

Urbanisation & its impact on Yamuna River - A case of Jamia Nagar Area

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Abstract

The paper assesses the physical extents of Yamuna to identify its impact over the various water resources in the city of Delhi. The paper highlights the water management scenario in the city of Delhi during its pre-independence and post-independence period. The impact of urbanisation on Yamuna River is described as part of post-independence development, which not only lead to the depletion in water quantity but also deteriorated its quality. The water quantity is analysed through the encroachments and tapering of Yamuna floodplains during the post-independence period. However, due to the limitation of time and scope of this study the water quality is assessed and analysed only for the Jamia Nagar area, due to the ease of data collection and subsequent testing using pH test in laboratory. The analysis and discussions identify the reason for the extensive use of RO systems implemented in Jamia Nagar area.

Keywords: Yamuna, water quality, urbanisation, surface water, ground water

1. History of Yamuna

The Yamuna River is the longest tributary river of the Ganga in northern India. The Yamuna originates at "Yamnotri in Uttarakhand. The total length of the river from the Glacier to the Ganga Sangam at Allahabad is about 1,300 km" (board). Historically, the waters of the Yamuna were distinguishable as "clear blue", as compared to the silt-laden yellow of the Ganges (Sommer, n.d.). Especially during the olden days, Delhi received its main source of water from, step wells dug on the floodplains of Yamuna. In addition to the ponds locally called *johads* that had connection with the local streams, rivulets and their tributaries. In order to better understand the existing water management system in Delhi it is categorized under two headings as pre independence and postindependence scenario, described as follows:

- 1.1. History of Delhi water supply development pre-independence as represented in Figure 1
- 1.2. History of Delhi water supply development post-independence as represented in Figure 2

During both the periods a significant shift in water management practices is observed. From locally managed water resource practices prevailing during pre-independence era. It shifted to the municipally managed post-independence scenario, which is significantly impacted by the urbanization impacts in Delhi. The rapid population growth of Delhi has resulted in an increase in the density of population from "6,352 persons per sq kms in 1991 to 9,340 persons per sq kms in 2001 and further to 11,297 persons per

sq kms in 2011” (Palnning, 2014-15, p. 1). This increase in population contributed to the new practices of water tankers and water mafia. Besides, encouraging the practice of private tube wells, which are largely responsible for ground water depletion in Delhi. It is also observed from various literature reviews that Yamuna and its floodplains remain unaffected during the pre-independence period whereas these flood plains were tampered post-independence period to accommodate urban development.

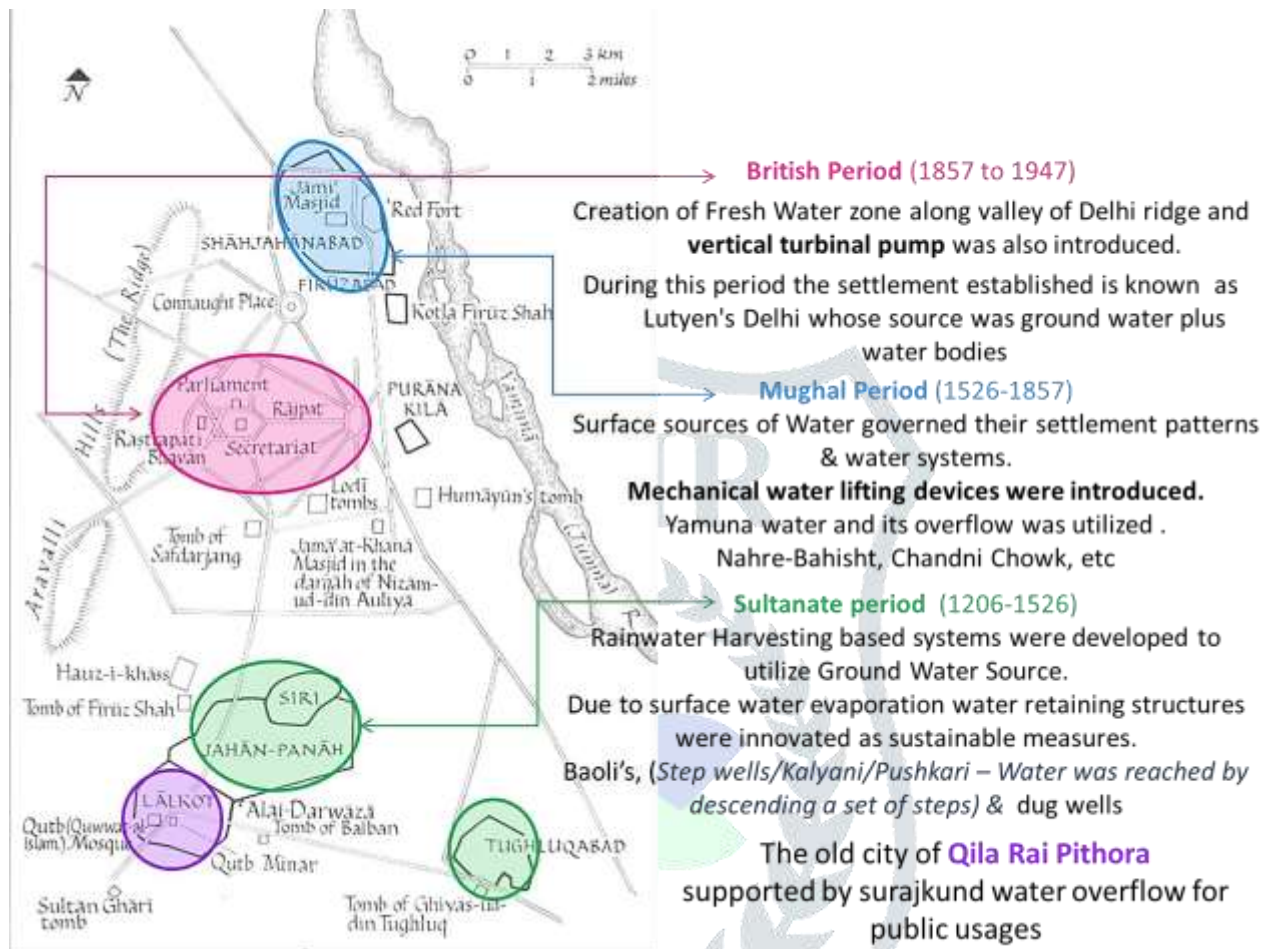


Figure 1 History of Delhi Water supply management - Pre independence period (Author)

1940-1970	1970-2000	2000-Present
Populations:26.6lakhs (1961)	Populations: 62.22lakhs (1981)	Populations: 138.5lakhs (2001)
Sources of Water		
Row of wells sunk along the river Yamuna,	Row of wells sunk along the river Yamuna, bhakra storage/Yamuna, upper ganga canal,	Row of wells sunk along the river Yamuna, bhakra storage/Yamuna, upper ganga canal, bhakra storage, ground water
Water Barrages B1 Wazirabad Barrage & B2 Okhla Barrage	B1 - Wazirabad Barrage, B2 - Okhla Barrage, B3 - Bhakra Barrage	B1 - Wazirabad Barrage, B2 - Okhla Barrage, B3 - Bhakra Barrage
Waste Treatment Plant		
Chandrawal i and ii, wazirabad i,ii and iii,	Chandrawal i and ii, wazirabad i,ii and iii, haiderpur i and ii, bhagirathi,	Chandrawal i and ii, wazirabad i,ii and iii, haiderpur i and ii, bhagirathi, nangloi, sonia vihar, ranney wells & tube wells
Total capacity: 35mgd	Total capacity: 303mgd	Total capacity: 715mgd
Sewage Treatment Plant		
Okhla phase i,	Okhla phase i, delhi gate, timarpur, rithala, kondli, ghitorni, vasant kunj,	Okhla phase i, delhi gate, timarpur, rithala, kondli, ghitorni, vasant kunj, mehrauli, papankala, narela, rohini
Capacity: 18 mgd	Capacity: 122 mgd	Capacity: 346 mgd

Figure 2 History of Delhi water supply in post - independence period (Author)

2. Yamuna river at present

The river stretches for 22kms along the city of Delhi. Entering at wazirabad in north to okhla barrage in south, is a major source of water for drinking, irrigation & other uses. It has significant impacts on the settlement patterns witnessed by the city. Delhi being the biggest consumer of Yamuna's water resources has also become the biggest polluter by contributing 80-90% of the total sewage discharge into Yamuna reducing its water quality & also the possibility of the survival of biodiversity. The same has been cited by various literature including Sharma and Kansal (2011) stating that " it has been subjected to immense degradation and pollution due to the huge amount of domestic wastewater entering the river"(Sharma & Kansal, 2011, pg.147)

The figure below highlights the length of Yamuna that belongs to Delhi.

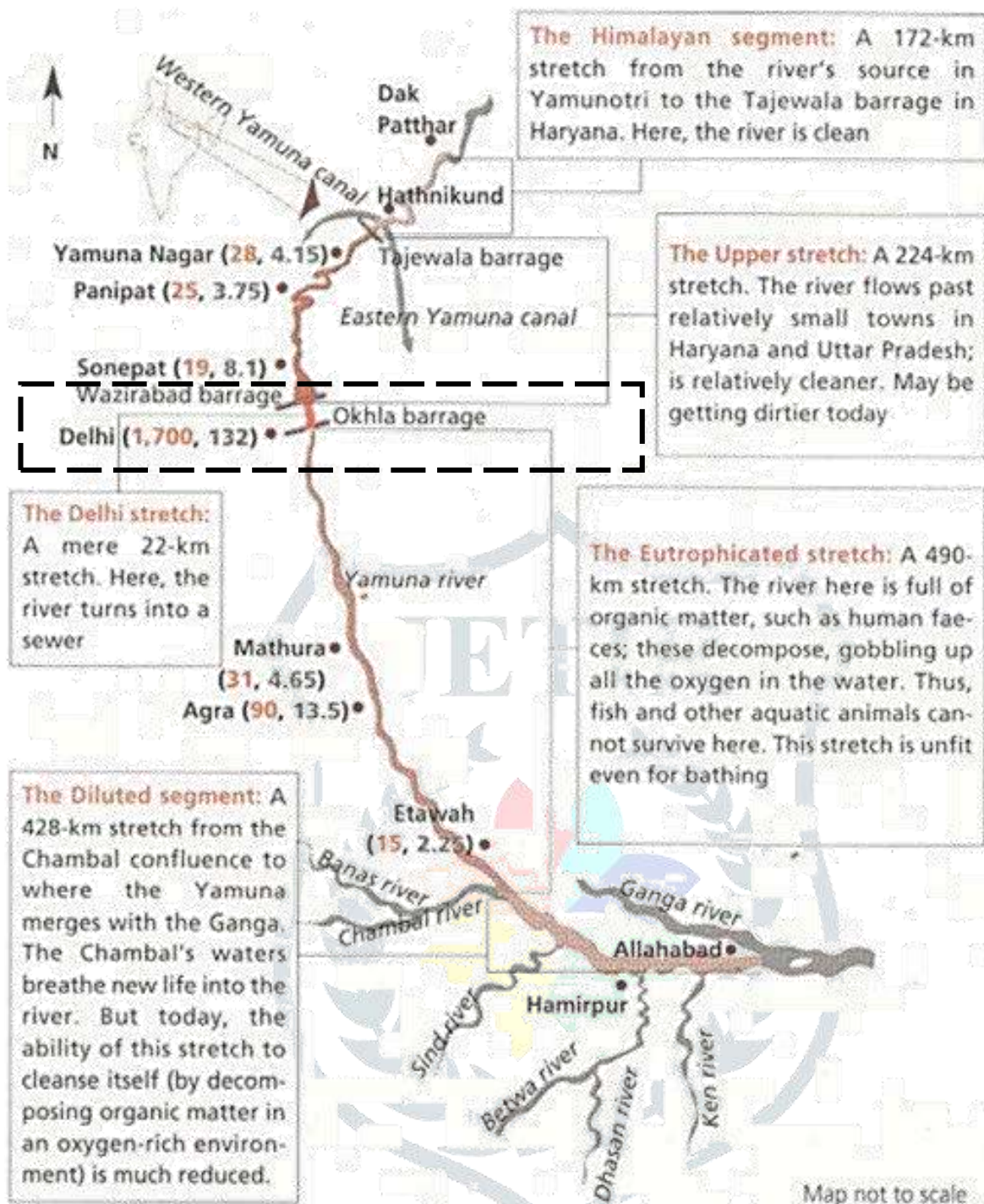


Figure 3 Details for Yamuna Stretch (Sharma & Kansal, 2011, pg. 149)

2.1. Structural Briefs of Yamuna in Delhi

The meandering action of Yamuna River increases the length of the stream or river and tends to reduce the slope. The three broad sections w.r.t the meandering of Yamuna in the Delhi territory i.e., from Wazirabad barrage to Okhla barrage can be seen in the map (Trust). Each section is marked with the flyovers and bridges in a particular section. Section I is more or less linear whereas Section II Curves at a Larger Radius and The Final section III is moderately meandering.

2.2. Relevance of different sections of Yamuna: The 22km stretch of Yamuna in Delhi is composed of various bridges and barrages that are critical to its operation and maintenance. These structural segregations are

analysed in Figure 4 below, which identifies the location of various bridges across its stretch in Delhi alongside its importance and relevance.

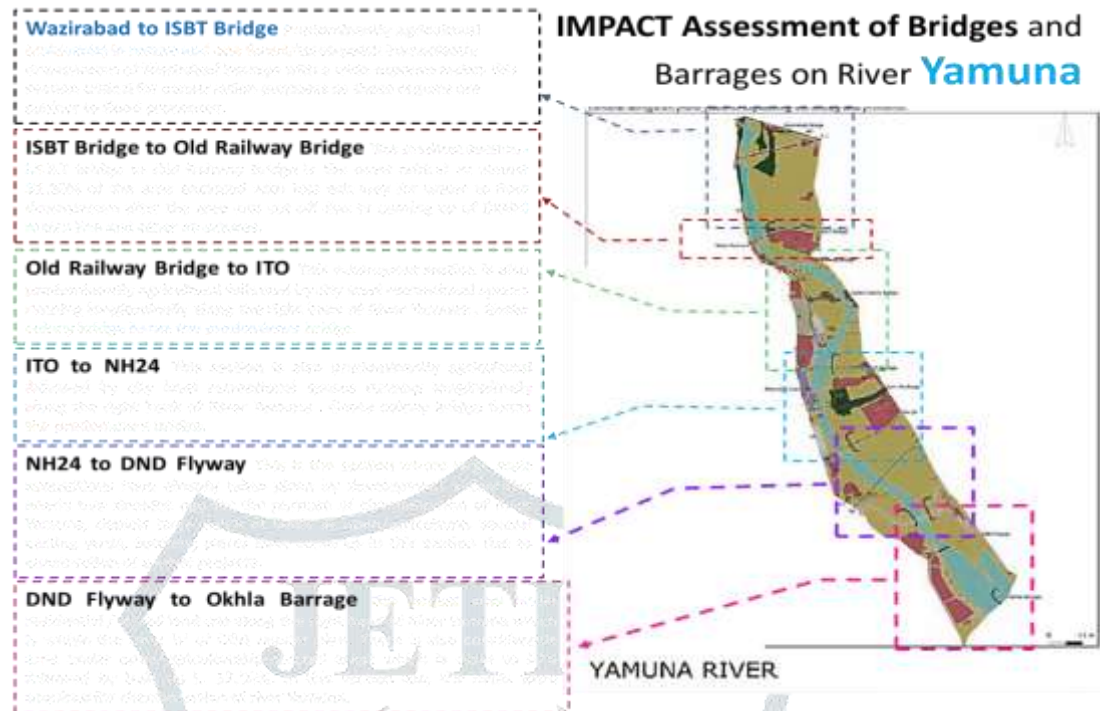


Figure 4 IMPACT Assessment of Bridges and Barrages on River Yamuna (Author)

- 2.2.1. **Wazirabad to ISBT Bridge** Predominantly agricultural (cultivable) in nature and one forest/scrub patch immediately downstream of Wazirabad barrage with a wide expanse makes this section critical for conservation purposes as these regions are subject to flood proneness.
- 2.2.2. **ISBT Bridge to Old Railway Bridge** The smallest section - I.S.B.T bridge to Old Railway Bridge is the most critical as almost 51.20% of the area enclosed with less exit way for water to flow downstream after the area was cut off due to coming up of DMRC metro line and other structures.
- 2.2.3. **Old Railway Bridge to ITO** This subsequent section is also predominantly agricultural followed by city level recreational spaces running longitudinally along the right bank of River Yamuna, Geeta colony bridge forms the predominant bridge
- 2.2.4. **ITO to NH24** This section is also predominantly agricultural followed by city level recreational spaces running longitudinally along the right bank of River Yamuna, Geeta colony bridge forms the predominant bridge.
- 2.2.5. **NH24 to DND Flyway** This is the section where large scale acquisitions have already taken place by development authorities nearly two decades ago for the purpose of channelization of River Yamuna, depicts large patch of lands as open/agriculture. Several casting yards, batching plants have come up in this section due to construction of several projects.

2.2.6. **DND Flyway to Okhla Barrage** the largest area under residential / mixed land use along the right bank of River Yamuna which is within the zone 'o' of DDA master plan. There is also considerable area under open/agricultural/protected areas which is close to "37% followed by built up i.e., 17.56%. In this section too, the lands were acquired for channelization of river Yamuna" (Trust).

3. Analysis & discussions

3.1. Yamuna's Impact on Delhi water resources

Impact on ground water resources	Impact on surface water resources
<p>Over a period of time ground water table has depleted as:</p> <p>Rate Of Extraction > Rate of Replenishment</p> <p>Total ground water resources in the (National Capital Territory) Delhi are</p>	<p>Surface water contributes to over "86% of Delhi's total drinking water" (Delhi, 2015, p. 26). Yamuna provides the major share of this water.</p>
<p>estimated around as 28156.32 ham as per the central ground water board.</p> <p>The annual extraction of ground water is estimated approximately more than twice of its replenishment rate. Multiple sources including rainfall during monsoons and other sources during non-monsoon period are known for recharging Delhi's ground water aquifers.</p>	<p>Reportedly there use to be a total of 611 water bodies including lakes, ponds & reservoirs in Delhi which have depleted over the time.</p> <p>Similarly, as per the state forest report, in 2003 Delhi had 170.17 sq.kms as forest cover against "1483" sqkm (India, 2001, p. 6). Of land area which is "11.4% of lung space in city. This is reduced to only 6.2% at present which is below the national average of 21%" (India, 2001).</p>

3.2. Impact of Urbanisation on Yamuna

The Delhi Floodplain has been tampered initially by post-independence settlements in Yamuna floodplains during emergency (1975-1977). By 1982, when delhi hosted the asian games, trilokpuri, himmalputi, khichripur and kalyanpuri came up further to the east, while the new indraprastha indoor stadium was built on the western bank. By 1990, the east Delhi localities of laxmi nagar, Patparganj and

mayur vihar, and the Noida township had come up in the Yamuna floodplains. With growing impact of urbanization & accelerate demands of 2010 commonwealth games the Yamuna's flood plains are consistently being deprived. Today most of the extended floodplains of east Delhi known as trans-Yamuna area falls 3-4 meters below the 1978 flood level. This area is crucial of Delhi's water needs as it has the highest flooding & groundwater recharge every monsoon. Further a lot of construction activity happened after 2012 is rajeev nagar, sonia vihar jagatpur & jaitpur extension which are flood-prone areas falling under "zone-o".

3.3. Land management & water quality

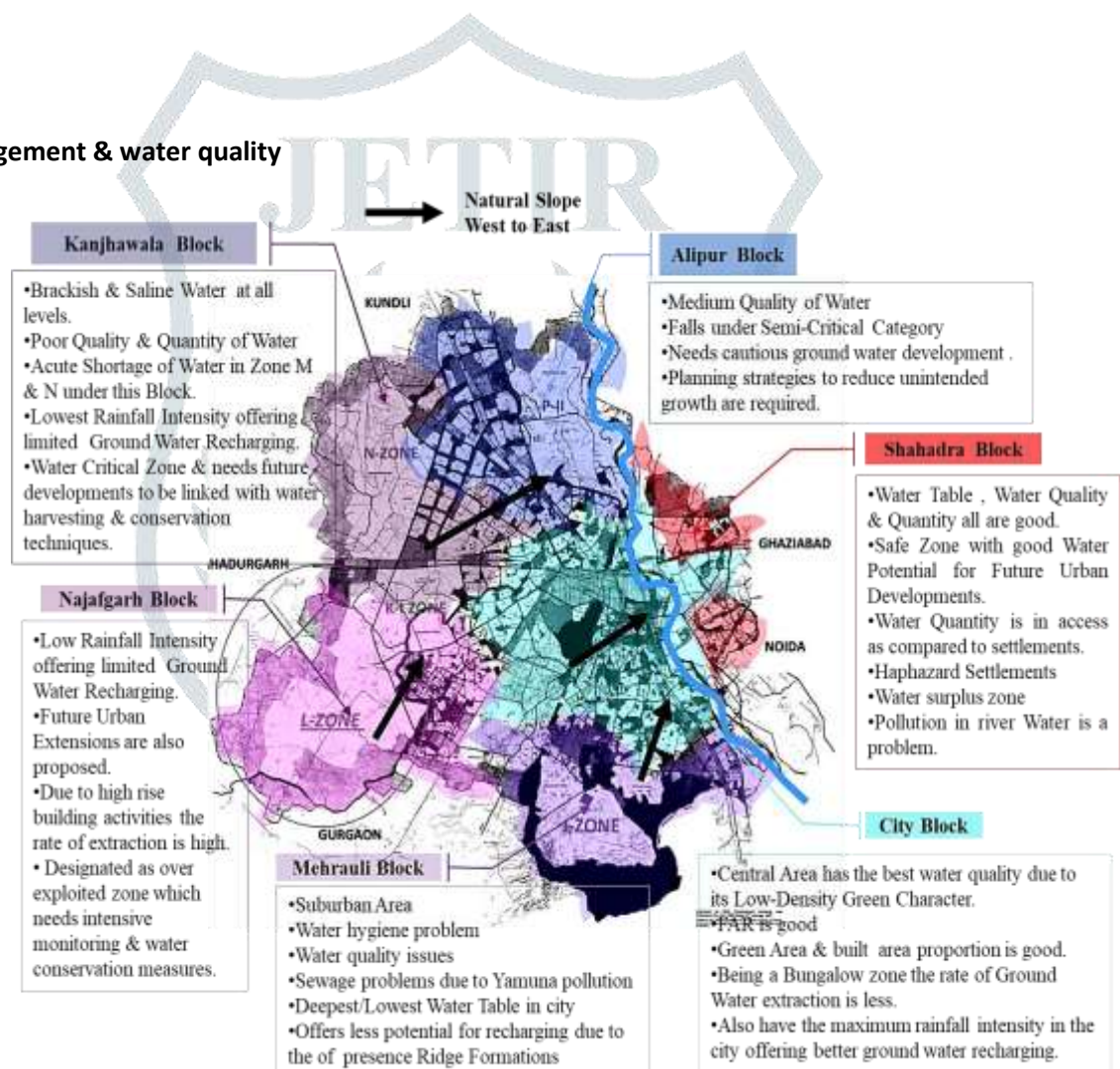


Figure 5 Geological Blocks Overlay with Delhi Master Plan 2021 Zones (Author)

As per the Delhi masterplan 2021 Delhi has been divided into 6 blocks based on geological configuration namely: Alipur block, Kanjhawala block, Najafgarh block, City block, Mehrauli block, shahadra block as depicted in the figure. For the purpose of this study Geological blocks of Delhi map is overlay over Delhi Master plan 2021. This overlay intends to inform about the impacts over water quality due to existing geological formations, which are described in figure5.

3.4. Assessing water quality impacts in Jamia Nagar area: Water sample was collected from various locations in Jamia Nagar area. These locations are marked in the map below, includes localities of abul fazal, ghaffar manzil, shaheen bagh and zakir Nagar.



Figure 6 Locations of water sample collection (Author)



Figure 7 Water samples collected for testing (Author)

The water samples collected were tested in the environmental lab of dept. civil engineering at Jamia Millia Islamia university, using TDS meter – Combo Ph& EC. Based on these investigations it was found that ground water extraction and private pumping is quite common in these areas with predominant use of RO systems. These systems treat locally extracted Ground Water which is then used for Drinking purposes in these localities. The pH value for water samples collected from these localities range between 5-7, which makes this soft water and therefore qualifies for RO systems. These Ro systems offer a broad spectrum for contaminant reduction, which is essential in view of the water quality aspects observed during this study.

Table 1 Water Quality parameters tested for Jamia Nagar Area (Author)

Locality	Temp.	TDS	Ec	pH	mS	Remarks
Zakir nagar	30.8	0.01/10	300	5.91	0.03	pH Acidic
Shaheen Bagh	31.7	0.03/30	600	6.51	0.06	pH Acidic
Ghaffar Manzil	31.9	0.29/29	580	6.67	0.58	pH Acidic
Batla house	31.5	0.005/5	100	6.78	0.01	High Rank Membrane
Abul Fazal	31.2	0.05/50	110	6.7	0.11	Extra Soft Water

4. Conclusions

As per the assessments made in this paper Yamuna and its flood plain areas are largely impacted by urbanisation, which effected its overall quantity as well as quality of water. Therefore, we require to create new paths towards safe water for human consumption and a clean Yamuna. There is a need to understand the whole picture through cooperation and participation, including multiple perspectives, knowledge systems, and experiences. To offer better solutions to the problems that prevails with Yamuna in Delhi. Especially ground water recharging mechanisms are urgently required to dilute the ground water which is loaded with pollutants and contaminants effecting the water quality in Jamia Nagar area.

References:

- (1986). *Groundwater quality in the Union Territory of Delhi: abridged report*. New Delhi: Central Board for the Prevention and Control of Water Pollution.
- board, U. P. (n.d.). *Action plan for restoration of polluted stretch of river yamuna*. Retrieved from UP pollution control board: <http://www.uppcb.com/pdf/PRIORITY-I/RIVER-YAMUNA-5july15.pdf>
- Delhi, G. N. (2015). *Delhi state action plan on climate change*. Retrieved from <http://moef.gov.in/wp-content/uploads/Delhi-State-Action-Plan-on-Cimate-Change.pdf>
- India, F. s. (2001). *State of forest report*. Retrieved from the times of India: <https://timesofindia.indiatimes.com/city/delhi/delhis-total-forest-and-tree-cover-up-by-1-27-per-centin-two-years/articleshow/73032663.cms>
- Planning, D. (2014-15). *ECONOMIC SURVEY OF DELHI*. Retrieved from <http://delhiplanning.nic.in/sites/default/files/ESD%2B2014-15%2B-%2BCh-1.pdf>
- Sharma, D., & Kansal, A. (2011). *Water quality analysis of River Yamuna using water quality index in the national capital territory, India (2000–2009)*. *Applied Water Science*, 1(3–4), 147–157. <https://doi.org/10.1007/s13201-011-0011-4>
- Sommer, M. (n.d.). *India - Uttar Pradesh - Mathura - Boats at Yamuna River - 113*. Retrieved from Flickr: <https://www.flickr.com/photos/asienman/33468841064>
- Trust, E. (n.d.). *Final report on impact assessment of bridges and barrages on river yamuna (wazirabadokhla section)*. Retrieved from <http://environicsindia.in/wp-content/uploads/2016/03/ImpactAssessment-of-Bridges-and-Barrages-on-River-Yamuna.pdf>

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