# River-groundwater mixing: how irrigation and N excess drive N dynamics in Po Plain watersheds

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From global to local scales, N budgets performed to investigate and manage anthropogenic pressures generally hypothesize but do not quantify N accumulation in soils and groundwater. This is a key issue for river basins like the Po River and its sub-basins (Northern Italy), which drain a heavily fertilized and irrigated agricultural land and are characterized by springs. We hypothesize widespread river- nitrate-polluted groundwater interactions during irrigation periods. Large fractions of river discharge are diverted to irrigate permeable soils by flooding, a practice that enhances nitrate transfer from soils to groundwater and from groundwater to rivers via springs and river-groudwater interaction. As a result, nitrate display sharp increase in stretches without point N inputs and crossing areas with springs. Aim of the work, part of the INTEGRON project supported by Fondazione Cariplo, is to integrate N budget at watershed scale with the role of groundwater as N source, quantifying N-rich groundwater input to rivers. Soil N budgets were calculated for Oglio, Adda and Ticino watersheds and were integrated with experimental N mass budgets. During 2017 we performed reach-scale N balances by seasonal samplings of river water in segments crossing the springs area. For all basins a soil N surplus and water contamination risk emerged, as N inputs (mostly livestock manure and synthetic fertilizers) largely exceeded outputs (mostly crop uptake). Reach-scale N and conservative parameters balances suggested diffuse contamination of nitrate-rich groundwater into the river. Similar outcomes were found for the Oglio River using a water quality model (QUAL2Kw). The combination of basin level budgets, experimental balances and QUAL2Kw modelling represents an effective tool for the evaluation of diffuse N pollution and for optimal water quality management.