# Assessment of the Physico- chemical Characteristics of Waste Water of Nalapani Rao, Dehradun, India

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**Abstract**

This study was undertaken to assess the Physico- chemical characteristics of waste water of Nalapani Rao, Dehradun city, before it merges with the Rispana River near MDDA colony, Dalanwala. The variations in the parameters were observed by monitoring the drain water atfour locationsfrom July to December on monthly basis.The observed DO values were very low that varied from 0.98 to 1.70 mg/L, which itself reflecting the poor quality of the drain. The observed range of other parameters were: pH (7.56–7.81), TDS (1142- 1372 mg/L), EC (1598 - 1892 µS/cm), TH (473 –536 mg/L), DO(0.98 – 1.70 mg/L), BOD (96–201mg/L), COD (218– 431 mg/L), nitrate (16.6 – 42.8 mg/L), phosphate (0.11- 0.21 mg/L), and chloride (21.2- 57.4). Except, pH, nitrate and chloride the observed levels of all the parameters at all the locations were much higher than standard values. Further, during high flow months because of strong dilution effect due to high flux of rain water, the observed values of TDS, BOD, COD, chloride were improved and recorded comparatively lower values, than during October to December. On computing Pearson's correlation analysis, the highly positive correlations between EC and TDS (r = +0.9348), COD and DO (r = +0.9997), nitrate and BOD (+0.7578) and COD (+0.7687) and phosphate and nitrate (+0.9267), COD (+0.8892) and BOD (+0.8825) were observed. Similarly, a highly negative correlations were observed between DO and BOD (-0.9572), COD (-0.9584). Upon application of one way ANOVA at $p<0.05$ level, significant differences among the season wise and location wise experimental values of various parameters were also computed.

**Keywords**: Nalapani drain, Wastewater Parameters, Pearson's Correlation, One Way ANOVA.

## I. INTRODUCTION

During last few decades the self purifying capability of ground water, rivers and lakes gradually diminished as a result of continuous charging of these water bodies with industrial and domestic waste. Consequently, the rate of discharge of contaminants into the water bodies has become much higher than the rate of its purification[1].Municipal sewage and industrial wastewater have a dominant role in degradation of rivers and other water bodies [2].Once, water is contaminated; it is difficult to restore its original quality. A wide variety of untreated waste and waste water from industrial units, sewage, households waste water, educational institutions, R &D–Pharma sector, hospitals, laundry - dry cleaning effluents, automobile washings, livestock's dung water, open area and agricultural runoff etc. uninterruptedly reaching into water bodies that alter the status of water quality considerably [1,3]. These industrial wastes often contain chlorinated hydrocarbons, minerals and heavy metals, humus materials, various acids, alkalis, dyes, and other chemicals. Synthetic detergents in waste water when reaches the flowing rivers generate huge foams that are harmful to aquatic life [4, 5].The role of dairy industry in contamination of water bodies is related with pasteurization, preparation and bottling of milk, butter water, cheese, milk powder, etc., all these generate nearly 2- 3 times the volume of milk processed [6].The untreated waste water when used for irrigation, the toxic chemicals and metals find their way to the farm products that may exert adverse impact on the health of the end users. Waste management strategies adopted in developing countries have failed to keep pace with the industrial growth and urbanization [4]**.**When the wastewater is allowed to settle and suspended solids are filtered the BOD and COD is reduced upto some extent, if further treated for nitrogen and phosphates, the coliforms can also be reduced. On further treatment for organic matters, BOD, COD, nitrate, phosphate are reduced 65 to 90% and coliforms can be restricted below 800-1000 MPN/100ml [7, 8, and 9].During rainfall events, outflow from agri-fields carries significant quantities of nutrients, pesticides, herbicides and other pollutants to nearby streams and rivers[10].

This presentation is focused on the studies of various physical, chemical and biological characteristics of waste water of Nalapani Rao between *Tapovan Mandir area* and *MDDA colony*, where it merges with Rispana River. The waste water samples were collected during July 2016 toDecember2016 on monthly basis from different locations of Nalapani Rao. The characteristics of waste water of Nalapani Rao was assessed by monitoring the drain at four locations, (i) *Tapovan Mandir area*, (ii) *Near IGNOU*, (iii) *Near Kali Mandir (Tapovan Chauwk)*, (iv) *Near MDDA Colony* by analyzing waste water for pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Total Hardness (TH),Dissolved Oxygen (D.O), Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), nitrate, phosphate and chloride.

## II MATERIALS & METHOD

### 2.1. Study Area

The study area is in Doon valley that exists between latitudes 29° 55'N and 30° 30'N and longitudes 77° 35'E and 78° 24'E. Dehradun district is bordered by the Himalayan range to the north, the Shivaliks to the south, the Ganges to the east and the Yamuna River to the west [11].The climate of Dehradun is temperate and surrounded by dense Sal forests [12]. Nalapani Rao is originated from the north-eastern part of the city and then flows south wards upto MDDA colony, Dalanwala, where it merges with Rispana River that flows southward across the central part of Dehradun city. Once a perennial stream, during last few decades the Nalapano Rao experienced dumping of urban solid waste, open area cum agri run-off and other garbage that gradually transformed it to a *drain* carrying urban waste water**.** During the last two decades Dehradun City has gone through a large scale urban growth with large number of residential buildings, residential and commercial complexes, shopping malls, hotels, restaurants, fast food plazas, hospitals, pathology labs, nursing homes, with different kind of human activities causing contamination of water bodies [12, 1, and 13].

**2.2. Collection of Water samples:** To observe temporal and spatial variations in various physico-chemical parameters, the representative samples were collected from the most encroached and heavy garbeged segments of Nalapani drain between *Tapovan Mandir area* to *MDDA colony*. The samples were collected from four monitoring locations during July, 2016 to December, 2016, on monthly basis. The new transparent polythene cans were used for the collection of waste water samples, which were cleaned with tap water and finally rinsed with distilled water. However samples for dissolved oxygen, and biochemical oxygen demand were collected in pre-cleaned BOD bottles. The collection of samples was done in accordance to Standard Methods for the Examination of Water and Wastewaters, APHA [14]. All necessary precautions were taken during sampling and transportations to the laboratory.

**2.3. Analysis of Water Quality Parameters:** The samples for pH and DO were analyzed by following standard procedures on the spot using EUTECH pH Meter and WTW OXI 3205 Portable DO Meter. Determination of EC, TDS, TH, $BOD_5$, COD, nitrate, phosphate and chloride were done in the laboratory as per standard procedures [14-16]. The BOD was estimated by the modified Winkler method, using WTW OXI Top IS 16 BOD Meter. COD values were determined by refluxing wastewater sample in a reflux flask with mercuric sulphate and sulphuric acid. On cooling, the resultant solution was reacted with known concentration of potassium dichromate and known volume of sulphuric acid, the solution was refluxed for 2 h and cooled. The resultant solution was diluted to twice its volume, cooled to room temperature and excess $K_2Cr_2O_7$ in it was determined by titrating with ferrous ammonium sulphate using ferroin indicator [17]. Similarly, a blank with all reagents added in 25 mL of distilled water was titrated.TH was determined by complexometric titration method. Conductivity was measured on Cyber Scan CON 700 Conductivity Meter. TDS was determined by the evaporating the sample in a weighed dish to constant weight in an oven at105°*C*.Phosphate and nitrate were estimated spectrophotometerically using Carry 60 UV-Vis spectrometer (Agilent). Chloride was determined by Argentometric titration method. All the reagents, solvents and chemicals used were of analytical grade. Doubly- distilled water was used for all purposes.

## III RESULTS & DISCUSSION

The experimental results of various physico-chemical parameters of samples collected from four monitoring locations of the Nalapani drain during July 2016 to December 2016 are presented in Table- 1.The quality of waste water varies from place to place and with seasonal changes.As water flows through the various geological environments, the site-wise and seasonal variation in water quality is governed by soil, geology, climate and anthropogenic activities that keep modifying the composition of dissolved materials and other parameters [17].The results revealed that most of the parameters have higher values than the recommended and admissible values by APHA [14]. Their as such discharge to the nearby land and water bodies will be harmful to the ecosystem. The fast flowing water during high flow season results in decomposition of contaminants faster than standing water and therefore some of the water quality parameters significantly improve during high flow season [18].

**3.1. Statistical analysis:** *Pearson Correlation analysis* (r) was computed in order to find out the closeness of relationship between the parameters, results are presented in Table- 2. To evaluate significant differences among the season and location wise experimental values of various parameters, the *one-way ANOVA* was computed at $p<0.05$ level, by using www.socscistatistics.com/tests/anova/default2.aspx. The ANOVA outputs are presented in the text at appropriate places.

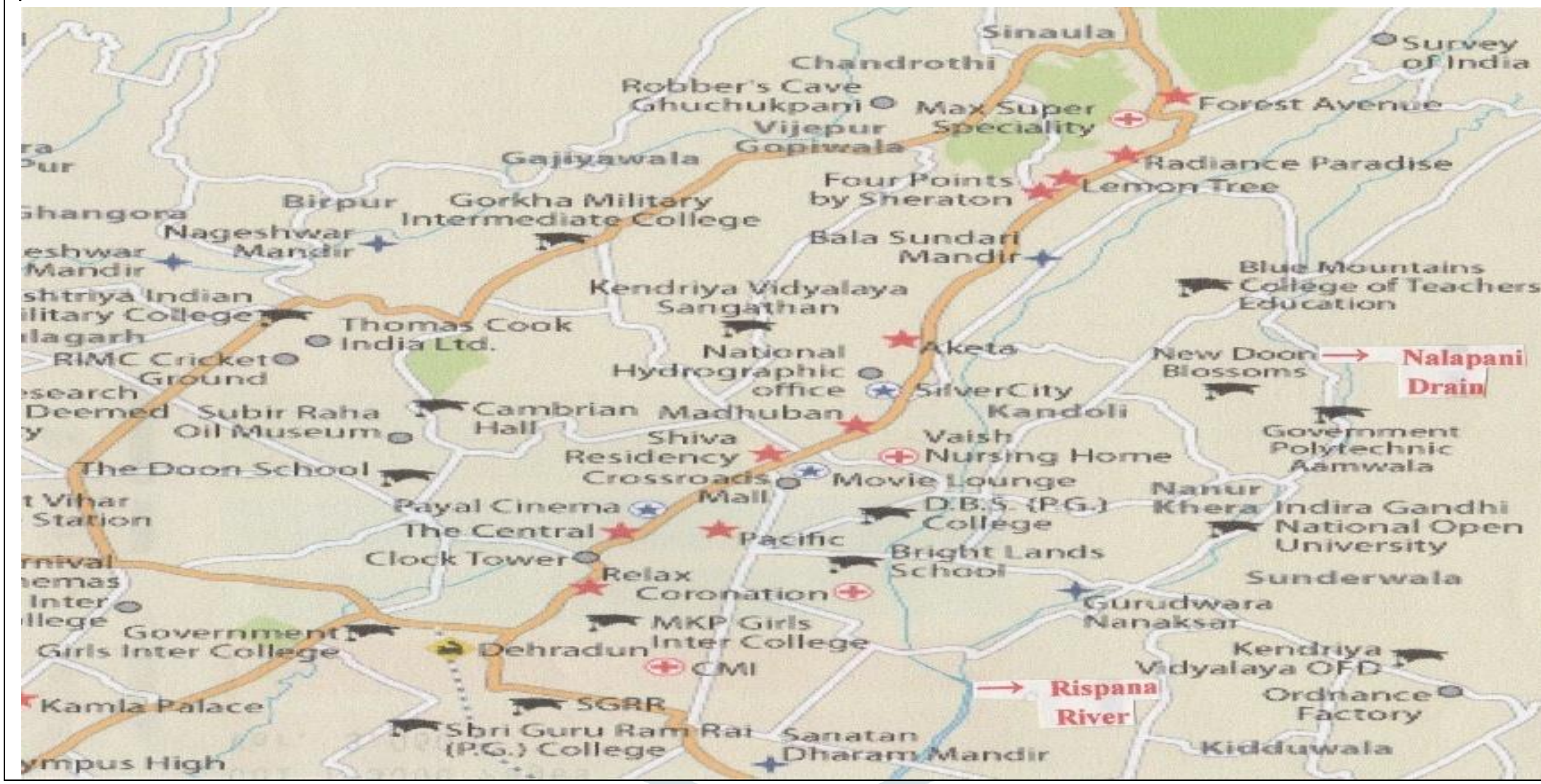



**Fig.-1: Google Map of Study Area showing Nalapani Rao and Rispana River**

**3.2. The pH:** The pH of water is governed by the equilibrium between carbon dioxide, bicarbonate, and carbonate ions. As pH controls the chemical state of many nutrients including dissolved oxygen, phosphate, nitrate etc., therefore, change in pH affects the metabolic activities of aquatic organisms [12]. Excessive high or low pH values may exert adverse effect on aquatic life and can also change the nature and toxicity of some contaminants [13]. The recorded pH values varied from 7.56 to 7.81, means pH remained throughout slightly alkaline. The ANOVA results of pH showed that there were no significant difference at $p<0.05\%$ level among season and locations.

**3.3. Total Dissolve Solids (TDS) :** TDS is the measure of total solids dissolved in a water sample that mainly composed of carbonates, bicarbonates, chlorides, sulphates, phosphates, and nitrates of calcium, magnesium, sodium, potassium, iron, and manganese, etc. TDS content in water is a measure for salinity. The water with TDS up to 2,000 mg/L is considered useful for irrigation purposes, while water with TDS above 3,000 mg/L are not suitable even for irrigation [22]. The range of TDS was 1142 to 1372 mg/L and highest TDS was recorded at ML-4 (1162 to 1372 mg/L) while the lowest at ML-1 (1142 to 1339 mg/L). Lowest TDS were recorded at all the locations in very high flow month of August, which may be due to strong dilution effect on drain by high flux of rain water during monsoon [18]. Higher TDS values at particular location may be due to fresh waste discharge at the site and the type of soil through which water flows [23]. The ANOVA results of TDS concluded that there was highly significant seasonal difference at p<0.05% level, but among locations no significant difference was observed.

**Table- 1: Locations wise observed Values of Waste Water Parameters of Nalapani Rao during July to December 2016 (**Values are as mean ± SD**)**

| Parameters | Period | ML-1 | ML-2 | ML-3 | ML-4 | Standard |
|---|---|---|---|---|---|---|
| **pH** | July- September | 7.59± 0.045 | 7.59±0.12 | 7.62±0.087 | 7.65±0.093 | 7.0-8.5 |
| | October- December | 7.69±0.038 | 7.71±0.05 | 7.73±0.051 | 7.76±0.058 | (**WHO**) |
| **TDS** , | July- September | 1170 ±30.7 | 1190 ±42.3 | 1191 ±33.8 | 1193±45.1 | 500 |
| mg/L | October- December | 1300 ±39.0 | 1319 ±34.6 | 1309±35.1 | 1332±41.6 | (**WHO**) |
| **EC**, | July- September | 1662 ±44.2 | 1673 ±72.1 | 1699 ±72.1 | 1717 ±67.1 | 500 |
| µS/cm | October- December | 1801 ±34.5 | 1828 ±36.5 | 1837 ±35.0 | 1854 ±11.1 | (**WHO**) |
| **TH**, | July- September | 485 ±5.87 | 491 ±5.05 | 508 ± 14.02 | 522 ±18.3 | 100 |
| mg/L | October- December | 472 ±6.04 | 482 ± 4.06 | 496 ±6.67 | 504 ±11.1 | (**WHO**) |
| **DO**, | July- September | 1.55 ±0.15 | 1.48 ±0.15 | 1.52 ±0.14 | 1.48±0.16 | 5.0 |
| mg /L | October- December | 1.32 ±0.08 | 1.26±0.08 | 1.21 ±0.07 | 1.14 ±0.14 | (**WHO**) |
| **BOD**, | July- September | 106 ±12.7 | 116 ±15.1 | 107 ±8.7 | 115 ±20.5 | 28-30 |
| mg/L | October- December | 142 ±17.5 | 153 ± 18.0 | 164 ±18.0 | 174 ±24.6 | (**WHO**) |
| **COD,** | July- September | 233±24.7 | 251±31.6 | 236±15.6 | 252±42.4 | 10 |
| mg/L | October- December | 303±32.5 | 331±36.7 | 357±34.0 | 378±48.3 | (**WHO**) |
| **$NO_3^-$** | July- September | 20.9 ±4.03 | 23.0 ±4.54 | 25.7 ±4.3 | 30.4 ±4.60 | 45 |
| mg/L | October- December | 30.7 ±2.50 | 33. 0 ±2.37 | 36.6 ±1.85 | 40.9 ±2.12 | (**BIS**) |
| **$PO_4^{-3}$**, | July- September | 0.11 ±0.01 | 0.13 ±0.02 | 0.13 ±0.02 | 0.19 ±0.02 | 0.10 |
| mg/L | October- December | 0.12 ±0.01 | 0.14 ±0.02 | 0.17 ±0.01 | 0.20 ±0.02 | (**WHO**) |
| **$Cl^-$**, | July- September | 25.8 ±4.24 | 29.3 ±4.16 | 33.4 ±5.11 | 38.9±6.37 | 200 |
| mg/L | October- December | 41.6 ±3.59 | 45.3 ±4.35 | 49.9 ±4.46 | 54.7±2.50 | (**WHO**) |

ML = Monitoring Locations

**Table 2: Pearson Correlations (r) among the Parameters of Nalapani Rao, during July 2016 – December 2016**

| **Parameters** | **pH** | **TDS** | **EC** | **TH** | **DO** | **BOD** | **COD** | **Nitrate** | **Phosphate** | **Chloride** |
|---|---|---|---|---|---|---|---|---|---|---|
| **pH** | 1 | | | | | | | | | |
| **TDS** | 0.2719 | 1 | | | | | | | | |
| **EC** | 0.3034 | 0.9348 | 1 | | | | | | | |
| **TH** | 0.0870 | -0.6515 | -0.4102 | 1 | | | | | | |
| **DO** | -0.2030 | -0.8809 | -0.6621 | 0.8875 | 1 | | | | | |
| **BOD** | -0.2030 | 0.9060 | 0.7495 | -0.9081 | -0.9572 | 1 | | | | |
| **COD** | 0.0956 | 0.9132 | 0.7598 | -0.9007 | -0.9584 | 0.9997 | 1 | | | |
| **Nitrate** | 0.2864 | 0.9467 | 0.9914 | -0.4159 | -0.6840 | 0.7578 | 0.7687 | 1 | | |
| **Phosphate** | 0.2797 | 0.9927 | 0.9086 | -0.6277 | -0.8862 | 0.8825 | 0.8892 | 0.9267 | 1 | |
| **Chloride** | 0.3130 | 0.9868 | 0.8778 | -0.7268 | -0.9332 | 0.9367 | 0.9441 | 0.8965 | 0.9799 | 1 |

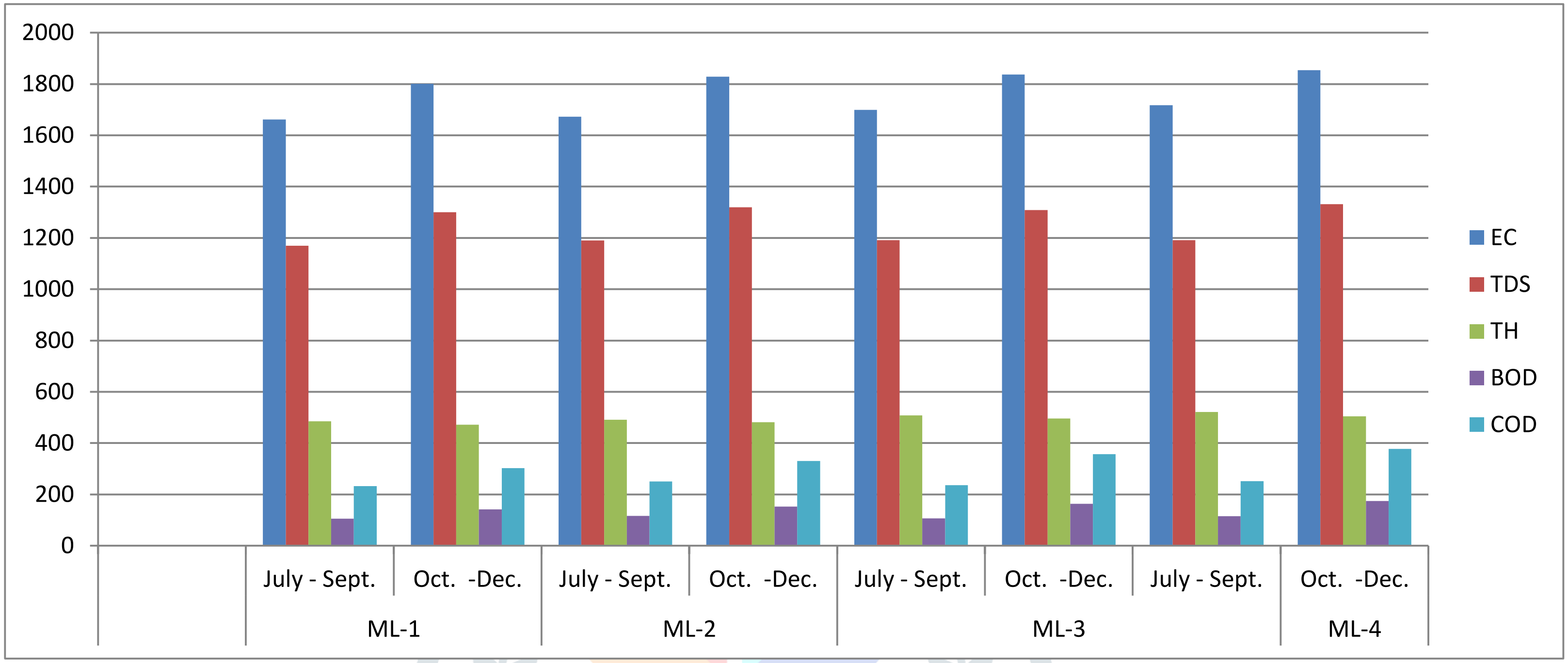


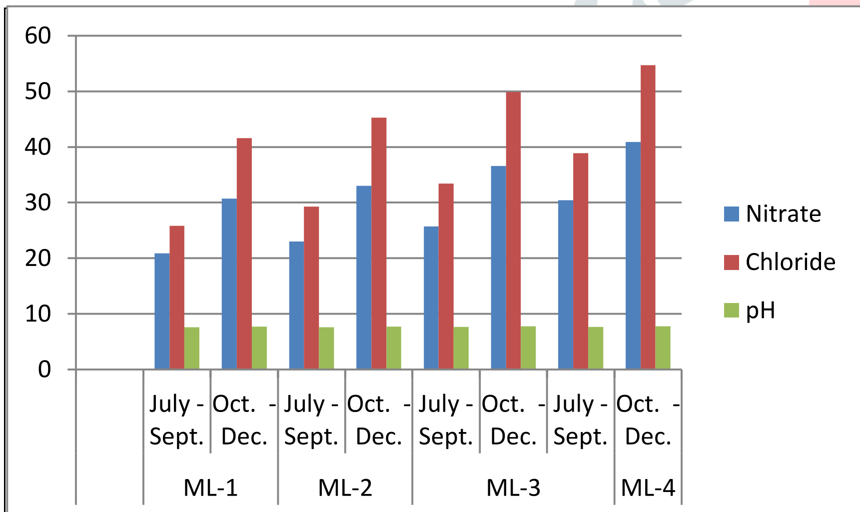

**Fig.- 2: Location and Season wise Values of EC,TDS, TH, BOD and COD**

**3.4. Electrical Conductivity (EC):** Conductivity depends on the total concentration, mobility, valence and the temperature of the solution of ions [19].Almost all the dissolved inorganic substances in water are in the ionic form and therefore contribute to conductance. Thus the observed conductivity of a sample is the estimation of the variation in dissolved mineral content of the water supply. Wastewater contains high amounts of dissolved salts from domestic sewage. High salt concentrations in waste water increase the salinity of the receiving water, which may result in adverse ecological effects on aquatic biota [20]. The EC values during high flow months i.e. July to September, ranged from 1598 to 1772 µS/cm and from 1765 to 1892µS/cm during October to December. High EC values indicate the presence of high amount of dissolved inorganic substances in ionized form [21].As per Table-2, highly positive correlations was found between EC and TDS ($r = +0.9348$). The ANOVA results of EC showed that there was significant seasonal difference at $p<0.05$% level among sites, however no significant difference was found among monitoring locations.

**3.5. Total Hardness (TH):** The Hardness is mainly caused by calcium, magnesium, alkaline earth metal such as iron, manganese, strontium, etc. The total hardness is the sum of calcium and magnesium concentrations, both expressed as $CaCO_3$ in mg/L. Carbonates and bicarbonates of calcium and magnesium cause temporary hardness and sulphates and chlorides cause permanent hardness. Calcium hardness is predominant in the total hardness of water. Comparatively low concentration of calcium carbonate prevents corrosion of metal pipes by laying down a protective coating, but increased amount of calcium precipitates on heating to form harmful scales in boilers, pipes and utensils and, encrustation in water supply structure [10].The recorded TH values during high flow months ranged from 478 to 536 mg/L, while lower values were recorded during October to December i.e. from 466 to 506 mg/L. Thus, all the monitoring locations recorded lower values of TH during October to December, than during July to September. Further, the upstream monitoring locations recorded lower values of TH than in the downstream, as reported Earlier [18].The ANOVA results of TH showed that there was no significant difference at $p< 0.05$% level among seasons, however monitoring locations wise ANOVA results of TH was significant at $p< 0.05$% level.

**3.6. Dissolved Oxygen (DO)**: Dissolved Oxygen is a measure of how much oxygen is dissolved in water. DO in the water is depleted due to decomposition of organic compounds present in water body. Organic wastes from municipal, agricultural and industrial source decreases the dissolved oxygen in water. A water body that is rich in nutrients flourishes algal growth which upon decomposition may deplete dissolved oxygen that may kill aquatic organisms [17].Lower values of DO indicate the presence of organic pollutants in the samples that is not suitable for the survival of aquatic life. Dissolved oxygen is influenced by water temperature and water movement. On increasing temperature DO showed reverse pattern because lower atmosphere hold less concentration of oxygen on increasing the temperature [24]. The DO values of waste water samples ranged from 0.98 to 1.70 mg/L, which were far below than WHO values of 5 mg/L. This may be due to heavy load of organic waste matters and nutrients. High values of DO at all the 4 locations (1.64 to 1.70) were observed in August, this is possibly by washing away of garbage from the drain-bed by huge flux of rain water [18].DO is inversely related with BOD, greater the BOD, lesser will be the DO [21].BOD directly affects the amount of dissolved oxygen (DO), the greater the BOD, the more rapidly oxygen is depleted in the water [4].Highly negative correlations were observed between DO and BOD (-0.9572), COD (-0.9584), nitrate (0.7578), phosphate (-0.8862) and chloride (-0.9332).The ANOVA results of DO was highly significant difference at 0.05% level among the seasons, but the results were not significant among monitoring locations at $p<0.05$ level.

**3.7. Biological Oxygen Demand (BOD):** BOD is the rate of consuming oxygen from water body, waste water or untreated effluents by microorganisms during aerobic degradation of the dissolved organic matter over a 5-day period [17]. Sources of BOD in aquatic environment include leaves and woody debris, dead plants and animals, animal manure, industrial effluents, wastewater treatment plants, and food-processing plants, seepage from faulty septic systems, and urban storm water runoff [4**]**.The greater the decomposable matter present, the greater the oxygen demand and the greater the BOD values[19, 24]. Increases in BOD can be due to heavy discharge of industrial effluent, animal and crop wastes and domestic sewage [4].BOD values of all the samples have recorded much higher levels that exceeded the WHO threshold limits [18].The lowest BOD (96 to 104 mg/L) was observed in high flow month of August, this may be due to strong dilution effect during monsoon [18]; however the highest (159 to 201mg/L) was recorded in the dry month of December. Gradual increase in BOD values may be due to input of domestic sewage, agriculture run-off etc. [4, 21]**.** The BOD has highly negative correlation with DO ($r = -0.9572$). The ANOVA results of BOD indicated a highly significant difference at $p< 0.05$ level among the seasons, but no significant difference was found among the locations wise results.



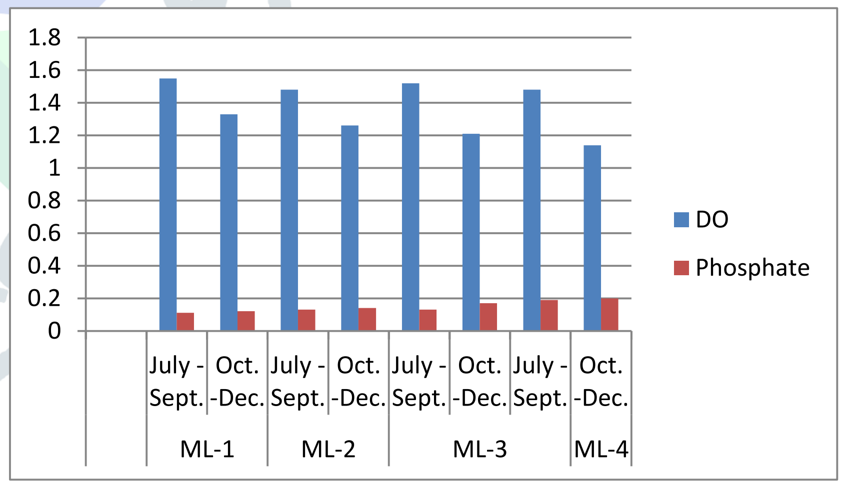




**Fig.-3: Location and Season wise Values of Nitrate, Chloride and pH**

**Fig.-4: Location and Season wise Values of DO and Phosphate**

**3.8. Chemical Oxygen Demand (COD):** The COD is a measure of amount of oxygen required by both potassium dichromate and concentrated sulphuric acid to breakdown both organic and inorganic matters [19]. The COD values determine the oxygen equivalent to that portion of the organic matter in a sample that is susceptible to oxidation by a strong chemical oxidant. Generally, COD test is used to measure the load of organic pollutants in the industrial waste water. COD is similar in function to BOD, that both measure the amount of organic compounds in water [4, 21]**.** The COD values for Nalapani waste water samples varied from 214 to 431 mg/L and all exceeded the standard limits for waste water. The observed values of COD in the high flow month of August were lowest at all the locations (214, 218, 221 and 228 mg/L), while the highest values (332, 370, 392 and 432 mg/L) were recorded in the month of December, the lower values of COD in August may be the effect of strong dilution of waste water. The high value of COD during December indicates high organic matter and nutrients in waste water, and absence of dilution effect as observed in high flow months [18].A highly positive correlation of COD with DO (r = +0.9997) and a highly negative correlation (r = - 0.9584) with BOD was concluded. The ANOVA results of COD revealed a highly significant difference at $p< 0.05$ level, among the seasons, while no significant difference was found among the locations wise results.

**3.9. Nitrate:** The concentration of nitrate is usually expressed in units of mg/l of nitrate as nitrogen. Nitrogen compounds mostly enter a water supply as nitrate $^-$ from agri forest, sewage, drainage from livestock feeding areas and farm manures [21, 25]. Other sources are fertilizers, decayed vegetable, industrial and municipal wastewater, septic systems and nitrogen fixation from atmosphere by algae, bacteria and lightning. Nitrates may find their way into ground water through leaching from soil [26]. The nitrate concentrations in waste water at all the locations were within BIS standard and varied from 16.6 minimum during high flow months (July to September) to 42.8 mg/l maximum during low flow months (October to December) [18]**.** Such a high levels of nitrate at all the locations indicated the presence of some bacterial action and bacterial growth [25].As per Table -2, nitrate exhibited a highly positive correlation with BOD (+0.7578) and COD (+0.7687), while a negative correlation with DO (-0.6840).A highly significant difference in ANOVA results of nitrate at $p< 0.05$ level was recorded among the seasons and no significant difference were found among the locations wise results.

**3.10. Phosphate:** Main source of phosphates in water bodies are the garbage and dung water from small and medium dairies, laundry effluents, agriculture and urban runoff. Phosphate in low concentration is an essential nutrient for the growth of living organisms and it occurs in wastewater due to detergents, fertilizers etc. [21**.** However, the excess phosphate along with nitrates and potassium favours algal blooms, when this excess algae dies, oxygen is used in its decomposition leading depletion of dissolved oxygen. The waste water causes eutrophication of the water bodies leading to the mortality of aquatic animals [18].The levels of phosphate in the entire sampling point were higher than the WHO limit of 0.10mg/L for the discharged of wastewater into river [19]. Table-2 revealed a highly positive correlations of phosphate with nitrate (+0.9267), COD (+0.8892) and BOD (+ 0.8825) and a negative correlation with DO (-0.8862). The ANOVA results of phosphate exhibited a highly significant difference at $p< 0.05$ level among the season wise, as well as location wise results.

**3.11. Chloride:** Chloride enters in water due to dissolution of salt deposits, discharges of industrial and domestic effluents, sewage, agricultural and irrigation runoff. The anthropogenic sources of chloride are kitchen wastes from households, restaurants, and hotels [18, 26]. In natural water chlorides is mainly due to dissolution of salt deposits. A high concentration of chloride has a corrosive effect for galvanized iron pipes used in domestic supply systemand survival of crop and other plants. It also generates potential carcinogenic halogenated disinfection by-products (DBPs) in water supply systems [4, 10]. Chloride concentrations in all samples were within the WHO permissible limits. During October to December i.e. in low flow season, chloride levels at all the locations were found highest (37.6 to 57.2 mg/L), when drain water was constituted of domestic and industrial waste and agri-runoff only, and there is no dilution of drain water during post monsoon and summer [18]. On contrary of this, due to strong dilution effect on drain water, the levels of chloride during high flow season (July to September) were lowest i.e. 21.2 to 41.2 mg/L [18].Table-2 revealed a highly positive correlations of phosphate with nitrate (+0.9267), COD (+0.8892) and BOD (+ 0.8825) and a negative correlation with DO (-0.8862). The ANOVA results of chloride presented a highly significant difference at $p< 0.05$level among the season wise data, but no significant difference was found among the locations wise results.

## IV Conclusions

The release of untreated urban or industrial waste water containing non-degradable toxic chemicals, in the ecosystem is dangerous to the agri-soils, animals, plants and human life. The experimental results revealed that most of the various physical, chemical and biochemical parameters have higher values than the recommended and admissible by WHO or BIS. Thus, the recorded DO values that varied from 0.98 mg/L to 1.70 mg/L were much lower than 5mg/L recommended by WHO. The observed levels of EC, TDS, TH, BOD, COD and phosphate at all the monitoring locations were much higher than recommended values, except the pH, nitrate and chloride that were within the standard permissible limits. Thus, in view of the above findings, the waste water of Nalapani drain is unfit even for irrigation purpose, therefore it’s as such discharge to the nearby agri- soil or Rispana River should be restricted. This is also important for effective implementation of the Rispana River rejuvenation Project. It is also suggested to commission more STP (Sewage Treatment Plants) of appropriate capacity in the catchment area of the drain, so that only properly treated waste water is discharged to the ecosystem including Rispana River.

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