# Proceedings of the
# 2nd International Conference on Tourism Research

## University Portucalense
## Porto, Portugal
## 14-15 March 2019

**Edited by**
**Cristina Sousa, Isabel Vaz de Freitas and Jorge Marques**

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# Water Quality of the Lakes: Consequences of Tourism Development

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**Abstract**: Lake water is the main tourist attraction in the Schuchinsk-Burabay resort area located in the Northern Kazakhstan. However, during the last decades, water quality of the main lakes has deteriorated along with the development of the tourism industry in the region. The drop in water quality can threat the success of the tourism development in the area on the medium to long run. Thus, this study attempts to analyse the changes in water quality of the main lakes of the region using water pollution index, and water variance rate for each lake. Furthermore, we examine the evolution of tourism, focusing on tourism accommodation sector and attempt to measure its influence on water quality of main lakes of the Schuchinsk-Burabay resort area. Finally, we propose some recommendations for local authorities in order to guarantee the sustainability of the water resources and thus secure the future of tourism in the studied area.

**Keywords**: water resources, tourism, water quality, Schuchinsk-Burabay resort area

## 1. Background

Water is one of the most critical and scarce resources for the tourism industry (UNWTO, 2013). Tourism activities require water, both in quantity and quality, for direct and indirect consumption (Rico-Amoros et al, 2009). In recent years, the development of tourism activities has increased the levels of overexploitation and contamination of water resources in many tourist destinations around the world. This issue is more important if we take into account that the competitiveness of many tourist destinations is based on quality of water resources (i.e., rivers, waterfalls, lakes, hot springs, etc.) (Essex et al, 2004; Eurostat, 2009). Among them, the lakes as one of the most sensitive and vulnerable water resources for many tourist destinations are suffering from tourism pressure (Hall and Härkönen, 2006). Although lake tourism is a relatively new type of tourism and less investigated in academic literature, the importance of lakes for tourism has been recognized (Tandyrak et al, 2016).

Lake ecosystems are sensitive and vulnerable to the effects of increasing human activities leading to degradation of water resources. Development of tourist activities can affect lake water and shoreline directly and indirectly. Its impact depends on the type, size and depth of the lakes (Dokulil, 2014). Dokulil (2014) considers that the direct impact of tourism on the lakes comes from recreational activities such as swimming, boating and angling. While construction and existence of tourism infrastructure, airports, accommodation, restaurants indirectly affect the environmental state of the lakes through disposal of wastewater arising from provision of various tourism services. Water pollution is considered ecological problem for many countries worldwide. Thus, in recent years, there has been an increasing interest in assessing ecological state of the lakes by using water quality parameters (Kumar et al, 2014).

However, on the scope of our knowledge, not many studies have been conducted in analysis the links between water quality changes and tourism. For example, Lee and Lee (2015) conducted a research on impact of water quality on visual and olfactory satisfaction of tourists at Taiwan's Hsinchu Fishing Port. According to Burak et al (2004), groundwater used to satisfy the demands of accommodation establishments lower the water level and result in lake water intrusion in the most coastal aquifers. One of the examples is Turkey, where heavy construction of tourism facilities on coastal areas resulted to pollution of water resources. Kurleto (2013) also mentioned negative impacts of high degree of tourism seasonality on the lakes. According to Zhong et al (2011), pollution from development of tourism activities could lead to eutrophication of water, occurrence of infectious disease and degradation of water saving forests. The research conducted by Hadwen et al

(2003) on the impact of tourism in dune lakes in Australia revealed that three lakes out of 15 are strongly used and heavily threated by tourist activities.

Despite the increasing concern on water quality and pollution of the lakes due to tourism, a lack of common methodology has been observed to measure its impacts. Thus, it is complicated to assess tourism impacts on environmental state of the lakes. According to Gladstone et al (2012), the lack of tourism statistics in some recreational activities such as scuba diving, fishing, boating, makes difficult the assessment of current impacts of tourism on water. Kurleto (2013) considers that an objective assessment of the influence of the tourism industry on lake ecosystem is quite complicated even for a country like New Zealand, which is famous for its huge number of lakes, which are used as main tourist attractions for destination.

This issue in crucial for Kazakhstan, as one of the most water scarce countries on the Eurasian Continent, where growth of tourism industry can cause negative effects on water resources. The year 2000 has been a turning point in impressive development of tourism infrastructure in the region, and deterioration of water quality of the lakes can be caused by growth of this sector. Thus, this study aims to investigate development of tourism in the Schuchinsk-Burabay resort area and attempt to measure its impact on water quality of the main lakes.

## 2. Methodology

### 2.1 Materials and methods

Statistical data on tourism development were obtained from Department of Tourism and Department of Statistics of Akmola region (2017). Data on water quality of the lakes were collected from the Department of Geology and Subsoil Use “Sevkaznedra” (2014) and RSE "Kazhydromet (2017). Water Pollution Index (WPI) has been used to assess water quality, while water quality variance rate (r) has been applied to reveal the qualitative changes of water parameters.

#### *2.1.1 Assessment index for water quality*

The present study is focused to assess the water quality of the lakes by using Water Pollution Index (WPI). This index is a coefficient, representing the average proportion of exceeding of maximum permissible concentration (MPC) of individual parameters. WPI is strictly calculated on six parameters having the highest values of given concentrations, whether they exceed MPC or not, where Potential of hydrogen (PH), biological oxygen demand (BOD5), and dissolved oxygen content (DO) are mandatory parameters (Kazhydromet, 2017). The following formula shows the calculus method,

$$WPI = \frac{1}{n} * \sum_{i=1}^{n} \frac{Ci}{\mathrm{MPCi}}$$

where: $C_i$ – component concentration (value of the physico-chemical parameter); $n$ – number of parameters, used to calculate the index, $n$ = 6; $MPC_i$ – established standard value for the special type of the water body.

Depending on the WPI value, the water bodies are divided into classes (Table 1).

**Table 1**: Quality class of water bodies

| Quality class | Characteristics of water quality | The value of WPI |
|---|---|---|
| 1 | Very clean | ≤ 0,3 |
| 2 | Clean | 0,31 - 1,0 |
| 3 | Moderately polluted | 1,01 - 2,5 |
| 4 | Polluted | 2,51 – 4,0 |
| 5 | Dirty | 4,01 – 6,0 |
| 6 | Very dirty | 6,01 – 10,0 |
| 7 | Extremely dirty | > 10,0 |

*2.1.2 Water quality variance rate*

Water quality variance rate (r) indicates the qualitative changes of water parameters during the last decade for four main lakes in the region. If the values of "r" are over "1", they represent a tendency of improvement, while if the values are lower than "1", they show a worsening tendency, and if "r" is equal to 1, it means that the water quality parameter is in a stagnant tendency. We have calculated the variance rate for the following parameters: PH, DO, BOD, HCO3, SO4, Cl, Ca, Mg, F, Cu. The water quality variance rate for each parameter of the analysed lakes was calculated based on following equation (Enea et al, 2017).

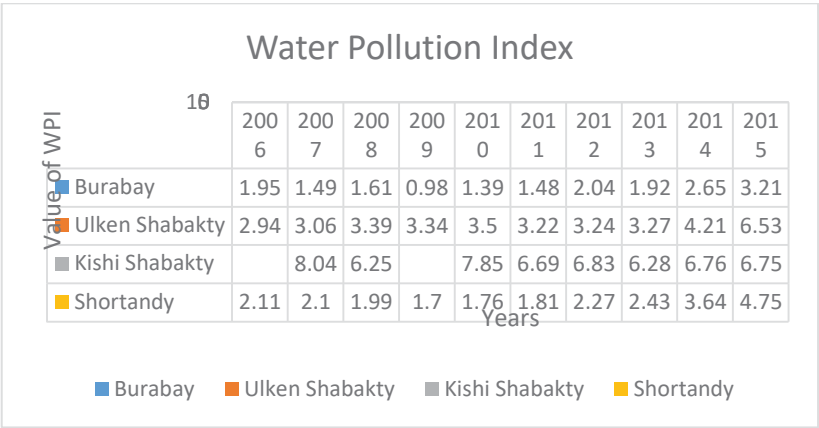
$$r = \frac{\sum_{i=1}^{k} n_i^{(+)} / n}{\sum_{j=1}^{m} n_j^{(-)} / n} = \frac{\sum_{i=1}^{k} f_i^{(+)}}{\sum_{j=1}^{m} f_j^{(-)}}$$

where:
r - quality variance rate;
k – number of positive values;
m – number of negative values;
*ni (+) - number of absolute frequency values for rises;*
nj (-)-number of absolute frequency values for reductions;
n - total number of absolute frequency values;
fi (+), fj (-) - relative frequencies.

## 3. Results

### 3.1 Water Pollution Index

Figure 1 indicates the evolution of WPI of the lakes for each year. The value of WPI of Burabay Lake was 1.95, quality class 3 “Moderately polluted” in 2006, while this value has increased to 3.21, indicating the quality class 4 “Polluted” in 2015. In the case of Ulken Shabalty, in 2006 the WPI value was 2.94, with quality class 4 “Polluted” and it has reached the value 6.53, with the quality class of 6 “Very dirty” in 2015. The WPI was 8.04 (quality class 6 “Very dirty”) in 2007 in the Lake Kishi Shabakty and it remained the same quality class in 2015 with the WPI value 6.75. The WPI of Shortandy was 2.11, indicating the quality class 3 “Moderately polluted”, and it reached the quality class 5 “Dirty” with the value of WPI 4.75.




| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Burabay | 1.95 | 1.49 | 1.61 | 0.98 | 1.39 | 1.48 | 2.04 | 1.92 | 2.65 | 3.21 |
| Ulken Shabakty | 2.94 | 3.06 | 3.39 | 3.34 | 3.5 | 3.22 | 3.24 | 3.27 | 4.21 | 6.53 |
| Kishi Shabakty | | 8.04 | 6.25 | | 7.85 | 6.69 | 6.83 | 6.28 | 6.76 | 6.75 |
| Shortandy | 2.11 | 2.1 | 1.99 | 1.7 | 1.76 | 1.81 | 2.27 | 2.43 | 3.64 | 4.75 |

**Figure 1:** WPI dynamics of the main lakes

### 3.2 Water quality variance rate

As for water quality variance rate, the mentioned dynamic can be observed and analysed for each parameter of four lakes (Figure 2). The results show that the most of the parameters reveal a degrading tendency, while some of them are in a stagnant tendency. The worsening tendency of these parameters is most probably determined by the accumulation of sewage water from the human settlements, industries and accommodation facilities located around the lakes. The comparative analysis of this indicator for the four lakes indicate one can observe a worsening tendency of the analysed parameters for each lake, as follows: 80% in Ulken Shabakty, 70% in Shortandy, 60% in Burabay and Kishi Shabakty.

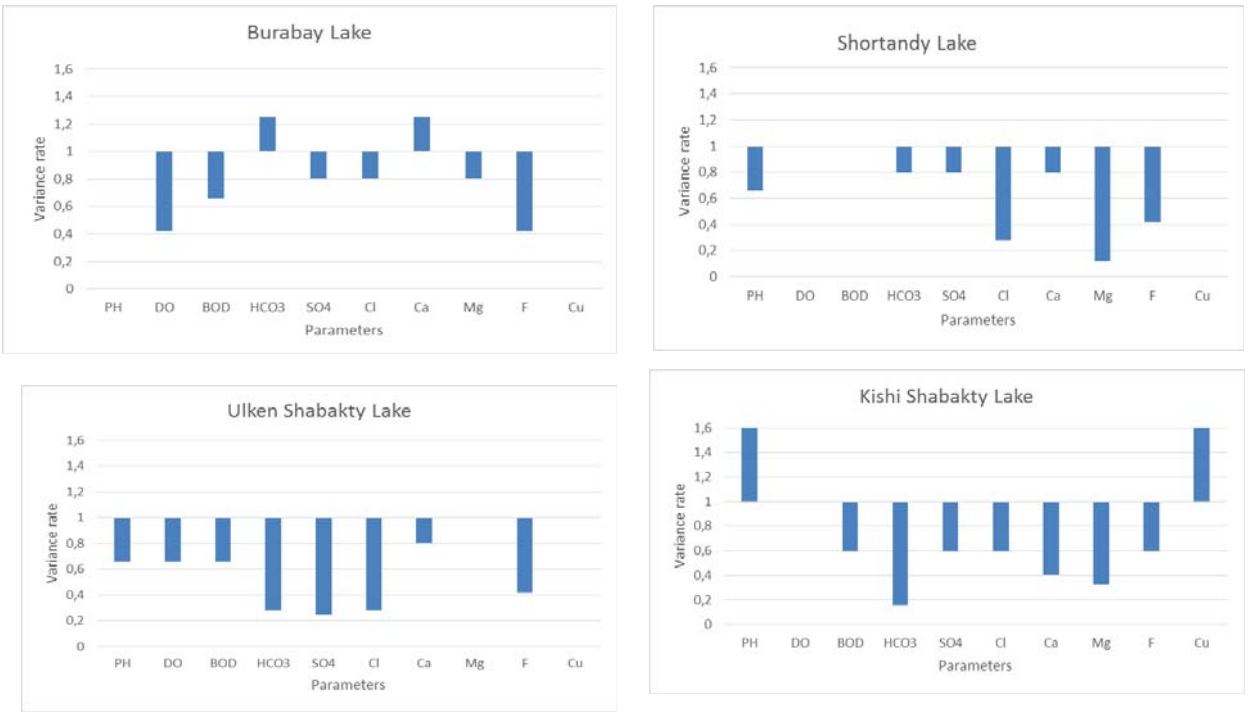



**Figure 2:** Water quality variance rate

## 4. Further research

The results of current work indicate a degrading tendency of water quality of main lakes in the region. One of the responsible factors upon this can be tourism along with which other possible factors. Thus, we aim to develop a methodology to assess the impact of tourism activities on water quality of the lakes located in the Schuchinsk-Burabay resort area. Based on results, we will propose some recommendations for local authorities to guarantee the sustainability of water resources in the region.

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