Water Crisis in Cities: The Case of 'Day Zero' in Chennai, India

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1. Introduction

Many cities around the world face a severe water crisis as a result of the rapid growth of urban population, industrialization, and climate change. Such is the case of Chennai, India, wherein June 2019; the city woke up to the unfortunate news that all the main water reservoirs of the city have dried. This crisis came as a surprise because the city and its surroundings have been traditionally home to numerous water bodies and rivers along with a canal, making it a unique city with a wealth of water distribution channels and adequate drainage. Chennai has the potential to be a water resilient city but instead is facing a water crisis.

The developing regions throughout the world are enduring a significant demographic change. This change can be observed as a transition from a rural to urban and from an agrarian society to an industrial one. Currently, more than half of the global population inhabits urban areas. From 2018 to 2050, an additional 2.5 billion people could be inhabiting urban areas, which is equivalent to 68% of the total global population (United Nations 2019). The scale and pace of urban change are expected to bring along significant challenges, many of which the urban areas are already experiencing. One of the central challenges is to supply water to urban areas. The growing size and density of the urban population add dramatic pressure on the water resources at a speed and scale unprecedented in history. Several cities have already begun experiencing this anticipated water shortages, whereas having access to water is considered a fundamental right. In the recent past, particularly two coastal cities in two consecutive years have set a warning for the rest of the world. Cape Town in South Africa and Chennai in India declared 'Day Zero' in 2018 and 2019, respectively.

One may question what is 'Day Zero?" 'Day Zero' is a concept associated with water resources becoming scarce because of drought conditions as aggravated by climate change. The term came into highlight when it was used for Cape Town in 2018, referring to the day when the level of the dam catering the city reached low as 13.5%, therefore requiring all the taps in the city to be shut off. It marks as a wakeup call indicating an inconceivable, but real, situation of extreme water scarcity (Nhamo and Agyepong 2019). Decreasing water supply and increasing demand is not exclusive to Cape Town and Chennai, but the rate of declining supply and consumption has made the situation extreme from a global perspective.

On the one hand, the world aspires to achieve equitable access to safe and affordable drinking water by 2030 under Sustainable Development Goals; on the other hand, crucial water resources catering cities are drying out. Intuitively, the question arises: How the primary sources of water of a city inhabiting millions of people, dried out?

Figure 1: Puzhal Lake, one of the primary rain-fed reservoirs in Chennai as on May 31, 2018 (Top), and June 19, 2019 (Bottom). Source: NASA Earth Observatory (2019)

2. Aim and Objective

In 2019, India's fourth most populous metropolitan area, Chennai experienced the worst drought in the city's history as the main reservoirs dried out. Over 10 million people inhabit the urban agglomeration, which includes peri-urban areas, towns, and villages. Figure 1 shows the difference in the volume of water in one of the four main reservoirs of Chennai using satellite imagery. The first image reflects the situation of the Puzhal lake presence with water on May 28, 2018, whereas, in the second image, the lake is bone dry, nearly a year later, on June 19th, 2019.

Is Chennai naturally a drought-prone city? Chennai is not a rainfall-deficient city and despite several warnings in the previous years, Chennai ran out of water. Thus, raising an eyebrow on the approach of the water management system and urban water governance. Urban water governance refers to the interaction between stakeholders and actors consisting of governments, private sector, international agencies, and civil societies, that are involved in socio and political confrontations around how water resources and services should be governed, by whom, and for whom (Miranda, Hordijk and Molina 2011). It is critical to understand that urban nature is not given but socially produced. Consequently, a critical perspective is required to question whether scarcity is only attributed to climate change, or could such disaster be human-induced or 'manufactured.' A perspective to make the connection between the ecology of water and political influence is necessary. The study hypothesizes that the problem lies when the extreme water crisis is perceived to be more of an environmental cause (unpredictable weather patterns and brought on by climate change) than that of mismanagement of water resources (shrinking groundwater levels caused by years of unregulated use). Consequently, while the entire city experiences water shortage, events like droughts often impact the citizens differently.

The main research question that the article seeks to address is 'How has urban water governance influenced to manufacture the water crisis in Chennai?' The article aims to understand the various indicators that direct towards the scenario resulting in the inefficiency of the water management system of Chennai. This research will trace how urban interventions and development reflects on the inefficient water management system by drawing on an Urban Political Ecology (UPE) framework.

The article dwells deep into understanding the experience of the locals and connecting the outcome with the effects of urban planning decisions over the years. Therefore, the paper points out unsustainable land use planning and that such environmental disasters can be highly politically influenced. An increase in inequality is another important outcome of such a water crisis, where the powerful are favored at the expense of marginal groups of the city. The study reflects that in order to achieve SDGs in order to tackle the complexities of climate change, requires a holistic approach which incorporates the cross-cutting solutions to address the interdependency and interrelation of the social, economic, and environmental aspects.

3. Urban Political Ecology (UPE) framework

3.1 Overview

The article looked into urban scholars and radical theorists who explored theories and frameworks that focus on the relation between the environment and the applicable policies of the region. Through the lens of the UPE framework, the inter-relation between societal, ecological, and political influence and reliance can be distinctively observed. The principle of the framework is that in an urban scenario, all that constitutes as nature is a result of the urban interventions. It is essential to understand how urban interventions based on land use planning, which are an outcome of political influence and policies, have over the years negatively impact the ecology of the region and further increasing the social disparities.

3.2 Political Ecology of Water

Natural factors like climate change are widely perceived as the foremost reason for the water crisis. The political ecology of water views it from a different perspective and questions whether it is climate change, or could it be human induced? It gets further complicated by questioning whether the dynamics of natural variables or factors are also loaded with anthropogenic influences. Such critical questions need to be investigated in order to understand and observe water crisis or water scarcity, UPE tries to make these connections.

There is a considerable difference between the level of consumption between the so-called water-rich and poor people. On the one hand, the droughts and desertification are increasing; a look into the rural sector reveals several cases of farmers who are starving and suffering from the lack of entitlement or access to water resources for irrigation of their field for basic requirements and livelihood. On the other hand, corporations and private corporate capitalists are aggressively continuing to convert free-flowing water into bottled water for hefty profits. The globalized economy is altering the meaning of water from a common good to a private property, which can be extracted and traded freely. The emergence of corporate culture in the water sector has led to erosion and corrosion of the community or communal water rights. Such a situation points towards a global war regarding water, which might surpass the oil wars of the previous century (Shiva 2016).

3.3 Exponential Growth versus Ecological Sustainability

If one observes the economic development and urban growth in the last few decades, these have been directly or indirectly responsible for the conversion of almost half of the wetlands all around the world and loss of several ecosystem services. However, again, the question arises on development for whom and at what cost? These scenarios can be clearly illustrated by the example of dams.

Post Second World War, more than 45 thousand dams have been constructed across the world. The objective of the construction of these dams has been to produce hydroelectricity, to irrigate paddy fields, and to control the flow of water of the rivers. One can observe a significant difference between the official projections or promises and the reality. Dams have been related to the cause of massive floods, severe ecological, and social disruptions in most of the areas. Many dams have impacted negatively like reduced biodiversity, poor water quality, decreased crop yield, lower fish populations, increasing water-borne illnesses, and even triggered earthquakes. While not every dam causes enormous problems, cumulatively these reservoirs are also responsible for almost 28 percent of greenhouse gases (International Rivers 2019). Additionally, severe ecological catastrophes like floods and droughts lead to disruptions in the social livelihood of the indigenous people and, more importantly, women that have suffered. Unfortunately, the massive infrastructural projects have kept the affected people excluded from its benefits. Therefore, it is crucial to question, within the domain of political ecology, that the development is for whom and at what cost?

Therefore, UPE investigates the uneven distribution mechanism that produces uneven waterscapes. If we observe who determines where the pipelines would be constructed, who decides which houses and neighborhood would be allocated what amount of water, we will understand that everything is thickly loaded with politics, economics and political decisions made by the statecraft and in association with private companies and stakeholders involved in this entire power game. It all boils down to the fact that, for the urban elite, water supply is relatively abundant and cheap; and for the urban poor, the scarcity of water is a daily hardship.

4. Case of Chennai

Chennai, formerly known as Madras, is the capital of a semi-arid state of Tamil Nadu in south-eastern India. Chennai and its surrounding regions traditionally had around 3600 water bodies, and three rivers: Adyar, Cooum and Kosasthalaiyar along with Buckingham canal running through the city. Due to excessive garbage dumping and encroachment, the majority of the water bodies have either diminished in size or entirely disappeared. Unfortunately, falling victim to untreated wastewater, the three rivers too have shrunk to mere channels, making the water unfit for aqua life and human consumption. Although the annual average rainfall of Chennai is 1400 mm, which is higher than the average of the country, it has the lowest per capita availability of water amongst the mega-cities of India (Goutham 2019) (Roumeau, et al. 2015). Piped water supply is highly irregular and available only for a few hours daily. As the supply of public water is unreliable, people rely on private wells.

4.1 Land Use and Urban Planning

Chennai has been known for its centuries-old indigenous technique of water bodies know as eri. Eries were seasonal water bodies, along with their networked drainage channels, which formed an interconnecting irrigation system for the region. The agriculture sector entirely relied on this system, which worked smoothly for centuries until they were eliminated from the 1960s onwards. The forced expansion of the city of Chennai reflected in the disappearing of the water bodies through in-filling. State agencies, like the Tamil Nadu Housing Board (TNHB) and Chennai Metropolitan Development Authority (CMDA), played an essential role in establishing official schemes to increase the availability of land. Vast expanses of water bodies were filled with waste, often at considerable cost, to provide land for housing, infrastructure, and institutions. In 1993, an environmental NGO challenged one such case, to which the government's defense justified that the lakes were 'abandoned and useless for groundwater recharge' (Coelho 2018). Figure 2 shows how the massive unplanned increase in the built-up area has led to the reduction of the extent of water bodies in the past three decades in the Chennai Metropolitan Area.

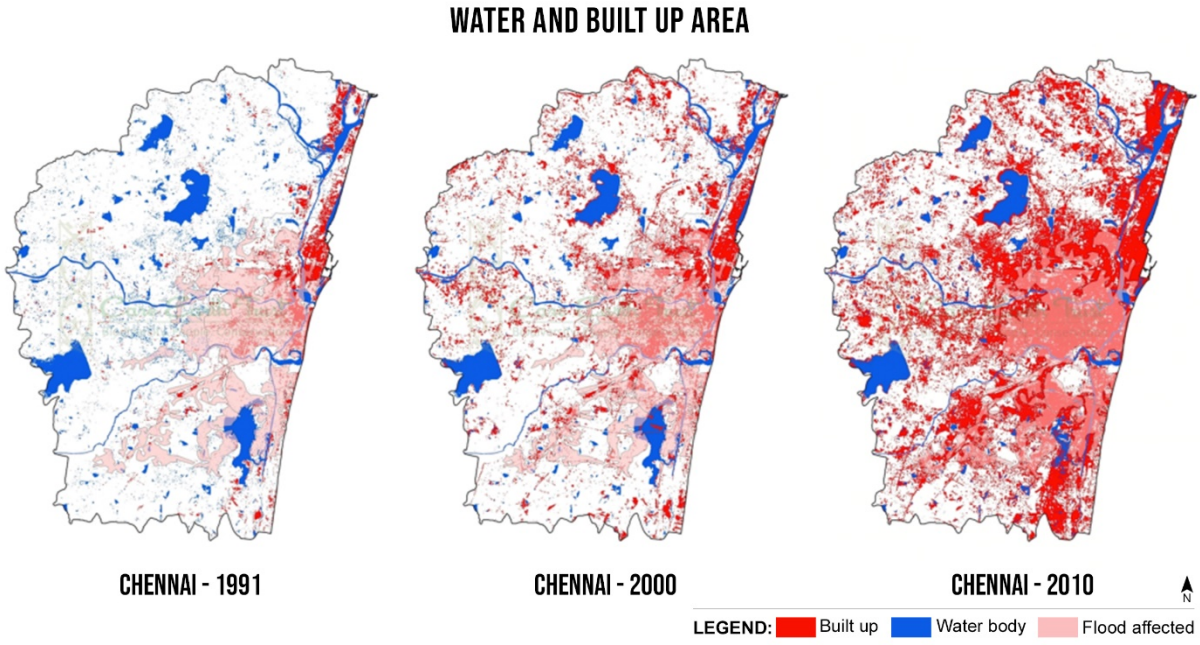

Figure 2: Urban area expansion of Chennai. Source: Vijayan, Prem (2017): Care Earth trust. A touch of green.

Chennai is a coastal city, and the development in the city is also taking place close to the coastal line. Residential areas were constructed very near to the beach, which had its pros and cons. The potential of groundwater close to the coastal line was high, and as most of the population relied on groundwater, it was therefore favorable for the residents. As the typology of Chennai's beach is sandy, it promotes the percolation of rainwater into the ground and thus increasing groundwater. The potential groundwater attracted many of the developers, and much of the development in terms of building construction has come up extending up to 30 to 40 kilometers along the coast. The situation soon began to affect negatively as overdevelopment and overexploitation of groundwater become dangerous. It was soon realized that the reason for natural rainwater percolation was being disrupted by the construction of buildings. The residential areas had been built in low-lying areas where the natural drainages accumulated water. The builders that had constructed these areas had completely paved the setback areas too, leaving no chance for water to be percolated into the soil or ground and reach the groundwater table. The rainwater was directed towards the streets instead, which were equally paved and therefore leading to waterlogging and flooding. Simultaneously, when groundwater is being extracted at such a pace, saline seawater is waiting to replace it. The developers did not anticipate the danger.

It is observed that the rainfall is directly blamed for the flooding in the residential area. However, it is not to be ignored that the allowance and contribution to filling in traditional water bodies have resulted in the disruption of the natural drainage system of rainwater. The rainwater, which would earlier percolate to the groundwater or ultimately flow out to the sea, now, is disturbed by the construction, under the name of development, and urban interventions, resulting in waterlogging and flooding. Taking the example of flooding, the map below (Figure 3) shows the consumption of numerous water bodies to make way for building construction represents a direct indication of poor land use planning.

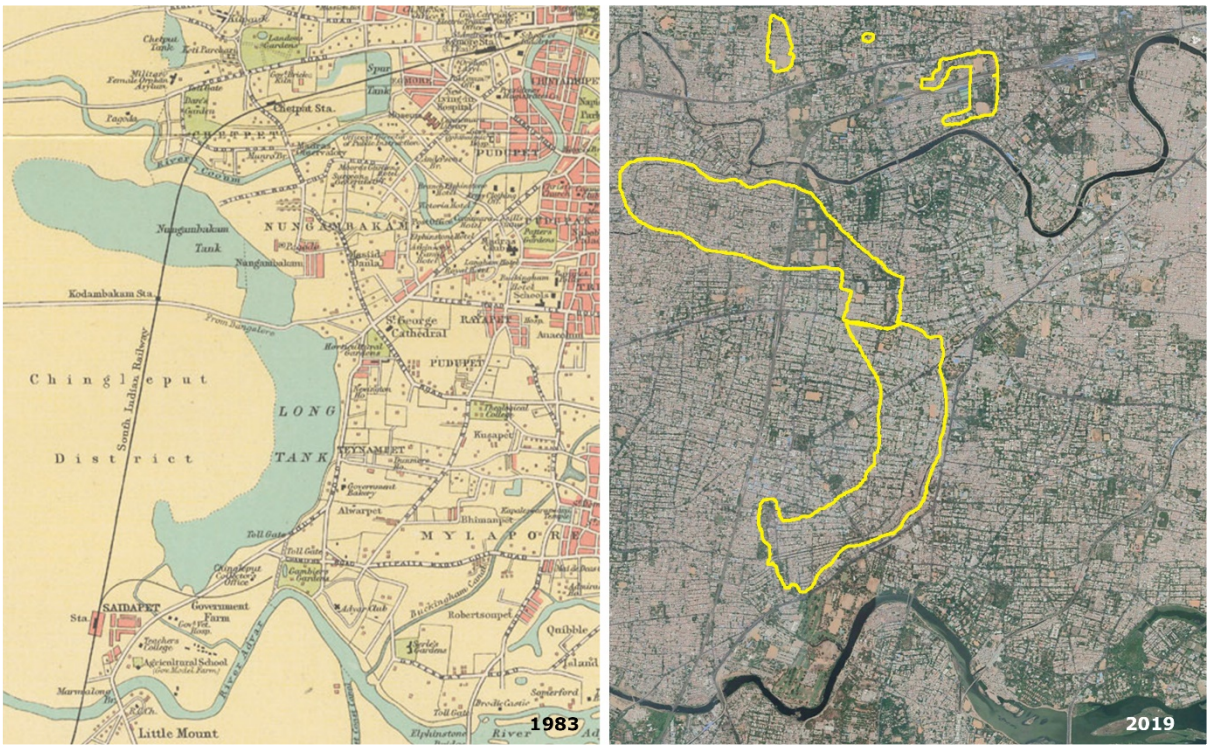

Figure 3: Much of the traditional waterbodies are a flood risk hotspot now. Source: Roumeau et al (2015)

Post-World War, the city of Chennai (known as Madras at that time), began crowding. The available accommodations were tightly-knit street sides row housings. Soon, there was a shift in the housing requirement, as the influential people and the financially upper-class

looked for bungalows with gardens. To accommodate such a demand, the city's urban planners turned to the enormous water body towards the western edge of the city. As shown in Figure 3, the Long Tank, which comprised of the Mylapore Tank and Nungambakkam Tank, had an area of 18 sq. km. It was soon drained out to make way for the housing and shopping district of Thyagaraya Nagar or T. Nagar. The urban planners and politicians never considered the largest lake in the city as a water source. T. Nagar was considered Madras's utmost accomplishment in urban planning, without realizing that the same area could have protected the city at times of flood or drought. The decision had a strong political influence as one can observe that the roads, parks, and the locality itself were named after the leaders of the political party in power (Ramakrishnan 2019).

During an interview on 7th October 2019, with Dr. Sekhar Raghavan (Director, The Rain Centre), who has been working to promote and encourage rainwater harvesting in the city for around 25 years now and therefore popularly known as Chennai's "Rain Man," discussed that Chennai Metropolitan Development Authority (CMDA) is the nodal body which is primarily concerned about land use pattern and master plans for Chennai. It is the organization that approves building constructions. Therefore, as a Department and the role it plays concerning the city is of utmost importance. However, observing the speed at which indiscriminate urban development is proceeding, indicates that CMDA's concern towards the city is all only on paper. Dr. Raghavan said, "they [CMDA] should have been the saviors of this city, but instead, they are the ones destroying the city." The CMDA provides the building plan approval. At the end of the construction, the CMDA inspects your construction. Only after scrutinizing the construction of rainwater harvesting system, the inspector is supposed to provide the completion certificate, which then allows the construction agency to apply for water, electricity, and sewerage connection before occupancy of the construction. Dr. Raghavan explained, "these CMDA people simply take the money and give the completion certificate, without complying with the law; corruption is one factor, and the bureaucratic apathy is another reason why it is not happening."

Another example of urban interventions by the government negatively affecting the ecology of Chennai is the Pallaikaranai marshland. Pallaikaranai marshland was once a vast expanse of a freshwater swamp and home to the important biodiversity of the city. Unfortunately, it is now consumed by luxury residential and commercial complexes, garbage dumps, and road corridors. Over a period of three decades, it has been transformed from an active complex of water basins and drainages of 50 sq. km. to a dispersed patchwork of plots spread over only three sq. km. (Koushik 2019). Figure 4 showcases the decline in the catchment area of the Pallikaranai Marshland in the past years. The development along the "IT (Information Technology) Corridor," which includes industries and residential complexes, threatens the Pallikaranai Marshland as a whole and harmfully disturbing its biodiversity. It is being used for sewage treatment, garbage disposal, as well as for drainage.

Additionally, an official dumpsite has been established since 1989 within the marshland. In 1995, the Perungudi dumpsite, which was situated within the marsh initiated with an area of 50 acres and enlarged to 110 acres in 2002. Currently, the dumping site has an area of around 198 acres (Roumeau, et al. 2015) (Oppili and Srikkanth 2019). Understanding that this massive dumping site is situated within a marshland tells what all problems that can be anticipated. For example, the dumpsite is poorly drained and is in direct contact with the underground and likely to contaminate groundwater. Furthermore, untreated and treated sewage discharges into the marshland. Metrowater, the water supply department for Chennai metropolitan area, has been annually releasing 32 million liters of sewerage directly into the marshland, increasing the TDS (Total Dissolved Solids) from a permissible limit of 500 mg/l to even higher than 2000 mg/L (Roumeau, et al. 2015).These sources of pollution certainly have adverse effects on the ecological balance of the marshland. The rainwater that the marsh would earlier be able to contain and provide drinking water quality is now not possible with the involvement of pollutants.

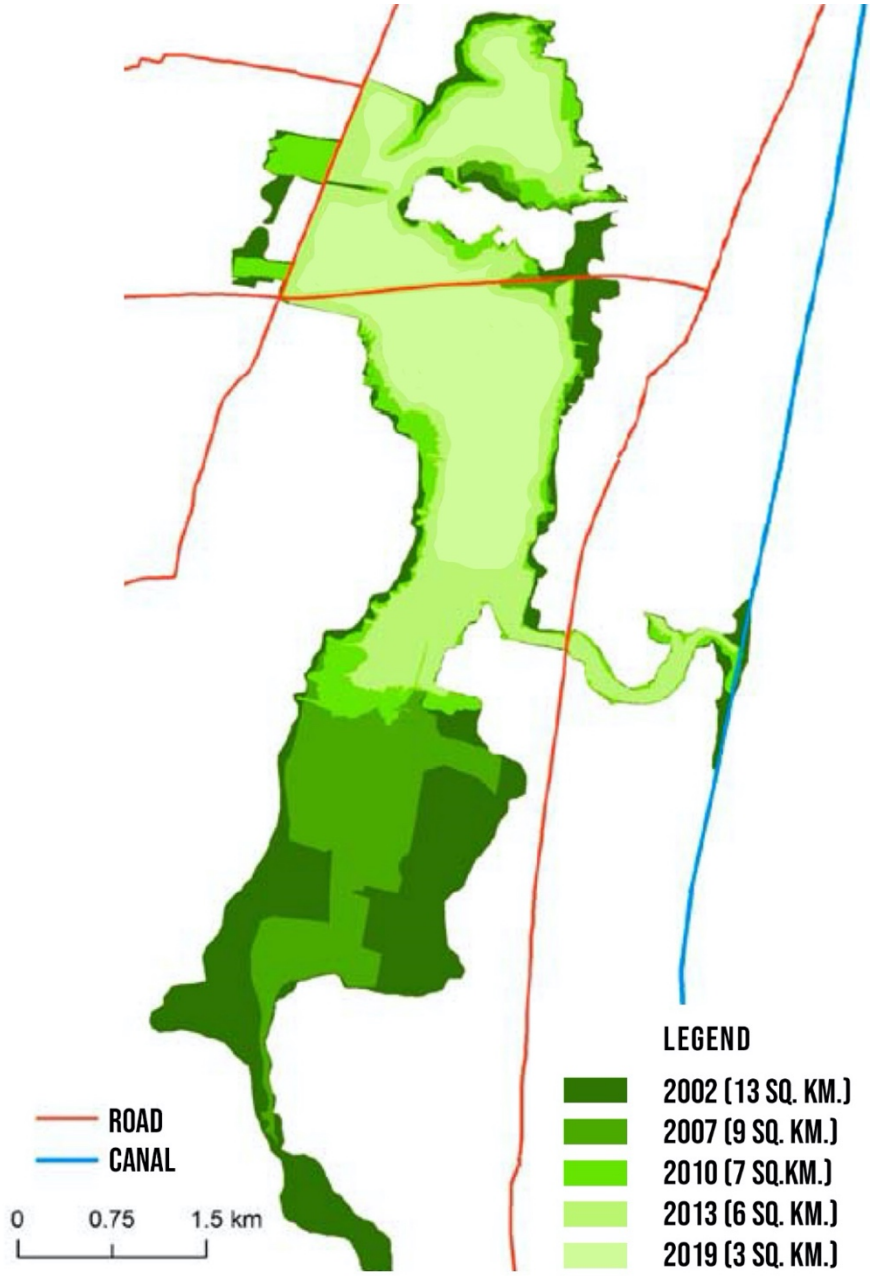

Figure 4: The decline in the catchment area of Pallaikarnai Marshland in the past years. Source: own map based on Roumeau et al (2015)

In an interview on 10th October 2019 with Dr. Jayshree Vencatesan, Managing Trustee of local NGO CareEarth Trust, who has been involved in the conservation of the Pallaikaranai Marshland for over two decades, suggested that government's involvement and attempts to conserve the marshland has been minimal. The Pallaikaranai Marshland was officially classified as 'wasteland' for a long time to facilitate the legally dump of waste and raw sewerage inflow. The motive of the government was towards 'generating' land to achieve unhindered property development in the area. Such has been the case over the past decades where TNHB has introduced housing colonies built on lake-beds as the name suggests 'Eri Schemes' for middle- and high-income groups (MIG and HIG), funded by the World Bank. Expectedly, the TNHB colonies were among the worst-affected housing developments during the rains. Notably, along with the housing schemes, there are government institutes that are continuing to encroach and build on the marshland itself. The National Institute of Wind Energy and the National Institute of Ocean Technology fall within the former boundary of the marshland.

Along with the negative ecological impacts, the government's policy and interventions have deepened the already existing social and spatial inequalities. Another such case is of the state government's decisions to prioritize the implementation of the provision of water supply and sewerage infrastructure for the IT Corridor. The decision to change the pace of urban development for the IT Corridor is directly linked to the area's economic activities. The policy was introduced by the State Government to provide special treatment to the southern Chennai area in order to push economic growth. The characteristics of the incentives lean towards providing a guarantee or at least reassuring to welcome potential investors with necessary infrastructure (Roumeau, et al. 2015).

Concentrating on specific geographical spaces and selected economic actors promote societal and spatial disparities. However, the inability of Metrowater, the concerned authority to achieve sustainable and efficient infrastructure, led to the rise of alternative practices, out of the public realm's control, leaving residents and companies dependent on private sources of drinking water. Therefore, allowing digging borewells and extraction of unregulated groundwater.

5. Contested Alternatives to Solve the Water Crises

In June 2019, when the city was left with complete depletion of groundwater and dried surface water reservoirs, the Government resorted to other cities and states for fetching water for its residents. The short- and long-term solutions opted by the Government were exorbitantly expensive and irrational. Although, apparently, the water crisis was experienced by the entire city; however, the impact was uneven. The result was inequality with respect to quality, quantity, and access to the water arranged by the Government. As one goes down the economic scale, the amount of time, and the impact of the water crisis is significantly higher. The improvement in the system for the supply of water included transporting water via pipes, trucks and special trains (Figure 5) to a central distribution system. The city's distribution system has a limited piped water network serving majorly to the core of the city mainly in areas resided by the influential members of the society.

Figure 5: A newspaper article highlighting the success of government's initiative to bring water from Jolarpet to Chennai. Source: The Hindu (2019)

The other option provided by the government was to book a water tanker online, instead of the existing phone call option, which added to the social discrepancies and unequal access to water, as the wealthier and more educated members of the society could book the water tankers online conveniently; whereas the illiterate and economically weaker section of the society, who ironically lacked piped water connection in the first place and were made to stand in queues for hours to gain access to little water.

Several examples reflect how strongly the political agendas and ecology are linked. While the poor are still recovering from the impacts of policies established nearly 60 years ago that depleted the water around the city and the agriculture sector along with it, the city officials have now decided to spread the city limits by seven-folds. With more area under the Chennai Metropolitan Area (CMA), the focus will be only on urban development. It will further add damage to the ecology and environment. The value of the land would go up significantly, thus benefiting real estate barons who had already purchased large strips of land in the two districts. This paves the way for social disparity and systemic corruption (Shekhar 2018).

A pattern can be observed as after every major incident, there opens a window for more international funding. Such was the case after the 2015 flood, which caused huge damage to the city, more international donors were attracted to invest in Chennai, and it is likely to repeat after the 2019 drought. As the title of P. Sainath's famous book (1996) goes, 'Everyone loves a good drought,' and 'Day Zero' incident seems to be a part of it.

6. Urbanizing responsibly: Sustainable Land Use Planning

An essential requirement for Chennai is to urbanize responsibly, focusing on Sustainable Land Use Planning. Several issues directed towards the downfall of the city's water assurance were directly linked to the interventions at the urban planning level. In order to achieve the responsible development of the city, the department of urban planning in Chennai needs to have the capacity to evaluate the proposed urban development interventions holistically. In various interviews, with academician, urban planner, and architect in Chennai, it was confirmed that the team of the department of Chennai handling urban planning comprises only one category of professionals, i.e. Urban Planners. The recommendation for such a vital department is to have a diversity of personnel in the team to have a variety of perspectives on the urban development proposals. The involvement of members of the team, which could also connect to the ecological, social, and economic outcomes of the urban intervention proposals is required. Environmental connections and repercussions are essential and should be considered. Having an interdisciplinary team helps to foster a holistic approach within the urban planning paradigm so that an integrated approach is used to address environmental concerns through sustainable land use planning strategies and policies.

A collaborative management system of urban land and water resources has historically existed in India. The management system run by the community paid primary attention to the contextual environmental conditions. However, it has drastically transformed since colonial times. The rising pressure of the population and economic development pressed towards a different approach, which continues until today. Various agencies and visions that dominate Chennai's governance prospects have made it challenging for environmental realities to be integrated into the urban planning scene. The visions of the city that transform into the policies need to incorporate ecological concerns, focusing on adaptation and mitigation of climate change, in order to withstand, manage and reduce its vulnerabilities and therefore become more resilient. Channeling the elements of adaptation and mitigation into policies is required to be done at the early stages of planning and implementation.

As opposed to the city's previous approach towards urbanization of filling water bodies to prepare the land for construction, it is essential to focus on increasing city vegetation, protecting the water bodies, and recognizing the critical role water bodies play in climate

adaptation. It is vital to identify critical risks of climate change and their potential impacts on a coastal city like Chennai, which include sea-level rise, coastal erosion, floods, droughts, and heatwaves. Therefore, engaging different adaptation methods that include ecological and social measure, instead of only focusing on capital-intensive engineering and technological solutions. It is essential to prioritize efforts towards highly vulnerable places, such as low-lying areas, and low-income settlements.

Statistically, Chennai's annual requirement of water is around 11 TMC (thousand million cubic feet) and the four reservoirs, namely Chembarambakkam, Puzhal, Poondi, and Sholavaram, supplying water to Chennai have a capacity of 11.257 TMC of water storage (Goutham 2019). If these four lakes were de-silted and maintained as needed, then they could have supplied the lion's share of the city's water needs themselves. It is unfortunate to see that the rain is falling on the terrace, yet the residents are ordering a tanker to bring water. The city officials are replicating it, as the city is getting adequate rainfall, the government is ordering trains to bring water from other places.

For land-use planning and ensuring that the development is in alignment with the natural environment, it is essential to conduct a water resource mapping. The hydrologic and hydrodynamic mapping of the vulnerable areas of the city would be critical to engage the civic organization and, therefore, going forward with responsible urban development proposals based on the data and information. It is crucial to map the extent of surface water bodies such as rivers, lakes, ponds, streams, surface, and groundwater flows, flood plains, location of groundwater wells and corresponding water table observed over time, rainfall variability, topographic characteristics, hydrological features such as soil types, vegetation of watershed areas, soil moisture and water resource infrastructure. Additionally, it is critical for Chennai's master plan to incorporate policies based on the information to protect the water bodies, to promote groundwater recharge, and prevent floods.

7. Conclusion

Over the decades, the policies by the Government of Chennai have influenced the economic, environmental, and social aspects of the city and thereby controlling the quotient of sustainability in the city's development. Evidence from nearly half a decade ago highlights how political agendas have influenced agricultural practices — altering policies to support corporate interests at the cost of the farmer's livelihood. To continually support corporate interests, the government altered regulations and kept a blind eye to the unregulated construction. In the name of economic development, the government ignored the ecological development.

This article has highlighted how the 'Day Zero' incident of Chennai can be termed as a human-made water crisis through the lens of the UPE framework. The UPE approach facilitated to view the water crisis from a perspective that any ecological intervention in the urban context requires a detailed analysis of the variety and complexity of socio-natural relations, which are rooted in the landscape, and the potential inequitable effects and differential values caused due to this intervention. Previous water calamities of Chennai, coupled with a particular social, economic, and political arrangement, showcased the basis of crisis to be 'natural.' However, the 'Day Zero' was only a product of after-effects of the interventions made historically and even at present, while completely ignoring the role of nature as the prerequisite for progress and development.

Climate change is estimated to increase the probability of droughts by three times. Consequently, the next few decades are likely to experience much hotter and drier droughts and, therefore, making climate change a vital factor in the field of water governance. Access to safe and adequate water is a human right, but the dominance of neoliberal policies and globalization repeatedly favor the dominant society at the expense of the weaker society.

Endorsing water justice suggests political negotiations address not only the fair distribution of water, but also recognizing equality in terms of water rights, protection of ecological integrity, and participation in concerned decisions. Therefore, a “water crisis” is not merely about the quantity of water, but often a “governance crisis” which arose due to inadequate measures taken by concerned institutions leading to this unfortunate scenario.

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