ABSTRACT

The water quality and human health are closely related. The rapid development in agriculture, land mining, urban and civic globalization, and industrialization activities, is causing the river water contamination with hazardous waste; and wastewater is becoming a common phenomenon. The domestic waste from each building along with the effluent of small scale industries is disposed into the open drains and gutters which ultimately enter into the rivers. The quality of water is mainly deteriorated by human activities. With about 70% of the earth’s cover being water, it undeniably becomes one of our greatest resources. So it is absolutely necessary to ascertain the portability of water before it is used for human consumption. The water used for drinking purpose should be free from toxic elements, living and non-living organisms and excess amount of minerals that may be hazardous to health.

Water pollution not only affects water quality but also threats human health, economic development, and social prosperity. Furthermore water impacts human health; both directly and indirectly. The direct impacts of water on health are derived from the quality of water consumed and the indirect impacts pertain to the quantity used for personal, domestic and household hygiene. as the quality of water resources being seriously threatened due to increasing sources of pollution, it may not be possible to sustain long term growth and development in the study area. It is, therefore, essential to protect public health from hazards by taking ameliorative measures regularly and in time by conducting regular ground water quality monitoring.

Water quality of any specific area or specific source can be assessed using physical, chemical and biological parameters. Therefore, the suitability of water sources for human consumption has been described in terms of Water quality index (WQI), which is one of the most effective ways to describe the quality of water. WQI utilizes the water quality data and helps in the modification of the policies, which are formulated by various environmental monitoring agencies

This research work is targeted towards the eastern zone of Doon Valley which includes villages around Song river, to evaluate the quality of water being used at study areas for drinking as well as domestic purposes. Dehradun is situated in North Western corner of
Uttarakhand state. The Dehradun district (also called as “Doon Valley”) has various types of physical geography from Himalayan Mountains to Plains and is drained by Ganga, Yamuna and their tributaries. Song and Suswa are two main tributaries of the Ganges.

It is known by the fact that major factors affecting the quality of water are both physical and chemical parameters (together called as physicochemical parameters). This study attempts to learn the presence of all such parameters and their intensity (quantity per volume) in water samples thus establishing the facts about usability of this water for drinking and domestic purposes. Statistically relevant sampling has been used to testify the hypothesis. Sampling stations were selected considering the population, location and source of water. These samples were analyzed for various parameters in the laboratory according to standard procedures. Various physicochemical parameters like Temperature, pH, Turbidity, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Hardness, Biochemical Oxygen Demand (BOD), Dissolved Oxygen (DO), Electrical Conductivity (EC), Total alkalinity, Chemical Oxygen Demand (COD), Iron, Calcium, Magnesium, Lead, Chromium, Zinc were recorded and analyzed. The sample collection was completed during May-12 (Summers/Pre Monsoon – 2012), aug-12 (Post Monsoon – 2012), Nov-12 (Winters 2012) and Feb-13 (Spring 2013) months (duration).

The results obtained after experimentation were analysed and have been compared to some standards and it has been concluded that all the water samples were well within pH range of 6.5 to 8.5 as defined in standards. Ground water samples were more alkaline (though marginally) as compared to surface water.

Water is a good solvent and picks up impurities easily. Calcium and magnesium dissolved in water are the two most common minerals that make water "hard." Nearly 67% of water sample collected were found to be “chemically” hard with special emphasis on its temporal variation. The hardness varied from season to season and only water collected during colder months was in prescribed hardness range. Almost all water samples whether, groundwater or surface water, treated municipal water or untreated river water, was found to be hard. Correspondingly, all the water samples that were chemically “hard” also had consistently higher TDS throughout the year. all ground and surface water samples had permissible limits of TDS.
another interesting fact revealed that the BOD values were well within range as per standards and almost all water samples were free from organic waste. However, only one ground water site had slightly higher value of BOD across all seasons. The sample with higher BOD was observed to have poor sanitation of human faecal material close by, indicating a lot of biological content leaching down to groundwater. Dissolved Oxygen concentration in all the surface water samples ranges from 4.490 ppm - 9.596 ppm and in underground water samples it was undetected.

It is well known that no straight forward reasons can be advanced for the deterioration of water quality, as it is dependent on several water quality parameters. However, various studies on water quality have been completed and it has been widely accepted that there exists strong correlations among different parameters and a combined effect of their inter-relatedness indicates the water quality. Most of the parameters were found to bear statistically significant correlation with each other indicating close association of these parameters with each other.

In the present study, pH shows significant positive correlation with EC \(r = 0.759, t = 2.33\) whereas it had a negative correlation with temperature \(r = -0.517, t = 1.208\). A significant positive correlation was found between total alkalinity and total hardness \(r = -0.111, t = 0.224\), Ca\(^{2+}\) \(r = 0.781, t = 2.497\), Magnesium \(r = 0.818, t = 2.842\), Cl\(^-\) \(r = 0.683, t = 1.872\), TDS \(r = 0.668, t = 0.827\) and EC \(r = 0.987, t = 1.486\). This shows that with increase or decrease in the values of Total alkalinity; Hardness, Ca\(^{2+}\), Mg\(^{2+}\), Cl\(^-\), total dissolved solids and EC also exhibit decrease or increase in their corresponding values. Total hardness bears positive correlation with Mg\(^{2+}\) \(r = 0.818, t = 2.842\), Ca\(^{2+}\) \(r = 0.781, t = 2.497\), Cl\(^-\) \(r = 0.683, t = 1.872\) and TDS \(r = 0.908, t = 4.334\), it inferences that that total hardness of water samples is mainly due to the presence of the Magnesium Chloride and Calcium Chloride. Iron shows positive correlation with Cl\(^-\) implying iron chloride may be absent in water samples. Chloride ion bears significant positive correlation with TDS \(r = 0.329, t = 0.696\), Mg\(^{2+}\) \(r = 0.184, t = 0.375\), EC \(r = 0.869, t = 3.51\). It reveals that Mg\(^{2+}\) mainly remains present as MgCl\(_2\). With the increase or decrease in the values of chloride ion, the values of TDS, Mg\(^{2+}\) and EC increases or decreases respectively. A significant positive correlation was found between TDS and Ca\(^{2+}\) \(r = 0.948, t = 5.967\), Total Suspended Solids \(r = 0.827, t = 2.943\) and Total Solids \(r = 0.919, t = 4.647\) and EC \(r = 0.679, t = 1.852\).
Water quality can similarly be defined as its suitability for a defined use based on selected physical, chemical, and biological parameters. According to the NSF, WQI varied between 41.76 and 82.21. The lowest value indicates that at least one sample was classified as “Bad” for drinking purposes. Overall, 49% of sample collected qualified as “Medium” quality whereas, 37% sample was of “Good” quality. None of the sample collected could be established as “Very Good” or “Excellent”. Further interpretation of data reveals that water samples collected from river heads and approachable river points were of Medium quality. 100% surface water was tested to be of medium quality, however, the Water quality varied considerably from location to location and across seasons.