iJRASET
International Journal For Research in Applied Science and Engineering Technology

# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

**Volume:** 12 **Issue:** XII **Month of publication:** December 2024

**DOI:** https://doi.org/10.22214/ijraset.2024.65978

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
*ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538*
*Volume 12 Issue XII Dec 2024- Available at www.ijraset.com*

# Analysis of Drinking Water Quality through Water Quality Index (WQI) Calculated from Ahmedabad City

Mihir B. Suthar[1], Rakesh L. Pagi[2], Tejal M. Suthar[3], Dr. J. R. Prajapati[4]
[1]*Ph.D. Student, Zoology Department, University School of Sciences, Navrangpura, Gujarat University, Ahmedabad – 380 009. Gujarat. Bharat and Associate Professor, Biology Department, K. K. Shah Jarodwala Maninagar Science College, J. L. Trust Campus, Rambaug, Maninagar, Ahmedabad -380008*
[2]*Assistant Teacher, Kunda Primary School, Ta. Sanjeli, Dahod Jilla Panchayat. Dist. Dahod. Gujarat, India and Alumni, KKSJMSC, Ahmedabad*
[3]*Associate Professor of Nursing Class-1, Government Institute of Nursing Education and Research (GINERA), Near B. J. Medical College, Civil Hospital Campus, Asarwa, Ahmedabad– 380016*
[4]*Ph.D. Guide, Gujarat University, Ahmedabad-380009 and Professor and Head, Department of Biology, Shri P. H. G. Municipal Arts and Science College, Kalol-382 721, North Gujarat. India*

***Abstract:*** ***According to UNDP World Urbanization Prospect Data Set, nearly 4.2 billion of World's human population lives in towns and cities. After independence, the urban population of India has grown nearly five times during last 75 years. Gujarat has more than 37 % people living in cities and towns, higher than the average of India. Ahmedabad is the largest city of Gujarat and sixth largest city in India with a population of almost 5 million. It is located at 23.03$^0$ N 72.58$^0$ E. The present study was carried out to find water quality index (WQI) of drinking water from the data of 36 samples from 18 areas of Ahmedabad city studied in the year 2004. Water quality index is one of the most effective ways to communicate water quality information to the public and administrators. The data of total hardness, calcium hardness, magnesium hardness, chlorinity and salinity were subjected to WQI. The WQI was calculated by taking the weighted arithmetic mean of the quality rating using Gujarat Pollution Control Board (GPCB) drinking water standards. The present data indicate that most of samples are not suitable for drinking purpose. However, they can be used for drinking after proper treatment or else for other purposes.***
***Keywords: WQI, Physico-chemical Parameters, Drinking water, Ahmedabad***

## I. INTRODUCTION

A water quality index (WQI) provides a single number (like a grade) that expresses overall water quality at a certain location and time based on several water quality parameters. The objective of an index is to turn complex water quality data into information that is understandable and useable by the public. This type of index is similar to the index developed for air quality that shows if it's a red or blue air quality day. The use of an index to "grade" water quality is a controversial issue among water quality scientists and institutes (Kankal et al., 2008; Shah et al., 2008; Suthar and Mesariya, 2012; Suthar and Suthar, 2010). A single number cannot tell the whole story of water quality; there are many other water quality parameters that are not included in the Water Quality Index. The index presented here is not specifically aimed at human health or aquatic life regulations. However, a water index (numerical value) based on some very important parameters can provide a simple indicator of water quality. It gives the public a general idea the possible problems with the water in the region (Khandwala and Suthar, 2007). Our previous studies (Suthar et al., 2008a-d; Suthar et al.,) showed that various areas of Ahmedabad city have poor quality of drinking water. Hence, the present study was carried out as a part of continuous monitoring.

## II. MATERIALS AND METHODS

The present study is associated with water quality evaluated from 18 areas of Ahmedabad city of Gujarat state. Ahmedabad is the largest city in Gujarat state located on the bank of Sabarmati River. It is located at 23.03°N and 72.58°E. Total 36 tap water samples were collected from municipal and tube well sources in the morning and labelled appropriately (Suthar et al., 2008a-d). Samples were analysed for various physico-chemical characteristics by standard methods (Sunilkumar & Ravindranath, 1998). The chemical parameters analysed were total hardness, calcium hardness, magnesium hardness, chlorides and salinity for WQI calculation.

The data were compared with Gujarat Pollution Control Board (GPCB) drinking water standards as mentioned by Kapila & Mehta (2006). These standards are same as IS: 10500 of Bureau of Indian Standards for parameters studied (Shankar & Balasubramanya, 2008). The data were analysed bio-statistically by calculating mean, range (minimum and maximum values) and Student's t-test. Water quality index (WQI) was calculated based on GPCB standards.

### *A. Water Quality Index (WQI)*

Water quality index (WQI) is a very useful and efficient method for assessing and communicating the information on overall quality of water. To determine suitability of water for drinking purposes, WQI is computed as per various researchers (Sinha and Saxena, 2006; Asadi et al., 2007; Dwivedi & Pathak, 2007). Five physicochemical parameters, viz. total hardness, calcium hardness, magnesium hardness, chlorinity, and salinity values of 2004 data were used to calculate WQI (Suthar et al., 2008a-d).

#### *1) Calculation of unit weight (Wi)*

For a given pollutant or component of water ($i^{th}$ parameter), if it is more harmful then its recommended standard (Si) for drinking water will have smaller magnitude. So, the unit weight (Wi) for the $i^{th}$ parameter is assumed to be inversely proportional to its recommended standard (Si) for the $i^{th}$ parameter. Where, i = 1, 2, 3…, n and n = number of parameters considered for WQI (n = 5 as five parameters studied in the present study).

Thus, $Wi = K/Si$

Where, K = Proportionality constant, Wi = Unit weight for $i^{th}$ parameter, Si = Drinking water standard (i.e. highest desirable limit) prescribed by GPCB (or BIS) for $i^{th}$ parameter].

The proportionality constant (K) was derived from

$$\sum_{i=1}^{n} K = [1/\sum 1/Si]$$

These assumed unit weights (Wi) for all five water quality parameters used here as given in the last column of Table 1.

#### *2) Calculation of quality rating (qi)*

The quality rating (qi) was calculated for the $i^{th}$ parameter using the following formula.

$$qi = [(V_{actual} - V_{ideal})/(V_{standard} - V_{ideal})] \times 100$$

Where, qi = Quality rating of $i^{th}$ parameter; $V_{actual}$ = Actual value of the $i^{th}$ parameter obtained from laboratory analysis; $V_{ideal}$ = Ideal value of ith parameter which can be obtained from the standard tables (here, for all parameters, $V_{ideal}$ is equivalent to zero) $V_{standard}$ = GPCB standard value of $i^{th}$ parameter (i.e., highest desirable value of $i^{th}$ parameter as per GPCB standards)

#### *3) Calculation of subindex*

The subindex (qiWi) has been calculated by multiplying quality rating (qi) and unit weight (Wi) of $i^{th}$ parameter.

#### *4) Calculation of Water Quality Index (WQI)*

The water quality index was calculated by taking the weighted arithmetic mean of the quality rating using following formula adopted by various investigators (Swarnalatha et al. 2007, Dwivedi & Pathak 2007, Shankar & Balasubramanya, 2008; Suthar et al., 2010).

$$WQI = [\sum qiWi] / [\sum Wi]$$

Here, $\sum Wi = 1$ was considered. Both the summations were taken from i = 1 to i = n = 5 (i.e., the total number of parameters considered in the present study). The status of water quality based on WQI was evaluated as per classification adopted by various investigators (Asadi et al., 2007; Suthar et al., 2010; Shah et al., 2008) as given in Table 1.

## III. RESULTS

The water quality index (WQI) showed that almost 29 samples (80%) were having the index value more than 100. Only 7 samples were having WQI value less than 100. Both Municipality and Tubewell sources do not have any significant difference in mean WQI values. The calculated WQI data suggests that drinking water is unsafe as per GPCB standards adopted in present study.

Table: 1 Water Quality Parameters, Their GPCB Standards, Bureau Of Indian Standards (BIS:2003) Standards and assign unit weights

| Name of Parameters | Standard Value (Si) (Highest Desirable Limit) (HDL) | Maximum Permissible limits (MPL) | Unit weights used for WQI values (Wi) |
|---|---|---|---|
| Total Hardness | 300 | 600 | 0.0592898 |
| Calcium Hardness | 75 | 200 | 0.2371592 |
| Magnesium Hardness | 30 | 90 | 0.5938982 |
| Chlorinity | 250 | 1000 | 0.0711477 |
| Salinity | --(450#) | 1800 | 0.0395265 |
| ∑Wi | | | 1 |

GPCB = Gujarat Pollution Control Board standard values (as adopted by Kapila and Mehta, 2006)
#Salinity values were calculated from chlorinity value;
Double Dash '--' represents there is no standards prescribed by GPCB (Kapila and Mehta, 2006).

Table: 2 Status of Water Quality Based on Water Quality Index (WQI) By

| WQI value | Status | Number of samples in the present study | Percentage (%) |
|---|---|---|---|
| 0-25 | Excellent | 00 | 0.00% |
| 26-50 | Good | 01 | 2.78% |
| 51-75 | Poor | 01 | 2.78% |
| 76-100 | Very poor | 05 | 13.89% |
| Above 100 | Unsuitable for drinking | 29 | 80.55% |
| | Total | 36 | |

Weighted arithmetic mean of the quality rating (inversely proportion) using formula adopted by investigator (Please refer Swarnalatha et al., 2007; Dwivedi & Pathak, 2007; Shankar & Balasubramanya, 2008; Suthar et al., 2010).

Table: 3 Sample and Area -wise Water Quality Index (WQI) of Ahmedabad City (For Actual Value Of Each Parameter Please refer Suthar et al., 2008-b).

| Sample Number (S-1 to S-33) | Area | Sample Source | WQI Calculated |
|---|---|---|---|
| S-3 | Amraiwadi | Tubewell | 202 |
| S-33 | Amraiwadi | Tubewell | 447 |
| S-10 | Bapunagar | Tubewell | 48 |
| S-13 | Bapunagar | Tubewell | 169 |
| S-14 | Bapunagar | Municipality | 101 |
| S-27 | Bapunagar | Municipality | 128 |
| S-31 | Bapunagar | Municipality | 59 |
| S-8 | CTM | Municipality | 155 |
| S-12 | CTM | Tubewell | 314 |
| S-35 | CTM | Tubewell | 88 |

| | | | |
|---|---|---|---|
| S-25 | Ellisbridge | Tubewell | 93 |
| S-36 | Shah-e-alam | Tubewell | 118 |
| S-23 | Ghodasar | Municipality | 194 |
| S-26 | Ghodasar | Municipality | 261 |
| S-19 | Hatkeshvar | Municipality | 178 |
| S-1 | Isanpur | Municipality | 109 |
| S-15 | Kankaria | Municipality | 352 |
| S-30 | Kankaria | Municipality | 550 |
| S-6 | Maninagar | Municipality | 306 |
| S-7 | Maninagar | Tubewell | 162 |
| S-20 | Maninagar | Municipality | 95 |
| S-32 | Maninagar | Tubewell | 111 |
| S-2 | Meganinagar | Tubewell | 78 |
| S-18 | Narayan Nagar | Municipality | 128 |
| S-5 | Naroda | Municipality | 106 |
| S-4 | Narol | Tubewell | 296 |
| S-17 | Narol | Municipality | 136 |
| S-34 | Nikol | Municipality | 94 |
| S-9 | Odhav | Tubewell | 325 |
| S-11 | Odhav | Tubewell | 380 |
| S-16 | Rakhial | Municipality | 205 |
| S-22 | Rakhial | Municipality | 110 |
| S-21 | Vastral | Tubewell | 225 |
| S-24 | Vastral | Municipality | 223 |
| S-28 | Vastral | Tubewell | 451 |
| S-29 | Vastral | Tubewell | 178 |

Table : 4 water quality index (WQI) as per sample source.

| Source | Total Number of Samples Studied and Used for Analysis | Water Quality Index -WQI Value (Mean ± SEM) | Minimum Value Recorded | Maximum Value Recorded |
|---|---|---|---|---|
| Municipality | 19 | 183.68 ± 27.049 $^{NS}$ | 59 | 550 |
| Tubewell | 17 | 219.19 ± 32.420 $^{NS}$ | 48 | 451 |
| Total | 36 | 199.31 ± 20.503 $^{NS}$ | 48 | 550 |

Bio-statistical Method Used: Student's t-test; two-tailed; Unequal Variance;
SEM= Standard Error of Mean; NS= Not Significant.

## IV. DISCUSSION

Water quality index is one of the most effective ways to communicate water quality information to the public and policy makers. A water quality index (WQI) may be defined as a rating reflecting the composite influence of a number of water quality parameters on the overall quality of water (Shankar & Balasubramanya, 2008). The numerical value of the water quality index implies that the water under consideration is fit for human consumption if its WQI is less than 100. Moreover, the larger the WQI value, the water is considered to be more polluted. In the present study, WQI values exceeded 100 in all samples collected. It is considered that the water samples studied were unfit for drinking purpose without suitable treatment. In the present study, the major factor for higher WQI values in most of the samples may be the higher due to calcium and magnesium hardnesses (Suthar et al., 2011; Suthar et al., 2013; Suthar et al., 2017; Suthar et al., 2022).

## V. CONCLUSION

Water Quality Index (WQI) can be used to calculate and analyse on the bases on the number of physico-chemical parameters of drinking water studied and best analyzed on the basis of mathematical / statistical procedures.

## VI. ACKNOWLEDGEMENTS

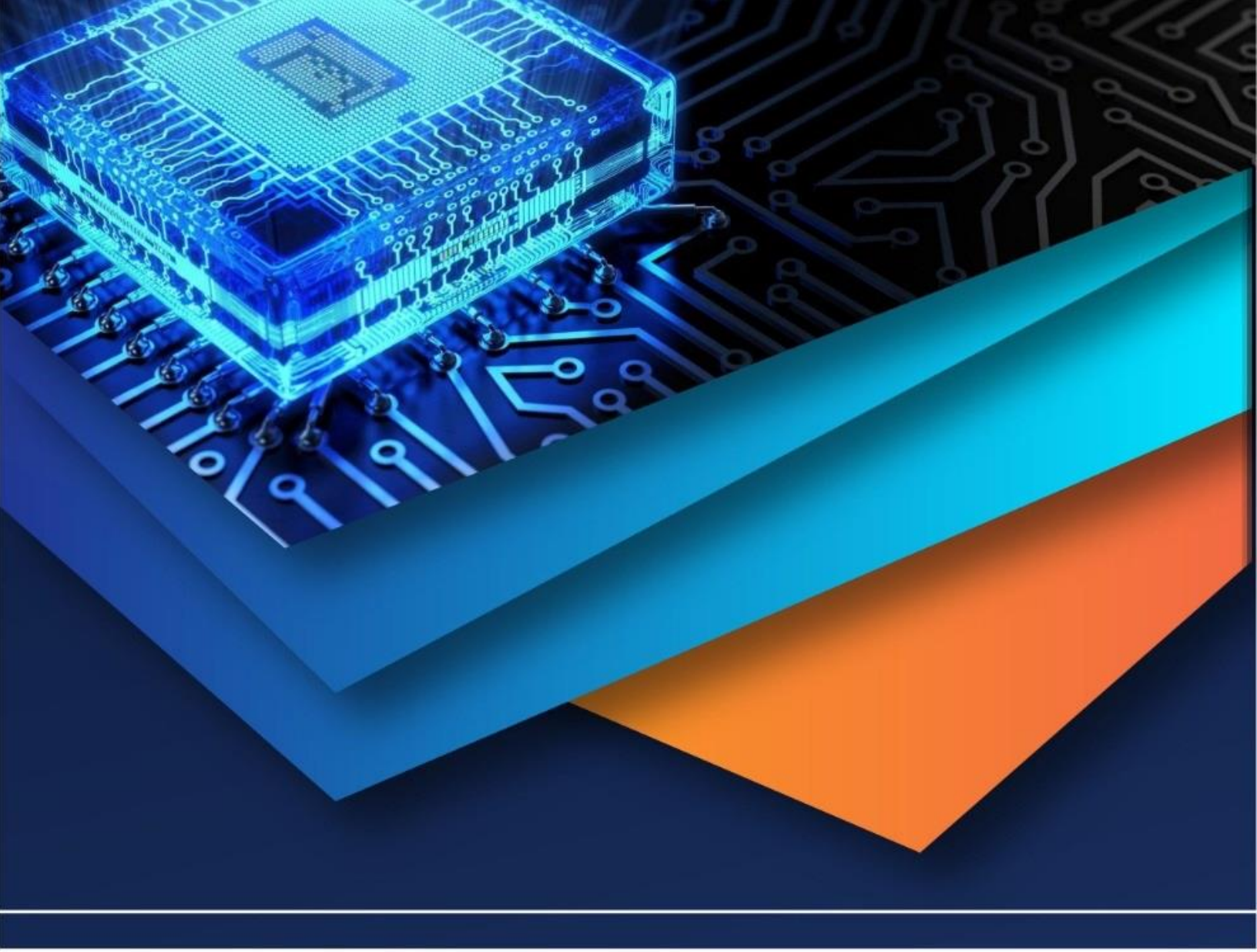
Authors like to thank Dr. R. R. Shah and Dr. U. J. Naik, Prof. V. A. Bheda (Principal, K. K. Shah Jarodwala Maninagar Science College, Ahmedabad) Staff and Management of Bai Jivkore Lallubhai Trust for providing opportunity and facility for the research work. Authors are also thankful to Dr. K. V. Kanjariya (HOD), Dr. R. S. Patel, Dr. S. V. Menon and Smt. K.Y. Dave of Biology Department for their help. The sincere and voluntary help of SYBSc (CZ) of batch 2004-05 for the collection and analysis of water sample is highly appreciated. Authors are also thankful to all the authorities of GINERA, Ahmedabad; Smt. PHG Muni. Arts & Science College, Kalol and Kunda Prathamic Shala, Dist. Dahod.

## REFERENCES

[1] Asadi, S. S., Vuppala, P., and Anji Reddy, M. 2007. Remote sensing and GIS techniques for evaluation of ground water quality in municipal corporation of Hyderabad (Zone-V), India. International Journal of Environmental Research and Public Health, 4(1): 45-52.
[2] Dwivedi, S. L. and Pathak, V. 2007. A preliminary assignment of water quality index to Mandakini river, Chitrakoot. Indian Journal of Environmental Protection, 27(11): 1036-1038.
[3] Kankal, N. C., Indurkar, M. M., Gudadhe, S. K. and Wate, S. R. 2012. Water Quality Index of Surface Water Bodies of Gujarat, India. Asian Journal of Experimental Science, 26(1) : 39-48.
[4] Kapila, M. and Mehta, N. M. 2006. Evaluation of ground water quality of Amalsad village used as drinking water. International Journal of Bioscience Reporter, 4(1): 127-131.
[5] Khandwala, R. V. and Suthar, M. B. 2007. Concept of "Apah" in Indian vedic literature- A comparative study. Int. J. Bioscience Reporter, 5 (1) : 1-6.
[6] Shah, A. N., Ghariya, A. S., Puranik, A. D. and Suthar, M. B. 2008. A preliminary study on water quality from Kharicut canal passing through Vatva area of Ahmedabad city, Gujarat. Electronic Journal of Environmental Sciences, 1 : 49-56 (ISSN 0973-9505).
[7] Shah, M. C., Shilpikar, P. G. and Acharya, P. B. 2008. Groundwater quality of Gandhinagar Taluka, Gujarat, India. E-Journal of Chemistry, 5(3): 435-446.
[8] Shankar, B. S. and Balasubramanya, N. 2008. Evaluation of quality indices for the groundwaters of an industrial area in Bangalore, India. Nature Environment and Pollution Technology, 7(4): 663-666.
[9] Sinha, D. K. and Saxena, R. 2006. Statistical assessment of underground drinking water contamination and effect of monsoon at Hasanpur, J. P. Nagar (Utter Pradesh, India). Journal of Environmental Science and Engineering, 48(3): 157-164.
[10] Sunilkumar, M. and Ravindranath, S. 1998. Water Studies : Methods for Monitoring Water Quality. Centre for Environmental Education (CEE), Ahmedabad.
[11] Suthar, M. B. and Mesariya, A. R. 2012. Study on Drinking water quality from selected areas of Ahmedabad city, India. Lifesciences leaflets (Special Issue : LSIC2011) : 329-335.(ISSN 0976-1098) 29th Feb.2012.
[12] Suthar, M. B. and Suthar, T. M. 2010. Status of ground water quality in urban environment in India during last two decades. Bioscience Guardian, 1(1): 1-23. (RNI/TVL: GUJ ENG 01015/06/1/2010-TC).
[13] Suthar, M. B., Kanjariya, K. V., Ravat, N. M. And Suthar, T. M. 2022. Assessment of Drinking Water Quality Through Physico-chemical Parameters from Samples Collected in Monsoon 2009 From Ahmedabad City of Gujarat State. In: Recent Advances in Soil and Water Education and Research by Dr. D. Saini, Dr. B. Sharma, Dr. A. Rawat and Dr. S. Kumar. ABS Books, Delhi-110086. Pg. 178-188 (ISBN :978-93-94424-24-1).
[14] Suthar, M. B., Mesariya, A. R. and Prajapati, K. R. 2011. Physico-chemical properties of the Drinking water in Ahmedabad city of Gujarat State. Electronic Journal of Environmental Sciences, 4: 39-45 (ISSN 0973-9505).
[15] Suthar, M. B., Mesariya, A. R. and Ravat, N. M. 2008a. Analysis of water quality from Ahmedabad city (Gujarat) using chemical parameters. Indian Journal of Environment and Ecoplanning, 15(1) : 171-176 (ISSN 0972-1215).
[16] Suthar, M. B., Mesariya, A. R. and Ravat, N. M. 2008b. Study on drinking water quality from some areas of Ahmedabad city of Gujarat. Electronic Journal of Environmental Sciences, 1: 23-27 (ISSN 0973-9505).
[17] Suthar, M. B., Mesariya, A. R., Kanjariya, K. V. and Ravat, N. M. 2008c. Evaluation of drinking water quality of some areas of Ahmedabad city (Gujarat) in the year 2007. Bulletin of Environment Sciences, 26 (1) : 51-56. (ISSN 0971-1732).

[18] Suthar, M. B., Mesariya, A. R., Ravat, N. M. and Kalola, S. K. 2008d. The status of drinking water quality from eastern areas of Ahmedabad city, Gujarat. International Journal of Bioscience Reporter, 6(1): 55-59.
[19] Suthar, M. B., Mesariya, A. R., Surpati, B. K. and Vohra, Z. H. 2013. Study of Drinking water quality of selected fifteen areas of Ahmedabad city during monsoon 2011. Indian Journal of Applied Research, 3(4) : 16-19. (ISSN 2249-555X).
[20] Suthar, M. B., Ravat, N. M., Mesariya, A. R. and Kanjariya, K. V. 2010. Alterations in Physico-chemical characteristics of Drinking water collected from some areas of Ahmedabad city in the year 2007. Nature Environment Pollution Technology (NEPT), 9(2) : 399-408 (ISSN 0972-6268).
[21] Suthar, M. B.., Suthar, T. M., Talati, D. D. and Kanjariya, K. V. 2017. Study on drinking water quality of selected samples collected from Ahmedabad city during January 2015. International Journal of Scientific Research, 6 (1): 25- 27 (ISSN 2277-8179).
[22] Swarnalatha, P., Rao, N. K., Ramesh Kumar, P. V. and Harikrishna, M. 2007.Water quality assessment at village level -A case study. Indian Journal of Environmental Protection, 27(11): 996-1000.

********



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY