

## Nutrients levels in paddy soils and flood waters from Tagus-Sado basin: the impact of farming system

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Application of fertilizers for crops can contribute to nutrients surplus, namely nitrogen, in both groundwater and surface waters resulting in serious environmental problems. The impacts on water quality due to fertilizers are related to land management. In paddy fields using high amounts of water, the nutrient dynamic knowledge is essential to evaluate the impact of farming system. The aims of this study were to evaluate: i) nutrients levels in soils and floodwaters from rice cultivation in Tagus-Sado basin (Portugal); ii) the effect, under controlled conditions, of different irrigation techniques on nutrient enrichment of floodwaters from rice cultivation.

Composite samples (n=24) of paddy soils (0–15 cm) and floodwaters were collected, during rice flooding period. In the field, pH and electrical conductivity (EC) were determined in waters. Soil pH, concentrations of Corganic, NPK and nutrients (Ca, Cu, Fe, Mg, Mn, Zn) in soils and floodwaters (nitrites, nitrates, phosphates) were determined.

A mesocosm assay was performed in lysimeters with a paddy soil (pH: 5.6; g/kg- Ntotal: 2.0, Pextractable: 0.04, Kextractable: 0.6, Corganic: 35.5) and different irrigation techniques (n=3): a) flood; b) four floods per day (great water renewal); c) flood until rice flowering and then a normal superficial irrigation. Rice cultivation was done by transplant as in the field. Irrigation water come from a well. Same chemical characterization than in field assay were determined in floodwater and irrigation water.

In field conditions, paddy soils had values of pH between 5.1 and 8.1 and a great fertility range (g/kg; Ntotal: 0.4–2.2; Pextractable: 0.01–0.2; Kextractable: 0.04–0.7; Corganic: 6.5–37.9). Total soil concentrations of Cu, Fe, and Zn in soils were in same range and below maximum admissible values for agriculture. Total soil concentrations of Ca, Mg and Mn, showed higher heterogeneity (g/kg; 1.2–19.3, 7.6–34.2 and 0.2–1.5 respectively). Floodwaters presented pH  $\approx$  7 and, usually, EC > 1 mS/cm (MRV–maximum recommended value for irrigation water). Nitrites concentrations were < 0.1 mg/L in floodwaters, while concentrations of nitrates (< 2.4 mg/L), Cu (< 2–12.3  $\mu$ g/L), Fe (< 0.1–0.9 mg/L) and Zn (0.04–1.9 mg/L) were below MRV. The fertilizers used in rice cultivation did not seem to affect the water quality.

Nitrates concentration in irrigation water of lysimeters (24 mg/L) was close to MVR for irrigation water. Intensive agriculture of corn surrounding the well can explain the greater nutrients concentrations, especially nitrates, nitrites and phosphates, in this water compared to water from river used for paddy fields irrigation. Independently of irrigation technique, nutrient concentrations in lysimeters floodwaters (except phosphates in some samples) were in same range of those in irrigation water from well. The nutrients excess in water seems not to be uptake by rice contributing to nutrient enrichment of nearby waters and soils.

Studied paddy fields from Tejo-Sado basin are not a potential pollution source of nutrients. However, according mesocosm assay, the potential irrigation of paddy soils with water rich in nitrates can contribute to serious environmental risks.

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