

6. BMBF-Forum für Nachhaltigkeit 10.09.2009 Hamburg A3: Internationale Verantwortung



Bundesministerium
für Bildung
und Forschung



GLOWA: kein Tropfen auf den heißen Stein

The GLOWA initiative

- launched by the German BMBF in 2000
- focus on the Water Cycle
- a prime example for the German commitment to the United Nations International Decade for Action
- one of the first long-term research programs aimed at mitigating the anticipated impacts of global change in the water sector
- a unique contribution to developing sustainable resource management with its multidisciplinary integrated approach and the considerable resources invested (approximately 75 million €)

The GLOWA initiative

- Deals scientifically with the core problems of
 - Climate change, variability of precipitation, variations caused by human activities , and their effect on the hydrological cycle
 - Interactions between biosphere/ land use and the hydrological cycle
 - Water availability and conflicting water uses
- combines competence and capacities of natural and social sciences and thus provides sound user orientated techniques and services
- integrates and transfers knowledge, tools and complex interdisciplinary research results to stakeholders by developing user-friendly decision support systems (DSS)

GLOWA Pilot Studies

GLOWA Danube

Integrative techniques, scenarios and strategies of global change in the water cycle using the river Danube as example.

www.glowa-danube.de
Start: October 1st 2000

GLOWA Elbe

Global change impact on the environment and society in the Elbe region.

www.glowa-elbe.de
Start: May 1st 2000

GLOWA Jordan River

GLOWA Jordan River - Global change and integrated water management in the Jordan River catchment.

www.glowa-jordan-river.de
Start: June 1st 2001



GLOWA IMPETUS

An integrated approach to the efficient management of scarce water resources in West Africa.

www.impetus.uni-koeln.de
Start: May 1st 2000

GLOWA Volta

Sustainable water use under changing land use, rainfall reliability, and water demands in the Volta basin.

www.glowa-volta.de
Start: May 1st 2000

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GLOWA: kein Tropfen auf den heißen Stein

GLOWA Africa Projects: Sustainable?



B. Reichert, A. Fink, M. Christoph,
B. Dieckrüger, H. Goldbach,
T. Heckeley, M. Rössler, P. Speth,
and about 70 colleagues



J. Liebe, C. Rogers, N. van de Giesen,
P.L.G. Vlek, colleagues, and more than
80 students



Motivation

West and Northwest Africa are “hot spots” of global change:

- Natural climate variability exceeds those anywhere on Earth in many regions
- Climate models agree on substantial drying trend for Northwest Africa
- High population growth (including urbanization and migration)
- Rapid land-use change especially in West Africa
- Present land use practices lead to over-grazing, erosion, and salinization of water and soils

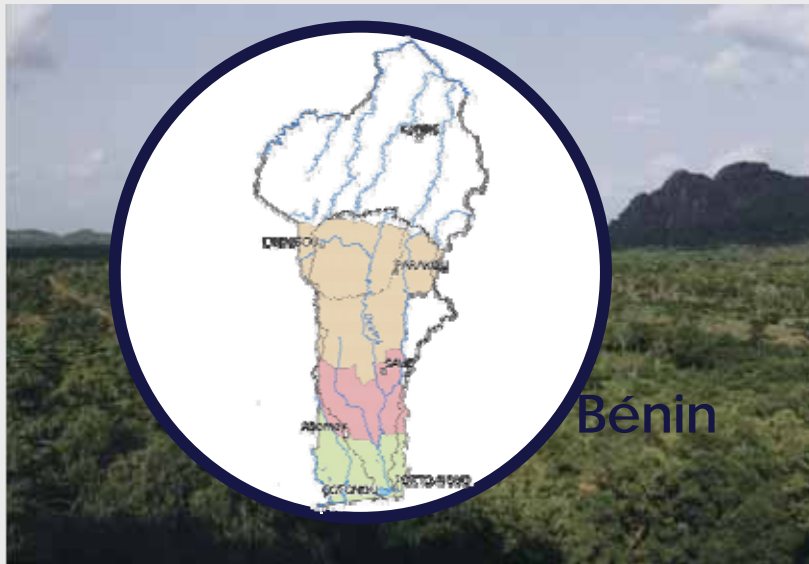
⇒ **Reduction of freshwater availability per capita**

⇒ **Vulnerable food and livelihood security**

⇒ **Growing potential of conflicts**



Catchment characteristics



Ouémé (Bénin)

- 46,500 km²
- sub-humid to humid, bi-/ uni-modal rainy seasons (1,127 mm)
- weakly undulated Pedi plain with isolated inselbergs
- vegetation: forest-savannah mosaic, mostly degraded



Drâa (Morocco)

- 29,500 km²
- arid to semi-arid climate (718 mm in the north, 42 mm in the south)
- heterogonous geologic setting
- sparse vegetation cover (acacia, shrubs, juniperus trees) only dense in the oasis



Atmosphere

Hydrosphere

Anthroposphere

Biosphere

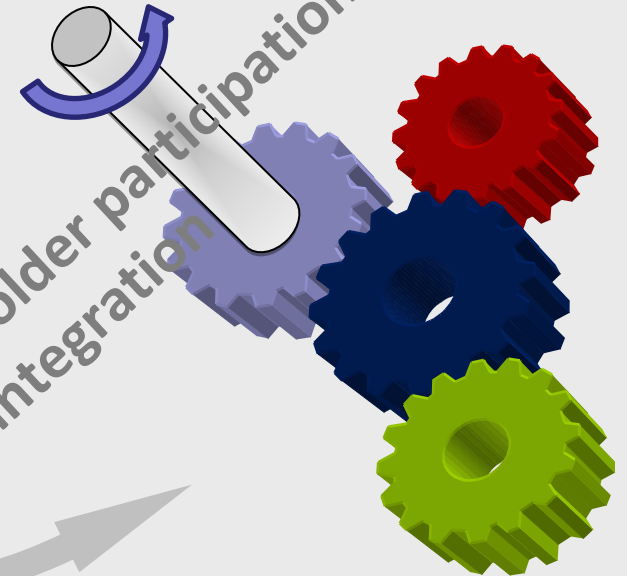
the IMPETUS method

Problemcluster

Models & Scenarios



Stakeholder participation and integration



Spatial Decision Support systems



Universität zu Köln



Ministry of Innovation, Science, Research and Technology of the German State of North Rhine-Westphalia



Bundesministerium für Bildung und Forschung



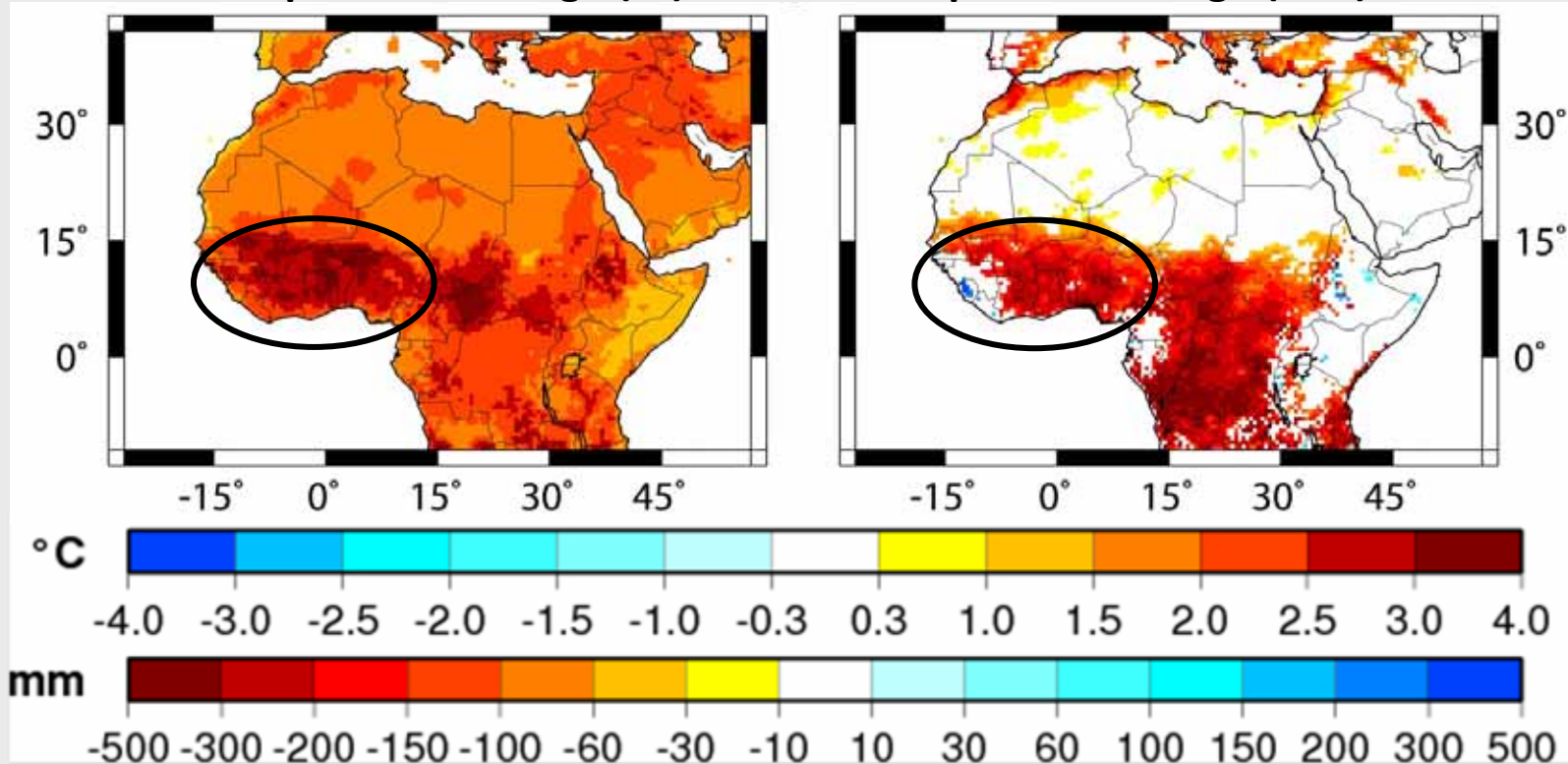


REMO Climate Projections until 2050



Temperature change (°C)

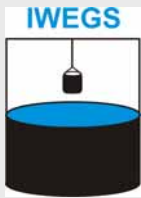
Precipitation change (mm)



The IPCC A1B climate projections were substantially modified:
West Africa exhibits a **stronger significant warming** and a **significant drying trend**

Source: Paeth et al. 2009





Groundwater Levels in the Drâa Oases

Scenario:

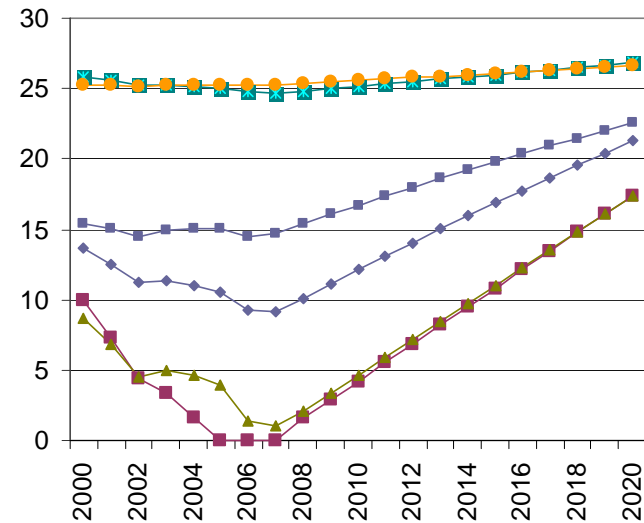
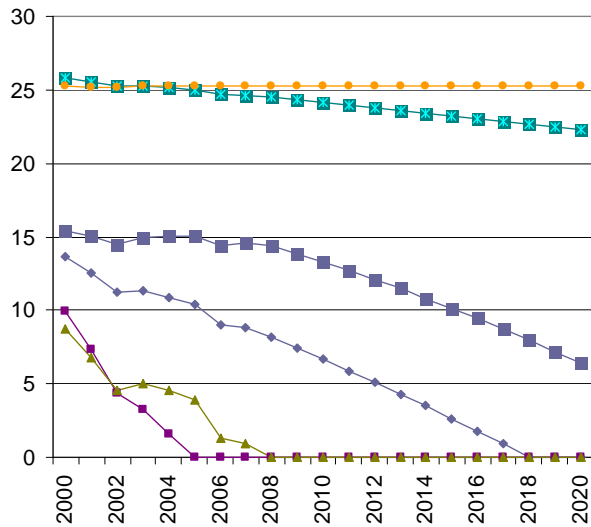
10 % precipitation reduction and increasing water demand

Intervention scenario:

Transfer of flood runoff, demand based proportion for each oases



Saturated aquifer thickness [m]



➔ Significant depletion in two oases of the Middle Drâa valley

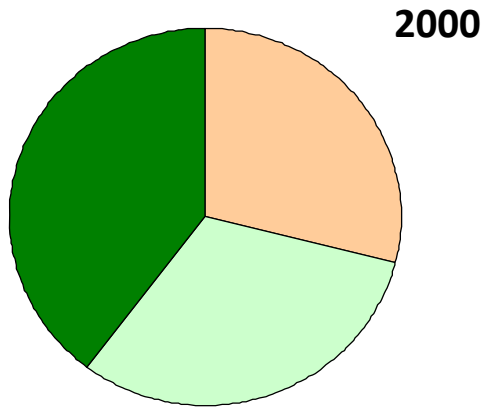
➔ Mitigation of the effects



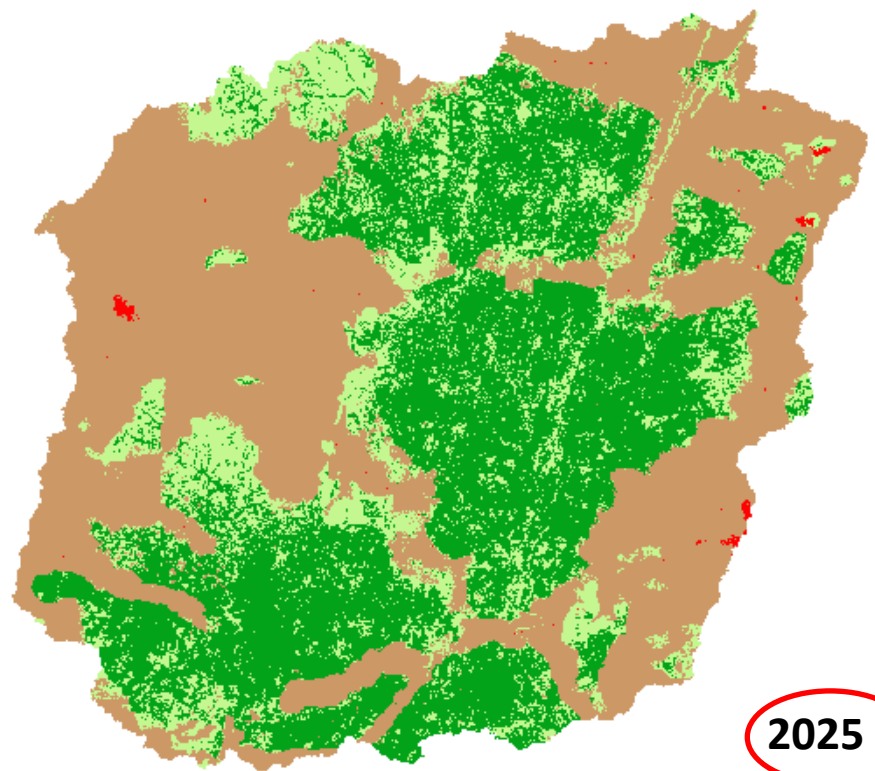
Land use change scenarios Upper Ouémé catchment



- Settlement
- Agricultural land (>20%)
- Forest and dense savannah
- Shrub and grass savannah

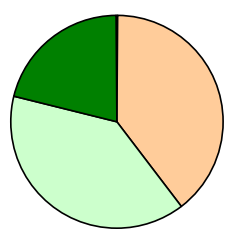


B3: Business as usual

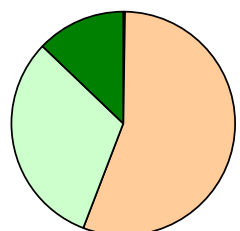


2025

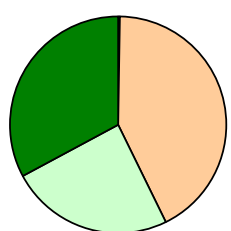
B1 Economic growth &



B2 Economic stagnation



B3 Business as usual



2025

Source: Judex, 2008

Long-lasting project heritage

- The IMPETUS Framework with about 30 SDSS/IS/MT



- The digital and print versions of the IMPETUS atlases, the IMPETUS book as transfer of the broad research results
- The rich IMPETUS data base mirrored in the partner countries



- Increased staff competence in Germany and in the two partner countries, including support for young researchers, for education and training and exchanges of scientists

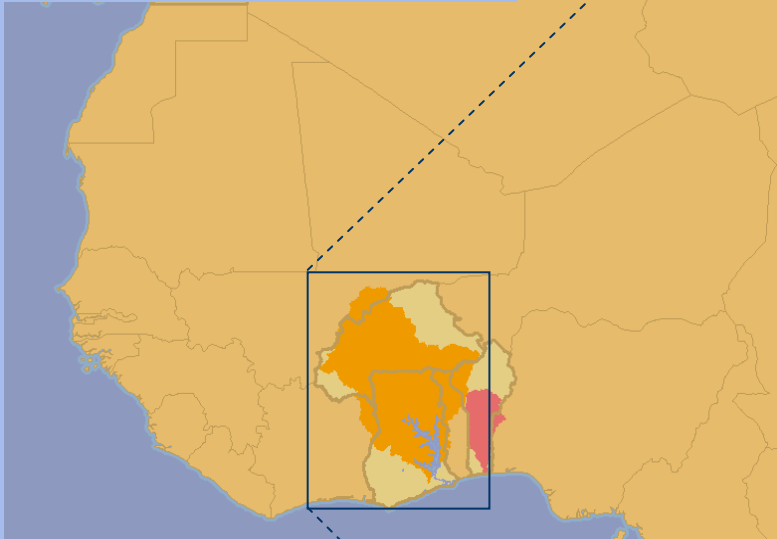
Conclusions with respect to sustainability



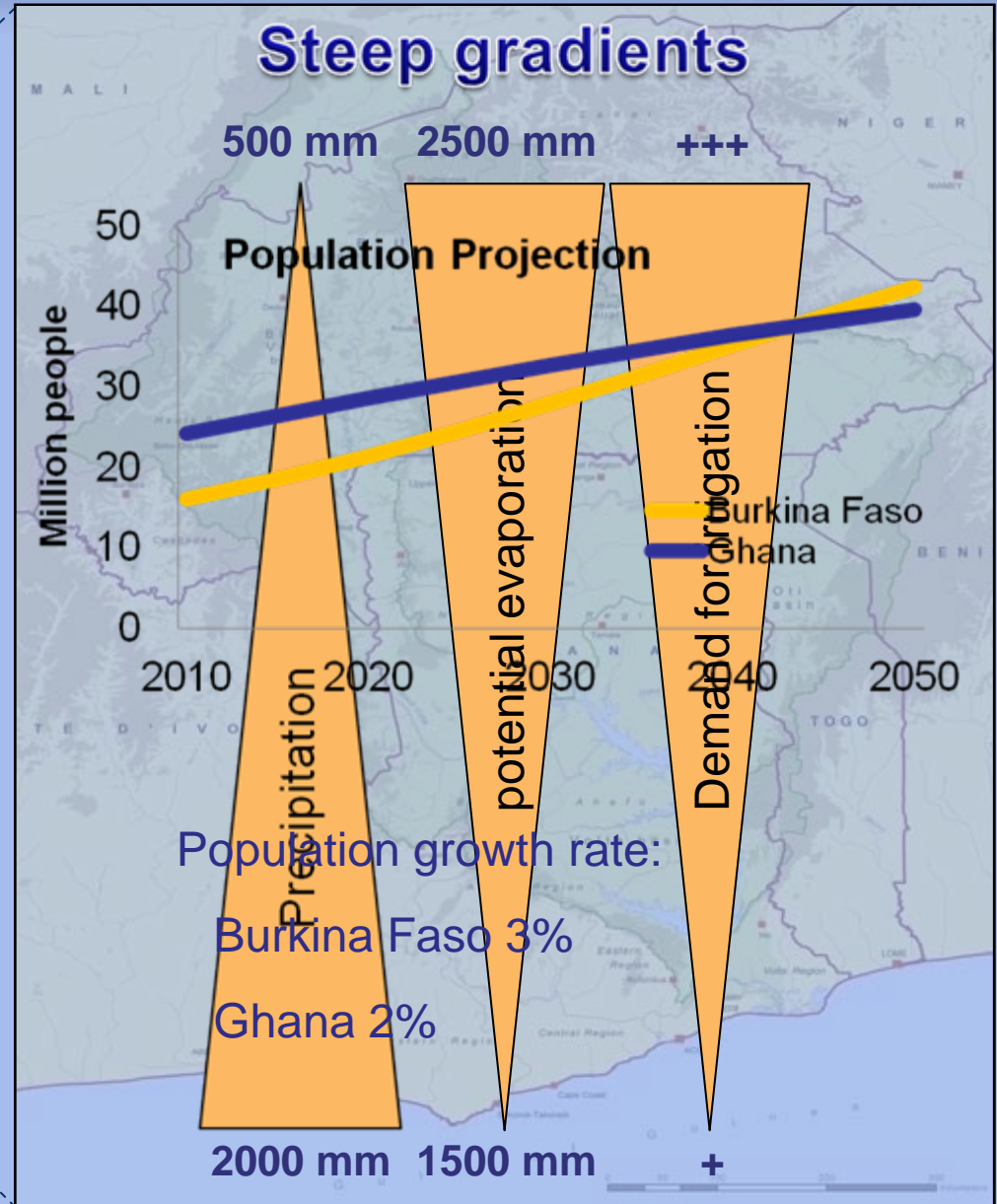
- Perception of IMPETUS in Benin and Morocco as a “Showcase project” of interdisciplinary research
- Multi-level capacity development of political decision makers, of academic users, and of individuals was successful
- Use of the SDSS/MT/IS in integrated water management, food security, and health management, of the atlases, and of the geo data base in both countries
- Institutional development e.g.
 - transfer of the bio-geochemical laboratory in Parakou to DGEau
 - transfer of the hydro-meteorological network to complement the existing national networks
- *The IMPETUS approach can be applied to other catchments, but it has to be adapted to the local conditions*



The Volta Basin:

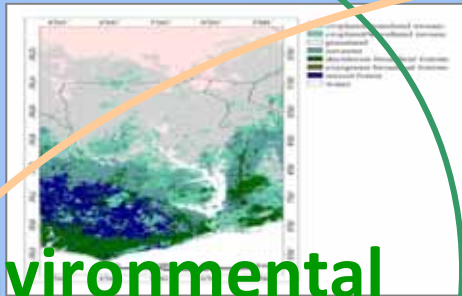


- 400,000 km²
- 6 riparian countries
- 20+ million inhabitants
- 1,000 mm avg. precipitation



Climate, Land Use, Hydrology

Economics, Institutions, Stakeholders



Environmental Change

Land Conversion



Field Investigations



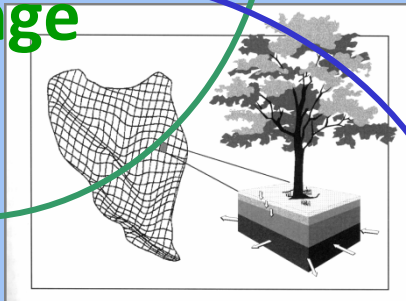
Processes of decision making and information flows

Remote Sensing

Change



Instrumentation



Hydrology

Decision Support

Stakeholder Dialogue, Capacity Building

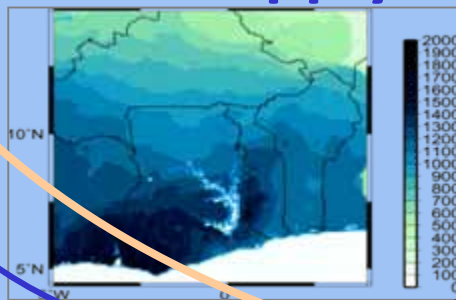
Dialogue

Capacity Building

Institutional Analysis

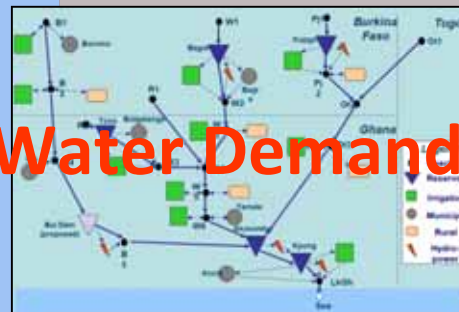


Water Supply



Mesoscale Climate

Water Demand



Integrated Basin Model

Environmental Change

Climate Change

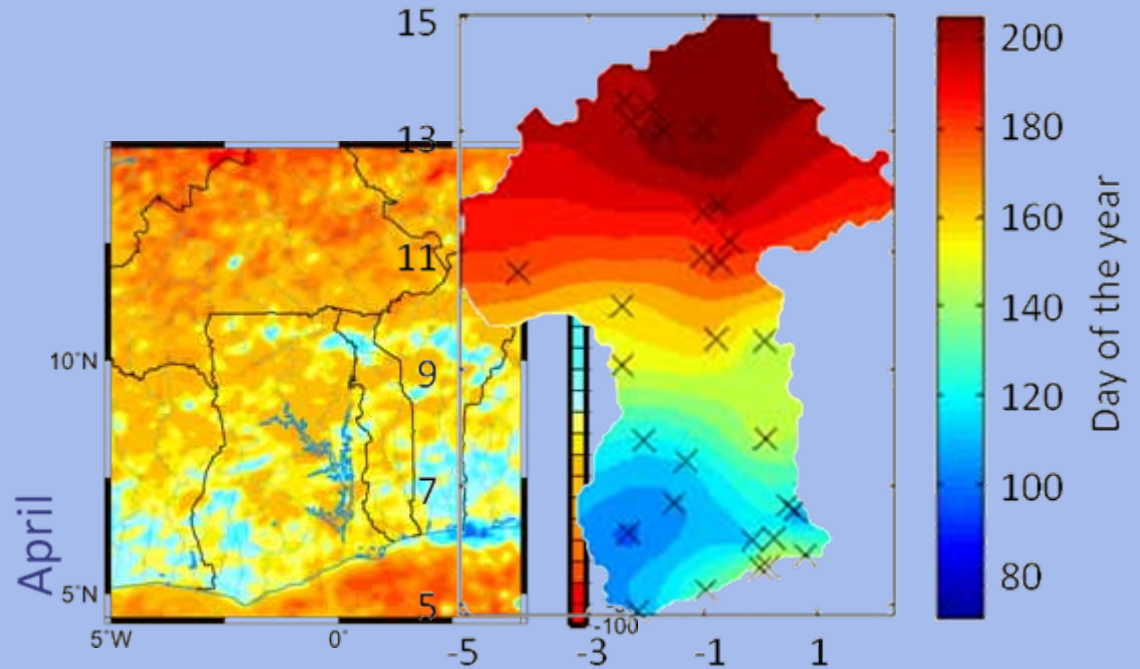
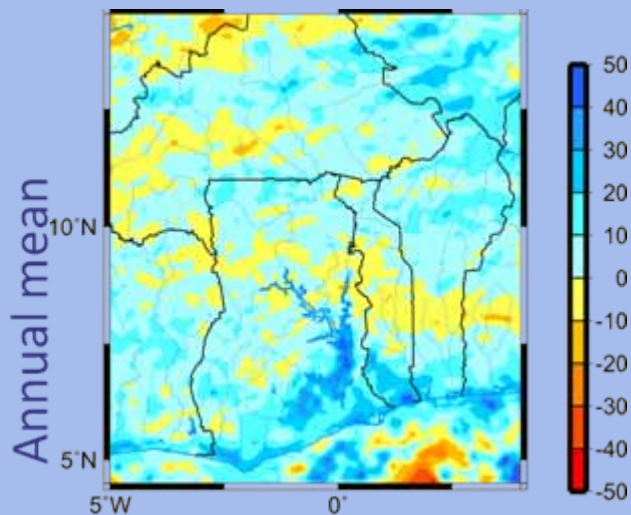
- Increase in Temperature (1.2-1.3 °C)
- Greater variability
 - rainfall
 - runoff
- greater frequency of extremes
 - Regional floods and droughts

Onset of the rainy season

- Prolongation of the dry season
- ORS more variable, today up to 30 days later than 40 years ago
- Increase and intensification of rainfall at the end of the rainy season

Mean onset of the rainy season

Precipitation Change [%]



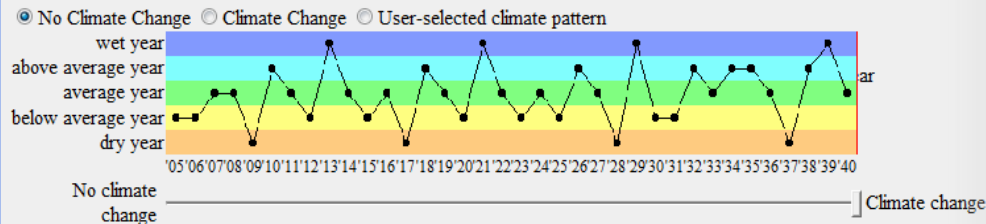


M³ WATER hydro-economic model

Time frame of the simulation

First year Last year

Hydrology and Climate Change Model



Country development scenarios

Population Growth Rate (%)

Ghana		Burkina Faso	
<input type="radio"/> High rate scenario	<input type="radio"/> High rate scenario	<input type="radio"/> High rate scenario	<input type="radio"/> High rate scenario
<input checked="" type="radio"/> Medium rate scenario	<input checked="" type="radio"/> Medium rate scenario	<input checked="" type="radio"/> Medium rate scenario	<input checked="" type="radio"/> Medium rate scenario
<input type="radio"/> Low rate scenario	<input type="radio"/> Low rate scenario	<input type="radio"/> Low rate scenario	<input type="radio"/> Low rate scenario
<input type="radio"/> Custom rate scenario <input type="text" value="2.0"/> %	<input type="radio"/> Custom rate scenario <input type="text" value="3.0"/> %	<input type="radio"/> Custom rate scenario <input type="text" value="3.0"/> %	<input type="radio"/> Custom rate scenario <input type="text" value="3.0"/> %

GDP Growth Rate per capita (%)

Ghana		Burkina Faso	
<input type="radio"/> High growth scenario (2.5 %)	<input type="radio"/> High growth scenario (1.5 %)	<input type="radio"/> High growth scenario (1.5 %)	<input type="radio"/> High growth scenario (1.5 %)
<input checked="" type="radio"/> Medium growth scenario (1.5 %)	<input checked="" type="radio"/> Medium growth scenario (1.5 %)	<input checked="" type="radio"/> Medium growth scenario (1.5 %)	<input checked="" type="radio"/> Medium growth scenario (1.5 %)
<input type="radio"/> Low growth scenario (1.0 %)	<input type="radio"/> Low growth scenario (0.5 %)	<input type="radio"/> Low growth scenario (0.5 %)	<input type="radio"/> Low growth scenario (0.5 %)
<input type="radio"/> Custom rate scenario <input type="text" value="1.5"/> %	<input type="radio"/> Custom rate scenario <input type="text" value="1.5"/> %	<input type="radio"/> Custom rate scenario <input type="text" value="1.5"/> %	<input type="radio"/> Custom rate scenario <input type="text" value="1.5"/> %

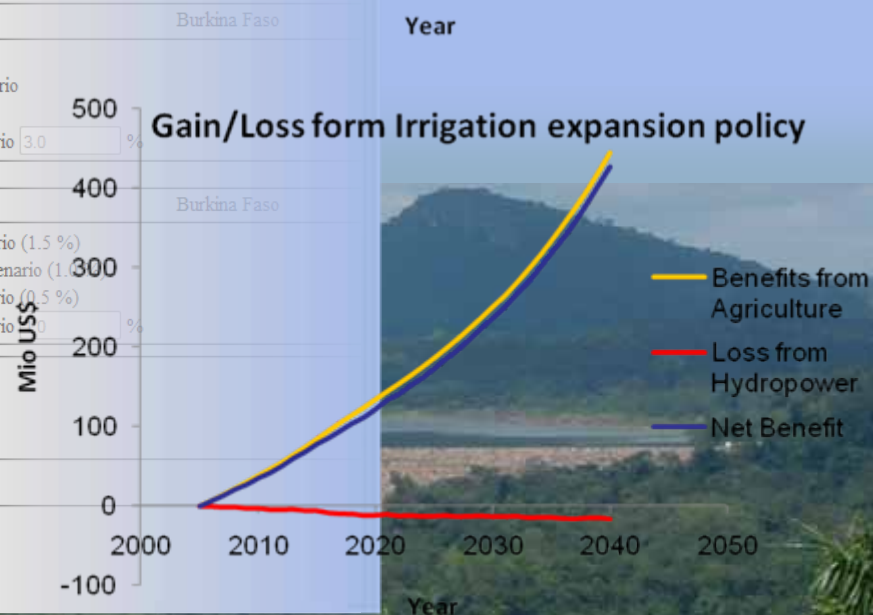
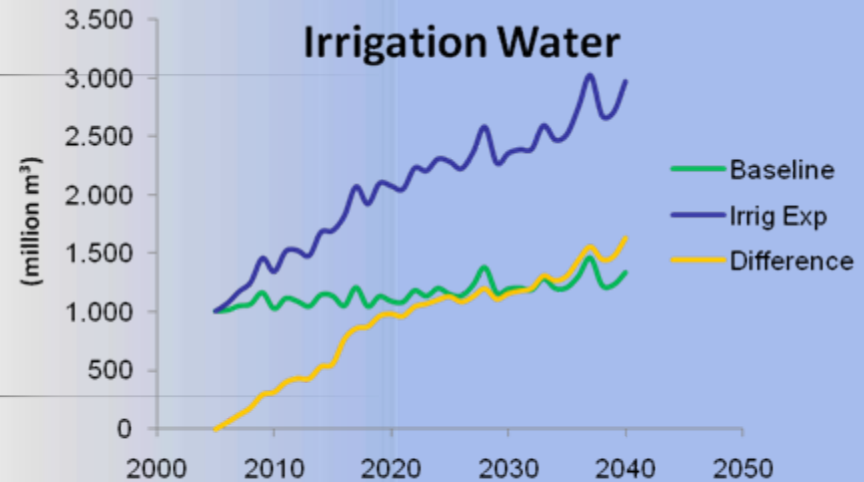
Optimize the policy model by maximizing the social benefit of the countries with respect to the water, labor and land constraints

- Optimize for Burkina Faso first, then for Ghana
- Joint maximization of social benefits of both countries (Integrated Basin-wise)

+ Policy alternatives

Scenario description

-
-



Decision Support

Example GVP Geoportal

Contents

- overview
- search
- data categories
- maps
- map basket
- log out

Management

- admin
- metadata
- meetings

Info

- help
- about
- partners

Links

- GLOWA Volta
- ZEF
- Informatik III

You are logged in as **antorog**.

Welcome to the GLOWA Volta Geoportal

[search]

[view maps]

[share data]

Developed by:
 Computer Science Department III
 Center for Development Research
 University of Bonn

Funded by:
 Federal Ministry for Education and Research (BMBF)

Data search

- find and assess
- download

Interactive geodata

- ◆ compose, view and analyze on map
- ◆ download from map

Publish and share data

- ◆ index and administrate
- ◆ assign use rights
- ◆ upload for distribution



Conclusions

- Research networks have formed, capacity building was successful
- Data scarcity is reduced
- Environmental change leads to greater variability in precipitation, runoff
- Population growth leads to increased demand, competition for water
- GVP provides Decisions Support Resources at different levels
- GVP supports the Volta Basin Authority



Thank you for your attention

A warm thanks to the numerous African
colleagues and research partners without whom
these achievements would not have been possible
and
for the funding by



Federal Ministry
of Education
and Research



GLOWA



Projektträger im DLR

Ministry of Innovation, Science, Research
and Technology of the German State of
North Rhine-Westphalia



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University of Bonn