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Seasonal variation in sewage water quality of Musi River Peri-Urban agriculture, Hyderabad, Telangana, India

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Abstract
Seasonal Variation in sewage water quality of Musi river peri-urban agriculture, Hyderabd, Telangana, India. The water samples were collected at different locations along the Musi river belt just before sowing of the crops during *Kharif* 2012 and *Rabi* during 2012-13. These Water, were analysed for different parameters. Thai is Results indicated that, among the different parameters studied in water samples of Musi river belt area, the pH, EC, BOD, Alkalinity, TS, TDS, TSS, CO_3^{-2} and HCO_3 in Musi sewage water were more than in normal non polluted water. These values were more during *Rabi* than in *Kharif* season. The pH, EC and BOD were within the permissible limits and the TDS, TSS, TDS, and COD contents exceeded the permissible levels based on the limits for irrigation purpose.

Keywords: Seasonal variation, sewage water quality, Urban Agriculture

Introduction
Hyderabad, being the most populous agglomeration in the world, generates daily huge amounts of solid, liquid and gaseous wastes from houses, industries, agriculture fields, automobiles *etc*. The generated wastes contain different type of pollutants in the form of detergents, pesticides, nitrates, fluoride and heavy metals (CPCB 2000) [1]. Surface runoff with these Organic and Inorganic pollutants through numerous drains ultimately ends up in Musi river and deteriorates the water quality. Due to the over-exploitation of the groundwater in adjoining areas of the Musi river basin pollutants also enter into the groundwater aquifers along with the river water. So the Musi river acts as a source of groundwater pollution. Further, Musi water is also being directly used for irrigation in some areas, so these pollutants added through irrigation water may pollute the field soil. Farmers of the peri-urban areas are also practicing intensive agriculture through imbalanced application of fertilizers and pesticides. The indiscriminate use of agro-chemicals like fertilizers and pesticides and/or irrigation with contaminated water can also pollute the soils of these irrigated areas. Hence the present study was undertaken.

Materials and Method
Peri urban area of Hyderabad (Peerzadiguda to Bacharam), Telangana, was selected as study area. Ten water samples were collected in three replicas at ten selected locations at two times during *Kharif* (2013) and *Rabi* seasons of (2012-13) from different surface sources of irrigation to the crops of these polluted waters were analyzed as per Standard Procedure (APHA, 1985) [2]. The collected water samples were used for analysis. The Electrical Conductivity (EC) of the water samples was by Conductivity Bridge Meter (Jackson 1973) [3]. The pH was also measured by pH Meter using glass electrode assembly (Jackson 1973) [3] and the sewage water samples analysed for TS, TDS, TSS, BOD, COD, HCO_3^{-1}, CO_3^{-2}, Acidity and Alkalinity as per the standard methods (APHA 1985) [2]. The pH, Salinity, Total solids, Total dissolved solids, Total suspended solids, Biological oxygen demand, Chemical oxygen demand, Carbonate, Bicarbonate, Acidity and Alkalinity at *Kharif* 2012 and *Rabi* 2012-13 seasons are given in the Table.1 and 2. The groundwater samples were also collected from the selected villages of the study area.

Results and Discussion
pH : The pH values of water samples collected at different locations of Musi river belt area ranged from 7.23 to 7.86 during *Kharif* 2012 and from 7.50 to 8.00 during *Rabi* 2012-13,

indicating Neutral to slight Alkaline in reaction (Table.1). Slightly higher pH values in water sample were observed during *Rabi* 2012-13 than *Kharif* 2012.

Electrical Conductivity (EC)

Electrical Conductivity values of sewage water samples collected at different locations along the Musi river area during *Kharif* 2012 and *Rabi* 2012-13 ranged from 1.65 to 2.60 and 2.20 to 2.90 dS m^{-1} with the mean values of 1.92 and 2.33 dS m^{-1}, respectively.

The mean Electrical Conductivity of sewage water samples collected from Musi river area during *Rabi* 2012-13 (2.33 dS m^{-1}) was higher than that in the *Kharif* 2012 (1.92 dS m^{-1}), indicating 21% more during *Rabi* 2012-13. This can be attributed to higher contents of Sulphates, Chlorides and high concentration of solutes in the polluted water discharged into water bodies. On the basis of permissible limit (2.25 dS m^{-1}) as prescribed by ISI (1982) for irrigation waters, one sewage water at (Peerzadiguda) were more than Critical limit during *Kharif* 2012 season whereas seven out of ten sewage water samples had Electrical Conductivity more than permissible limit during *Rabi* 2012-13 season.

Total Solids (TS)

Total Solids content in the sewage water sample collected at different locations of Musi River bed area ranged from 2034 to 2400 mg L^{-1} with a mean of 2200 mg L^{-1} and from 2102 to 2587 mg L^{-1} with a mean of 2310 mg L^{-1} respectively during *Kharif* 2012 and *Rabi* 2012-13 (Table 1). All the sewage water samples exceeded permissible limit of 1000 mg L^{-1} as proposed by (ICMR, 1975) showing that all the water samples are polluted.

Total Dissolved Solid (TDS)

Total Dissolved Solids (TDS) of sewage water samples collected during *Kharif 2012* and *Rabi* 2012-13 varied widely ranging from 1652 to 1950 mg L^{-1} and 1710 to 2103 mg L^{-1} with the mean of 1782 mg L^{-1} and 1855 mg L^{-1}, respectively (Table 1). These observed values were higher than the permissible value of 500 mg L^{-1} as prescribed by ISI (1982). This water is not suitable for irrigation for both the seasons.

Total Suspended solids (TSS)

Total Suspended solids (TSS) in sewage water samples varied within the range of 382 to 450 mg L^{-1} and 392 to 484 mg L^{-1} with mean values of 418 and 455 mg L^{-1} during *Kharif* 2012 and *Rabi* 2012-13 respectively (Table 4.1) The TSS values in water samples during both the seasons were above the permissible limits of 100 mg L^{-1} (EPR, 1993) prescribed for irrigation. This water with high levels of suspended solids may be aesthetically disagreeable and unsatisfactory for the purposes of bathing and irrigation.

Biological Oxygen Demand (BOD)

Biological Oxygen Demand (BOD) of sewage water samples collected at different locations of Musi River catchment area varied from 152 to 225 mg L^{-1} with an average of 184 mg L^{-1} during *Kharif* 2012 and ranged from 224 to 303 mg L^{-1} with the mean value of 254 mg L^{-1} during *Rabi* 2012-13 (Table 2). This indicates high organic matter in this sewage water. All the sewage water samples in both the seasons were within the safe limits of 100 mg L^{-1} for irrigation as prescribed by (ISI, 1983) and within the safe range value of 200-500 mg L^{-1} (NEERI, 1985) [6] and they can be used for irrigation purposes.

Biological Oxygen Demand (BOD) values in all the sewage water samples during both the seasons were higher than the Critical limit of 2 mg L^{-1} as prescribed by ISI (1983) for drinking waters and hence the sewage water is not suitable for drinking purpose.

Chemical Oxygen Demand (COD)

Chemical Oxygen Demand (COD) values in the sewage water samples collected at different locations of Musi River area were in the range of 518 to 650 mg L^{-1} with a mean of 577 mg L^{-1} during *Kharif* 2012 and within the range of 622 to 746 mg L^{-1} with a mean value of 674 mg L^{-1} during *Rabi* 2012-13 (Table. 2).

The Chemical Oxygen Demand (COD) values of the sewage water samples of Musi River area during both the seasons were above the Critical limit of 500 mg L^{-1} prescribed by ISI (1982) for effluents to be discharged into a cultivable land. The higher Chemical Oxygen Demand (COD) values in the present study might be due to contamination of the water bodies with the industrial effluents.

Carbonates (CO_3^{-2}) and Bicarbonates (HCO_3^-)

Carbonates were not found in the sewage water samples collected at different location of Musi river bed area during both *Kharif 2012* and *Rabi* 2012-13 seasons (Table 2).

The Bicarbonate contents recorded in sewage water samples collected at different locations of Musi River bed area during *Kharif 2012* and *Rabi* 2012-13 seasons ranged from 64 to 128 mg L^{-1} and from 76 to 158 mg L^{-1} with the mean values of 89 and 110 mg L^{-1} respectively (Table.2). Bicarbonate values recorded in sewage water samples were comparatively more in *Rabi* season than in *Kharif* season. Highest Bicarbonate values in sewage water samples were recorded at Peerzadiguda and lowest was at Bacharam during both the seasons.

Acidity

The Acidity values ranged from 2.8 to 4.7 mg L^{-1} and 2.8 to 5.8 mg L^{-1} with the mean values of 3.71 and 4.12 mg L^{-1}, respectively during *Kharif* 2012 and *Rabi* 2012-13 seasons. The highest Acidity was observed in sewage water (4.7 and 5.5 mg L^{-1}) in Peerzadiguda and the lowest Acidity (2.8 mg L^{-1}) values were observed in Bacharam village during of *Kharif* 2012 and *Rabi* 2012-13 season respectively. Relatively higher Acidity values were observed in sewage water during *Rabi* 2012-13 seasons when compared to *Kharif* 2012 season in Musi river catchment area.

Alkalinity

The Alkalinity values ranged from 480 to 654 mg L^{-1} and 520 to 720 mg L^{-1} with the mean values of 574 and 624 mg L^{-1} respectively during *Kharif* 2012 and *Rabi* 2012-13 seasons. The highest Alkalinity was observed in sewage water (654 and 720 mg L^{-1}) in Peerzadiguda and the lowest alkalinity (480 to 520 mg L^{-1}) values were observed in Bacharam village during Kharif 2012 and *Rabi* 2012-13 season respectively. Relatively higher Alkalinity values were observed in sewage water during *Rabi* 2012-13 season when compared to *Kharif* 2012 season in Musi river catchment area. High values of Alkalinity recorded might be due to presence of weak and strong Bases such as Carbonates, Carboxides and Hydroxides in the water and also might be due to waste discharge from industries.

Table 1: Physico-Chemical, Chemical and Biological characteristics of water samples collected at different locations along the Musi river belt area during Kharif 2012 and Rabi 2012-13 (Mean of five samples)

Name of the village	Kharif (2012)						Rabi (2012-13)					
	BOD (mg L^{-1})	COD (mg L^{-1})	CO_3^{2-} (mg L^{-1})	HCO_3 (mg L^{-1})	Acidity (mg L^{-1})	Alkalinity (mg L^{-1})	BOD (mg L^{-1})	COD (mg L^{-1})	CO_3^{2-} (mg L^{-1})	HCO_3 (mg L^{-1})	Acidity (mg L^{-1})	Alkalinity (mg L^{-1})
Peerzadiguda	225	650	Traces	128	4.7	654	303	746	Traces	158	5.5	720
Parvathapuram	201	619	Traces	93	4.5	623	267	693	Traces	129	5.4	688
Kachivani Singaram	205	632	Traces	112	4.3	647	270	721	Traces	136	4.8	707
Pratap Singaram	194	593	Traces	88	3.8	608	255	687	Traces	120	4.6	676
Sadataliguda	187	567	Traces	85	3.7	564	248	661	Traces	104	4.7	593
Muthawaliguda	183	589	Traces	85	3.5	587	252	672	Traces	112	3.5	652
Korremula	172	552	Traces	83	3.4	539	246	657	Traces	92	3.4	581
Chowderguda	159	522	Traces	73	3.5	510	237	631	Traces	84	3.2	539
Gowrelli	166	531	Traces	76	2.9	524	235	647	Traces	87	3.3	559
Bacharam	152	518	Traces	64	2.8	480	224	622	Traces	76	2.8	520
Minmum	152	518	-	64	2.8	480	224 -	622	-	7 6	2.8	520
Maximum	225	650	-	128	4.7	654	303	746	-	158	5.8	720
Mean	184	577	-	89	3.71	574	254	674	-	110	4.12	624

Table 2: Physico-Chemical, Chemical and Biological characteristics of Water samples collected at different locations along the Musi river belt area during Kharif 2012 and Rabi 2012-13 (Mean of five samples)

Name of the village	Kharif (2012)					Rabi (2012-13)				
	pH (1.2)	EC (dS m^{-1})	TS (mg L^{-1})	TDS (mg L^{-1})	TSS (mg L^{-1})	pH (1.2)	EC (dS m^{-1})	TS (mg L^{-1})	TDS (mg L^{-1})	TSS (mg L^{-1})
Peerzadiguda	7.86	2.60	2400	1950	450	8.00	2.90	2587	2103	484
Parvathapuram	7.72	1.94	2263	1833	430	7.80	2.32	2415	1938	477
Kachivani Singaram	7.70	2.20	2333	1892	441	7.80	2.35	2443	1965	478
Pratap Singaram	7.65	1.90	2244	1819	425	7.76	2.30	2360	1884	476
Sadataliguda	7.60	1.85	2181	1766	415	7.70	2.28	2290	1828	462
Muthawaliguda	7.52	1.89	2233	1813	420	7.75	2.28	2327	1862	465
Korremula	7.45	1.75	2139	1714	425	7.65	2.26	2237	1782	455
Chowderguda	7.38	1.70	2076	1681	395	7.58	2.22	2153	1730	423
Gowrelli	7.34	1.72	2098	1697	401	7.62	2.23	2184	1746	438
Bacharam	7.23	1.65	2034	1652	382	7.50	2.20	2102	1710	392
Minmum	7.23	1.65	2034	1652	382	7.50	2.20	2102	1710	392
Maximum	7.86	2.6	2400	1950	450	8.0	2.90	2587	2103	484
Mean	7.55	1.92	2200	1782	418	7.70	2.33	2310	1855	455

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