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Aquascopev 1: A Water Quality Analysis Software for Computing Water Data Using Aquascope Quality Indexing (AQI) Scheme

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Abstract: Water Quality Index (WQI) is a widespread technique used to work out the water quality. Computing methodology suitable for diverse water sources, using a large number of water quality elements is an immense mission. In this learning, we demonstrate a proficient water quality analysis software tool named AQUASCOPEv1 (AQUASCOPE variant-1). An indexing catalog which holds up to 30 Water Quality (WQ) parameters was structured. We established a water quality indexing scheme named Aquascope Quality Index (AQI) accustomed to calculate the suitability of water for healthy drinking use. The arranged directory was geared up with the water quality standards suggested by WHO (World Health Organization), EPA (Environment Protection Agency) and BIS (Bureau of Indian Standards). A typical software and AQI model were modernized for water quality computation of remarkable water sources. The proposed AQUASCOPEv1 Software was attempted for the quality assessment of a miraculous water source called Wadi Darbat Lake located in the Salalah city of Sultanate of Oman. The water qualities were checked before, after and during the Khareef monsoon season, the annual rain fall of Salalah. Besides, AQUASCOPEv1 was also tested to produce quality results for commercially offered drinking water in Oman. The estimated outputs were classified into Excellent (E), Medium (M), Severe (S), Very Severe (VS) and Extremely Severe (ES).

Key words: Water quality analysis modeling, Water Quality Index (WQI), Aquascope Quality Index (AQI), water quality standards, water quality catalog, wadi darbat, salalah, Oman

INTRODUCTION

Water is the primary requisite of a human life. Drinking water is vital for human health but it can act as a medium to spread infecting agents which affect the public health due to lack of quality. Water qualities are resolute based on physical, chemical, microbiological, aesthetic and radiological constituents. The Water Quality Index (WQI) is expanded as a general estimation tool to renovate the various water quality element values into a distinct score which indicates the quality score of a water pool. Environmental Engineers realized the difficulty in establishing water quality from a number of parameters and made the solution called WQI to acquire a single digit that shows the water quality (Hernandez *et al*., 2014). Horton (1965) was an initiator for the concept of WQI in 1965. NSFWQI (National Sanitation Foundation Water Quality Index) (Poonam *et al*., 2013) Samantray *et al*., 2009), CCME (Canadian Council of Ministers of the Environment) (Poonam *et al*., 2013; Lumb *et al*., 2006), OIP (Overall Index of Pollution) (Poonam *et al*., 2013; Sargaonkar and Deshpande, 2003; Sharma *et al*., 2013; Ismail, 2014), OWQI (Oregon Water Quality Index) (Poonam *et al*., 2013), BCWQI (British Columbia Water Quality Index) Poonam and Salim are few of the indices widely used by the environmental researchers and scientists. There are also many other form of water quality indices particularly available for lakes (Mukhtar *et al*., 2014; Donia, 2011), reservoirs (Hernandez *et al*., 2014; Mustapha, 2008; Arias *et al*., 2012), rivers (Samantray *et al*., 2009; Lumb *et al*., 2006; Sargaonkar and Deshpande, 2003; Sharma *et al*., 2013; Ismail, 2014; Moscuzza *et al*., 2007; Shujairi, 2013; Chen *et al*., 2012), streams (Hamid *et al*., 2013), ground water (Asadi *et al*., 2007; Bairu *et al*., 2013), coastal area (Maraqa *et al*., 2007; Falah *et al*., 2012), waste water (Abhishek and Khambete, 2013) and other water bodies developed based on following four categories: public use; specific consumption use; planning type and statistical type. In addition, water quality software approaches were

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designed for effective deployment and intelligent computations. IWQIS (Iranian Water Quality Index) (Nabizadeh *et al*., 2013), NSFWQI (27), SWQAT (Surface Water Quality Assessment Tool) (Sharma *et al*., 2013) and AQUASCOPE (Blessing and Benedict, 2014) are some of the software models. GIS (Geographical Information System) based methods with the WQI models are considered as a significant arrangement for evaluating the drinking water quality (Donia, 2011; Asadi *et al*., 2007; Bairu *et al*., 2013). Standards for drinking water quality, surface water quality, fisheries and aquatic water quality and irrigation water quality are developed based on four categories, Global stage; National stage; Region stage and Organizational stage. Ecological friendly nations may have their own legal ranges and principles for determining the water quality. However, it is significant to follow the guidelines of international rank environmental support groups like WHO (World Health Organization), EPA (Environmental Protection Agency) and EU (European Union). A report comparing and explaining the limits suggested by WHO, EU, USA, Canadian and Russian standards tends to be useful for the researchers for water analysis with the parameter variations and set up (Chapman and Kimstach, 1996). EPA (Environmental Protection Agency) was to promote maximum of 101 elements for water quality (EPA, 2001). The guidelines framed by WHO, United States and Canada were to advise 164 parameters for drinking water quality standard which includes, 5 microbiological elements; 129 chemical and physical parameters; 20 aesthetic elements and 10 radiological elements (Droste, 1997). Finding the results for all the available elements are impractical, pricey and time consuming. Thus, it is practically complex to make feasible for examining all the elements or to install water quality sensors for all the water pools to check the entire contaminants (Blessing and Benedict, 2014). Hence, there is aneed for a skillful indexing technique to estimate the results from the minimum available data. Most of the water quality indices are limited with the number of parameter elements. Consequently, it becomes tedious to compute the quality with the available elements. A quality study stated that, it is not viable to establish a specific WQI due to local barriers (Nabizadeh *et al*., 2013). An overall WQI developed for Mexico reservoir (Arias *et al*., 2012) are predicted to produce risk in their results. For instance, out of 11 elements (pH, Color, Turbidity, Electrical Conductivity, Dissolved Oxygen, Ammonia Nitrogen, fluorides chlorides, sulfates, total dissolved solids and phosphorus), if any one or more elements end result are beyond the limits, then the corresponding WQI was producing the output as “Excellent”.

In this study, we have developed water quality computing software known as AQUASCOPEv1 (AQUASCOPE variant-1). AQUASCOPE (Blessing and Benedict, 2014) was considered as the base plan for the proposed research. The innovation of AQUASCOPEv1 software was motivated by the obligation for an advanced computing tool bound for the quality assessment of water sources by checking the suitability in drinking use. The other highlights of this article will be a WQI suitable for drinking use and to investigate the water quality of Wadi Darbat Lake, Oman using AQUASCOPEv1. We recommend a public type of WQI named Aquascope Quality Index (AQI) which is implemented in AQUASCOPEv1. The foremost idea in this research is to provide the water health awareness for the society through the AQI outcomes produced by AQUASCOPEv1 which is intended for water quality. Moreover, the facility to compute maximum number of water elements that are general to any kind of flowing water and standing water resources will be an improvement. If any of the measured parameter fails to meet its standard range, then the water quality falls to the next lower level. The estimated AQI outcomes are classified to the following scores and criterion: 1-20: Extremely Severe (ES); 21-40: Very Severe (VS); 41-60: Severe (S); 61-80: Medium (M) and 81-100: Excellent (E).

MATERIALS AND METHODS

Study area: The Sultanate of Oman is situated at the South Eastern angle of the Arabian Peninsula. Nearly, 82% of the country is filled with sand and gravel desert as a piece of bigger Arabian Desert (Shahalam, 2001). Typically, Arabian Desert regions have very less annual rain fall and very rare fresh water resources. In such case, water is the most crucial natural resource for those regions. In Oman, the mean annual rainfall is below 50 mm in the core areas and around 100 mm in coastal regions. Wadi Darbat is a natural freshwater lake situated in 41 km East of Salalah city in Sultanate of Oman. The location coordinates are 17.0517 North and 54.4256 East (in decimal degrees). Wadi Darbat water treasures are the most astonishing natural water pool in Dhofar landscape of Salalah province (Baawain *et al*., 2014). Wadi Darbat lake is considered as a marvel among the gulf desert region. It is a prominent tourist spot that gives spectacular view for the travelers visiting from the neighboring GCC (Gulf Cooperation Council) countries. Khareef is the Omani name for the south western monsoon season in Salalah during July and August (Hilbert, 2012). During the

Khareef, Wadi Darbat is refilled and the waterfalls are seen over the hills and rocks. These stated water resources are used by domestic animals like camels, cows, goats, donkeys and other livestock. It is also used by public for the domestic use, boating and agricultural irrigation. The water quality study for this particular region was carried out from February 2014. Therefore, several water samples were obtained from different parts of the country and analyzed. However, only the water samples measured from Wadi Darbat Lake in the year 2014 May, June, July, August, September and October were considered for calculating the proposed scheme.

Estimation of Aquascope Quality Index (AQI): AQI is an effectual indexing tool simplified for fabricating water quality effect aimed for the communal healthiness and alertness. Test value inputs up to 30 parameter elements can be considered for AQI. Based on the impact, temporary based Parameter Weights (PW) were assigned for the parameter elements from 1-5 respectively as given in Table 1. An element, Magnesium was assigned with the minimum weight, though it may not be harmful by itself (Hamid *et al.*, 2013) while the damaging parameter, total coliforms allotted with the maximum weight. The Unit Weight (UW) for each parameter used for AQI computation was defined using Eq. 1. The given parameter weights could be modified based on the local impact and requirement:

$$UW_i = \frac{PW_j}{TPW}$$

Where:

UW_i = Unit Weight, i = 1-30
PW_i = Parameter weight
j = 1-30
TPW = Total parameter weight is the sum of weights used for the calculation

$$AQI = \Sigma UW_i^* \min(score)_k$$

Where:

AQI = Aquascope quality index
UW_i = Unit Weight
$\min(score)_k$ = Minimum score of a particular range in score

The first step of computation is to select the required parameter and its Parameter Weights (PW) for calculation based on the AQI catalog given in Table 2. Then, the Unit Weight (UW) should be formulated for each parameter based on the Eq. 1. Next for every parameter, the corresponding UW is multiplied with the minimum score of the particular classification by using an input value. The value of 'k' is given as 1, 21, 41, 61 and 81. Finally, the AQI score will be generated using (Eq. 2).

Table 1: WQ parameters with Temporary Parameter Weights (TPW)

Parameters	Measure unit	Parameter Weights (PW)	Range	Standard for the range
pH	pH value	4	6.5-8.5	WHO 2012
Turbidity	NTU	3	1-5	WHO 2012
Color	Hazen units	4	15	WHO 2012
TDS	mg/L	4	500-2000	IS 10500:2012
DO	mg/L	4	5-7	WHO, [19]
BOD	mg/L	3	5	EPA 2001
Hardness as $CaCO_3$	mg/L	3	200-600	IS 10500:2012
Alkalinity	mg/L	3	200-600	IS 10500:2012
Ammonia	mg/L	3	1.5	WHO 2012
Phosphate	mg/L	3	0.5	EPA 2001
Sulfate	mg/L	4	200-400	IS 10500:2012
Nitrate	mg/L	4	50	WHO 2012
Calcium	mg/L	2	75-200	IS 10500:2012
Magnesium	mg/L	1	30-100	IS 10500:2012
Sodium	mg/L	3	200	EPA 2001
Chloride	mg/L	3	250-1000	IS 10500:2012
Aluminum	mg/L	3	0.03-0.2	WHO 2012
Anionic	mg/L	2	0.2-1.0	IS 10500:2012
Baron	mg/L	3	0.5-1.0	EPA 2001
Copper	mg/L	3	2.0	WHO 2012
Zinc	mg/L	3	5-15	IS 10500:2012
Arsenic	mg/L	4	0.01-0.05	IS 10500:2012
Mercury	mg/L	4	0.001	EPA 2001
Cadmium	mg/L	4	0.003	IS 10500:2012
Chromium	mg/L	4	0.05	EPA 2001
Lead	mg/L	4	0.01	WHO 2012
Fluoride	mg/L	4	1.5	WHO 2012
Manganese	mg/L	4	0.1-0.3	IS 10500:2012
Iron	mg/L	2	0.3	WHO 2012
Total coliforms	CFU 100 mL^{-1}	5	0	EPA 2001

Water quality elements, ranges and standards: Water parameters were selected for the catalog based on the significance in social health. The ranges were designed based on the suggestions by WHO (World Health Organization), EPA (Environmental Protection Agency) EPA (1997) and BIS (Bureau of Indian Standards). The WHO comments that the guidelines are to be well thought-out for the ecological, societal, fiscal and cultural setting of any nation. Bureau of Indian Standards IS 10500: 2012 was prepared based on the directives of European Union (EU) water quality for human consumption, United States Environmental Protection Agency (USEPA) national drinking water standard, WHO guidelines for drinking water quality and the Manual of water supply and treatment. In Table 1 and 2, the listed parameters include some of the essential physical elements, trace elements and microbiological elements. The parameters pH, Color, Turbidity are measured in the standard pH scale, Hazen units and NTU (Nephelometric

Table 2: AQI catalog for the parameters with its score and range

Parameter AQI score	Excellent 81-100	Medium 61-80	Severe 41-60	Very severe 21-40	Extremely severe 1-20
pH	7.00-8.00	6.50-6.99, 8.01-8.50	4.01-6.49, 8.51-10.00	0-4.00	>10.00
Turbidity	0-1.0	1.01-5.00	5.01-50.00	50.01-100	>100
Color	0-15	16-25	26-100	101-200	>200
TDS	0-500	501-2000	2001-2500	2501-3000	>3000
DO	>5.00	3.01-5.00	2.01-3.00	1.01-2.00	<1.00
BOD	0-3.0	3.01-5.0	5.01-50.0	50.01-100	>100
Hardness as $CaCO_3$	201-400	401-600	0-200	601-800	>800
Alkalinity	201-400	401-600	0-200	601-800	>800
Ammonia	0-1.50	1.51-3.00	3.01-4.50	4.51-6.00	>6.00
Phosphate	0-0.50	0.51-0.70	0.71-0.90	0.91-1.10	>1.10
Sulfate	0-200	201-400	401-600	601-800	>800
Nitrate	0-50	51-75	76-100	101-125	>125
Calcium	0-75	76-200	201-400	401-600	>600
Magnesium	0-30	31-100	101-170	171-240	>240
Sodium	0-150	151-200	201-300	301-1000	>1000
Chloride	0-250	251-1000	1001-1500	1501-2000	>2000
Aluminum	0-0.03	0.04-0.20	0.21-0.40	0.41-0.60	>0.60
Anionic	0-0.20	0.21-1.00	1.01-2.00	2.01-3.00	>3.00
Baron	0-0.50	0.51-1.00	1.01-1.50	1.51-2.00	>2.00
Copper	0-0.05	0.06-2.00	2.01-3.00	3.01-4.00	>4.00
Zinc	0-5.0	5.01-15.00	15.01-40.00	40.01-65.00	>65.00
Arsenic	0-0.01	0.02-0.05	0.06-0.08	0.09-0.10	>0.10
Mercury	0-0.001	0.0011-0.002	0.0021-0.005	0.0051-0.007	>0.007
Cadmium	0-0.003	0.004-0.005	0.006-0.007	0.008-0.009	>0.009
Chromium	0-0.05	0.051-0.06	0.061-0.07	0.071-0.08	>0.08
Lead	0-0.01	0.02-0.05	0.06-0.08	0.09-0.10	>0.10
Fluoride	1.01-1.50	0-1.0	1.51-4.00	4.01-7.50	>7.50
Manganese	0-0.10	0.11-0.30	0.31-0.50	0.51-1.00	>1.00
Iron	0-0.3	0.31-0.60	0.61-0.90	0.91-1.20	>1.20
Total coliforms	0	0-1	2-10	11-20	>20

Turbidity Units), respectively. Total Coliforms are measured in CFU (Colony Forming Unit) and the others are measured in mg/L (milligrams per litre). The abbreviations are selected elements are set as Total Dissolved Solids (TDS), Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD). The water quality standard ranges are sub-divided into five different groups based on the standard classifications that as given in Table 2. The classification of parameter range includes static value, lesser than value, greater than value and a range between two values.

Software setup: In this learning, an innovative user friendly software tool has been developed based on the computational concept of AQI. This water quality analysis package is known as AQUASCOPEv1. It can be competently utilized to compute water quality data according to the choices promoted by the water quality analyst for deciding the elements, weights and standard limits. The AQUASCOPEv1 framework provides a new outlook in the water quality analysis. This software is definitely capable to offer prominent solutions for the water quality analysts. It was completely structured using NET (dot net) frameworks and MySQL databases (Fig. 1).

Two levels of users are categorized as, administrator and the normal user. The administrator can manage the parameter settings and the quality settings. The details about the water pools are stored by the administrator. The water analysts are considered as normal users. The new user can register at the main page of the system. The user login provides the facility to calculate the AQI score and the AQI result. Figure 2 explains the parameter setting options. The corresponding weights, measuring units and ranges are also set at this page. In Fig. 3 the information of corresponding water pools are selected for the index generation. It holds the information about the country, place, region, pool name, pool identification number, date of testing and the geographical information. Once the data are filled, then the user can proceed by clicking the option Aquascope Calculation from the listed menu named Calculation. The final examining page will occur as present in Fig. 4. The user can select the essential parameters and give the input values. By selecting the Aquascope Result button, the tool will generate the vital AQI score and AQI results. As an advantage, AQUASCOPEv1 is considered as flexible to add number of parameters as per the user's requirement and also able to modify the weights, standard ranges and limits at any circumstances

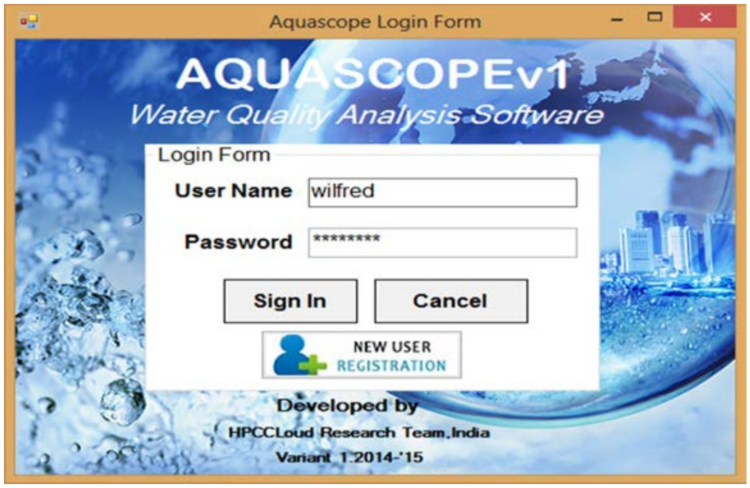

Fig. 1: Main page of AQUASCOPEv1

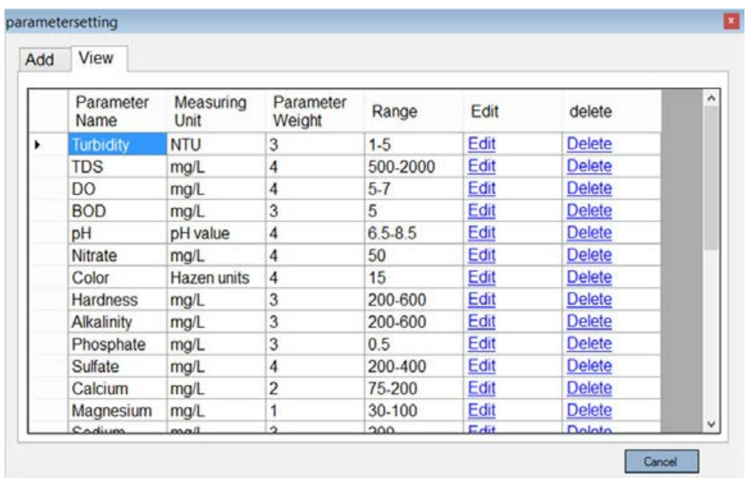

Fig. 2: Parameter settings of AQUASCOPEv1

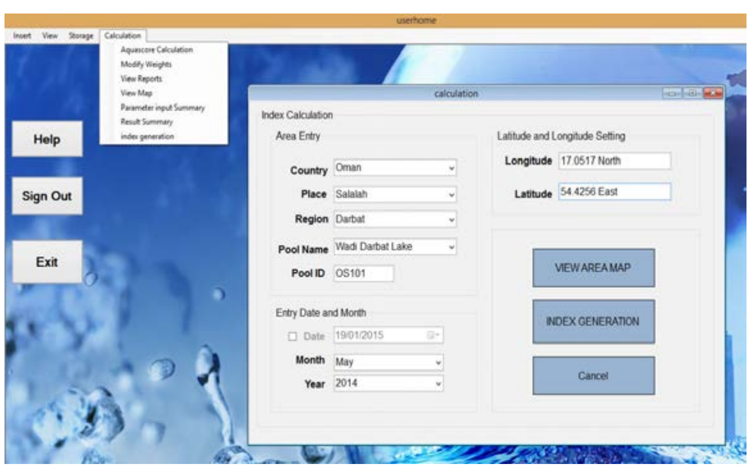

Fig. 3: Selection of water pool for the index generation

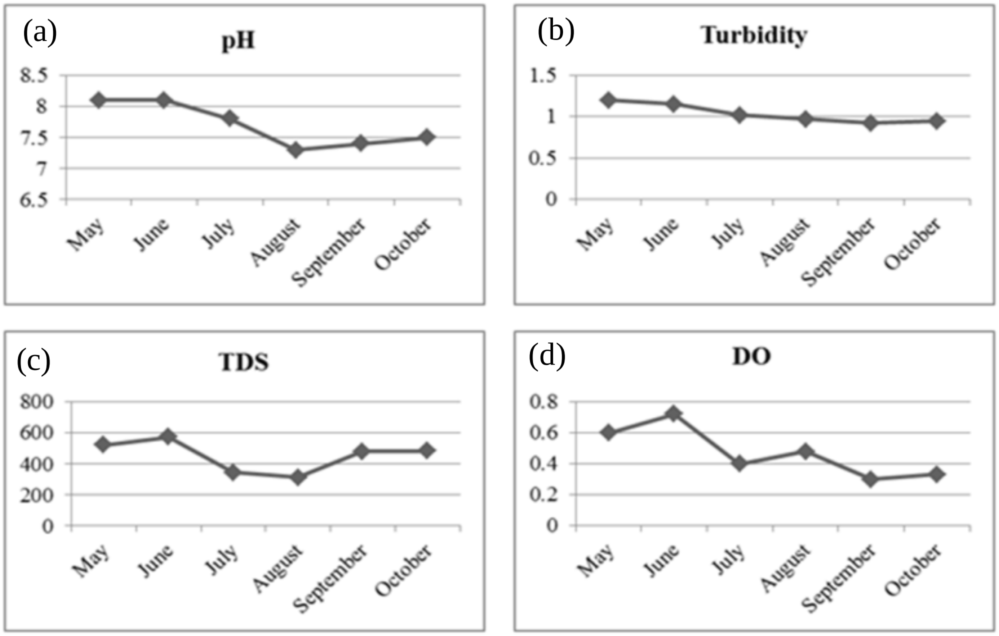

Fig. 4: Display of AQI score and its AQI result generated for "salsabeel" brand bottled water

when the water analysts need to update the parameter and quality settings for better results and findings.

RESULTS AND DISCUSSION

AQI for Wadi Darbat lake: The water test results obtained from Wadi Darbat Lake at different monsoon seasons such as, before the Khareef season (May, June), during the Khareef season (July, August) and after the Khareef season (September, October) in 2014 were analyzed to produce the AQI results. As an advantage, it is not mandatory to have all the parameters listed in the AQI catalog to compute AQI Score and AQI Results. Based on the availability of test consequences, AQI results could be examined from minimum of 1 parameter to maximum of 30 parameters. In this discussion, 16 parameters (pH, Turbidity, TDS, DO, Chloride, Sulfate, Nitrate, Fluoride, Phosphate, Sodium, Iron, Zinc, Copper, Calcium, Manganese and Hardness as $CacO_3$) assessed from the study area were considered for the computation. APHA (American Public Health Association) and HACH methods were used to test the samples in addition to the analysis instruments or meters. In Table 3, the list of parameters used for the computation with its test methods and the collected water quality data from May 2014-October 2014 of Wadi Darbat pool are given. AQI scores and AQI Classification results that are generated using the tool AQUASCOPEv1 are obviously mentioned in Table 3.

The AQI for the month "May" was computed as follows: the equivalent PW was selected for all the 16 parameters and the sum of these parameters were determined as TPW=53. Subsequently, UW was examined for every parameter from i=1-16 as per Eq. (1). The sample test results of each parameter for the month "May" given in Table 3 were balanced with the AQI catalog cited in Table 2. It was mandatory to note the minimum score of the particular classification for each parameter. The scores and its relevant UW were considered to examine the AQI using the Eq. 2. Using the esteemed output AQI score, the related classification was done visibly. Respectively, AQI was computed for other sampling months June, July, August, September and October. The results of all the six sampling months and its AQI resulting scores are given in Table 3 and compared in Fig. 5-8. Based on the classification criteria, the AQI results are represented as follows; AQI between 1-20 as Extremely Severe (ES), 21-40 as Very Severe (VS), 41-60 as Severe (S), 61-80 as Medium (M) and 81 or above as Excellent (E). The AQI outcome for all the six months of study period was rated in same category as "Medium (M)". When matching the AQI result, it is observed that, during Khareef and after Khareef monsoon season, the percentage of AQI was gradually improved which shows the quality progress of Wadi Darbat Lake. In the month of October, the AQI score 72.70 was higher than the other four months. Obviously, before the start of Khareef, the AQI score was little down than the other sampling months.

Table 3: List of parameters used for AQI calculation, data sampled from Wadi Darbat lake with AQI scores and AQI results for the testing period in 2014

Parameters	Test method or device	May	June	July	August	September	October
pH	APHA 4500 H+	8.1	8.1	7.8	7.3	7.4	7.5
Turbidity	Turbidity Meter	1.20	1.15	1.02	0.97	0.92	0.95
TDS	APHA 2540 C	520	573	343	313	480	483
DO	WQ Checker U-10	0.60	0.72	0.40	0.48	0.30	0.33
Chloride	APHA 4500 Cl-B	275	252	243	226	215	212
Sulfate	HACH 8051	180	187	183	191	213	198
Nitrate	HACH 8171	13.6	12.0	14.4	15.7	13.2	13.8
Fluoride	HACH 8029	0.12	0.14	0.17	0.10	0.22	0.21
Phosphate	HACH 8048	0.06	0.07	0.08	0.07	0.10	0.08
Sodium	APHA 3120 B	208	202	185	128	136	139
Iron	APHA 3120 B	0.055	0.032	0.062	0.071	0.057	0.052
Zinc	APHA 3120 B	0.055	0.045	0.046	0.043	0.048	0.043
Copper	APHA 3120 B	0.013	0.012	0.016	0.011	0.018	0.021
Calcium	APHA 2340 B	206	218	207	184	173	197
Manganese	APHA 3120 B	0.004	0.010	0.012	0.011	0.006	0.004
Hardness as $CaCO_3$	APHA 2340 C	505	608	511	462	321	346
AQI Score		66.28	64.02	68.55	71.57	71.19	72.70
AQI Results		M	M	M	M	M	M

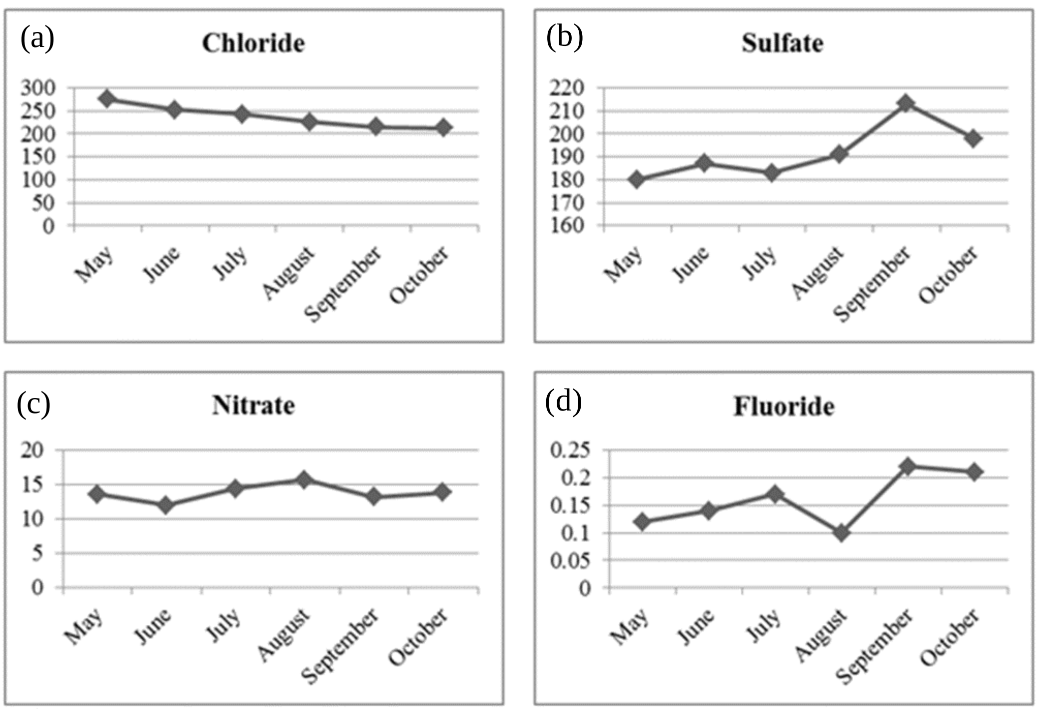

Fig. 5: Comparison of the parameter values sampled in 2014: a) pH; b) Turbidity; c) Total dissolved solids; d) Dissolved oxygen

The average AQI score determined prior to Khareef are noted as 65.15 during the Khareef are calculated as 70.06 and after the Khareef are 71.94 which shows the uppermost measure. The level of Dissolved Oxygen was extremely severe in all the sampling periods (Fig. 9). This may decrease the taste of the drinking water and also affect the aquatic organisms of the water resource. There were also significant differences in the elements like TDS, Sodium and Hardness. It was observed that, the values of water quality parameters like DO, pH, Conductivity, BOD, TDS may vary due to the influence of the temperature. Generally, the water from the very rare fresh water resources is good for drinking with no appropriate treatment demands. When the AQI result does not fall under the category “Excellent (E)”, the water requires a necessary treatment before it is used.

Applicability of aqi in bottled drinking water: As a trial in understanding the applicability of the AQI in mineral water, commercial based bottled drinking water, made in

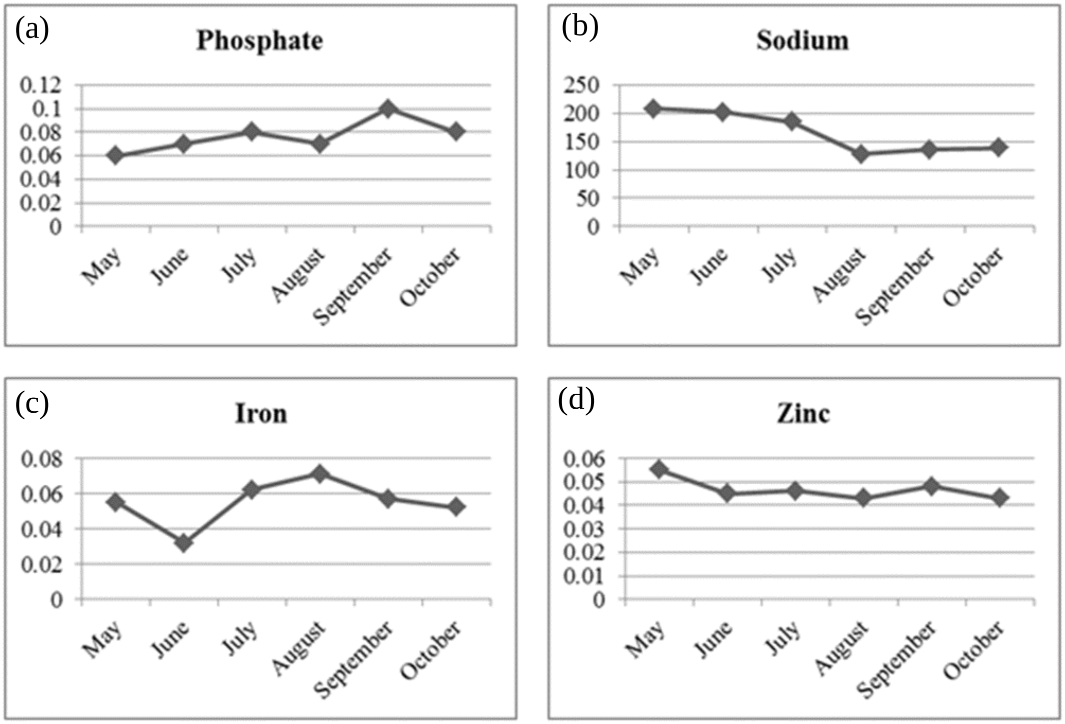

Fig. 6: Comparison of the parameter values sampled in 2014: a) Chloride; b) Sulfate; c) Nitrate; d) Fluoride

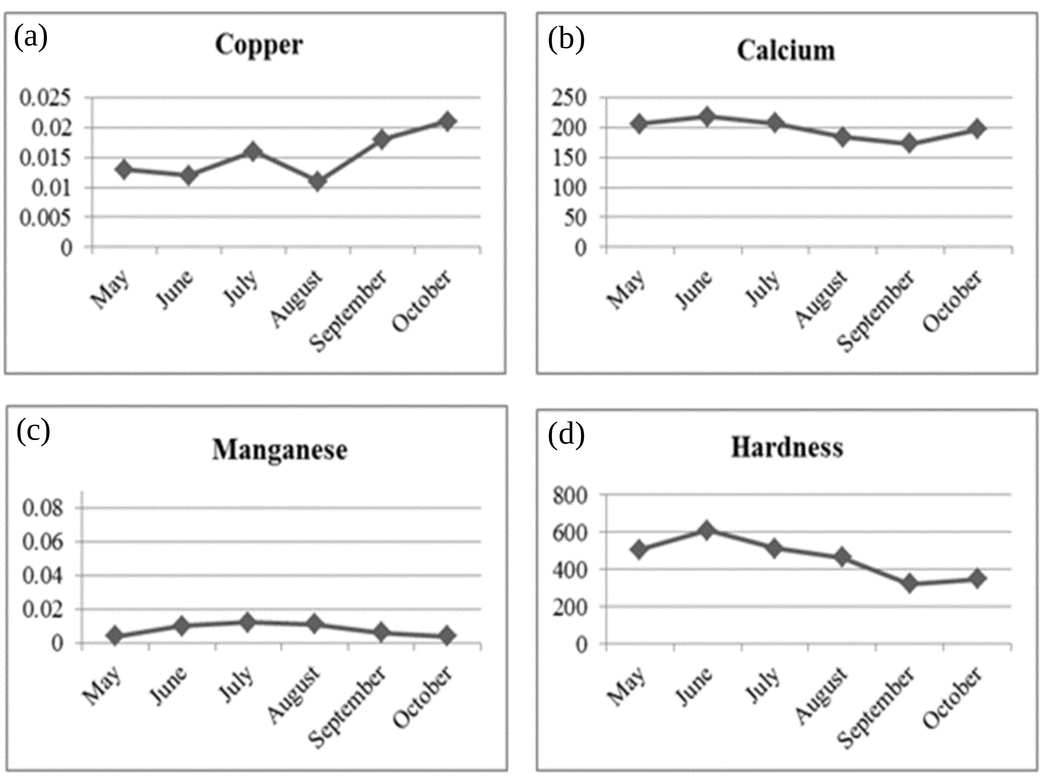

Fig. 7: Comparison of the parameter values sampled in 2014: a) Phosphate; b) Sodium; c) Iron; d) Zinc

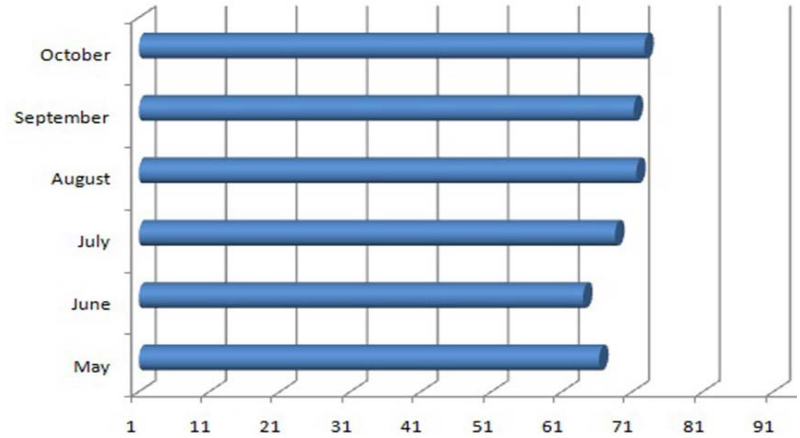

Fig. 8: Comparison of the parameter values sampled in 2014: a) Copper; b) Calcium; c) Manganese; d) Hardness as $CaCO_3$

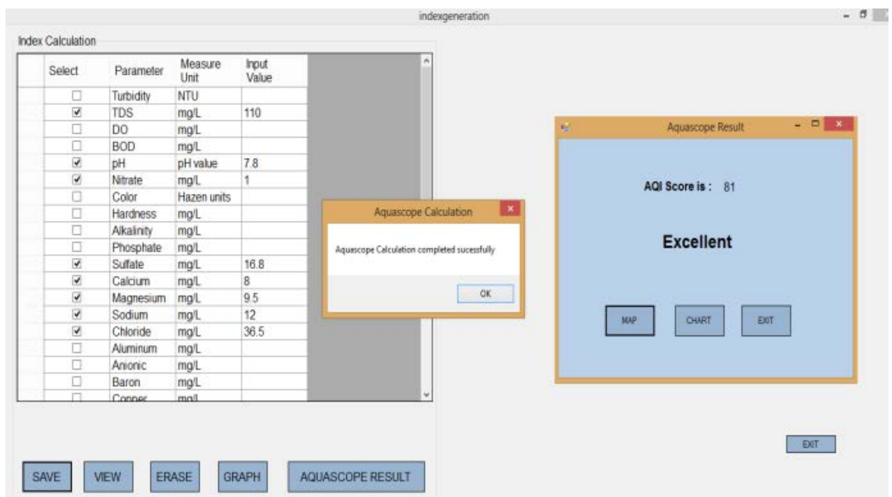

Fig. 9: Evaluation of the scores obtained using the AQI scheme for the water samples collected from May 2014 to October 2014 from Wadi Darbat lake

Table 4: Characteristics of commercially available bottled drinking water in Oman, November 2014

	Drinking water products made in Oman						Imported from UAE	
Parameters	Oasis	Arwa	Tanuf	Darbat	Salsabeel	Al Bayan	Masafi	Al ain
pH	7.1	7	7.7	7.8	7.8	7.49	7.96	7.3
TDS	120	172	115	120	110	110	178.2	110
Calcium	6	1	7.5	5.2	8	1.67	37.5	8.00
Magnesium	8	29	9.2	3.0	9.5	1	1.7	13.00
Fluoride	0.14	0.03	-	0.06	-	0.4	-	0.1
Nitrate	2.6	0.22	1	-	1	4.4	3.22	0.30
Sulfates	19	103.2	15	5.0	16.8	1.86	5.37	5.00
Sodium	9	3	11.6	6	12	10	2.6	8.00
Chloride	16	0.02	35	14	36.5	23.2	1.07	40.00
Iron	-	0.003	-	-	-	-	-	-
Hardness	48	119	-	-	-	-	-	75
AQI result	E	E	E	E	E	E	E	E

Oman, imported from UAE-Oman were randomly purchased and the water characteristics mentioned in their water bottle labels were carefully noted from Oasis, Arwa, Tanuf, Darbat, Al Bayan products of Oman and Masafi, Al ain products of UAE (United Arab Emirates) (Table 4).

The water elements and its data measured in mg/L were selected based on the AQI catalog. Interestingly, the most anticipated classification output "Excellent-E" were produced by all the brands, after examining the quality using the tool AQUASCOPEv1 in where the AQI techniques (Eq. 1 and 2) were implemented. For example, Fig. 4 shows the results produced for the commercially available bottled water quality inputs named "Salsabeel" by the AQUASCOPEv1 through its AQI score and AQI result. The AQI score for all the above products falls as the maximum score 81 after the successful evaluation.

CONCLUSION

In the main phase, AQI was simplified and resulted using the quality data of the marvelous water source Wadi Darbat Lake. This study was considered as an initial trial in water quality using AQI. The solutions can produce a good impact among the environmentalists and environmental engineers who work for a public type of WQI. In particular, this learning could create health consciousness for the society in gulf region with the feasibility of computing even using minimum available information. Usually, water quality elements are selected for computation based on the instruments, sensors or methods that are accessible in local testing laboratories. AQI is flexible in selecting water quality elements and able to generate water quality results from minimum of 1 variable to maximum of 30 variables. Thus, any level of environmentalists could access this scheme effortlessly. The AQI catalog would be extended further for more number of elements. Manually, AQI evaluation is complex when calculating with more number of elements. Therefore, a software approach is most essential for producing the examinations and public awareness of the results. AQUASCOPEv1 tool fulfilled the requirement and acting as trouble-free assessment tool for the water researchers in calculating the quality results with the available data. AQI was an effective technique used for implementing the proposed software. AQUASCOPEv1 will be further enhanced with the facilities of online computation and distributed system analysis. The targeted version will be considered as Software-as-a-Service (SaaS) to facilitate the water quality calculations for global community using the middleware agents under cloud computing platform. The intelligent computation of water quality may also be enhanced by the computer scientists by means of installing multi parameter water quality sensors, wireless technologies for water data sensor networks, automatic water sampling analysis systems, artificial intelligence and fuzzy logic in water pollution control, cloud applications in SaaS (Benedict, 2013), cloud based water data storage with data migration facility and mainly, distributed software applications with online computing efficiency to coordinate all the intelligent networking approaches.

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REFERENCES

Abhishek, S. and A.K. Khambete, 2013. Statistical analysis to identify the main parameters to the wastewater quality index of CETP: A case study at VAPI, Gujarat, India. J. Environ. Res. Dev., 7: 1294-1304.

Arias, H.R., M.C. Caraveo, R.M. Quintana, R.A.S. Teran and A.P. Munguia, 2012. An overall Water Quality Index (WQI) for a man-made aquatic reservoir in Mexico. Intl. J. Environ. Res. Public Health, 9: 1687-1698.

Asadi, S.S., P. Vuppala and M.A. Reddy, 2007. Remote sensing and GIS techniques for evaluation of groundwater quality in municipal corporation of Hyderabad (Zone-V), India. Int. J. Environ. Res. Public Health, 4: 45-52.

Baawain, M.S., M.A. Jabri and B.S. Choudri, 2014. Characterization of domestic wastewater sludge in Oman from three different regions and recommendations for alternative reuse applications. Iran. J. Public Health, 43: 168-177.

Bairu, A., N. Tadesse and S. Amare, 2013. Use of geographic information system and water quality index to assess suitability of groundwater quality for drinking purposes in Hewane areas, Tigray, Northern Ethiopia. Ethiopian J. Environ. Stud. Manage., 6: 110-123.

Benedict, S., 2013. Performance issues and performance analysis tools for HPC cloud applications: A survey. Comput., 95: 89-108.

Blessing, W.N.R. and S. Benedict, 2014. Extensive survey on software tools and systems destined for water quality. Intl. J. Appl. Eng. Res., 9: 12991-13008.

Chapman, D. and V. Kimstach, 1996. Selection of Water Quality Variables. 2nd Edn., Chapman University, Orange, California,.

Chen, Y.C., H.C. Yeh and C. Wei, 2012. Estimation of river pollution index in a tidal stream using kriging analysis. Intl. J. Environ. Res. Public Health, 9: 3085-3100.

Donia, N., 2011. Water quality management of lake Temsah, Egypt using Geographical Information System (GIS). Intl. J. Environ. Sci. Eng., 2: 1-8.

Droste, R.L., 1997. Theory and Practice of Water and Wastewater Treatment. John Wiley and Sons-Inc, Hoboken, New Jersey, USA., ISBN:9780471124443, Pages: 800.

Falah, A., R.E. Khatib and N. Yahfoufi, 2012. Water quality survey of Arabian Peninsula in regions of Dubai in the United Arab Emirates. Can. J. Chem. Eng. Technol., 3: 1-5.

Hamid, A., N.A. Dar, S.U. Bhat and A.K. Pandit, 2013. Water quality index: A case study of Vishav stream, Kulgam, Kashmir. Int. J. Environ. Bioenergy, 5: 108-122.

Hernandez, P.C., D. Rocio, M.T. Alvarado, J.A.H.S. Luis and N.C. Lopez, 2014. Water quality of a reservoir and its major tributary located in east-central Mexico. Intl. J. Environ. Res. Public Health, 11: 6119-6135.

Hilbert, Y.H., 2012. An investigation of late palaeolithic stone tool assemblages from the Nejd Plateau, Southern Oman. University of Birmingham, Birmingham, England, Pages: 393.

Horton, R.K., 1965. An index number system for rating water quality. J. Water Pollut. Control Fed., 37: 300-306.

Ismail, A.H., 2014. Applicability of Overall Index of Pollution (OIP) for surface water quality in assessment of Tigris River quality within Baghdad. Eng. Technol. J., 32: 74-90.

Lumb, A., D. Halliwell and T. Sharma, 2006. Application of CCME Water Quality Index to monitor water quality: A case study of the Mackenzie River basin, Canada. Environ. Monit. Assess., 113: 411-429.

Maraqa, M.A., A. Ali and N. Khan, 2007. Modeling selected water quality parameters at Jebel Ali Harbour Dubai-UAE. Coastal Res., 50: 794-799.

Moscuzza, C., A.V. Volpedo, C. Ojeda and A.F. Cirelli, 2007. Water quality index as a tool for river assessment in agricultural areas in the pampean plains of Argentina. J. Urban Environ. Eng., 1: 18-25.

Mukhtar, F., M.A. Bhat, R. Bashir and H. Chisti, 2014. Assessment of surface water quality by evaluating the physico-chemical parameters and by checking the water quality index of Nigeen Dasin and Brari Nambal Lagoon of Dal lake, Kashmir. J. Mater. Environ. Sci., 5: 1178-1187.

Mustapha, M.K., 2008. Assessment of the water quality of Oyun Reservoir, Offa, Nigeria, using selected physico-chemical parameters. Turk. J. Fish. Aquat. Sci., 8: 309-319.

Nabizadeh, R., M.V. Amin, M. Alimohammadi, K. Naddafi and H.A. Mahvi *et al*., 2013. Development of innovative computer software to facilitate the setup and computation of water quality index. J. Environ. Health Sci. Eng., 11: 1-10.

Poonam, T., B. Tanushree and C. Sukalyan, 2013. Water quality indices-important tools for water quality assessment: A review. Intl. J. Adv. Chem., 1: 15-28.

Samantray, P., B.K. Mishra, C.R. Panda and S.P. Rout, 2009. Assessment of water quality index in Mahanadi and Atharabanki rivers and Taldanda canal in Paradip area, India. J. Hum. Ecol., 26: 153-161.

Sargaonkar, A. and V. Deshpande, 2003. Development of an overall index of pollution for surface water based on a general classification scheme in Indian context. Environ. Monit. Assess., 89: 43-67.

Shahalam, A.M., 2001. Review of Omani aflaj systems: An element of national water resources, technology and economic developments. Sci. Technol., 6: 1-14.

Sharma, A., M. Naidu and A. Sargaonkar, 2013. Development of computer automated decision support system for surface water quality assessment. Comput. Geosci., 51: 129-134.

Shujairi, S.O.H.A., 2013. Develop and apply water quality index to evaluate water quality of Tigris and Euphrates rivers in Iraq. Intl. J. Mod. Eng. Res., 3: 2119-2126.