



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJIRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 6, June 2022

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 8.118



9940 572 462



6381 907 438



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# Physico-Chemical Analysis of Water Collected from Various Sources in Peren District, Nagaland-A Preliminary Study

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**ABSTRACT:** The present investigation is aimed at analyzing the different spring water (30 samples) from Peren district, Nagaland, India using Physico- chemical parameters and comparing the result values with BIS and WHO standard. The following Physico-chemical parameters TDS, EC, DO, BOD, ORP, Total hardness, calcium, magnesium, alkalinity, chloride, iron, Sulphates, phosphate and pH, were assessed via titrimetry, suitable test kits, photometer . Most of the result values were found to be a little lower but of acceptable range. For TDS (Total Dissolve Solids) almost all the 30 samples fall in the permissible limit. In the case of EC (Electrical Conductivity), TH (Total Hardness) the values for all 30 samples were found to be within the permissible limit. As for Calcium and Magnesium, the values are within permissible limit which indicates the nature of the water to be soft. And for Chloride, the concentration ions are low, for Iron only a few samples contain 1 or 2mg/L of iron. Phosphate levels are not high, in case of Sulphate, all the 30-water samples are below 20. As for DO (Dissolve Oxygen), 25 samples are within permissible limit and 5 samples are below as given by BIS and WHO. Similarly, for BOD (Biological Oxygen Demand), almost all the samples fall within the permissible limit. For ORP, the values are quiet high which allows us to consider the spring to be clean. This study shows that the water quality in Peren district is not polluted and can be used from domestic as well as drinking purposes.

**KEYWORDS:** Water quality, pH, TDS, EC, TH, Alkalinity, Ca, Mg, ORP, DO, BOD

## I. INTRODUCTION

The main feature of this work deals with the physico-chemical analysis of water collected from various sources (especially spring water) of Peren district, Nagaland, India. Nagaland state lies between 25°60' and 27°40' latitude North of equator and 93°20' and 95°15' longitude and having an area of 16578km<sup>2</sup>[1]. According to climate Research and Services India Meteorological Department, Ministry of Earth Science Pune, Peren district receives an annual rainfall of 1404.6 mm and has Coefficient of variation (CV) equal to 86. The temperature ranges from 2- 25°C and humidity from 25- 98%. In Nagaland, natural springs and the dug well are the only viable means of utility and to fulfill the human need of fresh water for this present world. In hilly region most of the drinking water is harnessed from natural springs and rivers [1]. Spring water plays an important role for the people residing in Peren district. Springs supply water for livelihood, drinking, livestock and irrigation in the paddy fields. Water is appraised as a necessary resource and life preservative. But the main problem is the access to clean water where many villages, towns, cities lack access to safe and clean drinking water. The insufficient availability of clean water results in a great problem in human life such as health issue, economic crisis in a family [2]. Currently, due to increasing population, the demand of water supply has been increasing tremendously. Human activities interfere in many ways with natural water cycle and affect the society water relationship. The spring and fresh water which is very precious and limited and a vital resource needs to be protected, conserved and used judiciously and wisely by men for a sustainable life [3]. Water quality concerns are often the most important component for measuring access to improved water quality and sources [4]. Acceptable quality shows the safety of drinking water in term of its physical, chemical and bacteriological parameters. Depending on their perception on odour, taste and appearance the quality of water is known [5]. Management of water is not a very easy task because only one person cannot manage the quality of water. We need a collective effort to improve the quality of water and management of water quality is by far the most concern in today's life [6]. The study of water quality conducted for the water samples, were collected from different water sources under Peren district. The result of water analysis gives a great knowledge about the water quality, acidity, alkalinity, its chemical constituents, whether the

spring water is hard or soft and whether the water can be used directly in the household and drinking water. Knowledge of water quality is a very important measure for a sustainable life [7].

## II. RELATED WORK

**Gaetano Ragno, Michelle De Luca (2007)** [6] studied an application of cluster analysis and multivariate classification methods of spring water, monitoring data in the land of Serra St. Bruno, Calabria Italy. They studied the presence of multiple variables and monitoring it by different parameters for each spring water. They analyzed 30 parameters for each water sample. The results show that high nitrate content was ascribed to the practice of crop rotation by using nitrogenous fertilizers.

**Lilia Voahangiarilala Rasofomanana, 2009** [8] had analysed the Ranofana lake and their analytical parameter were systematically recorded. The analysis proceeded and the temperature difference was found to be 2<sup>0</sup>C from morning to afternoon. The water pH was slightly alkaline from 7.17 to 8.12 in the surface and the bottom is from 7.1 to 7.95. Due to photosynthesis the dissolved oxygen increased from morning to the afternoon i.e. 4-8 mg/L but did not experience oxygen depletion and the whole water is aerobic. But the lake had high phosphorus and algae concentration which increase water turbidity. To improve the lake, they recommend to reduce nutrients loads, promote algae growth and to remove the excess algae which turbid water.

**M. Pamei, G. Naresh, D. Dutta, A. Puzari (2020)** [9] examined the surface and groundwater water quality in Dimapur city. They collected 15 water sample from different parts of Dimapur during post-monsoon and perform 20 physico-chemical parameters such as Temperature, pH, DO, Conductivity, Total Dissolve Solid, Salinity, Turbidity, Hardness, Aluminium, Cr, Fe, Mn, Ag, Zn, Fluoride, Nitrate, Nitrite, Phosphates and Sulphates. Except heavy metals such as Fe, Mn and nutrient phosphate levels, other parameters show within the permissible limit. The result shows that Dimapur city groundwater is contaminated and expecting to identify more with further analysis. To detect other contaminants and any changes in the water sources the surface and groundwater needs to be regularly monitored. A systematic field- base study was done to analyze the quality of water and possible health hazards component present in drinking water.

**T. Tiakaba Jamir and R. K Bhubon Singh (2010)** [1] analyzed the water samples from three different district under Nagaland, India and studied physico- chemical parameters like temperature, pH, conductivity, TDS, total hardness, DO, BOD, and COD. Trace elements such as iron, copper, zinc, nickel, manganese and non- trace element such as lead, cadmium, silver and arsenic was determined. From the analytical result the collected water sample shows within a permissible limit given by ISI and WHO. For essential and non- essential trace element the concentration was evaluated by using Atomic Absorption Spectroscopy. The concentration of lead, cadmium and manganese in water sample was within the evaluated values given by WHO guidelines for domestic water.

## III. OBJECTIVE OF THE STUDY

The objective of this research is to assess the Physico- Chemical parameters of spring water from Peren district, Nagaland, India and to analyze the water sample quality with reference to BIS and WHO standard, and to impart knowledge about the importance of water and how to improve the water quality when needed, and to manage the water resources properly.

**Study area and Sampling Site** :Peren district is a hilly region with a total area 1799 Sq km with a density of 41 per sq km and located at the bottommost part of the Nagaland state with 25 31'00 -26 52'00 N latitude and 93 39'00- 93 66'00 E longitude bounded by Assam state in the west, Dimapur district in the north western, Kohima district in the east and Manipur state in the south part and mainly inhabited by Zeliang and Kuki tribes. The terrain is mountainous with an altitude of 1445m. Under Peren district, the total population as of 2021 is 105,694 out of which 13,790 are in urban area and 81,615 are in rural area. 2860 households are in urban 15,615 are in rural area. 9,849 literate people are in urban, 52,355 are in rural area. Peren is divided into 7 subdivisions i.e Pedi, Jalukie, Athibung, Khelma, Nsong, Tening and Peren as on 2011 census.





Fig.1 Map of Nagaland



Fig. 2 Map of Peren

#### IV. METHODS AND METHODOLOGY

In this study, 31 water samples were collected from different springs in mineral water bottles 300ml, 500ml, 1000ml capacity and the experiment was conducted at the college departmental laboratory.

The following physico- chemical parameters and their methods of determination are shown below :-

Parameters	Method of determination
pH	EZ-9908
TDS	EZ-9908
EC	EZ-9908
TH	EDTA- Titrimetry
Calcium	EDTA- Titrimetry
Magnesium	EDTA- Titrimetry
Alkalinity	HCl- Titrimetry
Chloride	AgNO <sub>3</sub> - Titrimetry
Iron	Test kit (HI 3834)
Sulphate	Test kit (HI38001A-0)
DO	Benchtop meter (H15421)
BOD	Benchtop meter (H15421)
ORP	ORP meter (H198201)
Phosphate	Multiparameter Photometer (H183300)

Table 1:- Method of determination of water quality parameters

Spring Name	Village Name	pH	TDS (mg/L)	EC ( $\mu$ S/cm)	DO (mg/L)	BOD (mg/L)	ORP (mV)	Iron (mg/L)
Keba	Gaili	4.5	39	75	4.8	3.1	341	0
Keba	Gaili-1	5.1	9	18	4.21	3.7	365	0
Neitou	Gaili	5.3	225	495	4.3	3.6	495	0
Keba	Gaili 2	5.5	18	43	4.4	3.7	312	0
Gingkang Teko	Punglwa	7.1	49	99	4.3	3.6	241	0
See	Inbung	5.5	55	111	3.7	4.3	326	1
Tinbadi Teko	New Peren	5.9	55	114	4.4	3.5	213	1
Keyidwolung Teko	New Peren	6	140	70	4.5	3.5	213	0
Spring 1	Shikavi	5.9	40	82	4.1	3.9	225	0
Spring 2	Shikavi	5.8	30	60	4	4	245	0
Spring 1	Ghokuto	5.9	38	76	4.6	3.3	240	0
Spring 2	Ghokuto	6.4	26	51	4.2	3.7	235	0
Spring 3	Ghokuto	6.6	67	135	4.1	3.8	228	0
Spring 1	Hovishe	5.6	23	27	4.7	3.8	325	1
Spring 2	Hovishe	5.8	77	47	4.6	3.4	303	1
Spring 1	Kiyezu B	6	99	154	4.6	3.3	240	0
Spring 2	Keyezu B	5.8	13	198	4	3.9	310	0
Spring 1	AK	5.5	30	57	4.6	3.3	235	0
Spring 2	AK	5.4	28	53	5.3	2.6	253	0
Rikhuba	Jalukieyangdi	6.3	^	50	4.1	3.8	301	0
Peicing Teko	Old Jalukie	7.1	231	463	4.2	3.7	280	0
During	Beisumpuikam	6.1	21	41	4.4	3.5	290	0
Sepoy luikhuh	Inbung	6.1	35	71	4.3	3.6	308	1
Living water	Jalukieyangdi	5.9	61	122	4.31	3.6	310	2
Longkhai	Inbung	6.2	14	26	1.4	6.5	270	0
Baptist Church	Jalukieyangdi	6	61	123	4.8	3.8	278	1
Lulkuh	New Chalkot	5.3	36	72	4.4	3.5	304	0

Mutsuba	Jalukiezangdi	6.1	20	40	4.3	3.6	295	0
Rukhroba	Jalukiezangdi	6	21	42	4.3	3.6	301	0
Nrimbam	Beisumpuikam	5.6	56	113	4.4	3.5	273	0

Table 2:- Obtained values of pH, TDS, EC, DO, BOD, ORP and Iron.

Spring Name	Village Name	Ca (mg/L)	Mg (mg/L)	Alkalinity (mg/L)	Cl (mg/L)	SO <sub>4</sub> <sup>2-</sup> (mg/L)	PO <sub>4</sub> <sup>3-</sup> (mg/L)	TH (mg/L)
Keba	Gaili	4	21.1	17.5	9.9	<20	90	49
Keba	Gaili 1	7.2	26.4	17.5	7.2	<20	60	58
Neitou	Gaili	12	26.4	30	21.3	<20	30	54
Keba	Gaili 2	4.8	15.8	22.5	11.4	<20	60	48
Gingkang Teko	Punglwa	20	23.7	20	11.4	<20	10	96
See	Inbung	4	22.4	10	7.1	<20	20	48
Tinbadi Teko	New Peren	5.6	25.1	20	18.5	<20	50	88
Keyidwolung Teko	New Peren	12.8	64.6	45	5.7	<20	10	130
Spring 1	Shikavi	8.8	52.7	35	11.4	<20	20	102
Spring 2	Shikavi	4	59.3	25	7.1	<20	20	100
Spring 1	Ghokuto	7.2	36.9	30	4.3	<20	0	74
Spring 2	Ghokuto	8	29	4.5	4.3	<20	20	64
Spring 3	Ghokuto	12	42.2	45	4.3	<20	0	94
Spring 1	Hovishe	6.4	34.3	10	4.3	<20	0	68
Spring 2	Hovishe	1.6	39.6	18.5	3.7	<20	30	64
Spring 1	Keyizu B	3.2	87	40	8.5	<20	0	140
Spring 2	Keyizu B	6.4	72.5	50	19.9	<20	20	126
Spring 1	AK	4	46.2	25	7.1	<20	0	80
Spring 2	AK	5.6	33	50	5.7	<20	0	64
Rikhuba	Jalukiezangdi	28.9	58	35	12.8	<20	0	160
Peicing Teko	Old Jalukie	18.4	62	65	7.1	<20	10	140
During	Beisumpuikam	11.2	92.3	85	2.8	<20	20	98
Sepoy luikhuh	Inbung	15.2	44.8	55	1.4	<20	90	132
Living water	Jalukiezangdi	42.5	112	47.5	8.5	<20	80	276

Longkhai	Inbung	6.4	46.2	27.5	12.8	<20	90	86
Baptist Church	Jalukiezangdi	48.1	72.5	52.5	3.7	<20	60	136
Lulkuh	New Chalkot	14.4	8	60	4.3	<20	40	196
Mutsuba	Jalukiezangdi	25.7	229	120	2.8	<20	30	386
Rukhroba	Jalukiezangdi	9.6	31.6	95	4.3	<20	20	123
Nrimbam	Beisumpuikam	32.1	12	1.5	3.8	<20	70	112

Table 3:- Obtained values of Calcium, Magnesium, Alkalinity, Chloride, Sulphate, Phosphate and TH.

#### IV. RESULTS AND DISCUSSION

**pH** : pH is most important in determining the corrosive nature of water. Lower the pH value higher is the corrosive nature of water [10]. As per BIS and WHO the samples collected for analysis showed that the maximum pH was 7.1(Gingkang Teko and Peicing Teko) and the minimum pH was found to be 4.5(Keba 1). Out of 30 samples, majority of the sample was found to be acidic and only 3 sample falls within the desirable limit. This shows that spring water of Peren slightly acidic in nature.

**TDS (Total Dissolved Solids)**: TDS is the amount of organic and inorganic materials such as metals, minerals, salts and ions dissolved in a particular volume of water. From the present analysis, the TDS values for all the 30 samples were found to be moderate. The maximum value was found to be 231 mg/L (Peicing Teko) and the minimum values found to be 9 mg/L (Keba 2).

**EC (Electrical Conductivity)**: Electrical conductivity is a measure of water capacity to convey electric current. It signifies the amount of total dissolved salts[11].In the present study, the values measured for EC (Electrical Conductivity), the maximum value was found to be 495 $\mu$ S/cm (Neitou spring) and the minimum value was found to be 26 $\mu$ S/cm (Longkhai spring). So all 30 water samples were within the permissible limit as per BIS and WHO guidelines.

**DO (Dissolved Oxygen)**: Dissolved oxygen is important parameter in water quality assessment and reflects the physical and biological processes prevailing in the water. The DO values indicate the degree of pollution in water [12]. DO levels below 3 mg/L are of concern and water with levels below 1mg/l are considered hypoxic and usually devoid of life. The measured values for all the 30 samples range between 1.4mg/L–5.3mg/L. Only 5 samples are below the permissible limit.

**BOD (Biological Oxygen Demand)**:BOD is the amount of dissolve oxygen required by aerobic organisms to break down organic material present in the water. The BOD is an important parameter for assessing water quality In this case, the BOD values varied from 2.6mg/L – 6.5mg/L. As per WHO standard 29 water samples were within the permissible limit, except 1 sample (Longkhai spring) which was found to be of higher value (6.5mg/L).

**ORP (Oxidation Reduction Potential)**: ORP measures the ability of a lake, pond, or spring water to cleanse itself or break down waste products. In general, the higher the ORP values the healthier the spring water. This is due to the action of bacteria in the sediments to decompose dead tissues which use up the available oxygen. In the present study, the ORP values ranges from 213mV - 495mV, this denotes high ORP values thus indicating healthy springs.

**Iron**: Water containing ferrous iron is clear and colorless because the iron is completely dissolved but on exposure to air, the water turns cloudy and a reddish brown substance begins to form. Iron is considered a secondary or aesthetic contaminant. In the present analysis the Iron contents is zero for 23 of the water sample while 6 samples values were found to be 1 mg/L and one of the sample was found to be 2 mg/L.

**Calcium**: Calcium is naturally present in water. It may dissolve from rocks such as limestone, marble, calcite, dolomite, etc. In the present analysis for Calcium, for 30 samples the titrated values found to be between 1.6mg/L - 48.1mg/L which is, within the permissible limit indicating the water sample to be soft and safe for drinking and livestock uses.

**Magnesium**: Magnesium is also naturally present in water and is required by the human body. Mg is a mineral which the body uses as an electrolyte. As per the WHO guidelines out of the 30 water samples analyzed, 29 samples was found to be within the permissible limit, except Mutsuba spring which was found to be 229.4.

**Alkalinity**: The alkalinity refers to a measure of the ability of the water body to neutralize acids and bases and thus maintain a fairly stable pH level. In the present study it was found to be within the permissible limit given by WHO standard with the maximum value at 120 (Mutsuba) and the minimum value at 1.5 (Nrimbam). Based on these values, the water is considered to be neutral and fit enough for human consumption.

**Chloride:** Chloride is a naturally occurring element common in most natural waters and often found as a component of salt (sodium chloride) or in some cases in combination with potassium or calcium. As per the BIS and WHO guidelines the optimum value is below 250mg/L and the analyzed water samples values ranges between 1.42mg/L - 19.9mg/L. This relatively low concentration of Chloride will result water tasteless but still can be used for drinking water and domestic purposes.

**Sulphate:** Sulphate occurs naturally in water as a result of leaching from gypsum and other common minerals[13]. In the current study, Sulphate is found to be lesser than 20 mg/L. From this result it is seen that the spring water is clean and free from algae too.

**Phosphate:** During the natural process of weathering, the rock gradually releases the phosphorus as phosphate ions which are soluble in water. Phosphate in water feed algae, which grow out of control in water ecosystem. From the present analysis of water, the values ranged from 90 mg/L - 0 mg/L indicating clean water.

**TH (Total Hardness):** Total hardness is a chemical parameter of water that represents the total concentration of calcium and magnesium ions. In the current analysis for Total Hardness, 29 of the sample values ranged between 48 mg/L – 196 mg/L, i.e within the permissible limits and only spring Mutsuba was found to have a relatively high value i.e 386 mg/L.

## V. CONCLUSION

For the analysis of different water samples under Peren district, we can conclude from the results that:

The pH values ranged from 4.5 – 7.1, out of which majority of the water sample were found to be acidic. For the TDS, almost all the water samples are within the permissible limit and few may be lower. EC (electrical conductivity) is within the permissible limit as per the study, TH (total hardness) of the water sample is found within the permissible limit except in 1 (Mutsuba) is 386mg/L, thus the water can be termed as soft water. For Calcium all the samples are within permissible limit and safe for drinking water, for Magnesium, 29 samples are within the permissible limit, except 1(Mutsuba spring) which is beyond the BIS and WHO standard, for Alkalinity the values are within the permissible limits, For Chloride the analyzed results show a low concentration range from 1.42mg/L – 19.9 mg/L but this spring water is still useable for domestic purpose. Most of the springs were found to be free from Iron, except 7 samples which had Iron content of 1 mg/L – 2 mg/L. Also, for Sulphate all the water sample shows value below 20 mg/L, thus the springs are considered to be healthy and clean. As for DO (dissolve oxygen), from the analyzed result, only 5 samples are below permissible limit and the rest is within the permissible limit, which shows an enough present of oxygen in the spring/ water. Similarly, for BOD (biological oxygen demand), the calculated values ranges from 2.6mg/L – 6.5mg/L which falls within the permissible limit indicating that organic materials are absent. As for ORP (oxygen reduction potential), all 30 water sample has high ORP values, which indicates the clean nature of water fit for drinking and domestic used too. Lastly, for Phosphate, the resulted values are not as high thus the spring water can be considered clean.

From the above result, we conclude that for the parameters that were analyzed, majority of the water samples fall within the permissible limit which makes it good enough for drinking, household used, domestic purpose and livestock uses too.

**ACKNOWLEDGMENT:** The Authors are grateful to the Department of Land Resource, Government of Nagaland for all the help and support for successful completion of this work.

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