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"Evaluating Water Health: A Review of Varied Water Quality Index Computation Techniques"

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Abstract: ***The Water Quality Index (WQI) is a useful and distinctive assessment that summarises the state of the water supply in a single phrase, making it easier to choose the best treatment method to address the challenges at hand. WQI, on the other hand, illustrates the combined impact of several water quality measures and disseminates water quality data to the general public and legislative decision-makers. Despite the lack of a universally recognised composite water quality index, certain nations have utilised and are still utilising aggregated water quality data to construct water quality indices. There have been attempts to evaluate the WQI standards for the suitability of drinking water sources. The current article also emphasises and brings attention to the creation of a new, widely used "Water Quality Index" in a simpler format, which may be used to reflect an accurate representation of water quality.***
Keywords: water quality, water quality index

I. INTRODUCTION

Water, a valuable natural resource and national treasure, is an ecosystem's primary component. Rivers, lakes, glaciers, rainwater, groundwater, and other natural bodies of water are the most common water sources. Aside from the necessity of water for drinking, water resources are essential to many economic sectors, including agriculture, the raising of cattle, forestry, industrial activity, the production of hydropower, fishing, and other creative endeavours. Due to certain significant reasons like population growth, industrialisation, urbanisation, etc., the availability and quality of water, whether it be surface or groundwater, have worsened. Physical, chemical, and biological factors can be used to evaluate the water quality of any particular place or source. If these metrics' values exceed the established limitations, it is detrimental to human health. As a result, the Water Quality Index (WQI), one of the best ways to define the quality of water, has been used to assess the acceptability of water sources for human consumption. WQI makes use of water quality data and aids in the revision of policy developed by various environmental monitoring organisations. It has been discovered that using a single water quality variable to represent the water quality for the general audience is difficult to grasp. Because of this, WQI has the capacity to condense a large amount of information into a single number to provide the information in a clear, logical manner. It gathers data from several sources and synthesises it to create an overall assessment of a water system. They improve both policy makers' and the general public's capacity to comprehend difficulties with the quality of the water that are being emphasised. In the present study, several of the crucial water quality indices that are used to measure water quality are reviewed. Their mathematical foundations, sets of parameters, and computations are also provided, along with their benefits and drawbacks, since these indices are widely applied.

II. WATER QUALITY INDEX

WQI was initially developed by Horton (1965) in the United States by choosing 10 of the most frequently used water quality variables, such as dissolved oxygen (DO), pH, coliforms, specific conductance, alkalinity, and chloride, among others. It has since gained widespread use and acceptance in countries throughout Europe, Africa, and Asia. The allocated weight had a significant influence on the index and showed the importance of a parameter for a certain usage. Additionally, the Brown group created a new WQI based on weights to various parameters in 1970 that was comparable to Horton's index. Numerous scientists and specialists have recently thought about changing the WQI idea. The most prevalent elements, which are explained in the following three phases, serve as the foundation for a general WQI approach:

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1) Parameter selection is done in accordance with the professional judgement of institutions, agencies, or the government as determined in the legislative field. It is advised to choose the variables from the five categories—oxygen level, eutrophication, health factors, physical qualities, and dissolved substances—that have a significant influence on water quality.
2) Establishing the Quality Function (curve) for Each Sub-Index Considered Parameter: Sub-indices are created by transforming the variables of their various units (ppm, saturation %, counts/volume, etc.) into non-dimensional scale values.
3) Sub-Indices Aggregation using Mathematical Expression: This is often done using geometric or arithmetic averages.

However, numerous national and international organisations have developed a large number of water quality indices, including the Weight Arithmetic Water Quality Index (WAWQI), National Sanitation Foundation Water Quality Index (NSFWQI), Canadian Council of Ministers of the Environment Water Quality Index (CCMEWQI), Oregon Water Quality Index (OWQI), etc. These WQI have been used to assess the water quality in a specific location. Furthermore, these indices frequently base their results on a variety of different types and numbers of water quality measures in comparison to regional norms. Water quality indicators are certified to quickly and effectively show trends in water quality even at low concentrations, as well as yearly cycles, regional and temporal changes in water quality. The existing indices contain significant differences and limits dependent on the amount of water quality factors employed and not universally acknowledged, according to the studied literature. Therefore, it requires acceptance on a global scale with a variety of water quality characteristics. Here, many WQI calculation techniques are explained.

A. National Sanitation Foundation Water Quality Index (NSFWQI)

A universal water quality index technique was created by carefully choosing characteristics, creating a standard scale, and allocating weights. The National Sanitation Foundation (NSF), which is known as NSFWQI, provided support for the effort to determine the WQI of several dangerously contaminated water bodies. Nine water quality measures, including temperature, pH, turbidity, faecal coliform, dissolved oxygen, biochemical oxygen demand, total phosphates, nitrates, and total solids, are used in the suggested technique to compare the water quality of different water sources. The weighting curve chart receives the data about the water quality and converts it to a numerical value to determine Qi. The NSF WQI mathematical expression is given by

$$WQI = \sum_{i=1}^{n} QiWi$$

Where,
Qi = sub-index for ith water quality parameter;
Wi = weight associated with ith water quality parameter;
n = number of water quality parameters.

The ratings of water quality have been established using this NSFWQI technique using the data in Table 1 below:

Table 1. Water Quality Rating as per different Water Quality Index method

National Sanitation Foundation Water Quality Index (NSFWQI)	
WQI Value	Rating of Water Quality
91-100	Excellent water quality
71-90	Good water quality
51-70	Medium water quality
26-50	Bad water quality
0-25	Very bad water quality

Canadian Council of Ministers of the Environment Water Quality Index (CCME WQI)	
95-100	Excellent water quality
80-94	Good water quality
60-79	Fair water quality
45-59	Marginal water quality
0-44	Poor water quality

Oregon Water Quality Index (OWQI)	
90-100	Excellent water quality
85-89	Good water quality
80-84	Fair water quality
60-79	Poor water quality
0-59	Very poor water quality

B. Canadian Council of Ministers of the Environment Water Quality Index (CCME WQI)

In order to communicate information on water quality to management and the general public, Canadian authorities developed the CCME WQI, which offers a standardised approach. Additionally, WQI was created by a committee under the Canadian Council of Ministers of the Environment (CCME), and with a little adjustment, it may be used by many water agencies worldwide. This approach was created to assess surface water protection for aquatic life in compliance with predetermined standards. The parameters associated with different measures might differ from station to station; therefore the sampling technique calls for sampling at least four parameters at least four times. The following relationship may be used to calculate index scores using the CCME WQI method:

$$CCME\,WQI = 100 - \left(\frac{\sqrt{F_1^{\,2} + F_2^{\,2} + F_3^{\,2}}}{1.732} \right)$$

Where Scope (F1) = The number of variables whose goals are not achieved
F1= [No. of failed variables /Total no. of variables]*100
Frequency (F2) = Number of times by which the objectives are not met
F2 = [No. of failed tests/Total no. of tests]*100
Amplitude (F3) = Amount by which the objectives are not met

(a) excursion_i = [Failed test value_i /Objective_j]-1

(b) $$\text{nse} = \frac{\sum_{i=1}^{n} \text{excursion}_i}{\text{Total number of tests}}$$

(b) F_3 = [nse/0.01nse+0.01]

C. Oregon Water Quality Index (OWQI)

In order to assess the overall water quality of Oregon's streams and the applicability of this methodology to other geographic locations, OWQI develops a score that includes eight into a single number, several aspects of water quality.The parameters this approach takes into account are temperature, Biochemical oxygen demand (BOD), dissolved oxygen (DO) , pH, total nitrogen, ammonia, and nitrate nitrogen faecal coliform, total solids, and phosphorus. The NSFWQI, where the first OWQI was created, The Delphi technique was employed to choose the variables. It reflects the state of and trends in the water quality for the water quality status evaluation required by law. When weighting the index, there is no arbitration involved. factors, as well as using the harmonic averaging. The way this WQI is expressed mathematically technique is described b

$$WQI = \sqrt{\frac{n}{\sum_{i=1}^{n} \frac{1}{SI_i^{\,2}}}}$$

Where, n = number of subindices
SI = subindex of ith parameter

D. Weighted Arithmetic Water Quality Index Method

Using the most often measured water quality, the weighted arithmetic water quality index approach assessed the water quality according to the degree of purity by using quality factors. The approach has been utilised by the several researchers' calculations, as well as WQI was created using the equation below**:**

$$WQI = \sum QiWi / \sum Wi$$

The quality rating scale (Qi) for each parameter is calculated by using this expression:

$$Qi = 100 [(Vi-Vo/ Si-Vo)]$$

Where,

Vi is estimated concentration of ith parameter in the analysed water

Vo is the ideal value of this parameter in pure water

Vo = 0 (except pH =7.0 and DO = 14.6 mg/l)

Si is recommended standard value of ith parameter

The unit weight (Wi) for each water quality parameter is calculated by using the following formula:

$$Wi = K/Si$$

Where, K = proportionality constant and can also be calculated by using the following equation:

$$K= 1/ \sum (1/Si)$$

The rating of water quality according to this WQI is given in Table 2

Table 2. Water Quality Rating as per Weight Arithmetic Water Quality Index Method

WQI Value	Rating of Water Quality	Grading
0-25	Excellent water quality	A
26-50	Good water quality	B
51-75	Poor water quality	C
76-100	Very Poor water quality	D
Above 100	Unsuitable for drinking purpose	E

III. CONCLUSIONS

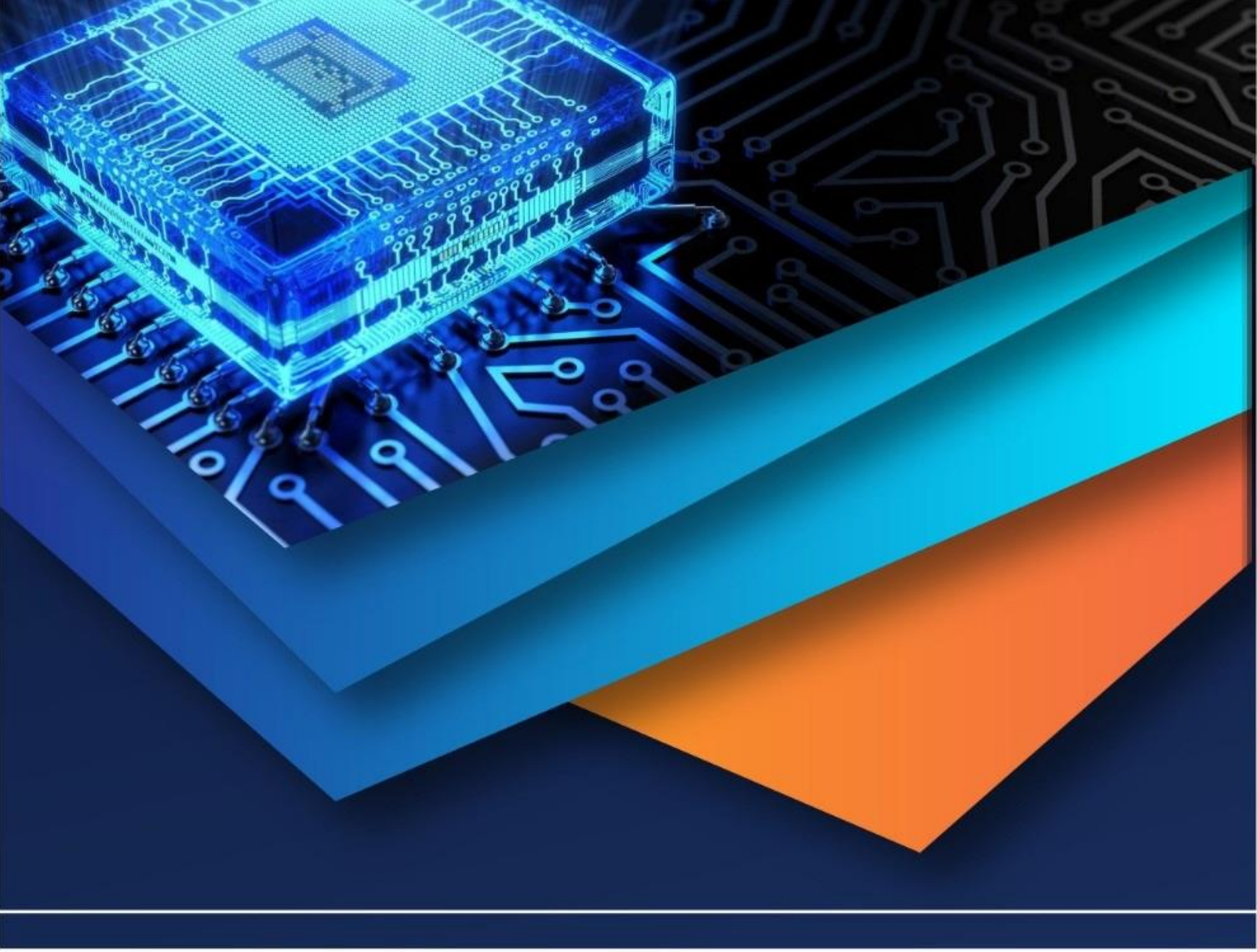
After examining several water quality indices, it can be concluded that the purpose of WQI is to assign a single number to a source's water quality while also lowering greater levels of contaminants. number of arguments into a straightforward phrase, using data from water quality monitoring into simple interpretation.

Additionally, this is an attempt to evaluate the crucial indexes utilised to measure the sensitivity of water quality as well as offers details on the makeup of the indexes and mathematical structures. These indexes make use of different parameters of physico-chemistry and biology, and has been produced as a consequence of work and research, work being done by several government agencies and specialists worldwide in this field .Despite all the work and several mentioned indices being used internationally, no index has yet been adopted by everyone, and the hunt for The Water Quality Index continues to be a more practical and global tool. thereafter, so that water managers, users, and authorities in It may be used and adapted by several nations with little modifications.

REFERENCES

[1] Guidelines for Drinking-water Quality, Fourth Edition, World Health Organization ISBN 978 92 4 154815 1. 2012.
[2] Bureau of Indian Standards, Specification for drinking water. IS: 10500, New Delhi, India, 2012.
[3] United State EPA 816-F-09-004, May 2009, http://water.epa.gov/drink/contaminants/upload/mcl-2.pdf (Accessed 12 July 2013).
[4] Guide Manual: Water and Waste Water, Central Pollution Control Board, New Delhi. http://www.cpcb.nic.in/upload/Latest/Latest_67_guidemanualw&wwanalysis.pdf (Accessed 12 July 2013).
[5] Bharti, N. and Katyal, D, "Water quality indices used for surface water vulnerability assessment", Int. J. Environ. Sci., 2(1). 154- 173. 2011.
[6] Akoteyon, I.S., Omotayo, A.O., Soladoye, O. and Olaoye, H.O., "Determination of water quality index and suitability of urban river for municipal water supply in Lagos-Nigeria", Europ. J. Scientific Res, 54(2). 263-271. 2011.
[7] Babaei Semiromi, F., Hassani, A.H., Torabian, A., Karbassi, A.R. and Hosseinzadeh Lotfi, F., "Water quality index development using fuzzy logic: A case study of the Karoon river of Iran", African J. Biotech.., 10(50). 10125-10133. 2011.
[8] Karbassi, A. R., Mir Mohammad Hosseini, F., Baghvand, A. and Nazariha, M., "Development of water quality index (WQI) for Gorganrood River", Int. J. Environ. Res., 5(4). 1041-1046. Autumn 2011.

[9] Das, K.K., Panigrahi, T., Panda, R.B., "Evaluation of water quality index (WQI) of drinking water of Balasore district, Odisha, India", Discovery life, 1(3). 48-52. 2012.
[10] Jena, V., Dixit, S., Gupta, S., "Assessment of water quality index of industrial area surface water samples", Int. J. Chem. Tech. Res., 5(1). 278-283. 2013.
[11] Saberi Nasr, A., Rezaei, M. and Dashti Barmaki M., "Groundwater contamination analysis using Fuzzy Water Quality index (FWQI): Yazd province, Iran", J Geope 3., (1). 47-55. 2013.
[12] Abdulwahid, S.J., "Water quality index of delizhiyan springs and shawrawa river within soran district, erbil, kurdistan region of iraq", J. Appl. Environ. Biol. Sci., 3(1). 40-48. 2013.
[13] Srinivas, J., Purushotham, A.V. and Murali Krishna, K.V.S.G., "Determination of water quality index in industrial areas of Kakinada, Andhra Pradesh, India", Int. Res. J Env. Sci., 2(5). 37- 45. 2013.
[14] Radmanesh, F., Zarei, H. and Salari, S., "Water Quality Index and Suitability of Water of Gotvand Basin at District Khuzestan, Iran", Int. J. Agron. Plant Prod., 4(4). 707-713. 2013.
[15] Bhadja, P. and Vaghela, A.K. "Assessment of physicochemicalparameters and water quality index of reservoir water", Int. J. Plant Animal and Environ. Sci., 3(3). 89-95. 2013.
[16] Khwakaram, A.I., Majid, S.N. and Hama N.Y., "Determination of water quality index (wqi) for qalyasan stream in sulaimani city/ kurdistan region of Iraq", Int. J. Plant Animal and Environ. Sci., 2(4). 148-157. 2012.
[17] Mazhar, S. M., Khan, N. and Kumar, A.R. "Geogenic assessment of water quality index for the groundwater in Tiruchengode taluk, Namakkal district, Tamilnadu, India, Chem Sci Trans., 2(3). 1021- 1027. 2013.
[18] Ansari, K. and Hemke, N. M., "Water quality index for assessment of water samples of different zones in Chandrapur city", Int. J. Engineer. Res. Appli., 3(3). 233-237. 2013.
[19] Sirajudeen, J., Manikandan, S.A. and Manivel, V., "Water quality index of ground water around Ampikapuram area near Uyyakondan channel Tiruchirappalli district, Tamil Nadu, India", Archiv. Appl. Sci. Res., 5 (3). 21-26. 2013.
[20] Patil, V.T. and Patil, P.R., "Groundwater quality status using water quality index in Amalner town, Maharashtra", J. Chem. Pharmaceut. Res., 5(5). 67-71. 2013.
[21] Sujaul, I.M., Hossain M.A., Nasly, M.A. and Sobahan, M.A., "Effect of industrial pollution on the spatial variation of surface water quality", Ameri. J. Environ. Sci., 9 (2). 120-129. 2013.
[22] Sharifinia, M., Ramezanpour, Z., Imanpour, J., Mahmoudifard A. and Rahmani, T., "Water quality assessment of the Zarivar Lake using physico-chemical parameters and NSF- WQI indicator, Kurdistan Province-Iran", Int. J. Adv. Bio. Biomed. Res., 1(3). 302-312. 2013.
[23] Srivastava, G. and Kumar, P., "Water quality index with missing parameters", Int. J. Res. Engineer. Technol., 2(4). 609-614. 2013.
[24] Jagadeeswari, P.B. and Ramesh, K., "Water quality index for assessment of water quality in south Chennai coastal aquifer, Tamil Nadu, India", Int. J. Chem. Tech. Res., 4(4). 1582-1588. 2012.
[25] Chowdhury R.M., Muntasir S.Y. and Hossain M.M., "Study on ground water quality and its suitability or drinking purpose in Alathur block -Perambalur district", Archiv. Appl. Sci. Res., 4(3). 1332-1338. 2012.
[26] Nasirian. M., "A new water quality index for environmental contamination contributed by mineral processing: A case study of Amang (tin tailing) processing activity", J. Appli. Sci., 7(20). 2977-2987. 2007.
[27] Horton, R.K., "An index number system for rating water quality", J. Water Pollu. Cont. Fed., 37(3). 300-305. 1965.
[28] Brown, R.M., McClelland, N.I., Deininger, R.A. and Tozer, R.G., "Water quality index-do we dare?", Water Sewage Works, 117(10). 339-343. 1970.
[29] Bhargava, D.S, Saxena, B.S. and Dewakar, R.W., "A study of geo-pollutants in the Godavary river basin in India", Asian Environ., 12. 36-59. 1998.
[30] Dwivedi, S., Tiwari, I.C. and Bhargava, D.S., "Water quality of the river Ganga at Varanasi", Institute of Engineers, Kolkota, 78, 1-4. 1997



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