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Conference Abstract

Assessing the Impact of Land Use and Land Cover on Water Quality: A Case Study of the Rákos Catchment in Hungary

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Abstract

Water quality maintenance is a crucial goal in today's society due to the increasing demand for water resulting from urbanization and population growth. Surface water quality can be impacted by various sources, particularly land uses in the surrounding basin. Land use and land cover (LULC) influence several processes in the water cycle, including interception, infiltration, evapotranspiration, runoff, and water storage. LULC changes can have significant effects on local water resources, including water quantity and quality.

Hungary, despite its abundance of freshwater sources, faces the challenge of pollution in most of its water bodies. This study focuses on the Rákos catchment in Hungary to monitor and analyze its water quality and the effects of land use and land cover on it.

The Rákos stream flows through different land use areas, including residential, industrial, agricultural, forested, and mixed zones, which can influence water quality conditions, especially due to anthropogenic sources. Additionally, the stream receives water from communal wastewater treatment facilities.

The study area was divided into eight sampling points, considering changes in land use. Water samples were analyzed for temperature, pH, electrical conductivity, dissolved oxygen, nitrite, nitrate, ammonium, phosphate, chlorophyll-a, and total cyanobacteria. The monitoring campaign commenced in November 2019 with biweekly data collection, and this paper covers the data collected until November 2021.

To understand the relationship between land use and water quality, land use and land cover information from the Corine Land Cover datasets for 2018 was incorporated. Pearson's correlation analysis was performed to assess the correlations between LULC types and water quality parameters based on monthly and seasonal averages.

The findings from the Pearson's correlation analysis provide valuable insights into the relationships between land use types and water quality parameters in the study area. The significant correlations observed highlight the influence of specific land use categories on water quality, emphasizing the need for effective land management strategies to protect and improve water resources.

Heterogeneous agricultural areas demonstrated positive correlations with nitrite, ammonium, and total dissolved solids, suggesting that agricultural activities in these areas may contribute to elevated levels of these water quality parameters. The use of fertilizers and pesticides in agricultural practices can lead to increased nutrient and sediment runoff, which may explain the observed positive correlations. These findings underscore the importance of implementing best management practices in agricultural areas to minimize potential negative impacts on water quality.

Pasture areas, on the other hand, exhibited negative correlations with nitrate, ammonium, phosphate, and total dissolved solids, suggesting that pasture land may have a filtering or buffering effect on these water quality parameters. Vegetation in pasture areas can help intercept and absorb nutrients, reducing their transport to water bodies. However, the mixed effects observed in pasture land indicate that additional factors, such as grazing intensity and management practices, may also influence water quality outcomes in these areas. Further research is needed to better understand the mechanisms driving these correlations and to develop targeted management strategies for pasture lands.

Industrial-commercial areas, urban fabric, forests, arable land, and pasture showed negative correlations with total dissolved solids but positive correlations with heterogeneous agricultural areas, dumpsites, and transitional woodland. These results suggest that non-agricultural land use types may contribute to lower levels of total dissolved solids in the water, potentially due to reduced sediment and pollutant runoff. However, these land use types also exhibited positive correlations with heterogeneous agricultural areas, dumpsites, and transitional woodland, indicating potential sources of pollution in these areas. Effective pollution control measures should be implemented in industrial, urban, and transitional areas to mitigate their impact on water quality.

Interestingly, green urban areas showed a positive correlation with dissolved oxygen. This finding highlights the potential positive impact of urban green spaces on water quality.

Vegetation in urban areas can enhance oxygenation through photosynthesis and provide habitat for diverse aquatic organisms. Urban planning initiatives that prioritize the incorporation of green spaces and the preservation of natural features can contribute to maintaining healthier water bodies within urban environments.

It is important to note that the correlations observed in this study are based on monthly and seasonal averages, providing a general understanding of the relationships between land use types and water quality parameters. However, temporal variations, such as rainfall events and specific land use practices, may influence these relationships differently. Long-term monitoring and more detailed investigations are necessary to capture the full extent of these dynamics and to develop targeted management strategies for different land use categories.

Overall, the results of the correlation analysis underscore the significance of considering land use types when assessing and managing water quality. This information can guide decision-making processes related to land use planning, agricultural practices, and urban development to ensure the preservation and improvement of water resources. Integrating these findings into water resource management strategies can contribute to the protection of aquatic ecosystems and the provision of clean water for both human and ecological needs.

Keywords

water quality, land use, pollution, Rákos catchment

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Conflicts of interest

The authors have declared that no competing interests exist.