Physico-Chemical Study of Some Surface Water Bodies of Punjab

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Abstract. In recent years, the surface water quality has been observed deteriorating due to industrial activities and pollution in the Punjab state. Evaluation of surface water quality is an important issue to assure from its safe and stable use. However, describing quality conditions is generally difficult considering spatial variability of pollutants and a wide range of indicators like biological, physical and chemical substances which can be measured. This paper includes the study of surface water quality parameters in the northern Punjab region. Samples from different sources across northern Punjab were analysed for pH, TDS, TSS, turbidity, DO, chloride content, iron content and hardness of surface water. The pH, TDS, TSS, turbidity, DO, chloride content, iron content and hardness were found in the range of 6.7-8.7, 1358.00-1430.60 mg/l, 135.10-141.21 mg/l, 0.001-0.62 NTU, 0.96-7.80 mg/l, 0.80-15.56 mg/l, 0.01-0.02 mg/l and 1.2-13.9 mg/l respectively. The obtained results were compared with the acceptance limits as given by Indian standard code IS: 10500-2012. The high values of water quality parameters obtained as a result of this study indicates the level of pollution of the different sources of surface water of northern Punjab. At the end the obtained results were critically examined and suggestions were made for better management of surface water resources.

Keywords : Water Quality, Surface Water, Environmental Pollution, Water Pollution, Water Resources

1. Introduction
Surface water is one of the most important sources of potable water in Punjab. Historically, surface water has been one of the most important sources of drinking water [1] and irrigation use [2] in areas of northern part of Punjab. Today surface water is the most vulnerable for pollution due to its easy accessibility for disposal of pollutants and waste-water [1, 3]. Most districts in Punjab are using surface water for their house hold uses and agricultural works. But as per recent surveys there will be collapse in agricultural out come in states like Punjab and Haryana and there can be a severe shortage of water. Punjab is plagued by an identical problem related to water required to irrigate crop land. In Punjab the subsoil water table has been dipping at fast rate because of the scarcity of surface water In recent years, the surface water quality has been observed deteriorating due to industrial activities and pollution in this region. Evaluation of surface water quality is an important issue to assure from its safe and stable use [4,5]. However, describing quality conditions is generally difficult considering spatial variability of pollutants and a wide range of indicators (biological, physical and chemical substances) which can be measured [6-8]. The primary objective of this paper is to study the surface water quality parameters in the northern Punjab region.
2. Materials and Methods

2.1 Study area
This investigation was carried out in 6 districts of Punjab state of India which were Pathankot, Amritsar, Hoshiarpur, Ludhiana, Kapurthala (Phagwara) and Jalandhar. Water samples were collected from ponds and reservoirs located in places from these districts (Table 1) located in northern Punjab.

| Sr. No | Place                  | Sr. No | Place     |
|-------|------------------------|--------|-----------|
| 1     | Bhakra reservoir       | 6      | Hardaspur |
| 2     | Amritsar               | 7      | Kukur Pind|
| 3     | Hoshiarpur             | 8      | Kot kalan |
| 4     | Sutlej River (Ludhiana)| 9      | Meheru    |
| 5     | Phagwara               | 10     | Kot Kurd  |

2.2 Methods of analysis.
Water samples were collected in bottles. All the precautions were taken during the sampling. The collected water samples were analyzed for different physico-chemical parameters (Table 2) such as for Total solids, turbidity, pH, hardness, chloride ion, dissolved oxygen, iron ion and alkalinity by the standard protocols of IS: 3025. All the analyses were performed in triplicate to insure accuracy in the results.

| Sr. No | Water Quality Parameter               | Method of Analysis                      |
|--------|--------------------------------------|-----------------------------------------|
| 1      | Solid (TDS, TSS and volatile solids)  | Water and soil analysis kit model no 161|
| 2      | Turbidity                            | Turbidity meter                         |
| 3      | pH                                   | pH meter                                |
| 4      | Hardness                             | EDTA method                             |
| 5      | Chloride                             | Chemical method                         |
| 6      | Dissolved Oxygen                     | Winkler's method                        |
| 7      | Iron                                 | Chemical method                         |

3. Results and Discussion
Results of different parameters as per Table 2 were analyzed and have been presented in following subheads.
3.1 Solids
The samples were analyzed for Total suspended solids, total dissolved solids and volatile solids which are shown (in ppm) in the figure 1, 2 and 3.
Figure 1. Value of suspended solids found in surface water from different places

As per figure 1, values of total suspended solid lie within allowable limit of 500 mg/l. Maximum value of 143.06 mg/l of solid was observed to be found in surface water collected from Kot Kalan.

Figure 2. Value of total solids at different places

As per figure 2, total solid content at all the places are much above the allowable limit of 500 mg/l as prescribed in IS:10500. This is due to high content of dissolved solid (figure 3). As most of the surface water bodies receive wastewater, the total solid content is much higher.
3.2 Turbidity
Turbidity of each sample was measured using turbidity meter. Test was repeated thrice and results were presented as in figure 4. As per observation, it was concluded that turbidity in the surface water at all the places was below the allowable limit of 1 NTU as per IS:10500.

3.3 Chloride ion and Iron contents
Chloride ion and Iron contents were measured as per the standard methods of measurement prescribed in IS: 3025 and the results were plotted (in mg/l) and results were presented in figure 5 and figure 6. It is seen that contents of both the ions at every place were well within limits described by IS 10500:2012.
As per figure 5, the chloride ion content at all the places are well below the allowable limit of 250 mg/l as prescribed by IS:10500. Maximum value of chloride content equal to 15.56 mg/l was noticed in the surface water of Phagwara, which is an industrial area.

Figure 6 depicts iron content found in the surface water of places under study. Maximum value of iron was found in water from Hosiarpur and Kukur Pind and the value of iron in each of these places was equal to 0.02 mg/l. Iron content of all the places was found to be within allowable limit of 0.3 mg/l as prescribed by IS:10500.

3.4 Dissolved oxygen content
Winkler method was used to determine D.O. contents. The results were plotted in the figure 6. Minimum D.O. for survival of aqua life is considered as 4 ppm [9-11, 13-16]. However, in the surface water of Ludhiana, Hardaspur, Kukur Pind, Kot Kalan, Meheru and Kot Kurd, the value of dissolved oxygen was found to be less than desirable limit of 4 ppm and water from these sources is not fit for drinking. Minimum amount of DO content was found in the water from Kot Kurd and it’s value was 1.1 mg/l.

![Figure 7. Dissolved oxygen content of surface water at different places](image)

3.5 pH measurement and hardness test results  

pH of the samples were measured using pH meter and hardness was measured using EDTA method. It was noticed that pH of Hoshiarpur was above limit (6.5-8.5) than required for drinking purposes (figure 8) while hardness of all the samples (figure 9) were well within limits (200 mg/l) [12].

![Figure 8. pH value at different places](image)
4. Conclusion
As a result of current study, following conclusions were drawn.

- Total suspended solids at each places were within limits but Total Disolved solids at Hardaspur, Kot Kalan, Meheru, Kot Kurd and Phagwara much above were above limits.

- TDS at each sampling location was more than acceptable limit of IS 10500:2012 which means the water from each location must be given TDS treatment before use for drinking purpose.

- Turbidity at each sampling location was below maximum limits prescribed for drinking purpose. Maximum value of turbidity was found to be equal to 0.61 NTU at Phagwara. Immediate attention should be given to surface water at this location.

- Chloride and Iron contents were below the maximum allowable limit described by Indian drinking water standards. However, surface water from Hoshiarpur and Kukur Pind are close to allowable limit and timely action to control increasing iron content is recommended.

- pH at Hoshiarpur was above limit of Indian drinking water standards and hence water from this location need to be treated before use for drinking purpose. pH of surface water in other locations are within allowable limit of 6.5-8.5.

- Water at each sampling location was within acceptable hardness limit. Maximum value of hardness was found to be equal to 13.9 mg/l and this is recommended to treat surface water from Phagwara before human consumption.

- Dissolved oxygen content in surface water from Ludhiana, Hardaspur, Kukur Pind, Kot Kalan, Meheru and Kot Kurd was found below minimum required value of 4 mg/l. This shows presence of organic impurities in the surface water at these locations. This is strongly recommended that surface water from these locations should be given proper treatment forllwed by aeration before human consumption.

Figure 9. Total hardness of surface water at different places
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