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Explaining nitrate pollution pressure on the groundwater resource in Kinshasa using a multivariate statistical modelling approach

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Drinking water in Kinshasa, the capital of the Democratic Republic of Congo, is provided by extracting groundwater from the local aquifer, particularly in peripheral areas. The exploited groundwater body is mainly unconfined and located within a continuous detrital aquifer, primarily composed of sedimentary formations. However, the aquifer is subjected to an increasing threat of anthropogenic pollution pressure. Understanding the detailed origin of this pollution pressure is important for sustainable drinking water management in Kinshasa.

The present study aims to explain the observed nitrate pollution problem, nitrate being considered as a good tracer for other pollution threats. The analysis is made in terms of physical attributes that are readily available using a statistical modelling approach. For the nitrate data, use was made of a historical groundwater quality assessment study, for which the data were re-analysed. The physical attributes are related to the topography, land use, geology and hydrogeology of the region. Prior to the statistical modelling, intrinsic and specific vulnerability for nitrate pollution was assessed. This vulnerability assessment showed that the alluvium area in the northern part of the region is the most vulnerable area. This area consists of urban land use with poor sanitation.

Re-analysis of the nitrate pollution data demonstrated that the spatial variability of nitrate concentrations in the groundwater body is high, and coherent with the fragmented land use of the region and the intrinsic and specific vulnerability maps. For the statistical modeling use was made of multiple regression and regression tree analysis. The results demonstrated the significant impact of land use variables on the Kinshasa groundwater nitrate pollution and the need for a detailed delineation of groundwater capture zones around the monitoring stations.

Key words: Groundwater , Isotopic, Kinshasa, Modelling, Pollution, Physico-chemical.