In-situ soil loss monitoring in a small Mediterranean catchment to assess the siltation risk of a Limno-reservoir

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1. INTRODUCTION

Limno-reservoirs are designed to mitigate some of the impacts caused by large reservoirs under Mediterranean climate (Molina Navarro *et al*., 2010). Its most representative characteristic is the maintenance of a constant water level. Pareja Limno-reservoir was built in 2006 and it is one of the first initiatives of this type. Despite its interest, there are some issues about its environmental viability, including those related with the siltation risk, as the area shows signs of high erosion rates.

The main goal of this research is to study *in-situ* the soil loss in the Pareja Limno-reservoir catchment, discovering the areas with highest erosion risk and estimating sediment yield rates in the limno-reservoir.

Fig. 1: Pareja Limno-reservoir view.

2. STUDY SITE

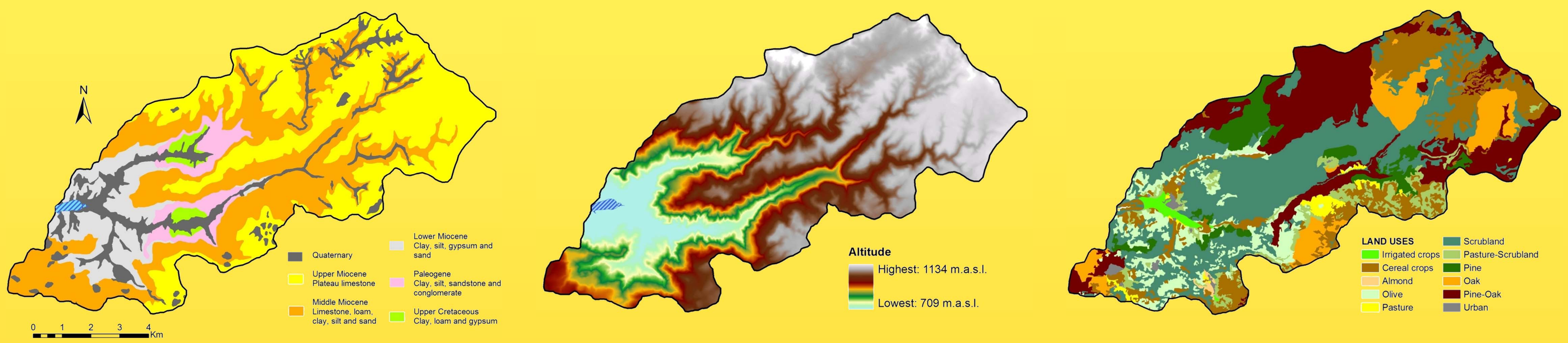

Figure 2: Geological scheme, digital elevation model and land uses map of the Pareja Limno-reservoir catchment.

The Pareja Limno-reservoir is located in the Entrepeñas Reservoir potential inundation area (Guadalajara, central Spain). The catchment enjoys a Continental Mediterranean climate. Average annual precipitation is 600 mm, with high variability.

Pareja Limno-reservoir facts:

- Capacity: 0.94 Hm^3
- Inundation area: 26 ha
- Maximum depth: 9.0 m
- Main tributary: Ompólveda River
- Catchment area: 87.8 km^2

3. METHODOLOGY

An *in-situ* soil monitoring network was installed in order to determine the soil loss and deposition rates (fig. 3) It includes:

- 15 sampling plots for inter-rill erosion (16 sticks each) (fig. 4a)
- 7 sampling plots for sedimentation (16 sticks each)
- 8 sites for to study rill erosion with a needle micro-profiler (fig. 4b), quantifying sedimentation in the terminal zone with sticks.

These control points were located in places where the soil type, the land use and the slope present are representative of the catchment. Monitoring was performed for three years (starting in 2009) and every three months. Soil samples were taken to obtain bulk density values and calculate sedimentation and soil loss rates.

The whole catchment was divided into homogeneous polygons and rate values obtained were extrapolated based on aerial photography, slope and lithology. A soil loss correction factor was applied in terrace areas based on Wischmeier & Smith (1978). Soil loss values in the plateau area were given by the SWAT model, as applied in Molina-Navarro *et al.* (2012).

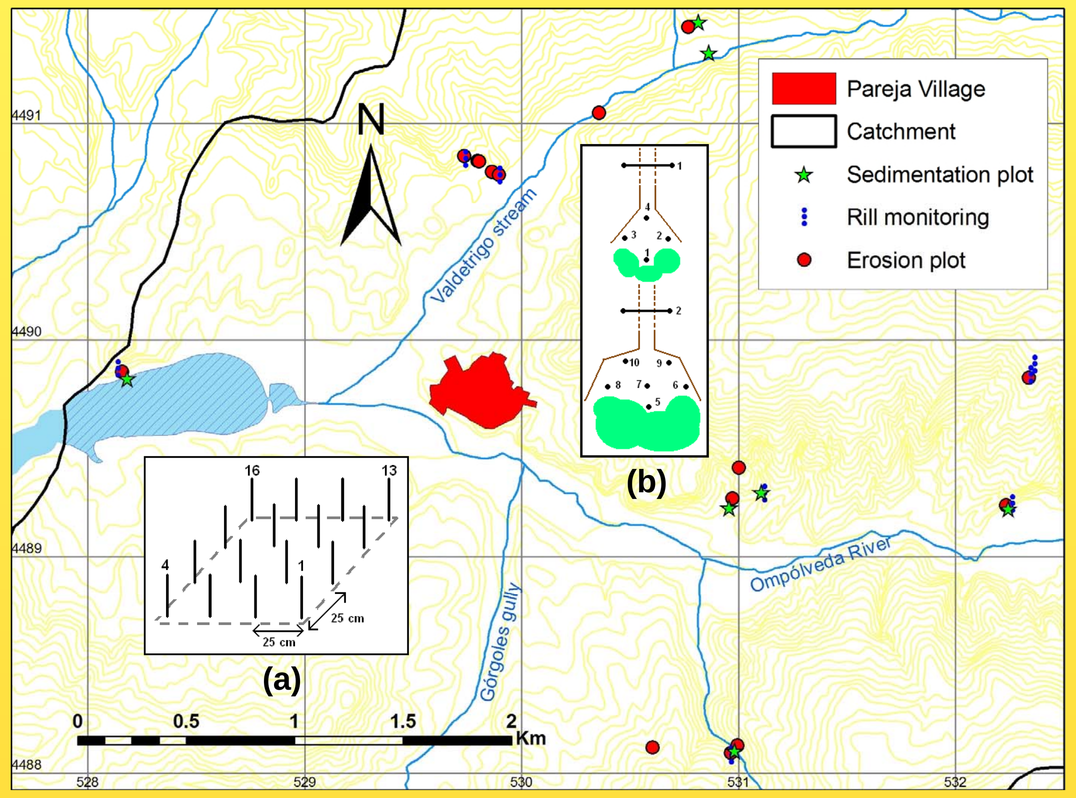

Figure 3: *In-situ* soil monitoring network installed. Design of the sedimentation and erosion plots (a) and rill monitoring (b).

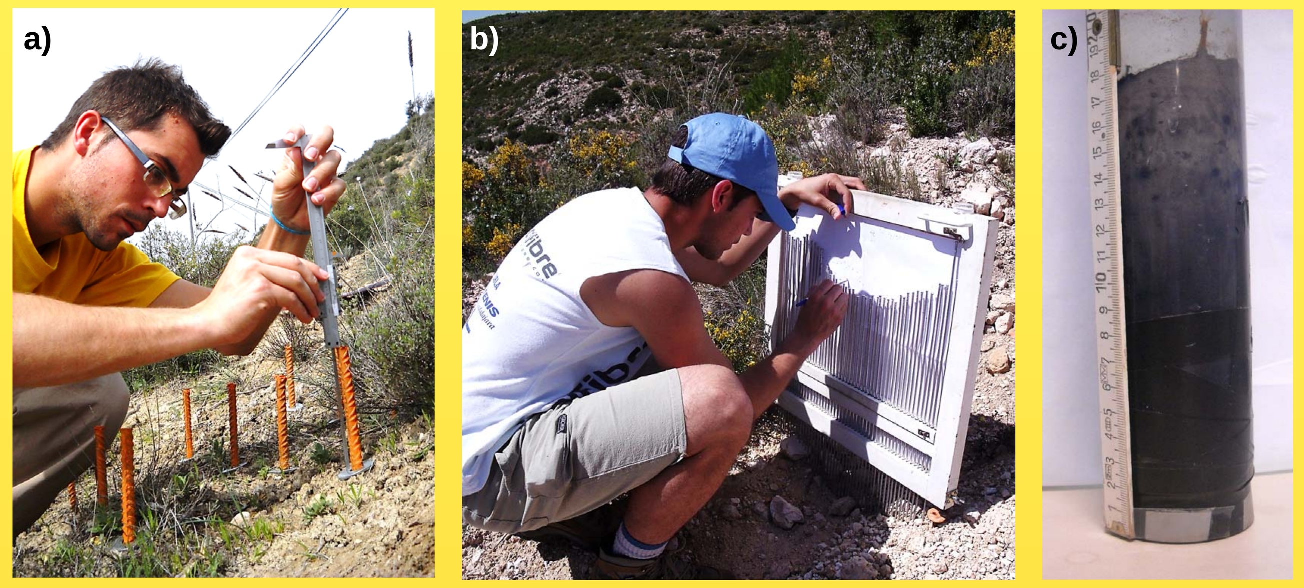

Figure 4: Inter-rill (a) and rill (b) erosion monitoring and sediment witness taken from the limno-reservoir (c).

Three sediment witnesses (fig. 4c) were taken from the limno-reservoir to calculate approximately the siltation rate and then check the degree of fit of the results obtained with the *in-situ* network

4. RESULTS AND DISCUSSION

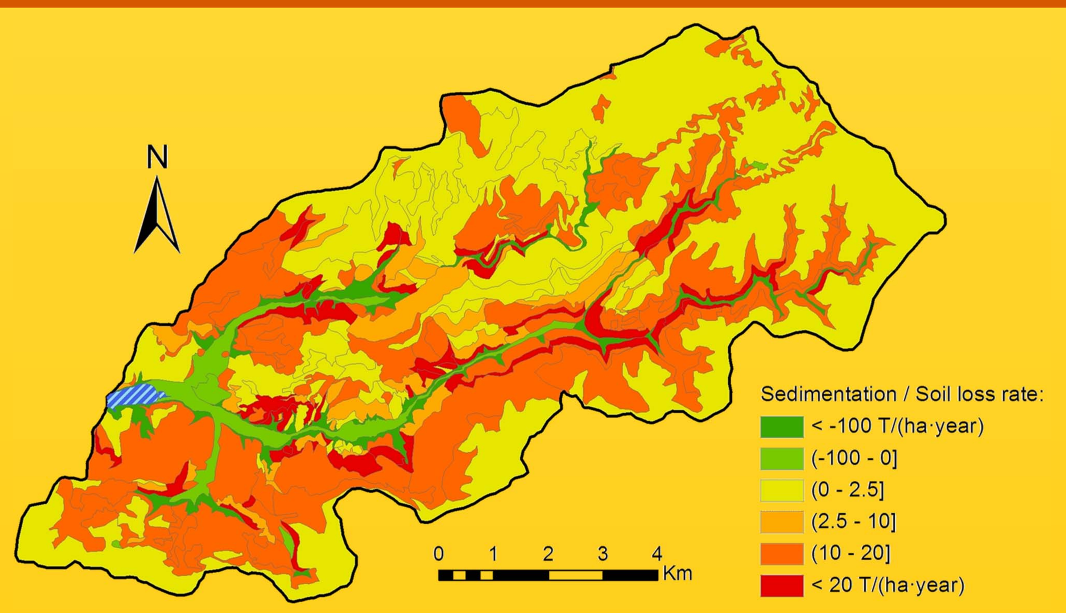

Figure 3: Sedimentation and soil loss rates obtained.

Sedimentation and soil loss rates obtained after monitoring, extrapolation and weighting of rill and inter-rill erosion are shown in figure 5. Maximum soil loss rates were obtained in hillsides of clayey lithology with high slope and low vegetation cover, representing a serious erosion risk (Bienes *et al*., 2001).

The average soil loss rate obtained for the catchment was **6.5 $T \cdot ha^{-1} \cdot year^{-1}$**. This value is in agreement with the findings done by Arévalo (2008), who obtained a soil loss rate of 10.6 $T \cdot ha^{-1} \cdot year^{-1}$ with a modified USLE equation but just considering erosion, not sedimentation.

The thickness of sediments obtained with the witnesses was 4.50 cm in the riverine zone, 3.63 cm in the central zone and 1.94 in the dam zone. Considering their bulk densities, a siltation of 6319 tons have take place in 3.4 years, which would mean a net soil loss rate of 0.21 $T \cdot ha^{-1} \cdot year^{-1}$ in the catchment.

The difference between 6.5 and 0.21 $T \cdot ha^{-1} \cdot year^{-1}$ is in agreement with the sediment delivery ratio of 5% obtained in other catchments in Spain (Alatorre *et al.*, 2011) and may be explained by the deposition in the alluvial floodplain, considered null in the calculations.

5. CONCLUSIONS

- An *in-situ* soil monitoring network was installed in the Pareja Limno-reservoir catchment, which yielded values of sedimentation and soil loss rates satisfactorily, in agreement with previous observations done.
- The average soil loss rate obtained in the catchment was 6.5 $T \cdot ha^{-1} \cdot year^{-1}$. Highest erosion risk was found in clayey hillsides with high slope and low vegetation cover.
- Results obtained taking witnesses from the limno-reservoir sediments suggest a net soil loss rate in the catchment of 0.21 $T \cdot ha^{-1} \cdot year^{-1}$. The difference with the value obtained with the *in-situ* network is in agreement with the sediment delivery ratios observed by other authors. Then, the network installed seems useful to assess the siltation risk.

6. ACKNOWLEDGEMENTS

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