



## **Hydrological services and biodiversity conservation under forestation scenarios: comparing options to improve watershed management**

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Humans rely on ecosystems for the provision of hydrological services, namely water supply and water damage mitigation, and promoting forests is a widely used management strategy for the provision of hydrological services. Therefore, it is important to model how forests will contribute for this provision, taking into account the environmental characteristics of each region, as well as the spatio-temporal patterns of societal demand. In addition, ensuring forest protection and the delivery of forest ecosystem services is one of the aims included in the European Union biodiversity strategy to 2020. On the other hand, forest management for hydrological services must consider possible trade-offs with other services provision, as well as with biodiversity conservation. Accurate modeling and mapping of both hydrological services and biodiversity conservation value is thus important to support spatial planning and land management options involving forests.

The objectives of this study were: to analyze the provision and spatial dynamics of hydrological services under two forest cover change scenarios (oak and eucalyptus/pine) compared to the current shrubland-dominated landscape; and to evaluate their spatial trade-offs with biodiversity conservation value. The Vez watershed (250km<sup>2</sup>), in northwest Portugal, was used as case-study area. SWAT (Soil and Water Assessment Tool) was applied to simulate the provision of hydrological services (water supply quantity, timing and quality; soil erosion and flood regulation), and was calibrated against daily discharge, sediments, nitrates and evapotranspiration. Good agreement was obtained between model predictions and field measurements. The maps for each service under the different scenarios were produced at the Hydrologic Response Unit (HRU) level. Biodiversity conservation value was based on nature protection regimes and on expert valuation applied to a land cover map. Statistical correlations between hydrological services provision and biodiversity conservation value were assessed using the Spearman rank correlation.

The current delivery of hydrological services in the Vez watershed is higher at the high and low mountain sub-basins, with lower provision in the valley. The overall performance for water quantity and timing is better under the shrubland and the oak scenarios, when compared to the eucalyptus/pine scenario, which performs better for flood regulation and erosion control, especially in the low mountain sub-basin. However, this scenario is the one with more spatial trade-offs with biodiversity conservation value, especially inside protected areas. Several strategies may be suggested for effective land use planning in the Vez watershed. Eucalyptus/pine is the scenario with the best results for flood regulation and soil erosion control, associated to the positive revenues from the pulp production industry. However, cautions should be taken regarding strategies for biodiversity conservation (preferably by favoring native oak species), as well as the potential increase in fire risk. This study highlights SWAT as an effective tool for modelling and mapping hydrological services generated at the watershed scale, therefore contributing to improve the options for land management.