Water Demand, Land Use, and Income Security under Conditions of Global Change in the South of Morocco

GLOWA Conference
Ouagadougou, 25th – 28th August 2008

H.E. Goldbach, Th. Heckelei, A. Kuhn, M. Abdel-Razek, C. Frank, F. Gresens, A. Roth, Th. Gaiser, S. Klose, B. Reichert, S. Platt, C. Rademacher, and C. Heidecke*

Universität zu Köln
GLOWA
Ministry of Innovation, Science, Research and Technology of the German State of North Rhine-Westphalia
Bundesministerium für Bildung und Forschung
universitätbonn

Water and Income in the Drâa Valley

- Water main limiting factor for land use
- Family income is generated by agriculture, livestock and small enterprises (in addition to remittances of migration ~ 69%)
- Agriculture in Drâa oases mostly for subsistence and local markets
  Exception: palm dates, spices and fragrances (roses)

Water and Income in the Drâa Valley

- Water demand for human consumption less than 20% of the evaporation losses; irrigation highest water demand
- but irrigation / agricultural use of the oases is needed for securing basic livelihood
- Tourism and urbanization change the demand for water → the region has to optimize the use of scarce and diminishing water resources.

Importance of Tourism

Economy and employment

- Only available alternative to farming with a certain economic potential
- Strong local / regional component:
  2/3 of all employers and 95% of all employees are from the region (between Zagora and M‘Hamid)
- Incentives for other business activities in the cities

Water demand

- Higher economic benefit as in agriculture
- Water demand mostly covered by own wells
- Constant (good) water quality and availability is required
- If tourism should further boom, there might be conflicts about (water) resources: water consumption (Ø 520 L/overnight stay)
- Although *per capita* consumption of tourists exceeds that of local households by large, it uses less than 5% of total water resources: actually similar water consumption of households and tourism

Importance of Tourism

- Within the past 10 years, 2/3 of the capacity in the southern Drâa valley with increasing length of stay
- Concentration of touristic infrastructure at the „hot spots“ Ouarzazate, Zagora and M‘Hamid/Oulad Driss
- Cause and/or consequence of enhanced urbanization
- Most important source for foreign currency in Morocco, objective: 10 millions of tourists in 2010

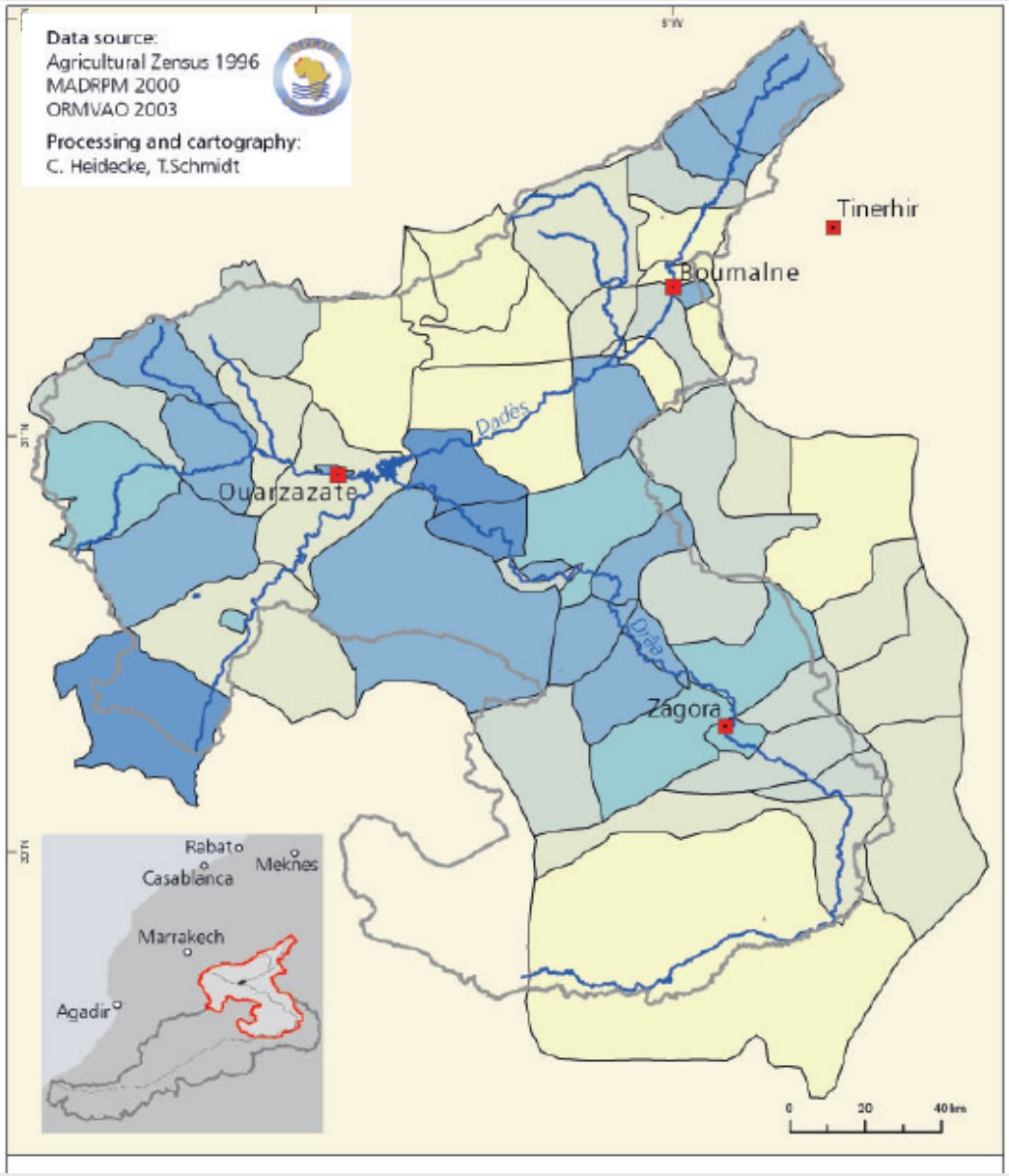
2005 Tours to:	Dades-Valley	Draa-Valley	Marrakesch
Travelers per day	ca. 655	ca. 570	ca. 950
Guided groups per day	ca. 75	ca. 85	ca. 95
Individual travellers per day	ca. 280	ca. 140	ca. 300
Ratio package tours to individual trips	2,6 : 1	4,7 : 1	3,5 : 1
Cars /day	146	110	181
Tourists per day	1010	798	1347

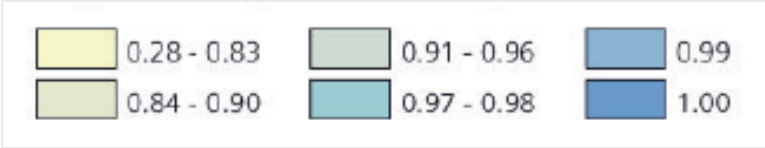
C. Frank: 2005/2006

Questions raised

- How will a change in water supply affect income generation in the Drâa valley?
- How to optimize water distribution economically?
- What are the perspectives for different economic sectors under water shortage and increased salinity (esp. in the southern oases)?

Irrigated area in the Drâa Valley





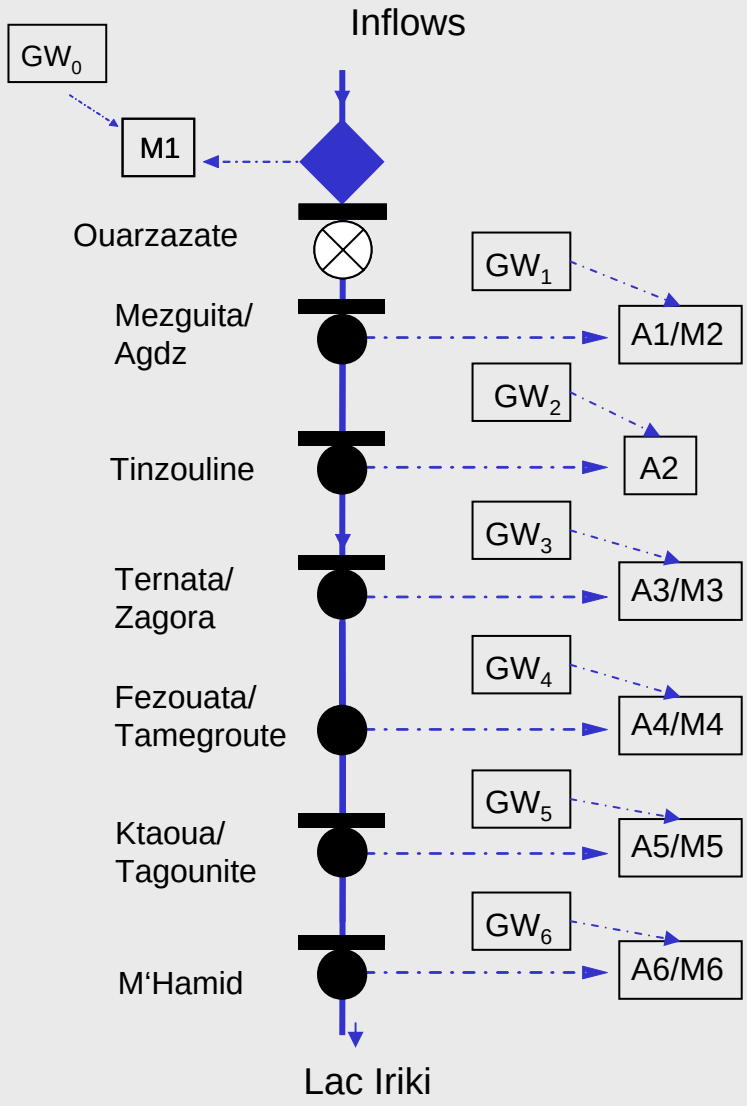
Ratio of irrigated area to total arable land in the region of Ouarzazate

Water and Income in the Drâa Valley

- Management options for expected changes over the next decades → SDSS MIVAD
- MIVAD allocates available water resources in the economically most feasible way
- components:
  - hydrological data
  - yield functions of crops
  - economic assessment: calculating profits from agricultural production

Structure of MIVAD

- Model is configured as a network which reflects spatial relationships within the Drâa region
- Nodes are formed by river side-arms, reservoirs, and points of demand such as villages or oases
- Simulation period: agricultural year with monthly sub-periods
- Data based on ORMVAO information, literature, agro-economic survey in 2005



MIVAD

Model Output

- Revenues from crop production, area cultivated in total and per oasis, yields per crop (dates, wheat, barley, corn, alfalfa, henna, beans, vegetables)
- Water allocation to different crops
- Use of different water resources (ground- / surface- water)

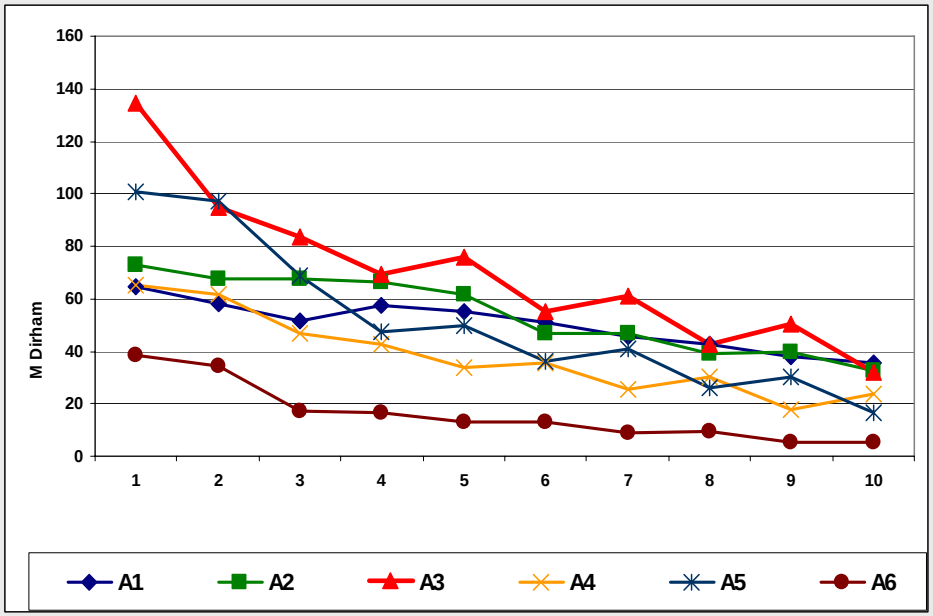
Use of the model for different scenarios

- Water resource development and land use in the coming years
- Effects of water shortages on water resources and land use pattern
- Agricultural income under different climatic conditions and changes in the future

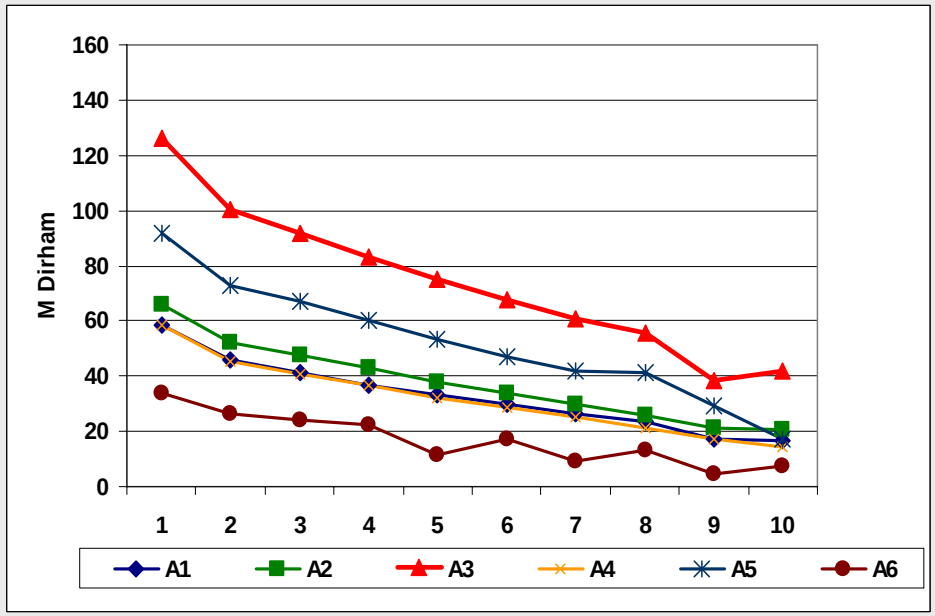
Scenario:

Effect of ten years drought on **agricultural income**

Without charges for groundwater use



Charge for groundwater use of 1 MAD/m³



Agricultural income for the six oases A1 to A6

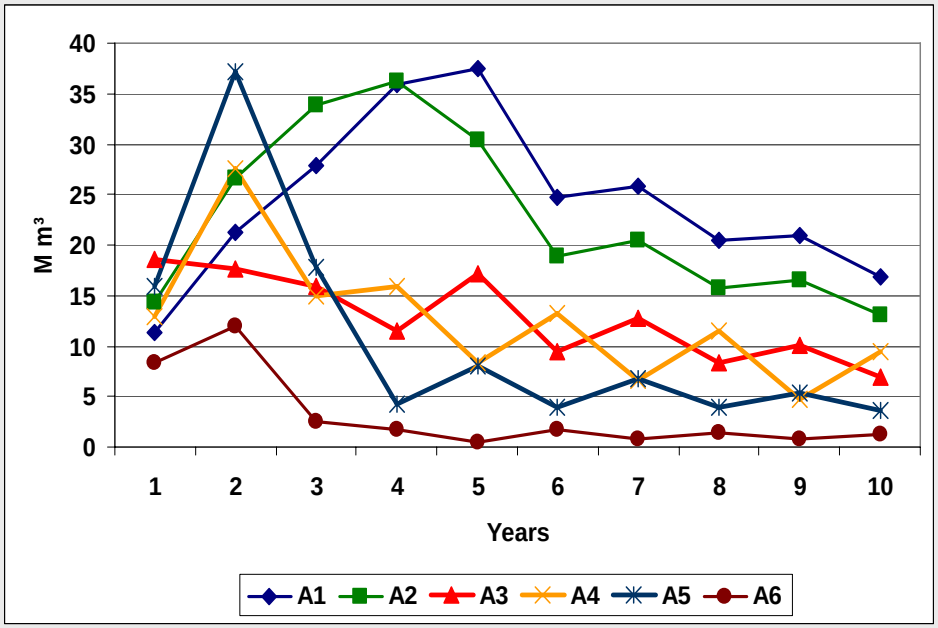
Assumptions:

- **Water availability is declining by 6% per year**
- **Population growth in the villages**

Scenario:

Effect on of ten years drought on **groundwater use**

without charge



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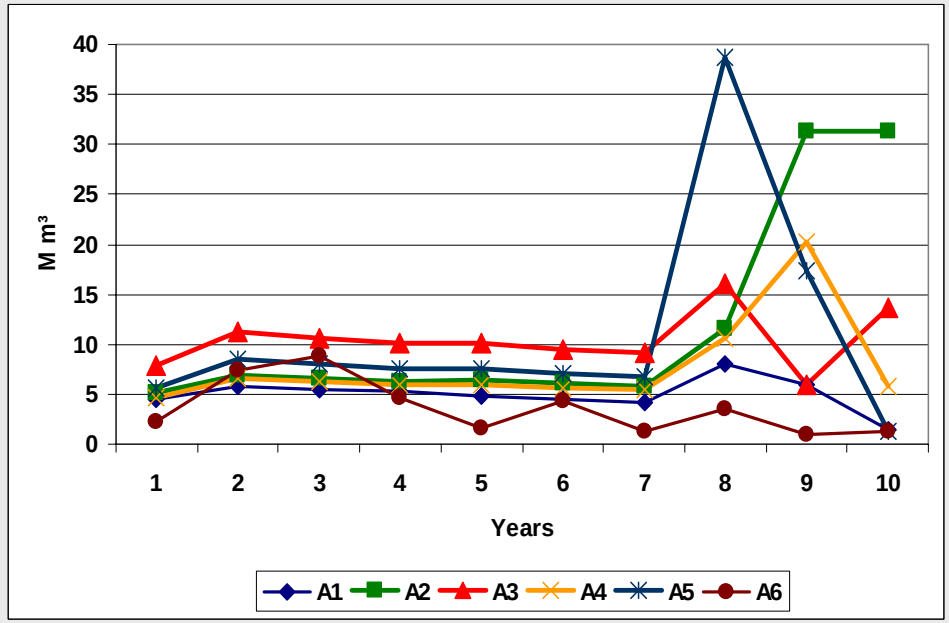


Groundwater use for irrigation (A1 to A6)

Assumptions:

- **Water availability is declining by 6% per year**
- **Population growth in the villages**

Exemplary results of hydro-economic modelling

- Decreasing surface water availability leads to increasing use of groundwater for irrigation $\Rightarrow$ effect of declining groundwater tables!!

See also IWEGS

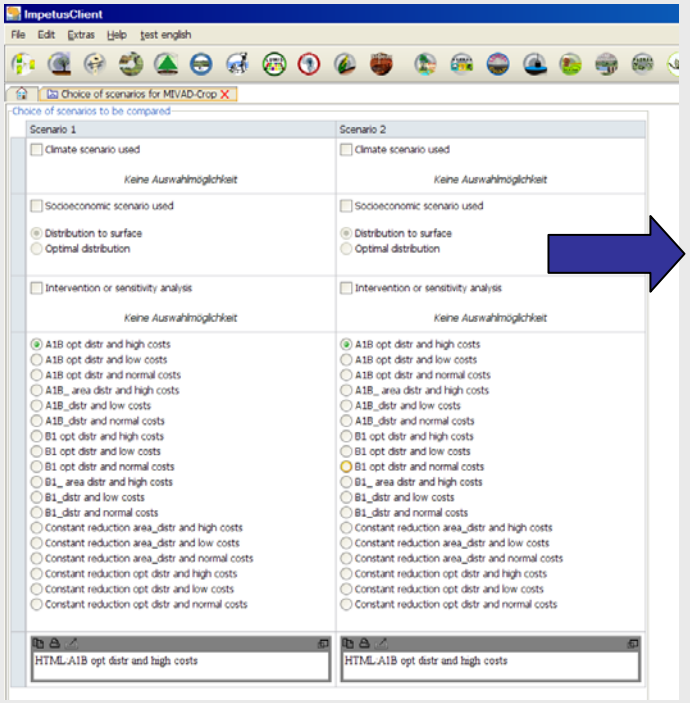
- Decreasing surface water availability can lead to declining farm income of around 400 Million Dirham to ~ 100 Million Dirham for the region

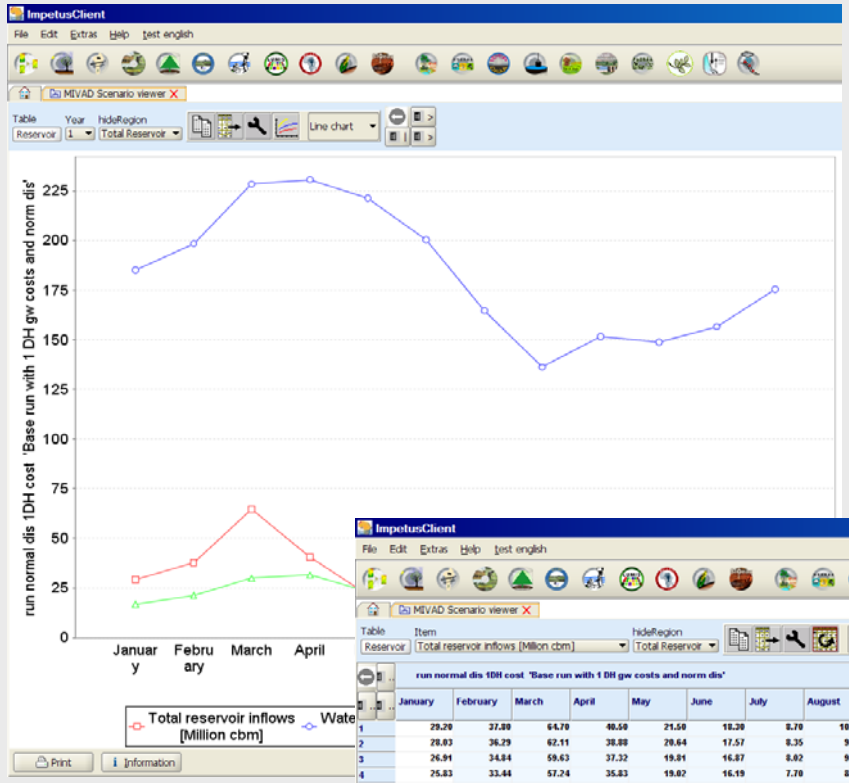
- Water pricing is an option to preserve groundwater resources and/or to make use of its buffer function

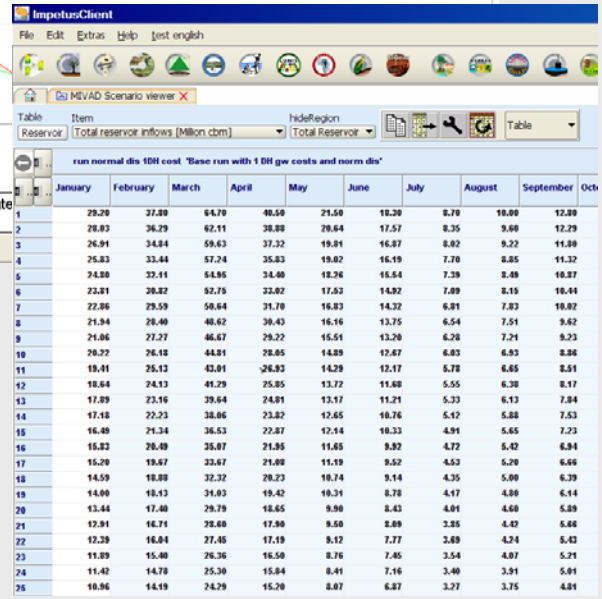
MIVAD SDSS / Scenario viewer

Options:

1. **Compare two scenarios**
2. **Upload new model results**







PIVOT function for individual table design


Thank you for your attention