Creation and restoration of wetlands for the improvement of water quality and biodiversity in agricultural watersheds

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Abstract Riparian forests and wetlands were restored (increasing the hydrologic connectivity, constructing simple dikes and planting native species) in the River Flumen watershed (NE Spain) (Life09ENV/ES/431 CREAMAgua) to show their potential for improving the quality of the water discharged from irrigated fields and the biodiversity of agricultural watersheds. Restoration sites were selected following a protocol which integrates scientific-technical, social and economic aspects. Nitrogen and suspended solids in the wetlands showed a high dispersion after two years. Fast development of low diversity plant cover is observed in permanently flooded (in-stream) wetlands compared to off-stream wetlands. Repeated planting was required in riparian zones after the first year flood disturbance. Bird communities show an initial increase of diversity in permanently flooded wetlands; developing a landscape structure is required in other types of wetlands. Integrated planning and development is required for successful wetland restoration at watershed scale.

Introduction

An ecosystem restoration project must be based on the integration of scientific-technical, social and economic aspects to be successful (Comín et al. 2005). The objective of the Life CREAMAGUA project is to show the potential of restoring wetlands at watershed scale for improving the quality of the water exceeding agricultural fields and improving biodiversity. Project planning and preliminary results of the first two years of wetlands functioning are presented here to show the potential of this approach for planning wetland restoration at watershed scale.

Material and methods

In 2011-12, sixteen wetlands were restored (extending the flooding area through diking) following a protocol based on SWAT (Soil and Water Assessment Tool) and first order areal removal model for, respectively, selecting sites and dimensioning wetlands for nitrate removal (Comín et al. 2013). Fourteen degraded riparian zones were restored (facilitating flooding in riparian zones through lowering river banks and channels) to improve the biodiversity and landscape of the region. Planting with native species was performed in all the sites.

Results

The greedy algorithm used (Fig. 1) is a method to select sites for restoring wetlands and accomplishing the social and economic requirements of CREAMAGUA project. It is, according to the UE Life Programme, to demonstrate actions which can be performed later at larger scale. It does not give a solution for the improvement of the water quality of the whole river watershed. However, it shows a way to integrate the
social and economic aspects for restoring wetlands at watershed scale. In a few wetlands 25% of the incoming nitrates are removed after two years functioning. A rich plant community developed fast after the works (plant cover represented 80% of the wetland area) but diversity is still low two years after restoration. Riparian zones showed contrasted features: geomorphology is changing rapidly showing natural forms (e.g., side meandering channels) as result of flood impacts but plant community is still present in low density and diversity. The bird community show indicators of fast richness and diversity improvement (nesting ducks, different functional groups).

Acceptance of restoration works was common in all the municipalities were wetlands were restored, after the high number of persons and groups performing visits to the restored sites. The economic restrictions of the restoration project budgeting limited some constructive aspects. The average cost of restoration ranged between 4,972 €/ha for restoring wetlands and 2,163 €/ha for restoring riparian zones, which is in agreement with similar simple wetland restoration works (Russi et al. 2013).

**Discussion**

A marked contrast between different types of wetlands is observed two years after restoration, which is common for this type of approaches (Tanner and Kadlec 2013). Riparian zones show a high dynamic community (including plants and birds); off-stream wetlands are showing a slow recovery of functional aspects (improvement of water quality); a few in-stream wetlands show a marked nitrate and suspended solids removal just two years after restoration works. A longer time after restoration is required for wetlands to show all their functional performances.

**Acknowledgments**

This work is part of the European Union Life09 ENV/ES/431 CREAMAgua project.

**References**


Russi D et al. 2013 The Economics of Ecosystems and Biodiversity for Water and Wetlands. IEEP, London and Brussels; Ramsar Secretariat, Gland.