

A STUDY ON PHYSICO-CHEMICAL PROPERTIES OF YAMUNA RIVER AT DELHI STRETCH

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ABSTRACT

For every mankind source of water (H₂O) is very crucial for their livelihood and it's a primary conduct of our environment. Hence, the source of water must not waste and pollute for the instance cited above. The prominent river Yamuna which originated from the glacier Yamunotri at a height of 6,387 meters (20,955 ft) on the southwestern slopes of Banderpoch peak of the Lower Himalaya in Uttarakhand, the main stream of this river crosses 5 states followed by Uttarakhand, Himachal Pradesh, Haryana, Delhi and Uttar Pradesh before meeting with Ganga at Allahabad and forms second largest tributary of the Ganga river. It plays various role in various segment as it's flowing through various states being not for the reason of public utilization purpose, agriculture use and runoff, religious devotees take bath and discharge of extracts, discharge of household and industrial effluents, etc, for the reason it held as toxic water and even ground water of that area is not suitable for human health. All such activities and events are hindering its natural phenomena of our ecosystem leading to devastating situation. In the present study is to find and assess how the people residing near the bank of Yamuna River are physically affected for due reasons, using of river water directly and indirectly for various purposes. Various physical and chemical parameters like DO, BOD, COD, pH, Total Suspended solid, Heavy Metals, Total Dissolved Solids, Alkalinity, Turbidity, Hardness, Chloride contents, Sodium, Calcium, Electric conductivity are determined for different samples and compared with the standard limits recommended by WHO, IS 10500. Water samples are collected from five different places under the standard conduct of lab test.

KEYWORDS: Pollution, BOD, COD, Heavy Metals, Ground water, Yamuna River, WHO.

1. **INTRODUCTION:** Since there has been a long agitation with tenants, daily wage earner and people residing near Old Iron Bridge on Yamuna River locating at Shahdara, Old Delhi as the river is considered Dead River from Panipat to Agra. Due to excessive pollutant in water, their cultivated crops and vegetables are taint in the market and facing various health issues like; liver disease, Diarrhea, disorder of kidney, stomach cramp, dysentery, etc due to utilization and consumption of its water. For the similar instance they showed me few samples of vegetables and crops even the place where they cultivate their crops. And it found to be very unreliable for human health due to very poor and severely contaminated water. On the basis of natural phenomena it is sure, there is very excessive of CO₂ (acidic in nature) leading to increasingly growing of Alga Bloom. The current trend of my research is on the water uses for farming, drinking and other utilization. The water they use for drinking, farming and household utilizations which are mostly supplied from nearby government water tanker as well as bore well and the polluted water of Yamuna respectively. According to them the water they use from bore well is very acidic as well as chalky in nature and this is due to various factors affecting the ground water like, the bore well is installed nearly 150 meter distance from highly polluted Yamuna and many inland water logged area for a decade. Even I found there are various chamber of surface pit, where residing workers wash various kinds of cloths and garments with Washing Soda (Sodium Salt) formally Sodium Carbonate (Na₂CO₃) and it is also nearest to the bore well.

2. **SAMPLING LOCATION:** Burari (S1), Signature Bridge (S2), Old Iron Bridge (Shahdara) (S3), Nizamuddin (S4), Okhla (S5).

3. MATERIALS AND METHODS

3.1. pH: The pH of samples was determined directly by pH meter. The pH value indicates the hydrogen concentration present in water. Thus it represents the alkalinity or acidity of water. The pH is logarithm of reciprocal of hydrogen (H⁺) value, so higher the value of pH denotes lower in hydrogen ion and it determine the acidic concentration.

3.2. Dissolved Oxygen (DO): The DO was determined by using starch as indicator and fixation reagent. In distilled water the concentration of dissolved oxygen decides how much pure the water is. Because the oxygen is the major element in water for its self-purification to support aquatic life. DO even help to maintain its taste and odor, less the oxygen higher the chances of odor and bitter taste.

3.3. Alkalinity: The alkalinity was determined by acid based titration using phenolphthalein and methyl orange indicator. It is basically used to measure for determining the level of dissolved carbonates, bicarbonates and hydroxides present in water. More the amount of carbonates more alkaline the water.

3.4. Hardness: The hardness was determined by acid based titration using Erichrome black T indicator and standard (0.01N) EDTA solution. It is basically used to measure the amount of dissolve calcium and magnesium in water. More the elements are dissolved more hard the water.

3.5. TDS: The TDS was measured by Whatman filter paper No 1 and heat bathing, in this

process water samples are filtered through the paper and dry it in a normal heating temperature. After the filtered dish gets dry totally, we weigh it to calculate the Total Dissolved Solids present in water.

3.6. Ca (Calcium): The concentration of calcium was determined by acid based titration using Erichrome black T indicator and standard EDTA solution. Lead to hardness in water and it is always naturally present in ground water.

3.7. Ni (Nickel): The Nickel content was determined by Ion exchange method by ICP-OES (Inductive coupled Plasma-Optical Emission Spectrometry) which is an analytical technique.

3.8. Cl (Chloride): The chloride content was determined by Argentometric titration using K₂CrO₄ as an indicator. It is a naturally occurring element in water and it is commonly found as a component of salt.

3.9. BOD: The BOD was determined by using chemical based titration with 0.025N sodium thiosulphate and alkaline-iodide-azide solution.

3.10. COD: The COD was determined by titrated ferrous ammonium sulfate using orthophenanthroline ferrous complex as an indicator.

4. RESULTS AND DISCUSSIONS

4.1. Locations of Sampling:

The samples are taken from five geographical sites during pre-monsoon and monsoon season to compare the physiochemical property and characteristic of water collected from five prominent places of Delhi region. These are Burari (S1), Signature Bridge (S2), Old Iron Bridge (S3), Nizamuddin (S4) and Okhla (S5). The analysis of water quality was taken during pre-monsoon as well as monsoon for various parameter i.e. pH, Hardness, Alkalinity, BOD, COD, TDS, Na, Ca, Cl and DO. The geographical locations

of the samples taken for analyzing and study are shown down in fig.1.

4.2. Potential Hydrogen or Hydrogen ion concentration:

The pH level varies from 6.9 to 8.1 during pre-monsoon and 7.6 to 8.7 during monsoon. As per the WHO recommendation the standard pH value should be within 6.5 to 8.5 and beyond this value there is no

relaxation in permissible limit shown in fig.3. According to WHO standards all the samples are within the limit, except one sample where it's exceeding up to 8.7 at Burari. The pH level is showing maximum due to residential and various agricultural waste discharges that merged in Yamuna River. Another reason of high pH value is may be due to high insolation of Sunlight, which leads to high photosynthesis of macro and micro vegetation of water and resulting in decrease in O₂ and increase in CO₂. Shifting towards the basic equilibrium.

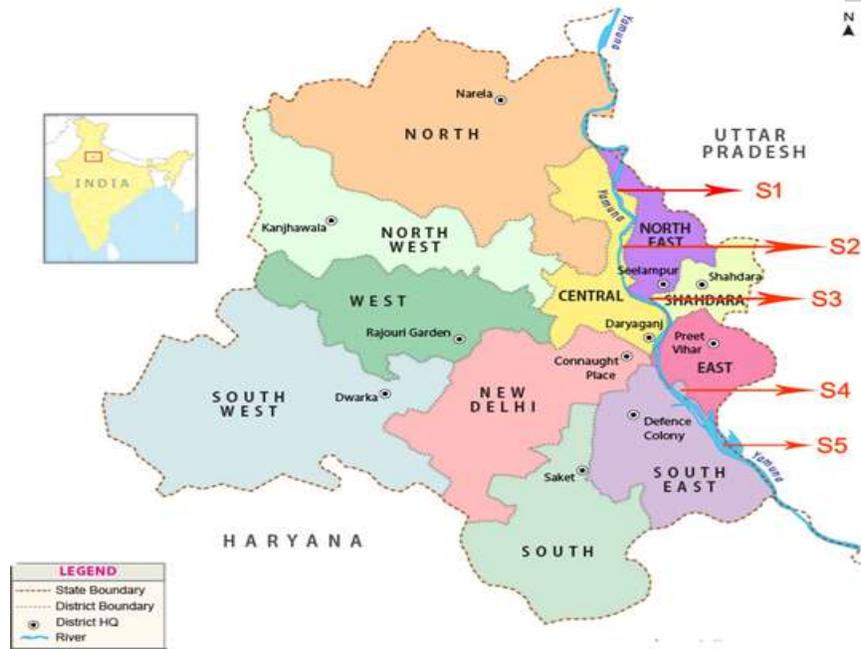


Fig. 1. Geographical location of studied area and sampling sites.

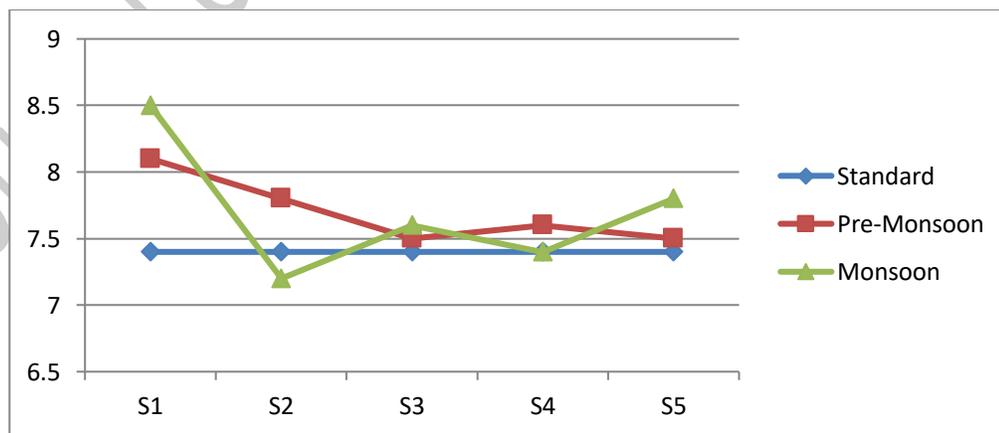


Fig. 2. The plot is showing pH variation during pre-monsoon and monsoon differing from standard limit.

4.3. **Total Hardness (CaCO₃):** The total hardness varies from 356 to 625 during pre-monsoon and 496 to 606 during monsoon. Considerably the sample results are above the permissible limit of the WHO and ISI standards shown in fig.4. As per standards 200 mg/l is considered as soft water as desire and above this limitation is considered as hard water. The maximum permissible limit with no relaxation is up to

600 mg/l; hence the water is no more desirable for drinking even for other human purpose. The lowest limit of hardness has been seen near Burari and the highest is near Signature Bridge. Due to various effluents discharge from industry and residential complex the hardness of water is very high at that place as many drainage systems adjoined near this bridge.

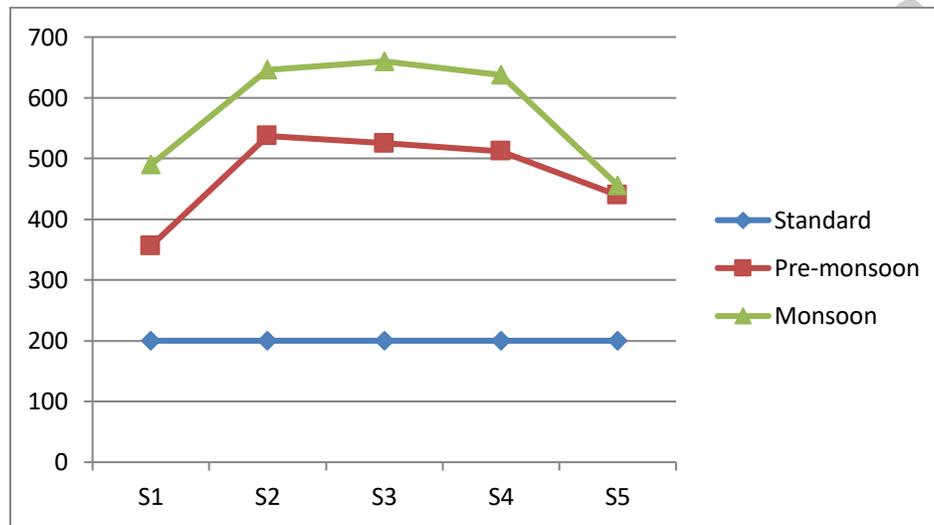


Fig. 3. The plot is showing Hardness variation during pre-monsoon and monsoon differing from standard limit.

4.4. **Total Alkalinity:** The total alkalinity of the sample varies from 175 to 340 during pre-monsoon and 117 to 263 during monsoon. As per the WHO recommendation the standard value of alkalinity should be 200 mg/l and should be in a permissible limit of 600 mg/l shown in fig. 5. According to the sample result the alkalinity of water sample

was considerably higher than the standard value near Signature Bridge and near Old Iron Bridge. During pre-monsoon the value of alkalinity was higher as compare to on monsoon. Therefore, the growth of algae bloom rate was comparatively high during pre-monsoon.

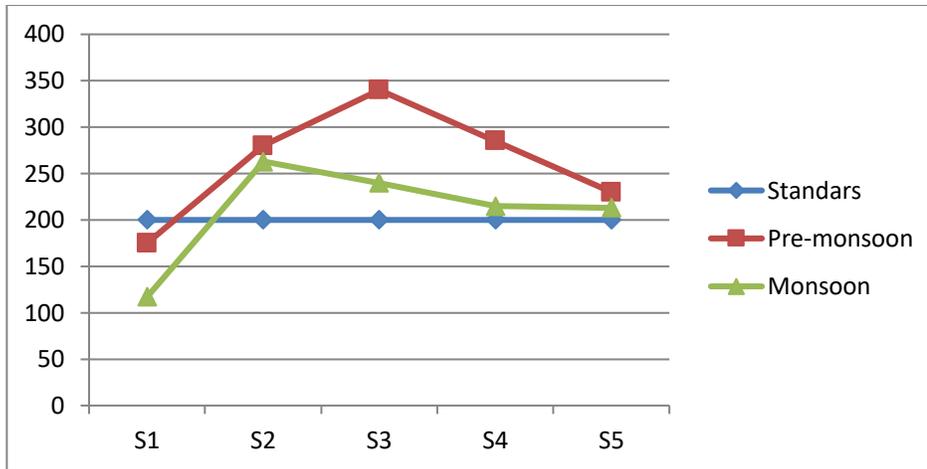


Fig. 4. The plot is showing Alkalinity variation during pre-monsoon and monsoon differing from standard limit.

4.5. **DO (Dissolved Oxygen):** The dissolved oxygen of the sample varies from 0.0 to 5.6 during pre-monsoon and 0.0 to 6.9 during monsoon shown in fig. 6. The dissolved oxygen basically signifies the amount of oxygen present or dissolved in the water, up to ten molecules of oxygen per million of water. As per the USGS (United States

Geological Survey) and USPH (United States Public Health) the standard value of DO (Dissolved Oxygen) should be 6.5 to 8mg/l. According to the sample result the value lies within the limit only in one place but other than these remaining four places are very low or can be said zero.

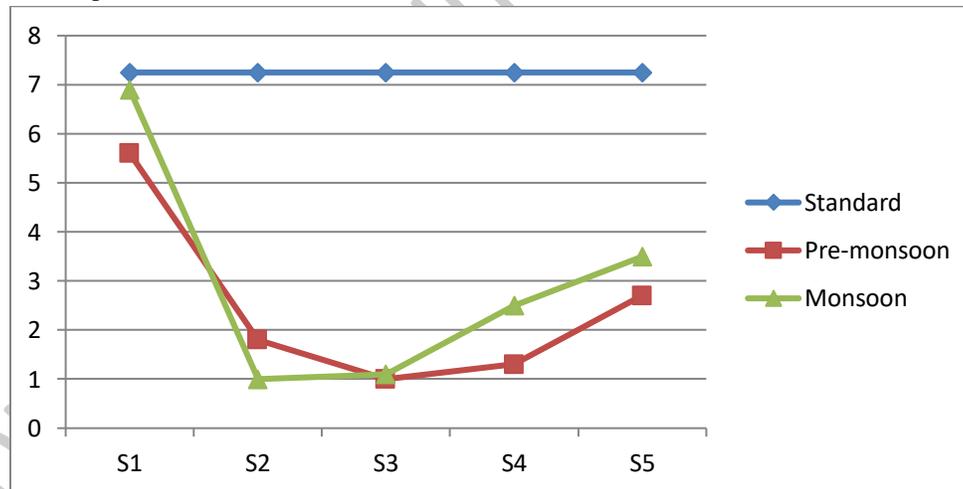


Fig. 5. The plot is showing DO (Dissolved Oxygen) variation during pre-monsoon and monsoon differing from standard limit.

Parameter		SAMPLE LOCATION				
		S1	S2	S3	S4	S5
pH	Pre-monsoon	8.1	7.8	7.5	7.6	7.5
	Monsoon	8.5	7.2	7.6	7.4	7.8
Hardness	Pre-monsoon	356	537	625	512	440
	Monsoon	540	646	660	638	456
Alkalinity	Pre-monsoon	175	280	340	285	230
	Monsoon	117	263	240	215	213
DO	Pre-monsoon	5.6	1.8	1.0	1.3	2.7
	Monsoon	6.9	1.0	1.1	2.5	3.5
TDS	Pre-monsoon	3850	4268	4980	3937	2117
	Monsoon	2315	3808	3500	2463	2061
BOD	Pre-monsoon	2.3	19	36	27	31
	Monsoon	2.1	18	33	26	24
COD	Pre-monsoon	6	12	91	75	89
	Monsoon	15	18	113	72	74
Ca	Pre-monsoon	195	325	360	340	410
	Monsoon	310	390	427	425	483
Cl	Pre-monsoon	380	600	860	910	598
	Monsoon	273	580	652	693	417
Ni	Pre-monsoon	1.05	1.01	1.2	1.28	1.4
	Monsoon	0.83	0.98	1.25	0.9	0.7

Table.1. Physico-chemical analysis Yamuna river water during pre-monsoon and onset monsoon season of five different stations.

4.6. **TDS (Total Dissolved Solid):** The TDS (Total Dissolved Solid) varies from 2117 to 4980 mg/l during pre-monsoon and 2061 to 3500 mg/l during monsoon season shown in fig. 7. The TDS (Total Dissolved Solid) represents the concentration of organic and inorganic particles or substances present in the water at mg/l. As per WHO 1200 mg/l and IS: 10500-1991 2000 mg/l is the maximum permissible limit for domestic use and 500 gm/l for drinking. According to the

standard limits all the samples tested from various stations are higher than the permissible limit and it is deteriorating the natural phenomena of flora and fauna. Due to industrial runoff and effluents from residential complex the value tend to high and Cl. content is always high of industrial discharge. During pre-monsoon the value was very high at Old Iron Bridge.

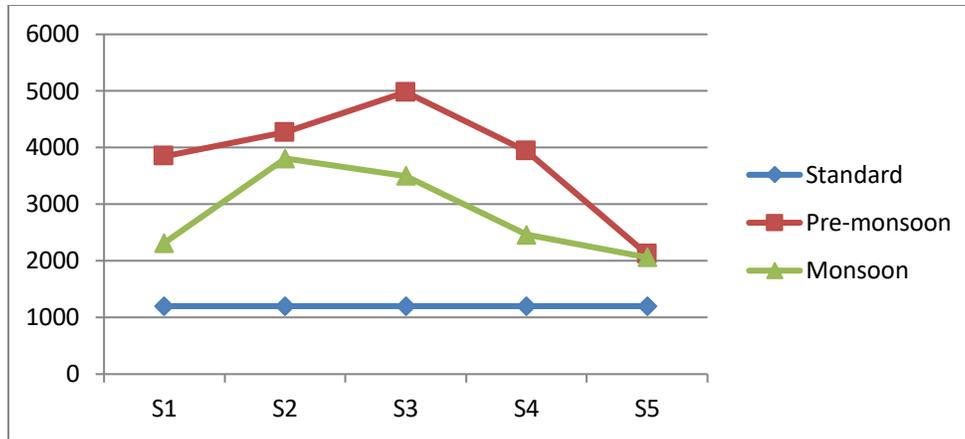


Fig. 6. The plot is showing TDS (Total Dissolved Solid) variation during pre-monsoon and monsoon differing from standard limit.

4.7. BOD (Biochemical Oxygen Demand): The BOD (Biochemical Oxygen Demand) value varies from 2.3 to 36 mg/l during pre-monsoon and 2.1 to 33 mg/l during monsoon shown in fig. 8. As per the IS 10500 and EPA the value of BOD should be 3 to 5 mg/l as standard and permissible limit respectively. According to standard value, the tested samples of various stations are not

considerable except at Burari. BOD is basically a chemical process where it determines the amount of dissolved oxygen required for organisms present in water for aerobic biological process to disintegrate (break down) the matter present in water sample. More the water polluted more will be BOD.

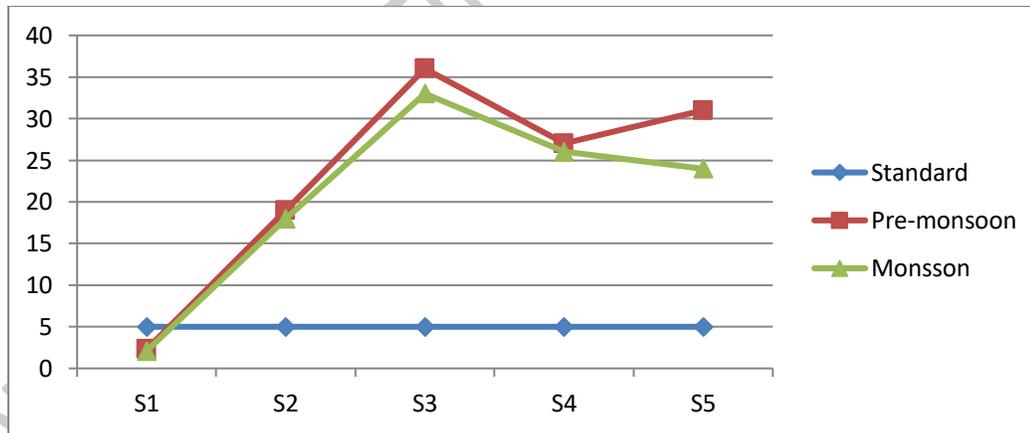


Fig. 7. The plot is showing BOD (Biochemical Oxygen Demand) variation during pre-monsoon and monsoon differing from standard limit.



Fig.8.Devastated condition of Yamuna River due heavy pollution and constant anthropogenic activities.

4.8. COD (Chemical Oxygen Demand): The COD (Chemical Oxygen Demand) varies from 8 to 96 mg/l during pre-monsoon and 12 to 115 during monsoon season. As per the CPCB and EPA the value should not exceed 50 gm/l, there is no proper standard limit for COD, in many cases the limit is 75

to 100 mg/l and in some case its 250 mg/l for domestic and industrial effluent respectively. According to standard limit in few stations the value has exceeded i.e. 6 to 91 mg/l during pre-monsoon and 15 to 113 mg/l during monsoon.

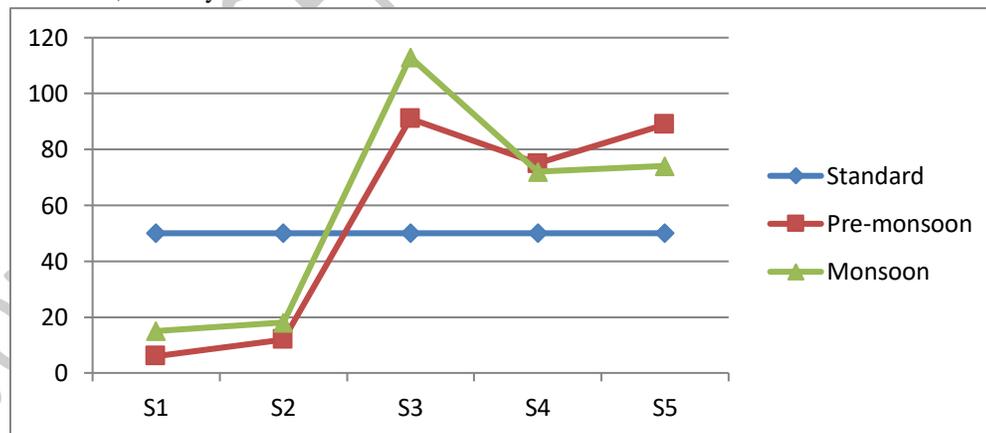


Fig. 9.The plot is showing COD (Chemical Oxygen Demand) variation during pre-monsoon and monsoon differing from standard limit.



Fig.10. Polluted runoff merging at Yamuna, Public urinating and littering in Yamuna, Black polluted water of Yamuna due to trash, garbage and residuals of idol immersion.

4.9. Ca (Calcium), Cl (Chloride), Ni (Nickel):

According to the stationary samples Calcium value is 195 to 410 mg/l during pre-monsoon and 310 to 483 during monsoon. The Chloride value is 380 to 910 during pre-monsoon and 273 to 693 during

monsoon. The Nickel value is 1.05 to 2.4 during pre-monsoon and 0.80 to 1.95 during monsoon. As per the standard limits all the values are exceeding its permissible limits for drinking purpose

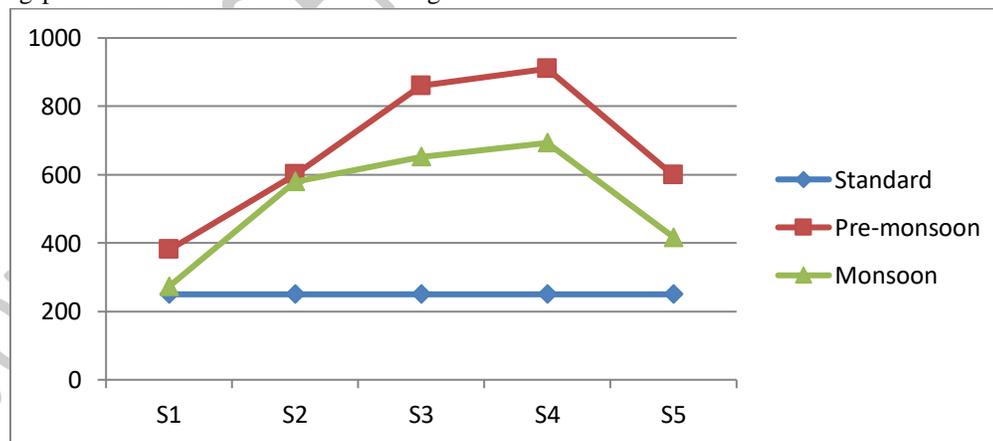


Fig. 11. The plot is showing Cl (Chloride) variation during pre-monsoon and monsoon differing from standard limit.

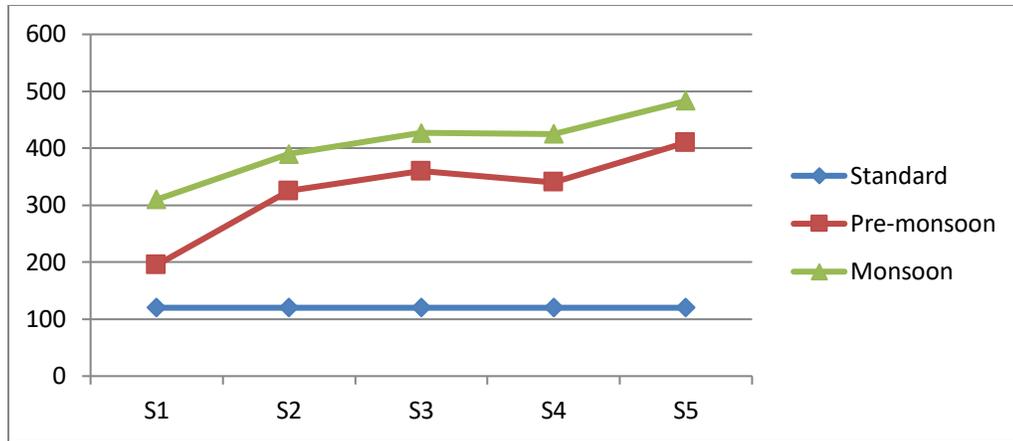


Fig. 12. The plot is showing Ca (Calcium) variation during pre-monsoon and monsoon differing from standard limit.

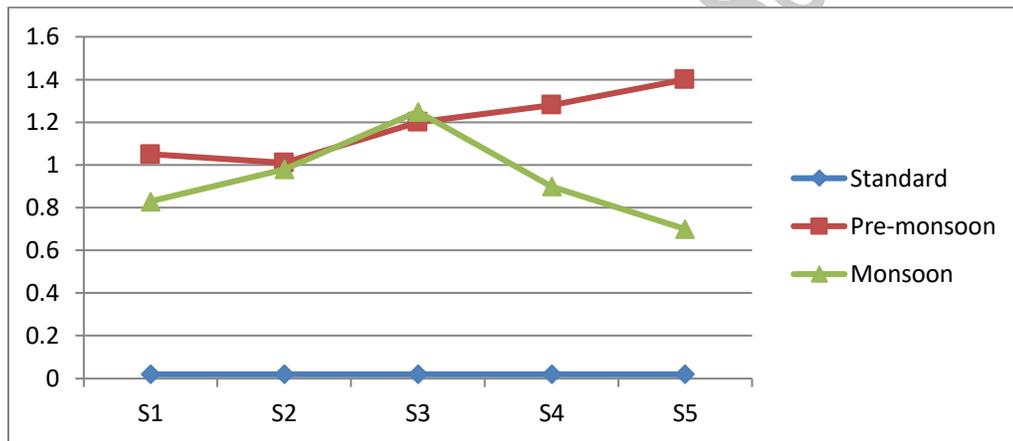


Fig. 13. The plot is showing Ni (Nickel) variation during pre-monsoon and monsoon differing from standard limit.

5. CONCLUSION

A Physicochemical study on Yamuna River, where the most polluted runoff and effluent meet with stream of the river explicitly defining that the quality of river water is not desirable for drinking as well as domestic use. The data during Pre-monsoon and on monsoon any way remain polluted due to various anthropogenic activities and industrial activities. Many parameters i.e. Hardness, Alkalinity, DO, TDS, BOD, Ni, Ca, Cl, are above or below the desirable limit and not compatible for any other use than waste and deteriorating cause of ecosystem. Therefore, controlling over the factors polluting the river water and the ecosystem should be accompanied with more

stringent guidelines as the present guidelines are not enough effective.

6. REFERENCES

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