Verification and Determination Optimal Relationship between Water Quality Index and Physical and Chemical Parameters (Case study: Bamdezh Wetland, Iran)

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Abstract

The main aim of current study was evaluation relationship between water quality index and physical, chemical, and biological parameters of water for management wetland. Because of wetlands are valuable ecosystems that have economic, social, ecological and biological benefits and other values but degradation these natural systems in all round the world are increased. Bamdezh wetland is one of the important wetlands in Khuzestan province, southwest of Iran. This wetland according to the definition of international Ramsar convention is riverine and palustrine wetland. Water quality of this wetland is fresh water and for purposes of temporal is permanent wetland. Bamdezh wetland has important role to control floodwater and over flow of Dez and Shavoor rivers. In addition, existence vegetation and different species animals show important of management planning for conservation this wetland. Because of important of Bamdezh wetland in current study was optimization the relation between water quality index (WQI) that has represented by U.S.A National Sanitation Foundation and temperature, biochemical dissolve oxygen (BOD), NO_3, PO_4, pH, Turbidity, TSS, Coliform, chemical dissolve oxygen (COD) and dissolve oxygen (DO). Results show that relation between water quality index and mention parameters are nonlinear. Verification the best equations of each parameters showed good agreement between water quality index that were obtained from these equations and current method.

Key words: Bamdezh wetland, Water quality index and U.S.A. National Sanitation Foundation.

Introduction

According to the definition of international Ramsar convention wetland is natural or artificial marshy, permanent or ad interim with fresh water, marginal water, or brackish water zones. Wetlands have area equal 856 million hectares, the international wetlands have 75 million hectares, and the number of them is 1118. The wetlands areas of Iran are 2-2.5 million hectares and cover 1.5 percentage of the total area of Iran. The numbers of international wetlands of Iran are 20 with 1.3 million hectares areas.The most important factors that causes environmental crisis for wetlands in Iran are drainage, discharge wastewater, human encroachment, immethodical hunting, etc. The results of these factors are decreasing of aquatics production, decreasing groundwater resources, decreasing quality of human environmental and death of wetland. Wetlands have more advantage such as; direct recovery of water with people, securement and storage water in aquifer, regularization water flow especially flood flow, debarment of infiltrating saline ground and surface water, conservation articles of food, gene bank, sources for natural production of wetland. So, knowledge about water quality helps for management wetland. Several methods for evaluation quality of surface water are existed in the world. Between those, using of water quality index is the most application and the easiest.

Some chemical and physical index in papers and researches have been represented that can be divided to general index, special purpose index, design index, statistical index and biological index. These main groups have some sub index such as, Horton quality index, U.S.A. National Sanitation Foundation index, Prati index, Mc Duffie index, Dinius index, Dojlido index, Walski and Parker index, Nemerow and Sumitomo index, Oregon index, National Canada index, Harkins index, Beta index and etc (Ott, 1978). These indexes have some advantages and limitations. In statistical index cannot be compared some data to another. Design index use for management and are not use for classification surface water. Some parameter that requirement for general index are not measured in Iran so, cannot be used. Also, some indexes such as, Oregon index is local index. Between indexes that have been introduced, U.S.A. National Sanitation Foundation (NSFWQI) index is the most application and easiest index. Nevertheless, although, U.S.A. National Sanitation Foundation index has many advantages, has limitation. In this index some parameter such as, color and oily material do not use. Water quality index is an important factor for evaluated surface water. Donizetti and Galizia (2003) measured temperature, pH, electrical conductivity, dissolve oxygen, PO_4, NO3, coli form, and biochemical dissolve oxygen in watershed of Jaboata River from March 1998 to February 1999 for evaluation water in eight points of river monthly. Results showed that the amount of dissolve oxygen, PO_4, and coli form were critical. Lin et al. (2003) measured on Clyde frith from 1990 to 2000 in the southwest of Scotland water quality variables on seven stations regularly. Vandenberghe et al. (2002) did a research for calibration the model of water quality in Dender River in Belgium. Water quality model that used was ESWAT Model. In this research, the percentage of safety model as a function of measurement data has defined. Najafi (1994) evaluated self purification of Jajrood River in north of Iran by using water quality and amount of self purification by physical, chemical, biological and input wastewater were determined.

Gharae (1994) evaluated during four years quality variation of Ghareh-Ghach River. The analysis showed that electrical conductivity was increased and pH did not have any variation. Nasrolahzadeh and Varedi (2003) evaluated quality of Tajan River on north of

Iran with water quality index in four stations. Results showed that in two stations of upstream water was pure and in two stations of downstream start of severe variation in quality was beginning. Generally, water quality of this river was in good classification. Jaafarzadeh et al. (1998) did a research for evaluation effects of wastewater on quality of Dez River from north of Dezful to Ban-Ghir. Jaafarzadeh et al. (1998) did a research for evaluation variation of Karoon River on raw water of refinery of drinking water in Ahvaz. For that, reason by using ten years data, variation of water quality index have evaluated and seasonal variation was calculated. Then, the effects of water quality in each steps of water purification have analyzed. Morovati et al. (2000) evaluated effects of industrial wastewater on water quality of Karoon River. In this research the sources of pollution have recognized, hydrology and morphology of river and the proportion of industries on pollution Karoon River have evaluated.

Study water quality index have been often performed on water river. So, Because of important wetlands and water management of them in this paper were obtained the relation between water quality index and physical and chemical parameter of water in wetland. For case study was selected Bamdezh wetland one of the most important wetland in Iran. After that, the optimum equations were obtained by using statistical index. Finally, verification the best equations of each parameters were performed.

Materials and Methods

Declared wetlands in Khuzestan province in southwest of Iran are; Shadegan, Hor-Alazim, Bamdezh and Miangaran. Bamdezh wetland was located on 40 km of northwest of Ahvaz-Dezful road. Kharkheh river located on west and Dez river located in east of Bamdezh wetland. This wetland located between $48^{0}\ 27^{'}$ to $48^{0}\ 42^{'}$ eastern longitude and $31^{0}\ 38^{''}$ to $31^{0}\ 55^{''}$ northern latitude. The area of this wetland is equal to 40 km^2 with 11 km of length and 4 km of width. Bamdezh wetland is a natural wetland, permanent fresh water marsh, and recharge with Shavoor River as surface water. Vegetation of this wetland consists of; hydrophytes, halophyte, xerophytes, and wildlife consist of; water, beside water and xerophile fowl, fishes, amphibian and reptilian. This area has an average annual precipitation of 260 mm, temperature of 24 degree of centigrade and evaporation of 1900 mm. Bamdezh wetland is suitable ecosystem for birds, suitable places for growing plant, suitable place for fish of fresh water, flood control, creation microclimate that cause increasing relative humidity and decreasing temperature, natural landscape, etc (Bostanzadeh, 2003).

The input of Bamdezh wetland is Shavoor River and the outlet of this is Kharoor that after pass of Tavana canal discharge to Dez River. According to data of 2002 the mean, minimum and maximum of input discharge of wetland respectively was 16.58, 14.60, and 18.90 ($m^3.s^{-1}$) without to take into account the different use such as agricultural use before enter to wetland. The mean, minimum and maximum of output discharge of wetland that has been obtain of balance equation respectively was 12.03, 6.54, and 15.05 ($m^3.s^{-1}$) (Afkhami, 2004). Figure 1 show the satellite image of Bamdezh wetland.

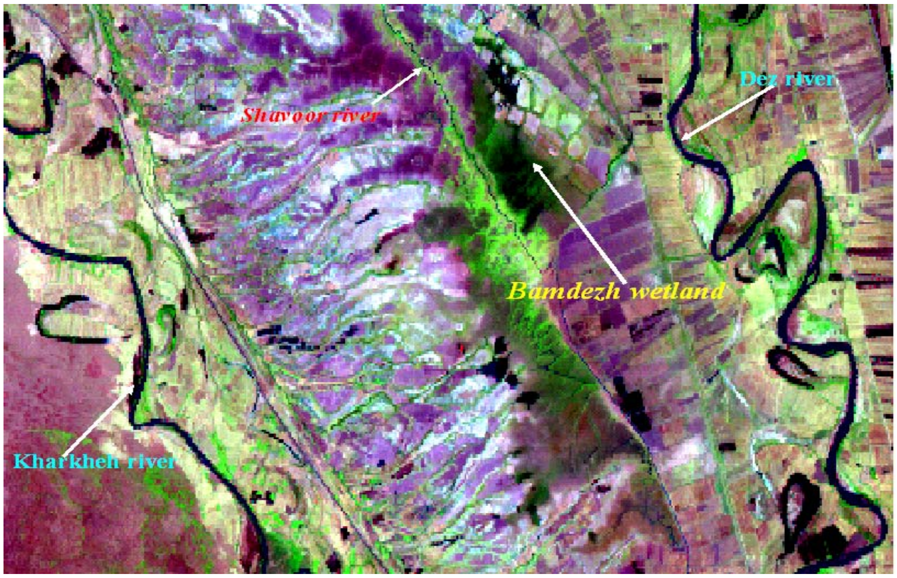

Figure 1. Satellite image of Bamdezh wetland

In this paper for determination WQI has been used temperature, dissolve oxygen, biochemical dissolve oxygen, chemical dissolve oxygen, NO_3, PO_4, pH, Turbidity, TSS and Coliform of Bamdezh wetland in four measurement stations of 2001-2002 and 2007-2008. By using measurement data, water quality index of each parameter has been calculated then by function 1 water quality index of each station has been determined.

$$NSFWQI = \Sigma W_i Q_i \tag{1}$$

W_i is sub index of each variable and Q_i is weight factor of each variable.

To obtain mathematical models were used SPSS12.0 software. Water quality parameter as independent variable (X) and WQI as dependent variable (Y) were used as input of SPSS. Then 10 mathematical models were obtained. For evaluated mathematical formulas performance were calculated maximum error (ME), root mean square error (RMSE), coefficient of determination (CD or R^2), modeling efficiency (EF) and coefficient of residual mass (CRM). The mathematical expressions of these statistics are as follows (Homaee et al, 2002):

$$ME = Max \left| P_i - O_i \right|_{i=1}^{n} \tag{2}$$

$$RMSE = \left[\frac{\sum_{i=1}^{n} (P_i - O_i)^2}{n} \right]^{1/2} \times \frac{100}{\overline{O}} \tag{3}$$

$$R^2 = \frac{\sum_{i=1}^{n} (P_i - \overline{O})^2}{\sum_{i=1}^{n} (O_i - \overline{O})^2} \tag{4}$$

$$EF = \frac{\sum_{i=1}^{n} (O_i - \overline{O})^2 - \sum_{i=1}^{n} (P_i - O_i)^2}{\sum_{i=1}^{n} (O_i - \overline{O})^2} \tag{5}$$

$$CRM = \frac{\sum_{i=1}^{n} O_i - \sum_{i=1}^{n} P_i}{\sum_{i=1}^{n} O_i} \tag{6}$$

Where P_i is the predicted data, O_i the measured data and n is the number of samples. By statistical index, determine sum of degree and was classified 10 equations.

Results and Discussion

For determination optimum function between WQI and BOD, NO_3, PO_4, pH, Turbidity, TSS, Coliform, COD and DO 10 function (Linear, Logarithmic, Inverse, Quadratic, Cubic, Power, Compound, S, Growth, Exponential) were obtained by using SPSS12.0. The results of SPSS 12.0 and statistical index that were calculated have been represented on tables 1-9.

Table 1. Imperial mathematical models between WQI and DO and statistical index

Model	Mathematical Model	ME	RMSE	R^2	EF	CRM	Total Ranking
Linear	WQI=0.152DO+37.822	0.950	5.284	0.548	-0.838	-0.143	4
Logarithmic	WQI =14.118LnDO-10.812	1.736	7.572	0.798	-2.448	-0.143	3
Inverse	WQI =-1105.400/DO+65.583	3.915	9.865	0.720	-6.269	-0.263	6
Quadratic	$WQI=-0.010DO^2+1.759DO-20.999$	1.242	3.403	0.758	-1.990	-0.130	2
Cubic	$WQI=-0.106DO^3+1.789DO^2-19.871DO+0.114$	1.224	0.003	0.830	-2.620	-0.111	1
Power	$WQI=15.559DO^{0.265}$	4.470	8.149	0.754	-8.742	-0.312	4
Compound	$WQI=39.154*1.003^{DO}$	1.058	7.096	0.730	-1.305	-0.034	5
S	$WQI=e^{(4.187/DO-21.35)}$	2.021	4.755	0.502	-5.780	7.370	7
Growth	$WQI=e^{(0.003DO+3.668)}$	1.059	7.593	0.730	-1.302	0.035	8
Exponential	$WQI=39.154e^{0.003DO}$	1.059	3.450	0.730	-1.302	0.035	4

Table 2. Imperial mathematical models between WQI and COD and statistical index

Model	Mathematical Model	ME	RMSE	R^2	EF	CRM	Total Ranking
Linear	WQI=-0.245COD+59.826	0.853	6.509	0.784	-0.837	-0.200	4
Logarithmic	WQI =-7.009LnCOD+75.769	2.706	8.072	0.876	-3.400	-0.491	3
Inverse	WQI =152.547/COD+46.293	3.891	9.222	0.606	-6.003	-0.345	7
Quadratic	$WQI=-0.021COD^2+1.427COD+29.812$	1.128	3.603	0.887	-1.041	-0.496	2
Cubic	$WQI=0.003COD^3-0.387COD^2+14.994COD-127.340$	1.008	0.025	0.913	-2.399	-0.498	1
Power	$WQI=85.650COD^{-0.154}$	5.658	9.947	0.749	-9.742	-0.291	8
Compound	$WQI=59.983*0.995^{COD}$	1.080	8.006	0.871	-1.437	-0.129	5
S	$WQI=e^{(3.796/COD+3.556)}$	1.317	4.839	0.415	-4.099	6.927	7
Growth	$WQI=e^{(-0.005COD+4.094)}$	1.081	6.056	0.871	-1.002	0.054	6
Exponential	$WQI=59.983e^{-0.005COD}$	1.081	3.332	0.871	-1.002	0.054	3

Table 3. Imperial mathematical models between WQI and BOD and statistical index

Model	Mathematical Model	ME	RMSE	R^2	EF	CRM	Total Ranking
Linear	WQI=-2.833BOD+64.550	0.920	4.284	0.802	-0.543	-1.543	1
Logarithmic	WQI =-14.749LnBOD+70.695	1.321	8.572	0.789	-1.567	-0.543	7
Inverse	WQI =44.581/BOD+36.527	3.965	8.365	0.427	-6.653	-0.943	6
Quadratic	$WQI=0.223BOD^2-5.973BOD+71.864$	2.242	3.954	0.876	-1.760	-0.640	3
Cubic	$WQI=0.020BOD^3-0.218BOD^2-3.346BOD+68.006$	1.824	0.653	0.876	-1.920	-0.181	1
Power	$WQI=75.161BOD^{-0.310}$	4.470	8.769	0.758	-6.723	-0.732	7
Compound	$WQI=66.487*0.941^{BOD}$	1.858	7.546	0.931	-1.905	-0.144	5
S	$WQI=e^{(3.606/BOD+0.920)}$	2.021	4.233	0.353	-5.430	7.650	7
Growth	$WQI=e^{(-0.610BOD+4.197)}$	0.959	7.328	0.931	-1.923	0.534	2
Exponential	$WQI=66.487e^{-0.610BOD}$	2.059	4.289	0.931	-0.642	1.095	8

Table 4. Imperial mathematical models between WQI and PO_4 and statistical index

Model	Mathematical Model	ME	RMSE	R^2	EF	CRM	Total Ranking

Linear	$WQI=-25.033PO_4+53.443$	1.350	3.994	0.838	-1.838	-0.983	2
Logarithmic	$WQI =-1.208 Ln\ PO_4+47.748$	1.956	7.092	0.838	-2.768	-0.653	6
Inverse	$WQI =-0.018/ PO_4+51.231$	4.015	9.015	0.485	-5.289	-1.653	7
Quadratic	$WQI =-436.090\ PO_4^2+103.221\ PO_4+47.898$	1.762	2.129	0.906	-1.543	-0.980	3
Cubic	$WQI =1357.130\ PO_4^3-1020.7\ PO_4^2+168.270\ PO_4+46.224$	1.544	0.993	0.910	-2.765	-0.811	1
Power	$WQI =47.380\ PO_4^{-0.017}$	3.770	7.149	0.758	-8.054	-2.362	3
Compound	$WQI =51.954*0.629^{PO4}$	1.548	7.566	0.928	-2.875	-0.734	3
S	$WQI =e^{(3.920/ PO4-0.001)}$	1.921	4.565	0.369	-5.864	7.054	5
Growth	$WQI =e^{(-0.465\ PO4+3.950)}$	0.059	5.973	0.928	-1.972	0.975	3
Exponential	$WQI =51.954e^{-0.465\ PO4}$	1.959	3.876	0.928	-2.122	0.633	4

Table 5. Imperial mathematical models between WQI and T and statistical index

Model	Mathematical Model	ME	RMSE	R^2	EF	CRM	Total Ranking
Linear	$WQI=-1.414T+86.654$	5.247	12.296	0.746	-8.310	0.110	4
Logarithmic	$WQI =-35.014 Ln\ T+162.656$	1.867	10.345	0.731	-3.073	0.391	4
Inverse	$WQI =-811.175/ T+16.260$	3.915	5.893	0.696	-5.321	0.812	3
Quadratic	$WQI =--0.003\ T^2-1.271\ T+84.916$	3.217	7.443	0.746	-2.311	0.020	7
Cubic	$WQI =-0.003\ T^3-1.345\ T^2+68.270\ T+46.224$	5.139	8.560	0.746	-2.900	0.303	2
Power	$WQI =493.720\ T^{-0.720}$	7.862	3.906	0.745	-3.100	0.113	6
Compound	$WQI =103.698*0.971^{T}$	4.889	7.002	0.725	-8.410	0.661	5
S	$WQI =e^{(3.193/ T-16.620)}$	4.095	14.306	0.685	-9.607	0.244	3
Growth	$WQI =e^{(-0.029T+4.642)}$	3.830	8.005	0.745	-10.843	0.102	8
Exponential	$WQI =103.698e^{-0.029T}$	9.247	10.513	0.745	-9.034	0.987	1

Table 6. Imperial mathematical models between WQI and NO_3 and statistical index

Model	Mathematical Model	ME	RMSE	R^2	EF	CRM	Total Ranking
Linear	$WQI=0.927NO_3+40.716$	5.312	4.074	0.622	-1.593	-0.032	5
Logarithmic	$WQI =7.540 Ln\ NO_3+34.557$	3.312	6.194	0.542	0.511	-0.038	3
Inverse	$WQI =-38.674/ NO_3+56.940$	4.967	4.024	0.322	-1.283	-0.013	3
Quadratic	$WQI =0.025\ NO_3^2+0.362\ NO_3+42.953$	3.076	1.996	0.826	0.468	-0.116	8
Cubic	$WQI =-0.002\ NO_3^3-0.038\ NO_3^2+1.001\ NO_3+41.414$	7.203	3.949	0.963	0.341	-0.077	6
Power	$WQI =36.368\ NO_3^{0.143}$	3.351	4.387	0.530	0.944	-0.024	3
Compound	$WQI =41.051*1.017^{NO3}$	7.007	9.463	0.600	0.886	-0.063	1
S	$WQI =e^{(4.023/ NO3-0.764)}$	9.611	3.119	0.475	0.670	-0.640	4
Growth	$WQI =e^{(0.017\ NO3+3.715)}$	8.703	9.664	0.429	-1.021	-0.762	2
Exponential	$WQI =41.051e^{0.017\ NO3}$	3.265	5.225	0.563	-0.024	-0.502	7

Table 7. Imperial mathematical models between WQI and EC and statistical index

Model	Mathematical Model	ME	RMSE	R^2	EF	CRM	Total Ranking
Linear	$WQI=-0.001EC+56.838$	0.591	4.258	0.318	-1.838	0.133	7
Logarithmic	$WQI =-6.484 Ln\ EC+103.371$	1.706	7.255	0.644	-4.288	7.370	6
Inverse	$WQI =1277.2/ EC+45.542$	3.970	6.589	0.532	-5.022	-0.113	8
Quadratic	$WQI =3*10^{-8}\ EC^2-0.002\ EC+58.502$	2.144	4.303	0.723	-1.013	-0.448	8
Cubic	$WQI =3.2*10^{-11}\ EC^3-1*10^{-6}\ EC^2+0.005EC+48.388$	1.204	1.084	0.403	-2.004	-0.020	9
Power	$WQI =163.207\ EC^{-0.147}$	7.330	7.006	0.377	-4.726	-0.019	3
Compound	$WQI =56.637*1.010^{EC}$	7.800	4.550	0.592	-1.307	-0.087	4
S	$WQI =e^{(3.778/ EC+299.325)}$	2.210	8.655	0.431	-1.733	2.304	1
Growth	$WQI =e^{(-3*10^{\wedge}-5EC+4.037)}$	5.003	3.701	0.377	-3.040	0.216	5
Exponential	$WQI =56.637e^{-3*10^{\wedge}-5EC}$	4.329	5.505	0.377	-2.260	6.327	2

Table 8. Imperial mathematical models between WQI and pH and statistical index

Model	Mathematical Model	ME	RMSE	R^2	EF	CRM	Total Ranking

Linear	WQI=-5.028pH+91.821	3.904	5.973	0.811	-.3.908	0.035	5
Logarithmic	WQI =-41.648Ln pH+137.929	9.302	6.543	0.607	-4.211	0.116	3
Inverse	WQI =338.200/ pH+8.757	7.113	3.005	0.591	-5.001	-0.118	6
Quadratic	$WQI = 1.360pH^2-27.404pH+182.609$	2.908	1.207	0.891	-1.209	-0.038	9
Cubic	$WQI = 3.157\ pH^3-25.789pH^2+0.006pH+134.076$	3.004	1.703	0.870	-2.903	-0.024	8
Power	$WQI = 297.714\ pH^{-0.858}$	5.018	9.916	0.481	-7.305	-0.027	4
Compound	$WQI = 115.446*0.901^{pH}$	4.332	5.401	0.823	-10.014	0.118	7
S	$WQI = e^{(3.038/ pH+6.946)}$	7.911	10.703	0.391	-17.001	-0.102	4
Growth	$WQI = e^{(-0.104pH+4.749)}$	10.807	8.002	0.405	-9.304	0.145	2
Exponential	$WQI = 115.446e^{-0.104pH}$	12.030	11.030	0.632	-4.004	0.120	1

Table 9. Imperial mathematical models between WQI and TSS and statistical index

Model	Mathematical Model	ME	RMSE	R^2	EF	CRM	Total Ranking
Linear	WQI=-0.012TSS+53.510	1.480	9.825	0.420	-4.550	-0.033	5
Logarithmic	WQI =0.230Ln TSS+49.769	2.212	5.768	0.431	-0.695	-0.071	4
Inverse	WQI =-81.704/ TSS+52.271	2.980	6.292	0.830	-6.523	-0.083	7
Quadratic	$WQI = -0.001TSS^2+O.081TSS+47.988$	2.636	9.811	0.611	-1.864	-0.085	3
Cubic	$WQI = 2.4*10^{-7}TSS^3-0.001TSS^2+0.112TSS+46.893$	4.358	7.340	0.821	-8.005	-0.027	6
Power	$WQI = 49.963\ TSS^{-0.002}$	5.314	9.983	0.330	-6.486	-0.453	2
Compound	$WQI = 52.820*0.998^{TSS}$	4.186	5.650	0.703	-5.160	0.304	5
S	$WQI = e^{(3.927/ TSS-1.416)}$	3.667	3.796	0.562	-3.606	0.271	3
Growth	$WQI = e^{(-0.001TSS+3.9679)}$	9.153	4.094	0.334	-4.197	0.064	2
Exponential	$WQI = 52.820e^{-0.001TSS}$	10.812	9.983	0.549	-6.485	0.020	1

For determination optimum equation was used statistical index and was calculated ME, RMSE, CD (R^2), EF and CRM between observation and measurement. ME indicate the worst-case performance of the model. RMSE value shows how mush the simulation overestimate or underestimate the measurements. The CD or R^2 gives the ratio between the scatter of the simulated and measurement. Compares between the simulated data to the average measured values determine with EF.The CRM is a measure of the tendency of the model to overestimate or underestimate the measurements. For determination optimum equation should be arranged ME, RMSE, EF and CRM of each equation from minimum to maximum and R^2 of each equation should be arranged from maximum to minimum. Then, average of degree was calculated for equations and each equation that was obtained maximum number was selected as optimum equation. According to table 1 cubic equation is the best imperial mathematical model between WQI and DO. Total ranking of statistical indexes indicate that cubic equation the best equation.

Table 2 indicates that cubic equation is the best imperial mathematical model and by measurement COD and using this equation can be determined WQI with coefficient of determination equal to 0.913. Also, the maximum error between measurement and calculated when using this equation is 1.008 that is suitable error in natural phenomena.

Statistical indexes in table 3 show that cubic equation is the best imperial mathematical model between WQI and BOD.

According to table 4 total ranking of statistical indexes indicates that cubic equation is the best imperial mathematical model between WQI and PO_4. By using this equation can be determined WQI with coefficient of determination equal to 0.910.

Table 5 indicates that exponential equation is the best imperial mathematical model and by measurement temperature and using this equation can be determined WQI with coefficient of determination equal to 0.745.

Results in table 6 indicate that total ranking of statistical indexes of compound equation is number one and chosen as best mathematical model between WQI and NO_3. By using this equation can be determined WQI with coefficient of determination equal to 0.600.

According to table 7 S equation is the best imperial mathematical model between WQI and EC. Total ranking of statistical indexes indicate that s equation the best equation.

Table 8 and 9 indicate that exponential formula is the optimum equation between WQI and pH and TSS.

Generally, all tables that have been represented, show the relationship between WQI and water quality parameter is nonlinear and with application these equations and measurement BOD, NO_3, PO_4, pH, Turbidity, TSS, Coliform, COD and DO can be determined WQI in Bamdezh wetland.

In order to verification the best equations of each parameter were used measurement data of Bamdezh wetland from 2009 year. Using measurement data such as; BOD, NO_3, PO_4, pH, Turbidity, TSS, Coliform, COD and DO were calculated WQI. Then, the best equation of each mention above parameters was used for calculation WQI and using formula 1 were determined final WQI. Compare the result showed good agreement between WQI that calculated using these equations and current method.

Conclusion

Generally, for determination optimum equation in researches often is used coefficient of determination (R^2). This paper was shown that R^2 is not sufficient and should be used other statistical index such as; maximum error (ME), root mean square error (RMSE), modelling efficiency (EF) and coefficient of residual mass (CRM). Because some equation had high coefficient of determination but according to mention statistical index is not optimum equation. The results of this paper indicate that the best relation between water quality index and DO, COD, BOD, PO_4 is cubic and the optimum equation between water quality index and temperature and pH and TSS is exponential. S and compound equations are the best imperial mathematical models for water quality index, EC and NO_3. Generally, the results were indicated that the relationship between water quality index and physical and chemical parameter is nonlinear. By using obtaining equations and measurement BOD, NO_3, PO_4, pH, Turbidity, TSS, Coliform, COD and DO can be determined WQI with suitable coefficient of determination in Bamdezh wetland. Verification the best equation of each parameters showed that can be used these equations for future study.

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References

- Afkhami, M. 2004. Determination environmental water requirement of Bamdezh wetland for management and monitoring water quality. Report Khuzestan Environmental Protection (Persian).

-Bostanzadeh, M. 2003. Water and pollution management of Bamdezh wetland. Mc.S thesis, Azad University. Science and research branch of Ahvaz (Persian).

- Donizetti, G. and T.J. Galizia, 2003. Water quality in watershed of Jaboata River: case study. Journal of biology and technology., 46 (4): 711-721.

- Gharae, H., 1994. Water quality of Ghareh-Ghach. 3rd international conference of river engineering, Ahvaz, Iran, p 12. (Persian).

- Homaee, M., C. Driksen and R. A. Feddes, 2002. A macroscopic water extraction model for non-uiform transient salinity and water stress. Soil Science Society of American Journal., 66

- Jaafarzadeh, N., K. Morovati and H. Kabi, 1998**.** Effect of wastewater of agriculture and industrial on water quality of Dez River**.** 5th international conference of river engineering, Ahvaz, Iran, p 343**.** (Persian).

- Jaafarzadeh, N., K. Morovati, A. Lahijanzadeh, H. Kabi, S. Rostami and A. Mahdaviani, 1998. Effect of wastewater of agriculture and industrial on water quality of Karoon River**.** Journal of Environmental. (Persian).

- Lin, B.S., M. Kashefipour and P. A. Falconer, 2003. Predicting near-shore coli form bacteria concentrations using ANNS , Water science and technology., 48 (10): 104-117.

- Morovati, K., A. Mahdaviani, A.. Lahijanzadeh, S. Rostami, N. Jaafarzadeh and H. Kabi, 2000. Effecst of variation of Karoon River on raw water of refinery of drinking water in Ahvaz. Proceeding of environmental conference. (Persian).

- Najafi, M., 1994. Evaluation of self purification of Jajrood River. M.Sc. thesis. Tarbiat Modarec University, Tehran. (Persian).

- Nasrolahzadeh, H. and A. Varedi, 2003. Evaluation water quality of Tagen River by using water quality index. 6th international conference of river engineering, Ahvaz, Iran, p 903. (Persian).

- Ott , W.R., 1978. Environmental Indices – Theory and Practice , Ann Arbor Science , publishers , Inc. , Ann Arbor , Michigan.

- Vandenberghe , V., A. Vangriensven and W. Bauwens , 2002. Detection of the most optimal measuring points for water quality variables : application to the river water quality model of the riner Dender in ESWAT , water science and technology , 40(3): 1-7 , IWA publishing .