Influence of salt concentration and topographical position on water resource quality: The Spanish Case Study

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Abstract

Water resource quality (WRQ) is affected by salt concentration and topographical position. Indeed, an increase in salt concentration, which decreases water availability for animal and plant nutrition, and lower altitude, which diminishes the potential for production of hydropower, negatively affects WRQ. Therefore, it is useful to develop indicators like osmotic power (OP) and hydraulic power (HP) to evaluate, respectively, the influence of salt concentration and topographical position on WRQ. The main objective of this work was to evaluate the WRQ in 11 hydrographical basins in peninsular Spain. In this paper, OP, HP and the total power (TP), obtained by adding OP to HP, were calculated at three different basin levels:

- Height H_{25} (m) corresponding to 25% of total surface area of the basin
- Height H_{50} (m) corresponding to 50%
- Height H_{100} (m) corresponding to 100%.

Results showed that OP, HP and TP values of water basins decreased from the northern to the southern parts of peninsular Spain, according to water scarcity and hydrographical characteristics of water basins. The higher OP, HP and TP values, the higher is WRQ of the basin. Therefore, TP, OP and HP can be used to evaluate WRQ at the administrative water basin level as a basis for water resource management. Indeed, these indicators can assist water managers and planners in deciding between inter-basin water transfers and water desalination, especially in countries where water is a scarce resource.

Keywords: water resource quality (WRQ), hydraulic power (HP), osmotic power (OP), total power (TP).

Introduction

Peninsular Spain has a surface area of 493 771 km^2 that can be divided into 11 administrative hydrographical basins corresponding mostly to natural hydrographical catchments (Fig. 1). The climate is Mediterranean and seasonal except in the north where it is humid and in the south-east where it is semi-arid. Climate, topography and rock weathering determine salt-water concentration associated with osmotic energy. The relief, with a mean altitude of 568 m, determines a topographical position associated with potential hydraulic energy.

The Spanish Water Act (SWA) considers water to be a matter of general interest (BOE, 2001a) as water is a scarce resource in Spain. Indeed, making water availability an issue for public planning should ensure its rational use in harmony with the environment. The Spanish National Hydrological Plan (SNHP) is a useful instrument to:

- Identify different supplies
- Rationalise water availability
- Guarantee an ecologically sound water supply
- Achieve sustainable water usage

Public investments in hydraulic infrastructure and the water desalination industry have been laid out by the Spanish National Hydrological Plan (SNHP) for the period 2001 to 2008 (BOE, 2001b). The investment projected is approximately €2 000m./a^{-1}. SNHP gives priority to investments in exploitation systems that do not require external transfer to cover demands. In Spain,

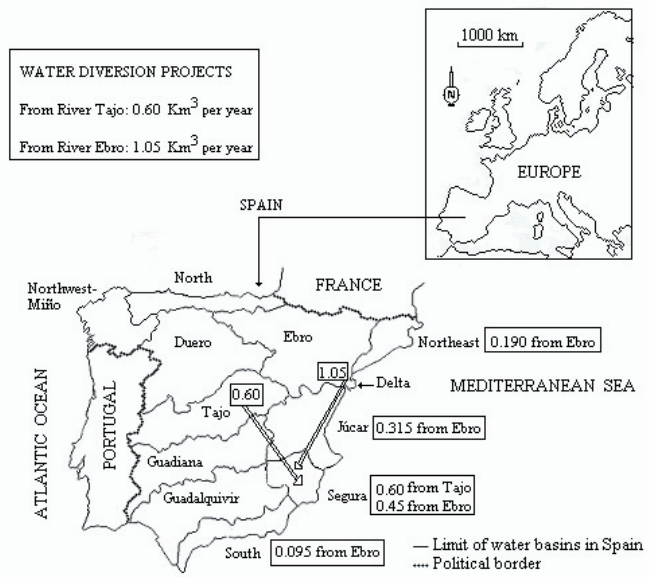

Figure 1
Hydrographical basins of Spain and the main water transfer projects

water resource management has traditionally been based on temporal regulation of surface waters by dams and bars, due to seasonality of water precipitation and evapotranspiration (cold and rainy weather in winter, warm and dry in summer, and intermediate in autumn and spring). Water transfers have been considered and implemented only in situations of structural scarcity demonstrated over years, and then in areas where the highest potential productivity of irrigated land over dry land

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Received 8 September 2004; accepted in revised form 21 November 2004.