Physical Characteristics of Groundwater at Pantnagar (Uttarakhand)

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Abstract: ***The study on physical properties of hand pump water at Pantnagar was carried out. Five places were identified for collecting the water samples. The samples were collected from Ta Colony, Jha Colony, Phool Bagh, Lal Bagh and Nagla. The depth of boring at these places was 100 feet. I was found that, in general the water is suitable for consumption except for the samples taken from hand pump at Lal Bagh, since its' appearance is not suitable for drinking purpose The water quality standards for drinking water as per described by the WHO guidelines and IS standards need to be maintained and if the standards are not met the water should be filtered and treated properly before its consumption.***

Keywords: Ground water, Pantnagar

1. Introduction

Water is the most precious natural resource and a universal asset. It is a wonderful gift of nature to human beings, plants, animals and millions of other species living on the earth. It is also a vital part of socio-ecological system. It is, therefore, important that adequate supplies of water be developed to sustain such lives. The use of water sources should be undertaken in such a way as to preserve the hydrological balance and the biological functions of our ecosystems. There should be strict as well as clear rules and regulations for management of water sources to ensure sustainability and to safeguard the sources against pollution. With the increasing population, the demand of water is increasing proportionally. Hence, it is need of hour to take care of water resources for the sake of future generation.

Groundwater usually contains large amount of dissolved substances because it percolates through the rock and soil formations. The greater the depth below ground from which the groundwater comes, the higher the level of dissolved minerals in the water. However, since it percolates through the earth, groundwater contains relatively small quantities of suspended impurities and very little colour. The one certainty about groundwater is that its quality will continue to deteriorate over a period of time. The rate of deterioration will depend on the rate at which the water is extracted from the source levels of pollution that enters the source from time to time. Testing water samples regularly is advisable to keep track of the changes.

Several researchers conducted studies on groundwater. Chadha (2000) studied the causes and nature of various inorganic, organic and metallic constituents in the wells in the major cities in India. The organic, inorganic and heavy metal constituents including colour unit frequently exceeded WHO/BIS for drinking water. Pande (2001) studied Ram Ganga River for a stretch of 36 km at Moradabad for pollution in surface water, bed sediments and groundwater in river width area. The untreated water effluents wastes of nearly 450 electro-plating plants and entire brass and stainless steel industry apart from the domestic waste water mainly cause the pollution. Pujari *et al.* (2004) analyzed the groundwater quality near a landfill site in Nagpur, India. The study was about the impact of different factors on the quality of groundwater in the study area by applying factor analysis. Alam *et al.* (2007) collected water samples from a part of Surma River along different points due to the presence of two major industries a paper mill and a cement factory and analyzed for various water quality parameters during dry and monsoon periods. Effects of industrial wastes, municipal sewage and agricultural runoff on river water quality were investigated. Prasad and Patil (2008) studied physicochemical parameters of Krishna River water in the month of May 2008. Nine samples were collected from different locations. The parameter like pH, EC, TDS, BOD and DO etc. were determined. Sharma and Sharma (2008) studied ground water quality of selected village of Alwar district. The result revealed that electrical conductivity and alkalinity of all samples were very high as compared to permissible limit. Enache *et al.* (2009) studied various physico-chemical characteristics of the Danube river water which were studied during summer, autumn and winter for three sampling points. The parameters like pH, hardness, chloride, fluoride, ammonium and metallic ions were analyzed in order to assess the water quality Danube River. Gupta *et al.* (2009) collected water samples from the rivers Kerva and Kaliasote at Bhopal district, Madhya Pradesh. All the parameters such as total dissolved solids, pH, alkalinity, total hardness, chloride, sulphate, nitrite, fluoride, iron, calcium and magnesium were found to be within WHO and BIS permissible limits. Samantray *et al.* (2009) assessed the water quality of Mahanadi river and its distributaries rivers and streams and Atharbanki river and Taldanda Canal in Paradip area was studied in three different seasons namely summer, pre-monsoon and winter. Adhikary *et al.* (2010) analysed the ground water quality parameters of the existing wells of the Najafgarh and the thematic maps were generated using geo-statistical concepts. Dhakyanaika *et al.* (2010) collected water samples from river Krishna and analyzed physical, chemical and bacteriological water quality parameters in the village Chanedna Maal. Hand-pumps abstracting water from shallow and deep unconfined aquifers have been found to deliver polluted water in terms of colour, organics and coliform bacteria. Rai *et al.* (2010) analyzed for nine metals and 15 physico-chemical parameters, collected from four sites in a tropical lake receiving the discharge from thermal power plant, coal mine,

and chloralkali industry. Tiwari and Saxena (2010) studied the water quality of shallow groundwater in command of Jamrani dam, Haldwani. They analyzed 27 samples of groundwater for physico-chemical parameters namely colour, odour, pH, total dissolved solids, chloride, alkalinity, acidity, free carbon dioxide, nitrate, total hardness, calcium hardness, magnesium hardness, calcium content, magnesium content and ammonia. Khan *et al.* (2012) analyzed groundwater samples from 37 locations in parts of the Central Ganga Plan during post monsoon 2005 and pre monsoon 2006 period. Eight parameters such as TDS, HCO_3, CL, SO_4, Na, K, Ca and Mg were selected as the groundwater variables in this study. After going through these studies, the idea was conceived to determine the water quality parameters of groundwater at Pantnagar.

2. Materials and methods

The study was conducted at Pantnagar, Udham Singh Nagar district of Uttarakhand state (Fig. 1). The area lies in the foothills of Himalayas in the *Tarai* region of state. The sampling location lies at a longitude 79° 41' E and latitude 28° 97' N. The elevation of the place was 243.8m above mean sea level. The area experiences subtropical and humid climate. The maximum temperature ranges between 35°-45°C and the minimum temperature between 2°- 5°C. The average rainfall of Pantnagar is 1400 mm. Most of the rainfall (90%) occurs during monsoon season.

A survey was conducted for identifying the locations where hand pumps are present for collecting the water samples. Five places were identified for collecting the water samples. The samples were collected from Ta Colony, Jha Colony, Phool Bagh, Lal Bagh and Nagla. The depth of boring at these places was 100 feet.

Physical Properties of Water

The study was based on the physical properties of water, which affects water quality up to smaller or greater extent. The paper discusses the importance of parameter, which affects human beings, flora and fauna.

Colour, Odour and Taste

The samples collected from hand pumps located at 5 locations in the University campus. The taste of the samples was decided by drinking. The odour of the samples was decided by smelling and the colour of the samples was decided by visual interpretation.

Figure 1: Location of study area

Electrical conductivity (EC)

This is the measurement of the ability of water to conduct an electric current, the greater the content of ions in the water, the more current the water can carry. Ions are of dissolved metals and other dissolved materials. Conductivity is reported in terms of micro Siemens per centimetre (µS/cm). Specific conductivity may be used to estimate the total ion concentration of the water, and is often used as an alternative measure of dissolved solids. It is often possible to establish a correlation between conductivity and dissolved solids for a specific body of water [dissolved solids = conductivity x 0.55 to 0.9 (the most often used is 0.7)]. Anthropogenic sources of EC are mining, industrial & municipal effluents.

Total dissolved solids (TDS)

This is a measure of the amount of dissolved material in the water column. It is reported in mg/l. Dissolved salts such as sodium, chloride, magnesium and sulphate contribute to elevated filterable residue values. High concentrations of TDS limit the suitability of water as a drinking and livestock- watering source as well as irrigation supply. High TDS waters may interfere with the clarity, colour, and taste of manufactured products. Anthropogenic sources of TDS are mining, industrial effluent, sewage treatment.

Turbidity

This is a measurement of the suspended particulate matter in a water body, which interferes with the passage of a beam of light through the water. Materials that contribute to turbidity are silt, clay, organic material, or microorganisms. Turbidity values are generally reported in Nephelometric Turbidity Units (NTU). Pure distilled water would have non-detectable turbidity (0 NTU). High levels of turbidity increase the total available surface area of solids in suspension upon which bacteria can grow.

3. Results and discussion

The water samples of different locations were tested in the water quality laboratory to determine the value of various parameters viz, EC, TDS, and turbidity. The parameter's data of physico-chemical properties of water samples from 5 different locations are presented in Table 1. Comparisons were made for the purpose of drinking water according to the WHO specifications and BIS standards (Table 2). The results of the study are discussed below.

Colour, Odour and Taste

The samples collected from hand pumps located at Ta Colony, Jha Colony, Phool Bagh, Lal Bagh and Nagla were found to be colourless. Also it was found to be odourless al all the locations except at Lal Bagh, where the colour of the water was found to be yellowish. This water can be treated by filtration, distillation, reverse osmosis, ozonisation and if odour is also concerned than it could be treated by activated carbon, air stripping, oxidation. The taste of water was pleasant at Ta Colony and Nagla Gate, while it was unpleasant for Lal Bagh. The taste of the water was found to be somewhat sweet at Jha Colony and Phool Bagh.

Electrical conductivity (EC)

The value of EC of water sample for Nagla gate was found to be 301 µS/cm; for water sample from Temple Ta Colony was found to be 440 µS/cm; for water sample from Jha Colony was found to be 591 µS/cm; for water sample from Phool Bagh was found to be 353 µS/cm; for water sample from Lal Bagh was found to be 388 µS/cm.

Total dissolved solids (TDS)

The value of TDS of water sample for water sample from Nagla gate was found to be 196 mg/l; for water sample from Temple Ta Colony was found to be 282 mg/l; for water sample from Jha Colony was found to be 414 mg/l; for water sample from Phool Bagh was found to be 226 mg/l; for water sample from Lal Bagh was found to be 268 mg/l.

Turbidity

The value of turbidity of water for water sample from Nagla gate was found to be 3 NTU; for water sample from Temple Ta Colony was found to be 4 NTU; for water sample from Jha Colony was found to be 7 NTU; for water sample from Phool Bagh was found to be 6 NTU; for water sample from Lal Bagh was found to be 16 NTU. The desirable limit of turbidity for drinking purpose is 5 and the permissible limit is 10. The turbidity of the samples of hand pumps located at Nagla Gate and Ta Colony were was found to be below the desirable limit specified by IS Standards and WHO Standards for drinking water. The turbidity of the samples of hand pumps located at Lal Bagh was found to be above the permissible limit specified by IS Standards and WHO Standards for drinking water.

Table 1: Physical properties of sampled water at various locations

Parameters	Units	Ta Colony	Jha Colony	Phool Bagh	Lal Bagh	Nagla Gate
Colour	-	Colourless	Colourless	Colourless	Yellow	Colourless
Odour	-	Odourless	Odourless	Odourless	Odourless	Odourless
Taste	-	Pleasant	Sweet	Sweet	Unpleasant	Pleasant
EC	µS/cm	475	591	353	388	301
TDS	mg/l	225	414	226	268	196
Turbidity	NTU	2	7	6	16	3

Table 2: IS Standards and WHO Standards for drinking water

Parameters	Unit	IS Standards (IS 10500:1991)		WHO Standards (1989)	
		Desirable	permissible	desirable	permissible
TDS	mg/l	500	2000	500	2000
Turbidity	NTU	5	10	5	10

Comparisons of Water Sample Parameters at Different Locations

The results obtained from various parameters at different locations are also presented graphically in Fig. 2 through Fig. 4.

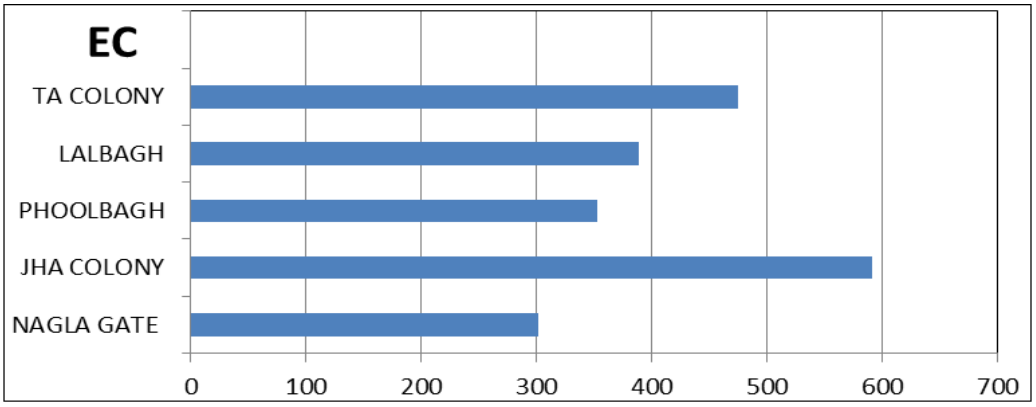

Figure 2: Variation of EC with the location

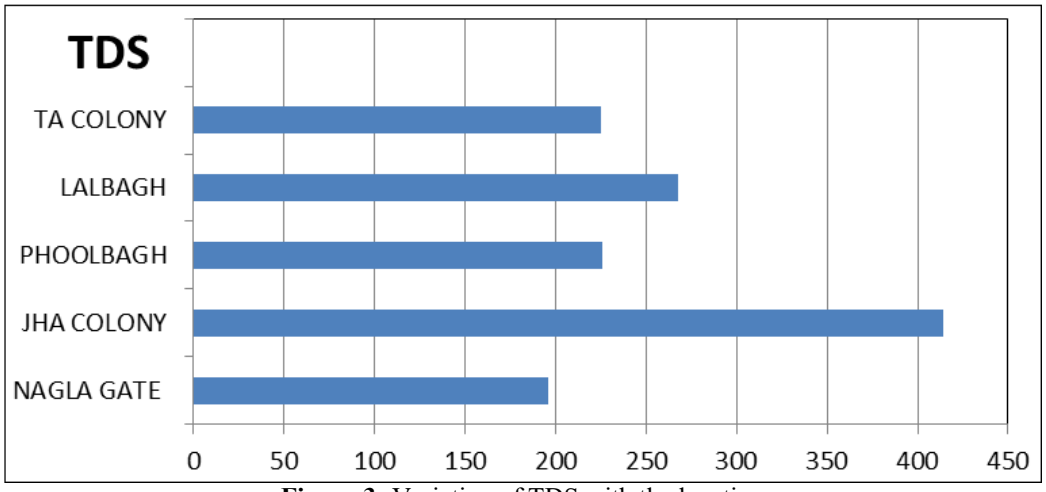

Figure 3: Variation of TDS with the location

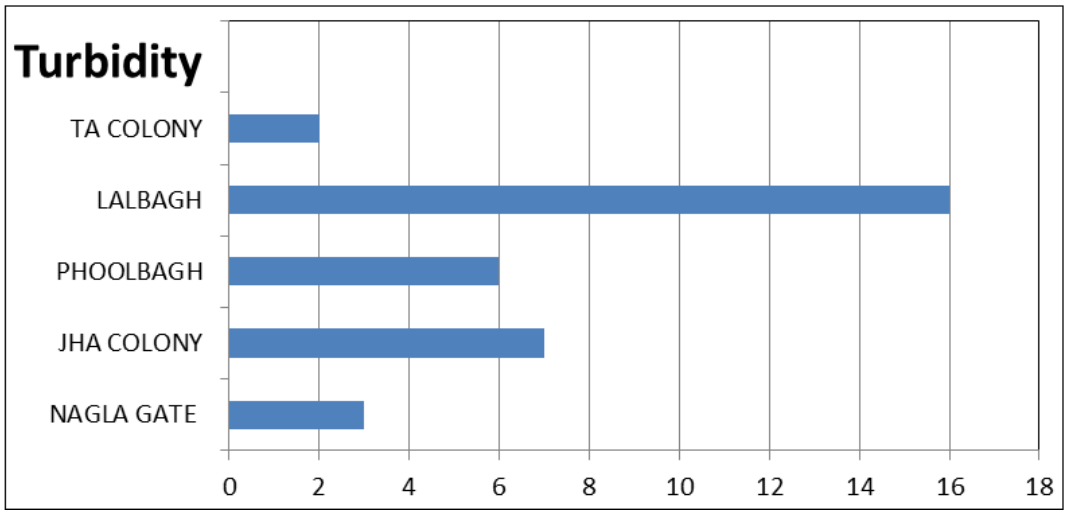

Figure 4: Variation of turbidity with location

4. Conclusions

It may be concluded in general that the water is suitable for consumption except for the samples taken from hand pump at Lal Bagh, since its' appearance is not suitable for drinking purpose The water quality standards for drinking water as per described by the WHO guidelines and IS standards need to be maintained and if the standards are not met the water should be filtered and treated properly before its consumption.

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