Section A -Research paper

Status of Domestic water supply service: A case of Sonipat town, Haryana in the event of COVID-19 pandemic

Amrita Khandelwal[1]*, Ajay Monga[2]
[1]Department of Architecture, Deenbandhu Chhotu Ram University of Science and Technology, Murthal, Sonipat, Haryana, India
*Corresponding author Email ID: *amritakhandelwal49@gmail.com*
[2]Department of Architecture, Deenbandhu Chhotu Ram University of Science and Technology, Murthal, Sonipat, Haryana, India
Email ID: ajaymonga2008@gmail.com
(Corresponding author: Amrita Khandelwal)*
doi: 10.48047/ecb/2023.12.si4.1262

Abstract
The study developed a preliminary assessment of the current domestic water supply in Sonipat, Haryana, a Municipal Corporation (MC) that was deeply affected by the COVID-19 pandemic of 2020 and the situation is still not normal. To control and prevent the spread of the COVID-19 pandemic, water and hygiene-related practices emerged as a critical component all over the world. The inspiration was to develop an understanding of the water supply status at the domestic level in MC Sonipat to improve the water security with management in future.
For this purpose, the study has analysed the secondary information collected from local water utilities with respect to domestic water supply concerning distribution system, supply coverage, the extent of metering and per capita water supply in MC Sonipat. Geographic Information System (GIS) was used to explore the spread of COVID-19 and the water distribution system spatially.
Results revealed that the water distribution system in the study area is based on a dead-end system which creates water stagnancy problems with water shortage conditions. It has also been found that the domestic water supply coverage is 81.3%, which fell short of its target levels & extent of metering of water connections is 85.7%, which further needs improvement. However, it could not achieve the desired targets due to a lack of funds. Overall, out of twenty wards, 25% of the wards are water-sufficient wards and the remaining 75% are facing water scarcity problems due to a lack of domestic water supply of approximately 9MLD. Nevertheless, since the arrival of the COVID-19 pandemic, 35% of the wards have experienced a slight increase in domestic water demand in MC Sonipat.
To solve all facing challenges, the following strategies were proposed: 1) Expansion of domestic water supply coverage by substantial investment; 2) Extension of metering by providing subsidies; 3) Augmentation of water sources by setting up additional ranney wells and canals; 4) Strategizing domestic water demand by analyzing household's water consumption pattern.
Keywords: *Domestic water supply coverage, Extent of metering, Geographic Information System (GIS), Water demand, Water distribution system, Water scarcity*

Introduction

COVID-19 disease outbreak rapidly spread across the whole world and was declared a pandemic by the World Health Organization (WHO) on March 11, 2020 (WHO 2019). As of December 2022, the WHO reported that the outbreak has already caused over 6.6 million deaths globally (WHO 2022). COVID-19 is an infectious disease caused by the Novel Coronavirus SARS-CoV-2, transmitted through inhalation of infected person's respiratory droplets/aerosols when they sneeze or cough (WHO 2020). To prevent the spread of the disease, numerous precautionary measures have been recommended viz. social distancing of at least 1 metre, wearing face mask, frequent handwashing with soap/water for at least 20

seconds after coughing and sneezing, before and after preparing food, before and after eating, after using toilet and when hands are visibly dirty, get vaccination, etc.(WHO 2019) However, adequacy of water supply services can influence the ability of households to comply with precautionary measures related to water utilization including handwashing in pandemic situation.

Outlining the challenges during pandemic and its disastrous impacts, many studies/reports have been evolved surrounding the influence of COVID-19 pandemic on domestic water demand. Study conducted among the general population of India to access the household level water consumption status shown that there is tremendous increase in water usage during COVID-19 pandemic situation due to changed behavioral routines through bathing, washing clothes, and hand washing practices thus creating a tremendous pressure on the water resources. (Amita Bera et.al. 2022). Moreover, study conducted in Brazil aimed to investigate the influence of the pandemic on personal hygiene and household´s behaviour pointed that pandemic caused an increase in the frequency and length of hand washing along with increased frequency of showering (Marcus André Siqueira Campos, et. al. 2021). However, according to a report of United Nations International Children's Emergency Fund (UNICEF), in 2020, 71% of the global population had basic handwashing facilities with soap and water at home and 2.3 billion people lacked basic services, including 670 million people with no handwashing facilities at all. Therefore, there is a need of research that examines the household level water supply status to improve the water security with management in future.

The purpose of the study was to understand the current domestic water supply status of MC Sonipat, one of the most affected city by the COVID-19 pandemic in Haryana. It is aimed to analyse information procured from local water utility in the municipal corporation area to inspect specifically the following questions: 1) What type of water distribution system does Sonipat have? 2) What is the status of water supply coverage and extent of metering of water connections in study area? 3) Does the current domestic water supply is adequate with respect to requirement? Based on this evaluation, subsequent growth strategies were established to overcome the current knowledge gaps while informing future improvement in domestic water supply during the circumstances of the pandemic in the MC Sonipat.

The paper is arranged in this fashion. Section 2 describes the study area, the Sonipat MC, encompassing its demographic background, COVID-19 spread scenario and available water sources. Section 3 outlines the method applied for collecting data, includes secondary survey from water utilities. Section 4 presents the study results, covering the water distribution system, water supply coverage, extent of metering and state of domestic water supply with respect to requirement Section 5 discusses the results and concludes the paper.

Methods:

The Study area: Sonipat Municipal Corporation (MC)

Demographic background

The study area Sonipat is one of the economically developing Municipal Corporation (MC) in Sonipat district, Haryana, India located at $77^{0}01$ Longitude and $28^{0}57$ Latitude (Fig. 1). At present, MC occupies a total land area of about 103.90 km² with total population of approximately 427,270 *(Building department, Municipal Corporation)* (*Municipal Corporation*, Ward bandi map & summary, 2018). Since the occupation of the citizens is largely depending on Industry and Agriculture, a lot of industrial activities, trade and commerce are coming up in recent years. Consequently, there is an immense demand for the residential sector over the last few years. Administratively, MC Sonipat is divided into 20 wards comprises colonies/villages. The population density of the developed wards in the city core (19k to 21k ppl/sqkm) is greater than the population density of the developing wards at the periphery (1200 to 11k ppl.sqkm.). According to Yashi Consultancy Services, survey team 2022-2023, land use in the MC Sonipat is dominated by vacant land followed by agricultural, residential, commercial, institutional, industrial, special category, mix use and tower area. (table-1)

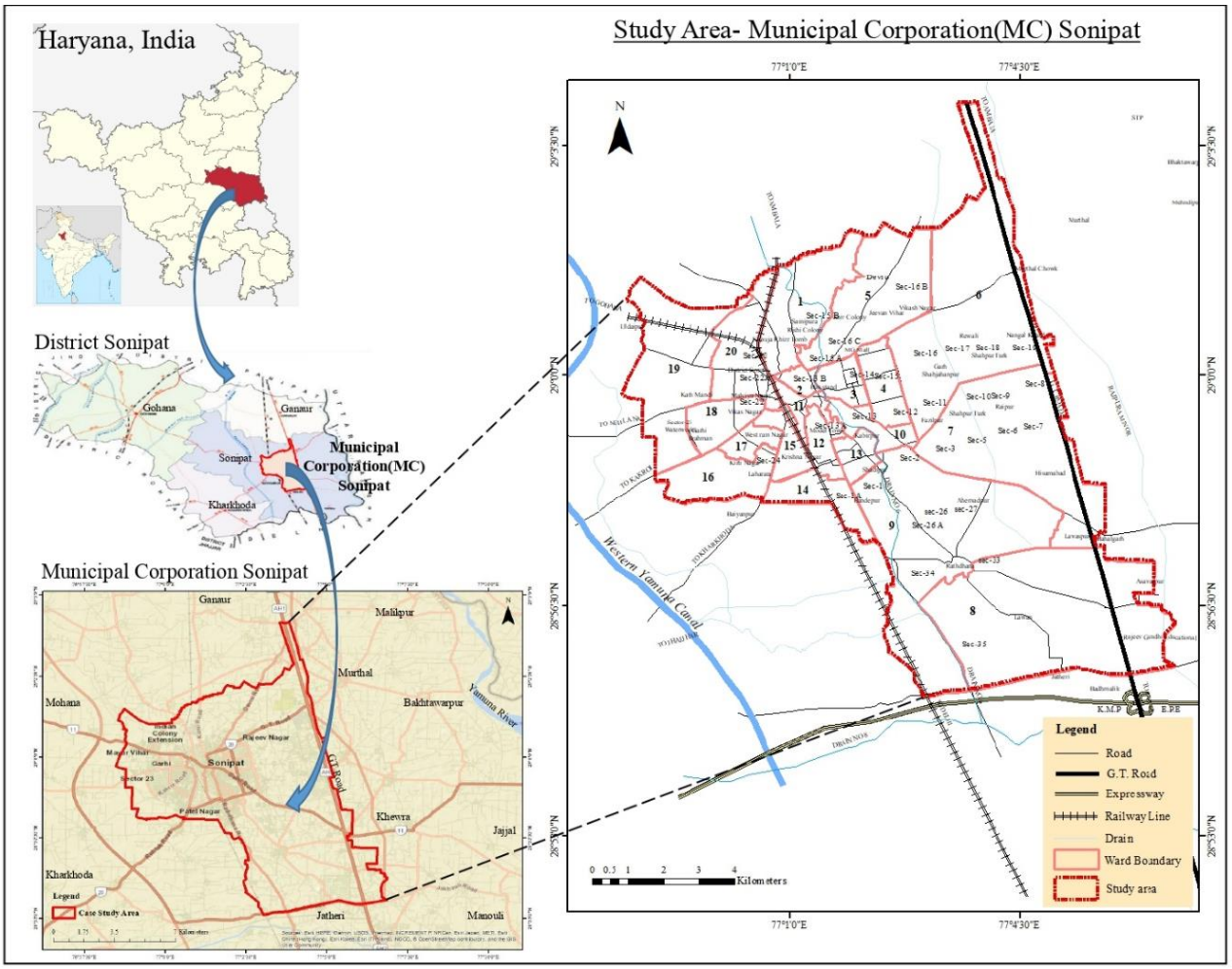
Table-1: Land use classification in Municipal Corporation Sonipat in 2022.

Land use	Area (km²)	Percentage (%)
Agricultural	16.67	18.4
Commercial	5.97	6.6
Industrial	4.51	5

Institutional	4.92	5.4
Mix use	1.96	2.2
Residential	14	15.5
Special category	3.92	4.3
Tower	0.3	5
Vacant plot	38.32	42.3

Source: Yashi Consultancy Services Pvt. Ltd. (2022)

Fig-1: Geographic location of Municipal Corporation Sonipat, Haryana.
Source: Municipal Corporation, Sonipat (2018)

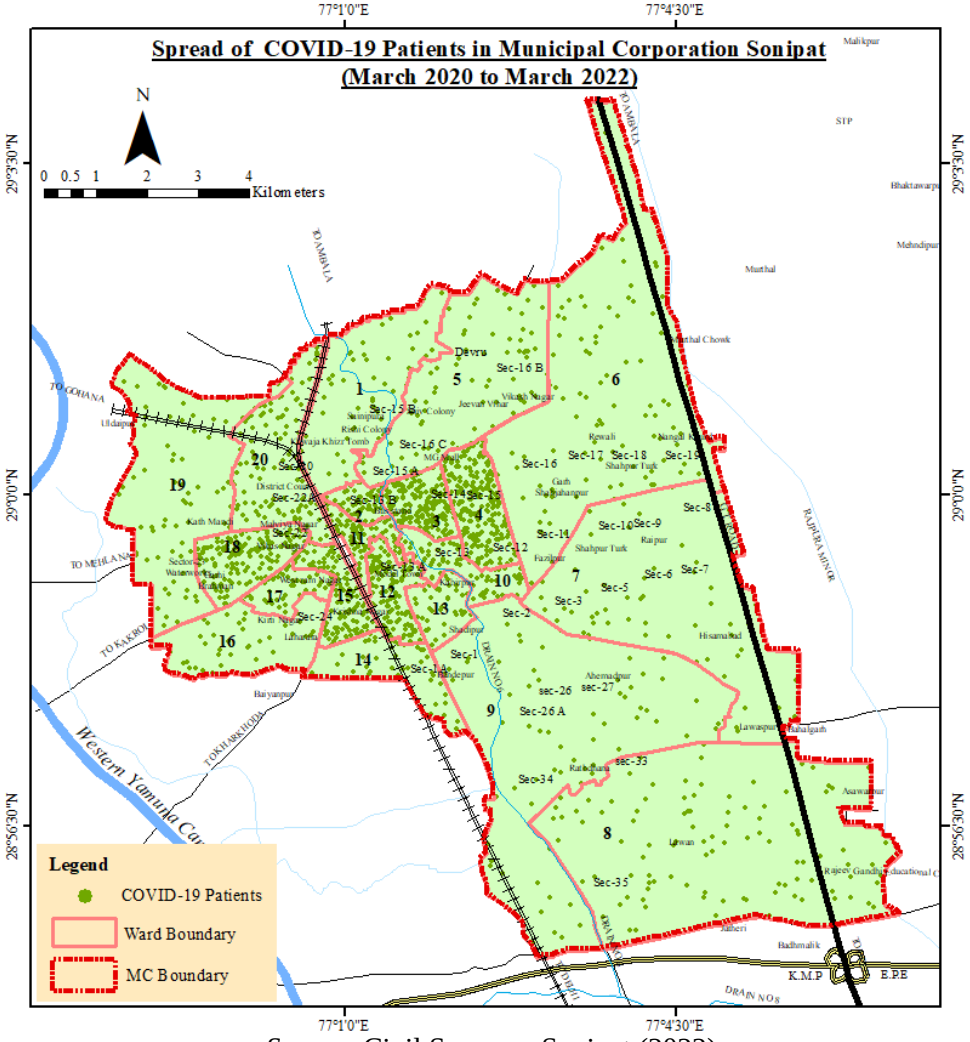


March 2022 in MC Sonipat, Haryana.

COVID-19 spread scenario

Sonipat is one of the most affected city by the COVID-19 pandemic after Faridabad and Gurugram in Haryana. The total COVID-19 patients reported in Sonipat MC from March 2020 to March 2022 were about 1,91,24 (Cheif Medical officer, Haryana), and the cases are still being reported. The spread was observed densely clustered in the city core while loosely scattered on the peripheries of the MC. Fig 2 shows the spread area of COVID-19 patients from March 2020 to

Fig-2: Spatial distribution of the spread of COVID-19 patients in Municipal Corporation Sonipat, Haryana.



Source: Civil Surgeon, Sonipat (2022)

Available Water Structures

Location of the Railway line (i.e, Delhi-Kalka line, Sonipat-Jind line) had developed two separate regions for water supply in Sonipat city, viz. eastern and the western side. Urbanizable area situated on the eastern side of railway line are served by the ranney wells that extracts water from Yamuna River provides potable water, whereas region on the western side of railway line served from Western Yanumna Canal (WYC) that undergoes water treatment near sector-23 at 18 MLD water treatment plant as the underground water in this area is of distinct standards, which can be hard, silty, brackish or fresh, is unfit for human consumption. Additionally, tubewells are present at various locations to serve the households. Moreover, major sewage disposal and treatment works are located along the Drain no 6 & 8. (Explanatory note on the Final Development Plan for Sonipat-Kundli Multifunctional Urban Complex-2031 AD) (Fig-3). The details of water serving structures in Sonipat town is elaborated in table-2.

Table-2: Water serving structures in Municipal Corporation Sonipat in 2022.

Structures	Existing (2022)	Proposed
Ranney Wells (RW)	4	5 RW (3-Murthal Block, 2-Rai Block)
Main Boosting stn.(MBS)	1, village Jajal	3 MBS (2-Murthal Block, 1-Rai Block)

Boosting Stn. (BS)	12	3 BS
Tubewells (TW)	91	60 TW (36-Murthal Block, 40-Rai Block)
Sewage Treatment Plant (STP)	4	One 15 MLD STP (serve sec-58 to 64)

Source: Municipal Corporation, Haryana Shahri Vikas Pradhikaran

Data Collection

For the assessment of status of domestic water supply including, distribution networks, supply coverage, extent of metering, water supply with respect to requirement, and gaps in water supply, secondary data was collected from the local water utilities called Municipal Corporation (MC) and Haryana Shahri Vikas Pradhikaran(HSVP) in the form of statistical documents, reports and maps. The information sources include ward bandi report, landuse area report, available water sources and domestic water supply related reports, domestic water supply coverage and extent of metering related documents, brief note on major works and water distribution network maps. Detailed report related to number of COVID-19 patients was collected from Chief Medical officer, Civil Hospital, Sonipat, Haryana. Note that during the data collection period from May to June 2022, the most recent information on distribution network, population & water supply was from 2010, 2018 & 2022 respectively which may actually reflect the state of 2023.

Results and Discussion:

Water distribution system

Domestic water supply system in urban areas across Municipal Corporation Sonipat is operated by utility organizations called Municipal Corporation (MC) and Haryana Shahri Vikas Pradhikaran(HSVP). MC supply water to the ward no-1,2,3(part),4(part), 5,10(part), 11, 12, 13, 14, 15, 16,17, 18(part), 19 & 20. However, HSVP supply water to the ward no-3(part),4(part),6, 7, 8, 9,10(part), 18(part). Water distribution network in the Sonipat city is based on the dead-end system. This type of water supply networking not only deteriorate the water quality but also creates water stagnancy problem with water shortages conditions. Instead, it is an economically cheaper system appropriate for the old unplanned cities (conveyed by the official of Municipal Corporation). Fig3 displays the water distribution network.

Water supply services

According to the handbook of service level benchmarking, there are various indicators of water supply services such as coverage of water supply connections, per capita supply of water, extent of metering of water connections, extent of non-revenue water, Continuity of water supply, Quality of water supplied, Efficiency in redressal of customer complaints, Cost recovery in water supply services and Efficiency in collection of water supply-related charges (MoUD, 2009). In this study, three indicators have been discussed viz., coverage of water supply connections, extent of metering of water connections & per capita supply of water.

1. Coverage of water supply connections:

The rates of coverage of water supply connections were estimated based on the percentage of total number of households in the service area that are connected to water supply network with direct service connections to the total number of households in that service area (MoUD, 2009). Total number of households in the service area was calculated by dividing population of the city viz. 4,27,270 to the average household size of 5 people that was taken from the Sonipat District Census Handbook report. The data related to total number of direct service connections was collected from the water utilities (HSVP & MC, Sonipat). It has been found that in the year 2022, the total water supply coverage of the study area fell short of its target levels and needs improvement. Target levels was referred from the Sub-regional plan for Haryana sub-region of NCR-2021, Service level Benchmarking- Chapter 8. Table-3 describes the percentages of urban settlement covered by the water supply in 2022.

Table-3: Percentage of water supply coverage in Municipal Corporation of Sonipat in 2022.

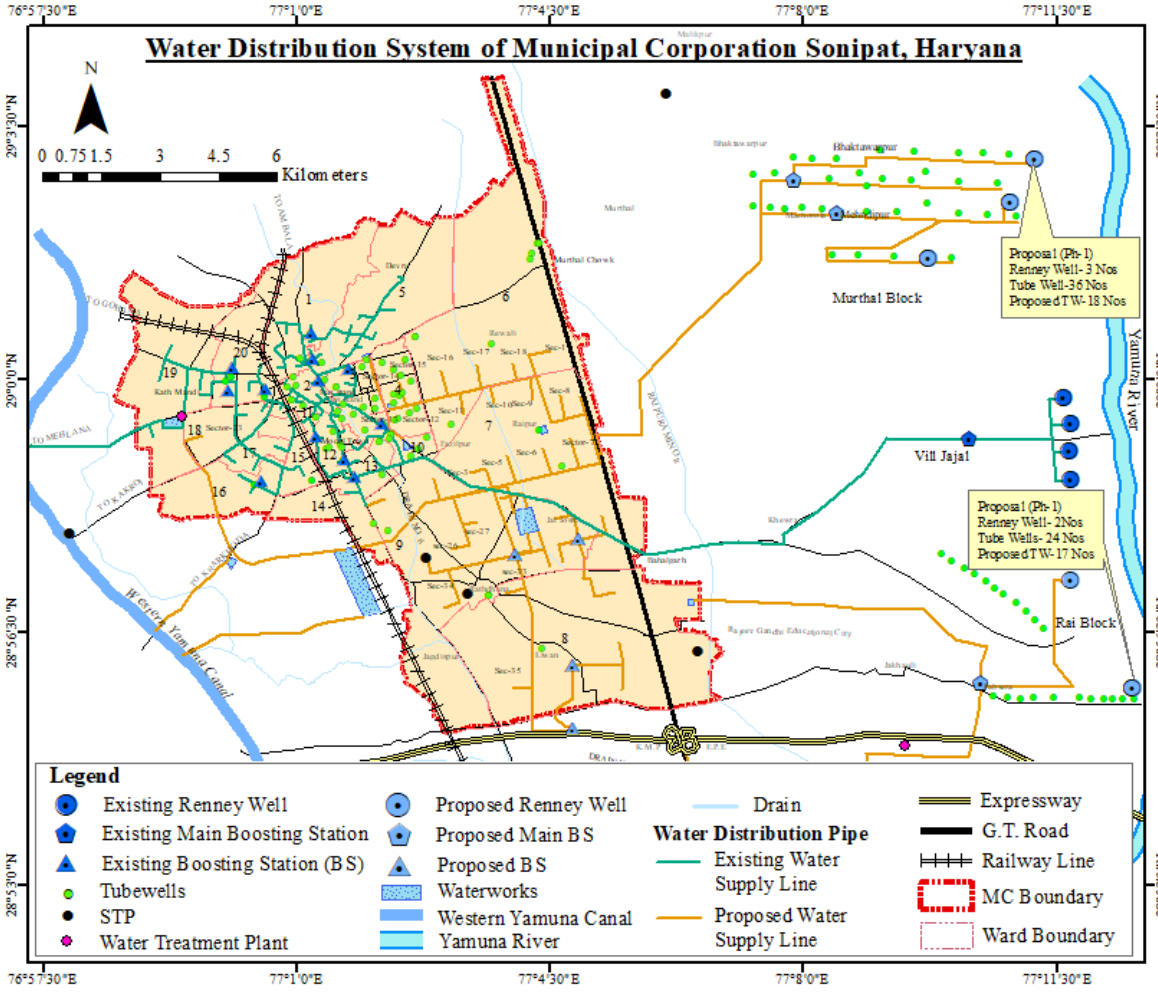
Year	Study area	Number of Households	Number of Direct service connections	Water supply coverage (%)		
				Target	Achieved	Gap
2022	Municipal Corporation,	85,454	69,509	100	81.3	18.7

	Sonipat					

Source: Municipal Corporation (2022), Haryana Shahri Vikas Pradhikaran (2022)

Fig-3: Water distribution system of Municipal Corporation Sonipat, Haryana in 2010.

Source: Municipal Corporation, Haryana Shahri Vikas Pradhikaran



2. Extent of metering of water connections

Extent of metering was estimated based on the percentage of total number of functional metered water connections to the total number of water supply connection (MoUD, 2009). The data regarding number of active functional connections was collected from HSVP & MC, Sonipat. It has been revealed in the year 2022, the extent of metering of water connections fell short of its benchmark levels, referred from the Sub-regional plan for Haryana sub-region of NCR-2021, Service level Benchmarking- Chapter 8, which further needs improvement. Table-4 represent the achieved extent of metering of water connections in the residential households.

Table-4: Extent of metering of water connections of Residential Households in Municipal Corporation Sonipat in 2022.

Year	Type of installed connection	Number of water supply connections	Number of active/functional connections	Extent of metering of water connections (%)		
				Target	Achieved	Gap

2022	Residential	69,509	59,617	100	85.7	14.3

Source: Municipal Corporation (2022), Haryana Shahri Vikas Pradhikaran (2022)

3. Domestic water supply status

Water supply in Sonipat town is contributed by Ranney wells, western Yamuna canal & tubewells. Ranney wells available at village Jajal outside the MC limit contributed in water supply of 28 MLD on the eastern side of railway line. Whereas, Western Yamuna Canal supply 20.7 MLD of water on the western side of railway line. Additionally, tubewells available at various locations are responsible for the water supply of 11.5 MLD. Overall, the quantity of water supplied in Sonipat town is 60.2 MLD. It is estimated based on the availability of number of pumps, discharge per pump and average operational hours. The data related to water supply in the year 2022 was collected from the MC & HSVP. Fig.-5 displays the Domestic water supply status in Municipal Corporation Sonipat, Haryana in 2022.

The current water requirement in Sonipat town is 69.2 MLD approximately, which is calculated by multiplying the current population by the desired rate of water supply per head per day in urban settlements viz. 135 lpcd (CPHEEO standards, Haryana sub-region of NCR-2021, Service level Benchmarking- Chapter 8) and adding an additional 20% for evaporation & per calculation losses. It is observed that Sonipat town is facing water shortfall of 9 MLD due to paucity of water sources leading to the per capita water supply below the desired level. Table-5 represent the water supply & requirement gap in Municipal Corporation Sonipat in 2022.

Table-5: Analysis of water supply and requirement gap according to available water sources in Municipal Corporation Sonipat in 2022.

Sr. No	Water Sources	Number of pumps	Average Pump Discharge (lpm)	Average Working	Supply (MLD)	Requirement (MLD)	Gap (MLD)
1	Ranney wells (RW)	4	5800	24 hrs	28	69.2	9
2	Western Yamuna Canal (WYC)	1	12600	30 days	20.7		
3	Tubewells (TW)	91	600	3-4 hrs	11.5		
Total					60.2		

Observing the water supply at ward level in study area, it has been found that the water deficiency is greater on the western side of railway line as compared to the eastern side in MC Sonipat (table-6, Fig-4) (MC, HSVP, 2022). Overall, 75% of the wards are facing the problem of water scarcity to meet the present domestic water needs (fig. 5). According to the officials of HSVP, since last three years work of the construction of 3 nos of ranney wells in Murthal block is in progress to cater future water requirement of 30 MLD & now, it is 95 % completed as well as 2 nos of ranney wells has been proposed in Rai Block for future also.

Table-6: Ward-wise analysis of water supply, requirement & gap in Municipal Corporation Sonipat in 2022.

Sr. No	Study area	Population	Water deficient wards	Water sufficient wards	Supply (MLD)	Requirement (MLD)	Gap (MLD)
1	Eastern side of Railway line	2,66,049	1, 2, 3 (part), 5, 10 (part), 11, 12, 13	3(part),4 (part), 6, 7, 8, 9,10(part)	39.1	43.1	4
2	Western side of Railway line	1,61,221	14, 15, 16, 17, 18(part), 19, 20.	18(part)	21.1	26.1	5
Total		4,27,270			60.2	69.2	9

Fig-4: Water supply and requirement gap analysis in Municipal Corporation Sonipat, Haryana in 2022

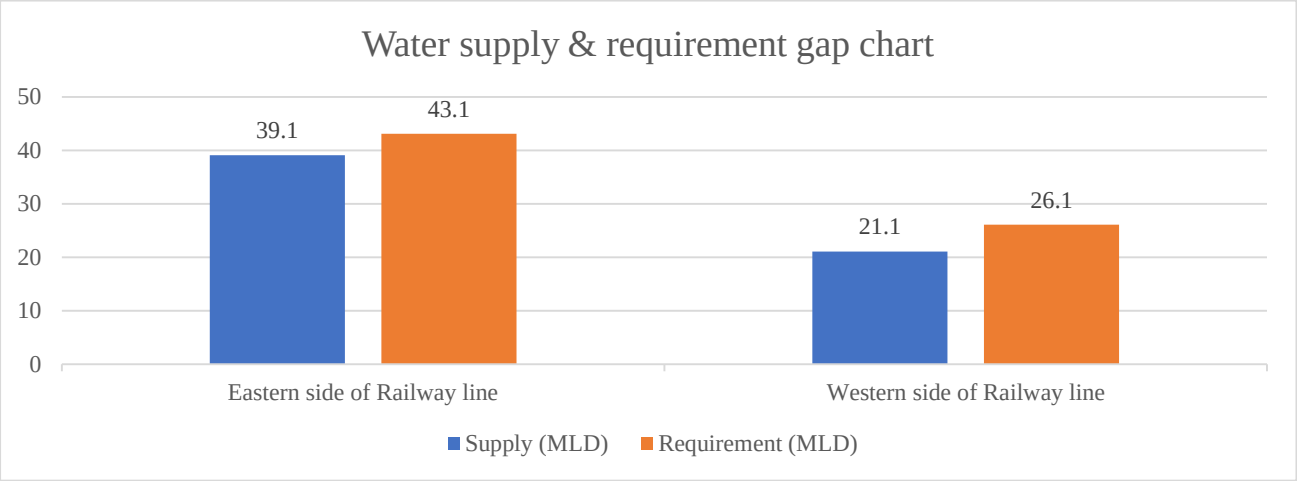
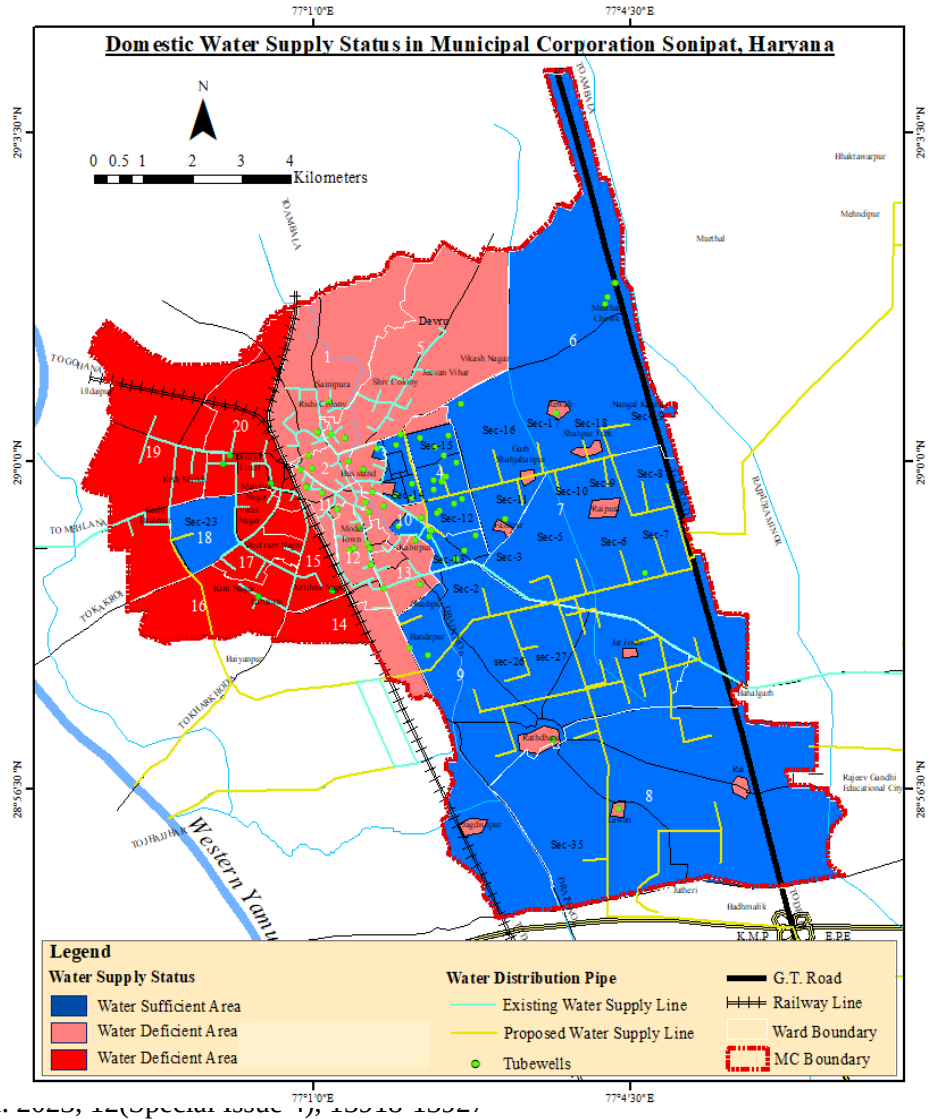


Fig-5: Domestic water supply status in Municipal Corporation Sonipat, Haryana in 2022.



Source: Municipal Corporation (2022), Haryana Shahri Vikas Pradhikaran (2022)

Discussion

Local water utilities are facing an acute shortage of funds to expand the water supply coverage including extent of metering and augmentation of water sources in MC Sonipat. Since the last three years, the work of the construction of 3 Nos of Ranney wells and rising mains up to the main Boosting Station in Murthal block, Sonipat is in progress and is delayed because due payments of the contractual agencies are not being released in time. So far, Rs. 32.65 Crores (appx.) has been incurred in the construction work and work of the construction of the rising main has been enhanced worth Rs. 38.02 crore after various requests which slow down the progress of work at the site. In addition, delay in the completion of works occurred due to the reason of non-availability of a suitable site of the land well in time for the construction of ranney wells as the land was to be purchased by the contractual agency. Moreover, the status of extent of metering of water connection is only 85.7%, which can be further extend by providing subsidies in low-income group areas. Therefore, substantial investment is needed to expand water supply coverage, extent of metering and augmentation of water sources focusing on the water-deficit wards viz. 1, 2, 3 (part), 5, 10 (part), 11, 12, 13, 14, 15, 16, 17, 18(part), 19 & 20 to overcome the shortfall of 9 MLD.

Despite being conveyed by Haryana Shahri Vikas Pradhikaran(HSVP) as sufficient water sources available to serve 25% of the wards located majorly on the eastern side of railway line, rest 75 % of the wards regulated by Muncipal Corporation (MC) are water deficient due to paucity of water availability of approximately 9MLD. To solve the problem, water sources such as additional ranneywells and canals should be set up by the local water utilities and government to support not only the domestic water supply in the areas where water supply is insufficient but also to cater for the sudden water needs as in case of a pandemic.

This has been reported by local water utilities that COVID-19 pandemic has increased domestic water demand due to compliance of precautionary measures. In the peak of COVID-19, MC borrowed a minimum 2 MLD water from HSVP to balance the uncontrolled water demand of the residential households due to sudden hike in various water consumption related precautionary measures to prevent the spread of COVID-19 including frequent hand washing, for the first time. To overcome the increased water demand in such pandemic situation there is a need to analyze household level water consumption pattern for strategizing water security with management.

Conclusions

The water supply system of MC Sonepat, Haryana is getting affected due to huge demand for the domestic sector as a result of large-scale migration of the population from Delhi. The reason behind this migration is the coming of KMP, KGP, operationalization of Delhi-Panipat Expressway, several industrial activities, regional rapid transit system, and Narela-Kundli Metro, etc. Additionally, COVID-19 pandemic is further worsening the situation because of the sudden hike in water consumption related precautionary measures as reported by water utility (MC). Consequently, domestic water demand in MC Sonipat is exceeding the water supply and imposing tremendous stress on the water resources.

Based on secondary information collected from water utilities and government bodies, it has been observed that there is shortfall in domestic water supply and needs improvement. Nevertheless, the performance of local water utilities remains of great concern. This is particularly reflected in the acute shortage of funds at local water utilities, which not only delays the progress of work at site but also challenges the improvement and expansion of water services.

Perhaps the most important finding of the study is that 75% of the wards are facing the problem of water scarcity due to inadequacy of water sources. Nevertheless, according to the officials of

municipal corporation, since the arrival of the COVID-19 pandemic, 35% of the wards are experiencing slight increase in water demand.

The findings may set the foundation and rationale for upgrading water supply services and performance in the city. There is a need for a comprehensive, systematic approach to accelerate domestic water supply in MC Sonipat. The above analysis based on water supply services underscores the need and importance of extending water supply coverage, expansion of metering connections, augmentation of water sources, and actions to improve the financial performance of the utilities. This study can be further expanded by analyzing household's water consumption pattern to improve the water security with management for future.

References

1. WHO. 2022 Timeline: WHO's COVID-19 Response. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/interactive-timeline (accessed 28 Dec 2022)

2. WHO. 2022 WHO Coronavirus (COVID-19) Dashboard. https://covid19.who.int/ (accessed 28 Dec 2022)

3. WHO. 2022 Coronavirus disease (COVID-19. https://www.who.int/health-topics/coronavirus#tab=tab_1 (accessed 29 Dec 2022)

4. WHO. 2022 Advice for the public: Coronavirus disease (COVID-19). https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public (accessed 27 Dec 2022)

5. Bera, A., Das, S., Pani, A., Bera, B. and Shit, P.K. (2022). Assessment of household water consumption during COVID-19 pandemic: a cross-sectional web-based study in India. *Sustainable Water Resources Management*, 8(3). doi:10.1007/s40899-022-00672-7.

6. Campos, M.A.S., Carvalho, S.L., Melo, S.K., Gonçalves, G.B.F.R., dos Santos, J.R., Barros, R.L., Morgado, U.T.M.A., da Silva Lopes, E. and Abreu Reis, R.P. (2021). Impact of the COVID-19 pandemic on water consumption behaviour. *Water Supply*, 21(8), pp.4058–4067. doi:10.2166/ws.2021.160.