World Water Diplomacy & Science News- 2019 -10001

World Water Diplomacy & Science News

ENISSN : 12019-10009 www.hidropolitikakademi.org

How the Aral Sea Will Look Like in Foreseeable Future ?

Dursun Yıldız
Director
Hydropolitics Academy
dursunyildiz001@gmail.com

SUMMARY

In 2011, Together with Ambassador (R) and Hydropolitical Academy founding Member M. Nuri Yildirim we made a technical trip to Central Asia .In this trip 2 hours after we left Kızılorda city to reach Aral Sea , we began to witness the great damage caused to the environment by drying a lake along the dirt road. As the water was drawn from the sea, it also took away the ecological balance. Because of the strong winds in the region, salt and drugs in the vicinity of the lake spread very alarmingly, this problem was felt in the capital of Uzbekistan, Tashkent, which is 500 km away.In this article I'm looking for an answer to the question of whether the Aral Sea will go back or not.

Keywords : Aral Sea, Environmental Disater,

1. Introduction

Since the 1960s, the Aral Sea has been severely shrunk due to the excessive use of water resources that feed the lake in the period of USSR for agricultural irrigation. This decrease in the amount of water in the Aral Lake brought many ecological problems for the lake and its surroundings. The area of 33.000 km2 in Aral Lake is completely dried and the mineral content in its water is increased. The lake ecosystem is almost completely destroyed.
In the period between 1911 and 1960, an annual average of 56 billion m3 of water was spilled on the Aral Sea. Since the mid - 1980s, the decline in the Aral Sea water volume has accelerated. It was divided into two part in December 1987. The depth of the small Aral to the north dropped to 12 m. The depth of the Great Aral in the south dropped to 23 m. The Aral Lake, on this date, shrank by 74% in area and 84% in volume .

The area of Aral Lake, which was 67 500 km2 in 1960, decreased to 17 200 km2 in 2003. The most populous countries in the region are also the most industrialized countries. For this reason, these countries need important water to feed their populations as well as to provide water to their industries.

Ambassador (R) Nuri Yıldırım and Dursun Yıldız at Kok -Aral Dam –(Kazakhistan 2011)

Related with Aral Sea environmental disaster, the protection of the environment in Central Asia encountered two obstacles. The first of these is addressing human needs in front of environmental protection which remain from the period of USSR and the economic obstacle.

The amount of water flowing into the Aral Lake declined rapidly and in 2000 and 2001 The measured average annual flow at observation station located 102 km. far away from the sea showed that discharge was too low to feed the lake.

2. The Aral Sea was Seperated Into two Part

Because of the decrease in the amount of water flowing into the Aral Sea, the lake was seperated into two part in 1998 as the Northern Aral and Southern Aral.The eastern part of the southern Aral Sea was then completely dried. In order to replenish the Northern Aral Sea, a relief structure (Kok-Aral Dam) was built by Kazakhstan .It stored Syr Darya river flow in the Northern Aral Sea

Photo 1 Aral Sea (22 August 2017)

The Aral Sea, known as the 4th largest lake in the world until about 65 years ago, was the blue eye of the desert during the 20th century. However, this blue eye has not reached the 21st century. The surface of the sea has shrunk by 90 percent and replaced by Aralkum Desert which is the youngest desert in the world .It was formed in the section where the waters were drawn. (Photo 2).

Photo 2.The Aralkum Desert

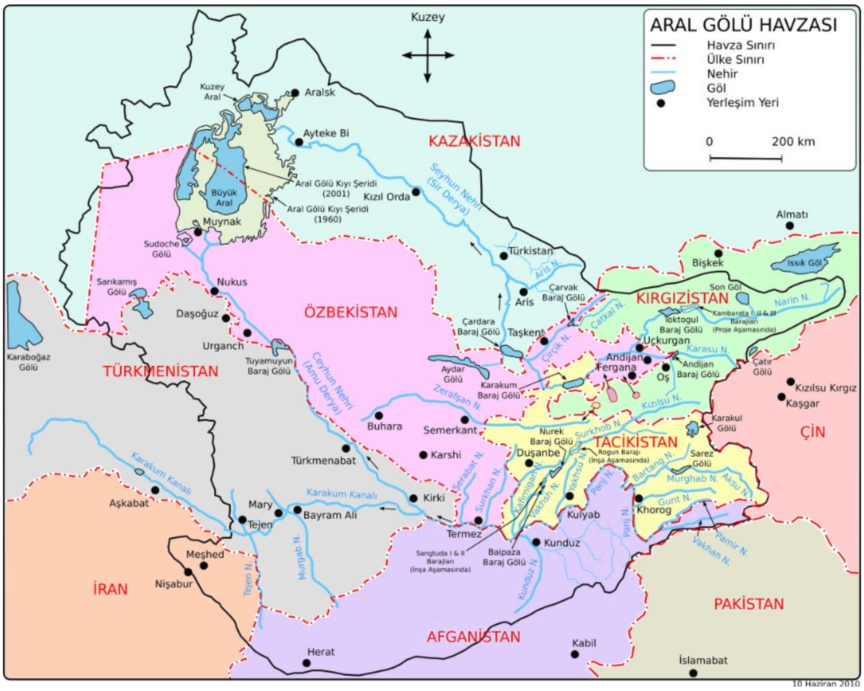

Figure 1. Aral Sea Basin

3.What Went Wrong with the Aral Sea

In the early 1960s during the SSCB period , most of the waters of Amu Darya and Syr Darya Rivers feeding the Aral Sea were diverted to agricultural land where cotton was produced.

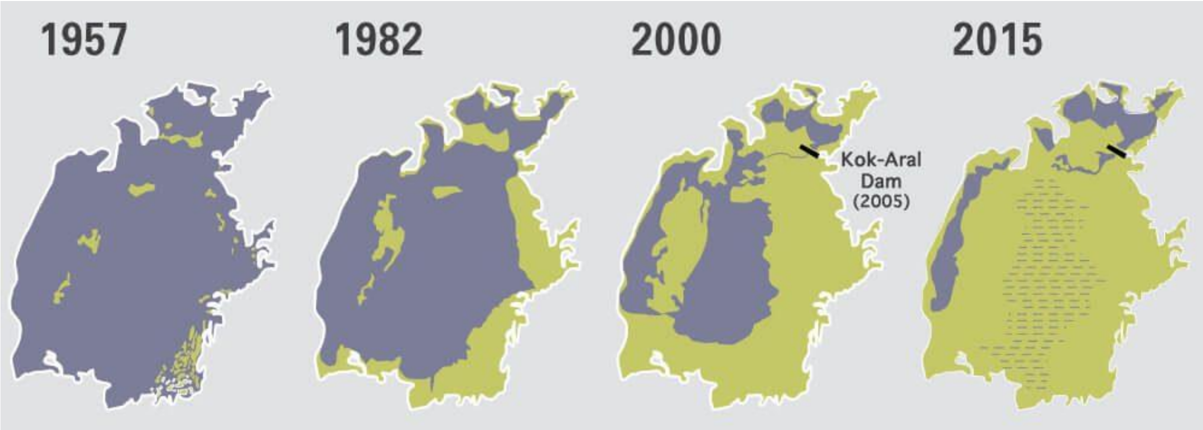

Figure 2. Shrinking of the Aral Sea

In this period, water consumption increased by three times, and areas opened to irrigation increased by more than three times, reaching 8.11 million hectares. Each year the water level in the sea has dropped as of 1,5-2 meters.

This mismanagement of water created the youngest desert in the world .It was formed by salty sand layers in an area of 54,000 square kilometers in the bed of former Aral Sea .Each year, around 15-75 million tons of salty sand dusts flying around the Aral Sea are spread over an area of 150-500 km and left the region facing a major environmental disaster.

In order to prevent the formation of these dust clouds ,in the bed of the Aral Sea fast growing suitable trees called Saksaul and Tominisk were planted (Photo 3).

Photo 3. A fast growing plant called Tominisk (2011 -Kazakhstan -Kızılkum)

More than 300 plants, 35 birds and 23 other animal species were recorded in Uzbekistan in the 1960s in the Aral Sea Basin. In 1960, 34 fish species were found in the sea at that time an average of 60 thousand tons of fish fishing while, today, fishing in the North Aral has been severly destroyed. Canned fish factories and cold storages in Moynak were abandoned. However, fishing in Northern Aral started again in 2005 After Kok-Aral Dam was built.

In December 1998, the Aral Lake was divided into two separate water bodies, of which Northern Aral remained entirely in Kazakhstan, and a large part of South Aral was located in the territory of Kazakhstan. This is interpreted as Kızılkum in the region and Aralkum Desert after Karakum deserts.

The withdrawal of water from the Aral Lake also affected the climatic conditions in the region. The local IFAS experts in Kazakhstan explained that when Aral Sea was full climate was mild and especially in the region between day and night temperature difference was less. After the water of Aral lake was taken and replaced by Aral Desert, the surface quickly warmed and cooled quickly increased day and night temperature differences. In 1960, Bayalimov Daulet Aymagambetovich, an Kazakhstan-based IFAS expert, stated that the average daytime temperatures in the vicinity of the Aral Lake were between 40-45 ^oC ,at night they were between 30-35 ^0C. After Aral Sea dried up it decreased 20 ^oC at nights.

A few months ago, Mr.Güzgeldi , chairman of IFAS, the International Fund for the Rescue of the Aral Sea, told a media company that 'Recently, there were salt particles in the air during 4 days. This has negatively affected the health of people as well as harming the crops.

4. Efforts to Revive the Aral Sea (IFAS)

The leaders of the five countries of Central Asia signed an agreement to solve the Aral Sea problem. İn 1993. Within the framework of this agreement, the establishment of International Fund for Saving the Aral Sea (IFAS) was also decided. This decision has caused an increase in the interest of the international organizations such as OSCE and UNDP in the revive efforts of the Aral Sea. However, in a study by the World Bank, it was determined that the complete revive of the Aral Sea would not be possible in the near future. It is determined that 75 billion m^3 of water is needed annually during 25 years to fill Aral Sea completelly.

The average long term annual flow rate of Seyhun (Sry Darya-37 billion m^3 / year) and Ceyhun (Amu Darya-79 billion m^3/year) that is total as of approximately 116 billion m^3/year. Therefore it seems to be difficult to meet this water requirement during 25 years considering that the vast majority of this water is converted without reaching the lake. For this reason, the lake revive works have been started with Northern Aral Sea Project and positive effects have already been obtained. Two main reasons have been effective to be successful fort his project. The first one is the fact that the project is fully supported by Kazakhstan because it is related with the Northern Aral Se apart that lies in the borders of Kazakhstan. The other is that the volume of the Northern Aral Sea is much smaller than that of the Southern one.

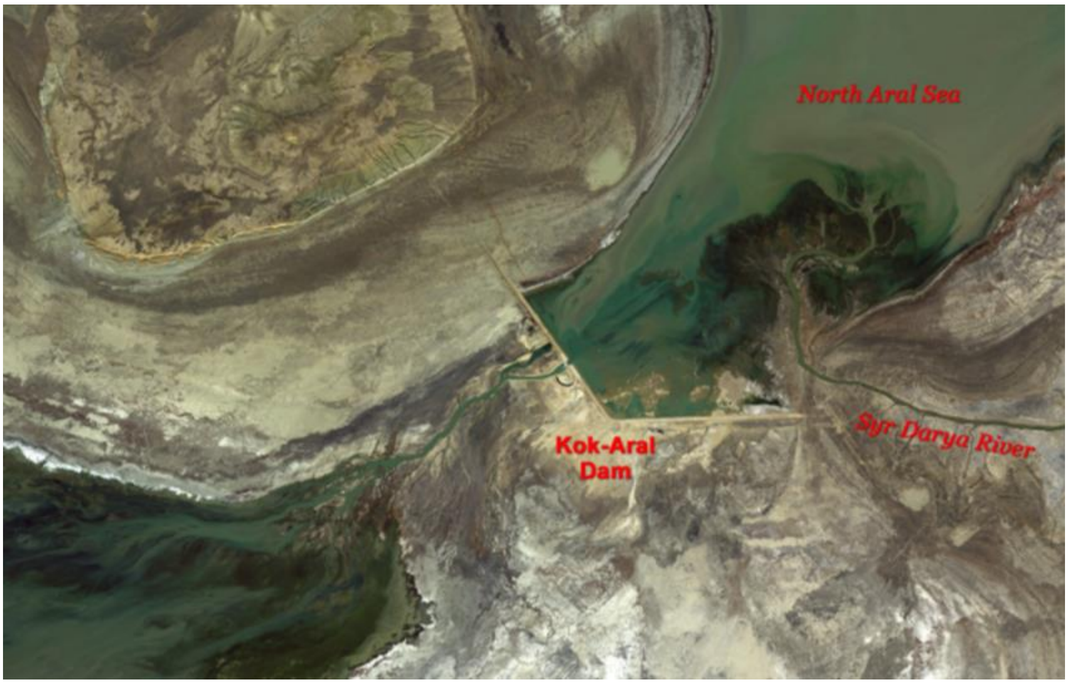

Figure 3.Kok-Aral Dam

Photo 2. North Aral Sea /Kazakhstan -May 2011

The International Fund for Saving the Aral Sea (IFAS) was established in 1993, but no summit at the level of leaders was held for last 10 years. Although the member states worked separately during this 10 years to revive the lake, the summit was intended to re-launch and activate a joint work. In this respect, the summit was successful. The member countries made a very important decision at the summit. The foundations of a new strategic and joint action plan were principally accepted. In the plan, which aims to better manage water use, suggestions such as the use of green technologies 'that reduce the need for irrigation and planting plants with salt-resistant plants were evaluated.

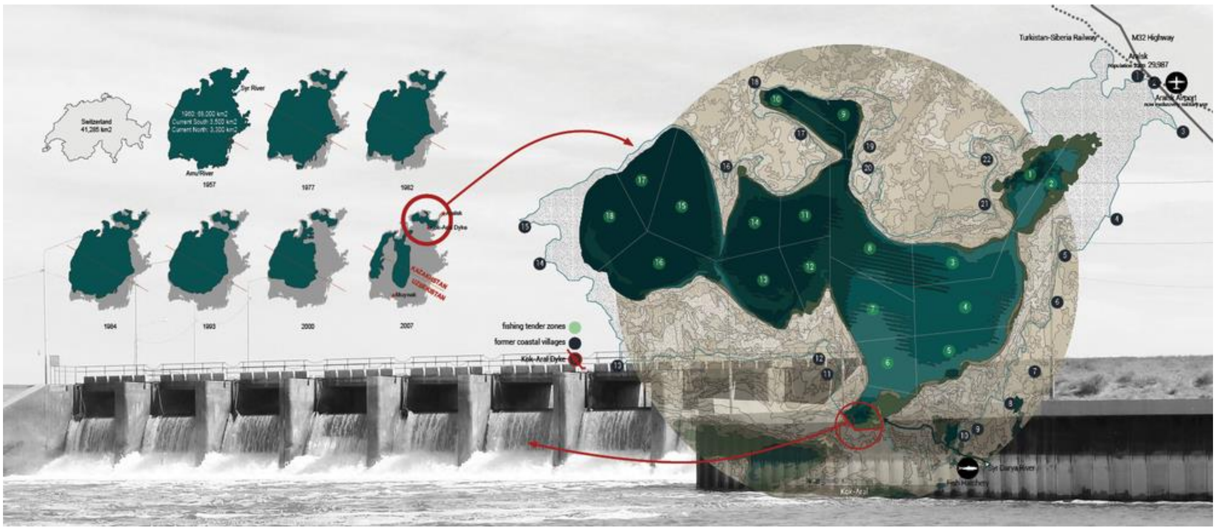

Figure 4. Kok Aral dam (dike) spillway and it's location

Photo 3. Kok Aral Dam (dike) Spillway Photo Credit by Dursun Yıldız

5. Partial Restoration of the Small (Northern) Aral Sea

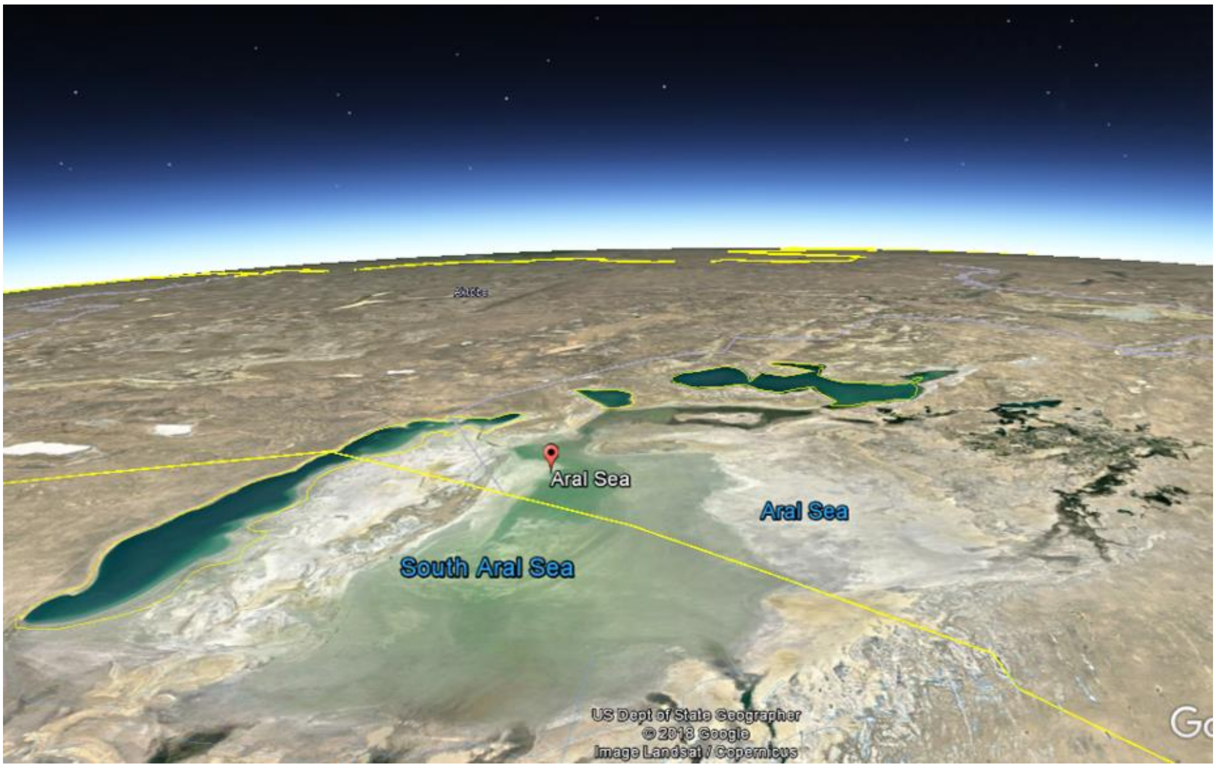

Figure 5. Norhern and Sothern Aral Sea (2018 August)

The Aral separated into two water bodies in 1987 – a "Small" Aral Sea in the North and a "Large" Aral Sea in the south. The Syr Darya flows into the former, and the Amu Darya into the latter. After separation, a channel formed connecting the two lakes, with flow from the higher level Small Sea to the lower level Large Sea. This flow was primarily during the spring/early summer period when discharge from the Syr Darya to the Small Aral was greatest.

The World Bank and the Government of Kazakhstan had been considering funding construction of a more engineeringly sound facility as part of the Phase 1 Aral Sea Basin Program (ASBP) since the program inception in 1993 (6). Detailed Design of the project was completed by the early years of the new century (7).

Photo4. Kok-Aral Dam (dike) Relesing water from the North Aral to South Aral

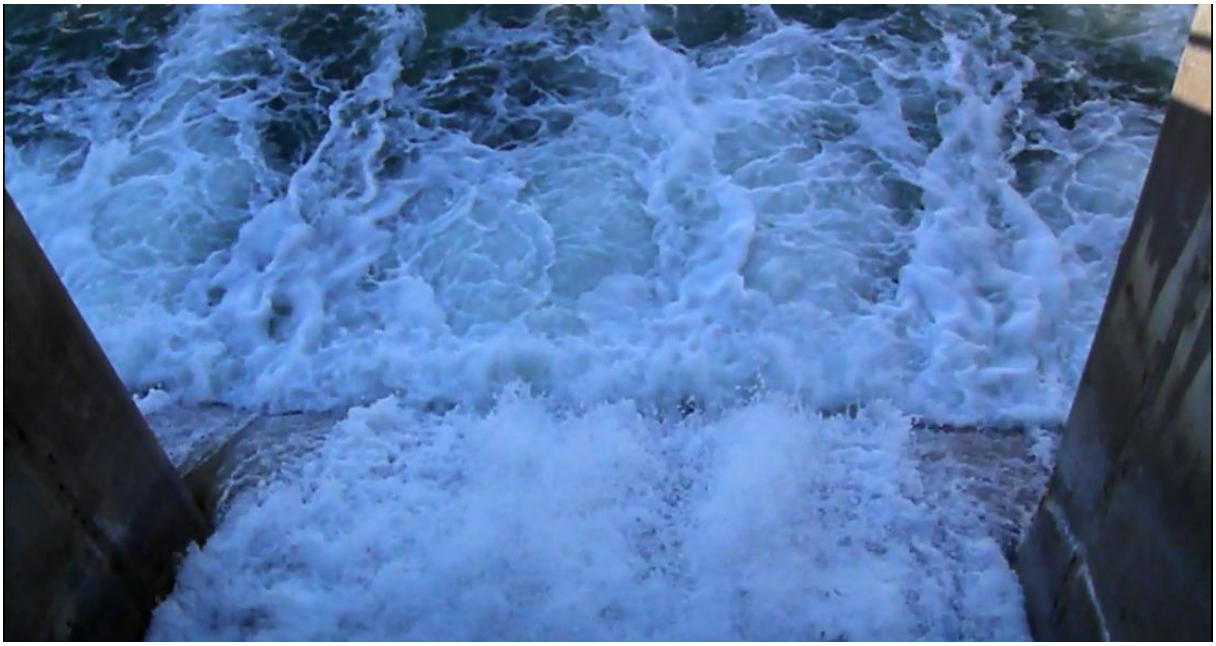

Photo 5. Relased water from North Aral to South Aral by spilway structure
Photo: Dursun Yıldız

The main element of the project would be a 13-km low dike (named Kok-Aral for the former Island/peninsula on its western side) across the former Berg Strait that formerly connected the Small Aral to the Large Aral. The dike would have a concrete regulating dam with 9 gates to control outflow from the Small Aral (Photo 3). A new weir was built at Ak-Lak on the lower Syr to regulate flow and allow the diversion of some water eastward to supplement the water balance of deltaic lakes.

Photo 6. Aklak Weir. Kazakhstan (May 2011)

Northern Aral Sea Dike and Spillway located at the Kokaral Peninsula, the dike has the following parameters: fill material of local sand, fill volume of about 3,000,000 m^3, length of 13.5 km, average height of 4 m, crest elevation at 44.50 m asl and crest width at 8 m.The spillway consists of 9 radial gates 5.5 x 5.3 m each provided with stoplogs.

Aklak Weir and auxiliary offtakes located at the Aklak village in the Syrdarya Delta consist of four openings controlled by radial gates 10 m wide and 4 m high each with a sill elevation at 48.00 m asl.(Photo 6).

Photo 6. Fish Passage of the Aklak Weir Photo Credit. Dursun Yıldız

The maximum expected runoff of the Syrdarya at the site is 515 m^3/s in summer and 395 m^3/s in winter. The auxiliary structures consist of eight gated offtakes to be rehabilitated and/or reconstructed with capacities between 1 and 10 m^3/s upstream of the weir, which supply water for fishing lakes and irrigation of hayfields in the Syrdarya Delta. The weir has a fish pass of a slot type (Photo 6) . The works completed within three years.

Improvements were also to be made to the bed of the Syr Darya down stream of the Chardarya Dam to enhance water flow to the sea. Cost of the entire project was set at 86 million USD with the World Bank providing 65 million and the Kazakhstan government 21 million. Construction work began in 2003 and the dike-dam were completed by August 2005 (7).

After the completion of Kok-Aral Water storage structure in 2005, the water level in the lake was 38 m. This dam (dike) caused the lake area to increase by 874 km^2 to 3288 km^2 and the volume of water in the lake increased by 11.5 billion m^3 to 27 billion m^3 and the salinity amount decreased from 23 g / lt to 17 g / lt. its salinity decreased substantially reaching an average of about 8 g/l by September 2011, leading to greatly improved ecological conditions and a revitalized fishery. This situation allowed to catch 8000 tons of fish a year and export it to Russia and Eastern Europe (Figure 4).
The level of the Small (northern) Aral has been stabilized by this dike at 42 m above sea level that is still 11.4 m below its 1960's level(3).

How to Bring It Back ?

What about bringing the Aral Sea back to its pre-drying up conditions, characteristic of the first 60 years of the twentieth century with a level near 53 m, area of the water surface about 66,100 km^2, volume around 1,064 km^3 and average salinity from 9.3 to 10.3 g/l (4)? This would be ideal, but is it realistic? Such rejuvenation would require average annual aggregate inflow from the Amu + Syr rivers of 56 km^3, assuming surface net evaporation of 869 mm (evaporation of 993 mm minus precipitation of 124 mm derived from data published in reference 4) and estimated net groundwater inflow of 2.5 km^3.According to an Excel based annually iterated fill model devised by the author that assumes a trapezoidal cross section for the portion of the sea to be restored, refilling would require about 103 years given its area and volume in September 2011 (5).

The restoration would follow a logistics curve: rapid at first as inflow greatly exceeded net evaporation, then slowing and approaching zero as net evaporation grew and approached total inflow fromthe rivers Amu Darya and Syr Darya plus net groundwater influx. However, the sea would reach 50 m (94 % of stability level) and have an area of 60,000km^2 (91% of stability area) and volume over 800 km^3 (75 % of stability volume) in just 43 years (3).

The restoration time also depens on the climate change effects in the region . If surface evaporation rose by 11 %, likely a conservative assumption, with other water balance parameters remaining the same, it would take 63 km^3/year and 97 years to refill the sea its pre-1960s conditions. The level of 50 m, area of 60,000 km2 and volume of 800 km^3 would be reached in 40 years. But the recent flows to the Aral have been far below 56 km^3, let alone 62–63 km^3. The author(3) estimates the average annual inflow to the sea from 2000 through 2011 at 8.8 km^3 (6.6 km^3 from the Syr and 2.2 km^3 from the Amu, including direct irrigation.

In his study ,Micklin stated that "It is doubtful the Aral could be restored to its former grandeur in the foreseeable future(3). The amount of water that would need to be saved is far above even the most optimistic and costly scenario of water use efficiency improvements. For example, assuming net water savings in irrigation of 20 km^3/year could be reached, there still would be a deficit of 27 km^3, assuming average future inflow of 8.8 km^3 that was experienced from 2000 through 2011"

6.Results and Evaluations

What will all these efforts bring for the future of the Aral Sea ? It will bring a potential positive environmental impacts in and around the Northern Aral Sea and the Syrdarya delta would include:

(i) the creation of a freshwater reservoir;
(ii) the filling of lagoons and delta lakes;
(iii) an increase in wetlands;
(iv) a reduction in salt and dust storms;
(v) the restoration if biological diversity; and
(vi) an improved ecological system.

The actual impact would depend on the design water level in the Northern Aral Sea .The progress in the Northern Aral has increased hopes for the return of the Aral Sea. However, the complete return of the Sea will not be as easy as the Northern Aral Part .It is clear that engineering structures and facilities provided by the geography have helped to solve the problem in this part. However, the solution for South Aral is more dependent on water management and hydro-political relations among the riparian state .

The alternative of carrying water from the other basin to the Aral Sea may not be a sustainable solution. Therefore, instead of bringing water out of the basin, the solution should be searched primarily within the basin. This makes it possible to link the return of the Aral Sea with the more efficient use of water in the basin countries. The water resources in the Aral Basin are threatened by the inefficient use of water as well as the climate change effects.

If one ask that will the Aral Sea come back? In fact ,it is difficult to give a favorable response this question for a near future. Therefore, we assume that the lake, which was lost in half a century as a whole, will be able to come back in a longer period and it will occur part by part.

The annual average water of the Ceyhun River pouring into the Southern Aral Sea is approximately twice that of Seyhun, which is still pouring into the Northern Aral . However, this water is used in a very inefficient way to reach the lake. It seems to be difficult to fill a lake volume about 10 times larger than the North Aral.

As a result, there are many problems to the return of South Aral Sea, ranging from the inefficient use of water in the basin, the negative consequences of global climate change and the geopolitical obstacles to the softening of hydro-political relations among riparian state.
I regret to say that the Aral Sea will also be given by next generation as a live example of an environmental disaster created by the water mismanagement.

Referanslar

1-Yıldız D. 2011 Orta Asya'nın Stratejik Suları. Truva Yayınları.İstanbul (in Turkish)

2-Yıldız D. 2011 Orta Asya'nın Saatli Bombası: Su Sorunu. Truva Yayınları. İstanbul (in Turkish)

3-Micklin P 2014 "Efforts to Revive the Aral Sea" P. Micklin et al. (eds.), The Aral Sea, Springer Earth System Sciences, DOI 10.1007/978-3-642-02356-9_15, © Springer-Verlag Berlin Heidelberg 2014 Referanslar

4- Bortnik VN, Chistyaevaya SP (eds) (1990) Hydrometeorology and hydrochemistry of the Seas of the USSR, vol VII, Aral Sea. Gidrometeoizdat, Leningrad (in Russian)

5- Micklin P (2012a) Annualized excel spreadsheet fill model with input parameters of initial sea volume (km3), area (km2) and initial and final level (meters), average river inflow (km3), average groundwater inflow (km3), average net evaporation (E-P) in millimeters and a measure of the increase in area for each meter rise of the sea in (km2/m) derived from the slope of the sides of the trapezoid

6-Aral Sea Program (1994) Phase 1 aide memoire, World Bank Preparation Mission, March 1994. Europe and Central Asia Region, Country Department 3, Country Operations Division I, Washington, DC, pp 43–45

7-Expedition (2005) Unpublished observations, information, and data gathered during an expedition to the Aral Sea led by Philip Micklin and Nikolay Aladin, Aug 22–Sept 23. Funded by the Committee on Research and Exploration, National Geographic Society, Grant 7825–05

Biography

Dursun Yıldız is a hydropolitics expert and Director of the Hydropolitics Academy Association located in Ankara-Turkey .He is a civil engineer and used to be Deputy Director at State Hydraulic Works in Turkey; completed hydroinformatics post graduate course at the IHE in Delft,Technical training programme in USBR-USA and a master degree in Hydropolitics at the Hacettepe University-Turkey. He has over 5 years of teaching experiences in some Turkish Universities and now works as head of his own Hydro Energy & Strategy consulting company located in Ankara. He has published severel international articles and 13 Books. He recieved Most Succesful Reseracher Award on International Water Issues from Turkish Agricultural Association in 2008 and from Central Union of Irrigatıon Cooperatives in 2016.

(Recieved : 2 Feb. 2019   Accepted: 18 Feb 2019)