Cigr Eurageng 2026
Emerging Technology and Innovation in Biosystems
Polytechnic of Turin, Italy, 24-26 June 2026

Paper ID: 608

Application of Geospatial Statistical Methods to Study Spatially Varying Nitrate Concentrations in a Rice-Growing District (Northern Italy)

Petra Baják[1], Marco Masetti[1], Arianna Facchi[2], Giulio Gilardi[2], Daniele Pedretti[1], Lorenzo Sangalli[1], Darya Tkachenko[2], Alessandro Sorichetta[1]

[1] Università degli Studi di Milano (UNIMI), Dipartimento di Scienze della Terra 'Ardito Desio' (DISTAD), Milan, Italy
[2] Università degli Studi di Milano (UNIMI), Dipartimento di Scienze Agrarie e Ambientali – Produzione, Territorio, Agroenergia (DiSAA), Milan, Italy
Corresponding author (e-mail): petra.bajak@unimi.it

Abstract. Sustainable water management in Mediterranean rice systems must balance productivity and environmental protection. Traditional continuous flooding limits nitrate leaching through denitrification, but the transition toward water-saving irrigation practices (dry seeding, turn-based irrigation) may affect nitrogen dynamics and groundwater quality. This study investigates spatially varying nitrate concentrations and the drivers of nitrate distribution in the phreatic aquifer in the Lomellina district (Northern Italy), one of Europe's most important rice-growing areas. Nitrate concentration was measured in groundwater, and a geospatial database of 102 environmental and anthropogenic variables was developed. Multivariate generalized linear regression models were implemented to quantify relationships between the selected variables and nitrate concentrations. Based on the results, we identified groundwater table depth, groundwater flow velocity, vertical hydraulic conductivity, soil type, and soil protective capacity as key determinants. The study was carried out in the context of the projects: i) "Applicazione di metodi di statistica spaziale per la valutazione della vulnerabilità e disponibilità della risorsa idrica sotterranea in diversi contesti idrogeologici", funded by the Piano di Sostegno alla Ricerca (PSR Linea 4) by the University of Milan, and ii) "PROMEDRICE project (https://promedrice.org/; PRIMA-Section2-2022)" funded, for the Italian partners, by MUR (Italian Ministry of University and Research).

Keywords: PROMEDRICE, nitrate contamination, agricultural land use, generalized linear regression models, groundwater vulnerability