WATER RESOURCES OF KAZAKHSTAN: THE LAKES' FUND

Zariia Zhumangalieva, MSc, PhD student

Russian State Hydrometeorological University/Saint-Petersburg, Russia

Abstract

Features of geographical distribution as well as morphometry of Kazakhstan natural lakes were studied. Analyses are based on the field data obtained for 3,380 natural lakes, mainly comprised in the global limnological database WORLDLAKE as well as on unpublished data.

Keywords: Lakes, Kazakhstan, water resources, database WORLDLAKE

Introduction:

Water supply to the population and various sectors of the economy in the required quantity and quality becomes one of the major problems of the Republic of Kazakhstan. Spotty distribution of water resources on the territory and in time, insufficient consideration of the water factor when placing the industry and agriculture, rapid growth of water consumption, the irrational use of water resources have resulted in lowland area of Kazakhstan there is acute shortage of water. Therefore, the assessment of the impact of economic activity on river runoff in the zone of insufficient humidification, which refers to Western, Northern and Central Kazakhstan has not only scientific but also of great practical importance.

At present great attention is paid to investigation of surface water (river, sea and glacier) and underground water resources, and natural lakes, in view of their significant and spotty distribution over the territory, are studied partially (Balkhash, Alakol, Zaisan, Borovskaya group of lakes etc), but small lakes since the development of virgin and fallow lands are studied with insufficient attention.

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Almost all the territory of Kazakhstan, along with The Great Basin (North America), Atacama (South America), etc., belongs to the largest inland areas of the globe without outflow. It covers the inside area of Asia, and only its North area belongs to the basin of the Arctic ocean. Almost 36% of Kazakhstan's territory is desert, and the climate is sharply continental with insufficient humidification - evaporation dominates precipitation and with the exception of some mountain areas. Lake or extremely high (Caspian, Aral, Balkhash) or extremely small. They are separated from one another for hundreds of kilometers or are so thick, that form a lake region, for example in the Northern part of Kazakhstan. Despite this, Kazakhstan has approximately $4.82 \cdot 10^4$ natural lakes (Ryazhin 2001, 2003, 2005), of which $4.52 \cdot 10^4$ are divided into small and 21 to large squares with A≤1 km2 and A≥100km2, respectively (Table of symbols) (Philonets, Omarov, 1973).

Table of symbols
A – surface area of the lake, km^2
W_0 - volume of the lake, km^3
H_{max} – maximum depth of the lake, m

Within the territory of Kazakhstan, despite the arid climate, there are more than 48000 natural and 4200 artificial water bodies (Muravlev, 1973). The variety of relief and climatic

conditions of Kazakhstan gives irregularity distribution of surface water bodies on the territiry. There are some lakes in the desert areas, much more of them are in the North and in the mountains.

On Northern Kazakhstan accounts for 45 % of all lakes in the Central and Southern - 36 %, in other regions - 19 %. Due to severe climate variability and water balance over years and seasons are observed instability of lakes' area and the regime of the lakes, the total salinity and salt composition of these water bodies. Under the terms of the water exchange in Kazakhstan is dominated by the endorheic (drainless) lakes.

In the work (Myakisheva, Zhumangalieva, 2013) were studied lakes of the Northern Kazakhstan on the basis of the nature of the external water exchange lakes, which in turn is one of the most important hydrological and hydro-ecological characteristics. External water lakes is characterized by morphometric index of water exchange MM (rate of exchange of water mass of a reservoir) and climate index, which speaks about the impact of humidity of the territory.

In calculating the indices of the external water exchange method was used to aggregate indicators used in the conditions of deficiency of the information, which is rather urgent for the present time, when to get a wide range of field data is not economically viable. Given that the information on field research conducted in the middle of the last century, is outdated and does not reflect the reality.

To identify features of distribution of lakes on the territory of Kazakhstan in this paper were used in-situ data on the morphometric parameters of the 3 360 reservoirs collected in the database WORLDLAKE developed Ryanzhin (2005a, 2006). Datebase gathered from the different sources. There were used a wide actual material of World Atlas of water resources, Map of the USSR (1986), publications Philonets and Omarov (1973, 1974), Domanitsky (1971), Hendendorf (1982), Adamenko (1991), Popolzin (1967), Doganovsky (2005), Kalesnikov and Shnitnikov (1961), Molchanov (1929), Shnitnikov and Smirnova (1976), Smirnova (1993), Baranova (1979), and others. Calculated distributions of lakes of Kazakhstan depending on the morphometric characteristics of the lake surface area,.

The bar graphs of distribution of Kazakhstan lakes according to such morphometric characteristics as the lake surface area,   the volume and the maximum depth of the lake were calculated. The the proportion of each category of the total number investigated lakes was estimated (figure 1 - 4).
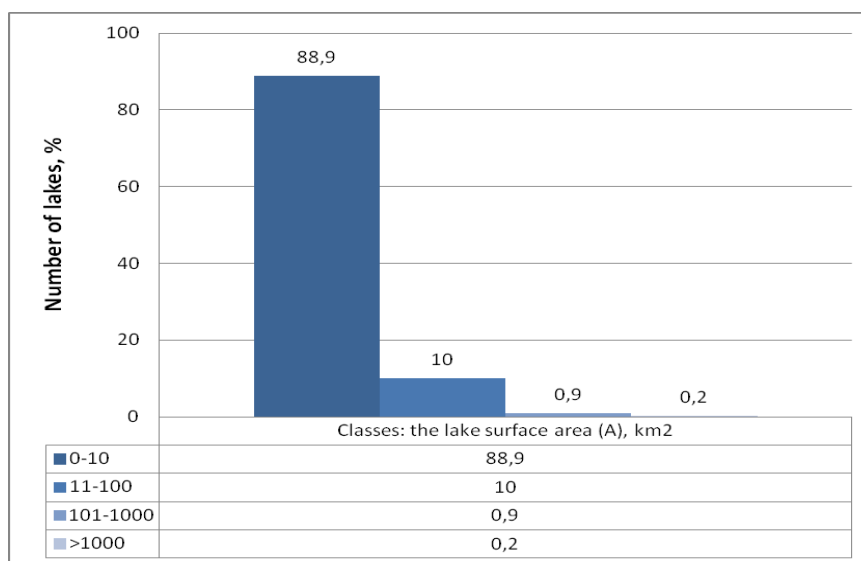

Classes: the lake surface area (A), km2	
■ 0-10	88,9
■ 11-100	10
■ 101-1000	0,9
■ >1000	0,2

Figure 1 – Distribution on classes of the lake surface area (A), %

Sampling in evaluating the distribution of Kazakhstan lakes depending on the lake surface area is covered by 3 211 lakes: there were small of them 2 856 (88.9 %), and the very high - 6 (0.2 %) – of this number.
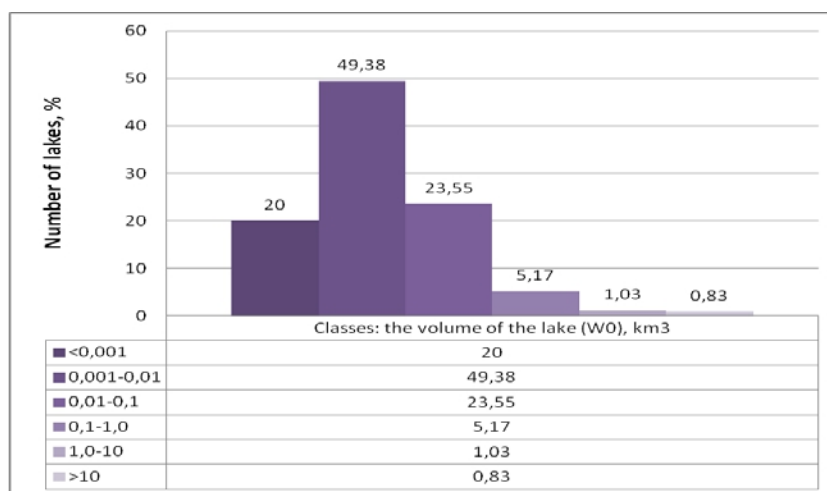
Figure 2 – Distribution on classes of the volume of the lake (W_0), %

Sampling in evaluating the distribution of lakes territory, depending on the volume of the lake included 484 lake: there were small of them 469 (96.9 %), and very large - 4 (0.83 %). The total volume of the investigated lakes amounted 473.548 km^3.

While estimating the distribution of lakes of Kazakhstan depending on volume, in addition to the classification recommended in the normative documents there was used classification (Myakisheva, 2010), in which the scale of the volume consists of a small ranges.   This ranking allows to clearly identify the category of very small lakes (W_0 =0.001-0.01 km^3), which number is significantly greater than the other (figure 2).

Sampling in evaluating the distribution of lakes of Kazakhstan, according to the maximum depth of the water body included 549 lakes, of which have a very low depth H_{max} there were 492 lake (89.6 %), and with an average depth of H_{max} - 20 lakes (3.7 %). Category «large lake» (H_{max} more than 50 m) is absent.

Thus, on the territory of Kazakhstan there are numerous small lakes. They are located in deltas and river channels. Among them there are a lot of temporal: in the spring, filled with water, and by the fall dry up, turning into "sor" and salt-marshes. Most of the lakes are drainless that such the huge evaporation contributes to their mineralization. Therefore, on the lowlands of Kazakhstan is dominated by the lake with brackish and salt water, and in particularly dry areas – lake-salt containing a variety of salt.
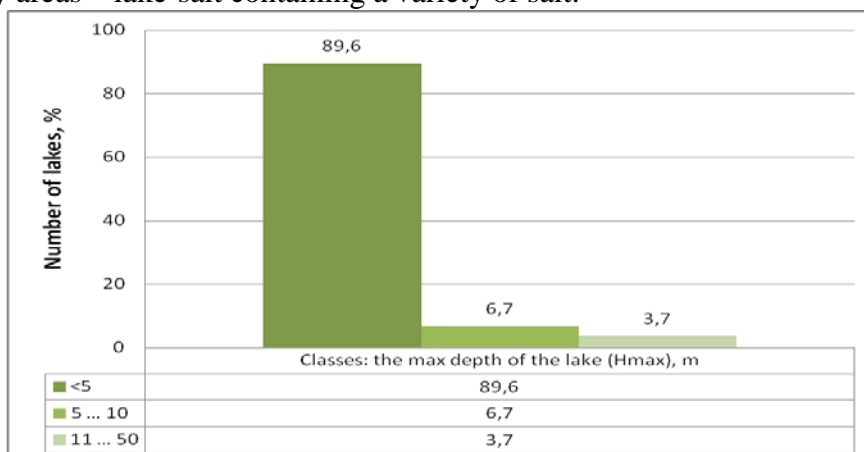

Figure 3 – distribution on classes of the maximum depth of the lake (H_{max}), %

The bar graphs of the distribution of Kazakhstan lakes according to the salinity allow to estimate of the ratio of lakes of different salinity (figure 4). Here should be noted that not all of the lake from the database are studied on the water quality characteristic. From 3 360 lakes studied are only 506. Of these 506 lakes almost half - 230 - are salty. But this does not mean that Kazakhstan is more salty lakes than fresh.

The bar graph is presented on the figure 4, shows, that on the territory of Kazakhstan are concentrated saline, brackish and saline lakes.
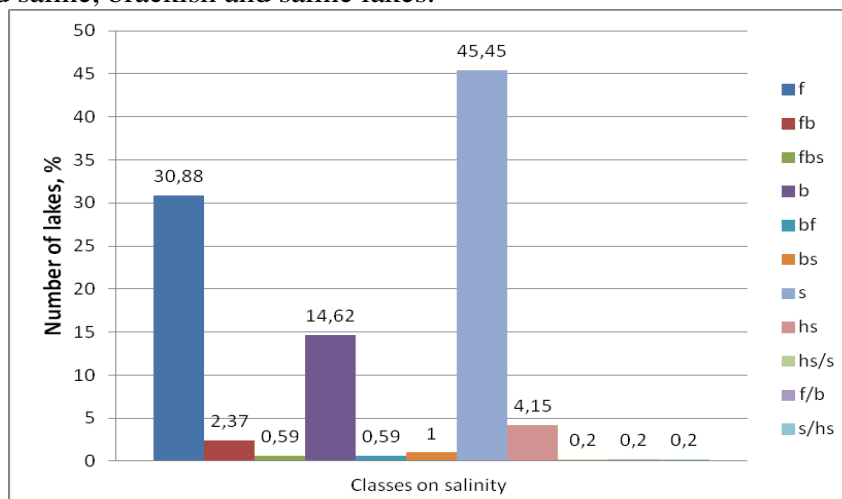

Figure 4 – Distribution on classes of salinity, %

Conclusion:

Lake of Kazakhstan or extremely high (Caspian, Aral, Balkhash) or extremely small. Lake of the first group are unique natural objects. They should be studied separately. Among small lakes in Kazakhstan examined in this study, 93% have a volume of water mass is less than 0.1 km^3. Normative documentation small volume lakes are considered water bodies with the value of this quantity is less than 0.5 km 3.

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