

## Physico-Chemical Analysis of Drinking Water Quality Parameters of Galore Area in Lower Himalayan Region, India

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Rec date: April 17, 2018; Acc date: April 23, 2018; Pub date: April 27, 2018

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### Abstract

The work presented an analysis of drinking water samples collected from different ground handpumps at 102 sites in Galore area of Dist. Hamirpur, Himachal Pradesh, India. The samples have been analysed for three physico-chemical parameters like, pH, conductivity and iron content. The results showed that pH ranged from 5.9 to 8, conductivity from 120 to 790  $\mu\text{S}/\text{cm}$  and iron content from zero to 3.54 mg/l. The measured parameters of only 33 sites water samples were within the WHO standard drinking quality values whereas in the remaining 69 sites water samples beyond the standard values. In general, the present investigation found that the quality parameters were at the level of pollution at almost more than 65% sites.

**Keywords:** Physico-chemical quality parameters; Drinking water quality; Water quality standard; Water samples

### Introduction

Water is the elixir of life from the simplest organisms to the most complex human body. It is a significant substance due to the unique physical and chemical properties [1-3]. It has become a survival factor for the sustainable development and the quality of life [4]. Safe drinking water is essential to life and hence satisfactory safe supply of water must be made to the public [5]. The water contaminated with harmful chemicals and pathogens is the cause of diseases amounting to 75% of the total ones [6]. Based on this fact the determination of water quality is the most important activity for life. Acceptable quality of water shows the safety of drinking water in terms of physical, chemical and bacteriological parameters [7]. The adverse health effects are due to the contaminants that have cumulative toxic properties, such as heavy metals and substances that are carcinogenic [8]. It is found that most common problems in household water supplies may be attributed to hardness, iron, sulfides, sodium chloride, acidity, alkalinity, bacteria and viruses [9].

Therefore, the intake of toxic chemicals is checked from the drinking water which is a very difficult task [10]. Drinking water quality is the major issue in our country and studies related to the drinking water quality of Galore area of Dist. Hamirpur, Himachal Pradesh (HP) have not been conducted. Therefore, the aim of our study of drinking water is to examine the levels of some physico-chemical parameters of drinking water of Galore area. Hence, we studied pH, conductivity and iron content levels in the drinking water of the area.

### Materials and Methods

Drinking water samples were collected from Galore area of Dist. Hamirpur, HP, which lies at an altitude of 738 m above sea level with average temperature of 27°C.

### Selection of the study area

After scrutinizing many areas, Galore Development Block Area was selected for the collection of groundwater samples to analyze the quality parameters of water due to its problem.

The selection of the area was made on the following reasons:

- Complaints from the consumers for the bad taste and odour of drinking water.
- Visual sign of reddish brown residue in water.
- Staining of clothes and sanitary wares was noticed in the area.

### Selection of monitoring stations

There are 240 groundwater hand pumps in Galore development Block out of which 102 hand pumps were selected at random for the analysis of quality parameters of water. The water samples were collected during the period of September 2015 to May 2016.

### Sample collection

Drinking water samples were collected from 102 sampling sites of Galore Development Block. The samples were collected in plastic polyethylene bottles and then taken to the laboratory in a box having ice in it to avoid the change in water quality parameters. Before the sampling the polyethylene bottles were washed, cleaned and rinsed thoroughly with distilled water. Standard methods [11] were followed for the sample collection and preservation. The goal in the sampling was to collect the samples that are fully descriptive of water quality parameters. Samples collected were as small as possible and sufficient

for experimentation. The samples were handled in such a manner that their characteristics did not change. Grab samples were collected from the sites as per Standard Methods [11]. Only one sample from each hand pump was collected during the study period.

### Determination of physico-chemical parameters of drinking water

**Determination of pH:** The pH of each sample was measured with the portable pH meter model pH600.

**Determination of conductivity:** Conductivity of each sample is measured by portable conductivity meter model CD600.

**Determination of iron content:** Iron Content of each sample was determined using Photometer of Hanna Instrument, Inc, USA make. HI 721-25 Iron High Range Reagent was used to measure the iron content in the sample. The resolution of the instrument was 0.01 ppm. The photometer was standardized using Standard Reagent.

### Results and Discussion

Values of the measured physico-chemical parameters of drinking water (hand pump samples) are shown in Table 1.

S No	Hand Pump Location	Hand Pump No	pH	Conductivity	Iron content (ppm)
1	Lohra	IPH-BSR-GLR-1	6.4	260	0.27
2	Near Akash Model School(Galore)		6.7	270	0
3	Panyali Jattan	IPH-BSR-GLR-20	7	200	0.21
4	Galore Bazzar	IPH-BSR-GLR-2	7.2	210	2
5	Budhwin Chowk In H/B	IPH-BSR-GLR-168	5.9	120	0.35
6	Baloh Radha Swami	IPH-BSR-GLR-36	6.1	190	0.08
7	Kardoh Nr. Guru Dwara	IPH-BSR-GLR-28	6.9	140	0.17
8	Nukhel	IPH-BSR-GLR-4	6.7	350	0.42
9	Bharari Mata	IPH-BSR-GLR-6	6.7	190	0.21
10	Near Patwar Ghar Mair	IPH-BSR-GLR-217	6.7	330	0
11	Sukrala Nr.Janj Ghar	IPH-BSR-GLR-39	7.5	170	0.13
12	Aghthaan	IPH-BSR-GLR-37	7	410	0.24
13	Kai-Di-Bahal-II	IPH-BSR-GLR-21	7.2	190	0.49
14	Badaran	IPH-BSR-GLR-165	6.9	790	0
15	Galore Hospital	IPH-BSR-GLR-8	6.8	230	0.29
16	Panyali Brahmana	IPH-BSR-GLR-24	6.8	310	0
17	Panyali	IPH-BSR-GLR-19	6.8	340	0
18	Mandyanni Nr. H/O Purshottam Chand	IPH-BSR-GLR-5	6.4	530	0
19	Jiana Bazar	IPH-BSR-GLR-26	6.7	260	0.17
20	Upper Amroh	IPH-BSR-GLR-10	7	190	1.09
21	Jiana Lower (Prem Dass)	IPH-BSR-GLR-25	7.1	190	0.24
22	Tagoh Nr Fields		6.7	350	0.15
23	Kardoh In Vill	IPH-BSR-GLR-31	6.9	220	0.13
24	Baloh Bhuvneshwar Temple	IPH-BSR-GLR-35	6.8	290	0.23
25	Panyali Jattan Nr Kartar House	IPH-BSR-GLR-33	8	300	0.37
26	Baloh Nr By Home		7.1	300	0
27	Kardoh Nr. Parsottam House	IPH-BSR-GLR-27	7.2	170	1.94
28	Kai-Di-Bahal-II	IPH-BSR-GLR-22	7	230	0.08

29	Paplah Nr GMS	IPH-BSR-GLR-14	6.5	250	0
30	Galore Khas In Vill	IPH-BSR-GLR-60	6.3	180	2.31
31	Tagoh Carshed Onkar	IPH-BSR-GLR-16	6.7	470	0.14
32	Lower Amroh	IPH-BSR-GLR-11	7.8	210	1.77
33	Baloh Nr Curve		6.9	290	1.04
34	Sukrala Shiv Mandir	IPH-BSR-GLR-34	7.8	210	0.71
35	Raina Middle School	IPH-BSR-GLR-181	6.7	310	0
36	Nalangar Nr GSSS		7.1	390	0.11
37	Nehlwin	IPH-BSR-GLR-148	6.8	470	0
38	Gahllian Nr H/O Oshiar Singh	IPH-BSR-GLR-179	6.6	390	0.3
39	Lower Haretta Nr. Gsss	IPH-BSR-GLR-50	6.4	330	0
40	Upper Haretta Nr Sohan Lal House	IPH-BSR-GLR-48	6.5	240	0.19
41	Bhallu Nr. H/O Jagar Nath	IPH-BSR-GLR-41	6.1	530	0.12
42	Upper Haretta Nr Fateh Chand Shop	IPH-BSR-GLR-45	6.8	340	0.12
43	Gahllian GHS	IPH-BSR-GLR-132	6.1	160	0
44	Bhallu Nr. H/O Sukh Dev	IPH-BSR-GLR-44	6.5	150	0
45	Gahllian Nr H/O Deena Nath	IPH-BSR-GLR-129	6.1	380	0
46	Nagehrada Nr. Janj Ghar	IPH-BSR-GLR-137	6	380	0
47	Farsi Nr Mouji Ram House	IPH-BSR-GLR-206	6.3	300	0.13
48	Raina Nr H/O Harnam Singh	IPH-BSR-GLR-212	6.9	500	0.19
49	Gahllian Nr. Harizen Basti	IPH-BSR-GLR-139	6.3	370	0.06
50	Dodwin Nr Janj Ghar	IPH-BSR-GLR-54	6.4	330	0.13
51	Changer-I	IPH-BSR-GLR-146	6.3	330	0
52	Fangsana Nr H/O Roshan Lal	IPH-BSR-GLR-211	6.8	270	0
53	Upper Haretta Nr Desh Raj House	IPH-BSR-GLR-47	6.1	430	0.13
54	Bhallu Nr. H/O Desh Raj	IPH-BSR-GLR-42	6.8	350	0
55	Bhallu Nr. H/O Shakti Chand	IPH-BSR-GLR-40	6	230	1.54
56	Bhallu Nr. H/O Sohan Lal	IPH-BSR-GLR-43	6.9	360	0.31
57	Nagrerada Nr Junj Ghar	IPH-BSR-GLR-188	6	350	0
58	Galot		6	250	0
59	Nagrerada Nr Harzen Basti	IPH-BSR-GLR-189	6	230	0
60	Galot Khurd -I	IPH-BSR-GLR-143	6	560	0.17
61	Lower Haretta Gharan Nr H/O Ravi Dutt	IPH-BSR-GLR-52	6.1	170	0.42
62	Galot Kallan	IPH-BSR-GLR-142	6.9	330	0
63	Nr Nehelwi		6.8	320	0
64	Rahan Nr H/O Mansa Ram	IPH-BSR-GLR-51	6	250	2.05

65	Galot-II	IPH-BSR-GLR-151	6.9	360	0
66	Galot I	IPH-BSR-GLR-141	6.8	450	0.06
67	Shagriani Pump House	IPH-BSR-GLR-52	6.3	190	0.13
68	Ropa(Balauni)	IPH-BSR-GLR-227	6.8	190	0
69	Balouni	IPH-BSR-GLR-117	6.3	240	0.49
70	Dhaned Market	IPH-BSR-GLR-121	6.5	270	3.54
71	Upper Ser	IPH-BSR-GLR-118	6.1	260	0.63
72	Phal-I	IPH-BSR-GLR-58	6.1	260	0.2
73	Phal-II	IPH-BSR-GLR-59	6.2	200	0.21
74	Plassi	IPH-BSR-GLR-60	6.9	350	0.3
75	Tihri	IPH-BSR-GLR-63	7.1	120	1.9
76	Tihri Nr Vijay Sastri House	IPH-BSR-GLR-64	7.3	120	0.16
77	Tihri Nr Sharma Niwas	IPH-BSR-GLR-65	6.2	310	0.09
78	Phal Nr Surjeet House	IPH-BSR-GLR-66	6.8	370	0.77
79	Tihri Nr Hoshiar Singh House	IPH-BSR-GLR-	6.2	300	0.07
80	Karsai	IPH-BSR-GLR-72	7.2	200	0
81	Kultheen Nr Rattan Chand House	IPH-BSR-GLR-73	7.1	200	0.21
82	Jharmani Nr Rajinder House	IPH-BSR-GLR-74	7	210	0
83	Jharmani Nr Prithvi House	IPH-BSR-GLR-75	6.9	200	0.13
84	Jharmani Nr Balvir House	IPH-BSR-GLR-76	6.4	170	0.2
85	Dudhana Lohian	IPH-BSR-GLR-78	7.1	180	0.17
86	Dudhana	IPH-BSR-GLR-79	7.1	190	1.07
87	Than In Vill	IPH-BSR-GLR-82	7.1	210	0.45
88	Than Nr Sher Singh House	IPH-BSR-GLR-83	7	170	0
89	Gudwin Nr Garden In Vill	IPH-BSR-GLR-85	7.6	220	0.56
90	Bahlari Nr Shop Of Rattan Chand	IPH-BSR-GLR-86	6.3	180	0.39
91	Nara Janh Ghar	IPH-BSR-GLR-88	7.5	180	0.42
92	Dadoh Nr House Of Bhram Dass	IPH-BSR-GLR-95	6.8	280	0.27
93	Khorar Nr Guga Temple	IPH-BSR-GLR-96	6.7	180	0.27
94	Tippri Near Mango Tree	IPH-BSR-GLR-	6.1	250	0.21
95	Kotlu Mangat Ram House	IPH-BSR-GLR-108	7.2	170	0.06
96	Kotlu Road Side	IPH-BSR-GLR-109	7.1	280	0.31
97	IPH Galore Sub Station	IPH-BSR-GLR	7	120	0.9
98	Near Mango Tree Dadoh	IPH-BSR-GLR-221	6.9	300	0.21
99	Bhudwin Chowk In H/B	IPH-BSR-GLR-168	7.3	290	0.36
100	Farsi-I	IPH-BSR-GLR-99	7	290	0

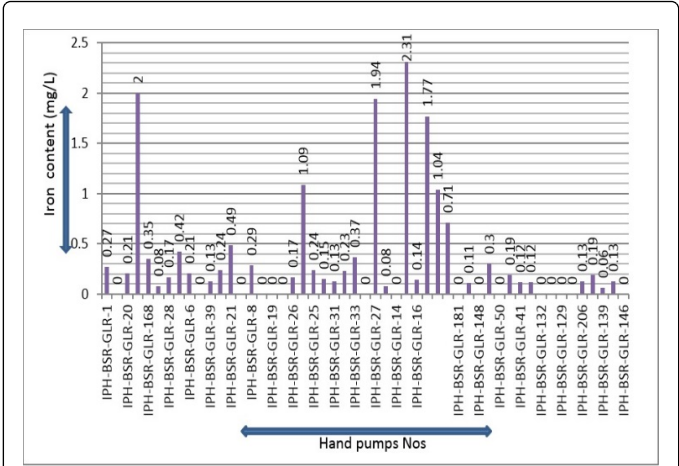
101	Near Chander Prakash House	IPH-BSR-GLR-222	6.9	180	0.19
102	Daswin	IPH-BSR-GLR-223	7.1	200	0

**Table 1:** Physico-chemical parameters of drinking water.

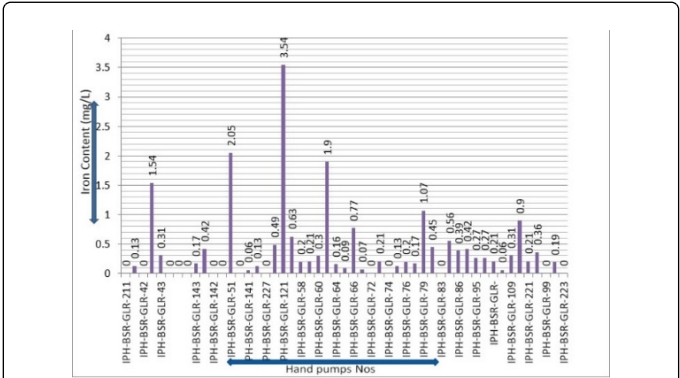
**pH:** Drinking water with pH between 6.5 to 8.5 is considered satisfactory (WHO permissible value range). If pH is below 6, water is corrosive. Water with pH value above 8.5 has a bitter astringent taste [12]. The pH of the collected water samples ranged from 5.9 to 8 out of which 68 water samples are having pH value above 6.5 and less than 8.

**Conductivity:** Conductivity is a useful tool to assess the purity of water [13] as it is due to the dissolved electrolytes in water. The permissible limit for conductivity is 300  $\mu$ S/cm. The conductivity of collected water samples ranged from 120-790  $\mu$ S/cm.

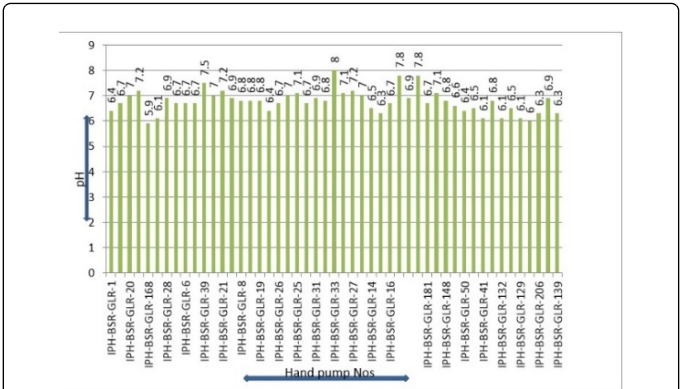
**Iron content:** In this area 102 samples were collected and analyzed. It was observed that 30 samples have no iron present i.e., 29.4% of samples have no iron content. It was found that 74 samples were having iron content less than 0.3 mg/l i.e., in 72.5% of the samples, the iron content in water is within WHO permissible limit. It was observed that 28 samples were having iron content more than 0.3 mg/l i.e., 27.7% of the samples have iron content more that permissible limits. It means that 27.7% of the samples are having iron content more than the maximum permissible limit. It was noted that 11 samples were having iron content more than 1.0 mg/l i.e., 10.7% the total samples are analyzed. In 4 samples the iron content was found more than 2 mg/l i.e., 3.29% of the total samples. In one sample the iron content was observed more than 3 mg/l i.e., 0.09% of the total samples. The range of iron content in samples is from zero mg/l to 3.54 mg/l (Figures 1-6).



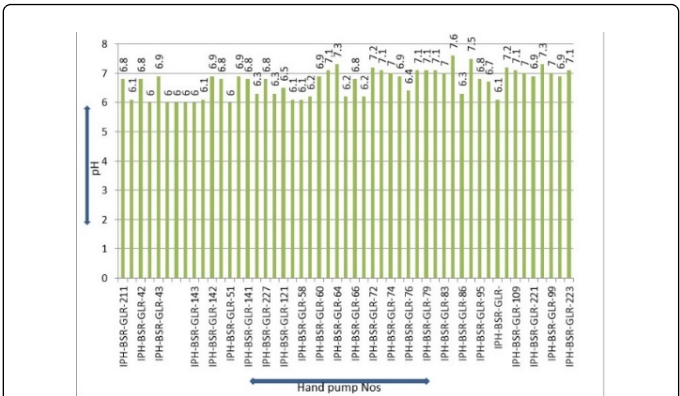
**Figure 1:** Graph of Iron content for samples 1-25.



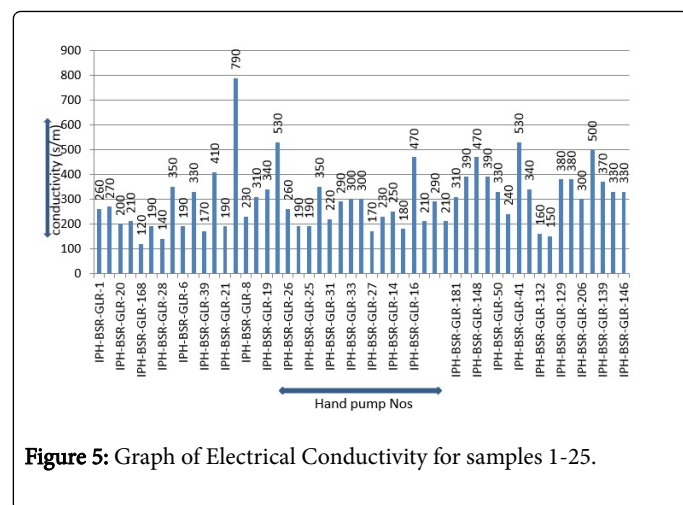
**Figure 2:** Graph of Iron content for samples 26-50.



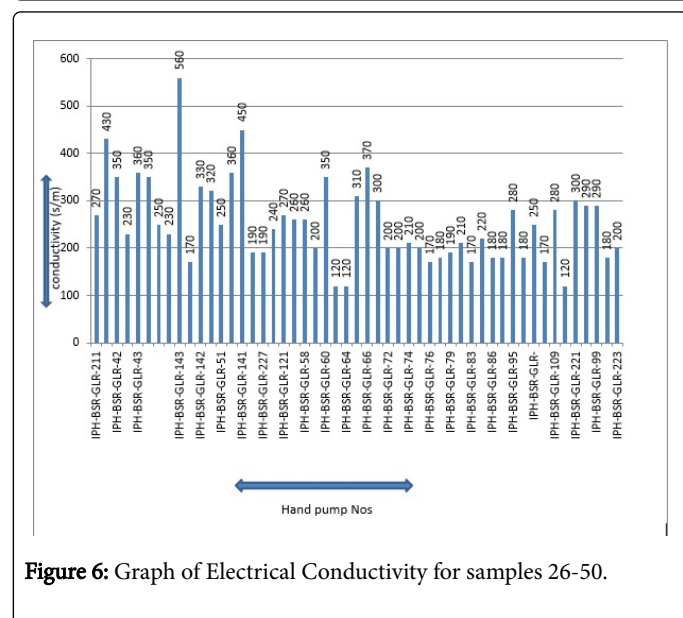
**Figure 3:** Graph of pH for samples 1-24.



**Figure 4:** Graph of pH for samples 25-49.



**Figure 5:** Graph of Electrical Conductivity for samples 1-25.



**Figure 6:** Graph of Electrical Conductivity for samples 26-50.

## Conclusion

A study was carried out to quantify the pH, conductivity and iron content in Galore area of Hamirpur district in Himachal Pradesh. It revealed that keeping in view the permissible values of water quality parameters (pH, conductivity and iron content) only 33 water samples are found fit for drinking purpose and the rest 69 samples are harmful for human consumption.

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