HELMHOLTZ ZENTRUM FÜR UMWELTFORSCHUNG UFZ

TECHNISCHE UNIVERSITÄT DARMSTADT

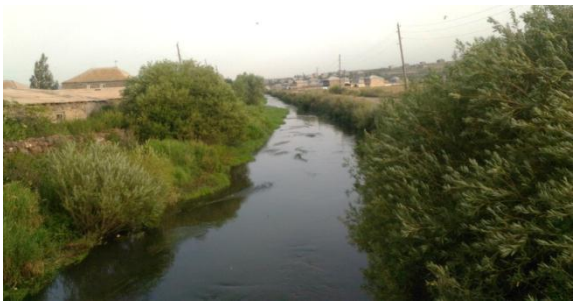
Bundesministerium für Bildung und Forschung

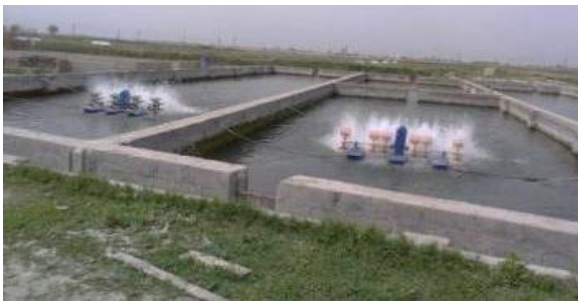
Travelling Conference: „Sustainable Water Resource Management in Regions with Heavily Overexploited Aquifers under Consideration of Regional Impacts of Climate Change" ("TC WaterUse")

Book of Abstracts

July 2-3, 2019

Institute of Geological Sciences of NAS, Yerevan, Armenia





IGS

„Sustainable Water Resource Management in Regions with Heavily Overexploited Aquifers under Consideration of Regional Impacts of Climate Change"

("TC WaterUse")

Contents

“Sustainable Water Resource Management in Regions with Heavily Overexploited Aquifers under Consideration of Regional Impacts of Climate Change” (TC-WaterUse)

«Ջրային ռեսուրսների կայուն կառավարում ջրատար հորիզոնների խիստ գերօգտագործմամբ առանձնացող տարածաշրջաններում՝ հաշվի առնելով կլիմայի փոփոխության ազդեցությունները» գիտաժողով

Institute of Geological Sciences, National Academy of Sciences, Armenia

ՀՀ ԳԱԱ Երկրաբանական գիտությունների ինստիտուտ

Agenda / Օրակարգ

Tue, July 2, 2019 / Երեքշաբթի, հուլիսի 2, 2019թ.

08:30 – 09:00	*Registration, Coffee / Գրանցում, սուրճ*
09:00 – 09:10	**Kh. Meliksetyan**, Director of IGS: Welcome speech. **Խ. Մելիքսեթյան**, ԵԳԻ տնօրեն. Ողջույնի խոսք:
09:10 – 09:30	**M. Schubert**: TC WaterUse - Project introduction. **Մ. Շուբերտ**. TC WaterUse նախագծի ներկայացում:
09:30 – 10:00	*Round Table Discussion: TC WaterUse - Conference networking goals.* *Քննարկում. TC WaterUse գիտաժողովի համագործակցային նպատակներ:*
10:00 – 10:30	**B. Klauer**: Water in Germany - Overview over the hydrological and hydrogeological situation, water problems and management. **Բ. Քլաուեր.** Ջուրը Գերմանիայում՝ հիդրոլոգիական և հիդրոերկրաբանական իրավիճակի, ջրային պրոբլեմների և կառավարման խնդիրների ամփոփ ներկայացում:
10:30 – 11:00	**A. Arakelyan:** Water in Armenia - Overview over the hydrological and hydrogeological situation, water problems and management. **Ա. Առաքելյան.** Ջուրը Հայաստանում՝ հիդրոլոգիական և հիդրոերկրաբանական իրավիճակի, ջրային պրոբլեմների և կառավարման խնդիրների ամփոփ ներկայացում:
11:00 – 11:30	*Coffee Break / Սուրճի ընդմիջում*
11:00 – 11:15	**K. Knoeller:** The Helmholtz Association of Research Centres: Addressing the challenges of integrated terrestrial environmental research. **Կ. Քնոյլեր.** Հելմհոլցի անվան հետազոտական կենտրոնների ասոցիացիա. Դիտարկելով համապարփակ ցամաքային բնապահպանական հետազոտությունների մարտահրավերները:
11:15 – 11:45	**Ch. Schueth:** Sustainable water management in water scarce regions - A global perspective. **Ք. Շուեթ.** Ջրային ռեսուրսների կայուն կառավարում ջրասակավ շրջաններում. գլոբալ հեռանկար:

11:45 – 12:15	**B. Klauer:** Water management at extreme shortage - results of the Jordan Water Project. **Բ. Քլաուեր.** Ջրային ռեսուրսների կառավարումը ծայրահեղ դեֆիցիտի պայմաններում. Հորդանանի ջրային նախագծի արդյունքները:
12:15 – 12:45	**P. Tozalakyan:** Lake Sevan in the management of water resources of the Ararat valley and the importance of the state of its ecosystem. **Պ. Թոզալաքյան.** Սևանա լճի դերը Արարատյան դաշտի ջրային ռեսուրսների կառավարման մեջ և դրա կարևորությունը էկոհամակարգի վիճակի համար:
12:45 – 14:00	*Lunch Break* / Ընդմիջում**
14:00 – 14:30	**V. Khondkaryan:** Climate change and water resource management in Armenia: adaptation strategies for disaster risk management. **Վ. Խոնդկարյան.** Կլիմայի փոփոխությունը և ջրային ռեսուրսների կառավարումը Հայաստանում. ադապտացիոն ռազմավարություններ աղետների ռիսկերի կառավարման համար:
14:30 – 15:00	**K. Knoeller:** Tackling the challenges of water resources quality assessment and prediction by application of natural tracer techniques. **Կ. Քնոյլեր.** Ջրային ռեսուրսների որակի գնահատման և կանխատեսման մարտահրավերներին դիմակայումը՝ բնական ինդիկատորների մեթոդների կիրառմամբ:
15:00 – 15:30	*Coffee Break / Սուրճի ընդմիջում*
15:30 – 16:00	**M. Schubert:** Assessing groundwater/surface water interaction and groundwater residence times using natural short-lived radionuclides as environmental tracers: ^{222}Rn, ^{35}S. **Մ. Շուբերտ.** Ստորերկրյա/մակերևութային ջրերի փոխազդեցության գնահատումը և ստորերկրա ջրերի տեղակայման ժամանակը՝ օգտագործելով բնական կարճաժամկետ ռադիոնուկլիդները՝ ^{222}Rn, ^{35}S որպես բնապահպանական ինդիկատորներ:
16:00 – 16:25	**Yu. Javadyan:** On the natural rechargeable groundwater resources of Ararat Artesian Basin and their current water use state. **Յու. Ջավադյան.** Տեղեկատվություն Արարատյան արտեզյան ավազանի ստորերկրյա ջրերի բնական վերականգնվող ռեսուրսների և դրանց առկա ջրօգտագործման վիճակի վերաբերյալ:
16:25 – 16:50	**L. Harutyunyan:** Groundwater use trends in the Ararat Valley. **Լ. Հարությունյան.** Արարատյան դաշտում ստորերկրյա ջրերի օգտագործման միտումները:
16:50 – 17:20	**Ch. Schueth:** Managed aquifer recharge: Lessons learned from the EU project "MARSOL". **Ք. Շուեթ.** Կառավարվող ջրատար հորիզոնների վերականգնումը. ԵՄ «MARSOL» ծրագրից քաղված դասերը:

** Refreshments will be served / ֆուրշետային հյուրասիրություն*

Wed, July 3, 2019 / Չորեքշաբթի, հուլիսի 3, 2019թ.

08:30 – 09:00	*Registration, Coffee / Գրանցում, սուրճ*
09:00 – 09:25	**L. Taslakyan:** Sustainable water management in Armenia: Challenges and opportunities. **Լ. Թասլակյան.** Ջրային ռեսուրսների կայուն կառավարում Հայաստանում. մարտահրավերներ և հնարավորություններ:
09:25 – 09:50	**A. Arakelyan:** Issues related to the water resources management in Lake Sevan Basin. **Ա. Առաքելյան.** Ջրային ռեսուրսների կառավարման հետ կապված խնդիրները

	Սևանա լճի ավազանում:
09:50 – 10:15	**B. Zakaryan / A. Gevorgyan:** Decision-Support Tools for sustainable water resources management in the Ararat Valley. **Բ. Զաքարյան / Ա. Գևորգյան.** Արարատյան դաշտի ջրային ռեսուրսների կայուն կառավարմանն աջակցող որոշումների կայացման գործիքներ:
10:15 – 10:40	**L. Tadevosyan / N. Mirzoyan:** Upgrading small- and medium-scale aquaculture farms in Ararat valley into semi-closed Recirculating Aquaculture Systems: environmental and economic aspects. **Լ. Թադևոսյան/Ն. Միրզոյան.** Արարատյան դաշտում փոքր և միջին մասշտաբի ակվակուլտուրային տնտեսությունների փոխակերպում կիսափակ վերաշրջանառվող ակվակուլտուրային համակարգերի. բնապահպանական և տնտեսական ասպեկտներ:
10:40 – 11:05	**A. Harutyunyan:** Water Quality Monitoring of Lake Sevan with Remote Sensing. **Ա. Հարությունյան.** Սևանա լճի ջրի որակի մոնիթորինգը հեռահար զոնդավորման միջոցով:
11:05 – 11:30	*Coffee Break / Սուրճի ընդմիջում*
11:30 – 11:55	**M. Voskanyan:** The Investigation of the Hydrochemical Parameters of Vayots Dzor's Several Natural Monuments. **Մ. Ոսկանյան.** Վայոց Ձորի որոշ ջրաերկրաբանական բնության հուշարձանների ջրաքիմիական ցուցանիշների ուսումնասիրություն:
11:55 – 12:20	**L. Hambaryan:** "Blooming" of the microalgae of phytoplankton as an indicator of the instability of Lake Sevan (Armenia) ecosystem. **Լ. Համբարյան.** Ֆիտոպլանկտոնի միկրոջրիմուռների «ծաղկումը» որպես Սևանա լճի (Հայաստան) էկոհամակարգի անկայունության ցուցանիշ:
12:20 – 12:45	**L. Margaryan:** Long-term hydrochemical study of groundwater in Ararat valley. **Լ. Մարգարյան.** Արարատյան դաշտի ստորերկրյա ջրերի երկարաժամկետ հիդրոքիմիական ուսումնասիրություն:
12:45 – 13:10	**S. Khachatryan:** Water-balance calculation of deep wells in Ararat valley, in the context of the changing irrigation systems in Armenia. **Ս. Խաչատրյան.** Արարատյան դաշտի խորքային հորերի ջրատնտեսական վերլուծություն Հայաստանի ոռոգման փոփոխվող համակարգի համատեքստում:
13:10 – 14:00	*Lunch Break* / Ընդմիջում**
14:00 – 14:25	**R. Minasyan:** Ararat Artesian Basin Hydrodynamic Condition and Re-evaluation of Exploited Groundwater Resources. **Ռ. Մինասյան.** Արարատյան արտեզյան ավազանի հիդրոդինամիկ պայմանները և ստորերկրա ջրերի շահագործական պաշարների վերագնահատումը:
14:25 – 14:50	**H. Igityan:** Changes of geo-environmental conditions of the artesian Ararat basin as a result of large-scale water intakes. **Հ. Իգիթյան.** Արարատյան ավազանում երկրա-բնապահպանական պայմանների փոփոխությունը որպես մեծածավալ ջրառի արդյունք:
14:50 – 15:15	**Ch. Schueth:** Fossil groundwater resources: Potential and challenges. **Ք. Շուեթ.** Հանածո ստորերկրյա ջրերի ռեսուրսներ: Ներուժը և մարտահրավերները:
15:15 – 15:45	*Coffee Break / Սուրճի ընդմիջում*
15:45 – 16:10	**K. Knoeller:** Stable isotopes reveal pathways and potential for nitrate mitigation in aquifers used for drinking water production. **Կ. Քնոյլեր.** Կայուն իզոտոպերի բացահայտման ուղիները և դրանց ներուժը որպես խմելու ջրի աղբյուր հանդիսացող ջրատար հորիզոններում նիտրատների

	կրճատման համար։
16:10 – 16:35	**B. Klauer:** Pharmaceutical Residuals in German Waters. **Բ. Քլաուեր.** Դեղագործական մնացորդները Գերմանիայի ջրերում։
16:35 – 17:00	**M. Schubert:** On-Site detection of ^{222}Rn in water samples using mobile detector. **Մ. Շուբերտ.** Ջրի նմուշներում ^{222}Rn-ի որոշումը նմուշառման տեղամասում՝ դյուրակիր դետեկտորի օգտագործմամբ։
17:00	Closing Ceremony / Փակման արարողություն

**Refreshments will be served / ֆուրշետային հյուրասիրություն*

Thu, July 4, 2019 / Հինգշաբթի, հուլիսի 4, 2019թ.

09:30 – 16:00 Field trip to Ararat Valley**

Visits to USAID ASPIRED Project pilot areas (Sayat-Nova, Sipanik and Aratashen Communities)

http://www.aspired.wadi-mea.com/en/pilot-projects/

09:30 – 16:00 Դաշտային այցելություն Արարատյան դաշտ**

Այցեր ԱՄՆ ՄԶԳ ԳԱՏՕ ծրագրի պիլոտային տարածքներ (Սայաթ-Նովա, Միփանիկ և Առատաշեն համայնքներ)

http://www.aspired.wadi-mea.com/en/pilot-projects/

Fri, July 5, 2019 / Ուրբաթ, հուլիսի 5, 2019թ.

09:30 – 16:00 Excursion to Lake Sevan**

09:30 – 16:00 Էքսկուրսիա Սևանա լիճ**

**Registration required / Անհրաժեշտ է գրանցվել

Issues related to the Water Resources Management in the Lake Sevan Basin

A. Arakelyan[1], A. Avagyan[1], G. Shahnazaryan [2], N. Tarasyan[1], L. Sargsyan[1], A. Nersisyan[1], H. Uloyan[1]

[1]*Institute of Geological Sciences, NAS, Armenia*

[2]*Environmental Monitoring and Information Center, Ministry of the Environment, Armenia*

alex.arakelyan@outlook.com[1]

This abstract summarizes the results of the first phase Draft Sevan River Basin District Management Plan development.

Basin of the Lake Sevan is situated in the Eastern part of the Armenia, within the Gegharkunik Province. Lake Sevan is one of the greatest freshwater high mountain lakes of Eurasia. The basin of Lake Sevan makes up one sixth of the total territory of Armenia.

Lake Sevan has a very important role in the economy of Armenia: it is the source of irrigation water for large territories and provides low cost electricity, fish, recreation, and tourism.

Water released from the lake for irrigation purposes first transferred through the Sevan-Hrazdan derivation system, after which the water is abstracted by 5 primary canals (Kotayk, Arzni-Shamiram, Lower Hrazdan, Artashat and Nork) and distributed by WUAs. According to the Armenian legislation, maximum annual amount of water outlets from the Lake Sevan is limited to 170 million m^3. Outlets exceeding that amount should be made according to the relevant decisions of the Government of Armenia.

Sevan-Hrazdan Cascade a key part of the Armenian electricity system. Sevan-Hrazdan HPPs Cascade includes 7 HPPs with 560 MW total installed capacity and 2.32 billion kW designed annual generation of electricity.

Within the scope of this study, physico-geographical, socio-economic and water resources management peculiarities of Sevan Basin were analyzed. After that, main anthropogenic pressures on surface water and groundwater quality and quantity in the Lake Sevan Basin were identified and their impacts assessed (communal-household wastewater discharge, diffuse pollution from solid waste and agriculture, etc.). Based on this, the parts of water resources on which the impact of the pressures assessed as significant, have been identified as water bodies being at risk of failing to meet the environmental objectives (Article 4 of EU Water Framework Directive). Heavily modified and artificial water bodies have been identified as well.

Main issues related to the water resources management in the basin were classified to the following groups: health, quality, quantity, ecosystems, governance. Recommendations on measures for addressing these issues were provided.

Water Quality Monitoring of Lake Sevan with Remote Sensing

A. Harutyunyan

AUA Acopian Center for the Environment, American University of Armenia

a.harutyunyan@aua.am

Anthropogenic pollution coupled with global climate change-derived high temperatures resulted in an extremely strong eutrophication process in Lake Sevan in summer of 2018. The prognosis for the repeated eutrophication events in this lake suggest the need for continuous monitoring of these events.

Here I suggest application of remote sensing technology for monitoring water quality parameters and changes in Lake Sevan with an aim of establishment of continuous monitoring process and subsequent decision making process for the Lake Sevan ecosystem health and functioning. Currently, no systematic efforts and capacity of remote sensing in water bodies in general and Lake Sevan in particular exist in Armenia.

Remote sensing imagery can help to monitor and forecast the eutrophication events for understanding impacts on the ecosystem and/or human health. Remote sensing observations can inform water resource managers where to apply their sampling effort to verify the presence of eutrophication and can be used as a data layer to integrate into models or forecasting systems. Satellite imagery can be used to derive several of the water quality properties such as:

- Physical Properties: Color, Temperature, Turbidity, Total Suspended Matter
- Chemical Properties: Salinity, Dissolved Oxygen
- Biological Properties: Algal Bloom, Organic Carbon

Since the main biological parameter describing the eutrophication of lake water quality is phytoplankton biomass, the photosynthetic phytoplankton pigment chlorophyll-a was used in this study.

Freely available Sentinel-2 MSI (MultiSpectral Instrument) sensor data from the Copernicus program were used, which are jointly operated by the European Space Agency (ESA) and the European Commission. The data are available in the Copernicus Open Access Hub.

Changes of Geo-Environmental Conditions of the Artesian Ararat Basin as a Result of Large-Scale Water Intakes

R. Minasyan[1], H. Igityan[2], R. Karamyan[3]

[1] *"Hydroscope" Scientific Research Company LTD, Armenia*
[2] *Institute of Geological Sciences, NAS, Armenia*
[3] *Institute of Geophysics and Engineering Seismology after A. Nazarov of NAS, Armenia*

hydroscope2006@yahoo.com

Recently, intense use of underground water resources in the artesian Ararat basin has led to the formation of an entire complex of man-made processes that have influenced and changed the natural geo-environmental situation in the area. The following must be considered among the most active impacts: a) Drastic reduction of seam pressure in the productive artesian water-bearing horizon, resulting in almost 3-fold reduction of the area of self-pouring wells, and drying of many springs, has actually deprived a number of settlements of the sufficient quantity of underground water used for irrigation and potable water supply. b) Constant drop of the piezometric level of underground waters has been observed to cause formation of depression craters, in places covering areas more than several square kilometers in size; c) In individual areas, reduced level of underground waters in the near-surface water-bearing horizon has led to dewatering of the soil stratum and depression (and, possibly, loss) of vegetation and over-draining of the adjacent agricultural lands: the observed effects of secondary consolidation of the dried-up loose near-surface rocks result in day-surface deformations and effects of subsidence of individual buildings and structures. The complicated geo-environmental situation that has developed in the area of the artesian Ararat basin calls for urgent actions aimed to restore settings of the natural terrain and to develop measures ensuring reasonable management of water resources in the area.

“Blooming” of the Microalgae of Phytoplankton as an Indicator of the Instability of Lake Sevan (Armenia) Ecosystem

L. Hambaryan[1,2], L. Stepanyan[1], T. Khachikyan[1]

[1]*Institute of Hydroecology and Ichthyology of the Scientific Center of Zoology and Hydroecology, NAS, Armenia*

[2]*YSU Department of Ecology and Natural Protection, Armenia*

lusinehambaryan@ysu.am/lus-ham@yandex.ru; listeus@mail.ru; tkhachikyan@mail.ru

Microalgae “blooming” have influence on the physico-chemical and biological parameters of water quality. The morphometric changes of Lake Sevan caused instability of ecosystem. As a result of the water level fluctuations (for example the water level of Lake Sevan has been lowered more than 20m and since 2002 the water level has been increase more than 3m), an increase of anthropogenic impact as well as climatic change leads to an increase of water temperature of the reservoirs which caused unpredictable succession processes and development of monodominant species in phytoplankton community. The domination of the eutrophycator species in the plankton is considered to be a sign of the eutrophication of the reservoir. Intensive algae "blooming" was recorded in summer of 2018, which was caused by the cyanobacteria Anabaena flos-aquae (66 g/m^3). The most development of the blue green algae was registered in the coastal zone. In autumn the “blooming” was caused by diatomic algae Melosira granulate (11 g/m^3). During summer “blooming” the surface water temperature was 20-23 °C, the transparency decreased by 3 times compared to this period of the last year and was about 2 m. The amount of phosphates during the period of intense “blooming” of cyanobacteria was 0.08 mg / l, and the amount of nitrate ions was 0.18 mg / l.

Space shooting of the lake made it possible to estimate the extent of “blooming”, the transformation of biomass and areas of the most development of algae, which monitoring investigations will allow predict the phytoplankton “blooming” in the early stage.

Long-Term Hydrochemical Study of Groundwater in Ararat Valley

L. Margaryan

Yerevan State University, Armenia

liana_margaryan@yahoo.com

Ararat Valley artesian basin is the largest underground freshwater reserve in the Republic of Armenia. The underground water is used by up to 30 communities for drinking water supply; therefore, any significant changes in water quality are sensitive and can lead impact on public health.

The purpose of this work is to investigate the hydrochemical quality changes of groundwater in Ararat valley from 2012-2017 compering with background monitoring data for 1981. The study was carried out for groundwater wells which supplied drinking water to 16 communities in Masis region, Ararat Marz and 9 communities in Armavir region, Armavir marz. The concentration of main ions, mineralization and total hardness were tested in water samples. The water test results were compared with the background water monitoring data conducting in 1981. In addition, correlation was reveled between changes in water mineralization and water level for 2 observation points from the period of 1981-2017.

According to the study results, the groundwater in the Masis and Armavir region was characterized by high mineralization with a predominance of calcium, magnesium and hydrocarbonates, and high total hardness, which 1.3-2.5 times exceeded the drinking water norms set up in Armenia. The highest level of mineralization and total hardness were observed in the well supplied drinking water to Miasnikyan community in Armavir region: as of 2017, mineralization of water was above 2000 mg/l, which twice exceeded the drinking water national norm (1000mg/l) and 5 times the US EPA and the WHO drinking water norm (500 mg /l)). The long-term (1981-2017) hydrochemical observation of groundwater quality in two observation points was showed 1.5-3.1 times increase in mineralization and up to 9.2 times decrease in water level, 32% of which were observed only in 2013-2015.

Sustainable Water Management in Armenia: Challenges and Opportunities

L. Taslakyan

College of Natural Resources, University of Idaho, USA

lusine.taslakyan@gmail.com

It is considered that Armenia has sufficient water resources, however river runoff has significant variability during the year, and available water resources are not distributed evenly throughout the country. Water scarcity in dry regions is exacerbated by the climate change. Hence, efficient management of water resources in Armenia is vital for healthy ecosystems and economic development. The two water "hot spots" waiting for urgent actions are Lake Sevan with eutrophication problem and groundwater depletion in Ararat Valley. Due to absence of wastewater treatment facilities water bodies are polluted by municipal and industrial sources.

Lake Sevan faces serious ecological issues originated back in 1930s due to shortsighted decisions made by the central Soviet government, decreasing the level by 20 meters. The lake ecosystem was disturbed by the decreased water volume and increased nutrient load. Wetland areas in the basin have dried, important spawning sites for endemic trout were lost, resulting in extinction of the two subspecies.

Groundwater resources in Armenia comprise 40% of total water withdrawals, are of good quality and provide 96% of potable water in the country. Rapid development of fish farms in Ararat Valley since 2006 led to groundwater depletion in Ararat Artesian Basin, with decreased level on average by 6–9 meters, in some places by 15 meters, leaving dozens of rural communities with potable and irrigation water issues.

Number of policy documents and legal acts were adopted in the Republic of Armenia after the independence. Relevant institutional framework is in place, Basin Management Districts are delineated, development of Basin Management Plans is underway, and Water Use Permitting (WUP) system has been introduced. However, lack of implementation and enforcement are serious issues hindering efficient management of water resources in the country. Insufficient monitoring of water quality and quantity lead to inadequate data collection and weak information management.

Introduction of low cost water treatment technologies, improved monitoring networks, cooperation among different agencies and enhanced transparency, especially in the WUP issuance process, with real public participation mechanisms would be critical for improved implementation of Integrated Water Resources Management in Armenia.

The Investigation of the Hydrochemical Parameters of Vayots Dzor's Several Natural Monuments

M. Voskanyan[1], M. Nalbandyan[2]

Yerevan State University, Armenia

marinecolog@yahoo.com[1]; martirosnalbandyan@gmail.com[2]

Republic of Armenia is not only rich with its surface water resources, but also with underground water, which has different chemical compounds. Groundwater is the most abundant source of fresh water on the Earth. In recent years, the protection of water resources in Armenia has become very urgent due to the development of the mining industry and the ever-growing fish breeding complexes. Taking into account all of these, the necessity to maintain, manage and effectively use the environmentally-friendly water resources becomes apparent.

The main objective of the paper is investigation of hydrochemical parameters of three hydrogeological natural monuments located in Vayots Dzor. The parameters for the analysis were selected based on the main characteristics of existing brands in the market of mineral water, as well as the requirements for drinking water in Armenia.

The result of investigation of literature resources and lab-analyses data shows that the water of two nature monuments could be classified in drinking water category and the water of the source third nature monument after appropriate medical and health investigation, as a healthful mineral spring water, because the values of indicators are significantly higher than the values of other sources. So, the therapeutic and health investigation of hydro geological natural monument of the water of "The source Grav" should be further done by the Ministry of Health,

The water of the three monuments are strategic reserves of fresh water, but most of it is not used efficiently and mingling with river or local sewage networks, it loses its hydrochemical quality indicators.

Lake Sevan in the Management of Water Resources of the Ararat Valley and the Importance of the State of Its Ecosystem

P. Tozalakyan

Institute of Geological Sciences, NAS, Armenia

tozalakyan@mail.ru

The Ararat valley occupies 4% of the territory of Armenia and provides 40% of the country's agricultural production. The artesian aquifers located in the Armavir and Ararat marzes of Armenia is strategic reserve of excellent fresh water of the republic.

In the 2000s, there was a drastic increase in fish farming: during the peak period, 235 fish farms were established, resulting in the need of 1.7 billion cubic meters of high-quality water.

Even after some decline in fish farming, when the number of fish farms was reduced to 135, their need of water was 1.359 billion M^3, whereas the self-recovery potential of these aquifers was 1.226 billion M^3. As a result, the groundwater area decreased by 30%, and it`s level dropped by 5-15 m. Water from the mountainous lake Sevan was directed to the Ararat valley through the river Hrazdan and the cascade of power stations on it, because it considered as an easiest way to compensate the lack of groundwater.

However, Lake Sevan is not a simple reservoir of fresh water. Water quality in the lake and its ecosystem are closely interrelated, but this ecosystem itself is extremely important for Armenia. It was, and continues to be, under strong natural and anthropogenic pressure.

The main natural impacts include: the geochemical composition of the basin and the lake bottom, their active tectonics, gas emissions through faults, and climate change.

Anthropogenic impacts, unlike natural ones, can be affected by human. The following examples of anthropogenic impacts can be listed: artificial changes of the water level in the lake, human economic activity on and around the lake, the problem of household and agricultural waste in the Sevan basin.

The geochemistry of the bottom and the water temperature determine the quality of water (chemical composition of water) in certain areas of the lake; temperature and hydrological regimes, the configurations of the lake and its bottom regulate the mixing of water and the properties of the lake's ecosystem. Any seemingly minor changes are fraught with violations of the elements of the ecosystem.

Preserving the lake's ecosystem is strategically important for the survival of Armenia. In 1990s, during an acute energy crisis and transport blockade, the water reserves of Lake Sevan made it possible to produce electricity in the Hrazdan cascade, and also the lake's bio-resources saved many people from famine.

Thus, the approach to water management in the Ararat Valley in the face of climate change has to be comprehensive and should take into consideration the state of the Lake Sevan ecosystem. It should cover well-known water saving measures, including the rational use of water resources, application of efficient irrigation methods, reuse of already utilized water and the maximum use of the potential of water storage. At the same time, when using the waters of Lake Sevan, limits of water discharges established by the RA law should be strictly kept.

Ararat Artesian Basin Hydrodynamic Condition and Re-Evaluation of Exploited Groundwater Resources

R. Minasyan, G. Mkhitaryan, G. Torosyan, A. Gevorgyan

"Hydroscope" Scientific Research Company LTD, Armenia

hydroscope2006@yahoo.com

In the present work, the effects of the "man-nature" relationship are observed, particularly, in the center of the Armavir artesian basin, Armavir depression where due to the long-term consumption of inadmissible amounts of water led to a significant decrease in the exploited groundwater resources. Firstly, current situation requires to clarify the area so as to adjust new hydrodynamic requirements. New cartographic materials and new calculations have been made for the solution of the problem, the geophysical scheme of the area has been implemented, ie the mathematical model of the Armavir depression, which is the studied area basin, has been developed. As a result, the following data are obtained: a) a map of pressure water-bearing horizon hydroisogips is compiled corresponding to present geodynamic conditions of the area, which is compared with similar map compiled on the data of experimental wells, b) in the wells operating in this area, the values of permissible groundwater reductions level were determined, c) in order to effectively exploit water collecting wells, the values of their depression surface are determined, and hence interwell optimal distances, e) it is proposed to carry out similar studies for the other two Ararat water basins - Artashat and Araksavan hydro-geological depressions. The re-evaluation of the present value of the underground water resources of the entire basin has become a priority issue. The solution of the problem can be achieved by application the mathematical modeling hydraulic method and previously used hydraulic method.

Water-Balance Calculation of Deep Wells in Ararat Valley, in the Context of the Changing Irrigation Systems in Armenia

S. Khachatryan[1], Y. Vardanyan[2],

[1]*National University of Architecture and Construction of Armenian (NUACA), "Modul" LLC, Armenia*

[2]*National University of Architecture and Construction of Armenian,*

stepan.v.khachatryan@gmail.com[1]; e_vardanyan2002@yahoo.fr[2]

Study of technical condition of irrigation systems and assessment of required investment needs was done by NUACA and "Modul" LLC, financed by the World Bank (WB) in 2018. Within the framework of the project, the technical condition of about 450 deep wells were investigated under the operation of Ararat, Armavir, Artashat, Shenik and Vagharshapat Water Use Associations.

Based on the results of the study, the water level of the aquifers in deep wells, the economic productivity of the deep wells and their efficiency were analyzed.

Particularly, the spatial changes of water level in the aquifers, the electricity used by pumps at the deep wells per WUA and the efficiency of the pumping, were evaluated, in frame of possible impact of nearby irrigation canals (water sources).

Upgrading Small and Medium-Scale Aquaculture Farms in Ararat Valley into Semi-Closed Recirculating Aquaculture Systems: Environmental and Economic Aspects

L. Tadevosyan[1], N. Mirzoyan, N. Avetisyan, Sh. Mirakyan, V.Urutyan

International Center for Agribusiness Research and Education (ICARE), 74 Teryan str., 0009 Yerevan, Armenia

lusinet@icare.am[1]

Following the unusual boost in fish farming in Armenia in the beginning of millennia, most of aquaculture production in the country has been located in Ararat valley, contributing to decreased viability of groundwater aquifers.

In response to observed reduction in water availability in Ararat valley, starting in 2013, new policies and stricter regulations for water use were enacted, including promotion of semi-closed Recirculating Aquaculture Systems (RASs) instead of traditional flow-through configurations.

Implementation of intensive semi-closed RASs for sustainable groundwater use in Ararat valley, Armenia, might be difficult, if not impossible in real-life scenarios, where technological complexity of these operations and large initial construction costs play a major role. If these issues can be easily overcome by large aquaculture farms with high production volumes and revenues, the economic viability of small- and medium-scale farms might be challenging. Additionally, while water use reduction is the main goal of the implementation of RAS configurations, the negative environmental impact of excess pollutant loads as a result of intensification is not considered.

Here we will discuss the real-life scenarios of potential upgrades in 15small- and medium-scale aquaculture farms into semi-closed RAS configuration, and the suitability of these modifications in both environmental and economic aspects.

Climate Change and Water Resource Management in Armenia: Adaptation Strategies for Disaster Risk Management

V. Khondkaryan

Western Survey for Seismic Protection MES, Armenia

khondkaryan@yahoo.com

One of the problems of climate change is degradation of natural and man-made ecosystems, which is mainly conditioned by the reduction of water resources. Disaster risk increases because of the impact of climate change. I order to confront climate change, it should be developed the capacities to adapt to predictable effects. However, the lack of our knowledge makes it difficult to solve the problem. Reservoirs as water bodies are the most important component of water resources. Water management should be a central element in climate change adaptation strategies. During the first years of the 21st century, thousands of lives and billions of dollars were lost around the world as a result of natural disasters related to water resources. The construction and operation of dams is a potential source of danger: the destruction of dams can cause enormous damage to society and the environment. Maintaining dam safety requires proper management of all safety elements, in particular, maintenance, elimination of identified deficiencies, replacement of aging dam components and modernization of monitoring systems. Most of the Armenian dam, whose average age exceeds 50 years, were built in the past century with underestimated real danger of accident. The practice of dam management and operation should constantly adapt to changing conditions throughout whole operation of the dam.