Drivers of water quality changes: Impact of the Common Agricultural Policy in the Guadalquivir river basin (south Spain)
Salmoral, G. and Garrido, A.
Water Observatory Botín – CEIGRAM, Technical University of Madrid

**OBJECTIVES**

The 2003 Common Agricultural Policy (GAP) reform, which was in force in 2006, promoted a more market oriented and sustainable agriculture. The aim of this study is to determine the influence that this agricultural reform could have had on water quality of surface water bodies in the Guadalquivir River Basin (South Spain) over the period 1999-2009.

**METHODS**

**Site and variables of study**

Records of monthly nitrates (NO₃, mg L⁻¹) and suspended solids (SS, mg L⁻¹) for surface water.

**Time trend analysis**

Correction of autocorrelation but preserving the original trend

Linear

Correction of autocorrelation but preserving the original trend

Quadratic

Kendall rank correlation coefficient

Per subbasin i and agricultural season t: $y_{i,t} = x'_{i,t} \beta + z_{i,t} \alpha + \epsilon_{i,t}$, where $X_{i,t}$ is the ith observation on i explanatory variable, the i & j is the individual effect and $\epsilon_{i,t}$ is the error term. We deal with heteroskedasticity, cross sectional dependency and autocorrelation of residuals using Panel Corrected Standard Errors (PCSE).

**RESULTS**

Most of the subbasins do not exhibit statistically significant trends for both NO₃ and SS, neither for linear nor quadratic equations. Despite the acute SS concentrations in the basin, only five subbasins present an improvement trend. Subbasins showing a U-shaped trend for SS are heterogeneously spread throughout the watershed (Figures 3 and 4).

In the panel data analysis we found that growing agriculture intensification and subsidies to irrigated land cause greater NO₃ concentrations (Table 1). Larger NO₃ p50 concentrations occur with lower percentage of coupled subsidy, since subbasins with smaller percentage of coupled subsidy include more extension of crops not entitled to receive subsidies (vegetables and citrus trees). Greater SS concentrations are associated with larger biomass and subsidies to irrigated areas. After 2006, the extreme values of suspended solids decreased, although the median values increased, since soil erosion in olive orchards became worse due to expansion on soils with steeper slopes.

![Figure 1. Subbasins under study](image)

![Figure 2. Subbasins where annual median NO₃ and SS (mg L⁻¹) did not meet the good chemical status before (top) and after (bottom) the reform. Compliance of nitrates in groundwater bodies is also illustrated.](image)

![Figure 3. Subbasins spatial distribution for annual suspended solids (SS) trends (mg L⁻¹), differentiating percentiles 50 (p50) and 90 (p90).](image)

![Figure 4. Suspended solids trends (mg L⁻¹) for percentiles 50 (p50) and 90 (p90) per subbasin over the study period. The reference value of 35 mg L⁻¹ is visualized when observations exceed it.](image)

**CONCLUSIONS**

The general high concentration of suspended solids throughout the watershed is highlighting a worrying water deterioration process in surface water, because of an inappropriate land use and agricultural management in the region. The agricultural intensification in terms of biomass production per unit of subbasin causes greater concentrations of both water quality indicators throughout the watershed. The implications of intensification on water quality are particularly significant in areas where olives and semi intensive crops predominate. CAP has evolved according to economic conditions, but the agricultural policy reform did not help to alleviate the nitrate and suspended solids concentrations in surface water bodies of Guadalquivir River Basin. In accordance with our study, after the agricultural reform and with lower values of coupled subsides, farmers have oriented their productions towards the market, probably worsening the environmental conditions of the basin.