SEASONAL VARIATIONS IN WATER QUALITY INDEX OF SIRHIND CANAL PASSING THROUGH MOGA, PUNJAB, INDIA

Jasvir Kaur[1], Simerjit Kaur[2]

[1]*Research Scholar, Department of Botany, Jodhpur National University, Jodhpur, Rajasthan, India*
[2]*Corresponding author: Associate Professor, Department of applied Sciences, Rayat-Bahra Institute of Engineering & Biotechnology, Mohali Campus, Punjab, India*

Abstract

Monitoring of the various parameters was carried out to assess the pollution level in Sirhind Canal passing through Moga, Punjab, India. Sampling was done in the three different seasons i.e summer, monsoon & winter in the year 2012. During these investigations, various parameters viz temperature, pH, electrical conductance, alkalinity, calcium, magnesium, total hardness, nitrate & phosphate were studied. It has observed that increased alkalinity & total hardness has made this water unsuitable for drinking & for various industrial applications. Decreased pH level at some sampling spots has made this water unpleasant. Nitrate & phosphate may pose disastrous effects by accelerating the process of eutrophication. It has also observed that most of the parameters have shown increased concentration during summer in comparison to monsoon and winter except nitrate & phosphate that have shown maximum concentration during monsoon. This may be due to flushing out of the agricultural runoff from adjacent agricultural fields. While comparing among various seasons, all the studied parameters have shown significant variations at ($p<0.005$) level.

Keywords: *Sirhind Canal, water analysis, water pollution, seasonal variations, alkalinity, calcium concentration, magnesium concentration, total hardness.*

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1. INTRODUCTION

Water pollution occurs when waste water from industries and any other anthropogenic activities is discharged in to any water body without any treatment. Water pollution is damaging not only to individual species and populations, but also to the natural biological communities. It is a serious threat to mankind. It has estimated that the leading worldwide cause of deaths and diseases [1] and that it accounts for the deaths of more than 14,000 people daily [2]. An estimated of 580 people in India die of water pollution related sickness every day [3]. Water supply and sanitation in India continue to be inadequate, despite longstanding efforts by the various levels of government and communities at improving coverage. The situation is particularly inadequate for sanitation, since only one of three Indians has access to improved sanitation facilities (including improved latrines). While the share of those with access to an improved water source is much higher than for sanitation (86%), the quality of service is poor and most users that are counted as having access receive water of doubtful quality and only on an intermittent basis. A study by NEERI shows that 70% India's fresh waters are polluted by conventional standard. Rivers are found to be more polluted in India for purified like drinking water, supply, irrigation and fisheries yetthe rivers have been largely used as the channels of waste discharging path for domestic and industrial waste. Total annual river flow of World is 37,000 cubic kilometers while tat of Indian rivers is 1645 cubic kilometers i.e. 45% of total world river water. River water is used in many ways like boating, drinking, municipal water supply navigation, irrigation and fishing. River pollution becomes apparent at times during accidents through horrifying scenes of dead fish floating on the surface of water. But more often, it exists as chronic and insidious pollution originating from different human activities. Pollution causes a general deterioration in the state of health of rivers across the entire planet. The growing problem of river pollution has necessitated the monitoring of the Water quality of the river in different states of our country to restore the waste quality.

A review of literature reveals that various studies have already been carried out by different workers in studying the various physio-chemical and biological parameters of Indian rivers and this work is briefly reviewed here [4] [5] [6] [7] [8] [9] [10] [11] [12] [13] [14] [15] [16] [17] [18].

1.1 Purpose of Study

Water and health too are intimately linked. The shortage of clean drinking water in the country is slowly affecting the lives of people as well as the environment around them. Most of them depend on unsafe water sources to meet their daily needs. Therefore, keeping this thing in mind, analysis of Sirhind canal passing through Moga, Punjab was carried out in various seasons to check the level of pollution in this River.

2. MATERIALS & METHODS

2.1 Materials

2.1.1 Water Sampling

2.1.1.1 Purpose of Water Sampling

Water sampling wss needed to determine the Physico-chemical constituents in a body of water. The purpose of sampling was to handle the water sample very carefully in such a way that no significant changes occur in composition before the tests are made. The bottles were properly labeled with the sample number and date of sampling and were put in the bag to carry them to the area of testing. Sampling was done in three different seasons in year 2012. The physical parameter like temperature was taken at the site of collection and samples were brought to the laboratory for detailed physico-chemical analysis. The standard methods [19] adopted for analysis of water samples collected from various sampling spots in three seasons.

2.1.1.2 Area of Sampling

These investigations were carried on Sirhind Canal, a stretch of 50 miles of Sirhind canal covering 10 stations along its course in Moga, Punjab, to find out whether the water is suitable for drinking, irrigation and other various purposes.

Sampling Sites: S-1=Raunta; S-2=Mardi Mustafa; S-3=Bhaga Purana; S-4=Sivian; S-5=Daate Wala; S-6=Langiana; S-7=Bhalour; S-8=Phule Walan; S-9=Ranian; S-10=Daudhar.

2.2 Methods

Table-1: Various methods used during these investigations for Physiochemical analysis are given below:

Parameters	Method used for estimation/Instrument
Temperature	Thermoprobe
pH	pH Meter
Electrical Conductivity	Conductometric method
Alkalinity	Titration method
Calcium	EDTA Titration Method
Magnesium	EDTA Titration Method
Total Hardness	EDTA Titration Method
Nitrate and phosphate	Spectro-photometric method

Physiochemical analysis of surface water that include temperature, pH, electrical conductance, total alkalinity, Calcium, Magnesium, total hardness, Nitrate, phosphate was done along the stretch of Sirhind Canal, Moga, Punjab, India in the three seasons (Summer, Monsoon & Winter) in 2012. Methods are same as discussed by Kaur & Malik [20]. Data was statistically analyzed by using one way ANOVA at 5% level of significance among various spot and different seasons.

3. RESULTS & DISCUSSION

3.1 Temperature

Water temperature influences the chemical, biochemical and biological characteristics of water body. Water quality is highly sensitive to change in temperature as it affects the aquatic life present in that water. High water temperature enhances the growth of microorganisms and may increase taste, odour, colour, and corrosion problems.

During these investigations, maximum temperature was observed at S-1 & minimum at S-4 in both summer & monsoon season. In winter, S-10 has shown maximum temperature & S-4 has shown minimum temperature. Temperature has shown significant variations at ($p<0.005$) level in its values among various seasons & different spots.

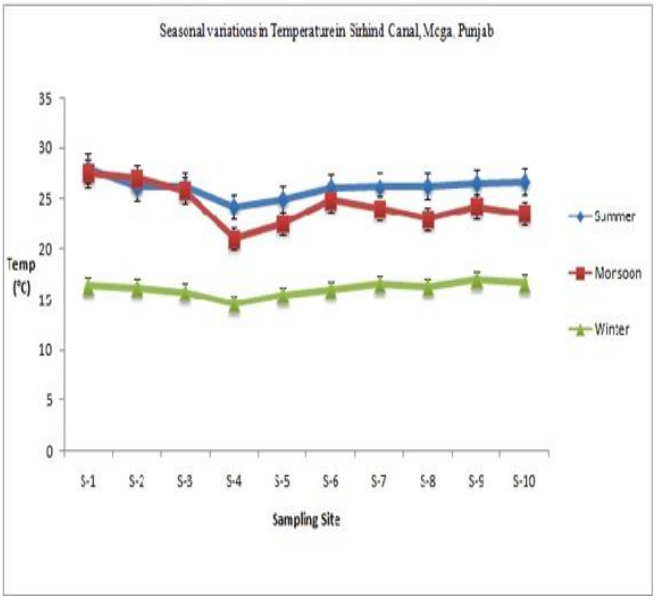

Chart-1: Seasonal variations in concentration of temperature in Sirhind Canal, Moga, Punjab

3.2 pH

Measurement of pH is one of the most important and frequently used tests in water chemistry. pH is important in almost all phases of water and waste water treatment. Aquatic organisms are sensitive to pH change and biological treatment requires either pH control or monitoring.

During these investigations, pH value was found to be high in summer season in comparison to monsoon & winter season. In summer, maximum value of pH was observed at S-9 followed by S-10 & S-5. In winter, S-9 & S-10 have shown the highest pH value. In monsoon, S-2 & S-9 have shown the highest pH value. At rest of the sampling spots, pH value was almost at same level in all three seasons.

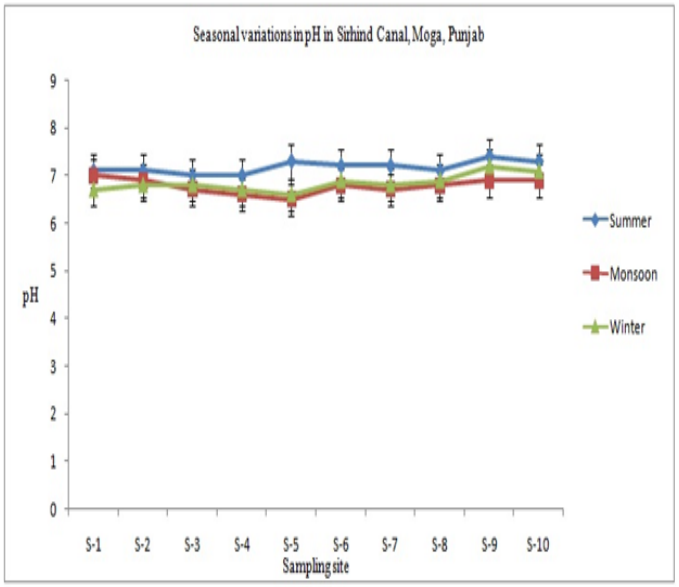

Chart-2: Seasonal variations in concentration of pH in Sirhind Canal, Moga, Punjab

3.3 Electrical Conductivity (EC)

EC is conductance of 1cm cube of solution. It depends upon the ionization of the dissolved solids in the water. Water are said to be saline in nature when their EC is 4 ds/m.
In summer season, EC has shown maximum value at S-1 & S-7 followed by S-3 and minimum value at S-10. In monsoon, S-9 has shown maximum value of EC followed by S-3 & S-6 and minimum value at S-2. In winter, EC was maximum at S-9 followed by S-7, S-4 & S-6. EC was found to be low in Monsoon season in comparison to summer & winter season. Significant variations ($p<0.005$) were observed among various seasons.

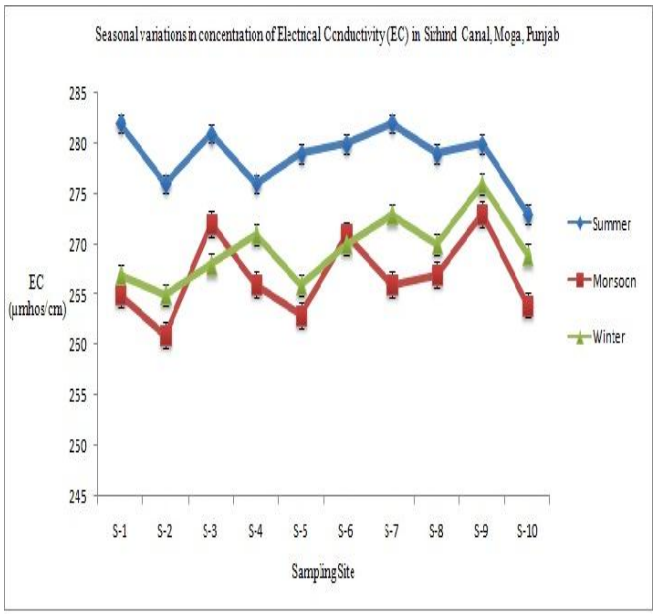

Chart-3: Seasonal variations in concentration of Electrical Conductivity (EC) in Sirhind Canal, Moga, Punjab

3.4 Alkalinity

Alkalinity is not a pollutant. It is a total measure of the substances in water that have "acid-neutralizing" ability. It is not to be confusing alkalinity with pH. pH measures the strength of an acid or base; alkalinity indicates a solution's power to react with acid and "buffer" its pH — that is, the power to keep its pH from changing. Therefore, Alkalinity is important for fish and aquatic life because it protects or buffers against pH changes and makes water less vulnerable to acid rain.

In summer season, maximum value of alkalinity was at S-9 followed by S-10, S-1 & S-7. In monsoon season, an elevated level of alkalinity was observed with maximum value at S-7 followed by S-10 & S-9. Alkalinity at these spots is observed to be high because of the fact that these sites are used for agricultural purposes and the all the soil-runoff from these sites get into the river, itself. Minimum value of alkalinity was observed at S-4 in winter season. Alkalinity has shown significant variations ($p<0.005$) between summer & winter season.

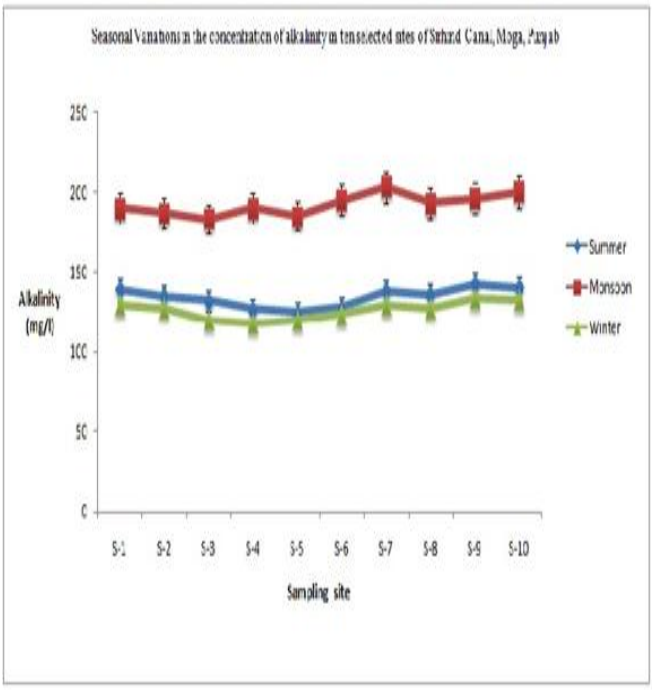

Chart-4: Seasonal variations in concentration of alkalinity in Sirhind Canal, Moga, Punjab

3.5 Total Hardness (TH)

Hardness is due to the presence of multivalent metal ions which come from minerals dissolved in the water. Hardness is based on the ability of these ions to react with soap to form a precipitate or soap scum. In fresh water, the hardness of the water is mainly due to the calcium ions (Ca^{2+}) and magnesium ions (Mg^{2+}) which combine up with the other ions present in the solution to give rise to the hardness of the water sample; however iron and manganese may also contribute.

During these investigations, in summer, TH has shown maximum concentration at S-6 followed by S-4, S-5 & S-1 and minimum concentration at S-10. In monsoon, maximum concentration was at S-4 followed by S-1, S-6 & S-5 and minimum at S-10. In winter, S-4 has shown maximum concentration of TH followed by S-6, S-1 & S-5. Total hardness has shown low concentration in monsoon in comparison to summer & winter. Data has shown significant variations ($p<0.005$) in TH concentration among various seasons.

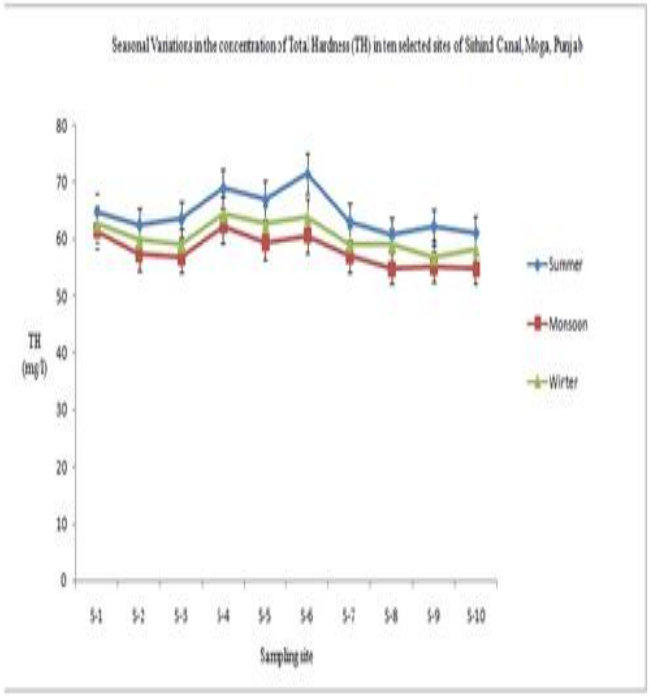

Chart-5: Seasonal variations in concentration of TH in Sirhind Canal, Moga, Punjab

3.6 Calcium Concentration

It is the concentration of the calcium ions (Ca^{2+}) present in the water sample. Calcium is usually one of the most important contributors to hardness. Calcium salts and calcium ions are among the most commonly occurring in nature. Even though the human body requires approx. 0.7 to 2.0 grams of calcium per day as a food element, excessive amounts can lead to the formation of kidney or gallbladder stones. High concentrations of calcium can also be detrimental to some industrial processes. In natural water it is known to reduce the toxicity of many chemical compounds on fish and other aquatic life.

During these investigations, maximum concentration of calcium was observed in summer followed by winter & monsoon. In summer, S-6 has shown high concentration of calcium followed by S-4, S-5 & S-1. In monsoon & winter, Maximum concentration was observed at S-4 followed by S-1 and minimum concentration at S-9. Data has shown significant variations ($p<0.005$) between summer & monsoon season.

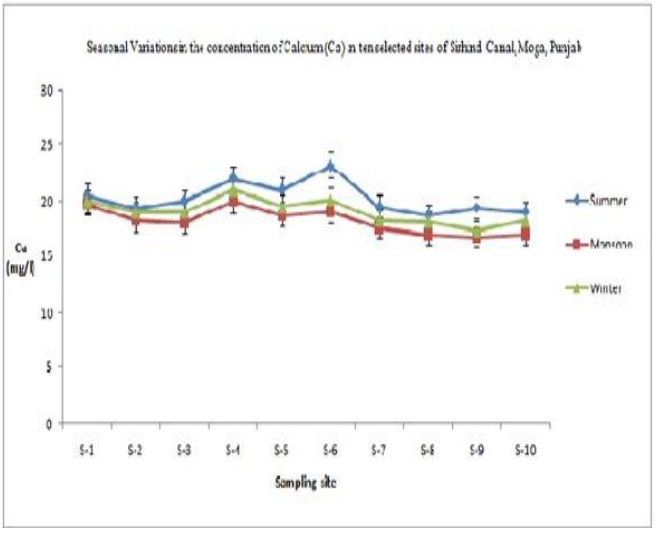

Chart-6: Seasonal variations in concentration of Calcium in Sirhind Canal, Moga, Punjab

3.7 Magnesium concentration

It is the concentration of the magnesium ions (Mg^{2+}) present in the water sample. It is also very chemically active; therefore it is not found in the elemental state in nature. It may contribute to water hardness.

Magnesium is widely distributed in ores and minerals. With the exception of magnesium hydroxide, which has a high pH value, its salts are very soluble. Concentrations of magnesium and calcium in water may also be a factor in the distribution of certain crustaceans, fish and other organisms in streams.

During these investigations, Magnesium concentration was found to be almost at the same level in summer, monsoon & winter season with maximum concentration at S-5 followed by S-7 & S-8. Magnesium has shown minimum concentration at S-2 & S-3 in winter season. No significant variations ($p<0.005$) were observed among various seasons.

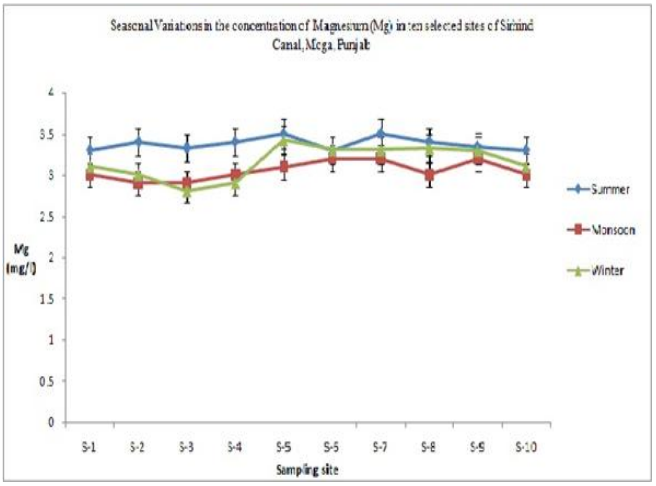

Chart-7: Seasonal variations in concentration of Calcium in Sirhind Canal, Moga, Punjab

3.8 Nitrate Concentration

It is the concentration of the nitrates ions (NO^{3-}) present in the water. Nitrogen-containing compounds act as nutrients in streams, rivers, and reservoirs. Bacteria in water quickly convert nitrites [NO^{2-}] to nitrates [NO^{3-}] and this process uses up oxygen, hence lowering down the oxygen content of water too. The major routes of entry of nitrogen into bodies of water are municipal and industrial wastewater, septic tanks, feed lot discharges, animal wastes (including birds and fish), runoff from fertilized agricultural field and lawns and discharges from car exhausts. Water with nitrate levels exceeding 1.0 mg/L should not be used for feeding babies. High nitrates in drinking water can cause digestive disturbances in people. Nitrate levels below 0.5 mg/L seem to have no affect on warm water fish. The major impact of nitrates/nitrites on fresh water bodies is that of enrichment or fertilization called **eutrophication**.

During these investigations, high concentration of nitrate was found in monsoon in comparison to summer & winter. Maximum concentration of nitrate was found at S-1 followed by S-2 & S-6 in both summer and monsoon. Low nitrate concentration was observed in winter with maximum value at S-1 and minimum at S-8. Nitrate concentration does not vary significantly ($p<0.005$) between summer and monsoon but it varies significantly between summer and winter.

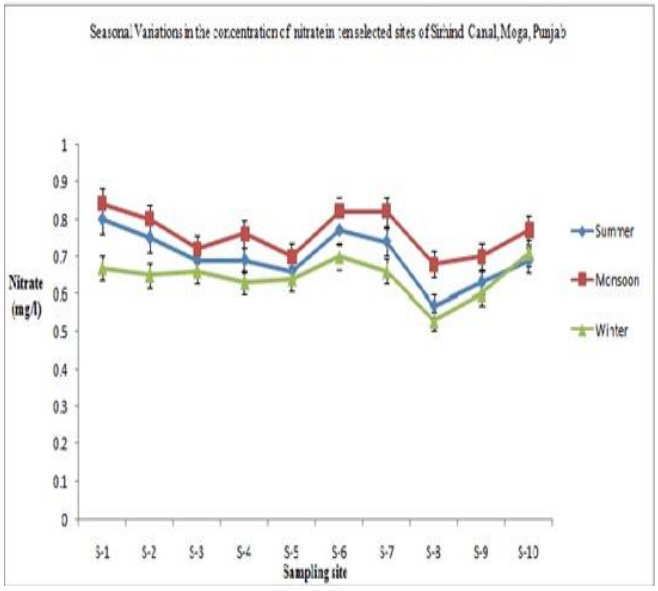

Chart-8: Seasonal variations in concentration of nitrate in Sirhind Canal, Moga, Punjab

3.9 Phosphate Concentration

It represents the amount of the phosphate ions (PO^{4-}) present in the sample whether present in the free form or in bound form. Phosphorus is one of the key elements necessary for growth of plants and animals. Phosphates PO^{4-} are formed from this element. Phosphates exist in three forms: orthophosphate, metaphosphate (or polyphosphate) and organically bound phosphate. Rainfall can cause varying amounts of phosphates to wash from farm soils into nearby waterways. Phosphate will stimulate the growth of plankton and aquatic plants which provide food for fish. This may cause an increase in the fish population and improve the overall water quality. But high concentration of phosphate leads to the eutrophication (excessive algal growth leading to oxygen depletion in the water body).

During these investigations, Phosphate has shown elevated levels in monsoon with maximum at S-1. Phosphate concentration was found to be same at S-3, S-6 & S-7. In summer, Maximum concentration was at S-1 followed by S-3 & S-4 and minimum at S-5. Phosphate has shown significant variations ($p<0.005$) between summer & monsoon season. Also data vary significantly ($p<0.005$) between monsoon & winter season.

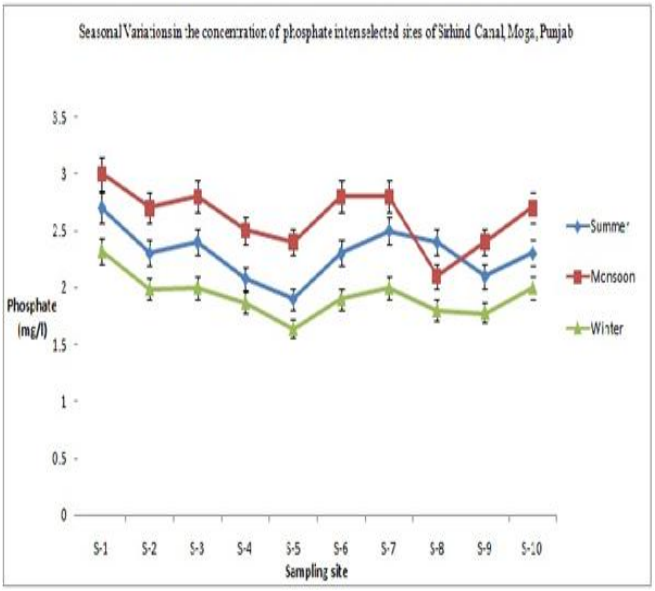

Chart-9: Seasonal variations in concentration of phosphate in Sirhind Canal, Moga, Punjab

4. CONCLUSIONS

The above findings have shown though most of the parameters studied are within permissible limits of BSI [21] & WHO [22] still exceed the desirable range given by these agencies. Increased calcium and total hardness makes this water unfit for domestic purpose. Large daily changes in pH & alkalinity can cause stress, poor growth and even death of the farmed animals. In these investigations, pH and alkalinity have also shown significant variation among various sampling spots that can pose a threat to aquatic life in future. If Nitrate & phosphate levels keep on increasing at the same rate, it may have a disastrous effect by accelerating the process of eutrophication. Therefore, it is concluded that this water is not fit for drinking purpose without proper treatment but can be used for irrigation. Hence, there is a serious need to put efforts for the proper implementation of the antipollution laws & various legislations to improve the water quality of Sirhind Canal, Moga, Punjab, India.

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