Pearson and Regression Model Analysis of Ground water Quality Assessment of Hilly and Ganges Region of Sahibganj Town.

Anil Kumar[1], Jyoti Kumari[2], Sourav Thakur[3], Tejaswani Sharma[3], Sanjay Kumar Pandit[3], Puja Kumari[3]

1.Asst. professor [1],(H.O.D),P.G Dept. of Chemistry, Sahibganj College, Sahibganj,S.K.M.U, DumkaUniversity.
2. Asst. professor [1], (H.O.D), Department of Library and Information Science, Sahibganj College,Sahibganj, S.K.M.U, Dumka University.
3. P.G. Final Year, P.G.Dept. of Chemistry, Sahibganj College, Sahibganj, S.K.M.U, Dumka

Abstract –

The research aims to analyze co-relation between surface water quality parameters of Hilly and Ganges region of Sahibganj town on the basis of physical, chemical parameters like temperature, pH, DO (Dissolved solid), BOD (Biological oxygen Demand), COD (Chemical oxygen demand), TDS (Total Dissolved Solid), Turbidity, Fluoride, Total Alkalinity, Total Hardness, Calcium, Magnesium, Arsenic, etc. Pearson co-relation is determined using co-related matrix to identify the highly co-related and interrelated water quality parameters. To test the significance of the pair of parameters,r-value is carried out. There is relationship between variables which shows that how one variable affects the other variable. The highest co-relation exists for Hardness with Calcium and Magnesium, while the minimum correlation exists between Alkalinity -pH and Fluoride-TDS. The regression model has been used to show how well the regression fits well with the observations; the Rvalue shows the variance between the observations.

***Keyword*: - Ground water, Hilly & Ganga region, Co-relation, Sahibganj town, Water quality parameters.**

1. STUDY AREA

Sahibganj Town has been selected as the study area which comes under the jurisdiction of Sahibganj district shown in Fig 1.Sahibganj town (Latitude 25.2381°N and longitude 87.6454°E) is a Scenic town and a port city with the sacred Ganga and the sturdy hills in the Sahibganj District of Jharkhand state India [1]

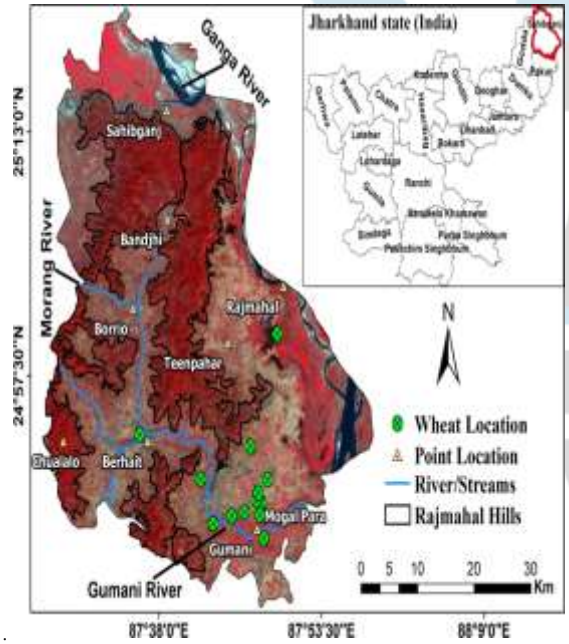

Fig 1: Map of Sahibganj district.

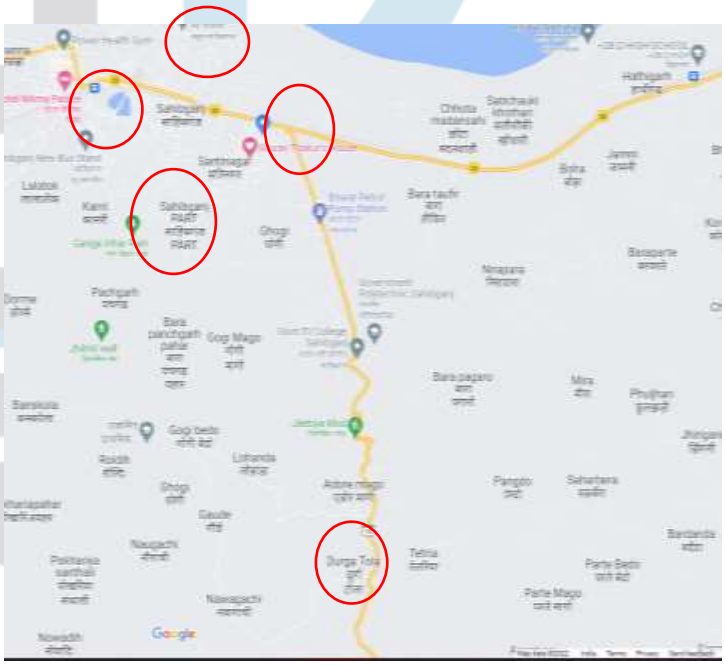

Fig 2: Study area in Sahibganj town indicated by circle.

2. WATER SAMPLING

The sample study has been done in 5 locations of Sahibganj town Fig. 2,like Durga Tola (D.T), Katarganj(K), Sahaibganj Park (S.P), College Campus (C.C) and Purani Sahibganj(P.S) while moving from the Hilly region towards the Ganga region with proper longitudes and latitudes accuracy.The water samples were collected in plastic bottles which were collected with acid water followed by rinsing twice with distilled water. The water samples were chemically analysed using standard methods. These various parameterswere pH, TDS, Turbidity, Fluoride, Hardness, Calcium, Magnesium and Arsenic.

3. INTRODUCTION

Most of the earth surface is covered with water but the availability of fresh water is limited for human consumption [2]. As per UNICEF, less than 50 per cent of the population in India has access to safely managed drinking water. Chemical contamination of water, mainly through Fluoride and Arsenic, is present in 1.96 million dwellings. The quality of the ground water is cleaner than surface water so it is an indispensable renewable resource on earth as it is recharged, recycled and filtered through natural process hence is free from pollution and other contamination [3].Water plays an essential role in the life of all human beings. It supports all types of uses, drinking irrigation and Industrial uses [4].The quality of water can be equated with the health risk of an individual therefore the evaluation of water quality is very important all around the world [5]. Water quality evaluation can be done on various method of which regression modelling method has been chosen to study the various parameters of the groundwater in the Hilly and Ganges regions [6]. The main source of groundwater in the region comes from two sources that being rain fall and Ganges water therefore rainfall plays a vital role in recharging the groundwater [7]. The quality of groundwater depends on hydro chemical processes normal, physical and compound condition of water through regional hydrogeological and anthropogenic actions [8]. The Groundwater composition change is dependent upon rock and water interaction, temperature, mineral dissolution, the duration of interaction and other anthropogenic activities in the hilly and Ganges region [9]. The study is intended to investigate the quality of drinking water and the influence it has on the human health particularly in this region. This study would prove to be beneficial in assessing the groundwater resource and its suitability for human consumption. It also aims to identify the relationship between water quality and health hazards[10]. Water contamination has posed severe threat of water borne diseases in developing countries and can be associated with unhygienic conditions and degraded water quality. The degradation, depletion and contamination are major concern originating due to the modern agricultural practices, industrialization and urbanization for the increasing population [11-12].

4. MATERIAL AND METHODS

The pH was measured bythe pH meter. Total Hardness, Calcium, Magnesium, was measured by EDTA preparation method. Total Alkalinity was determined by volumetrically by Silver Nitrate Titrimetric method using Potassium Chromate as indicator. Fluoride content in water was measured by Spectrometric Method. Turbidity and TDS were measured with the help of digital water kit. Nitrate was determined by Phenol Di sulphonic method. All the investigations were done by standard methods [13, 14, 15, 16].

Parameter	Durga Tola (D.T)	Katarganj (K)	Sahibganj Park (S.P)	College Campus (C.C)	Purani Sahibganj (P.S)	Mean	Median	Mode	S. D
pH	6.67	7.0	7.27	7.0	7.0	6.988	7.0	7.0	0.212
TDS (mg/l)	342	192	120	246	136	207.2	192	N/A	90.25
Turbidity (NTU)	4.0	3.0	4.3	2.0	3.0	3.26	3.0	3.0	0.91
Fluoride(mg/l)	0.38	0.19	0.42	0.39	0.39	0.354	0.39	0.39	0.092
Total Alkalinity (CaCo3) (mg/l)	242	210	246	226	130	210.8	226	N/A	47.36
Total hardness(mg/l)	600	600	292	436	182	422	436	N/A	185.78
Calcium(mg/l)	166.2	151.2	77.6	109.6	56.8	112.28	109.6	N/A	46.66
Magnesium(mg/l)	43.68	53.28	23.52	38.88	9.6	33.79	38.88	N/A	17.27
Total arsenic(mg/l)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	0.0

Table 1: Analysis Table of GroundWater near Sahibganj Hills and Ganges Region

Sl.No:	Water quality parameters	Minimum	Maximum
1	pH	6.67	7.27
2	TDS	120	342
3	Turbidity	2.0	4.1
4	Fluoride	0.19	0.42
5	Total Alkalinity	130	246
6	Total Hardness	182	600
7	Calcium	56.8	166.2
8	Magnesium	9.6	53.28
9	Arsenic	0.0	0.0

Table 2: Statistics of the Analytical Results in Hilly and Ganges Region

Pairs of parameters	Regression equation	R- square%
pH – Calcium	pH=6.688 +0.006 Calcium	79.52
TDS – Calcium	TDS=86.7 +1.736 Calcium	95.45
TDS – Turbidity	TDS=68.7 + 2.77 Turbidity	94.20
Turbidity – Calcium	Turbidity=2.78 + 0.16 Calcium	07.64
Alkalinity -Hardness	Alkalinity=144.8 + 1.32 Hardness	77.67
Alkalinity – Calcium	Alkalinity=130.2 + 1.456 Calcium	85.42
Hardness-Calcium	Hardness=136 + 5.72 Calcium	94.79
Hardness-Magnesium	Hardness=345.8 + 25.4 Magnesium	04.67
Calcium -Magnesium	Calcium =39.18 + 1.462 Magnesium	98.16

Table 3: - Correlation Coefficient and Regression Equation for some pairs of Parameters

	pH	TDS	Turbidity	Fluoride	Alkalinity	Hardness	Calcium	Magnesium
pH	1							
TDS	-0.88567	**1**						
Turbidity	0.046978	-0.05253	1					
Fluoride	0.11687	-0.02755	0.222834	1				
Alkalinity	-0.01965	0.438134	0.356116	0.051365	1			
Hardness	-0.59349	0.749319	-0.00735	-0.59795	0.580733	1		
Calcium	-0.68382	0.804185	0.067397	-0.54	0.551158	0.989442	1	
Magnesium	-0.4105	0.617586	-0.13519	-0.67044	0.599795	0.968938	0.922872	1

Table 4: Pearson co-relation (r) study of Physico-Chemical analysis Hilly and Ganges Region area

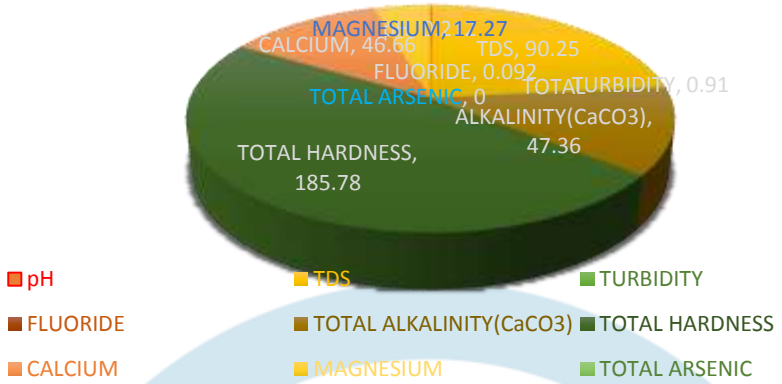

Fig 3: Standard Deviation Graph of Physico-Chemical Parameter of Ground Water Quality Assessment of Hilly and Ganga Region of Sahibganj Town

The standard deviation is a statistic that measures the dispersion of data set relative to its mean and is calculated as the square root of the variance by determining each data points relative to the mean. The higher the data the higher the deviation within the data set. It was calculated using the formula [17].

$$\sigma = \sqrt{{}^{1}/_{N} \sum_{i=1}^{N} (x_i - \mu)^2} \text{----------1}$$

Where: -

x_i isan individual value

μ is the mean/expected value

N is the total number of values

i is initial value

σ is standard deviation

As per the data in Fig 3 and Table 1 & Table 2, Total Hardness has the highest deviation which means that hardness varies too much in all sample, followed by TDS, Alkalinity, Calcium and Magnesium. The least deviation was found to be in the samples of Fluoride followed by pH and Turbidity.

5. PEARSON PRODUCT- MOMENT CORRELATION

Pearson correlation coefficientis a measure of the strength of a linear association between two variables and is denoted by *r*. Basically, a Pearson product-moment correlation attempts to draw a line of best fit through the data of two variables, and the Pearson correlation coefficient, *r*, indicates how far away all these data points are to this line of best fit.

The Pearson correlation coefficient, *r*, can take a range of values from +1 to -1. A value of 0 indicates that there is no association between the two variables. A value greater than 0 indicates a positive association; that is, as the value of one variable increases, so does the value of the other variable increases. A value less than 0 indicates a negative association; that is, as the value of one variable increases, the value of the other variable decreases [18].

6. LINEAR REGRESSION MODEL

Regression analysis is widely used statistical methods to estimate the relationships between one or more independent variables and dependent variables. Regression is a powerful tool as it is used to assess the strength of the relationship between two or more variables, and then it would be used for modelling the relationship between those variables in the future.

Y=a + bX + ∈----------2

Where:

- **Y – is the dependent variable**
- **X – is the independent (explanatory) variable**
- **a – is the intercept**
- **b – is the slope**
- **∈ –is the residual (error)**

The formula for intercept "a" and the slope "b" can be calculated per below [19] [20] [21].

$$a = \frac{(\Sigma y)(\sum x^2) - (\sum x)(\sum xy)}{n(\Sigma x)^2 - (\Sigma x)^2} \text{---------- 3}$$

$$b = \frac{n(\sum xy) - (\Sigma x)(\sum y)}{n(\Sigma x^2) - (\Sigma x)^2} \text{----------4}$$

Graphical relation of various parameters of ground water has been plotted for the Hilly and Ganges region of the Sahibganj town to show the variation of different quality parameters.

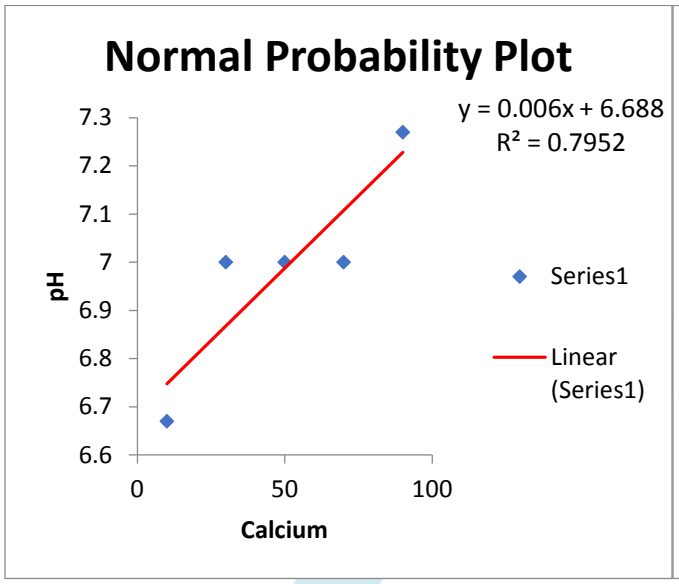

Fig 4: Graph for Correlation between pH and Calcium

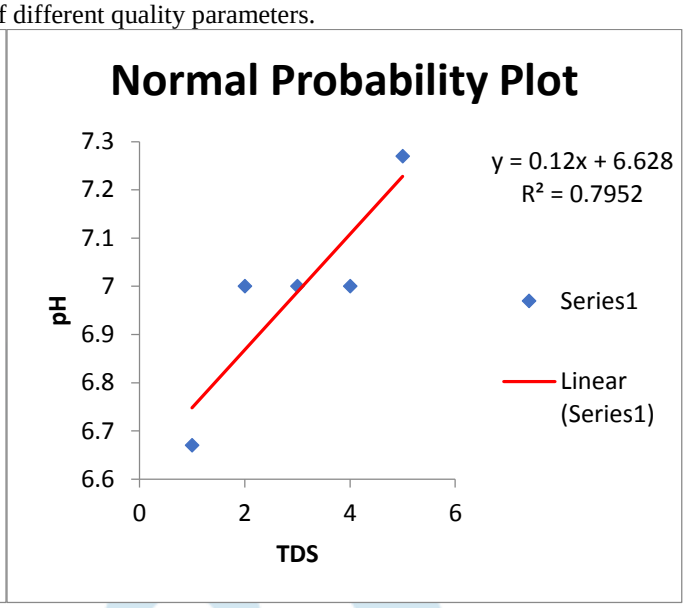

Fig 5: Graph for Correlation between pH and TDS

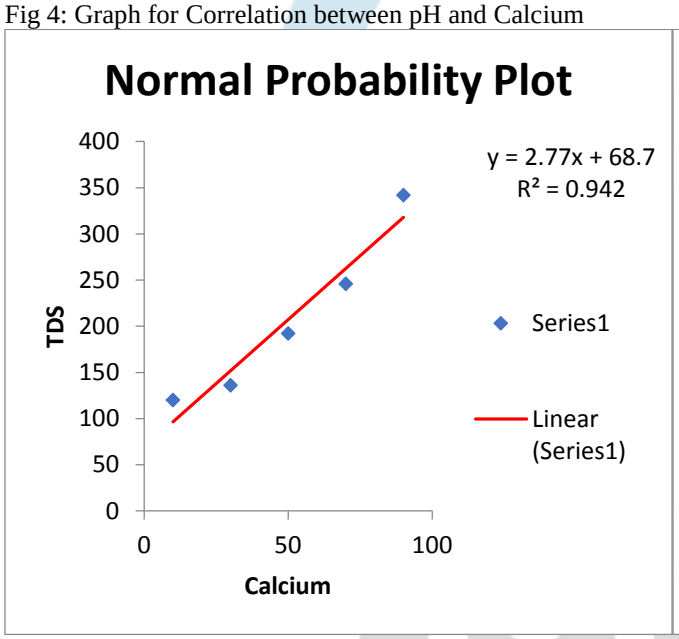

Fig 6: Graph for Correlation between TDS and Calcium

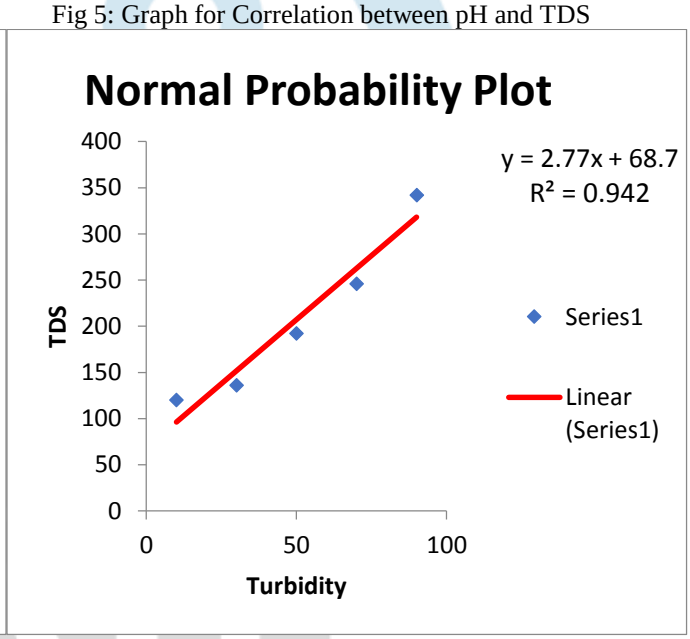

Fig 7: Graph for Correlation between TDS and Turbidity

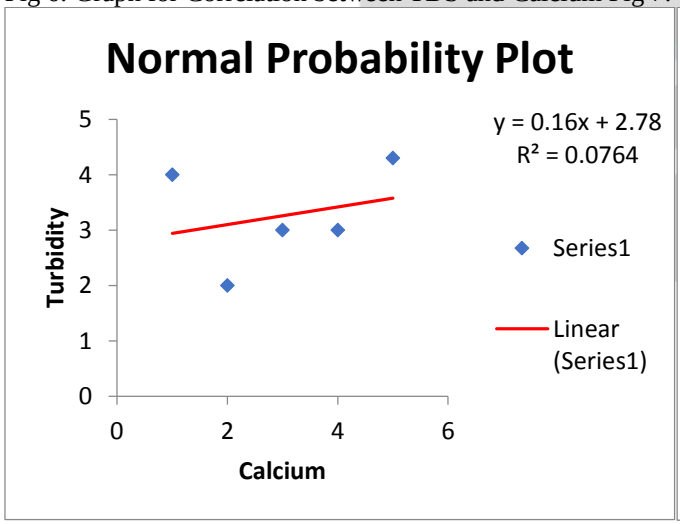

Fig 8: Graph for Correlation between Turbidity and Calcium

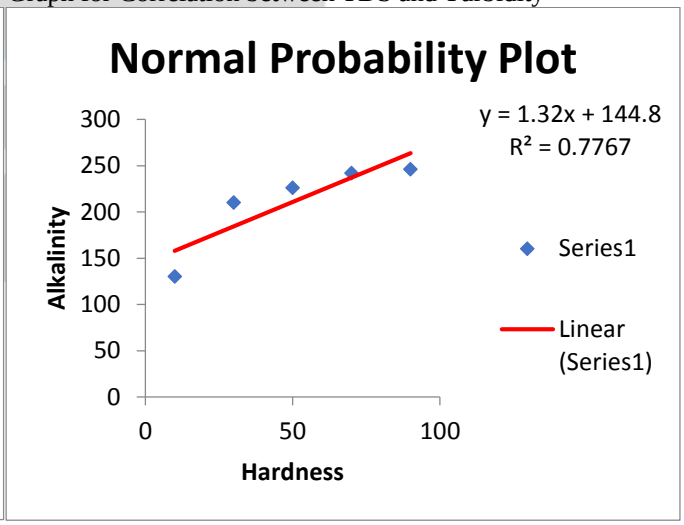

Fig 9: Graph for Correlation between Alkalinity and Hardness

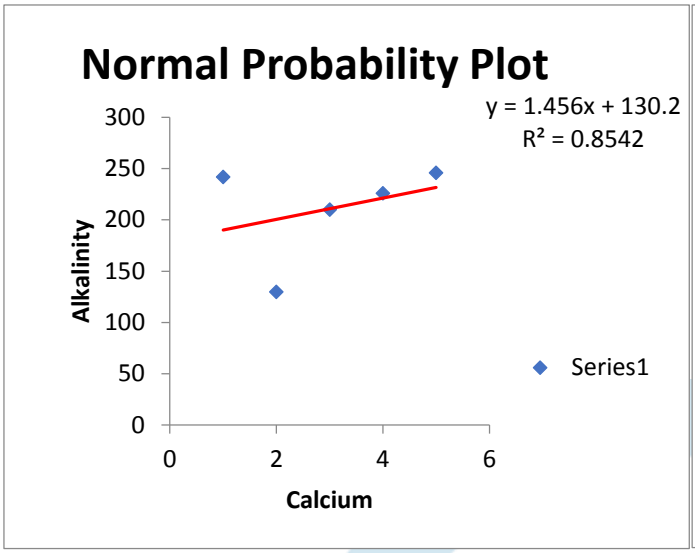

Fig 10: Graph for Correlation between Alkalinity and Calcium

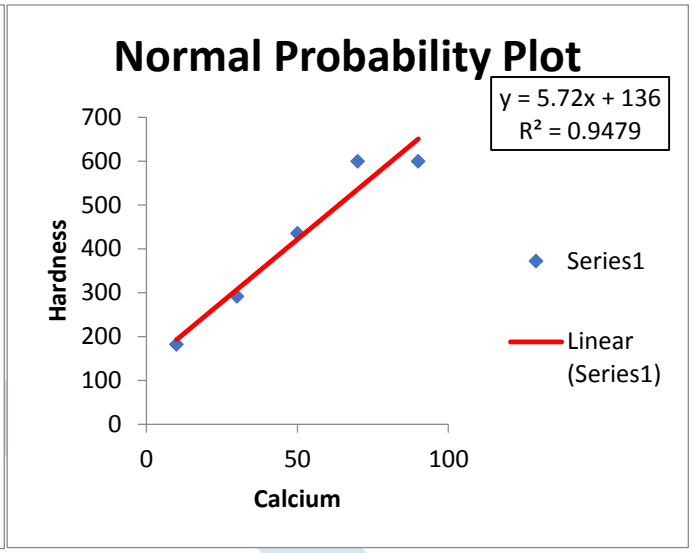

Fig 11: Graph for Correlation between Hardness and Calcium

No direct relation

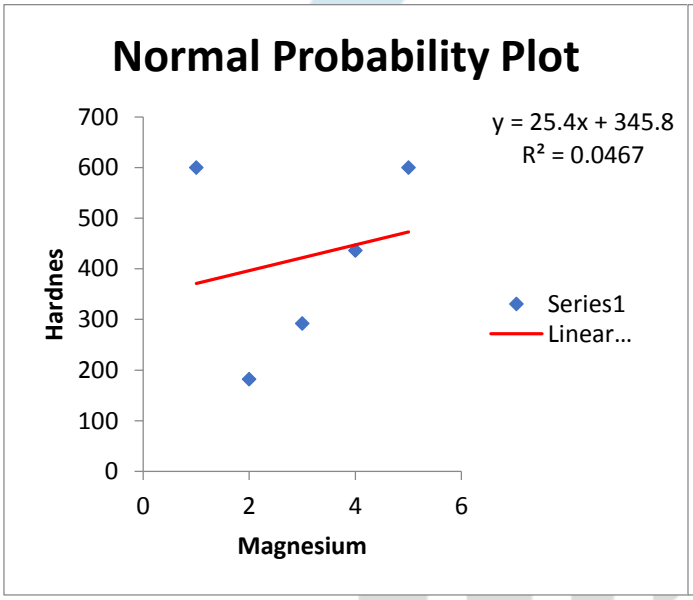

Fig 12: Graph for Correlation between Hardness and Magnesium

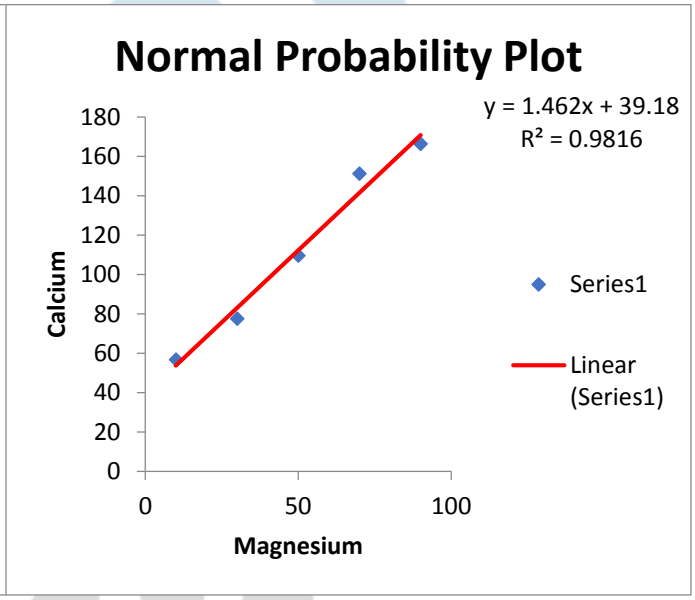

Fig 13: Graph for Correlation between Calcium and Magnesium

From the graph in Fig 4, Table 1 and Table 3, it can be seen that the pH value increases with the increase in the value of Calcium so the pH is found to depend on the variation of Calcium minerals cause increase in the Alkalinity and increae in pH as it is found in the foothills ofSahibganj Park(7.27) region. This shows that the Calcium(limestone) present in the hill may have caused the increase in the pH value while the other regions showed less variation.The value (R=0.7952) in Fig 4shows that the linear graph fits well with positive slope.

From the above graph in Fig 5, Table 1 and Table 3,it can be seen that as pH decreases TDS increases and vice versa, like in Durga tola sample pH is 6.67 and TDS is 342 whereas in Sahibganj Park sample, pH is 7.27 and TDS is 120. This is because TDS adds metal ions which on solubility with water decreases the pH of water hence increases the acidity or toxicity of water [22].The value (R=0.7952) in Fig 5 shows that the linear graph fits well with positive slope.

From the graph Fig 6, Table1 and Table 3,it can be seen that there is a direct linear positive relation between the given parameters as the TDS increases with the increase in the value of Calcium. As the Calcium Carbonate and Magnesium cause increase in the Hardness of water which in turn results in the increase in the TDS which can be seen in the slope.[23] The value (R=0.9552) in Fig 6 shows that the linear graph fits well with positive slope.

From the graph Fig 7, Table 1and Table 3,it can be seen that there is a direct linear positive relation between the two parameters as the TDS of water increases with the increase in the value of the Turbidity so it can be said that the TDS is directly related to Turbidity, or in other words Turbidity causes an increase in the value of TDS. as is evident from the linear positive relation depicted in the graph.The value(R=0.9420) in Fig 7 shows that the linear graph fits well with positive slope.

According to the above graph in Fig 8,Table 1and Table 3,it can be seen that as the Calcium level increases, the Turbidity gets on increasing which can be correlated by saying that the water contains $CaCO_3$ from which CO_2 get dissolved in water that makes water turbid (whitening)[24] [25]. The value (R=0.0764) in Fig 8 shows that the linear graph doesnot fit well with positive slope.

From the graph in Fig 9, Table 1and Table 3of Alkalinity and Hardness plotted to establish the relationship between the two variables, the graph was found to have a linear positive direct relationship for the regression coefficient. It can be seen in the graph that that the increase in Total Hardness is found to related with the increase in the alkalinity. The relation indicates that Alkalinity and Hardness changes depending on the pH or mineral content in the study area. Alkalinity is often related to Hardness as it mainly occurs due to carbonate rocks which are mainly $CaCo_3$[26][27]. The value (R=0.7767) in Fig 9 shows that the linear graph fits well with positive slope.

From the graph in Fig 11,Table 1and Table 3of Calcium and Total Hardness plotted for the groundwater analysis to find the relationship between the given parameters, the graph is found to have a linear positive slope indicating direct relationship showing that the Hardness was caused due to the presence of Calcium Carbonate (limestone)present in the region[28][29]. The value (R=0.9479) in Fig 11 shows that the linear graph fits well with positive slope.

From the graph in Fig 12, Table 1and Table 3of Magnesium and Total Hardness plotted for the groundwater analysis to find the relationship between the given parameters, the graph is found to have a linear positive slope indicating direct relationship showing that the Hardness was caused due to the presence of Magnesium Carbonate present in the region.The increase in Hardness was found to increasewith the increase in Magnesium concentration in all samples.[30] [31]The value (R=0.0467) in Fig 12 shows that the linear graph doesnot fit well with positive slope.

From the graph in Fig 13, Table 1 and Table 3plotted above show the two water quality parameters i.e., Calcium and Magnesium which show the linear positive slope because the presence of Calcium indicates Hardness level of water which also hint the presence of Magnesium.The value (R=0.9816) in Fig 13 shows that the linear graph fits well with positive slope.

RESULT: -

Water Temperature

During the whole study period at the sampling locations, a maximum water temperature ofwas 28.6 °C±1℃recorded on 27th December 2021. The water from the study area has no colour, odour. Taste of water from all samples are pleasant to taste. Few samples like D.T, and C.C had slightly metallic taste.

Effect of pH

The pH of all samplesis found to be within the acceptable limit of 6.5 to 8.5.,D.T (6.67),K (7.0), S.P(7.27), C.C(7.0) andP.S(7.0). [Table-1]USEPA (United States Environmental Protection Agency) recommends that the pH level of water sources should be at a pH measurement level between 6.5 to 8.5 on a scale that ranges from 0 to 14[32].Low pH in water maylower the natural stomach acidity, which helps kill bacteria and expel other undesirable pathogens from entering our bloodstream. Additionally, an overall excess of Alkalinity in the body may cause gastrointestinal issues and skin irritations.While this higher pH does not pose any health risks, it can cause skin to become dry, itchy and irritated.

Pearson: - The pH is found to be in association with Turbidity**(r=0.046)** andFluoride**(r=0.116,)** while it was not associated with TDS**(r=-0.885)**, Alkalinity**(r=-0.019)**, Hardness**(r=-0.593)**, Calcium**(r=-0.683)** and Magnesium**(r=-0.410)**[Table 4].

Effect of Hardness

The Hardness of water was maximum for Durga tola and Katarganj mainly due to high amount of Calcium and the Hardness decreases from hilly region towards Ganga regiondue to decrease in Calcium.D.D(600), K(600), S.P (292), C.C (436) and P.S(182) [33][Table 1]. With an exception for Purani Sahibganj as it has an exceptionally low Calcium content.

There are no serious adverse health problems associated with drinking hard water. However, hard water can contribute to dry skin and hair. Washing your hair frequently with hard water can leave your scalp feeling itchy. Higher Sodium levels in soft water may be a concern for some people, but that can be managed with a Potassium-based softening system[34].

Pearson: - The Hardness is found to be in association with TDS**(r=0.749)**, Alkalinity **(r= 0.580),** Calcium**(r=0.989)** and Magnesium**(r=0.968)** while it is not in association with pH**(r=-0.593)**, Turbidity**(r=-0.007)** and Fluoride**(r=-0.597)** [Table 4].

Effect of Alkalinity

The Alkalinity of all samples were higher than the acceptable limit of 200mg/L [35]while that of Ganga region was found to be well within the limit mainly due to less amount of Calcium Carbonate while the other regions had the influence of Calcium Carbonate which may have percolated down due to leaching from the nearby hill. D.T (242), K(210),S.P(246) C.C (226) and P.S(130) [Table 1].

Additionally, an overall excess of Alkalinity in the body may cause gastrointestinal issues and skin irritations. Too much alkalinity may also agitate the body's normal pH, leading to metabolic alkalosis, a condition that may produce the following symptoms: nausea, vomiting, hand tremors, muscle twitching, tingling in the extremities or face confusion. Alkalosis can also cause a decrease in free Calcium in the body, which can affect bone health. However, the most common cause of hypocalcemia isn't from drinking alkaline water, but from having an underactive parathyroid gland[36].

Pearson: - The Alkalinity is found to be in association with TDS**(r=0.438)**, Turbidity**(r=0.356)**, Fluoride **(0.051),** Hardness**(r=0.58)**, Calcium**(r=0.551)**, and Magnesium**(r=0.599)** while it is not in association with the pH**(r=-0.019)** [Table 4].

Effect of TDS

The TDS was higher than the suitable limit for D.T(342), K (192), C.C(246) [Table 1], while that of P.S (136), S.P(120) was within the suitable limit as per the permissible limit of W.H.O.[37].High levels of TDS mean it is unfit for consumption and several diseases like nausea, lung irritation, rashes, vomiting, dizziness etc., Drinking water with elevated amount of TDS for longer periods will expose body to various chemicals, toxins and may cause chronic health conditions like cancer, liver, kidney failures, nervous system disorders, weaken immunity and may also cause birth defects in the new born. A low TDS level actually means you have high-quality water, but it may have a flat taste, as it is devoid of many minerals.

Pearson: - The TDS is found to be in association with Alkalinity**(r=0.438)**, Hardness**(r=0.749)**, Calcium**(r=0.804)** and Magnesium**(r=0.617)** while it is not in association with pH**(r=-0.885)** and Fluoride**(r=-0.027)**AND Turbidity **(r= -0.052)** [Table 4].

Effect of Turbidity

The Turbidity of water was well within the acceptable limit of 5 NTU[38]. D.T(4.0), K(3.0),S.P(4.3), C.C (2.0) and P.S(3.0) [Table 1]. Turbidity itself does not always represent a direct risk to public health; however, it can indicate the presence of pathogenic microorganisms and be an effective indicator of hazardous events throughout the water supply system, High turbidity in source water can harbour microbial pathogens, which can be attached to particles and impair disinfection[39].

Pearson: - The Turbidity is found to be in association with pH**(r=0.046)**, Fluoride**(r=0.222)**, Alkalinity**(r=0.356)** and Calcium**(r=0.067)** while it is not in association with Hardness**(r=-0.007)** and Magnesium**(r=-0.135)** [Table 4].

Effect of Calcium

Calcium is slightly above the acceptable limit in two samples that are D.T (166.2), and K(151.2) while all other samplesS.P (77.6) C.C (109.6) and P.S(56.8)[Table 1] had the Calcium well within the permissible limit but beyond the acceptable limit as per WHO[40].The Calcium concentration of water varies from 1 to 135 mg/L across the USA and Canada. Most spring waters were found to have a relatively low Calcium concentration, with an average of 21.8 mg/l. Purified waters contain a negligible Calcium concentration.

Hypercalcemia can cause stomach upset, nausea, vomiting and constipation. In most cases, the excess calcium in blood was leached from bones, which weakens them. This can cause bone pain and muscle weakness. Hypercalcemia, also known as calcium deficiency disease, occurs when the blood has low levels of Calcium. A long-term calcium deficiency can lead to dental changes, cataracts, alterations in the brain, and osteoporosis, which causes the bones to become brittle[41].

Pearson: - The Calcium is found to be in association with TDS(**r=0.80)**, Turbidity**(r= 0.067)**, Alkalinity**(r=0.551)**, Hardness**(r=0.989)** and Magnesium**(r=0.922)** while it is not in association with pH**(r=-0.683)** and Fluoride**(r=-0.54)** [Table 4].

Effect of Magnesium

Magnesium sample was just above the limit in K (53.28) sample while all other samples D.T (43.68) S.P (23.52) C.C (38.88) and P.S (9.6) [Table 1] were found to be well within the permissible limit and slightly above acceptable limit. Increased intake of magnesium salts may cause a change in bowel habits (diarrhea). Drinking-water in which both Magnesium and Sulphate are present in high concentrations (~250 mg/l each) can have a laxative effect. A lack of magnesium leads to a decrease in the concentration of intracellular Potassium whileit leads to an increase in calcium levels. Magnesium deficiency may increase the contractility of blood vessels, as shown in animal experiments[42].

Pearson: - The Magnesium is found to be in association with TDS**(r=0.617),** Alkalinity**(r=0.599),** Hardness**(r=0.968)** and Calcium**(r=0.922)**[Table 1]while it is not associated with pH**(r=-0.415),** Turbidity**(r=-0.135)** and Fluoride**(r=-0.67).**

Effect of Fluoride

All samples of Fluoride were found to be well within the limit.D.T (0.38), K(0.19), S.P (0.42), C.C (0.39) and P.S (0.39)[Table 1]. Ingestion of excess Fluoride, most commonly in drinking-water, can cause fluorosis which affects the teeth and bones. Moderate amounts lead to dental effects, but long-term ingestion of large amounts can lead to potentially severe skeletal problems. Paradoxically, low levels of Fluoride intake help to prevent dental caries. The control of drinking-water quality is therefore critical in preventing fluorosis [43] [44].

Pearson: - The Fluoride is found to be in association with pH**(r=0.116),** Alkalinity**(r=0.513)**and Turbidity**(r=0.222)**while it is not associated with Hardness**(r=-0.597),** Calcium**(r=-0.067)**and Magnesium**(r=-0.67)**[Table 4].

CONCLUSION: -

The Statistical analysis of the experimentally analysed water Quality parameters in Hilly and Ganges area yielded a range of variation, Mean, Standard deviation, Pearson co-relation, Linear regression model, Correlation of variation. Since the correlation coefficient gives the interrelationship between parameters, Co-relation coefficient wascalculated. Result of analysis reveals that the assessment of water quality essential to check the suitability of the water for its designated use. As the result showed the excess and deficit of all the parameters used for testing the water quality, soit helps to identify the effects and diseases caused due to different parameters and provide opportunity torectify them.With the help of this report, the different organisations and self-help group of Sahibganj Town can spread awareness about the water quality of this area and diseases related to it, and will also provide ideas for Medicinal Researchers and Doctors to provide best and exact treatment for diseases related to water contaminations.They can assist locals in maintaining the cleanliness of water near them.This study can offer the requisite information for the authority to pursue the sustainable approaches on water management and contamination prevention. Regression and Pearson Model is used for the present investigation may help the people of Sahibganj to see the development of a future water resource program, different Physico – Chemical properties, source of contamination, (due to soil type, industrialization, Water chemistry and other human activities. The Water Quality is good and most of the parameters are within the limits set by W.H.O and BIS. However, awareness programme, Health issues, infrastructure, chemical treatment, must be provided by the government, W.H.O, UNICEF, UN- Health Organisation so that people will be aware and there will be minimum loss of life and health problems.

ACKNOWLEDGEMENT: -
The authors are grateful for the Honourable V.C, SKMU, Dumka for their moral support, infrastructure analysis of samples. The authors are also thankful to H.O.D, P.G. Department of Chemistry Sahibganj College, Sahibganj forthe guidelines, inspiration and providing the research facility& ethical discussion, for the present work. The authors are also thankful to Executive Director, Drinking and Sanitation Division, the P.H.E.D Department of Sahibganj for their help in analysing the water quality. The authors would like to thanks and appreciates the colleagues and people who have willingly helped out with their abilities.

REFERENCES:-

1.]https://sahibganj.nic.in/
2.]Esmaeil Asadi, Mohammad Isazadeh, Saeed Samadianfard, Mohammad Firuz Ramli,Amir Mosavi, Narjes Nabipour, Shahaboddin Shamshirband, Eva Hajnal and Kwok-Wing Chau https://www.mdpi.com/2071-1050/12/1/177
3.] Singh, R.; Upreti, P.;Allemailem, K.S.; Almatroudi, A.;Rahmani, A.H.; Albalawi, G.M.Geospatial Assessment of Ground Water Quality and Associated HealthProblems in the Western Region of India. Water 2022, 14, 296. https://doi.org/10.3390/w14030296
4.] Hamzaoui-Azaza F, Ameur M, Chaouch R, Cheikha L, Gueddari M, José Joel R, Assessment of Groundwater Quality based on GIS and Geochemical Methods: Coastal Aquifer of Bouficha (North-Eastern Tunisia). J Coast Conserv 24:45 2020. https://doi.org/10.1007/s11852-020-00762-8
5.] Ricolfi L, Barbieri M, Muteto PV, Nigro A, Sappa G, Vitale S. Potential Toxic Elements in Groundwater and their Health Risk Assessment in Drinking Water of Limpopo National Park, Gaza Province,Southern Mozambique. Environ Geochem Health, 42:2733–2745. 2020.https://doi.org/10.1007/s10653-019-00507-z
[6.] Xiaogang Fu, Zihan Dong, Shuang Gan,Zhe Wang, and Aihua Weihttps://doi.org/10.1155/2021/3008567
Department of Water Resources, RD & GR Central Ground Water Board Faridabad: Faridabad, India, 2019.
7.] Government of India Report. National Compilation on Dynamic Ground Water Resources of India, Ministry of Jal Shakti, 2017.
[8.] Mehmet Taşana, Yusuf Demir b and Sevda Taşan b, Groundwater Quality Assessment using Principal Component Analysis and Hierarchical Cluster Analysis in Alaçam, Turkey, (2021)https://iwaponline.com/wp/article/22/1/121/71871/Securing-the-critical-role-of-groundwater-for-the
[9.]Mukhopadhyay BP, Barua S, Bera A, Mitra AK, Study on the Quality of Groundwater and its Impact on Human Health: a case Study from Murshidabad District, West Bengal. J Geol Soc India 96:597–602. 2020.https://doi.org/10.1007/s12594-020-1608-8
10.] Singh, R.; Upreti, P., Allemailem, K.S., Almatroudi, A., Rahmani, A.H., Albalawi, G.M,Geospatial Assessment of GroundWater Quality and Associated HealthProblems in the Western Region ofIndia. Water, 2022, 14, 296. https://doi.org/10.3390/w14030296
11.] Government of India Report. National Compilation on Dynamic Ground Water Resources of India, 2017; Ministry of Jal Shakti, Department of Water Resources, RD & GR Central Ground Water Board Faridabad: Faridabad, India, 2019.
12.] Ducci, D., GIS Techniques for Mapping Groundwater Contamination Risk. Nat. Hazards, 1999, 20, 279–294.
13.]W.H.O guideline for drinking water quality, Recommendations World Health Organisation, Geneva, (1984), Vol.1, 130.
14.] W.H.O World Health Organisation, Guidelines for drinking water Quality, Fourth edition incorporating the First edition.
15.] Bureau of Indian Standards, Product Manned for drinking water according to 1S, 10500: 2012, October- 2020.
16.] Anil et al, Physico – Chemical Assesment of Sahibgan Town Ground Water Quality and its Health Impact vol. XIII, Issue XII, sec – 2021. P – 1830 -1841.
17.] https://g.co/kgs/WCE1yR
18.] https://statistics.laerd.com/statistical-guides/pearson-correlation-coefficient-statistical-guide.php
19.] https://www.wallstreetmojo.com/regression-formula/20.] https://www.thebalancesmb.com/what-is-simple-linear-regression-2296697
21.] https://www.statisticshowto.com/probability-and-statistics/regression-analysis/find-a-linear-regression-equation/
22.]https://www.iosrjournals.org/iosr-jnhs/papers/vol6-issue5/Version-9/E0605093540.pdf
23.] https://iopscience.iop.org/article/10.1088/1755-1315/118/1/012019/pdf
24.]https://www.researchgate.net/publication/230112845_Calcium_Carbonate_Precipitation_and_Turbidity_Measurements_in_Otisco_Lake_New_York
25.] https://www.topper.com
26.] http://www.state.ky.us/nrepc/water/ramp/rmalk.htm
27.]https://www.researchgate.net/publication/292185663_Alkalinity_and_Hardness_Critical_but_Elusive_Concepts_in_Aquaculture
28.]https://www.researchgate.net/publication/307122312_Understanding_Water_Hardness
29.]https://www.usgs.gov/special-topics/water-science-school/science/hardness-water
30.]https://www.researchgate.net/publication/40907387_Relationship_between_Tap_Water_Hardness_Magnesium_and_Calcium_Concentration_and_Mortality_due_to_Ischemic_Heart_Disease_or_Stroke_in_the_Netherlands
31.]https://www.google.com/url?sa=t&source=web&rct=j&url=https://www.sciencedirect.com/topics/agricultural-and-biologicalsciences/waterhardness&ved=2ahUKEwiHverrgrz2AhUhTmwGHaNPB_QQFnoECA0QAQ&usg=AOvVaw0mWgdHwY6CgTbZPyfmWHOP
32.] https://www.researchgate.net/publication/307122312_Understanding_Water_Hardness

33.]https://www.who.int/water_sanitation_health/dwq/chemicals/HARDNESSsummarystatement.pdf
34.]https://www.healthline.com/health/hard-water-and-soft-water#hard-water-risks
35.]https://www.google.com/url?sa=t&source=web&rct=j&url=https://www.twadboard.tn.gov.in/content/water-quality-standards&ved=2ahUKEwj35Ov-s7H2AhXpslYBHeMaCeQQFnoECAQQBQ&usg=AOvVaw37iCJkHaHDzSjEA0z_aeZP
36.]https://www.healthline.com/health/food-nutrition/alkaline-water-benefits-risks#risk-factors
37.]https://www.indiawaterportal.org/questions/permissible-tds-level-domestic%20water
38.]https://www.google.com/url?sa=t&source=web&rct=j&url=https://www.lenntech.com/turbidity.htm%23:~:text%3DThe%2520WHO%2520(World%2520Health%2520Organization,ideally%2520be%2520below%25201%2520NTU.&ved=2ahUKEwjNrcX1tbH2AhXMzjgGHYnmA1oQFnoECAQQBQ&usg=AOvVaw1-c3eCHZtngYxflhUbf56J
39.]https://apps.who.int/iris/rest/bitstreams/1080642/retrieve#:~:text=For%20example%2C%20high%20turbidity%20in,biofilms%20and%20oxide%20scales%20or
40.]https://www.twadboard.tn.gov.in/content/water-quality-standards
41.] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2488164/
42.] https://apps.who.int/iris/bitstream/handle/10665/70168/WHO_HSE_WSH_10.01_10_Rev1_eng.pdf
43.] https://apps.who.int/iris/rest/bitstreams/1257901/retrieve
44.] https://www.twadboard.tn.gov.in/content/water-quality-standards