

INTEGRATED WATER AND ECOSYSTEM MANAGEMENT IN AN ATLANTIC REGION OF EUROPE USING STOCHASTIC ANALYSIS AND NUMERICAL MODELING

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The Member Countries of the European Community (EC) are facing at this moment an important challenge regarding water and ecosystems management, derived from the implementation of the Water Framework Directive (WFD). Cantabria is one of the 17 administrative regions of the country of Spain, and is situated in the centre of the northern Atlantic coast. It extends over approx. 5300 km² and has a fixed population of around 535.000 people. During the last years, the number of visitors in the summer has increased notably, and the rivers have not been able to satisfy the water demand, even disregarding any kind of maintenance or ecological discharge. Due to this fact, the regional and national authorities, with the cooperation of the EC, have initiated several studies and works, which are described in the paper.

Firstly, a water-demand prognosis was made for the different zones. The best mathematical model to represent the quarterly water demand volumes, in terms of goodness of fit and number of parameters, was based on an exponential smoothing technique, more exactly a Holt-Winters model with linear growth and multiplicative seasonal factors (Gardner, 1985). Daily consumption synthetic time-series have finally been obtained for each zone of the region using a Monte Carlo simulation.

Afterwards, a lumped hydrological model, the HEC-HMS from the US Army Corps of Engineers, was calibrated with daily time-interval for 12 of the main rivers. Once the natural discharge regimes have been characterized, maintenance discharges have been calculated at 54 stations (an average of 5 for each river), using two different methodologies, considering biological variables.

Finally, a study of alternatives for the whole system has been carried out using water resources numerical models. The selected alternative, in terms of global cost-effectiveness (including environmental costs), is now under construction and consists of the following principal infrastructures (fig. 1):

A south-north water pipe (SN-WP). It conveys water to a large existing reservoir during the rainy season and back during the summer

An east-west main distribution water pipe, connecting along 140 km all the consumption nodes

A set of small lateral reservoirs situated in several river basins, contributing with a

certain amount of regulated water (approx. 4 Hm³ altogether).

The main features of the whole system are: a) global interconnection of water sources, and b) water pumping during the winter to a large out-of-basin existing reservoir, to retrieve it during the dry season. The total construction cost is estimated in 268 million € (approx. 355 million \$)

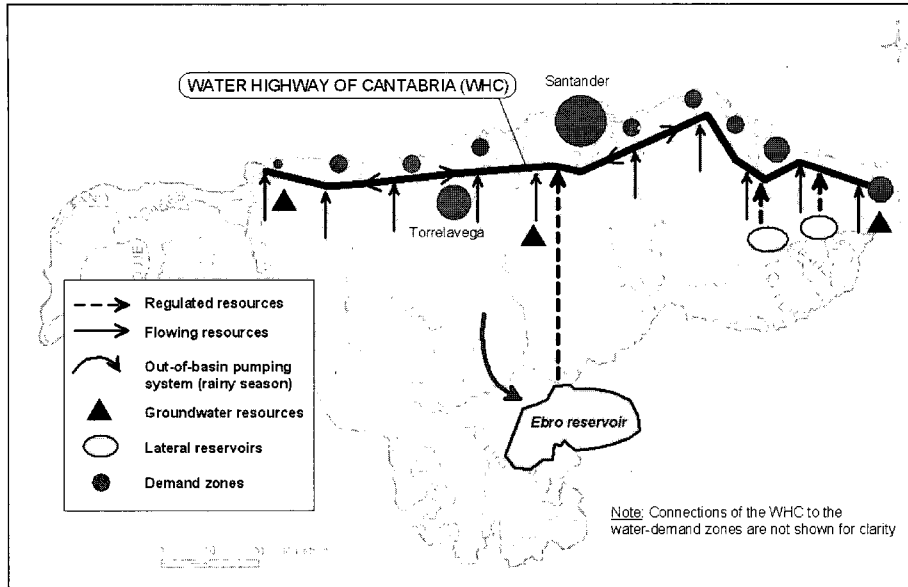


Fig. 1 General sketch of the proposed water management system

REFERENCES

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