# IMPETUS Morocco

# Decision support for river basin management in the Drâa basin (Morocco)

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## The current situation

The Drâa Valley in arid south-eastern Morocco has experienced periods of drought in the last decades. During the last 10 years water availability was generally low, the Middle Drâa Valley is more concerned than the Upper Drâa basin with its rivers and wadis fed by rain and snow from the High Atlas Mountains. This results in:

- Reduced water availability for irrigation agriculture downstream of the reservoir
- Decreasing drinking water quality
- Overexploitation of the groundwater resource in the Middle Drâa Valley resulting in decreasing groundwater levels

## Possible future development

Climate change and socio-economic development of the Drâa region have different impacts on water availability and water demand, as there are:

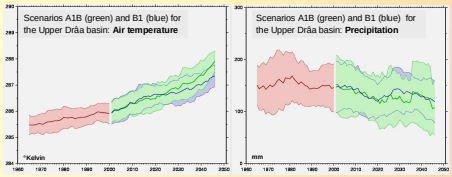
- Decreasing overall precipitation amounts generally aggravate water scarcity
- Higher rain intensities might compensate for water delivery but increases risk of soil degradation
- Irrigation agriculture looses importance because of non-profitability and increased remittances due to labor migration.
- Urbanization increases water demand.

## Modelling the impact of climate change on water cycle and water availability in the Drâa catchment

### Modelling climate scenarios and near future prognoses with a dynamical and statistical downscaling approach

Regional climate downscaling of GCP model results for IPCC scenarios A1B and B1 with **REMO** shows similar trends for the climate in West Africa and the Drâa region (figure: Upper Drâa):

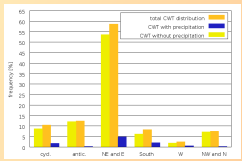
- Increase of mean temperature
- Insignificant decrease of mean annual precipitation




The weather generator **SMGHydrâa** provides regionalised data for hydrological modelling by combining data from REMO with statistical analyses of meteorological measurements, and weather prognoses for the near future (weeks to months).

The possible development of precipitation and evaporation in the Upper Drâa basin is modeled using a statistical-dynamical downscaling approach with **IDEP Drâa** (**FOOT3DK model**) in three steps:

1. classification of pressure fields on the synoptic scale
2. simulation of representative episodes of these fields with a mesoscale model
3. statistical recombination of these episodes



Distribution of the total frequency of the classified Circulation weather types (CWT) for 2002

**Results are available from the Information Systems:**

Statistical Model for the Generation of meteorological data for Hydrological modeling in the Drâa region

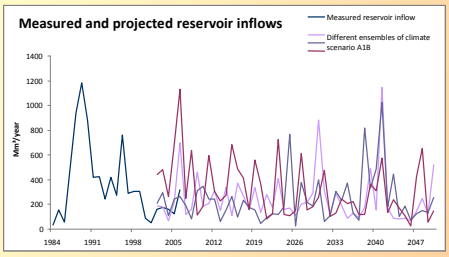
IMPETUS - Possible Future Developments of Evaporation and Precipitation for the Drâa Catchment

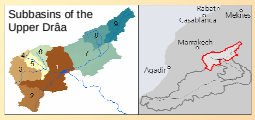
### Modelling river discharge and water availability in the Upper Drâa basin

Two different hydrological models have been integrated into the IMPETUS ISDSS-framework to simulate current and future water availability by river discharge and reservoir inflow:

- the distributed model **SWAT** (Soil and Water Assessment Tool) for long-term studies
- the conceptual model **SRM** (Snowmelt Runoff Model) for seasonal prognosis of snow melt runoff

Both models use meteorological measurements and scenario data, but they differ in regional discretisation and model complexity. Seasonal snowmelt runoff simulations are adapted forecasts which are regularly improved by data assimilation.
Water loss through irrigation of mountain and basin oases is modelled within the framework.




⇨ **Poster 24**
**Hydrologic cycle in the Upper Drâa Valley**

**Results are available from the SDSS HYDRAA and the Monitoringtool PRO-RES:**

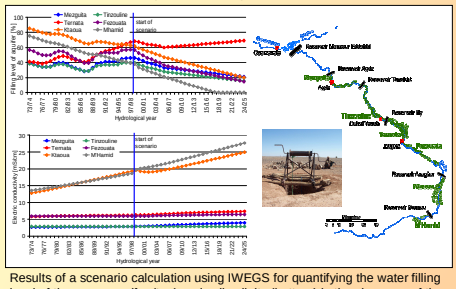
Hydrologic model for the Drâa catchment

Prognosis of snowmelt runoff for the Mansour Eddahbi Reservoir

### Modelling water use, groundwater and soil in the Middle Drâa Valley

Water availability in the six oases of the Middle Drâa Valley depends on water releases ("lâchers") from the Mansour Eddahbi reservoir since 1973. Due to surface water scarcity groundwater exploitation is of increasing importance but cost intensive. Scenarios of water availability and soil salinisation driven by climate change and water use are modeled interdisciplinary with **IWEGS** in annual time steps by coupling the following models:

- Groundwater flows and balances (**BIL**)
- Salinisation of soil and groundwater (**SAHYSMOD**)
- Agricultural water use (**CROPDEM**)
- Domestic water use (**C.E.M. Drâa**)



Results of a scenario calculation using IWEGS for quantifying the water filling level of the upper aquifer (top) and soil salinity (bottom) in the six oases of the Middle Drâa Valley.

⇨ **Poster 25**
**Assessing water use, groundwater availability and soil salinity in the Middle Drâa basin**

⇨ **Poster 27**
**Soil information for the Drâa catchment – from point to regional scale**

Input for hydrological modelling in the Middle Drâa

Input for hydro-geological modelling in the Middle Drâa

Input for economical modelling related to water in the Middle Drâa

**Results are available from the SDSS:**

Impacts of Water Exploitation on Groundwater and Soil

**Economic aspects** of water availability and water use in the Middle Drâa Valley are examined with the SDSS **MIVAD** (C. Heidecke and A. Kuhn)

⇨ **Poster 20**
**Agricultural production and income security under increasing water uncertainty in the Drâa Valley**

## Conclusions

- For the analysis of the current water related environmental and socio-economic situation in the Drâa Valley an interdisciplinary approach is required.
- Tools developed in this context are available to support water resources management by stakeholders.
- Future development of the Drâa Valley depends on both, feedbacks between environmental and socio-economic processes as well as on political decision.

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