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Water Quality Assessment of Khadki River and Nalganga Reservoir, Nalgangapur, Dist. Buldana, M.S., India

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Abstract

Water is elixir on earth, making it alive. Generally, water has no shape but it occupies the shape of container in which it is stored. During research work two spots were selected for water quality assessment and thirteen different physico-chemical parameters were analysed. The first spot is Khadki and second one is Nalganga Reservoir in 2011 to2013. Nalganga reservoir is the second largest reservoir in Buldana district, M.S.

Keywords: khadki river, Nalganga Reservoir, Physico – Chemical Parameters

Introduction

Water is the life as well as the cardinal need for the fulfillment of human. They created an idea to storage much water of the flowing rivers and streams in the deep place means human made many reservoirs for the water storage and due to that man could fulfill their water need to storage water in large scale is very difficult task but by constructing big reservoirs on the rivers can do storage water in it by the flow of rivers and streams blocking. The rivers and streams flowing and meet to the reservoir.

Nalganga reservoir, which is one of the second largest reservoirs, built in Buldana district. The river Nalganga originates from the high hills of Ajintha. This region is totally mountainous in the surrounding of this reservoir many small villages have located, the water is provided by this river, due to this reservoir they get sufficient water for drinking as well as irrigation purpose. Some rivers and streams feeding Nalganga reservoir have also originated from the hills of Ajintha.

Ponds, lakes, reservoir (lentic ecosystem) and rivers, streams (lotic ecosystem) are the source of surface inland water. Resevoir, as it built by damming the river therefore there will be some effect on its limnological characteristics as it changes from flowing to standing ecosystem. It is very obvious when an aquatic ecosystem get converted into lotic to lentic ecosystem the general profile of physical, chemical and biotic characters get changed. The seasonal variations in physico-chemical characteristics in four

seasons of Barna reservoir, the physico-chemical parameters like depth, air temperature, color, odor, water temperature, transparency, turbidity, pH, electrical-conductivity, TDS, Free CO2, total alkalinity, DO, BOD, total hardness, calcium hardness, magnesium content, nitrate-nitrogen, Ortho-phosphates were analysed by Namdeo et al., (2013). Similarly, Finding by Ayyanna and Narayudu (2013) studied monthly changes in Hydrological study of pH, temperature, dissolved oxygen, carbondioxide, chlorides, carbonates and bicarbonates of fresh water pond at Kalkinada rural village. The physico-chemical characteristics are altered or molded due to the activities of the aquatic biota particularly the metabolism of the aquatic organisms. Any alteration in the environmental parameters may bring in an undesirable aquatic condition which may lead to the aquatic pollution. The physico-chemical parameters such as water depth, water temperature, transparency, ph, electrical conductivity, dissolved oxygen, free carbon dioxide, alkalinity, total hardness, chloride, silicates, Nitrate nitrogen and total phosphorous were studied by Ganie et al., (2012). Similarly, water quality of Raipur reservoir in Gwalior, the physico-chemical parameters like ambient temperature and water temperature, depth, transparency, colour, pH, dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, chlorides, calcium and magnesium were determined by Saxena and Saksena, (2012).

Material and Methods

The study was conducted on Nalganga reservoir situated 18 Km away from Malkapur which lies between 20 43’ 34’’ N latitude and 76 10’ 49’’ E longitude. During the study, it is the sincere efforts of the investigator to evolve physico-chemical parameters during the year February 2011 to January 2013. For the study two sampling locations were selected which are as follows.

1) Rajur and

2) Nalganga Reservoir

Nalganga reservoir is an earth fill reservoir, constructed about 16 miles from source across Nalganga river near village Sanglad in the state of Maharashtra in India. This has resulted information of Nalganga reservoir named after the river Nalganga itself. This reservoir was constructed as part of irrigation project by the government of Maharashtra in the year 1967 and impounds Nalganga river nearest city to Reservoir is Malkapur and the Reservoir is situated in Motala Taluka of Buldana District of Maharashtra, around 8741 hectors land of 28 villages. This reservoir is spread across an area of 1098 hectors and benefits. The purpose of this water reservoir is irrigation as well as drinking.

Rivers and Streams Feeding Nalganga Reservoir:

Nalganga Resevoir is largest in Buldana district, has built by clay-wall, waters storage of this reservoir is mainly of flowing South side rivers i.e. Nalganga - river, Jalganga - river, Mohgaon - river and Khadki – river and some small l streams. Being largest water storage capacity this reservoir is much beneficial to the surrounded area of this reservoir.

For the study of this reservoir sampling locations are as follows.

1) Khadki,

2) Nalganga reservoir.

Khadki :- A small village located at the foot of high hills 36 km always from Malkapur from the South direction of this village Khadki river is originated from the high hills and flows to North direction. On few distance ahead at Rajur place from East direction. Mohagaon river comes and meets to Khadki river at Rajur then combined way both rivers flow to North direction by flowing straightly meets to Nalganga Reservoir. Motala place divided in to two parts after few distance this river meets to Khadki river near Chinchpur village is 20 km away from Malkapur is located on the South direction of this Reservoir is on the high place.

Nalganga Reservoir :- Last water collection spot Nalganga Reservior is 18 km away from Malkapur and 1 km from the main high way road to the West direction. In Nalganga Reservior so many different kinds of fishes are found in large scale. Fishes like Catla, Rohu, Bhakda, Kalwat, Lalpari, Maral, Bam, Mrigle, Sandkol, Chal, Zanjara, Katyarna, Cyprinus, Silver- carp.

To minimise the errors and to assess the quality of water and the perfect data of Nalganga Reservoir and rivers. For the study, the samples were collected in plastic cans and in BOD bottles from each location in the morning hours from 6.00 am to 10.00 am and carried to laboratory for the analysis of physico-chemical parameters.

Samplings:

Water Samplings were done for the physico-chemical analysis of water in the first week of each month for about two years from January 2011 to January 2013 and thirteen physico-chemical parameters were analysed during this study.

Most of the physico-chemical parameters like atmospheric temperature, water temperature, pH were recorded at the time of sampling at each spot samples for the analysis of different chemical parameters were collected in acid wash of opaque plastic carboy of two litres from the depth of sechii disc.

Separate samples were collected for analysis of Dissolved Oxygen and fixed on the field by Winkler's solutions. Physico chemical parameters were analysed as per standard methods used by Trivedy and Goel (1986); Saxena (1990); APHA (1992); Diwakar (1995); Mishra (2002); Gupta (2007);Singh and Singh (2008).

For the analysis of physico-chemical parameter following methods are used during the research work.

Observation and Result:

Cardinal canticle of this Nalganga reservoir is the flow of rivers and streams such as some tributaries like Khadki, Mohgaon, Gulbheli, Rajur, Rohinkhed, Chinchpur, and Motala. Assessment of water resource quality from any region is an important aspect for developmental activities of the region because of the rivers, streams and man-made reservoirs surrounded for water supply to domestic, agricultural and fish culture use. Water quality assessment and taxonomical study of Ichthyofauna of rivers and streams feeding Nalganga Reservoir was under taken from February 2011 to January 2013 with view of investigate the various changes in its physico-chemical features for confirming the good quality of water resources large number of physico-chemical parameters.

The result showed a direct relationship between atmospheric temperature, water temperature, pH, total alkalinity, chlorides, total hardness, calcium, magnesium, turbidity, total- dissolved-solids, biological-oxygen-demand, and chemical-oxygen-demand and inversed relation between temperature and dissolved-oxygen. There was also a direct relationship between dissolved-oxygen and phytoplankton bloom. There is not a single factor but at a time so many factors have direct and indirect influences in the ecological system. It varies at different times of the day and during seasonal a year from February 2011- January 2013 and from latitude to latitude.

The distinct physico-chemical parameters of rivers and streams feeding Nalganga reservoir water sample were analyzed and discussed.

1) Atmospheric Temperature:

Temperature is one of the important physical characteristic which directly influence of some chemical reaction in aquatic ecosystem. The atmospheric temperature is of great significance as it regulates all biochemical reactions and influences the water temperature, pH, electrical-conductivity, dissolved-oxygen, alkalinity as well as biotic components of aquatic ecosystem.

In the present study revealed that, the atmospheric temperature were observed minimum in the month of December of winter season, moderate in monsoon season and atmospheric temperature were maximum in May of summer season in 2011-2012. Similarly, in 2012-These entire tributaries meet to the Nalganga reservoir, the atmospheric temperature were minimum in winter season, moderate in monsoon season and maximum in summer season. At N8- Nalganga reservoir, in 2011-2012, the atmospheric temperature was minimum in the month of January of winter season, while maximum in the month of May of summer season. Similarly in 2012-13, the minimum atmospheric temperature was recorded in January month of winter season, moderate in September of monsoon season and maximum atmospheric temperature were observed.

In 2011-2012, the atmospheric temperature showed fluctuation because of rainfall less than 2012-2013. So the atmospheric temperature range is variable than that of each month of each season. The atmospheric temperature values were maximum in summer season while temperature values were

minimum in winter season because during the summer season, solar-radiation and clear sky condition enhanced the atmospheric temperature. Whereas, during the monsoon season rainfalls and cloudy-skies brought down the atmospheric temperature and subsequently the water temperature noted decreased trend. In winter season due to cloudy skies and low intensity of light the atmospheric temperature is lower than other season. Similar observation made by Govindswamy et al., (1991); APHA (1992).

Atmospheric temperature is one of the most ecological factors which control the physiological behavior of the aquatic ecosystem and distribution of the microorganisms. Similar findings stated by Arain et al., (2009), Kumar et al., (2006) observed that, the atmospheric and water temperature both play an important role in the physico-chemical and physiological behavior of aquatic system. According to Singhai et al., (1990) the atmospheric temperature varies with the water temperature and also found by a direct relationship between atmospheric and water temperature. Also by Sathe et al., (2001) from Ped reservoir; Nisar Shaikh and Yeragi (2004) studied on Tansa reservoir of Thane; Bade et al., (2009) in Sai reservoir, Latur; Manjare et al., (2010) in Tamlade tank, has observed the similar findings.

2) Water Temperature:

In the present study, water temperature were minimum in the month December of winter season, while maximum in the month of May in summer season and moderate in monsoon season of 2011-2012. In winter season water temperature were minimum in December month, while in the month May water temperature were maximum of summer season and moderate in monsoon season of 2012- 2013 at sampling station N1- Khadki2013, the minimum atmospheric temperature were observed in the month January of winter season, moderate in monsoon and maximum atmospheric temperature were observed in summer season at sampling station N1-Khadki. In 2011-2012, the water temperature observed minimum in January of winter season, while moderate in monsoon season and rised water temperature in the month of May in summer season. Similarly, in 2012-2013, water temperature were decreased in January month of winter season, moderate in monsoon season and higher in the month of May of summer season at the last sampling station N8- Nalganga reservoir also.

The water temperature levels were minimum in winter season, while maximum in summer season at all eight sampling stations due to environmental fluctuations. In summer season water temperature were higher because of low water level, low velocity, clear atmosphere and greater solar radiations. The minimum water temperature in the rainy seasons and winter months because of frequents clouds, high percentage of humidity, high current velocity and high water levels reported by Shaikh and Yeragi (2004). Similar findings by Pawale and Lokhande (2012) observed Dhanora reservoir in Nanded and Lokhande (2013) noted water temperature fluctuation of Dhanegaon reservoir, Osmanabad

3) Hydrogen Ion Concentration pH:

The pH of natural water provided important information about many chemical and biological processes and provides indirect correlations to a number of different impairments of environment. The pH is typically monitored for assessments of aquatic ecosystem health, recreational waters, irrigation sources and discharges, live stock, drinking water sources, industrial discharges, intakes and storm water runoff.

In the present study, at sampling station N1- Khadki, the lowest pH values were recorded in the month of September in monsoon season, while medium in winter season and highest in May of summer season in 2011-2012. In 2012-2013, the lowest value of pH in September of monsoon season, while highest pH values were in May of summer season. Similarly, the pH values were recorded lower in September of monsoon season, higher in May of summer season in 2012-2013. Similar observation at sampling station N-8 of Nalganga reservoir. The values of pH were noted lower in September of monsoon season, while higher in May of summer season in 2011-2012. A pH range of 6.5 to 9.5 is common for natural waters.

Lendhe and Yerassgi (2004) observed the high values of pH in Phirange Kharbau Lake of Thane. Begum and Narayana (2006) recorded maximum pH values during summer in four lentic water bodies in and around Davangarere city, Karnataka. Kamat et al., (2006) reported the pH of Hosalli tank in Shinga; Jaybhaye et al., (2008) observed in a minor reservoir of Sawana of Hingoli district, Maharashtra.

Higher pH values of studied lake water during summer ascribed to increased photosynthetic assimilation of dissolved inorganic carbon by planktons Goldman (1972). A similar effect also produced by water evaporation and precipitation of mono-carbonate studied by Khan and Chowdhary (1994).

Many workers studied on pH ranges by Kataria et al., (1996); Paka and Narsingrao (1997) in Usmania University pond, Hydrabad, Devi (1998) reported the pH values from Utrapat Lake, Manipur, Jakkar and Rawat (2003) observed the maximum pH during summer, explained this by correlating rise of temperature with increase in rate of photosynthesis which results in higher consumption of carbon-dioxide. Lendhe and Yerassgi (2004) observed the high values of pH in Phirange Kharbau Lake of Thane. Begum and Narayana (2006) recorded maximum pH values during summer in four lentic water bodies in and around Davangarere city, Karnataka. Kamat et al., (2006) reported the pH of Hosalli tank in Shinga; Jaybhaye et al., (2008) observed in a minor reservoir of Sawana of Hingoli district, Maharashtra.

4) Total Alkalinity:

Alkalinity of water is measure of its capacity to neutralize acids. This is due to the primarily salts of weak acids and strong bases. Bio-carbonates represent the measure form of alkalinity. Bicarbonates are formed in considerable amount from the action of carbon-dioxide upon basic materials. Alkalinity is the measure of buffering capacity of the water. It is generally imparted by the salts of carbonates, bicarbonates, phosphates, nitrates etc. Alkalinity of surface water is primarily function of carbonates, hydroxides content and also includes the contributors from borates,

phosphates, silicates and other bases. Total alkalinity is the sum of hydroxides, carbonates and bicarbonates. Total alkalinity is a measure of capacity of water to neutralize a strong acid.

The total alkalinity were recorded minimum in January month of winter season, while moderate in monsoon season and were recorded maximum in the month of May in summer season during 2011-2012 and in 2012-2013, total alkalinity were minimum in the month of January of winter season, maximum in the month of May in summer season at sampling station N1- Khadki, and at N8- Nalganga reservoir. In 2011-2012, the total alkalinity was noted minimum in December of winter season, and maximum in May of summer season.

Jesudass and Akia (1995) reported variation in the values of total alkalinity which interferes with the water quality. The values were high during the summer and low during winter. The fall in values during monsoon may be due to dilution of water. The high value of alkalinity indicates the presence of weak and strong base such as carbohydrate and hydroxide in the water body, also similar observation reported by Jain et al., (1997); Abhasi et al., (1999); Nair (2000) and Mane et al., (2002); Gawas et al., (2006).

5) Chloride:

The calcium is known to indicate and produce hazardous effect on human health. The calcium and magnesium hardness are the two elements in fresh water. The main source of Ca and Mg is leaching of rocks and exoskeleton of arthropods as well as shells of mollusks stated by Rajshekhar et al., (2007).

Chloride is a natural substance present in all portable water as well as sewage effluents and metallic salt. High chloride ion concentration indicates organic contamination in the water. The chloride concentration is quite low in fresh natural water generally less than sulphate and bicarbonates. In the present study period, 2011-2012 at sampling station N1- Khadki, the minimum values of chloride were recorded in the month of September of monsoon season, while moderate in winter season and maximum in the month of May of summer season, similar values of cholride and at sampling station N8- Nalganga also.

Chloride also increases the degree of eutrophication reported by Goel et al., (1980); Adoni (1985) attributed high chloride values due to increased organic matter, also by WHO (1993); Chapman (1996); Lohar and Patel (1998). Chloride values were higher during summer due to high anthropogenic and animal activities whereas lower during rainy season due to dilution of rain water and decreased anthropogenic and animal activities. Similar trend of chloride ion concentration was given by Garg et al., (2011).

6) Total Hardness:

Hardness is governed by the concentration of calcium and magnesium salts largely combined with biocarbonates and carbonates giving temporary hardness while sulphate, chloride and other anions of mineral acids causing permanent hardness. Total Hardness of water is the sum of concentration of alkaline earth metal cataions.

The low values of total hardness were in the month of September in monsoon season, while moderate in winter season and the values were higher in May of summer season in 2011-2012 and similar result obtained in 2012-2013 at sampling station N1- Khadki, and at N8- Nalganga reservoir.

According to Kanan (1991) has classified water on the basis of hardness values as 00 mg/L to 60 mg/L is soft, 61 mg/L to 120 mg/L is moderately hard, 121 mg/L to 180 mg/L is hard and greater than 180 mg/L is very hard. Hardness is mainly due to calcium and magnesium. The major cation present in natural waters as calcium and magnesium. Its concentration restricts water use, while it is an important component in the exoskeleton of arthropods and shells in mollusca observed by Piska (2000). Similar results reported by Pawar and Pulley (2005) on Pethroadaj Dam, Nanded, the maximum values of hardness were recorded during monsoon while minimum during winter. Salve and Hiware (2005) reported that the total hardness was higher in winter, moderate in monsoon, and lower in summer season.

7) **Calcium Hardness:**

The concentrations of calcium ions were decreased in September of monsoon season, while medium in winter season and the concentrations were increased in the month of May in summer season in 2011-2012, and in 2012-2013 also similar trend showed at sampling station N1- Khadki, and at N8- Nalganga reservoir. Calcium is most abundant ion in the fresh water and in an important in shell construction, bone building and plant precipitation of lime studied by Vasanthy et al., (2009). According to WHO (1984), the values were minimum in the month of August in monsoon season, while maximum in the month of April in summer season. The maximum desirable limit of calcium in drinking water is 75 mg/L. Similar trend reported by APHA (2005); Narayana et al., (2005). Permissible limit of magnesium content for drinking purpose is 50 mg/L and maximum limit is 150 mg/L. The maximum values were found to be below the desirable limit. The maximum values were recorded in the summer season as high temperature causes rapid decomposition of organic matter and minimum value was recorded in the winter season due to low temperature. Similar results were observed by Abubakar et al., (2004); Chowbay and Xaman (2006).

8) **Magnesium Hardness:**

The magnesium hardness of the water were decreased in the month of September in monsoon season, while moderate in winter season, and increased in the month of May of summer season in 2011-2012. In 2012-2013, the values of magnesium concentration were noted minimum in September of monsoon season, and maximum values were noted in the month of May in summer season at sampling station N1- Khadki, and at sampling station N8- Nalganga reservoir also.

In 2011-2012, the value of magnesium was recorded minimum in September month of monsoon season, while moderate in winter season, and was recorded maximum in May of summer season, while during 2012-2013, the value was noted minimum in the month of September of monsoon season, while recorded maximum in the month of April in summer season at sampling station N1- Rajur river the magnesium level showed increased trend indicated impurity of water. Magnesium is absolutely essential for Chlorophyll hearing plants and algae. Magnesium appears to act as a carrier of phosphorous. The season wise analysis showed that minimum in rainy season and maximum in summer season, similar findings by Kumar et al., (1997); and Sujitha et al., (2012).

9) **Turbidity:**

Suspension of particles in water interfering with the passage of light is called turbidity. Turbidity is caused by wide variety of suspended matter, which range in size from colloidal to coarse dispersion depending upon the degree of turbulence and also ranges from pure inorganic substances to those that are highly organic in nature. Turbid water was undesirable from aesthetic point of view in drinking water.

The decreased turbidity were recorded in May month of summer season, while moderate were in winter season, and the increased values were recorded in the month of September in monsoon season in 2011-2012. Similar results were recorded in 2012-2013. The values were noted minimum in May month of summer season, and maximum value recorded in September month of monsoon season at sampling station N1- Khadki. The values of turbidity were minimum in February, and May month of summer season, while were maximum turbidity in September of monsoon season, at N8- Nalganga reservoir.

In the present study, the maximum turbidity values were maximum during monsoon and minimum during summer. High values of turbidity in monsoon due to suspended influx of rain water from catchments and cloudiness, less penetration of light, washes silts, sand, high organic matter and low transparency due to suspended inert particulate matter. However, low values of turbidity in summer due to clear atmosphere, evaporation of water and high light penetration. Similar, results have been reported by Kulkarni et al., (1995); Ismail et al., (2007); Reddy et al., (2009) recorded the highest turbidity in monsoon. Turbidity is the suspension of particles such as clay, silt and organic matter. Maximum value was observed in the month of July in monsoon season, while minimum during October of winter season. During rainy season silt, clay and suspended particles contribute to the turbidity values while during

winter season settlement of silt, clay and suspended particles resulting low turbidity. High turbidity during rainy season has been reported by Garg et al., (2006) and Nikam et al., (2011).

10) **Total Dissolved Solid:**

TDS are various kinds of mineral substances present in water. Some dissolved organic matter contributes to total dissolved solid. The season wise values of Total Dissolved Solids showed the minimum at winter. The concentration of total dissolved solids in water gives an idea about suitability of this potable water studied by Trivedy (1995). All the values of total dissolved solids were within the highest desirable limit reported by WHO (1971). Total dissolved solid means the amount of particles that are dissolved in water.

In the year 2011-2012, the values of total-dissolved-solid were minimum in the month of January of winter season, while moderately fluctuated in summer season, and the values of total-dissolved-solid were maximum in the month of September in monsoon season. Similar results observed in 2012-2013, the total-dissolved-solid were minimum in January of winter season, and maximum in the month of September in summer season at sampling stations N1- Khadki, and at N8- Nalganga reservoir also.

Ajagekar et al., (2011) stated that the total dissolved solids are the amounts of particles that are dissolved in the water. The seasonal distribution of total dissolved solid is minimum in winter season and maximum in the rainy season. It slightly fluctuated in the summer season due to the leaching of surrounding rain water. Similar trend reported by Chinnaiah et al., (2011). According to Gother (2002), Total dissolved solid is very significant parameter describing the chemical constituents of the water and can be considered as general of edaphically relation that contributes to productivity within the water body. The maximum value of total dissolved solid were observed during pre-monsoon season and minimum value of total hardness observed during post-monsoon.

11) **Dissolved - Oxygen:**

DO is important factor of water quality, as its concentration in water is an indicator of ability of a water body to support a well balanced aquatic life. Dissolved oxygen in water is replenished through photosynthesis, dissolution from the atmosphere and addition of oxygen rich water through runoff. Simultaneously, dissolved oxygen is consumed during heterotrophic oxidation of organic matter and respiration by aquatic flora and fauna as well as oxidation of some naturally occurring constituents in water. The equilibrium is maintained between consumption and replenishment of dissolved Oxygen.

In 2011-2012, the values of dissolved oxygen were noted lower in February, and March month of summer season, while moderate in monsoon season, and were recorded higher in January month of winter season. In 2012-2013, dissolved-oxygen were recorded lower in the month of April of summer season, and was noted higher in January of month of winter season at sampling station N1- Khadki.

In 2012-2013, also low values were noted in May of summer season, and high values were noted in January month of winter season. Similar results obtained at station N8- Nalganga reservoir.

In the present investigation, the higher dissolved-oxygen were recorded during winter, moderate during monsoon and lower during summer. The dissolved oxygen is most important factor in fresh water life. The value of dissolved oxygen were obtained as winter > rainy > summer season in present study. The results are similar and co-related with investigation of Dwivedi and Pandey (2002) on Girija kund, Faizabad. Dissolved oxygen inclined in winter due to the circulation by cooling and drawn down the dissolved in water. Maximum values of dissolved-oxygen in winter due to the fact that the solubility of dissolved-oxygen increases with the decrease in water temperature by Arvind Kumar and Singh (2002). Similar results were by Bansal (1989); Mohanta and Patra (2000); and Khinchi et al., (2011).

12) Biological Oxygen Demand (BOD):

BOD is the measure of degradation of organic matter present in water. The biological oxygen demand refers the oxygen used by the micro-organisms in the aerobic oxidation of organic matter. The biochemical oxygen demand is indication of relative oxygen requirements of water for oxidation and organic matter. Microorganisms use the atmospheric oxygen dissolved in water. The biological oxygen demand is used amount of bio-chemically degradable organic matter which is present in water At sampling station N1- Khadki, in 2011-2012, the values of biological oxygen demand were lower in January month of winter season, while moderate in winter season, and were noted higher in May month of summer season.The values of biological oxygen demand were recorded minimum in January month of winter season, while maximum were noted in May of summer season in 2011-2012. In 2012-2013, the values of biological oxygen demand were recorded lower in January month of winter season, and higher were recorded in May month of summer season at sampling station at N8- Nalganga reservoir.

In the present investigation, the maximum biochemical oxygen dissolved in summer is probably due to high microbial activities during summer. Similar findings made by Patel (1999); Devi et al., (2009); and Verma et al., (2012). The maximum range of available biological oxygen demand is 3 mg/L for fisheries of the type Salmonid EEC (1978).The increased levels of biological oxygen demand indicated the nature of chemical pollution. Biological oxygen demand variations were observed maximum being in polluted waters and minimum in pollution free waters by Solanki and Karlikar (2011

13) **Chemical Oxygen Demand (COD):**

COD is another measure of organic material in water. Chemical oxygen demand is the amount of dissolved oxygen required to cause chemical oxidation of the organic material in water. Both biological oxygen demand and chemical oxygen demand are the key indicators of environmental health. Chemical oxygen demand test is useful in pinpointing toxic condition and presence of biochemical resistant substances in waterIn the present study of 2011-2012, the values of chemical oxygen demand were recorded lower in May of summer season, while moderate in winter season, and higher values were noted

in September of monsoon season. Chemical oxygen demand values were noted lower in April month of summer season and were higher in September of monsoon season at sampling station N1- Khadki in 2012-2013.

Similar observation in 2012-2013, the value of chemical oxygen demand were lower in May month of summer season, and higher value was recorded in September of monsoon season and at N8- Nalganga reservoir also.The studied sites in N1- Rajur, and N8- Nalganga Reservoir showed a general trend as compared to chemical oxygen demand in summer and rainy season. This is an indication of increased organize loads due to increased household waste water and waste discharges. The season wise analysis showed that the values of chemical oxygen demand were minimum in summer season and maximum in rainy season. High value of Chemical Oxygen Demand than Biological Oxygen Demand indicates high degree of organic pollution studied by Adholia and Vyas (1992); Hajarika (1996); Thirumala et al., (2006); Rawat and Jakher (2007); Shastri et al., (2008). The minimum and maximum values of chemical oxygen demand recorded in the reservoir water due to the presence of accumulation of organic matter at the bottom of reservoir water. Similar observation made by Drusilla et al., (2004); Zombade et al., (2012).

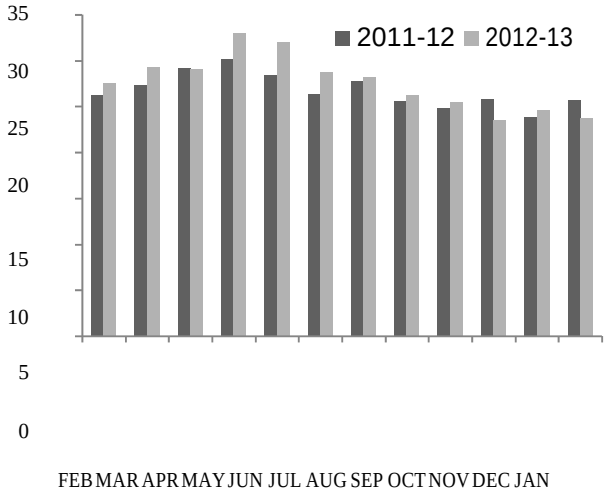
The observation and result chart given below:

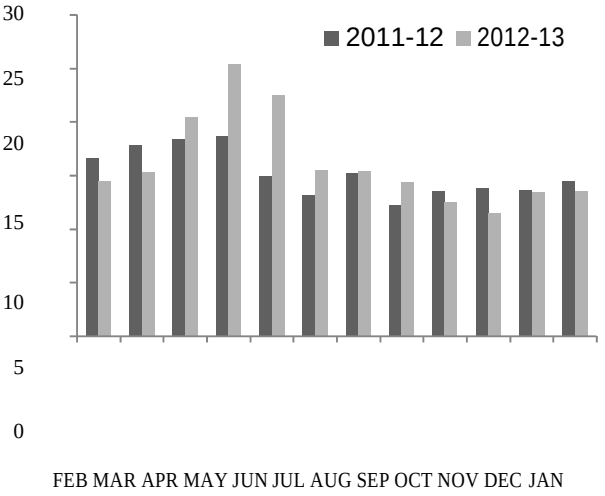
2011-2012													
S.N.	**Parameters**	**FEB**	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**	**JAN**
1	Atmospheric Temp. (^{0}C)	26.2 □0.8	27.4 □2.96	29.2 □2.36	30.2 □2.0	28.4 □3.16	26.4 □3.40	27.8 □2.28	25.6 □3.16	24.8 □2.60	25.8 □2.36	23.8 □2.68	25.7 □ 2.40
2	Water Temp. (^{0}C)	16.6 □2.28	17.8 □1.41	18.4 □3.16	18.6 □2.28	16.9 □2.64	13.9 □1.67	15.2 □2.23	16.2 □1.67	13.8 □2.28	13.7 □3.16	13.6 □2.28	14.5 □1.91
3	pH	7.71 □0.04	7.78 □0.02	7.91 □0.02	8.34 □0.02	7.42 □0.02	7.41 □0.03	7.40 □0.03	7.58 □0.02	7.61 □0.03	7.62 □0.03	7.68 □0.03	7.64 □0.02
4	Total alkalinity (mg/L)	480.7 □3.16	486.4 □3.34	497.1 □3.16	511.6 □3.03	491.2 □2.60	480.8 □1.67	480.2 □2.96	472.2 □2.96	462.2 □3.16	461.6 □4.26	450.6 □4.47	441.3 □3.16
5	Chlorides (mg/L)	138.6 □1.78	141.2 □3.16	144.4 □2.68	146.4 □3.16	138.6 □2.28	136.4 □3.16	131.9 □6.66	130.9 □2.28	139.6 □3.16	138.2 □2.28	137.1 □2.60	137.9 □2.96
6	Total Hardness (mg/L)	163.1 □0.34	341.2 □0.30	351.6 □0.26	363.4 □0.29	595.4 □1.0	592.6 □0.26	586.8 □0.33	612.2 □0.22	588.2 □0.63	565.8 □0.24	482.6 □0.22	464.4 □0.31
7	Calcium (mg/L)	75.8 □2.28	74.6 □1.67	74.6 □2.28	81.4 □1.78	76.8 □2.44	76.2 □1.67	74.6 □2.28	71.4 □2.60	79.2 □2.28	77.8 □1.67	74.2 □2.28	71.6 □1.67
8	Magnesium (mg/L)	44.4 □0.29	48.8 □0.22	50.6 □0.34	52.6 □0.17	32.1 □0.26	31.8 □0.29	30.4 □0.29	29.2 □0.22	37.6 □0.31	36.2 □0.26	37.6 □0.18	38.2 □0.24
9	Turbidity (mg/L)	5.21 □1.67	5.42 □1.41	5.84 □2.28	5.16 □1.41	6.2 □ 1.67	6.4 □ 2.28	6.6 □ 2.28	7.8 □ 1.41	7.1 □ 1.67	6.6 □ 1.67	6.1 □ 1.67	5.2 □ 1.41
10	Total Dissolve Solids (mg/L)	501.4 □1.70	478.8 □1.88	467.6 □2.64	472.2 □2.28	525.6 □2.32	514.4 □2.38	542.6 □2.28	506.1 □1.32	361.2 □2.28	359.6 □2.28	359.6 □2.28	353.6 □2.1
11	Dissolved Oxygen (mg/L)	5.22 □0.54	5.22 □0.31	6.71 □0.31	6.68 □0.29	7.02 □0.32	7.22 □0.35	7.58 □0.29	7.68 □0.38	8.21 □0.33	8.16 □0.26	8.12 □0.32	8.74 □0.41
12	Biological oxygen demand (BOD) (mg/L)	8.54 □0.29	8.58 □0.35	9.06 □0.26	9.14 □0.47	9.2 □ 0.31	8.18 □0.38	8.12 □0.22	8.18 □0.67	7.78 □0.29	8.12 □0.23	7.48 □0.32	7.42 □0.26
13	Chemical Oxygen Demand (COD) (mg/L)	28.1 □0.21	26.8 □1.73	25.4 □0.54	24.6 □1.67	31.2 □0.16	32.7 □0.16	36.6 □1.14	38.2 □1.78	32.1 □2.28	27.2 □1.67	26.4 □1.41	26.2 □0.02

TABLE 1.1: STATION I- KHADKI

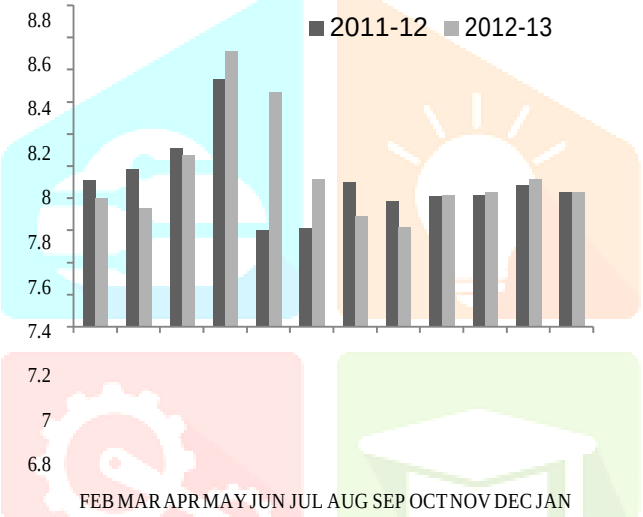
2012-2013													
S.N.	**Parameters**	**FEB**	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**	**JAN**
1	Atmospheric Temp. (^{0}C)	27.6 □1.14	29.06 □2.41	29.04 □1.67	33.04 □0.93	32.06 □1.06	28.70 □0.97	28.2 □0.58	26.2 □0.77	25.4 □0.58	23.5 □0.71	24.6 □0.88	23.7 □1.09
2	Water Temp. (^{0}C)	14.5 □1.09	15.3 □0.93	20.5 □0.86	26.5 □0.84	22.5 □0.95	15.5 □0.96	15.4 □0.93	14.4 □1.04	14.8 □0.72	14.5 □0.88	13.4 □0.96	13.5 □1.12
3	pH	7.60 □0.10	7.54 □0.09	7.87 □0.05	7.53 □0.09	8.26 □0.11	7.72 □0.04	7.49 □0.05	7.42 □0.06	7.62 □0.05	7.64 □0.04	7.72 □0.03	7.64 □0.03
4	Total alkalinity (mg/L)	455.2 □3.16	479.4 □3.74	489.3 □4.35.	519 □ 3.31	492.2 □2.44	485.4 □2.64	480.2 □2.44	478.2 □4.0	456.4 □5.38	452.2 □3.16	448.4 □4.0	442.5 □4.7
5	Chlorides (mg/L)	144.2 □3.87	147.1 □316	149.2 □4.35	44.5 □2.64	142.6 □5.09	139.2 □3.16	135.2 □4.0	132.2 □5.09	133.6 □3.16	138.2 □3.16	136.4 □3.31	135.2 □3.16
6	Total Hardness (mg/L)	363.2 □0.38	345.4 □0.72	353.4 □0.31	58.7 □0.28	597.4 □0.54	539.2 □0.26	587.4 □0.31	512.4 □0.60	587.5 □0.31	566.2 □0.48	484.4 □0.78	465.2 □0.50
7	Calcium (mg/L)	74.2 □3.03	74.2 □4.24	75.6 □4.79	52.4 □5.01	78.2 □3.16	77.2 □5.31	75.6 □4.24	72.8 □3.03	78.2 □3.16	78.2 □4.24	75.8 □3.16	72.9 □3.16
8	Magnesium (mg/L)	46.2 □0.26	47.2 □0.26	49.8 □0.26	8.7 □ 0.26	42.8 □0.31	41.6 □0.24	36.2 □0.26	36.2 □0.31	40.8 □0.31	42.4 □0.26	44.8 □0.31	45.8 □0.31
9	Turbidity (mg/L)	5.62 □0.2	5.81 □0.26	5.23 □0.24	5.7 □ 0.24	5.72 □0.26	5.89 □0.26	6.98 □0.26	7.22 □0.31	7.12 □0.31	6.58 □0.31	6.69 □1.44	6.78 □0.26
10	Total Dissolve Solids (mg/L)	402.4 □3.16	416.8 □3.16	487.2 □3.16	367.4 □2.28	537.2 □2.44	546.2 □3.10	566.4 □3.16	572.2 □3.16	462.4 □5.47	426.2 □2.28	382.2 □2.38	372.4 □3.16
11	Dissolved Oxygen (mg/L)	6.21 □0.31	6.42 □0.26	5.81 □0.24	6.2 □ 0.31	6.94 □0.31	7.24 □0.31	7.58 □0.31	7.86 □0.24	8.12 □0.26	8.24 □0.31	8.36 □0.31	8.88 □0.31
12	Biological oxygen demand (BOD) (mg/L)	8.24 □0.31	8.12 □0.31	8.41 □0.31	8.7 □ 0.24	8.26 □0.26	8.12 □0.31	7.78 □0.31	7.68 □0.31	7.62 □0.31	7.54 □0.26	7.38 □0.31	7.42 □0.31
13	Chemical Oxygen Demand (COD) (mg/L)	26.8 □0.24	27.2 □0.31	26.4 □0.42	40.3 □0.26	32.4 □0.24	34.6 □0.31	35.6 □0.31	39.8 □0.31	36.8 □0.31	35.2 □1.19	34.2 □0.37	32.6 □0.33

1.1 KHADKI

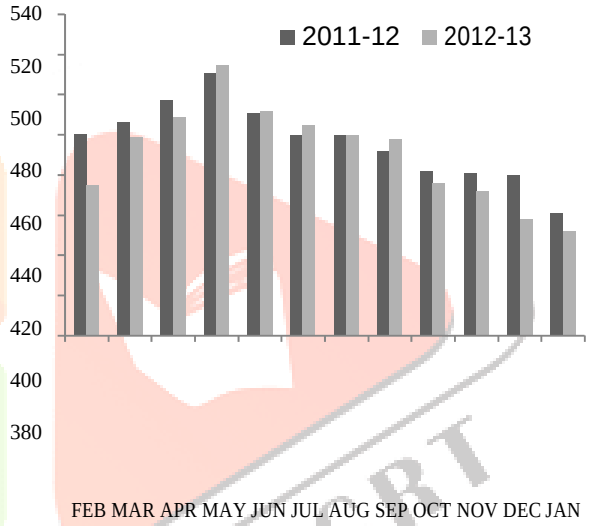




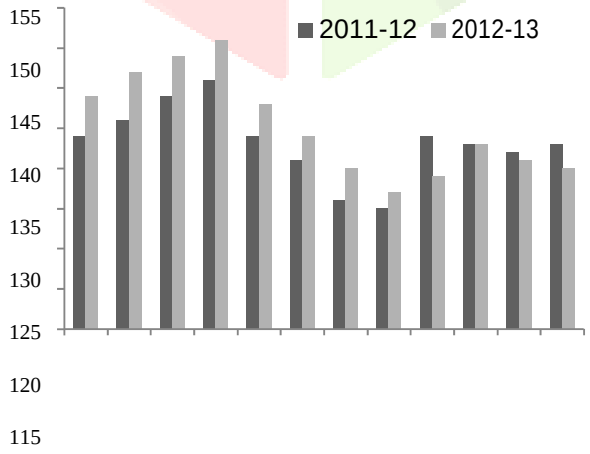
1. Atmospheric Temperature



2. Water Temperature



3. pH



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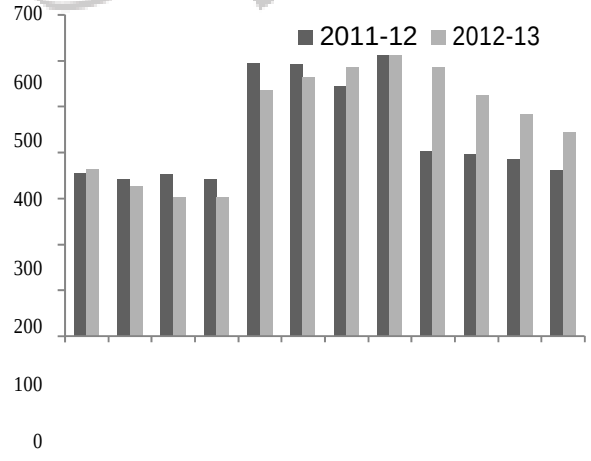

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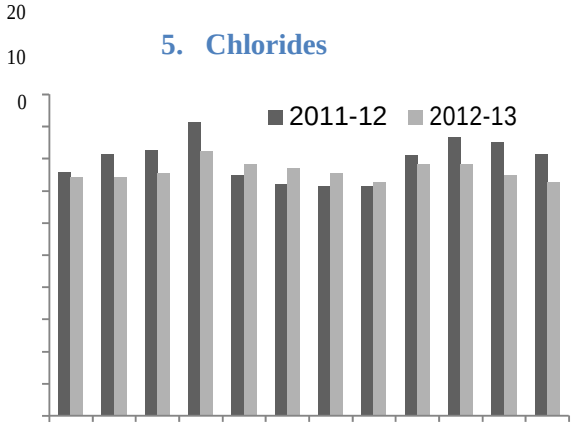
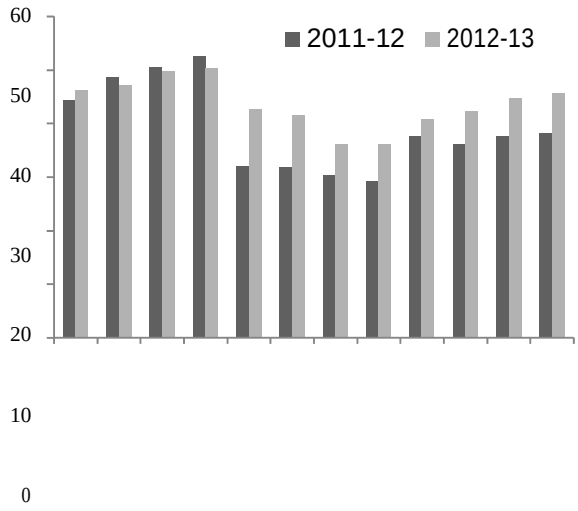


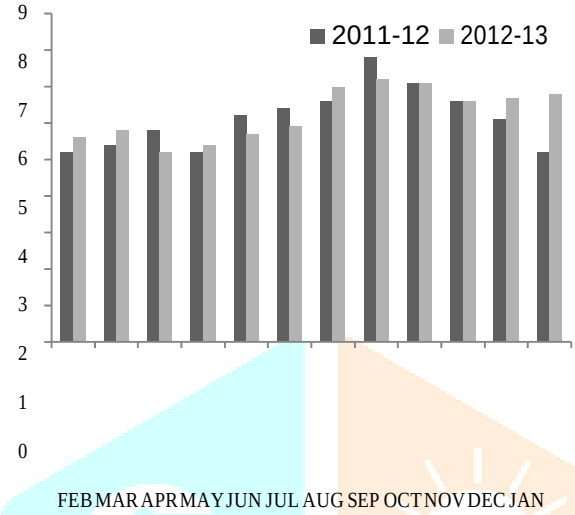
6. Total Hardness



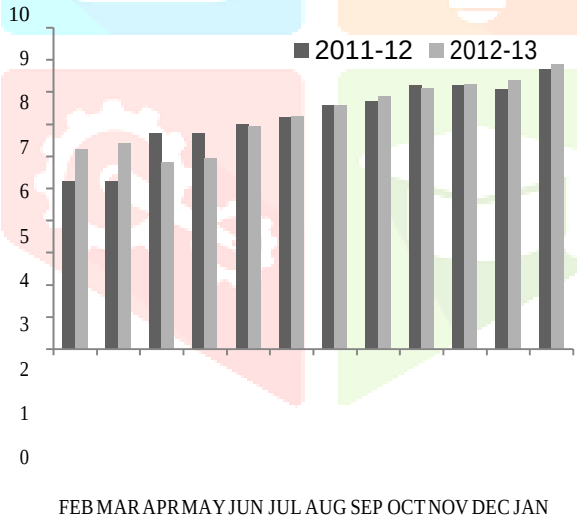
7. Calcium

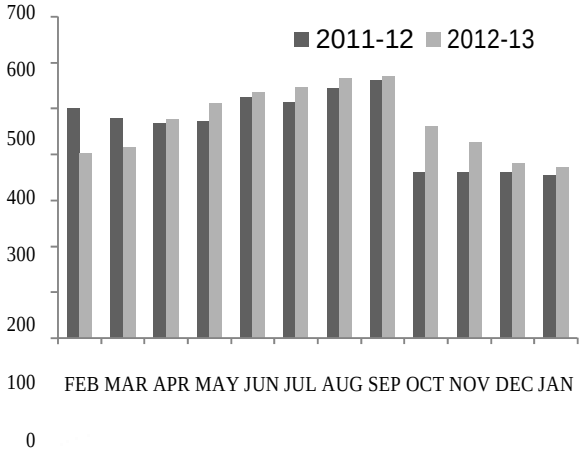
8. Magnesium

1.1 KHADKI

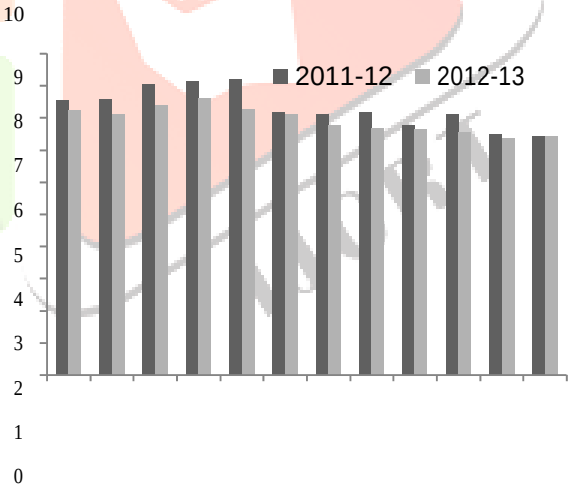


9. Turbidity



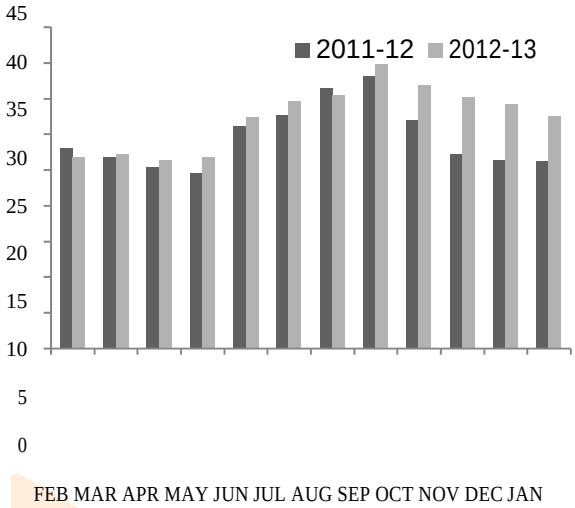


10. TDS



11. Dissolved Oxygen

12. BOD

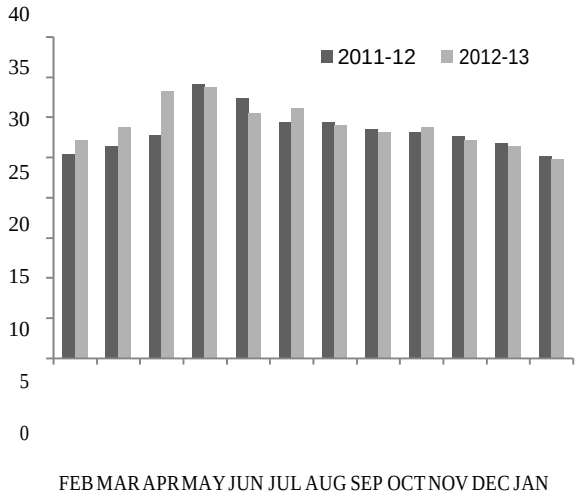


13. COD

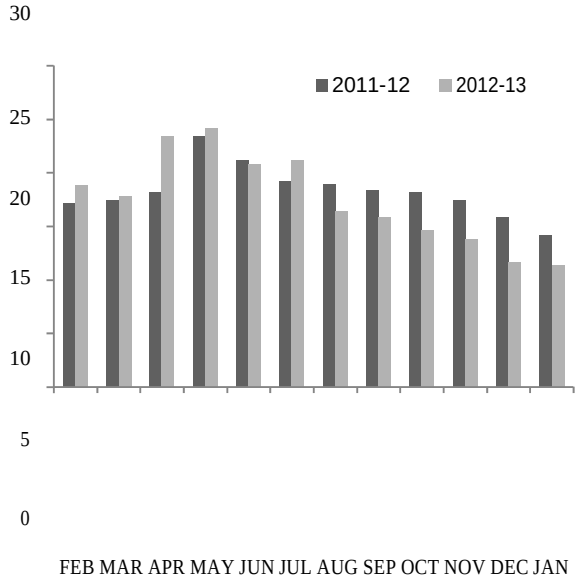
TABLE NO. 1.2: SPOT No 2- NALGANGA RESERVOIR

2011-2012													
S.N.	**Parameters**	**FEB**	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**	**JAN**
1	Atmospheric Temp. (^{0}C)	25.4 □2.19	26.4 □1.41	27.8 □1.58	34.2 □2.60	32.4 □2.82	29.6 □1.89	29.4 □1.63	28.6 □2.30	28.2 □1.92	27.6 □1.89	26.8 □1.58	25.2 □2.60
2	Water Temp. (^{0}C)	17.2 □2.60	17.5 □1.37	18.2 □1.30	23.4 □1.67	21.2 □1.37	19.2 □0.67	19.0 □2.28	18.4 □1.09	18.2 □2.70	17.5 □1.61	15.8 □1.30	14.2 □4.0
3	Ph	8.36 □0.02	8.43 □0.03	8.56 □0.05	8.85 □0.26	7.38 □0.02	7.40 □0.02	7.32 □0.02	7.35 □0.02	7.45 □0.02	7.54 □0.01	7.64 □0.02	7.87 □0.02
4	Total alkalinity (mg/L)	437.6 □2.28	436.6 □2.28	482.4 □2.28	572.6 □3.19	460.4 □2.28	437.8 □2.96	435.2 □2.44	430.8 □1.67	429.4 □1.78	430.2 □2.96	426.6 □3.13	425.2 □2.0
5	Chlorides (mg/L)	144.2 □2.0	145.8 □1.67	148.6 □1.78	156.4 □2.28	127.2 □1.67	121.2 □1.09	118.8 □1.67	115.6 □2.0	131.6 □1.67	135.6 □2.60	138.4 □2.60	140.2 □2.96
6	Total Hardness (mg/L)	480.2 □0.21	440.4 □0.2	438.4 □2.19	436.2 □0.22	515.4 □0.22	527.6 □0.22	568.2 □0.29	602.2 □2.0	571.2 □1.5	578.4 □0.2	495.2 □1.22	432.4 □0.22
7	Calcium (mg/L)	84.2 □2.44	86.7 □2.0	85.9 □2.28	90.8 □2.44	86.8 □2.0	82.2 □2.0	75.4 □1.48	74.2 □1.30	75.6 □1.89	75.2 □1.44	76.8 □1.67	84.2 □2.0
8	Magnesium (mg/L)	86.4 □0.13	85.2 □0.17	91.2 □0.69	93.4 □0.16	78.8 □0.22	76.2 □0.16	74.4 □0.22	71.2 □0.2	75.6 □0.16	79.4 □0.24	82.8 □0.2	84.2 □0.16
9	Turbidity (mg/L)	7.04 □0.16	6.72 □0.24	6.78 □0.2	6.24 □0.24	7.12 □0.24	7.52 □0.16	7.58 □0.16	8.18 □0.47	8.02 □0.87	7.72 □0.32	6.58 □0.23	6.24 □0.22
10	Total Dissolve Solids (mg/L)	440.2 □2.96	410.8 □1.67	400.2 □2.0	380.8 □1.67	565.8 □1.18	570.8 □1.67	578.4 □4.24	598.2 □1.78	490.2 □2.96	488.2 □1.67	480.8 □1.67	448.2 □3.06
11	Dissolved Oxygen (mg/L)	5.18 □0.14	5.28 □0.16	5.76 □0.22	6.16 □0.14	6.40 □0.21	6.78 □1.48	7.12 □0.19	7.48 □0.16	7.82 □0.14	8.12 □0.14	8.28 □0.22	8.58 □0.22
12	Biological oxygen demand (BOD) (mg/L)	7.58 □0.16	8.18 □0.2	8.52 □0.21	9.12 □0.26	9.04 □0.16	8.52 □0.17	8.24 □0.2	8.12 □0.22	7.56 □0.10	7.48 □0.28	7.35 □0.19	7.12 □0.2
13	Chemical Oxygen Demand (COD) (mg/L)	32.12 □0.16	34.56 □0.17	35.52 □0.22	36.22 □0.14	38.56 □0.22	39.54 □2.24	39.82 □2.96	40.54 □2.28	36.42 □1.67	35.20 □1.09	28.62 □2.28	27.48 □0.24

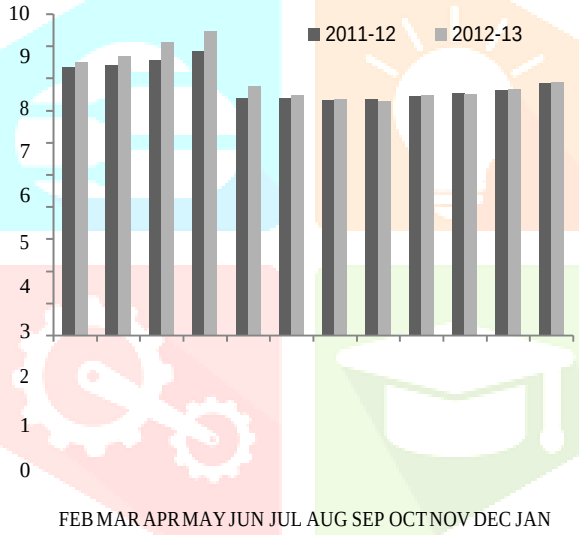
S.N.	Parameters	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN
1	Atmospheric Temp. (^{0}C)	27.2 □1.67	28.8 □1.78	33.2 □1.18	33.8 □2.04	30.6 □1.78	31.1 □1.73	29.1 □2.64	28.1 □1.41	28.8 □1.67	27.2 □2.28	24.8 □1.67	26.4 □1.67
2	Water Temp. (^{0}C)	18.8 □1.67	17.8 □2.28	23.4 □1.67	24.2 □1.78	20.8 □2.28	21.2 □1.41	16.4 □1.67	15.8 □1.67	14.6 □1.09	13.8 □1.08	12.6 □1.67	11.4 □1.67
3	pH	8.50 □0.02	8.71 □ 0.022	9.12 □0.02	9.48 □0.02	7.77 □0.03	7.49 □0.02	7.37 □0.33	7.30 □ 0.026	7.48 □ 0.026	7.52 □ 0.024	7.66 □ 0.026	7.89 □0.04
4	Total alkalinity (mg/L)	438.8 □3.13	440.4 □2.28	481.6 □2.28	571.2 □1.67	459.6 □1.67	435.4 □2.28	434.4 □1.41	428.8 □2.28	428.4 □2.28	432.2 □1.73	425.6 □3.16	424.8 □2.44
5	Chlorides (mg/L)	141.4 □2.28	142.6 □2.60	148.6 □2.28	158.2 □3.16	130.4 □2.28	127.6 □1.73	125.6 □2.28	121.6 □2.64	137.4 □2.28	144.6 □2.28	150.4 □2.28	154.6 □2.28
6	Total Hardness (mg/L)	481.4 □2.28	441.6 □2.64	439.6 □2.28	435.6 □2.28	516.2 □2.28	524.8 □2.28	570.6 □2.28	612.4 □2.44	592.4 □2.28	575.4 □2.60	485.4 □2.28	431.2 □2.28
7	Calcium (mg/L)	84.3 □2.28	87.4 □2.32	86.4 □2.0	92.4 □3.16	87.2 □2.60	83.2 □2.60	77.6 □2.60	76.4 □2.28	75.2 □2.28	75.4 □2.60	77.2 □2.60	82.2 □2.28
8	Magnesium (mg/L)	82.4 □0.26	87.1 □0.55	93.2 □0.24	94.4 □0.24	82.2 □0.31	81.4 □0.26	77.1 □0.26	76.2 □0.26	78.5 □0.79	78.1 □0.24	81.4 □0.28	82.5 □0.24
9	Turbidity (mg/L)	7.72 □0.24	7.70 □0.24	7.21 □0.24	7.14 □0.26	7.71 □0.26	7.62 □0.26	8.02 □0.26	8.28 □0.42	8.24 □0.36	8.71 □0.31	8.14 □0.31	8.15 □0.26
10	Total Dissolve Solids (mg/L)	357.2 □2.28	367.4 □2.60	449.6 □2.28	478.2 □2.28	512.4 □2.28	525.2 □2.60	535.6 □2.60	546.2 □2.28	505.2 □2.8	487.6 □2.28	479.6 □2.28	353.2 □2.28
11	Dissolved Oxygen (mg/L)	4.72 □0.31	5.30 □0.31	4.62 □2.61	4.16 □2.61	5.72 □2.61	6.12 □3.23	5.86 □3.80	5.92 □1.81	6.66 □2.61	7.50 □2.61	8.24 □0.31	8.76 □3.80
12	Biological oxygen demand (BOD) (mg/L)	7.64 □2.61	7.76 □0.31	8.54 □2.61	9.52 □2.61	9.52 □3.31	9.54 □2.29	9.32 □3.31	9.14 □2.61	8.66 □2.61	7.84 □2.61	7.04 □2.61	7.76 □2.61
13	Chemical Oxygen Demand (COD) (mg/L)	56.22 □3.23	49.28 □3.80	47.26 □2.61	46.14 □2.61	44.34 □2.61	42.2 □0.31	41.22 □3.80	38.34 □2.61	36.76 □2.61	35.24 □2.61	32.14 □2.61	58.14 □2.97



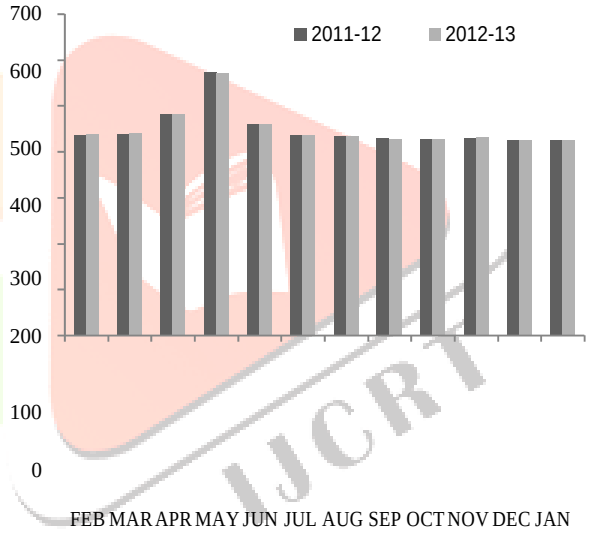
1. Atmospheric Temperature



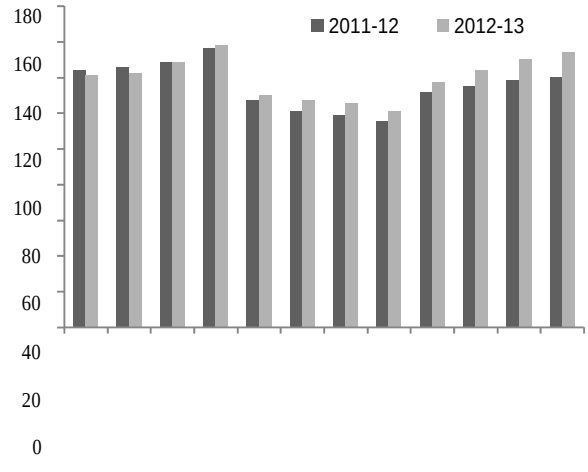
2. Water Temperature

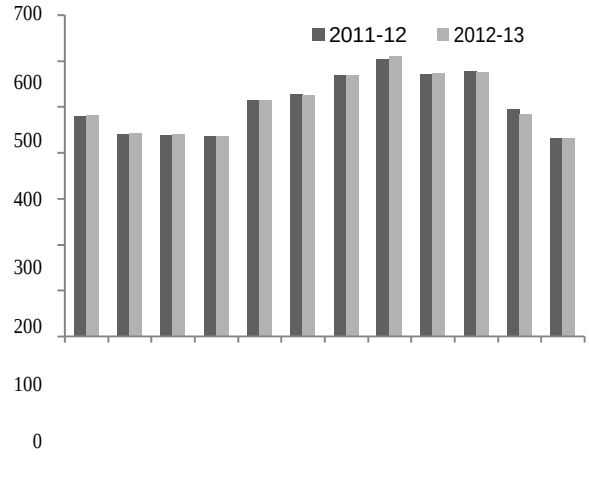


3. pH

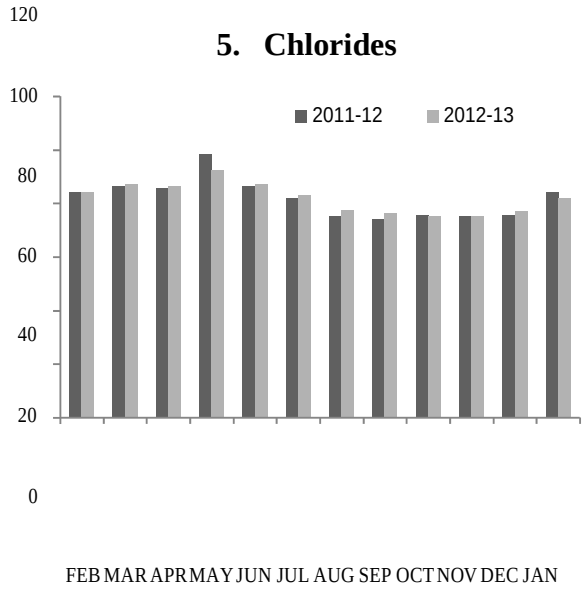


4. Total Alkalinity

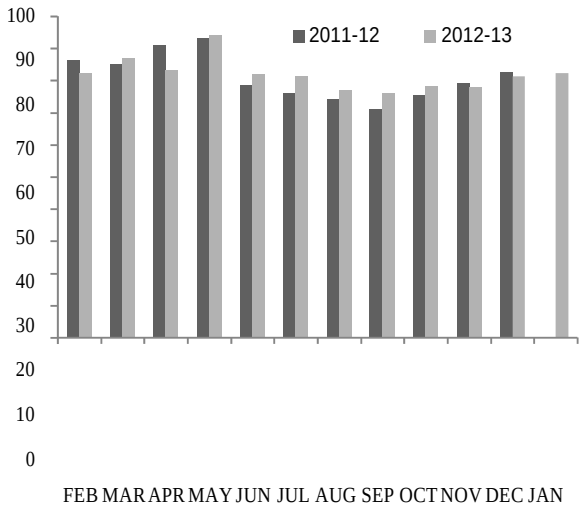




5. Chlorides

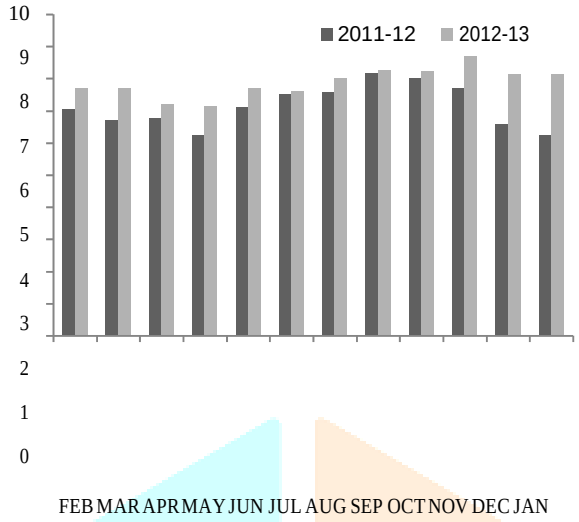


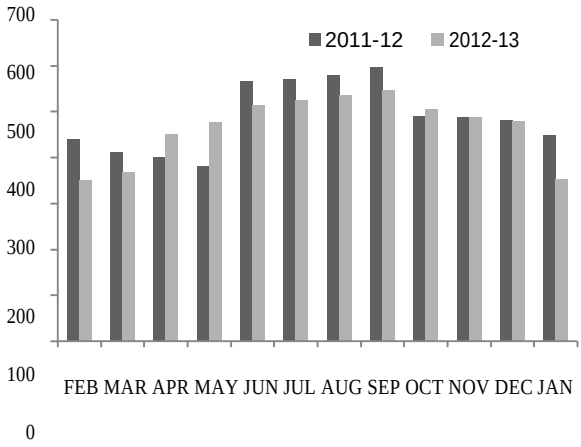
6. Total Hardness



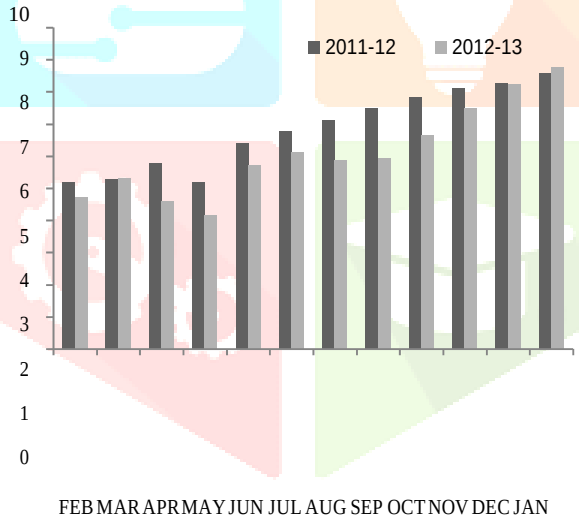
7. Calcium

8. Magnesium

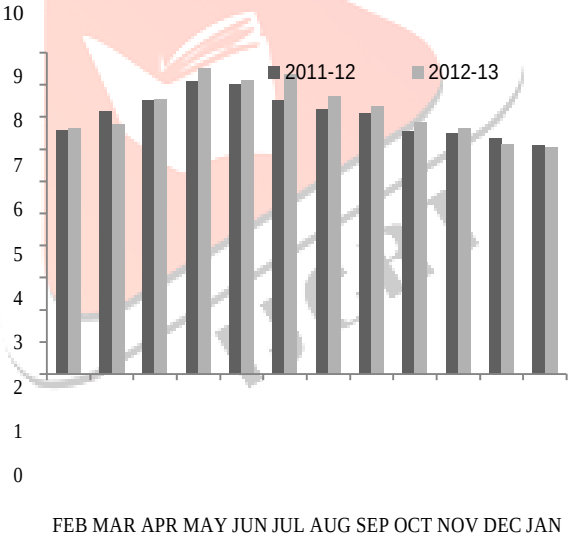




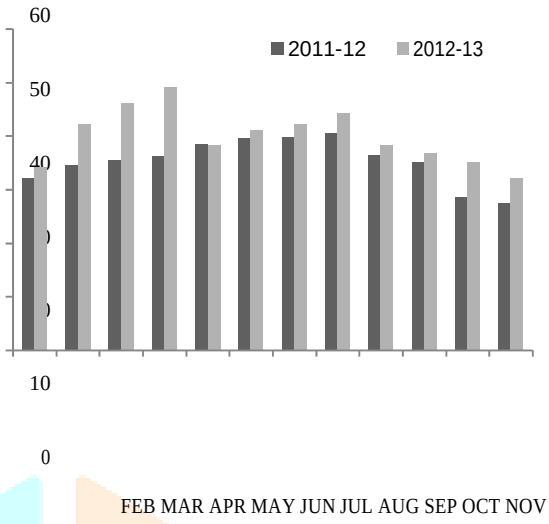
9. Turbidity



10. TDS



1. Dissolved Oxygen **12. BOD**



13. COD

Summery and Conclusion:

There was no pollution in this Reservoir due to sewage or industrial enffluents, but the major problem was ever increasing amount of silt.

Analysis of water quality parameters of Nalganga Reservoir showed that the values are well within the permissible limit of WHO and BIS standards. The Nalganga Reservoir water is suitable for drinking, purposes. It is also useful for domestic, irrigation and fishculture activities because the physico-chemical parameters are in suitable range of the growth of fishes, molluses , zooplankton and phytoplankton also.

Besides, when decreasing water level, addition of domestic sewage , mixing of agricultural runoff may altert the natural quality of water and may directly affect the natural echo-balance altering the food cycles and food-web in the water body.

Pisciculture has the potential to fulfill the nutritive food supply and can also enhance the food security and income generation of fishermen communities of this area.

For healthy life, surrounding must be fresh and clean. It is responsibility of everyone to conserve water and avoid its contamination.

Atmospheric Temperature: The atmospheric temperature was always higher than that of water temperature. In April and May temperature of atmosphere were generally higher as compared to other months. Atmospheric temperature was maximum in summer season than other months of both the years and minimum in winter and monsoon season.

Water Temperature: In winter season the water temperature were low as compared to other seasons in both the years but water becomes clear and calm due to sunlight penetrated in water due to the luxuriant growth of aquatic animals were recorded. In monsoon water temperature was recorded moderate.

pH : The pH of rivers and streams feeding Nalganga Reservoir ranged between acidic and less alkaline. It was less alkaline throughout the year and showed minor seasonal variations of rivers and streams also. The present pH ranges showed that the water of the Nalganga reservoir were suitable for aquatic life, irrigation and domestic uses.

Total Alkalinity: The total alkalinity of water from the water body was mainly due to bicarbonates. The total alkalinity values were higher in summer and lower in winter season. The presence of total alkalinity indicated that the reservoir is productive.

Chlorides: The chloride values were higher in summer and less in winter of all rivers and streams feeding Nalganaga reservoir. This indicated that the contamination of water is negligible except Gulbheli, Rajur, and Motala rivers.

Total Hardness : Total Hardness values were higher in monsoon season, moderate in winter season, and lower in summer season in all rivers and streams of Nalganga reservoir.

Calcium: The values of calcium were maximum during monsoon and minimum during summer and winter season of rivers and streams of Nalganga reservoir.

Magnesium: The values of magnesium were maximum during monsoon and minimum during summer and winter season. Magnesium contents were observed relatively lower than calcium in both the years of study period of rivers, streams and Nalganga reservoir.

Turbidity: The turbidity of water showed fluctuations. Turbidity values were higher in monsoon, moderated in winter season and lowered in summer season of all rivers and streams of Nalganga reservoir. Turbidity of Gulbheli, Rajur, and Motala were much higher due to this it becomes contaminated.

Total Dissolved solids: Total Dissolved solids means the amount of particles that are dissolved in water. The total dissolved solids were maximum in monsoon and winter season and minimum during summer.

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