International Journal of Agriculture Sciences
ISSN: 0975-3710&E-ISSN: 0975-9107, Volume 10, Issue 9, 2018, pp.-5928-5930.
Available online at https://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

Research Article

PHYSICOCHEMICAL ASSESSMENT OF THE QUALITY OF SURFACE AND GROUND WATER SOURCES IN SELECTED RURAL COMMUNITIES OF CHITRAKOOT

YADAV AMITA[1], GUPTA G.S.[1] AND SINGH D.P.*[2]
[1]Mahatma Gandhi Chitrakoot Gramoday Vishwavidyalaya, Chitrakoot, Satna, 485334, Madhya Pradesh, India
[2]Indira Gandhi Krishi Vishwavidyalaya, Krishak Nagar, Raipur, 492012 Chhattisgarh, India
*Corresponding Author: Email- dp_jagdalpur@rediffmail.com

Received: April 27, 2018; Revised: May 06, 2018; Accepted: May 07, 2018; Published: May 15, 2018

Abstract- Statistical analyses (Descriptive analysis and ANOVA test) were applied to water quality (Physico-chemical) data monitored for year 2017 for observations to check the seasonal and temporal variations in water quality in selected rural communities of Chitrakoot Nagar Panchayat. Changes in concentrations of various physico-chemical parameters such as (pH, Temperature, electrical conductivity (EC), turbidity, total dissolved solids (TDS), total hardness (TH), Alkalinity, BOD and chemical oxygen demand (COD) were observed using statistical techniques. Statistical analyses revealed that concentrations of parameters were changing with seasonal variation but variations in three variables *viz*., EC, TDS and COD were statistically more significant variation were observed.

Keywords- ANOVA, physico-chemical parameters

Citation: Yadav Amita, *et al*., (2018) Physicochemical Assessment of The Quality of Surface and Ground Water Sources in Selected Rural Communities of Chitrakoot. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 10, Issue 9, pp.-5928-5930.

Introduction

Water is the valuable source for life and also for various activities. About 80% of the earth's surface is covered with water and it is used for drinking, agriculture, domestic and industrial use. River, hand pump and dug well are important water resource and these resources are widely utilized by mankind over the years to the extent that very few, if not many are now in a normal condition. The maintenance of healthy aquatic ecosystem mainly depends on the physicochemical properties of water and biological diversity of aquatic organisms [1]. The main objective of our study was to test out the seasonal and temporal variations in water quality using statistical techniques *i.e*., descriptive statistics and ANOVA test. In this study variability and measure of variability are the major focal points of attention. The basic reason of examining the variations among physico-chemical parameters was to check the impact of seasonal variations on water quality that is linked with changing climatic and hydrological conditions. A relationship has also been established between physico-chemical parameters concentrations of water with seasonal variations using statistical methods. We also studied the concentrations of various parameters were changed with change in season, while working in water quality of Chitrakoot Nagar Panchayat. The physico chemical data obtained in the different water sources could be used as a reference and baseline point when assessing further changes caused by man or nature in these sites.

Materials and Methods

Description of sampling area

Water samples were collected from eight different sources *viz*., Purani Lanka (PHE), Hanuman Dhara (PHE), Raghav Prayag (hand pump), Rajoula (hand pump), Arogya Dham (Mandakani river), JankiKund (Mandakani river), Ramghat (Dug well), and KsheerPurwa (Dug well) spreading over Chitrakoot Nagar Panchayat. Samples were collected four times in a year 2017, *i.e*., Summer (March), Pre monsoon (June), post monsoon (September) and winter (December).

Physico-chemical Properties of the Water Samples

The collected samples were analyzed for physicochemical properties (pH, electrical conductivity (EC), turbidity, total dissolved solids (TDS), total hardness, Alkalinity, chemical oxygen demand), using the standard analytical procedures [Table-1].

Data Preparation and Statistical Analysis

The physico-chemical parameters of total 08 monitoring sites, which comprise 10 water quality parameters monitored for March to December, 2017, were subjected to descriptive statistics and ANOVA test to check the seasonal variations in water quality. Relevant statistical packages (R 3.1.3 Statistical Tool Pack) were used to analyze the data obtained and their levels of significance. Descriptive statistics and two-way (seasons & sites) analysis of variance (ANOVA) were some of the analyses carried out in this study.

Table-1 *Summary of analytical methods used for the analyses of water samples*

Parameter measured	Standard Analytical Method used
pH	pH meter
Water temperature	Thermometer
Turbidity	Turbidity meter
EC	EC meter
Total dissolved solids (TDS)	TDS meter
Total Hardness	Titration method
Alkalinity	Titration method
DO	Winkler titration method
BOD	Direct BOD for 5 days
COD	Dichromate reflux method

Results and discussion

Descriptive Statistics

To assess the impact of seasonal variation on water quality mean value were taken into the consideration as a physicochemical characteristics value to check the variations as shown in [Table-2].

Table-2 *Descriptive statistics of physicochemical parameters in the water samples at different stations of 2017*

Parameter	Season	Mean ± SD	CV (%)
Temperature	Summer	28.53±0.72	2.51
	Pre-Monsoon	28.00±0.94	3.34
	Post Monsoon	26.76±0.90	3.38
	Winter	28.94±1.03	3.56
pH	Summer	7.33±0.16	2.25
	Pre Monsoon	7.36±0.18	2.40
	Post Monsoon	7.32±0.13	1.84
	Winter	7.31±0.14	1.93
EC	Summer	575.00±176.67	30.72
	Pre Monsoon	583.82±171.91	29.45
	Post Monsoon	580.94±173.35	29.84
	Winter	585.29±172.57	29.48
Turbidity	Summer	3.15±0.18	5.74
	Pre Monsoon	3.34±0.31	9.36
	Post Monsoon	3.16±0.30	9.41
	Winter	3.28±0.39	11.81
TDS	Summer	425.88±152.36	35.77
	Pre Monsoon	442.35±162.11	36.65
	Post Monsoon	446.76±163.43	36.58
	Winter	451.24±163.02	36.13
TH	Summer	248.00±25.59	10.32
	Pre Monsoon	250.29±25.17	10.06
	Post Monsoon	247.76±25.35	10.23
	Winter	245.71±25.27	10.29
Alkalinity	Summer	163.35±17.93	10.97
	Pre Monsoon	162.94±18.18	11.16
	Post Monsoon	161.24±18.87	11.70
	Winter	165.12±19.37	11.73
DO	Summer	5.12±0.33	6.38
	Pre Monsoon	5.09±0.18	3.47
	Post Monsoon	5.15±0.23	4.40
	Winter	5.18±0.25	4.74
BOD	Summer	4.99±0.19	3.78
	Pre Monsoon	5.22±0.22	4.19
	Post Monsoon	5.20±0.23	4.35
	Winter	5.24±0.24	4.58
COD	Summer	31.41±6.79	21.62
	Pre Monsoon	31.18±5.19	16.64
	Post Monsoon	29.71±4.87	16.40
	Winter	31.29±5.07	16.21

Mean values of various parameters of eight different sites of 2017 were taken into consideration. A significant seasonal variation in pH of groundwater was observed, at the 0.05 level of significance. The comparison of mean values shows higher pH (7.36) in pre-monsoon season and lowest (7.31) in winter season. pH means value changes from 7.36 (pre-monsoon) to 7.32 (post-monsoon) with standard deviation of 0.18 and 0.13, respectively. The pH is an important parameter in evaluating the acid-base balance of water [2]. A significant seasonal variation in EC of groundwater was observed, at the 0.05 level of significance. The comparison of mean values shows higher EC (585.29) in winter season and lowest (575) in summer season. EC mean value changes from 583.82 (pre-monsoon) to 580.94 (post-monsoon) with standard deviation of 171.91 and 173.35, respectively. High EC value indicated the presence of high amount of dissolved inorganic substances in ionized form [3]. The comparison of mean values shows higher Turbidity (3.34) in pre-monsoon season and lowest (3.15) in summer season. Turbidity mean value changes from 3.34 (pre-monsoon) to 3.16 (post-monsoon) with standard deviation of 0.31 and 0.30, respectively. The comparison of mean values shows higher TDS (451.24) in winter season and lowest (425.88) in summer season. TDS mean value changes from 442.35 (pre-monsoon) to 446.76 (post-monsoon) with standard deviation of 162.11 and 163.43 respectively. In drinking water, it is exclusively important parameter which gives particular test to water. Water with a high total dissolved solid indicated more ionic concentration. Kataria, *et al*., (1996) [4] detailed that expansion in estimation of TDS showed contamination by incidental sources. The examination of higher TH (250.29) in pre-monsoon season and most minimal (245.71) in winter season. TH mean value changes from 250.29 (pre-monsoon) to 247.76 (post-monsoon) with standard deviation of 25.35 and 25.17 respectively. The hardness of water is not a pollution parameter but indicates water quality. Although hard water has no effect on health but it is unsuitable for domestic use [5]. The comparison of mean values shows higher Alkalinity (165.12) in winter season and lowest (161.24) in post monsoon season. Alkalinity mean value changes from 162.94 (pre-monsoon) to 161.24 (post-monsoon) with standard deviation of 18.18 and 18.87 respectively. The comparison of mean values shows higher DO (5.18) in winter season and lowest (5.09) in pre monsoon season. DO mean value changes from 5.09 (pre-monsoon) to 5.15 (post-monsoon) with standard deviation of 0.18 and 0.23 respectively. The comparison of mean values shows higher BOD (5.24) in winter season and lowest (4.99) in summer season. BOD mean value changes from 5.22 (pre-monsoon) to 5.20 (post-monsoon) with standard deviation of 0.22 and 0.23 respectively. The mean value shows higher COD (31.41) in summer season and lowest (29.71) in post monsoon season. COD mean value changes from 31.18 (pre-monsoon) to 29.71 (post-monsoon) with standard deviation of 5.19 and 4.87 respectively [Table-2].

Analysis of Variance

ANOVA results revealed that there was statistically significant difference between seasonal and temporal variations in water quality parameters under Chitrakoot regions [Table-3]. Two ways Analysis of Variance (ANOVA) was carried out for four seasons and 8 different sites to evaluate the variation of water quality parameters. From the [Table-3] it can be seen that the only TDS and DO physiochemical parameters of water which are statistically significant ($p < 0.01$) different between seasonal and temporal variations in water quality parameters. Statistical analysis by Two-way ANOVA on water temperature, TDS and DO of water as a function of variation among seasons is statistically significant ($p < 0.01$) differ to each other, rest of parameters are not found significant ($p<0.05$) difference among seasons. Statistical analysis by Two-way ANOVA on EC, Turbidity, TDS, TH, DO and COD of water as a function of variation among locations is statistically significant ($p < 0.01$) differ to each other, rest of parameters are not found significant ($p<0.05$) difference among locations. Conductivity and total Dissolved solids results obtained significant difference among seasons [6]. Seasonal variations of the water quality parameters observed in different seasons. Highly significant (at 0.01% level) difference observed among the locations in surface and ground water [7]. From the [Table-3] on only pH and BOD parameters of water as a function of variation among seasons as well as sites is not found statistically significant ($p < 0.05$). Statistical analysis by Two-way ANOVA on pH of water as a function of variation between stations and seasons are statistically non significant [8, 9].

Conclusion

The physico-chemical parameters variability between seasons and locations analyzed in different locations of Chitrakoot area indicated a considerable spatio-temporal heterogeneity of patterns associated. From the ANOVA test, it is concluded that there are changes except pH and BOD in almost all the parameters associated changes variability between seasons and locations.

Table-3 *ANOVA for seasonal and temporal variation of physicochemical parameter*

Parameter	Source of variation	Sum of squares	df	Mean squares	F value
Temperature	Between seasons	24.38	3	8.13	11.29**
	Between sites	8.38	7	1.2	1.66ns
	Total	47.88	31		
pH	Between seasons	0.06	3	0.02	1.0 ns
	Between sites	0.28	7	0.04	2.0 ns
	Total	0.67	31		
EC	Between seasons	768.38	3	256.13	1.15 ns
	Between sites	797354.88	7	113907.84	512.48**
	Total	802790.88	31		
Turbidity	Between seasons	0.19	3	0.06	2.0 ns
	Between sites	0.59	7	0.08	2.66*
	Total	1.36	31		
TDS	Between seasons	1112.59	3	370.86	15.14**
	Between sites	951262.97	7	135894.71	5550.43**
	Total	952889.72	31		
TH	Between seasons	99.13	3	33.04	2.39 ns
	Between sites	3875.88	7	553.70	42.00**
	Total	4251.88	31		
Alkalinity	Between seasons	57.63	3	19.21	2.01 ns
	Between sites	801.88	7	114.55	12.01**
	Total	1059.88	31		
DO	Between seasons	0.18	3	0.08	8.0**
	Between sites	0.42	7	0.06	6.0**
	Total	0.89	31		
BOD	Between seasons	0.12	3	0.04	0.08 ns
	Between sites	0.12	7	0.02	0.04 ns
	Total	1.20	31		
COD	Between seasons	27.34	3	9.11	1.27 ns
	Between sites	630.47	7	90.07	12.53**
	Total	808.72	31		

Application of research: The physico-chemical data obtained in different water sources could be used as a base line point when assessing further changes caused by man or nature in these sites.

Research Category: Ground Water Sources

Abbreviations:
BOD: Biochemical Oxygen Demand
COD: Chemical Oxygen Demand
DO: Dissolved Oxygen
ANOVA: Analysis of Variance

Acknowledgement / Funding: Author thankful to Faculty of Science and Environment, Mahatma Gandhi Chitrakoot Gramoday Vishwavidyalaya, Chitrakoot, Satna, 485334, Madhya Pradesh, India

***Research Guide or Chairperson of Research: Dr G. S. Gupta**
University: Mahatma Gandhi Chitrakoot Gramoday Vishwavidyalaya, Chitrakoot, Satna, 485334, Madhya Pradesh, India
Research project name or number: PhD Thesis

Author Contributions: All author equally contributed
Author statement: All authors read, reviewed, agree and approved the final manuscript

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

References

[1] Venkatesharaju K.P., Ravikumar R.K., Somashekar and Prakash K.L. (2010) *Kathmandu University Journal of Science, Engineering and Technology*, 6(1), 50-59.
[2] Usha N.M., Jayaram K.C. and Kantha H.L. (2008) *Proceedings of Tall 2007: The 12thWorld Lake Conference*: 1737-1741.
[3] Gupta N., Yadav K.K., Kumar V. and Singh D. (2013) *International Journal of Chemistry Technology Research*, 5(1), 528-531.
[4] Kataria H.C., Quereshi H.A., Iqbal S.A. and Shandilya A.K. (1996) *Pollution Research*, (15), 191-193.
[5] Priya S., Sam S., Manohar Dasand and Vareethiah K. (2016) *International Journal of Innovative Science, Engineering & Technology*, 3 (8), 319-323.
[6] Okechukwu R.I., Ogukwe C.E. and Igboasoiyi O.O. (2015) *Research Journal of Chemical Sciences*, 5 (1), 83-87.
[7] Kumar R., Chauhan A. and Rawat L. (2017) *Journal of Environmental and Analytical Toxicology*, (6), 420-426.
[8] Eliud Limo (2017) *Journal of Chemical, Biological and Physical Sciences*, 7(3), 588-602.
[9] Sahoo M., Mahananda M.R. and Seth P. (2016) *Journal of Geoscience and Environment Protection*, (4), 26-37.