A comparative statistical study on water pollution before and during pushkaralu in Tungabhadra-2020 River in Kurnool (urban), AP, India

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Abstract: Humans are creatures who believe in higher entities. In a land like India which has multiple cultures and religions, some practices may cause harm to the environment. Pushkaralu is a festival that taken place on the bank of a river according to the zodiac sign in Hindu mythology. The year 2020 was the year for the river of Tungabhadra and as it is a year of pandemic, many things have changed regarding mass gatherings and even more regarding mass bathings. Though there were many norms to be followed, the mass gatherings affected the quality of water and as Kurnool town being one of the hotspots for covid-19 and pushkaralu simultaneously.

Keywords: Mahapushkar, Mass Bathing, River Thungabadhra, COVID-19, Water Quality, E. coli

1. Introduction

In the time of the pandemic, while the world froze after a century, everyone had their faith in science but kept their trust in God. As the pandemic started wildly spreading around the world and after lockdown, everyone had a sense of profanity over life. Many started living like there is no tomorrow and be grateful to the higher entity which helped them survive this chaos around them. In a country with a majority of Hindu population in the world, every small device event is gonna attract a large amount of crowd. Pushkaralu is a kind of event which generally attracts a huge amount of devotees around the country. As the vigorous spread of covid-19, many people dropped their idea to take bath in holy waters, but still, comparatively, a large number of devotees from states of Maharashtra, Karnataka, Tamil Nadu, and Telangana visited the river Tungabhadra banks and had their holy baths. To avoid the spread of the covid-19, there were separate showers built on ghats, and the water after the bath was sent into the river.

There were 8 ghats constructed around the town in prime areas along the riverside. These sites were constructed in a month and included Pushkar ghats, showers, pipelines, cabins, etc. the ghats were set around in the order I table no.1

Table.1. designated Pushkar ghat code, name, location, and total population who took a mass bath at each ghat

Ghat no.	Ghat Name	GPS(Degree Decimal)		Total No. of devotees
		Longitude east	Latitude north	
G1	Panchalingala	15.859	78.008	19827
G2	Sankal bagh	15.842	78.043	78563
G3	Sai baba temple	15.8413	78.044	10660
G4	Old pump house	15.8414	78.043	9595
G5	Raghavendra matam	15.8388	78.049	10858
G6	Naga sai temple	15.8387	78.050	1681
G7	Rambotla alayam	15.829	78.056	14533
G8	Nagareshwara temple	15.826	78.058	7038

Study area

Location:- Tungabhadra River is originated by joining rivers Tunga and Badhra in koodli flowing from eastern ghats to western ghats in Karnataka. The rate of microbial contamination in river water increases tremendously and tends to disturb river ecology during mass bathing and affects human health immediately (Saini,

2008; Pandey, 2005; Kumarasamy, 2009; Arora and Tewari, 2012). Hence, a statistical analysis was conducted to observe the Physico-chemical, biological and microbial characteristics of Tungabhadra river water in the Kurnool district of Andhra Pradesh, India, during 'The pushkaralu period. The study was done around 12 days of pushkaralu 2020.

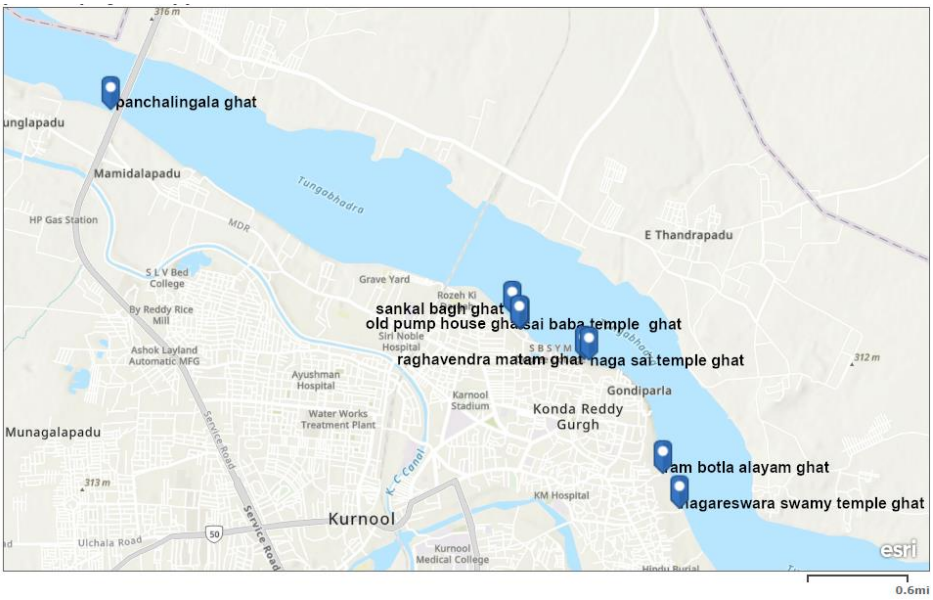


Figure1. location of ghats along the river in the Kurnool town

ii) Climate:- As it was during the time of winter, the temperatures were less and due to the sudden occurrence of cyclone Nivar, there were climate changes during the 25th and 26th of November 2020 in Kurnool. Local climatic parameters like maximum temperature, humidity, etc play an important role for people who arrive at ghats for mass bathing. The measured temperature of Kurnool city during the Pushkar period is given in Table 2.

date	21	22	23	24	25	26	27	28	29	30	1	2
Highest Temperature (Co)	35	34	32	33	32	25	23	25	27	32	32	32
Lowest Temperature (Co)	19	23	21	21	22	20	20	22	21	20	20	19

Table2:-Details of climate parameters during the Pushkar period (21st November to 2nd December 2020)

2 Methodology

River water samples were collected separately in clean polyethylene bottles for physical, chemical analysis and BOD bottles for biological analysis. Physical parameters (pH, temperature, electrical conductivity, turbidity)and chemical analysis Biological analysis (DO, BOD, COD, MPN, TFC, TBC, E. coli) was carried out at regional lab, Kurnool Andhra Pradesh. Na and K were determined using a Flame photometer and UV-Spectrophotometer was used to determine NO3. Dissolved Oxygen was fixed by adding fixator Mn(OH)2 in BOD bottles. MPN and TFC is a presumptive test specific for detecting Coliform bacteria. TBC and E. coli were estimated by serial dilution/Pour-plate technique.

3. Results And Discussions

The study was done in 3 parts. River water samples were collected from 8 important ghats in Kurnool town in each phase i.e during the pre-Pushkar(20/10/2020) and Pushkar(21/11/2020 to 02/12/2020),. The average values of the physical analyses of the samples collected during these two phases are given in Tables 3 and 6 respectively. The Chemical properties in table 4 and 7. The biological analysis of the pre-Pushkar event, during Pushkar event and post-Pushkar event are in table 5 and 8, respectively.

Table3:-physical analysis of water sample collected on 20/10/2020 (pre-pushkar event)

Sno.	source	Turbidity(NTU)	Total Hardness	Total alkalinity	TDS(mg/lts)	EC(mhos/cm)
1	panchalingala	13	287	182	1103	1684
2	Sankal bagh	12	284	180	1041	1602
3	Sai baba temple	13	288	185	1126	1652
4	Old pump house	13	279	183	1109	1645
5	Raghavendra matam	13	273	178	1023	1623
6	Naga sai temple	11	272	176	1008	1602
7	Rambotla alayam	06	270	173	983	1592
8	Nagareshwara temple	08	263	169	975	1575

All units square measure in mg/l. TH: Total Hardness as CaCO3. TDS: Total Dissolved Solids, EC: Electrical physical phenomenon

Table4:-chemical analysis of water sample collected on 20/10/2020 (pre-Pushkar event)

Sno.	source	pH	Alkalinity	Cl	N	Fl	S
1	panchalingala	8.2	220	236	12.2	0.74	170
2	Sankal bagh	7.9	180	240	6.5	0.78	205
3	Sai baba temple	7.8	180	240	6.6	0.72	203
4	Old pump house	7.7	166	196	3.3	1.27	215
5	Raghavendra matam	7.5	159	182	3.2	1.16	212
6	Naga sai temple	7.4	153	175	2.8	1.02	193
7	Rambotla alayam	7.6	170	178	4.5	1.2	223
8	Nagareshwara temple	7.8	173	171	5.2	1.35	255

Table5:-biological analysis of water sample collected on 20/10/2020 (pre-Pushkar event)

Sno.	**Ghat Name**	**BOD(mg/l)**	**COD(mg/l)**	**DO(mg/l)**	**Coliform(CFU)**
1	panchalingala	8.0	19.0	1.9	1523
2	Sankal bagh	9.2	20.2	2.2	1569
3	Sai baba temple	9.2	21.5	2.1	1592
4	Old pump house	9.5	20.6	2.6	1632
5	Raghavendra matam	10.1	19.8	3.2	1592
6	Naga Sai temple	9.8	23.6	3.5	1625
7	Rambotla alayam	9.6	22.5	3.8	1682
8	Nagareshwara temple	11.2	24.0	3.6	1701

Table6:-physical analysis of water sample collected from21/11/2020 to 02/12/2020(Pushkar event)

Sno.	**source**	**Turbidity(NTU)**	**Total Hardness**	**Total alkalinity**	**TDS(mg/lts)**	**EC(mhos/cm)**
1	panchalingala	32	292	201	1165	1752
2	Sankal bagh	38	308	215	1280	1863
3	Sai baba temple	38	308	215	1280	1865
4	Old pump house	38	311	210	1202	1824
5	Raghavendra matam	39	302	209	1195	1809
6	Naga sai temple	39	300	203	1193	1816
7	Rambotla alayam	28	301	208	1210	1856
8	Nagareshwara temple	28	303	208	1213	1853

Table7:-chemical analysis of water sample collected from21/11/2020 to 02/12/2020(Pushkar event)

sno	**source**	**pH**	**Alkalinity**	**Cl**	**N**	**Fl**	**S**
1	panchalingala	8.3	250	250	14.2	1.2	203
2	Sankal bagh	9.2	286	278	15.8	1.5	254
3	Sai baba temple	9.1	285	278	15.8	1.5	254
4	Old pump house	8.9	272	263	14.8	1.35	238
5	Raghavendra matam	8.6	265	265	14.6	1.32	226
6	Naga sai temple	8.7	258	270	14.2	1.29	215
7	Rambotla alayam	8.6	264	267	14.9	1.42	235
8	Nagareshwara temple	8.5	262	256	14.8	1.39	228

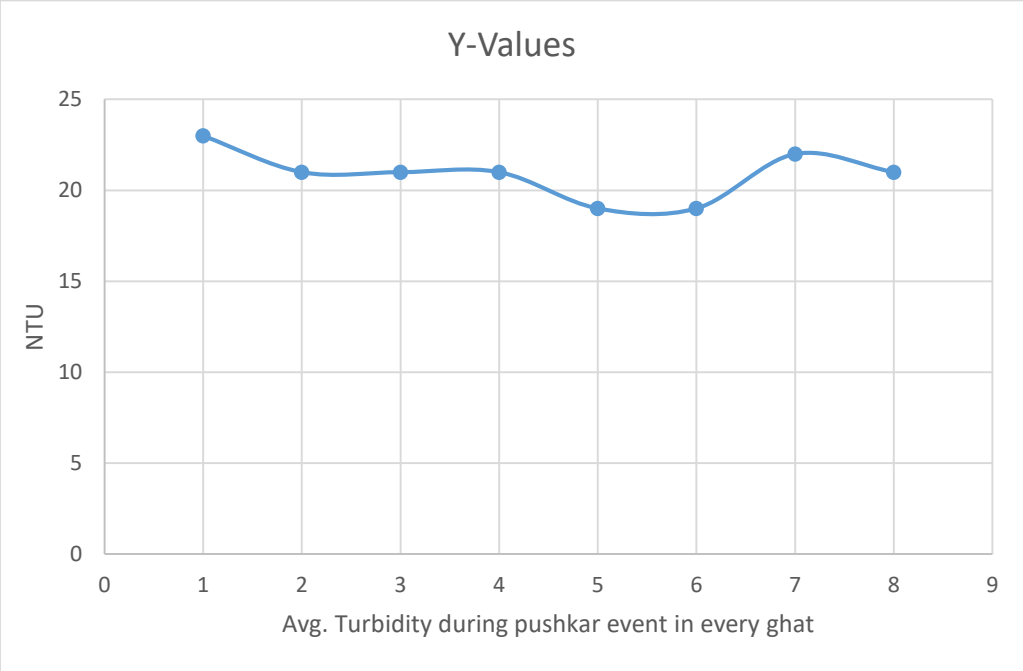
Table8:-biological analysis of water sample collected from21/11/2020 to 02/12/2020(Pushkar event)

Sno.	**Ghat Name**	**BOD(mg/l)**	**COD(mg/l)**	**DO(mg/l)**	**Coliform(CFU)**
1	panchalingala	9.0	23.6	4.6	1952
2	Sankal bagh	13.0	26.1	5.8	2123
3	Sai baba temple	12.8	26.5	5.8	2103
4	Old pump house	12.2	24.8	5.2	2086
5	Raghavendra matam	11.5	24.1	4.9	1993
6	Naga Sai temple	10.2	22.5	5.0	2012
7	Rambotla alayam	11.9	23.6	5.3	2096
8	Nagareshwara temple	11.2	23.2	5.1	2108

All units square measure in mg/l. TH: Total Hardness as CaCO3. TDS: Total Dissolved Solids, EC: Electrical physical phenomenon

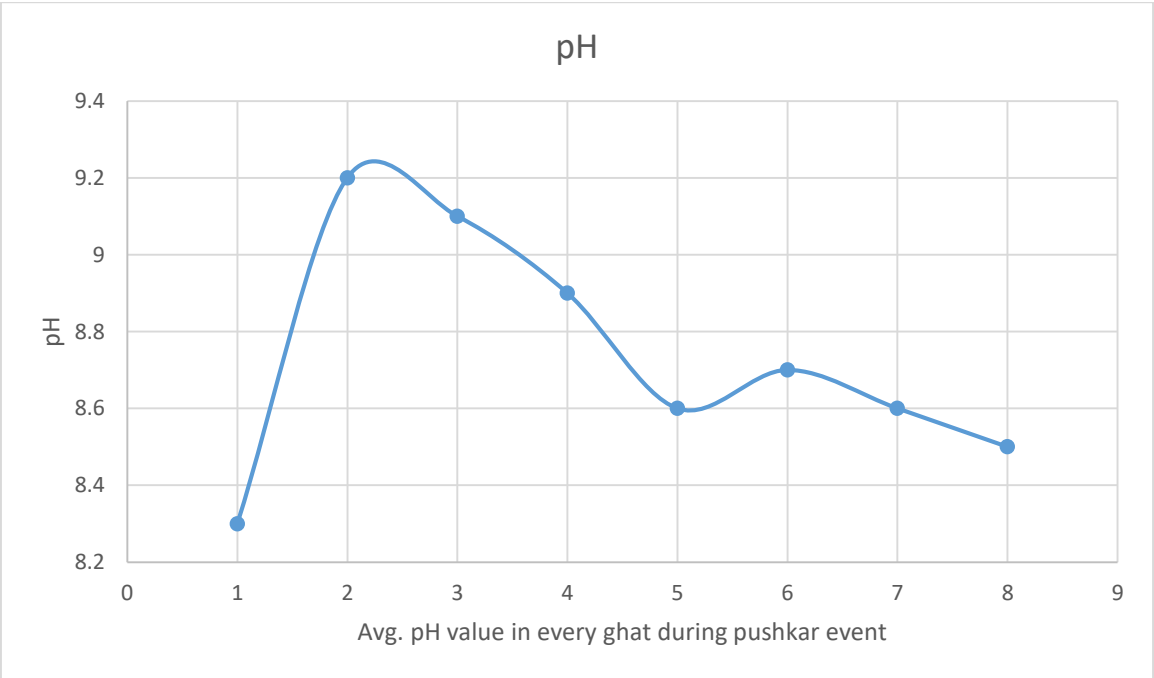
Temperature: The comman temperature (°C) of stream water throughout the pre-Pushkar, Pushkar, and post-Pushkar periods was found to be 35.2, 30.9, and 31.8 severally.

Turbidity: the common cloudiness (NTU) of water throughout the pre-Pushkar, Pushkar, and post-Pushkar periods is found to be 13, 36.4, and 23.6 severally. the utmost permissible cloudiness of water for bathing functions is a smaller amount than five NTU. Comparison of those values indicates the extremely mirky nature of water throughout the full sampling amount. The variation in cloudiness is also attributed to varied anthropogenetic activities at ghats and no important streamflow at these ghats. the common cloudiness of stream water shrunken throughout the Pushkar amount which can be primarily because of the rain pattern and succeeding dilution. The gradual change in turbidity during in noted in graph 1



Graph 1:- Avg. Turbidity during Pushkar event in every ghat

pH: The pH may be alive of the acidity/alkalinity of water. the overall pH limit (BIS, 2012) for potable water is 7.5 to 9.3. The pH price was found to vary between 7.4- 9.3 throughout the study amount. the common pH of stream water throughout the pre-Pushkar, Pushkar, and post-Pushkar periods is 7.73, 8.74, and 8.5 severally. The pH of all water samples was found to be over seven so indicating that water was well buffered and basic. The gradual change in pH value is noted in graph 2



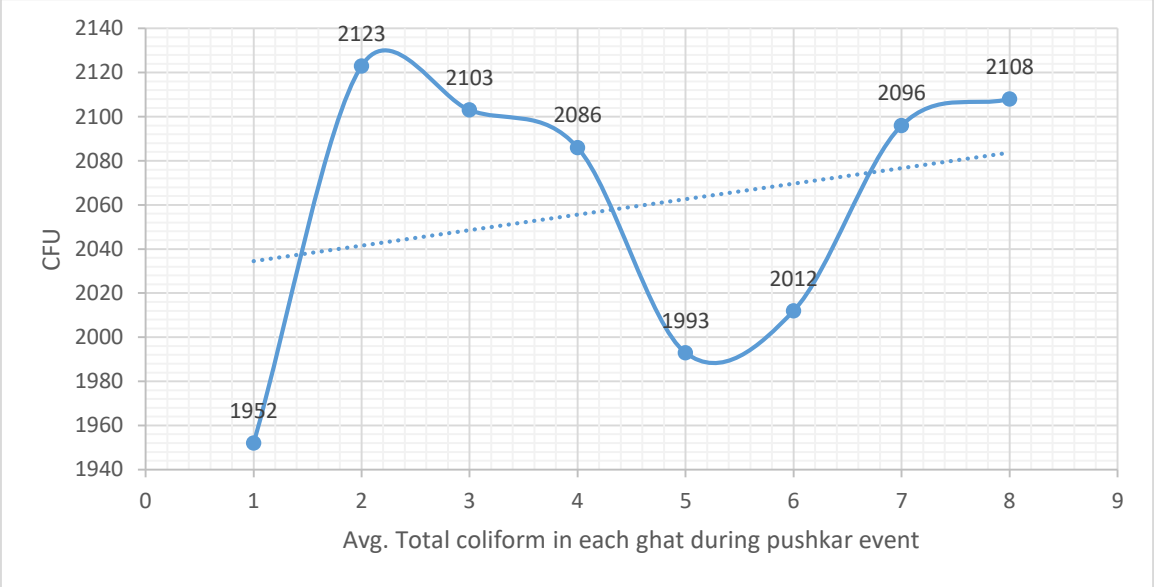
Graph 2:- Avg. pH value in every ghat during Pushkar event

Electrical physical phenomenon (EC) and Total Dissolved Solids (TDS): the common EC of samples throughout pre-Pushkar, Pushkar, and post-Pushkar periods is 1423.65, 1828.5, and 1509 mho/cm at 25°C severally. Similarly, the common TDS in mg/l throughout the corresponding 3 phases square measure 1046,1217.5, and 987 severally

Biological parameters: Major biological parameters analyzed square measure dissolved O (DO), organic chemistry O demand (BOD), and chemical O demand (COD). the first issue that governs whether or not biological changes square measure led to by aerobic or anaerobic organisms will. The organic chemistry O Demand (BOD) may be alive of the number of food for the bacterium that's found in water. It determines the strength in terms of O needed to stabilize domestic and industrial wastes (Kavita and Vineeta, 2010). COD is that the quantity of O needed to with chemicals oxidizes organic compounds in water.

The concentration of those parameters within the water samples collected at mass bathing ghats is given in Table.6. The vary of DO (mg/l) throughout pre-Pushkar, Pushkar, and post-Pushkar phases is 1.9 to 3.8, 4.6 to 5.9, and 2.4 to 3.2 severally. The vary of COD (mg/l) of stream water throughout pre-Pushkar, Pushkar, and post-Pushkar periods is 19 to 24, 22.2 to 26.1, and 18.5 to 22.3 severally. The BOD (mg/l) concentration throughout 3 phases is 10, 13.1, and 10.4. a standardized decrease in DO and increase in organic structure and COD has been discovered altogether Ghats.

Total coliform that has been calculated was calculated using the standard technique by APHA 1995. The variation was noticed in 3 phases by1614,2059 and 1794 CFU. This concludes that the water has an excess amount of microorganism content than iso standards that are harmful and should be used only after treatment. In graph no. 1, we can see the gradual changes in avg total coliform in each ghat during the Pushkar event.



Graph1:- Gradual change in Avg. Total coliform in all ghats during Pushkar event

4. Conclusions

The present study assesses the impact of mass bathing and acts on stream water quality throughout the PUSHKARALU event. The study showed that except pH scale and cloudiness all alternative Physico-chemical parameters of stream water samples collected at varied ghats area unit at intervals BIS water limits. The impact of mass bathing has been ascertained particularly in terms of biological and microorganism parameters and every one of these parameters was higher than the permissible limits for mass bathing. The inclined in E. coli count is observed throughout Pushkar relative to the pre-Pushkar amount. This confirms the presence of high fecal coliform within the hand-picked reaches of stream Tungabadhra in Kurnool town. thus appropriate preventive measures area unit to be taken throughout mass bathing to avoid health disorders. stream Bank Filtration (RBF) could be a potential technique for pumping stream water for mass bathing through showers for kids and elder folks.

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