

## Lake Sevan: Environmental Story

Elen Karayan

**Abstract** Lake Sevan is the largest freshwater lake in Armenia, the largest lake in Trans-Caucasus and one of the largest freshwater lakes in Eurasia. Only one river flows out from the lake, Hrazdan River, which flows toward the Ararat Valley (one of the important croplands in Armenia) and is one of the sources of irrigation for the cropland. But since 1930s, because of lack of energy in the country, Sevan-Hrazdan hydropower cascade was built which was used to generate energy and also was a source of irrigation for the Ararat Valley, which was located in a lower attitude than the lake. Because this water outflow from Lake Sevan had increased dramatically, it lead not only to environmental problems, but also to a loss of cultural value. The bad ecological condition of the lake had influence on the economy of Armenia. As a consequence several steps and policies were undertaken with a purpose to stabilize the environmental condition of Lake Sevan, and one of the steps was the construction of tge Arpa-Sevan tunnel in 1982, which increased the inflow of water into the lake.

**Keywords** Armenia - Aquaculture - Biodiversity - Ecology - Endangered species  
Environment - Environmental impact - Environmental regulation  
Eutrophication - Fishery - Irrigation - Lake Sevan - Natural resource  
Pollution - Water - Sewage

**JEL Classification** Q25 - Q22 - Q42 - Q51 - Q53 - Q57 - Q58

The purpose of this narrative essay is to give a brief overview on the environmental story of Lake Sevan, which is the largest lake in Trans-Caucasus and one of the largest freshwater lakes in Eurasia. Its surface was once 1416 km<sup>2</sup> but dropped by 13% and is now 1241 km<sup>2</sup>.

Brief characteristics of Lake Sevan:

- Natural soil is mainly black loam,
- Sunshine hours per year are 2400-2800, and are comparable to Egypt
- Annual participation is 340-720 mm
- Length of the lake is 75 km,
- Mean width is 19.2 km
- Largest width is 32 km,
- In history iced once every 15-20 years, but since 1970s iced every year<sup>1</sup>

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<sup>1</sup> Temperature of Lake Sevan, available at <http://www.fao.org/docrep/003/X2614E/x2614e13.htm>

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Water flow into Lake Sevan and out from Lake Sevan:

- Overall 29 rivers and streams flow into Lake Sevan from watershed.
- The river Hrazdan is the only river that flows out from the lake, downstream of Yerevan and through the Ararat valley it flows into Araks River.
- The lake outflow has been regulated for irrigation.
- The Sevan-Hrazdan hydropower cascade is being used since 1930s.<sup>2</sup>

Biodiversity of Lake Sevan:

- 1600 plant species, 48 of which are in the Red Book<sup>3</sup>,
- 6 fish species, 2 of which are in the Red Book,
- 210 bird species, 36 of which are in the Red Book,
- and other mammals, reptiles etc<sup>4</sup>



Lake Sevan is located higher altitude than the Ararat Valley (a fertile but at the same time arid cropland). Therefore, the water from the lake could be used for irrigation purposes in the Ararat Valley. Lake Sevan had a large surface. In Soviet times a large surface area meant wasteful evaporation. Thus, in order not to waste the valuable water of Lake Sevan it was decided to start the destruction process of the lake, as it would solve several problems such as irrigation of the Ararat Valley, and lack of power resources. Therefore, since 1933:

the outflow from the Lake Sevan increased for:

- power generation (56% of total national HP)
- irrigation (25% for region and 12% for Ararat Valley)
- 6 hydro-power plants (total capacity 556 MWt) were constructed

By 1960 the ecological condition of the lake was getting worse and worse. In 1964 eutrophication started.<sup>5</sup>

<sup>2</sup> Morphometry of Lake Sevan, available at <http://www.fao.org/docrep/003/X2614E/x2614e13.htm>

<sup>3</sup> Flora of Lake Sevan, available at [http://enrin.grida.no/htmls/armenia/soe\\_armenia/english/sevan/sevan/flora.htm](http://enrin.grida.no/htmls/armenia/soe_armenia/english/sevan/sevan/flora.htm)

<sup>4</sup> Fauna of Lake Sevan, available at [http://enrin.grida.no/htmls/armenia/soe\\_armenia/english/sevan/sevan/fauna.htm](http://enrin.grida.no/htmls/armenia/soe_armenia/english/sevan/sevan/fauna.htm)

<sup>5</sup> Sevan Management Information System (SEMIS): Lake Sevan, available at [https://www.uni-hohenheim.de/lake-sevan/sevan\\_problem.htm](https://www.uni-hohenheim.de/lake-sevan/sevan_problem.htm)

The decrease in the level of Lake Sevan and also the decrease in the quality of its water brought with it several problems, such as

- Loss of irrigations resource
- Loss of hydro-power resource
- Ecosystem instability
- Loss in cultural values

Therefore several areas of the country were affected, such as ecology, tourism, cultural values and economic production.

After realizing the bad environmental condition of Lake Sevan attempts were made in order to recover the level of the lake. In 1982 the Apra-Sevan tunnel was completed which stabilized the level of the lake and brought on average 250 million m<sup>3</sup>/year water from the Arpa River.<sup>6</sup> In 1992-1995 due to energy crisis again high level of water releases were made.<sup>7</sup> In 1995 the net inflow became positive. It was estimated that 512 million m<sup>3</sup>/year can be taken from the lake still maintaining its level. Therefore, overall 370 million m<sup>3</sup>/year was allowed to be taken from the lake (300 million m<sup>3</sup>/year for irrigation and 70 million m<sup>3</sup>/year for hydro power).

Even though the level of the lake was rising, the quality of the water still had some problems. 37% of phosphorus load and 10% of nitrogen load come from domestic waste, because approximately 210,000 people discharge domestic waste into the lake. Agriculture has its negative influence on the quality of the water as well, because 33% of phosphorus load and 70% of nitrogen load come from fertilizers.<sup>8</sup> Also, another problem was the broken sewer pipeline from Jermuk, as a result of which the sewage dropped into the river flowing into Lake Sevan.

In order to stabilize and improve the quality of water several policies were considered, such as:

- Bill of Principles of Environmental Protection
- United Nations Convention on Climate Change
- Convention on Wetlands of International Importance
- Convention on Biodiversity
- UN Convention to Combat Desertification
- Agreement of Cooperation in the Sphere of Ecology and Environmental Protection
- FAO International Code of Conduct in the Distribution and Use of Pesticides

Plus National regulation and Laws, such as:

- Formulating policy
- Drafting laws and planning their enforcement
- Establishing annual
- Fish catch
- Water release
- Three cutting quotas
- Establishing functional zones in National Park
- Adopting standards and service charges
- Managing state-owned lands
- Issuing water use permits and ecological passports
- Imposing pollution and extraction fees
- Maintaining water and land disasters

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6 Sevan Management Information System (SEMIS): Lake Sevan, available at [https://www.uni-hohenheim.de/lake-sevan/sevan\\_problem.htm](https://www.uni-hohenheim.de/lake-sevan/sevan_problem.htm)

7 Lake Sevan: Experience and Lessons learned brief, Table 1. Lake Sevan water balance in different periods (million m<sup>3</sup>/year), available at [http://www.worldlakes.org/uploads/21\\_Lake\\_Sevan\\_27February2006.pdf](http://www.worldlakes.org/uploads/21_Lake_Sevan_27February2006.pdf)

8 Sevan Management Information System (SEMIS): Lake Sevan, available at [https://www.uni-hohenheim.de/lake-sevan/sevan\\_problem.htm](https://www.uni-hohenheim.de/lake-sevan/sevan_problem.htm)

Another problem that still exists and affects biodiversity of Lake Sevan is related to fishing. Historically, Lake Sevan had 4 subspecies of trout, in Armenia mostly known as Ishkhan, (winter bakhtak, bodjak, summer bakhtak and gegharkhouni), 2 types of white-fish, in Armenia known as sig, 2 carp types and barbel.<sup>9</sup> Some of the problems associated with fishing are the following:

- Excessive fishing pressure
- Illegal fishing
- Loss of fish habitats

Of course several policies are enforced to order to meet this problems, but they as well have some issues, such as:

- Difficulty in enforcing licensing system
- Difficulty in controlling illegal fishing especially during a hard economic period

Of course, after all the policies and attempts to increase the level and the quality of water of Lake Sevan the level of the lake increased, which had its impact on the environment.

- In 2004 Vorotan-Arpa tunnel was completed, which brings with it 165 million m<sup>3</sup>/year water into the lake<sup>10</sup>
- In 2010 the level of Lake Sevan was 1899m and 23cm<sup>11</sup>
- In 2012 the level of Lake Sevan was 1900m and 13cm

It was predicted that the lake will refill in 30 years, but with its current speed it can take only 15 years. The cleaning of surroundings of the lake was supposed to start in 2007, but because of the rapid growth in the level of the lake it started in 2005. For this reason cleaning efforts were inefficient.

It appears that the level of the lake would continue to rise and everything would be back to normal, but there are other environmental aspects that affect the environmental condition of the lake. Because of climate change the volume of the water inflow into the river is projected to reduce naturally. The projection of the water inflow, A2 the pessimistic scenario, into Lake Sevan by Third National Communication on Climate Change are provided in the table below.

**Table 1 The projection of inflows in Arpi reservoir and Lake Sevan according to A2 scenario, milion m<sup>3</sup>**

Water body	1961-1990	2030	2070	2100
Arpi reservoir	60,15	56,12	51,43	45,47
Lake Sevan	787,00	734,00	673,00	595,00

In 2030 the inflow water into the Lake Sevan will decrease by about 50 million m<sup>3</sup> in comparison to baseline (787 million m<sup>3</sup>). In 2070 the inflow water into the Lake Sevan will decrease by about 110 million m<sup>3</sup> and in 2100 by 190 million m<sup>3</sup>. Therefore, the water level will decrease by 16 cm annually.

In conclusion, Lake Sevan is a very important part of Armenia. It is one of the cultural values of Armenia and also a source of water and a source of living for people, animals, birds and fishes. The Armenian government is working hard to refill the lake and solve all the problems that arise in a way.

<sup>9</sup> Fish and Fisheries in Lake Sevan, Armenia, and in some other high altitude lakes of Caucasus, Fish Fauna of Lake Sevan, available at <http://www.fao.org/docrep/003/X2614E/x2614e13.htm>

<sup>10</sup> Lake Sevan: experience and lessons learned brief, 5. Responses to threats, available at [http://www.worldlakes.org/uploads/21\\_Lake\\_Sevan\\_27February2006.pdf](http://www.worldlakes.org/uploads/21_Lake_Sevan_27February2006.pdf)

<sup>11</sup> Case Lake Sevan- Integrated Environmental Assessment of Lake Sevan (ИНТЕГРАЛЬНАЯ ОЦЕНКА ЭКОЛОГИЧЕСКОГО СОСТОЯНИЯ ОЗЕРА СЕВАН) page 12, Table 4, available at <http://www.grida.no/publications/lake-sevan/>

## References

- Temperature of Lake Sevan, available at <http://www.fao.org/docrep/003/X2614E/x2614e13.htm>
- Morphometry of Lake Sevan, available at <http://www.fao.org/docrep/003/X2614E/x2614e13.htm>
- Flora of Lake Sevan, available at [http://enrin.grida.no/htmls/armenia/soe\\_armenia/english/sevan/sevan/flora.htm](http://enrin.grida.no/htmls/armenia/soe_armenia/english/sevan/sevan/flora.htm)
- Fauna of Lake Sevan, available at [http://enrin.grida.no/htmls/armenia/soe\\_armenia/english/sevan/sevan/fauna.htm](http://enrin.grida.no/htmls/armenia/soe_armenia/english/sevan/sevan/fauna.htm)
- Sevan Management Information System (SEMIS): Lake Sevan, available at [https://www.uni-hohenheim.de/lake-sevan/sevan\\_problem.htm](https://www.uni-hohenheim.de/lake-sevan/sevan_problem.htm)
- Sevan Management Information System (SEMIS): Lake Sevan, available at [https://www.uni-hohenheim.de/lake-sevan/sevan\\_problem.htm](https://www.uni-hohenheim.de/lake-sevan/sevan_problem.htm)
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- Fish and Fisheries in Lake Sevan, Armenia, and in some other high altitude lakes of Caucasus, Fish Fauna of Lake Sevan, available at <http://www.fao.org/docrep/003/X2614E/x2614e13.htm>
- Lake Sevan: experience and lessons learned brief, 5. Responses to threats, available at [http://www.worldlakes.org/uploads/21\\_Lake\\_Sevan\\_27February2006.pdf](http://www.worldlakes.org/uploads/21_Lake_Sevan_27February2006.pdf)
- Case Lake Sevan- Integrated Environmental Assessment of Lake Sevan (ИНТЕГРАЛЬНАЯ ОЦЕНКА ЭКОЛОГИЧЕСКОГО СОСТОЯНИЯ ОЗЕРА СЕВАН) page 12, Table 4, available at <http://www.grida.no/publications/lake-sevan/>