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Research Article

ASSESSMENT OF DRINKING WATER QUALITY PARAMETERS FROM GROUNDWATER SOURCE OF JASRA BLOCK ALLAHABAD

KHAN SHAMEEM*, TIWARI VERTIKA AND AHSAN MD JAFRI

Department of Soil Water Land Engineering & Management, Vaugh School of Agricultural Engineering and Technology, Sam Higginbottom Institute of Agriculture Technology and Sciences, Allahabad, India Email- shameem.praetor@gmail.com, vertikatiwari19@gmail.com, mohdjafriahsan@gmail.com
*Corresponding Author: Email- shameem.praetor@gmail.com

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Abstract- Water is an essential resource for life on Earth and freshwater resources are emerging as a limiting factor not only in quality for human development and ecological stability in a growing number of locations. The aim of this thesis report is to assess groundwater quality intended for drinking water purposes in the Jasra Block (Kanjasa Uparhar village), as a site study. It involves defining and determining groundwater quality parameters due to domestic effluent discharges, farming. Water quality was determined at 06 selected water point sources. This analysis incorporates procedures involved in the determination of water quality parameters and comparing to some of the existing water quality was compared with the Indian Standard Specification for drinking water. The use of alternative sources, improvement of water supply structures and water treatment are possible solutions to improve the quality of drinking water in the Jasra Block (Kanjasa Uparhar village). The physico-chemical parameters such as pH, DO, TSS, TDS, BOD, COD, Total Alkalinity, Total Hardness, Turbidity, Temperature and Cl of the sample have been taken into account for deciding the groundwater quality of the village. Results of the assessment confirmed that in the studied area there are several parameters health and aesthetic concern.

Keywords- Drinking water, Human development, Eological stability, Water treatment, Freshwater resources, Groundwater, Domestic effluent discharges.

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Introduction

Safe drinking water is one of the important basic needs of every people of the world to live healthy lives. Safe drinking water should meet all the criteria set to be drinkable [2]. Many people in developed countries are enjoying the good quality water through the centralized water supply system. However, in undeveloped and developing countries safe drinking water is greatly threatened. Every year, millions of people die of drinking polluted water. UNICEF has suggested that about 1.1 billion people in the globe do not have access to safe water [7]. Consumption of poor quality water can expose humans to bacterial diseases, metal poisoning and other health hazards. However, many people in poor countries consume water from contaminated tube wells, rivers and springs directly leading their health in great risk. The contamination of the water source can be of natural origin or it can be caused by human activities. Natural calamities such as floods, landslides and dissolution of naturally occurring contaminants for example arsenic, boron, uranium and other metals and metalloids in ground or surface water, are some typical examples of natural contamination of water sources. Industrialization, agricultural activities, mining, poor waste management are examples of human activities that pollute the water sources [2]. To minimize the risk of water pollution, several point-of-use mechanisms (POU) such as boiling, chlorination and solar disinfection are suggested as the cheaper methods to purify the water at household level [3].

Water is one of the most indispensable resources and is the elixir of life. It is believed that ground water must possess degree of purity, free from chemical contamination and micro organisms. But the rapid increase in population and ndustrialization together with the lack of wisdom to live in harmony with nature has led to the deterioration of good quality of water; thus, resulting water pollution [5]. Ground water is the main resource for living organisms, due to short fall of rain, failure of monsoon and improper management of rain water results in the pollution of ground water. The objective for surface waters is to achieve a “good” quality status of both ecological and chemical aspects [12]. Hence, a continuous monitoring on ground water becomes mandatory to minimize and have control on the pollution causing agents.

Ground water as a source of drinking water, and even today more than half the world’s population depends on ground water for survival [8]. The assessment of water quality is very important for knowing the suitability for various purposes.

The present investigation reveals the assessment of ground water quality near Jasra Block, people residing around were using open well and groundwater for domestic purpose, the municipal water supply facilities are not made available.

Objective

- To assess the water quality parameters of drinking water samples of hand pump and open well of Jasra block.
- To compare the quality of collected drinking water samples with the Indian Standard Specifications for Drinking Water (IS: 10500).

Background of the study

During the last various few years, various studies have been conducted for assessment of drinking water quality parameters from groundwater source by researchers that are summarized below:-

Thackeray et al. (2013) [13] provided a rigorous assessment of a number of proposed phytoplankton metrics for assessing the ecological quality of European lakes, specifically in response to nutrient enrichment or eutrophication, the most widespread pressure affecting lakes. To quantify metric variability, the authors analyzed the data from a multi-scale field campaign of 32 European lakes, resolving the extent to which seven phytoplankton metrics (including chlorophyll a, the most widely used metric of lake quality) vary among lakes, among sampling locations within a lake and through sample replication and processing. They also related these metrics to environmental variables, including total phosphorus concentration as an indicator of eutrophication.

Gelting and Baloch (2013) [6] analyzed the irrigation water quality in environmental assessments related to food borne outbreaks. As environmental assessments have become more widespread, all of these factors limiting their implementation and effectiveness should be improved. The results from improved environmental assessments will also help to develop more effective strategies to prevent outbreaks. Management of irrigation water may also benefit from a more formalized preventive approach similar to the World Health Organization's (WHO) Water Safety Plan (WSP) process. WSPs were developed to assess and manage risk in drinking water systems, and include an assessment of risks within a drinking water system and the surrounding environment that may affect water quality. WSPs are also a stake holder-based process that aim to bring together relevant partners to address those risks. A WSP-style process could provide a potential framework for looking at irrigation water quality in a more systematic manner that would not require a regulatory approach. Applying this type of approach to agricultural water would include a systematic identification of potential risks to irrigation water quality. This would encompass a wide variety of issues, including examples such as identifying point and non-point sources of contamination and seasonal variation in water quality for surface waters [11].

Oyelami et al. 2013 [10] assessed the impact of an open dumpsite on the quality of surface and shallow groundwater on the shallow groundwater and surface water quality close to an active dumpsite in Oshogbo metropolis. Twenty water samples were collected and analyzed for physicochemical parameters, major ions, and trace metals. The low contamination observed may be attributed to a high compaction level observed in most of the weathered overburden of the soil underlying this area which could act as an impervious, protective layer. Assessment of water quality in relation to the bacteriological analysis is encouraged to complement the hydro chemical results. Improved waste disposal management system is also advised, since the wetlands in the vicinity of this dumpsite could promote the migration of leachate, especially during the raining season, which could potentially lead to severe contamination of the groundwater resources in the area. A constant monitoring of the groundwater quality is highly recommended especially at the Northeastern part of the studied area where the highest concentrations were measured.

Laak et al. 2012 [9] studied broad target chemical screening approach used as tool for rapid assessment of groundwater quality. In this study a 'broad' target screening approach for water quality assessment using high resolution and accurate mass spectrometry (HR MS) was applied to detect a wide variety of organic chemicals in 42 groundwater samples. In this approach, both known and unidentified chemicals observed in previous samples define the training set for the analysis of future samples and, additionally, new samples can be used to extend the training set. Nearly 400 chemicals were observed in the samples, of which 82 were known and more than 313 are of unknown identity. The total MS responses corrected for the internal standard are applicable as a generic qualitative comparative tool for organic contamination. The obtained results were interpreted in relation to the source characteristics and land use. Groundwater that was affected by landfills showed the highest total MS response (ion counts) and most individual chemicals and was therefore considered most contaminated. Moreover, this approach can be used to prioritize the unidentified chemicals for further research (e.g. identification) based on the frequency of observation. Thereby, the broad target screening approach provides more information on the total contamination of a sample than conventional target analysis. Additionally, the broad array of chemicals covered by this approach makes it a suitable analytical technique to link observed toxicological effects to specific constituents of complex mixtures of contaminants.

Cidu et al. 2011 [4] compared inorganic components in bottled water and Italian tap water for drinking water quality. The study reports an evaluation on the quality of drinking waters: 37 bottled water samples available in the market and 15 tap water samples supplied by municipal pipelines. Water samples were analyzed for 57 dissolved inorganic components. Considering the Italian and WHO guidelines for drinking water, results show an ample compliance with respect to the toxic elements Cr, Cd, Hg and Pb. In 20% of the bottled water samples, one or more components have been found at concentrations exceeding the Italian regulations (Cl^-, SO_4^{2-}, NO_3^- limit for infants, F^-, As) and the WHO guidelines (B, U). These bottled waters are natural mineral waters, sometimes containing trace elements at concentrations significantly higher than those normally accepted in drinking water. With reference to the studied components, the overall quality of the investigated bottled waters does not appear to be always superior when compared with the municipal tap waters. Results indicate the need to update the current guidelines for drinking waters (including bottled waters) on the basis of epidemiological studies capable of assessing the toxicity related to long-term exposure to toxic and harmful trace elements. The mineral waters with excess concentrations of harmful elements should clearly report on the label the maximum daily uptake based on the lowest health risk exposure.

Materials and Methods

Study area

A cross-sectional case-control study was conducted at Kanjasa Uparhar Village (Latitude 25.2806902, Longitude 81.7751084) in Jasra Tehsil of Allahabad District, State Uttar Pradesh, India. It is located 18 km towards South from district headquarters Allahabad and 4 km from Jasra. Allahabad, Lal Gopalganj, Nindaura, Phulpur, Mauganj are the nearby cities to Kanjasa Uparhar. [Fig-1] shows the area of study.

Fig-1 Map showing the study area

Data collection method

The selection of the area was a rural settlement. The village had market area but minimum of public facilities like markets, shops, high school, health centers and others. A stratified random sampling technique was adopted to select the sample needed for the study. As a first stage the water points were selected. These water points were selected randomly and gave us a total of 6 water points. In the second stage household heads were selected for interview

Water sampling

Water samples were collected from different sources of water used by the communities in rural sources. A total of six water samples were collected from the study area. Based on the water quality of the samples investigated, the status of the existing water quality was compared with the Indian Standard Specification for drinking water [**Table-1**].

Tests of water samples

Laboratory experiments were carried out in Biotechnology Laboratory of the Jacob School of Biotechnology and Bioengineering, SHIATS, Allahabad. All the water samples were brought back to the laboratory and various parameters were evaluated. pH and Temperature of the samples were measured on site with pH strips and Thermometer. Turbidity was determined with Turbidimeter and Total Dissolved Solids with Gravimetric Method. To determine Alkalinity, Chlorine content, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Hardness of the water samples laboratory tests were performed [**Fig-2**] and [**Fig-3**].

Table-1 *Indian Standard Specifications for Drinking Water IS: 10500*

Drinking Water Quality Parameter	Requirement Desirable Limit	Remarks
Color	5 Hazen Units	May be extended up to 50 Hazen Units if toxic substances are suspected
Turbidity	10 NTU	May be extended up to 50 NTU if toxic substances are suspected
Total Dissolved Solids	500-600 mg/L	-
pH	6.5 to 8.5	-
Total Hardness	300 mg/L	May be extended up to 600 mg/L
Chlorides	250 mg/L	May be extended up to 1000 mg/L
Alkalinity	200 mg/L	-
Biochemical Oxygen Demand (3 days at 27˚C)	30 mg/L	-
Chemical Oxygen Demand	250 mg/L	-

Determination of Total Alkalinity of water samples

Generally, pH of water remains neutral. Alkalinity of water represents the presence of hydroxyl ions (-OH) in water; hence, it is capacity of water to neutralize a strong acid. In natural or wastewater alkalinity is due to the presence of hydroxyl ions, which cause through hydrolysis of salts by weak acids and strong basis (e.g. carbonate and bicarbonates)

a) Requirements

Conical Flask (100 ml capacity), Water sample, Titration assembly, HCL solution (0.1N), Na_2CO_3 solution (0.1N) (dissolve 5.3 g of Na_2CO_3 in distilled water and dilute to make 1 L), Phenolphthalein indicator (dissolve 0.5 g phenolphthalein in 50 ml of 95% ethanol and 50 ml of distilled water. Add 0.05N NaOH solution drop by drop to make solution faintly pink), Methylene orange indicator (dissolve 0.5 g of methylene orange in 100 ml of distilled water)

b) Procedure

i. Take 50 ml of water sample in a conical flask (100 ml capacity).
ii. Add s few drops of Phenolphthalein indicator. If color of water does not change, it means that Phenolphthalein alkalinity (PA) is nil due to absence of carbonates in the water sample. Moreover, if there develops pink color, determine PA.
iii. Pour 0.1N HCL solution in burette and titrate with water sample. Note the end point when pink color becomes colorless.
iv. Take another 50 ml of water sample in flask and add 2-3 drops of methyl orange into it. Color turns to orange.
v. Transfer 0.1N HCL solution into burette in titration assembly and titrate with the water sample (methylene orange added) until yellow color change to pink. Note the end point.

c) Results

Calculate PA and total alkalinity of water sample as below:

$$\text{Phenolphthalein indicator(mg/L)} = \frac{\text{Volume of 0.1N HCL solution used as totrante}}{\text{Volume of water sample}} * 1000$$

$$\text{Methylene orange alkalinity(mg/L)} = \frac{\text{Volume of 0.1N HCL solution used as totrante}}{\text{Volume of water sample}} * 1000$$

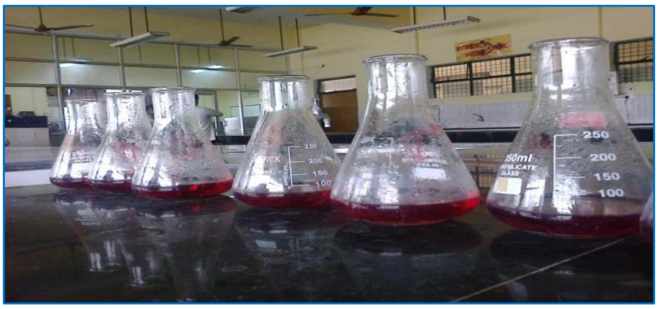

Fig-2 Alkalinity test for water samples

Determination of Chlorine in water

The potable water is chlorinated to make the water free from microorganisms. However, some times the concentration of chloride ions in water is increased than what is normally required. Apart from this water also receive chloride ions from multifarious sources. The chloride ions(Cl^-) can be estimated by titrating with silver nitrate solution.

a) Requirements

Water sample, Conical flask, Pipette, Titration assembly, Silver nitrate ($AgNO_3$) solution (0.025N) (dissolve 3.4 g dried $AgNO_3$ in distilled water and dilute to make 1 L. Store in colored bottle), Potassium dichromate solution (5%) (Dissolve 5 g of $K_2Cr_2O_7$ in 100 ml of distilled water)

b) Procedure

i. Take 50 ml of sample in a conical flask and add 2 ml of $K_2Cr_2O_7$ solution.
i. Pour 0.025N $AgNO_3$ solution into burette set with titration assembly.
ii. Titrate the water sample with $AgNO_3$ solution until reddish tinge appears. Note the end point ($AgNO_3$) reacts with Cl^- ions and forms very slightly soluble white precipitate of $AgCl_2$ (silver chloride). Free silver ions (Ag^{++}) react with chromate ions (Cr_2O_7) to form silver chromate of reddish brown colour.

c) Results

Calculate the amount of chloride ions in water sample as below:

$$\text{Chloride(mg/L)} = \frac{\text{Volume of AgNO3 solution} * 100 * 35.5}{\text{Volume of water sample}}$$

Determination of Dissolved Oxygen of water

Dissolved oxygen is measured by titrimetric method. The theory behind this method is that the dissolved oxygen combines with magnous hydroxide which in turn liberates iodine (equivalent to that of oxygen fixed) after acidification with H_2SO_4. The iodine can be titrated with sodium thiosulfate solution by using starch indicator.

a) Requirements

BOD bottles (250 ml capacity), Water sample from a water body, sewage or treated water, etc, Alkaline iodine-azide solution, Sodium thiosulfate (.025), Manganese sulfate solution, H_2SO_4 concentration, Pipette (2 ml), Titration set.

Alkaline KI solution: Dissolve 100 g of KOH and 50 g KI in 200 ml of distilled water.

Manganese sulfate ($MnSO_4.4H_2O$) solution: Dissolve 100 g of manganese sulfate in 200 ml of distilled water, filter and keep in stoppered bottle.

Starch Indicator: Dissolve 5 g of starch in 100 ml hot distilled water (boiled) and e few drop of formaldehyde (HCHO).

b) Procedure

i. Collect water sample in a BOD glass bottle (250 ml) in such a way that water bubble should not come out.
ii. Pipette separately 2 ml of manganese sulfate and 2 ml of alkaline iodine-azide solutions.
iii. Add these solutions in succession at the bottom of bottle and place the stopper of bottle.
iv. Shake the bottle upside down for about 6-8 times. There develops brown precipitate.
v. Leave the bottle for a few minutes, the precipitate settles down.
vi. Add 2 ml of concentration H2SO4 in the bottle. Shake properly so that brown precipitate may dissolve.
vii. Take a clean flask and pour 50 ml of this water sample. Titrate it against 0.025N sodium thiosulfate solution taking in a burette until pale straw colour develops.
viii. Add 2 drops of starch solution to the flask. Colour of contents changes from pale to blue.
ix. Again titrate against thiosulfate solution until the blue colour disappears. Note the volume of sodium thiosulfate solution used in titration.

c) Results

Calculate the amount of dissolved oxygen (DO) (mg/L) by using the following formula:

$$\mathrm{DO(mg/L)} = \frac{8 * 1000 * \mathrm{N}}{\mathrm{V}} * \mathrm{v}$$

Where, V = Volume of water sample used for titration
v = Volume of sodium thiosulfate (titrant)
N = Normality of titrant

8 = It is a constant since 1 ml of 0.025N sodium thiosulfate solution is equivalent to 0.2 mg oxygen

Determination of Biochemical Oxygen Demand (BOD) of water

For measuring BOD, water samples are incubated at 20 ˚C for 5 days in dark under aerobic condition, whereas the same can be incubated at 27 ˚C for days in tropical and subtropical regions where metabolic activities are higher. Oxygen is also consumed during nitrification; therefore, 1.0 ml of 0.05% allylthiourea should be added to water sample to check over estimation of BOD.

a) Requirements

BOD free water (deionised distilled water passed through activated carbon and re-distilled), BOD bottles, Erlenmeyer flask, Pipette, BOD incubator, pH meter, Phosphate buffer solution (pH 7.4), H_2SO_4 1N (2.8 ml in 100 ml BOD free distilled water), Allylthiourea solution (0.5%).

All reagents required for estimation of dissolved oxygen as given in previous experiment.

b) Procedure

i. Add 1N acid/1N alkali in the water sample to adjust the pH to 7.0
ii. Gently transfer this water into BOD bottles so as bubbles should not come out.
iii. Add 1 ml of allylthiourea to each bottle to avoid nitrification.
iv. Measure dissolved oxygen following the steps as described for dissolved oxygen.
v. Incubate the other BOD bottle at 20 ℃ for 5 days in a BOD incubator.
vi. Measure the amount of oxygen as done earlier.

c) Results

Calculate the BOD of water by using the following formula:

$$\mathrm{BOD(\,mg/L)} = \mathrm{D_1} - \mathrm{D_2}$$

Where, D_1 = Total dissolved oxygen (mg/L) in the sample (mg/L)
D_2 = Dissolved oxygen (mg/L) in the second sample after 3 days of incubation

Determination of Chemical Oxygen Demand (COD) of water

The chemical oxidance such as potassium dichromate ($K_2Cr_2O_7$) or potassium permanganate ($KMnO_4$) are used to measure the oxidisability of the organic matter of water where the oxidants oxidise the constituents (or the hydrogen but not nitrogen). Then potassium iodide (KI) is added. The excess amount of oxygen reacts with KI and librates iodine. The excess amount of oxygen librates equal amount of iodine. By using starch indicator, iodine is titrated with sodium thiosulfate and amount is estimated.

a) Requirements

Water sample, conical flask (100 ml capacity), $K_2Cr_2O_7$ solution (0.1N, 3.67 g), H_2SO_4 solution 2M (10.8 ml conc. H_2SO_4/100 ml distilled water), Sodium thiosulfate 0.1M (15.811 g/2 L distilled water), Starch solution (1%), Water bath, Distilled water control blank (3), Titration assembly.

b) Procedure

i. Pour 50 ml of water sample in a conical flask (100 ml capacity).
ii. Similarly take 50 ml distilled water in a flask.
iii. Pour 5 ml $K_2Cr_2O_7$ solution separately in both the flasks.
iv. Incubate the flasks at 100 ℃ for one hour keeping in a water bath.
v. Thereafter, remove the flasks to coo l for 10 minutes.
vi. Mix 5 ml KI solution, and 10 ml of H_2SO_4 solution in each flask.
vii. Transfer 0.1M sodium thiosulfate solution in burette fitted in titration assembly, and titrate with both the samples in flasks till pale yellow colour disappears. In each case note the amount of sodium thiosulfate solution used.
viii. Add 1 ml of starch solution to both flasks. Colour turns blue.
ix. Again titrate with sodium thiosulfate as above till complete disappearance of blue colour. Note the volume of sodium thiosulfate used for both the water samples.

c) Results

Calculate the COD (mg/L) of water using following formula:

$$\mathrm{COD(mg/L)} = \frac{8 * \mathrm{C} * (\mathrm{V_B} - \mathrm{V_A})}{\mathrm{V_S}}$$

Where, C = Concentration of titrant (mM/L)
V_A = Volume (ml) of titrant used for control
V_B = Volume (ml) of titrant used for water samples
V_S = Volume (ml) of water sample taken

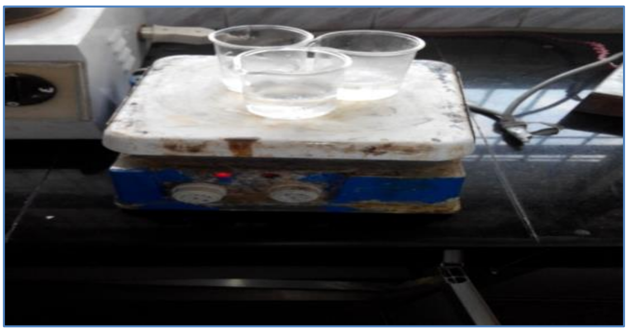

Fig-3 Test of Total Dissolved Solid of the water samples

Table-2 *Health effects of chemical parameters*

Parameter	BIS Guideline value (maximum allowable)	General & Health effect
Chloride	1000	Taste affected; corrosive
Total Dissolved Solids	2000 mg/L	Undesirable taste; gastro intestinal irritations; corrosion or incrustation
pH	6.5- 8.5	Affects mucous membrane; bitter taste; corrosion; affects aquatic life
Alkalinity	600 mg/L	Boiled rice turns yellowish
Hardness	600 mg/L	Poor lathering with soap; deterioration of the quality of clothes; scale forming; skin irritation; boiled meat and food become poor in quality

Water quality

Chemical properties of pump well water were investigated in 2 rural villages near Allahabad, India. Total of 06 well water samples were collected from 2 villages, namely Chhota Kanjasa and Bada Kanjasa village. The water of the hand-pump being utilized by local villager. All the wells investigated were tube type hand pump well, except one well in Bada Kanjasa which was open type well.

Some health effects of chemical parameters are shown below in [**Table-2**]. The Indian Standard Specifications for Drinking Water analysis of the drinking water sample is depicted in [**Table-1]**

Results

Consumers concerning their drinking water said aesthetic factors such as taste, odour, and color were very important. Likewise the drinking water trustworthiness depends on the perception of consumers and the resultant complaints due to tastes, odors, color or any other particulate matter.

The Indian Standard Specifications for Drinking Water analysis of the drinking water sample is depicted in Table 3.1. The results of experiments performed in laboratory are illustrated below [**Table-3 and 4**].

Table-3 *Summary of the physical parameters of drinking water samples collected from various locations of Jasra Block*

List of Sample	Taste	Color	Temperature	Turbidity (NTU)
Open Well	No taste	No color	22°C	11.48
Hand pump I	No taste	Yellowish-brown	21°C	1.14
Hand pump II	No taste	Yellowish-brown	20°C	3.66
Hand pump III	No taste	Yellowish-brown	20°C	30.0
Hand pump IV	No taste	Yellowish-brown	20°C	0.87
Hand pump V	No taste	Yellowish-brown	21°C	2.43

Table-4 *Summary of the quality parameters of drinking water samples collected from various locations of Jasra Block*

S. No.	Water Quality Parameters in (mg/L)	Permissible limit as per Indian Stnd. (mg/L)	Volume of quality parameters of various location					
			Open well	Hand pump-I	Hand pump-II	Hand pump-III	Hand pump-IV	Hand pump-V
1	Alkalinity	200	Nil	Nil	Nil	Nil	Nil	Nil
2	Total Hardness	300	100	150	200	175	240	180
3	TSS	200	100	200	100	100	100	100
4	TDS	500-600	100	100	600	400	100	200
5	DO	8	8.8	7.2	8.0	6.4	6.8	6.0
6	BOD (3 Days at 27 °c)	30	2.6	2.2	1.8	2.0	1.6	1.8
7	COD	250	18.4	16	16.4	15.2	15.6	16
8	Chloride	250	461.5	269.8	340.8	241.4	248.5	255.6
9	pH	6.5-8.5	8	7.5	7.5	7.5	7	7.5

None of the samples gave positive response to alkalinity test. Alkalinity of water may be due to the presence of one or more of a number of ions. These include hydroxides, carbonates and bicarbonates. Hydroxide ions are always present in water, even if the concentration is extremely low. However, significant concentrations of hydroxides are unusual in natural water supplies, but may be present after certain types of treatment. The EPA Secondary Drinking Water Regulations limit alkalinity only in terms of total dissolved solids (500 ppm) and to some extent by the limitation on pH. Water sample of hand pump no. IV showed highest amount of calcium and magnesium content present in it. When the water becomes "hard" it has too many dissolved solids. Dissolved solids are the minerals in the water. The values of total dissolved solids were approximately same for all samples except water sample numbers II, IV and V which was comparatively very high. The presence of free chlorine (also known as chlorine residual, free chlorine residual, residual chlorine) in drinking water indicates that a sufficient amount of chlorine was added initially to the water to inactivate the bacteria and some viruses that cause diarrheal disease and the water is protected from recontamination during storage. The presence of free chlorine in drinking water is correlated with the absence of most disease-causing organisms, and thus is a measure of the potability of water. Chlorine content and pH in water sample of hand pump no. I was found to be highest in comparison to all the other samples tested. High DO levels in a community water supply are good because it makes drinking water taste better. Higher turbidity increases water temperatures because suspended particles absorb more heat. This, in turn, reduces the concentration of dissolved oxygen (DO) because warm water holds less DO than cold. The amount of dissolved oxygen, biochemical oxygen demand, chemical oxygen demand was found to be highest in water sample of open well. Even though surface waters are frequently turbid, turbidity problems with well waters is also found, especially when the well screen is not sized correctly or the water table drops and the water cascades into the well. Turbidity of open well was considerably high and hand pump no. III was found to be highest. The figure below shows the analysis of the result [**Fig-4-13**].

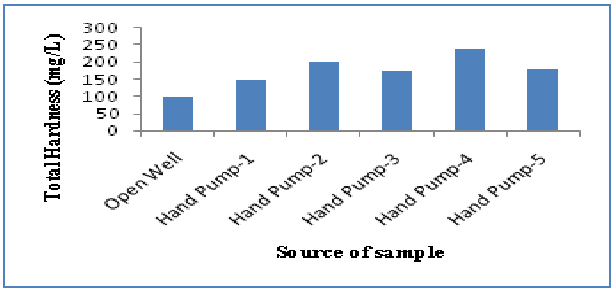

Fig-4 Total hardness of the water samples collected from various location of Jasra block

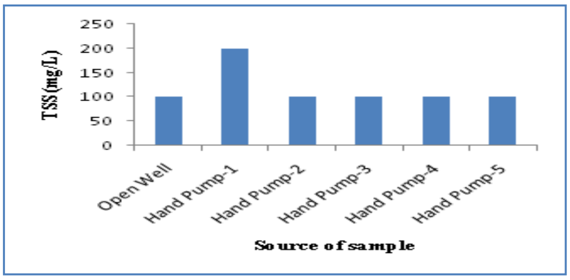

Fig-5 Total suspended solids of the water samples collected from various location of Jasra

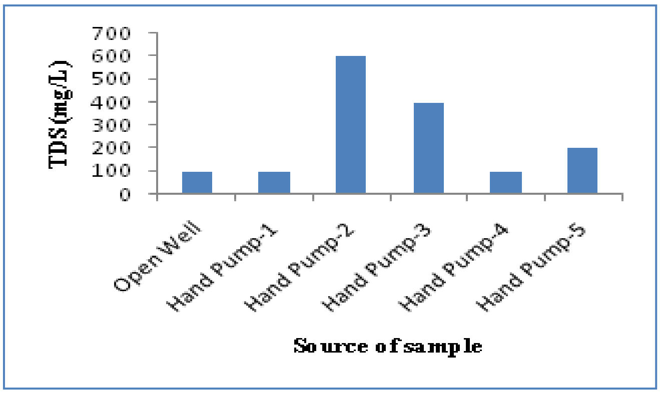

Fig-6 Total dissolved solids of the water samples collected from various location of Jasra block

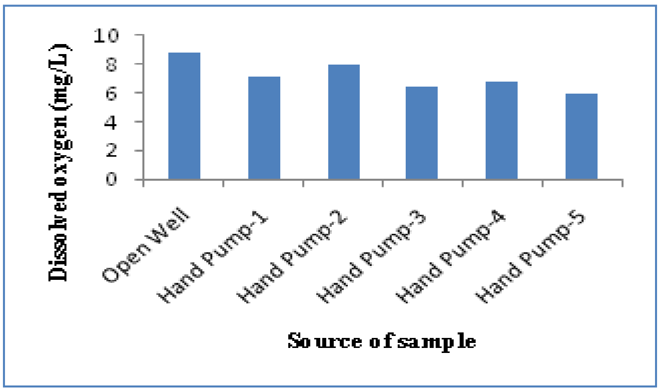

Fig-7 Amount of dissolved oxygen of the water samples collected from various location of Jasra

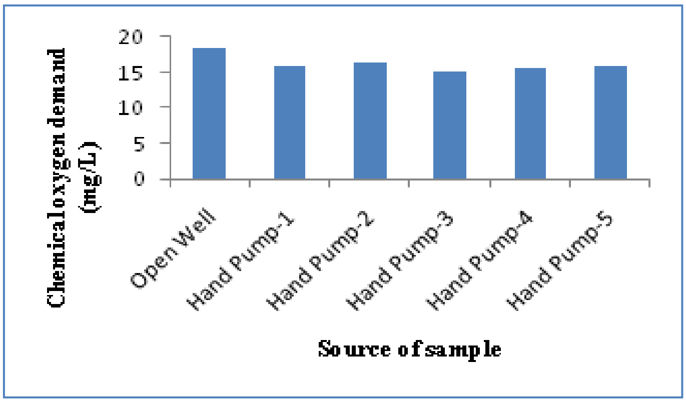

Fig-8 Amount of chemical oxygen demand of the water samples/ collected from various location of Jasra block

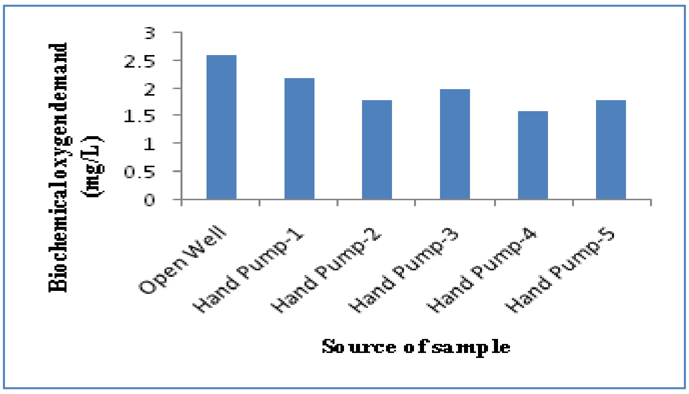

Fig-9 Biochemical oxygen demand of the water samples collected from various location of Jasra block

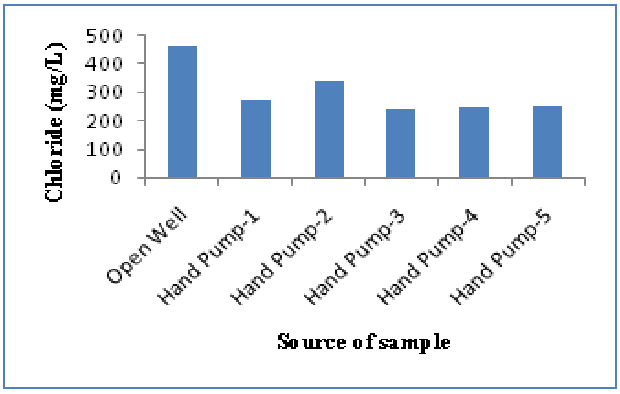

Fig-10 Chloride content of the water samples collected from various location of Jasra block

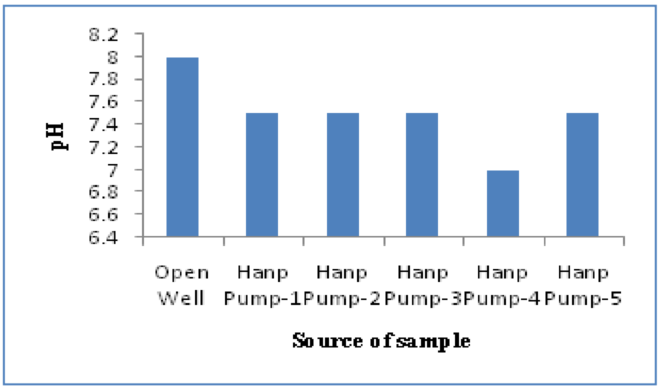

Fig-11 pH value of the water samples collected from various location of Jasra block

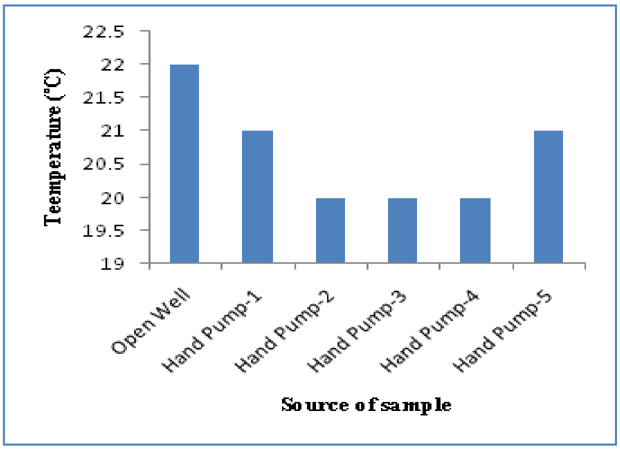

Fig-12 Temperature of the water samples collected from various location of Jasra block

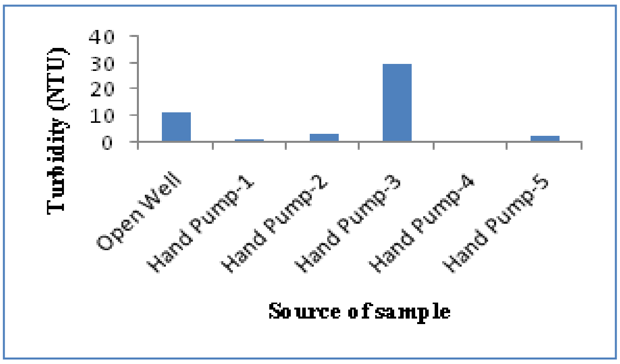

Fig-13 Turbidity of the water samples collected from various location of Jasra block

In a survey conducted at the village, it was considered ratio of female was bigger because woman in rural village did not appear much in public. The number of young people and children was large; therefore, effect of contamination to them was a great concern to address in the future.

From results of water source for human, all the people answered the survey and used hand pump well water as drinking water without any treatment within past 15 years. From results of stable foods and vegetables for human, some grains and vegetables were eaten by rural people. Results of disease for human survey showed most of rural people have no disease with arsenic symptom, but in fact, inadequate knowledge of arsenic disease for village people was suspected.

From results of age, sex and kinds for livestock animals, most of the livestock animals were less than 5 years old female and mixed breed. Millets, weeds, rice straw, wheat straw and wheat husk as feed for livestock animal grew in rural village. Livestock animals lived in their own village and water sources they used were nearby hand pump wells.

Conclusion

- The test results shows that at all the locations the alkalinity of water samples were showed thus it is with the permissible limit as per Indian Standard.
- The samples did not give a positive reaction with the alkalinity test.
- Comparative higher level of turbidity in few samples with respect to the Indian Standard Specifications for drinking water.
- BOD and Chlorine content of the three samples exceeded the IS standard limit.
- The pH value was in range of drinking water standards.

Conflict of Interest: None declared

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