# EVALUATION OF ANTHROPOGENIC ACTIVITIES IN UDYAVARA RIVER BASIN, SOUTH WEST COAST OF INDIA

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## Abstract

*River environment is one of the highly water yielding place for present generation. It is influenced by geomorphic processes like shoreline erosion, siltation, sedimentation, flooding etc. Modification in river ecology is also influenced by the estuaries and sea. Most of the population will be alongside the river basin fetching river water for daily use. In this project work, Udyavara river basin is taken into consideration which is also prevailing at the coastal belt of Karnataka in Udupi district. Udyavara River incorporates the catchment that feed into the estuaries, coastlines and the groundwater that underlies the river basin. Increasing population, industrialization, solid waste dumping and improper sanitary conditions may contaminate the river water for future use. This study considers implementing of measures aimed at maintaining and improving the aquatic environment by restriction to adverse anthropogenic activities. Recently environmental problems have arisen in the river basin which is leading to monitoring and settling environmental objectives for groundwater and surface water pollution. The overall objective of the present study is to prevent deterioration and achieve environmental improvement. It can be concluded based on the results that environmental problems can be solved in this stage and sustainability can be achieved.*

***Keywords:*** *Udyavara River Basin, anthropogenic activities, third order, riverine environment, water pollution, water quality*

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## 1. INTRODUCTION

Udyavara River is one of the rivers situated in south west part of India influenced by the coastal zone of Arabian Sea. The path of a river basin is continuously influenced by geomorphic processes like erosion, deposition, sedimentation, periodic storms and floods and changing sea level. Increasing population, industrial establishments and developments are common in and near river banks. Soil erosion is the biggest problem in river coasts and poses greater threats by destruction of natural habitats and destruct agro-ecosystem and a growing burden of pollution. Life in Karnataka's rivers, lakes, estuaries and the seas is under greater stress than that on the land. The area of study experiences a typical maritime climate with an average temperature of 26.5°C [14]. Coastal Karnataka is emerging as an urbanized region giving rise to industrial growth. The rapid industrialization must be restricted to reduce pollution of water of rivers which joins sea. Though many big industries have withdrawn due to peoples' movement, the region is still the destination for investment. Fishing is the main occupation of people residing near coastal plains thus fish mills are established increasing the employment among people. Pollution of water is not only caused by the nutrients and salts but also by solid waste generated due to anthropogenic activities. River acts as a sink to many types of pollutants due to unscientific sanitation in adjacent areas, port activities and effluent discharge by industries of different kind and dumping of fish and organic wastes. Eutrophication problems may also arise due to nutrients degrading water quality and posing threat to aquatic organisms. If industrial effluents have toxic chemicals, bioaccumulation of pollutants in aquatic organisms can be noticed. The population is expected to increase due to industrialization, urbanization, and widening of roads in Udupi district where Udyavara is a part. Water pollution problems will also increase alongside developmental activities. Groundwater exploitation is increasing day by day everywhere. Manual survey of different places in Udupi district give an outline of problems posed due to anthropogenic activities in brief. Quantitative estimates and monitoring helps to overcome the environmental issues and problems related to river ecology, sustainability and river developments.

## 2. STUDY AREA

### 2.1 Introduction to the Udyavara River Basin

Focusing on the much needed attentiveness to Udupi for the solution towards the water quality, geological, environmental, socio-economic changes provoking problems, the present study is done. The area of study is Udyavara river basin which is located in Udupi district which lies in southwest coast of Karnataka. It lies between the latitude of $13^0$ 00' 00" - $13^0$ 45' 00" north and longitude of $74^0$ 47' 30"- $74^0$ 30' 00" east respectively. It spans an area of 422 sq. kms. The area under investigation is accounted for in the survey of India maps No. 48K/ 11, 12, 15, 16; 48/ 4 [4].

The river ecosystem which is 21kms in length has contributed for ecology and sustainable development and rising environmental and socio-economic issues. Anthropogenic activities and fast urbanization may degrade the river water quality. Continuous monitoring and a necessity of in-depth and holistic baseline data acquisition and interpretation in inland use/land-cover, hydrological study, observing the changes in the chemical and biological composition of the basin through time bound is needed.

The main objective of the study is to understand and estimate the impact of water pollution by the anthropogenic activities on the third order river points. The south west monsoon brings a lot of rains both to the coast and the ghat sections. During monsoon period, i.e. June to September, as there is heavy down pour, the rivers and streams of Western Ghats flow westward though the lengths of the rivers are short but carry a huge volume of water.

Rivers are perennial during normal rainfall years where as tributaries and smaller streams become dry during summer [14]. Slope of the terrain varies widely from $2^0$ to $14^0$. The north central parts of the basin are low energy depositional environments. Rest of the basin is of relatively higher energy [4]. The prevailing high gradient in the hilly terrain and heavy rainfall brings great volume of water in these rivers during monsoon. These rivers join Arabian Sea and are prone to tidal effects to considerable lengths in the inland area.

### 2.2 Hydrology Map of Udyavara River Basin

Fig-1 below shows the hydrology of basin. The riverine ecosystem covers the maximum area of the total area where most of the third order river points flows and narrows towards the western part of the basin.

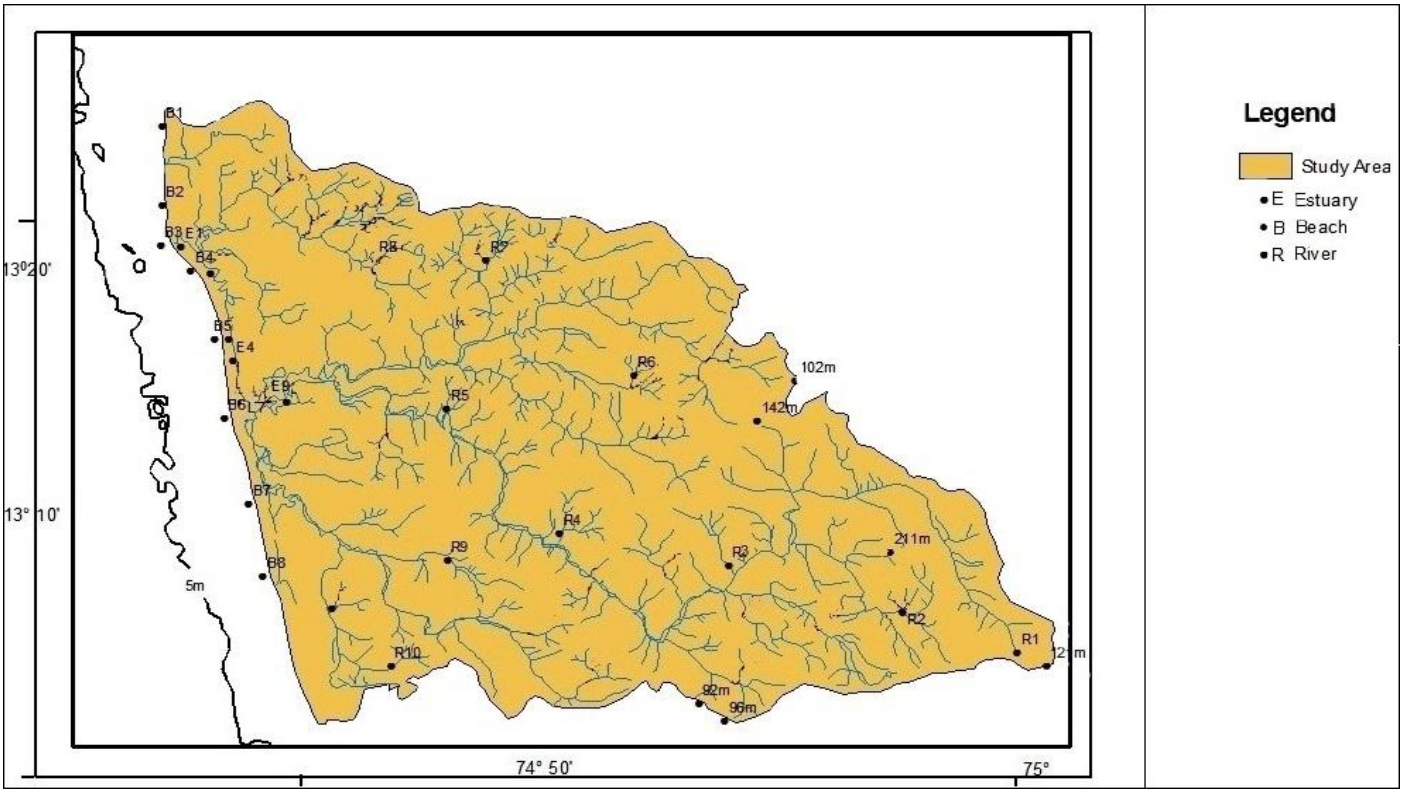


**Fig-1**: Hydrology map of Udyavara River Basin

## 3. METHODOLOGY

This part mainly deals with the details about the step by step procedure followed in each work done, how it is done and using what equipments, method of analysis adopted in order to get the results from the analysis part. All the experiments were conducted according to Standard methods for the examination of water and wastewater, APHA 21st Edition, 2005.

Sampling is done in 9 third order river points of Papanashini and Udyavara rivers from R2-R10 and 1 lake point R1 i.e., Anekere. The sampling station to be sampled throughout the basin was also marked in the maps after selecting them. Surface water samples were collected with clean bottles. After the analysis of waters from different places, Turbidity was measured using Elico CL 52D Nephelometer. pH, Conductivity, Total Dissolved Solids, Salinity and Resistivity were measured using Hach multi-meter.

Summer season, in the month of March was considered for sampling of third order river points for identifying greater impacts. In the field, co-ordinates of sampling points were also noted. Samples were kept in Rotek Deep freezer until analysis for all the parameters was undertaken. Initial dissolved oxygen and Biochemical oxygen demand was

measured using Winkler's method by 0.01N Sodium Thiosulphate as Titrant and Biochemical oxygen demand at $20^0$C for 5 days in Rotek incubator with 5% dilution for initial and final oxygen demand. Most Probable Number of bacteria was counted using 3 sets of 5 tubes by sterilizing in a Rotek autoclave. Chemical oxygen demand was analyzed using 0.25N Ferrous Ammonium Sulphate and $KMnO_4$. Finally Nitrates were analyzed by Devarda's Alloy Method. Heating in both Chemical oxygen demand and Nitrates experiments used Mac Kjeldal digestion unit. Variation in the measured parameters were noted which are highlighted for conclusion from the results obtained after analysis. The river name, co-ordinates and names of places were also marked which is shown in Table-1.

**Table-1:** Names and co-ordinates of the sampling points

| Point | Place name | Co-ordinates |
|---|---|---|
| R1 | Anekere lake | $13^0$ 12' 20.67" N<br>$74^0$ 59' 52.49" E |
| R2 | Bajakala | $13^0$ 12' 54.6" N<br>$74^0$ 56' 32.91" E |
| R3 | Kallya- Papanashini river | $13^0$ 13' 24.01" N<br>$74^0$ 53' 25.84" E |
| R4 | Kodu- Papanashini river | $13^0$ 24' 34.48" N<br>$74^0$ 49' 25.98" E |
| R5 | Belle- Papanashini river | $13^0$ 16' 32.65" N<br>$74^0$ 48' 3.73" E |
| R6 | Kodangala | $13^0$ 18' 8.87" N<br>$74^0$ 48' 10.8" E |
| R7 | Pernankila | $13^0$ 17' 41.85" N<br>$74^0$ 50' 54.24" E |
| R8 | Alewoor | $13^0$ 17' 59.88" N<br>$74^0$ 46' 45.45" E |
| R9 | Panjimar | $13^0$ 13' 57.63" N<br>$74^0$ 47' 48.69" E |
| R10 | Shanthigudde | $13^0$ 12' 4.93" N<br>$74^0$ 47' 49.22" E |

## 4. RESULTS

Results are based on parameters of third order river waters and a lake obtained by analysis in different sampling points of Udyavara River Basin. These results help in knowing the level of pollution in third order river points for water resource management in the region. Table-2 gives the third order river water quality parameters.

**Table-2:** Third order river water quality parameters

| Point / Parameter | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 |
|---|---|---|---|---|---|---|---|---|
| pH | 4.14 | 6.15 | 6.59 | 6.88 | 7.19 | 6.77 | 7.04 | 6.86 |
| Electrical Conductivity (µS/cm) | 245 | 49.7 | 58.1 | 82.5 | 85.9 | 295 | 65.9 | 137 |
| Total Dissolved Solids (mg/L) | 117.1 | 23.3 | 27.3 | 38.8 | 40.5 | 141 | 31 | 64.8 |
| Salinity ($^0/_{00}$) | 0.12 | 0.02 | 0.03 | 0.04 | 0.04 | 0.14 | 0.03 | 0.06 |
| Resistivity (kΩ.cm) | 4.08 | 20.13 | 17.21 | 12.13 | 11.63 | 3.39 | 15.18 | 7.30 |
| Turbidity (NTU) | 3.7 | 13.5 | 5.5 | 6.4 | 5.8 | 9 | 11 | 11 |
| Initial Dissolved Oxygen (mg/L) | 4.0 | 3.84 | 5.5 | 3.96 | 4.64 | 4.48 | 4.48 | 4.80 |
| Biochemical Oxygen Demand (mg/L) | 54.4 | 22.4 | 58.8 | 21.6 | 6.4 | 41.6 | 35.2 | 16 |
| Chemical Oxygen Demand (mg/L) | 72 | 28 | 80 | 64 | 64 | 104 | 96 | 96 |
| Most Probable Number/ 100ml | ≥2400 | ≥2400 | ≥2400 | ≥2400 | 920 | ≥2400 | ≥2400 | ≥2400 |
| Nitrates (mg/L) | 7 | 5 | 4 | 2 | 5 | 8 | 8 | 7 |

Water is more acidic at lake R1 having pH 4.14 and near neutral in other points of the consistent range 6.15-7.19 shown in Chart-1. Electrical conductivity is in the range of 49.7-295 in µS/cm having peak value at river point R6. Lake R1 also has a high value at 245µS/cm as shown in the Chart-2. The values of Total Dissolved Solids have exactly the same pattern as that of Electrical conductivity in lake and river points provided they are in the range 23.3-141 in mg/L shown in Chart-3.

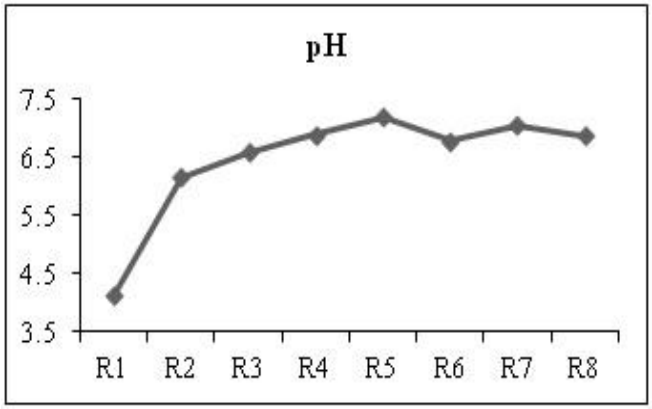


**Chart-1:** Variation of pH in third order river water samples

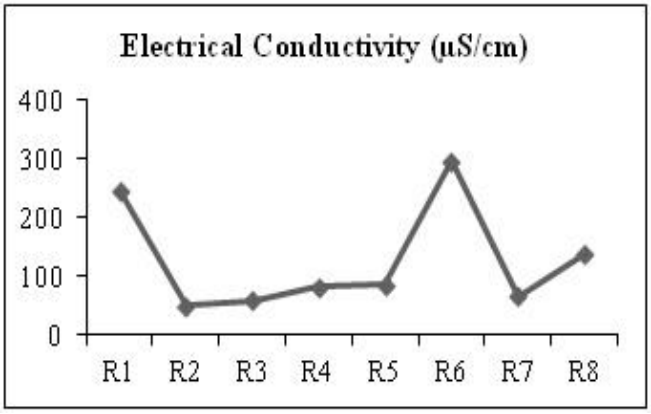


**Chart-2:** Variation of Electrical Conductivity in third order river water samples

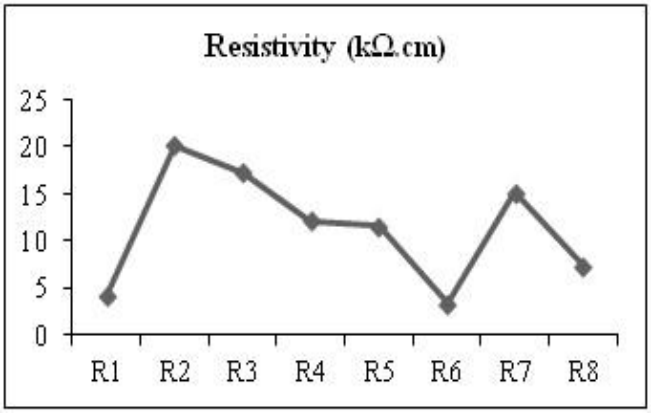


**Chart-5:** Variation of Resistivity in third order river water samples

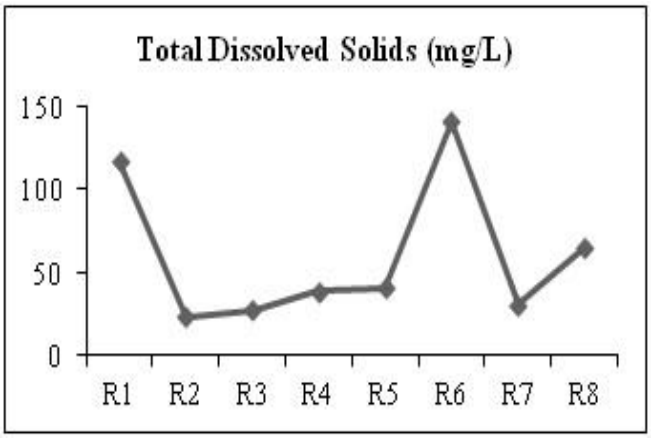


**Chart-3:** Variation of Total Dissolved Solids in third order river water samples

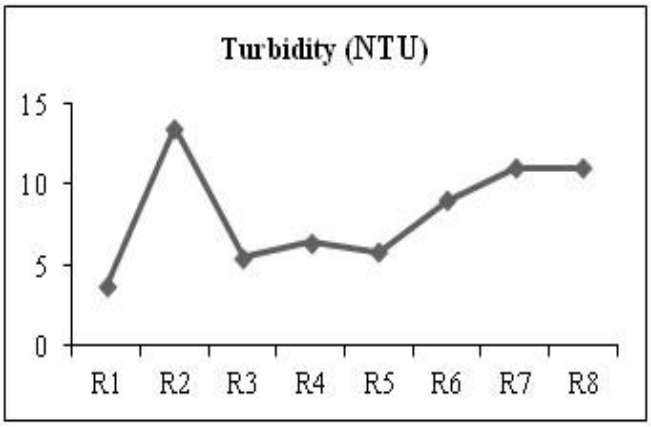


**Chart-6:** Variation of Turbidity in third order river water samples

Very less Salinity ($^0/_{00}$) in the range of 0.02-0.16 are analyzed where 2 peak points at rivers R6 and R8 and Lake R1 are seen as in the Chart-4. Resistivity in kΩ.cm follows opposite trend of Salinity and in the range 3.39-20.13. A very high Resistivity at point R2 is present as in Chart-5. Turbidity is very less in the lake at 3.7NTU and in rivers; a wide range of 5.5-13.5 NTU is present. Peak value is at R2 and the graph varies as in Chart-6.

Initial Dissolved Oxygen at all points is less and only point R3 has higher content out of the range 3.84-5.5 in mg/L as represented in Chart-7. A wide range of Biochemical Oxygen Demand values are analyzed in the range of 6.4-58.8 in mg/L where high values are at point R1 of the lake and point R3 of the river and lowest value at point R5, shown in Chart-8. Chemical Oxygen Demand is present in the range of 28-104 in mg/L which is in the Chart-9.

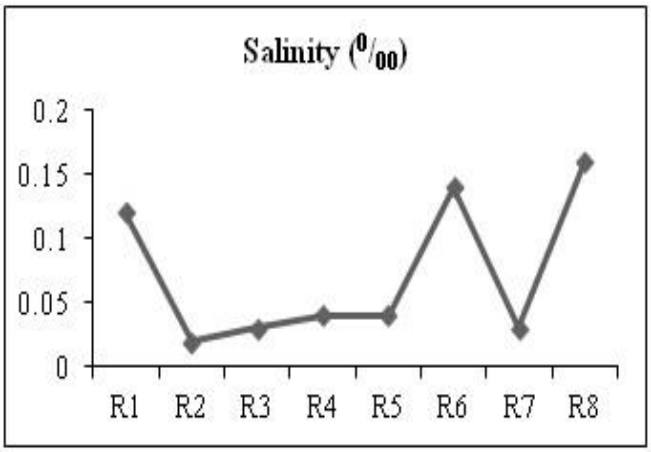


**Chart-4:** Variation of Salinity in third order river water samples

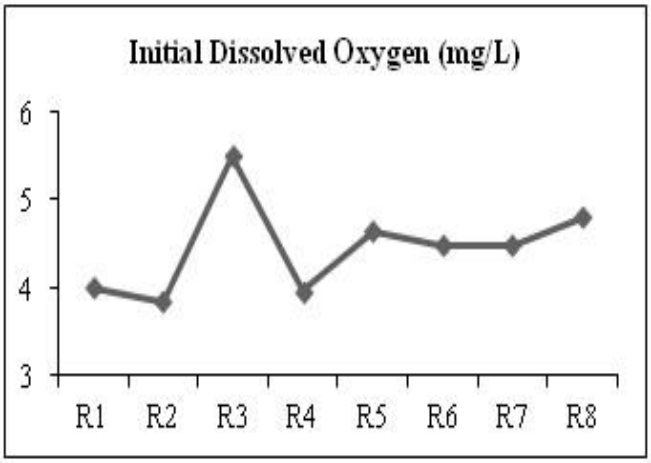


**Chart-7:** Variation of Initial Dissolved Oxygen in third order river water samples

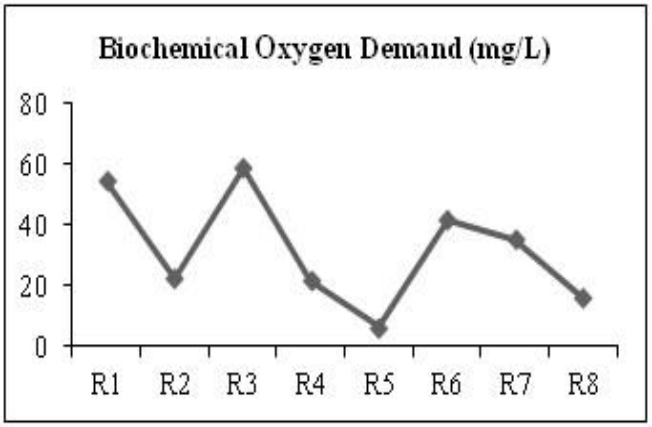


**Chart-8:** Variation of Biochemical Oxygen Demand in third order river water samples

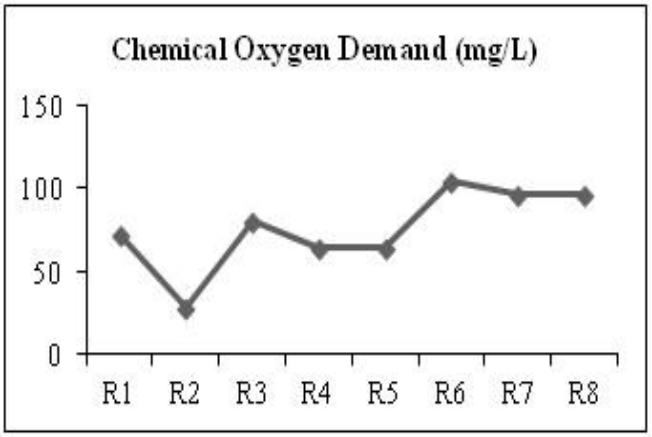


**Chart-9:** Variation of Chemical Oxygen Demand in third order river water samples

Bacterial count is found very high per 100ml in all points except R5 as analyzed by Most Probable Number technique as in the Chart-10. Very less Nitrate content is present at point R4 out of the range 2-8 in mg/L represented in the Chart-11.

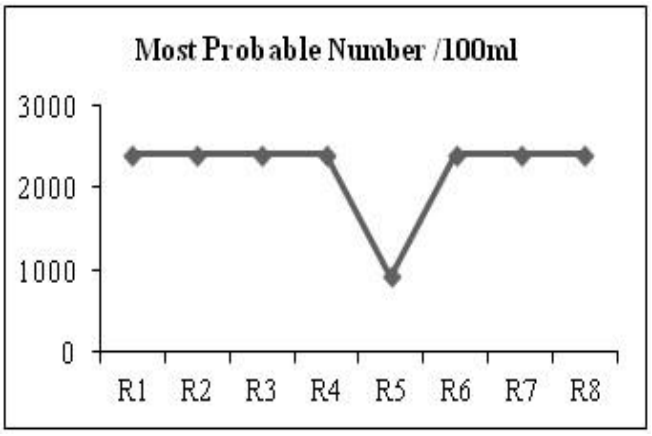


**Chart-10:** Variation of Most Probable Number in third order river water samples

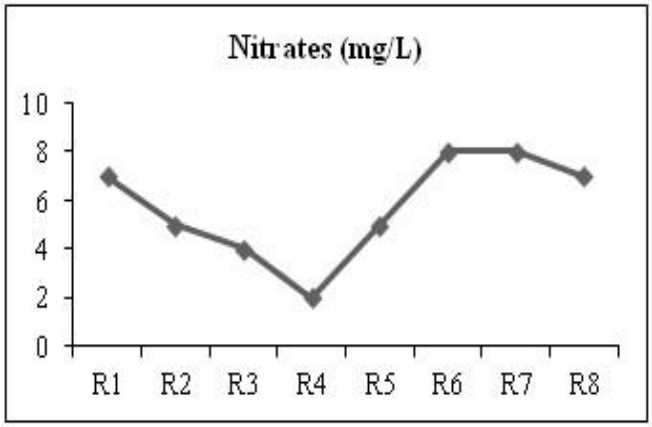


**Chart-11:** Variation of Nitrates in third order river water samples

## 5. CONCLUSION

Scarcity of water will arise during late winter and early summer. The wells will be dry and rivers will be in no flow conditions in many places. No water conservation programmes or artificial recharge schemes have been implemented in Udupi district [14]. Immediate need for water resource management in the river points by adopting water conservation practices. Anthropogenic activities in the basin have polluted water in almost all the streams. Some of them are disposal of organic and inorganic wastes into rivers, leaching of pesticides and chemical fertilizers from farmlands and improper sanitary conditions. Bacterial count in higher concentration in human habitat region means there is a need for prevention of disposal of organic wastes into water bodies from industries and domestics. Amount of rainfall in the area is reducing in the recent years [14] due to deforestation and thus afforestation in process will reduce soil erosion and also provide home for some rare species of birds. Sanitary conditions are not maintained and monitored along with solid waste management throughout the region of study which must be done alongside developmental activities. Lake R1 must be preserved from eutrophication and death of lake. River points R9 and R10 were dry and no flow condition prevailed there. Nearby wells was also dry indicating the scarcity of water in the beginning of summer only.

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