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EDITED BY
Jenia Mukherjee,
Indian Institute of Technology Kharagpur, India

REVIEWED BY
Brighton Austin Chunga,
Mzuzu University, Malawi
Innocent Nojiyeza,
University of Zululand, South Africa

*CORRESPONDENCE
Soma Sarkar
somasarkar1990@gmail.com

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# Urban water crisis and the promise of infrastructure: a case study of Shimla, India

Soma Sarkar*

School of Development Studies, Tata Institute of Social Sciences, Mumbai, India

Urban water configurations evolve through synergetic relationships that are non-linear, spatially variable, and temporally contingent. As urban development grows in complexity, dense water flow networks intensify within the urban landscape and pose a major challenge to urban water governance. At this junction, this study takes up the specific case study of the water crisis in Shimla, a city situated in the Western Himalayas, which was once the summer capital of British India. Shimla witnessed two significant episodes of a severe water crisis in 2016 and 2018, respectively. While the mainstream discourses identified erratic rainfall due to climate change, urban growth, and tourism as the prime causes, the crisis was not marked by absolute scarcity. Multitude configurations of infrastructure politics, distribution, and access produced scarcity, which differentially impacted the people in the city and continues to do so. Marginalized social groups (class, caste, gender, and religion) and people living on the periphery, such as slum dwellers, daily wage laborers, and informal sector workers with inadequate economic and social safety nets seem to have been missing from the discourse. In addition, the crisis events in Shimla have led to institutional changes in the governance of water by establishing a parastatal body for a water utility in the city and the proposal of mega water infrastructure projects for the bulk supply of water from the Sutlej River. Deriving from a situated urban political ecology approach, this study presents an in-depth empirical understanding of the complex urban waterscape of Shimla city, where the tourism industry is a major stakeholder, and a critical analysis of the emerging "new" politics of water, which is also a politics of infrastructure in Shimla's post-crisis phase. It adopts a qualitative research design involving in-depth interviews with different stakeholders in urban water governance in Shimla and a neighborhood-level case study to understand the post-crisis water scenario in the city. Locating the Shimla case study within the broader planetary geography, this study argues that the water crisis, as a context, is dialectical. Despite the implementation of several hydraulic projects and the financialization of nature, the inherent fissures of inequality within the city that cause differential access to water remain.

KEYWORDS

**water crisis, infrastructure, institutional reforms, financialization, equity**

## 1. Introduction

Water has become a pressing concern in the Anthropocene for billions of people across the globe, as it threatens the survival of humankind in the next century. In the Global South, millions of people (mostly the poor and children) die annually due to inadequate access to clean water (Mollinga et al., 2007; Enqvist and Gina, 2019; Enqvist et al., 2022). Approximately 785 million people lack even a basic drinking water service,

including 144 million people who are dependent on surface water (World Health Organization., 2019). It is a prime urban challenge since infrastructural and spatial planning often falls behind the rapid scale of urbanization (Bakker, 2010). However, the urban water challenges resulting from urbanization are not absolute scarcities but are often primarily the question of distribution (Mehta, 2005). There is an agenda setting and framing of a "crisis" discourse to usher in large infrastructural developments (Giglioli and Erik, 2008). Along these lines, studies in urban political ecology have explored the material flows that unevenly shape the urbanization process while focusing on objects in the context of capitalist power relations. Large infrastructure networks, mainly water infrastructure, have been a frequent site of inquiry (Swyngedouw, 1997, 2004, 2006; Gandy, 2004; Kaika, 2004; Loftus, 2012). Going back in time, we see that water and urban environments have co-evolved continuously through intricate interrelationships that are temporally contingent and spatially variable, moving across non-linear progressions leading to unceasingly embryonic urban and resource configurations. However, in recent times, these relationships have intensified because of the urban communities' increasing dependence on water to first satisfy their own basic needs and then feed into the increasing large-scale production and consumption of water-based goods and services (Castro, 2013). Over the years, however, the scholarship on water has shifted from viewing water as a material substance to an understanding of the complex assemblages that water forms, linking the social, political, economic, and cultural systems, which then govern the different flows of water through societies, thereby shaping urban environments (Cook and Erik, 2012). As new urban development grows in complexity, dense networks of water flows intensify within the urban tissue and pose a major challenge to urban water governance.

Water crises have become frequent in recent times in cities around the world (e.g., Bangalore, Chennai, Mexico City, and Cape Town), as they struggle with over-extraction of water, contamination, shortages, and flood risks (Colven, 2022). With reference to Cape Town's "day zero", scholars have argued that the water crisis of 2015 to 2018 cannot be understood outside its already precarious and contradictory water governance system, which is defined by multi-scalar fractures in conjunction with historical and persistent inequality (race and class) (Enqvist and Gina, 2019). Rather, the crisis was situated within an existing reliance on the path that was shaped by a conflicting paradigm of governance, one characterized by ongoing tensions between imperatives of ecology, economics, and equity (Bigger and Nate, 2020). In Cape Town, the transformations were commensurate with that of the corporatization of water services by establishing a competitive atmosphere, performance-based management, and cost recovery policies aimed at reducing public sector inefficiencies (Smith and Susan, 2003). In the context of the Flint water crisis, critics argued that the relics of segregation and discrimination present in Flint made it an exclusive target, and this would not have been the case if Flint had been wealthier and white (Anand, 2017). In São Paulo, water shortages were felt across the city in 2015, and cuts in the supply of water were felt overwhelmingly by low-income residents and those living outside the urban center. Although, in the urban outskirts of São Paulo, there was no systematic rationing of water, the combination of less water storage space, further distance from treatment centers, and more insecure hook-ups meant that peripheral residents experienced longer periods of scarcity (Millington, 2018).

In India, water is listed in the Indian Constitution as a state subject, and with the state, the executive control over the production and management of water resources is concentrated. The state can legislate on who should have ownership, access, and user rights and what should be the mechanisms for distribution. This arrangement changed after the 74th constitutional amendment; thereby, municipality bodies are in charge of the above activities but with state control mechanisms. Among the previous studies, Zérah (2000) illustrated the differences between the water network connection and supply adequacy in New Delhi, highlighting that 50% of Delhi's residents do not have a reliable water supply despite having piped water connection. Anand (2011, 2012) explored the hydraulic infrastructural practices in Mumbai and the critical role of pumps, pipes, pressure, and water expertise in managing the city. Biswas and Druti (2021) further argued that groundwater will be extracted and depleted more in Delhi if the percentage of piped water network does not increase in tandem with the rapid urban transformation. However, Drew (2020) argues for a shift from "pipe politics" to "catchment politics" or the "politics of water capture" in her case study of the Hauz Khas Lake in New Delhi. Such explorations are possible in regions where traditional water management infrastructures are considered to be wiser ways of using resources.

In the context of Chennai, Niranjana (2021) explored the role of water works engineers within the fragmented water infrastructure of the city and highlights the fragmentary and pluralistic epistemologies that make up modern infrastructures. On the other hand, Coelho (2022) conceives urban waterlines as dynamic assemblages that employ water circulations in projects of transmuting territories and re-valuing urban nature and also as an analytical tool to capture the dialectic hybridity of water and society that reflects the power relations of capitalist development. In India, research has focused on big coastal cities such as Mumbai (Shaban and Sharma, 2007; Cooper, 2011; Ranganathan, 2014a,b; Anand, 2017), Kolkata (Das, 2009; Allen et al., 2017), and Chennai (Coelho and Venkat, 2009; Srinivasan et al., 2013), but there has also been an emerging focus on the small and intermediate level towns. Chatterjee and Kundu (2022) explore the changing power relations between actors within the locality (which they call "para") and their differential access to water services in their case study of Baruipur town, in West Bengal, India. They critically engage with the two cases of the stand post and the packaged drinking water in analyzing the relationship between public actors and private water vendors in the town. Sarkar (2022) problematizes water as a socioecological space of caste and gender and explores the differential access to water within communities at the level of neighborhoods (para) in the Purulia district of West Bengal, India.

Despite the huge spectrum of water research in India, most of it focuses on the plains or coastal plains. Only a few studies have explored urbanization and the urban waterscape in mountain cities (Boelens, 2014; Dame et al., 2019). In addition to the challenges of the landscape, this is important because of two aspects:

verticality and seasonality. Verticality in the relational production of space is of significance in the mountains. Negi et al. (2017) call this "contoured urbanism", where upward mobility entails new susceptibilities and where the everyday negotiations with inherited hierarchies through practices produce geographically situated forms of urbanization in parts of the Himalayas. In this vertical contoured urbanscape, water is a perennial challenge that is compounded by the neglect of traditional water systems, such as stone spouts and springs (Wester et al., 2019), outdated and poorly constructed water distribution systems that get superimposed on traditional water systems, pipe leakages, and poor governance that puts primacy on piped water supply over other time-tested and sustainable sources. In Darjeeling, private water tankers provide water to millions of residents.

Second, there is a sense of seasonality attached to the mountain cities in India. In Mussoorie, for example, the number of tourists increases to 200,000 during the peak months of May and June, and this has, directly and indirectly, affected the region (Madan and Laxmi, 2000; Koner and Gopa, 2021). In this regard, scholars have argued that tourism-led urban water use can significantly impact the regional level since it is concentrated in time and space (Gössling et al., 2012). This is particularly the case with the Himalayan cities, which attract a large number of tourists amidst their dwindling water supply. It results in more urbanization and newer water-consuming urban amenities (swimming pool, western flush toilet, showers, etc.). This results in new uses, production, practices, management, and control of urban water flows, which pose a challenge to the current governance mechanisms. The Global Water Partnership rooted in the experiences of the United Nations Development Programme (UNDP) — World Bank Water and Sanitation Program (WSP) has been providing developing countries with technical assistance aimed toward the urban use of water (Rana and Lauren, 2004). On the other hand, Biswas (2008) is critical of this partnership and the ambiguity around the concept of "integration" in Integrated Water Resource Management (IWRM). He argues that its application to better manage macroscale and mesoscale water policies, programs, and projects has a dismal track record. Synthesizing the existing literature, this study argues that the flows of water in a city are complex in nature and the interconnected dimensions of the social, cultural, economic, environmental, political, and topographical arenas in which water is embedded need to be considered. Due to the lack of this holistic approach, discourse on the water crisis has often been recognized as a crisis of governance. This study furthers this argument by situating the Shimla water crisis within the broader planetary geography.

Shimla, the erstwhile summer capital of colonial India, has witnessed two major incidences of the water crisis in recent times. In 2015–16, contamination in Ashwani Khad, one of the major water sources of the city, caused a hepatitis outbreak affecting many lives. It also disrupted the water supply because a major source was cut off. This was followed by another incidence of the water crisis in the peak summer of 2018, when the city nearly reached "day zero", as the water supply was disrupted for more than 2 weeks. In both incidences, the tourism industry was badly impacted, but the latter garnered immense social media attention as the residents urged the tourists not to visit Shimla that summer. These water shortages affect men, women, and marginalized communities differently. In most areas, the poor who live in marginal areas within the city, especially in the peri-urban areas outside the municipal water supply limits, pay a higher price for buying water from informal sources (Wester et al., 2019). The same is true for residents who rent accommodation, even in the core city center—they often do not have guaranteed rights to use the municipal connection, which is reserved for the house owner, and end up paying more than double for water (Wester et al., 2019). In Shimla, there have been major institutional shifts in the governance of water in the post-crisis phase.

Taking this as the point of departure, this study explores the complex urban mountain waterscape of Shimla city to understand the nature of the water crisis in the city, how it led to specific interventions and institutional responses, and how people's relationship with water in the city changed/evolved as Shimla underwent shifts in the water governance structure. Using an urban political ecology framework, it presents a critical analysis of the emerging "new" politics of water in Shimla's post-crisis phase. Urban political ecology investigates how a particular urban environment is produced and who gains and who loses due to particular power relations influencing changes within the urban environment and in the coproduction of urban society and environment (Swyngedouw, 1996, 1997; Braun and Castree, 1998; Swyngedouw and Heynen, 2003; Kaika, 2005; Heynen et al., 2006). More recent studies have also applied this framework for understanding nuances of water in smart city environments (Drew, 2020), urban waterlines (Coelho, 2022), and differential access to water (Chatterjee and Kundu, 2022).

## 2. Materials and methods

The study followed a qualitative research design involving in-depth interviews with different stakeholders in urban water governance in Shimla. A total of 45 in-depth interviews were conducted with key government officials, elected political representatives, consultants, residents, migrants, representatives from the hotel associations, business owners, academicians, media representatives, and lawyers. In addition to this, 50 semi-structured interviews and two focus group discussions were conducted at the neighborhood level of the Krishnanagar municipal ward as a case study. The participants for the study were selected using the snowball method. The fieldwork was conducted in 2021 amidst COVID-19 challenges, taking all precautionary measures. The interviews were conducted in English and Hindi, which were later transcribed and translated into English. After identifying the broad themes from the narrative threads, an interpretive analysis was conducted. In this study, pseudonyms are used for the names of the participants. The transect walk method was used in mapping the different water practices in the localities, understanding pipe networks, and also understanding people's perceptions of the water infrastructures. The secondary data include gazettes, government reports, project DPRs (Detailed Project Reports), popular articles, and a rigorous content analysis of all the proceedings of the house of the Shimla Municipal Corporation from 2015 to 2021.

# 3. Results and discussion

## 3.1. Situating Shimla's waterscape

The erstwhile summer capital of British India, Shimla, is situated on a transverse spur in the shape of an irregular crescent in the lower Himalayas, at a mean elevation of ∼7,100 feet above sea level. In 1851, Shimla was first constituted as Municipal Committee and became a class I Municipality in 1871. In 1874, it was brought under the Punjab Municipal Act of 1873. After becoming a part of Himachal Pradesh and by the Himachal Pradesh Development and Regulation Act 1968, Shimla Municipal Committee was converted into a corporation in 1969. With the promulgation of the Himachal Pradesh Municipal Corporation Act of 1994, the number of wards was delimited to 21, and elections were conducted (Kanwar, 1990). The main functions of the corporation included ensuring sufficient water supply, maintaining sewerage and drainage systems, preventing the spread of seasonal diseases and epidemics, and undertaking the construction of civic infrastructure facilities such as roads, bridges, schools, health centers, and commercial complexes. The number of wards later rose to 25 after some nearby areas were included in the municipality, and as of 2016, Shimla has 34 municipal wards.

The history of water supply in Shimla relates to great engineering feats. The city has one of the oldest lift water supply systems in India, which is 135 years old and pumps at an average head of 1,470 meters. Before British settlement in Shimla, the region depended on its 17 baolis and natural springs for water. As the demand for water grew, a water supply system, planned by the British, was set up in 1875 to cater to 16,000 people. In 1880, 15,000 acres of land were converted into a catchment forest in Seog, and a gravity scheme was introduced. In 1893, the catchment forest was extended and pumping engines were installed at Cherot Nallah. In 1899, this was further augmented. In 1914, electricity was introduced, and the Gumma Water Lift Scheme was introduced on the Nauti Khad between 1919 and 1924. It was the highest water lift scheme in the world at that time (Buck, 1904). In total, two more rounds of augmentation were performed post-independence — first at Ashwani Khad in 1992 with an installed capacity of 10.8 MLD (millions of liters per day); second at Giri in 2007–2008 with an installed capacity of 61.3 MLD, taking the total installed capacity of the system to 61.2 MLD. In addition to this, the Municipal Corporation has 11 borewells providing 3–4 MLD of water and a buffer water scheme from Chaba with an installed capacity of 10 MLD.

At present, the drinking water for Shimla is lifted from seven sources, which are then treated in four water treatment plants. The treated water is sent through the network to the five major service reservoirs and then to 25 overhead tanks through gravity. The water from these overhead tanks is then supplied to the water connections in the city. The approximate capacity of water at the source is 51.5 MLD. Of the seven water sources, only two (Gumma and Giri) are reliable and contribute to more than 73% of the total water production. The following, Figures 1, 2, show the transmission of water from the source to the tank of the Gumma and Giri scheme.

The socioecological configuration of water is complex in Shimla because of the terrain. The increase in population, urban expansion of the city, and the incoming tourist influx have put additional pressure on the existing water systems. Shimla was built to cater to the needs of a maximum of 25,000 (British) people, who considered the place their summer haven. Since then, the population has increased to ∼1.7 lakhs or 0.17 million (as per the 2011 census), but the infrastructure has not been augmented accordingly. This results in Shimla often facing a shortage of piped water supply during the peak of summer, which is also the peak tourist season. There have been two peak water crisis scenarios in Shimla, in 2015–16 and 2018, and after each one of them, there were major institutional shifts in the governance of water in Shimla city.

## 3.2. Hepatitis outbreak and water crisis of 2015–16

Contamination in the Ashwani Khad in January 2016, which is the major water source of Shimla, caused a widespread outbreak of hepatitis in Shimla, infecting ∼6,000–10,000 people. Before this, Shimla experienced episodes of contamination almost every other year (2007, 2009, 2013, and 2016), but the cause was not identified and the one in 2016 affected a significant portion of the population in Shimla and the neighboring districts of Solan. Several assessment reports have often highlighted the issue of contamination risk from untreated water and sewage. For many residents of Shimla, the term "water crisis" is still used to refer to the hepatitis outbreak of 2015–16.

Ashwani Khad is a major source of water for the residents of Shimla, providing 10.8 MLD of water, which is ∼20% of Shimla's water requirement. It became operational in 1994. In 2005, a sewerage treatment plant was constructed 5 kilometers upstream of the water treatment plant in Malyana. In 2015–16, the Malyana Sewage Treatment Plant malfunctioned and discharged sludge into the Ashwani Khad. This led to an outbreak of hepatitis, mostly affecting the localities of Kasumpati, Vikas Nagar, Panthaghati, Chotta Shimla, New Shimla, and Khalini, and later spread to the entire city (Sharma et al., 2021). After the contamination, a special investigation committee was constituted for inspection. Some of the main observations after visiting the Malyana Sewerage Treatment Plant were as follows:

1. The sewerage treatment plant at Malyana was underutilized and not functioning properly.
2. There is no approach road to the plant, causing difficulties in the lifting of sludge that was lying there.
3. Since there was no power backup, the plant becomes non-functional during a power failure, causing raw effluent to be discharged.

Due to this, the High Court ordered the Irrigation and Public Health Department (now Jal Shakti Vibhag) to stop lifting water from Ashwani Khad until the quality of water is improved to the drinking level. The general public was advised to clean their water storage tanks. Since a major water supply source was cut off, the city experienced severe water shortages for months. Water from only Koti and Brandi Nallah was tapped for potable purposes. Regular water testing was mandated.

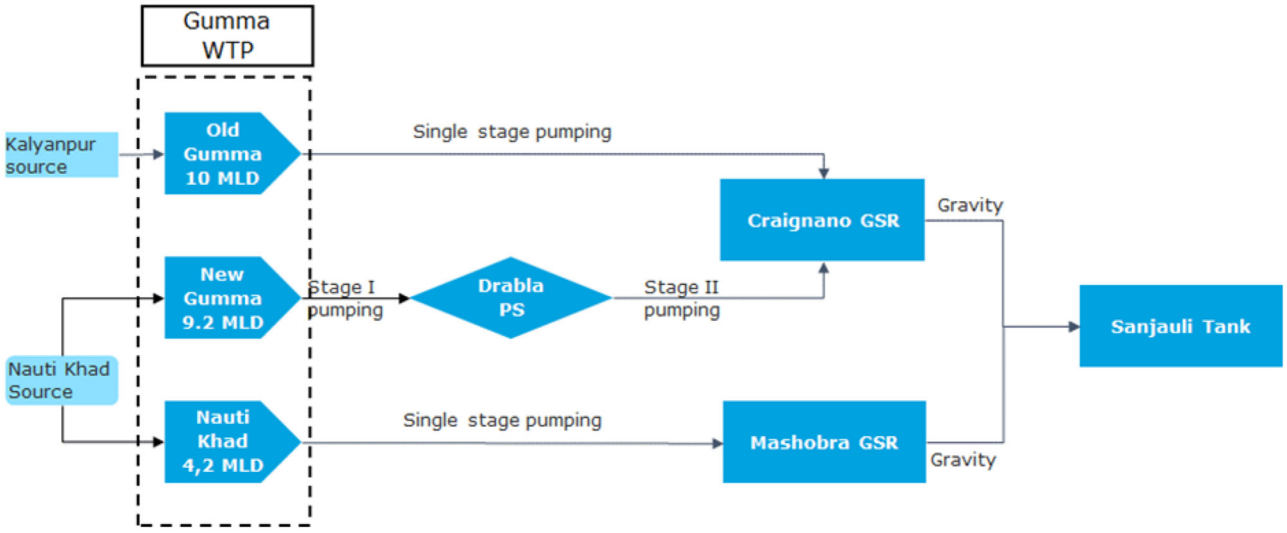


FIGURE 1
An outline of the Gumma water sourcing scheme. Source: Situation analysis report, 2018. Greater shimla water supply and sewage circle (GSWSSC), Shimla (Deloitte Touche Tohmatsu India LLP., 2018).

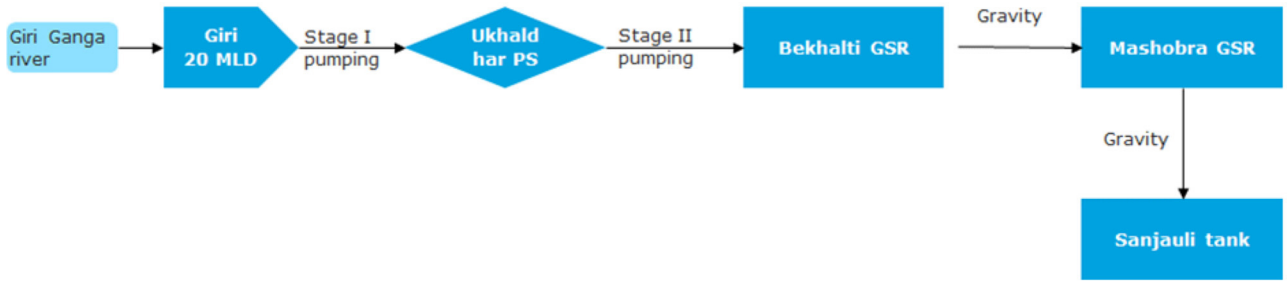


FIGURE 2
An outline of the Giri water sourcing scheme. Source: Situation analysis report, 2018. Greater shimla water supply and sewage circle (GSWSSC), Shimla (Deloitte Touche Tohmatsu India LLP., 2018).

What followed was a blame game between different authorities involved in the water lifting and distribution process. As per the institutional structure, the Irrigation and Public Health Department was responsible for lifting raw water and its treatment, along with the operation and maintenance of the transmission system, and the Shimla Municipal Corporation was responsible for the distribution, billing, and grievance redressal. Major questions of accountability, misgovernance, and failure of institutions were raised after the outbreak. Due to all this chaos, the city council demanded a change in the governance structure so that the entire water supply system could be handed over to the municipality. There was a change in the governance structure with the establishment of the Greater Shimla Water Supply and Sewage Circle (GSWSSC).

## 3.3. The urban conquest of water in the crisis of 2018

Shimla reached "day zero" at the peak of the shortage of piped water supply in May 2018, with several localities going without water supply for ~10–15 days. While the closure of Ashwani Khad in 2016 and the lack of precipitation are often cited as the triggers for this crisis, one cannot deny the role of the tourist influx, inefficient infrastructure, poor governance of the water supply system, and inequitable distribution. For many reasons, this crisis garnered extensive media and social media attention across the country and world and came to be known as the "Shimla Water Crisis" of 2018.

The official response from the water authorities attributed the water crisis to climate change, meaning less snowfall in the winter and scanty rainfall resulting in a shortage of water at the source itself. In doing so, they cast nature into pole position to explain scarcity. It is, thus, presented in a way where "nature" becomes the principal cause of water scarcity and not the existing political–economic configurations that lead to the urbanization of water in selective and uneven ways (Kaika, 2004). This eventually results in "scarcity" of the poor and powerless and water abundance for the socioeconomic and political elites. Apart from the shortage of water due to the Ashwani Khad closure and scanty rainfall, the 24 h power cut near the Giri and Gumma pumping stations further aggravated the situation. The Giri and Gumma are major water sources in the city's supply. In the absence of power backup, it is

a vulnerable dependency of the water-lifting process on electricity. The pumping of water is also affected during heavy rains because of high turbidity and over-siltation. However, that was not the case in the 2018 crisis. The 2018 crisis was instrumental in exposing the sectoral and spatial inequities in the water supply system of Shimla.

With regard to the commercial sector, the hotel industry incurred severe financial losses in the summer of 2018 due to tourists canceling their reservations due to the water situation. While interviewing members of the hotel association, it was found that none admitted to having water shortages in their hotels in 2018. It was informed that the hotel industry remains ever-prepared for the water uncertainties in the city and relies on private water tankers to suffice their needs. Many of the hotel owners had their own business of water tankers. These were used for their own needs and were also available for hire by the municipality when required. This crisis also brought to the forefront the networking of these tankers and people's gullible dependence on them. Transect walks in the Lower Bazaar neighborhood also revealed that some of the commercial water pipelines connecting the hotels had water running throughout the day, while those connecting the domestic connections had water for a limited time. The keyman in charge of the particular locality plays a significant role in this process.

Spatially, Shimla is divided into six water zones based on the areas under each overhead tank — Chaura maidan zone, Central Zone, Lakkar Bazaar Zone, Chotta Shimla Zone, New Shimla Zone, and Sanjauli zone (Figure 3).

During the crisis, not all localities were impacted in a similar way. In one of the field interviews, a professor commented, *"the whole city does not experience water crisis in the same way nor does [sic] all sections of people. The elite localities and the hotels did not run out of water. The university guest houses and faculty quarters had sufficient water while the hostels had an erratic water supply."*

He was referring to inter-locality and intra-locality inequities in the water supply referring to the university located in the Summerhill area. In addition, the pertinent question that arises here is who is prioritized over whom? Similar narratives of inequitable distribution were found all over the town. Higher-income neighborhoods get a regular water supply. Lower-income neighborhoods, on the other hand, get water at intervals. Even within one single municipal ward, water supply frequency and pressure vary with localities. The reasons cited for this discrepancy were manifold. While the authorities concerned (SJPNL and the Municipal Corporation) blamed gravity, inaccessibility (no roads for tankers), congestion, and other technical glitches, there were a group of people who blamed the vested interests of the political party leaders who got water themselves and diverted the remaining water to the hotels.

This was also the time when several officials (Engineers to Keymen) who were in charge of the water supply and distribution and were handling it for many years were routinely transferred to other departments. Managing the water supply and distribution in a mountain city requires experience because it all rests on a delicate balance of which valve is to be opened and when, otherwise all the water will gush downstream due to gravity. This would result in neighborhoods located on the higher side of the mountain slope not getting water. The new appointees were unaware of this and could not manage the peak summer water demand in the city. As households went without water for weeks, many women took to the streets expressing their disappointment and demanding water. There were several protests and many were arrested. Mostly, it was women, who were at the forefront of the protests. In one such protest for water in the Bolieuganj locality, cases were filed against several women. The cases were heard at the Chakkar District Court on 9 September 2021. After the hearing, one of the women, aged 51 years old, who was also a shopkeeper by profession, shared, *"we absolutely did not have water in the house. What could we do? After reaching out to the councilor[sic], one water tanker was provided, but one water tanker was not sufficient for the whole neighborhood. Many women protested because we were not able to run our households. Cooking, bathing, washing, and everything else were on halt because we barely had water to drink."* It is evident from this that the issue of water is a personal issue for women because it disrupts the private sphere of the "household". The 2018 water crisis exposed many fissures of inequality within the existing system, but most importantly brought the plight of women into the discourse.

## 3.4. Institutional shifts in response to the crises

In India, water governance is decentralized at the state level. The state governments receive financial support from the central government to implement national-level projects. In their administrative and physical borders, the states are in charge of developing and managing water resources. To develop and manage water resources, states have a variety of institutions at their disposal, including regulatory bodies, water departments, gram panchayats, irrigation departments, and public work departments (Ahmed and Araral, 2019). Rural and urban areas have different water management systems at the state level. Water management in urban areas is handled by a variety of political and administrative institutions, including municipalities and districts, where both elected and appointed officials carry out their duties. State-to-state variations in these arrangements are possible. The formulation, execution, and delivery of policies are the purview of these municipal- and district-level bodies. Water infrastructure construction and maintenance, water distribution, and other related tasks are all included in the provision of services *(ibid)*.

In Shimla, historically, the entire water supply was managed by the municipal committee until 1979 when the Irrigation and Public Health Department (IPH) (now Jal Shakti Vibhag) was formed and took over the responsibility of creating the water supply and sewerage (WSS) infrastructure in the state of Himachal Pradesh. It was responsible for providing WSS services to the whole state, with the exception of Nagar Panchayats and Municipal Committee areas. Only bulk water was provided there. Within the city, the Shimla circle of the IPH department was responsible for asset creation (bulk water supply, distribution network, sewerage network, and sewerage treatment plants). The IPH was also responsible for providing treated bulk water and for treating sewage for the SMC area. The WSS department of the Shimla Municipal Corporation was responsible for the distribution of treated water and collection of sewage within SMC limits.

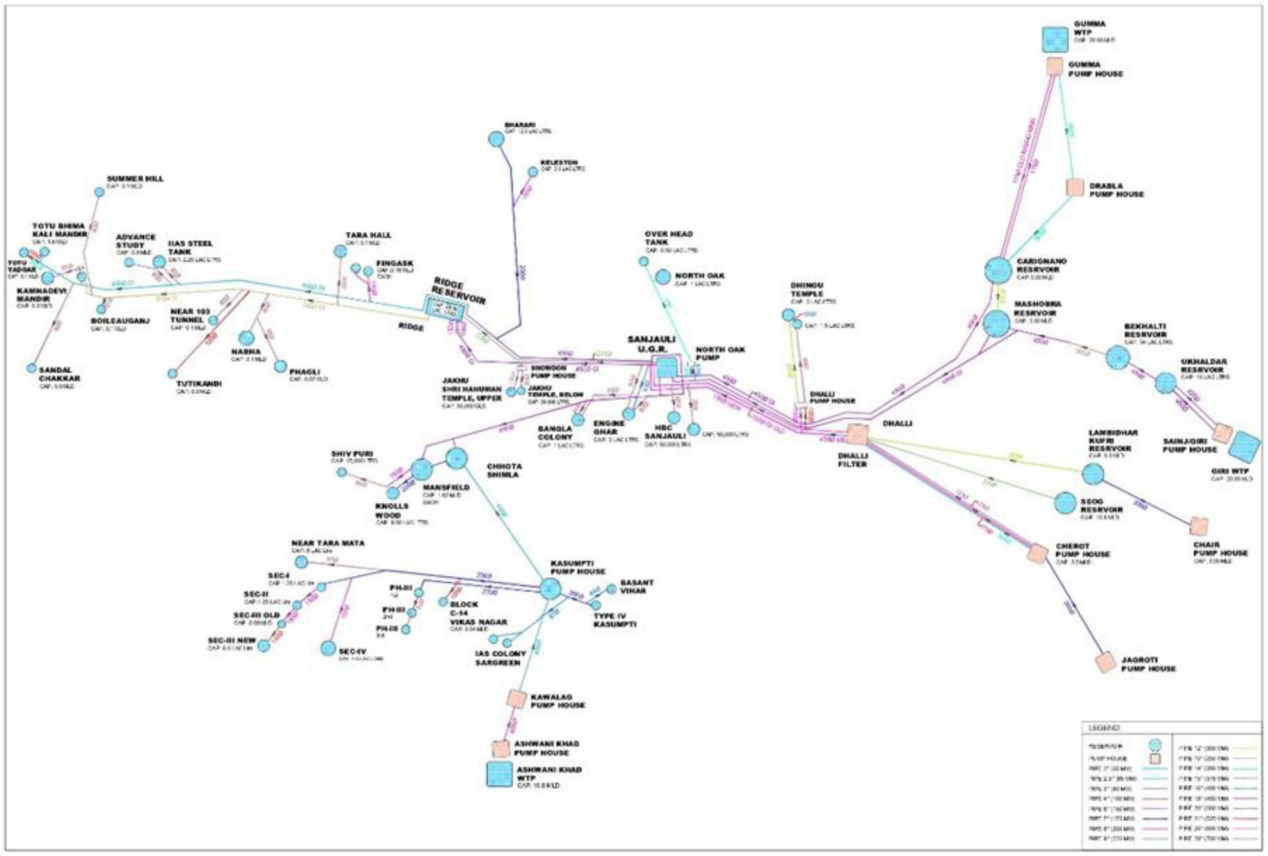


FIGURE 3
Water distribution network of Shimla. Source: Shimla Jal Prabandhan Nigam Limited (SJPNL).

The hepatitis outbreak of 2015–2016 was the outcome of poor water governance, whereby the contamination of the water source remained unnoticed for days and later, the duality between the different authorities involved in the water lifting and distribution process was blamed. There were questions of accountability, misgovernance, and failure of institutions. This incident resonates with the water contamination case of Flint when its water source was switched from Lake Huron to the Flint River. Flint River's water was acidic compared to Lake Huron, and corrosion control chemicals were not added to the water. A lack of chlorine in the water resulted in bacterial growth, causing an outbreak of Legionnaires' disease in 2014–2015, killing over 80 residents, and infecting more than 100 residents (Anand, 2017). In the hepatitis outbreak in Shimla, ~6,000–10,000 people were affected, which led to major institutional shifts in the governance of water.

After the hepatitis outbreak of 2015–2016, the Honorable High Court of Himachal Pradesh ordered reforms in the water supply and sewerage administration of the city of Shimla specifically, and the State of Himachal in general. It wanted one statutory body/post to be manned by a competent authority and members along with requisite staff to deal with the entire water supply system of Shimla town and the entire water crisis relating to the State of Himachal Pradesh. The Greater Shimla Water Supply and Sewage Circle (GSWSSC), was created under the Municipal Corporation as a separate, ring-fenced body for the delivery of all integrated services related to water supply and sewage disposal in the Greater Shimla Planning Area. It was envisioned that the accounts for the circle would be ring-fenced from the rest of the Municipal Corporation. The GSWSSC was also envisaged to have standard operating procedures for the delivery of water and sewerage services. It was envisaged that the Government of Himachal Pradesh would support all initiatives to strengthen the circle by way of adequate and qualified personnel and adequate need-based financing. The GSWSSC was functionally, financially, and operationally ring-fenced within SMC, with a separate bank account. A director, deputed from IPH, was the head of the circle and would exercise all operational powers for WSS, and the IPH provided the staff required for the functioning of the circle. Most importantly, service levels and tariffs within the entire Greater Shimla area (GSA) were mandated to be uniform. A Memorandum of Understanding (MOU) between the IPH, Urban Development Department (UDD), and SMC was required to set up the GSWSSC.

Since 2016, the GSWSSC has improved the water supply and sanitation system in the city by repairing leakages and reducing non-revenue water. However, the 2018 water crisis called for another major institutional shift in the governance of water in the city, whereby there was a shift from this ring-fenced entity to an

independent utility. The GSWSSC transformed into a company called the Shimla Jal Prabandhan Nigam Limited (SJPNL). The Government of Himachal Pradesh and Shimla Municipal Corporation jointly owns the company with the corporation having a 51% shareholding in the company, representing the interests of Shimla city, and the Government of Himachal Pradesh owning a 49% shareholding in the company, representing the interests of peri-urban areas. Today, the SJPNL is responsible for the management of the city's water supply. The core performance standards, as mandated by 2025 as a part of the Medium Term WSS Program funded by the World Bank are as follows:

1. Universal access to piped water supply and sewerage will be provided to all households in the Greater Shimla area. The safe and piped water supply of 135 lpcd per person per day and sewerage connection will be provided. The water supply standards in the entire Greater Shimla area would be uniform, and there would be no difference in standards between Shimla city and the peri-urban area, nor would there be different standards of supply for low-income neighborhoods/households.
2. Continuous pressurized water supply (24 × 7) will be provided. The supply of potable water to end users through a system of pipes — comprising interlinked bulk transmission and/or distribution systems — which are continuously full and under positive pressure throughout their whole length, such that the end user may draw off the water at any time of the day or night, 24 h a day, every day of the year. Continuous pressurized supply will be accompanied by 100% metering of all households and supply points and volumetric incremental block tariff.
3. In total, 100% water quality and effluent compliance with applicable potable water and environmental standards are specified by the Central Public Health Engineering Environmental Organization (CPHEEO), the Central Pollution Control Board, and the Himachal Pradesh Pollution Control Board.

The governance of the urban hydro-social cycle, the demand aspect, in particular, operates *via* public awareness campaigns about water conservation and attempts to increase water extraction or reduce consumption by technological fixes. There is always an inclination toward engineering solutions. The 2018 water crisis in Shimla paved the way to pitch the long-withstanding Sutlej project plan in front of the World Bank. While the core performance standards under the project are much needed, the concern is around the cost recovery aspect of the project. The cost of the project, which involves augmenting the water supply to Shimla from the Sutlej with an additional 67 MLD to meet the water demand until 2050 is Rs. 1,168 Cr (1 crore = 10 million). This amount will finally be recovered from the general public itself.

In Shimla, there is going to be 100% metering of the taps, and public taps are slowly being discontinued. This resonates with the prepaid water meter case from Phiri, Soweto, a low-income community in Johannesburg. The case involved a disagreement over water provision policies and the installation of a prepaid water meter system in Phiri, pitting five impoverished residents of Phiri against the City of Johannesburg, Johannesburg Water, and the national Minister for Water Affairs and Forestry (Naidoo, 2005). The sufficiency of Johannesburg's Free Basic Water Policy, which only allowed 6,000 free liters of water per household per month, or 25 liters per person per day for a household of eight, was put to the test *(ibid)*. The case was taken to the High Court and Supreme Court and resulted in controversial shifts of legal opinions, but this was the first case where the court was forced to rule on the availability and sufficiency of water. In Shimla, the tariff for domestic water connection within the municipal area from 0 to 20 kiloliters is Rs. 17.55 per kiloliter. Water is no longer available for free. The question remains as to, in the absence of any tariff concessions for the low-income group of people in the city, how socioeconomically accessible the "new" water infrastructure is And what this entails for equity and water justice in the future. While services may become efficient under such a regime, the challenge of service delivery to the poor in urban areas remains. The following neighborhood case study further elaborates along these lines.

## 3.5. Life "below the Cart road": a case study of Krishnanagar

In Shimla, the British left behind a very nebulous "way of life," which was reserved for a section of Anglophiles and affluent Indians who now occupied the posh localities, which were previously only reserved for the British (Bhasin, 1992). This spatial segregation, along with class lines, is visually evident in Shimla. The settlements have developed over the years with subsequent waves of urbanization. These spatial differentiations have deeper connotations when juxtaposed with social configurations. These are particularly visible when it comes to access to resources.

Krishnanagar municipal ward is located at the core of Shimla city along the sunny slopes of the Ridge. The mountain slope is divided by Cart Road, and Krishnanagar is located below it. Shimla was built by the British as a "hill station" and sanatorium for themselves. There was a particular sense of "seasonality" attached to its ontology since the city served as the summer capital of colonial India. In Shimla, the topography was used to carry out racial segregation by the elevation difference. An average Indian was an outcast in that colonial stratosphere who was more likely to service providers such as porters, rickshaw-pullers, clerks, etc. During the British time, while the officials resided in the Ridge and present-day Jakhu area, the Indian service providers had their settlements down the slopes, that is, how this slope developed as well. A steep road down the Cart Road near Mahamaya hotel takes us to Krishnanagar. The road is narrow and steep, so much so that car drivers from only that locality can drive on that slope. Some of the localities within Krishnanagar are Ghora Sarai, Mistri Line, Valmiki Mandir, Ladakhi Mohalla, Cowshed, Slaughter House, Lalpani, Gurudwara, and Gaddikhana. Most of the localities are symbolic of the occupation of the original residents. For example, Ghora Sarai was originally inhabited by horsecart pullers during the colonial period, and horses can still be found there. These horses are now used for tourism and recreation at Mall Road.

Krishnanagar is the largest slum in Shimla. Out of 2,758 houses in the slums of Shimla, 1,213 houses are in Krishnanagar. The area is often neglected in terms of basic amenities. In addition,

the general perception of this locality among the Shimla residents is quite negative. The Valmikis (untouchables), the Ravidasis (leather workers), the Ladakhis, the Punjabis, and many others who live in Krishnanagar have lived there for generations. Migrant laborers from Nepal and Indian states also call Krishnanagar their home because of the low property value. There is also a Valmiki community, which was engaged in leather processing. It was found that there are variations within the neighborhood as well. Many businessmen live in the Gaddikhana area closer to Cart Road, and their perceptions about the neighborhoods situated downhill are often biased. This neighborhood was purposively chosen to understand the contours of social and spatial hierarchy across a slope and how it limits one's access to provisions.

The neighborhood-level study of 50 households revealed that the water source choices for the people living in Krishnanagar are municipality home connections ($n = 27$), municipality joint connections ($n = 2$), public taps ($n = 6$), natural springs ($n = 4$), municipality home connections and natural spring both ($n = 9$), natural spring and public tap both ($n = 1$), and not having any connection of one's own but sharing from the neighbor ($n = 1$). In Krishnanagar, the ratio of water connections to properties is very low. This indicates that multiple properties are sharing one connection, and/or that several properties are without connection. For people depending on municipality home connections, water was received once every 3 days for a duration of 30 min to 1 h. They face a particular problem in the summer months of May and June because during that time, water is diverted to all the hotels located uphill from Krishnanagar, and much less water is given to the locality. Summer months are particularly challenging at the household level because many people have relatives/guests visiting, and the requirement for water in the house increases.

Figure 4 maps the daily water needs of the studied households in the Krishnanagar ward. Based on the amount of water they needed to run the household and the water they receive daily, they responded based on whether the water they receive is sufficient or insufficient for them. It was found that people with sufficient water needs are households of smaller family sizes who have a maximum cap of 1,000 liters requirement per day. Those with insufficient water are households of larger family sizes with an upper cap of 2,000 liters per day. Here, water sufficiency also includes their dependence on the natural springs/baolis. Springs are used alongside formal household water provisions as a backup. As the springs continue to supplement, complement, and substitute for formal piped water connections, even in households with municipality home connections, the waterscape of mountain cities such as Shimla becomes more complex (Müller et al., 2020).

In a case study of the city's waterscape in Coimbatore, Tamil Nadu, India, Biswas (2021) argued that the amount of storage available at the household level can significantly and long-lastingly affect the procurement burden placed on women in the case of intermittent water supply. Even though there is a difference in the quality of stored water and flowing water, under intermittent water supply, theoretically at least, if a household can store enough water to meet their entire water needs during the supply days, then the procurement burden on women can be minimized. In Shimla, access to storage is an important factor in water sufficiency as well. Households with sufficient water were also the ones with more than 1,000 liters of storage tanks. Such households often maintain dead storage of a minimum of 500 liters as a preparedness mechanism in anticipation of another water crisis. With regard to the 2018 water crisis, a middle-aged entrepreneur and resident of the Gaddikhana area of Krishnanagar remarked, *"we get water once every 3 days and we maintain storage of two thousand liters. With a newborn baby in the house, our water requirement is also high. It is because we maintain some water storage, we did not face many difficulties in the 2018 crisis but had to call water tankers twice."* Storage of water is essential, but not every household has access to it in a similar way. For low-income households without plumbing infrastructure, water is stored in drums, buckets, and cans, and the total storage capacity is within 250 liters. Similarly, people who reside in rented accommodations depend on their landlords for water. In many cases, even when the supply of water in the city is once every 3 days, the house owners release water to their tenants after meeting their own needs. Thus, the people without adequate storage are the first ones to be affected when there are disruptions in the city's water supply.

Apart from this, the timing of the water supply is an important factor. Water is mostly supplied in this locality between 4:00 a.m. and 5:30 a.m. The early morning timing for water is problematic for many residents whose water taps are outside the house or who are accessing public water taps. This is because the region has witnessed many human–wildlife conflicts with leopards. Since the opposite slope is forested, it becomes an easy passage for leopards to come to this locality to hunt for dogs for food. There have been incidences of attacks on children and the elderly as they come out of their houses at unusual hours (early morning or late at night) to access tap water or toilets. Being located downhill of the slope, water is first released in this locality phase by phase and then in the uphill localities. This is done to ensure that the water pressure is maintained and the uphill localities also get water. Otherwise, the entire water supply will gush downhill under gravity. This intricate balance of pressure and valves is regulated by the keyman of the locality. The timing, duration, and frequency of water supply often depend on them as they become the first point of contact for many people when it comes to grievance redressal. The keyman holds a certain level of power when it comes to the water supply in the city. Hansen and Oskar (2009) call them urban specialists or middlemen who form a bridge between the slum dwellers and the services of the city. Anand (2012) calls this "plumber raj" where the plumbers play a significant role in the water supply, where the formal water connections become complex. This is similar to the case of Shimla.

A major problem faced by the residents of Krishnanagar is getting a new water connection. Most of the constructions in this area are unauthorized and to get a water connection, the house deed is required along with proof of electricity payment. It is because of this challenge that many households in this locality are still out of the water supply network, and the role of the plumbers and keyman become significant. For many of these people and people for whom the supplied water is not sufficient, the natural springs are the only resort. After the hepatitis outbreak of 2015–2016, water testing was done in the natural springs in the city. Most of them were declared unfit for consumption. The spring upon which the people of Krishnanagar are dependent flows polluted water into

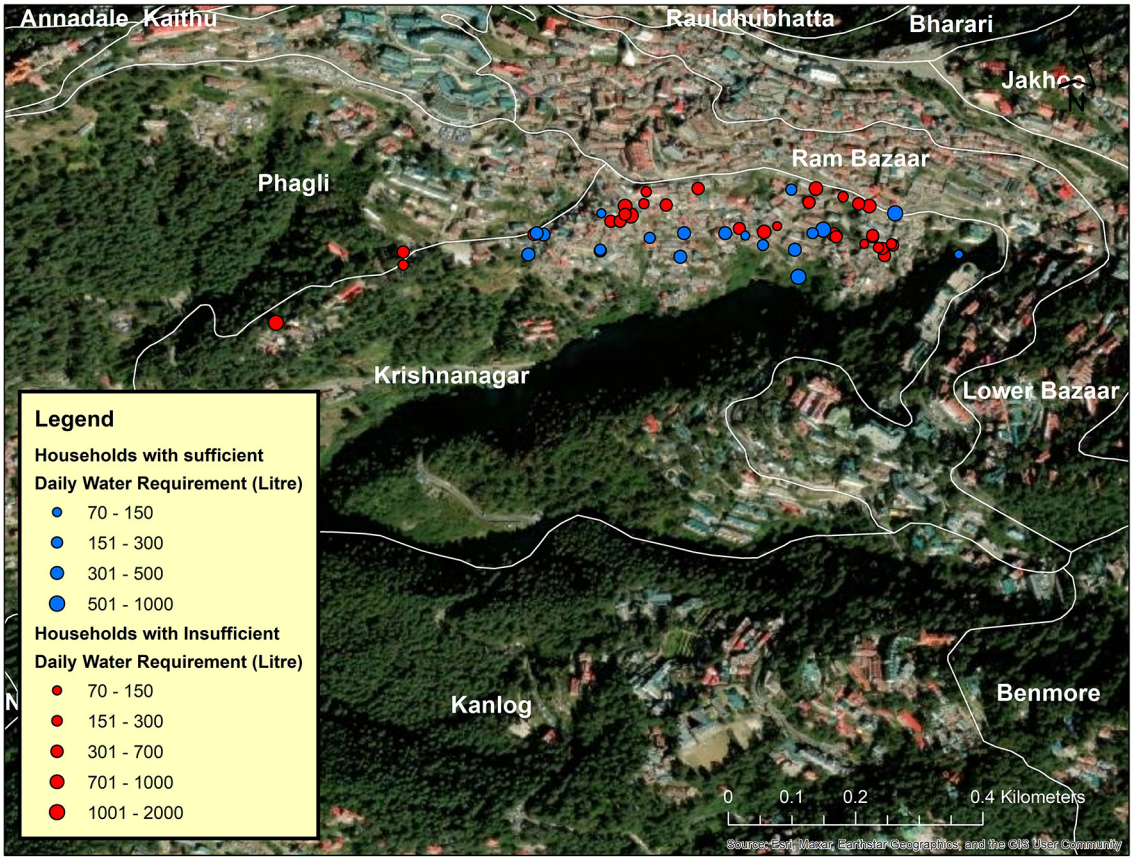


FIGURE 4
Map showing the daily water requirements of residents in Krishnanagar, Shimla, India. Source: Author.

the locality from the Mall Road above. Water from that spring is tapped through pipes and spread out within Krishnanagar, and the households depend on it for drinking, cooking, washing, and cleaning. Scholarly research engaging with urban waterscapes often overemphasize access to a particular quantity of water rather than the quality of that water for domestic use (Lavie et al., 2020). There is a need to define access and adequacy in terms of the quality and source of water too, as in the case of Shimla.

An interesting response from one of the participants highlighted that when the water crisis in Shimla happened in 2016 and 2018, many people in this ward were not greatly affected because, either way, they were dependent on the natural springs and not on the supplied water. They were already "out of the network" Being out of the network of the water supply is not just about connectivity to the infrastructure, it is also symbolic of how a particular population group is viewed by the state and produced as abject to the modern city (Anand, 2012). Hence, in Krishnanagar, we see a decentralized locally developed water alternative (natural springs) and subjectivities regarding service delivery thriving under the shadow of the large hydraulic infrastructural system. Radonic and Sarah (2015), in their case study of Sonora, found that the steep eroding slopes were covered with networks of "illegal" PVC pipes, blurring the boundaries between humans and technology. The act of carrying water containers, filling rooftop cisterns, and carrying out manual waste disposal render bodies a part of the urban infrastructural fabric. This is different from mainstream infrastructural thinking, which surrounds the state and capital as sites of governance and the role of civil society in the everyday forms of water management where the state is perceived to be absent is less explored (*ibid*).

We know that urban societies both shape and are shaped by water both materially and discursively as water embeds social relations (Gandy, 2004; Kaika, 2004; Swyngedouw, 2004; Loftus, 2012). Infrastructures also tend to reflect and reproduce social inequities within the city. Grounded case studies, such as Krishnanagar, offer a different lens to look at the production, politicization, and contestations around urban space. The "urban" provides a more nuanced understanding of urbanization, revealing how urban settings are shaped, politicized, and contested.

## 4. Conclusion

In the promise of infrastructure, while there has been an augmentation in the city's water infrastructure through large investments, this detailed fieldwork and literature review highlights the need to focus on the efficiency of the infrastructure and people's access to it. Despite the huge infrastructural technological fix as a solution to the city's water crisis, the water supply system of Shimla

appears fragmented. The company claims to have eased out the water shortages and, to some extent, they have done so, but only in specific localities. "Geography" continues to be a barrier for certain localities. Volumetric tariffs levied as a part of cost recovery are making piped water a commodity of luxury for the marginalized and low-income groups of people without social safety nets and residing on the periphery of the city and in vertical orogeny in mountain cities. In short, the urbanization of water and the social, economic, and cultural processes associated with its domestication have brought access to and control over nature's water squarely into the realms of class, gender, cultural differentiation, and struggle. On top of that, the commodification of water incorporates the circulation of water with money circulation, and in doing so, makes access to water dependent on positions of social power.

Hence, in the case of Shimla, the "crisis", as a context, is dialectical. The specific geographical characteristics of marginal settlements — poor location, difficult topography, and obsolete infrastructure — facilitate the continuing exclusion of the urban poor by reinforcing technical arguments and blaming the lack of investment funds as the main reasons for continued water deprivation. At the same time, despite the implementation of hydraulic projects and the financialization of nature, the inherent fissures of inequality within the city that cause differential access to water remain. While infrastructure is essential for a city's growth, people's participation and inclusivity are important for the infrastructure to be effective.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

## Author contributions

The paper is authored by SS and the research is derived from her ongoing doctoral research.

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## Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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