

G. Darchidze

*SOURCES OF POLLUTION OF SURFACE WATERS, DEVELOPMENT OF RECOMMENDATIONS FOR THEIR DETECTION AND DEVELOPMENT OF PREVENTION METHODS*

UDC – 504.453

**SOURCES OF POLLUTION OF SURFACE WATERS, DEVELOPMENT OF RECOMMENDATIONS FOR THEIR DETECTION AND DEVELOPMENT OF PREVENTION METHODS**

**Guram Darchidze**

Technical University of Georgia

Tbilisi, Merab Kostava st. N68

e-mail: [darchidz1995@gmail.com](mailto:darchidz1995@gmail.com)

ORCID iD: 0000-0002-7597-856X

Georgia

<https://doi.org/10.56243/18294898-2024.1-91>

**Abstract**

The problem of water pollution is becoming more and more urgent for the whole world. Unfortunately, Georgia is not an exception, where water sources, despite their number, are small and a significant part of them is polluted.

Unlike contamination of industrial wastewater treatment plants, which comes from multiple diffuse sources, biological contamination results from the movement of precipitation or snowmelt onto and into the soil. As runoff moves, it collects and transports natural and anthropogenic pollutants and deposits them in rivers, groundwater, or lakes.

Special attention should be paid to the biological pollution of water sources, which occurs as a result of washing or flushing of sources of anthropogenic biological pollution with rain and melt water. After entering the water environment, under favorable conditions, pathogenic organisms can multiply rapidly, which poses a threat to the environment.

Contamination of water sources is a major cause of water quality problems. The impact of source water contaminants on specific waters varies and cannot always be fully assessed. However, we know that these pollutants have harmful effects on drinking water supplies and wildlife.

That is why it is necessary to find the source of biological pollution of water in order to develop an effective method of its elimination.

**Keywords:** river, wastewater, Adjara region, water sources, pollution.

**Introduction**

Water pollution is one of the most important problems that people are trying to solve these days in a variety of ways. Despite the measures taken to improve wastewater treatment methods, the issue remains relevant. One of the most common is biological pollution, directly related to the entry of pathogenic microorganisms, bacteria, viruses and protozoa into water [1], [12].

G. Darchidze

**SOURCES OF POLLUTION OF SURFACE WATERS, DEVELOPMENT OF RECOMMENDATIONS FOR THEIR DETECTION AND DEVELOPMENT OF PREVENTION METHODS**

The main sources of contamination include wastewater [2]. Their bacterial contamination is characterized by the coli titer value, that is, the volume of water in milliliters that contains E. coli. This type of pollutant is most often found in domestic and wastewater from factories, wool washers and hospitals.

**Conflict Setting**

The purpose of the research is to study the sources of surface water pollution, develop recommendations for their identification and treatment methods.

**Research Results**

Organic compounds and microorganisms can enter both surface and groundwater, causing serious damage to ecosystems. The danger is primarily caused by pathogens of infections and diseases that negatively affect the health of people and animals. In the worst-case scenario, they can lead to total or irreversible consequences [3].

Organic pollutants include substances of plant, animal and chemical origin. The first category is the remains of vegetables, fruits, paper, the second is waste products of humans and animals, as well as various fatty and muscle tissues. Chemical pollutants are a particularly dangerous category, represented by petroleum products, pesticides and various industrial wastes [4].

Of the 341 studied water sources in Adjara, 144 were contaminated with E-Coli pollution (Tab. 1), 10 of them were marked by the presence of household waste, and in 2, turbidity was periodically observed (Tab. 2) [5].

**Table 1.****Number of rivers contaminated with E-Coli**

Municipality	Number of polluted sources	Number of unpolluted sources	Total
Kobuleti	40	34	74
Khelvachauri	17	52	69
Keda	17	45	62
Shuakhevi	19	43	62
Khulo	23	23	46
all	144	197	341

Petroleum oils cause the greatest harm to water in open sources, as they are extremely persistent pollutants and can spread over long distances [6]. The most dangerous are the light fractions, which actually completely stop gas exchange between water and the atmosphere, forming a film. Within one country, pollution with such substances can be local or regional [7].

G. Darchidze

**SOURCES OF POLLUTION OF SURFACE WATERS, DEVELOPMENT OF RECOMMENDATIONS FOR THEIR DETECTION AND DEVELOPMENT OF PREVENTION METHODS**

Everyone knows the fact that on the territory of the city of Batumi there were oil refineries and chemical plants, on the territory of which the depreciated old systems still pollute the Baartskhanistskali and Kubistskali rivers (Fig. 1) [8].

**Table 2.****Number of rivers with high turbidity**

Municipality	Number of polluted sources	Number of unpolluted sources	Total
Kobuleti	44	30	74
Khelvachauri	37	32	69
Keda	45	17	62
Shuakhevi	32	30	62
Khulo	31	15	46
all	217	124	341

**Fig. 1. Source of oil pollution in the Baartskhanistskali and Kubistskali rivers.**

Water contamination with bacteria and pathogenic microorganisms can lead to outbreaks of dangerous intestinal diseases. This is possible primarily if the quality of the treatment systems is insufficient or if they are absent. For this reason, third world countries are considered the main centers of such diseases. In this case, the danger may come not from the drinking water itself, but from the organisms living in it and the compounds formed as a result of various reactions.

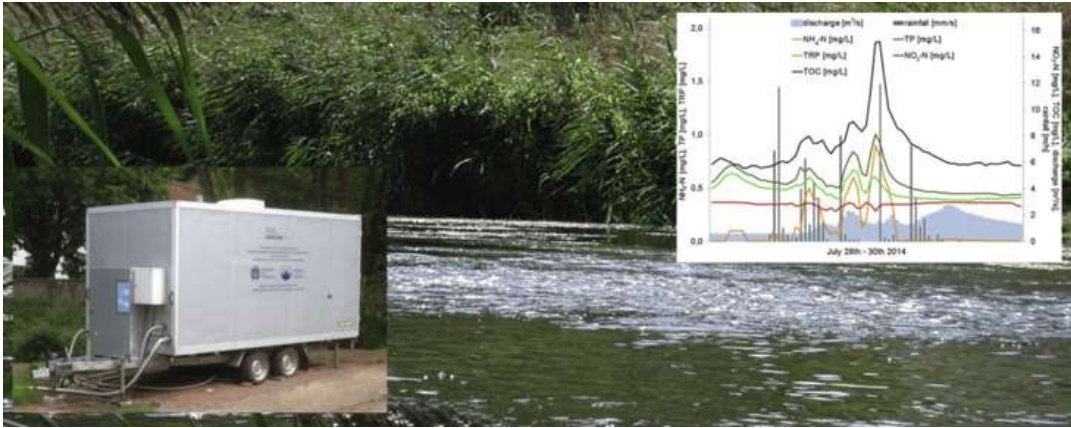
Among them is hydrogen sulfide, a substance that can cause serious harm to the body if formed outside the human body. In this case, it is extremely toxic and can affect various organs, including the liver and stomach. Sometimes, to suffer from bacterial contamination, it is enough to wet your hands or food, but the substance produces an unpleasant odor [9], [11].

According to the studies of the London School of Hygiene and Tropical Medicine, one of the most common methods of cleaning water from microbiological contamination in the household environment is boiling. It kills 85 to 99% of bacteria [12], that die at high temperatures, but do not make the water suitable for drinking. Biological pollutants can also

G. Darchidze

**SOURCES OF POLLUTION OF SURFACE WATERS, DEVELOPMENT OF RECOMMENDATIONS FOR THEIR DETECTION AND DEVELOPMENT OF PREVENTION METHODS**

be removed using electrocoagulation and electroflotation in electrolyzers. During purification, contaminants are absorbed by aluminum and iron hydroxides formed during the process and are then removed through sedimentation, flotation or filtration [5].



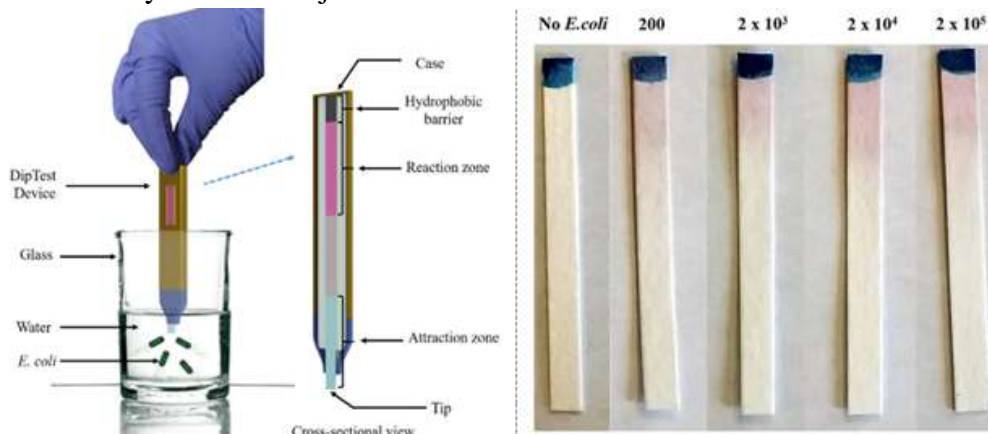
**Fig. 2 Mobile station for water quality monitoring and a sample of typical output of this station.**

To identify biological contaminants in the age of modern technological boom, we can use:

1. Traditional laboratory tests in accredited laboratories, which are time-consuming and require on-site processing of samples (see process description below);
2. Technological innovation "portable TLF sensors" working on site 24/365, which shows the change in the level of *E. coli* pollution in the swimming areas of the sea (Fig. 2) [12];

3. DipTest method - in the sample taken from the water source, pre-prepared litmus-like impregnated paper (with dimensions 70mm\*5mm) is placed and observed which area of the paper will be colored (Fig. 3). With this method, it is possible to determine the level of pollution in 60-65 minutes [13];

4. On the banks of the rivers, it is possible to place a sensor device, the sensors of which perceive *e. coli* content in water and records it, but it should be noted that this device is new and its accuracy is still a subject of research.



**Fig. 3 Methodology of research and Concentration on *E. coli* increases**

G. Darchidze

**SOURCES OF POLLUTION OF SURFACE WATERS, DEVELOPMENT OF RECOMMENDATIONS FOR THEIR DETECTION AND DEVELOPMENT OF PREVENTION METHODS**

Among the listed methods, traditional laboratory studies stand out among the most common ones, but its main disadvantage is still time-consuming, when field laboratory studies range from 60 to 120 minutes. However, it should be noted that the laboratory analysis compared to other types of research gave us 100% accuracy, which is a very important factor.

Rehabilitation measures should be carried out immediately after river pollution. These measures vary depending on the type of pollutant.

- One of these measures is mechanical cleaning. For this purpose, disposal of solid waste discharged into rivers is carried out using containment and collection devices/devices.

- Another most common practice is phytoremediation. Several species of plants are used to effectively remove heavy metals from polluted rivers. For example, Eichhornia crassipes (water lily) is used to absorb cadmium and copper. Similarly, the symbiosis of blue-green algae Azolla-anabena and Azolaii is used for bioremediation of rivers polluted with arsenic and other metalloids[9].

- Some types of bacteria and derivatives of some fungi are used to break down pollutants in rivers (biodegradation). Acintobacter, Pseudomonas, Imycobacter species destroy alkanes, monoaromatic and polyaromatic substances, respectively[10].

- The study of the state of water sources and the development of recommendations for the treatment of waste water, taking into account the existing modern technologies, should continue the research.

### **Conclusion**

Based on all of the above, it is recommended to arrange periodical or permanent mode research points on the rivers to monitor them to determine the level of pollution. The selection of the mentioned points and the selection of the research type require additional studies, which we will propose in future editions.

**This research [N PHDF-22-2127] has been supported by Shota Rustaveli National Science Foundation of Georgia (SRNSFG)**

### **References**

1. Appendix of the Chorokhi-Acharishkali Basin Management Plan: Coastal and transitional waters. EU Water Initiative Plus for Eastern Partnership Countries (EUWI+): Outcomes 2 and 3 ENI/2016/372-403. Tbilisi, Consortium of Member States of the European Union, Austrian Environment Agency, Vienna, Austria, 2021, 197 pp.;
2. Pavliashvili N. "Anthropogenic transformation of the territory of Adjara." Qualifying work for the master's degree in geography, TSU, Tbilisi, 2013, 70 pp.;
3. Trapaidze V. Training course on water resources, TSU 2012
4. Megrelishvili Z., Kifiani G., Didmanidze I., Chkhubiani D., Darchidze G., Field monitoring of Adjara rivers, SCIENTIFIC-TECHNICAL JOURNAL "BUILDING" N3(67), 2023 Tbilisi, <http://openlibrary.ge/handle/123456789/10379>;

G. Darchidze

**SOURCES OF POLLUTION OF SURFACE WATERS, DEVELOPMENT OF RECOMMENDATIONS FOR THEIR DETECTION AND DEVELOPMENT OF PREVENTION METHODS**

5. Darchidze G., Kifiani G., Natsvlishvili M. Field monitoring of Adjara rivers, SCIENTIFIC-TECHNICAL JOURNAL "BUILDING" N3(67), 2023 Tbilisi, <http://openlibrary.ge/handle/123456789/10379> ;
6. Tokmajyan V.H., Azizyan L.V., Avanesyan E.V., Tokmajyan S.H. The impact of the development of irrigation infrastructure in mountainous regions on the environment //Scientific-technical journal "Building", N3(67), 2023, Tbilisi, <http://openlibrary.ge/handle/123456789/10379>;
7. Inventory of water reserves of Georgia, IORDANISHVILI I., GAVARDASHVILI G., IREMASHVILI I., VARTANOV M., IORDANISHVILI K., Tbilisi, Georgia, UNIVERSAL Publishing House, 2018, 260 pp.
8. Kifiani G., Darchidze G., Study of the centers of pollution of flowing rivers in populated areas of Adjara, International Conference of Young Scientists "Modern Problems of Earth Sciences" - (2022), <http://openlibrary.ge/handle/123456789/10224>;
9. Darchidze G., Chkubiani D., A complete study of the bed of the "Tibeta water" river in the village of Tibeta in the Adjara region to identify the source of E.coli contamination, International Conference of Young Scientists "Modern Problems of Earth Sciences" - (2022), <http://openlibrary.ge/handle/123456789/10224>;
10. Darchidze G., Rivers with the main catchment basins of Adjara Laboratory study of the level of fecal contamination, INTERNATIONAL SCIENTIFIC CONFERENCE "Geophysical Processes in the Earth and its Envelopes" Dedicated to 90-th Anniversary of Mikheil Nodia Institute of Geophysics of Ivane Javakhishvili Tbilisi State University Tbilisi, Georgia, November 16-17, 2023, <http://openlibrary.ge/handle/123456789/10379>;
11. #Envision2030: 17 Goals To Transform The World For Persons With Disabilities, <https://www.un.org/development/desa/disabilities/envision2030.html>, was checked last time on 2024-01-03;
12. mobile station for water quality monitoring and a sample of typical output of this station. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2829912/#R5uun>, was checked last time on 2024-01-03;
13. DipTest: A litmus test for E. coli detection in water, <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0183234>, was checked last time on 2024-01-03.

**ՄԵՐԿԵՐԵՎՈՒԹՅԱՆ ՋՐԵՐԻ ԱՂՏՏՈՏՄԱՆ ԱՂԲՅՈՒՐՆԵՐԸ. ԴՐԱՆՑ  
ՀԱՅՏՆԱԲԵՐՄԱՆ ԱՌԱՋԱՐԿՈՒԹՅՈՒՆՆԵՐԻ ԵՎ ԿԱՆԽԱՐԳԵԼՄԱՆ  
ՄԵԹՈԴՆԵՐԻ ՄՇԱԿՈՒՄ**

**Գուրամ Դարչիձե**

*Վրաստանի տեխնիկական համալսարան*

Ջրի աղտոտվածության խնդիրն ավելի ու ավելի հրատապ է դառնում ողջ աշխարհի համար: Ցավոք, բացառություն չէ Վրաստանը, որտեղ ջրային աղբյուրների

G. Darchidze

**SOURCES OF POLLUTION OF SURFACE WATERS, DEVELOPMENT OF RECOMMENDATIONS FOR THEIR DETECTION AND DEVELOPMENT OF PREVENTION METHODS**

զգալի մասն աղտոտված է: Ջրի աղբյուրների աղտոտումը ջրի որակի խնդիրների հիմնական պատճառն է: Այդ պատճառով անհրաժեշտ է գտնել ջրի կենսաբանական աղտոտման աղբյուրը՝ դրա վերացման արդյունավետ մեթոդ մշակելու համար:

Առանձնահատուկ ուշադրություն պետք է դարձնել ջրային աղբյուրների կենսաբանական աղտոտմանը: Ջրային միջավայրում հայտնվելով բարենպաստ պայմաններում ախտածին օրգանիզմները կարող են արագորեն բազմանալ, ինչը լուրջ վտանգ է ներկայացնում շրջակա միջավայրի համար:

**Բանալի բաներ.** գետ, Աջարիայի շրջան, աղբյուրներ, աղտոտվածություն, կեղտաջրեր:

**ИСТОЧНИКИ ЗАГРЯЗНЕНИЯ ПОВЕРХНОСТНЫХ ВОД: РАЗРАБОТКА РЕКОМЕНДАЦИЙ ПО ИХ ОБНАРУЖЕНИЮ И МЕТОДОВ ПРОФИЛАКТИКИ**

Гурам Дарчидзе

Грузинский Технический университет

Проблема загрязнения воды становится все более актуальной для всего мира. К сожалению, Грузия не является исключением, где источники воды, несмотря на их количество, невелики и значительная их часть загрязнена.

В отличие от загрязнения промышленных очистных сооружений, которое происходит из нескольких диффузных источников, биологическое загрязнение возникает в результате перемещения осадков или талого снега на почву и в нее. По мере движения сток собирает и переносит природные и антропогенные загрязнители и откладывает их в реки, грунтовые воды или озера.

Особое внимание следует уделить биологическому загрязнению водных источников, которое происходит в результате промывки или промывки источников антропогенного биологического загрязнения дождевыми и талыми водами. Попадая в водную среду, при благоприятных условиях болезнетворные организмы могут быстро размножаться, что представляет угрозу для окружающей среды.

Загрязнение источников воды является основной причиной проблем с качеством воды. Воздействие загрязнителей исходной воды на конкретные воды варьируется и не всегда может быть полностью оценено. Однако, мы знаем, что эти загрязнители оказывают вредное воздействие на запасы питьевой воды и дикую природу.

Вот почему необходимо найти источник биологического загрязнения воды, чтобы разработать эффективный метод его устранения.

**Ключевые слова:** река, сточные воды, Аджарский регион, водные источники, загрязнение.

Submitted on 03.01.202

Sent for review on 11.01.2024

Guaranteed for printing on 25.03.2024