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# Study Of Water Quality Index (WQI) Of Different Physicochemical Parameters Of Taladanda Canal Water In Cuttack And Paradeep City, Odisha, India

**Hemanta Meher[1], P.K. Behera[2], S.N. Panda[1*]**

[1]*School of Chemistry, Sambalpur University Jyoti Vihar, Sambalpur-768019, Odisha*
[2]*Director, SCN institute of Public Health University, Bhubaneswar, Odisha*

*Email:hemanta1892.ppl@gmail.com[1], pkb.chem.su@gmail.com[2], samarendranath.panda@gmail.com[1*]*

***Corresponding Author:** S.N. Panda*
*Email: samarendranath.panda@gmail.com*

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*Abstract*

A physicochemical study of Taladanda canal water samples were collected in the area of Cuttack and Paradeep city; from upstream (CW1), midstream (CW2) and downstream (CW3) of the canal. It has been carried out for the suitability and drinking purposes of the surface water. During 2020-2021 in four different seasons' namely winter, summer, monsoon and post-monsoon the surface water was monitored. Percolation of domestic sewage and anthropogenic activities into the canal water of the study area has been proved by the analysis. Downstream parameters levels of canal water were significantly elevated than the corresponding upstream. The major source of potable water in Paradeep area is canal water, it need constant monitoring to maintain water quality.



***Keywords: Canal water, World Health Organization drinking water quality standards, Physicochemical parameters and WQI.***

## Introduction

Water is one of the precious natural resources for mankind. Human needs it for doing their daily different activities (IDWR. 2005). In our life it's a fundamental unit (Caddis et al., 2012). Due to rapid growth of population and the accelerated pace of industrialization; there has been a tremendous increase in the demand for freshwater (Ramakrishnaiah et al., 2009). The most crucial steps for controlling the water bodies are the water quality assessment, (Letcher et al., 2007) data categorization, modeling and analysis (Sharma et al., 2013). Canal is an artificial constructed channel that carries water from source (River/Reservoir) to the fields. In India, canals are the major water delivery system for irrigation from dam or reservoir (Chawla et al., 1979). Canals are not only useful for irrigation purpose but also valuable for day to day activities of human being (Planning Commission., 2002). By most of the agricultural development activities i.e. in relation to excessive application of fertilizers and unsanitary conditions the human health is threatened (Okeke et al., 2003).

***"Life is the matrix of water. Within water life is originated, thriving and also it's medium and solvent" (Mahanada et al., 2010).***

Taladanda canal is originated from Cuttack near Jobra barrage and merged in Bay of Bengal in Paradeep. It is off-taking from right side of Mahanadi Barrage (Fig. 1) (Pradhan et al., 2010). Once it was the life line of people of undivided Cuttack district. The length of the canal is around 85 Km. It was the longest canal of Odisha (Federation et al., 2005). The coastal area in many places suffers from extreme water scarcity, as well as from arsenic and saltwater contaminations (Abedin et al., 2012). People living in these areas are able to afford fresh water supply for domestic and agricultural uses is a challenge (BanDuDeltas, 2015b). This canal being used as waterway and also fulfil the irrigation purpose of nearby villages. It is also one of the sources to supply water to Cuttack city and Paradeep city and industries of Paradeep (Federation et al., 2005). But it has become polluted due to discharge of municipal and industrial effluents, dumping of solid waste etc (Sujitha et al., 2012). One of the most effective tools to communicate information on the quality of water to the concerned citizens and policy makers is water quality index. A rating reflecting the composite influence of different water quality parameters is known as WQI. (Atulegwu et al., 2004).
Realising the importance of this problem the objective of the present research is to provide information on the physicochemical characteristics of Taladanda Canal water in order to appreciate the impacts of unregulated waste discharge on the quality of the canal as well as to discuss its suitability for human consumption based on computed water quality index values.

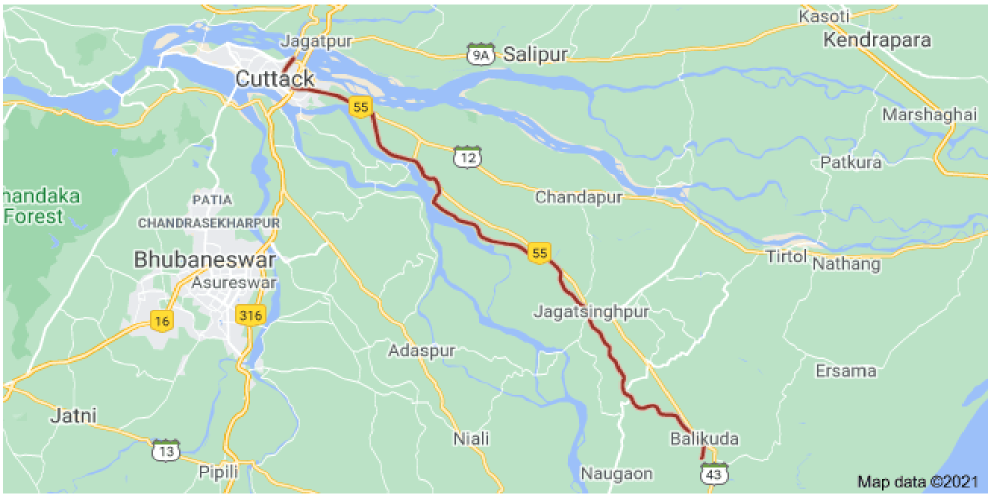


**Fig. 1:** Map of Taladanda Canal

## Materials & Methods

### Study Area

Water bodies and atmosphere have become dumping ground for many pollutants emanating from various industrial activities. This practice causes damage to plant and animal kingdom and endangers the ecosystem.

(a).CW1

(b).CW2

(c). CW3

AT LABORATORY

**Fig. 2:** (a), (b) and (c): Location of the sampling points in three streams.

**Sample Analysis**

The samples of water were collected in pre-cleaned polyethylene 1liter of bottles, about 1m away from the canal bank and at a depth of 1m, in the morning between 9.00 to 10.00 am in different season (winter, summer, monsoon and post-monsoon) respectively. From three different locations the water samples were collected like upstream, midstream and downstream during the year 2020-21. In the Table no-1 and fig. 2 and 3 description of the sample location and the sites of sampling station are given. The samples were transported to the laboratory of Environmental department, PPL, Paradeep within 12 hrs. With the help of following standard methods, the physicochemical parameters of water samples were determined.

**Table 1:** Locations of sampling points

| Sl. No. | Location | Sampling No. | Description of the sample location's surroundings |
|---|---|---|---|
| 1 | Taladanda Canal Upstream | CW1 | Canal water at Taladanda before mixing of Mahanadi water. |
| 2 | Taladanda Canal Midstream | CW2 | Canal water at Taladanda after mixing of Mahanadi water. |
| 3 | Taladana Canal Downstream | CW3 | Canal water at Atharabanki. It mix here with Mahanadi river |

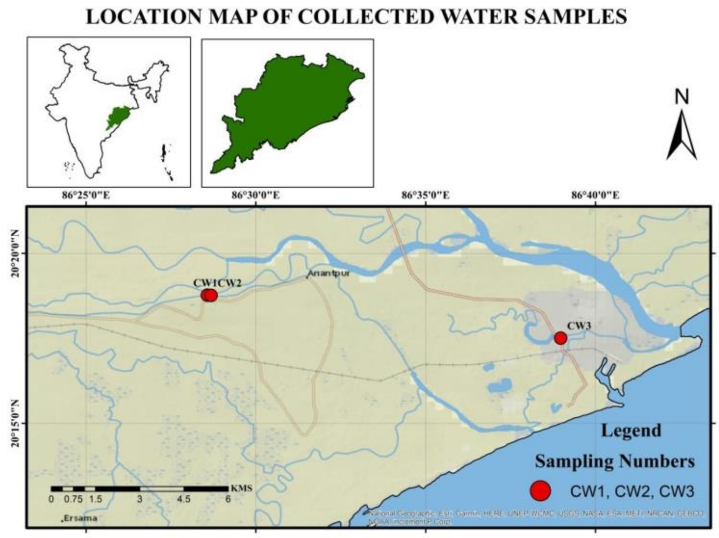


**Fig. 3:** Locations of the sampling stations on Taladanda cana

**Method**

Water quality index (WQI) of canal water was calculated seasonally by using different physiochemical parameters with following Weighted Arithmetic Water Quality Index method (Chatterjee et al., 2002). This method is mostly used by the scientific fraternity to standardise the water quality. The WQI was using following equations;

Let there be 'n' water quality parameters and quality rating ($q_n$) corresponding to nth parameter was evaluated by using the mathematical expression shown in equation 1.1;

$$q_n=100(V_n-V_io)S_n-V_io \qquad (1.1)$$

This gives the relative value of the parameters in the sample with reference to its standard value.
Where,
$q_n$ = Quality rating of respective physicochemical parameters.
$V_n$ = Value of respective physicochemical parameters.
$V_io$= Ideal value of respective parameters in pure water
(For example 6.5 for pH and 14.6 mg/L for DO. For all other Physic-chemical parameters it is 0).
$S_n$ = BIS permissible limit for respective physicochemical parameter.
Unit weight ($w_n$) was estimated by applying formula which is represented in equation 1.2;

$$W_n=KS_n \qquad (1.2)$$

Here, K= Constant for proportionality.
Finally the water quality index can be estimated using eq. 1.3,

$$WQI=q_nw_n/W_n \qquad (1.3)$$

But, as $W_n$=1 so WQI=$q_nw_n$

**Results**

The $q_n$ are for samples CW1, CW2 and CW3 have been calculated using the equation 1.1 as described in above in different season and weights were assigned on scale to human health based on their importance in drinking and threatening potential (Table 2). Experimentally determined physiochemical data are reported in the Table 3-5 and the plots are given in Fig. 4-6.

**Table 2:** Water Quality parameters used in the present study.

| Sl. No. | Parameters | BIS Standards (Si) | Weight (wi) | Relative Weight (Wi) |
|---|---|---|---|---|
| 1. | pH | 6.5-8.5 | 4 | 0.085 |
| 2. | Temperature | 40 | 2 | 0.042 |
| 3. | Conductivity | 2000 $ohm^{-1}cm^{-1}$ | 2 | 0.042 |
| 4. | Total hardness | 300-600 | 3 | 0.064 |
| 5. | Alkalinity | 200-600 | 2 | 0.042 |
| 6. | Salinity | 100 PPT | 3 | 0.064 |
| 7. | Turbidity | 5-25 NTU | 1 | 0.021 |
| 8. | TDS | 500-2000 | 4 | 0.085 |
| 9. | TSS | 500 | 3 | 0.064 |
| 10. | DO | 5-7 | 2 | 0.042 |
| 11. | BOD | 5 | 2 | 0.042 |
| 12. | COD | 20 | 2 | 0.042 |
| 13. | Fluoride | 1.0-1.5 | 3 | 0.064 |
| 14. | Chloride | 250-1000 | 3 | 0.064 |
| 15. | Phosphate | 5 | 1 | 0.021 |
| 16. | Sodium | 20 | 3 | 0.064 |
| 17. | Potassium | 10-50 | 2 | 0.042 |
| 18. | Iron | 0.1-1.0 | 2 | 0.042 |
| 19. | Zinc | 5.0-15.0 | 3 | 0.064 |

All parameters are reported in mg/L except pH, conductivity, turbidity , Salinity and Temperature.

**Table 3:** Calculation of $q_n$ and WQI of CW1 in different seasons.

| Sl. No. | Parameters | WINTER | | | SUMMER | | | MONSOON | | | POST MONSOON | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Values | ($q_n$) | WQI | Values | ($q_n$) | WQI | Values | ($q_n$) | WQI | Values | ($q_n$) | WQI |
| 1. | pH | 7.6 | 55 | 4.675 | 7.2 | 35 | 2.975 | 7.40 | 45.0 | 3.825 | 7.22 | 36.0 | 3.06 |
| 2. | Temperature | 26 | 65 | 2.73 | 32 | 80 | 3.36 | 26 | 65.0 | 2.73 | 26 | 65.0 | 2.73 |
| 3. | Conductivity | 202.8 | 10.14 | 0.426 | 204.2 | 10.21 | 0.429 | 207.8 | 10.39 | 0.436 | 207.7 | 10.38 | 0.436 |
| 4. | Hardness | 66.0 | 11.0 | 0.704 | 68.0 | 11.33 | 0.725 | 70.0 | 11.67 | 0.747 | 62.0 | 10.33 | 0.661 |
| 5. | Alkalinity | 63.0 | 10.5 | 0.441 | 66.0 | 11.0 | 0.462 | 74.0 | 12.33 | 0.518 | 71.0 | 11.83 | 0.497 |
| 6. | Salinity | 0.12 | 0.00012 | 0 | 0.14 | 0.00014 | 0 | 0.19 | 0.00019 | 0 | 0.09 | 0.00009 | 0 |
| 7. | Turbidity | 11.7 | 117 | 2.457 | 11.6 | 116 | 2.436 | 11.9 | 119 | 2.499 | 13.7 | 137 | 2.877 |
| 8. | TDS | 99.6 | 4.98 | 0.423 | 100.2 | 5.01 | 0.426 | 105.3 | 5.26 | 0.447 | 104.6 | 5.23 | 0.444 |
| 9. | TSS | 16.8 | 3.36 | 0.215 | 18.2 | 3.64 | 0.233 | 22.8 | 4.56 | 0.292 | 22.4 | 4.48 | 0.286 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10. | DO | 5.4 | 95.83 | 4.025 | 6.8 | 81.25 | 3.412 | 4.8 | 102.08 | 4.287 | 4.9 | 101.04 | 4.244 |
| 11. | BOD | 1.0 | 20 | 0.84 | 1.02 | 20.4 | 0.857 | 2.0 | 40.0 | 1.68 | 1.04 | 20.8 | 0.874 |
| 12. | COD | 92.8 | 464.0 | 19.489 | 99.0 | 495.0 | 20.79 | 107.0 | 535.0 | 22.47 | 94.0 | 470.0 | 19.74 |
| 13. | Fluoride | 0.104 | 6.93 | 0.443 | 0.181 | 12.07 | 0.772 | 0.188 | 12.53 | 0.802 | 0.121 | 8.07 | 0.516 |
| 14. | Chloride | 34 | 3.4 | 0.218 | 42.0 | 4.2 | 0.269 | 76.0 | 7.6 | 0.486 | 64.0 | 6.4 | 0.409 |
| 15. | Phosphate | 0.68 | 13.6 | 0.285 | 1.02 | 20.4 | 0.428 | 0.98 | 19.6 | 0.412 | 0.67 | 13.4 | 0.281 |
| 16. | Sodium | 38 | 190.0 | 12.16 | 68.0 | 340.0 | 21.76 | 74.0 | 370.0 | 23.68 | 58.0 | 290.0 | 18.56 |
| 17. | Potassium | 0.42 | 4.2 | 0.176 | 2.8 | 28.0 | 1.176 | 1.8 | 18.0 | 0.756 | 0.98 | 9.8 | 0.412 |
| 18. | Iron | 0.0016 | 0.16 | 0.006 | 0.0040 | 0.4 | 0.017 | 0.0038 | 0.38 | 0.016 | 0.0026 | 0.26 | 0.010 |
| 19. | Zinc | 0.0012 | 0.0024 | 0 | 0.0038 | 0.025 | 0.002 | 0.0031 | 0.02 | 0.001 | 0.0017 | 0.01 | 0 |
| | | WQI =49.713 | | | WQI =60.529 | | | WQI =66.084 | | | WQI =56.037 | | |

**Table 4:** Calculation of $q_n$ and WQI of CW2 in different seasons.

| Sl. No. | CW2 | WINTER | | | SUMMER | | | MONSOON | | | POST MONSOON | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Parameters | Values | ($q_n$) | WQI | Values | ($q_n$) | WQI | Values | ($q_n$) | WQI | Values | ($q_n$) | WQI |
| 1. | pH | 7.1 | 30 | 2.55 | 7.4 | 45.0 | 3.825 | 7.15 | 32.5 | 2.762 | 7.12 | 31.0 | 2.635 |
| 2. | Temperature | 27 | 67.5 | 2.835 | 36 | 90.0 | 3.78 | 27 | 67.5 | 2.835 | 27 | 67.5 | 2.835 |
| 3. | Conductivity | 195.0 | 9.75 | 0.409 | 194.0 | 9.7 | 0.407 | 196.5 | 9.825 | 0.412 | 202.2 | 10.11 | 0.425 |
| 4. | Hardness | 60.0 | 10 | 0.64 | 62.0 | 10.33 | 0.661 | 68.0 | 11.33 | 0.725 | 58.0 | 9.67 | 0.619 |
| 5. | Alkalinity | 55.0 | 9.17 | 0.385 | 63.0 | 10.5 | 0.441 | 70.2 | 11.7 | 0.491 | 68.0 | 11.33 | 0.476 |
| 6. | Salinity | 0.08 | 0.00008 | 0 | 0.09 | 0.00009 | 0 | 0.08 | 0.00008 | 0 | 0.05 | 0.00005 | 0 |
| 7. | Turbidity | 10.2 | 102 | 2.142 | 11.2 | 112 | 2.352 | 9.28 | 92.8 | 1.949 | 10.8 | 108 | 2.268 |
| 8. | TDS | 92.6 | 4.63 | 0.393 | 96.0 | 4.8 | 0.408 | 101.2 | 5.06 | 0.430 | 99.7 | 4.985 | 0.424 |
| 9. | TSS | 15.2 | 3.04 | 0.194 | 16.2 | 3.24 | 0.207 | 18.4 | 3.68 | 0.235 | 18.2 | 3.64 | 0.233 |
| 10. | DO | 5.1 | 98.95 | 4.156 | 6.1 | 88.54 | 3.718 | 4.2 | 108.33 | 4.550 | 4.2 | 108.33 | 4.550 |
| 11. | BOD | 0.98 | 19.6 | 0.823 | 0.92 | 18.4 | 0.773 | 1.96 | 39.2 | 1.646 | 0.98 | 19.6 | 0.823 |
| 12. | COD | 88.6 | 443.0 | 18.606 | 94.0 | 470.0 | 19.74 | 102.0 | 510.0 | 21.42 | 86.2 | 431.0 | 18.102 |
| 13. | Fluoride | 0.086 | 5.73 | 0.366 | 0.122 | 8.13 | 0.520 | 0.092 | 6.13 | 0.392 | 0.085 | 5.66 | 0.362 |
| 14. | Chloride | 32.0 | 3.2 | 0.205 | 38.0 | 3.8 | 0.243 | 72.4 | 7.24 | 0.463 | 58.0 | 5.8 | 0.371 |
| 15. | Phosphate | 0.46 | 9.2 | 0.193 | 0.84 | 16.8 | 0.353 | 0.75 | 15.0 | 0.315 | 0.42 | 8.4 | 0.176 |
| 16. | Sodium | 36.0 | 180.0 | 11.52 | 63.0 | 315.0 | 20.16 | 68.0 | 340.0 | 21.76 | 52.0 | 260.0 | 16.64 |
| 17. | Potassium | 0.38 | 3.8 | 1.596 | 2.1 | 21.0 | 0.882 | 1.2 | 12.0 | 0.504 | 0.72 | 7.2 | 0.302 |
| 18. | Iron | 0.0012 | 0.12 | 0.005 | 0.0032 | 0.32 | 0.013 | 0.0027 | 0.27 | 0.011 | 0.0018 | 0.18 | 0.007 |
| 19. | Zinc | 0.0009 | 0.006 | 0 | 0.0026 | 0.017 | 0.001 | 0.0022 | 0.015 | 0 | 0.0010 | 0.007 | 0 |
| | | WQI =47.018 | | | WQI =58.484 | | | WQI =60.9 | | | WQI =51.248 | | |

**Table 5:** Calculation of $q_n$ and WQI of CW3 in different seasons.

| Sl. No. | CW3 | WINTER | | | SUMMER | | | MONSOON | | | POST MONSOON | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Parameters | Values | ($q_n$) | WQI | Values | ($q_n$) | WQI | Values | ($q_n$) | WQI | Values | ($q_n$) | WQI |
| 1. | pH | 7.5 | 50.0 | 4.25 | 7.8 | 65.0 | 5.525 | 7.75 | 62.5 | 5.312 | 7.45 | 47.5 | 4.037 |
| 2. | Temperature | 25 | 62.5 | 2.625 | 35 | 87.5 | 3.675 | 26 | 65.0 | 2.73 | 25 | 62.5 | 2.625 |
| 3. | Conductivity | 798.0 | 39.9 | 1.676 | 926.0 | 46.3 | 1.945 | 964.0 | 48.2 | 2.024 | 794.0 | 39.7 | 1.667 |
| 4. | Hardness | 94.0 | 15.67 | 1.003 | 106.0 | 17.67 | 1.130 | 178.0 | 29.67 | 1.899 | 128.0 | 21.33 | 1.365 |
| 5. | Alkalinity | 87.0 | 14.5 | 0.609 | 94.0 | 15.67 | 0.658 | 78.0 | 13.0 | 0.546 | 102.0 | 17.0 | 0.714 |
| 6. | Salinity | 1.88 | 0.00188 | 0 | 1.78 | 0.00178 | 0 | 1.99 | 0.002 | 0 | 1.98 | 0.00198 | 0 |
| 7. | Turbidity | 25.4 | 254 | 5.334 | 26.2 | 262 | 5.502 | 25.8 | 258 | 5.418 | 27.8 | 278 | 5.838 |
| 8. | TDS | 206.0 | 10.3 | 0.875 | 204 | 10.2 | 0.867 | 278 | 13.9 | 1.181 | 302 | 15.1 | 1.283 |
| 9. | TSS | 20.2 | 4.04 | 0.258 | 19.6 | 3.92 | 0.250 | 19.9 | 3.98 | 0.255 | 24.4 | 4.88 | 0.312 |
| 10. | DO | 6.25 | 86.98 | 3.653 | 6.6 | 83.33 | 3.499 | 6.7 | 82.292 | 3.456 | 5.8 | 91.67 | 3.850 |
| 11. | BOD | 2.3 | 46.0 | 1.932 | 2.2 | 44.0 | 1.848 | 2.2 | 44.0 | 1.848 | 3.02 | 60.4 | 2.537 |
| 12. | COD | 128.0 | 640.0 | 26.88 | 114 | 570.0 | 23.94 | 144.0 | 720.0 | 30.24 | 139.0 | 695.0 | 29.19 |
| 13. | Fluoride | 0.34 | 22.67 | 1.450 | 0.32 | 21.33 | 1.365 | 0.48 | 32.0 | 2.048 | 0.56 | 37.33 | 2.389 |
| 14. | Chloride | 198.0 | 19.8 | 1.267 | 188.0 | 18.8 | 1.203 | 276.0 | 27.6 | 1.766 | 268.0 | 26.8 | 1.715 |
| 15. | Phosphate | 6.8 | 136.0 | 2.856 | 6.7 | 134.0 | 2.814 | 5.8 | 116.0 | 2.436 | 8.0 | 160.0 | 3.36 |
| 16. | Sodium | 684.0 | 3420.0 | 218.88 | 792 | 3960.0 | 253.44 | 804.0 | 4020.0 | 257.28 | 732.0 | 3660.0 | 234.24 |
| 17. | Potassium | 7.9 | 79.0 | 3.318 | 8.7 | 87.0 | 3.654 | 8.6 | 86.0 | 3.612 | 7.5 | 75.0 | 3.15 |
| 18. | Iron | 0.0044 | 0.44 | 0.018 | 0.0054 | 0.54 | 0.023 | 0.0052 | 0.52 | 0.022 | 0.0048 | 0.48 | 0.020 |
| 19. | Zinc | 0.0022 | 0.015 | 0 | 0.0044 | 0.029 | 0.002 | 0.0042 | 0.028 | 0.002 | 0.0034 | 0.023 | 0.001 |
| | | WQI =276.884 | | | WQI =311.34 | | | WQI =322.075 | | | WQI =298.293 | | |

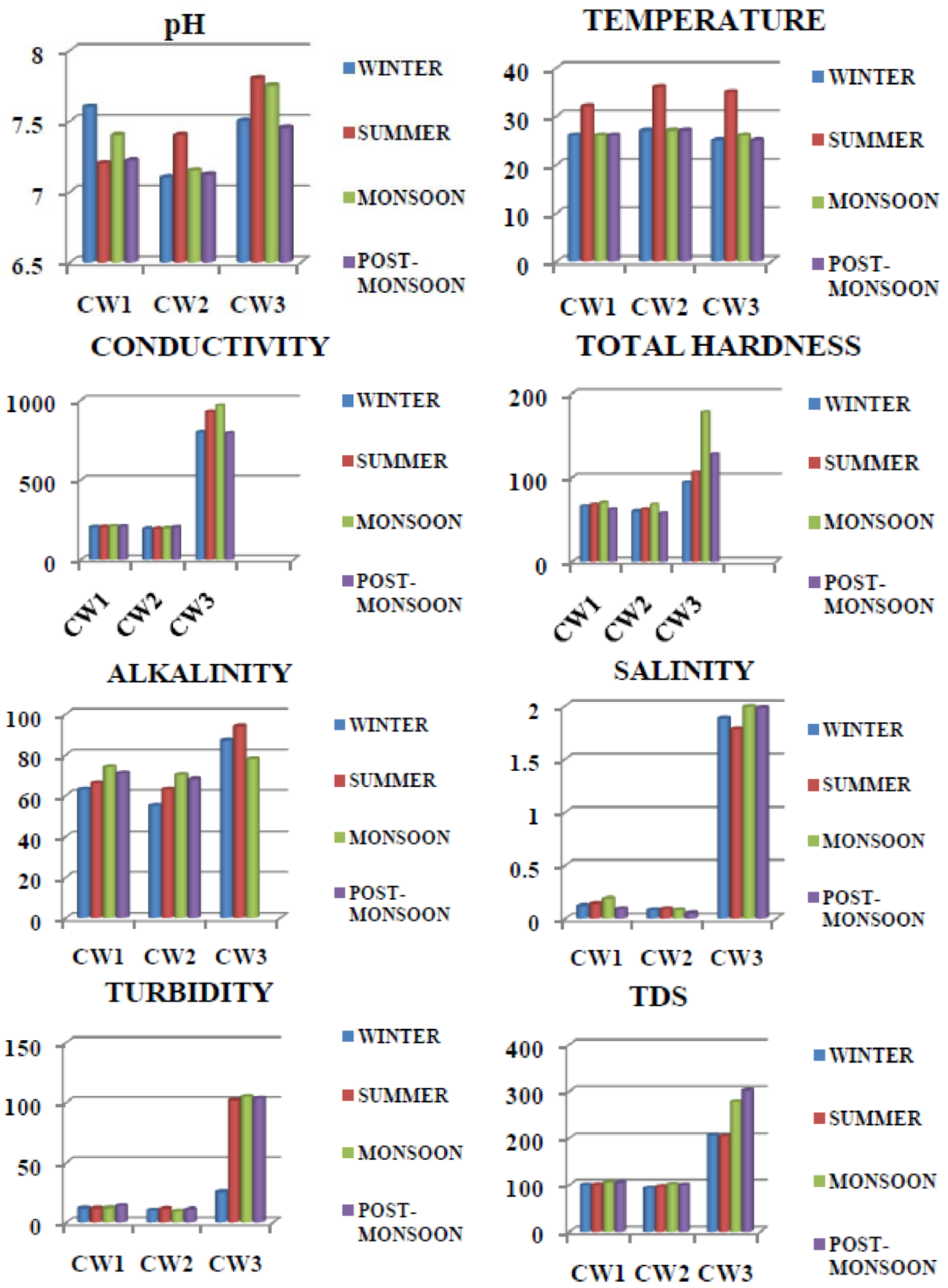


**Fig.4:** Graphical representation of physicochemical parameters (pH, Temperature, Conductivity, Total hardness, Alkalinity, Salinity, Turbidity and TDS) of Taladanda Canal Water in different seasons

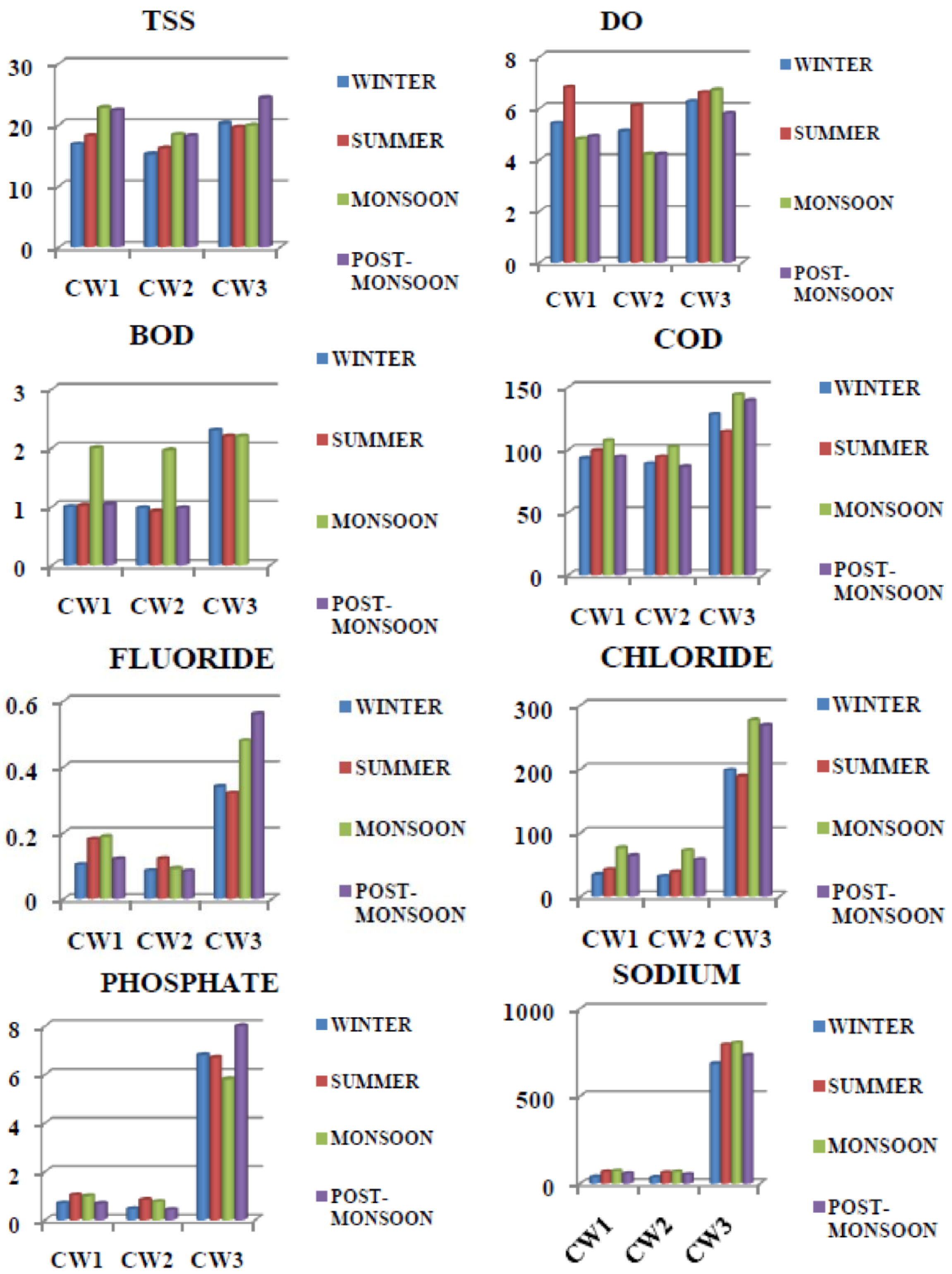


**Fig. 5:** Graphical representation of physicochemical parameters (TSS, DO, BOD, COD, Fluoride, Chloride, Phosphate and Sodium) of Taladanda Canal Water in different seasons

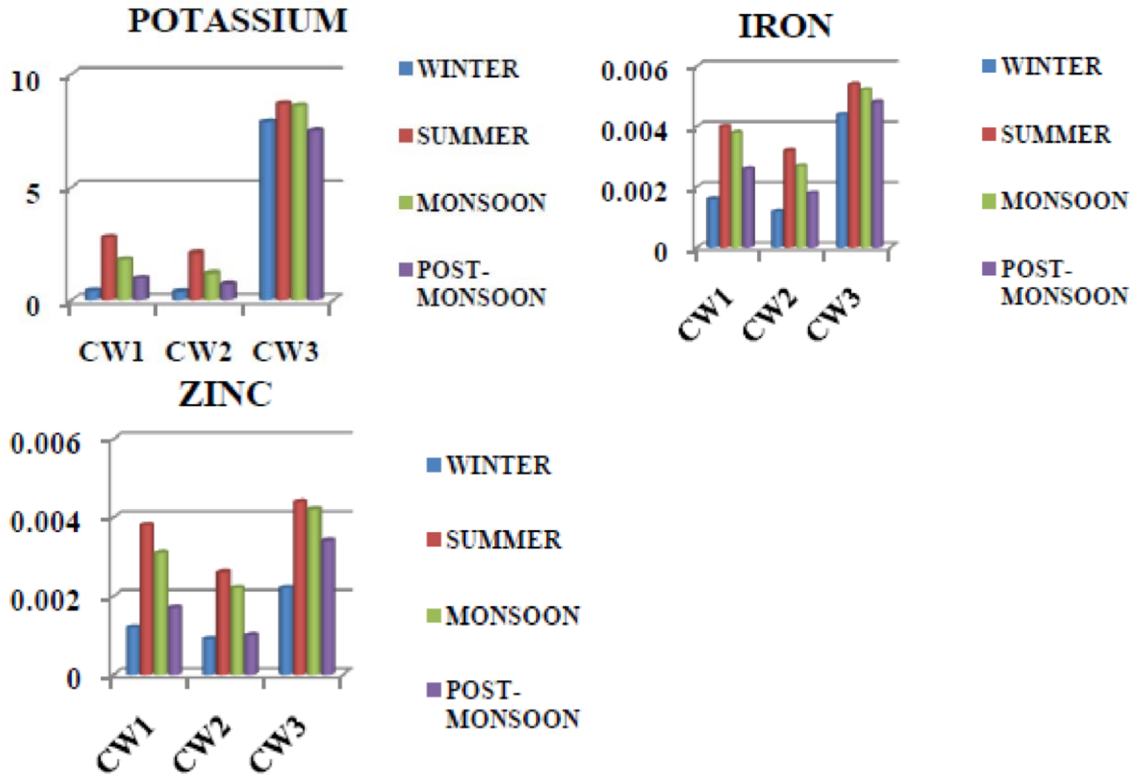


**Fig. 6:** Graphical representation of physicochemical parameters (Potassium and Iron and Zinc) of Taladanda Canal Water in different seasons.

From the Table 3-5 and Figure 4-6, the following observation was obtained for physicochemical parameters in different seasons for Taladanda canal.

It was found from the literature, pH has got no direct adverse affect on health only it produces sour taste if pH is below 4.0 and above 8.5. As per BSI guidelines, pH ranging in between 6.5 to 8.5 is normally acceptable. In this work, pH values ranged between 7.2 (in summer) to 7.6 (in winter) for CW1, 7.1(in winter) to 7.4 (in summer) for CW2 and 7.45 (in post-monsoon) to 7.8 (in summer) in CW3. So the pH value obtained in this work is within the admissible range.

In an aquatic environment, temperature is one of the important factors on biological reactions. Water temperature varies with the atmospheric temperature. In the present study, temperatures ranges from 26.0 (in winter, monsoon and post-monsoon) to 32.0 (in summer) for CW1, 27.0 (in winter, monsoon and post-monsoon) to 36.0 (in summer) for CW2 and 25.0 (in winter & post- monsoon) to 35.0 (in summer) for CW3. So the temperature data in this work is within the admissible range.

In the present study, conductivity value ranges from 202.8 (in winter) to 207.8 (in monsoon) for CW1, 194.0 (in summer) to 202.2 (in post- monsoon) for CW2 and 794.0 (in post- monsoon) to 964.0 (in monsoon) for CW3. So the conductivity data in this work is within the admissible range i.e. 2000 $ohm^{-1}cm^{-1}$.

Total hardness (TH) in water is due to presence of multivalent metals like calcium and magnesium. In this study, TH ranges from 62.0 (in post monsoon) to 70.0 (in monsoon) for CW1, 58.0 (in post- monsoon) to 68.0 (in monsoon) for CW2 and 94.0 (in winter) to 178.0 (in monsoon) for CW3. So in the present study area the TH value of all the water samples are within the permissible limit i.e 300-600 mg/L.

In the present study, alkalinity found to be from 63.0 (in winter) to 74.0 (in monsoon) for CW1, 55.0 (in winter) to 70.2 (in monsoon) for CW2 and 78.0 (in monsoon) to 102.0 (in post- monsoon) for CW3. The low values of alkalinity compared to admissible level i.e. 200-600 mg/L may be due to affect of rainwater.

In the present study, salinity values found to be 0.09 (post-monsoon) to 0.19 (monsoon) for CW1, 0.05 (post-monsoon) to 0.09 (summer) for CW2 and 1.78 (summer) to 1.99 (monsoon) for CW3. So the study revealed that the values are within admissible range (100 PPT).

Turbidity in water is due to presence of suspension in water. In the present study, turbidity found to be from 11.6 (summer) to 13.7 (post-monsoon) for CW1, 9.28 (monsoon) to 11.2 (summer) for CW2 and 25.4 (winter) to 27.8 (post- monsoon) for CW3. In some case turbidity is higher than the acceptable limit (5-25 NTU) may be due to mixing of sewerage water.

The TDS in the present study found to be 99.6 (winter) to 105.3 (monsoon) for CW1, 92.6 (winter) to 101.2(monsoon) for CW2 and 204.0 (summer) to 302.0 (post- monsoon) for CW3. The values are within admissible limit (500-2000 mg/L). In some cases, TDS is higher in winter and summer than monsoon and post- monsoon. This may be due to deposits of carbonate, mineral springs and intrusion of sea water.

In the present study, TSS ranges from 16.8 (winter) to 22.8 (monsoon) for CW1, 15.2 (winter) to 18.4 (monsoon) for CW2 and 19.6 (summer) to 24.4 (post- monsoon) for CW3. But the values are within admissible limit (500 mg/L).

The physical and biological processes in water are reflects by dissolved oxygen (DO). In the present study, DO ranges from 4.8 (monsoon) to 6.8 (summer) for CW1, 4.2 (monsoon & post-monsoon) to 6.1 (summer) for CW2 and 5.8 (post- monsoon) to 6.7 (monsoon) for CW3. Comparatively low values of DO observed in this case may be due to restricted flow of canal water and the decomposition of organic matter.

Amount of oxygen consumed by bacteria for the decomposition of organic material is known as BOD. In the present study, BOD ranges from 1.0 (winter) to 2.0 (monsoon) for CW1, 0.92 (summer) to 1.96 (monsoon) for CW2 and 2.2 (summer & monsoon) to 3.02 (post- monsoon) for CW3. The BOD in the present study is in admissible limit (5 mg/L).

Oxygen required to oxidize the organic substances is known as COD. In the present study, COD ranges from 92.8 (winter) to 107.0 (monsoon) for CW1, 86.2 (post-monsoon) to 102.0 (monsoon) for CW2 and 114.0 (summer) to 144.0(monsoon) for CW3. High values of COD compare to permissible value (20 mg/L ) may be due to the presence of high content organic matter due to disposal of sewage into the canal. It indicates that the water of canal is polluted.

Several diseases like cancer, osteoporosis, brittle bones, arthritis and infertility in women, Alzheimer's disease, brain damage and thyroid disorders are causes due to excess of fluoride. In the present study, fluoride ranges from 0.104 (winter) to 0.188 (monsoon) for CW1, 0.085 (post-monsoon) to 0.122 (summer) for CW2 and 0.32 (summer) to 0.56 (post- monsoon) for CW3. The permissible level of fluoride in portable water is 1.5 mg/L. So fluoride is in admissible level (1.0-1.5 mg/L) in this wok.

In the present study, chloride ranges from 34.0 (winter) to 76.0 (monsoon) for CW1, 32.0 (winter) to 72.4 (monsoon) for CW2 and 188.0 (summer) to 276.0 (monsoon) for CW3. Chloride content is found to be higher in winter and summer season than monsoon season. The values are within admissible range (250-1000 mg/L). Higher values of chloride in some cases may be due to the influence of cleaning clothes and mass bathing.

Phosphate in water is due to the excessive growth of algae. In the present study phosphate ranges from 0.67 (post- monsoon) to 1.02 (summer) for CW1, 0.42 (post-monsoon) to 0.84 (summer) for CW2 and 5.8 (monsoon) to 8.0 (post- monsoon) for CW3. Higher value of phosphate compare to admissible value (5 mg/L) in some samples may due to the effect of phosphate industry in Paradeep.

In the present study, sodium ranges from 38.0 (winter) to 74.0 (monsoon) for CW1, 36.0 (winter) to 68.0 (monsoon) for CW2 and 684.0 (winter) to 804.0 (monsoon) for CW3. Higher value of sodium compare to admissible value (20 mg/L) in some samples may due to the effect of sea i.e. Bay of Bengal.

In the present study, potassium ranges from 0.42 (winter) to 2.8 (summer) for CW1, 0.38 (winter) to 2.1 (summer) for CW2 and 7.5 (post- monsoon) to 8.7 (summer) for CW3. Potassium in this study is within the admissible level.

In the present study, iron ranges from 0.0016 (winter) to 0.004 (summer) for CW1, 0.0012 (winter) to 0.0032 (summer) for CW2 and 0.0044 (winter) to 0.0054 (summer) for CW3. The values are within admissible level (10-50 mg/L) .

In the present study, zinc ranges from 0.0012 (winter) to 0.0038 (summer) for CW1, 0.009 (winter) to 0.0026 (summer) for CW2 and 0.0022 (winter) to 0.0044 (summer) for CW3. The values are within admissible level (0.1-1.0 mg/L).

**Analysis**

The WQI are classified as per standard values of water quality rating. The WQI for samples CW1, CW2 and CW3 have been calculated using the equation 1.3 as described in above. The average values are reported in the Table 6.

**Table 6:** WQI in different seasons in various locations.

| Location | WQI in different season | | | | Average WQI |
|---|---|---|---|---|---|
| | Winter | Summer | Monsoon | Post -monsoon | |
| CW1 | 49.71 | 60.53 | 66.08 | 56.04 | 58.09 |
| CW2 | 47.02 | 58.48 | 60.91 | 51.25 | 54.42 |
| CW3 | 276.88 | 311.34 | 322.07 | 298.29 | 302.15 |

The WQI values for the four sample site presented in the Table 6 clearly indicate the declining of water quality in CW3. The WQI values obtained are classified as per standard values of water quality rating and following conclusions are drawn (Table 7).

**Table 7:** Average Water quality in various locations.

| Sampling Source | Average WQI | Rating | Possible Usages |
|---|---|---|---|
| CW1 | 58.09 | Fair | Industrial Activities and Irrigation |
| CW2 | 54.42 | Fair | Industrial Activities and Irrigation |
| CW3 | 302.15 | Unfit | Before use proper treatment required |

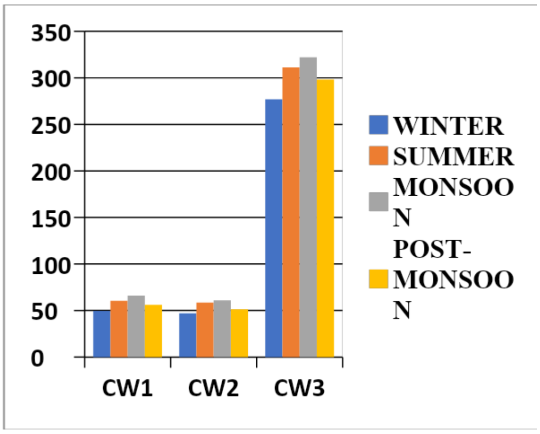


**Fig.7:** WQI of CW in different seasons

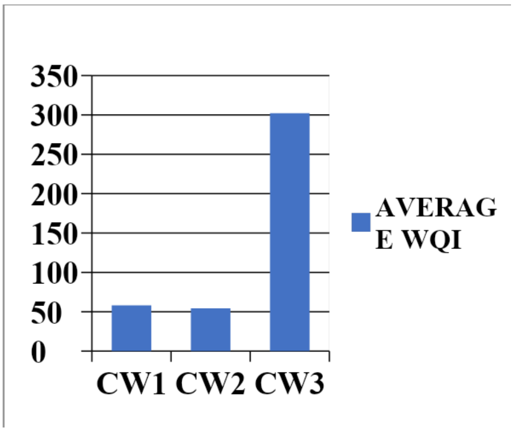


**Fig.8:** Average values of WQI

Water quality of CW1 and CW2 in monsoon season was maximum whereas minimum in winter season (Table 6 & Fig 7). The values of parameters like turbidity, DO, COD and sodium were high due to mixing of effluents and pollutant in the upper area of canal. The quality of water comes under fair category and it can be used for irrigation and industrial activities. If the above parameters are discarded than the WQI value becomes 15.85 for CW1 and 15.24 for CW2, so the quality of water changes to almost excellent category.
Water quality of CW3 in monsoon season was maximum whereas minimum in the winter season (Table 6 & Fig 7). The values of parameters like turbidity, DO, COD, chloride, sodium and phosphate were too much higher as compared to up and mid stream. High values of all these parameters were due to high organic matter contents effluent, untreated sewage disposal by hospitals, nursing homes, industries and people of nearby area, growth of weeds with effect of the sea. The quality of water is unfit for drinking which needs treatment before use. If the above parameters are discarded than the WQI value becomes 23.75, so the quality of water changes to almost excellent category. Chloride and sodium cannot be controlled as it is due to impact of sea. But other parameters can be controlled if disposal of organic matter contents effluent and untreated sewage disposal by hospitals and industries can be checked. Also the manmade activities should be controlled.

## Conclusion

The physicochemical analysis of water samples from Taladanda Canal indicates a notable disparity in pollution levels among the downstream, midstream, and upstream samples. The downstream water exhibits higher levels of contamination, likely attributed to factors such as urban waste leaching, open defecation practices, and the proximity of a dumping yard. The current state of the Taladanda Canal surface water reveals that it is only suitable for domestic purposes and falls short of the standards required for human consumption. Therefore, treatment measures are imperative to enhance its quality before considering it safe for human use.

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