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"PHYSICAL-CHEMICAL ASSESSMENT OF GROUND WATER QUALITY AT PIRANGUT AND ADJACENT VILLAGES"

AKSHAY D. KOLEKAR,ROHIT I. WADMARE, RAMESH S. KARCHUNDE, SACHIN A. TARU , JYOTI B. GIRIGOSAVI ,G. S. YADAV

CHAPTER 1

INTRODUCTION

Water is vital resource for all kinds of life on this planet. However, it adversely affected both quantitatively and qualitatively by all kinds of human activities on land, in air or in water.

The main source of water on the earth is rainfall, a little portion of it penetrates beneath the surface, a small portion is evaporated into the atmosphere and some of it runoff. A portion which penetrates into the earth is called the ground water and that can be collected by digging wells, tunnels or drainage galleries or flows naturally on earth's surface.

The total water amount on the earth is about 1.35 billion cubic kilometers and only 0.6% is in underground form. But unfortunately, it has been getting polluted day by day due to different activities. So, it is need to conserve water and prevent from every type of pollution and this could be possible by continuous water quality assessment.

Day by day the pollution is rapidly increasing, so for drinking and other regular activities the peoples are depending on ground water. In order to know the groundwater quality of the village, we have identified 29 sampling stations from dug wells and bore wells covering PIRANGUT and adjacent villages of study area.

1.1 Importance of ground water

1.1.1. Quality of water –

The quality of groundwater is of the great importance in determining the suitability of groundwater for a certain use. The quality of ground water is resultant of all the processes and reaction that have acted on the water from the moment is condensed in the atmosphere to the time is discharged by a well. Therefore, quality of ground water varies from place to place with depth of water table and from season to season.

In many residential areas, especially those where purified and treated water is not available, ground water is main source of potable water for people. In case of contamination groundwater, spread of water borne diseases is likely to happen.

The quality of ground water is much better than surface water, because surface water contains large number of suspended impurities whereas groundwater is free it. But sometimes groundwater dissolves minerals, salts etc. which come in its contact while in movement.

1.2. Impact of pollution on ground water quality –

Groundwater quality is strongly dependent on bedrock geology and climate but may also be impacted in parts by pollution, particularly from agricultural and residential sources. The most important agricultural pollutants are nitrate and pesticides, through it is recognized that fertilizer and pesticides applications are not intensive.

By far the most serious natural ground water quality problem known in India derives from high fluoride concentrations which are dissolved from the bedrocks by geochemical processes and have resulted in severe fluorides in large population. High iron concentrations have also been reported in some aquifer, particularly in confined aquifers which are typically anaerobic. High iron concentrations are not detrimental to health but may defer use of the groundwater due to aesthetic problems and lead to use of alternative fewer safe sources of water.

1.2.1 Municipal Sources and its Effects

a) Sewer Leakage –

Sanitary sewer is intended to be watertight; however, in reality leakage of sewage into ground is a common occurrence, especially from old sewers. Sewer leakage can introduce high concentration of BOD, COD, nitrate, organic chemicals, and possibly bacteria into the ground water.

b) Solid Waste:

The land disposal of solid wastes creators an importance source of ground water pollution. A landfill may be defined as any land serving as a depository of urban or municipal solid waste.

The important pollutants frequently found in leach it include Hardness, Alkalinity, Chloride content, Acidity, Turbidity are often increased, while generation of gases, such as methane.

1.2.2. Agricultural sources and its effects

a) Irrigation Return Flows

Approximately one-half to two-third of water applied for irrigation of crops is consumed by evapo-transpiration; the reminder, termed irrigation return flows, drain to surface channels or joins the underlying groundwater. Irrigation increases the salinity of irrigation return flow from there to ten times that of applied water. The degradation results from the addition of salts by dissolution during the irrigation process. From salts added as fertilizers or soil amendments and from the concentration of salts by evapo-transpiration. Principal cations include calcium, magnesium, sodium; major anions include bicarbonates, sulphate, chlorides, and nitrates. Because of irrigation is the primary use for water and arid and semiarid region, irrigation return flow can be the major cause of groundwater pollution in such region.

b) Fertilizers And Soil Amendments:

When fertilizers are applied to agricultural land, a portion usually leaches though the soil and the water table. The primary fertilizers are compounds of nitrogen, phosphorus, and potassium. Phosphate and potassium fertilizers are readily absorbed on soil particles and seldom constitute a pollution problem. But nitrogen in sodium is only used by plants or absorbed by the soils, and it is the primary fertilizer pollutant.

1.3 Aim and Objectives

During the period of investigation some of the objectives are considered which seems to be better for evaluating the quantity of water for different purpose.

Objectives are given to be as follows:

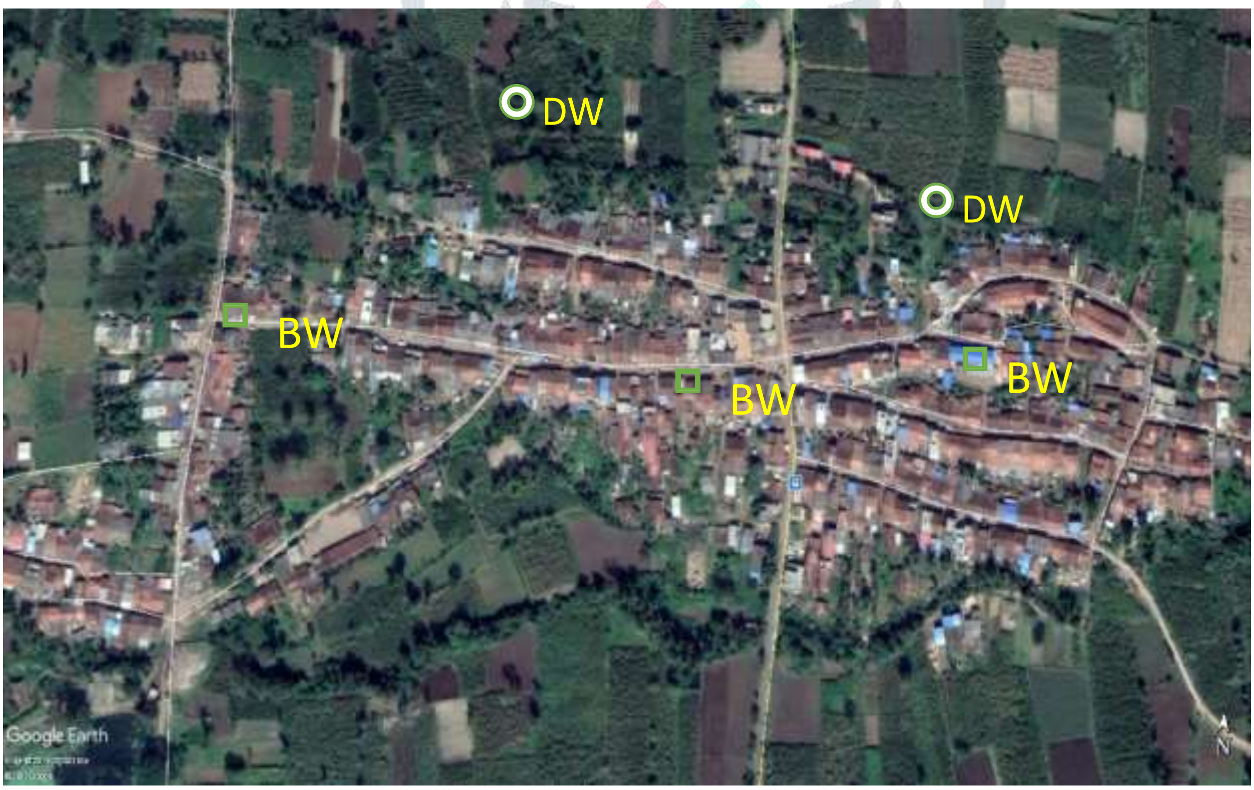
- To focus primarily in public supply wells that are in PIRANGUT & adjacent villages where ground water is an important source of drinking supply.
- To determine physicochemical analysis of groundwater quality of study area.
- To suggest precautionary measures to prevent groundwater contamination if any

1.4 Study Area

Physico-chemical assessment of ground water quality at PIRANGUT and adjacent village, Dist-Pune, Maharashtra India. Our study area lies between Latitude 18.67790, Longitude 73.85276. The PIRANGUT village is near to confluence of MULA river bank. The study area is covered by Deccan volcanic basalt of Upper Cretaceous to Lower Eocene in age.

1.5 Location map (a):

1.6 Dug well and borewell location map (b):



CHAPTER 2

LITERATURE REVIEW

2.1 P. Balakrishnan, Abdul Salem and N. D. Mallikarjun: Groundwater quality mapping using geographic information system (GIS): A case study of Gulbarga City, Karnataka, India:

They found that the domestic sewage that enters the different water bodies located in the city which are responsible for polluting the groundwater sources. On that basis they had given the suggestion to engineers to help a planning for effective sewage treatment plant and minimizing groundwater pollution by sewage.

2.2 C. K. Jain, A. Bandyopadhyay and A. Bhadra: Assessment Of Ground Water Quality For Irrigation Purpose, Dist. Nainital, Uttarakhand, India:

The ground water quality varies from place to place and with the depth of water table. The ground water abstraction sources and their surroundings should be properly maintained to ensure hygienic conditions and no sewage or polluted water should be allowed to percolate directly to ground water aquifer.

Proper cement platforms should also be constructed surrounding the ground water

2.3 Deshpande S.M. and Asher K.R.: Evaluation of Groundwater Quality and its Suitability for Drinking and Agriculture use in Parts of Vaijapur, District Aurangabad, MS, India.

They found a few wells of the study area record extraordinary values of conductivity and chloride due to the application of fertilizer for agricultural exhibiting the higher concentration of ions contributes to groundwater degradation in varying degrees.

2.4 M V Prasanna, S Chidambaram, A Shahul Hameed and K Srinivasamoorthy: Hydrogeochemical analysis and evaluation of groundwater quality in the Gadilam river basin, Tamil Nadu, India:

They found that contaminated water from industrial effluent and saline water intrusion with higher ionic concentration was noted near the coastal region. The potable groundwater occurred away from the coastal area.

2.5 Hemant Pathak and S. N. Limaye: Assessment of Physico-Chemical Quality of Groundwater in rural area nearby Sagar city, MP, India.:

They collected 30 groundwater samples for physico-chemical analysis of water samples of Gambhiria and Baheria villages of sagar city. Physico-chemical parameters are out of the highest desirable limit or maximum permissible limit set by IS: 10500. Hence, these sample water cannot be absolutely fit for directly drinking. Some essential treatment needed to convert in drinkable water. In conclusion, from the results of the present study it may be said that the people in these rural areas are therefore at higher potential risk of contacting water-borne and/or sanitation- related diseases. Both villages water is not absolutely fit for directly drinking purpose need treatments to minimize the contamination. It is recommended that water analysis should be carried out from time to time to monitor the rate and kind of contamination.

2.6 P.Satyanarayana, N.Appala Raju, K.Harikrishna and K.Viswanath: Urban Groundwater Quality Assessment: A Case Study Of Greater Visakhapatnam Municipal Corporation Area (Gvmc), Andhra Pradesh, India.:

Groundwater pollution is one of the environmental problems in urban areas, resulting out of improved living standards, growing population and interference with natural eco-system. In this study, the most of the major ions of the water samples from industrial area have been found in excess of BIS, WHO and CPHEEO(Central Public Health and Environmental Engineering Organization) recommended guide line values due to impact of industrial effluents. The areas situated nearer to the Steel Plant, BHPL, Fertilizers industries are highly polluted groundwater samples.

2.7 M. Adekunle, M. T. Adetunji, A. M. Gbadebo and O. B. Banjoko: Assessment of Groundwater Quality in a Typical Rural Settlement in Southwest Nigeria.:

The water quality change in season from dry to wet period influenced the concentrations of the water quality parameters. Based on the results, the groundwater resource, without standard treatment is unfit for drinking and domestic uses.

2.8 S. M. Shah and N. J. Mistry: Groundwater Quality Assessment for Irrigation Use in Vadodara District, Gujarat, India.:

They found a few wells of the study area record extraordinary values of conductivity due to the application of fertilizer for agricultural exhibiting the higher concentration of ions contributes to groundwater degradation in varying degrees.

2.9 H.D.Bhosale and A.S. Yadav: Environmental quality of groundwater in Kagal taluka, kolhapur district, maharashtra.

Different physico-chemical properties of dug wells of Kagal Taluka were compared with the national and international water quality standards set for drinking and irrigation purpose. The ground water quality varies from place to place and with the depth of water table. The groundwater abstraction sources and their surroundings should be properly maintained to ensure hygienic conditions and no sewage or polluted water should be allowed to percolate directly to ground water aquifer.

CHAPTER 3

METHODLOGY

The bore wells and dug wells located within study area were used as sampling points for ground water collection. The water samples have been collected from 20 bore wells and 9 dug wells during the time of post-mansoon (November 2018) and Pre-mansoon (March 2019). Total water sample location covered by residential area. In present study various physical and chemical parameters of water samples were determined and the results compared with values of various water quality standards.

Sample collection and analysis –

Samples were collected in good quality polyethylene bottles of one liter capacity. Sampling has been carried out without adding any preservatives in well rinsed bottles. Only high pure chemicals and distilled water was used for preparing solution for analysis. The collected samples were analyzed for physical and chemical parameters such as pH, Ca, Mg, Na, K, Cl, HCO3, Hardness, Acidity, Alkalinity, Turbidity, Electrical conductivity etc. were determine using standard procedure in laboratory. The sodium absorption ratio (SAR) values of each water sample were calculated by using Richard equation and the total hardness (TH) in ppm and the sodium percentage (Na%) values were determined using the equation Todd. The respective values for all these parameters are reported in table ( ) and ( ) ; all results are compared with standard limit recommended by the Bureau of Indian Standards (BIS), Indian Council of Medical Research.

Water Quality Index –

Calculation of water quality index is an important technique for demarcating ground water quality and its suitability for drinking purpose. WQI is defined as technique of rating that provides the composite influence of individual water quality parameters on the overall quality of water for human consumption.

CHAPTER 4

RESULT AND DISCUSSION

Results obtained from the analysis of water samples from study area of PIRANGUT and adjacent villages are shown in table - . The results of physic-chemical analysis are presented in Table- for pre- mansoon and post- mansoon for the year 2018-2019.a comparison of the physic-chemical groundwater samples have been made with WHO and BIS drinking water standards. The pH values of groundwater varied from 5.65 to 7.90 indicating slightly acidic in nature.In the present investigation the electrical conductivity of the samples varies from 203.18 to 390.76 mhos/cm. In the present study, total hardness of water samples ranged from 66 to 161 mg/L.

Table 1- Standard for drinking water quality

Parameters	BIS:1999	ICMR:1975	WHO:2004
PH	6.5-8.5	7-8.5	6.5-8.5
EC (µs/cm)	250-2000	---	1400
TDS	2000	500	500-1000
Na+	200	---	200
K+	10	---	20
Ca++	200	200	100
Mg++	100	200	50
Cl-	1000	200	250
HCO3-	200-600	---	125-350
SO4--	400	200	250
TH	600	600	500

pH -

pH of solution is taken as negative logarithm of H2 ions for many practical practices. Value range of pH from 7 t0 14 is alkaline, from 0 to 7 is acidic and 7 is neutral. In the study area pH varies from 5.65 to 7.90 (Table 5&7) indicates the ground water is slightly acidic in nature. The range of desirable pH of water prescribed for drinking purpose by BIS and WHO is 6.5 to 8.5.

Electrical Conductivity (EC) –

Conductivity is the capacity of water to carry an electrical current. In contrast, the conductivity of distilled water is less than 1umhos/cm. This conductivity depends on the presence of ions their total concentration, mobility and relative concentration .Solutions of most inorganic acids, bases, and salts are relatively good conductors. Electrical conductivity is an indication of the concentration of total dissolved solids and major ions in given water badies. Electrical conductivity in ground water varies from 203.18 to 390.76 μmohs/cm (Table 5 &7) where as permissible limit is <1500 μmohs/cm for domestic purpose. The EC values of all the samples were within permissible limit.

Table No.2 - Standard limits of EC

EC in μmhos/cm at 25℃	Classification
<250	Excellent
250 – 750	Good
750 – 2000	Permissible
2000 – 3000	Doubtful
>3000	Unsuitable

Calcium (Ca) -

Calcium is naturally present in water. Calcium is a determinant of water hardness, because it can be found in water as Ca ions. Calcium content in the groundwater varies from 143 to 183 mg/lit (Table 5 &7). All samples were within maximum permissible limit.

Magnesium (Mg)-

A number of minerals contain magnesium; Magnesium is washed from rocks and subsequently ends up in water. Magnesium has many different purposes and consequently may end up in water in many different ways. Chemical industries add magnesium to plastics and other materials as a fire protection measure or as filler. It also end up in the environment from fertilizer application and from cattle feed. The values of magnesium ranges from 49 to 93 mg/lit (table) 100% samples were within the permissible limit (Table 5 &7) prescribed by BIS. In the study area the rock type is basalt hence source of magnesium is the groundwater is the basaltic rock type.

Total Hardness (TH) –

Total Hardness is considered as a major character of drinking water. Hardness is defined as the concentrations of calcium and magnesium ions. Calcium (Ca) and Magnesium (Mg) are dissolved from most soils and rocks. A total hardness value ranges from 66 to 161 mg/lit (Table 5 &7) which may be due to presence of Calcium (Ca) and Magnesium (Mg). The study concluded that 100% samples were within the permissible limit prescribed by BIS.

Chloride (Cl)-

Chloride originates from sodium chloride which gets dissolved in water from rocks and soils.It is good indicator of groundwater quality and its concentration in groundwater will increase if it is mixed with sewage or sea water. The chloride content in study area varies from 73.7 to 246.74 mg/lit. 100% samples were within the permissible limit prescribed by BIS. The values of Chlorides suggest leaching of effluents from Agricultural fertilizer in to the groundwater.

Bicarbonate alkalinity (HCO3)-

Alkalinity is the measure of the capacity of the water to neutralize a strong acid. The Alkalinity in the water is generally imparted by the salts of carbonates and silicates etc. The bicarbonates alkalinity varies from 249 to 548 mg/lit.

Sodium (Na)-

Sodium is the sixth most abundant element in the Earth's crust and sodium stems from rocks and soils. Not only seas but also rivers and lakes contain significant amounts of sodium. Concentrations however are much lower , depending on geological conditions and waste water contamination sodium compounds serve many different industrial purposes and may also end up in water from industries. The Sodium content in study area has varies from 138 to 200 mg/lit.100% samples were within the permissible limit prescribed by BIS.

Table No.3- Standard limit of percent sodium

Sodium	Water class
<20	Excellent
20 – 40	Good
40 – 60	Permissible
60 – 80	Doubtful
>80	Unsuitable

Potassium (K)-

Potassium is an essential element for humans,plants and derived in food chain mainly from vegetation and soil. The main source of potassium in groundwater include rain water, weathering of potash silicate minerals, use of potash fertilizer and use of surface water for irrigation.

The European Economic Community (EEC) has prescribed the guideline level of potassium at 10 mg/lit for drinking water. Through potassium is extensively found in some of igneous and sedimentary rocks, its concentration in natural water is usually quite low. This is due to the fact that potassium minerals offer resistance to weathering and dissolution. In the present investigation the groundwater samples from different part of the study area revealed that there is marked variation in groundwater quality. Potassium content in study area has varies from 6.1 to 10.2 mg/lit.

Sodium Adsorption Ratio (SAR) –

The sodium adsorption ratio (SAR) is commonly used as an index for evaluating the sodium hazard associated with an irrigation water supply. The SAR is defined as the square root of the ratio of the Sodium (Na) to Calcium + Magnesium (Ca + Mg).

SAR where all cation measurement is expressed in mill imoles per liter (mmol/l). Alternatively, if the cation measurement are expressed in milli equivalents per lit (meq/l) , then the SARis defined to be: Irrigation waters having high SAR levels can lead to the build-up of high soil Na levels over time, which in turn can adversely affect soil infiltration and percolation rates duet to soil dispersion.

Additionally, excessive SAR levels can lead to soil crusting, poor seedling emergence and poor aeration. Measurements of the electrical conductivity (EC) and/or total dissolved solids (TDS) also represents commonly used indexes for evaluating the salinity hazard of the irrigation water. Generally, th potential for water infiltration and/or soil dispersion problems can only be adequately addressed when the salinity and SAR indexes are considered. Increasing EC levels tend to mitigate negative sodium effects, but can simultaneously induce crop stress by degrading the quality of the available water for the crop via salinization. Hence, to properly assess the suitability of a particular irrigation water supply, the apparent salt tolerance of the specific crop must also be taken into consideration for typical irrigation water. The quality of irrigation water depends primarily on the presence of dissolved salts and their concentration. Sodium Absorption Ratio (SAR) and Residual Sodium Carbonate (RSC), Soluble Sodium Percentage (SSP) are the most important quality criteria, which influence the water quality and its suitability for irrigation. When water having appreciable concentrations of Calcium (Ca++) and/or bicarbonates (HCO3) are employed for irrigation, a variable fraction of this constituent will precipitate in the soil as CaCo3 according to the equation: $Ca^{2+} + HCO^{3-} = CaCO_3 + H_2O + CO_3$

$$\text{SAR} = \frac{Na^+}{\sqrt{(Ca^{2+} + Mg^{2+})/2}}$$

Were,

SAR = Sodium Absorption Ratio

Na = Sodium

Ca = Calcium

Mg = Magnesium

Table No 4- Classification of ground water on the basis of SAR :

Parameter	Range	Water class	No. of samples	%
S.A.R	< 10	Excellent	-	
	10 – 18	Good	29	100
	18 - 26	Doubtful	-	
	>26	Unsuitable	-	

NA%-

Wilcox used percentage sodium and electrical conductance in evaluating the suitability of groundwater for irrigation. The percent Sodium is computed with respect to the relative proportions of cations present in water, where the concentration of ions is expressed in meq/lit using the formula excess Na+, combining with carbonate, leads to formation of alkali soils, whereas with chloride, saline soils are formed. Na+ % should not exceed 60% in irrigation water.

$$\text{Na\%} = \frac{Na^{+} + K^{+}}{Ca^{2+} + Mg^{2+} + Na^{+} + K^{+}} \times 100$$

Were,

Na = Sodium

K = Potassium

Ca = Calcium

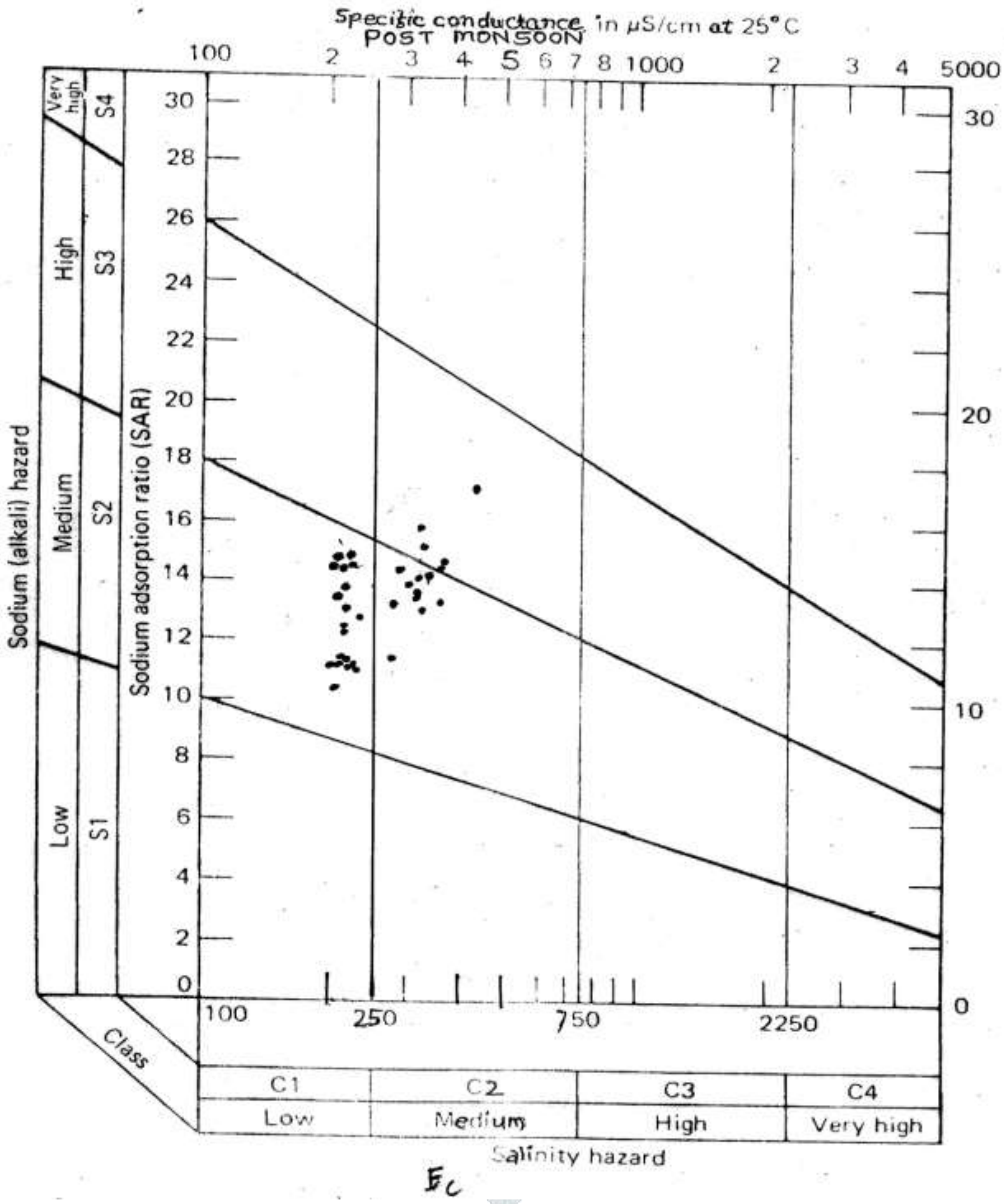
Mg = Magnesium

Table No 5- Physico-chemical analysis of ground water during post-monsoon:

Physico chemical analysis of Post Monsoon season											
					Cations				Anions		
Sr. No.	Site No	ph	Ec	TH	Ca	Mg	Na	K	Cl	Hco3	So4
1	BW 1	7.35	289.21	93	151	76	180	8.5	167.08	459	183
2	BW 2	7.08	260.69	161	182	88	178	9.1	174	468	178
3	BW 3	6.81	311.23	122	178	85	189	8.8	185.08	525	186
4	BW 4	6.56	277.02	109	168	79	193	8.5	197.99	494	189
5	BW 5	7.03	300.55	103	170	86	182	9.7	221	401	180
6	DW 1	6.18	240.35	122	143	56	154	6.1	76.25	258	126
7	DW 2	6.56	308.54	69	164	58	146	7.5	73.7	265	138
8	DW 3	6.22	203.18	84	171	53	158	5.6	86.8	307	119
9	DW 4	6.53	220.97	104	168	49	140	6.1	78	245	145
10	DW 5	5.65	285.44	72	161	66	138	6.4	87	326	158

Table No 6-Results of ground water in study area on the basis of SAR & Na%

No.	Post-monsoon	
	SAR	Na%
BW 1	16.89	45.36
BW 2	15.31	40.93
BW 3	16.48	42.92
BW 4	17.36	44.92
BW 5	16.08	42.81
DW 1	15.43	44.58
DW 2	13.85	40.87
DW 3	14.92	42.20
DW 4	13.44	40.23
DW 5	12.95	38.87


Specific conductance in µS/cm at 25° C
POST MONSOON
100
2
3
4
5
6
7
8
1000
2
3
4
5000
Sodium (alkali) hazard
Very high
High
Medium
Low
S4
S3
S2
S1
Sodium adsorption ratio (SAR)
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
Class
100
250
750
2250
C1
C2
C3
C4
Low
Medium
High
Very high
Salinity hazard
Ec

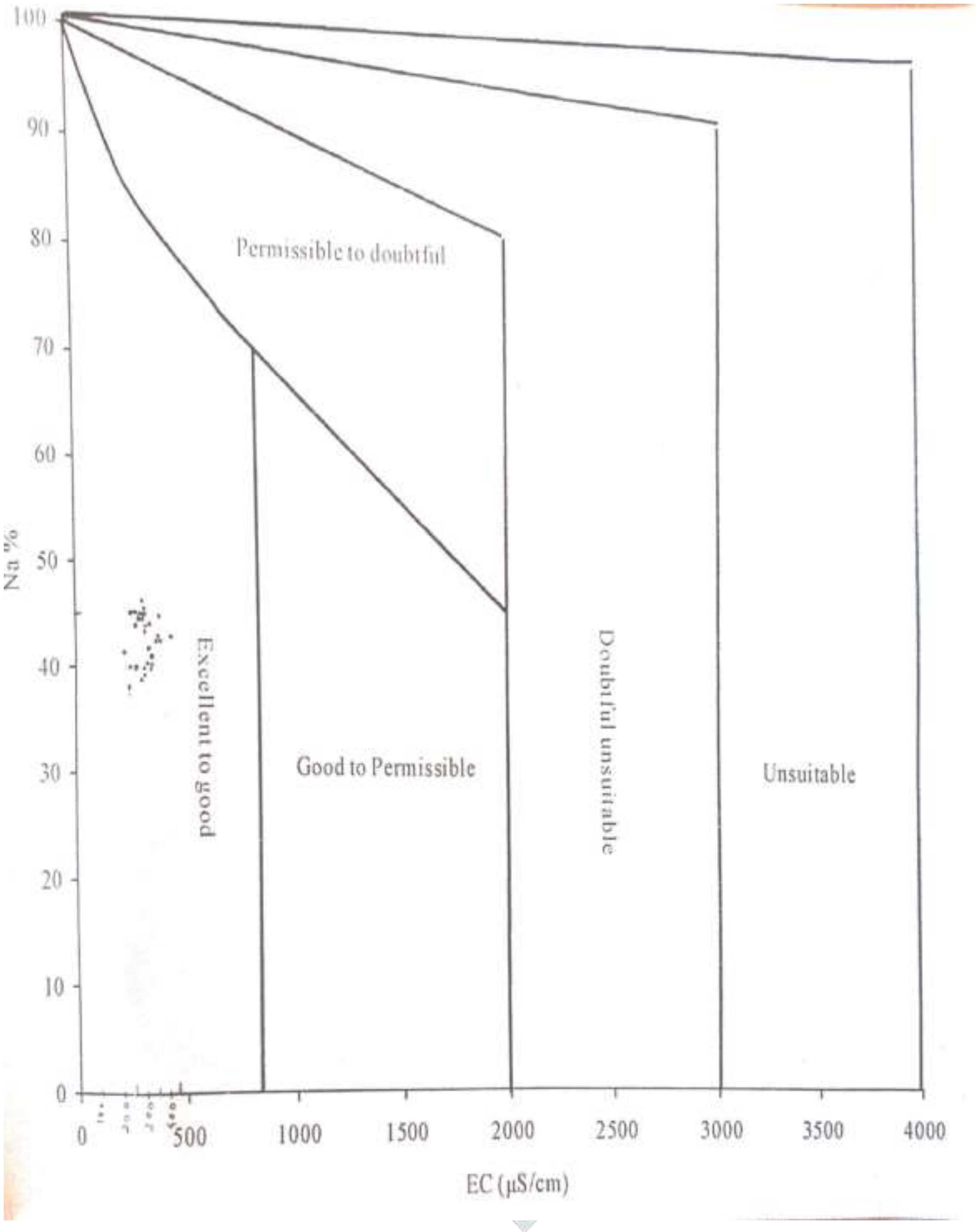
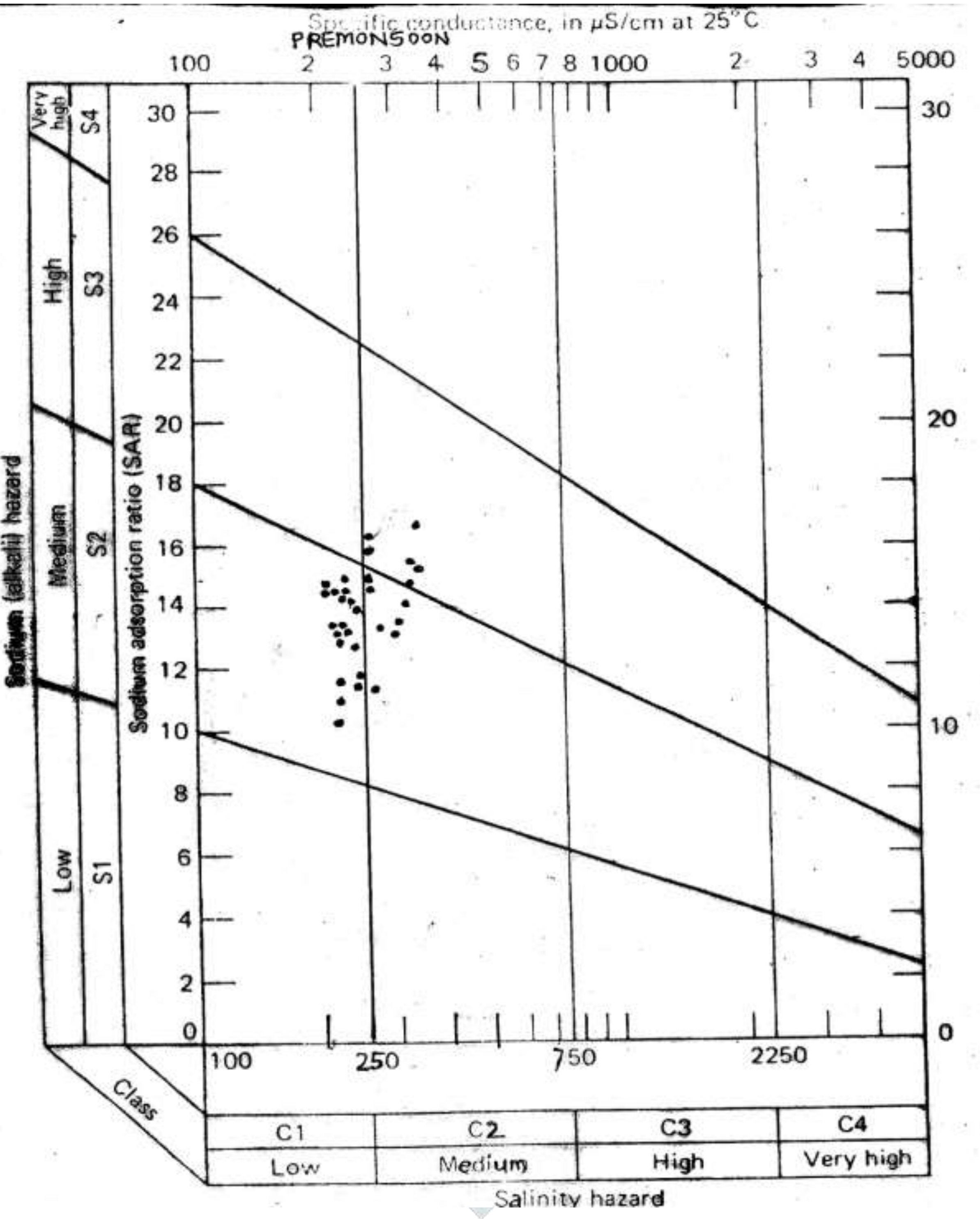

Permissible to doubtful
Excellent to good
Good to Permissible
Doubtful unsuitable
Unsuitable
Na %
EC (µS/cm)
0
10
20
30
40
50
60
70
80
90
100
500
1000
1500
2000
2500
3000
3500
4000

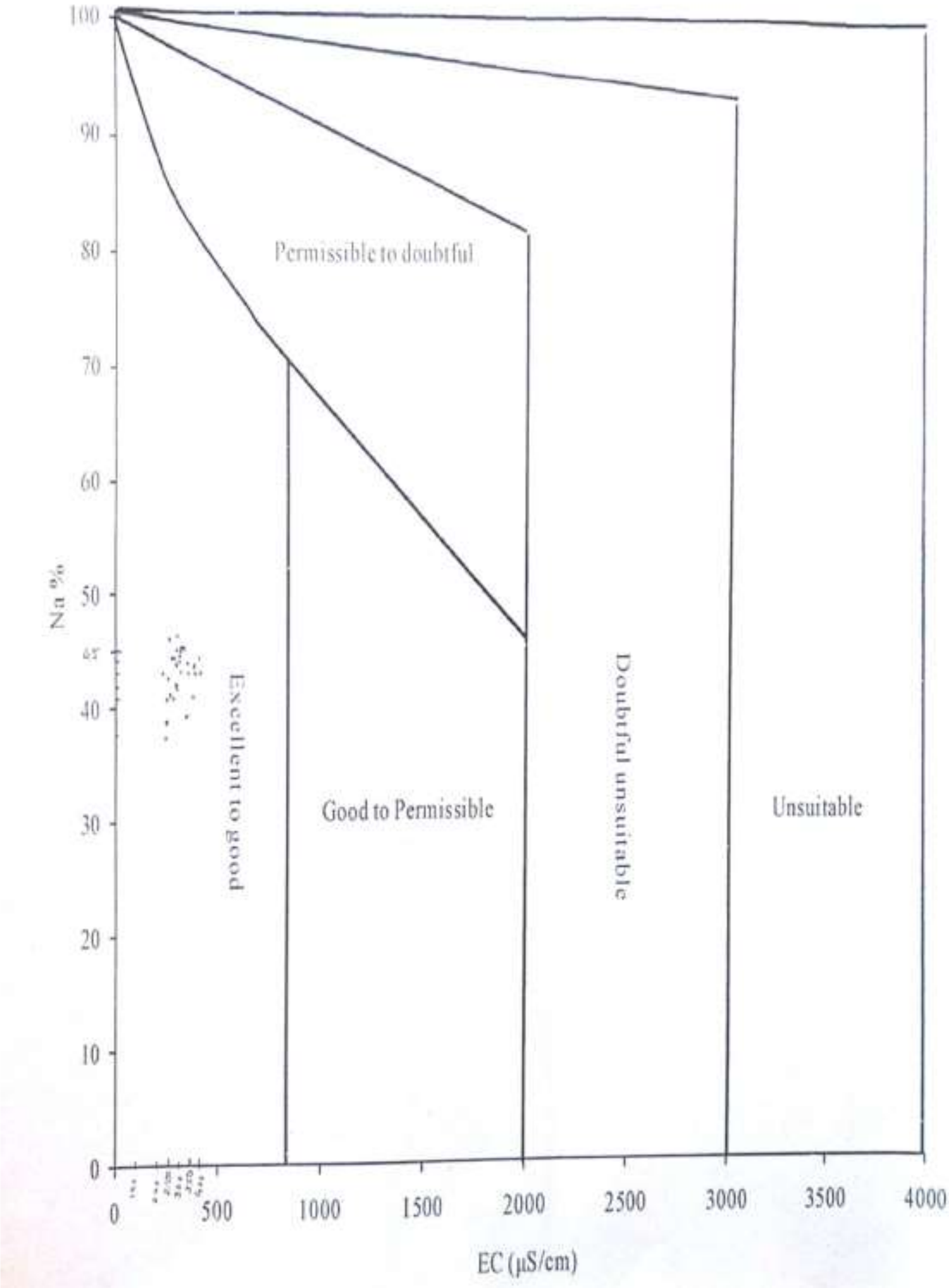
Table No 7- Physico-chemical analysis of ground water during pre-monsoon

Physico chemical analysis of PRE-MONSOON											
					Cations				Anions		
Sr No.	Site No	Ph	Ec	TH	Ca	Mg	Na	K	Cl	Hco3	So4
1	BW 1	7.63	296.52	86	153	77	183	9.1	175.20	461	186
2	BW 2	7.59	276.15	146	182	90	184	9.3	186.01	473	179
3	BW 3	7.32	313.76	119	179	87	191	9.4	197.71	526	188
4	BW 4	7.01	243.25	99	170	80	198	8.8	213.36	497	192
5	BW 5	7.63	293.49	93	173	88	185	10.2	246.74	405	185
6	DW 1	6.78	276.96	112	144	56	159	7.0	82.46	262	132
7	DW 2	6.97	346.81	66	166	61	148	8.1	79.31	267	139
8	DW 3	7.09	215.27	79	171	54	162	6.2	97.16	311	126
9	DW 4	6.79	220.97	101	170	51	146	6.7	89.25	249	146
10	DW 5	6.14	261.73	70	163	68	141	6.9	88.97	329	163

Table No 8-Results of ground water in study area based on SAR & Na%

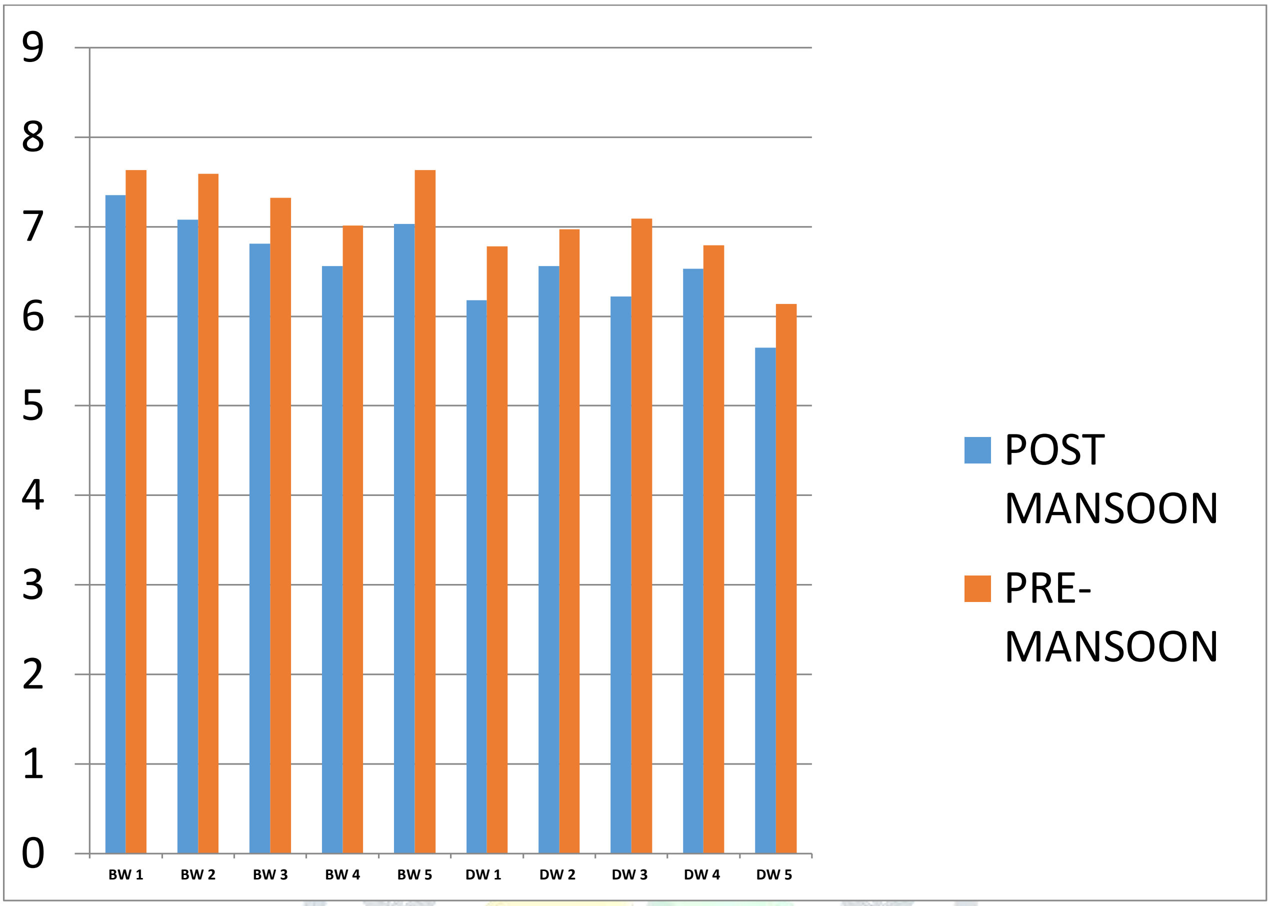
	Pre-monsoon	
No.	SAR	Na%
BW 1	17.06	45.51
BW 2	15.77	41.54
BW 3	16.48	42.96
BW 4	17.36	45.27
BW 5	16.08	42.78
DW 1	15.9	45.35
DW 2	13.89	40.74
DW 3	15.27	42.77
DW 4	13.88	40.86
DW 5	13.11	39.03


Specific conductance, in µS/cm at 25°C
PREMONSOON
100 2 3 4 5 6 7 8 1000 2 3 4 5000
Sodium (alkali) hazard
Very high
High
Medium
Low
S4
S3
S2
S1
Sodium adsorption ratio (SAR)
100
250
750
2250
Class
C1
Low
C2
Medium
C3
High
C4
Very high
Salinity hazard


Na %
EC (µS/cm)
Permissible to doubtful
Excellent to good
Good to Permissible
Doubtful unsuitable
Unsuitable
0
10
20
30
40
50
60
70
80
90
100
500
1000
1500
2000
2500
3000
3500
4000

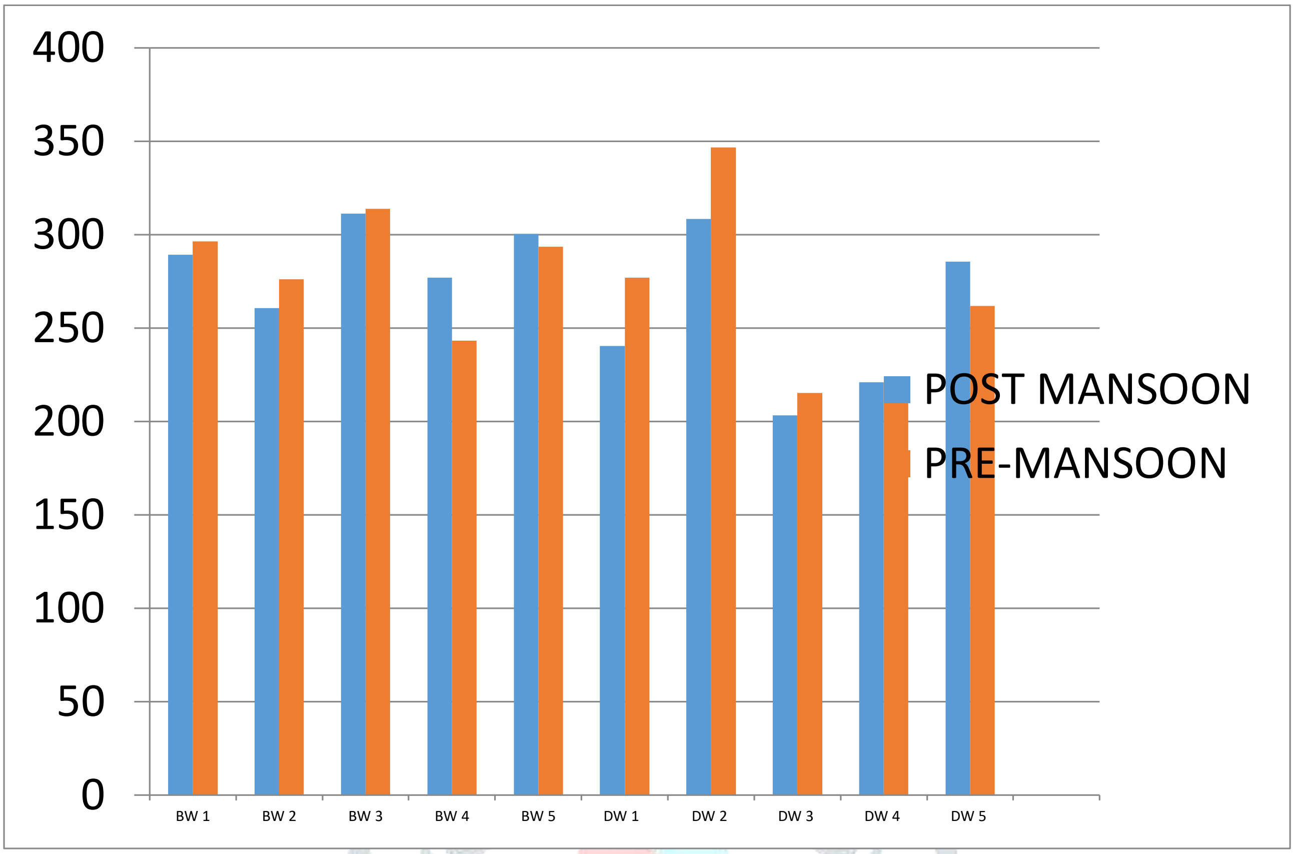
GRAPH OF ALL PARAMETERS

pH



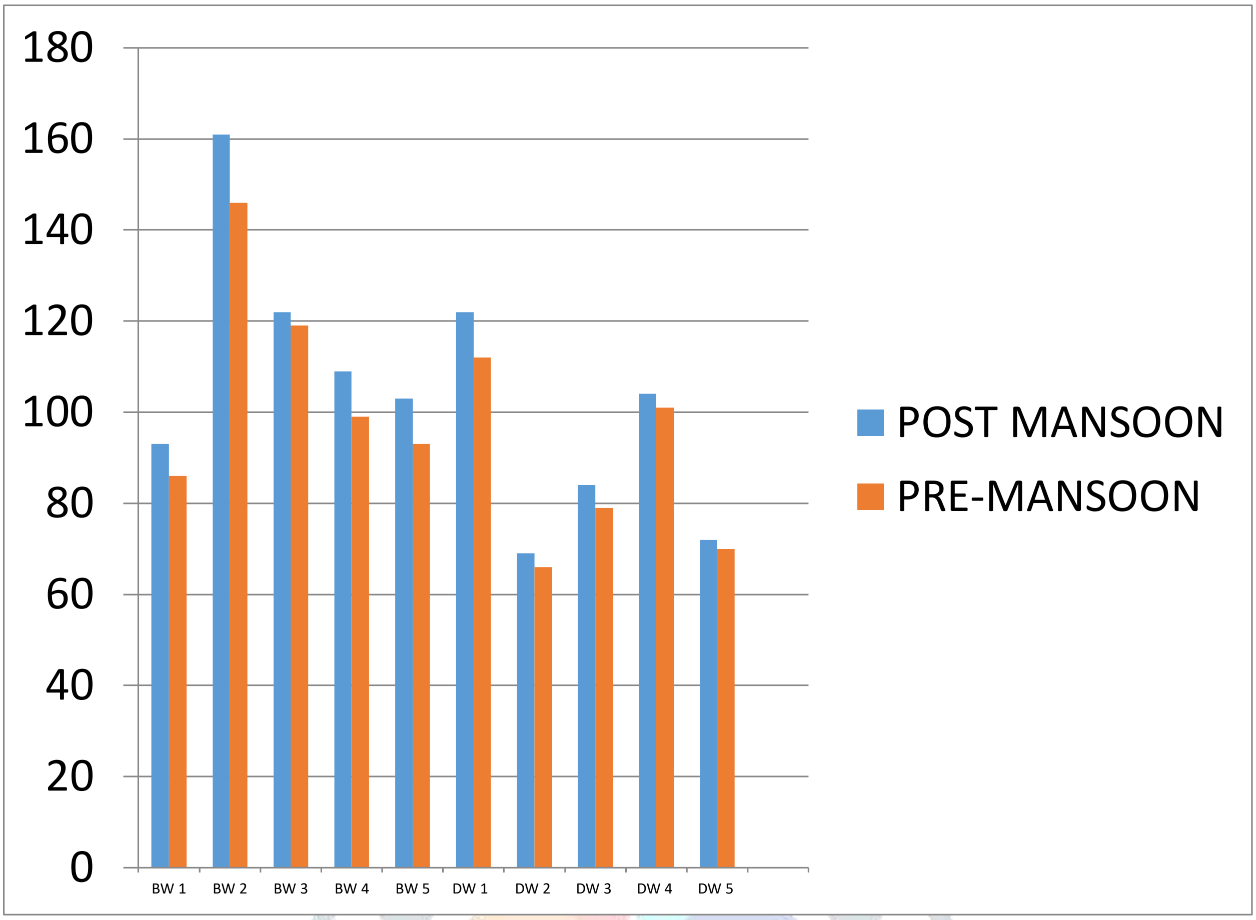
Physico-chemical data of pH

EC



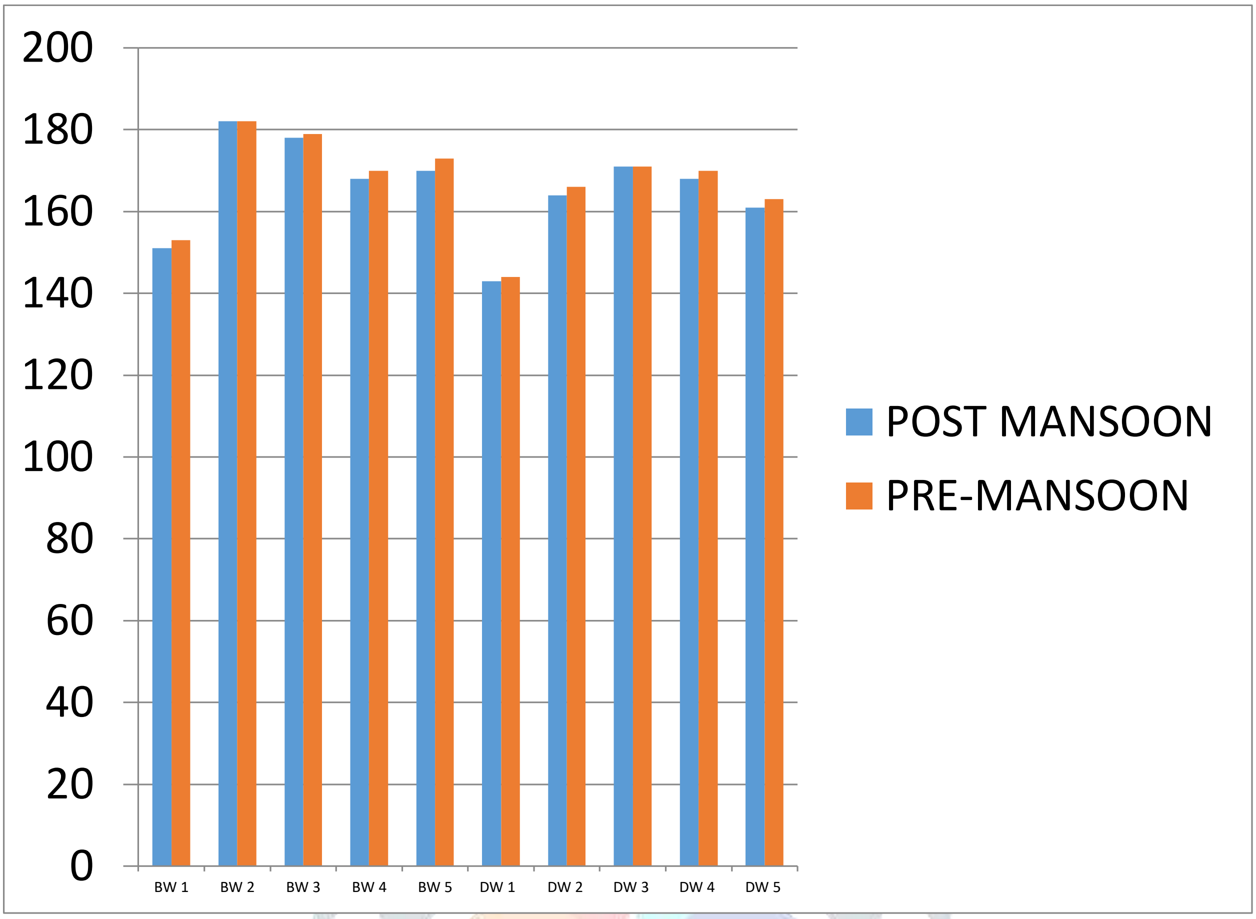
Physico-chemical data of EC

TH



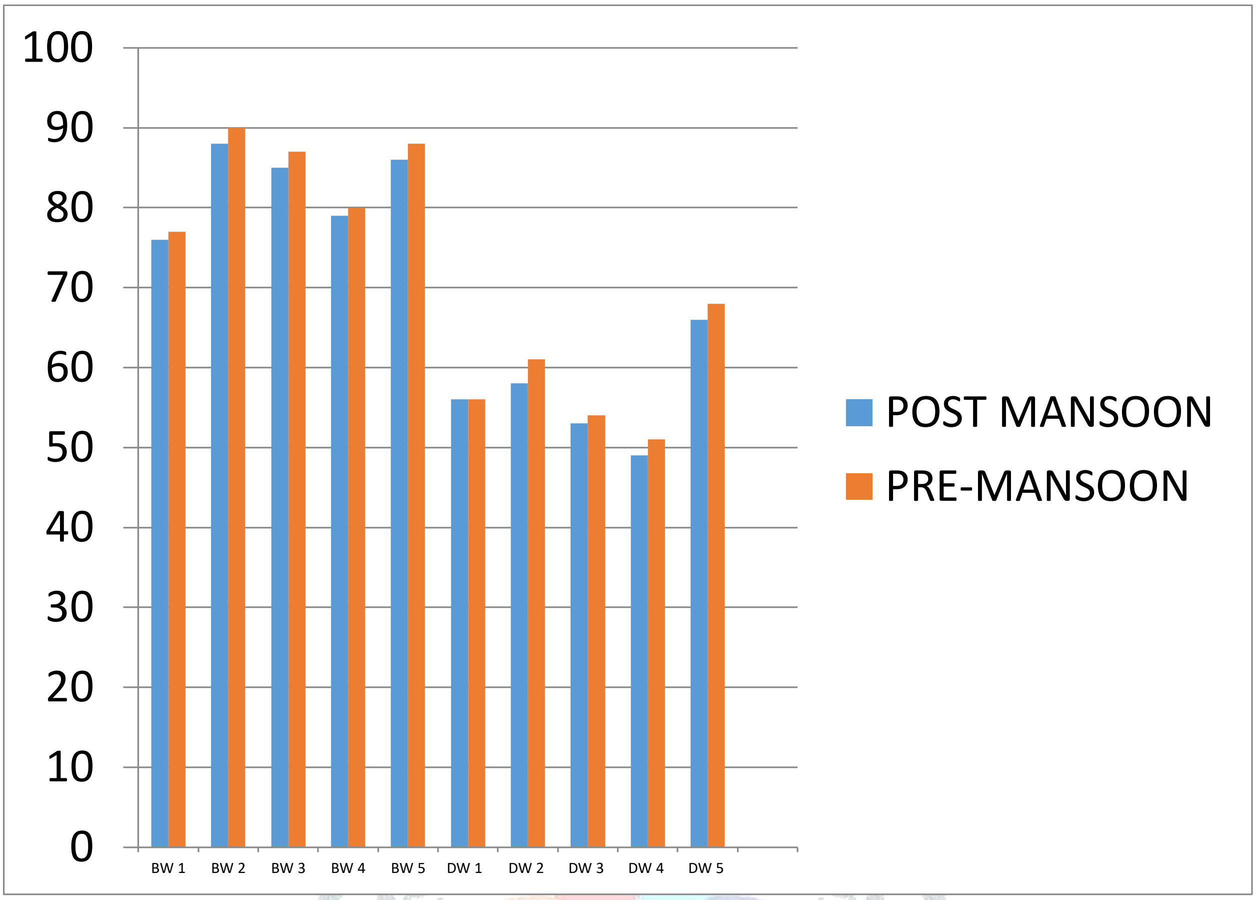
Physico-chemical data of TH

Ca



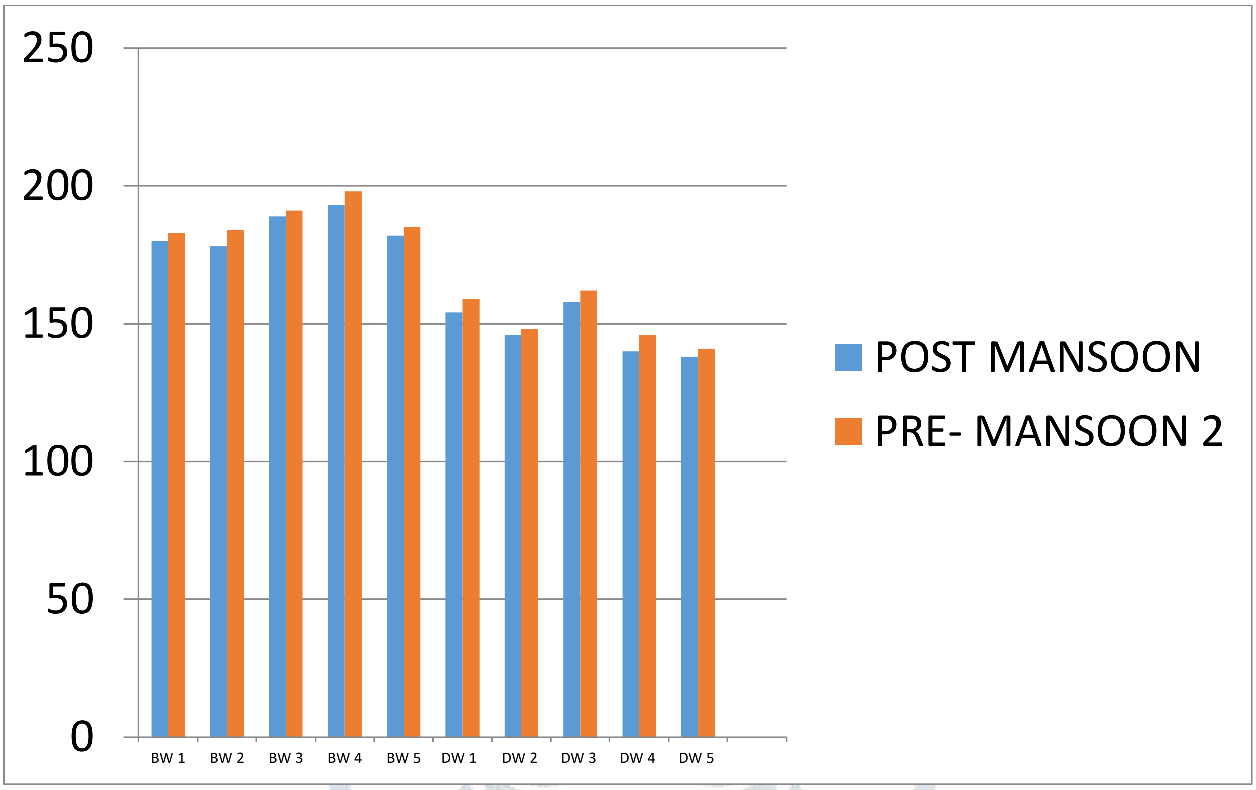
Physico-chemical data of Ca

Mg



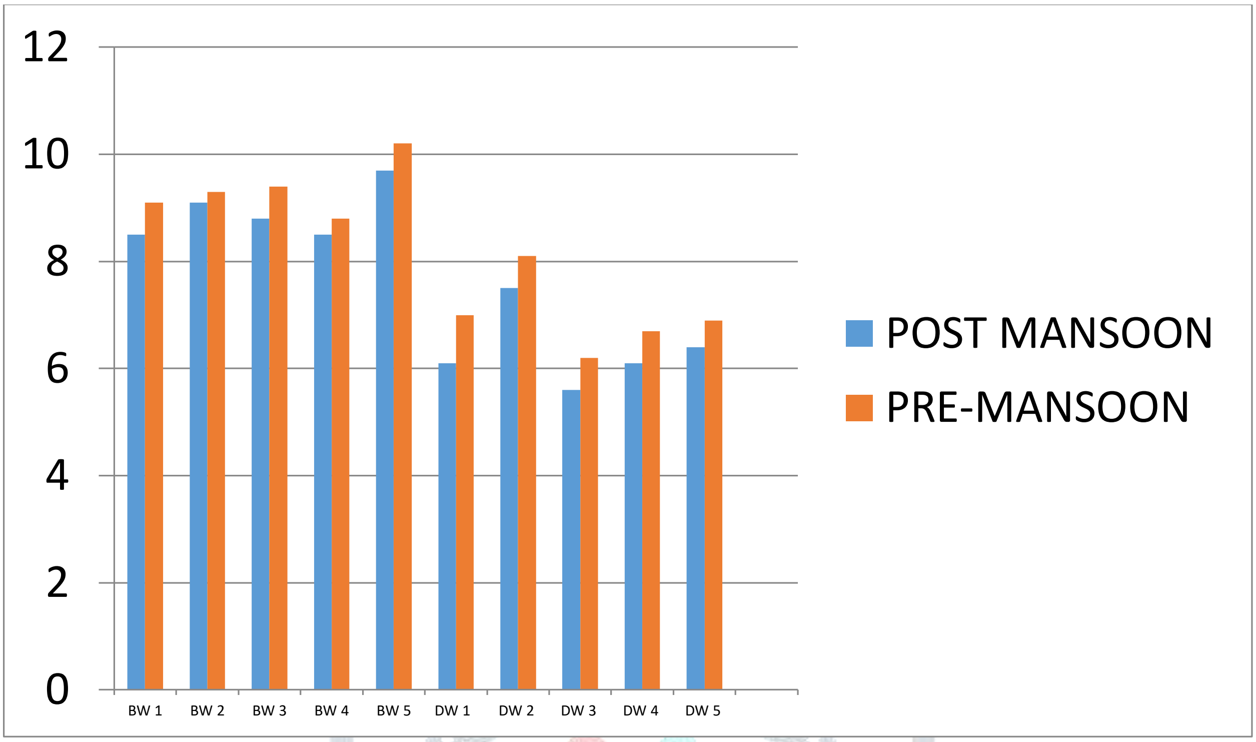
Physico-chemical data of Mg

Na



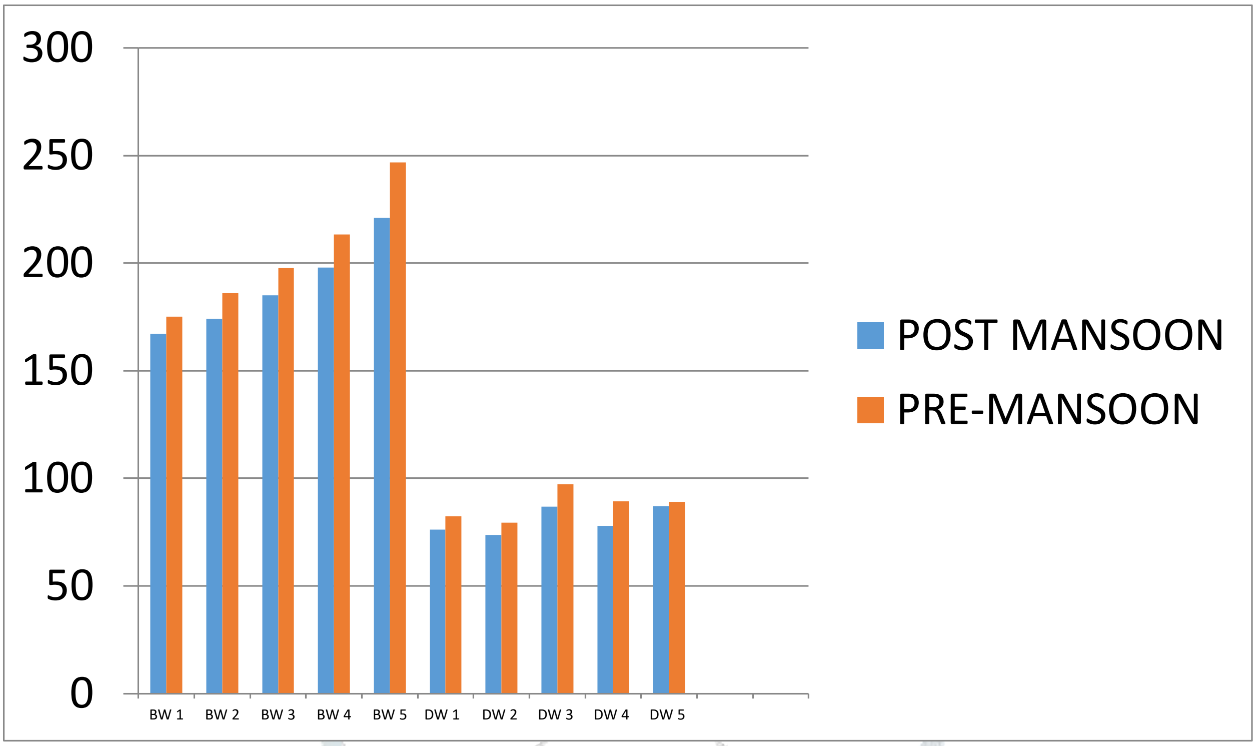
Physico-chemical data of Na

K



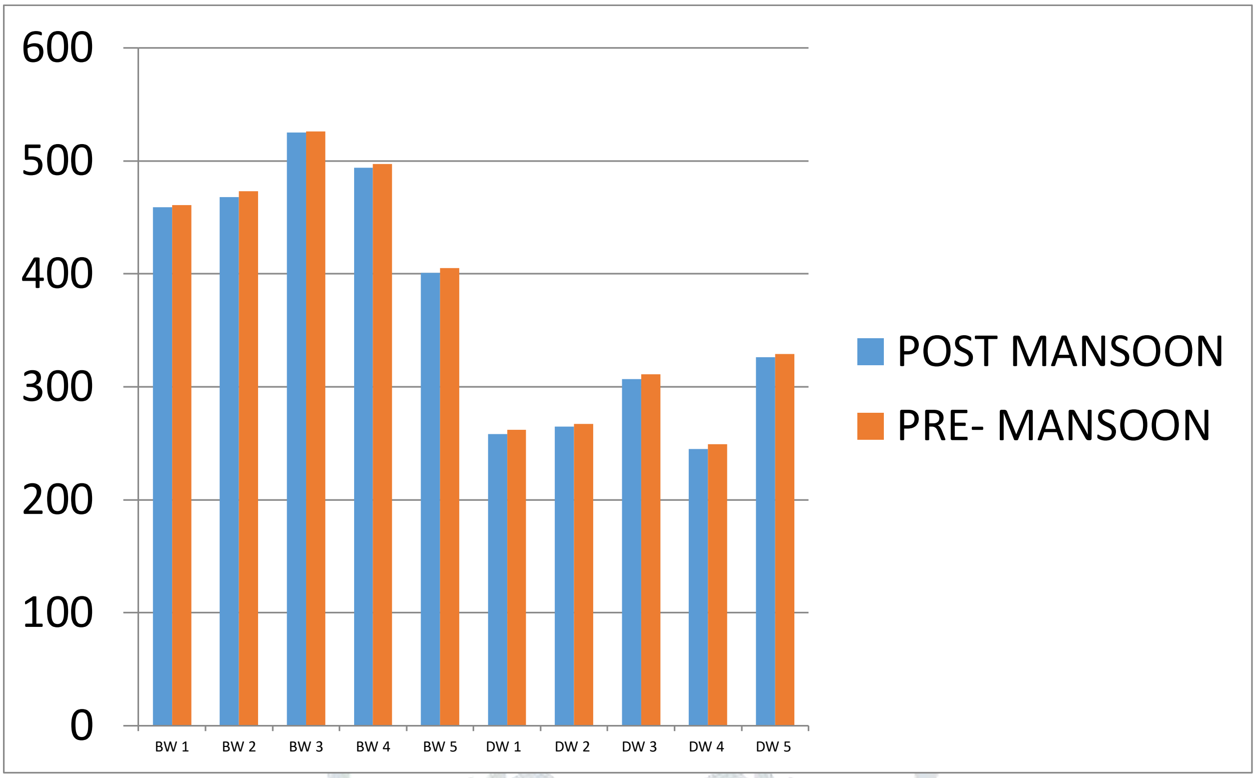
Physico-chemical data of K

Cl



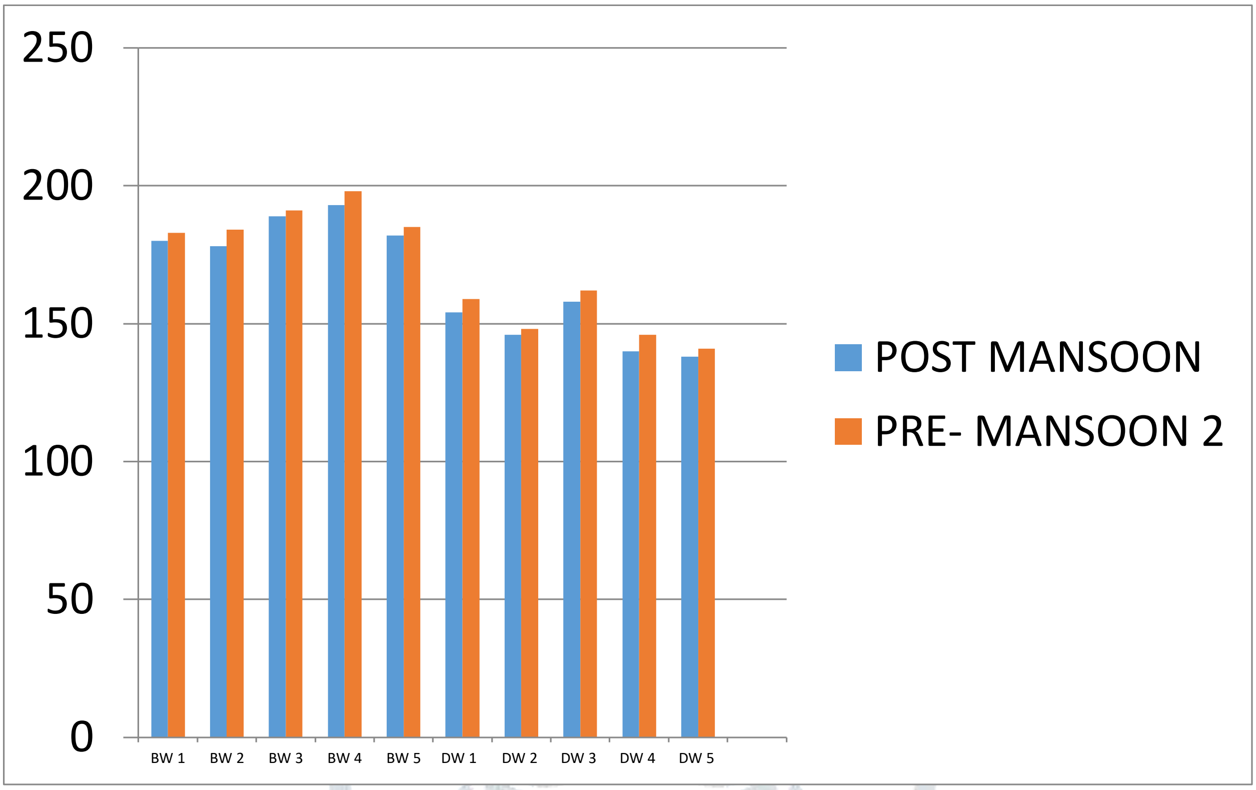
Physico-chemical data of Cl

HCO3



Physico-chemical data of HCO3

SO4



Physico-chemical data of SO4

CHAPTER 5

CONCLUSION

Aim of the project was to determine the ground water quality with special reference to physical and chemical analysis of ground water in terms of their potential for drinking and irrigation.

The tremendous use of fertilizer and expansion of population has changed the qualities of ground water. In order to collect the data regarding quality of ground water at PIRANGUT and adjacent villages, chemical laboratory tests were carried out on collected post monsoon and pre- monsoon water samples. The analysis included determination of Magnesium, Potassium, Bicarbonates, Sulphate, Calcium, Hardness, Chloride content, Ph.

The result of various post monsoon and pre-monsoon analysis in present study reveals that most of the stations give satisfactory result. The results revealed that groundwater in the study area were mostly acidic. The pH value of 30.3% water samples were exceeded the permissible limit given by WHO (6.5-8.5). Sodium absorption ratio (SAR) values suggest suitability of groundwater from the study area for irrigation. Some groundwater samples are unsuitable for irrigation purpose according to Sodium absorption ratio (SAR). The data structures show that application according to fertilizer for agricultural contributing the slightly higher concentration of ions in bore well of adjacent villages of PIRANGUT. This research may serve as preliminary study to provide baseline information that may direct future water quality assessment studies in the study area.

SUGESSIONS

1) Encourage the framers to use biofertilizer to avoid the soil, surface water and groundwater contamination.
2) Proper casing and covering should be provide for borewell to minimize contamination due to falling of leaves, branches etc.
3) Proper drainage system should be provided near the bore wells and dug wells.
4) Monitoring of ground water at regular interval should be carried.
5) RCC pavement should be constructed around the dug well and bore well.
6) Avoid the washing of clothes and utensils near the bore wells and dug wells.
7) Adopt the rainwater harvesting technique to improve the groundwater table.

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