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# Pre and post monsoon quality assessment of selected physico-chemical parameters of public hand pump water in a rural area of Barabanki District, Uttar Pradesh

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**Abstract**
**Introduction:** It is important to have safe and potable source of water supply for health benefits. Government public hand pump are now a days most common mode to access safe and potable ground water to the villagers for drinking and other domestic purposes.
**Objectives:** The aim of present study was to assess pre and post monsoon variations in selected physico-chemical properties of public hand pump water in a rural area of Barabanki district.
**Material & Methods:** A descriptive study was conducted among five randomly selected villages in Satrik block of Barabanki district, Uttar Pradesh. Water sample were collected twice (before and after monsoon) from most frequently used 23 public hand pumps in these villages. The pH was assessed using pH indicator strips and total hardness and chloride content was estimated using standard EDTA (Ethylene di-amine tetra-acetic acid) and $AgNO_3$ (Silver Nitrate) titration method respectively. The total dissolved solid (TDS) was estimated using digital TDS meter.
**Results:** Proportion of public hand pumps with water specimen better in colour, transparency and odour tends to increase after monsoon. However no difference was observed in palatability of water. A significant increase was observed in mean level of chloride content (from 125.04 ± 4.06 mg/L to 120.30-133.9 mg/L), TDS levels (from 275.86 ± 11.63 mg/L to 277.56 ± 11.61 mg/L) and hardness of water (from 111.60 ± 5.96 mg $CaCO_3$ /L to 120.40 ± 5.57 mg $CaCO_3$ /L) in pre and post monsoon water samples. (p=0.00)
**Conclusion:** Groundwater accessed through public hand pumps were found quite safe for drinking and domestic purpose in basic physical parameters, TDS, hardness and chloride content both before and after the monsoon period.

**Keywords:** Hardness, Parameters, Rural

## Introduction
Water is one of the most fundamental needs for the survival of human beings on the earth for its usages in drinking and other domestic purposes. Water is vital to the survival of living organisms but this valued natural store is increasingly being endangered as human population is expanding which increases the demand for more water. Ground water is the largest reservoir of drinkable water as it is less contaminated as compared to surface water due to the natural filtration [1]. Groundwater comes indirectly from rain, snow, sleet, and hail that move down into the ground because of gravity, passing between particles of soil, sand, gravel and rock till it reaches a level where the ground is reserved and saturated with water. It is estimated that approximately one billion people do not have access to a safe water supply worldwide [2]. India is the largest user of groundwater in the world. It uses an estimated 230 $kl^3$ of groundwater per year [3]. In India, issues related to groundwater quality have assumed great importance with increasing population and contamination of ground water at discrete points. The ground water quality in area largely depends on the nature and extent of the industrial, agricultural and other human activities which leads to pollution of ground water. Thus, the present study was conducted to assess any variation in quality of ground water (pre and post monsoon) at public hand pumps (India Mark II), for its potability and selected physio-chemical in a rural area of Barabanki District, Uttar Pradesh. Barabanki stretches from 26°30' and 27°19' North Latitudes and 80° 58'and 81°55' East Longitudes. Occupying an area of 3895.4 sq. km, the district is home to 30, 60,990 people as per Census 2001 [4].

## Material and Methods
- **Study Setting:** The study was conducted in Satrik block of Barabanki
- **Study Design:** Descriptive study.
- **Duration of Study:** The study was conducted in a period from June 2016 to September 2016.

### Sample collection
A total 23 ground water samples were collected (twice), from most frequently used India Mark II (IM2) hand pumps following standard methods from 5 randomly selected villages in Satrik block. There were total 98 public hand pumps out of which 84 were in working conditions in these 5 randomly selected villages. First 23 samples were collected in month of June before monsoon arrives and the next consecutive samples were collected in September at approximate end of monsoon season. Water samples were collected directly from the hand pumps after running the water for about 15 minutes.

### Water Parameters assessed
The collected water samples were assessed physically for colour, odour and palatability. Local people using these hand pumps were asked about their perception for any change in

these basic properties before and after the monsoon. Chemically the water samples were tested for pH, Total dissolved solids (TDS), total hardness and chloride content. The pH of water was approximately estimated using pH paper strips on discrete scale. TDS level of water was assessed using portable digital TDS meter. The total hardness and chloride content were estimated using standard titration method with EDTA (Ethylene di-amine tetra-acetic acid) and $AgNO_3$ (Silver Nitrate) respectively. The readings for all the parameters were experimented in laboratory until two consecutive same readings were obtained.

**Data Processing and Analysis:**

The information obtained was transferred on the pre- designed classified tables and analysed according to the aims and objectives using appropriate statistical test (paired t-test).

**Results**

The results were obtained for various physiochemical parameters of ground water sample accessed through public hand pumps. Proper concrete platform was present in 43.4% of the public hand pumps while more than half were in broken condition. The collection of water around platform was seen 39.1% of the hand pumps. Only there were 5 hand pumps out of 23 which were present at the distance of more than 10 meters from the nearest pollution source. Other than that there were 4 hand pumps that were present within 40 meters of nearest pit latrine. About half (47.8%) of the hand pumps were situated within 30 meters of the cattle kraal. Regular monitoring of hand pump water was reported in 56.5% sampling site. [Table no.1] A well observed variation was seen in the physical properties of water before and after monsoon. The number of hand pumps giving normal coloured water increases proportionately (from 69.6% to 95.7%) after the monsoon. Quite similar pattern was observed with respect to transparency and odour of water specimen, which becomes better after monsoon. However, no difference was observed in palatability of water. [Table no.2] In chemical properties, the pH tends to increase approximately from 7 to 8 in groundwater sample from majority of the hand pumps (from 21.7% to 78.3).A significant increase was observed in mean level of chloride content, TDS levels and hardness of water (p= 0.00) inn pre and post monsoon water samples. [Table 3]

**Table 1:** Details of hand pumps from where the water samples were collected. (N=23)

| Hand pump Settings | | Number | Percentage (%) |
|---|---|---|---|
| Status surrounding concrete Platform | | | |
| Present | In proper condition | 10 | 43.4 |
| | Broken | 13 | 56.5 |
| Absent | | 0 | 0 |
| Collection of Water around platform | | | |
| Present | | 9 | 39.1 |
| Absent | | 14 | 60.9 |
| Distance for nearest pollution source | | | |
| < 10 metres | | 18 | 78.3 |
| ≥ 10 metres | | 5 | 21.7 |
| Distance from nearest pit latrine | | | |
| < 40 metres | | 4 | 17.4 |
| ≥ 40 metres | | 19 | 82.6 |
| Distance from nearest cattle kraal | | | |
| < 30 metres | | 11 | 47.8 |
| ≥ 30 metres | | 12 | 52.2 |
| Regular monitoring of Hand pump water | | | |
| Yes | | 13 | 56.5 |
| No. | | 10 | 43.5 |

**Table 2:** Pre and post monsoon variation in Physical properties of water of Public Hand, (N=23)

| Physical Parameter | Pre – monsoon | Post – monsoon |
|---|---|---|
| Colour | | |
| Normal | 16 (69.6) | 22 (95.7) |
| Abnormal | 7 (30.4) | 1 (4.3) |
| Transparency | | |
| Transparent | 18 (78.3) | 22 (95.7) |
| Suspended impurities seen | 5 (21.7) | 1 (4.3) |
| Odour | | |
| Good | 17 (73.9) | 23 (100) |
| Bad | 6 (26.1) | 0 (0) |
| Taste | | |
| Palatable | 20 (87.0) | 20 (87.0) |
| Non-palatable | 3 (13.0) | 3 (13.0) |

**Table 3:** Pre and post monsoon variation in Chemical properties of water of Public Hand, (N=23)

| Chemical Parameter | Pre – monsoon | Post – monsoon |
|---|---|---|
| **pH*** | | |
| 7 | 17 (73.9) | 5 (21.7) |
| 8 | 6 (26.1) | 18 (78.3) |
| **Total Dissolved solid** | | |
| Mean ± SD (mg/L) | 275.86 ± 11.63 | 277.56 ± 11.61 |
| Range (mg/L) | 240-290 | 242-291 |
| ***t= 5.3, p=0.00**** | | |
| **Chloride Content** | | |
| Mean ± SD (mg/L) | 125.04 ± 4.06 | 126.17 ± 3.82 |
| Range (mg/L) | 118.2-133.2 | 120.30-133.9 |
| ***t=5.6, p=0.00**** | | |
| **Hardness of water** | | |
| Mean ± SD (mg $CaCO_3$/L) | 111.60 ± 5.96 | 120.40 ± 5.57 |
| Range (mg $CaCO_3$/L) | 112-134 | 113-134 |
| ***t=1.43, p=0.00**** | | |

## Discussion

The quality of ground water samples from public hand pumps from a rural area of Barabanki were assessed for any variation in selected physio-chemical parameters. With respect to basic settings of public hand pumps, as per standard guidelines, it must be aided with a well-structured concrete platform without any deformity at any time with no collection of water around it and distance from nearest pollution source, pit latrine and cattle kraal should not be less than 10 metres, 40 metres and 30 metres respectively [5]. However in our study settings basic infrastructure and site were below standard. The platform of majority of hand pumps was broken (56.5%) with about one-third having collection of water around platform. The dirty water collected around platform and presence of pollution sites within optimal distance might lead to contamination of water table just adjacent to hand pump due to seepage of pollutants with water. The ordinary consumer judges the water quality by physical characteristic; therefore the drinking water should not only be safe but also pleasant in appearance, odour and taste [6]. In the present study physical properties of ground water tends to improve after monsoon. This might be due to dilution of ground table water with rain water seepage; thereby diluting the physical characteristics which get concentrated during the dry season. On the other hand significant difference was observed in mean level of chloride content, hardness, TDS and pH in pre and post monsoon samples. This might be due to leaching of the minerals present in upper layer which get mix with the rain water and sweeps down to lower water tables. However the physical parameters were within the permissible range as prescribed by Bureau of Indian Standard [7]. The study was subject to some limitations. The study was conducted in resource restricted setting and water samples were assessed only for limited selected physico-chemical parameters. Microbiological and other basic properties assessment couldn't be examined. Therefore there is need to conduct a more explorative study, thereby assessing for any variation in ground water sample after monsoon in microbiological and other basic parameter. However there is need to conduct a more explorative study, thereby assessing for any variation in ground water sample after monsoon in microbiological and other basic parameter also.

## Conclusion

The water at public hand pumps (IM2) may be regarded safe for drinking and other domestic purposes with respect to physico-chemical parameters assessed both before and after the monsoon.

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