Establishing a Groundwater Monitoring Network in the Drini i Bardhe River Basin, Kosovo: A Focus on Water Level and Temperature Monitoring

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Abstract Over the past few decades, groundwater has gained global recognition as one of our most important natural resources. Keeping track of groundwater levels helps us better understand how aquifers behave and how they're affected by things like climate change, water use, and land development. That's why setting up long-term monitoring systems is so important for managing groundwater in a sustainable way. Compared to surface water, groundwater has some clear advantages. The Hydrometeorological Institute of Kosovo, which oversees both surface and groundwater monitoring, also played a key role in the project. As part of this effort, 40 monitoring wells were installed across the country's four main river basins: 7 in the Morava e Binçes basin, 8 in the Ibër basin, 8 in the Lepenc basin, and 17 in the Drini i Bardhë basin.The main goal of this network is to keep an eye on how groundwater levels and quality change over time. This information will help improve how water resources are managed, support environmental protection, safeguard public health, and contribute to sustainable development across Kosovo.

Keywords: groundwater, Drini i Bardhe, groundwater monitoring network, groundwater level and temperature

1. Introduction

More than two billion people around the world depend on groundwater for their daily needs, including drinking, hygiene, and farming. About 69% of the groundwater we extract goes to agriculture, 19% is used in industry, and the remaining 12% supports domestic use. Given this heavy reliance, it's essential to understand how groundwater interacts with surface water over time and across different locations. This understanding is especially important for managing water resources effectively at both local and regional levels (Joshi et al., 2018). In many areas, groundwater is the main source of drinking water and plays a vital role in the natural water cycle—particularly in alluvial aquifer systems (Alley et al., 2002; Gleeson et al., 2015). Generally, two main approaches are used to design these networks: hydrogeological and statistical methods (Loaiciga et al., 1992). In Kosovo, the land is divided into four main river basins, each with different geographic and hydrological characteristics. Kosovo's rivers ultimately flow into three seas: the Drini i Bardhë flows to the Adriatic Sea, the Lepenci reaches the Aegean Sea, and the Ibër, Sitnica, and Morava e Binçës drain into the Black Sea (Avdullahi et al., 2022). This paper focuses on developing a groundwater monitoring network specifically to track water levels and temperatures in the Drini i Bardhe river basin.

2. Study area

The study area encompasses the Drini i Bardhe River basin, the largest river basin in Kosovo, covering an area of 4,340.14 km². The Drini i Bardhe River is one of the largest rivers in the country and serves as the primary hydrographic collector of the Dukagjini Plain. This region experiences a moderately continental climate, with Mediterranean influences extending through the Drini i Bardhë Valley. The long-term average annual temperature is 11.6°C.

3. Material and methods

In hydrogeological studies, geophysical methods particularly electrical resistivity techniques play a significant role in groundwater exploration. These methods are highly efficient and rapid in identifying both aquifer and impermeable layers.

Geophysical investigations were conducted at eleven locations within the Drini i Bardhë River basin. These investigations focused on the river alluvium and employed two methods ERT and VES. A total of 87 profiles were completed using ERT, while VES was conducted at 126 locations (Duras et al., 2017). The application of these geophysical methods covered an area of 19 km². The results of these investigations were used to select locations for exploratory drilling (Figure 1). A total of 25 boreholes were drilled at various sites within the Drini i Bardhe basin.

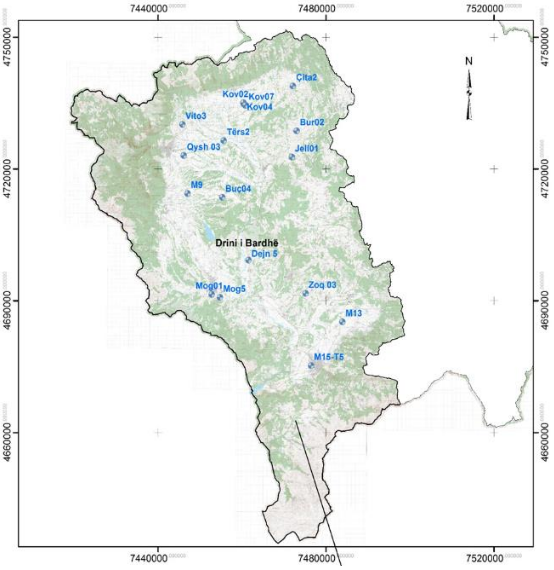

Figure 1: Locations of exploratory boreholes in the Drin i Bardhe river basin

4. Results and discussion

Out of a total of 25 wells located in the Drini i Bardhë River basin, 17 have been selected for inclusion in the groundwater monitoring network. Their distribution ensures comprehensive spatial coverage for groundwater monitoring within the basin. Sensors have been installed in all selected wells to automatically measure groundwater levels and temperature (Avdullahi, 2022).

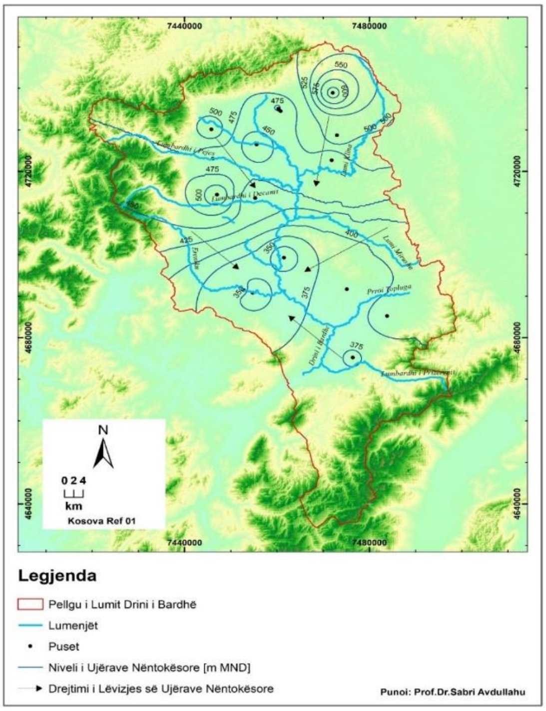

Figure 2: Map of groundwater flow direction

During the sensor installation phase, static groundwater levels were initially measured in all wells. Based on these measurements, a map of hydroisohypses was generated, allowing us to determine the direction of groundwater flow.

At this stage, continuous online monitoring of groundwater level and temperature is available for only three wells. Figure 2 presents groundwater level data from the wells during the sensor installation phase. As shown in the figure, groundwater generally flows toward the river.

5. Conclusion

This monitoring network has focused on studying changes in groundwater levels and temperatures. From a water management perspective, these parameters are essential for making informed decisions based on accurate and high-quality data. The monitoring network in the Drini i Bardhe River basin has been operational for one year. However, complete data on groundwater levels and temperatures are currently available only for the three wells equipped with online monitoring. Data collection for the remaining wells, which are not connected to the online system, has not yet been completed by the Kosovo Hydro-Meteorological Institute.

Future efforts should prioritize data collection from all wells to provide more accurate and comprehensive information on groundwater changes, particularly those influenced by climate change in the basin. Due to the lack of groundwater quality data and information on potential changes in these wells, it has not been possible to make specific recommendations for water resource conservation. In dynamic environments, monitoring groundwater levels is a critical task. All components of the system must be developed and integrated efficiently to achieve a comprehensive, accurate, and practical solution for real-time groundwater monitoring.

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