

Technical University of Denmark



Using stochastic dynamic programming to support catchment-scale water resources management in China

Davidson, Claus; Cardenal, Silvio Javier Pereira; Liu, Suxia; Mo, Xinguo; Rosbjerg, Dan; Bauer-Gottwein, Peter

Published in:
Geophysical Research Abstracts

Publication date:
2013

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):
Davidson, C., Cardenal, S. J. P., Liu, S., Mo, X., Rosbjerg, D., & Bauer-Gottwein, P. (2013). Using stochastic dynamic programming to support catchment-scale water resources management in China. *Geophysical Research Abstracts*, 15, [EGU2013-8968].

DTU Library

Technical Information Center of Denmark

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.



Using stochastic dynamic programming to support catchment-scale water resources management in China

Claus Davidsen (1,2,3), Silvio Javier Pereira-Cardenal (1), Suxia Liu (2), Xingguo Mo (2), Dan Rosbjerg (1), and Peter Bauer-Gottwein (1)

(1) Technical University of Denmark, Department of Environmental Engineering, DK-2800 Kgs. Lyngby, Denmark (clad@env.dtu.dk), (2) Key Laboratory of Water Cycle and Related Land Surface Processes, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, 100101, China (liusx@igsrr.ac.cn), (3) Sino-Danish Center for Education and Research (SDC), DK-8000 Aarhus C, Denmark

A hydro-economic modelling approach is used to optimize reservoir management at river basin level. We demonstrate the potential of this integrated approach on the Ziya River basin, a complex basin on the North China Plain south-east of Beijing. The area is subject to severe water scarcity due to low and extremely seasonal precipitation, and the intense agricultural production is highly dependent on irrigation. Large reservoirs provide water storage for dry months while groundwater and the external South-to-North Water Transfer Project are alternative sources of water.

An optimization model based on stochastic dynamic programming has been developed. The objective function is to minimize the total cost of supplying water to the users, while satisfying minimum ecosystem flow constraints. Each user group (agriculture, domestic and industry) is characterized by fixed demands, fixed water allocation costs for the different water sources (surface water, groundwater and external water) and fixed costs of water supply curtailment. The multiple reservoirs in the basin are aggregated into a single reservoir to reduce the dimensions of decisions. Water availability is estimated using a hydrological model. The hydrological model is based on the Budyko framework and is forced with 51 years of observed daily rainfall and temperature data. 23 years of observed discharge from an in-situ station located downstream a remote mountainous catchment is used for model calibration. Runoff serial correlation is described by a Markov chain that is used to generate monthly runoff scenarios to the reservoir. The optimal costs at a given reservoir state and stage were calculated as the minimum sum of immediate and future costs.

Based on the total costs for all states and stages, water value tables were generated which contain the marginal value of stored water as a function of the month, the inflow state and the reservoir state. The water value tables are used to guide allocation decisions in simulation mode. The performance of the operation rules based on water value tables was evaluated. The approach was used to assess the performance of alternative development scenarios and infrastructure projects successfully in the case study region.