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RESEARCH PAPER

Seasonal Variation in Zooplankton Population of Yamuna River at Delhi

Anand Kumar Dubey[1]* and I.R. Pathak[2]

[1]Department of Zoology, Post Graduate College Ghazipur, Uttar Pradesh, India
[2]Veer Bahadur Singh Purvanchal University, Jaunpur, Uttar Pradesh, India

*Corresponding author: dubeyakw@gmail.com (**ORCID ID:** 0009-0003-3686-8581)

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ABSTRACT

Zooplanktons are microscopic free floating animals, play a vital role in aquatic ecosystem. Zooplanktons are highly sensitive to environmental variations, as a result change in abundance, species diversity or community composition can provide important indication of environmental health. Present investigation was conducted to study the relationship between seasonal variation and the diversity of zooplankton of river Yamuna in the stretch of Delhi. Zooplankton samples were collected for one year during Feb 2024 to Jan 2025 from three different Locations i,e. SW1-Near Wazirabad bridge (Upstream and entry point of Yamuna River in Delhi), SW2-Near ITO (Mid-stream and located in middle of stretch of Yamuna River in Delhi) and SW3-Near Okhla barrage From Kalindi kunj (Downstream and exit point of Yamuna River from Delhi). Zooplankton analysis was carried out during whole sampling period. Four groups of zooplanktons were reported i.e. Rotifers, Cladocera, Copepods and Ostracods. Among all the group of the zooplankton Rotifers were found to be most dominant at all location followed by Cladocera, Copepoda and Ostracoda. The overall population of zooplankton were recorded maximum during summer season followed by winter and lowest in the monsoon season.

HIGHLIGHTS

- Seasonal variation in zooplankton diversity in Yamuna River was studied for one year at three locations, revealing overall low density and diversity at all locations.
- Only four groups of zooplanktons i.e. Rotifers, Cladocera, Copepods and Ostracods were recorded. Rotifers dominated at all locations and seasons.
- Zooplankton density was maximum during summer season followed by winter and monsoon.

Keywords: Zooplankton, Yamuna River, Seasonal Variation

Zooplanktons are diverse group of tiny aquatic organisms found drifting in aquatic reservoirs generally microscopic, free-floating animals which plays an integral role in aquatic ecosystem (Priya *et al.* 2024) and energy transfer. Among zooplanktons, Rotifers, Cladocerans, Copepods and Ostracods are major groups. They occupying the central position between autotroph and heterotroph and energy transfer to higher trophic level. They also play a very important role in organic material cycling (Shailendra Sharma, *et al.* 2010) Zooplankton is known not only to form an integral part of lotic community but also contribute significantly to the biological productivity of fresh water ecosystems (Sellner *et al.* 1993 & Hassan *et al.* 2009). The zooplanktons serve as bio indicator (Mathivonum, 2007) and it is well suited tool for understanding water pollution status (Ahmed,1996, Contreras *et al.* 2009). Odum 1971 observed that zooplanktons

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are sensitive to their environment and change in zooplanktons concentration can indicate specific environmental change. The diversity of species, amount of biomass and abundance of zooplankton communities can be used to determine the health of an ecosystem (Senthilkumar *et al.* 2016 Pooja Jakhar, 2013). Saldeek V 1983 & Saksena *et al.* 2006 reported that among zooplankton Crustaceans, Cladocerons and Copepods can be used as indicator of aquatic environment. Zooplankton community structure has significant potential for assessing aquatic ecosystem health. Zooplankton density has also been reported to vary depending on the availability of nutrients and the other water characteristics. Higher diversity means longer food chain and more cases of associations which further increases stability (Bhatnagar *et al.* 2013). Zooplanktons are indicators of water quality and purity of aquatic ecosystems. The present study was carried out to study the species diversity and their seasonal variation in River Yamuna at Delhi.

MATERIALS AND METHODS

Study Area

The study was carried out at Delhi stretch of the Yamuna River. Yamuna travels 48 km in Delhi, out of which 22 km stretch is severely polluted due to discharge of sewage and effluent by more than 20 drains. Delhi stretch counts only 2% of the total length of the river however 80% of its pollution is contributed by this stretch. Yamuna river enters in Delhi after crossing the Wazirabad Barrage. It travels for 22 kilometres (13.7 miles) through the northwest, north, northeast, east and south Delhi regions. It finally leaves Delhi at the Okhla Barrage Delhi. The following locations were chosen for sampling in order to study the distribution of zooplanktons of River Yamuna. Water samples were collected in sterile containers and maintained in an icebox on the site. A total of 3 surface water samples were collected in triplicate from 3 sites representing different environmental conditions. Information of the sampling sites with their latitude and longitude are provided below:

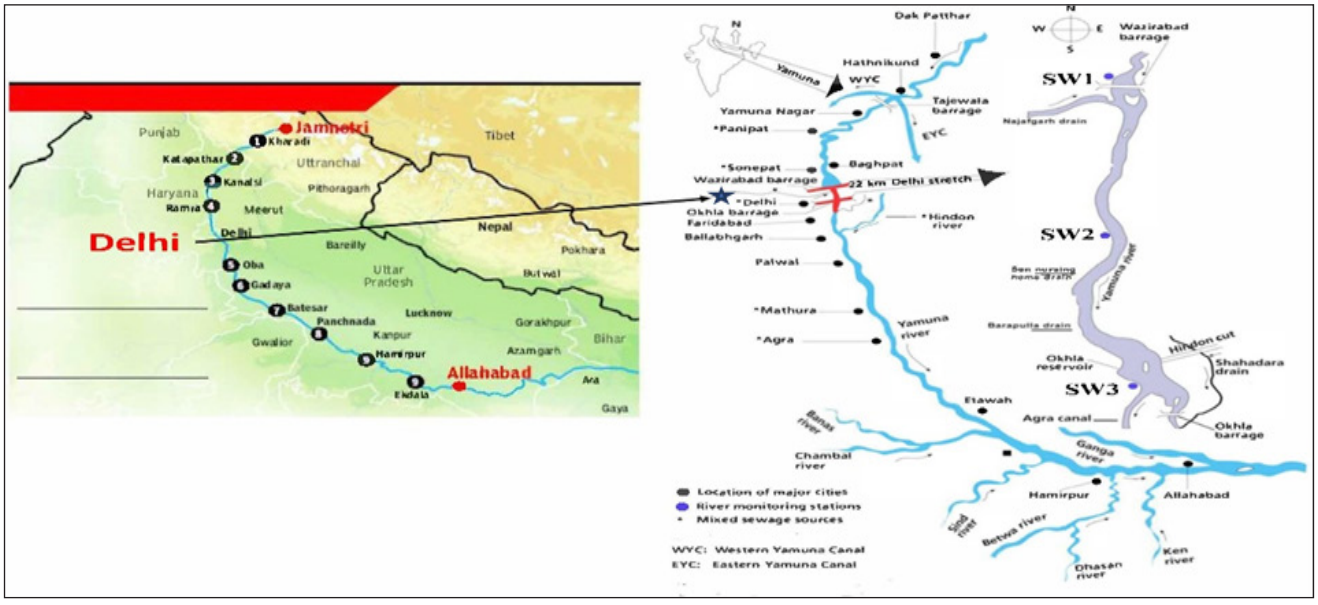
Location 1: SW1 (Wazirabad) - Near Wazirabad bridge (28°43'8.88" N, 77° 14' 27.36" E) (Upstream and entry point of Yamuna river in Delhi).

Location 2: SW2 (ITO) - Near ITO (28°37'39.18" N, 77°15'30.00" E) (Mid-stream and located in middle of stretch of River Yamuna in Delhi).

Location 3: SW3 (Kalindi Kunj) - Near Okhla barrage From Kalindi kunj (28°32'9.84" N, 77°19'29.16" E) (Downstream and exit point of River Yamuna from Delhi).

Zooplankton Sampling & Analysis

Monthly water samples for zooplankton study were collected in triplicate from three different site i.e., SW1 (Wazirabad Barrage), SW2 (ITO)



Details of Yamuna Stretch & Location of Sampling Sites

& SW3 (Kalindi Kunj) spanning from month of Feb 2024 to Jan 2025. The samples were collected on 15th day of every month in morning hours. Surface-grab samples (Martin *et al.* 1992; Nollet & De Gelder, 2014) were collected from all the three sites. Zooplankton sampling from river obtained by filtering 50 L of water through a small standard plankton net (mesh size 55 micron) using a 10 L plastic container. The collected samples preserved directly with 4% neutral formalin solution in 250 mL polyethylene bottles. The volume of all samples were concentrated to 100 mL, and the whole sample examined in a petri dish under a research binocular microscope. For quantitative assessment of zooplankton 1 ml of sample is taken and placed on Sedgwick-Rafter counter and the number of individuals of every species was enumerated as the number of organisms per cubic meter. The organisms were identified and counted. The total number of zooplankton present in a cubic meter (m^3) of water sample was calculated according to the following equation:

$$N = n\ (v/V) - 1000 \qquad \ldots(1)$$

Where N = total number of zooplankton per cubic meter of filtered water; n = average number of zooplankton in 1 ml of zooplankton sample, v = volume of zooplankton concentrates (ml), V = volume of total water filtered (L). The identification of zooplanktons was carried out with help of taxonomic keys and standard literature by Michael (1986); Kodarkar (1992) and Dhanapathi (2000).

RESULTS AND DISCUSSION

Zooplankton constitute necessary part of aquatic biological community they are the major link in the energy transfer at secondary level in aquatic food webs between autotroph and heterotroph (Deivanai *et al.* 2004). Zooplanktons communities responds to wide variety of disturbance including nutrient loading, acidification and pollution loading. Zooplankton diversity and their abundance are directly affected by seasonal variation as well as physicochemical factors of the environment (Poongodi *et al.* 2009 & Saba and Sadhu, 2015). Identification and counting of different zooplankton species had been done regularly during study period. In present study a total four groups of zooplankton were recorded which belongs to, Rotifera, Cladocera, Copepoda & Ostracoda consisting of total 33 Nos of genera Table 1.

Table 1: Zooplankton population in Yamuna River at Delhi during Feb 2024 to Jan 2025

Group	Species	Group	Species
Rotifera	*Brachionus angularis*	**Copepoda**	*Cyclops sp.*
	Brachionus falcatus		*Mesocyclops sp.*
	Brachionus plicatilis		*Paracyclops sp.*
	Brachionus quadridentata		*Microcyclops sp.*
	Brachionus forficula		*Eucyclops sp.*
	Brachionus mirabilis		*Naupilus larvae*
	Brachionus rubens		*Arctodiaptomus sp.*
	Monostyla sp.		*Heliodiaptomus sp.*
	Mytilina sp.	**Ostracoda**	*Stenocypris*
	Keratella tropica		*Heterocypris*
	Fillinia terminalis		
	Asplanchna intermedia		
	Conochilus sp.		
Cladocera	*Daphnia sp.*		
	Moina micrura		
	Moina macrocopa		
	Moina brachiata		
	Bosmina longirostris		
	Alona quadrangularis		
	Pseudosida bidentata		
	Simocephalus Sp.		
	Leydigia sp.		
	Macrothrix spinosa		

The abundance of zooplankton population for all group were recorded to be highest during summer season followed by winter and lowest in monsoon season at all the three stations Table 2 and Fig. 1,2,3. Similar results were reported by (Mehra and Arya. 2022 and Watker, 2013). As far as the density of zooplanktons are concerned, the maximum density was recorded for Rotifers followed by Cladocera, Copepoda & Ostracoda. The hierarchy revealed are as Rotifera>Cladocera>Copepoda>Ostracoda. Among these Rotifera comprises of 13 species, Cladocera 10 sp. Copepoda 8 sp, and Ostracoda 2 sp. It is also pertinent to mention here that Among the percentage distribution of all the zooplankton at all the three location sampled the maximum percentage

Table 2: Monthly and seasonal variation in density (No. /Litre) of zooplankton (Group Wise) Yamuna river during Feb 2024 to Jan 2025

Zooplaktonic Group	Sw1 (Wazirabad Bridge)												Total
	Summer (Pre monsoon)				Monsoon				Winter (Post monsoon)				
	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec	Jan	
Rotifers	18	13	16	21	12	7	8	9	12	10	13	15	154
Cladocera	9	11	5	7	6	8	5	4	9	5	6	7	82
Copepods	10	9	3	8	5	0	4	3	8	6	4	6	66
Ostracoda	7	9	6	4	2	3	0	6	7	4	4	3	55
Total	44	42	30	40	25	18	17	22	36	25	27	31	357
Season wise Variation	156				82				119				357
SW2 (Near ITO)													
Rotifers	10	7	8	10	5	2	2	4	6	7	2	9	72
Cladocera	7	3	4	2	2	1	1	2	4	5	3	3	37
Copepods	3	3	3	2	3	0	0	1	3	2	1	1	22
Ostracoda	4	2	2	1	1	2	1	3	1	2	3	2	24
Total	24	15	17	15	11	5	4	10	14	16	9	15	155
Season wise Variation	71				30				54				155
SW3 (Near Kalindi kunj)													
Rotifers	15	12	14	20	9	4	5	6	8	12	14	17	136
Cladocera	9	8	8	12	7	2	4	3	7	6	5	5	76
Copepods	9	7	5	6	6	1	2	4	5	4	1	3	53
Ostracoda	7	4	3	2	6	1	0	2	2	3	5	3	38
Total	40	31	30	40	28	8	14	15	22	25	25	25	303
Season wise Variation	141				65				97				303

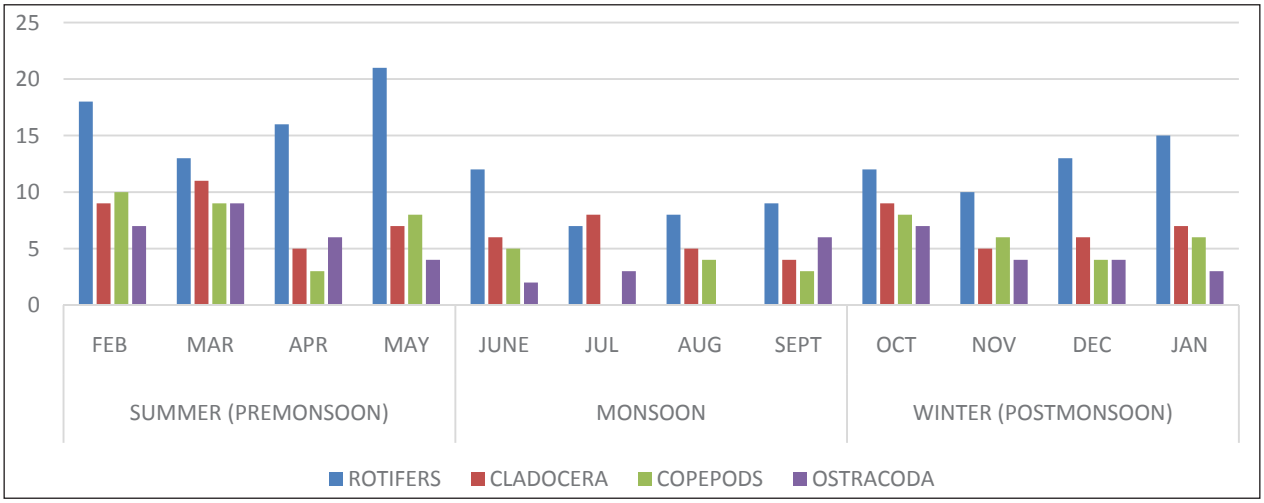


Fig. 1: Monthly Varition in Zooplankton Population during Feb 2024 to Jan 2025 at Monitoring Location (SW1)

of zooplankton was recorded at SW1 (Wazirabad Bridge) followed by SW3 (Near Kalindikunj) and Minimum in SW2 (Near ITO) Fig. 4.

Zooplankton population of Yamuna water varied depending on the season. Total four group of zooplanktons were reported i.e. Rotifera, Cladocera, Copepoda & Ostracoda, the overall population of Zooplanktons were found to be maximum during Summer (Pre monsoon Season) and minimum during monsoon season at all the three sampling locations. Findings are in accordance with the finding of Manoj Kumar (2017) in Yamuna River at Kalpi and Smt Sarika Gautam (2016) in Ganga River in Kanpur district and Seema *et al.* (2025) across

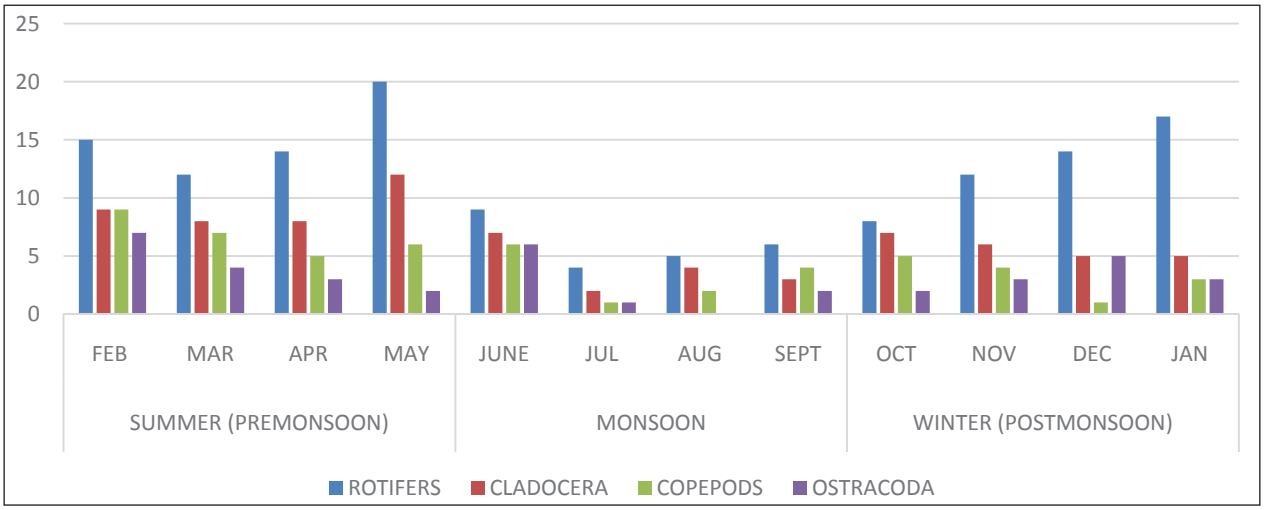


Fig. 2: Monthly Varition in Zooplankton Population during Feb 2024 to Jan 2025 at Monitoring Location (SW2)

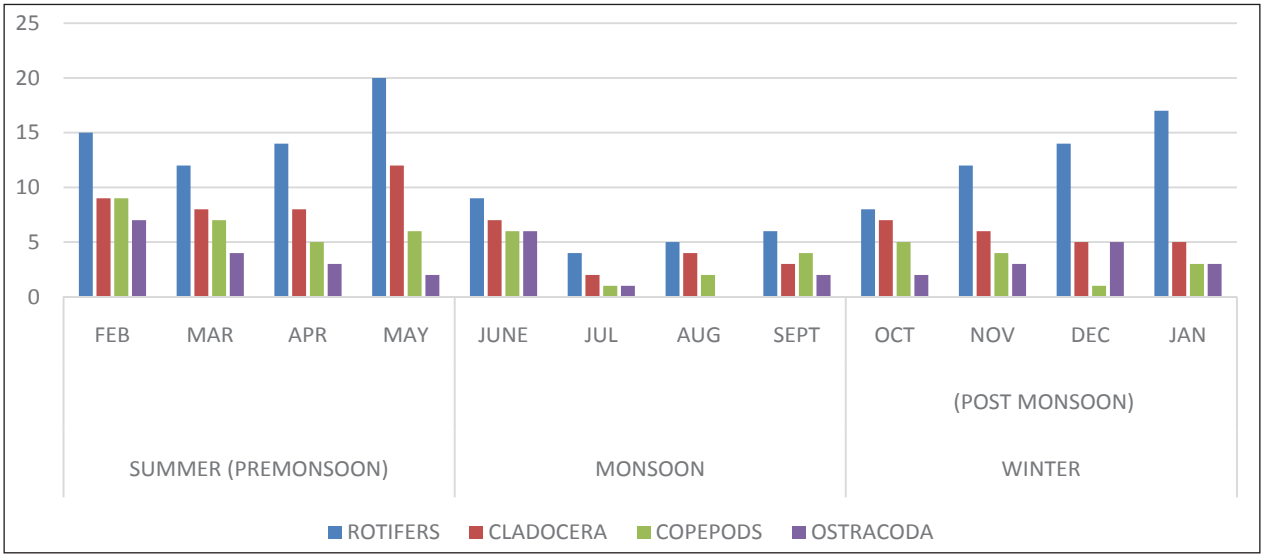


Fig. 3: Monthly Varition in Zooplankton Population during Feb 2024 to Jan 2025 at Monitoring Location (SW3)

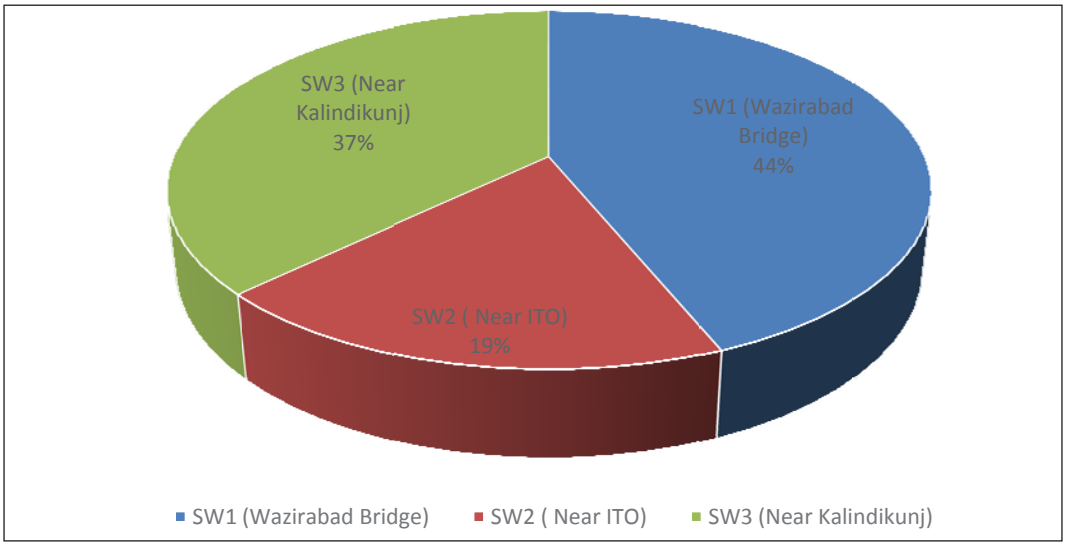


Fig. 4: Percentage Distribution of Zooplankton at all the three Station

selected Freshwater lakes in Northern India. During summer increasing temperature enhance the rate of decomposition due to which the water becomes nutrient rich similarly due to concentration followed by evaporation in summer season the nutrient concentration increases and abundant food present in form of phytoplankton and microorganism which favours the growth of zooplanktons. In summer season the reduced inflow of water bring stability to water body. Similar trend was noticed by Shinde *et al.* 2012 in Harsool –Savangi dam Aurangabad. The reason behind the low population density during monsoon season is attributed to heavy flood, freshwater inflow and lower densities due to its dilution effect and decreased photosynthetic activities by primary production. The Rotifers are found to be dominant at all three locations followed by Cladocera, Copepodes and Ostracodes. The dominance of rotifer population in freshwater system can be attributed to the hyper-trophical condition of the waterbody with high temperature and low water level (Harsha D Neelgund & Girish G Kadadevaru 2021). Since the rotifers have short life cycle they increase in abundance rapidly under favourable environmental conditions. Sinha and Sinha (1983) reported high rotifer population in summers because of high temperature, higher values of chlorides, nitrates and phosphates in summer season. Rotifers were frequently observed at all stations and this species is considered to be the indicators of eutrophication. The population of the zooplankton was found maximum at Wazirabad Barrage (SW1) because it is entry point of river Yamuna into Delhi and is upstream of the main pollution sources in Delhi, dilution of river water by freshwater release from the Wazirabad barrage, and a minimal discharge of industrial effluents compared to the downstream near ITO (SW2). The water quality near ITO (SW2) deteriorate severely due to mixing of large quantity of industrial effluent and sewage from the city, here the river water is characterized by high amounts of organic and pathogenic contaimination, turbid appearance, very low DO value and high values of BOD (CPCB 2010, 2011, 2012; Malik *et al.* 2014). The sampling location SW3 (Kalindikunj) is located in downstream of the major pollution sources in Delhi, at this point due to augmentation from Hindon cut canal to Yamuna near Okhla barrage there is small improvement in water quality (Suruchi *et al.* 2015).

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