The protection of Borjomi mineral waters and the preservation of ecological stability from external impacts

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Abstract: Borjomi mineral waters are one of the most important natural resources in Georgia, and their protection and the preservation of ecological stability are crucial for both the local population and the country's economy. However, the Borjomi springs are exposed to various external impacts, including erosion, landslides, flooding, and other anthropogenic factors, which negatively affect water quality and ecosystems. This paper discusses the issues of protecting Borjomi mineral waters, analyzes them, and examines the methods developed to preserve the ecological stability of this spring. The protection of Borjomi mineral waters and the maintenance of ecological stability is a contemporary challenge that requires a multifaceted approach and comprehensive measures. Based on our research and developed methods, it is possible to create a sustainable model that ensures the long-term protection of Borjomi waters and their ecological stability.

Keywords: Borjomi mineral waters, ecological stability, natural resources, environmental protection.

Introduction

Mineral waters are in special geographical conditions, where the development of the landscape infrastructure is often related to environmental protection issues. Solving these issues will contribute to the resolution of several socio-economic-demographic and other problems. As a result of the above, mineral springs are often located in the zones of the hydrological network of water catchment basins, which exposes them to negative impacts, such as floods, water erosion, mudflows, snow avalanches, and landslides, requiring protection against these phenomena. The normative functioning of these springs is directly related to environmental protection measures and the resolution of several tasks.

Main Part

The mineral water of Borjomi is located in the Borjomi district. Borjomi mineral water - a magical elixir flowing from the depths of the earth, is globally renowned for its healing properties. Originating from the Caucasus at a depth of 8,000 meters, it contains up to 60 minerals, explaining its unique attributes. Borjomi is a multifaceted balneological resort and ranks first among mountain resorts.

The resort of Borjomi is home to hotels and various recreational houses. There is a mountain-skiing sports base, as well as the best balneological resorts: Tskhvareri, Likani, Tsemi, Akhaldaba,

Bakuriani, and the Gudaretis resort group. Other notable recreational places include Tsikhisjvari, the town of Tba, and others. Additionally, there are significant settlements such as the village of Dviri, Borjomi Gorge, Atskhuri, and others (Galdava, M. 2014).

The primary sectors of the economy are resort management, industry, agriculture, and transportation. The northern part of Borjomi is crossed by the Transcaucasian Railway, with a branch line from Khashuri to Borjomi and Akhaldaba.

The hydrological network of the study area is represented by rivers: the Mtkvari, Tskherimela, Dzama, and mountain streams. The Mtkvari River crosses the central part of the district. The city of Borjomi is equipped with water supply, sewage systems, and flood-prevention structures. The coastal zone is lined with protective walls, which are often subject to natural disasters.

The mineral water of Borjomi is located in the transit area of the Borjomula River. The Borjomula River originates in the northeastern part of Tsikhisjvari village at an altitude of 1600 meters above sea level and is a tributary of the Mtkvari River. The river is 19 kilometers long (Bibilashvili, A. 2016; Lomidze, N., & Zhorzholiani, A. 2018; Kvirikashvili, N. 2015; Pirtskhalava, G. 2017; Gvishiani, T., & Tkeshelashvili, N. 2019; Kharadze, N. 2020).

As a result of the research, a study was conducted on the natural disasters related to Borjomi's water, the evaluation of erosion processes in the water catchment area, the determination of the diameter of the stones transported by the Borjomula River, and the calculation of the dam characteristics formed by landslide events. Based on environmental protection engineering decisions, engineering measures for the protection of the Borjomi mineral springs were developed (Giorgi Natroshvili, Master's thesis).

Despite the existing numerous engineering structures for preventing mudflows, any improvement and creation of new reliable constructions are considered significant achievements. To regulate mudflows, compared to the existing regulatory structures, a system of continuous longitudinal structures has been developed. The advantages of this system over the current one include gradual transformation in the height of the structures, elasticity, high reliability, constructive solutions, and the maintenance of ecological stability in the lower part of the minaret.

One of the effective measures against mudflows is the use of a trampoline-type structure.

A conical-type structure and its description represent a partially permeable construction in the shape of a semi-cone, where the blunt tip of the structure is connected to the main supporting arch through longitudinal supports and forms a trampoline.

The tip and the base of the arch are made of the hardest material, reinforced concrete, while the supports can be made from discarded rails.

Between the blind part of the structure and its end, longitudinal supports connecting the arch are placed on the side surface, creating triangular or trapezoidal shaped through grooves, allowing for the classification of the grain size of the debris carried by the mudflow. The semi-conical shape and construction of the structure make it particularly suitable for catastrophic mudflows. This structure is highly reliable and can be used multiple times.

According to preliminary data, the construction and installation work of this new structure is 3-4 times more efficient compared to the existing ones.

Conclusion

The protection of Borjomi's mineral waters and the maintenance of ecological stability is a modern challenge that requires a multifaceted approach and comprehensive measures. Based on our research and developed methods, it is possible to create a sustainable model that ensures the long-term protection and ecological stability of Borjomi's waters.

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ბორჯომის მინერალური წყლების დაცვა და ეკოლოგიური სტაბილურობის შენარჩუნება გარეგანი ზემოქმედებისგან

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ბორჯომის მინერალური წყლები ერთ-ერთი ყველაზე მნიშვნელოვანი ბუნებრივი რესურსია საქართველოში, რომლის დაცვა და ეკოლოგიური სტაბილურობის შენარჩუნება მნიშვნელოვანია როგორც ადგილობრივი მოსახლეობის, ისე ქვეყნის ეკონომიკისათვის. თუმცა, ბორჯომის წყაროები სხვადასხვა გარეგანი ზემოქმედების ქვეშ იმყოფება, მათ შორისაა: ეროზია, ღვარცოფი, წყალდიდობა და სხვა ანთროპოგენური ფაქტორები, რომლებიც უარყოფითად მოქმედებს წყლის ხარისხსა და ეკოსისტემებზე. ამ ნაშრომში განვიხილავთ ბორჯომის მინერალური წყლების დაცვის საკითხებს, ანალიზსა და იმ მეთოდებს, რომლებიც შემუშავდა ამ წყაროს ეკოლოგიური სტაბილურობის შენარჩუნების მიზნით.

ბორჯომის მინერალური წყლების დაცვა და ეკოლოგიური სტაბილურობის შენარჩუნება თანამედროვე გამოწვევაა, რომელიც მოითხოვს მრავალმხრივ მიდგომას და კომპლექსურ ღონისძიებებს. ჩვენი გამოკვლევებისა და შემუშავებული მეთოდების საფუძველზე, შესაძლებელია შეიქმნას მდგრადი მოდელი, რომელიც უზრუნველყოფს ბორჯომის წყლების ხანგრძლივ დაცვასა და მის ეკოლოგიურ სტაბილურობას.