

## APPM - A NEW TOOL FOR SUSTAINABLE ARID ZONE WATER MANAGEMENT

**Water scarcity**, rapid population growth and climate change imperatively require adaption strategies for a more efficient and sustainable exploitation of the earth's fresh water resources. Because this is a regionally specific problem only a tailor made integrated water resources management approach allows for optimal decisions and indicates the most beneficial actions while considering the physical reality together with the socio-economic and environmental development.

For ensuring both optimal sustainable water resources management and long-term planning in a changing environment we develop an integrated **Assessment, Prognosis, Planning and Management Tool (APPM)**. The APPM integrates the complex interactions of the strongly nonlinear meteorological, hydrological and agricultural phenomena, taking

into account the socio-economic aspects. Instead of straightforwardly applying currently available models and concepts, we set up the APPM - on the basis of innovative approaches - as a fully customised tool for the most beneficial and sustainable arid zone water management. It employs a new powerful optimisation tool and unites process modelling with artificial intelligence tools for achieving best possible solutions for water allocation, groundwater storage and withdrawal including saline water management with novel, highly efficient irrigation strategies. Together with the optimal design of a problem oriented, modern water distribution system this revolutionary strategy will open new horizons for problem solving in the field of water resources management in arid environments.



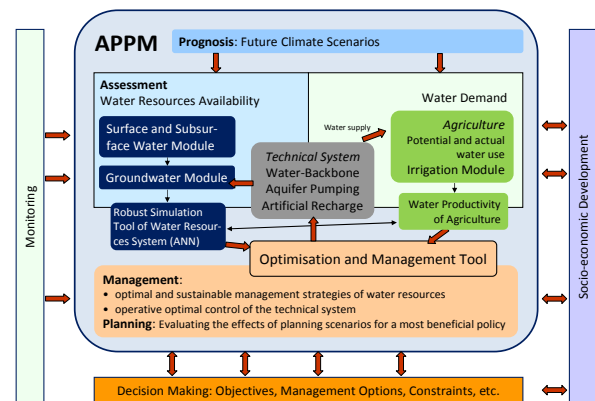
Falaj Al-Khatmeen: traditional water distribution system for irrigated agriculture in the Sultanate of Oman

# CASE STUDY: INTEGRATED WATER RESOURCES MANAGEMENT FOR THE BATINAH REGION, OMAN

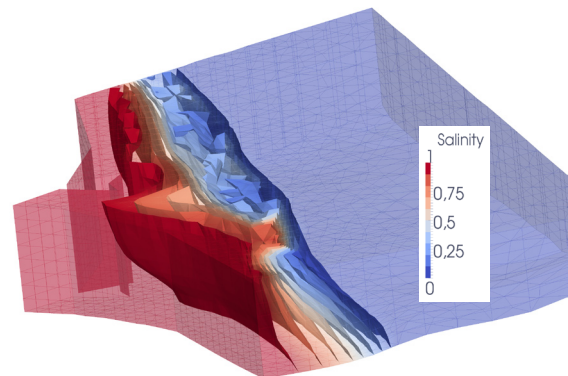
A pilot application of the APPM-Tool is carried out within the implementation of an integrated water resources management (IWRM) scheme for the Batinah region in the north of the Sultanate of Oman. The region is affected by saltwater intrusion into the coastal aquifers due to excessive groundwater withdrawal for irrigated agriculture. As a consequence, numerous farms near the coastline had to close down due to the increasing salinity of irrigation water and consequently of the soils. The APPM incorporates the:

- Analysis and modelling of actual and future water resources availability and demands;
- Evaluation of sustainable management strategies of water resources and agricultural production considering the demands of other water consuming sectors;
- Optimal design and control of a technical system for water allocation and distribution depending on given objectives, actual hydrological conditions and future prognosis.

Besides other innovative models a three-dimensional density driven groundwater flow model for simulating the aquifer response inclusive salt water intrusion phenomena and the assessment of most suitable sites for groundwater abstraction. For simulating the behaviour of high productive agricultural farms a database of crop water production functions is generated by means of soil-vegetation-atmosphere-transport modelling together with a new evolutionary optimisation algorithm for optimal irrigation scheduling and control. For managing both, water quality and water quantity, a new simulation based multicriterial optimisation technique is used to evaluate and optimise different irrigation practices, crop pattern and abstraction scenarios. The IWRM-implementation is accompanied by a comprehensive capacity development program. Besides a lot of different measures it contains a pilot farm program for demonstrating new techniques and strategies in modern irrigation.



General structure of the APPM-Tool



Three-dimensional density dependent groundwater flow model for simulating salt water intrusion phenomena, slices of salinity values



Implementation and setup of irrigation experiments

## Project Partners:

- Ministry of Regional Municipalities and Water Resources, Sultanate of Oman
- Ministry of Agriculture, Sultanate of Oman
- Institute of Groundwater Management, TU Dresden

**Contact:**  
 Dresden University of Technology  
 Institute of Hydrology and Meteorology  
<http://tu-dresden.de/fgh/was/hydrologie>

Dr. Franz Lennartz  
 Franz.Lennartz@mailbox.tu-dresden.de



Dr. Jens Grundmann  
 jens.grundmann@tu-dresden.de