

WATER QUALITY INDICES- IMPORTANT TOOLS FOR WATER QUALITY ASSESSMENT: A REVIEW

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Abstract

Water quality is a significant criterion in matching water demand and supply. Securing adequate freshwater quality for both human and ecological needs is thus an important aspect of integrated environmental management and sustainable development. To represent water quality in a lucid way different water quality indices for water quality assessment are used which aim at giving a single value to the water quality of a source reducing great amount of parameters into a simpler expression and enabling easy interpretation of monitoring data. In this review, various water quality indices (WQI) used for assessing surface water quality are discussed. As different National and International Agencies involved in water quality assessment and pollution control defines water quality criteria for different uses of water considering different indicator parameters, so there are numerous WQI specific to any region or area. An attempt to cover different water quality indices developed worldwide, their background and application area has been discussed here.

Key words: Water Quality, index, review, water parameters, quality scale

1. INTRODUCTION

Water is the prime natural resource. Acknowledging the vital importance of this scarce resource for human and animal life, as well as for maintaining ecological balance for economic and developmental activities of all kinds is a matter of utmost concern. In recent times, there has been a tremendous increase in demand for freshwater and water shortage in arid and semiarid regions due to population increase, urbanization, industrialization, and intense agricultural activities in many parts of the world. Due to inadequate supply of surface waters, most of the people are depending mainly on groundwater resources for drinking and domestic, industrial, and irrigation uses. Innumerable large towns and many cities derive water supply from groundwater and surface water for different uses through municipality network and also from large number of private boreholes. Regular water quality monitoring of the water resources are absolutely necessary to assess the quality of water for ecosystem health and hygiene, industrial use, agricultural use and domestic use. Assessment of water quality can be a complex process undertaking multiple parameters capable of causing various stresses on overall water quality [8]. To evaluate water quality from a large number of samples, each containing concentrations for many parameters is difficult [2]. Traditional approaches to assessing water quality are based on the comparison of experimentally determined parameter values with the existing guidelines [19]. So, water quality indices are such approaches which minimises the data volume to a great extent and simplifies the expression of water quality status. Water quality index can be evaluated on the basis of various physical, chemical and bacteriological parameters. Numerous water quality indices have been formulated all over the world which can easily judge out the overall water quality within a particular area promptly and efficiently. For example, US National Sanitation Foundation Water Quality Index (NSFWQI), Canadian Council of Ministers of the Environment Water Quality Index (CCMEWQI), British Columbia Water Quality Index (BCWQI), and Oregon Water Quality Index (OWQI) [1][35][40][63]. These indices are based on the comparison of the water
quality parameters to regulatory standards and give a single value to the water quality of a source. In this present paper a review of different water quality indices are presented.

2. WATER QUALITY INDICES

A brief history:

Categorization of water quality started in the mid-twentieth century by Horton in 1965 [32]. Then in 1970 Brown et al. developed a general Water quality index (WQI)[10]. In 1982 Steinhart et al. applied a novel environmental quality index to sum up technical information on the status and trends in Great Lakes ecosystem [69]. Water Quality Guidelines Task Group of the Canadian Council of Ministers of the Environment introduced WQI in Canada, in the mid-1990s [23][29][53]. Some frequently used WQI in public domains are the US National Sanitation Foundation Water Quality Index, NSFWQI, Florida Stream Water Quality Index, FWQI, British Columbia Water Quality Index, BCWQI, Oregon Water Quality Index, OWQI and the Canadian Water Quality Index (Canadian Council of Ministers of the Environment (CCME). The original BCWQI was modified into the CCME WQI, which was certified by the Canadian Council of Ministers of the Environment[57]. In India, the pioneer work on WQI was done by Bhargava, wherein the water quality is expressed as a number (ranging from 0 for highly/extremely polluted to 100 for absolutely unpolluted water) representing the integrated effect of the parameters amplifying the pollution load[5]. In the developing countries, the biggest challenge has been to develop cost effective pollution control strategies with analytical cost as a limiting factor due to restricted funds. Therefore, Ongley in 1998 suggested, for such situations only few critical parameters must be used to evaluate WQI [46][47]. Many researchers has applied water quality index for representing the quality status post monitoring and analysis. Some of them are listed in Table 1.

Categories of WQI:

In general, water quality indices are categorised into four main groups [34]. First, Public indices: these indices ignore the kind of water consumption in the evaluation process and used for general water quality, such as National Sanitation Foundation Water Quality Index (NSFWQI) [48]. Second, specific consumption indices: here, the classification of water is on the basis of the kind of consumption and application (drinking, industrial, ecosystem preservation, etc). The most important and applicable of these indices are the Oregon and British Columbia indices [20]. Third, designing or planning indices: This category is an instrument, aiding decision making and planning in water quality management projects. Fourth, statistical indices: In these indices statistical methods are used and personal opinions are not considered. Statistical approaches are used here for evaluating the data. Validation from a statistical point of view in regard to certain assumptions of water quality observations is another essential part in statistical approach. First three indices are also called as expert opinion (EO) approach. The EO approach is a subjective approach due to the different weights for the same variables given by various panels of experts [30]. Chances in lessening objectivity and comparability are still present in the different ratings given by the experts. So, many alternative indexes were developed. However, the subjectivity assumptions in developing the indices can be reduced by using statistical approaches. The statistical approaches can also be used to identify important parameters in determining the quality of a water body as well as the extent of their significance [42].
Basic procedure of WQI development:

For expert opinion approach first requirement for water quality index development is variable selections. For this monitoring of water samples is necessary for raw data generation. Once the raw data is generated variables are transformed. Different statistical approaches can be used for transformation. Various parameters have different units as well as range. By transformation process all the parameters are transformed into a common scale and sub-indices are generated. Weightage is assigned to each parameter according to their importance and potential impacts on the water quality. Expert opinion is needed to assign weights. Some indices developed by Sargaonker, Prati, aquatic toxicity index did not use weight assignment. Next step is aggregation of the sub-indices to generate a cumulative index value. And finally, assessment and classification of water quality is done [47]. The large amount of data presents challenges for the extraction of meaningful information of water quality parameters. In some indices, statistical approaches such as cluster analysis (CA), discriminant analysis (DA), factor analysis (FA) and principal components analysis (PCA) are widely used, to explore structure and relationships in multivariate data for transformation and aggregation steps of index development. Even artificial intelligence like fuzzy logic can be used in this approach[37]. Using statistical approaches reduces subjective assumptions and improves accuracy of the index.

Review of different types of water quality index:

National Sanitation Foundation Water Quality Index (NSFWQI):

Brown et al. developed a water quality index paying great rigor in selecting parameters, developing a common scale, and assigning weights for which elaborate Delphi exercises were performed. This effort was supported by the National Sanitation Foundation (NSF) and that is why also referred as NSFWQI. This work seems to be the most comprehensive and has been discussed in various papers [10][38]. Rating curves were developed by asking the experts to attribute values for variation in the level of water quality caused by different levels of each of the selected parameters. Having established the rating curves and associated weights, various methods of computing a water quality index are possible, like

Additive index- WQI = \( \sum_{i=1}^{n} I_i W_i Q_i \)

Where, \( \sum_{i=1}^{n} W_i = 1 \), \( I_i = \) Sub-index of each parameters, \( W_i = \) Weighting factor, \( Q_i = \) is the rating value of parameter \( i \) and \( n = \) Number of sub-indices.

Oregon Water Quality Index (OWQI):

The Oregon Water Quality Index, developed by the Oregon Department of Environmental Quality (ODEQ) in the late 1970s and updated several times since then is another frequently used WQI in public domain [17]. However, the original OWQI was discontinued in 1983 on account of the enormous resources required for calculating and reporting the results. With the advancements in the computer technology, enhanced tools of data display and visualization and a better understanding of water quality, the OWQI was updated in 1995 by refining the original sub-indice, adding temperature and total phosphorus sub-indice, and improving the aggregation calculation. OWQI expresses water quality by integrating measurements of eight water quality variables. It provided the ambient water quality of Oregon's streams for general recreational use and its application to other geographic regions or water body types should be approached with caution. The science of water quality has improved markedly since the introduction of the OWQI in the 1970s[24]. The original OWQI was modelled after the NSFWQI where the Delphi method was used for variable selection [43][18]. Delphi method was employed to develop recreational
water quality index. This technique can be characterised as a method for structuring information derived from a group of experts, so that consensus can be developed on the best available knowledge to deal with a complex problem [54][39]. Both indices used logarithmic transforms to convert water quality variable results into subindex values. Logarithmic transforms take advantage of the fact that a change in magnitude at lower levels of impairment has a greater impact than an equal change in magnitude at higher levels of impairment.

1. The original OWQI used a weighted arithmetic mean function.

\[ WQI = \sum_{i=1}^{n} SI_i W_i \]

3. The NSF WQI (McClelland, 1974) used a weighted geometric mean function

\[ WQI = \prod_{i=1}^{n} SI_i^{W_i} \]

Where, \( SI_i \) = Sub-index of each parameters, \( W_i \) = Weighting factor, \( n \) = Number of sub-indices.

The unweighted harmonic square mean formula, as a method to aggregate sub-index results, has been suggested as an improvement over both the weighted arithmetic mean geometric mean formula [22]. This formula allows the most impaired variable to impart the greatest influence on the water quality index and acknowledges that different water quality variables will pose differing significance to overall water quality at different times and locations. The formula is given by:

\[ WQI = \sqrt[2n]{\frac{1}{\sum_{i=1}^{n} SI_i^2}} \]

**Bhargava method:**

Bhargava identified 4 groups of parameters. Each group contained sets of one type of parameters. The first group included the concentrations of coliform organisms to represent the bacterial quality of drinking water. The second group included toxicants, heavy metals, etc. The third group included parameters that cause physical effects, such as odour, colour, and turbidity. The fourth group included the inorganic and organic nontoxic substances such as chloride, sulphate, etc. The sub-indices were worked out and the simplified model for WQI for a beneficial use is given by:

\[ WQI = \prod_{i=1}^{n} f_i(P_i)^{1/n} \]

Where \( n \) is the number of variables considered more relevant to the use and \( f_i(P_i) \) is the sensitivity function of the \( i^{th} \) variable which includes the effect of weighting of the \( i^{th} \) variable in the use. The index was applied to the raw water quality data at the upstream and downstream of river Yamuna at Delhi, India [6][7].

**Smith’s index:**

Smith developed an index for four water uses i.e., contact as well as non-contact. It is a hybrid of the two common index types and is based on expert opinion as well as water quality standards. The selection of parameters for each water class, developing sub indices, and assigning weightages were all done using Delphi. The minimum operator technique was used to obtain the final index score:

\[ I_{\text{min}} = \sum\min (I_{\text{sub1}}, I_{\text{sub2}}, \ldots, I_{\text{subn}}) \]

Where, \( I_{\text{min}} \) equals the lowest sub index value [67][68].
British Columbia Water quality Index (BCWQI):

British Columbia water quality index was developed by the Canadian Ministry of Environment in 1995 as an increasing index to evaluate water quality. This index is similar to Canadian Council of Ministers of the Environment Water Quality Index (CCMEWQI) where water quality parameters are measured and their violation is determined by comparison with a predefined limit (discussed in section vii below). It provides possibility to make a classification on the basis of all existing measurement parameters.

To calculate final index value the following equation is used:

$$BCWQI = 100 - \left( \frac{F_1^2 + F_2^2 + F_3^2}{1.453} \right)$$

The number 1.453 was selected to give assurance to the scale index number from zero to 100. It is important to note that repeated samplings and increasing stations increase the accuracy of British Columbia index. Disadvantages of this method are that this index does not indicate the water quality trend until it deviates from the standard limit and due to usage of maximum percentage of deviation, it cannot determine the number of withdrawals above the maximum limit of standard [58].

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

The Canadian Council of Ministers of the Environment (CCME) has developed a Water Quality Index (WQI) to simplify the reporting of complex and technical water quality data [12]. The CCME WQI is a science-based communication tool that tests multi-variable water quality data against specified water quality benchmarks determined by the user. The WQI mathematically combines three measures of variance (scope, frequency and magnitude) to produce a single unitless number that represents overall water quality at a site relative to the benchmark chosen (e.g., protection of aquatic life). The end result is a single unitless number from 0 to 100, where a score of 100 indicates that all variables were at or below the selected benchmarks during all monitoring times. To simplify, the CCME developed a calculator that is a pre-programmed spreadsheet with mathematical equations that helps users evaluate the condition (or health) of a water body. Canadian Water Quality Guidelines have been applied to the CCME WQI calculator to assess spatial and temporal changes in water quality [27][28]. In brief, the Canadian Water Quality Index (CWQI) equation is calculated using three factors as follows:

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

Where:

- $F_1$ represents Scope: The percentage of variables that exceed the guideline or the number of variables whose objectives are not met
- $F_1 = \frac{\text{No. of failed variables}}{\text{Total no of variables}} \times 100$;
- $F_2$ represents Frequency: The percentage of individual tests within each variable that exceeded the guideline or the frequency by which the objectives are not met
- $F_2 = \frac{\text{No of failed tests}}{\text{Total no of tests}} \times 100$;
- $F_3$ represents Amplitude: The extent (excursion) to which the failed test exceeds the guideline or the amount by which the objectives are not met

(a) excursion$ = [\text{Failed test value/Objective}] - 1$
(b) nse = \sum_{i=1}^{n} \frac{\text{Excursion}}{\text{No of tests}}$
(c) $F_3 = \frac{nse}{(0.01 \times nse + 0.01)}$

The constant, 1.732, is a scaling factor (square root of three) to ensure the index varies between 0 and 100.
The advantages of the CCME WQI are its ability to represent measurements of a variety of variables in a single number and the ability to combine various measurements with a variety of measurement units in a single metric. The limitations of the CCME WQI include the loss of information by combining several variables to a single index value, the loss of interactions among variables, the lack of portability of the index to different ecosystem types and the sensitivity of the results to the formulation of the index [75]. The CCME WQI was not developed to replace detailed variable analysis, but rather as a tool to help water managers communicate overall quality of water in a more consistent and on-going manner.

**Overall Index of Pollution (OIP):**

It was developed by Sargaonker et al. at National Environmental Engineering Research Institute (NEERI), Nagpur, India in order to assess the status of surface waters, specifically under Indian conditions. A general classification scheme has been formulated based on a concept similar to the one proposed by Pratit et al. and giving due consideration to the classification scheme developed by CPCB [52]. Sargaonkar and Deshpande developed OIP for Indian rivers based on measurements and subsequent classification of pH, turbidity, dissolved oxygen, BOD, hardness, total dissolved solids, total coliforms, arsenic, and fluoride [61]. Each water quality observation was scored as Excellent, Acceptable, Slightly Polluted, Polluted, and Heavily Polluted, according to Indian standards and/or other accepted guidelines and standards such as World Health Organization and European Community Standards. Once categorized, each observation was assigned a pollution index value and the OIP was calculated as the average of each index value given by the mathematical expression:

$$\text{OIP} = \frac{\sum P_i}{n}$$

Where $P_i$ = pollution index for $i$th parameter, $n$ = number of parameters.

**The River Ganga Index:**

The index was developed to evaluate the water quality profile of river Ganga in its entire stretch. The index had the weighted multiplication form and was based on the NSFWQI, with slight modifications in terms of weightages to confirm to the water quality criteria for different categories of uses as set by Central Water Pollution Board, India. Four important water quality parameters- dissolved oxygen (DO), biochemical oxygen demand (BOD), pH and fecal coliform were selected through Delphi. A weighted sum aggregation function was used to evaluate the overall water quality index.

$$\text{WQI} = \sum_{i=1}^{P} w_i I_i$$

where $I_i$ = subindex for the $i$th water quality parameter; $w_i$ = weight associated with the $i$th water quality parameter; $P$ = number of water quality parameters. The developed index was employed to evaluate the water quality profile of river Ganga in its entire stretch and to identify areas requiring urgent pollution control measures [15].

**Recreational water quality index (RWQI):**

Ideally, recreational water quality indicators are microorganisms or chemical substances whose concentrations can be quantitatively related to swimming and associated to health hazards. Selection of parameters has great importance to RWQI calculation because rigidity problems exist when additional variables are included in the index to address specific water quality concerns, but the faulty aggregation function might artificially reduce the value of the water quality index so that it does not accurately reflect the true water quality. As the number of
water quality variables increases, the magnitude of the aggregated index decreases raising the issue of ambiguity again [71]. Numerical scales related to the degree of quality were established for each variable to assess variation in quality water and to convey findings in a comprehensive manner to others. These rating curves are, in fact, the essence of the development of this index. Rating curves have the ability to reproduce the relationship between swimming-associated illness and water quality indicator. The success or failure of the application of the quality index developed will depend on rating curves. Once rating curves were established, various computing methods to water quality index are possible. The calculation of the proposed RWQI is (1):

\[
RWQI = \prod_{i=1}^{n} Q_i^{W_i}
\]  

(1)

Where, \( Q_i \) is the rating value of parameter \( i \) and \( W_i \) is the weighting factors (\( \sum W_i = 1 \)). Therefore, each analytical value is transformed in a non-dimensional value or quality level \( (Q_i) \) through a mathematical equation or through its corresponding graphic representation. \( W_i \) is the influence of each parameter in the total value of the index. To calculate each of them, their individual weight must be considered. \( W_i \) is calculated as (2):

\[
W_i = \frac{a_i}{\sum a_i}
\]

(2)

The \( a_i \) coefficient values vary from 1 (very important parameter) to 4 (less significant parameter) according to the importance assigned to each parameter involved in the index. In this way, the RWQI is calculated by the multiplication of all of the products of the parameter weights and sub-index values \( (Q_i^{W_i}) \) (Eq. 1). RWQI is a number among 0 to 100, where values close to 100 represent the best quality. This formulation avoids the problems of ambiguity and eclipsing to the number of water quality variables required to be aggregated in a given index. If the value of a sub-index is zero, RWQI has become zero automatically. Furthermore, weight factor of parameter allows obtaining large changes to little variations for each one of different parameters.

Besides, this formulation has great sensitivity to small parameter variations giving greater protection to people.

**Water quality index:**

According to Couillard and Lefebre, a WQI is an algorithm that expresses a measure of the qualitative state of the water. This may be obtained by either deductive or inductive method [69]. The final result can be a symbol or a simple combination of numeric and alphanumeric variables.

Water Quality Index (WQI):

Assigning weight to parameters - \( w_i \)

\[
W_i = \frac{w_i}{\sum_{i=1}^{n} w_i}
\]

(i)

Where, \( W_i = \) relative weight

\( n = \) number of parameters

\( q_i = \frac{C_i}{S_i} \times 100 \)

(iii)

Where, \( q_i = \) is the quality rating

\( C_i = \) is the concentration of each chemical parameter in each water sample in milligrams per litre

\( S_i = \) is the standard for each chemical parameter in milligrams per litre

\( SI_i = W_i \times q_i \)

(iv)
Classification of water quality index is done as excellent (index range >80-100), good (index range >60-80), moderate (index range >40-60), bad (index range >20-60) and very bad (index range >0-20) [70][71].

The WQI developed by Bascaran in 1979 provides a global value for water conditions and incorporates weighted individual values from a series of physical, chemical, or biological parameters measured in the field or laboratory. While this assessment may be carried out with the physical–chemical components from a normal water analysis (major ions, \( \text{pH} \), temperature and electrical conductivity), the greater the amount of elements, the better the accuracy of the estimation.

For the estimate, a weight and percent value were assigned according to the concentrations, or values, in question and the following relationship [13]:

\[
ICA = \sum_i \frac{C_i P_i}{\sum P_i}
\]

Where

- \( C_i \): percent value function assigned to the parameters
- \( P_i \): weight assigned to each parameter
- \( K \): a constant whose values are 1.0 for clear waters with no apparent contamination, 0.75 for waters with slight colour, scums, apparent non-natural turbidity, 0.50 for water with polluted appearance and strong odour, and 0.25 for black waters that present fermentations and odours.

For each sample assessed, the sum of the weighted parameters being considered is calculated and multiplied by a constant related to the sample’s sensitivity features, such as appearance and water odour. The parameters frequently used are: major ions, biochemical oxygen demand (BOD), dissolved solids or those in suspension, nitrogen compounds, phosphorous sulphur, \( \text{pH} \), hardness, turbidity, electrical conductivity and toxic and pathogenic elements. The major ions were used for assessing WQIs in the Mexico Basin. The ICA indices range from 0 to 100, and quality scales are 90-100 (Excellent), 80-90 (Acceptable), 70-80 (Slightly polluted), 50-70 (Polluted), 40-50 (Strongly polluted), and 0-40 (Excessively polluted).

### Contamination index (CI):

The CI represents the sum of the individual factors of those components that exceed permissible values, as established by the EPA. This method makes possible to assess and map the degree of groundwater contamination. It takes into account elements and species that exceed permissible limits for human health, according to Environmental Protection Agency guidelines.

Assessment of the CI was carried out as follows:

\[
C_{i} = \sum_{i=1}^{n} C_{f} \times C_{Ai}
\]

- \( C_{f} \): contamination factor for the \( N^{th} \) component
- \( C_{Ai} \): analytical value of the \( N^{th} \) component
- \( C_{Ni} \): permissible superior concentration of the \( N^{th} \) component (\( N \) means normative value).

This method uses the ion elements and species contained in the groundwater, as previously determined by chemical sample analysis done in the laboratory, and that exceed maximum limits permissible for human water consumption. Determination of CI is based on the sum of the individual factors of the components exceeding the permissible values according to the Official Mexican Standard NOM-127-SSA1-1994, “Environmental health, water for human use and consumption—quality permissible limits regarding quality and treatment to which water must be submitted for its drinkability”. It is worth pointing out that the NOM-127-SSA1-1994 does not
consider a large number of physical–chemical parameters, or guidelines, to be employed for the estimation of a more detailed CI. Therefore, in order to use the majority of the analytical results obtained from the wells (DGCOH1998), it was considered necessary to enrich the work by applying guidelines for human water consumption from the Ecological Water Quality Criteria (Mexico), the World Health Organization (WHO) and the European Economic Community (CEE); hence, it was possible to perform contamination mapping with a greater degree of sensitivity. The negative values obtained were not considered for the CI map. They are related to the main recharge zones (which do not have apparent contamination); only values greater than zero were considered [4].

**Aquatic Toxicity Index (ATI):**

It was developed by Wepener et al. to assess the health of aquatic ecosystems. Since extensive toxicity database are available for fishes, the toxic effects of different water quality to fishes have been employed as health indicators of the aquatic ecosystem [73]. The physical water quality parameters employed were pH, dissolved oxygen and turbidity while the chemical determinant included ammonium, total dissolved salts, fluoride, potassium and orthophosphates and the potentially hazardous metals chosen were total zinc, manganese, chromium, copper, lead and nickel concentrations. An ATI scale, similar to the WQI scale proposed by Smith for salmonid spawning was used. The Solway modified un-weighted additive aggregation function was initially employed to aggregate the values obtained from the rating curves [33].

\[ I = \frac{1}{100} \cdot \left( \frac{1}{n} \sum_{i=1}^{n} q_i \right)^2 \]

Where \( I \) is the final index score, \( q_i \) is the quality of the \( i \)th parameter (a value between 0–100) and \( n \) is the number of determinants in the indexing system. Wepener et al. didn’t employ the weighted sum system, as too little information is available about the importance of one determinant compared to another under different local conditions and the inherent chemistry of the system as a whole.

**Dinius Water Quality Index (DWQI):**

It is a multiplicative water quality index developed by Dinius for six categories of water uses: public water supply, recreation, fish, shellfish, agriculture and industry. He employed the liberal use of Delphi for decision making. The index included 12 parameters: dissolved oxygen, 5-day BOD, coliform count, E-coli count, pH, alkalinity, hardness, chloride, specific conductivity, temperature, colour and nitrate. The weightage of each parameter was assigned based on the evaluation of importance by the Delphi panel members [21]. The individual sub-index functions were combined with the help of a multiplicative aggregation function as follows

\[ IWQ = \sum_{i=1}^{n} l_i w_i \]

Where, \( IWQ \) is the Dinius water quality index whose value ranges from 0–100, \( l_i \) is the sub-index function of the pollutant parameter, \( w_i \) is the unit weight of the pollutant parameter whose value ranges from, 0–1 and \( n \) is the number of pollutant parameters.

**CONCLUSION**

The water quality varies according to the type of use. Furthermore, the criterion of an ‘acceptable water quality’ varies from region to region and from time to time depending upon the prevailing conditions. Water quality indices are necessary for resolving lengthy, multi-parameter, water
analysis reports into single digit scores. This, in turn, is essential for comparing the water quality of different sources and in monitoring the changes in the water quality of a given source as a function of time and other influencing factors. Time of the sampling also significantly influences water quality parameters and hence the index value. However, it is extremely difficult to develop a universally acceptable general water quality index. But researchers may develop region and source specific water quality index. Most of the developed water quality indices are surface water specific and there is ample scope to develop groundwater quality index. NSF WQI, CCME WQI and WQI are water quality indices which are frequently used for water quality assessment. CCME and BCWQI are most efficient for low parameter values. General WQI is an efficient one but parameters should be carefully selected depending on the source and time. Smith’s index gives a better aggregation of datasets. The main drawback of NSFQI is the eclipsing effect. Due to this affect one or more parameters which have values above permissible limit are masked if rest of the parameters are within the limits. In all the water quality indices cited in literatures organic pollutants are not considered, because analysis of organics is too expensive. Otherwise most of the important water quality parameters are taken into account. There is need for regular monitoring of water quality in order to detect changes in physiochemical parameters concentration and convey it to the public. So these indices are very helpful tool to represent water quality in a simple and understandable manner.

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