Weighted and Standardized Total Environmental Quality Index (TEQI) Approach in Assessing Environmental Components (Air, Soil and Water)

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Abstract. The paper investigates an innovative approach in assessing integrated environmental quality using indices that have been applied in many countries, such as Belgium, the former Soviet Union countries, the United States and Canada. The approach (abbreviated as TEQI) is more innovative than other indexed approach. Concretely, in this approach, the important weight of studied parameter taking into account theirs poisonous levels and classification scale for assessment of environmental quality depending on total number of parameters n (2≤n≤100) were established by calculating from theoretical formulas, not be assigned as the others. The results of the application of TEQI to the assessment of soil (n=5), ground water (n=20) and air components (n=5) show that the ranking in TEQI corresponds to the actual monitored data.

Keywords: index, weighted, standardized, scale, environmental components.

1. Some limitations of the indexed approaches that have been applied in some countries worldwide

- The Total Index Approach P in the former Soviet Union [1] as well as the PSI index (the United States of America – USA) which are used to assess air quality did not take into account the weights W_i (which is the level of toxicity) of the assessed parameters. In addition, the P approach has a very strict condition of P≤1. In reality, it is possible that there is an excess of a parameter (above the standard) but the contamination level is not as serious as to negatively affect the environmental quality and public health; the P approach especially does not rank in detail the level of pollution. Pollution ranking in PSI is very subjective and does not base on a theoretical basic and therefore less convincing.

- The water environmental quality index approaches used in other countries include the point-system (as it has been used in Belgium), water quality index approach WQI in USA [2] and CWQI in Canada [3]. Nonetheless, these approaches have following limitations:

- The number of assessed parameters is limited, with n=4 (Belgium), or n=9 (USA).
- The ranking to assess the environmental quality is subjective, does not base on a theoretical basic and is independent of the number of the assessed parameters n, which could lead to the inaccurate thresholds for environmental quality ranking as compared to the reality, for example when n=2, or when n is a large number.

- The weight $W_i$ which takes into account the importance of each parameter i is assigned from 0 to 1 in the WQI approach (USA), did not derive from a theoretical basic. In addition, to calculate the index $I_i$, 9 assessment diagrams need to be formed and they are rather complicated.

- The approach used in Canada has the advantage of unlimited n, simple calculation, however there is no weight $W_i$ for each parameter i.

2. Developing a Weighted and Standardized Total Environmental Quality Index (TEQI)

2.1. Developing formula to calculate the total index $P_j$

To deal with the above-mentioned limitations, Pham Ngoc Ho (11/2010) [4] improved the process of assessing environmental quality for different environmental components (air, soil, water) by using a weighted and standardized integrated environmental quality index in which pollutants are assessed by standardizing to one based parameter (substance) at the starting point to build up a scale (rank) for assessing environmental quality of index TEQI.

In this approach, at a given monitoring time point t, the environmental quality under the impacts of n parameters (substances), is calculated as follow:

$$P_j = \sum_{i=1}^{n} q_{ji} = \sum_{i=1}^{n} \frac{C_{ji}}{C_{ji}^*}$$

in which:

- $j = 1, 2, ..., N$ – the number of monitoring points;
- $n$ – number of assessed parameters;
- $q_{ji} = \frac{C_{ji}}{C_{ji}^*}$ - index of the environmental quality of parameter i at the monitoring point j;
- $C_{ji}$ – the value of parameter i at the monitoring point j;
- $C_{ji}^*$ - the limit value (environmental standard) for parameter i at j based on the national environmental standard for the given country;
- $P_j$ – the total index at the monitoring point j.

To standardize $P_j$ to the index $q_{11}$ at point j = 1, i = 1 (the starting point), formula (1) can be modified as follow:

With $j = 1$, from formula (1):

$$P_1 = q_{11} + q_{12} + q_{13} + \ldots + q_{1n}$$

$$= q_{11} \left( 1 + \frac{q_{12}}{q_{11}} + \ldots + \frac{q_{1n}}{q_{11}} \right)$$

$$= q_{11} \left( \frac{q_{11}}{q_{11}} + \frac{q_{12}}{q_{11}} + \ldots + \frac{q_{1n}}{q_{11}} \right)$$

(2)

Place $q_{1i} = \frac{C_{1i}}{C_{1i}^*}$ into (2):

$$P_1 = q_{11} \left( \frac{C_{11}}{C_{11}^*} \times \frac{C_{11}^*}{C_{11}} + \frac{C_{12}}{C_{11}^*} \times \frac{C_{11}^*}{C_{11}} + \ldots + \frac{C_{1n}}{C_{11}^*} \times \frac{C_{11}^*}{C_{11}} \right)$$

(3)
Assign \( W_i = \frac{C_{ji}^*}{C_{ji}^*} \), as shown in (3), the division is the weight of the parameter \( i \) in comparison to the standardized parameter \( i = 1, j = 1 \) or \( q_{11} \), it shows the level of toxicity (or level of pollution) of parameter \( i \). Then (3) becomes:

\[
P_i = q_{1i} \sum_{i=1}^{n} W_i \frac{C_{ji}}{C_{ji}} = q_{1i} \sum_{i=1}^{n} W_i \frac{C_{ji}}{C_{ji}} = C_{ji}^i \times \alpha_i \quad (4)
\]

here \( \alpha_i = \sum_{i=1}^{n} W_i \frac{C_{ji}}{C_{ji}} \) and it is called the total standardized coefficient of the standardized parameter at \( j=1 \).

Similar, we have a formula for any point \( j \):

\[
P_j = q_{ji} \sum_{i=1}^{n} W_i \frac{C_{ji}}{C_{ji}} \quad (5)
\]

Because \( q_{ji} \) at point \( j \) is different to \( q_{11} \) at the standardized point, therefore (5) must be modified to the standardized starting index \( q_{11} \):

\[
P_j = \frac{q_{1i}}{q_{1i}} \times q_{ji} \times \sum_{i=1}^{n} W_i \frac{C_{ji}}{C_{ji}}
\]

\[
= q_{1i} \times \left( \frac{q_{ji}}{q_{1i}} \times \sum_{i=1}^{n} W_i \frac{C_{ji}}{C_{ji}} \right)
\]

\[
= C_{ji}^i \times \left( \frac{1}{q_{1i}} \times \sum_{i=1}^{n} W_i \frac{C_{ji}}{C_{ji}} \right)
\]

\[
= C_{ji}^i \times \alpha_j \quad (6)
\]

\[
\alpha_j = C_{ji}^i \times \sum_{i=1}^{n} W_i \frac{C_{ji}}{C_{ji}} \quad (7)
\]

in which:

\[
W_i = \frac{C_{ji}^i}{C_{ji}^i} \quad \text{the weight of parameter } i \text{ as compared to the standardized parameter at any point } j;
\]

\( \alpha_j \) - the total standardized coefficient at any point \( j \);

\( C_{ji} \) – the monitored value of parameter \( i \) at \( j \);

\( C_{ji} \) – the value of the standardized parameter at \( j \).

When \( j = 1 \), formula (5) becomes (4). Therefore, (5) is the general formula about the total index, which is the basic to develop the scale to assess the total (or integrated) environmental quality using TEQI.

### 2.2. Developing the assessment scale

#### 2.2.1. Developing the assessment scale using TEQI

Divide the array \( n \) figures \( q_{ji} \) from (6) into two groups:

Group 1: Includes \( m \) figures \( q_{ji} \) which are \( \leq 1 \) (the group of parameters which meet the environmental standards),

\[
P_{jm} = \sum_{i=1}^{m} q_{ji} = q_{1i} \times \alpha_{jm}, \quad \alpha_{jm} = \frac{C_{ji}^i}{C_{ji}^i} \times \sum_{i=1}^{m} W_i \frac{C_{ji}}{C_{ji}} \quad (8)
\]

Group 2: Includes \( k \) figures \( q_{ji} \) which are \( > 1 \) (the group of parameters which do not meet the environmental standards),

\[
P_{jk} = \sum_{i=1}^{k} q_{ji} = q_{1i} \times \alpha_{jk}, \quad \alpha_{jk} = \frac{C_{ji}^i}{C_{ji}^i} \times \sum_{i=1}^{k} W_i \frac{C_{ji}}{C_{ji}} \quad (9)
\]

where \( m + k = n \).

Convert \( P_{jm} \) and \( P_{jk} \) to the scale of 100, because \( P_{jm} + P_{jk} = P_j \), therefore:

\[
\frac{P_{jm}}{P_j} \times 100 \quad \text{and} \quad \frac{P_{jk}}{P_j} \times 100.
\]
There are two approaches to develop the assessment scale: Based on the pollution level (when the pollution index increases, the pollution level increases, the environment is polluted more) and based on the clean environmental quality (when the index decreases, the environmental quality decreases). In this paper, the second approach is used as it will be easier to compare to WQI and CWQI. In this approach, to create a standardized scale of 100, the formula for TEQI at any $j$:

$$ TEQI = 100 - \frac{P_{jk}}{P_j} \times 100 $$

$$ = 100 \times (1 - \frac{P_{jk}}{P_j}) $$

$$ = 100 \times (1 - \frac{q_{11} \times \alpha_{jk}}{q_{11} \times \alpha_j}) $$

$$ = 100 \times (1 - \frac{\alpha_{jk}}{\alpha_j}) $$

$$ = \frac{C_j}{\sum_{i=1}^{n} W_j C_{ji}} \left( \sum_{i=1}^{k} W_j C_{ji} \right) = \frac{\sum_{i=1}^{k} W_j C_{ji}}{\sum_{i=1}^{n} W_j C_{ji}} $$

(10)

2.2.2. Criteria to develop TEQI

- Assessment thresholds must be built so that the TEQIs must fall into one of the zones.

- Assessment thresholds must correspond to the 100 scale, which is the scale of TEQI.

Therefore, the thresholds are dependent on the division $\frac{k}{n} \times 100$, in which $k$ is the number of parameters that do not meet the Environmental Standards, $n$ – is the number of assessed parameters:

$$ A_k = 100 \times \frac{k}{n} = 100 \times \left(1 - \frac{1}{n} \right) $$

Because $n$ must be a positive integer ($2 \leq n \leq 100$), and $k = 0, 1, 2, \ldots$ therefore:

1) The upper limit of the assessment scale =100, when $k = 0$ (the excellent environmental quality); the lower limit of the assessment = 0, when $k = n$ (the worst environmental quality).

2) The good threshold corresponds with $\min(k) = 1$ or $A_k = 100 \times (1 - \frac{1}{n}) = 100 \times \frac{n-1}{n}$.

3) The poor threshold (according to 11):

- When $n$ is even then $k = \frac{n}{2}$, or

$$ A_k = 100 \times (1 - \frac{n}{2n}) = 50 $$

- When $n$ is odd then $k = \frac{n+1}{2}$, or

$$ A_k = 100 \times (1 - \frac{n+1}{2n}) = 50 \times \frac{n-1}{n} $$

4) The moderate level is the average of the good and the poor thresholds:

- When $n$ is even,

$$ A_k = (100 \times (1 - \frac{n-1}{n}) + 50) : 2 = 25 \times (2 \times \frac{n-1}{n} + 1) = 25 \times \frac{3n-2}{n} $$

- When $n$ is odd,

$$ A_k = (100 \times (1 - \frac{n-1}{n}) + 50 \times \frac{n-1}{n}) : 2 = 75 \times \frac{n-1}{n} $$

5) The very poor threshold corresponds to $\max(k) = n - 1$ or $A_k = 100 \times (1 - \frac{n-1}{n}) = 100 \times \frac{1}{n}$.

Based on above basic thresholds:
Table 1. The environmental quality scale table with n is an even and odd number

<table>
<thead>
<tr>
<th>TEQI (n is even)</th>
<th>TEQI (n is odd)</th>
<th>Environmental Quality (EQ)</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>$100 \times \frac{n-1}{n} &lt; \text{TEQI} \leq 100$</td>
<td>$100 \times \frac{n-1}{n} &lt; \text{TEQI} \leq 100$</td>
<td>Very Good</td>
<td>Blue</td>
</tr>
<tr>
<td>$25 \times \frac{3n-2}{n} &lt; \text{TEQI} \leq 100 \times \frac{n-1}{n}$</td>
<td>$75 \times \frac{n-1}{n} &lt; \text{TEQI} \leq 100 \times \frac{n-1}{n}$</td>
<td>Good</td>
<td>Green</td>
</tr>
<tr>
<td>$50 &lt; \text{TEQI} \leq 25 \times \frac{3n-2}{n}$</td>
<td>$50 \times \frac{n-1}{n} &lt; \text{TEQI} \leq 75 \times \frac{n-1}{n}$</td>
<td>Moderate</td>
<td>Yellow</td>
</tr>
<tr>
<td>$\frac{100}{n} &lt; \text{TEQI} \leq 50$</td>
<td>$\frac{100}{n} &lt; \text{TEQI} \leq 50 \times \frac{n-1}{n}$</td>
<td>Poor</td>
<td>Orange</td>
</tr>
<tr>
<td>$0 \leq \text{TEQI} \leq \frac{100}{n}$</td>
<td>$0 \leq \text{TEQI} \leq \frac{100}{n}$</td>
<td>Very poor</td>
<td>Red</td>
</tr>
</tbody>
</table>

**Notes:** In some special cases:

1. With $n=2$

According to table 1, the thresholds very poor, poor, moderate and good overlaid. In this case, the TEQI scale is as follow:

<table>
<thead>
<tr>
<th>TEQI</th>
<th>Environmental Quality (EQ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$50 &lt; \text{TEQI} \leq 100$</td>
<td>Good</td>
</tr>
<tr>
<td>$0 \leq \text{TEQI} \leq 50$</td>
<td>Poor</td>
</tr>
</tbody>
</table>

2. With $n=3$

According to table 1, the thresholds very poor, and poor overlaid, the TEQI scale is as follow:

<table>
<thead>
<tr>
<th>TEQI</th>
<th>Environmental Quality (EQ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$67 &lt; \text{TEQI} \leq 100$</td>
<td>Very good</td>
</tr>
<tr>
<td>$50 &lt; \text{TEQI} \leq 67$</td>
<td>Good</td>
</tr>
<tr>
<td>$33 &lt; \text{TEQI} \leq 50$</td>
<td>Moderate</td>
</tr>
<tr>
<td>$0 \leq \text{TEQI} \leq 33$</td>
<td>Poor</td>
</tr>
</tbody>
</table>

2.3. Calculating the product of $\frac{C_{ji}}{C_{ji}}$ in the formula (10)

2.3.1. For $\sum_{i=1}^{n} W_i \frac{C_{ji}}{C_{ji}}$ (12)

Case 1: The lower limit $C_{ji} \leq C_{ji}^*$ (for example: the air environment), then $q_{ji} = \frac{C_{ji}}{C_{ji}^*} \leq 1$ and $q_{ji} = \frac{C_{ji}}{C_{ji}^*} > 1$, if $C_{ji} > C_{ji}^*$.

As $q_{ji} = \frac{C_{ji}}{C_{ji}^*}$, $q_{ji} = \frac{C_{ji}}{C_{ji}^*}$, hence

$q_{ji} = \frac{C_{ji}}{C_{ji}^*} = 1$, $q_{ji} = \frac{C_{ji}}{C_{ji}^*} = 1$, hence

$q_{ji} = \frac{C_{ji}}{C_{ji}^*} = \frac{C_{ji}}{C_{ji}^*} = \frac{C_{ji}}{C_{ji}^*} = \frac{C_{ji}}{C_{ji}^*} = \frac{C_{ji}}{C_{ji}^*} = \frac{C_{ji}}{C_{ji}^*}$, $q_{ji} = \frac{C_{ji}}{C_{ji}^*} = \frac{C_{ji}}{C_{ji}^*}$, with $W_i = \frac{C_{ji}}{C_{ji}^*}$ (13)

Case 2: The upper limit $C_{ji} > C_{ji}^*$ (for example: DO in the water environment), if $C_{ji} > C_{ji}^*$, the environmental quality meets standards then $\frac{C_{ji}}{C_{ji}^*} < 1$ and $C_{ji} < C_{ji}^*$ then
\[ \frac{C^*_j}{C^*_{ji}} > 1 \text{ (does not meet standards). Then,} \]

following the formula to calculate \( q^*_{ji} \) as in case 1, then

\[ W_i = C^*_j \times C^*_{ji} \times C^*_{11} \quad (14) \]

Case 3: The limits with both lower and upper values \([a,b]\) (for example: pH in soil or water), with a, b are the lower and upper limits of the standards for parameter \( i \).

- If \( C^*_j < a \) then

\[ W_i = a \times C^*_{11} \quad (15) \]

- If \( C^*_j > b \) then

\[ W_i = \frac{C^*_{11}}{b} \quad (16) \]

- If \( C^*_j \in [a,b] \) then

\[ W_i = C^*_{11} \quad (17) \]

2.3.2. For \( \sum_{j=1}^{k} W_i \frac{C^*_{ji}}{C^*_{ji}} \) \( (18) \)

In this case, only the group of \( q^*_{ji} > 1 \) (do not meet environmental standards), there are following cases:

Case 1: Lower limit (\( C^*_j \leq C^*_{ji} \)), only assess when \( C^*_j > C^*_{ji} \)

\[ W_i = \frac{C^*_{ji}}{C^*_{11}} \times C^*_{11} \times C^*_{11} \times C^*_{11} \times C^*_{11} \quad (19) \]

Case 2: Upper limit (\( C^*_j > C^*_{ji} \)), only assess when \( C^*_j < C^*_{ji} \)

\[ W_i = a \times C^*_{11} \times \frac{C^*_j}{C^*_{ji}} \times C^*_{11} \times C^*_{11} \times C^*_{11} \times C^*_{11} \times C^*_{11} \quad (20) \]

Case 3: The standards has both lower and upper limits \([a,b]\), only assess \( C^*_j < a \) or \( C^*_j > b \), where a, b have the same meaning as in formula (15) – (16)

\[ W_i = a \times C^*_{11} \quad (21) \]

\[ W_i = \frac{C^*_{ji}}{b} \times C^*_{11} \quad (22) \]

Notes: In order to calculate for (10), it is very important to select the standardized parameter at the first instance. In principle, the standardized parameter can be chosen randomly in the array of the monitored parameters which includes all n parameters that the values were obtained. However, to illustrate the toxicity level of a parameter in comparison to another parameter, it is best to select the standardized parameter \( i \) that has the lowest environmental standard and assign it as \( C^*_{11} \) corresponding with the starting point \( i=1, j=1 \). Then, the environmental standard is assigned = \( C^*_{11} \) at the point \( j=1 \). Therefore, the weight of the standardized parameter =1, where the weight of other parameters < 1.

2.4. An example, application of the total environmental quality index TEQI to assess air quality around traffic crossroads in Hanoi

2.4.1. Calculation

At 57 crossroads, the hourly monitored parameters were monitored at the same time in
rush hours: 7-8 h; 17-18h and at time with low vehicle flow: 11-12h on 19/7/2011. The average results from 3 samples include: noise, CO, SO\(_2\), \(\text{NO}_2\), \(\text{C}_6\text{H}_6\), \(\text{PM}_{10}\) and Pb. However, we select only 5 parameters for this research: noise, CO, \(\text{SO}_2\), \(\text{NO}_2\), \(\text{C}_6\text{H}_6\) because there are no hourly environmental standards for \(\text{PM}_{10}\) and Pb in the Vietnam standard (QCVN 05-2009/BTNMT).

Applying the calculation method to calculate the weights for the 5 selected parameters, and rank them based on the chronological scale from high to low toxicity: \(\text{C}_6\text{H}_6\), noise, \(\text{NO}_2\), \(\text{SO}_2\), CO corresponding to \(W_i\) of \(\text{C}_6\text{H}_6\) (1.00000), noise (0.29300), \(\text{NO}_2\) (0.11000), \(\text{SO}_2\) (0.063), CO (0.00073).

Applying the assessment scale for \(n = 5\) (\(n\) is odd) as in table 1, we have:

<table>
<thead>
<tr>
<th>TAQI</th>
<th>Air Quality</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>(80 &lt; \text{TAQI} \leq 100)</td>
<td>Very Good</td>
<td>Blue</td>
</tr>
<tr>
<td>(60 &lt; \text{TAQI} \leq 80)</td>
<td>Good</td>
<td>Green</td>
</tr>
<tr>
<td>(40 &lt; \text{TAQI} \leq 60)</td>
<td>Moderate</td>
<td>Yellow</td>
</tr>
<tr>
<td>(20 &lt; \text{TAQI} \leq 40)</td>
<td>Poor</td>
<td>Orange</td>
</tr>
<tr>
<td>(0 \leq \text{TAQI} &lt; 20)</td>
<td>Very poor</td>
<td>Red</td>
</tr>
</tbody>
</table>

2.4.2. Results

The calculation results for TEQI at 57 points are presented in table 3.

<table>
<thead>
<tr>
<th>j</th>
<th>TAQI</th>
<th>Air quality</th>
<th>j</th>
<th>TAQI</th>
<th>Air quality</th>
<th>j</th>
<th>TAQI</th>
<th>Air quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12,752</td>
<td>Very poor</td>
<td>21</td>
<td>8,338</td>
<td>Very poor</td>
<td>41</td>
<td>11,666</td>
<td>Very poor</td>
</tr>
<tr>
<td>2</td>
<td>14,183</td>
<td>Very poor</td>
<td>22</td>
<td>45,661</td>
<td>Moderate</td>
<td>42</td>
<td>9,072</td>
<td>Very poor</td>
</tr>
<tr>
<td>3</td>
<td>0,000</td>
<td>Worst</td>
<td>23</td>
<td>11,081</td>
<td>Very poor</td>
<td>43</td>
<td>29,279</td>
<td>Poor</td>
</tr>
<tr>
<td>4</td>
<td>0,000</td>
<td>Worst</td>
<td>24</td>
<td>28,876</td>
<td>Poor</td>
<td>44</td>
<td>9,202</td>
<td>Very poor</td>
</tr>
<tr>
<td>5</td>
<td>10,166</td>
<td>Very poor</td>
<td>25</td>
<td>31,925</td>
<td>Poor</td>
<td>45</td>
<td>25,323</td>
<td>Poor</td>
</tr>
<tr>
<td>6</td>
<td>0,000</td>
<td>Worst</td>
<td>26</td>
<td>0,000</td>
<td>Worst</td>
<td>46</td>
<td>30,291</td>
<td>Poor</td>
</tr>
<tr>
<td>7</td>
<td>0,000</td>
<td>Worst</td>
<td>27</td>
<td>41,842</td>
<td>Moderate</td>
<td>47</td>
<td>44,467</td>
<td>Moderate</td>
</tr>
<tr>
<td>8</td>
<td>26,549</td>
<td>Poor</td>
<td>28</td>
<td>46,837</td>
<td>Moderate</td>
<td>48</td>
<td>69,568</td>
<td>Good</td>
</tr>
<tr>
<td>9</td>
<td>0,000</td>
<td>Worst</td>
<td>29</td>
<td>45,919</td>
<td>Moderate</td>
<td>49</td>
<td>41,908</td>
<td>Moderate</td>
</tr>
<tr>
<td>10</td>
<td>47,918</td>
<td>Moderate</td>
<td>30</td>
<td>25,996</td>
<td>Poor</td>
<td>50</td>
<td>67,144</td>
<td>Good</td>
</tr>
<tr>
<td>11</td>
<td>0,000</td>
<td>Worst</td>
<td>31</td>
<td>0,000</td>
<td>Worst</td>
<td>51</td>
<td>38,774</td>
<td>Poor</td>
</tr>
<tr>
<td>12</td>
<td>31,766</td>
<td>Poor</td>
<td>32</td>
<td>13,143</td>
<td>Very poor</td>
<td>52</td>
<td>0,000</td>
<td>Worst</td>
</tr>
<tr>
<td>13</td>
<td>12,660</td>
<td>Very poor</td>
<td>33</td>
<td>100,000</td>
<td>Excellent</td>
<td>53</td>
<td>42,111</td>
<td>Moderate</td>
</tr>
<tr>
<td>14</td>
<td>24,120</td>
<td>Poor</td>
<td>34</td>
<td>28,785</td>
<td>Poor</td>
<td>54</td>
<td>70,038</td>
<td>Good</td>
</tr>
<tr>
<td>15</td>
<td>12,435</td>
<td>Very poor</td>
<td>35</td>
<td>47,457</td>
<td>Moderate</td>
<td>55</td>
<td>26,062</td>
<td>Poor</td>
</tr>
<tr>
<td>16</td>
<td>11,566</td>
<td>Very poor</td>
<td>36</td>
<td>11,578</td>
<td>Very poor</td>
<td>56</td>
<td>46,596</td>
<td>Moderate</td>
</tr>
<tr>
<td>17</td>
<td>0,000</td>
<td>Worst</td>
<td>37</td>
<td>45,567</td>
<td>Moderate</td>
<td>57</td>
<td>7,953</td>
<td>Very poor</td>
</tr>
<tr>
<td>18</td>
<td>0,000</td>
<td>Worst</td>
<td>38</td>
<td>40,205</td>
<td>Moderate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>22,252</td>
<td>Poor</td>
<td>39</td>
<td>49,432</td>
<td>Moderate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>0,000</td>
<td>Worst</td>
<td>40</td>
<td>12,209</td>
<td>Very poor</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Remarks

1. For 5 levels of assessment (Very good, good, moderate, poor, very poor), around 29.8% of the crossroads has an Moderate to good quality, the rest 70.2% have poor to very poor and worst quality.

2. The locations that have poor-very poor quality often have high concentration of traffic. In addition, where the streets are narrow, at traffic light or when there is congestion, motor vehicles do not turn the motor off or buses and trucks run on FO or diesel that do not burnt completely creating dangerous substances such as SO$_2$, CO$_2$, C$_6$H$_6$, NO$_2$, etc. On the other hands, around many crossroads, there is a high population density as well as many street food stalls that use honeycomb coal for cooking, that contributes to the air pollution in the area.

3. The crossroad that have the excellent air quality (TAQI = 100.00) is at the My Dinh Sport Complex. This is a new developed area with low traffic, mainly motorcycles.

4. The results of the air quality assessment for 57 crossroad in Hanoi as well as the soil quality assessment (based on 5 heavy metals), the ground water quality (with 20 parameters) in Hoa Binh Province [4] show that the assessment scale with 5 levels corresponds with the actual monitoring values.

The environmental component quality (air, soil, water) depends on the physical-chemical property of each parameter, which is regulated by the environmental standards. Therefore, based on the selection of featured parameters n for each component, then using the ranking table of TEQI to assess environmental quality of each component will be convenient and simple.

References