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ORIGINAL ARTICLE

Assessment of Physicochemical Parameters, Heavy metal Contamination, and Bacteriological Parameters of different water samples for irrigation purpose in Nilgiris District.

Merlin Seles.J and Chitra.K*
,Bharathiar University, Coimbatore, Tamil Nadu, India
*Assistant Professor, Bharathiar University, Coimbatore.
1Scholar, mail ID- merlinseles@gmail.com

ABSTRACT
Water is essential to all living beings and it is very important to human beings. The water contains some of the minerals that are essential for living beings to survive. For the present study, there are five different types of water such as tap water, canal water, bore well water, well water, and recycled water, which are collected from different locations in the Nilgiris. The physicochemical parameters, heavy metal contamination, and bacteriological assessment were analyzed in all types of water. The result of physical parameters such as turbidity is highly present in recycled water. Not only the presence of turbidity but also this water has a high amount of chemical parameters and heavy metal contamination. Then thecolour of recycled water is also yellowish. Therefore it is not used for drinking purposes. Due to the presence of a high amount of minerals in recycled water, it is used for irrigation purposes. The value of all the water samples of physicochemical parameters and heavy metal contamination is not exceeded the standard value. The value of total coliform is high in canal water. Hence all the collected water samples are fresh water.
Keywords: *Water, physicochemical parameters, heavy metal contamination, total coliform.*

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INTRODUCTION

Water is an essential and important renewable resources on our planet. It is involved in various aspects like food production, economic development, industrial activities, etc. Water is a natural resource which plays a main role in diversion, transportation, storage and recycling. There are different sources of water, among which surface water and groundwater are mainly used for agricultural purposes. In India, the availability of surface water has been much reduced compared to the previous years. Hence it is essential to preserve it through management. In Nilgiris, the forests and trees are important sources of water generation. It receives higher rainfall but at the same time, it faces a water shortage problem during the summer season. There is no proper development of infrastructure for irrigation purposes in the Nilgiris district despite having 29 hydroelectric power generation dams. The irrigation is done by the farmers. They generally dig wells to store rainwater and use it in their fields. In the Nilgiris district there are various types of irrigation such as well, canals, reservoirs, tube well, and open well. In India, some researchers discovered the quality of water by testing the physicochemical parameters. There are different types of water which consist of important elements such as TDS, Salinity, Phosphate, Nitrate, Total hardness, and Chloride.

Colour is one of the optical parameters which absorb a part of a spectrum of radiation by the substance which is present in water or sewage. The pH of water is important because plant and animal species can live in a range from slightly acidic to slightly basic conditions. [7]. Conductivity is used to measure the flow of electric charge. This flow of electric charge is directly proportional to the concentration of ions. These ions comes from inorganic substances namely alkalis, chlorides, and carbonate compounds. Total

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alkalinity composed of carbonate and bicarbonate and it plays a role of stabilizer for pH. The presence of higher amount of alkalinity leads to the poisonous of water. The Total dissolved solids contain inorganic salts and a small amount of organic matter which are dissolved in water. The concentration of total dissolved solids is based on the addition of cations and anions in water. Therefore it is used to determine the water quality. The TDS range of concentration describes the presence of inorganic salts and some amount of organic matter in water [46]. The chemical contaminants can be analyzed by consumers at a low concentration level, which has a low taste and odour. [59].

The presence of cloudiness in water is called turbidity and this is due to some of the suspended solids which are not seen through the naked eye, for example, smoke in the air. Water hardness is classified into soft, hard, moderately soft, and moderately hard [36]. The WHO and TBS recommended level for total hardness is 500 mgL-1. Sulphur is a mineral, which occurs in most sedimentary rocks. During the weathering process, the gypsum gets dissolved and sulphides are oxidized partly and give rise to sulphate which is carried out by water. In freshwater, the concentration of calcium ions is found to be in the range of 0 to 100 mg/L [1]. Magnesium is an important element present in water and some of the salts of magnesium are toxic [5]. Sodium and potassium are important elements for both plant and human nutrition. Phosphorus in aquatic systems occurs in both varieties organic and inorganic.Both can be dissolved in water [51].

NH4-N is formed by the heterogenous bacteria which is the nitrogenous end product. [55]It shows that the borewell water can be used for drinking purposes after the treatments such as filtering, boiling, reverse osmosis and electrodialysis. Due to the increase in the usage of metal fertilizer in agricultural land, it will be mixed with fresh water and it causes heavy metal toxicity, faucal pollution and waterborne diseases to human beings [2]. Some countries use sewage effluent as a fertilizer and they found out that it is a good fertilizer as it provides nutrients to plants [45].

The concentration level of toxicity to humans follows the sequence Co < Al < Cr <Pb< Ni < Zn< Cu < Cd < Hg [35]. The WHO suggested the safe limit of Cd level in wastewater is 0.003 ppm [16], [3]. The WHO recommended the critical limit of Pb in wastewater and soils are 0.01 and 0.1 ppm respectively [16], [8]. The metal chromium enters the environment through sewage and fertilizers. The safe limit of the metal chromium in wastewater is suggested by WHO as 0.05 and 0.1 ppm respectively[16],[3]. Nickel is a silver-coloured metal and it enters human beings through food, air and water [20]. The suggested safe limits by WHO for Ni in wastewater and soils of agriculture are 0.02 and 0.05 ppm respectively [16], [3]. The metal zinc has less toxicity to human health. Mainly it causes damage to neuronal development and the immune [42]. This zinc metal gives a metallic taste to drinking water at a level above 3.0 mg/L [40].

E. coli is one of the species of coliform bacteria which is served as the best indicator for faecal pollution and it is possible for the presence of pathogens. Many sectors that use water in the Nilgiris district are the electricity board, agriculture, and horticultural sectors. The water which comes from both Pykara and Bhavani dams met at the Metur area and it is moving to the Cauvery River for irrigation purposes.

MATERIAL AND METHODS

The water samples were collected from the Nilgiris Hills, Tamil Nadu. Around five different water samples were collected for analysis from different locations in Nilgiris Hills. The five different samples are tap water, bore well water, well water, canal water, and recycled water. The tap water was collected from the main area of Ooty town; the bore well and canal water were collected from Muthoraipalada; the well water was collected from Fernhill; and recycled water was collected from the Lovedale area. These samples were brought to the laboratory and some of the tests such as physicochemical parameters, biological parameters and heavy metals contamination tests were conducted

Coordinates	:11° 29' 29.7744'' N and 76° 44' 1.1400'' E.
Name of District and State	: Udhagamandalam Tamil Nadu
Forest Dept office	: Udhagamandalam 1Km
Total Area	:2565km^2
Height	:1,800 m above mean sea level
Average Rainfall	:1,920.80 mm

The temperature during the winter season and Summer season: 21°C, Min. 5°C, and 25°C, Min. 10°C respectively.

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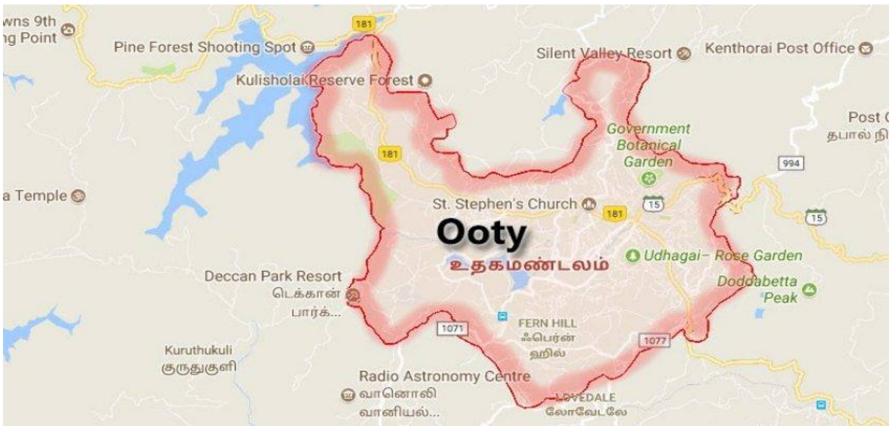


CANAL WATER BORE WELL WATER


RECYCLE WATER TAP WATER WELL WATER

Fig 1: Collection Site

PROCEDURES FOR WATER AS PER APHA

Color:

Color is determined by the method of APHA 23rd Edition 2120 B.

Determination of Odor

After collection of sample, fill a wide mouth bottle half-full of sample, insert the stopper, shake vigorously for 2 to 3 seconds and then quickly observe the odour [4]

pH @ 25°C

The pH measuring instrument is calibrated potentiometrically with an indicating (glass) electrode [4]

$$pH_B = -\log_{10} a_{H^+}$$

Where:

pH_B= assigned pH of NIST buffer

Electrical Conductivity @ 25°C in µs/cm

Rinse the conductivity probe with distilled water, Follow the instructions of conductivity meter (IOP), Dip Instrument Electrode in Sample, Take measurement for the samples [4].

Total Dissolved Solids @ 180°C in mg/l

Total Dissolved solids was determined by the method APHA 23rd Edition 2540C [4]

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Calculations:-

Mg total dissolved solids/L = (A-B) x 1000x1000
Sample volume in ml

Where A = Weight of dried residue +dish in mg
B = Weight of dish in mg

Turbidity in NTU

Turbidity is reported in nephelometric turbidity units (NTU). The working range is dependent on the instrument being used. [4)

Total Hardness as $CaCO_3$in mg/l

Take suitable volume of the sample add 2 ml of buffer solution, Adjust to pH 10 ± 0.1-Add Indicator(Eriochrome black T)-Titrate with EDTA(0.01 M), the color changes into blue colour marks the end point and note the Volume of EDTA [4].

Calculaion:-

Total Hardness as $CaCo_3$ mg/L = A x B x 1000ml of sample

A = ml titration for sample
B = Mg of $CaCo_3$ equivalent to 1 ml of EDTA Titrant

Calcium in as Ca in mg/l

Take 50ml of water sample in a 250ml conical flask and add 2ml of 1N NaOH solution. To this solution add a pinch of Mureoxideindicator-Titrate against EDTA until the color changes to pure violet from wine red. Note down the reading (A)-Run a blank reagent. Note down the reading (B)[4].

Calculation

Calcium Hardness:

Calcium (as $CaCO_3$) mg/l = (A-B) x 50 x 0.02 x 1000
Volume of sample

Where, A = ml of EDTA for sample,
B = ml of EDTA for blank.

Magnesium as mg in mg/l

Magnesium was estimated by the method of titration [4].

Calculation

Magnesium Hardness as mg/litre= [Total hardness (as mg $CaCO_3$/L) - calcium hardness (as mg $CaCO_3$/L)] X 0.243

Nitrate as NO_3

Take 50ml clear sample filtered if necessary and add 1ml IN HCl-Mix thoroughly-Read at 220 nm-Take reading at 275 nm [4]

Calculation:-

Nitrate Nitrogen mg/L = (A - 2B) x Slope
Volume of sample

A = Absorbance reading at 220nm
B = Absorbance reading at 275nm

Nitrite (as NO_2)

Take 50 ml of sample and add 2 ml of colour reagent NEDA (N-(1-Napthyl) ethylene diamine dihydrochloride) . Mix it Well and read at 543 nm [4].

Calculation: -

$$\text{Nitrite Nitrogen mg/L} = \frac{\text{Abs x Slope}}{\text{Volume of sample}}$$

Total iron

Total iron is determined by mixing the solution of thioglycolic acid and ammonia (A-6000 Activator Solution) to the sample. This solution gives the particulate iron and converts ferric iron to ferrous. Results are expressed as ppm (mg/L) Fe [6].

Chlorides (as Cl)

Sample preparation: Use 100 ml sample or diluted sample of volume of 100 ml. If the sample is colored add 3 ml of Al $(OH)_3$ suspension, mix, let settle and filter. If sulphide sulfite, highly or thio sulphate is present in the sample add 1 ml of H_2O_2 and stir for one minute [4].

Calculation :-

Chloride mg/L =(A-B) x N x 35.45x1000
Volume of sample

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Where

A = ml titrant for sample,B = ml titrant for blank,N = Normality of $AgNo_3$

Sulphate (as SO_4)

Measure suitable volume of the sample in a Nessler's tube, Make up the volume to 100 ml & stir. Then Add 20 ml buffer solution. While stirring add a spoonful of $BaCl_2$ crystals Stir for 60 + 2 s at constant speed. The sulphate is measured at 5± 0.5 min in a photometer at 420 nm [4].

Calculation:-

$$\text{Sulphate mg/L} = \frac{\text{mg } SO_4^{2-} \text{x}1000}{\text{Volume of sample}}$$

Sodium (as Na)

Sodium was determined by the instrument flame photometer [4].

Calculation:-

Na or K = Dilution × Value

Fluoride

The Fluoride was determined by the method of APHA 23rd Edition4500 F-D [4].

Heavy metal analysis.

Determination of heavy metal concentration was performed analytically with the digital UV-spectrophotometer [39]

Bacteriological analysis:

The test method of total coliform and Escherichia coli [9].

Data analysis

IBMMSPSS software was used for the calculation of mean values of water samples.

RESULTS AND DISCUSSION

Table 1: The standard limits for the physical parameters.

Physical parameters	Standard limit
pH	6.5-8.4
EC(μs/cm)	0-3000
TDS(mg/L)	0-2000
Total hardness	100mg/l
Turbidity	5 NTU
Colour (Hazen)	5.0
Odour	Agreeable

Table 2: The result of physical parameters for all the water samples.

PHYSICAL PARAMETERS	WELL WATER	RECYCLED WATER	TAP WATER	CANAL WATER	BORE WELL
Colour	<1.0	<1.0	<1.0	<1.0	<1.0
Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
Ph @ 25°C	5.94	6.76	6.65	6.67	6.96
EC @ 25°C	126 μS/cm	720 μS/cm	36 μS/cm	54 μS/cm	176 μS/cm
Total dissolved solids	76 mg/L	440 mg/L	22 mg/L	32 mg/L	104 mg/L
Turbidity	0.18 NTU	1.40 NTU	0.02 NTU	0.31 NTU	0.05 NTU
Total Hardness	51.7 mg/L	80 mg/L	28 mg/L	65.8 mg/L	84.6 mg/L

The standard value of colour is 5.0. The appearance of all the types of water samples was identified as tap water and bore well water was colourless and clear transparent liquid. The canal and well water are colourless. The recycled water colour showed yellowish. Due to the contamination of sewage water, it gives the odour of hydrogen sulphide. Chlorinated water gives the odour of chlorophenol odour. The taste of water can be identified by the impurities in water and odour. The result of the odour of all the water samples is agreeable. According to [50] report, mostly seventy per cent of water samples consist of pH values below the critical limit of 6.5-8.5. The accepted pH for irrigation water is 5.5 to 7.5. The result of the pH of all types of water shows acidic conditions. The pH value is above neutral it is because of the high concentration level of carbonate and bicarbonate. The alkaline water maintains the soil's sodic condition [10]. The high concentration level of pH in irrigation water may cause an imbalance in nutrition,

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[22]. The value of pH may increase the solubility of heavy metals. Therefore the result of well water shows a minimum value of pH 5.94 and a maximum value of 6.96 was seen in bore well water.
Mostly 25% of water samples are in the low salinity class and had EC values which are less than conductivity data revealing that the values are 20.25dS/m [52]. Then 75% of water samples had medium salinity class with the value 0.26–0.64 dS/m. The variation in the values of EC is due to the season. Due to human activities the salinity level increases [26]. In the present study, the result showed that the EC value is higher in recycled water which is 720 and it gets decreased in the order of bore well water, well water, canal water, and tap water. The lowest value is seen in tap water 36.Hardness is one of the important characteristics of agriculture and other purposes. High concentration may lead to the cause of Urolithiasis [15]. Based on the hardness of water, samples are classified into soft, moderately hard, hard and very hard in terms of the values. They are water with 0-75 mg/l, 75-150 mg/l, 150-300 mg/l and 300 mg/l [32]. The presence of calcium and magnesium is important for the hardness of water [31]. The result of the total hardness of water samples showed that the well, tap, and canal water are soft containing values of 51.7 mg/l, 28 mg/l, and 65.8 mg/l respectively. But the hardness of recycled water and bore well water is moderately hard. It has a value of 80 mg/l and 84.6 mg/l.
The acceptable concentration of turbidity for surface water range from 3.15 to 3.17 NTU and the drinking water range is 1 NTU [12], The result of the present study showed that the level of concentration of turbidity is increased in the order of tap water, bore well water, well water, canal water and recycle water with values of 0.02 NTU, 0.05 NTU, 0.18 NTU, 0.31 NTU, 1.40 NTU respectively. The value of turbidity in the recycled water is exceeded than standard so it is not acceptable for drinking purposes. According to [18], TDS are classified into four types based on the value such as freshwater (TDS < 1000 mg/L), brackish water (TDS 1000–10,000 mg/L), saline water (TDS10,000–100,000 mg/L) and brine water (> 100,000 mg/L). According to WHO and BIS, the acceptable and recommended limit of TDS standard is 500 mg/l. The result of the TDS of all water samples shows that all the samples are fresh water. The high concentration of TDS seen in recycled water is 440 mg/l. then it gets reduced in other samples in the order of bore well water with 104 mg/l, well water with 76 mg/l, canal water with 32 mg/l, and tap water with 22 mg/l.
According to the BIS standards, the maximum level of total alkalinity is 200 mg/l. The result of this present study reveals that a high level of alkalinity is seen in recycled water and bore well water with the value 164 mg/l, 148mg/l respectively, then it get decreased in other samples namely canal water, well water, tap water with values of 18 mg/l, 14 mg/l, 8.0mg/l.

Chemical parameters

Table 3: The standard range for the chemical parameters of water.

Chemical parameters	Unit	The usual range for irrigation water
Calcium	meq/l	0 – 20
Magnesium	meq/l	0 – 5
Sodium	meq/l	0 – 40
Chloride	meq/l	0 – 30
Sulphate	meq/l	0-20

FAO standard limit for irrigation water [24].
According to the Moroccan ministry of environment, water is classified based on nitrate content. If the water contains 1.7% then, the sample class is considered very good, 3.5% good, 23.2% average, and 71.5% bad or very bad. The sources of accumulation of nitrate content are septic tanks and municipal sewage [34]. The nitrate content in groundwater is due to the leaching of nitrate [37]. The collected samples indicate higher nitrate content in well water with 24.80 ± 0.3 mg/l and bore well water with 9.51± 0.015 mg/l and then the limited value is seen in other samples namely recycled water with 4.04± 0.015 mg/l, canal water with 0.693± 0.001mg/l and tap water with 0.026± 0.0015 mg/l. Magnesium is present naturally in a lesser amount than calcium because of the dissolution process and calcium is present more in the earth's crust [53]. The permissible level of magnesium in water is 30mg/l by WHO and BIS. The results of the present study showed that a higher amount is seen in canal water with 12.66± 0.57 mg/l and bore well water with 12.46± 0.15 mg/l and then it gets decreased in well water with 6.64± 0.22 mg/l, recycled water with 6.63± 0.22 mg/l and tap water with 5.53± 0.14 mg/l.
The standard level of calcium in water is 75 mg/l, by WHO and BIS. Sewage and industrial wastes are the important ones for calcium and more amount is seen in seawater [17]. The result indicates that the

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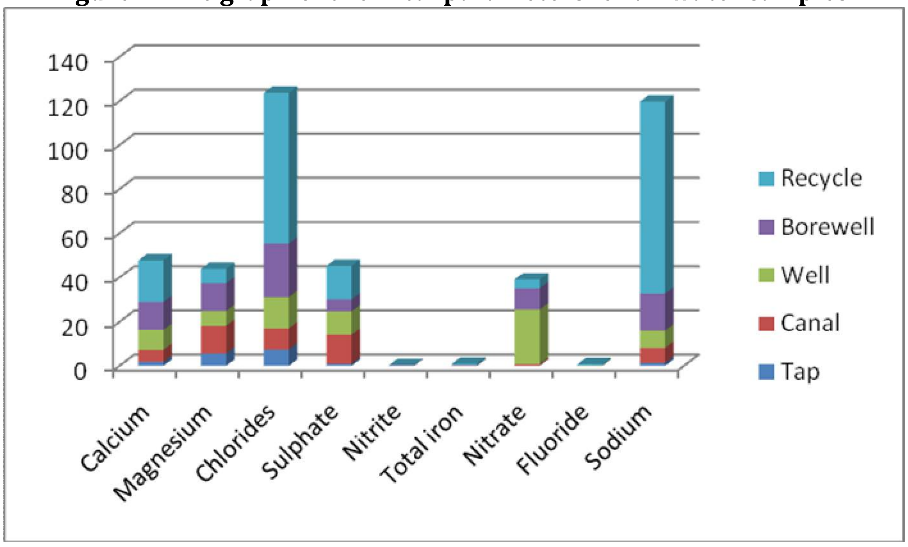
calcium level increased in recycled water at 18.83 ±1.64 mg/l, then it gets decreased in the order of bore well water with 12.6± 0.55 mg/l, well water with 9.17± 0.33 mg/l, canal water with 5.47± 0.15 mg/l and tap water 1.71 ±0.14 mg/l. The standard limits of chloride content are250mg/l by WHO and BIS. Industrial and domestic wastes are added to the groundwater which increases the salinity of water and it increases pollution [15]. The chloride content is seen high in recycled water with 68.33± 0.15 mg/l, and it gets reduced in the order bore well water with 24.3± 0.20 mg/l, well water with 14.00± 1.00 mg/l, canal water with 9.74± 0.03 mg/l and tap water 7.32± 0.02 mg/l. The sodium standard limit is 60mg/l according to WHO and BIS and high concentrations of sodium cause salinity problems in soil [14]. A high amount of sodium is present in recycled water with 87.1± 0.264 mg/l, bore well water with 16.66 ±0.577 mg/l and then the limited value is seen in well water with 7.96± 0.15 mg/l, canal water with 6.73 ±0.15 mg/l and tap water with 1.33± 0.115 mg/l. The high level of concentration is due to fertilizer usage. The damage in the skeletal system is due to the presence of high content of it in groundwater [33] The maximum content of fluoride showed in recycled water is 0.53± 0.002 mg/l, then the moderate value is seen in well water with 0.057± 0.001 mg/l, tap water with 0.056± 0.003 mg/l, bore well water with 0.042± 0.002 mg/l and canal water shows below the detectable limit.

The high recommended level of iron for drinking water is 0.3 ppm. The iron content is maximum in recycled water with 0.596± 0.002 mg/l and moderate value is seen in well water with 0.113± 0.001 mg/l, bore well water with 0.0913± 0.001 mg/l, tap water with 0.066± 0.003 mg/l followed by a lesser amount in canal water with 0.047± 0.002 mg/l. Sulphate is present in both natural water and wastewater. The maximum value of it is seen in recycled water with 15.2 ±0.20 mg/l, then the limited value is seen in canal water with 13.13 ±0.20 mg/l, well water with 10.6 ±0.2mg/l and bore well water with 5.42±0.01 mg/l. The lowest amount is shown in tap water with 0.9± 0.01 mg/l.The nitrite contamination is due to a low bacteriological status. According to WHO, the concentration of nitrite in all well water increased than the value of drinking water. In the study carried out by [29], nitrite contamination levels of water are between0.0014 and 0.066 mg/l. The maximum value is seen in bore well water with 0.181± 0.001 mg/l, and moderate value in well water with 0.073± 0.000 mg/l, recycled water with 0.05± 0.000 mg/l, 0.015± 0.001 mg/l, the lowest value is in tap water with 0.01± 0.001 mg/l.

Figure 2: The graph of chemical parameters for all water samples.



Heavy metals

Table 4: The FAO standard limit for irrigation water

Metals	FAO standard limit for irrigation water(mg/l)
Copper	0.2
Lead	0.1
Cadmium	0.1
Nickel	0.2
Chromium	0.1
Zinc	2.0

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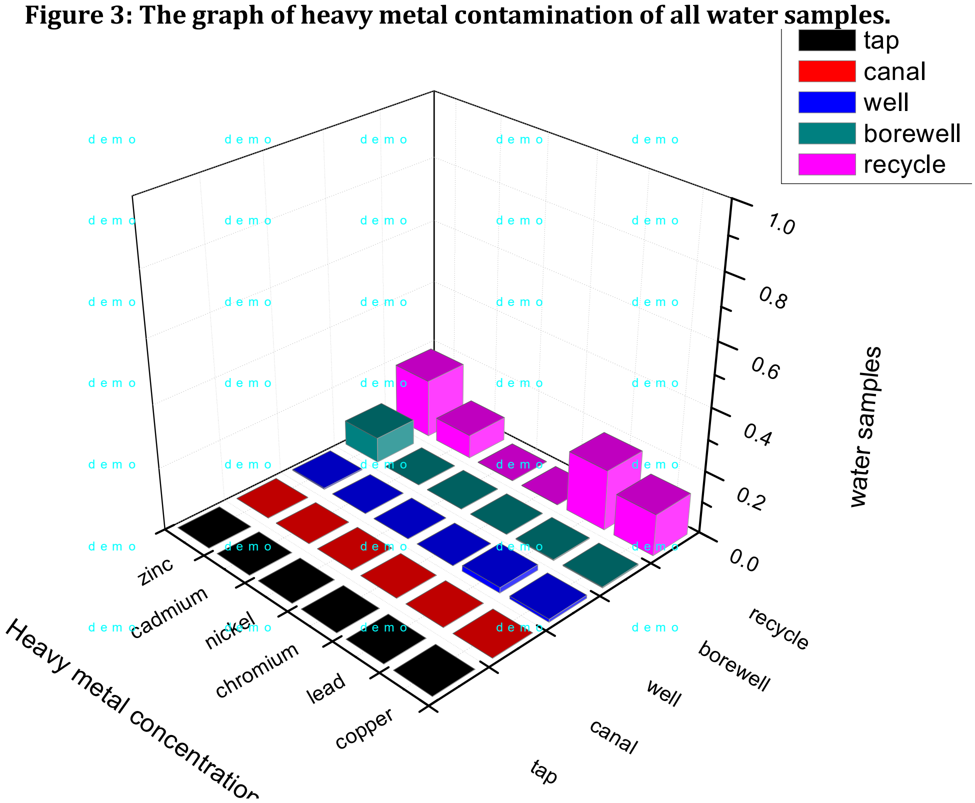
The maximum acceptable limit of concentration of copper is (0. l mg/L). The acceptable concentration of lead in drinking water by WHO and EPA is 0.05 mg/l [27], [58]. Although in some well water, the concentration of copper level ranged below the detectable limit to 0.87 mg/l [28], the result shows that the tap and canal water is below the detectable level and the recycled water shows 0.134 mg/L, then the bore well water and well water shows the value 0.0041 mg/L, 0.009 mg/L. According to KEBS and WHO, the maximum permissible level of drinking water is 0.1 mg/l [27], [11] ,[58]; [44]. The concentration level of lead is between the range from 0.003- 0.02 mg/l and below the permissible limit is 0.1 mg/l. The high level of concentration is due to activities such as agrochemical activities, industrial wastes and urban wastes [38], [41]. The result shows that tap water, and canal water is below the detectable level but the high value is seen in recycled water at 0.193 mg/l, then it gets decreased in bore well water at 0.003 mg/l and well water at 0.018 mg/l.

According to EPA and WHO, the acceptable concentration level of cadmium in drinking water is 0.01 mg/l and 0.03 mg/l respectively. In Germany, the recommended level is 6 mg/l and in South Africa, the standard is 5 mg/l [27], [58] , [47], [54].The collected water samples are below detectable levels except for recycled water with 0.077 mg/L. The high concentration permissible limit of Ni is0.2 mg/l in water [60]. In all the water samples, nickel ranged between the values 0.001 to 0.007mg/l which is below the permissible limit. The good quality of groundwater is considered by the value which is less than0.07 mg/L and it is used for other purposes [57]. The main source of nickel is ultramafic rocks [21]. The present study indicates that all the collected water samples show a value below the detectable level.

In all water samples the values of chromium range between 1.313 to 2.886mg/l [60]. The high value of chromium in groundwater is due to the presence of industrial sewage, agronomic and sewage run off and a small amount of chromium that is seen in basic rocks, ultramafic and soil [19]. The result findings reveal that all the collected water samples are below the detectable level. It is a metal which is present at a lower concentration in surface water it is because of its restricted movement from the place weathering of rock or natural sources. In water samples, the concentration of zinc ranged between 0.211 to 0.256 mg/l. The recommended limit of zinc in water is 5mg/l by WHO standards. The high concentration is seen due to the inputs of herbicides and pesticides and human activities [48]. The result shows that tap and canal water is below the detectable level, recycled water has a higher level of 0.189 mg/L, bore well water has mg/l, and well water shows a lesser value of 0.0041 mg/l.

Figure 3: The graph of heavy metal contamination of all water samples.



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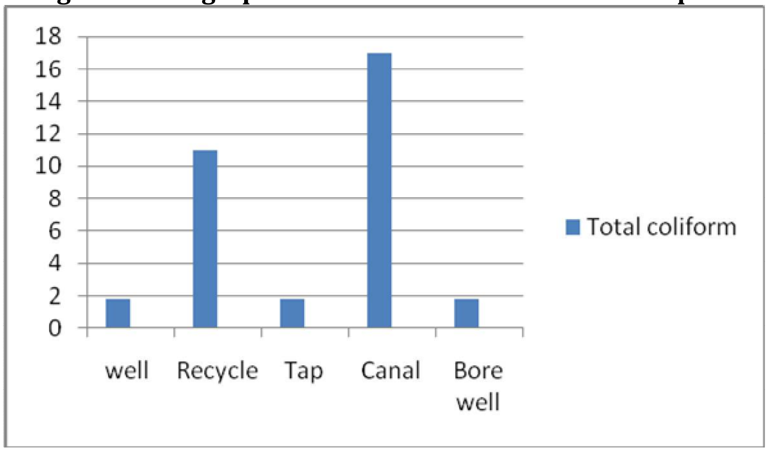
Total coliform and E.coli

The bacteriological studies were determined for the identification of total faecal and coliform bacteria. According to [56] and [25], *E. coli* or *thermo-tolerant coliform* bacteria must not be detectable and it is intended for drinking and other purposes. The total coliform and E. coli were seen higher in the private wells than in the public wells [43]. As per the Bureau of Indian Standards [13], counts should be less or equal to 10 CFU in 100ml which is a critical limit, which is accepted for drinking. [30]reported that an increase in the concentration level is due to the level of phosphorus in the water. This is helpful for the indication of coliform bacteria feeds on phosphates. In the present study, the result showed that the presence of total coliform in tap water, well water, and bore well water is less than 1.8 MPN/ 100 ml. The other water such as recycled water and canal water contains a total coliform count was 11 MPN/100 ml, and 17 MPN/100 ml. The bacteria E. coli was absent in all the water samples.

Figure 4: The graph of total coliform of all water samples.



CONCLUSION

The present study concluded that the result of all the parameters such as physicochemical parameters, heavy metal contamination were present within the critical limit. Therefore, all the water samples were used for irrigation purposes. The total coliform was present high in canal water.Due to the presence of high amount of mineral content except nitrate was seen in recycle water is used for irrigation purposes. The presence of high amount of nitrate in well water is due to the salinity. Hence all water samples are fresh and good for irrigation purposes.

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REFERENCES

1. Abboud (2014). Describe and statistical evaluation of hydrochemical data of Karst phenomena in Jordan: Al-Dhaher Cave Karst Spring. IOSR J Appl Geol Geophys (IOSR-JAGG) 2(3):23–42(e-ISSN: 2321–0990, p-ISSN: 2321–0982)
2. Adefemi S. O. and E. E. Awokunmi, (2010).Determination of physico-chemical parameters and heavy metals in water samples from Itaogbolu area of Ondo-State, Nigeria, African Journal of Environmental Science and Technology, 4(3): 145-148
3. Aneyo, I. A., Doharty, F. V., Adebesin, O. A. & Hammed, M. O.(2016).Biodegradation of pollutants in wastewater from pharmaceutical, textile and local dye effluent in Lagos, Nigeria. *Journal of Health & Pollution* **6**(12): 34–42 .
4. APHA (2017). Standard Methods for the Examination of Water and Wastewater (23rd ed.). Washington DC: American Public Health Association.
5. APHA (American Public Health Association) (2005) Standards methods for the examination of water and wastewater, 21st edn. American Public Health Association, Washington D.
6. APHA Standard Methods, 22nd ed., Method 3500-Fe B (1997). ASTM D 1068-77, Iron in Water, Test Method A
7. Ashin G. Godghate, Rajaram S. Sawant, Shobha D. Jadhav.(2009) "An evaluation of physico-chemical parameters to assess borewell water quality from Madyal and University; Issue 15 .
8. Ayeni, O. Assessment of heavy metals in wastewater obtained from an industrial area in Ibadan, Nigeria. *RMZ – Materials and the Geoenvironment* **61**, 19–24 (2014).2013; 2(1):68-73.
9. Baird, R., & Bridgewater, L. (2017). *Standard methods for the examination of water and wastewater.* 23rd edition. Washington, D.C., American Public Health Association
10. Bauder TA, Waskom RM, Sutherland PL and Davis JG (2014) Irrigation: Irrigation water quality criteria.

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Extension no. 0.506. Colorado State University, Colorado.
11. Baum, C., Wakane, N. and Peter, L., (2002). Evaluation of Agro-industrial By Products An nutrient Source for Plant Growth. *A Journal Archives of Agronomy and Soil Science*. **4:** 445-460.
12. BIS I (2012) 10500 Indian standard drinking water–specification, second revision. Bureau of Indian Standards, New Delhi
13. Bureau of Indian Standards-10500. Drinking water quality standards specification (p.8) (6th reprint, 2004). Bureau of Indian Standards (BIS), New Delhi; 1991
14. Chadrik Rout, Arabinda Sharma.(2011) Assessment of drinking water quality, a case study of Ambala cantonment area, Hariyana, India, International Journal of Environmental Sciences. 2(2):933-945.
15. Chari KVR, Lavanya MG.(1994) Groundwater contamination in Cuddapah urban area, Andhra Pradesh, In Proceedings on regional Workshop of Environmental aspects of groundwater development. KU, Kurukshetra, Kurukshetra, India.130-134.
16. Chiroma, T. M., Ebewele, R. O. & Hymore, F. K.(2014) Comparative Assessment of heavy metal levels in soil, vegetables and urban grey water used for irrigation in Yola and Kano. *International Refereed Journal of Engineering and Science* **3**(2):1–9 .
17. Chung SYS. Venkatramanan TH Kim, Kim DS, Ramkumar T.(2015) Influence of hydro geochemical processes and assessment of suitability for groundwater uses in Busan City, Korea, Environment, Development and Sustainability. 17(3):423-441.
18. Davis SN, Dewiest RJM (1966). Hydrogeology. John Wiley and Sons Inc, NY
19. Dixit S, Tiwari S (2008). Impact Assessment of heavy metal pollution of shahpura Lake, Bhopal. India Int J Environ Res 2(1):37–42
20. Duda-Chadak, A. & Blaszcyk, U.(2008) The impact of Nickel on human health. *Journal of Elementology* **13**(4): 685–696.
21. El Amari K, Valera P, Hibti M, Pretti S, Marcello A, Essarraj S (2014). Impact of mine tailings on surrounding soils and ground water:case of Kettaraold mine, Morocco. J Afr Earth Sci 100:437–449
22. FAO (1994) Grain Storage Techniques: Evolution and Trends in Developing Countries. Edited by D.L. Proctor, FAO Consultant, FAO Agricultural Services Bulletin No. 109. Food and Agriculture Organization of the United Nations (FAO), Rome.
23. FAO, 2009. Groundwater Management in Saudi Arabia, Rome: Food and Agriculture Organization of the United Nations
24. FAO. 1970a Irrigation Development Plan: Lower Shire Valley, Malawi. Report by Lockwood Survey Corporation Ltd., Toronto. Report for FAO/UNDP/MAL, Annex III: Climate and Hydrology
25. Government of Pakistan (2007). Drinking Water Quality: standards for Pakistan, Ministry of Health, Health Services Academy in collaboration with WHO.
26. Gupta, D. P., Sunita and J. P. Saharan, (2009), Physiochemical Analysis of Ground Water of Selected Area of Kaithal City (Haryana) India, Researcher, 1(2):1-5.
27. Hanaa, M. S., Eweida, A. E., &Farag, A.(2000). *Heavy metals in drinking water and their environmental impact on human health*: 542–556. Cairo: ICEHM, Cairo University.
28. J.G. Gichuki, J.M. Gichumbi, (2012). "Physico-Chemical Analysis of Ground Water fromKihara Division, Kiambu County, Kenya",Journal of Chemical, Biological and Physical Sciences,2(4):2193-2200
29. Kholtei, S. (2002) Plaine de Berrechid; Caractérisations des eaux usées de Settat et de Berrechid; Evaluation de leurs impact sur la qualité des eaux souterraines et risque toxicologique.
30. Lim CH, Flint KP.(1989). The effects of nutrients on the survival of Escherichia coli in lake water. Journal of applied bacteriology. 66(6):559–69. https://doi.org/10.1111/j.1365-2672.1989.tb04578.x PMID: 2666382
31. M. Rupal, B. Tanushree, and C. Sukalyan, (2012)—Quality characterization of groundwater using water quality index in Surat city, Gujarat, India,|| *Int Res J Env. Sci*.1(4): 14–23.
32. Makwe E, Chup CD.(2013). Seasonal variation in physicochemical properties of groundwater around Karu abattoir. Ethiopian Journal of Environmental Studies and Management,6(5):489-497.
33. Mangale Sapana M, Chonde Sonal G, Raut PD.(2012). Use of Moringa Oleifera (Drumstick) seed as Natural Absorbent and an Antimicrobial agent for Ground water Treatment, Res. J. Recent Sci. 1(3):31-40.
34. Mangukiya Rupal, Bhattacharya Tanushree, Chakraborty Sukalyan,(2012). Quality Characterization of Groundwater using Water Quality Index in Surat city, Gujarat, India, International Research Journal of Environment Sciences.1(4):14-23. ISSN 2319– 1414.
35. Mansourri, G. & Madani, M. (2016) Examination of the level of heavy metals in wastewater of Bandar Abbas Wastewater Treatment Plant.*Open Journal of Ecology* **6**: 55–61, https://doi.org/10.4236/oje.2016.62006 (2016).
36. Mato, R. R. A. M. (2002). Groundwater pollution in urban Dar es Salaam, Tanzania : assessing vulnerability and protection priorities. [Phd Thesis 2 (Research NOT TU/e / Graduation TU/e), Chemical Engineering and Chemistry]. Technische Universiteit Eindhoven. https://doi.org/10.6100/IR554794.
37. Mohamed Hanipha M, Zahir Hussian A. (2013). Study of Groundwater Quality at Dindigul Town, Tamilnadu, India, international journal on environmental sciences. Vol. 2(1), 68-73
38. Mwamburi, J., (2000). Trace Metal Concentration in Water and Sediments of Satellite Lakes within the Lake Victoria (Kenya) basin. *Lake Research management* **1:** 13-23.
39. N. Manivaskam, (2011). Physicochemical Examination of Water Sewage and Industrial Effluent, Pragati Prakashan, Meerut, India, 6th edition.

40. National Health and Medical Research Council (NHMRC). Australian Drinking Water Guidelines 6, 2011; National Water Commission: Canberra, Australia, 2011; Volume 3.4 : 1–1142.
41. Omwoma, S., (2011). MSc thesis of Maseno University on Impact of Agronomic Input in Sugarcane Farming on Total Heavy Metal Level in Aquatic Ecosystem and Soil with Lake Victoria, Basin Kenya :1-14.
42. Plum, L.M.; Rink, L.; Haase, H.(2010) The essential toxin: Impact of zinc on human health. Int. J. Environ. Res. Public Health**.** 7:1342–1365
43. Province of Alberta Public Health Act: Recreation area regulation: Alberta Regulation 198/2004 with amendments up to and including Alberta Regulation 85/2012. quality guidelines for Pakistan, Proposed by WWF Pakistan through consultation with stakeholders.2007:1-30
44. Ragan, P. and Turner T., (2009) Working to Prevent Lead Poisoning in Children: Getting the Lead out. *Journal of the American Academy of Physician Assistants* **7**:40-45.
45. Riordan, O', E. G., Dodd, V. A., Tunney, H., Fleming,G. A, (1983) The chemical composition of sewage sludges, *Ireland Journal of Agriculture Research.* 25: 239-49.
46. Sawyer C, McCarty P and Parkin G (1994) *Chemistry for Environmental Engineering* (Singapore:McGraw-Hill, Inc)
47. Schutte, R., Nawrot, T. S., Richart, T., Thijs, L., Vanderschueren, D., Kuznetsova, T., et al. (2008). Bone resorption and environmental exposure to cadmium in women: a population study. ***Environ. Health Perspect.*** 116 (6): 777–783. doi:10.1289/ehp.11167
48. Shen F, Liao R, Ali A, Mahar A, Guo D, Li R (2017) Spatial distribution and risk assessment of heavy metals in soil near a Pb/Zn smelter in Feng County, China. Ecotoxicol Environ Saf 139:254–262.
49. Simeonov V, Stratis JA, Samara C, Zachariadis G, Voutsa D, Anthemidis A *et al*. (2003).Assessment of the surface water quality in Northern Greece. Water Resources. 37:4119-4124.
50. SON (2007) Nigerian Standard for Drinking Water Quality. Sttandard Organization Nigeria (SON).
51. Spellman (2014). Handbook of water and wastewater treatment plant operations, 3rd edn. Taylor and Francis group, ISBN: 978-1- 4665-5385-5
52. U. S. Salinity Laboratory Staff U.S.D.A. Agricultural Handbook 60, Washington, D. C., Government Printing Office. 160 : 1954.
53. Varadarajan N, Purandara BK, Bhism Kumar (2011).Assessment of groundwater quality in Ghataprabha Command area, Karnataka, India, J. Environ. Science and Engg.53(3):341-348.
54. Walakira, P. and Okot-Okumu, J. (2011) Impact of Industrial Effluents on Water Quality of Streams in Nakawa-Ntinda, Uganda. Journal Applied Science and Environmental Management, 15: 289-296.
55. Wetzel RG (2001) Limnology. Academic Press, London.4(14) :1006.
56. WHO (2011). *Guidelines for Drinking-water Quality* (4th edition), Malta: Gutenberg WB-CWRAS, 2005.*Pakistan Country Water Resources Assistance Strategy*, water economy: Running dry. Report No. 34081-PK. Washington DC: The World Bank, November 14, 2005.
57. World Health Organization (2017) Guidelines for drinking-water quality.Fourth edition Incorporating the first addendum:1–63.
58. World Health Organization. (2004). The World health report : 2004 : Changing history. World Health Organization.
59. Young, W.F., H. Horth, R. Crane, T. Ogden and M. Arnott (1996). Taste and odour .
60. Zaigham Hassan, Zubair Anwar, Khalid Usman Khattak, Mazhar Islam, Rizwan Ullah Khan , Jabar Zaman Khan Khattak; et al.(2012). "Civic Pollution and Its Effect on Water Quality of River Toi at District Kohat, NWFP" , Research Journal of Environmental and Earth Sciences. 4(5)

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