

Assessing the private-economic costs and food-security impacts of water quality improvement: a case study for the Vouga catchment

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Resumo

Diffuse source water pollution from agricultural activities in coastal catchments tends to have negative impacts on coastal aquatic ecosystems, while these ecosystems are of vital importance from a social, environmental and economic perspective. The importance of catchment water resources management is addressed in the EU Water Framework Directives (WFD; 2000/60/EC; 2006/118/ECRF), that requires the definition of Catchment Management Plans (CMPs) including actions to meet set water quality standards. The CMPs developed in Portugal focus mainly on the adoption Best Agricultural Practices (BAPs) for diffuse source water pollution abatement. The adoption of BAPs may, however, involve considerable costs due to increases in production costs and/or decreases in yields. This study aims to determine the (long-term) private-economic costs and food-security impacts related to the adoption of BAPs across agricultural land use categories.

We apply the Soil and Water Assessment Tool (SWAT) to assess the (long-term) private-economic costs and food-security impacts associated with the adoption of BAPs for Dissolved Inorganic Nitrogen (DIN) water quality improvement across the key agricultural land use categories in the Vouga catchment (Central Portugal). The methodology uses gross-margin analysis techniques for the (plot level) financial-economic assessment of BAPs (based on a detailed description of management practice operations per land use category and corresponding SWAT-based estimates for agricultural production) and, in turn, meta-modeling techniques for the estimation of private-economic abatement cost and food-security abatement impact functions across agricultural land use categories (based on BAP adoption scenarios and corresponding SWAT-based estimates for agricultural production, agricultural incomes, and water pollution deliveries).

Results for the case of DIN surface water pollution by the key agricultural land use categories in the Vouga catchment show that the adoption of BAPs leads to a decrease in agricultural production and corresponding production values that are not outweighed by a reduction in N-fertilizer expenditures. Estimated private-economic abatement costs are quadratically increasing in the rate of DIN water pollution abatement – abatement costs being largest for the mixed annual crops & vineyards (Cat. III) land use category (between 41 900 Euro/tDIN/yr and 51 900 Euro/tDIN/yr) and fairly similar across the vineyards (Cat. II) and annual crops (Cat. I) land use categories (between 7 300 Euro/tDIN/yr and 15 200 Euro/tDIN/yr). Estimated food-security abatement impacts are largest for corn and oat production (~2.0%-2.2% and ~1.6%-1.8% reduction in corn and oat production,