# Evaluation of river water quality by Canadian water quality index,

# Case study of Taleghan River, Iran

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**Abstract:**
Taleghan sub basin is located in 90 km northwest of Tehran and is one of the main sub basins of Sefid-Rood basin. Naturally more than twenty small and big rivers and their branches form the surface water in Talegan region and their joining to the main Talegan River construct one of the main branches of Shahrood River as well as the agricultural and drinking water for Tehran city and Qazvin's plain lands. In order to evaluate the overall water quality of Taleghan River, Canadian water quality index is taken into consideration. Six sampling stations were selected along the river and composite sampling was performed. Parameters like BOD, major anions and cations, Ph, DO and turbidity were calculated. The overall water quality estimated to be marginal.

**Keywords:** Water quality, Canadian index, Taleghan River,

**Introduction:**
Assessment of surface water quality can be a complex process undertaking multiple parameters apable of causing various stresses on overall water quality. To evaluate water quality from a large number of samples, each containing concentrations for many parameters is difficult (Smith, 1990).To analyze water quality, different approaches like statistical analyses of individual parameter, multi-stressors water quality indices, etc have been considered (Singh *et al.* 2006). 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) (Shresta & Kazama, 2007), Canadian Council of Ministers of the Environment Water Quality Index (CCMEWQI) (Ahmed et al., 2004), British Columbia Water Quality Index (BCWQI), and Oregon Water Quality Index (OWQI)(Kim & Cardone, 2005). 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 (Kowalkowski et al., 2007).

Locating in 90 kilometer of Tehran North West, Talegan region is a pretty high area in the heart of the Alborz Chain.
Naturally more than twenty small and big rivers and their branches form the surface water in Talegan region and their joining to the main Talegan River construct one of the main branches of Shahrood River as well as the agricultural and drinking water for Tehran city and Qazvin's plain lands. We studied on 50 km of it by choosing 6 sampling stations (Figure 1, Table 1). This study comprises catchment of Taleghan River.

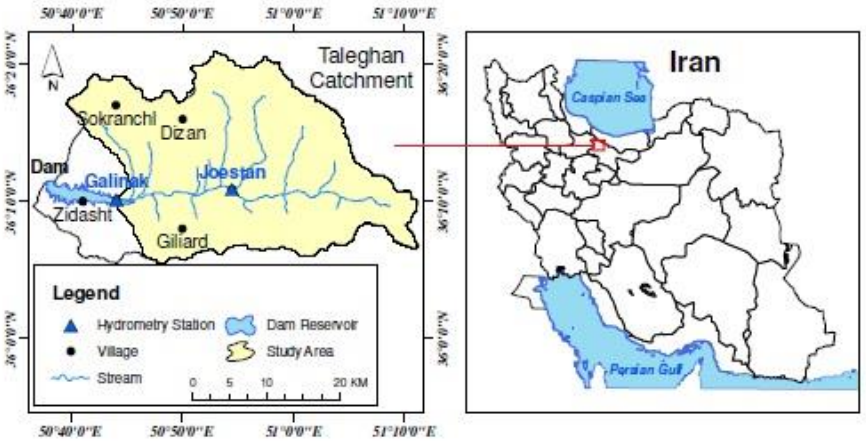


**Fig.1.** Position of the Taleghan River.

**Table 1.** Location of the sampling stations

| Stations | | UTM | | Elevation (m) | Distance from Upstream(Km) |
|---|---|---|---|---|---|
| Number | Name | X | Y | | |
| S1 | Gatedeh | 3610480 | 05059160 | 2858 | 0 |
| S2 | Bayzan | 3610927 | 05054325 | 2394 | 18 |
| S3 | Joyestan | 3610963 | 05052928 | 2261 | 29 |
| S4 | Mongolan | 3610550 | 05050867 | 2142 | 34 |
| S5 | Befor Shahrak | 3610215 | 05046380 | 1910 | 47 |
| S6 | Glinak | 3610007 | 05044880 | 1780 | 51 |

***Materials and methods.***

Site visits and review of the existing data was the first step followed by identifying major source of pollution and collecting its qualitative parameters and data analysis.

Therefore site visits were made in order to recognize sampling stations. Accordingly, 6 point was defined as stations all around the study area.

**Canadian Council of Ministers of Environment (CCMEWQI)**

CCMEWQI compares observations to a benchmark instead of normalizing observed values to objectives rating curves, where the benchmark may be a water quality standard or site specific background concentration. So, this acts as an advantage of the index which can be applied by the water agencies in different countries with little modification. To categorize water quality under this, four categories have been suggested i.e. Excellent, Good, Fair and Poor. Calculating index scores.

Find *F*1: the number of variables whose objectives are not met (scope)

F1= [No. of failed variables /Total no of variables]*100

*Find F*2: the frequency by which the objectives are not met (frequency)

*F2= [No of failed tests/Total no of tests]*100*

Find *F*3: the amount by which the objectives are not met (amplitude)

*F*3 (Amplitude)

The amount by which the objectives are not met (amplitude) that represents the amount by which the failed test values do not meet their objectives, and is calculated in three steps.
The number of times by which an individual concentration is greater than (or less than, when the objective is a minimum) the objective is termed an "excursion" and is expressed as follows. When the test value must not exceed the objective:

$$\text{excursion}_i = \left(\frac{\text{Failed Test Value}_i}{\text{Objective}_j}\right) - 1$$

For the cases in which the test value must not fall below the objective:

$$\text{excursion}_i = \left(\frac{\text{Objective}_j}{\text{Failed Test Value}_i}\right) - 1$$

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

$$F_3 = \left(\frac{\text{nse}}{0.01\text{nse} + 0.01}\right)$$

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

A recent study demonstrated that by using different CCME WQI protocols and sensitivity analyses, the specific problematic parameters that may be contributing towards lowering the index values can be identified.

**Results and discussion:**

The values of CWQI in all six stations in four seasons are calculated in Table 2.

Table 2- hydrochemical characteristics and CQWI values in Taleghan River

| Data Summary | Overall | Drinking | Aquatic | Recreation | Irrigation | Livestock |
|---|---|---|---|---|---|---|
| CWQI | 59 | 75 | 67 | 62 | 100 | 100 |
| Categorization | Marginal | Fair | Fair | Marginal | Excellent | Excellent |
| F1 (Scope) | 38 | 20 | 50 | 60 | 0 | 0 |
| F2 (Frequency) | 27 | 13 | 52 | 4 | 0 | 0 |
| F3 (Amplitude) | 21 | 40 | 27 | 0 | 0 | 0 |

In order to rank the water quality a rating criteria is considered for data interpretation (Table 3).

The above formulation produces a value between 0 and 100 and gives a numerical value to the state of water quality. Note a zero (0) value signifies very poor water quality, whereas a value close to 100 signifies excellent water quality. The assignment of CCME WQI values to different categories is somewhat subjective process and also demands expert judgment and public's expectations of water quality. The water quality is ranked in the following 5 categories:

**Table 3-** Water quality ranking for CWQI

1. Excellent: (CCME WQI values 95–100)

2. Good: (CCME WQI values 80–94)

3. Fair: (CCME WQI values 60–79)

4. Marginal: (CCME WQI values 45–59)

5. Poor: (CCME WQI values 0–44)

In this study the evaluation of the overall water quality of Taleghan River with Canadian water quality index is taken into consideration. Six sampling stations were selected along the river and composite sampling was performed. Parameters like BOD, major anions and cations, pH, DO and turbidity were calculated. Canadian standard was cited as the reference. The overall water quality estimated to be marginal. The quality level for different land uses like drinking, aquatic, recreation, irrigation and livestock were estimated to be fair, fair, marginal, excellent and excellent, respectively.

**References :**


1. Ahmed, S., David, K.S. and Gerald, S., (2004), Environmental assessment: An innovation index for evaluation water quality in streams, Environment Management., 34 pp 406-414.

2. Kim, A.G. and Cardone, C.R., (2005), Scatterscore: a reconnaissance method to evaluate changes in water quality, Environmental Monitoring and Assessment, 111, pp 277-295.

3. Kowalkowski T, Gaszala-kopciuch M, Kosobucki P, Krupczynska K, Ligor T. and Buszewski B., (2007), Organic and inorganic pollution of the Vistula River basin. Journal of Environmental Science and Health Part A, 42, pp 421-426.

4. Shrestha S, and Kazama F., (2007), Assessment of water quality using multivariate statistical techniques: A case study of Fuji river basin, Japan. Environmental Modeling

and Software, 22, pp 464-475.

5. Singh K.P., Malik A, and Singh V.K., (2006), Chemometric analysis of hydrochemical data of an alluvial river-A case study, Water, Air and Soil Pollution, 170, pp 383-404.

6. Smith, D. G., (1990), A Better Water Quality Indexing System for Rivers and Streams, Water Research, 24(10), pp 1237-1244.