

Pollution Studies in the Chengannur Segment of River Pampa Based on Chemical Parameters

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Abstract: Pampa River is the third longest river in the South Indian state of Kerala. The river is one of the most stressed rivers in Kerala. Water quality of Chengannur segment of Pampa River was determined based on Chemical parameters such as BOD, pH, Dissolved Oxygen, Nitrate and Phosphate followed by water quality index. Three study sites were selected. Mean with standard deviation were taken. Two ways ANOVA was conducted. The water quality index (WqI) was calculated. The quality index during pre-monsoon and summer was 81 and 59 for BOD, 68 and 80 for pH, 5 and 96 for Dissolved Oxygen, 99 and 96 for Nitrate, 31 and 43 for phosphate. The study shows that water in the Chengannur segment of Pampa river is of moderate quality.

Keywords: Pampa river, BOD, Dissolved Oxygen, Nitrate, Phosphate

1. Introduction

River Pampa originates at Pulachimalai hill in the Peerumedu plateau I of the Western Ghats at an altitude of 1650MSL and flows through Ranni, Ayoor, Pathanamthitta, Thiruvalla, Chengannur, Kuttanad and Ambalappuzha taluks. Most part of the river is flowing through Pathanamthitta and Alappuzha District, both are densely populated and the river is depended for various domestic and agricultural purposes. Studies on pollution of water had always been dealt with respect to the impacts on public health and hence discharge of industrial waste has to be monitored frequently

The physical and chemical characters of a river have a major role in sustaining its biota and maintaining the quality of its water. Any change in the parameters will result in alteration in the water quality and thence the diversity of its flora and fauna. The ecosystem balance in a riverine system has always been in correspondence with the physico-chemical characteristics of water. Parameters such as dissolved oxygen and carbon dioxide are the best indicators for analyzing the biological carrying capacity of water. The density and diversity of aquatic fauna is majorly determined by the availability of these gases. Any change in the structural, physical or chemical characteristics of a river can be considered as indication of increased perturbation either due to anthropogenic interventions or natural damages to the system. Alterations in nutrients in water will also determine the abundance and depletion of different organisms including benthic macro invertebrates and micro flora.

Riverine ecology has to be properly studied and dealt with, in term of physical and chemical aspects to find out whether potable water is available to the surrounding inhabitants who solely rely upon river water for domestic purposes. Urbanization, industrialization and unscientific exploitation of water for agricultural activities can cause a river to diminish its quality and will transform to a mere garbage dumping area. A sharp change in these parameters can be seen from the origin to the mouth of a river and hence

aquatic biota has shown a severe diversity fluctuation throughout

There are few studies conducted in river Pampa. The river is one of the stressed rivers in Kerala due to uncontrolled sand mining, pilgrimage, encroachment, reclamation, poaching etc. Therefore, it is interesting to study the physico-chemical and microbiological parameters in the water of river Pampa.

2. Methodology

2.1 Study Area

The study area was Chengannur Segment of River Pampa. It is located at latitude 9° 19' 29.07' N and longitude 76° 27' 54.31' E with an elevation of 6 Ft above mean sea level. Three study sites were selected in this segment. They were Mundankavu, Parumala and Veeyapuram.

2.2 Collection and Transportation of Sample

Monthly samples were collected from these study sites during Post monsoon (October, November and December 2011) and summer (January, February and April, 2012) seasons. Three samples were taken from each site with an average distance of 500 meters. Samples were collected in pre-sterilized containers and transported to the laboratory in iceboxes within shortest possible time to avoid erroneous data variation due to physical and bacteriological change.

2.3 Physical Analysis of Samples

In the laboratory pH and dissolved Oxygen was measured using a water quality analyzer. Nitrate, phosphate and Biological oxygen demand was determined as per the procedures of APHA (APHA, 2005).

2.4 Statistical analysis

Mean and standard deviation for each parameters were determined from the three samples using Microsoft excel software. Two way Analysis of variance (ANOVA) was

conducted to determine any significant difference in the value of each parameter between samples and between sites using SPSS package 11.00.

2.5 Water quality index

The overall water quality index of Chengannur segment was calculated season wise using National Sanitation Foundation (NSF) water quality index calculator (NSF, 2010)

3. Results

3.1 Biological oxygen demand - BOD (mg/L)

The average BOD level in Mundankavu was 1.34 and 4.45, for Parumala 2.34 and 4.28 and for Veeyapuram 2.24 and 4.21 (Table 1 and figure 1). The average value between sites was 1.97 for postmonsoon and 4.31 for summer. The average value between seasons were 2.895 mundankavu, 3.31 at Parumala and 3.225 at Veeyapuram

Table 1. BOD (mg/L) in samples from different sites during postmonsoon and summer

Sites	post monsoon	summer	Mean ± S.D
Mundankavu	4.45	1.34	2.895±2.20
Parumala	4.28	2.34	3.31±1.37
Veeyapuram	4.21	2.24	3.225±1.39
Mean ± S.D	4.31±0.12	1.97±0.55	

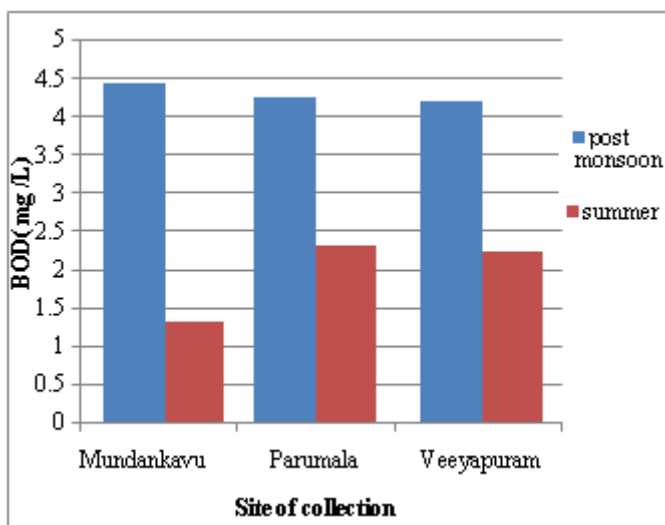


Figure 1: BOD (mg/L) of samples from different sites during post monsoon and summer

Two way ANOVA showed less difference in the BOD between sites (P=0.0432, P>0.05) and significant difference observed between samples (P=36.92, P<0.05) (Table 2).

Table 2: Anova showing the significance of variation in BOD in summer and postmonsoon

	Ss	Df	Ms	F Value	P Value	F Critical
Between Site	0.192233	2	0.096117	0.432082	0.698284	19
Between Sample	8.2134	1	8.2134	36.92245	0.026031	18.51282
Error	0.4449	2	0.22245			
Total	8.850533	5				

3.2 pH

The pH was 6.14 and 7.08 in Mundankavu, 6.67 at Parumala and 6.46 and 6.44 at Veeyapuram (Table 3 Figure 2). The average value between sites was 6.42 for postmonsoon and 6.73 for summer. The average value between seasons were 6.61 at Mundankavu, 6.67 at Parumala and 6.45 at Veeyapuram.

Table 3: pH in samples from different sites during postmonsoon and summer

Sites	premonsoon	summer	Mean ± S.D
Mundankavu	6.14	7.08	6.61±0.66
Parumala	6.67	6.67	6.67±0
Veeyapuram	6.46	6.44	6.45±0.01
Mean ± S.D	6.42±0.26	6.73±0.31	

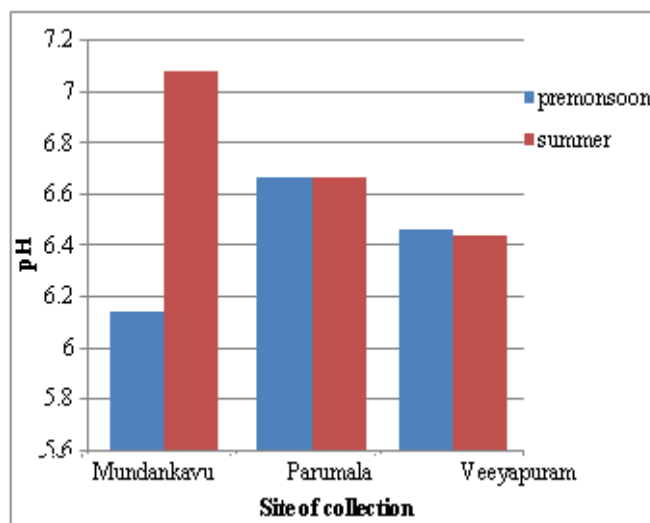


Figure 2: pH in samples from different sites during postmonsoon and summer

Two way ANOVA showed less difference in the pH between sites (P=0.1719, P>0.05) and samples (P=0.9375, P>0.05) (Table 4).

Table 4: Anova showing the significance of variation in pH in summer and postmonsoon

Source of Variation	SS	df	MS	F	P-value	F crit
Rows	0.051733	2	0.025867	0.17191	0.853308	19
Columns	0.141067	1	0.141067	0.937528	0.435062	18.51282
Error	0.300933	2	0.150467			
Total	0.493733	5				

3.3 Dissolved oxygen – D O (mg/L)

The DO was 6.20 and 5.20 in Mundankavu, 6.43 and 4.81 at Parumala, 7.48 and 5.25 at Veeyapuram. (Table 5 and figure 3). The average value between sites was 6.70 for postmonsoon and 5.08 for summer. The average values between seasons were 5.7 at mundankavu, 5.62 at Parumala and 6.3 at Veeyapuram.

Table 5: DO (mg/L) in samples from different sites during postmonsoon and summer

Sites	Premonsoon	Summer	Mean ± S.D
Mundankavu	6.20	5.20	5.7±0.7
Parumala	6.43	4.81	5.62±1.14
Veeyapuram	7.48	5.25	6.3±1.57
Mean ± S.D	6.70±0.68	5.08±0.24	

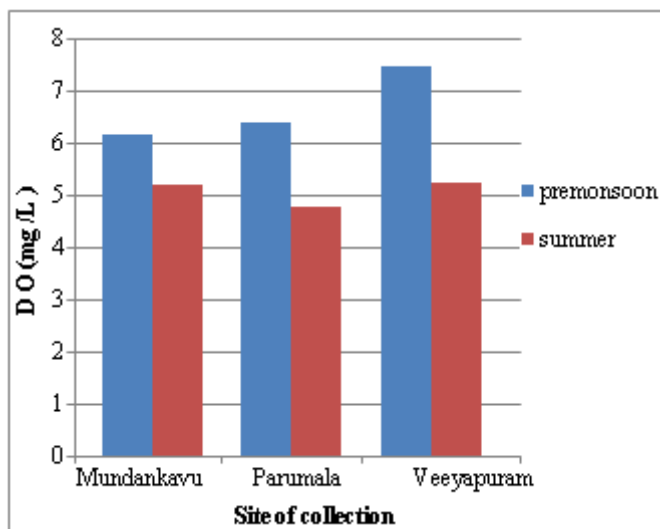


Figure 3: D O(mg /L) in samples from different sites during post monsoon and summer

Two way ANOVA showed less difference in the D O (mg/L) between sites ($P=1.76, P>0.05$) and significant difference observed samples ($P=20.73, P<0.05$) (Table 6).

Table 6: Anova showing the significance of variation in DO in summer and postmonsoon

Source of Variation	SS	df	MS	F	P-value	F crit
Rows	0.6691	2	0.33455	1.769014	0.361139	19
Columns	3.920417	1	3.920417	20.73015	0.045007	18.51282
Error	0.378233	2	0.189117			
Total	4.96775	5				

3.4 Nitrate (mg/L)

The Nitrate was 0.42at all sites during postmonsoon and 0.68 at Mundankavu, 0.52at Parumala, and 0.54 at Veeyapuram (Table 7 and figure 4). The average value between sites was 0.42 for postmonsoon and 0.582 for summer .The average values between seasons were 0.55at mundankavu, 0.473 at Parumala and 0.54 at Veeyapuram.

Table 7: Nitrate (mg/L) in samples from different sites during postmonsoon and summer

Sites	Postmonsoon	Summer	Mean ± S.D
Mundankavu	0.42	0.68	0.55±0.13
Parumala	0.42	0.526	0.473±0.07
Veeyapuram	0.42	0.54	0.54±0.08
Mean ± S.D	0.42±0	0.582±0.08	

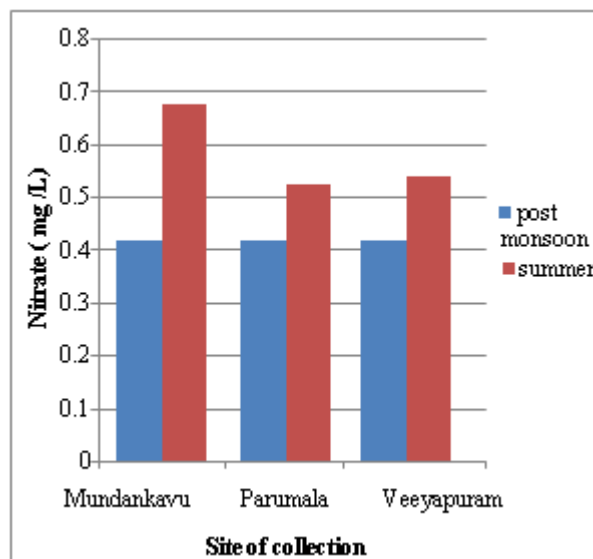


Figure 4: Nitrate (mg/L) in samples from different sites during postmonsoon and summer

Two way ANOVA showed less difference in the BOD between sites ($P=1.00, P>0.05$) and samples ($P=10.856, P>0.05$) (Table 8).

Table 8: Anova showing the significance of variation in Nitrate in summer and postmonsoon

Source of Variation	SS	df	MS	F	P-value	F crit
Rows	0.007252	2	0.003626	1	0.5	19
Columns	0.039366	1	0.039366	10.85659	0.081067	18.51282
Error	0.007252	2	0.003626			
Total	0.05387	5				

3.5 Phosphate (mg/L)

The Phosphate was 0.42 at all sites during postmonsoon and 0.68 at Mundankavu, 0.52at Parumala, and 0.54 at Veeyapuram. (Table 9 and figure 5). The average value between sites was 0.42 for postmonsoon and 0.582 for summer .The average value between seasons were 0.55at mundankavu, 0.473 at Parumala and 0.54 at Veeyapuram

Table9: Phosphate (mg/L) in samples from different sites during postmonsoon and summer

Sites	postmonsoon	summer	Mean ± S.D
Mundankavu	0.42	0.68	0.975±0.21
Parumala	0.42	0.526	1.265±0.45
Veeyapuram	0.42	0.54	1.365±0.58
Mean ± S.D	0.90±0.07	1.5±0.27	

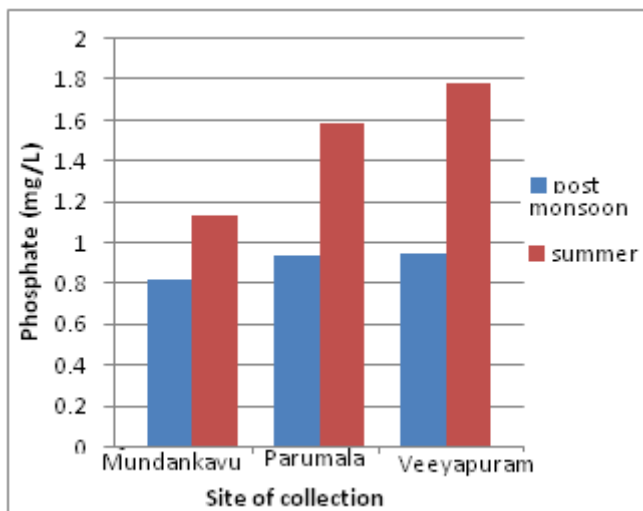


Figure 5: Phosphate (mg/L) in samples from different sites during postmonsoon and summer

Two way ANOVA showed less difference in the Phosphate between sites ($P=2.35$, $P>0.05$) and samples ($P=15.31$, $P>0.05$) (Table 10).

Table 10: Anova showing the significance of variation in Phosphate in summer and postmonsoon

Source of Variation	SS	df	MS	F	P-value	F crit
Rows	0.164133	2	0.082067	2.353728	0.298176	19
Columns	0.534017	1	0.534017	15.31597	0.059522	18.51282
Error	0.069733	2	0.034867			
Total	0.767883	5				

Table 11: Water quality index of Pampa river for post monsoon and summer

Parameters	Postmonsoon	Weight	Summer
	Quality Index		Quality Index
Dissolved oxygen	5	0.17	5
pH	68	0.11	80
BOD	81	0.11	59
Nitrate	99	0.10	96
Phosphate	43	0.10	31

4. Discussion

There is a great difference in the BOD in two seasons. The high BOD value in summer indicates less flow, more plankton growth, more temperature and less dissolved oxygen content. The pH did not show much variation during pre-monsoon and summer. The high DO of pre-monsoon is due to the high turbulence of water following pre-monsoon showers. The nitrate level of Pampa is moderate in premonsoon and monsoon. This indicates low level of riverbank agriculture during premonsoon and summer (Johnson, 2009). The Phosphate level also showed moderate value in both seasons which is an indication of low level agricultural practices in the banks of the river.

5. Summary and Conclusions

Water quality of Chengannur segment of Pampa river was determined based on chemical aspect followed by water quality index. Three study sites were selected in the study

segment as Mundankavu, Parumala and Veeyapuram. Three samples were taken from each study site monthly during post monsoon and summer seasons. Chemical parameters like pH, Dissolved oxygen, BOD, Nitrate and Phosphate were determined. Mean with standard deviation was taken for each parameter value. Two way ANOVA was conducted to test whether the samples have variation in values between site and between replicates. Water quality index (WqI) was calculated following NSF method in both seasons. Slight variation in water quality was observed for pH, nitrate and phosphate during postmonsoon and summer. Great variation in water quality parameters were observed for BOD and dissolved oxygen content in two seasons. The quality index during premonsoon and summer was 81 and 59 for BOD, 68 and 80 for p H, 5 and 96 for Dissolved Oxygen, 99 and 96 for Nitrate, 31 and 43 for phosphate. These values indicate a moderate water quality level in the Chengannur segment of Pampa river.

Since Pampa River has much religious importance it is essential to maintain the water quality. This study may serve as an eye opener to the public and government officials and also will lead to future research which may prevent the deterioration of water quality.

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