

Spatial Planning and Water Policies: A quest for coherent city planning for NCT Delhi

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Abstract

The world is undergoing significant changes in the social, economic, political, and environmental aspects of daily life. The challenges arising from these transformations are becoming unavoidable and extending beyond the reach of current solutions. A major concern is the heightened risk to urban communities due to the escalating natural resource crises. Of particular focus is the issue of water security, which garners substantial attention. Historical evidence indicates that there has been substantial discourse on water strategies within urban planning. Nonetheless, the incorporation of a framework for integrated water policies into a city's development plans is not an entirely novel concept, yet it remains largely unexplored within Indian cities. The formulation of water resource policies is now advancing, embracing the necessary steps for collaborative decision-making. Thus, the establishment of a legal framework at every level of city planning becomes pivotal for ensuring the sustainable advancement of urban settlements. With the aim of integrating water considerations into city planning, this research seeks to uncover the deficiencies and prospects within the existing master plans of Delhi, India's capital. The Master Plan for Delhi (MPD) holds responsibility for the comprehensive planning and development of the entire city. Guided by principles of water resource management, all three iterations of the MPD — 1962, 2001, and 2021 — undergo critical assessment and evaluation based on the 'water security' parameters. These predetermined criteria are adapted from the OECD principles of 'policy coherence' in water governance. The purpose of this evaluation is to identify gaps in policy coherence and explore the concept of integrating water policies across various levels of city planning. The thorough review offers insights into the tangible and intangible capabilities of the MPDs in executing existing water policies to achieve an inclusive approach to water in city planning. Currently, the concept of water-inclusive city planning necessitates special attention, especially as the Draft Master Plan for Delhi 2041 is under process of notification.

Keywords: City Planning, Master Plan for Delhi, Water inclusive city planning, Water management, Water Policies

1. Introduction

Urban planning and the management of water resources have garnered extensive scholarly attention within prominent frameworks such as Integrated Water Resource Management (IWRM), Water Sensitive Planning (WSP), Water Centric Planning (WCP), Urban Resilience (UR), and Green-Blue Infrastructure (GBI) (Nagata et al., 2021; Gleason & Flores, 2021; Shrestha et al., 2021; Arfan et al.,

2020; Tawfik & Chesterfield, 2020; Alves et al., 2019; GWP, 2000). Each concept possesses distinct objectives at various scales, yet all strive for interconnected aims. As we seek to establish a connection between urban planning and water resource management, the scope of intervention spans from macro to micro levels. This range encompasses the formulation of strategies and development policies within the realm of urban planning, descending to micro-level interventions in shaping city architecture and urban design (Zhang, Shen, & Lin, 2021; Designboom, 2020; Pena, Abreu, Magalhaes, & Cortez, 2020). The forefront of land and water management unveils a myriad of challenges. These challenges frequently channel issues in water management toward the governance of spatial planning. The dynamics of land and water governance stand apart in vertical, horizontal, and fluid dimensions (Hartmann & Spit, 2014). Adapting spatial planning to the multi-sectoral and multidimensional landscape of decision-making emerges as pivotal for cohesive progress across all domains, thus serving as the linchpin for sustainable development. The integration of coherent policy tools for settlement planning, infrastructure development, environmental regulations, and landscape policies can facilitate a comprehensive approach to integrated planning for sustainable development (Camagni, 2017) (Figure 1).

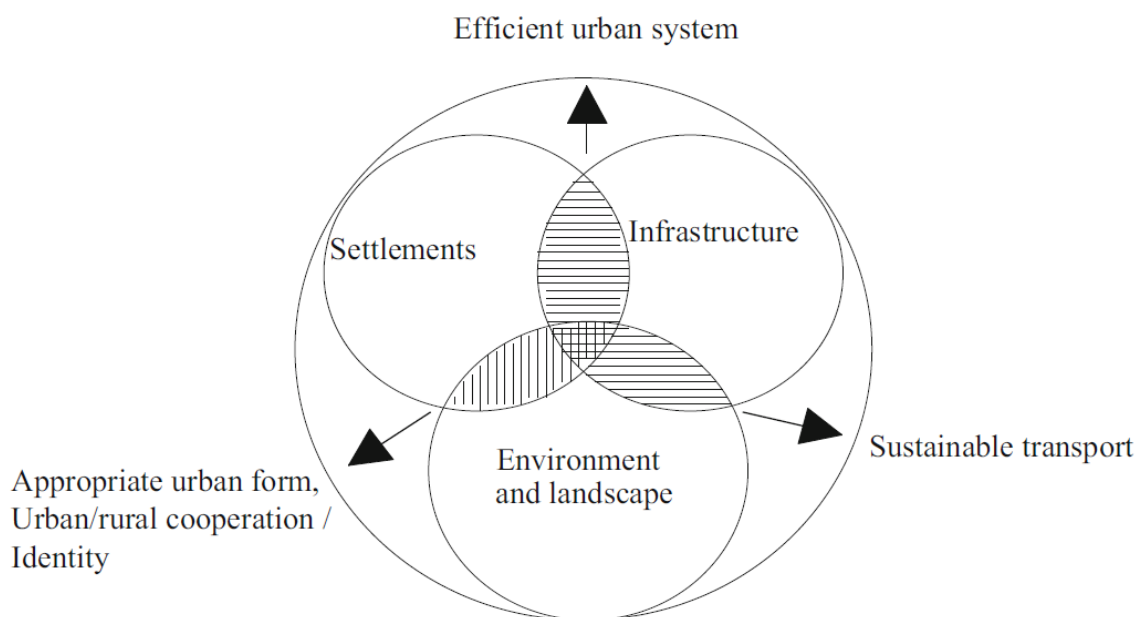


Figure 1 An Integrated Planning Approach, Source: Camagni, 2017

Hence, the integration of policies within spatial planning should not be perceived as an ultimate outcome or in isolation, but rather as an ongoing process aimed at achieving unified objectives across diverse governmental and sectoral levels. The factors influencing integration and its facilitation encompass a range of elements, including but not limited to political, institutional, organizational, economic, behavioral, cultural, and personal aspects (Stead & Meijers, 2009).

Following example help us to understand the types and scale of water policy integration in plans.

Example-1: A Dutch based study on ‘Integrating Water Management and Spatial Planning’ strategies has been published in 2007 (Woltjer & Al, 2007) to review the integration of water management and spatial planning through accepting the *water on land* in place of blocking it. Here water management responsibilities are distributed at National, Provincial, Regional and Local level. Whereas responsibilities of spatial planning are dispensed at National, Provincial and Local level. Land-use planning impacts water management and vice versa. Policy making in both is traditionally separated

however are known to be inherently connected. Need for coordination and climate change were two important reason behind such type of integration. Netherlands faces the weak connection of the policy interventions between spatial planning and water management, although not completely disconnected. Decisions related to prevailing water and water quality norms etc. are made without referencing to spatial planning and similarly the zoning for business parks, highways etc. are also mostly taken in isolation. But in recent years, Dutch is better planning for the challenges such as in situations like flood national committee suggests the construction of water storage areas near cities and along rivers. The suggestion from the national committee are adopted immediately into the new policy and the spatial planning memorandum. Spatial planning in Dutch happens with the concept of ‘key planning’ decisions set by government. It is now seeking collaboration of water resource management with urban and regional planning to overcome the challenges of climate change, flooding etc. These decisions are translated by provinces into regional plan and later detailed land use plan is prepared by the municipality. Tools like Water Impact Assessment has become compulsory since 2013 to be included in spatial plans and land use plans at every scale. Study concludes with four approaches as 1. Conventional, 2. Spatial planning, 3. Water Planning and 4. New-Water culture for possible integration. The approach of spatial planning recognised water under societal function to be united in strategies and regulations.

Example-2: Another study called ‘How Can Water Use Efficiency Strategies Inform Land Use Planning?’ in Bolivia, South America published on 2013 (Shi, et al., 2013). Solution like demand-side management was discussed as a key for reducing unit water consumption through proposing and monitoring such strategies through urban planning. Practices like reducing water loss, recycling wastewater were suggested be achieved during the expansion of water supply infrastructure. However, beside all the conventional techniques and ideas applied for water conservation fails to qualify when comes to practical expansion of water infrastructure. Thus, study suggest that the integration of infrastructure investment strategies to urban development priorities could be seen as opportunity, for example developing small industrial wastewater recycle facilities within industrial zones. It confirms that land use has considerable impact on water demand. Therefore, housing type, size, income, water prices, behavioral and cultural background are the key factors responsible for water demand. Pattern shows that single family uses more outdoor water than others and are not much user of water saving appliances. Housing type is proportional to water consumption then housing size. Hence housing typology is one of the factor which could be exercised while planning land-uses in sync with water strategies. Keeping in view the complexity of task-force and fund coordination in local politics over water, vulnerability of the poor is directly linked to the financial sustainability of water utility. Factors like climate change and situations like drought are directly linked to the concept of sustainable settlement and hence may lead to higher rates of rural to urban migration resulting into urban sprawl. This study informs that urban planning has an important role to play in changing environmental conditions and vice versa. Hence, there is a requirement for both horizontal and vertical coordination in water use and land-use management to ensure environmental and economical resilience of cities.

1.1. Master plan preparation process in India

In the context of India, the instruments for urban planning operate under the framework of the Town and Country Planning Act of 1947. The Master Plan, a blueprint endorsed by state legislatures, outlines objectives to be realized over a 20-year span. Primarily centered around zoning regulations based on land usage, the formulation of a Master Plan entails an approximate decade-long process, as evidenced

by cases such as Mumbai and Delhi. Notably, India houses approximately 2700 cities equipped with Master Plans. This document encompasses a collection of strategies devised by urban planners, architects, engineers, and other policy stakeholders. The initial phases entailed in the preparation of a Master Plan are illustrated in Figure 2.

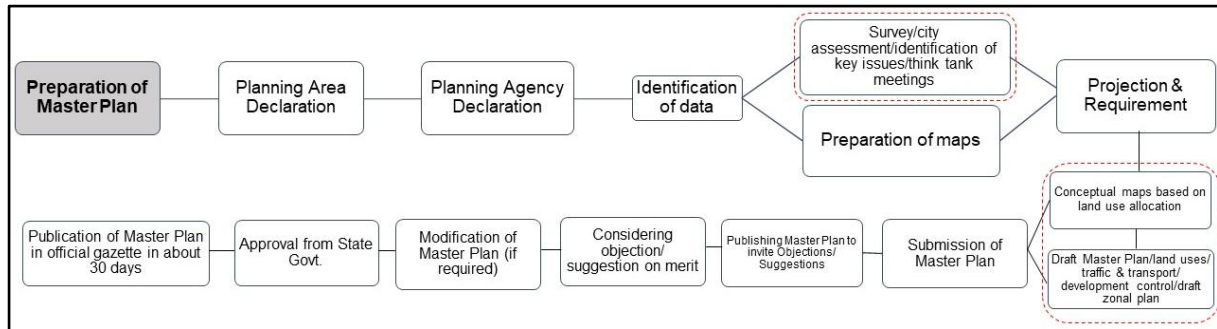


Figure 2 Stages in making of Master Plan, Source: Authors

1.2. Water policy preparation process in India

India took a pioneering step by introducing the National Water Policy in 1987. The formulation of this water policy was overseen by the Ministry of Water Resources, which underwent a transformation in 2014, becoming the Ministry of Water Resources, River Development, and Ganga Rejuvenation. Subsequently, on June 14th, 2019, the ministry underwent further evolution, emerging as the 'Ministry of Jal Shakti' (Ministry of Water Power). Under its current iteration, the Ministry of Jal Shakti operates through two distinct departments: The Department of Water Resources, River Development, and Ganga Rejuvenation, also referred to as 'Jal Sansadhan, Nadi Vikas Aur Ganga Sanrakshan Vibhag,' and the Department of Drinking Water and Sanitation, known as 'Peya Jal Aur Swachhata Vibhag.' The latter department was previously established in 2011 under the title Ministry of Drinking Water and Sanitation.

The inaugural National Water Policy (NWP) was adopted in 1987 and underwent updates in 2002 and subsequent revision in 2012. In 2019, the Union Water Resources Ministry established a committee to draft a new iteration of the National Water Policy. The formulation of NWPs in India entails the collaboration of the federal government, engaging the contributions of bureaucrats from various divisions and other public leaders. The initial stages of crafting a water policy are depicted in Figure 3.

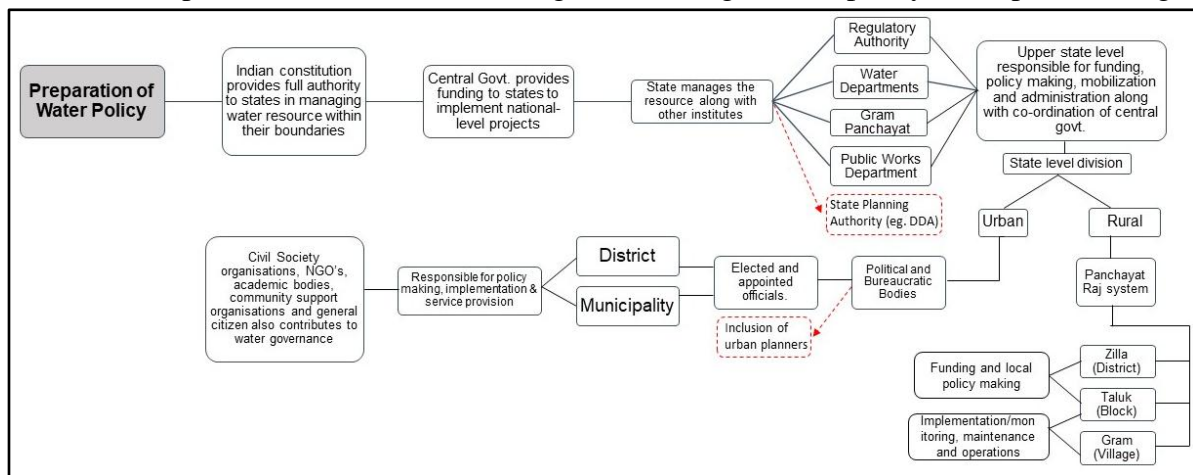
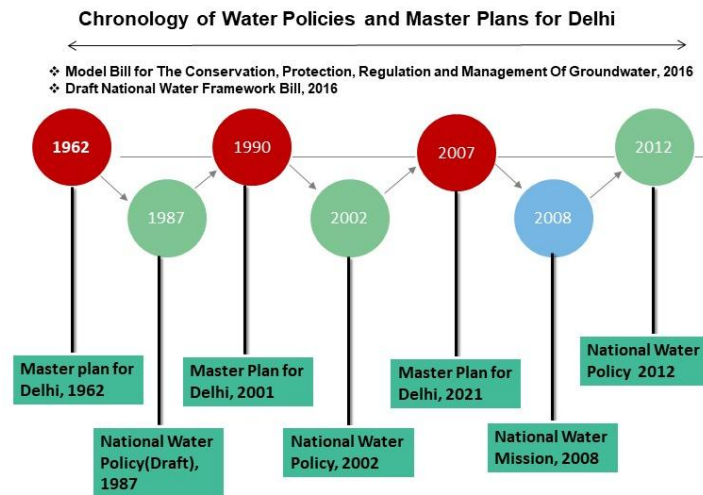


Figure 3 Stages in making of Water Policy, Source: Authors, based on Ahmad & Araral, 2019

Recognizing water resources as a subject under the jurisdiction of individual states in India, the approval of policies can be contingent upon their relevance within a specific state's context. Each state possesses the autonomy to devise its own strategies tailored to the demands within its borders, which may or may not align directly with the principles of national policies. In the realm of water procurement, the Delhi Jal Board, established in 1998 through the 'Delhi Water Board Act' by the Delhi Legislative Assembly, holds authority over water supply and sanitation in Delhi.

The processes involved in crafting development plans and water policies in India (refer to Figures 2 & 3) take distinct trajectories. Nevertheless, a few points of convergence can be discerned when contemplating the planning of two indispensable resources: land and water. The boxes outlined in red signify some of the gaps identified in the formulation process and the absence of considerations for constructing integrated policies. Therefore, this paper provides an overview of how current master plans of Delhi integrate water policies and what are the potential areas of consideration to achieve coherent city planning. Below is the representation of chronology of notified water policies and master plan for Delhi.



2. Background

The National Capital Territory of Delhi (NCTD), commonly referred to as Delhi, stands as a metropolis and holds the distinction of being India's capital city, boasting a populace exceeding 20 million individuals. The census of India in 2011 documented a population of 16.7 million. The inaugural Master Plan for Delhi was formulated by the Delhi Development Authority in 1962 with the assistance of the Ford Foundation. A subsequent iteration of the Master Plan was enforced in 1990, followed by the latest version, the Master Plan for Delhi 2021, crafted in 2007 (Figure 4). Eagerly awaited, the Master Plan of Delhi 2041 has unveiled its initial draft in June 2021, inviting public input in the form of objections and suggestions, currently under the process of notification. For an overview of the hierarchical structure governing development plans pertinent to spatial planning, please consult Figure 5.

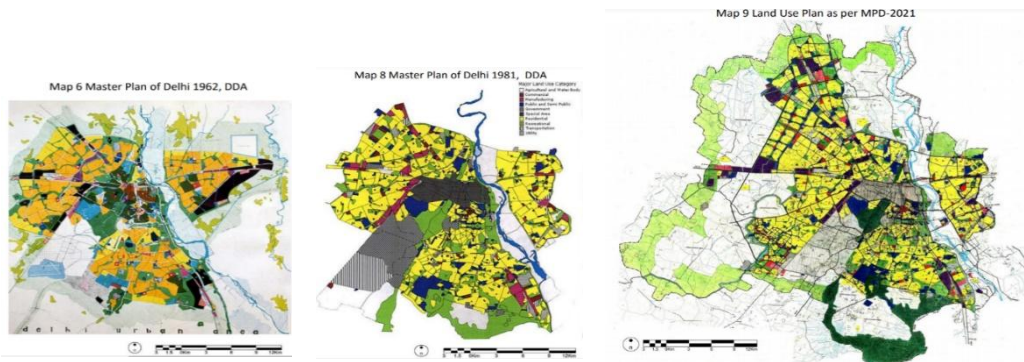
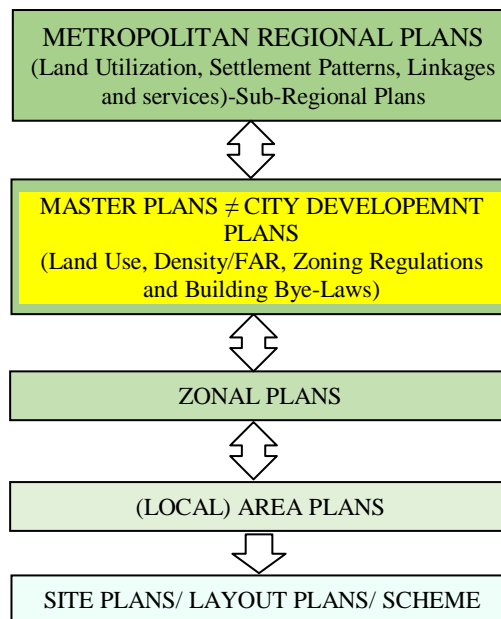


Figure 4 Master Plans of Delhi 1962, 1981 and 2021 showing land use distribution and urban extensions, Source: DDA



The acquisition, provision, and distribution of water within Delhi fall under the jurisdiction of the Delhi Jal Board, as outlined by the Delhi Water Act of 1998. The Delhi Jal Board operates as an entity of the state government. However, the realm of water policy formulation for Delhi encompasses other pivotal stakeholders. Among them, the federal government plays a vital role in shaping water policies on a national scale (Figure 6).

Figure 5 Hierarchy of development plans responsible for spatial planning, Source: Authors based on URDPFI

Yet, standing out among these stakeholders is the Delhi Development Authority (DDA), which was established under an act passed by the Indian Parliament in 1957. Serving as a city planning agency for the Government of India, the DDA shoulders the responsibility for structured and methodical urban development within Delhi. It's essential to clarify that the Delhi Jal Board remains the provider of water in all newly developed regions, regardless of size, ensuring a consistent supply across the city.

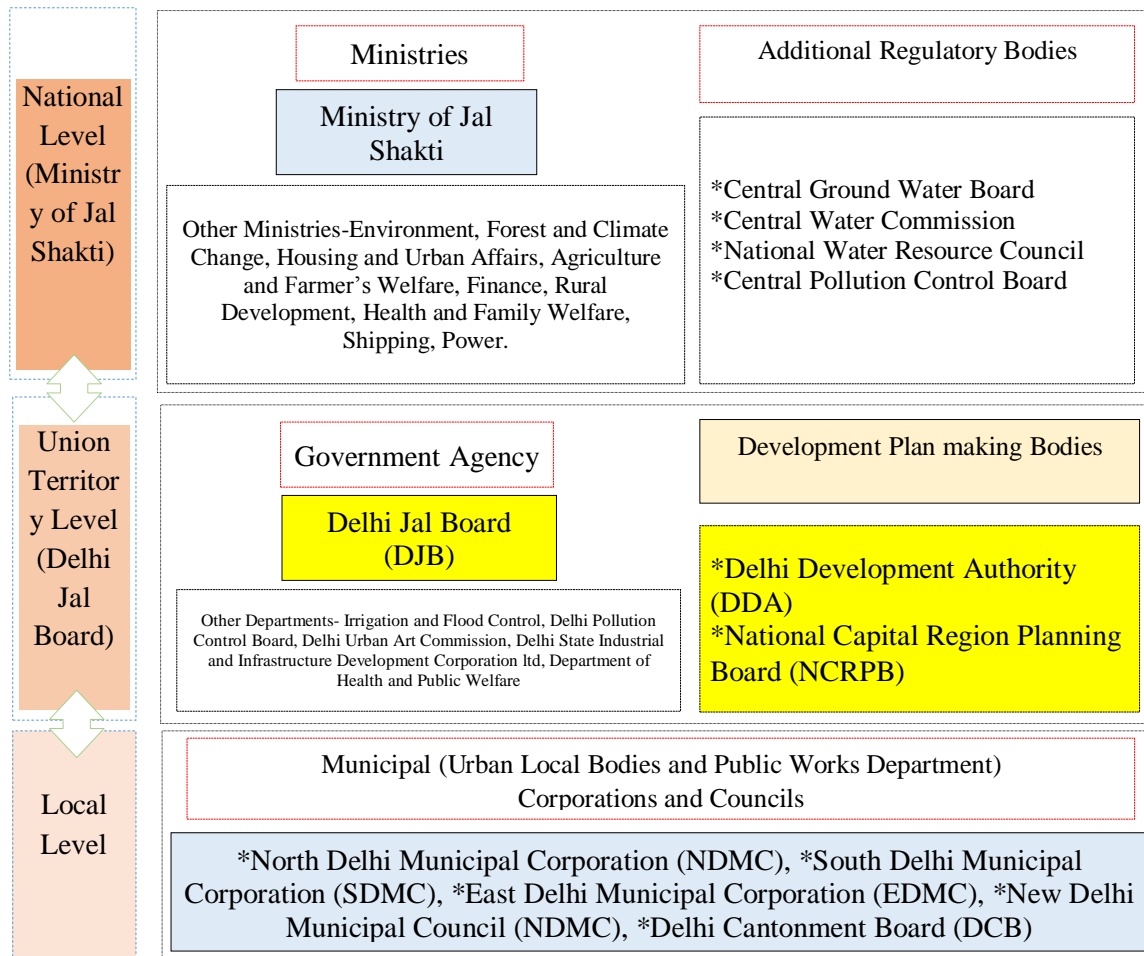


Figure 6 Hierarchy of institutions responsible for water resource management, Source: Authors

3. Methodology

This study undertakes a comprehensive evaluation of the succession of master plans within the National Capital Territory (NCT) of Delhi, aiming to gauge their prioritization of water supply and management. Employing a conceptual analysis, the research endeavors to ascertain the extent to which these policies ensure the fundamental parameters of ‘water security’ which are water accessibility, equity in distribution, adequacy in supply, affordable water tariffs, public engagement, transparency and public participation, and environmental sustainability.

The outcomes section of this study assesses whether the water policies delineated in the three master plans have effectively aligned with the aforementioned predetermined criteria. The ensuing discussion segment strives to synthesize a checklist, laying the groundwork for a framework tailored to water-inclusive urban development policies specific to Delhi. In concluding reflections, the research incorporates illustrative instances pertinent to the study, reinforcing its findings with real-world cases.

4. Review of Master plan for Delhi (three versions)

Examining insights from the three successive master plans of Delhi, this section undertakes an assessment of the research studies conducted for the Master Plan for Delhi in 1962 and 2001. A subsequent comparison is drawn between these research studies and the corresponding policies outlined

in both editions of the master plan. Despite the comprehensive nature of the research studies, it is notable that the two iterations of the master plan provide limited discourse concerning water and wastewater management within the city.

The initial two master plans relied heavily on the insights garnered from these research studies, which offered foundational support for shaping policy recommendations across various development sectors. These research undertakings played a pivotal role in informing the formulation of water-related policies that eventually found their place in the master plans. Conversely, in the case of the most recent edition of the master plan, namely the Master Plan for Delhi 2021, no corresponding research studies were conducted. Nevertheless, supplementary content pertaining to water and sanitation was incorporated in the annexures accompanying the plan.

4.1. Master Plan for Delhi, 1962 (for the planning period from 1961-81)

The Master Plan for Delhi (MPD) in 1962 outlined a comprehensive strategy for water supply in the region through the work studies done prior to the plan. It classified the area into three classes based on their population and geographic factors. In Class A areas, which encompassed the core of Delhi Urban Area, the plan proposed 24X7 water supply and the establishment of a treatment plant to process a significant portion of the water. While contradictions arose regarding the duration of water supply, the plan suggested either continuous supply or a minimum of 18 hours, with specific morning and evening hours proposed. In Class B areas, sourced from ground, infiltration galleries, and wells, 18-hour water supply was suggested along with treatment before distribution. Class C areas, relying on tube wells and infiltration galleries, faced a 12-hour supply without mention of water treatment. The division into these classes was critiqued as geographically discriminatory and unequal due to varying rates and times of supply. The plan further revealed the addition of 20 acres for expanding the Chandrawal Water Treatment Plant and 40 acres for the Wazirabad Headworks, while outlining water supply mechanisms for specific areas like Shahdara. However, the executed Master Plan for Delhi in 1962 appeared to largely disregard the framework set by the earlier work studies, indicating a departure from the policy foundation proposed in those studies.

In summary, the 1962 Master Plan for Delhi detailed diverse water supply strategies across different area classes, sparking debates over geographic inequity. Despite the plan's attempts to establish standards, contradictions and deviations emerged, reflecting the challenge of balancing water distribution policies across the city's varied landscape.

4.2. Master Plan for Delhi, 2001

The Delhi Master Plan of 2001, published in 1990, briefly addresses water supply within Chapter 8 on Physical Infrastructure. The plan projected the total water requirement for Delhi in the year 2001 and identified various water sources, including Tehri Dam in Uttar Pradesh, as well as Kishan and Lakhwar, and Giri Dams in Himachal Pradesh and Haryana respectively. For the first time, the plan proposed addressing the remaining water demand by exchanging wastewater with Haryana. To augment water supply, the plan advocated for utilizing groundwater for non-drinking purposes. Recognizing the need for additional water treatment, especially for an added 671 MGD (million gallons per day), the plan highlighted the inadequacy of existing water treatment plants. It recommended establishing additional

capacity and constructing a new water treatment plant in the North-West region by 2001. The plan set the water supply requirement at 80 GPCD (gallons per capita per day), with a domestic allocation of 225 liters per person per day, and a minimum domestic supply of 135 liters per capita per day for residential areas.

4.3. Master Plan for Delhi, 2021

The Master Plan for Delhi 2021 (MPD 2021), released in February 2007, lacks specific work studies but presents relevant details in Annexures A3-A16 and B within the context of Physical Infrastructure. A holistic approach to infrastructure integration, encompassing water-sewage-stormwater systems for recycling, harvesting, and optimal resource use, is endorsed for sustainable development.

Pointers	MPD, 1981	MPD, 2001	MPD, 2021	Remarks
Water Tariff	No mention	No mention	Water pricing suggestions were made in National Water policy, 2012 (revised), However it is not incorporated in the MPD 2021 (revision, 2017).	Master plan does not consider the aspect of water pricing/ water tariffs overlooking the important parameter of affordable water for all.
Public Participation and Data transparency	Lack of coordination and involvement between Stakeholders and NGOs. No common data sharing platform	No mention	No mention	Transparency seems major issue in the Master plan as it is failing to establish better coordination amongst various institutions such as DJB, CGWB etc. NWP also emphasizes on the issues related to the data transparency, whereas no such inclusion is made in any of the MPD's.

<p>Equity in distribution</p>	<p>Standards for distribution were decided on the bases of classes (A, B and C)</p>	<p>A large section of population living in resettlement, unauthorized colony, urban villages and New housing development at periphery had limited access to treated water supply.</p>	<p>“Some areas get 24 hours of water supply whereas, some of them hardly get 1- 2 hours of water supply”. (Neither the areas are mentioned, nor justification were made in the Plan)</p>	<p>The National Water Policy suggested the equitable water supply but master plan does not included guidelines for equitable distribution. Hence, Delhi Development Authority paid little regard to the idea of equity in water supply.</p>
<p>Supply standard & Duration for water supply</p>	<p>50 gallon per person per day was proposed. Area demarcated for the expansion of water purification plant and sources of augumentations were planned out. Augumentation was planned out in two stages, first stage till 1966 (112 mgd), and second till 1981(250 MGD).</p>	<p>No specific mention to the duration of water supply, However, the Plan reported the treatment plants would not be sufficient for treating the additional amount of 671 MGD untreated water.</p>	<p>No work study was carried out before MPD 2021.However Annexure A and B are dedicated to water sector. The actually availability of water supply was inefficient as (I -2 hour of water supply was observed in some area; however, no areas were identified). Prevention of wastage and theft of water is discussed.</p>	<p>Ideas from earlier plans were not included while making the successive plans. All three plans lack in incorporating the issues based on the certainty of the water supply. No standard for certainty and duration of water supply is transferred through plans.</p>
<p>Sustainability</p>	<p>Lack of Social and Political Sustainability. Environmental sustainability has been completely neglected with the use of statement such as ‘dependency of population on ground water extraction where applicable’.</p>	<p>Over dependency on water extraction from tube wells.</p>	<p>Recycle of waste water at the existing water treatment plant has been discussed.</p>	<p>Suggestions have been made in the plan but clear guidelines pertaining to social, political and environmental sustainability is not clearly defined.</p>

Efficiency enhancement via community engagement and decentralized management is advocated. Water supply improvements are recommended through the Inter-State River Water Allocation (IWRM) method, while reducing unaccounted water flow is emphasized without details. Community-driven water conservation is praised, yet the plan doesn't prioritize water quality or equitable distribution, a persistent challenge in policies. Non-uniform water distribution affects the urban poor significantly, but critical zones identification is missing.

The MPD 2021 doesn't reference existing national or state water policies, and spatial mapping for managing challenges or improvements isn't provided. A minimum water supply standard of 172 LPCD (liters per capita per day) with 15% line loss is set, but the Economic Survey of Delhi reveals 40% loss, threatening future water scarcity. Annexure A-7 recommends policy actions, including amending the Delhi Water Board Act to regulate groundwater, and financial considerations including levies for infrastructure funding. Reducing water losses is seen as more cost-effective than increasing capacity, but the plan lacks cost estimates for meeting additional city demands. Non-revenue water, attributed to illegal tapping and connections, questions water policy effectiveness.

5. Review of Master Plan of Delhi based on water security parameters

6. Discussion and conclusions

Referring to the indicators used for examining the MPD's, a preliminary checklist of possible framework has been designed (table 2) to showcase water inclusive cities framework to be practiced in making of development plans at any scale of the city.

Table 1 Checklist for water inclusive cities framework based on the 'water security parameters,

Source: Authors

INDICATORS Checklist for water inclusive cities framework				
<i>Checklist to qualify indicators</i>	<i>Accountable water Governance</i>	<i>Comprehensive city wide planning</i>	<i>Local Economic</i>	<i>City level economic incentives</i>
Water Pricing & Tariff	✓ equitable water tariff ensuring societal justice	✓Water related action in city plan related to water consumption pattern and tariff	✓Cost and benefits in city planning discussions, water tariff and revenue	✓Water business incentives ✓Tax incentives ✓Tax Credits
<i>Checklist to qualify indicators</i>	<i>Connecting land use and water use</i>	<i>City specific goals & stakeholder's vision in city-wide plan.</i>	<i>local economy around water and exchange of public information</i>	<i>Collaborative regional approaches to water management to address water-risks and solutions</i>
Public	✓ Evidence of	✓Shared vision	✓Provide	✓Regional,

Participation and Data transparency	discussions between multi stakeholders including land use and water planning approaches ✓Common data sharing during analysis of development plans impacting water availability, quality and supply. ✓Involving NGO's working on ground realities while land-use planning based on water availability, suitable future developments, water table , topography etc.	on water tariff, conservation, infrastructure distribution, Pollution control, flood management etc.	common analysis on water related benefits impacting local economy ✓Promoting engagement, incorporating feedback from the community	district, city and local collaborative approaches to water management ✓Stakeholders discussion on future trends and opportunities
Checklist to qualify indicators	<i>Water policies addressing water equity</i>	<i>Safe drinking water for all</i>	<i>Visions of comprehensive city plan.</i>	
Equity in distribution	✓Land-use zoning based on socio-economic activities as per accessibility and affordability of water ✓Equity in tariff and taxes ✓Ensuring water quality for all	✓Evidence and monitoring safe drinking water for all	✓City planning with common goal to solve inequitable distribution and social injustice.	
Checklist to qualify indicators	<i>Accountable governance</i>	<i>future trends and water supply</i>	<i>Collaborative regional approach</i>	
Supply standard & Duration for water supply	✓Strategies compiling to equitable supply standards and certainty	✓Management of equitable supply based on various sectors and uses.	✓Increased utilization of a water standard	
Checklist to qualify indicators	<i>sustainable urban water management</i>	<i>City storm water management</i>	<i>reuse and regeneration systems</i>	<i>Adoption of water related technologies</i>
Resource conservation	✓Retaining biological character of water	✓Timely evaluation of city	✓City plan dictating re-use-	✓Use of technology and

and Sustainable practices	bodies Mapping of water bodies and including in plans to ensure land-use zoning and regulations. ✓Adoption of green-blue infrastructure with detailed plans and mappings.	storm water management, promoting resilience by mitigation and adaptation considering climate change	recycle and reduce principle.	water saving devices and metering devices in all the sectors. ✓Reduction of non-revenue water with the use of technology
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Although funders, experts and policy makers are joining hands together to overcome challenges occurring in sustainable management of resources. There are still many objectives far from achieving the expectation. The overall governance of resource management is evolving through time and necessities. Therefore, engagement of DDA with DJB needs to be intensified for better planning and implementation of water policies.

We also observed that the stages involved in the preparation of water policy (fig.2) and that of master plan (fig.3) moves in distinct direction. Although there is no such listing provided in any of the document but consultants involved in policy preparation includes stakeholders such as Corporate leaders, Academia, Non- Governmental Organisations and Panchayati Raj representatives. Whereas, consultancy teams of urban planners, architects and engineers are in charge of proposing ideas and strategies for the development of any city. Figure 2 explains the route in preparation of water policies. Boxes outlines in red indicates the potential for inclusion of state planning authorities and urban planners while developing strategies for water resource management. Similarly, in figure 3 red boxes highlights possibility of intervention. For example, conceptual maps could be proposed on the basis of land use allocation in sync with water policies. Policies have no definite interval whereas plan is decided for the target of 20 years. By the time new plan is proposed, set of policies also changes leading to lack of synchronization between the two. The hierarchical collaboration of organisation varying from center to state is constantly missing. Development plan is recommended to have separate sectoral plans for infrastructure and service plan, separate mapping for Water supply, drainage and sanitation, supply and sewage network mapping for monitoring and implementation of water policies. Plan should also include current situation and proposed planning for immediate action. Therefore, it is anticipated that if there is participation of both water policy and master plan preparation teams, the challenges can be shouldered in a better way.

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