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Determination of physico-chemical characteristics of four canals of Allahabad region and its suitability for irrigation

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ABSTRACT

The present work was conducted by monitoring four canal water i.e. Ariyl canal, Ghoorpur canal, sharda Canal and Agriculture canal. The quality was assessed in terms of Physico-chemical parameters. Canal water samples were collected from four (4) various locations from January to April 2011. Attempts were made to study and analyze the Physico-chemical characteristics of the canal water various parameters such as Colour, pH, Temperature, Electrical conductance (EC), Total dissolved solid (TDS), Total alkalinity, Dissolved oxygen (DO), Chemical oxygen demand (COD)and Biological oxygen demand (BOD),were investigated to know the present status of the canal water quality of Allahabad .It was found that the water quality parameters were below the pollution level for canal water which satisfy the requirement for the use of irrigation in agriculture. The correlation between chemical oxygen demand (COD) and biochemical oxygen demand (BOD) were found highly significant. The present investigation was carried out with determination of Physico-Chemical Characteristics of four Canals of Allahabad region and its Suitability for Irrigation purpose

Key words: Canal water, physicochemical characteristics.

INTRODUCTION

Water is the precious gift of nature to the human being. It is essential for the growth and maintenance of our bodies; it is involved in a number of biological processes. The quality of irrigation water is a crucial factor for long term soil productivity. Use of Poor quality water for a long time can make the soil less productive or even barren depending on the amount and type of constituents present in canal water. Many areas in the country are facing a serious problem of not only scarcity of water, but also of its poor quality. Low or marginally saline water sometimes appear to stimulate crop growth, because of the higher amount of nutrient ions present, however excess of the soluble salts in water leads to their accumulation in the surface layer is it for basic monitoring water quality it is necessity to observe the demand and pollution level of canal water. A number of water analyses are regularly conducted by different groups of chemists and biologists across the country. Increasing population has led to the deterioration of surface and sub surface water [Dhiviyaa Pranavam *et al*., 2011]. Chemical composition is the most invoked factor in characterizing water quality. Biological, physical, and radiological factors are also considered when discussing water quality. Chemical Quality in major part of the district is fresh and suitable both for irrigation and for domestic purposes. Allahabad water is polluted by various kinds of natural wastes, domestic wastes and agricultural wastes and other factors creating water pollution problem particularly in fresh water system. . In order to improve the production of crops, it is necessary to improve the quality of irrigation water. Use of poor quality canal water deteriorates soil properties [Chaudhry *et al*., 1986, Bhatti,1986, Ghafoor *et al*., 1997; Chaudhry, 2000; Qureshi, and Masih, 2002;] resulting in crop yield loss [Akhtar *et al*., 2001]. The present investigation reveals the quality of irrigation water's, parameters like Colour, Temperature, pH, Electrical Conductivity (EC), TDS, Alkalinity, COD, DO, and BOD.

MATERIALS AND METHODS

Study area

The experiment was conducted at Department of Molecular and Cellular Engineering, Jacob School of Biotechnology and Bioengineering, Sam Higginbottom Institute of Agriculture Technology and Sciences, Allahabad. This is suburban area, located in the eastern gangetic plain of the Indian sub continent at $25^0$19`and $25^0$54`N latitude, $83^0$4`and $83^0$58`E longitude and 67.50 m above the sea level. The coldest months here are December-January and the hottest months are May-June. The Temperature varies from 5°C to 17^0C in winters and 30°C to 42°C in summers. But sometimes winter temperature decrease to 3° C and summer temperature shoots up to 45° C. In the summers, which begin from March and last till Mid June the temperature starts rising and sometimes it reaches 45° C. The annual rainfall in the district was between 800 mm. and 1200 mm and in 1997 the rainfall was 1034 mm. On the average there are 49-55 rainy days (days with rain fall of 2.5 mm or more) July and September the relative humidity are high being over 70 %. During the Post-Monsoon and winter season the humidity is high in the morning. By summer, the relative humidity becomes very low i.e. less than 25 %.

Sampling and sampling sites

A plastic bottle of capacity 2 liters were used to collect the sample, pH and temperature of canal water measured at the time of sample collection. The sampling was carried out in the month of January, February, March and April in the year 2011.Immediately after collection, water samples were brought to the laboratory and kept at 4 C^o till used for analysis.

Name of canals selected at different sites in Allahabad and designated as.

Canal code	Canal name
S_1	Ariyl canal,
S_2	Ghoorpur canal
S_3	Sharda canal
S_4	Agriculture canal

Estimation of physical contaminants

A set of physical contaminants were established which change the quality of water with their variation from standard values, only those constituents were discussed which are of paramount importance and play important role in quality change. They are Colour and temperature.

Estimation of chemical contaminant

Chemical analysis of canal water normally includes major cations and anion, trace element of special environmental important were also included pH ,Electrical conductance (EC),total Alkalinity, total dissolve solid (TDS), dissolved oxygen (DO) was calculated by the modified Winkler-azide method [Lind, 1979; APHA, 1985]. Biological oxygen demand (BOD) and COD was calculated by using standard methods.

RESULTS AND DISCUSSION

The canal water quality evaluation study was carried out to determine their suitability for agricultural irrigation purposes. The samples collected from four different canals of Allahabad were analyzed. Parameters such as Temperature, pH Colour, EC (Electrical conductivity), TDS (Total dissolved Solid), DO (Dissolved Oxygen), BOD (Biochemical oxygen demand), COD (Chemical oxygen demand), Alkalinity**,** were used to assess the suitability of water for irrigation purposes.

Colour

Water collected from Ariyl canal was brownish yellow, where as water of Ghoorpur canal was blackish yellow, however the sample from Gyanpur Pump Canal was greenish Yellow and water collected from agriculture canal was pale yellow in colour. Change in colour of canal water was due to contamination of water.

Table 1: Different ranges of colour of Canals of Allahabad 2011

Sample stations	colour of January	colour of February	colour of March	colour of April
Canal1	brownish yellow	brownish yellow	brownish yellow	brownish yellow
Canal2	blackish yellow	blackish yellow	blackish yellow	blackish yellow
Canal3	greenish Yellow	reenish Yellow	greenish Yellow	greenish Yellow
Canal4	Pale yellow	Pale yellow	Pale yellow	Pale yellow

pH

Measured pH value of the water samples under study fluctuate between 7.2 to 7.6. In the month of January pH of canal-3 was highest and canal-2 was lowest pH .In month of February pH of canal 3 was highest and pH of canal 1was lowest and in the month of April pH of Canal 4 was highest and canal 1 was lowest. The limit of pH value for irrigation water is specified BIS limits (1998) as 6.5 to 8.5. The values of pH were under the desirable limit. During the present investigation a pattern of pH change was noticed, which indicates the alkaline nature of water might be due to high temperature that reduces the solubility of CO_2, [Khan *et al* ., 1992., Jan *et al.*, 2002].

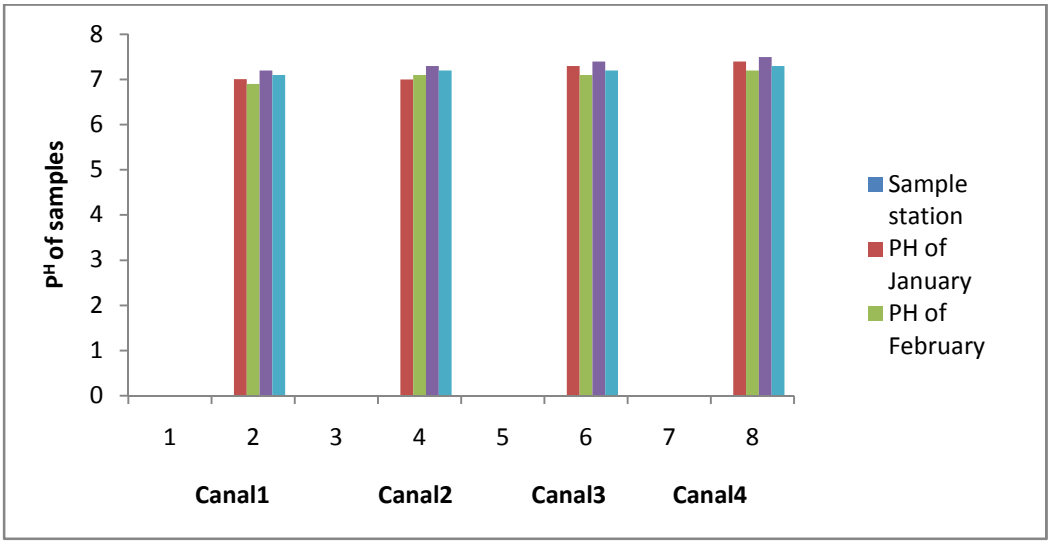

Figure 1: Different ranges of pH of Canals of Allahabad 2011.

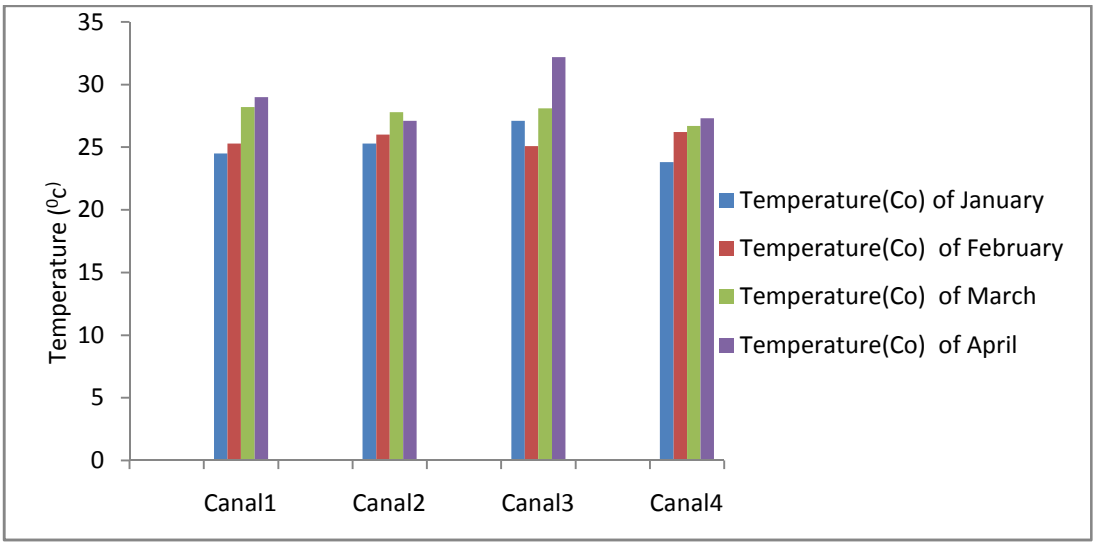

Figure 2: Different ranges of Temperature of Canals of Allahabad 2011.

Temperature

The temperature of the canal one in the month of January was highest (24.5^0C) and lowest in the month of in April (29^0C). Temperature of canal two highest in month of March (27.8^0C) and lowest in month of January (25.3^0C).Temperature of canal three was highest in month of April (32.2^0C) and lowest in month of February (25.1^0C).and temperature of canal four was highest in month of March (27.3^0C) and lowest in month of January (23.8^0C). In the present investigation, there was no great variation between the temperatures of the canal water. Temperature of the canal varied with climate and the season and its measurement is useful to indicate the trend of various chemicals, biochemical and biological activities. The rise in temperature led to faster chemical and biochemical reactions. Biological activity was also enhanced by higher temperature up to 60^0C. The growth and death of microorganisms, kinetics of biochemical oxygen demand is regulated to some extent by water temperature. Temperature also affects some other characteristics of water like dissolution of gases, pH and conductivity.

Variation in temperature of Canal Water from Jan to April was probably due to the addition of municipal and industrial effluents Sharma, S.D. and Pandey [1999], Khan *et al.*, [2002]. The variation in the water temperature may be due to different timing of Collection and influence of season [Jayraman *et al.*, 2003]. The limit of pH value for irrigation water is specified BIS limits (1998) maximum as 40C°. All samples were in desirable limit as prescribed for irrigation water standard.

Electrical Conductivity

The Electrical conductivity of the canal 1in the month of January was highest (1559.37 µ mho/cm) and lowest in the month of February (1503.12 µ mho/cm). Electrical conductivity of canal 2 was recorded highest in month of March (673.43 µ mho/cm) and lowest in month of February (556.25 µ mho/cm). Electrical conductivity of canal 3 was recorded highest in month of April (1268.75 µ mho/cm) and lowest in month of February (973.43 µ mho/cm) and Electrical conductivity of canal 4 was recorded highest in month of April (942.18 µ mho/cm) and lowest in month of February (848.43 µ mho/cm).The average specific conductivity exceeds this limit because of its high values during rainy season .In rainy season due to floods and rains, water level in the well increases, which contains more electrolytes. The conductivity indicates dissolved inorganic salts. The EC values were found higher at some samples due to concentrated colloids in water. The Electrical conductivity limit of value for irrigation water is specified BIS limits (1998) as 3000 (µ mho/cm.). All samples were in desirable limit as prescribed for irrigation water standard.

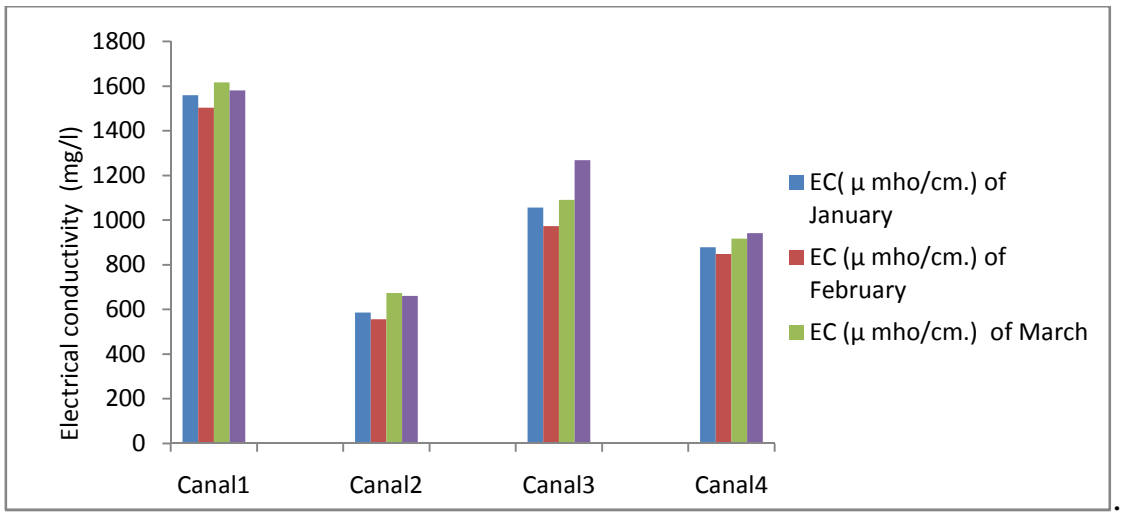

Figure 3: Different ranges of EC (µ mho/cm) of Canals of Allahabad 2011.

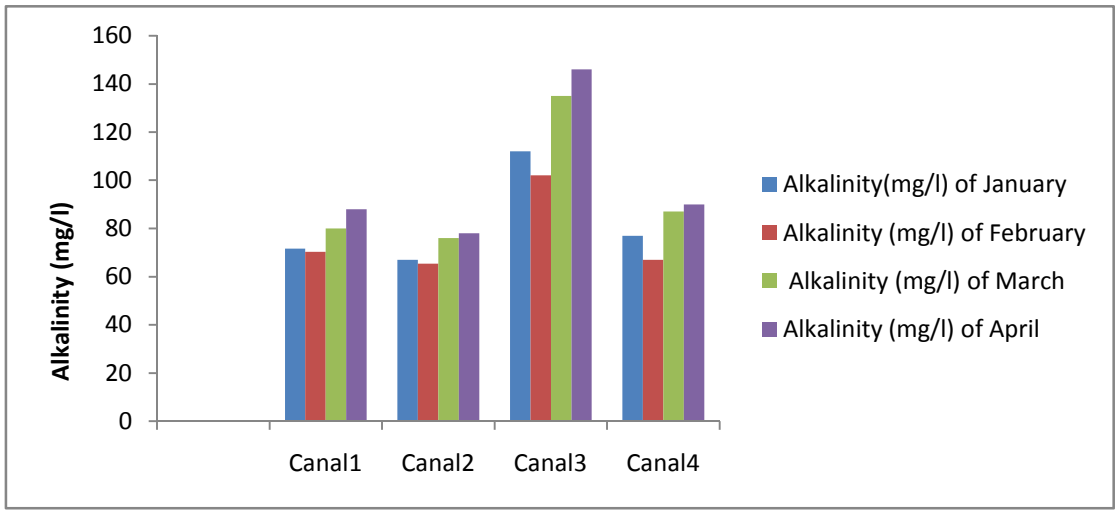

Figure 4: Different ranges of Alkalinity (mg/l) of Canals of Allahabad 2011.

Alkalinity

Total alkalinity of canal water in terms of $CaCO_3$ in the month of April was highest (88 mg/l) and lowest in the month of February (70.3 mg/l). Alkalinity of canal 2 was recorded highest in month of April (78 mg/l), and lowest in

month of February (65.4 mg/l). Alkalinity of canal3 was recorded highest in month of April (146mg/l) and lowest in month of February (102 mg/l) and alkalinity of canal 4 were recorded highest in month of April (90 mg/l), and lowest in month of February (67 mg/l). The values of total alkalinity were comparatively moderate. The alkalinity limit of value for irrigation water is specified BIS limits (1998) as (2000mg/l). The observation shows that the alkalinity was within the permissible range as prescribed by BIS limits (1998).

Total dissolved Solid

The Total dissolved solids (TDS) of the canal1in the month of March was highest (1035mg/l) and lowest in the month of in February (962 mg/l). Total dissolved solids (TDS) of canal 2 were recorded highest in month of March (431 mg/l) and lowest in month of February (356 mg/l). Total dissolved solids (TDS) of canal 3 were recorded highest in month of April (812 mg/l) and lowest in month of February (623 mg/l) and Total dissolved solids (TDS) of canal 4 were recorded highest in month of April (603 mg/l) and lowest in month of February (543 mg/l). The TDS limit of value for irrigation water is specified BIS limits (1998) as (600mg/l). The observation shows that the TDS is not within the permissible range as prescribed by BIS limits (1998), high TDS is due to pollution of canal water.

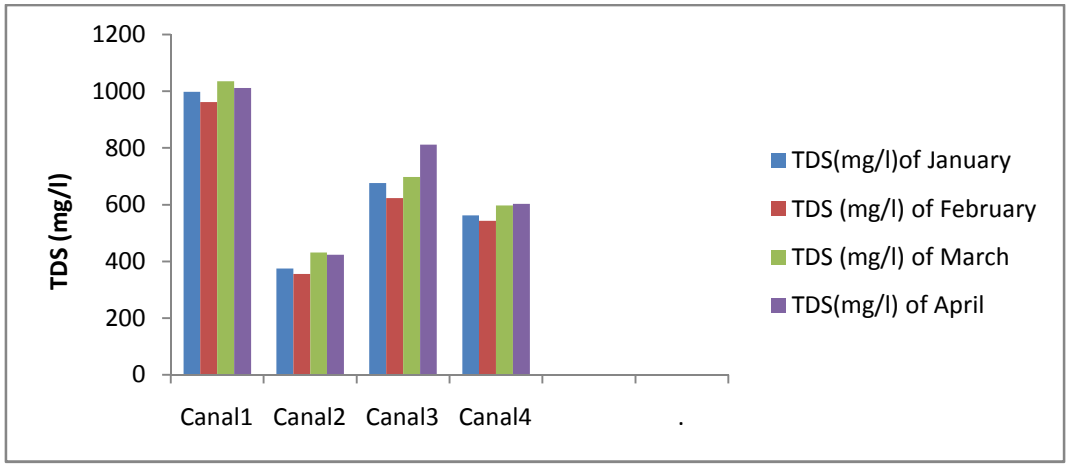

Figure 5: Different ranges of TDS (mg/l) of Canals of Allahabad 2011.

Dissolved Oxygen

The Dissolved Oxygen of the canal 1 in the month of April was highest (4.4 mg/l) and lowest in the month of in February (4 mg/l). Dissolved Oxygen of canal 2 was recorded highest in month of April (3.5 mg/l) and lowest in month of January (3.01 mg/l). Dissolved Oxygen of canal 3 was recorded highest in month of April (4.8 mg/l) and lowest in month of February (4.2 mg/l) and Dissolved Oxygen of canal4 was recorded highest in month of April (3.8 mg/l) and lowest in month of January (2.1mg/l). The Dissolved Oxygen limit of value for irrigation water is specified as (10 mg/l). The observation shows that the Dissolved Oxygen (DO) was within the permissible range as prescribed by BIS limits (1998).

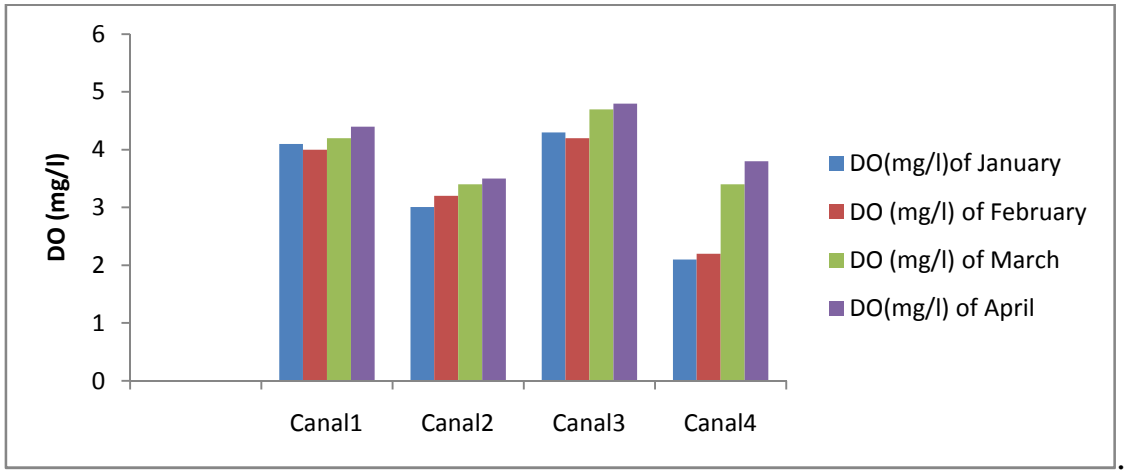

Figure 6: Different ranges of DO (mg/l) of Canals of Allahabad 2011.

Biochemical oxygen demand (BOD)

The Biochemical oxygen demand (BOD) of the canal 1in the month of February was highest (2.7 mg/l) and lowest in the month of March (1.6 mg/l). Biochemical oxygen demand (BOD) of canal 2 was recorded highest in month of March (2.7 mg/l) and lowest in month of January (2.3 mg/l). Biochemical oxygen demand (BOD) of canal 3 was recorded highest in month of April (3.6 mg/l) and lowest in month of February (3.2 mg/l) and Biochemical oxygen demand (BOD) of canal 4 was recorded highest in month of February (2.5 mg/l) and lowest in month of January (2 mg/l).The limit of BOD value for irrigation water is specified BIS limits (1998) as (30 mg/l). The observation shows that the BOD was within the permissible range as prescribed by BIS limits (1998).

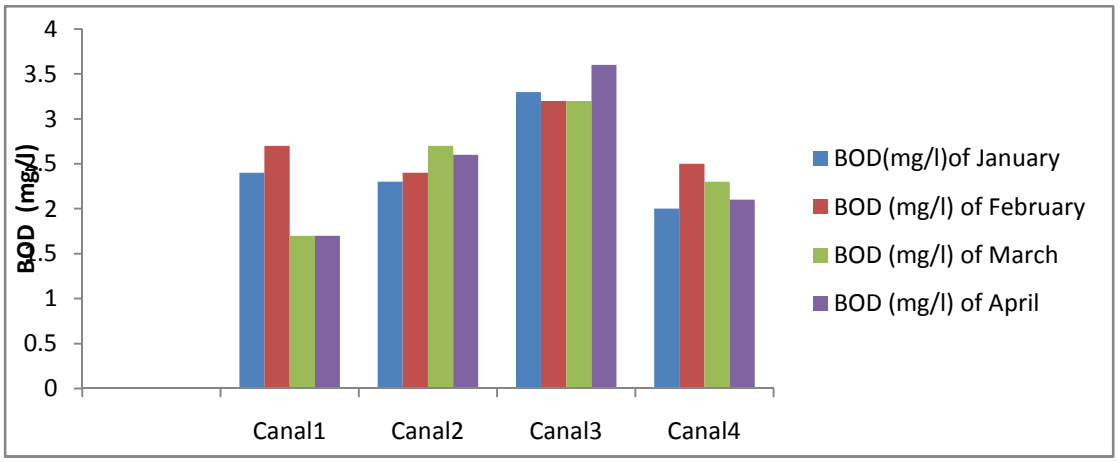

Figure 7: Different ranges of BOD (mg/l) of Canals of Allahabad 2011

Chemical oxygen demand (COD)

The Chemical oxygen demand (COD) of the canal 1 in the month of April was highest (16 mg/l) and lowest in the month of in February (15 mg/l). Chemical oxygen demand (COD) of canal 2 was recorded highest in month of February (13.2 mg/l) and lowest in month of January (12.2 mg/l). Chemical oxygen demand (COD) of canal 3 was recorded highest in month of April (38.2 mg/l) and lowest in month of February (32.2 mg/l) and Chemical oxygen demand (COD) of canal 4 was recorded highest in month of April (13.8 mg/l) and lowest in month of February (11.6 mg/l).The limit of COD value for irrigation water is specified BIS limits (1998) as (250 mg/l). The observation shows that the COD was within the permissible range as prescribed by BIS limits (1998).

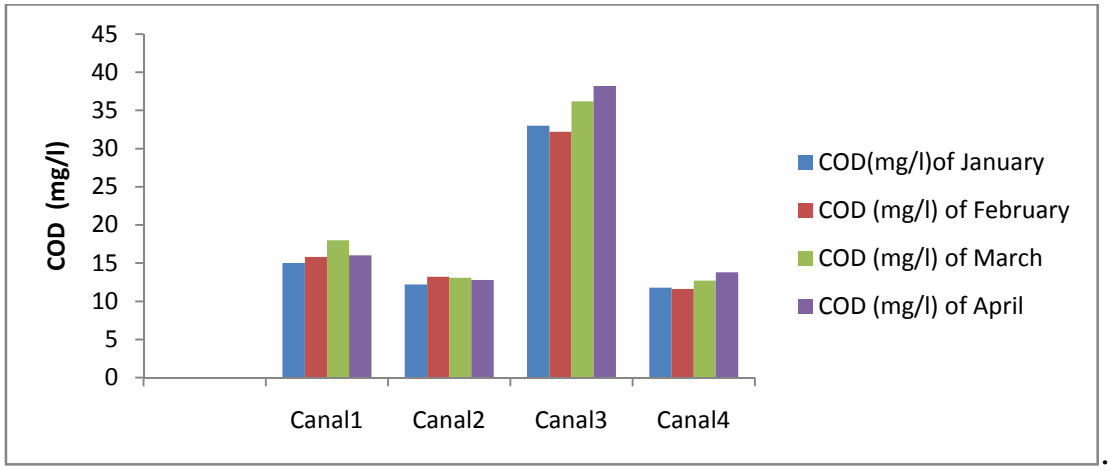

Figure 8: Different ranges of COD (mg/l) of Canals of Allahabad 2011

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