m.)	1 acre (4047 sq.m.)	70% of contiguous land within a prescribed sector.	Any size
Developer	Government/ Land-owner	Colonizer (Private developer)	Government	Consortium (Association of land owners/ developer entities)	Government
Land use distribution					
Residential for owners	50%	No land reserved for the government. However, at	20% to 25%	53% (including neighborhood-level roads and facilities)	No land return to land owners. Land use distribution is as per the prevailing

Land development policy mechanisms in India		Town Planning Scheme	Joint Development	Land Pooling Policy	Hybrid model	Land acquisition model
	Commercial for owners		least 45% of land to be reserved for roads, open spaces, and social infrastructure to be developed by colonizer.	2.5% to 5%	5%	Development Plan/Policy for the city.
	Social infrastructure for owners			Nil	2%	
	Residential for sale by Government	15%		20% to 27.5%	Nil	
	Commercial for sale by the government				Nil	
	Social Infrastructure for Government	5%		5%	8%	
	Recreational/ open space	5%		10%	16%	
	Roads/Utilities	15%		30%	12%	
	Socially backward/EWS housing	10%	No land reservation. However, 15% of the total number of developed flats will be allotted to EWS at government rates.	5%	No land reservation. However, 15% of built-up area for EWS housing over and above the maximum permissible residential built-up.	
Compensation to land-owners		-NA-	-NA-	Rs. 30,000 to 50,000 per acre annually to land-owners and Rs. 2,500 pension to landless for ten years	-NA-	Twice the market value of acquired land in urban areas and four times in rural areas. Additionally, rehabilitation and resettlement benefits for affected families.
Allocation of returned land		Same location, only readjustment of site boundaries	Same location	Dynamic allocation of plot(s) through lottery system	Based on the implementation plan prepared by the consortium	-NA-
Source of Finance for external infrastructure		Betterment charges paid by land-owners,	Development charges and license fees	Proceeds from sale of plots by	External Development Charges (EDC) to	Proceeds from sale of plots by the government

Land development policy mechanisms in India		Town Planning Scheme	Joint Development	Land Pooling Policy	Hybrid model	Land acquisition model
		proceeds from sale of plots by the government	paid by the colonizer	the government	be paid by the consortium	
Timelines		5 to 15 years	3 to 7 years	10 years (proposed)	7 to 12 years (proposed)	-NA-
FSI	Residential	1.8	1.75	2	2	as per prevailing Development Plan
	Commercial	1.8	1.75	2	1.5	
Ratio of built-up area in return land to original land holding (A) = FSI*return land/ original land		0.9	1.14	0.6	0.7	-NA-
Beneficiary		Land-owner	Colonizer	Land-owner	Developer entity	Land-owner

Source: Authors' analysis

6. CONCLUSION

This paper makes a comparitive analysis among the different land development polices implemented in India based on their legislative framework. Land development policies in India are concerned with land and floor space planning, acquisition, assembly, financing, development, maintenance, and regulation. Many city governments have evolved and adopted land policy tools such as land pooling, land readjustment, transfer of development rights, joint development model, negotiated land uses, reference land value system, added land value capture, pre-emption rights, and urban growth boundary. The rapid mechanism of joint ventures with private developer entities, in which the government agency's role is limited to facilitating the development and creating only external infrastructure, resulted in better financial gains to the developer entity. Moreover, the legal framework analysis has shown that the land development policies focus only on the infrastructure and financial attributes of development, and little concern is made for the environment, ecosystem, agriculture, and societal development. Even though the majority of land policies concentrate on the spatial and financial characteristics of the land that enhance living conditions, the developed property becomes unaffordable to the vast strata of the population. It may have a significant impact on natural environmental systems. An integrated strategy for land development has yet to materialize to achieve the Sustainable Development Goals (SDGs) objectives. Urban land development policies must also foster resilience, inclusiveness, and a sustainable built and natural environment to address the urban vulnerabilities to frequent disasters, disease outbreak events, and ecological sensitivity. The state governments in India have implemented land policies specific to their contexts, but limited research has been done to empirically assess the sustainability of these policies'. To find out how the land policies in India take into account the various components of urban sustainability, further research can be done using a quantitative approach for parameters other than spatial and economics.

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Contextualizing Environmental Regulations for Improving Public Health and Community Well-Being in Urban India

Kumud Dhanwantri, K. K. Yadav, Meenakshi Dhote, Kushagra Rajendra and Ila Gupta

Abstract

Cities in India are becoming vibrant economic centers as a result of the country's unparalleled urbanisation. But there are a lot of difficulties that have come with the rapid urbanisation, especially when it comes to environment, public health and community wellbeing. This study investigates the intricate relationship between environmental regulations and public health outcomes in the urban context of India. Recognizing the pivotal role of regulatory frameworks in shaping the urban environment, this research analyze key factors influencing public health. The research delves into the effectiveness of green space zoning regulations, air quality standards, environmental and public health policies, and their impact on public health in Gurugram. The impact of green spaces and biodiversity conservation on community wellbeing is explored. The study hypothesizes that "awareness and adherence to environmental regulations, promoting green spaces and biodiversity conservation positively influence public health in urban settings." The study methodology employed a mixed-methods approach, integrating quantitative and qualitative research techniques to thoroughly examine the diverse aspects of environmental regulations and their impact on public health and community welfare. Responses have been collected using quota and snow ball sampling techniques. A chi square test has been applied to test the hypothesis. By contextualizing environmental regulations, this study attempts to provide insights that can inform policy recommendations for a healthier and more sustainable urban India. The findings contribute to a nuanced understanding of how regulatory measures can be optimized to enhance public health in diverse urban settings.

1. INTRODUCTION

Urbanization in India has witnessed unprecedented growth, transforming cities into dynamic hubs of economic activity. However, this rapid urban expansion has brought about a multitude of challenges, particularly in the realm of public health and community wellbeing. In the wake of these challenges, the role of environmental regulations becomes increasingly pivotal in shaping the urban landscape and influencing the health outcomes of its residents (Purohit et al., 2019). The intricate interplay between environmental regulations, public health, and community wellbeing forms the nucleus of our inquiry. As urban areas grapple with the consequences of industrialization, vehicular emissions, inadequate waste management, and other environmental stressors, the need to contextualize and optimize existing regulations becomes paramount.

Urban India faces a complex tapestry of environmental issues, ranging from air and water pollution to challenges in waste management. Among these challenges, the degradation of

Kumud Dhanwantri; *Research Scholar, Amity School of Earth and Environmental Sciences, Amity University, Gurugram, Haryana*

K.K. Yadav; *Former Chief Town Planner, Department of Town and Country Planning, Haryana*

Meenakshi Dhote; *Professor and Head, Department of Environmental Planning, School of Planning and Architecture (SPA), New Delhi*

Kushagra Rajendra; *Associate Professor and Head, Amity School of Earth and Environmental Sciences, Amity University, Gurugram, Haryana*

Ila Gupta; *Professor and Director, Amity School of Architecture and Planning, Amity University, Gurugram, Haryana*

air quality has emerged as a critical concern, particularly in relation to the rise in respiratory diseases (Chakraborty & Basu, 2021; Kanaujia & Bhati, 2022; Pandey et al., 2021). This study aims to explore and analyze the multifaceted relationship between environmental regulations and their impact on public health and community wellbeing in the urban milieu of India. This research paper seeks to delve into the multifaceted role of environmental regulations in addressing the nexus between urban air quality and public health outcomes, with a specific focus on the placement and significance of green areas within cities. Urban green spaces play a pivotal role in mitigating the adverse effects of air pollution, fostering community wellbeing, and enhancing overall quality of life. To contextualize these issues, we will draw upon the case study of Gurugram, a rapidly growing metropolitan city in India facing distinctive challenges in air quality management and the provision of green spaces.

By exploring these dynamics in Gurugram, our research seeks to provide nuanced insights that can inform policy makers, urban planners, and community stakeholders in crafting targeted strategies to improve public health and community wellbeing. By analyzing the regulatory landscape and its impact on public health in urban India, this research aims to contribute valuable insights toward developing effective strategies for sustainable urban development, environmental stewardship, and improved community wellbeing. Addressing environmental concerns and public health necessitates a comprehensive understanding of the existing regulatory frameworks governing environmental practices. By contextualizing these regulations, we seek to uncover the key factors contributing to effectiveness in promoting public health and fostering community wellbeing.

Our investigation delves into the dimensions, including the national public health policy, the efficacy of pollution control measures, the role of green spaces and biodiversity conservation in urban planning. Additionally, we scrutinize the influence of community awareness on the effective implementation of these regulations and their subsequent impact on public health outcomes. In essence, this study endeavours to contribute to the ongoing discourse on urban sustainability and health by providing evidence-based insights into the contextualization of environmental regulations in the unique socio-environmental landscape of metropolitan India. As we navigate through the complexities of this relationship, we anticipate uncovering valuable knowledge that can guide future interventions and policy formulations for creating healthier and more resilient urban communities.

2. LITERATURE REVIEW

The literature review section navigates a comprehensive exploration of foundational research. Beginning with the intricate relationship between Chronic Respiratory Diseases (CRDs) and community wellbeing in India (Subsection 2.1), it delves into the advocacy of healthy cities (Subsection 2.2). Expanding the focus, Subsection 2.3 explores Environmental Regulations in the Urban Context of India, encompassing crucial facets such as Air Quality Standards (2.3.1), Green Spaces and Biodiversity Conservation (2.3.2), Water Quality Regulations (2.3.3), Waste Management Policies (2.3.4), Socio-economic Disparities (2.3.5), and Community Awareness (2.3.6). This synthesis of literature forms the basis for our multidimensional study of the intersection of public health and environmental regulations in the urban landscape of India.

2.1 Chronic Respiratory Diseases (CRDs) and Community Well-being in India

The research comprehensively examines the impact of chronic respiratory diseases (CRDs) on public health in India. By leveraging data from the Global Burden of Disease Study (Pandey et al., 2021) spanning over two decades, the published literature reveals a substantial and varied burden of CRDs across different states of the country. Air pollution emerges as a critical factor contributing to the burden of chronic respiratory diseases. States with higher levels of air pollution exhibit a correspondingly elevated prevalence of CRDs, highlighting the urgent need for targeted interventions to improve air quality (Salvi et al., 2018). The state-wise observed heterogeneity is attributed to diverse factors such as regional variations in air quality, socio-economic conditions, occupational hazards, and lifestyle choices. Notably, the study underscores the pervasive influence of air pollution on the prevalence of CRDs, emphasizing the imperative need for targeted interventions to improve air quality (Salvi et al., 2018). Such studies highlight the necessity of tailored approaches that address state-specific determinants to effectively alleviate the burden of chronic respiratory diseases and enhance community wellbeing.

2.2 Advocating the Concept of Healthy Cities

The World Health Organization (WHO) and the United Nations Human Settlements Programme (UN-HABITAT) have been instrumental in shaping the discourse around healthy cities through their comprehensive publications. WHO's initiatives, such as the "Global Age-Friendly Cities Guide" and "Urban Green Spaces and Health: A Review of Evidence," underscore the importance of creating urban environments that support the wellbeing of diverse populations (Nielsen & Bronwen Player, 2009; World Health Organization., 2007). These publications advocate for accessible public spaces, green infrastructure, and age-friendly urban planning, recognizing the role of such initiatives in promoting physical and mental health. Simultaneously, UN-HABITAT's reports, including "The State of African Cities 2018" and collaborative efforts with WHO like "Urbanization and Health: A WHO Guide to Identifying and Actioning Health Challenges within Urban Planning," emphasize the crucial link between urbanization and public health (United Nations Human Settlements Programme (UN-Habitat), 2018; World Health Organization., 2007). These publications delve into sustainable urban planning practices, housing conditions, and infrastructure development, recognizing their impact on health outcomes. Together, the WHO and UN-HABITAT publications advocate for an integrated approach to urban planning that considers health implications, thereby accelerating the concept of healthy cities.

The interconnection between urban planning and public health becomes evident as these organizations highlight interventions such as walkable neighborhoods, cycling infrastructure, equitable access to healthcare services, and the integration of green spaces. Urban planning, as advocated by WHO and UN-HABITAT, plays a pivotal role in fostering environments that encourage physical activity, reduce health disparities, and enhance overall wellbeing. By prioritizing health considerations in urban development, these publications contribute to the realization of healthy cities, where public health is an integral component of the urban fabric.

2.3 Environmental Regulations in the Urban Context of India

Urbanization in India has been characterized by rapid population growth, industrialization, and increased vehicular traffic, contributing to environmental challenges that have profound implications for public health and community wellbeing. The country's rapid urbanization brings myriad challenges, from escalating pollution levels to strained resources, impacting the health and wellbeing of its urban residents. In response to these challenges, environmental regulations are pivotal in safeguarding public health and fostering community wellbeing in urban areas. The regulatory framework governing environmental practices in urban areas is instrumental in mitigating these challenges. Existing literature underscores the imperative to contextualize environmental regulations to metropolitan India's unique socio-economic and environmental characteristics.

2.3.1 Air quality standards and public health

Numerous studies have highlighted the adverse impact of air pollution on respiratory health in urban centres (Salvi et al., 2018). Stringent air quality standards have been associated with reduced pollution levels, resulting in improved respiratory outcomes (Purohit et al., 2019). However, challenges persist in enforcement and compliance, particularly in rapid industrial expansion and urbanization (Chakraborty & Basu, 2021).

2.3.2 Green spaces, biodiversity conservation, and community wellbeing

The role of green spaces in enhancing community wellbeing is well-documented. Green spaces, regulated by environmental policies, contribute to improved mental health, physical wellbeing, and community cohesion (Ali et al., 2022; Ramaiah & Avtar, 2019; Rao & Rao, 2021). However, the accessibility and quality of green spaces in urban areas remain key considerations (Ramaiah & Avtar, 2019; Turaga et al., 2020).

2.3.3 Water quality regulations and waterborne diseases

The relationship between water quality regulations and the incidence of waterborne diseases has been extensively explored. Research indicates that effective implementation of water quality regulations is essential for preventing waterborne diseases in urban areas (Mishra et al., 2017). Nevertheless, studies also emphasize the need for comprehensive strategies to address challenges in urban water management (Sethi et al., 2019).

2.3.4 Waste management policies and public health

Inadequate waste management poses significant health risks in urban India (Kumar et al., 2009, 2017). Literature suggests that the proper disposal of waste, guided by robust waste management policies, is crucial for minimizing health hazards. Challenges persist in waste segregation practices and electronic waste disposal, necessitating targeted interventions India (Pujara et al., 2019; Reddy, 2021).

2.3.5 Socio-economic disparities and regulatory compliance

The research features the influence of socio-economic factors on regulatory compliance and subsequent health outcomes (Purohit et al., 2019). Studies reveal that marginalized

communities often bear a disproportionate burden of environmental hazards due to disparities in regulatory enforcement (Hajat et al., 2015; Wang et al., 2020). Addressing socio-economic inequities is essential for ensuring the equitable distribution of the benefits of environmental regulations.

2.3.6 Community awareness and environmental regulations

Community awareness is increasingly recognized as a determinant of the effectiveness of environmental regulations. Studies emphasize the role of public engagement and awareness campaigns in fostering adherence to regulations and influencing community behaviours (Arora et al., 2019). (Agency for Toxic Substances and Disease Registry, 2015; Ezaki & Vargas, 2021; Gutiérrez-Velasco et al., 2021). However, challenges remain in translating awareness into sustained action.

The literature reviewed underscores the complexity of the relationship between environmental regulations, public health, and community wellbeing in urban India(Amir & Agil Alsagoff, 2019). As we embark on contextualizing environmental regulations, this synthesis of existing knowledge guides our inquiry, highlighting critical areas for investigation and the potential avenues for policy interventions to create healthier and more sustainable urban environments.

2.4 Case Studies and Lessons Learned

This subsection looks into a series of case studies offering valuable insights and lessons learned in the realm of urban planning, public health and environmental regulations. First, by examining Green Spaces and Community Well-being in Pune (Subsection 2.2.1), the unique features and outcomes of this case study are drawn. Moving to the Chandigarh-Panchkula Region, section 2.2.2 analyzes the relationship between Green Spaces and Community Well-being, unravelling distinctive lessons from this specific context. The exploration then extends to the National Capital Region (NCR), where section 2.2.3 scrutinizes the dynamics of Environmental Regulations and their impact on public health. Finally, section 2.2.4 shift focus to Delhi, examining the intricate interplay between Air Quality and Environmental Regulations. These case studies serve as fundamental pillars, offering nuanced perspectives and practical insights that contribute to our broader understanding of the complex nexus between urban environments, public health, and regulatory frameworks.

2.4.1 Green spaces and community wellbeing in Pune

With its emphasis on sustainable urban development, Pune provides an intriguing case for studying the relationship between green spaces and community wellbeing. The Pune Municipal Corporation has implemented policies to enhance green cover and biodiversity conservation(Bari, 2019). The case study on Pune explores the impact of green space policies on community wellbeing. Positive correlations are found between access to green spaces, reduced stress levels, and increased physical activity (Bari, 2019; Padigala, 2012). However, the study also identifies challenges related to the equitable distribution of green spaces and the need for ongoing community engagement to ensure sustained benefits.

2.4.2 Green space and community wellbeing in Chandigarh-Panchkula region

The union territory of Chandigarh and its neighbouring city of Panchkula in the northern Indian state of Haryana stand out as exemplary models in urban planning, particularly when integrating green spaces (Sudhera Srishti, 2023). The judicious allocation of green areas and parks in these regions contributes to the aesthetic appeal and significantly enhances the wellbeing of the communities residing there (Bedi et al., 2020; Chandigarh Govt., 2015; Sudhera Srishti, 2023). Panchkula follows a green ethos in urban planning, emphasizing preserving and expanding green spaces. Green belts, parks, and well-maintained public gardens characterize the city. The Morni Hills, on the outskirts of Panchkula, further contribute to the region's lush greenery. These natural retreats provide fresh air and recreational opportunities, enhancing the overall quality of life for the residents.

Chandigarh and Panchkula's commitment to green urban planning aligns with sustainability principles. In essence, these two cities are shining examples of how meticulous urban planning, with a focus on green spaces, can profoundly influence the health and happiness of urban residents. These areas' harmonious coexistence of natural and built environments serves as a model (Bedi et al., 2020) for other cities hoping to develop vibrant, environmentally friendly, and people-focused communities. This, in turn, creates a sustainable and resilient urban environment for future generations.

2.4.3 Environmental regulations in the National Capital Region (NCR)

The National Capital Region (NCR) of India, grapples with a complex web of environmental challenges, necessitating robust environmental regulations. The region faces issues such as air pollution, water contamination, and urban sprawl, demanding comprehensive regulatory frameworks for sustainable development and public health (Kaur & Pandey, 2021; Neposlan, 2014). Air pollution stands out as a prominent concern in the NCR, primarily driven by vehicular emissions, industrial activities, and agricultural practices. Environmental regulations in the form of air quality management plans and emission standards aim to mitigate pollution levels. However, effective enforcement remains a challenge, with periodic episodes of severe air quality prompting emergency measures such as the odd-even scheme for vehicles and construction bans.

Waste management poses another significant challenge, with intensifying urbanization leading to increased solid waste generation (Kumar et al., 2017; Meena et al., 2023). Environmental regulations mandate proper waste disposal practices, waste segregation, and recycling initiatives. However, the efficacy of these regulations is often hindered by inadequate waste infrastructure, behavioural issues and illegal dumping, and the informal sector's involvement in waste handling. Water bodies in the NCR are under constant threat from industrial discharge, untreated sewage, and encroachments (Garg et al., 2018). Environmental regulations are in place to prevent water pollution, protect water bodies, and ensure sustainable water resource management. The Central Pollution Control Board (CPCB) and state pollution control boards play a crucial role in enforcing these regulations.

Urban planning in the NCR is guided by environmental regulations to ensure sustainable and balanced development. Zoning regulations, environmental impact assessments, and green space preservation norms contribute to the region's spatial planning (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), 2018; Upreti & Kumar, 2023). However, challenges arise due to rapid urbanization, unauthorized constructions, and the need for adaptive planning to address evolving environmental concerns. Despite existing environmental regulations, challenges persist in the NCR. Enforcement gaps, lack of coordination among regulatory bodies, and the transboundary nature of environmental issues across state borders pose hurdles. Future directions should include well-networked governance, stringent enforcement mechanisms, improved monitoring infrastructure, and a focus on public awareness and participation. In insinuation, environmental regulations in the National Capital Region play a crucial role in addressing the multifaceted challenges arising from rapid urbanization and industrialization. A holistic and adaptive regulatory approach, coupled with effective enforcement and public involvement, is essential for fostering sustainable development, mitigating environmental degradation, and ensuring the wellbeing of the region's residents.

2.4.4 Air quality and environmental regulations in Delhi

Delhi, the capital of India, faces severe air quality challenges, particularly during the winter months. Environmental regulations in Delhi aim to mitigate air pollution by implementing measures such as the odd-even scheme for vehicles, construction bans during high pollution periods, and stringent emission standards. Implementing the Graded Response Action Plan (GRAP) and the Odd-Even Scheme to control vehicular emissions has been a focal point in recent years (Guttikunda et al., 2023). A comprehensive case study on Delhi's air quality regulations reveals a correlation between GRAP's strict enforcement and improvements in air quality indices (Guttikunda et al., 2023; Sharma & Devara, 2016; Singh & Kulshrestha, 2020). However, challenges persist in sustaining these improvements, especially concerning vehicular emissions. The study highlights the need for continuous monitoring, stringent enforcement, and innovative solutions to address the dynamic nature of air pollution in a megacity like Delhi. Urban planning regulations in Delhi emphasize green spaces, sustainable construction practices, and waste reduction measures. Despite these efforts, challenges persist, including enforcement gaps, rapid urbanization, and regional factors influencing air quality. Continuous adaptation and stringent implementation of environmental regulations remain imperative for Delhi's sustainable development and the wellbeing of its residents.

Across these case studies, common themes emerge, highlighting the importance of effective regulatory enforcement, sustainability & conservation goals and community engagement. The studies collectively emphasize the need for adaptive and context-specific approaches to environmental regulations to ensure improvements in public health and community wellbeing in diverse urban settings across India. However, certain research gaps warrant further exploration. Firstly, there is a need for more nuanced investigations into the effectiveness of specific

environmental regulations in diverse urban contexts, considering the unique challenges each city presents. Additionally, the role of community engagement and awareness in influencing adherence to regulations and subsequent health improvements remains an underexplored aspect that demands focused attention. Furthermore, the research could delve deeper into the intersectionality of socio-economic factors, access to green areas, environmental justice, and health disparities, providing a more comprehensive understanding of the differential impacts of regulations on diverse population groups. Bridging these gaps will not only enhance the academic discourse but also contribute to the development of targeted policy recommendations for sustainable urban development, improved public health and community wellbeing in India.

3. METHODOLOGY

This research aims to comprehensively understand the contextual and methodological factors influencing the relationship between environmental regulations, public health, and community wellbeing in urban India.

3.1 Research Design

The primary objectives of this research are to i) contextualize environmental regulations in the urban context of India and evaluate their impact on public health and community wellbeing; ii) propose context-specific recommendations for enhancing the effectiveness of environmental regulations in urban India.

The study explores the hypothesis that ‘’awareness and adherence to environmental regulations, promoting green spaces and biodiversity conservation positively influence public health in urban settings.’’ This study attempts to examine the following research questions:

- How do existing environmental regulations in Indian cities impact environmental quality?
- How do urban green spaces and biodiversity conservation regulations impact public health and community wellbeing?
- How do community perceptions of environmental regulations influence their health-related behaviours and outcomes in urban environments in India?
- What role does public awareness about environmental regulations play in promoting adherence to environmental regulations and subsequent improvements in public health?
- How can the findings regarding the relationship between environmental regulations and human health in Indian cities inform future policy recommendations to improve public health outcomes?

3.2 Approach

This study adopted a mixed-methods approach, combining quantitative and qualitative research methods to comprehensively address the multifaceted dimensions of environmental regulations and their effects on public health and community wellbeing. The study focuses on urban areas across diverse regions of India through a literature review to get insights into their urban planning and regulatory frameworks.

3.3 Study Area, Sampling Design and Data Analysis

Gurugram, located in the National Capital Region (NCR) of India, is a prime example of the potential and problems that come with urban development and their impacts on community wellbeing. Therefore, using a convenient sampling method Gurugram is selected for detailed analysis. Besides, non-probability sampling techniques, i.e., quota and snowball, are used to determine representative samples from different professions. A total of five sampling quotas have been made representing associated professions. Respondents from each of these quotas, such as key government officials from the concerned departments, senior academicians (planning), environmental lawyers, involved NGOs and compatible media personnel, were selected. A hundred responses have been collected, twenty from each quota, for obtaining qualitative statements and quantitative data for hypothesis testing. A chi-square hypothesis testing method has been used to statistically test the hypothesis. Secondary data on air quality and CRDs was collected from reputed national newspaper coverages.

The spatial pattern of green space distribution was also mapped using GIS software based on Google Earth satellite imageries. A population density distribution map was also prepared based on the 2011 Census. City-wide green space distribution is compared with the ward-wise population density in Gurugram. We conducted a thematic content analysis of published research works, interviews and focus group discussion transcripts to identify key themes and narratives. The study engages in a policy analysis and expert consultation process to formulate context-specific recommendations. We recognize potential limitations, such as data availability on CRDs, census 2021, variations in regulatory enforcement, and the dynamic nature of urban environments, which may impact the generalizability of findings.

4. RESULTS AND DISCUSSION

This section comprehensively analyzes Gurugram, focusing on factors influencing public health and community wellbeing. It begins with insights from the National Health Policy of India, 2017 (Section 4.1) and then narrows down to Gurugram's environmental regulations (Section 4.2). Subsections 4.2.1 to 4.2.2.4 delve into Chronic Respiratory Diseases and environmental regulations for public health, including landscape, air quality, socio-economic disparities, and community awareness. Section 4.3 integrates expert opinions and hypothesis testing, while Section 4.4 draws conclusive inferences. Finally, Section 4.5 explores future prospects, outlining challenges and opportunities in the intersection of environmental regulations, public health, and community wellbeing. This structured approach provides an overview of our findings in Gurugram.

4.1 Insights from the National Health Policy of India, 2017

The National Health Policy (NHP) of India is a comprehensive framework outlining the country's approach to healthcare, encompassing prevention, treatment, and overall public health. In the context of respiratory health, the NHP reflects both strengths and

areas for improvement. The NHP's strengths include its integrated approach, a preventive focus, environmental health considerations, and strengthening primary healthcare and community engagement. This policy demonstrates a commendable commitment to an integrated healthcare approach, recognizing that respiratory health is intricately linked to various determinants, including environmental factors, socio-economic conditions, and lifestyle choices (National Health Policy, 2017). This recognition is pivotal in addressing the multifaceted nature of respiratory health issues.

Furthermore, prevention is rightfully highlighted in the NHP as a vital pillar of the healthcare strategy. The emphasis on preventive measures aligns with the understanding that many respiratory diseases, such as those caused by air pollution, are largely preventable. The policy acknowledges the need for proactive interventions to curb the rising burden of respiratory conditions (National Health Policy, 2017). The NHP also acknowledges the impact of environmental factors on public health, including respiratory health. This recognition is crucial in the Indian context, where urbanization and industrialization contribute significantly to air pollution. The policy implicitly underscores the need for environmental regulations and sustainable urban planning to mitigate respiratory risks (National Health Policy, 2017).

The Policy's emphasis on bolstering the infrastructure supporting primary healthcare is a step in the right direction. Improved access to primary healthcare facilities can contribute to early detection and management of respiratory issues, preventing complications and reducing the burden on tertiary care. The NHP encourages community participation and decentralized planning (National Health Policy, 2017). In the context of respiratory health, engaging communities is essential for creating awareness about preventive measures, advocating for clean air, and fostering a culture of respiratory wellbeing for the community.

While the NHP acknowledges the impact of air pollution on respiratory health, it could benefit from more specific targets and strategies related to air quality improvement. More explicit directives on reducing pollution levels, especially in urban areas, would enhance the policy's effectiveness in mitigating respiratory risks. The policy could provide more explicit measures for protecting occupational respiratory health. Given the prevalence of industries contributing to air pollutants, incorporating specific guidelines for occupational respiratory safety could further strengthen the preventive framework. The NHP could place a stronger emphasis on research and data integration in the context of respiratory health. Robust data on the prevalence of respiratory diseases, the impact of air quality on health, and the effectiveness of interventions can inform evidence-based policies and strategies. Additionally, bringing such data into the public domain through digital media will gradually sensitize the community to contribute to developing liveable cities. While the policy recognizes the impact of climate change on health, including respiratory health, it could delve deeper into climate resilience strategies. Addressing climate change-induced shifts in respiratory disease patterns requires a comprehensive and proactive approach.

The National Health Policy of India demonstrates a positive orientation toward preventive healthcare and acknowledges the critical interplay between environmental factors and respiratory health. Strengthening specific aspects of air quality and occupational health, interlinking urban planning and health policy, and climate change considerations could enhance the policy's effectiveness in addressing the growing challenges of respiratory diseases. A proactive and continually evolving approach and effective implementation will be essential to realize the NHP's vision for a healthier and more resilient urban India.

4.2 Environmental Regulations: A Case of Gurugram

Gurugram, a rapidly urbanizing city in Haryana, struggles with multifaceted challenges related to environmental regulations that significantly impact spatial planning, air quality, and public health. The city's unprecedented growth, driven by rapid industrialization, urban expansion, and population influx, has led to complex environmental issues that demand stringent regulations for sustainable development. Therefore, the city of Gurugram exemplifies the challenges and opportunities inherent in urban development. The rapid urbanization witnessed in the city has been accompanied by a surge in industrialization, vehicular emissions, and infrastructural expansion, resulting in complex environmental and public health concerns (Gurugram Metropolitan Development Authority, 2023).

Given the array of environmental challenges faced by Gurugram, environmental regulations play a crucial role in shaping policies, guidelines, and standards to ensure sustainable development and safeguard the city's ecological balance. Air quality management is a significant challenge for Gurugram, with vehicular emissions, industrial activities, and construction projects contributing to pollution. Environmental regulations aim to manage and control air quality by setting emission standards, regulating industrial processes, and mandating pollution checks. Despite these regulations, the city periodically experiences severe air quality issues (World Wide Fund, 2020), necessitating continuous efforts to enhance enforcement and implement targeted measures for pollution control.

Waste management poses another substantial challenge due to rapid urbanization and population growth. Environmental regulations govern waste disposal practices, waste segregation, and the establishment of waste treatment facilities. However, the city encounters hurdles such as unauthorized waste dumping, informal waste handling practices, inadequate waste infrastructure and health hazards due to the overflowing landfill site (Khanna & Chauhan, 2022). Strengthening waste management regulations and enhancing infrastructure are imperative to address these challenges effectively. Water scarcity and pollution concerns are prevalent in Gurugram, primarily from industrial discharges and untreated sewage. Environmental regulations focus on preventing water pollution, regulating groundwater extraction, and promoting sustainable water resource management. The effectiveness of these regulations hinges on robust enforcement mechanisms to protect and preserve the city's water bodies.

Challenges in Gurugram's environmental regulatory framework include enforcement gaps, insufficient monitoring infrastructure, and the imperative for greater public awareness.

The city's future trajectory relies on strengthening regulatory mechanisms, embracing technological solutions for monitoring, and fostering a culture of environmental responsibility among residents. Collaborative efforts involving governmental bodies, industries, and the public are essential to ensure effective implementation and sustainable environmental practices. Concisely, environmental regulations in Gurugram are indispensable for mitigating the adverse impacts of urbanization and industrialization. A comprehensive and adaptive regulatory framework, coupled with stringent enforcement measures, is crucial for achieving sustainable development, maintaining environmental quality, and enhancing the overall wellbeing of Gurugram's residents.

4.2.1 Chronic respiratory diseases (crds) and community wellbeing in Gurugram

Chronic Respiratory Diseases (CRDs) pose a formidable challenge to public health and community wellbeing in Gurugram. The rapid urbanization and industrial growth in Gurugram have led to elevated levels of air pollution, a primary contributor to CRDs such as asthma and chronic obstructive pulmonary disease (COPD). Residents, particularly those in proximity to industrial zones and high-traffic areas, are exposed to pollutants that significantly impact respiratory health. The burden of CRDs in Gurugram not only compromises individual wellbeing but also places considerable strain on the local healthcare system. Hospital admissions related to respiratory issues witness a surge during heightened air pollution, underscoring the immediate and tangible impact on community health (Behl Abhishek, 2022; Patti, 2023). According to Dr Virender Yadav, chief medical officer of Gurugram, the number of patients seeking treatment for respiratory conditions has increased by 20–25% (Patti, 2023). Asthma, COPD, lung infections, and rhinosinusitis are on the rise in both the outpatient department and the wards, according to Dr. Manoj Goel, director of pulmonology at Fortis Memorial Research Institute in Gurugram (Behl Abhishek, 2022).

Addressing CRDs in Gurugram requires a multifaceted approach encompassing environmental regulations, sustainable urban planning, and community awareness initiatives. Integrating green spaces into the urban landscape, promoting cleaner modes of transportation, and implementing stringent emission norms for industries are vital steps toward mitigating the impact of air pollution on respiratory health. Moreover, community engagement and education programs are essential to empower residents with the knowledge and tools to protect their respiratory wellbeing. In navigating the intersection of CRDs and community wellbeing in Gurugram, a concerted effort is needed to create a healthier and more resilient urban environment for its diverse population.

4.2.2 Environmental regulations for public health and community wellbeing in Gurugram

This section delves into the facets of environmental regulations for public health and community wellbeing in Gurugram. Each subheading, from environmental landscape and green spaces to air quality and health, socio-economic disparities, and community awareness, unravels specific dimensions of the regulatory landscape. This comprehensive exploration aims to provide a focused understanding of how environmental regulations intricately intertwine with public health and community wellbeing in the Gurugram context.

4.2.2.1 Environmental landscape and green spaces

Elevated levels of air pollution, water contamination, and challenges in waste management characterize Gurugram's environmental landscape. The city's burgeoning population (Figure 2) and substantial presence of industries and corporate hubs contribute to these environmental stressors. The Aravalli Range, an ecologically sensitive area, further adds a layer of complexity to the region's environmental dynamics. These Ranges, integral to Gurugram's regional context, play a vital role in preserving biodiversity, managing water resources, and mitigating air pollution (Chander & Kant, 2019; Dhanwantri et al., 2021). The Aravalli hills can contribute significantly to mitigating air pollution through the absorption of pollutants and maintenance of a healthier microclimate. As a natural buffer against urbanization adversities, the Aravalli hills contribute significantly to the ecological and environmental wellbeing of the entire National Capital Region. However, spatial policies and regulations in Gurugram have ignored to regionally contextualize and conserve Aravalli. Spatial and environmental regulations for Gurugram must prioritize the protection of Aravalli's habitats and its groundwater resources to enhance air quality and sustainable community living. Additionally, considering the cultural and recreational significance of the Aravalli hills, regulations should strike a balance between development needs and the preservation of this ecosystem for community wellbeing. Emphasizing climate change mitigation, regulations should address land-use changes and deforestation activities that may compromise the Aravalli's ability to sequester carbon and contribute to overall air quality & climate resilience. A comprehensive regulatory framework should involve collaboration between government bodies, environmental agencies, and local communities to ensure sustainable development while safeguarding the unique environmental characteristics of the Aravalli region.

Additionally, the urban development pressures and rapid construction have led to the reduction of green spaces in Gurugram. The abating green cover poses challenges to biodiversity conservation and adversely affects community wellbeing by limiting recreational spaces (Yadav, 2018) and contributing to the urban heat island effect. The availability and accessibility of green spaces in Gurugram are essential components in the study's examination of community wellbeing. While efforts have been made to create green zones (figure 1) and conserve biodiversity, the rapid pace of urban development poses a constant challenge. However, our analysis reveals that seventeen wards (figure 4) in Gurugram withstand much fewer green areas when compared with URDPFI guidelines. As per the planning guidelines, the ratio of existing vs required green spaces in these wards is 40:60%. On the other side, figure 3 portrays a better picture of the twelve wards where this ratio (existing vs required green spaces) is 80:20.

A comparison of the existing green and ward-wise population density in Gurugram reveals that seven wards (3,6,11,12,15,16,19) have very high population density (figure 2) and disproportionately fewer green areas (figure 4). In addition to that, seven other wards (9,10,13,14,21,22,31) are also on the same horizon of high population density and significantly less green areas. Ward no. 7, 23 & 24 also witness fewer green spaces, but these areas are presently developing and consequently have less population density (figure 2).

Figure 1: Ward-wise Location of Green Spaces in Gurugram

Figure 2: Ward-wise Population Density in Gurugram

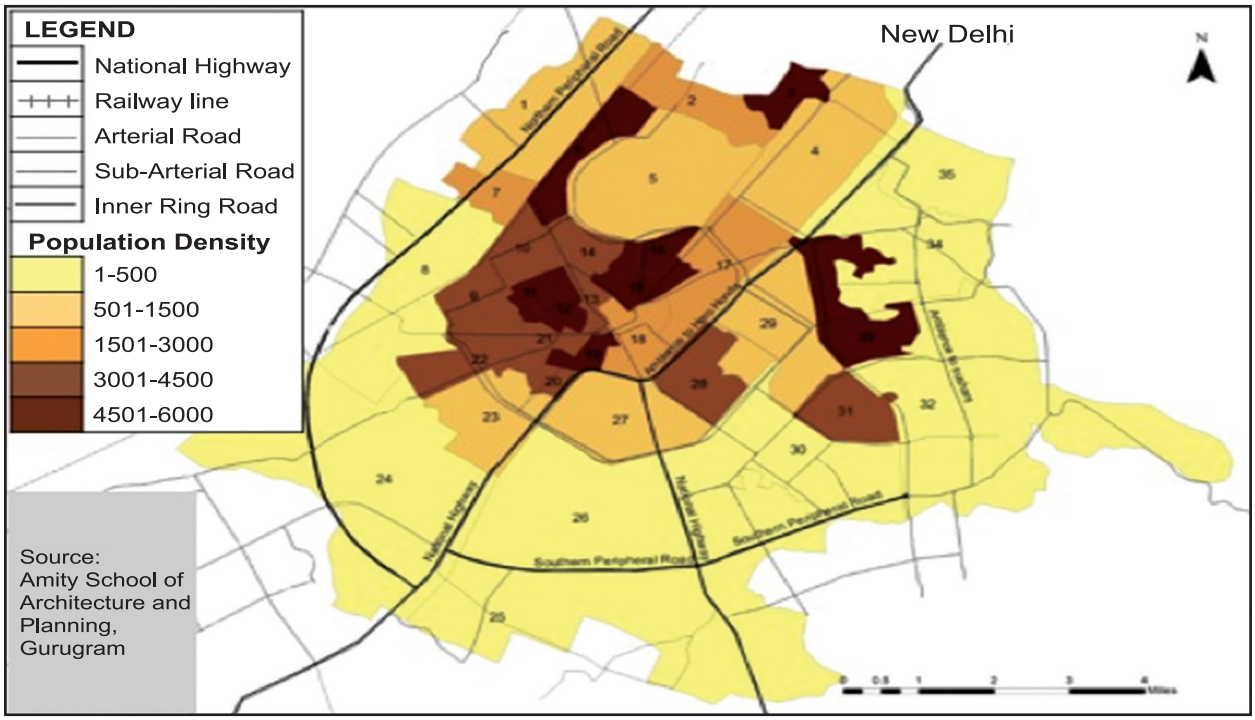


Figure 3: Ward-wise Green Area (Existing and Required) in Gurugram

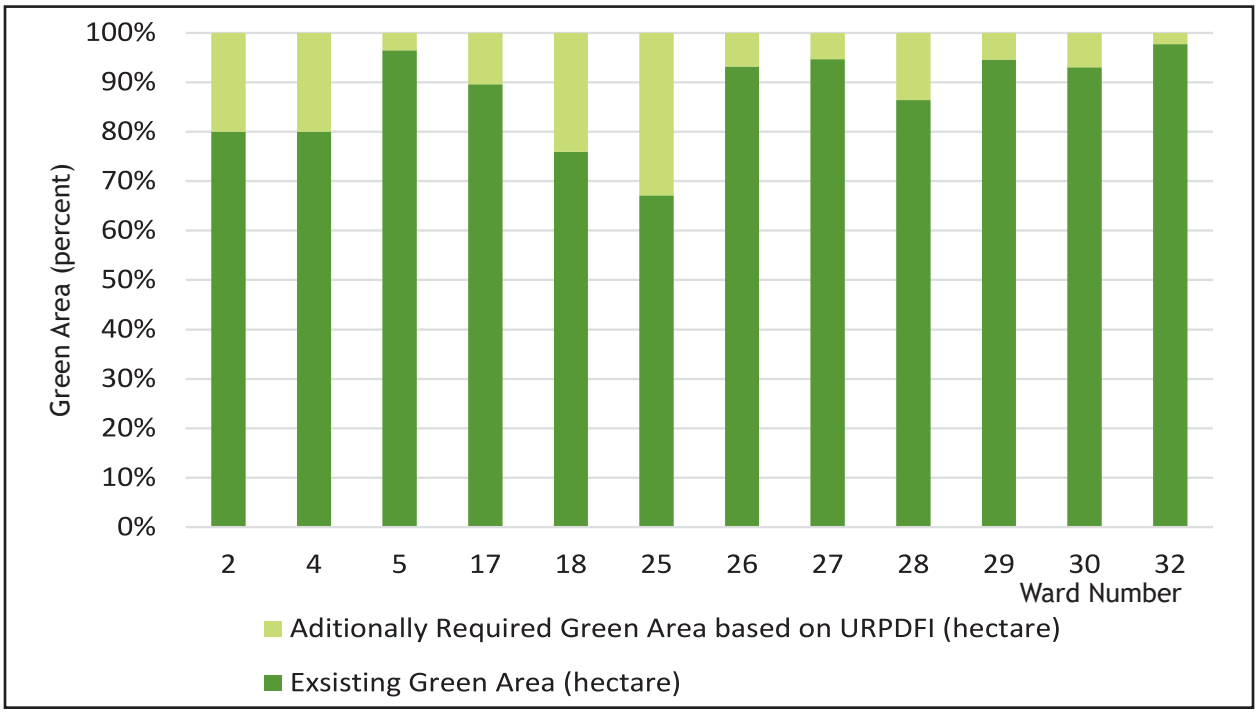
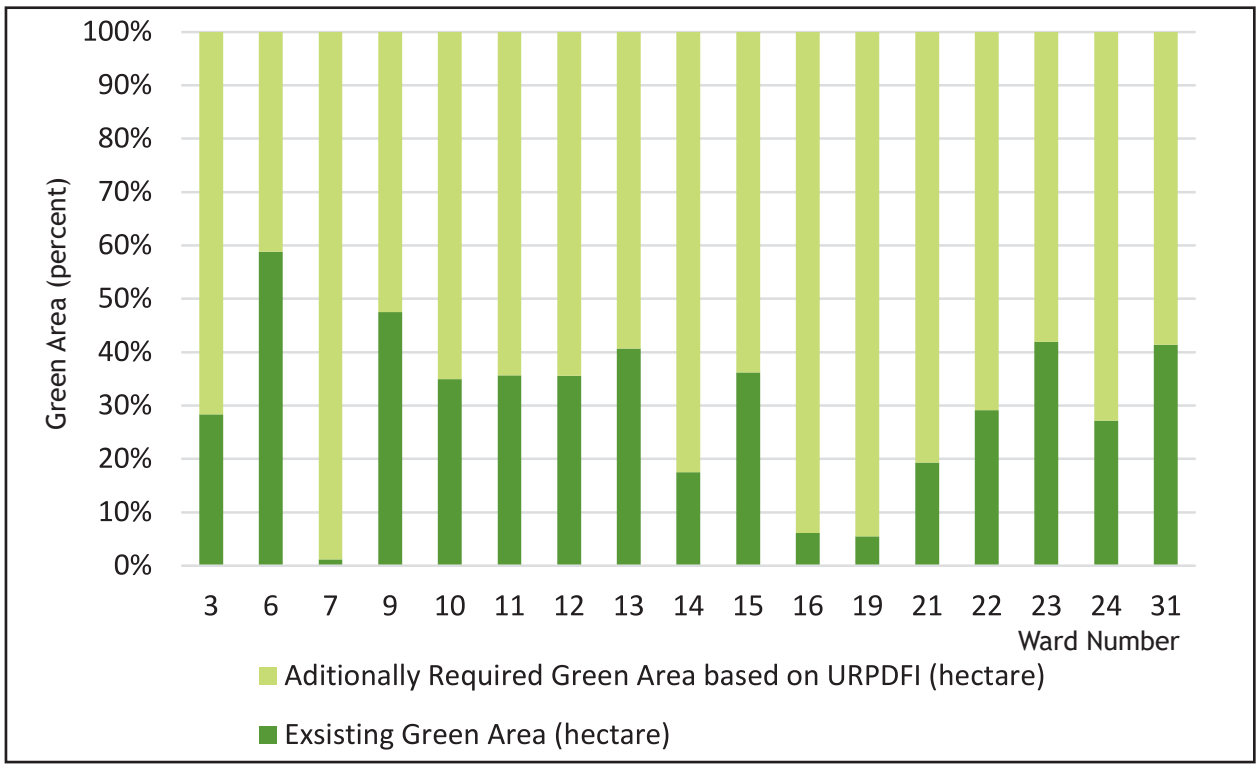


Figure 4: Ward-wise Green Area (Existing and Required) in Gurugram



The study highlights the necessity of adapting and strengthening regulations to prioritize green spaces, acknowledging their positive influence on mental health and overall community wellbeing. The enforcement of regulations related to green spaces and biodiversity conservation needs strengthening in Gurugram. Integrating these regulations into urban planning policies, incentivizing green building practices, and creating urban parks can enhance community wellbeing by providing residents with accessible and aesthetically pleasing green spaces.

4.2.2.2 Air quality and health

Gurugram is one of the Indian cities where the air quality has been the worst during the previous five years. The World Air Quality Report 2018 documented it as a polluted city in India. In March 2019, it was again ranked as the seventh most polluted city in the world (WWF India, 2020). The city's air quality index (AQI) was 127 in 2018, 266 in 2019, 277 in 2020, 290 in 2021, and 245 in 2022, all measurements made in December month (Pati Ipsita, 2022). According to the AQI bulletin, Gurugram's average AQI remained at 357 in November 2023 (Central Pollution Control Board, 2023).

Given that, the city faces severe challenges related to air quality, primarily due to vehicular emissions, industrial pollution, and ongoing construction activities. The Gurugram's air quality, reveals concerning levels of particulate matter, nitrogen dioxide, and other pollutants (Central Pollution Control Board, 2023). These factors correlate with an increased incidence of respiratory illnesses among residents. Over the last five years, media coverage in Gurugram has consistently reported a concerning upward trajectory in respiratory diseases, forming a prominent narrative in various newspapers. The prevailing theme revolves around the adverse impact of escalating air pollution on public health, particularly respiratory wellbeing. Numerous articles (Behl Abhishek, 2022; Patti, 2023; Salvi et al., 2018) delve into the surge of respiratory ailments, such as asthma and chronic obstructive pulmonary disease (COPD), drawing attention to the hazardous levels of air pollution prevalent in the city.

The impact of vehicular emissions and industrial activities on air quality underscores the need for stringent regulations and targeted interventions to safeguard public health. The implementation of air quality regulations has been hindered by rapid urbanization, a high density of vehicles, and the presence of industries contributing to air pollution. Government initiatives, such as introducing the Graded Response Action Plan (GRAP), aim to address air quality concerns. However, enforcing regulations and their impact on public health requires continuous monitoring and stricter measures to control emissions from industries and vehicular traffic. The published narrative and insights from experts' interactions highlight the urgent need for comprehensive interventions to address air quality issues and mitigate the increasing health risks Gurugram's residents face. Furthermore, media coverage consistently advocates for stricter environmental regulations, the expansion of green spaces, and heightened community awareness as essential measures to combat the escalating trend of respiratory diseases in the region.

4.2.2.3 Socio-economic disparities and regulatory compliance

Socio-economic disparities in Gurugram contribute to uneven regulatory compliance. Vulnerable communities may experience higher exposure to environmental hazards, affecting their health

outcomes disproportionately (Hajat et al., 2015). Addressing these disparities is crucial for ensuring equitable benefits from environmental regulations. The socio-economic inequalities in Gurugram contribute to variations in regulatory compliance. Specific communities may bear a disproportionate burden of environmental hazards, accentuating the need for policies that address these disparities. Gurugram's unique socio-economic fabric necessitates an inclusive approach to environmental regulations to ensure equitable health outcomes. Tailored programs that address socio-economic disparities and provide targeted support to vulnerable communities are essential. This may involve community engagement, education, and initiatives to improve living conditions in economically marginalized areas.

4.2.2.4 Community awareness and environmental consciousness

While awareness about environmental issues is growing, significant segments of Gurugram's population may still lack awareness about the implications of environmental degradation on public health. Bridging this awareness gap is essential for fostering a sense of responsibility and encouraging community participation. Community awareness and education programs play a pivotal role in Gurugram's environmental narrative. The city's diverse demographic requires targeted initiatives to enhance awareness and promote responsible environmental behaviour. The study emphasizes the importance of fostering a culture of environmental consciousness through community engagement and education programs. Community awareness and education programs should be expanded and tailored to the diverse population in Gurugram. These programs can include school initiatives, public awareness campaigns, and community workshops to inform residents about the importance of environmental regulations and their role in ensuring public health and community wellbeing.

Gurugram serves as a compelling case study within the broader research framework of contextualizing environmental regulations for public health and community wellbeing in urban India. The findings underscore the urgency of adapting regulations to the specific challenges and dynamics of the region, ensuring that environmental policies contribute to improved public health outcomes and the community's overall wellbeing. Implementing environmental regulations for public health and community wellbeing in Gurugram requires a multifaceted approach. Strengthening regulatory frameworks, enhancing enforcement mechanisms (Ezaki & Vargas, 2021; Kanaujia & Bhati, 2022; Purohit et al., 2019), addressing socio-economic disparities, and fostering community engagement (Hajat et al., 2015) are pivotal for ensuring the effectiveness of environmental regulations. By addressing these challenges, Gurugram can serve as a model for sustainable urban development that prioritizes public health and the wellbeing of its residents.

4.3 Expert Opinion and Hypothesis Testing

In the city of Gurugram, expert opinion strongly reflects the belief that awareness and adherence to environmental regulations play a crucial role in positively influencing public health. The residents of Gurugram, amidst rapid urbanization and industrial growth, recognize the interconnectedness of environmental wellbeing and their health outcomes. The increased awareness of the impact of air pollution and the preservation of green spaces has led to a

growing consensus on the importance of adhering to environmental regulations. Most respondents expressed the view that strict implementation of regulations can mitigate the adverse effects of pollution on respiratory health and overall wellbeing. Furthermore, promoting green spaces and biodiversity conservation enhances the city's aesthetic appeal and contributes significantly to mental and physical health.

The crucial statements of the key respondents cover the opinions of the concerned government officials, senior academicians, environmental lawyers, media and research organisation's perspectives. Their endorsements are as follows:

"Environmental regulations are precautions for our health, not merely rules to follow. We must restrict emissions, encourage sustainable practices, and dispose of garbage responsibly. It's an investment in everyone's long-term health and wellbeing."

Mr. Vishnu Som, Group Executive Editor, NDTV

"Preserving green spaces is more than just aesthetics; it's about creating a healthier city. The periodic awareness campaigns organized by GMDA around maintaining greenery and biodiversity in Gurugram are for protecting the environment and our public health. More green and blue spaces mean better air quality and a conducive environment for physical and mental wellbeing."

Sh. Subhash Yadav (IAS), Additional CEO, Urban Environment, Gurugram Metropolitan Development Authority, Haryana.

"With the worsening air quality in Gurugram, being aware of and strictly adhering to environmental regulations is not just a choice; it's necessary for our wellbeing. The pollutants in the air directly impact our respiratory health, and I believe that following regulations can significantly improve the overall air quality and, in turn, our health."

Mr. Vijay Yadav, DG Police (Rtd.), Gurugram

"It is evident that the nexus between environmental regulations, public awareness, and community health is integral to Gurugram's urban dynamics. The exponential urban growth has brought severe environmental challenges impacting air and water quality. Fostering awareness and strict adherence to environmental regulations in planning practices and residents' daily lives becomes paramount for safeguarding public health."

Prof. Dr P.S.N. Rao, Dean (Planning), Former Director SPA Delhi and Member, High-Level Committee on Urban Planning, MoHUA, GoI

"Having seen the impact of pollution-related illnesses on the wider community, I am now a staunch advocate for strict adherence to environmental regulations. NCR needs a collective effort to combat pollution, and I firmly believe that aligning our daily practices with regulations is key to ensuring a healthier future for all residents."

Mr. Rahul Choudhary, Senior Advocate and Trustee, Legal Initiative for Forest and Environment

"Whether it's reducing personal carbon footprints, upholding green spaces or supporting initiatives for cleaner air, it all contributes to a healthier living environment. Adhering to regulations is like a collective responsibility for our community's health."

Dr. Seema Yadav, Senior Program Associate- Sustainable Landscape and Restoration, World Resource Institute (WRI), India

Respondents' opinions in Gurugram and NCR draw attention to a collective understanding that fostering a sustainable and environmentally conscious community is pivotal for a healthier urban lifestyle. A chi-square test was also conducted to test the hypothesis that awareness and adherence to environmental regulations positively influence public health in urban settings. The data was collected through surveys using purposive snowball sampling, assessing the level of awareness and adherence to environmental regulations and the overall public health status in Gurugram. The chi-square test results yielded a statistically significant association between awareness and adherence to environmental regulations and public health outcomes in urban settings ($x^2[df, 8] = 2.9$, $p < 0.05$). The x^2 value indicates a meaningful relationship between awareness and adherence to environmental regulations and public health outcomes. Consequently, the null hypothesis is rejected, providing evidence to support the hypothesis that heightened awareness and compliance with regulations, coupled with initiatives promoting green spaces and biodiversity conservation, positively influence public health in urban contexts. These findings accentuate the interconnectedness of environmental factors and public health, emphasizing the pivotal role of regulatory and conservation efforts in fostering healthier urban environments.

4.4 Conclusive Inferences

The comprehensive exploration of environmental regulations in the urban context of India, with a specific focus on Gurugram, sheds light on the intricate interplay between regulatory frameworks, public health, and community wellbeing. The findings underscore the urgency of adopting a contextual approach to environmental regulations, recognizing the unique challenges and dynamics within diverse urban settings. In the case of Gurugram, the rapidly evolving urban landscape has presented both challenges and opportunities. The city, symbolic of India's urbanization story, grapples with severe air quality issues and the imperative to balance industrial growth with environmental sustainability. Gurugram's experience highlights the critical need for adaptive and tailored environmental regulations, considering the challenges posed by rapid urbanization, industrialization, and socio-economic diversity.

The underestimated green cover in Gurugram necessitates a re-evaluation of urban planning policies. Regulatory efforts focused on preserving and expanding green spaces, coupled with biodiversity conservation measures, can significantly contribute to enhancing community wellbeing. The city's experience underscores the importance of integrating environmental considerations into urban development planning. The challenges related to air quality management in Gurugram, exacerbated by vehicular emissions and industrial activities, underscore the necessity for robust regulatory frameworks. While initiatives such as the Graded Response Action Plan (GRAP) have been implemented, continuous efforts are required

to strengthen enforcement mechanisms and address the sources of pollution, particularly in the industrial sector.

Socio-economic disparities in Gurugram contribute to variations in regulatory compliance, amplifying the need for targeted interventions. Addressing these disparities requires regulatory measures and community engagement programs that empower vulnerable communities and ensure equitable access to the benefits of environmental regulations. Gurugram's journey highlights the pivotal role of community awareness and education programs in fostering a culture of environmental consciousness. Tailored initiatives, spanning from school programs to community workshops, are vital for bridging the awareness gap and garnering public support for regulatory compliance.

The study's overarching goal to propose context-specific recommendations aligns with the challenges and lessons learned from Gurugram. These recommendations should encompass a holistic approach, integrating environmental regulations with urban planning, health policies, and community development strategies. Adaptive governance structures that consider local nuances and foster multi-stakeholder collaboration are essential for effectively implementing these recommendations.

Finally, interpreting environmental regulations in the context of public health and community wellbeing in urban India is a multifaceted task. Gurugram, with its unique set of challenges, serves as a microcosm of the broader urbanization trends in the country. The insights gained from this study contribute to the ongoing discourse on sustainable urban development, emphasizing the need for dynamic and adaptive regulatory frameworks that prioritize public health, community wellbeing, and environmental sustainability. As India continues its urbanization journey, the lessons from Gurugram provide a foundation for shaping future policies and interventions that create healthier, more resilient, and livable urban spaces.

4.5 Future Prospects: Challenges and Opportunities

The relentless pace of urbanization in India poses a significant challenge. As cities expand, environmental stressors intensify, necessitating continual adjustments to regulations. However, embracing intelligent and sustainable urban planning that integrates environmental considerations can mitigate the adverse effects of rapid urbanization. Proactive measures, such as green building initiatives, efficient waste management and enforcing environmental regulations, can be pivotal in creating resilient urban spaces. The growth of industries, a key driver of economic development, often contributes to air and water pollution. Striking a balance between industrial growth and environmental sustainability is an ongoing challenge. Nevertheless, integrating cleaner technologies, strict emission standards, and incentivizing sustainable practices present opportunities to mitigate the environmental impact of industrial activities. Investing in green technologies can drive innovation while reducing ecological footprints.

Furthermore, socio-economic disparities continue to influence the uneven distribution of environmental hazards, limiting the effectiveness of regulations in safeguarding vulnerable

communities. Addressing socio-economic disparities requires a multifaceted approach, including targeted community development initiatives, education programs, and policies prioritizing equitable access to environmental benefits. Integrating social justice considerations into regulatory frameworks can enhance overall community wellbeing.

The rapid advancement of technology offers opportunities for real-time monitoring of environmental parameters and the developing of innovative solutions. Smart city initiatives, leveraging data analytics and IoT technologies, can enhance the efficiency of environmental regulations. Increasing public awareness and education remain critical components of effective environmental regulations. Robust communication strategies and educational programs can empower communities to participate actively in environmental conservation efforts.

Integrating environmental considerations into broader policy frameworks, including health, urban planning, and socio-economic development, presents an opportunity for a holistic approach. Cross-sectoral collaboration can create synergies that amplify the positive impact of regulations. Fostering collaboration between government bodies, non-governmental organizations, industries, and local communities is essential. Establishing collaborative governance structures ensures that diverse perspectives are considered, leading to more effective and inclusive regulatory frameworks. Aligning environmental regulations with climate resilience strategies is imperative. Creating regulations that address climate change challenges, such as extreme weather events and rising temperatures, ensures urban areas are better prepared for future environmental scenarios.

Contextualizing environmental regulations in the urban landscape of India is an ongoing journey marked by challenges and opportunities. Embracing these challenges as opportunities for innovation, collaboration, and systemic change can pave the way for a future where regulations mitigate environmental risks and actively contribute to urban communities' health and wellbeing. Balancing economic growth with ecological sustainability requires a collective commitment to shaping India's resilient and sustainable urban future.

5. CONCLUSION

In the pursuit of sustainable urban development, this study has delved into the nuanced relationship between environmental regulations, public health, and community wellbeing in the diverse urban landscape of India. The multifaceted exploration has illuminated the complexities inherent in contextualizing regulatory frameworks to address the unique challenges posed by rapid urbanization, industrial growth, and socio-economic diversity. The findings highlight the critical need for adaptive environmental regulations that transcend a generic, one-size-fits-all approach. India's urban centres, characterized by heterogeneity in environmental stressors and socio-economic dynamics, demand tailored strategies to safeguard public health and enhance the overall wellbeing of their communities.

At the heart of contextualizing environmental regulations is recognizing communities as active stakeholders. Community engagement, awareness, and education programs emerge as kingpins in fostering a sense of environmental responsibility. The study advocates for a bottom-up

approach that empowers communities to partner in the regulatory process, ensuring policies resonate with local needs and realities. Addressing socio-economic disparities is integral to the equitable implementation of environmental regulations. Vulnerable communities, often bearing a disproportionate burden of environmental hazards, require targeted support and inclusive policies. Regulatory frameworks should actively work towards narrowing the socio-economic gap in environmental vulnerability.

Preserving and expanding green spaces emerge as crucial elements in enhancing community wellbeing. Urban planning policies must prioritize creating and maintaining accessible green areas in each city. The study advocates for policies that conserve biodiversity and recognize the mental and physical health benefits of green spaces for urban dwellers. The challenges posed by air pollution, a pervasive issue in many urban areas, necessitate more stringent and dynamic measures. Regulatory interventions must extend beyond addressing vehicular emissions to encompass industrial sources, construction activities, and waste management practices. The experiences of cities grappling with air quality concerns offer valuable lessons in devising targeted policies.

As India continues its urbanization trajectory, the lessons gleaned from this study suggest a path forward that prioritizes adaptability, inclusivity, and community collaboration. Context-specific recommendations must be woven into the fabric of urban governance, informing policy decisions, urban planning initiatives, and public health strategies. In conclusion, the contextualization of environmental regulations is not merely a theoretical exercise; it is a call to action for policy makers, urban planners, and communities to collaboratively forge a sustainable and resilient urban future. This study aspires to contribute to the ongoing dialogue on creating urban environments that comply with environmental regulations and actively promote the health and wellbeing of the diverse communities that inhabit them.

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Demarcation of Central Business District of an Indian City: A Case Study of Thiruvananthapuram

V. S. Sanjay Kumar, Shabana Yoonus and M. V. L. R. Anjaneyulu

Abstract

The Central Business District (CBD) is a commercial or business center of a City. The hub will be geographically located in the city's center and at the center of the city's transportation networks. In comparison to other districts of the town, it will have the highest urban density and provides a healthy environment for carrying out a wide range of commercial activities, so the CBD is considered the heart of a city. The present paper explains an attempt to demarcate the CBD of Thiruvananthapuram, the capital city of Kerala, India. The parameters for demarcating CBD was identified from literature review which are land price, number of establishments, and distance to the nearest railway station. To form the CBD area, adjacent zones that satisfy either of the following conditions are grouped together: highest land price, highest number of establishments, and most distance from the nearest railway station.

1. INTRODUCTION

A city's Central Business District or CBD for short is the most commonly used, most expensive, and most centrally located area. Originally, the term Central Business District was used to describe the heart of a city characterized by an area with a large number of government buildings, most accessible from all parts of the city(Verma 2018). CBD is an urban model that developed in the capitalist United States in the 19th Century and then spread throughout the world while being supported by the functionalist architectural concept and state-led urban planning. CBDs have, however, seen a surge in global cities, where they are directly integrated into the flow of global capital and embody new topographies. The history and physical circumstances of the growth of every town are unique. In this part of the city, most people work or shop, indicating that it is a business center. A CBD is often the busiest part of a city, particularly in big metropolises around the globe. Within the city, it is the most widely used and well-known center. The CBD of a city has the highest concentration of business activity, and not many other areas have the same level of activity.

Our country's limited urban public resources are challenged by rapid economic growth and urbanization. Over time, the dynamics of an urban metropolis change. Planners and Planning organizations in India generally accept and use the term Central Business District. Historically, cities have been places of high concentration of people, goods, and information.

Cities remain the main drivers of development on the local, national, and international levels. Urban central places accordingly do not appear to lose their social cohesion, with ephemeral and repetitive characteristics that become void of local identity. In terms of their locations and functions, cities play different roles in terms of the flow of people, goods, and information.

V. S. Sanjay Kumar; *Principal Scientist, KSCSTE - NATPAC, Thiruvananthapuram*

Shabana Yoonus; *Project Fellow, KSCSTE - NATPAC, Thiruvananthapuram*

M. V. L. R. Anjaneyulu; *Professor, National Institute of Technology Calicut, Kozhikode*

Unlike other parts of the city, the Central Business District has specialized land uses and a distinctive function that sets it apart from the rest.

CBD's cartographic definition and representation are of great importance in studying urban development and its functions. India, being a developing country with a large population, depends heavily on the Central Business District to promote sustainable progress. There is typically no physical boundary that demarcates or indicates the CBD area, making it difficult to demarcate. Demarcating CBD from surrounding areas serves multiple practical and strategic purposes, collectively enhancing the overall efficiency and functionality of urban development. The delineation facilitates the concentration of economic activities in a specific region, cultivating a lively and dynamic business environment. This focus often results in heightened economic productivity, as businesses capitalize on proximity to one another, establishing a hub for innovation and competition. Additionally, planners can guarantee efficient land use, designing the area to accommodate the necessary infrastructure and facilities essential for sustainable growth.

2. LITERATURE REVIEW

The 1945 Multi-Nuclei model, devised by Harris and Ullman, defines the Central Business District (CBD) as the downtown retail hub housing department stores, smart shops, theaters, museums, banks, hotels, restaurants, and clubs. When identifying an urban CBD, essential distribution characteristics, such as hotspots, densities, and trends, must be taken into account (Yu, Ai, and Shao 2015).

The CBD is characterized by the highest land values (Pardeshi 2010, Verma 2018, Taubenbock et al. 2013, Battino, Borruso, and Donato 2012) and tallest buildings (Pardeshi 2010, Verma 2018). Positioned at the city's core, most city centers are strategically located where major rail and road routes converge, attracting both pedestrian and automobile traffic (Verma 2018). The proximity of transport facilities further contributes to the gravitational pull towards the core area (Pardeshi 2010).

The CBD's unique polarization of economic, financial, and capital activities distinguishes it within cities (Drozdz and Appert 2011). Recognized for its highest concentration of commercial land use, encompassing offices, commercial spaces, retail stores, and entertainment venues like theaters, cinemas, and libraries, the CBD exhibits peak employment densities (Pardeshi 2010, Verma 2018, Venkitaraman and Devadas 2014, Taubenbock et al. 2013). Moving away from the central area, there is a noticeable decrease in population density (Battino, Borruso, and Donato 2012).

From the literature review, the selected parameters along with the references are consolidated in Table 1.

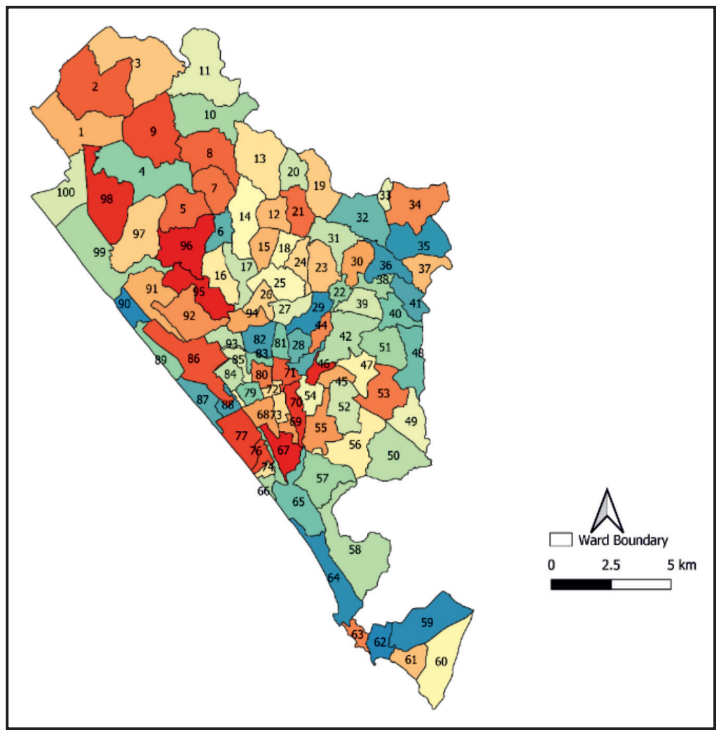
Table 1: Demarcation of CBD Parameters

Parameter	Reference
Land Price	Verma 2018, Taubenbock et al. 2013, Battino et.al 2012, Pardeshi 2010
Number of Establishments	Verma 2018, Venkitaraman and Devadas 2014, Taubenbock et al. 2013, Battino et.al 2012, Pardeshi 2010
Distance to Nearest Railway Station	Pardeshi 2010, Verma 2018

3. STUDY AREA

Thiruvananthapuram urban area in Kerala, part of the Thiruvananthapuram district, is the study area. It is the capital of Kerala, a south Indian state, and is located in the extreme southwest of the state. In addition to its undulating hills, the city is characterized by busy commercial alleyways, and narrow winding streets. In addition to being the capital, the city is also the centre of state politics. Thiruvananthapuram is a unique Indian city due to its combination of greenery and modernity. The Western Ghats and the Arabian Sea forms the backdrop to the city. There are many tourist attractions in Thiruvananthapuram, including the famous beaches. It is the oldest (created in 1940) and largest (by area and population) city corporation in Kerala. A phased expansion took the study area's zone strength to 100 as shown in figure 1 and its area to 214.36 sqkm in 2010, from 24 wards covering 30.66 sqkm in 1940. Approximately 9, 57,730 people live in the area, with 4, 67,739 men and 4, 89,991 women (Census 2011). There is no doubt that Thiruvananthapuram has been an important place in the history of Kerala and the region. Moreover, the city has a high level of human talent, top healthcare institutions, as well as a wide range of tourist attractions around the world.

Figure 1: Study Area



4. DATA AND METHOD

4.1 Methodology

Based on the literature review, the parameters identified for demarcation of CBD are land price, number of establishments, and distance to nearest railway station. The data required and the source of each data is explained in Table 2.

Surveys conducted in the field provided first-hand information on the number of establishments and land price. Through GIS analysis the distance to nearest railway station is calculated. The zones which fall in CBD will have a high land price, large number of establishments and least distance to nearest railway station. The adjacent zones satisfying minimum two of the criteria are grouped together to form CBD.

Table 2: Parameters for Demarcation of CBD

Parameters	Source
Land Price	Department of Registration
	Field Survey
Number of Establishments	Google Map
	Field Survey
Distance to Nearest Railway Station	GIS Analysis

4.2 Land Price

The market value of land was determined through direct surveys using a prepared questionnaire. A total of 690 land parcels where land transactions were performed recently were visited with local land dealers. Survey locations were spread across the 100 zones of the study area. In addition to the land price, GPS coordinates, plot area, and present land use were also collected. Coordinates of the filtered parcels were added to Google Earth as points. After exporting these points, they are imported into GIS for further analysis. The zone wise land price is shown in figure 2. A land price of Rs. 429.11 lakhs per Acre[1] is recorded as the highest while a price of Rs. 8.2 lakhs per Acre is recorded as the lowest.

4.3 Number of Establishments

The study area has a characteristic economic base centered on services since it is the administrative capital of the state and district. Google Maps was used to obtain establishment details. Based on Google maps, we collected the name of the institution, its type, whether it is a private company or a government agency, and its contact information. A ground check was conducted on these collected data in three zones for verification. Each category's correction factors were identified based on a comparison of on-the-ground and online data. Online data did not include many details about small grocery stores, bakeries, and vegetable and meat shops. Following the application of these correction factors, the total number of establishments in each category is determined and shown in figure 3. The

1 *1 Acre = 100 sqm*

Figure 2: Zone Wise Land Price

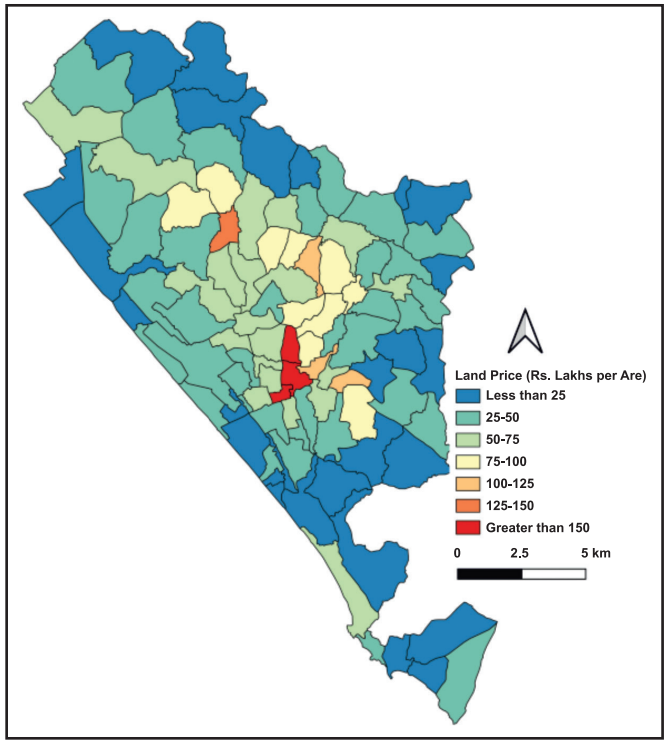
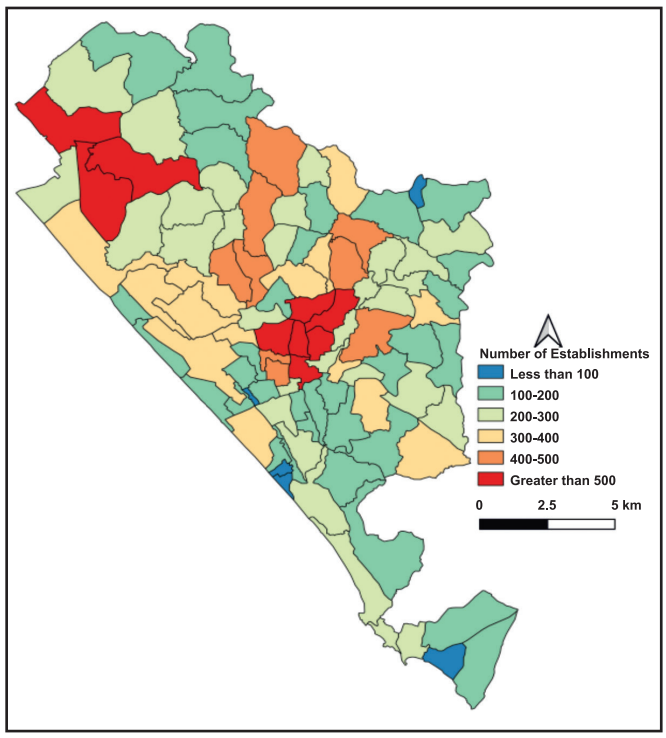


Figure 3: Zone Wise Number of Establishments

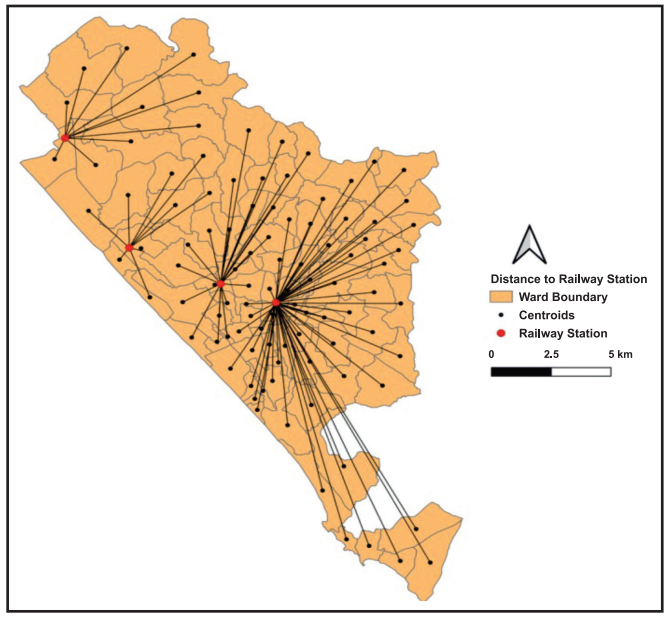


most establishments per zone are 1256, while the fewest are 57. As for the most stores, 2405 are in grocery, while the least is 11 in BEVCO outlets.

4.4 Distance to Railway Station

CBD areas will mostly be used for commercial purposes. Almost all of the goods that go to these shops are transported by goods trains (Pardeshi 2010; Verma 2018). Therefore, from the CBD the distance to the nearest railway station should be as short as possible. Four railway stations are identified in Thiruvananthapuram Corporation, namely Kazhakootam railway station, Kochuveli railway station, Pettah railway station, and Thiruvananthapuram Central railway station. From the identified railway stations, the Euclidean distance to the centroid of each near zone has been calculated and is shown in figure 4. Railway stations are located at a maximum distance of 13.83 kilometers, while a minimum distance of 250 meters is recorded.

Figure 4: Distance to Nearest Railway Station



4.5 Data Base

Parameters used in the model are summarized in following table 3:

Table 3: Parameter Summary

Parameter	Unit	Minimum	Average	Maximum
Land Price	INR per Acre	8.2	52.58	429.12
Total Number of Establishments	Nos.	57	284	1256
Distance to Railway Station	km	0.25	4.08	13.83

Figure 5 depicts the values of the parameters for all the 100 zones in the study region.

5. RESULTS

As inferred from the literature, conditions for defining an area as CBD are the following:

- Highest land price
- Largest number of establishments
- Least distance to nearest railway station

From the various analysis done for determining the above parameters, those adjacent zones satisfying any two conditions from the above listed parameters are grouped together, to form

the CBD area of Thiruvananthapuram, the study region. These zones are Palayam, Thycaud, Valiyasala, Chalai, Manacaud, Thampanoor, and Vanchiyoor. The CBD area demarcated is shown in figure 5 and 6. The respective values of the parameters, that defines these zones to be a part of CBD, are given in table 4.

Figure 5: CBD Area

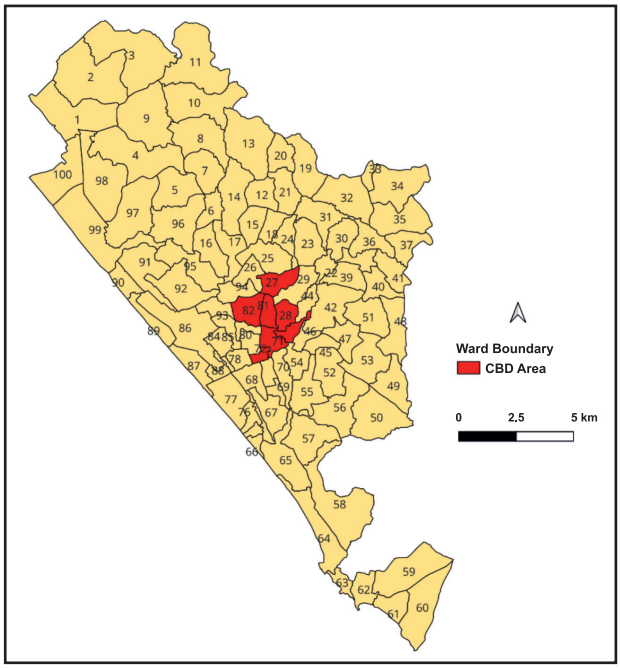


Figure 6: Parameter Values for all Zones in Study Area

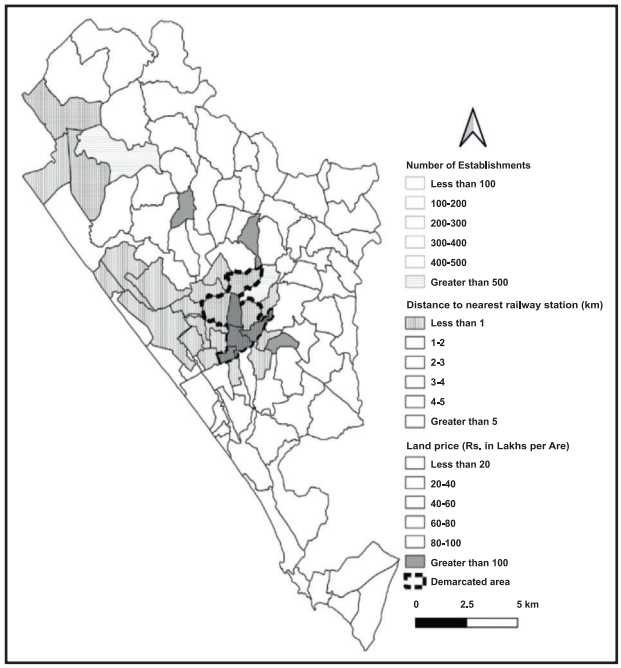


Table 4: Zones in CBD and the Parameter Values

Parameter	Land Price (INR per Acre)	Number of Establishments (Nos.)	Distance to Railway Station (km)
Palayam	90.61	654	2.03
Thycaud	86.96	648	0.75
Valiyasala	114.38	218	0.79
Chalai	429.12	1256	0.57
Manacaud	247.1	230	1.37
Thampanoor	202.82	686	0.71
Vanchiyoor	65.38	848	1.18

6. DISCUSSION

The combination of Palayam, Thycaud, Valiyasala, Chalai, Manacaud, Thampanoor, and Vanchiyoor zones is the CBD of the study area. CBD is the area with highest land price, largest number of establishments and least distance to nearest railway station.

Palayam zone, gets its name from the fact that it used to be the camp of the royal army and cavalry of the erstwhile kings of Travancore, and is one of the busiest localities in

the study area. The land price of the zone is Rs. 90 Lakhs per Acre and the distance to the nearest railway station is 2kms. The zone is characterised the fact that 15% of its total area is attributed to public/ semi-public use. It houses many administrative, cultural and educational institutions. The major establishments in the zone are stadiums, religious institutions, offices of University of Kerala, Legislative Assembly and hostel of the Members of Legislative Assembly. This zone is also one of the major shopping destinations of the study area with the total number of establishments as 654. The major one is the Connemara Market. This market was established by King Uthradom Thirunal in 1857 to provide day-to-day commodities for army members. During British rule, Sir Connemara inaugurated the archway leading to the market's interior at Thiruvananthapuram in 1888. In honor of him, the market was renamed as Connemara Market.

Thampanoor zone is the geographic centre of the study area. Trivandrum Central, the major railway station and the state owned public transport bus stand is located in this zone, both being the busiest ones in the state connecting almost all the parts of the State and other interstate cities. It also houses the headquarters of the Thiruvananthapuram railway division, one of the six administrative divisions of the Southern Railway Zone of the Indian Railways, and the Kerala State Road Transport Corporation (KSRTC), one of the country's oldest state-run public bus transport services. Thampanoor is also the hub of a variety of hotel suites and lodging facilities and major Cinema Halls of the city. One of the street in the zone is the state hub to numerous coaching centres for various Competitive exams. The number of establishments in the zone is 686 and land value is Rs. 202 Lakhs per Acre. Similar to all other wards, residential is the major land use, the second highest area is covered by public/ semi-public land use with 18% and commercial land use with 5%. The zone is also home to Regional offices of major newspapers and Media.Thycaud zone act as an extension of Thampanoor zone, so the character is almost similar with the total establishments as 648, land price of Rs. 87 Lakhs per Acre. The distance to railway station is less than 1 km. The second largest land use after residential is public/semi-public with a share of 15%. This zone houses the Non Resident Keralites Affairs, a department of the Government of Kerala formed on 6th December 1996 to redress the grievances of Non-Resident Keralites, State police training college and other educational institutions.

Chalai zone has total establishment of 1256 and has the highest land price in the study area, Rs. 429 Lakhs per Acre. The major share of land use are residential, public/semi-public and commercial with a share of 80%, 11% and 5% respectively. Chala bazar was officially established towards the end of 18th Century by Raja Kesavadas, Dewan of Travancore. It is a bustling marketplace with a fish market, textile market, provision market and so on. The market is spread through the narrow 2 km road with by-lanes also having an array of shops. The 2 km stretch is one of the busiest shopping streets in Kerala. The market sells almost every commodity, from fruits and vegetables, gold and silver to paint and hardware. The nearest railway station is at a distance 570 m.

Valiyasala zone act as an extension of both Thampanoor and Chalai zone, so the character is almost similar with the total establishments of 218, land price of Rs. 114 Lakhs per Acre and distance to railway station as less than 1 km. Valiyasala acts as the major hub for the parcel services and for the shops which sell hard ware items as well as the spare parts of vehicles.

For Manacaud zone, nearest railway station is Thiruvananthapuram Central with a distance of 1km and nearest airport is Thiruvananthapuram International Airport, around 4 km away. Manacaud is a bustling residential region of the study area- this zone is the one with highest population density and second highest land price after Chalai zone with Rs. 247 Lakhs per Acre. The number of establishments in the zone is 230.

Vanchiyoor zone occupies an important place in the history of Travancore. It was the district headquarters and most important offices were situated here. There are a lot of heritage monuments in the area. Major administrative, commercial, government and judicial establishments are still located in Vanchiyoor. Proximity with major educational institutions, offices and shopping centres coupled with easy road connectivity with all parts of the city make it a favoured residential locale in Thiruvananthapuram. The distance to the nearest railway station is 1km. It is the zone that houses the District criminal and Civil court. It is also the zone identified with second maximum number of establishments - 848. The land value of the area is Rs. 65 Lakhs per Acre.

7. CONCLUSION

An interesting set of results was obtained by utilizing spatial methods to highlight the CBD in the city. It is important to define and delineate the Central Business District based on human activities in order to apply urban planning, commercial site selection, and advertising recommendations. Thus, local determinants play an important role in CBD demarcation.

According to the literature review, the parameters that define the CBD are land price, the number of establishments and offices, and the distance from the nearest railway station. A primary survey is conducted to determine the land price. For the purpose of obtaining establishment details, Google Maps was used. Using a distance matrix, Euclidean distances from the centroid of each zone to the nearest railway station have been determined within the study area. The zones which fall in CBD will have a high land price, large number of establishments and least distance to nearest railway station. The adjacent zones satisfying minimum two of the criteria are grouped together to form CBD. The CBD area of Thiruvananthapuram Corporation has been demarcated accordingly, which is comprising of Palayam, Thycaud, Valiyasala, Chalai, Manacaud, Thampanoor, and Vanchiyoor Zones.

Ensuring a delicate balance between fostering economic growth in the Central Business District (CBD) and promoting sustainable, inclusive, and well-planned urban development is crucial for cities. As urban landscapes evolve, periodic reviews and adjustments to

zoning regulations become necessary to address the changing needs and dynamics within the CBD. The identification of a CBD significantly influences land use zoning, designating it as a high-density commercial zone where tall buildings, office spaces, and commercial establishments can flourish, streamlining urban development. This delineation also results in specific regulations governing building height and density, allowing for taller structures and higher population densities to accommodate concentrated commercial and business activities. To meet the increased mobility demands in the central area, authorities may invest in transportation networks, public transit, parking facilities, and pedestrian-friendly infrastructure.

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Factors attributing to Crop Residue Burning and their Contribution to GHG Emissions - A Case of Amritsar District, Punjab

Dr. Ritu Raj Kaur and Dr. Ashwani Luthra

Abstract

New technologies and the green revolution have increased crop production, increasing crop residues. A small time gap between the harvesting and sowing of the successive crops and the high cost of implements required to manage the crop residues has resulted in adopting inappropriate practices by the farmers, i.e. in-situ burning of residues. The incomplete and open farm combustion of crop residues has resulted in pollution in the area and the entire region. This paper estimates the total residue burnt and reviews various reasons why the farmers burn the residues by taking the case of the Amritsar district of Punjab state. The article also assesses the GHG contribution because of the residue burning. Further, it attempts to identify various reasons the farmers take these steps besides the national ban on residue burning.

1. INTRODUCTION

The growing population and increased food demand triggered the economies toward food security and forced the nations to adopt high crop-yielding varieties (Selvaraj et al., 2021; Dhiman et al., 2010). The nations' initiatives have undoubtedly increased crop production and resulted in residue management challenges. With the maximum population in the primary sector and the highest area under agriculture, India has taken several initiatives and reforms to improve crop yield and make food grains self-sufficient. The need to meet food security has pushed the country to produce sufficient grains, resulting in unutilised residues. Only a tiny amount of the residues are utilised locally as fodder, cow-dung cakes, thatching roofs, fuel for cooking, etc., by the village residents. However, a significant proportion still needs to be utilized and is burnt biannually by the farmers in the fields (Prasad, Singh et al., 2020; Prasad et al., 2018).

Punjab is the nation's most significant contributor to food grains, spread over only 1.53 percent of the area and is also known as the country's food basket. In the national pool of food grains, Punjab's contribution accounts for 32 to 49% rice and 51 to 75 % wheat (Dhiman et al., 2010). The enormous agricultural production has led to large proportions of farm residues with negligible market demand. Burning crop residues on the field is the easiest, fastest, and no-cost method farmers adopt to clear the land for the next crop.

The residue burning leads to extreme air pollution in northwestern India, including GHG emissions, black carbon aerosols, and trace gas emissions. Greenhouse gas emissions are a predominant contributor to climate change, one of the world's leading concerns. GHG emissions such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) are emitted during the incomplete combustion of agricultural residues. The residue burning in the northern and western states has also increased the concentration of black carbon aerosols covering North India, the

Dr. Ritu Raj Kaur; *Assistant Professor, Guru Ramdas School of Planning, Guru Nanak Dev University, Amritsar, Punjab*

Dr. Ashwani Luthra; *Professor, Guru Ramdas School of Planning, Guru Nanak Dev University, Amritsar, Punjab*

Himalayan slopes and the Indo-Gangetic Plains, impacting people's health (Kharol et al., 2012). The increase in pollution leads to various impacts, such as the melting of Himalayan glaciers, black clouds during winters, and increased temperature (Nagar et al., 2019; Vijayakumar, 2016; Kharol et al., 2012; Prasad et al., 2009; Ramanathan et al., 2001).

The present paper assesses the surplus residue that remains unutilised and burnt by the farmers in the Amritsar district of Punjab. It also estimates the GHG emissions attributed to the district's residue burning. Further, the paper also reviews why farmers burn the residues and do not manage them.

2. AMRITSAR DISTRICT OVERVIEW

Amritsar district is one of the border districts of Punjab state, having an area of 2683 sq. km. The district has nine blocks, namely Ajnala, Attari, Chogawan, Harsha China, Jandiala, Majitha, Rayya, Tarsika and Verka, with 743 villages in total. Amritsar, the second most populated city in the state, is located 27 km from the Indo-Pakistan border. The city is one of the important places for the Sikh community. Agriculture is the significant economic activity of the district. The district's area under all cities and towns comprises 8.2 percent of the total geographical area. The remaining area is under villages, with agriculture as the dominant economic activity. Of the entire geographic area under villages, 86.79 percent of the land is under agricultural use, 13.20 percent is under settlement area, and only 0.007 percent is under forests.

Ajnala and Chogawan, the two most enormous blocks of the district, have more than 300 sq. km area under agriculture. Jandiala and Verka are the smallest blocks and share boundaries with Amritsar city. The urban sprawl is visible in these blocks' villages. Attari is the border block and the third smallest block after Jandiala and Verka. Whereas Harsha China, Majitha, Rayya, and Tarsika have almost similar areas under agriculture, i.e. 220-230 sq. km. The summary of the block's area, villages in each block and the population is given in table 1.

Table 1: Number of Villages, Area and Population in Each Block of Amritsar District

Block	Villages (Number)	Total Area (sq. km)	Urban Population	Rural Population	Total Population
Ajnala	165	436.05	27505	1, 58,157	1, 85,662
Attari	59	247.92	10679	1, 27,601	1, 38,280
Chogawan	108	379.09	5416	1, 42,075	1, 47,491
Harsha Chinna	72	249.55	-	95,260	95,260
Jandiala	44	181.95	29232	1, 25,742	1, 54,974
Majitha	89	251.14	14503	1,50,271	1,64,774
Rayya	82	297.85	39019	1,60,421	1,99,440
Tarsika	81	242.03	-	1,29,367	1,29,367
Verka	43	173.23	38620	67,151	1,05,771
Total	743	2458.81	13,34,611*	11,56,045	24,90,656

*Note: *includes Amritsar City and Out Growth's population accounting for 11,69,637*
Source: Statistical Abstract of Punjab, 2016; District Census Handbook Amritsar, 2011

3. METHODOLOGY

To assess the residue yield, four major district crops have been selected, i.e. wheat, rice, maize and sugarcane. The gross sown area under four crops accounts for 97.7 percent of the total gross sown area in the district. The gross sown area includes the same area sown multiple times a year. Amongst these, Wheat and rice alone account for 87.1 percent. Village-level primary surveys, direct observations, discussions with various officials, and research papers have been included as data sources.

3.1 Sample Study: The sample villages have been selected from each block based on the population per acre of the gross sown area by applying a proportionate random sampling method. The sampling unit is a village, and the sampling method adopted for selecting the sample is proportionate stratified random sampling. It is a probability method of selecting a sample, wherein each unit has an equal chance of getting selected. Block-wise categorisation for population per hectare of the gross sown area under wheat and paddy has been done. Further, a proportionate random sample selection method was used for identified categories.

The village directory has been referred to access preliminary village information for sample selection at the block level. Preliminary village information means data on village population, gross sown area, net sown area, and gross sown area under wheat and rice. A final sample size of 68 villages out of 743 villages, which accounts for 9.11 percent of the total population (villages), has been surveyed to get crop yield, residue utilisation, residue burnt, and surplus residue details. Of the selected sample, thirty-two percent of the sample has been selected from <2 persons per acre of the gross sown area under wheat and paddy. Thirty-five percent and 32 percent have been chosen from 2-4 and >4 persons per acre of the gross sown area under wheat and paddy, respectively.

3.2 Data from Offices: The data collection from secondary sources includes the District Agriculture Department and the District Statistical Office. Research papers have been referred to as data collection tools for the residue-to-product ratios, heating values/calorific values, and emission factors for different crops. Each of these has been discussed in the following subsections:

District Statistical Office: Village directories have been accessed for information about demographic and agricultural area details.

Agriculture Department: Village-wise data for the area under different crops and crop yield have been gathered from the department. Expert opinions regarding agricultural field burning and government measures have also been employed.

3.3 Estimation of Surplus Crop Residues and GHG Emissions: The quantum of crop residue production is dependent on three variables, i.e. area under the given crop, crop yield of the specified crop and residue to product ratio of the selected crop. For crop area and crop yield data of the District Statistical Office and Agriculture Department. Further, for residue utilisation (uses as fodder for animals, fuel for cooking, and thatching), residue burnt, and residue surplus, sample survey results have been taken along with inputs from the experts in the Agriculture Department. The surplus residue and residues burnt have been computed using the following equations.

Surplus Crop Residues= (Crop area X Crop Yield X Residue to Product Ratio) - Residue Utilization

Total residue burnt depends on three variables, i.e., the surplus residue, dry matter fraction of different crops and fraction burnt.

Residue Burnt = surplus residue X dry matter fraction X fraction burnt.

The following equation has estimated the GHG emission from the burning crop residues.

GHG Emissions = Residue burnt X combustion factor X emission factor.

In the above equations, residue to product ratio, dry matter fraction, fraction burnt, combustion factor and emission factor have been taken from the existing research papers (tables 2 and 3), whereas crop area and crop yield have been taken from offices and inputs from the primary survey findings and expert opinions. As the fraction burnt for maize stalk is zero, it implies that the maize stalk is reused locally, and the same has been verified during the primary survey. Moreover, the quantity of maize grown is very marginal compared to wheat and rice.

Table 2: Crop-wise Dry Mass Fraction, Fraction Burnt and Combustion Factor

Crop	Residue	Dry matter Fraction[#]	Fraction Burnt [#]	Combustion Factor			
				IPCC[##]	IJAIR*	JGR**	Adopted
Rice	Straw	0.86	0.8	0.9	0.89-0.93	0.89	0.91
Wheat	Straw	0.88	0.23	0.8	0.86-0.91	0.86	0.89
Sugarcane	Baggase	0.88	0.25	0.8	0.9	0.68	0.79
Maize	Stalk	0.88	0	0.8	0.92-0.93	0.92	0.93

Source: *[#]Jain Niveta, et al., 2014. Emission of Air Pollutants from Crop Residue Burning in India. Aerosol and Air Quality Research. Vol. 14 pp 422-430.*

[##]IPCC Guidelines for National Greenhouse Gas Inventories, 2006

**Minooei, Omid, and S. Mokshapathy. 2017. Greenhouse Gas Emission as a Result of Burning of Agricultural Residues in Karnataka. International Journal of Agriculture Innovations and Research.*

***Turn, S.Q. Et al . 1997. Elemental characterisation of particulate matter emitted from biomass burning Wind tunnel derived source profiles for herbaceous and wood fuels. Journal of Geophysical Research*

Table 3: Emission Factors Adopted for Assessing GHG Emissions from Crop Residues

Category	GHG	Emission Factor	Source
Wheat	CO2	1344 g/Kg	Minooei, Omid, and S. Mokshapathy. 2017
	CH4	3.36g/Kg	Minooei, Omid, and S. Mokshapathy. 2017
	N2O	3.1 g/Kg	Sahai S., et al. 2007
Rice	CO2	1280 g/Kg	Minooei, Omid, and S. Mokshapathy. 2017
	CH4	5.32 g/Kg	Sahai S., et al. 2007
	N2O	0.48 g/Kg	Sahai S., et al. 2007
Sugarcane	CO2	1152.5	Minooei, Omid, and S. Mokshapathy. 2017
	CH4	5.82	Minooei, Omid, and S. Mokshapathy. 2017
	N2O	0.07	Minooei, Omid, and S. Mokshapathy. 2017

Source: *Sahai S., et al. 2007. A study for development of emission factors for trace gases and carbonaceous particulate species from in situ burning of wheat straw in agricultural fields in India, Atmospheric Environment*

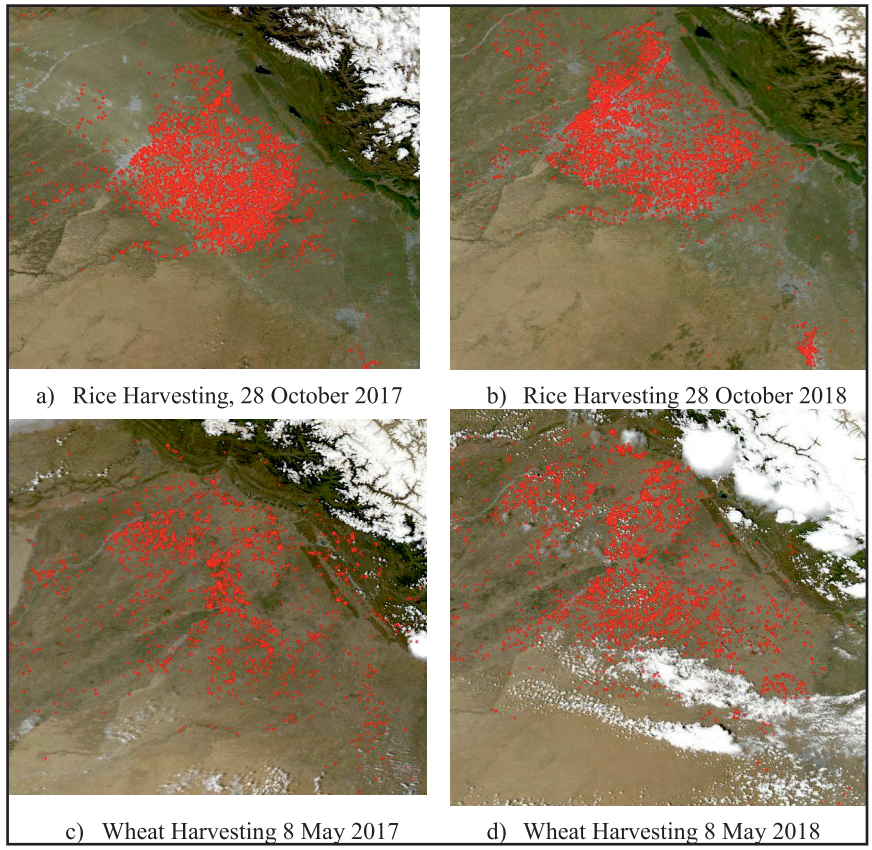
Minooei, Omid, and S. Mokshapathy. (2017). Greenhouse Gas Emission as a Result of Burning of Agricultural Residues in Karnataka. International Journal of Agriculture Innovations and Research

Considering the above assumptions, the assessment of residue burnt and GHG emissions has been done at the block and village levels. Further, the paper addresses various factors that force farmers to residue burning.

4. SURPLUS RESIDUE, RESIDUE BURNT AND GHG EMISSIONS

Punjab is an agriculturally dominant state known as the country's food basket, and most of its area is under two significant crops: wheat and rice. This results in huge quantities of residue generation, which is of no use or meagre use (Chauhan, 2012; Cardoen, 2015). The farmers opt for in-situ wheat and rice residue burning, a major problem in north-western India, covering the states of Punjab, Haryana, and Uttar Pradesh (Jain, 2014; Kumar, 2015; Lohan, 2018). Many farmers set their farms on fire to eliminate the residues having negligible usage and quickly prepare the fields for the next crop. Most surplus residues burnt are attributed to rice and wheat crops. However, the remaining unutilised resides are either ploughed in the fields or a heap of detritus along the roadsides. The images of active fire in agricultural areas of Punjab have been captured from the National Aeronautics and Space Administration (NASA) – worldview for 2017 and 2018 during wheat and rice harvesting seasons (figure 1). It is depicted in the figure that large numbers of fields are put on fire while harvesting during the rice crop season. Each red dot on the map represents active fire fields (figure 1).

Figure 1: Active Fire Areas in Punjab and the Surrounding States



Source: National Aeronautics and Space Administration (NASA), World View, 2018, 2017

Images captured from two years during Wheat and Rice harvest seasons

These are only one-day images of the active fire during wheat and rice harvest seasons. A similar situation prevails during the remaining days of respective harvest seasons. The active fire areas were very high during October–December, accounting for 55 percent compared to March, i.e. 36 percent, depicting that burning rice residue prevails over wheat (Singh et al., 2011). It has been evident from the images that rice straw burning is more prominent than wheat stalk. Besides a

complete ban on the National Green Tribunal, many fire incidents occurred with a minuscule reduction in residue burning. The Supreme Court case of M. C. Mehta vs.. the Union of India & Others ordered the formulation of a task force to look into alternatives. However, the complete elimination of stubble burning could not happen. Over 80 percent of rice straw burnt leads to enormous GHG emissions and air pollution.

5. BLOCK-WISE RESIDUE BURNING AND GHG EMISSIONS

A total of 1.64 million tonnes (65 percent) of residue is surplus out of 2.5 million tonnes of annual residue generation. Farmers utilise around 0.87 million tonnes, accounting for 34.5 percent (table 4). Out of the residue used, the maximum quantity is of wheat stalk. It is a vital animal fodder with market value, maximising utilisation. Only 20-25 percent of wheat residues are burnt which is challenging to remove from the fields (up to 10 cm lengths). The farmers are using thresher machines to extract fodder from the wheat straw. However, rice straw has limited uses and has no market value. Therefore, most rice straw is burnt in the fields to get rid of it, which is the quickest way to prepare the areas for the next crop.

Wheat and rice residues are generated across the blocks as these are the two predominant crops of the district. However, sugarcane is grown in villages near sugar mills, i.e., in Rayya and Ajnala blocks. Only a tiny fraction of the sugarcane residues are burnt. The rest is reused locally. The maize crop is grown in the district only to meet the localised demand, and there is the least area under its cultivation. The entire residues are utilised locally by the farmers as fodder for livestock. Therefore, the fraction burnt of maize is zero.

Table 4: Block-wise Surplus Residue and Residue Burnt (in tonnes)

Block	Surplus Residue	Residue Utilization	Residue Burnt	%age of Total Residue Burnt
Ajnala	333818	148156	180779	18.4
Attari	115736	112740	94848	9.7
Rayya	211588	71213	96890	9.9
Harsha Chinna	196957	85437	108714	11.1
Chogawan	287339	117998	159402	16.2
Jandiala	83420	77517	64074	6.5
Majitha	148687	98604	98019	10
Tarsika	190633	77199	110584	11.3
Verka	77418	84664	69194	7
Total	1645596	873528	982504	100

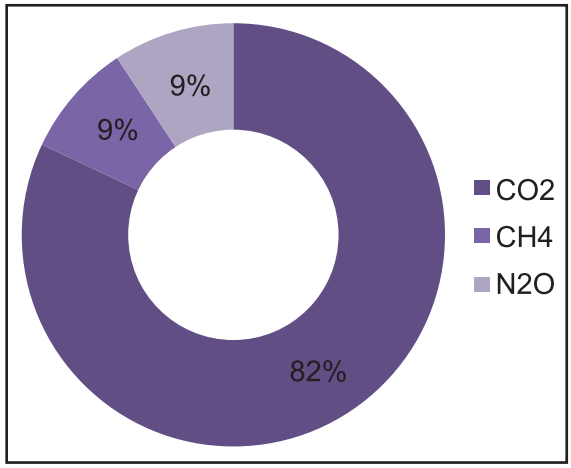
Source: Primary data based on estimations, 2018

GHG Emissions from Stubble Burning

GHG emissions have been calculated based on the quantity of residue burnt in each block, emission factors and combustion factors. The burning of residues in the district contributes a total of 1425.3 GT of annual CO2eq emissions. Out of the total GHG emissions, 82 percent are contributed by carbon dioxide, and methane and nitrous oxide contribute 18 percent (refer to table 5 and figure 2).

Due to NGT's complete ban on stubble burning in the state, farmers were reluctant to provide accurate information regarding stubble burning. Therefore, based on the secondary research results and interviews with the agricultural department, the fraction burnt for different crops has been taken along with dry matter fraction to arrive at residue burning in the district. Based on the estimation, it has been assessed that the farmers utilise wheat and sugarcane residues up to 75 percent. Further, it has been evaluated that almost 40 percent of the residues are burnt.

Figure 2: GHG emissions from Stubble Burning at District Level



Source: Computed Values, 2018

However, using the above assumption, 27 percent of residues still need to be utilized after deducting the residues burnt. It depicts that actual residue burning in the district is more than the assumptions taken based on the information provided. The fraction burnt is higher than the assumption taken. The same is evident as rice straw has no demand and is a waste product for the farmers.

Based on the estimates, the four blocks, Ajnala, Chogawan, Harsha Chinna and Tarsika, burn the maximum quantity of crop residues. Out of the total residues burnt, more than 50 percent are burnt in these blocks (table 5). These blocks have the highest proportion of rice cultivation, leading to maximum residue burning. Ajnala block also has the highest contribution to GHG emissions as the block has a maximum area under agriculture, the most increased residue generation, the highest surplus residue and the highest residue burnt, resulting in higher GHG emissions. Chogawan and Harsha Chinna blocks are the second and third-highest GHG-contributing blocks (figure 3). Verka block produces the least GHG emissions from burning crop residues, as it has the least quantity of residues. Ajnala, Chogawan, Harsha Chinna, Tarsika and Rayya add 67 percent of CO_{2eq} emissions, accounting for 952 GT to the atmosphere annually.

Table 5: GHG Emissions from Residue Burning at Block Level

Block	Carbon Dioxide (T)	Methane (T)	Nitrous Oxide (T)	Stubble Burning Annual CO_{2eq} Emissions (GT)
Ajnala	215743.6	790.3	91.3	262.3
Attari	113724.9	420.5	48.2	138.4
Chogawan	191072.3	701.7	81.3	232.5
Harsha Chinna	130083.2	475.6	55.4	158.2
Jandiala	76905.4	280.4	33.0	93.6
Majitha	117347.6	429.6	50.0	142.8
Rayya	114691.1	423.0	47.6	139.3
Tarsika	131679.3	494.6	54.4	160.1
Verka	82931.3	309.1	34.9	100.9
Total	1174179.0	4324.7	496.0	1428.2

Source: Computed Values, 2018

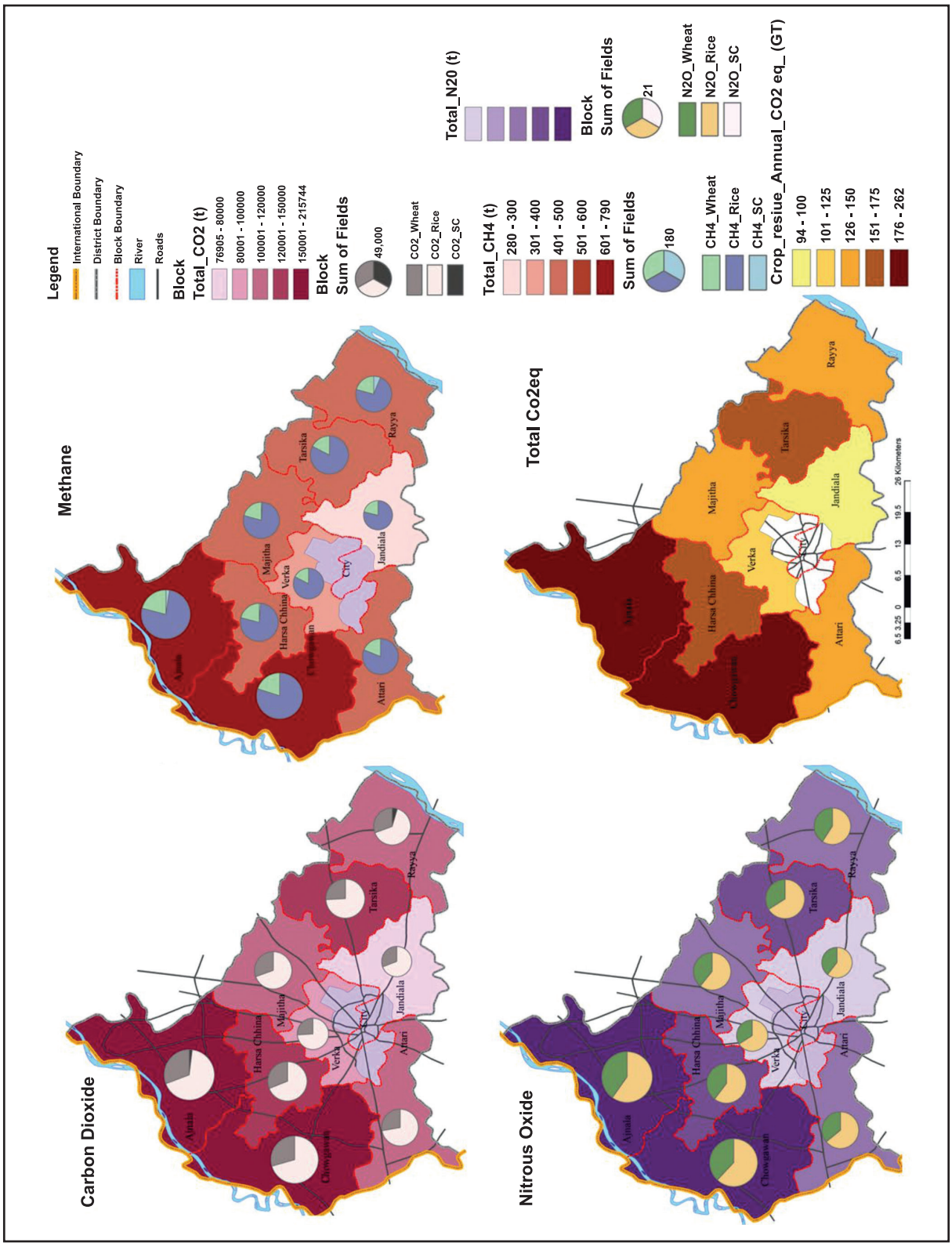


Figure 3: Block-wise GHG Emissions from Residue Burning

Rice residues are the highest contributor of CO_2, CH_4 and N_2O emissions, accounting for an average of 70 percent, 79 percent and 62 percent, respectively, in the district. The wheat stalk burning in the district contributes to 29 percent of CO_2 emissions, 20 percent of CH_4 and 38 percent of N_2O emissions. The bagasse from sugarcane contributes to 1 percent CO_2, 1.3 percent CH_4 and 0.13 percent N_2O emissions in the district (table 5 & figure 3). Chogawan and Ajnala blocks are the highest contributors to emissions from different greenhouse gases.

The area under active fire for residue burning is increasing due to larger residues left in the fields for mechanised harvest (figure 4). In addition to GHGs, it has also resulted in an increased concentration of PM2.5. The PM2.5 levels increased to 167.97µg/m3 in 2018, with a peak of 1546 µg/m3 against 127.69 µg/m3 in 2002, depleting air quality (Singha et al., 2021). As per another research, PM 2.5 varies from 60 to 390 mg m^3 during rice harvest season, which declines post-harvest (Lohan et al., 2018). Moreover, increased aerosol, SO2 and NO2 levels are also attributed to stubble burning (Mittal et al., 2009; Kharol et al., 2012). The pollution caused by residues also smog as pollutants are trapped near the ground due to temperature inversion, resulting in environmental harm.

Figure 4: Mechanized Reaping, Unutilized Crops Residues and Stubble Burning

Note: Photographs taken from Tarsika and Rayya Blocks; Source: Primary Survey, 2018

The smog can be seen in larger areas and travels long distances (Jain, 2016). In-situ burning of residues impacts human health and harms animals and fauna surviving around and under the agricultural fields, i.e., microorganisms, insects, birds, and reptiles (Lohan et al., 2018). The air pollution is caused during the rice harvest season and is further aggravated by festivals engulfing the entire region, including surrounding states covering Indo-gigantic plains(Badarinath, 2006).

6. GOVERNMENT MEASURES FOR RESIDUE MANAGEMENT

At the national level, the government has suggested a framework for managing and effectively using residues (NPMCR, 2014; CSS, 2020). The states can take various measures to manage residues, including in-situ and ex-situ crop residue management. The Commission on Air Quality Management (CAQM), Ministry of Environment, Forest and Climate Change has framed these recommendations. In-situ management includes using machinery to manage the residues in the field itself. These machines can be purchased at subsidised prices or hired from the hiring centres, making the seed available that is high yield and harvested in short duration, etc. Ex-situ residue management uses crop residues for power generation, such as biomass, cogeneration plants, and waste-to-energy plants (Kumar et al., 2015).

At the state level, agriculture policy highlighted the need to provide technology for managing residues. The crops' residues potentially need to be used for power generation. The approach also emphasises the preparation of specific guidelines for funding and setting up these plants by co-operatives or individuals. With the help of several campaigns by the Punjab Government, including training programs and farm festivals educating about the best practices of managing crops and related matters, farmers are made aware of the adverse effects of residue burning on the environment and declining soil health.

Different state departments are working on various aspects to manage these residues. The State Agriculture Department and Punjab State Council for Science and Technology are focusing on adopting new methods and machinery for efficient residue utilisation, crop diversification, incorporation of residues in the soil with the help of technology, and encouraging farmers to use new and innovative agricultural implements on subsidy. The Punjab Energy Development Agency facilitates the setting up biomass and co-generational plants. In Ghanaour village, Patiala, Punjab Biomass Power Ltd has set up a 12MW biomass power plant, in which the company provides machinery transportation and also pays the farmers for residues and given assurance to comply with the limited time between wheat and rice crop (Jitendra et al., 2017). The initiative has drastically reduced air pollution levels during the harvest season in the surrounding villages of Ghanaour village.

However, these initiatives are meagre compared to the extent of residues to be managed. These initiatives could not achieve the desired results, as most farmers still opt to burn the crop residues. Many farmers in the district are aware of local air pollution caused by burning residues, but they do not find an alternative to burning as it is cost-effective. There are various reasons why the farmers still burn the residues, which are included in the subsequent section.

7. REASONS FOR RESIDUE BURNING

The National Green Tribunal banned residue burning for stubble management and ordered state governments to offer machinery at subsidised rates. The mechanised equipment for straw management includes Straw choppers/shredders, mulchers, zero tillage, happy seeders, Straw management system (SMS), and bailing machines. These machines are subsidised by the farmers and community hiring centres (CHC).

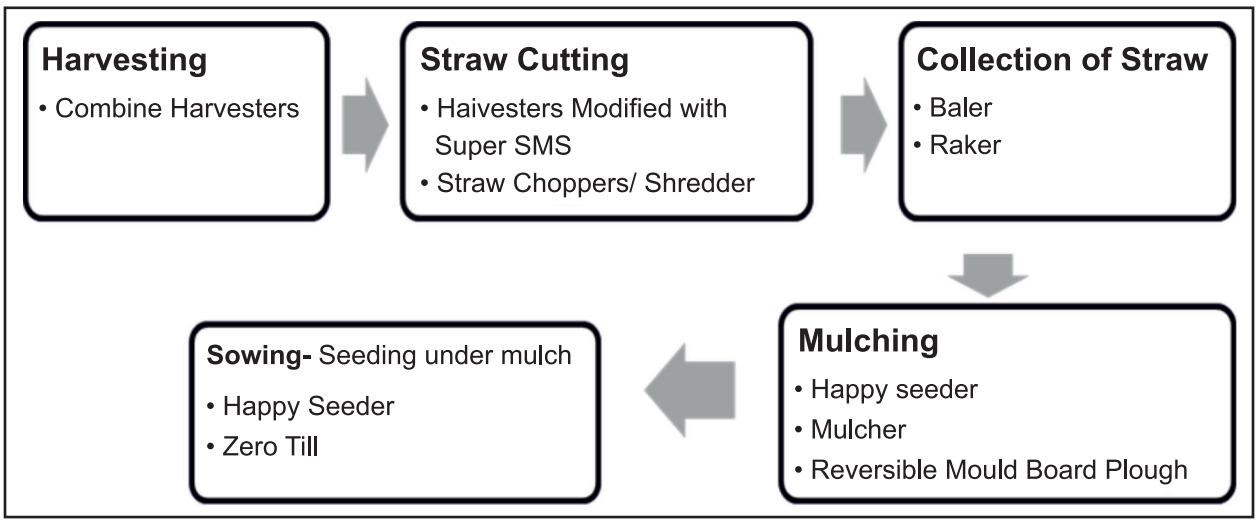
The Zero Till and Happy Seeders are used to drill wheat seed into the soil and mulch stubble. Another machine that the government has promoted is the super-SMS. It is attached to a combine harvester, cuts straw into smaller pieces, and spreads in the field. However, these technologies could not gain the required success due to the costlier way of sowing and mulching the straw.

Additionally, these machines are only used once a year. The number of devices supplied could have been higher, especially for small farmers. Various reasons for stubble burning besides the NGT complete ban have been discussed in subsequent parts.

7.1 A large number of Agriculture Equipments Required

Different machines are required for straw management as per the existing process of rice harvesting and straw management. Many types of equipment are needed, from rice harvesting to sowing wheat. These include combine-harvesters to reap the grains, modified harvester combines including a straw management system, and straw choppers and shredders for cutting the straw from the fields (figure 5). For collections of straw, baling and raking machines. Further, mixing the remaining residues with the soil includes happy seeders, mulchers/ reversible MB plough, sow/drill wheat seeds into the ground under the mulch happy seeder, and zero-till machines. However, as per current practices, combine harvesters are used to harvest rice. The residues left over in the field are removed manually, and the remaining standing residues in the field area are put on fire.

Figure 5: Machinery Requirement at Different Harvesting Stages of Crop Management



Source: Malik, Y S. 2017. Report of the Sub-committee of the High Level, Government of India

As per the Agricultural Department, the machinery is subsidised for farmers and community hiring centres (CHC). The farmers are given a 50 percent subsidy, whereas hiring centres can buy these machines at an 80 percent subsidy. Besides the support, farmers are not willing to purchase expensive equipment used only once a year. Moreover, the devices are not enough in number to cover the entire district (table 6).

Table 6: Availability of Equipment in the District and Cost of Machinery Associated with Straw Management

Process	Machinery Provided	Number*	Coverage per Machine #	Current Coverage (ha)	%age Area Coverage	Required Machinery	Cost of Machinery #	Total Cost
Chopping	Super-SMS	67	150	10050	5.7	553	0.14	77.42
	Paddy Choppers	16	100	1600	0.9	147	0.25	36.75
	Sub-Total	83	250	11650	6.6	700		114.17
Collection	Baling Machine	0	150	0	0	292	1.1	321.2
	Raker	0	150	0	0	292	0.3	87.6
	Sub-Total	0	300	0	0	584		408.8
Mulching	Mulchers	14	100	1400	0.8	404	0.25	101
	Reversible MB plough	6	70	420	0.2	152	0.225	34.2
	Sub-Total	168	315	12870	7.3	556		135.2
Seeder	Happy Seeder	138	75	10350	5.9	882	0.135	119.07
	Zero Till	30	100	3000	1.7	118	0.05	5.9
	Sub-Total	168	175	13350	7.6	1000		124.97
Associated Cost (Rs. in millions)							0.715*	1566.28

Note: ***Considering the cost of Super SMS, Raker, MB (Mould Board) plough and Zero Till machines*
#units are ha per Harvest Season

Source: *Computed Values and *Agriculture Department, Amritsar,*
#Report on the Sub-committee of the High-Level Task Force on Prevention of stubble burning in Punjab, Haryana and Western Uttar Pradesh, 2017.

Nearly 700 chopping machines, 584 collection machines, 556 mulching machines and 1000 seeder machines are required to manage the residue. The equipment provided serves only 5-8 percent of the area of the district and has a limited time of 10-15 days to sow wheat, which leaves no option for farmers but to burn the residues. After the stubble burning, the farmers pour water and plough the fields to remove signs of stubble burning.

Some of the affordable farmers managed to use equipment to contain residues. Still, complete elimination within the stipulated time could not happen as straw decomposition takes more

than a month. However, there is only a 15-20 day gap between rice harvesting and wheat cultivation. Considering the machinery constraints, small-scale farmers have gathered residues manually and made heaps around their fields and roadsides.

7.2 Machinery Not Suitable for Different Crops

The above machinery is not suitable for farmers opting for crops other than wheat, such as vegetables, potatoes, peas, pulses, etc., as Happy Seeder and Zero Till machines are used only for the manual drilling of wheat seeds. If farmers opt for other crops, they must clear the fields completely, thus making these machines unsuitable for such farm practices. The existing machinery is advised to promote only wheat farming.

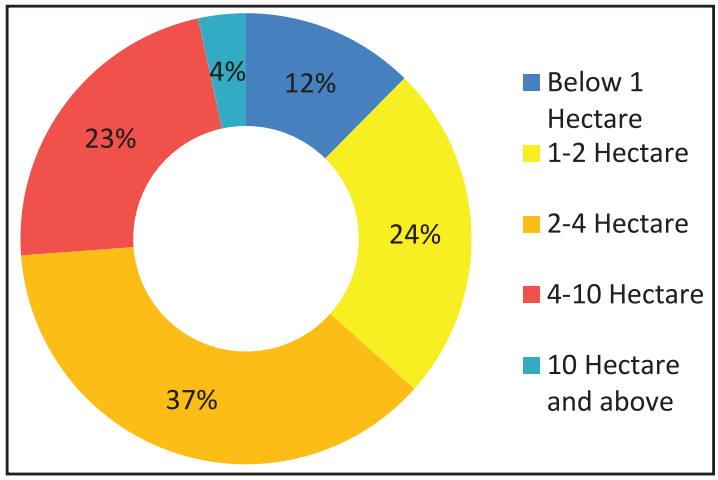
Therefore, the complete elimination of stubble burning can only be done in the proposed scenario once there is market demand for these residues, wherein farmers are willing to recover these residues. The National Green Tribunal has also recommended that NTPC use biomass as fuel for power generation (NGT, 2017).

Additionally, the machinery provided to farmers and corporate hiring centres at subsidised prices is used only once a year. The farmers will utilise these machines in the rice harvesting season, spread over an average one-month period. For the remaining 11 months of the year, these machines will remain redundant/unutilised.

7.3 Costlier Process

Other than the reasons mentioned above, one of the primary reasons for not using different types of equipment is the cost associated with hiring or buying the machinery. Currently, the equipment does not favour small and medium land-holding farmers. In the district, 36 percent of farmers have land less than 2 ha, and 37 percent have medium-sized landholdings, i.e. 2-4 ha. The remaining farmers have land holding more than 4 ha, i.e. 27 percent (figure 6). Thus clearly depicting that most farmers belong to small and medium-sized landholdings.

Figure 6: Landholdings Size in the District



Source: Statistical Abstract of Punjab, 2016

Suppose a farmer buys all the machinery required to manage residues, i.e. a Super SMS, a Raker, a Reversible MB Plough, and a Zero Till, at a subsidised rate. In that case, he has to spend Rs. 3.57 lakhs at a 50 percent subsidy (table 5). All these pieces of equipment are the least costly in their respective categories. In addition, to operate these types of machinery, farmers require

higher horsepower (70-80 BHP) tractors, which are more expensive (around Rs. 10 Lakhs) than the machines. Thus, it becomes costly and impossible for small and medium landholding farmers to buy all these types of equipment and a new tractor.

If the small and medium landholding farmer opts to rent the machines, again, there are various associated costs, which the farmer has to pay from his pocket. Much diesel consumption adds to the cost of straw management to operate the machinery. The farmers have to bear the cost of renting the machinery to harvest the crop, mechanised mulching of the residues, and associated transportation costs, thus adding to the burden on farmers without profit. The cost of renting a combine for reaping rice is relatively low, i.e. 2000/ha, compared to managing rice straw, which is around Rs. 8000-10000/ha (Shreeshan et al., 2017). The ideal process the government suggests to farmers takes much time and effort without returns. The small landholding farmers are not willing to purchase the machinery. Instead, the government needs to promote more custom hiring centres (CHC) to remove residues from the fields and biomass power plants in the state, which will add value to crop residues.

In the current year, due to a lack of machines and lesser revenue from smaller farmers, corporate agricultural societies/corporate hiring companies preferred to lend the machinery to big farmers. In addition, it is inconvenient for CHCs to operate machines in smaller land holdings than in larger areas where they make more money.

The central government has allocated Rs. 1151 crore for 2018-2020 under the Centre Sector Schemer to promote Agricultural Mechanisation for in-situ management of crop residues to deal with stubble-burning issues in Punjab, Haryana and Uttar Pradesh. Out of the total allocation, Rs. 269 crores has been allocated to Punjab to buy 24972 machines to manage straw. Amritsar District machinery costs Rs. 156.6 crores to contain the residues. However, the majority of this machinery is suitable for rice crops only.

Due to the above prevailing reasons, the farmers are still burning the crop residues and protesting against the government's strictness without providing them with financially feasible alternatives. Thereby, the residue burning contributes to greenhouse gas emissions. On-farm stubble burning also adds to smoke and poor air quality during harvest.

8. FINDINGS AND DISCUSSION

The district generates 2.5 million tonnes of crop residues, out of which the majority of residues, i.e., 55 percent consist of rice and 40 percent of wheat. Out of the total estimated residues, in-situ burning of residues contributes to almost 40 percent, which is done to clear the farm for the next crop. The blocks Ajnala, Chogawan, Harsha Chinna and Rayya, having a larger gross sown area under wheat and rice and lesser utilisation of residues, contribute up to 58 percent of residue generation in the district resulting in the increased number of open fires in fields during the harvest period. The central government and state governments have taken various measures to stop the residue burning, including in-situ and ex-situ residue management.

Amongst the selected crops, in-situ stubble burning due to abundant rice residues and negligible market demands results in the highest crop residue burning during the paddy harvest session. The wheat residues also contribute significantly to stubble burning, which needs to be tackled with the help of proper mechanisation of agricultural implements, limiting the residue left over in the fields that can be easily managed by the farmers instead of burning. Different research studies have found that residue incorporation has improved crop production. The NPK (Nitrogen, phosphorus and potassium) value of the soil improved, resulting in higher production (Reicosky et al., 2005; Khaliq et al., 2015; Cardoen et al., 2015; Lohan et al., 2018; Ali et al., 2019). The residue incorporation can be done with the help of cost-effective and readily available implements, such as mulchers and Reversible Mould Board ploughs, which are insufficient for the district's requirements.

It is crucial to address farmers' core problem, i.e., poor paying capacity to buy/hire expensive machinery. Moreover, the machinery is only suitable for some crops as farmers with small landholdings prefer to grow multiple crops yearly instead of wheat-rice crops. Most machines are only suitable for the wheat-rice cycles.

These problems must be addressed before forcing the farmers to burn the residues is challenging (Ahmed, 2015). The Government can address these challenges to a certain extent by providing required implements at a negligible hiring price or free of cost. Several implements are required from sowing to harvesting, and most farmers need help to afford all the necessities due to minuscule earnings from smaller landholdings, resulting in low income from the produce, which forces them to burn the residues.

Another solution that the government can adopt and prefers is ex-situ residue management. Instead of unthinkingly investing money in the costlier machinery, which will remain redundant for most of the year, there is a need to address the core issue of residues by adding value through biomass power plant initiations. If straw utilisation is done by proposing biomass plants and expenses of machinery, transportation is to be borne by the power company. It would be beneficial to the farmers as well as help the farmers get rid of the residues. The residue utilisation by the power industries can assure the returns on the sale of residues, and farmers can also earn from the agricultural waste.

Open field stubble burning of residues contributes to GHG emissions due to incomplete combustion. A total of 1428.2 GT GHG emissions are attributed to in-situ residue burning. GHG emissions currently added to the atmosphere lead to air pollution and global warming. The existing policy recommendations of the centre and state government encourage the utilisation of residues for incorporation residues in the fields and setting up of biomass, cogeneration plants, and waste-to-energy plants, which can reduce emissions and can also be used to provide renewable energy (Hiloidhari et al., 2014; Chauhan, 2012; Kumar et al., 2015; Hiloidhari et al., 2018).

The government can take these initiatives on a priority basis based on the size of the block, population, and area under rice and wheat cultivation. Depending on each block's residue generation, machinery can be allocated for residue incorporation. The competent authority can also prepare a detailed strategy for collecting, transporting, storing, and using residue for energy generation at the block level.

9. CONCLUSION

Managing rice and wheat residue is a significant challenge the state government deals with due to its vast quantities and minimal use. Besides several initiatives for on-site management of residues, the situation remained as grim as earlier. For multiple reasons, such as costly equipment, smaller landholding, poor buying/hiring capacity, number of machines required, etc., the farmers burn the residues, resulting in air pollution and GHG emission contribution. The pollution caused by the residues not only impacts the local air quality but also has a negative regional impact. Therefore, looking for pragmatic solutions acceptable to the farmers is vital for preserving the environment.

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