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Norbert Dichtl/Ulrich Menzel (eds.)

Climate Change and Global Water Problems: Documentation of the Summerschool Nov. 04-11, 2012

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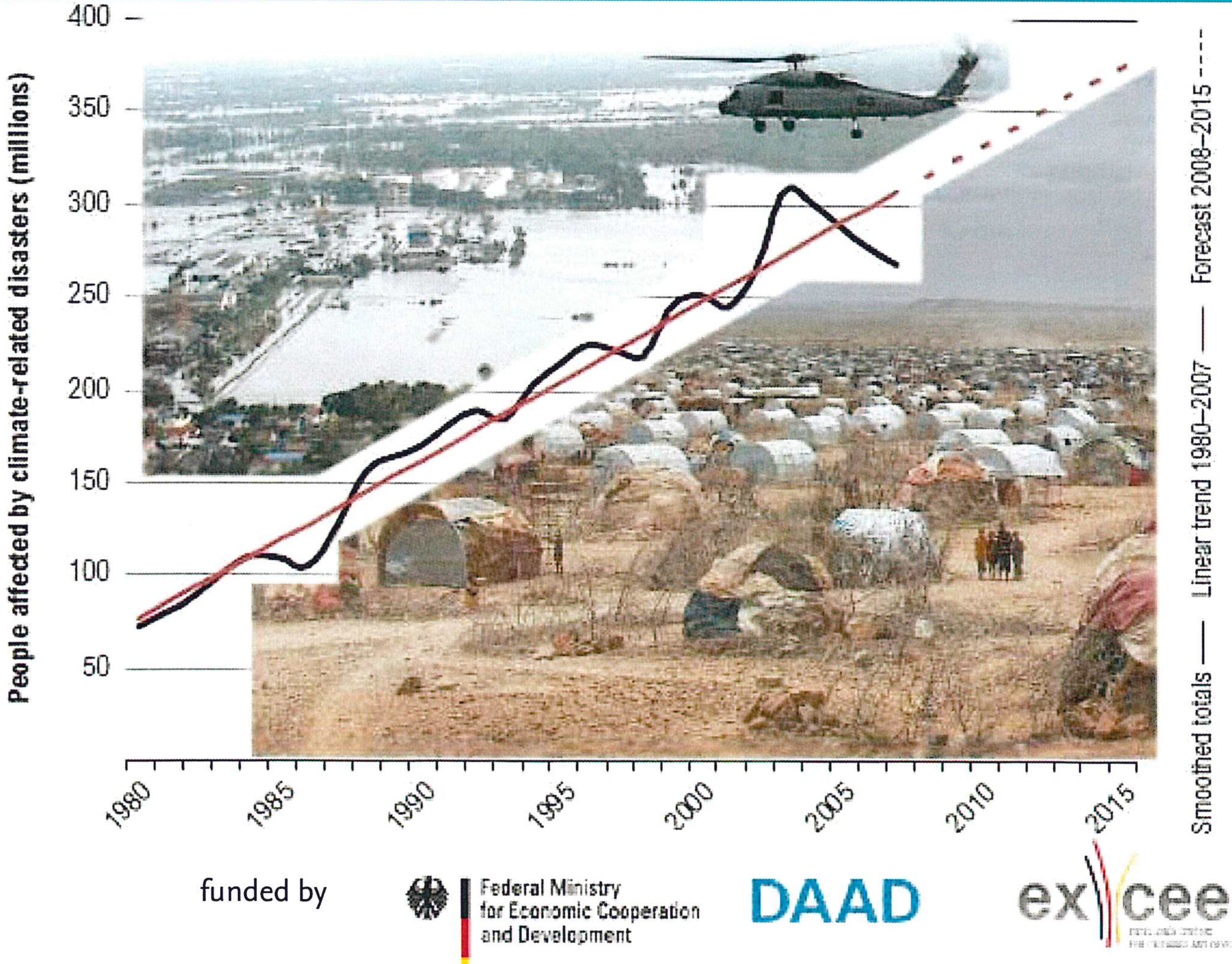
Technische Universität Braunschweig

EXCELLENCE CENTER FOR DEVELOPMENT COOPERATION
SUSTAINABLE WATER MANAGEMENT

Summer School on

Climate Change and Global Water Problems

November 04 – 11, 2012 / Braunschweig, Germany



funded by Federal Ministry for Economic Cooperation and Development | DAAD | exceed

Foreword

From November 5 to 11, 2012 the Institute of Sanitary and Environmental Engineering (ISEE) and the Institute of Social Sciences (ISS), Technical University of Braunschweig organized the international and interdisciplinary Summer School on "Climate Change and Global Water Problems" with German and foreign lecturers and participants from more than 15 countries. The Summer School is part of the ongoing project "Excellence Center for Development Cooperation" (EXCEED), dealing with sustainable and integrated water resources management. EXCEED is organized by the Technical University of Braunschweig in Cooperation with the University of Guadalajara, Mexico, the Université de Ouagadougou, Burkina Faso, the Mu´tah University, Jordan and the Water Resources University , Hanoi, Vietnam. The whole program is funded by the German Academic Exchange Service.

The Summer School provided introductions to the technical, ecological, political, social and economic aspects of the topic "water" under the conditions of the ongoing climate change. The courses started with key notes to general aspects of the related problems like "Change of Water Situation until the Year 2050", "New Sanitation Systems and Resources Management" and "The Tragedy of the Commons", continued with case studies to the "Savannah Region of Western Africa", the "Tragedy of the Lake Aral" in Central Asia, "Artificial Irrigation by Reuse of Treated Wastewater in the Braunschweig Region", "The Consequences of Climate Change for the Tibetan Plateau, the Major Asian Rivers, and Irrigation in Agriculture" and "Jordan Water and the Middle East Conflict". Lectures were given to the topics "Integrated Water Resources Management" and "Climate Change Policies". The Summer School ended with working groups to the topics "Climate Change, Water Scarcity, and Social Conflicts" and "Water Reuse, New Sanitation Systems, and Climate Change". In addition the participants visited wastewater treatment and reuse facilities in the neighborhood of Braunschweig and the UNESCO World Heritage "Upper Harz Water Management System".

Added is the "Braunschweig Water Declaration for Middle East Countries", approved ten years ago on October 28, 2002 at the Technical University of Braunschweig by the participants of the workshop "Intercultural Problems of Technology Transfer to the Middle East, Exemplified on Water and Wastewater Issues", which was discussed in the concluding session of the Summer School.

The general aim was to develop an understanding of major reasons behind climate change, the consequences of climate change for the availability of water resources worldwide and the theoretical and practical approaches, to handle the related problems.

The volume of the “Forschungsberichte aus dem Institut für Sozialwissenschaften” presents the given key notes, case studies and lectures and gives examples of the results worked out in the working groups.

Norbert Dichtl, ISEE

Ulrich Menzel, ISS

Contents

EXCEED Summer School on Climate Change and Global Water Problems
November 04-11, 2012, Braunschweig, Germany

Schedule

Date	Time	Schedule	Details
Sunday 11/04/2012		**Arrival**	
Monday 11/05/2012			
AM:	09.00-10.30		Opening Speech (D. Jahn, Vice President TU BS) General Introduction (Bahadir) Administrative Issues (Haarstrick)
	10.30-11.00	Coffee Break	
	11.00-12.30	Keynote	"Change of Water Situation until Year 2050" (Dichtl)
	12.30-14.00	Lunch	
PM:	14.00-15.30	Keynote	"New Sanitation Systems and Resources Management" (Dockhorn)
	15.30-16.00	Coffee Break	
	16.00-17.30	Keynote	"The Tragedy of the Commons" (Menzel)
	19.00	Bus Transfers to Restaurant	The Participants are picked up from their Hotels by University Staff Members
	19.30	Welcome Dinner	Restaurant Tandure
Tuesday 11/06/2012			
AM:	09.00-10.30	Case Study	"Climate Change & Adaptability in the Savannah Region of Western Africa" (Dorm-Adzobu)
	10.30-11.00	Coffee Break	Payment of daily allowances
	11.00-12.30	Case Study	"Post Socialist Water Distribution Conflicts: The Tragedy of the Lake Aral" (Garbowski)
	12.30-14.00	Lunch	
PM:	14.00-15.30	Case Study	"Artificial Irrigation by Reuse of Treated Wastewater in the Braunschweig Region" (Mesek / Teiser / Dichtl)
	15.30-16.00	Coffee Break	

	16.00-17.30	Case Study	"The Consequences of Climate Change for the Tibetan Plateau, the Major Asian Rivers, and Irrigation in Agriculture" (Schwalb)
Wednesday 11/07/2012			
AM:	09.00-10.30	Case Study	"Jordan Water and the Middle East Conflict" (Berthold / Bressler)
	10.30-11.00	Coffee Break	
	11.00-12.30	Working Groups (Köpke)	"Climate Change, Water Scarcity, and Social Conflicts"
	12.30-14.00	Lunch	
PM:	14.00-15.30	Working Groups (Köpke)	"Climate Change, Water Scarcity, and Social Conflicts"
	15.30-16.00	Coffee Break	
	16.00-17.30	Working Groups (Köpke)	"Climate Change, Water Scarcity, and Social Conflicts"
Thursday 11/08/2012			
AM:	09.00-10.30	Lectures	"Integrated Water Resources Management as a Tool for Adaption to Climate Change" (Al Alawi) "Climate Change Policies" (Al Sarayrah)
	10.30-11.00	Coffee Break	
	11.00-12.30	Working Groups (Klein)	"Water Reuse, New Sanitation Systems, and Climate Change"
	12.30-14.00	Lunch	
PM:	14.00-15.30	Working Groups (Klein)	"Water Reuse, New Sanitation Systems, and Climate Change" (Klein)
	15.30-16.00	Coffee Break	
	16.00-17.30	Working Groups (Klein)	"Water Reuse, New Sanitation Systems, and Climate Change"
Friday 11/09/2012			
AM:	08.15	Bus Transfer	From "Frühlingshotel"
	08.30	Bus Transfer	From "Hotel an der Stadthalle"

	09.00-12.30	Technical Visit	Wastewater Treatment and Reuse Facilities of Braunschweig (Siemers / Walther / Teiser)
	12.30	Bus Transfer	Back to "Haus der Wissenschaft"
	13.00-14.00	Lunch	
PM:	14.00-16.00	General Discussion	The "Braunschweig Water Declaration" Revisited – 10 Years after
	19.00	Farewell Dinner	Restaurant Tandure
Saturday 11/10/2012			
AM:	07.00	Bus Transfer	From "Frühlingshotel"
	07.15	Bus Transfer	From "Hotel an der Stadthalle"
	09.00-12.00	Excursion	UNESCO World Heritage "Upper Harz Water Management System"
	13.00	Lunch	Historical Restaurant "Butterhanne", Goslar
PM:	15.00-16.30	Guided Tour	"Historic City Center of the City of Goslar"
Sunday 11/11/2012		**Departure**	

Locations

***Event Venue**	**Haus der Wissenschaft** Seminar Room "Veolia" Pockelsstraße 11 38106 Braunschweig Phone: +49(0)531/391-2161 info@hausderwissenschaft.org	**Content**	**Prof. Dr. Ulrich Menzel** Institute of Social Sciences TU Braunschweig Bienroder Weg 97 D-38106 Braunschweig **Prof. Dr.-Ing. Norbert Dichtl** Institute of Sanitary and Environmental Engineering TU Braunschweig Pockelsstraße 2a D-38106 Braunschweig
****Hotels**	**Hotel "An der Stadthalle"** Leonhardstraße 21 38102 Braunschweig Phone: +49(0)531 - 73 068 info@hotel-an-der-stadthalle.de **Frühlingshotel** Bankplatz 7 38100 Braunschweig Phone: +49 (0)531 / 243 21-0 info@fruehlingshotel.de	**Organization**	**Apl. Prof. Dr. Andreas Haarstrick** Exceed Scientific Coordinator LWI – Leichtweiss-Institute TU Braunschweig Beethovenstraße 51a D-38106 Braunschweig

Opening Speech:

"Summer School on Climate Change

and Global Water Problems"

Dear Students, dear Scientist, dear Organizers, my fellow colleagues,

my name is Dieter Jahn, I am microbiologist and vice president of our University for research.

In the name of the President and the whole executive board of our university I like to welcome you to the

"Summer school on climate change and global water management in Braunschweig"

For me as biologist is absolutely clear:

Water is life.

Clean water is the basis for all forms of life.

Therefore, knowledge of water containment, management, quality control etc. are central issues to the majority of countries in the world. I learned, that worldwide more than 1.2 billion people have no access to drinking water, and three billion have neither sanitary nor wastewater disposal facilities.

Due to its geographical location Germany currently has a safe water supply and well organized water recycling systems. However, this was different only 40 years ago, where the majority of German rivers were dead. It took decades to develop the awareness for environmental protection. The in the meantime powerful Green party is only one result of this political movement.

Clearly, environmental, in this case water protection has a lot to do with education and political will. However, environmental protection costs money and puts constraints, costs on industrial production processes. The conflict between cheap industrial production and environmental protection is especially difficult to solve in developing countries. Consequently, many people in these countries suffer from polluted water, air and soil.

Let us come back to the problems of worldwide water supply. Global warming with extensive dryness lead food and water shortage and as consequences to hunger, death and war.The causing extensive use of fossil fuels with the corresponding CO_2 production for the last century was mainly facilitated by the industrialized countries in

Europe, America and Asia. In this context mobility is one of the major factors causing CO_2 production.

Our University has two major research focusses: Mobility and Life science! In the Life Sciences we are investigating for example marine environments, but also infections using a systems biology approaches. In the light of the observed climate changes, our mobility research is on electric mobility and other alternative ,,,Several new Research Centers are build focusing on cars, airplanes, but also on systems biology or pharmaceutical technologies.

Let us come back to the overall picture: the areas of the world suffering from the climate change are not necessarily the same causing it. Here lies the responsibility of the industrialized countries. This responsibility is taken up by your consortium.

We are impressed this excellence program, supported by the DAAD (German Academic Exchange Service) and the Federal Ministry for Economical Cooperation and Development. It comprises more than 35 partneruniversities and research centers in developing and emerging countries on 5 different continents.

The primary goal of the Braunschweig Competence Centre and its international cooperation partners is therefore to develop core proposals for sustainable water management.

On this summer school on climate change and global water problems you have the opportunity to get an interdisciplinary overview over the interplay of two major factors:

1 .the quantitative aspects of global water share

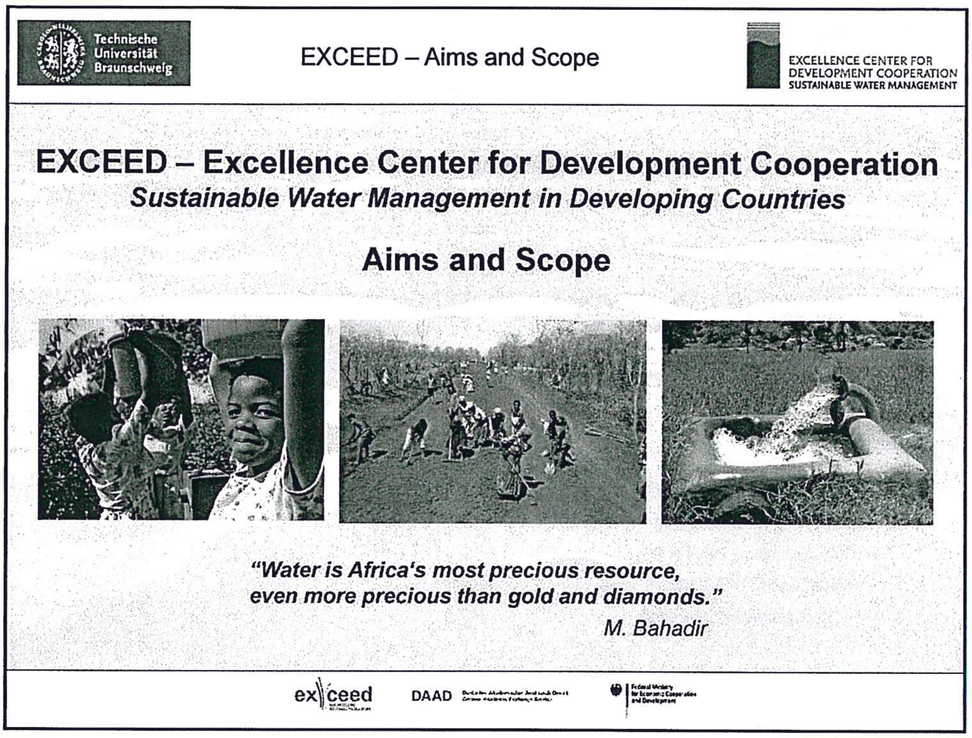
2. therelated water quality issues.

On the basis of case studies and in consideration of the specific local conditions, scenarios of the future water situation will be developed.

Please take the chance to interact and connect, to discuss and to get an insight into research activities beside one owns research focus.

The University of Braunschweig once again welcomes to this summer school and we hope you will have an exciting time here with fruitful discussion, lots of networking and helpful results.

Thank you for your attention


Technische Universität Braunschweig
EXCEED – Aims and Scope
EXCELLENCE CENTER FOR DEVELOPMENT COOPERATION SUSTAINABLE WATER MANAGEMENT
EXCEED – Excellence Center for Development Cooperation
Sustainable Water Management in Developing Countries
Aims and Scope
"Water is Africa's most precious resource, even more precious than gold and diamonds."
M. Bahadir
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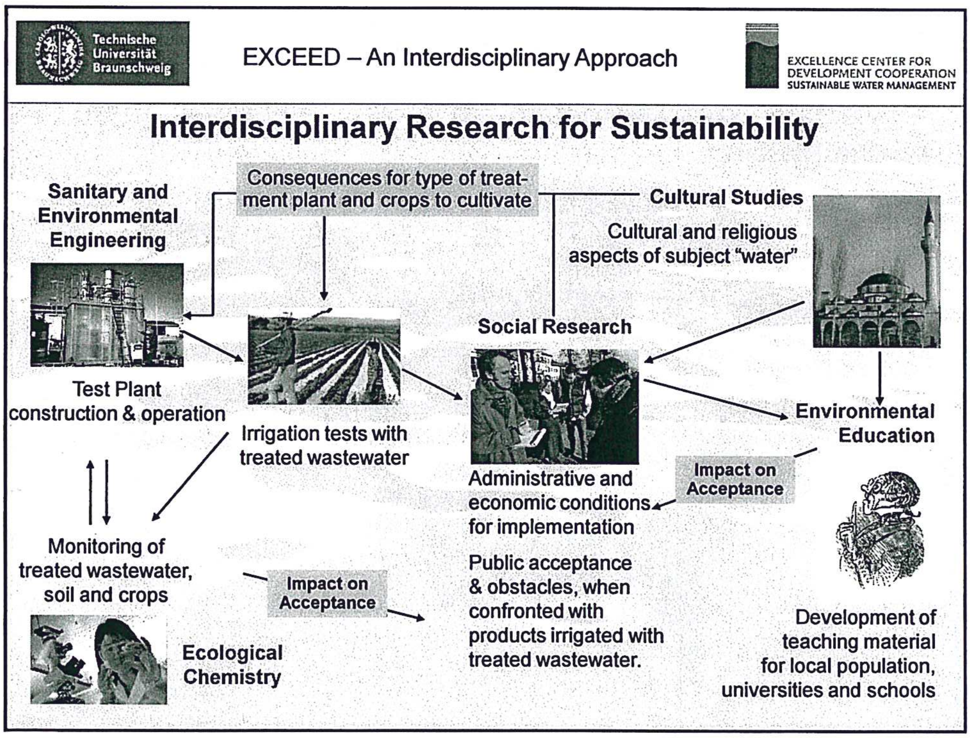
DAAD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EXCEED – An Interdisciplinary Approach
EXCELLENCE CENTER FOR DEVELOPMENT COOPERATION SUSTAINABLE WATER MANAGEMENT
Interdisciplinary Research for Sustainability
Sanitary and Environmental Engineering
Consequences for type of treatment plant and crops to cultivate
Cultural Studies
Cultural and religious aspects of subject "water"
Social Research
Test Plant construction & operation
Irrigation tests with treated wastewater
Environmental Education
Impact on Acceptance
Administrative and economic conditions for implementation
Monitoring of treated wastewater, soil and crops
Impact on Acceptance
Public acceptance & obstacles, when confronted with products irrigated with treated wastewater.
Ecological Chemistry
Development of teaching material for local population, universities and schools

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EXCEED - Objectives

EXCELLENCE CENTER FOR DEVELOPMENT COOPERATION SUSTAINABLE WATER MANAGEMENT

Sustainable Water Management in Developing Countries

OBJECTIVES

- Capacity Building in DC and in GER on Sustainable Water Management
- Putting Sustainable Water Management on Political Agenda in DC and in GER
- Cooperation at eye level with DC on Millennium Development Goals

STRATEGIES

- Building a global network
- Establishing and upgrading study programs
- Conducting joint research
- Providing suitable further education courses
- Creating a pool of experts

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EXCEED – Regional Networks

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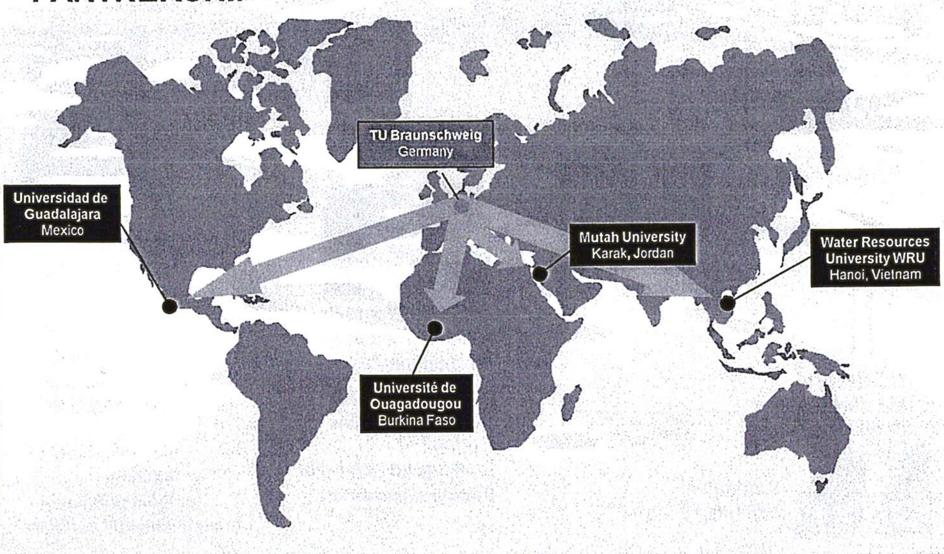
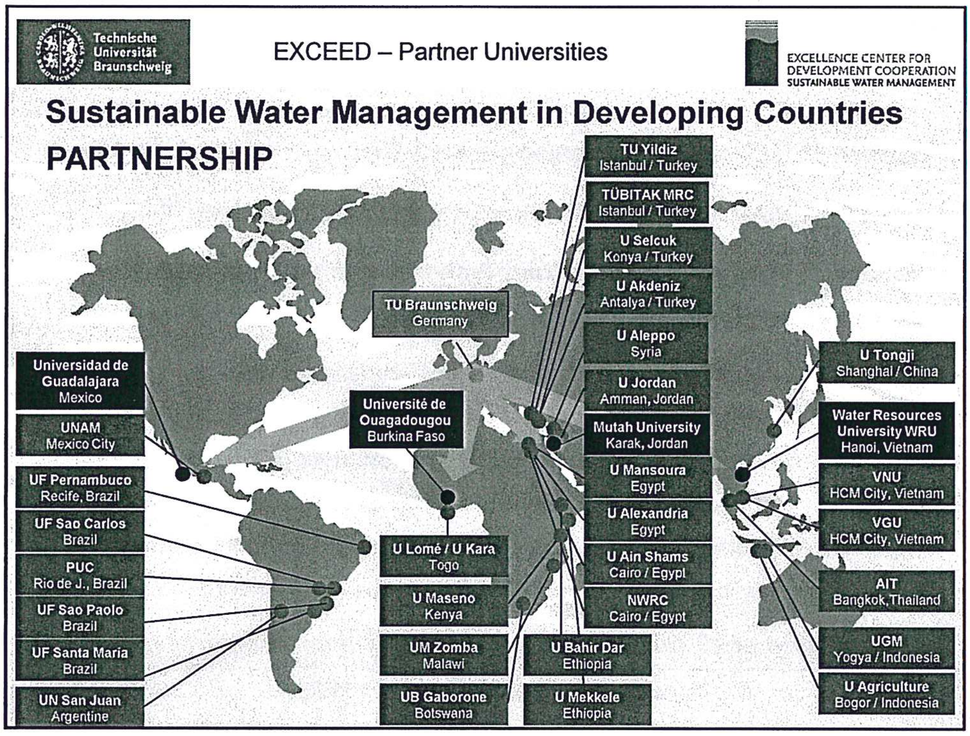
Sustainable Water Management in Developing Countries

PARTNERSHIP





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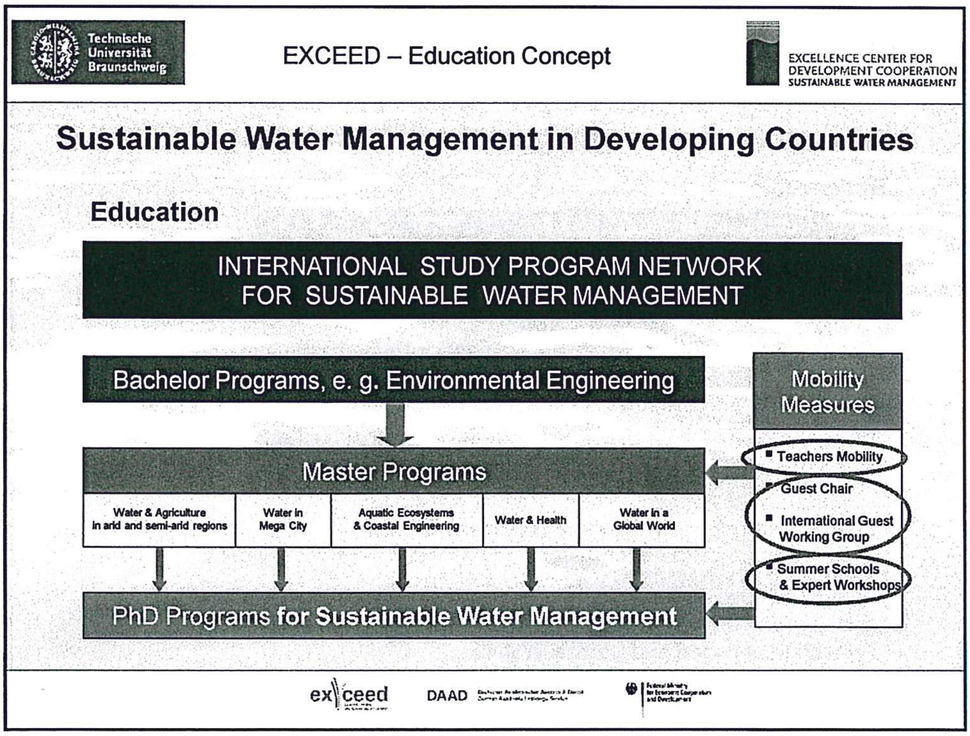
EXCEED – Partner Universities
EXCELLENCE CENTER FOR DEVELOPMENT COOPERATION SUSTAINABLE WATER MANAGEMENT
Sustainable Water Management in Developing Countries
PARTNERSHIP
TU Yildiz Istanbul / Turkey
TÜBITAK MRC Istanbul / Turkey
U Selcuk Konya / Turkey
U Akdeniz Antalya / Turkey
U Aleppo Syria
U Jordan Amman, Jordan
Mutah University Karak, Jordan
U Mansoura Egypt
U Alexandria Egypt
U Ain Shams Cairo / Egypt
NWRC Cairo / Egypt
TU Braunschweig Germany
Université de Ouagadougou Burkina Faso
Universidad de Guadalajara Mexico
UNAM Mexico City
UF Pernambuco Recife, Brazil
UF Sao Carlos Brazil
PUC Rio de J., Brazil
UF Sao Paolo Brazil
UF Santa Maria Brazil
UN San Juan Argentine
U Lomé / U Kara Togo
U Maseno Kenya
UM Zomba Malawi
UB Gaborone Botswana
U Bahir Dar Ethiopia
U Mekkele Ethiopia
U Tongji Shanghai / China
Water Resources University WRU Hanoi, Vietnam
VNU HCM City, Vietnam
VGU HCM City, Vietnam
AIT Bangkok, Thailand
UGM Yogya / Indonesia
U Agriculture Bogor / Indonesia



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EXCEED – Education Concept
EXCELLENCE CENTER FOR DEVELOPMENT COOPERATION SUSTAINABLE WATER MANAGEMENT
Sustainable Water Management in Developing Countries
Education
INTERNATIONAL STUDY PROGRAM NETWORK FOR SUSTAINABLE WATER MANAGEMENT
Bachelor Programs, e. g. Environmental Engineering
Master Programs
Water & Agriculture in arid and semi-arid regions
Water in Mega City
Aquatic Ecosystems & Coastal Engineering
Water & Health
Water in a Global World
PhD Programs for Sustainable Water Management
Mobility Measures
Teachers Mobility
Guest Chair
International Guest Working Group
Summer Schools & Expert Workshops
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EXCEED – Education Concept

EXCELLENCE CENTER FOR DEVELOPMENT COOPERATION SUSTAINABLE WATER MANAGEMENT

Summer Schools, Workshops and Conferences in 2012

- **UNESCO / DAAD / Exceed Conference „Water in Africa“ *(Kisumu, Kenya)***
- **SS Climate Change and Global Water Problems *(Braunschweig, GER)***
- **SS Wastewater Treatment Plants and Management *(Sao Carlos, Brazil)***
- **Regional Training Course on Water Quality *(Guadalajara, Mexico)***
- **Training Course on Basic Water Quality Testing *(Bahir Dar, Ethiopia)***
- **Regional WS Water Foot Print of Middle East Countries *(Mansoura / Egypt)***
- **Expert WS Water Losses Management in Water Supply Systems *(Antalya, TUR)***
- **Regional WS Water, Land and SEA Food Sovereignty *(Bogor, Indonesia)***
- **Expert Seminar Risk Management of Flash Floods *(Nakhon Pathom, Thailand)***

Participation of all African Scholars is highly appreciated.

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EXCEED – Research Concept

EXCELLENCE CENTER FOR DEVELOPMENT COOPERATION SUSTAINABLE WATER MANAGEMENT

Sustainable Water Management in Developing Countries

Research

WATER AND AGRICULTURE IN ARID AND SEMIARID AREAS

- **Integrated Water Management ▪ Modeling Methods**
- **Socio-economic Conditions**

WATER IN URBAN ENVIRONMENT

- **Sanitary Engineering ▪ Urban Water Supply ▪ Numeric Models**
- **Sanitation of Contaminated Sites**

AQUATIC ECOSYSTEMS

- **Climate Change ▪ Biodiversity ▪ Monitoring of Aquatic Ecosystems**
- **Micro Pollutants ▪ Floods and Droughts**

WATER AND HEALTH

- **Resources Protection ▪ Sewage Treatment**
- **Risk Perception and Assessment**

WATER IN A GLOBAL WORLD

- **Climate Change ▪ Distribution of Water Reserves**
- **Protection of Inland and Coastal Waters**

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Water in Developing Countries

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SUSTAINABLE WATER MANAGEMENT

Eutrophication Control in Nile Delta through Microalgae

Technische Universität Braunschweig

PROJECT PROPOSAL

إزالة الملوثات والعناصر المغذية للنباتات من مياه الصرف الزراعي باستخدام الطحالب الدقيقة

Nährstoff- und Schadstoff-Elimination aus Drainage Wasser durch Mikroalgen

Removal of Nutrients and Pollutants from Drainage Water through Microalgae

An Egyptian-German joint project for eutrophication control for the River Nile with mass production of microalgae for applied purposes

University of Mansoura / Mansoura, Egypt
Faculty of Sciences, Botany Department

Technische Universität Braunschweig / Braunschweig, Germany
Institute of Environmental and Sustainable Chemistry

Further Associated Partners

Ain Shams University / Cairo, Egypt
Zagazig University / Zagazig, Egypt
National Water Research Centre / Cairo, Egypt
BIRD Laboratories / Mansoura, Egypt

Principle Investigators
Egypt: Assoc. Prof. Dr. Mohammad Abdel-Hamid
Germany: Prof. Dr. mult. Dr. h.c. Müfit Bahadir

September 2012

Assoc. Prof. Dr. Mohammad Abdel-Hamid — Prof. Dr. mult. Dr. h.c. Müfit Bahadir

Abstracts

يستقبل نهر النيل في منطقة الدلتا مياه الصرف الزراعي المحملة بالملوثات والعناصر المغذية للنباتات، الأمر الذي يترتب عليه تدهور واضح في جودة المياه وظهور أعراض تأجن الماء نتيجة الحمل الزائد من عنصري النيتروجين والفسفور. يهدف هذا المشروع البحثي التطبيقي إلى تحسين جودة مياه الصرف الزراعي عن طريق الإستزراع الكثيف للطحالب الدقيقة في برك استزراع حقلية، والتي يتم فيها استهلاك عنصري النيتروجين والفسفور في بناء الكتلة الحيوية للطحالب والتخلص من الملوثات خلال عمليات الإدمصاص الحيوي على أسطح الجدر الخلوية للطحالب الدقيقة. يهدف المشروع إلى اختبار قدرة وكفاءة أنواع مختلفة من الطحالب الدقيقة على النمو المطرد في مياه الصرف الزراعي تحت الظروف الحقلية، وذلك لإختيار النوع الذي يتميز بأعلى معدل نمو وأعلى إنتاجية للكتلة الحيوية الغنية بالمكونات النافعة مثل المحتوى الدهني ونواتج الأيض الثانوية ذات النشاط الحيوي. يهتم المشروع بدراسة وتقييم الأهمية التطبيقية للكتلة الحيوية للطحالب في انتاج الوقود الحيوي (الديزل الحيوي أو وقود الطائرات النفاثة) أو بعض المركبات الصيدلانية، هذا إلى جانب تقييم استخدام الكتلة الحيوية للطحالب كمادة أولية لإنتاج علف الحيوان أو الغاز الحيوي. إن الهدف الأساسي للمشروع هو الوصول إلى طريقة ناجحة ومبتكرة تعتمد على الإنتاج الكثيف للطحالب الدقيقة للتخلص من الملوثات والمغذيات النباتية لمياه الصرف الزراعي، وستخضع جميع مدخلات ومخرجات تلك التقنية الحيوية للتقييم العلمي الشامل من بدايتها وحتى نهايتها، وهو ما يصطلح عليه عالميا بالتقييم الشامل لدورة الحياة (Life Cycle Assessment) وذلك لتقييم مستوى نجاحها وإمكانية تطبيقاتها العملية.

ومن الجدير بالذكر أن نجاح هذا المشروع سيسهم بشكل فاعل في الإدارة المستدامة لمصادر المياه وتحويل مياه الصرف الزراعي إلى منتجات حيوية ذات قيمة اقتصادية عالية، هذا إلى جانب الحفاظ على البيئة وحماية المصادر الطبيعية.

Through drainage of irrigated fields nutrients and pollutants enter the River Nile and Delta Region, deteriorating thereby the water quality and contributing to eutrophication. The applied research project aims to improve the drainage water quality through mass production of microalgae in open ponds and thereby to remove the nutrients N and P for algae cultivation. Through their large surfaces the algae will also remove the pollutants from water through biosorption. The microalgae species will be selected after their ability to mass production and formation of useful ingredients like lipids and secondary metabolites as bioactive compounds. The downstream use of these ingredients for biodiesel (jet fuel) and pharmaceuticals will also be investigated, besides the use of the whole biomass for the production of animal fodder and biogas. Finally, the successfully developed technologies will be evaluated by means of a Life Cycle Assessment LCA.

This project will substantially contribute to sustainable water management, the utilization of wastewater for the production of valuable goods, and the protection of natural resources.

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Water in Developing Countries

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SUSTAINABLE WATER MANAGEMENT

Water Born Diseases in Egypt

Bladder Cancer Prevalence due to Water Pollution in the Nile Delta Region

In the past, the bladder cancer was more attributed to schistosomal infection through *Schistosoma haematobium* causing Squamous Cell Carcinoma (SCC). This has changed in recent years to Transitional Cell Carcinoma (TCC). TCC is usually attributed to chemical intoxication.

The increasing trend of the non-bilharziae bladder cancer in the Nile Delta, which is much higher than in other regions in Egypt, has been attributed to water pollution. It was assumed that water pollution "with pesticides" might be the reason. But it is also likely that *emerging pollutants* discharged with industrial wastewaters and textile dyestuff may cause the TCC registered.

Participation of two German Exceed Centers (TU Braunschweig on Water and LMU Munich on International Health), the Exceed Middle East Network, experts of Occupational Health and Cancer from Cairo, the Medical Centre, and the Dept. Limnology of Mansoura University will ensure success of this project.

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Water in Developing Countries

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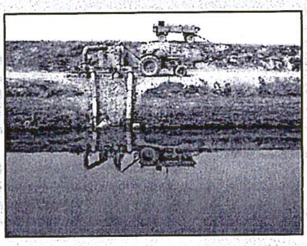
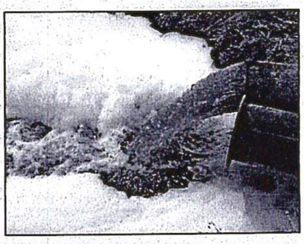
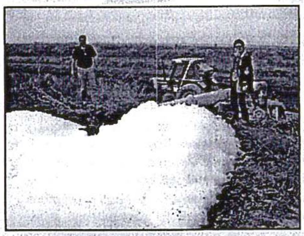
Field irrigation with untreated wastewater in Konya/TUR

P = 322 mm/a
E = 302 mm/a

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Water in Developing Countries

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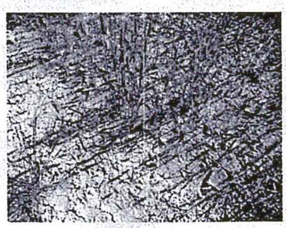
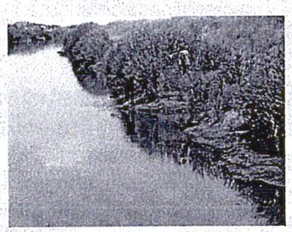
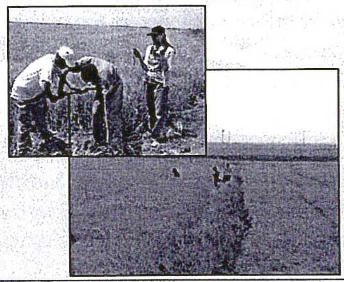
Sampling of WW irrigated farmland in Konya/TUR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Water in Developing Countries

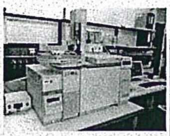
EXCELLENCE CENTER FOR DEVELOPMENT COOPERATION
SUSTAINABLE WATER MANAGEMENT

Sample analyses in Konya/TUR



Not through "reading in coffee grounds" ;-)

... but through GC/MS & ICP/OES




Soil Depth: 0-25, 25-50, 50-75 cm
Crop Type: Wheat – Roots, Stem, Grain
Distance: Channel sediments 0, 50, 100, 500 m
Pollutants: Persistent Organics, Heavy Metals
Methods: GC/MS, ICP-OES, AAS
Ecotoxicity: Primary Producer, Decomposer, Nitrifyer

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Water in Developed Countries

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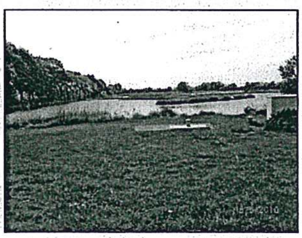
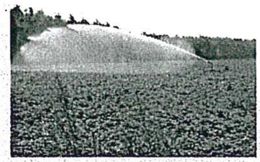
SUSTAINABLE WATER MANAGEMENT

... and comparison with Braunschweig/GER


Use of treated WW to supply wetland & bird sanctuary ...



... and to irrigate farmland for sugar beet, barley, and maize for biofuel production

Same sampling and analytical strategy as in Konya/TUR

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MESAEP – MENA – EXCEED

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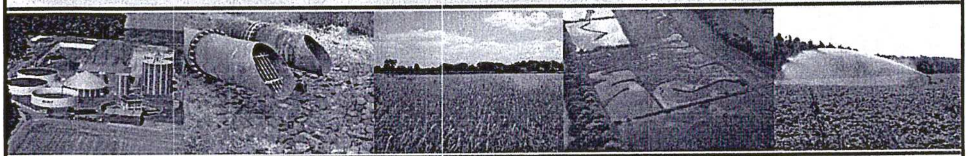
SUSTAINABLE WATER MANAGEMENT

Wastewater Recycling in Braunschweig
A "Best Practice" Example



Thank you for your attention

www.exceed.tu-braunschweig.de

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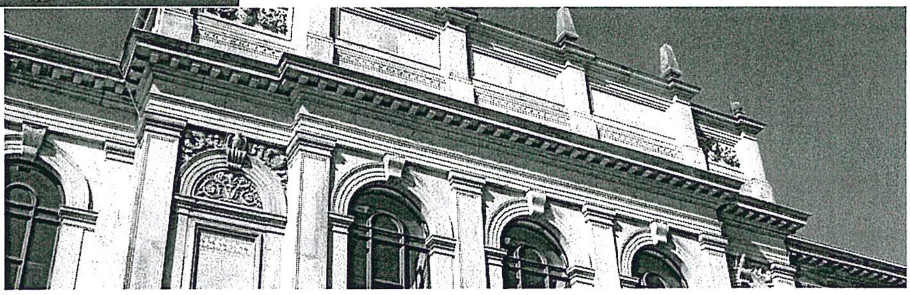

Keynote speech

Change of Water Situation until 2050

Prof. Dr.-Ing. Norbert Dichtl

1. Situation of "water" today **(~2010)**
   - Water use
   - Sanitation and health
   - Water footprint
   - Water crisis
2. Processes and changes until 2050 and consequences
   - Population growth
   - Urbanisation
   - Consumers behaviour
   - Climate change
3. Conclusions

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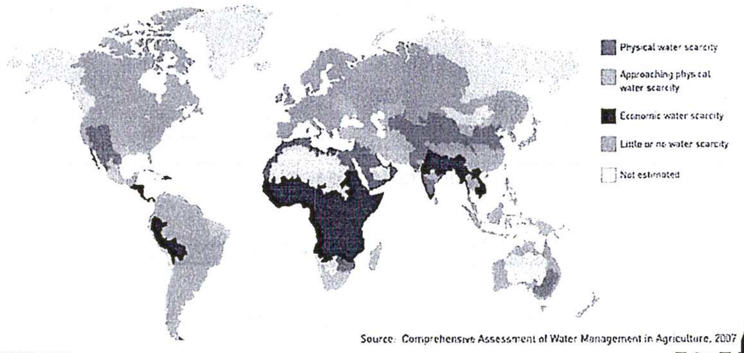
Global water scarcity 2007

AREAS OF PHYSICAL AND ECONOMIC WATER SCARCITY

- **Physical water scarcity** water resources development is approaching or has exceeded sustainable limits). More than 75% of the river flows are withdrawn for agriculture, industry, and domestic purposes (accounting for recycling of return flows). This definition—relating water availability to water demand—implies that dry areas are not necessarily water scarce.
- **Approaching physical water scarcity.** More than 60% of river flows are withdrawn. These basins will experience physical water scarcity in the near future.
- **Economic water scarcity** (human, institutional, and financial capital limit access to water even though water in nature is available locally to meet human demands). Water resources are abundant relative to water use, with less than 25% of water from rivers withdrawn for human purposes, but malnutrition exists.
- **Little or no water scarcity.** Abundant water resources relative to use, with less than 25% of water from rivers withdrawn for human purposes.



Source: Comprehensive Assessment of Water Management in Agriculture, 2007

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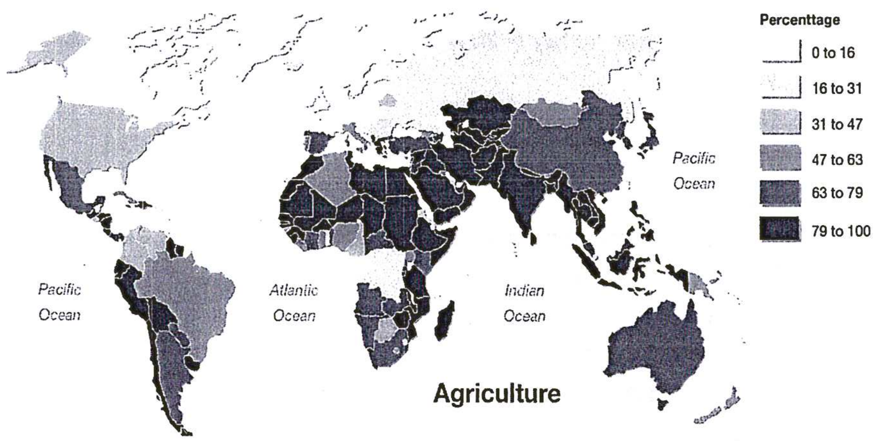
Water use in agriculture, year 2002



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Source: UNEP. http://www.unep.org/dewa/vitalwater/jpg/0213-freshwater-map-EN.jpg

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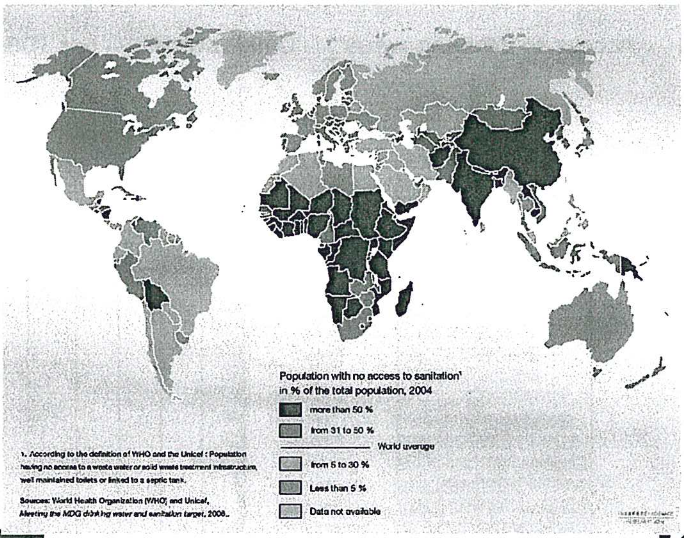
Access to sanitation, 2004



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Source: UNEP. http://www.unep.org/dewa/vitalwater/jpg/0215-0-sanitation-tot-EN.jpg

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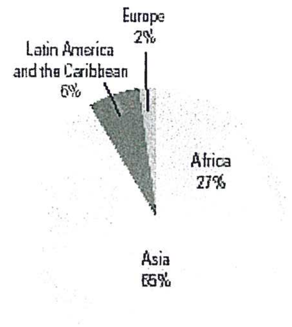
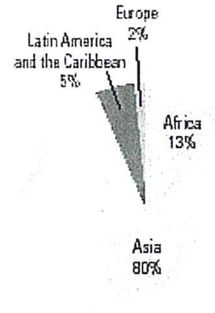
Access to drinking water and sanitation, 2001

Access to drinking water



Total unserved: 1.1 billion

Access to sanitation



Total unserved: 2.4 billion

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Source: World Water Development Report, Weltbank, 2001

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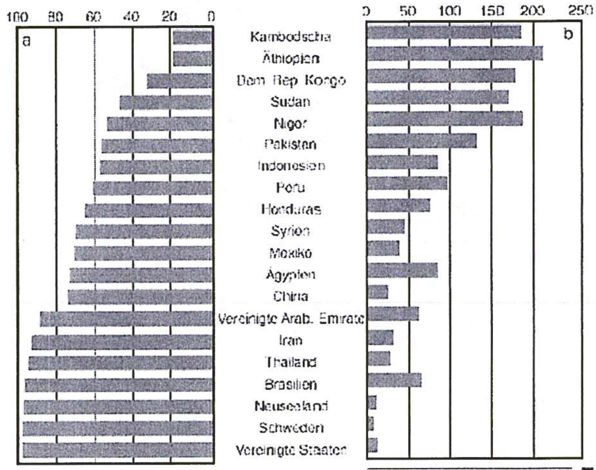
Correlation between drinking water supply and child mortality

Access to drinking water Child mortality (per 1000)



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B. Wiesmeier „Wasser für alle", 2004

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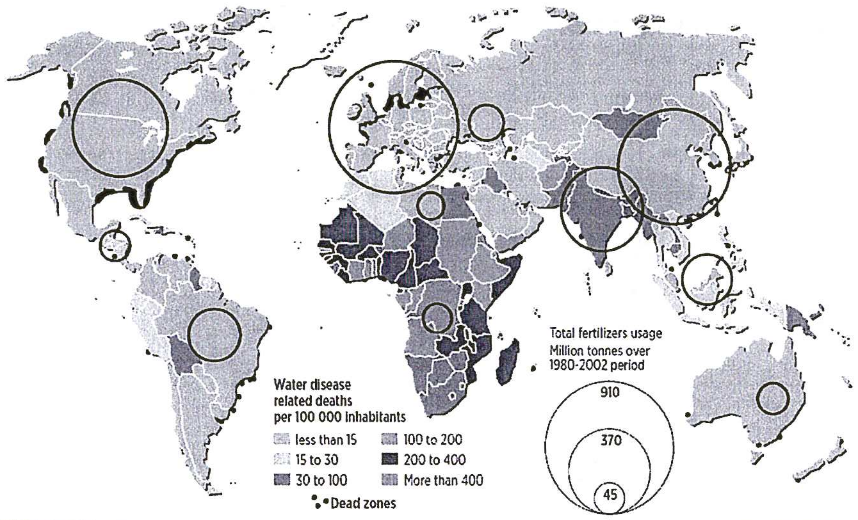
Water-disease related deaths 2012



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Unesco 2012; http://www.unep.org/dewa/vitalwater/index.html

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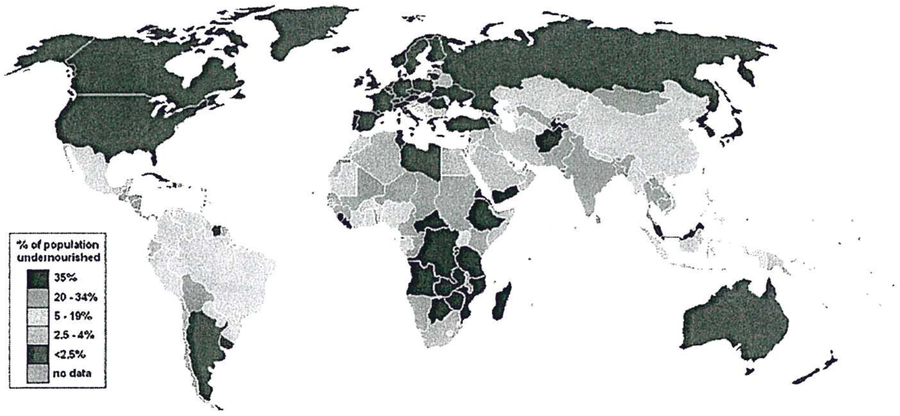
Malnutrition 2006



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http://upload.wikimedia.org/wikipedia/commons/thumb/7/78/Percentage_population_undernourished_world_map.PNG/800px-Percentage_population_undernourished_world_map.PNG

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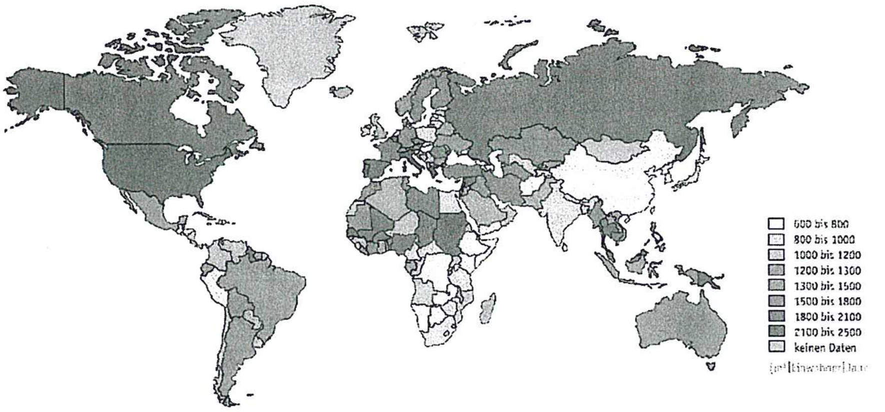
Global water footprint



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http://www.virtuelles-wasser.de/wasserfussabdruck.html

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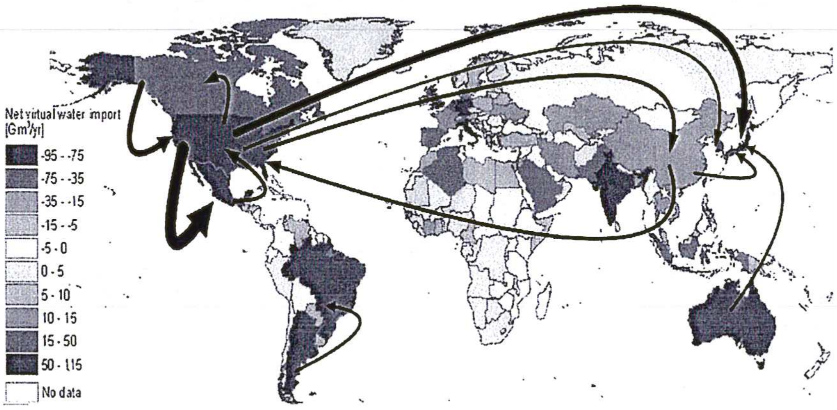
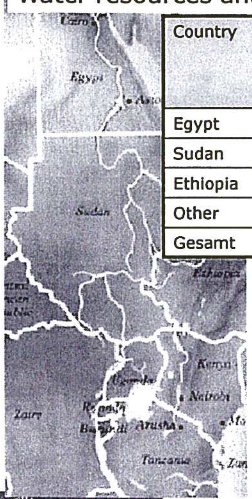
Virtual water trade



Excursus: Potential water related conflicts: Nile and Euphrat

Water resources and their use in the Nile system



Country	Water Resources [%]	Water Use [%]
Egypt	0	75
Sudan	1	25
Ethiopia	85	0
Other	14	0
Gesamt		

Construction of dams in the Euphrat system

Overview: Situation of "water" today

- Water scarcity in many parts of the world
- Most water is used for agricultural purposes, especially in the ***southern hemisphere and Asia***
- There is already a "global water crisis"
  - Insufficient sanitation (2.5 Billion people worldwide)
  - Lack of (clean) fresh- and drinking water (1.1 Billion)
  - Poverty and malnutrition
  - Health problems (5,000 children die each day due to water-related diseases)

... also mainly in the ***southern hemisphere and Asia***

- The water crisis is also a crisis of water management (e.g. global water trade etc)
- Regional and international conflicts related to water use

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1. Situation of "water" today **(~2010)**

2. Processes and changes until 2050 and consequences

- **Population growth**
- **Urbanisation**
- **Consumers behaviour and water footprint**
- **Climate change**

3. Conclusions

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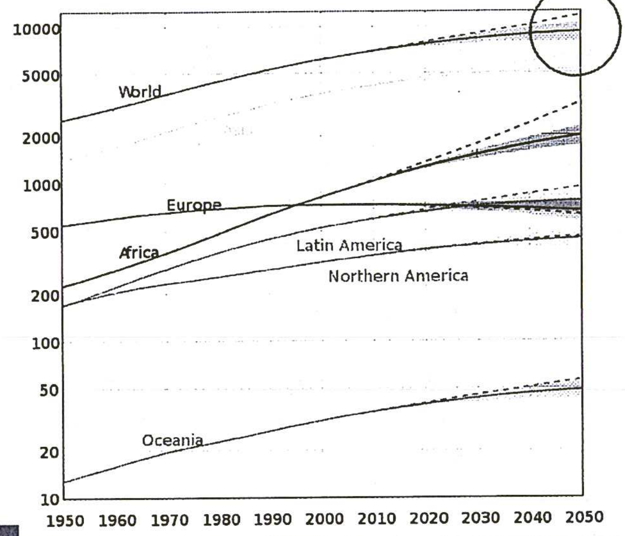
Global context: Growing world population until 2050



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Source: http://ftrctlb.com/node/158; data from *http://esa.un.org/unpp/*

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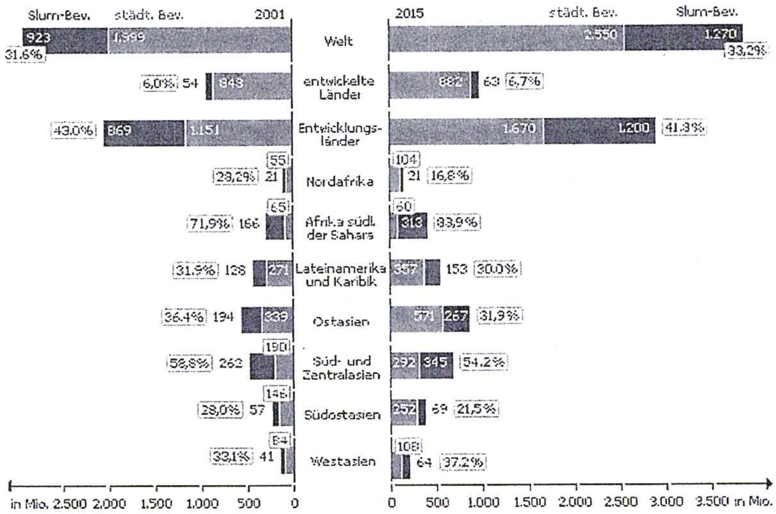
Urbanisation and growth of slums until 2015 ... and beyond



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Quelle: UN:World Urbanization Prospects: The 2001 Revision; UN-Habitat, Global Urban Obervatory, 2005

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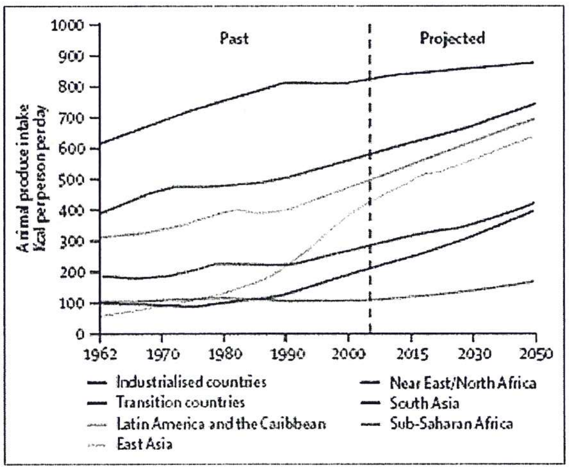
Change in meat consumption until 2050

Rapid increase of meat consumption in almost all regions of the world

... as an example for changing standards of living and a different consumer behaviour



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http://www.animalfreedom.org/pics/global-meat-consumption-projected.jpg

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The water demand of different products

Change in consumer behaviour will additionally increase the global water demand

Wheat (1 kg)

Meat (1 kg)

Coffee (1 L)

Car

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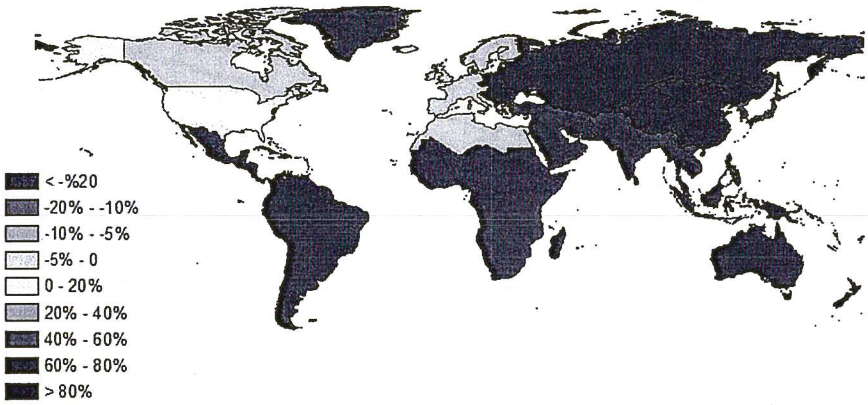
http://virtuelles-wasser.de/produktgalerie.html

Expected water footprint in 2050, compared to today

Global change in water footprint in %
(Scenario „economic growth, liberalized trade")



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http://www.waterfootprint.org/Reports/Report59-WaterFootprintScenarios2050.pdf

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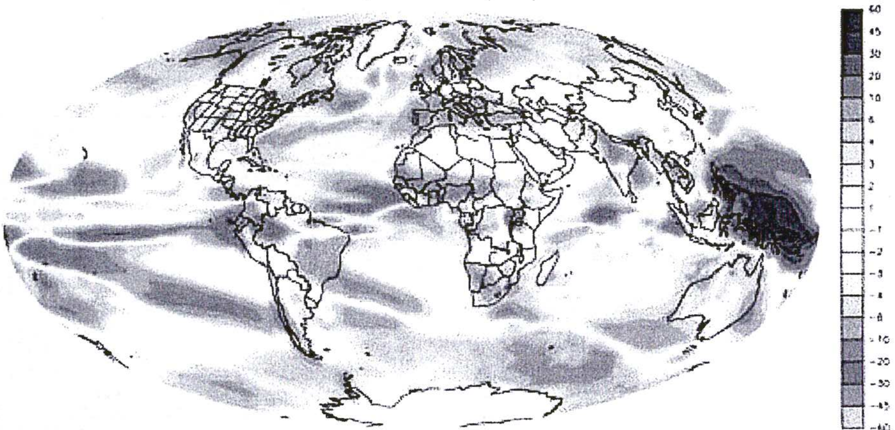
Climate change: Predicted precipitation changes until 2100

CHANGE IN PRECIPITATION BY END OF 21st CENTURY
inches of liquid water per year



as projected by NOAA/GFDL CM2.1

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http://www.esrl.noaa.gov/news/2007/ipcc.html

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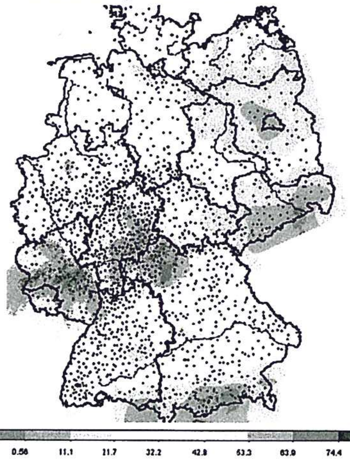
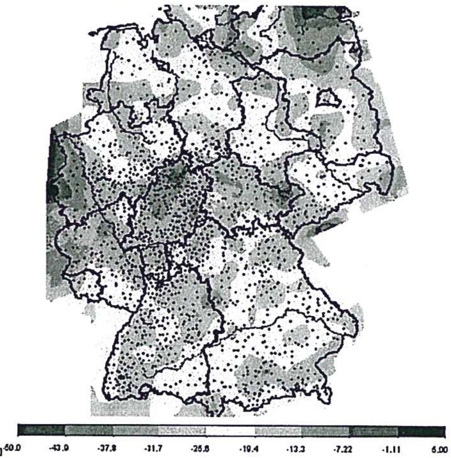
Regional scale: Precipitation change in Germany until 2100

Winter:
Increase up to 85%

Summer:
Decrease up to 50%





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aus: UBA: Regionale Klimaänderungen

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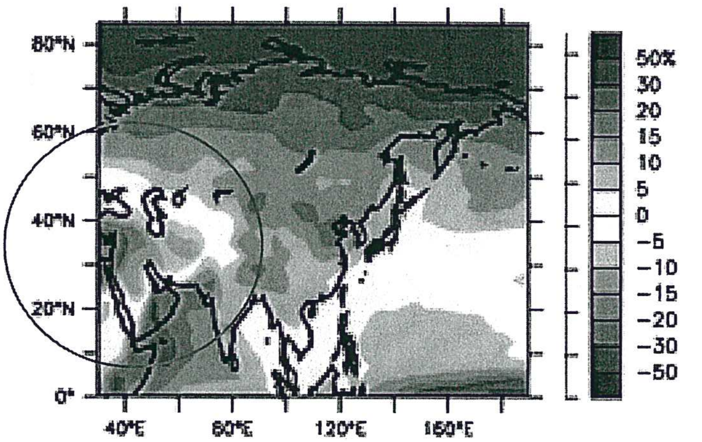
Regional scale: Precipitation change in Asia until 2100

Predicted precipitation changes in Asia:
Reduction up to 50% in Middle East



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http://www.ipcc.ch/publications_and_data/ar4/wg1/en/fig/figure-11-9-l.png

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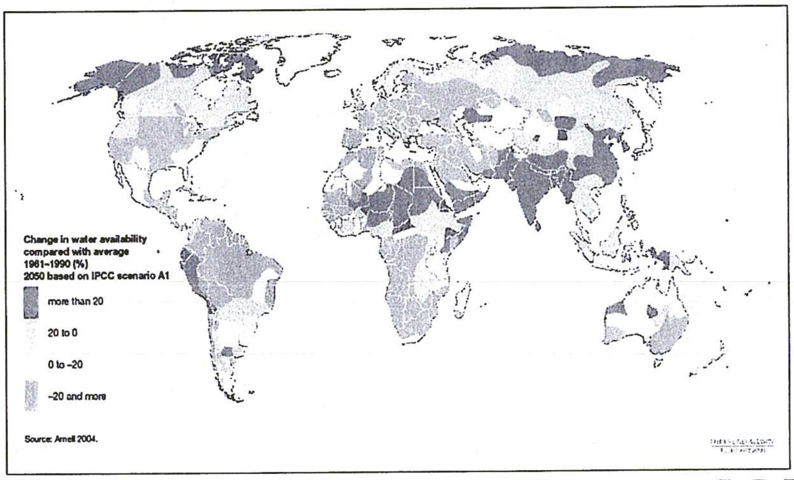
Consequences of climate change

Changes in water availability until 2050 due to climate change



http://www.unep.org/dewa/vitalwater/jpg/0407-runoff-scenario-EN.jpg

Overview: Processes until 2050 and consequences

- Rapid populating growth
- Growth of cities and megacities
- Changing consumer behaviour, change of water footprint
- Climate change will influence the water distribution and water availability

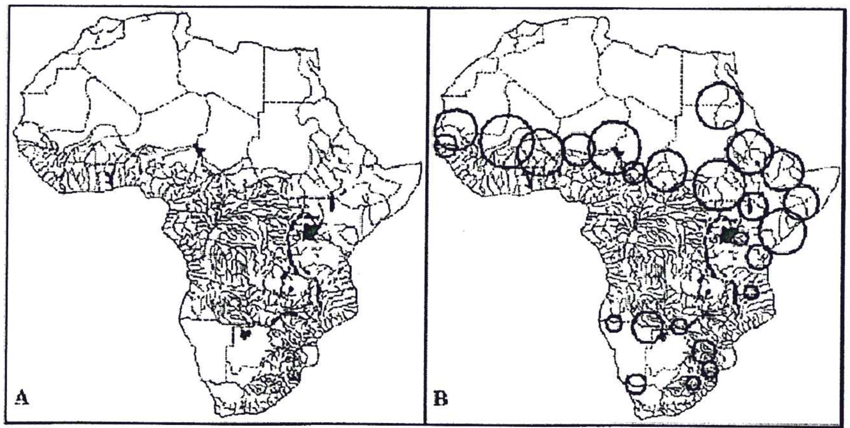
→

- Increase of ***total*** water demand
- Sanitation problems
- Increasing ***individual*** water demand

Especially the regions with water deficits today (e.g. Middle East, arid and semiarid parts of Africa...) will additionally suffer due to decreasing water availability

Consequences: Just one example

Predicted water related conflicts of the future; example: Africa



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from Dockhorn, 2009

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1. Situation of "water" today **(~2010)**
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3. Conclusions

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Strategies to solve the water crisis

- Increase access to safe drinking water (MDG!)
- Improving sanitation (MDG!)
  - New sanitation concepts
  - ***Adapted*** wastewater treatment concepts
  - Water reuse in agriculture and indutsry
- Reduction of water consumption and water losses
  - Households
  - Agriculture: Adapted farming and irrigation techniques
  - Industry
- Education and cross-border concepts
- Awareness of the global context!

To be discussed during the Summer School!

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Thank you for your attention

Norbert Dichtl, Daniel Klein
Institute of Sanitary and Environmental Engineering, TU Braunschweig

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Sources: Abwasserverband Braunschweig; SE/BS, W. Küchenthal

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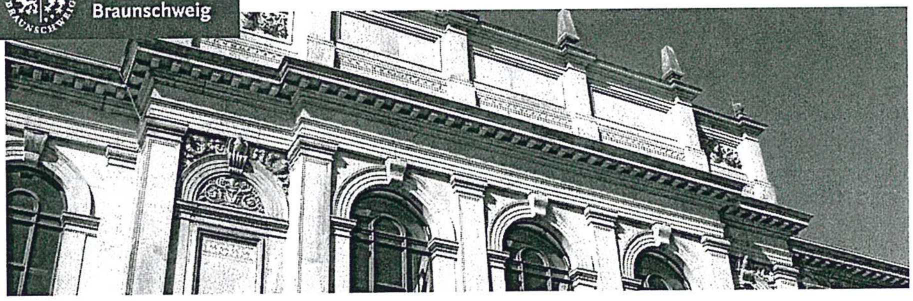
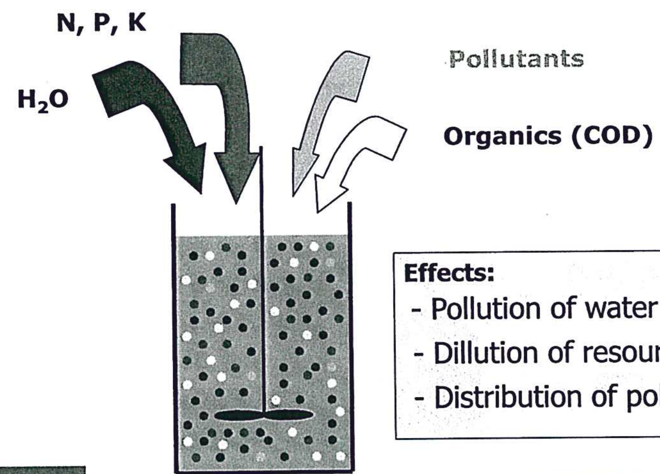


New Sanitation Systems and Resources Management

Prof. Dr.-Ing Thomas Dockhorn

EXCEED Summer School on Climate Change and Global Water Problems
November 05, 2012 Braunschweig

Production of wastewater and impact on the different resources



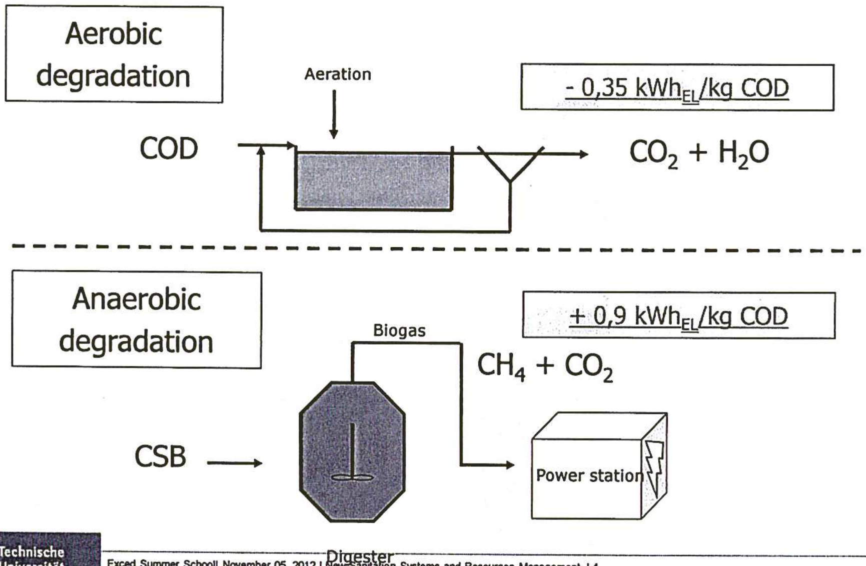
Effects:
- Pollution of water
- Dillution of resources
- Distribution of pollutants

Relevant constituents of wastewater

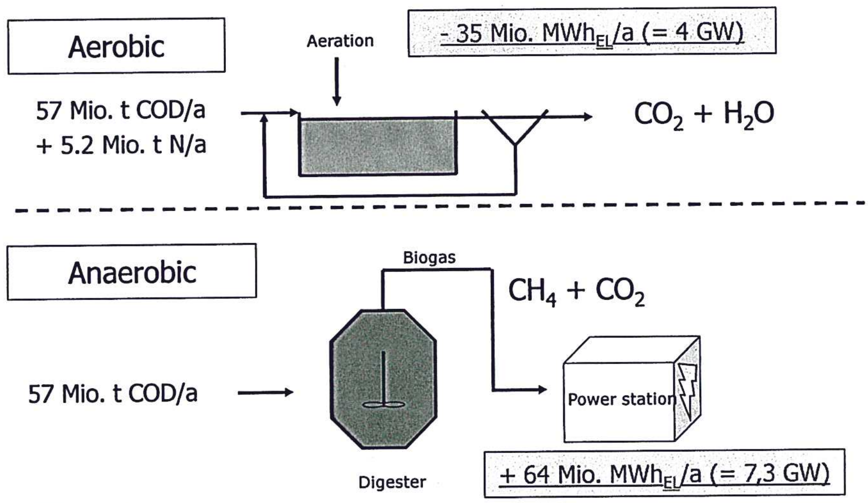
- Organic compounds (COD)
- Phosphorus (P)
- Nitrogen (N)

- Potassium (K)
- Sulfur (S)
- Calcium (Ca)
- Magnesium (Mg)
- ...etc.

Organic compounds (COD) as resource



Energy consumption of WWT vs. energy production from wastewater for China



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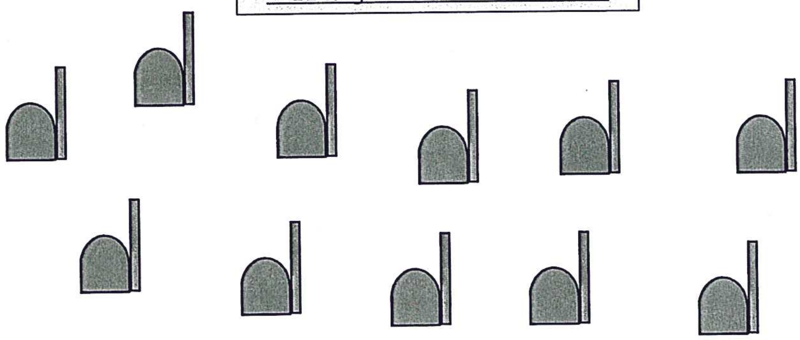
Energy consumption of WWT vs. energy production from wastewater for China

4 + 7.3 GW = 11.3 GW
= 11 large Nuclear Power Plants



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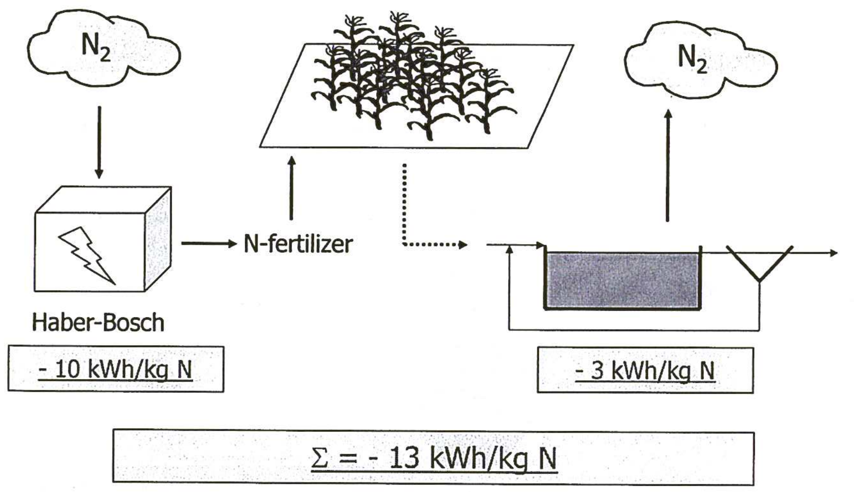
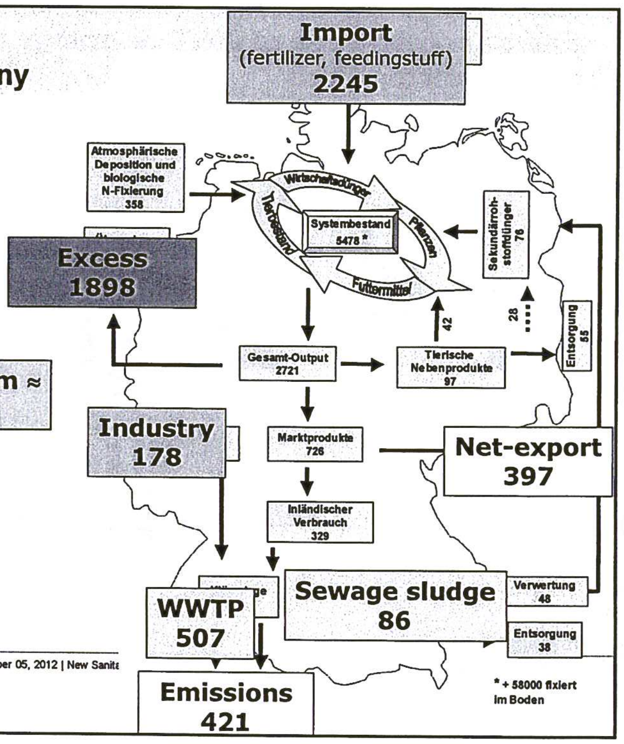
The resource nitrogen (N) - energy balance for production and elimination



N-balance for Germany

(1.000 t N/a)

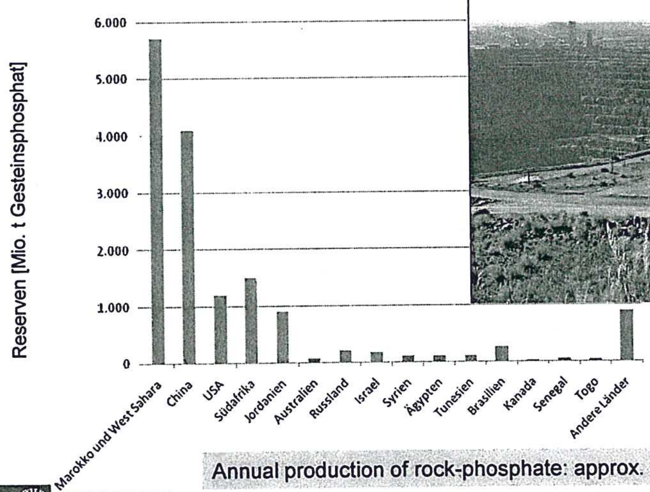
→ Input to the System ≈ Loss

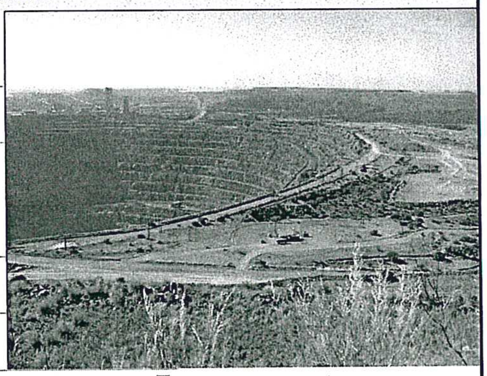


The resource phosphorus (P)

- Essential in agriculture and for industrial processes
- Phosphorus is mined (limited resources)
- Increasing concentration in heavy metals and radioactive components in rock phosphate
- Elektrothermal processing in fertilizer industry requires has high energy consumption (ca. 13 kWh/kg P)
- P-elimination at WWTPs: use of resources (Fe) for P-precipitation; disposal of sludge

Global reserves on rock-phosphate

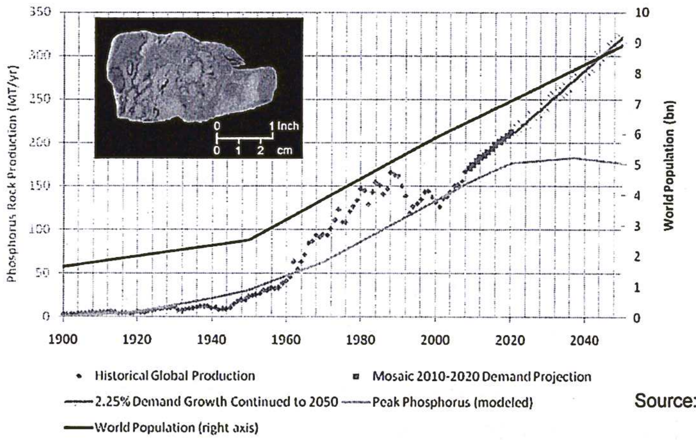




Source: USGS, 2010

Annual production of rock-phosphate: approx. 160 mio. t/a

Worldwide production of rock-phosphate (mio. t/a)



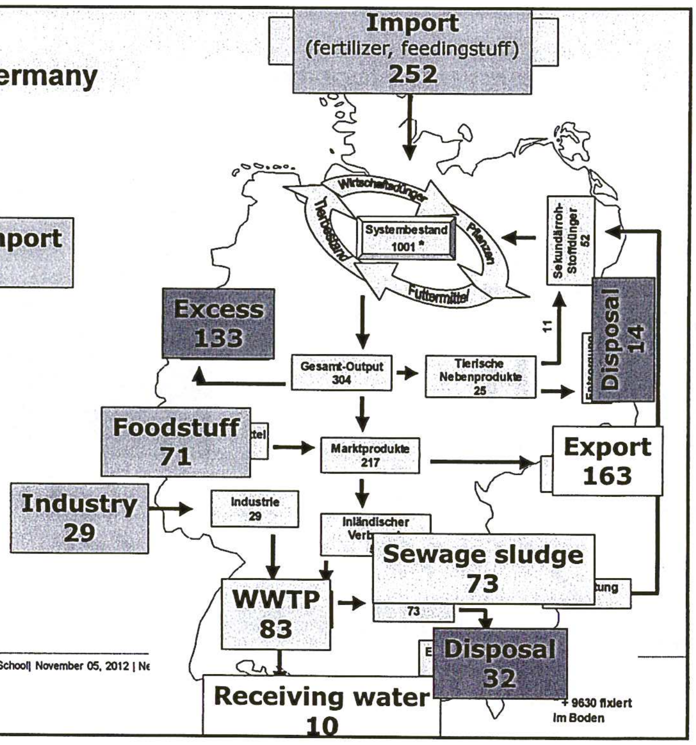
Source: Eamon Keane

Expected lifetime: approx. 60-300 years (reserves) or >1000 years (ressources) (depending on source, estimation model, quality and production costs

P-balance for Germany

(in 1.000 t P/a)

→ Net-import 179



The resource potential

Our daily statistical „per capita production" equals

- 120 g COD,
- 11 g nitrogen (N),
- 1,8 g phosphorus (P) and
- 4,9 g potassium (K)

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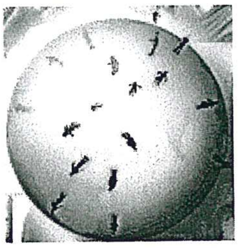
The increasing world population

Currently

7.083.139.999 people are living an earth.



http://www.dsw-online.de

⇒ **daily +220.000 people**

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The resource potential of the world population

For 7 billion people:

- 307 mio. t COD/a,
- 28.2 mio. t nitrogen/a,
- 4.6 mio. t phosphorus/a and
- 12.6 mio. t potassium/a

This resource potential equals

- 27 % of the global consumption of N-fertilizer,
- 28 % of the global consumption of P-fertilizer and
- 55 % of the global consumption of K-fertilizer.
- The energy content of the organic compounds equals 58 Mio. t coal equivalent/a in primary energy = 0.3 % of the global energy demand.

Global objectives regarding water

- **UN Millennium Development Goals (New York, 2000):**
  - Reduction of the world population without access to clean drinking water by 50% until 2015
  - until 2025: clean drinking water for all
- **Sustainability summit Johannesburg (2002):**
  - Bisection of people without access to adequate sanitation until 2015

The challenge in figures:

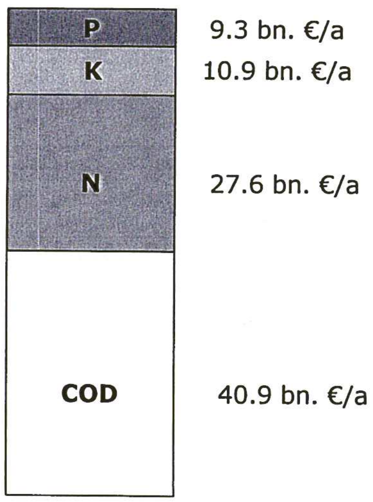
Every day access to sanitation for additional
330.000 people
+ increase in population (220.000/d)

= 550.000 people/d !!!

Economic value of the resources

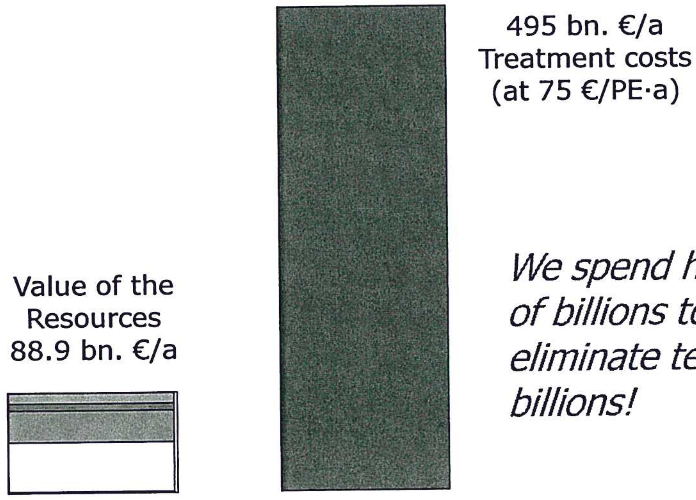
Resource	Market value
Phosphorus (P)	2.02 €/kg P
Nitrogen (N)	0.98 €/kg N
Potassium (K)	0.87 €/kg K
Org. comp. (COD)	0.13 €/kg CSB

Market value of the resources (for 7 billion people)



Σ = 88.9 bn. €/a

...and costs for their disposal



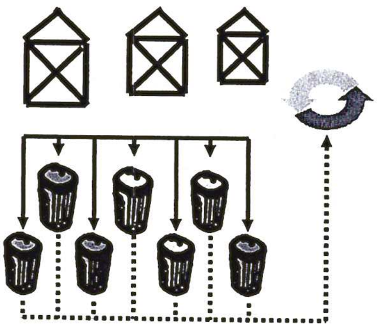
We spend hundreds of billions to eliminate tens of billions!

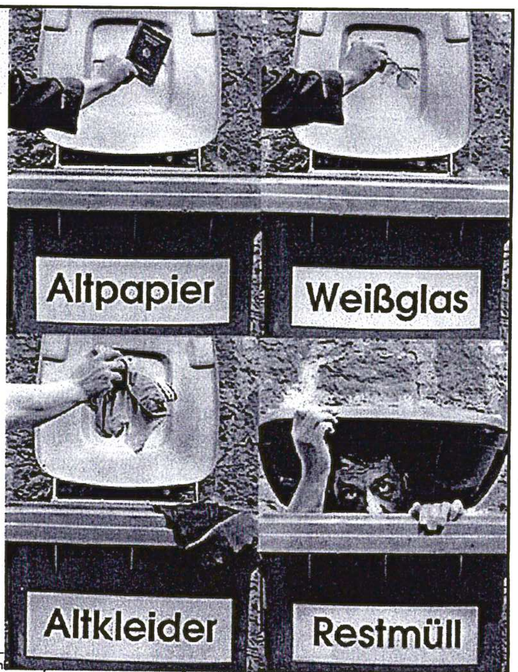
Problem! –Solution?

How can we achieve the objective of environmental and water protection in combination with a sustainable use of resources?

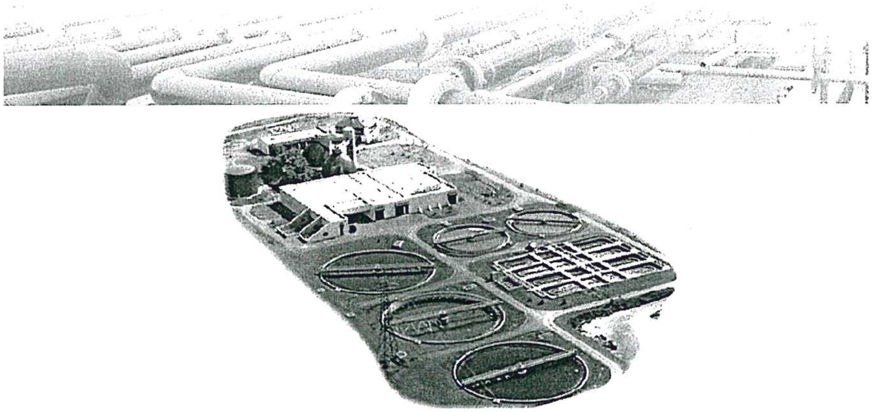
Example municipal waste management – yesterday...

...and today

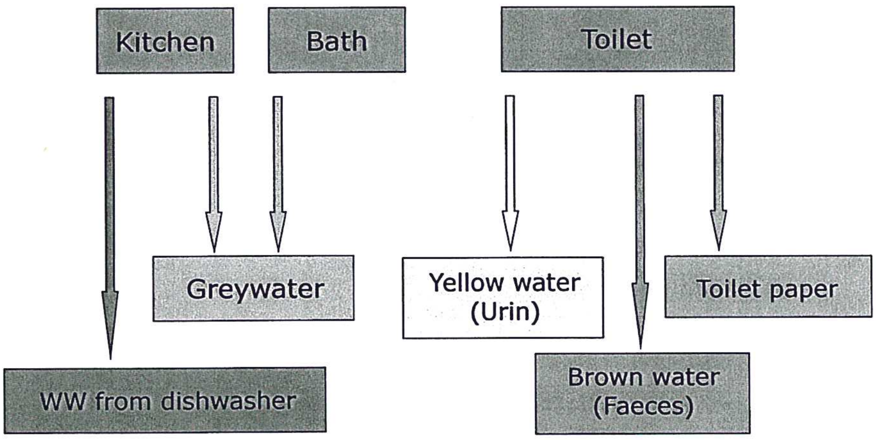




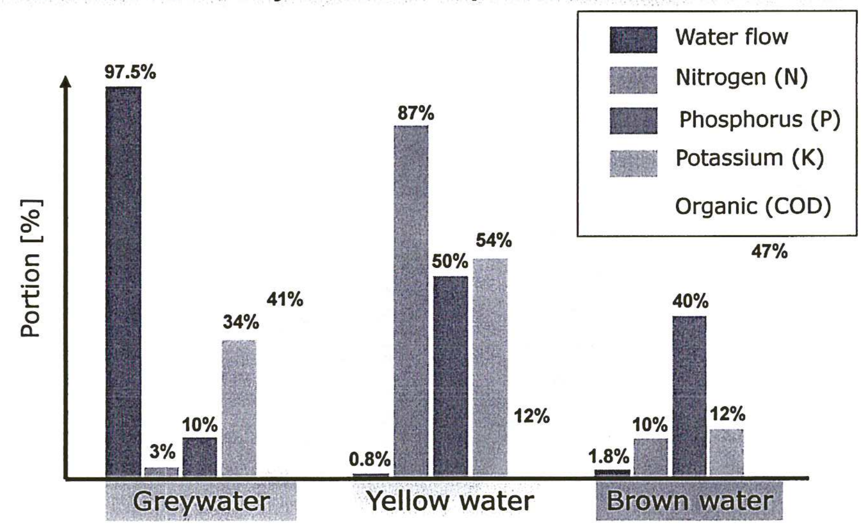
Municipal wastewater management: at the end of the pipe still stands end-of-pipe-technique



Solution: Source separation and reuse of the resources in the municipal wastewater sector

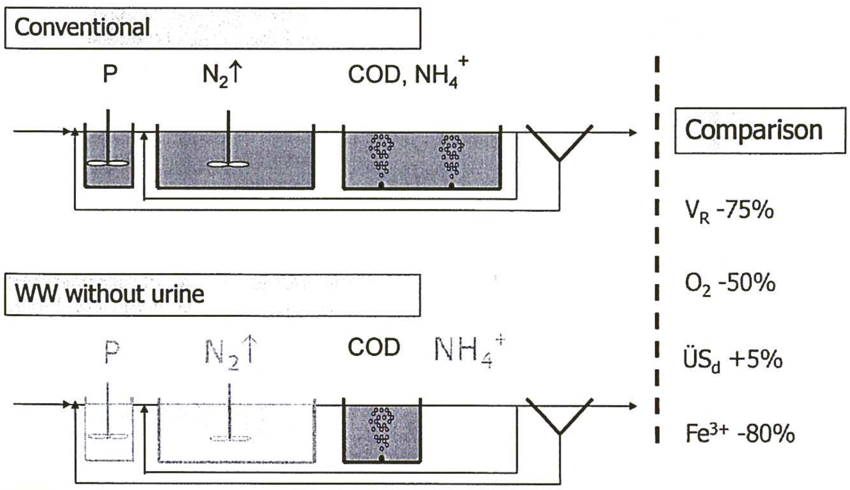


Materials flow analysis of municipal wastewater

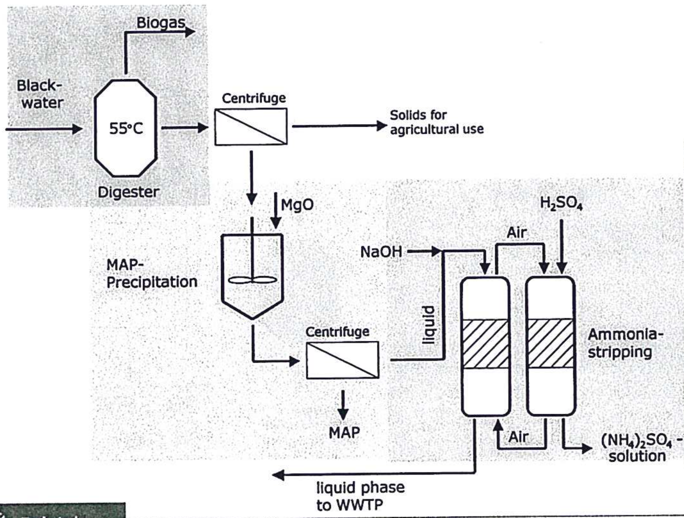


(Otterpohl, 2002)

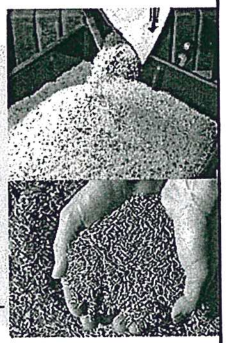
Adapted Wastewater Treatment Technology



Energy production and nutrient recycling from wastewater and sewage sludge



Products



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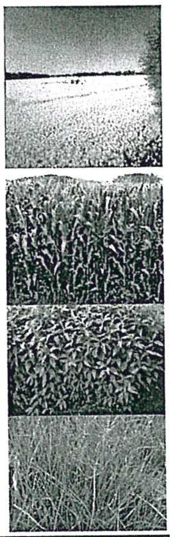
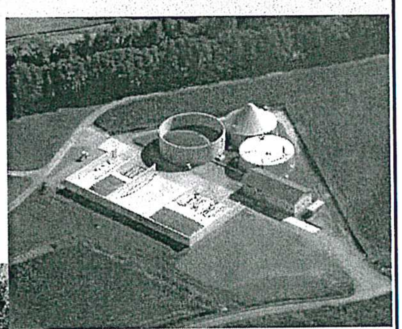
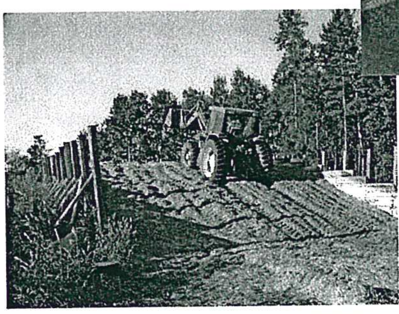
Concept for a direct use of black water –production of energy crops







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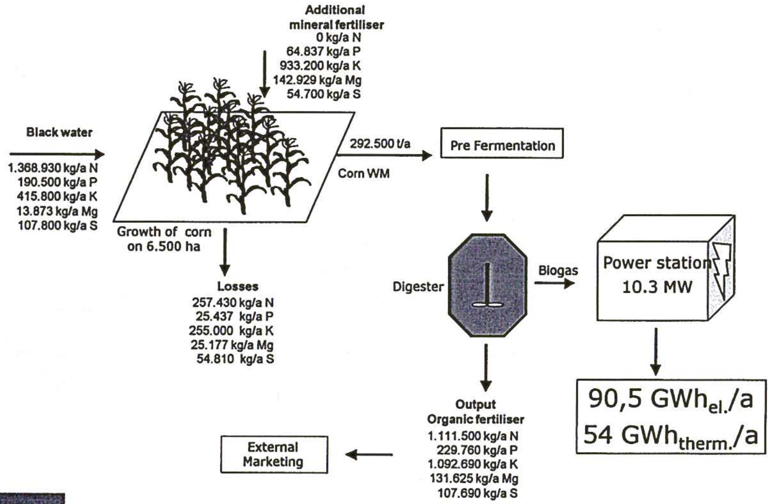
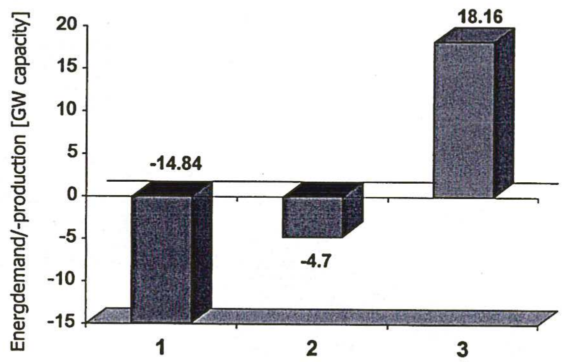
Materials flow analysis for a case study of 350 000 PE

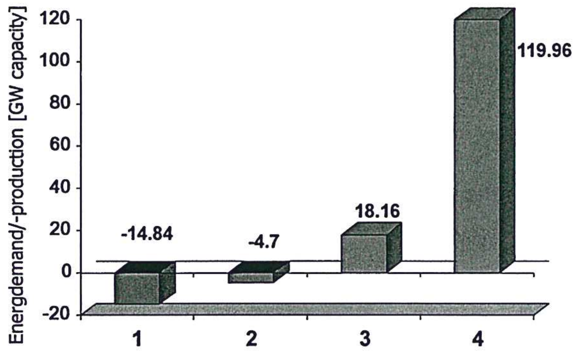


Demand/production of primary energy for different scenarios (for 1.3 billion PE)



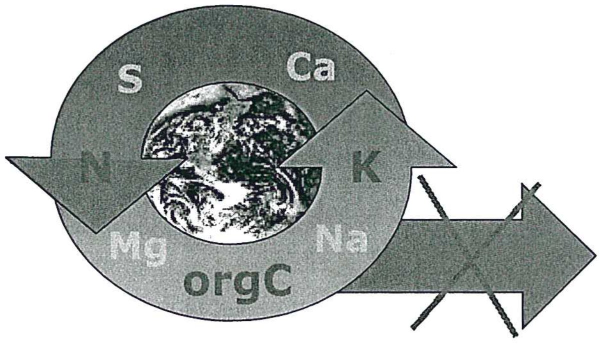
1 WWT (32 kWh/PE*a)
2 WWT and sludge digestion
3 Source separation and anaerobic WWT

Demand/production of primary energy for different scenarios (for 1.3 billion PE)



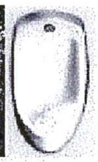
1 WWT (32 kWh/PE*a)
2 WWT and sludge digestion
3 Source separation and anaerobic WWT
4 Production of energy crops

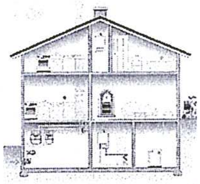
Outlook



Subsystems of a source separation system

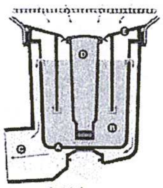
- Source separation toilet
- Household connections
- Collection and transport
- Adapted treatment / reuse



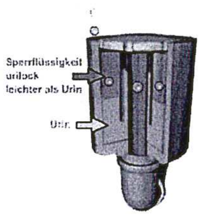


Dry Urinals

- Systems (e.g. Urimat, Waterless, Keramag)
- Odor trap (sealing liquid, valve)



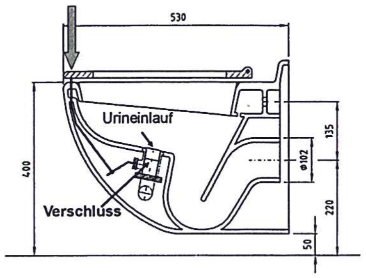
Source: Urimat



Source: Uridan

Urin diversion flush toilet

- Systems (e.g. Roediger, Saniresch)
- Urin is collected separatly without dilusion
- Feces are flushed and collectd as brown water
- Odor trap with valve



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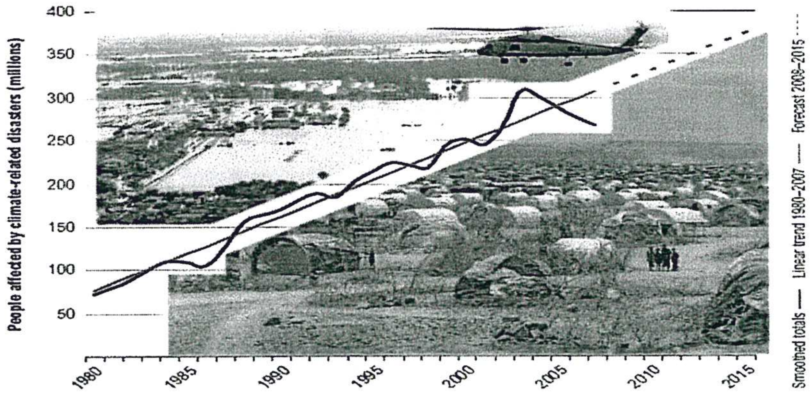
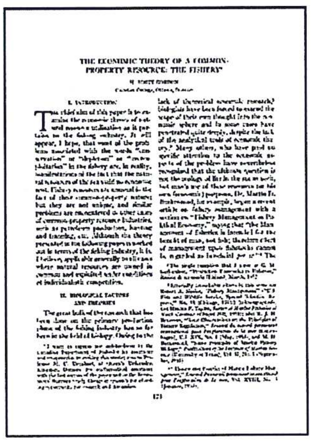
Prof. Dr. Ulrich Menzel
The Tragedy of the Commons



www.ulrich-menzel.de

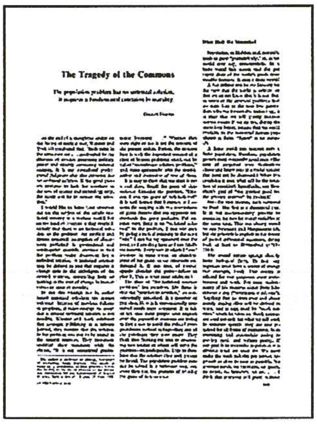
The Tragedy of the Commons



1954

Scott H. Gordon (Economist)

The Tragedy of the Commons

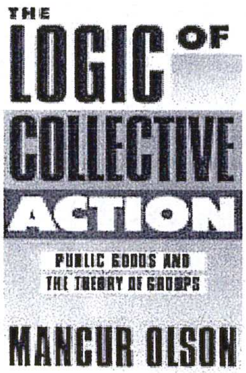

The Tragedy of the Commons

1968

Garret Hardin (Biologist)

(1915 - 2003)

The Tragedy of the Commons



1968

Mancur Olson
(Sociologist/ Economist)

(1932-1998)

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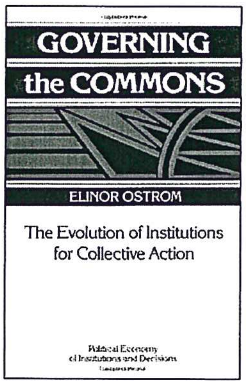
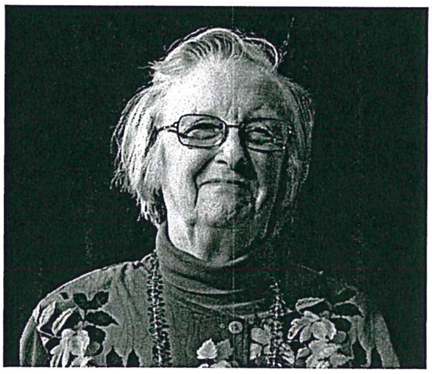
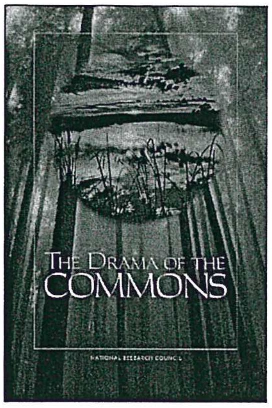


1990



Elinor Ostrom (Political Scientist)
(1933-2012)

The Tragedy of the Commons



2002

http://www.ulrich-menzel.de/lehre/literaturliste_wasservorlesung.pdf

The Tragedy of the Commons

The 4 kinds of goods

		Rivalry	
		Yes	No
Exclusion	Yes	Private goods 1	3 Club goods
	No	4 Common goods	2 Public goods

The Tragedy of the Commons

Aspects of the 4 kinds of goods

Property 1: Individual
Property 2: State
Property 3: Group
Property 4: free access

1 = Private goods
2 = Public goods
3 = Club goods
4 = Common goods

Allocation 1: private entrepreneurs
Allocation 2: State
Allocation 3: Club
Allocation 4: Nature

Regulation instance1: Market/ Prices
Regulation instance 2: State/Laws/ Ordinances
Regulation instance 3: Club/ Rules/ Constitution
Regulation instance 4: depends on who has access to it

The Tragedy of the Commons

Examples for "common goods"

National

- Grassland (alpine pastures)
- Forest (charcoal, firewood, timber, hunting, etc.)
- Water (fishing, irrigation, hydraulic energy, transport)
- mountains above the timberline
- Ore (e.g. rural mining and furnaces in Sweden)
- Salinas

International

- Open sea (fishing, whaling, sealing, seabed mining, shipping, seawater desalination, ocean dumping)
- Sun
- Air, Rain
- trans border river systems
- Polar regions

The Tragedy the Commons

The Drama of the Commons occurs when a natural resource (maritime ecological system, atmosphere, forest, water system) to which a lot of people/states have uncontrolled access, is depleted.

Every user has to decide: How much can/ am I allowed to use?

If everybody contains himself the natural resource can be sustained.

If I contain myself, but the others do not, the system will collapse and I would not have had any short-term profit of the using.

This is the users dilemma.

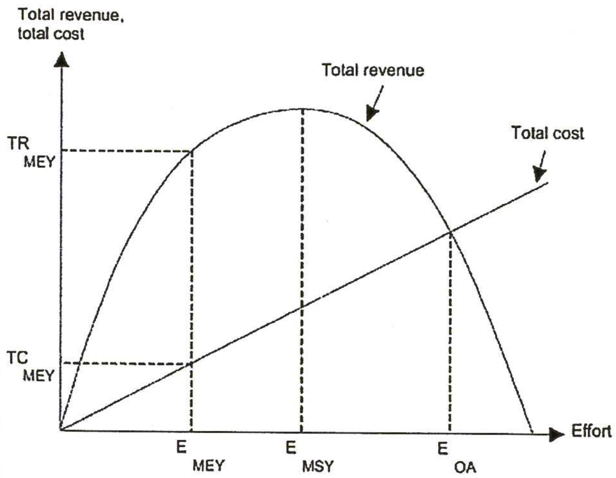
The Tragedy of the Commons

Why does a user not behave sustainable ?

1) Because there is a difference between maximizing the economic gain and maximizing the sustainable gain in using natural resources without control of access. Every fisher considers only his individual costs, but not the effect on others

The Tragedy of the Commons

Gordon/Schaefer- Model



Relationships among fishing effort, cost, and revenue.

NOTE: Total revenue, TR; total cost, TC; level of fishing effort; E; maximum economic yield, MEY; maximum sustainable yield; MSY; open access, OA. Profit is revenue minus cost and is represented by the vertical distance between the total revenue and total cost curves at any particular level of effort.

[Source: National Research Council. *The Drama of the Commons*. Washington, DC: The National Academies Press, 2002, S. 10]

The Tragedy of the Commons

2) Because users follow their individual rationality. The gain of using a common good belongs to the individual. The disadvantage of depletion is spread to everyone. As long as the individual advantage is bigger than the share of the collective disadvantage, it is rational to act in that way.
The sum of the individual rational behaviors ends in a common tragedy and not in the wealth of nations.

3) Because of the constellation modeled by the Prisoners Dilemma.

The Tragedy of the Commons

Prisoners Dilemma

A \ B	B1 deny	B2 confess
A1 deny	0.5 / 0.5	10 / 0
A2 confess	0 / 10	5 / 5

Numbers = degree of punishment in years

Decision rule:
Minimize the Maximum

Result because of two-way mistrust :
5 : 5

With cooperation (=denying) 0,5 : 0,5 would be possible

The Tragedy of the Commons

Hardin´s herdsman game as Prisoners Dilemma

Herdsman B Herdsman A	Limit number of animals	maximize number of animals
Limit number of animals	10 10	11 -1
Maximize number of animals	-1 11	0 0

Numbers= profit items

Result because of two-way mistrust:
0:0
With cooperation
10:10
could be possible

The Tragedy of the Commons

4) As they follow the free rider-argumentation.

The effect of my behavior is that low in comparison to the high number of fishers, water users, herdsmans etc. that it rarely counts. If I would cooperate, the effect for the community would rarely be countable, but my personal disadvantage would be very high.
Olson argues: The bigger a group, the stronger the free rider behavior.

5) Pioneer-Latecomer-Problematic: The contemporary threshold and developing countries argue that the wealth of the industrialized countries results (also) of the depletion of nature. Would these countries contain themselves, the development gap would maintain. Industrialized countries want to uphold their wealth.

The Tragedy of the Commons

Consequence for Hardin et. al:

Privatization of the common pool resource. The depletion affects everyone completely, so that he has an economical appeal to use it sustainable.

Example: Enclosures in England in 18th century. Communal land was privatized and used for individual sheep farming.
Consequence: Agricultural growth, displacement of the agrarian poor to the urban areas, where they belonged to the industrial proletariat in the beginning of the Industrial Revolution.

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17

The Tragedy of the Commons

Or: Nationalization of the Common good

The State decides the extent and the rules of using natural resources.

Example:
Cotton cultivation in the Central Asian Soviet Republics since the 1950s by using artificial irrigation. The inflows of the Aral Sea are used with the consequence, that the Aral Sea dries out and a salt desert remains. The salinization of the landscape affected the cotton cultivation. (Tragedy of the Aral Sea)

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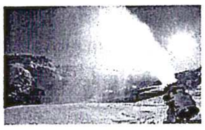
The Tragedy of the Commons

The opposite position is represented by Elinor Ostrom. Empirical studies on how common goods were used. Groups of farmers, fishers, user etc. are able to develop rules for sustainable use, to enforce compliance to rules of behavior and to sanction the violation of rules.

Hardin mixes common property with free access.
Common goods are often club goods.

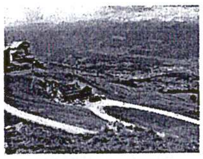
Examples:

Collective use of the alpine pastures in Switzerland and Austria. Although the milk and cheese belongs to every single farmer.



Using the mountains and waters for ski runs, cable cars, snow-making equipment, huts.

All members of the valley club get a share of the profit.
Sustainability?



The Tragedy of the Commons

The Tragedy of the Commons is not inevitable, it depends

- on the human behavior pattern
  (homo economicus, homo sociologicus, homo psychologicus)
- on the kind of common pool resource (local, national, international, global)
- on the group size of the users (local, national, international, global)
- on the homogeneity/ inhomogeneity of the group (hegemon?)
- on the kind of use (e.g. in case of water: fishing, water power, irrigation, transport, garbage dump, cooling)
- on the rules of using, trust between the users, the possibilities to control and to sanction the violations of rules

The Tragedy of the Commons

Functional Classification of Variables from the Commons Literature with Examples within Each Type

Interventions (Independent Variables)

Institutional arrangements regarding resource base (e.g., property rights regime for resource, simplicity of rules, graduated sanctions, accountability of monitors, coordination with institutions at other scales or in other regions)

Other institutional arrangements (e.g., development, tax, investment policy; political representation rules)

Technology choices (e.g., decision to adopt new monitoring technology)

Contingencies (Moderator Variables)

Resource system characteristics (e.g., size, boundaries, mobility of resource, storage, predictability)

User charactenstics (e.g., population, boundaries, social capital, leadership, heterogeneities, prevalence of honesty, interdependence, poverty)

Relationships between characteristics of resources and users

Institutional forms at other scales or in other regions (e.g., state support for local rules, nesting of institutions, international regimes)

Available technology (e.g., cost of technology for exclusion, monitoring)

Integration of resource base into global markets

Mediators (Intervening Variables)

Adherence of users to shared norms

Ease/cost of monitoring users' behavior

Ease/cost of monitonng state of resource

Ease/cost of enforcing rules

Users' understanding of rules and sanctions

Outcomes (Dependent Variables)

Sustenance of the resource system (sustainability)

Durability of resource management institutions

Economic output of the resource system (e.g., productivity, efficiency)

Distribution of the economic output (equity)

Democratic control

[Source: National Research Council, *The Drama of the Commons*, Washington, DC: The National Academies Press, 2002, S. 455]

EXCEED SUMMER SCHOOL
ON
CLIMATE CHANGE AND
GLOBAL WATER PROBLEMS

NOVEMBER 04-11, 2012,
BRAUNSCHWEIG, GERMANY

TOPIC

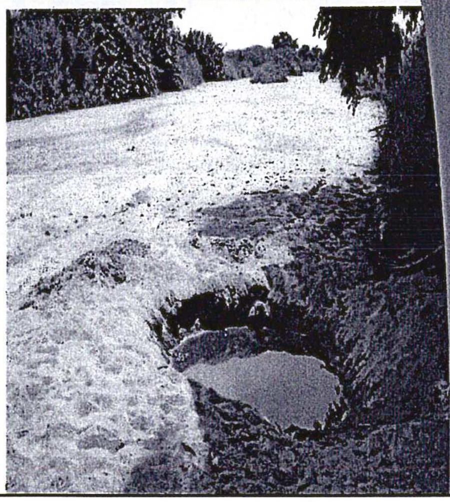
CLIMATE CHANGE ADAPTATION IN THE NORTHERN SAVANNA REGION OF GHANA, WEST AFRICA.

PRESENTED BY

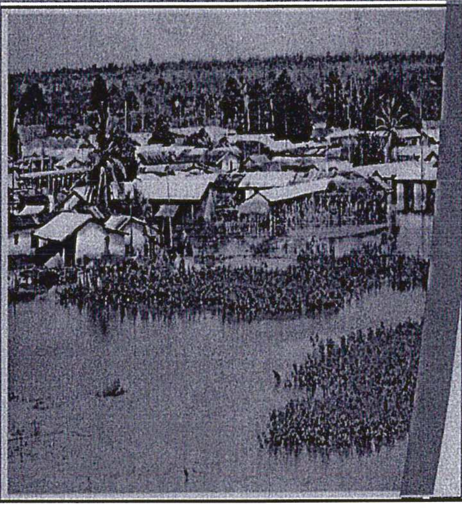
PROF. CLEMENT DORM-ADZOBU,
CENTRAL UNIVERSITY COLLEGE, ACCRA-GHANA
EXCEED GUEST PROFESSOR, TUB

CLIMATE CHANGE!

DROUGHT WITH DRY RIVER BED

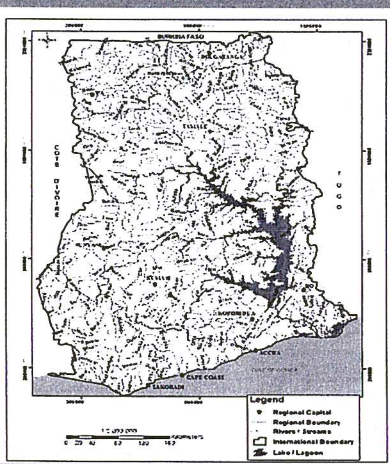


FLOODING ON THE WHITE VOLTA



INTRODUCTION

MAPS OF GHANA



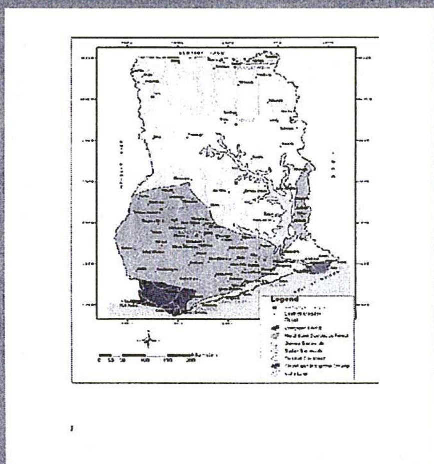
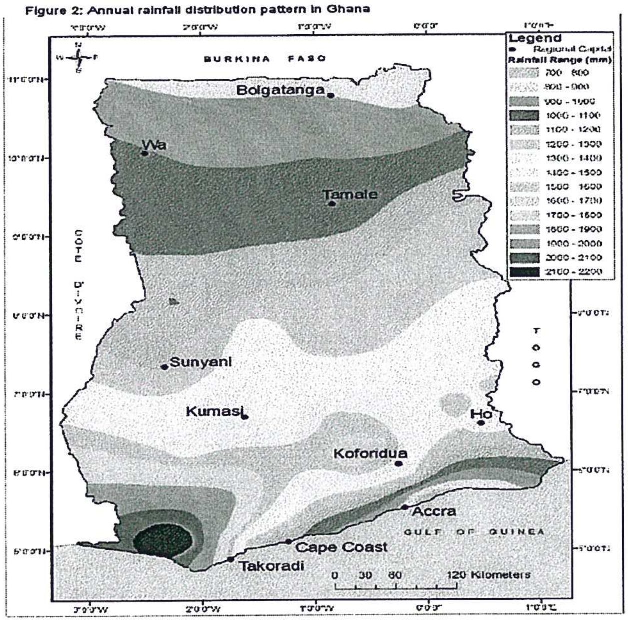


Figure 2: Annual rainfall distribution pattern in Ghana



DEFINITION OF KEY CONCEPTS

Climate change

Vulnerability

Adaptation

CLIMATE CHANGE

Any changes in climate over time, whether due to natural variability or as a result of human activity (IPCC, 2007)

VULNERABILITY

The degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change (ibid.)

ADAPTATION

Adjustment in Human and Natural systems in response to actual or expected change, stimuli or their effects that moderate harm or exploit beneficial opportunities (ibid.)

CLIMATE CHANGE AND IMPLICATIONS FOR GHANA'S WATER RESOURCES

Ghana is vulnerable to climate change and variability by virtue of its location in the tropics

About 35% of the land mass is prone to desertification which is currently proceeding at an estimated 20,000 ha per year.

Cont…1

Because of the rather small land surface of Ghana, the whole country may be exposed to changes that can lead to rainfall deficits, dry spells and drought.

Severe drought, variable rainfall and floods of 1983, 1998, 2005, 2007 and 2009 respectively are examples of extreme weather events due to climate change

Cont…..2

These events alter the quality and availability of natural resources and generally impact on human security through water and food insecurity.

EXPECTED IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES

1. Flooding

Increased precipitation intensity and variability are projected to increase the risks of flooding and inundation in many areas

2. Drought

At the same time, the proportion of land surface in extreme drought at any one time is projected to increase (likely)

Cont…1

3. Runoff and Stream flow

By the middle of the 21st century, annual average river runoff and water availability are projected to increase as a result of climate change at high latitudes and in some wet tropical areas, and decrease over some dry regions at mid-latitudes and in the dry tropics.

A reduction in runoff will be perhaps the most serious impact of global warming on the water environment

Cont.....2

4. Changing Groundwater recharge and storage

If the runoff from rainfall that flows into rivers and streams are affected by changes in temperature and land use, so too is the infiltration of water into underground formations

Cont....3

5. Water Quality

Higher water temperatures and changes in extremes, including floods and droughts, are projected to affect water quality and exacerbate many forms of water pollution from sediments, nutrients, dissolved organic carbon, pathogens, pesticides and salt, as well as thermal pollution (Bates et al., 2008)

Continuation from

CLIMATE CHANGE AND IMPLICATIONS FOR GHANA'S WATER RESOURCES

Given the multiple uses of water, addressing the problems of adaptation on what climate change poses cannot be achieved by managers of water alone.

Multi-sectoral and multi-disciplinary collaboration is required.

VULNERABILITY AND ADAPTATION MECHANISMS IN NORTHERN GHANA

Agriculture is the major driver of Ghana's economy, contributing more than 40% of the GDP and employing about 56% of the population

In the northern regions, much of the agriculture is rain-fed and on a small-scale around compound houses.

Food crops are cultivated mostly in only one season

Cont.....1

Since the agricultural practice is dependent upon the availability and distribution of the rainfall, farmers suffer significant losses when the rains fail.

Therefore water availability is the single most important production and livelihood factor in these regions

Cont....2

There is the need to counteract the negative impacts of climate change on water resources-reliant development and livelihoods

The strategy is to

look at both the <u>efficiency</u> of water use and possible <u>increases</u> in the supply of water.

To increase the ability to cope with situations of flood and droughts in order to protect people's livelihoods and development

SCOPE OF STRATEGY

1. WATER CONSERVATION AND STORAGE

For multiple uses including irrigation and climate risk reductions (flood and drought) To ensure climate-proof water infrastructure and community resilience through strategic objectives, e.g.:

Promote water capture i.e Rainwater Harvesting

Cont....

Conservation and flood control

Management for the sustenance of livelihoods of vulnerable communities

Cont…1

SCOPE OF STRATEGY

2. THE GHANA NATIONAL WATER POLICY

Sets out the strategic goals and key strategies for the management, use, conservation and protection of water resources.

NATIONAL WATER POLICY AND CLIMATE CHANGE

Construct flood protection structures at appropriate locations.

Apply appropriate technologies to provide necessary information for detection and early warning systems for floods and droughts.

Establish and enforce appropriate buffer zones along river banks including measures to compensate flood loss of lands.

Cont….1

Ensure that land use planning/building regulations are adequate and enforced in respect of waterways and flood prone areas.

Provide water conservation structures of adequate capacity after carrying out environmental assessment taking into account multiple uses.

Cont….2

Ensure rainwater harvesting techniques are incorporated into building code and enforced

Ensure implementation of mitigation strategies in consultation with affected communities (GoG, 2007)

Cont…2

SCOPE OF STRATEGY

3. NATIONAL IRRIGATION POLICY

Major way of using water to reduce poverty

Policy recognizes three main categories of irrigation

- Informal irrigation
- Formal irrigation
- Commercial large scale irrigation

Note

Strategy is to use the policy to realize the productive capacity of public and private enterprises through the provision of their water needs for agricultural production

Cont…3

SCOPE OF STRATEGY

THE PROJECT :

Climate Change Adaptation through Integrated Water Resources Management (IWRM) in the Northern Savanna Regions of Ghana

PROJECT OBJECTIVES:

To raise awareness on climate change and information in the Region

To reduce livelihood vulnerability

Develop adaptive and coping strategies for water resources use and management

Cont…4

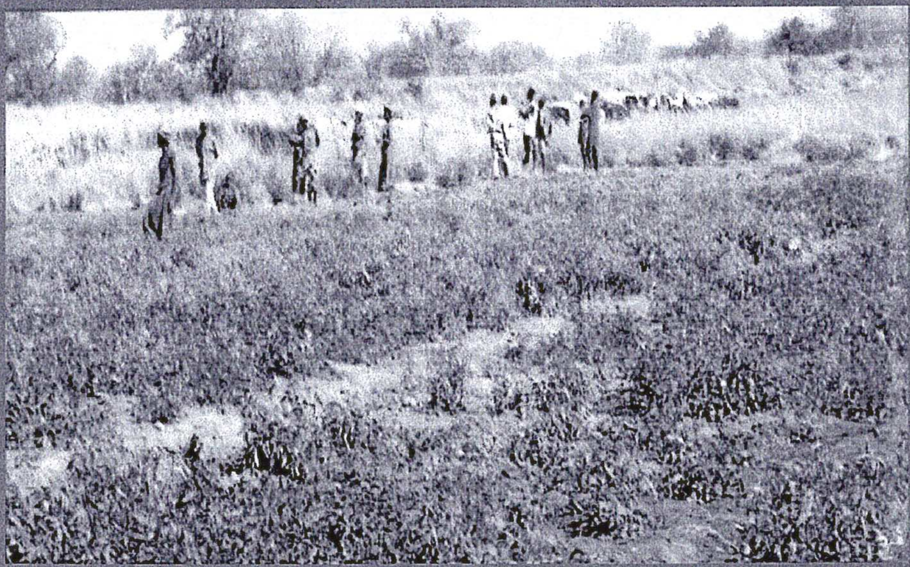
SCOPE OF STRATEGY

PROJECT COMPONENTS

WATER CONSERVATION AND IRRIGATION WITH RESPECT TO CLIMATE CHANGE:

Aim is to address the potential increase in water requirement for irrigation to meet food security and requirements and to promote water conservation measures

FLOOD CONTROL AND IRRIGATION

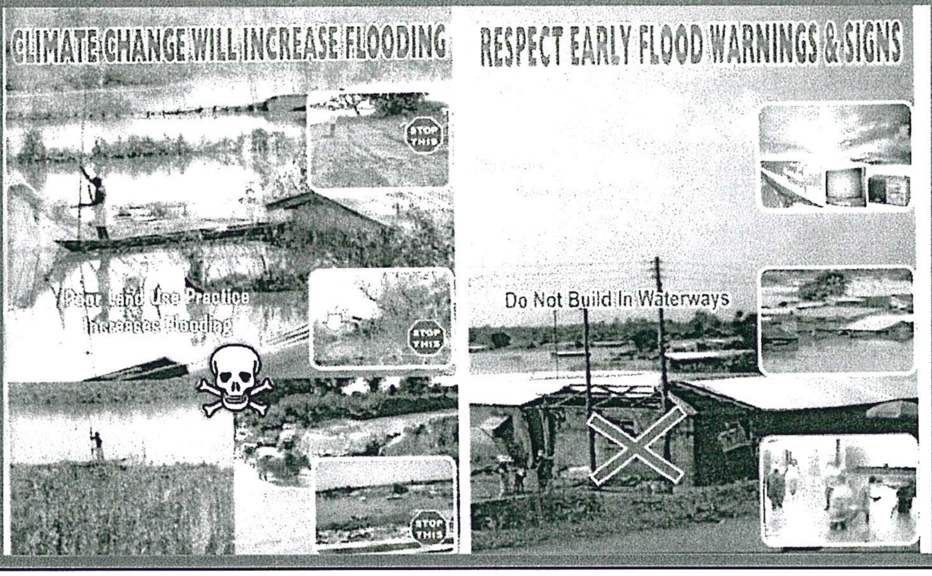


Cont....1
PROJECT COMPONENTS

FLOOD CONTROL AND INFORMATION SERVICES TO FACILITATE ADAPTIVE MEASURES TO CLIMATE CHANGE:

These are measures to adequately address the impact of extensive floods under climate variability and change scenarios.

FLOOD CONTROL INFORMATION

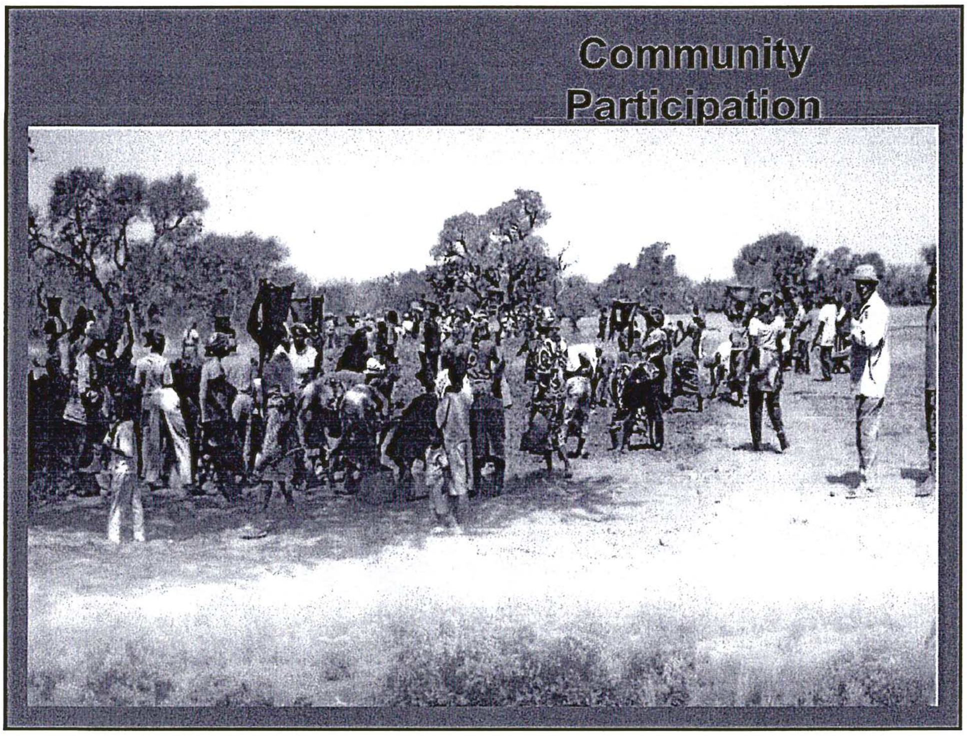


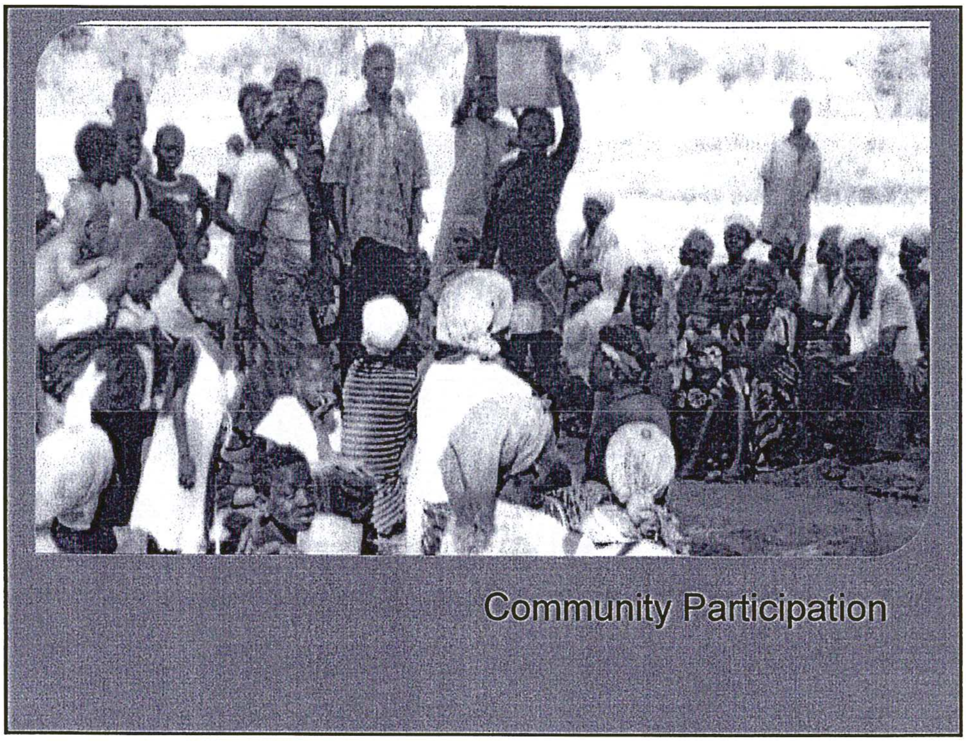
Cont....2

PROJECT COMPONENTS

INVOLVEMENT OF LOCAL COMMUNITIES IN ASSESSING THEIR NEEDS FOR ADAPTIVE MEASURES TO COPE WITH IMPACTS OF SEVERE WEATHER CONDITIONS:

Involve local communities and build their capacities to access relevant information on climate change and water resources.


Community
Participation


Community Participation

LESSONS LEARNT

COMPONENT 1:

IRRIGATION AND WATER CONSERVATION

Change approaches to planning water conservation including water harvesting and storage

Local water user associates should be organized and mobilized

Local government units (DA) should mainstream adaptation measures into their development plans

Cont….1

COMPONENT 2

FLOOD CONTROL MEASURES

Identify problems and find solutions with the local populations- e.g. creating of buffer zones

Identify education or awareness creation materials with local issues to ensure appreciation

Build indigenous knowledge and indicators into flood early warning systems

Map flood prone areas

Cont….2

COMPONENT 3

INVOLVEMENT OF LOCAL COMMUNITIES

Local communities are knowledgeable and skillful, with very high sense of ownership of resources

Poor timing and mobilization often weaken their resilience

Involvement of communities in major activities depends on the building of trust and display of transparency

Cont….3

It is important to allow the local communities to use their knowledge, skills and resources to experiment the process of climate change adaptation

CHALLENGES

The following challenges were identified in the process

- Raising awareness and building knowledge, since climate change is new and complex
- Making the issue central and acceptable in government circles
- Involving non-water sectors and local level institutions
- Linking local-level impacts with national-level responses

Cont….

- Strengthening institutions and capacities on sustainable basis
- Ensuring political will, since climate change adaptation is a long-term issue


THANK YOU FOR YOUR
ATTENTION

Post Socialist Water Distribution Conflicts: The Tragedy of the Aral Sea

Contributer: Michael Garbowski
Academic: Prof. Dr. Ulrich Menzel

EXCEED Summer School on Climate Change and Global Water Problems
Date: 06.11.2012

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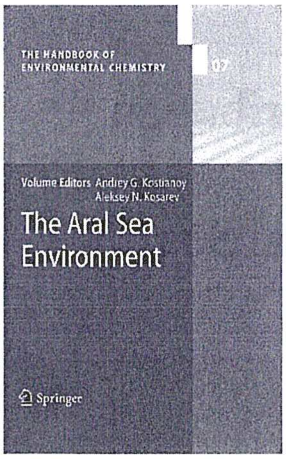
Useful Sources



- CAWater-Info; Portal of Knowledge for Water and Environmental Issues in Central Asia (www.cawater-info.net)

- The Aral Sea Environment; A.G. Konstianoy and A.N. Kosarev (www.springer.com)

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Introduction

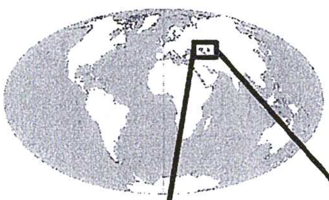

Fig. 1: World Map (Wikipedia 2012).

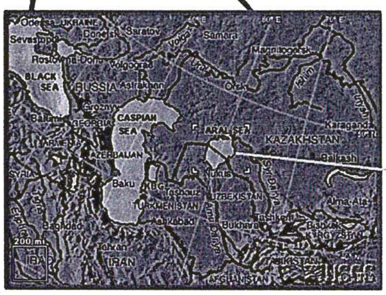

Fig. 2: Aral Sea Area (USGS, 2012).

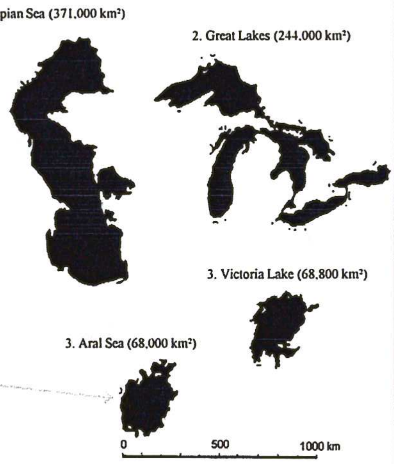

Fig. 3: World's Top Four largest lakes by area (USGS, 2012, modified).

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Introduction

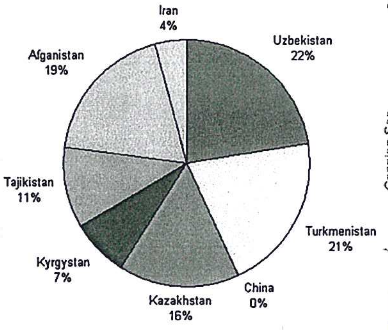

Fig. 4: Splitting of the Aral Sea basin (Akmansoy, 1997).

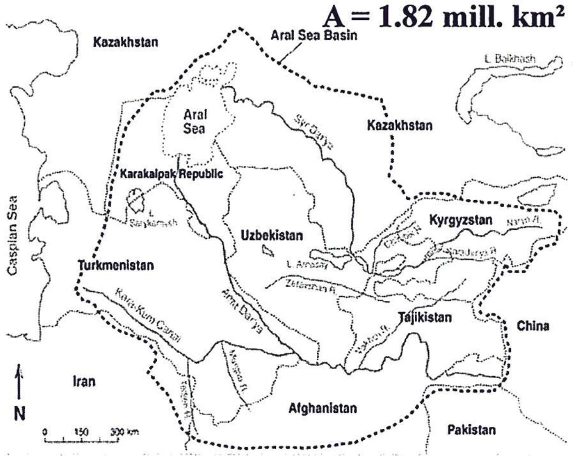

Fig. 5: The Aral Sea basin (Micklin, 2007).

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Introduction

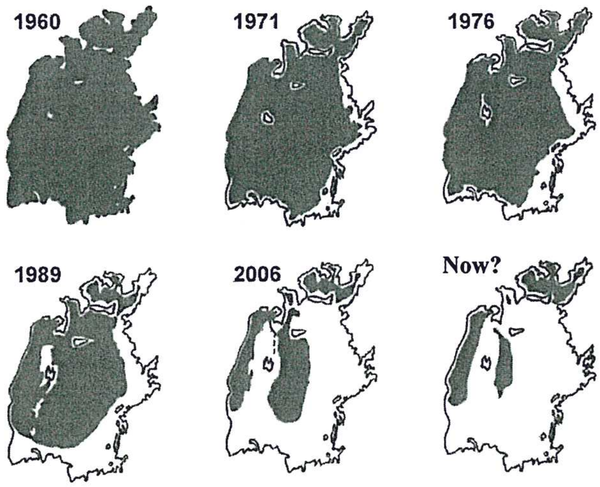

Fig. 6: Shrinking of the Aral Sea (Micklin, 2007).

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The Aral Sea up to 1960's

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Climate

- Continental climate
  → High daily and seasonal variability
- Nontropic deserts
- Low precipitation rate
- High evaporation rate

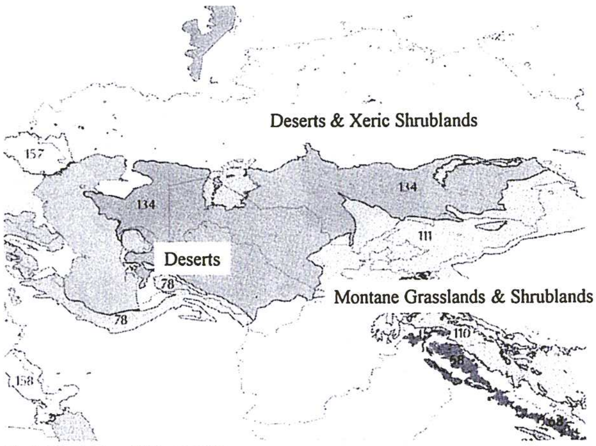

Fig. 7: Climatic Zones (Wikipedia, 2012).

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History

- Aral Sea was formed ca. 5000 b.c.
- Natural sea level fluctuations strongly depend on Amudarya inflow
- Least stable conditions:
  from beginning of 20th centrury to 1960s

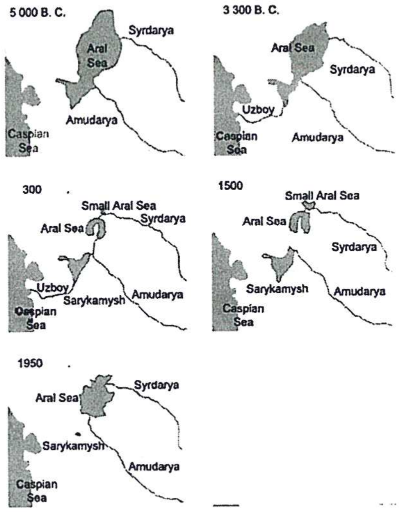

Fig. 8: The History of Aral Sea (CAWaterInfo, 2012).

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Aral Sea 1960

- **Inflow:** ¾ Q - Amudarya
  ¼ Q - Syrdarya
- **Average sea level:** 53 m a.s.l
- **Depth:** *maximum* 69 m
  average 16.1 m
- **Area:** ca. 68,000 km²
- **Volume:** ca. 1,000 km³
- **Salinity:** ca. 10.5 ppt

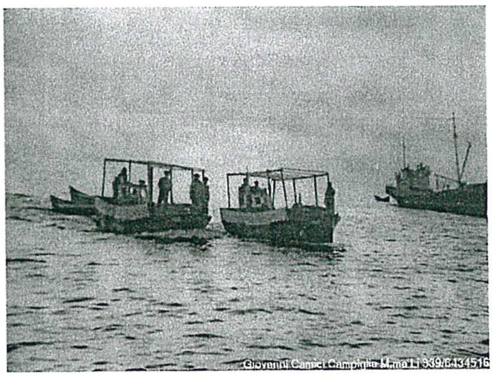

Fig. 9: Fishermen on the Aral Sea (www.forocomunista.com, 2012).

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Amudarya

- **Catchment area:**
  A = 309,000 km²
- **Length:**
  L = 1,450 km
- **Average annual flow:**
  $Q_{Pyandzh}$ = 36 km³/yr
  Q_{Vakhsh} = 20 km³/yr
  → Q_{total} = 70 km³/yr
- **Water loss (1960):**
  $Q_{irrigation}$ = 12 km³/yr
  $Q_{natural}$ = 15 km³/yr
  → Q_{total} = 27 km³/yr
- **Salinity:** 0.5 g/l

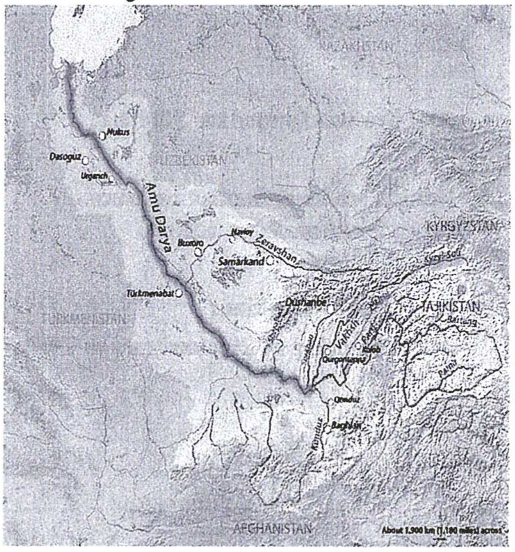

Fig. 10: Catchment area of the Amudarya river (Wikipedia, 2012).

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Syrdarya

- **Catchment area:**
  A = 219,000 km²
- **Length:**
  L = 2,137 km
- **Average annual flow:**
  Q_{Naryn} = 13 km³/yr
  $Q_{Karadarya\ \&Fergana\ Rivers}$ = 13 km³/yr
  → Q_{total} = 36 km³/yr
- **Water loss (1960):**
  $Q_{irrigation}$ = 14 km³/yr
  $Q_{natural}$ = 6 km³/yr
  → Q_{total} = 20 km³/yr
- **Salinity:** 1.3 g/l

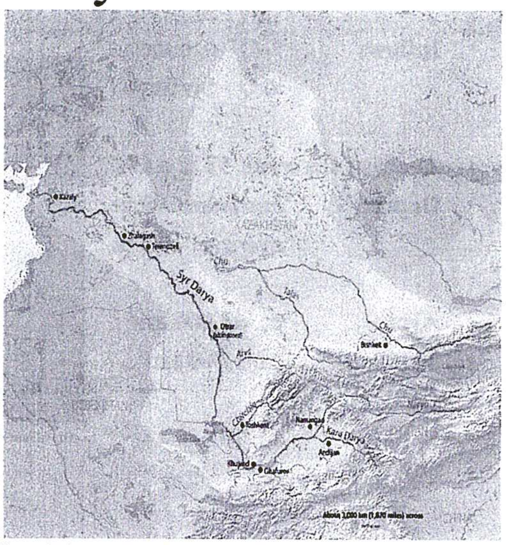

Fig. 11: Catchment area of the Syrdarya river (Wikipedia, 2012).

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Precipitation and Evaporation

- **Precipitation:** 90 – 120 mm/yr
  → P = 9 km^3/yr
- **Evaporation:** 800 – 1200 mm/yr
  → E = 66 km^3/yr

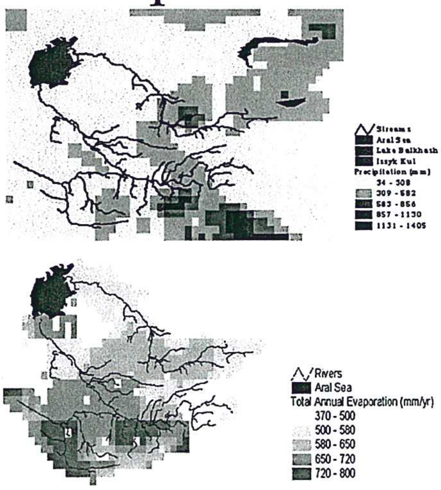

Fig. 12: Annual precipitaion and evaporation in Aral Sea basin (Akmansov, 1997).

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Water Balance

- **Amudarya:** Q_{runoff} = 70 km^3/yr
  Q_{loss} = 27 km^3/yr
  → Q_{inflow} = 43 km^3/yr
- **Syrdarya:** Q_{runoff} = 36 km^3/yr
  Q_{loss} = 20 km^3/yr
  → Q_{inflow} = 16 km^3/yr
- **Precipitation:** P = 9 km^3/yr
- **Evaporation:** E = 66 km^3/yr
- **Water balance equation:** $Q_{Amudarya\&Syrdarya} + P - E = \Delta S_{AralSea}$
  → $(43\ km^3/yr + 16\ km^3/yr) + 9\ km^3/yr - 66\ km^3/yr = 0\ km^3/yr$

→ $\Delta S_{AralSea}$ = +/- 0 **<u>→ stable condition</u>**

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Socio-Economic Conditions

Fig. 13: Mosaic in the Aralsk train station: "In response to Lenin's letter we will give 14 wagons of fish" (littlemissadventuress.wordpress.com, 2005).

- **Aral Sea played a significant role in USSR economics:**
  → Fishing: 40 – 50,000 t/yr (5 – 7 % total inland fish catchment)
  → Muskrat farming: 1 mill. pelts/yr
  → Recreation zones: pioneer camps and rest houses

- **Irrigated farming in the Aral Sea basin:**
  → irrigated area: 4 mill. ha
  → Uzbekistan: 1 mill. t cotton/yr
  → Turkmenistan: 122,000 t cotton/yr

Population: 14.1 mill.

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The Aral Sea after 1960

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Cottonization

- **USSR's main targets:**
  → cotton independence
  → allies supply

- **Increas of cotton production:**
  ❖ ***Uzbekistan :***
  1 mill. tons → 1.7 mill. tons
  ❖ ***Turkmenistan:***
  122,000 tons → 423,000 tons

- **Increase of irrigated area:**
  4 mill. ha → 8 mill. ha

- **Result:**
  → 90 % of cotton in the USSR
  → 40 % of rice in the USSR

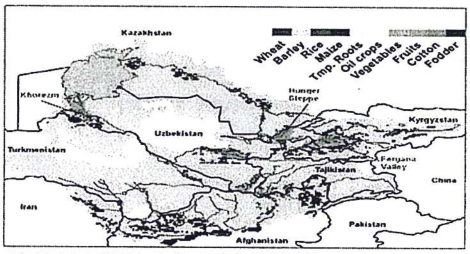

Fig. 14: Irrigated fields in Aral Sea basin in 1960 (CAWaterInfo, 2012).

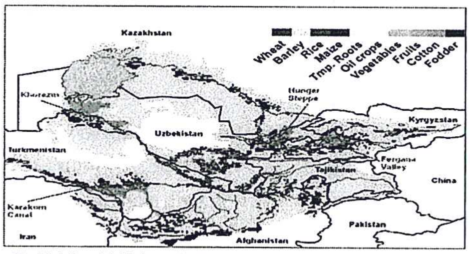

Fig. 15: Irrigated fields in Aral Sea basin in 2000 (CAWaterInfo, 2012).

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Side-Effects of Cottonization

- **Side-Effects:**
  → Irrigation of unsuitable land (high salinity, heavy soil texture)
  → High quantities of mineral fertilizers and pesticides
  → No use of crop rotation

- **Environmental impacts:**
  → soil salinization
  → large saline drainage flow

- **Counteraction:**
  → Three or four fold increase of water application rates
  (4,000 m^3/t cotton ----> 13,000 m^3/t cotton)

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Water-Management Projects

- **Soviet Union principle:**
  → inexhaustible water resources

- **Irrigation canals:**
  → Karakum
  (Q = 11 km³/yr from Amudarya)

- **Reservoirs:**
  → Nurek (V = 10.5 km³, Amudarya)
  → Tuyamuyun (V = 7.2 km³, Amudarya)
  → Toktogul (V = 19.5 km³, Narin - Syrdarya)
  → Chardara (V = 6.7 km³, Syrdarya)

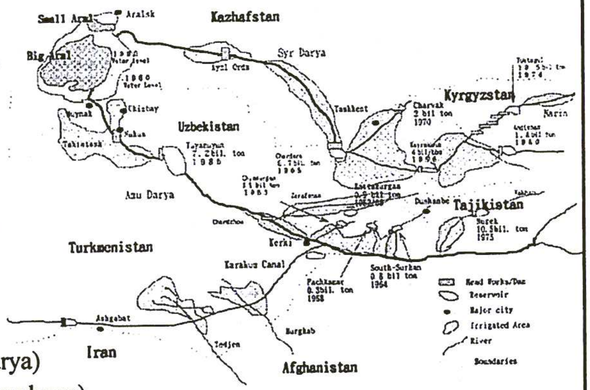

Fig. 16: Water management projects in Aral Sea basin (UNEP, 2012).

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"Creeping" Environmental Change

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Environmental Conequences: The Aral Sea

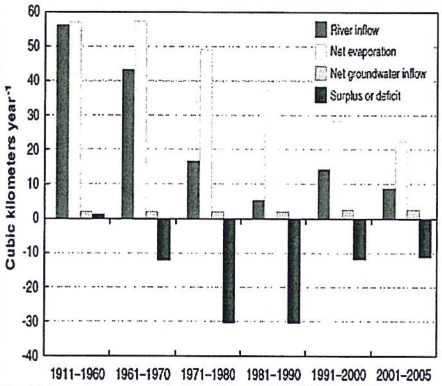

Fig. 17: Annual average water balance of the Aral Sea (Micklin, 2007).

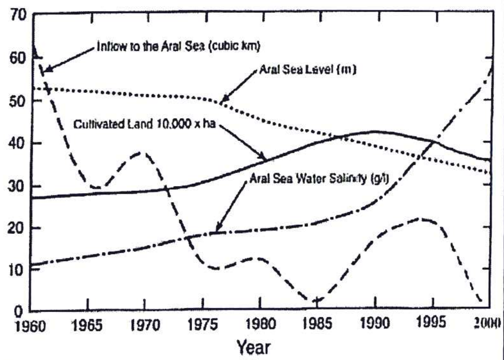

Fig. 18: Environmental conditions of the Aral Sea in 1960 -2000 (A. G. Kostianoy, 2010).

- > 25 m water level drop
- > 75 % surface reduction
- Water salinity increase 11 ppt → 150-200 ppt → degradation of biodiversity

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Environmental Conequences: The Aral Sea Basin

- Changing in regional climate
  → stronger continentality
- Progressive soil salanization
- Progressive land degradation
- Poor water quality and qauntity
- Dust/Salt storms
  → 75,000 t/yr
- Degradation of biodiversity

Fig. 19: Dust/Salt storm (http://infranetlab.org/blog/page/15/, 2012).

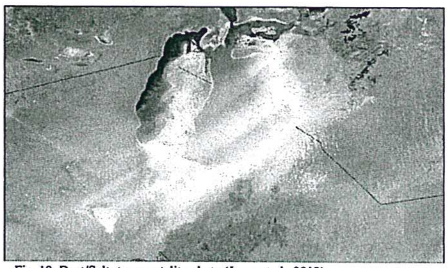

Fig. 19: Dust/Salt storm, satelite photo (Joger et al., 2012).

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Socio-Economic Consequences

- Public health problems
- Economic disaster
  → Collapse of fishing industry/ muskrat farming/ resort industry
- Decreased quality and quantity of crops production
- Migration

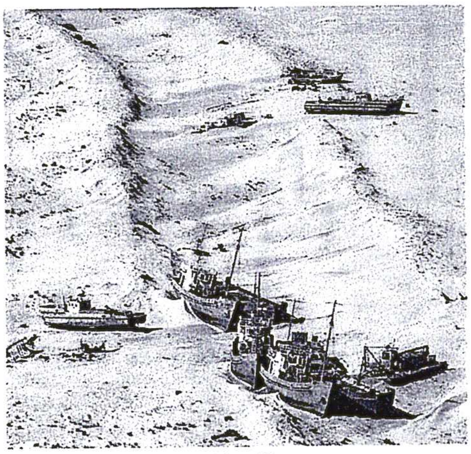

Fig. 20: Shipwrecks on the bottom of the Aral Sea (http://johnmckay.blogspot.de/2009_08_01_archive.html. 2009).

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The Fate of the Aral Sea

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1964

A = 68,000 km²

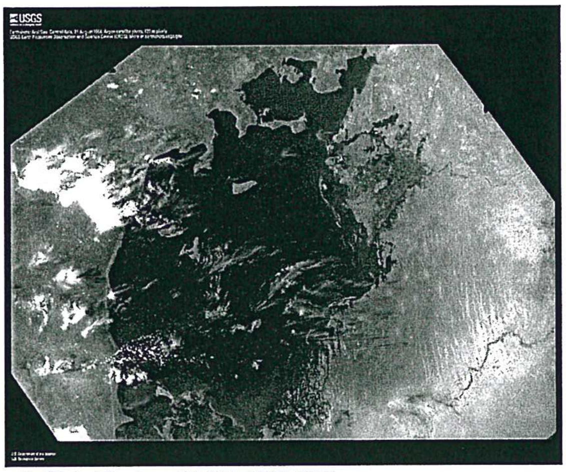

Fig. 21: Aral Sea, August 21, 1964 (USGS, 2012).

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1973

A = 60,000 km²

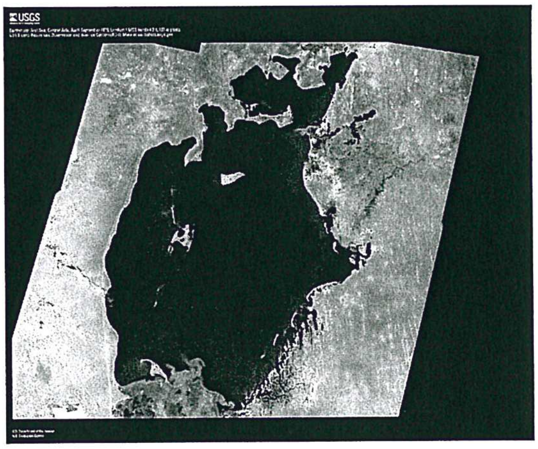

Fig. 22: Aral Sea, Sommer 1973 (USGS, 2012).

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1987

A = 41,000 km²

Fig. 23: Aral Sea, August 1987 (USGS, 2012).

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1999

A = 29,000 km²

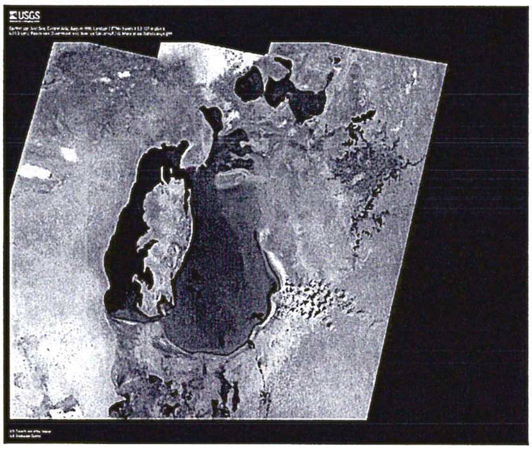

Fig. 24: Aral Sea, August 1999 (USGS, 2012).

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2000

A = 26,000 km²

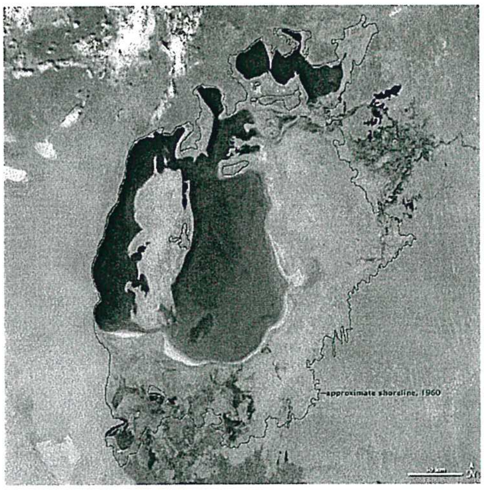

Fig. 25: Aral Sea, August 25, 2000 (NASA, 2012).

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2001

A = 22,000 km²

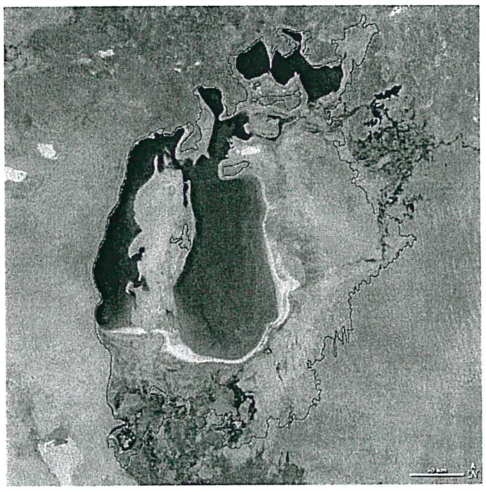

Fig. 26: Aral Sea, August 15, 2001 (NASA, 2012).

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2002

A = 19,900 km²

Fig. 27: Aral Sea, August 20, 2002 (NASA, 2012).

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2003

A = 19,700 km²

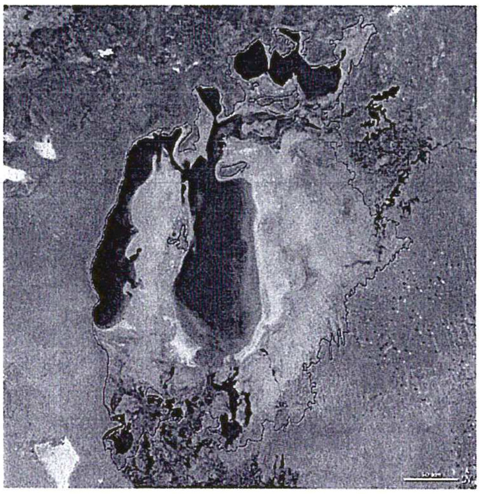

Fig. 28: Aral Sea, August 12, 2003 (NASA, 2012).

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2004

A = 17,900 km²

Fig. 29: Aral Sea, August 16, 2004 (NASA, 2012).

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2005

A = 16,900 km²

Fig. 30: Aral Sea, August 12, 2005 (NASA, 2012).

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2006

A = 15,700 km²

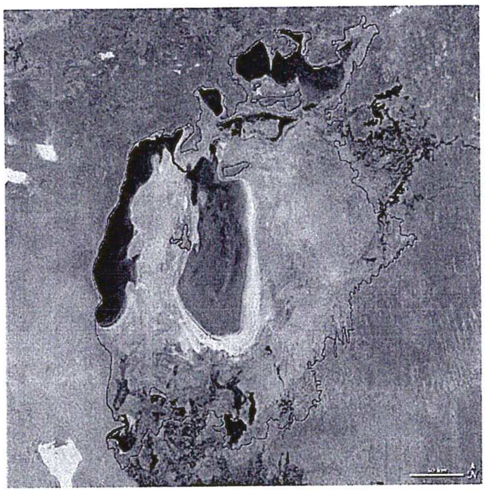

Fig. 31: Aral Sea, August 15, 2006 (NASA, 2012).

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2007

A = 12,200 km²

Fig. 32: Aral Sea, August 16, 2007 (NASA, 2012).

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2008

A = 10,400 km²

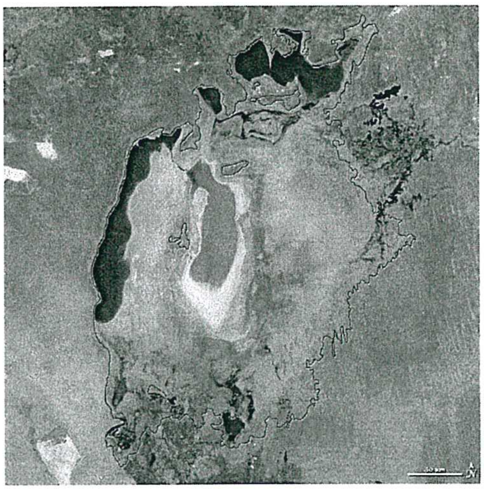

Fig. 33: Aral Sea, August 18, 2008 (NASA, 2012).

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2009

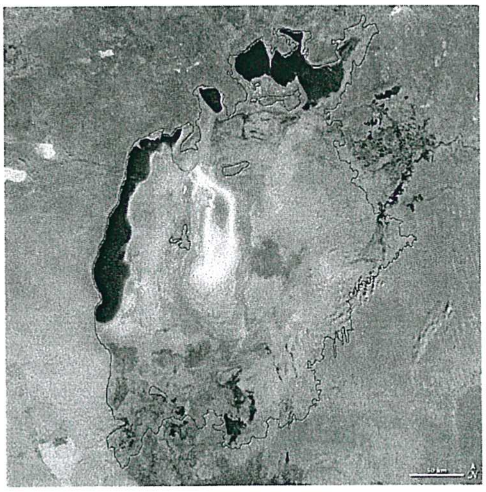

Fig. 34: Aral Sea, August 16, 2009 (NASA, 2012).

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2010

A = 13,800 km²

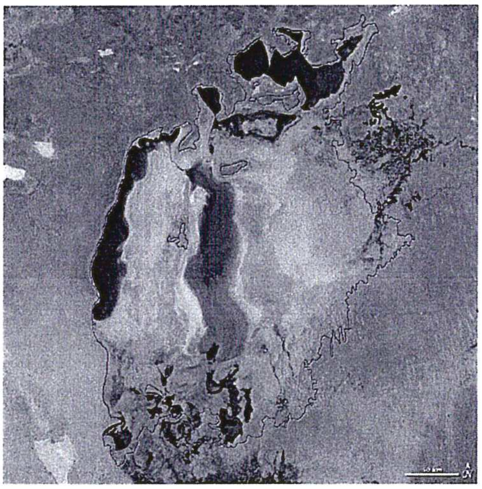

Fig. 35: Aral Sea, August 26, 2010 (NASA, 2012).

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2011

Fig. 36: Aral Sea, August 15, 2011 (NASA, 2012).

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2012

Fig. 37: Aral Sea, August 18, 2012 (NASA, 2012).

What Next…?

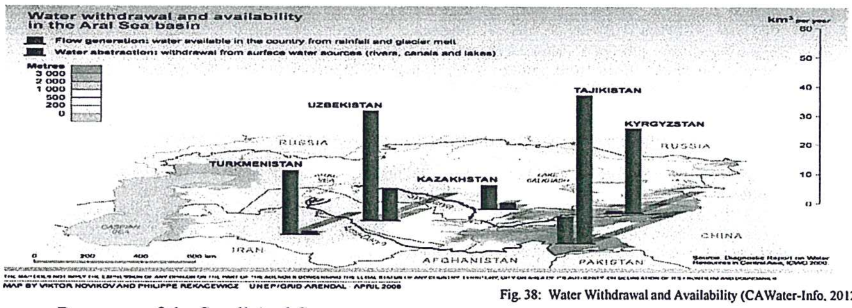

Fig. 38: Water Withdrawal and Availability (CAWater-Info. 2012).

- Recovery of the Small Aral Sea
  → recouping the evironmental degradation of the Aral Sea is possible
- International projects for regional problems exist
  → the International Fund for saving the Aral Sea (IFAS)
  → executed and sponsored by World Bank, UNEP, UNESCO
  → problems: financial and technical support
- Inter-state water resources management
  → The Interstate Commission for Water Coordination (ICWC)

Thank you for your attention!

Fig. 39: Aral Sea (Children's drawing contest, Ulbala Zhubanysheva, Aral'sk, Kazakhstan, 2010).

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Sources

- Sandra Akmansoy , Daene C. McKinney: *Spatial Hydrology of the Aral Sea Using Geographic Information Systems (GIS)*, Center for Research in Water Resources University of Texas at Austin, December 1997.
- Wikipedia, online: wikipedia.org, 2012.
- Philip Micklin: The Aral Sea Disaster; Annual Review of Earth and Planetary Sciences; Vol. 35: 47-72; 2007.
- Central Asia Water Info (CAWaterInfo): Portal of Knowledge for Water and Environmental Issues in Central Asia, online: www.cawater-info.net, 2012.
- T. Aus der Beek: Modelling the impact of Global Change on the hydrological system of the Aral Sea basin, Physics and Chemistry of the Earth, Parts A/B/C, Volume 36, Issue 13, 2011, online: www.sciencedirect.com/science/article/pii/S1474706511000489.
- UNEP: United Nations Environment Programme, online: www.unep.or.jp, 2012.
- Christopher Conrad: Auswirkungen intensiver Bewässerung in Zentralasien, Universität Würzburg, 2002.
- U. Joger, C. Giacoma , T. Dujsebayeva, Y. Chikin, C. Miaud : Statusbestimmung der Fauna des Aralseebeckens (Schwerpunkt reptilien/Amphibien) und Schlussfolgerungen für den Schutz natürlicher Habitate und den Erhalt der Biodiversität, DFG 2012.
- Severski, I., Chervanyov, I., Ponomarenko, Y., Novikova, N. M., Miagkov, S. V., Rautalahti, E. and D. Daler: Aral Sea; GIWA Regional assesment 24, UNEP, 2005.
- U.S. Geological Survey (USGS): Earthshots: Satellite Images of Environmental Change, online: http://earthshots.usgs.gov/Aral/Aral, 2012.
- NASA: Earth Observatory; Shrinking Aral Sea, online: http://earthobservatory.nasa.gov/Features/WorldOfChange/aral_sea.php, 2012.

Technische Universität Braunschweig

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Abwasserverband Braunschweig

Summer School
on Climate Change and Global Water Problems

SE|BS
BS|ENERGY Gruppe

The development of the reuse system in Braunschweig

Christine Mesek

06th of November, 2012

Ein Unternehmen der Veolia Environnement

VEOLIA ENVIRONNEMENT

Contents:

HISTORY ...

STATUS ... of water treatment and reuse in Braunschweig

FUTURE ...

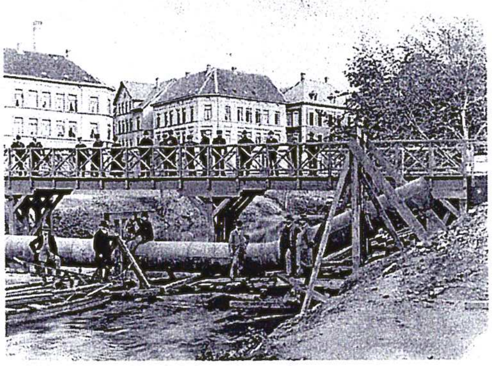
History of wastewater treatment and reuse

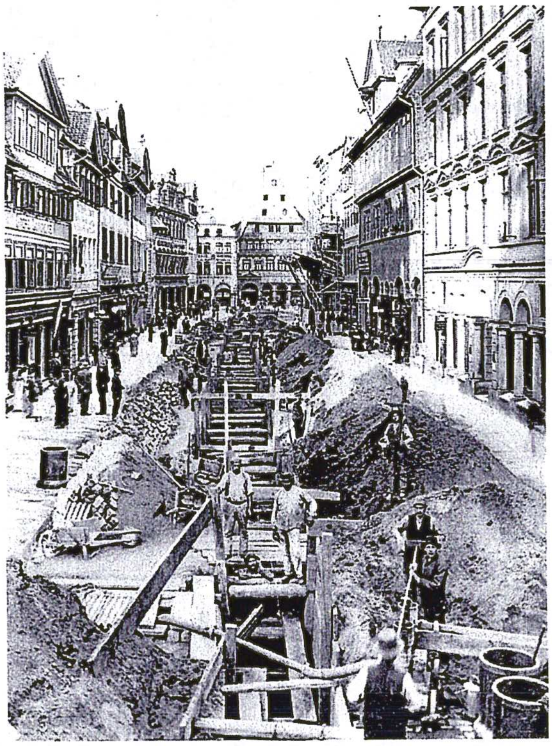
in Braunschweig

Timeline

...

1865	Expansion of the water supply
1880	Expansion of the sewer system
1895	Startup of sewage fields
▪	460 ha
▪	approx. 100.000 p.e.
▪	sewage water 10.000 m³/d





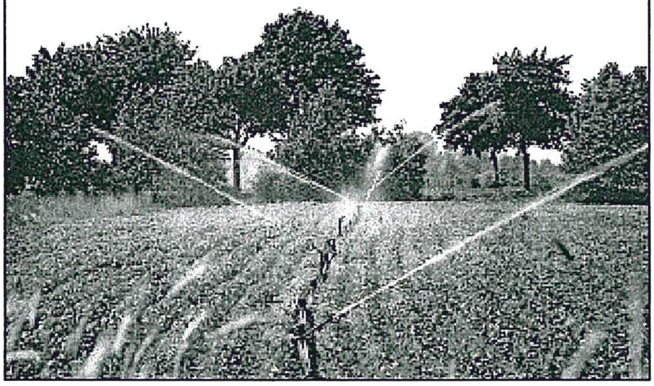
Abwasserverband Braunschweig SE|BS VEOLIA

Timeline

1954 | Foundation of local wastewater association and startup of sprinkler irrigation with mechanical treated wastewater (strong odor problems)

- irrigated / cultivated area: ~ 3,000 ha
- irrigation technique:

Pipe sprinkling 1956 - 1974

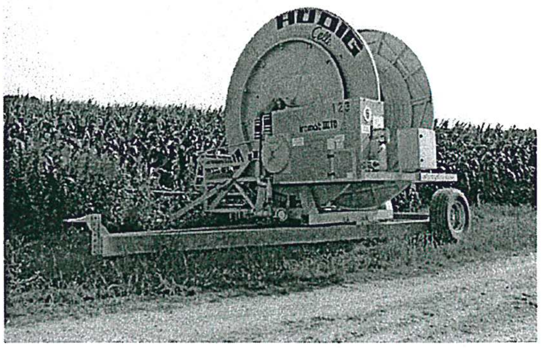


Source: Abwasserverband Braunschweig

Timeline

since 1974 | irrigation technique: sprinkling

Source: Abwasserverband Braunschweig



Timeline

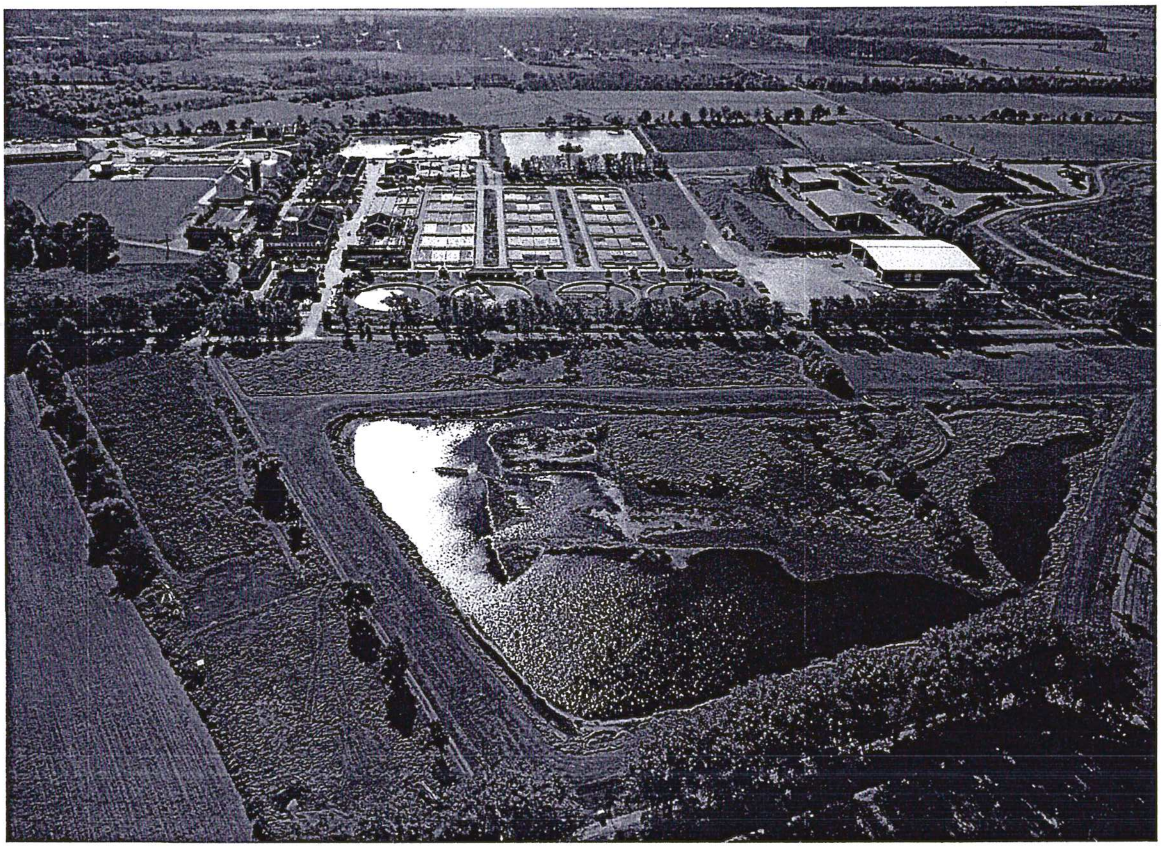
1979 Construction of the wastewater treatment plant
- highly stressed WWTP
- beginning of biological wastewater treatment
- irrigation of surplus activated sludge

1992 Expansion of WWTP
- nitrogen elimination
- phosphorus elimination
- production of nitritious irrigation water

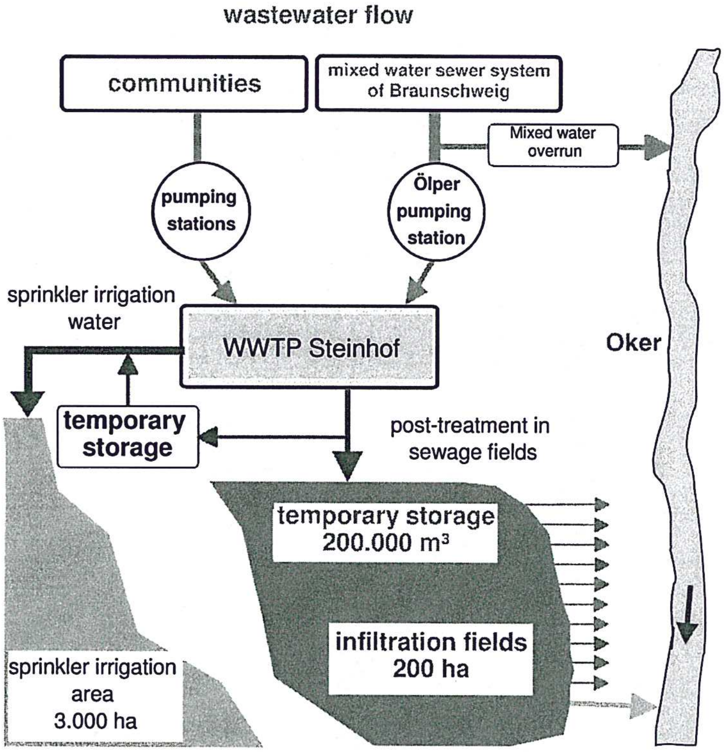
2001 Construction of sludge digestion

2006 SE|BS is the wastewater service provider of Braunschweig

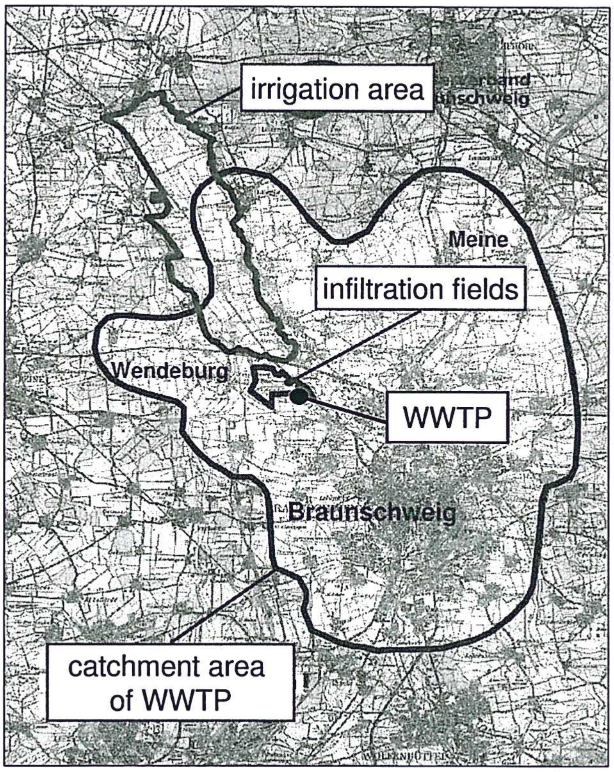
...



Concept of wastewater treatment and recycling



Overview plan Source: Abwasserverband Braunschweig

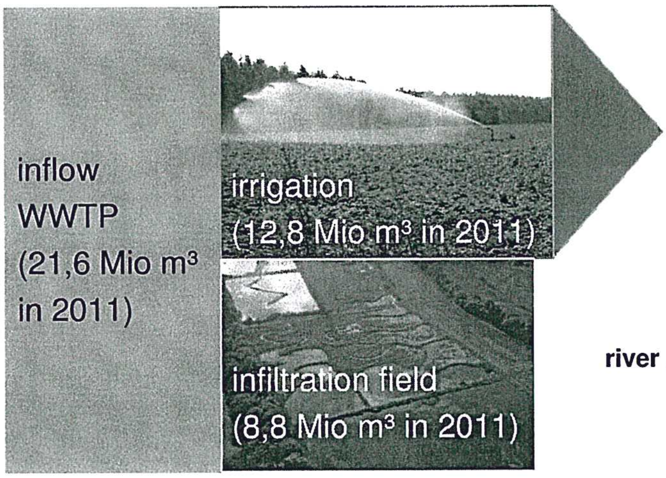


Status of wastewater treatment and reuse in Braunschweig

Latest figures

Population in catchment area	ca. 280.000
Total lenght of sewer system	1.373 km
wastewater pipes	557 km
rainwater pipes	672 km
mixed water pipes	78 km
pressure pipes	66 km
Pumping stations	95
Rain retention basins	55

Status of water reuse in Braunschweig



maize, wheat, sugar beet, potatoes and other

river „Oker“

infiltration fields

today 4th cleaning step: buffering and water storage

Other functions: Recreational area and resting place for migratory birds

Main elements of wastewater reuse

Main elements:

- organisation, coordination and management
- contractual obligations between water/nutrient supplier (WWTP) and user
- efficient infrastructure
- acceptance
  - long-term experience and know-how
  - transparency, communication, PR
  - prevention of aerosol spray by hedges alongside roads
- monitoring of sludge and water
- monitoring of soils and groundwater

Basis of a safe sludge reuse:

Discharge control

- Over 25 years
- City of Braunschweig and adjacent communities
- Over 400 companies / industry

Pre-treatment of industrial

Cooperation an coordination

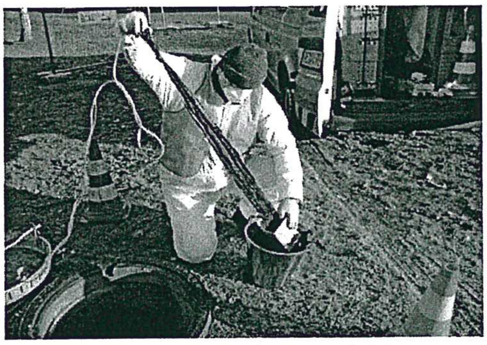
→ Reduction of heavy metals and other pollutants at the source

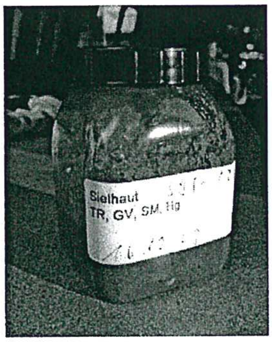
Analysis and monitoring of sewer films

- motivation: detection of increased heavy metal concentrations and their polluter

➢ 01.01.2014: new heavy metal limits for sewage sludge in DüMV

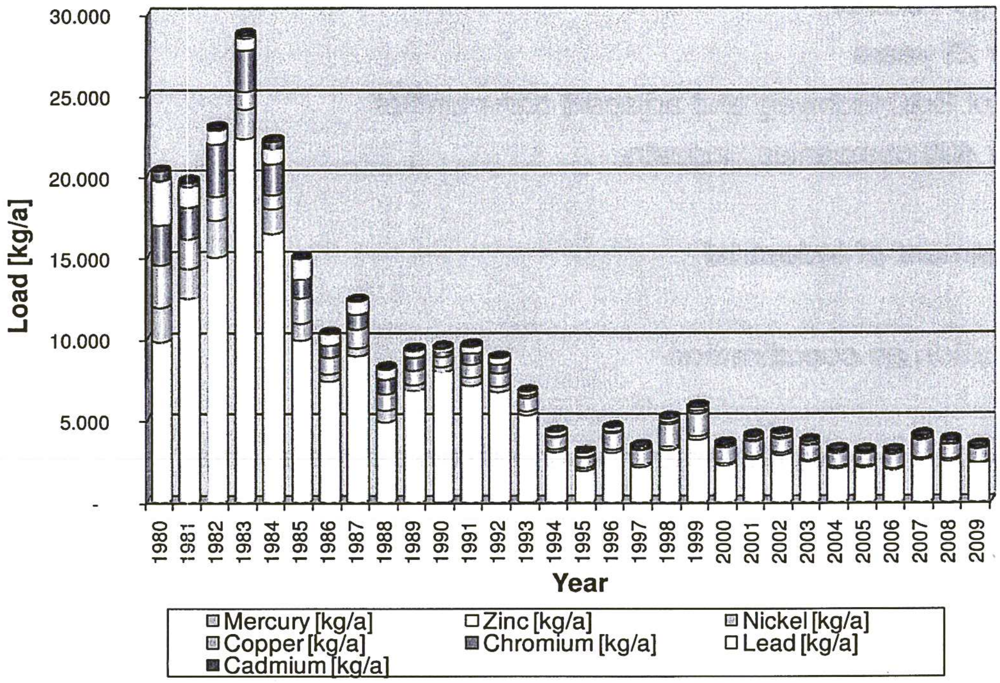
➢ Cd-limit = 1,5 mg/kg TR (dry residue) ↔
Cd-measurements in sewage sludge ≈ 1,2 mg/kg TR → marginal changes





sewer films sampling (since 2009):
Use about 2 cm wide strip of plastic as culture medium
Advantage: no channel entrance, plenty material of sewer films

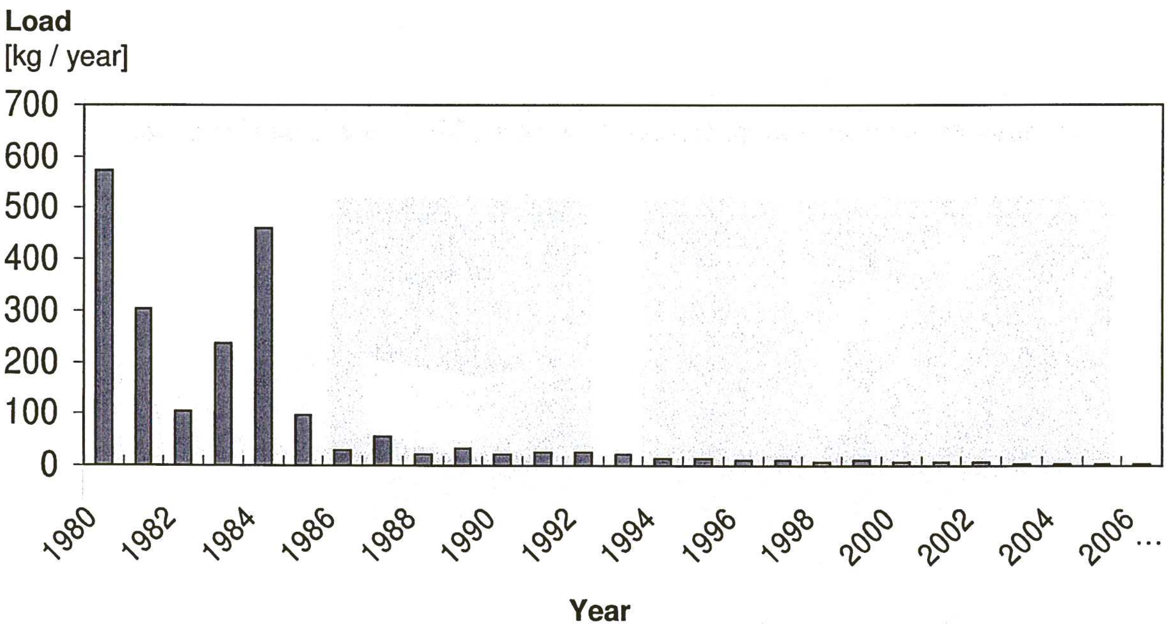
Development of the heavy metal loads in wastewater irrigation



 data source: Abwasserverband Braunschweig

Abwasserverband Braunschweig SE BS VEOLIA

Development of the cadmium load in sewage sludge



 data source: Abwasserverband Braunschweig

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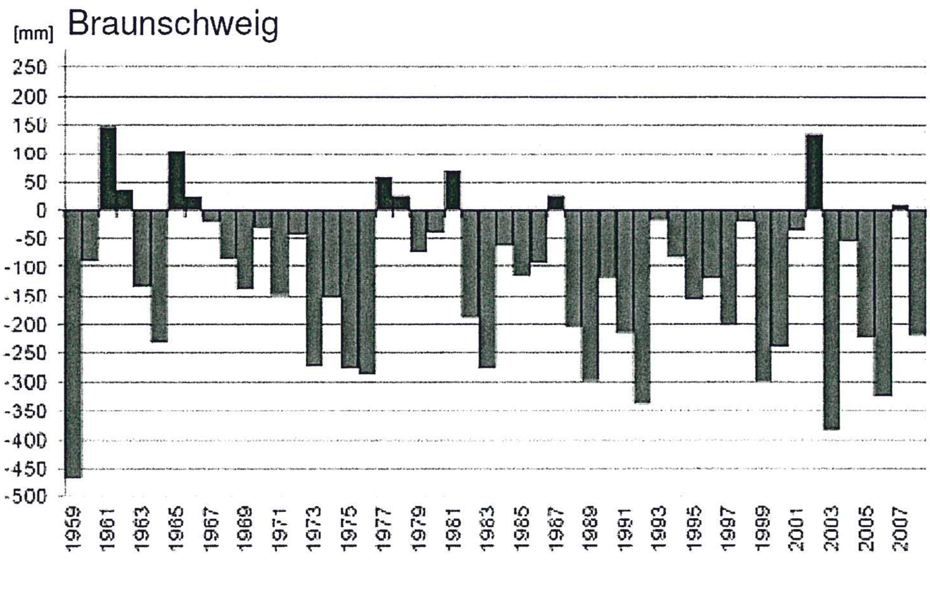
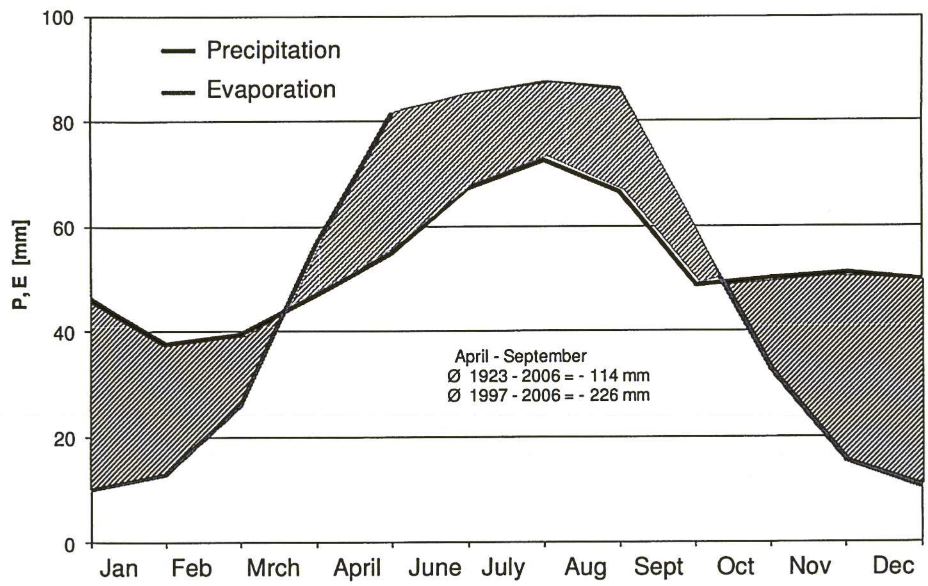
Need for water reuse in Braunschweig

Climatic water balance of Braunschweig



source: DWD und Fachverband Feldberegnung (1959 – 2009): Klimatische Wasserbilanz;
Graphik: Fachverband Feldberegnung (2009)

Average climatic water balance (1923 – 2006) of Braunschweig



source: Abwasserverband Braunschweig; data source: DWD

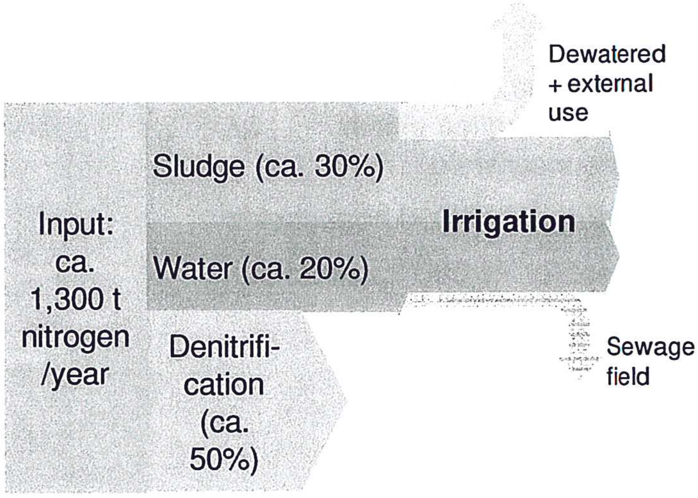
Nutrient reuse: Phosphorus

- ~ 200 t/year, almost completely reused:
  - Inside the system: Irrigation of digested sludge (summer)
  - Outside the system: Sludge dewatering, storage and reuse as dry fertiliser (winter)
- only small amounts of P have to be applied by artificial fertilisers
- decoupling from fertiliser market
- fossil deposits of P can be protected

Nutrient reuse: Nitrogen

- 40% of N is used within the system; 10% outside
- loss due to denitrification: 40 - 45%
- Artificial fertiliser is needed, because N is rapidly degrading in soils

- value of 1 kg N: 0,5 to 1€
- high energy demand to produce artificial N-fertiliser
- 1.300 t input (Brauschweig) theoretically sufficient for 6.000 to 8.000 ha



Seite 25 source: D. Klein, T. Dockhorn et al; Konya (2010)

Completition of the cycle

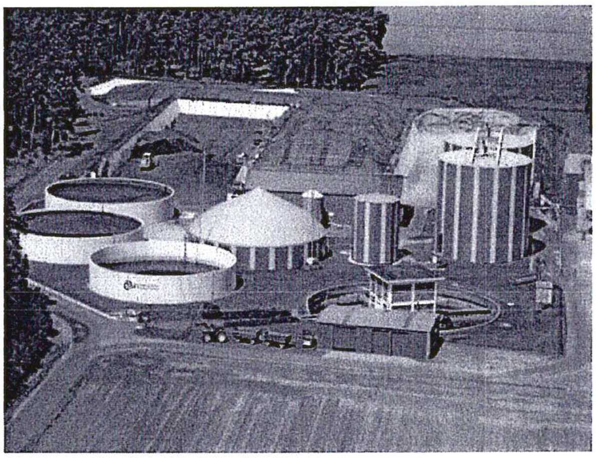
Seite 26

Energy use

In 2006, the biogas plant of the Wastewater Association was built.

Since then, ~ 1/3 of the irrigation area is used for production of renewable raw materials (maize and rye).

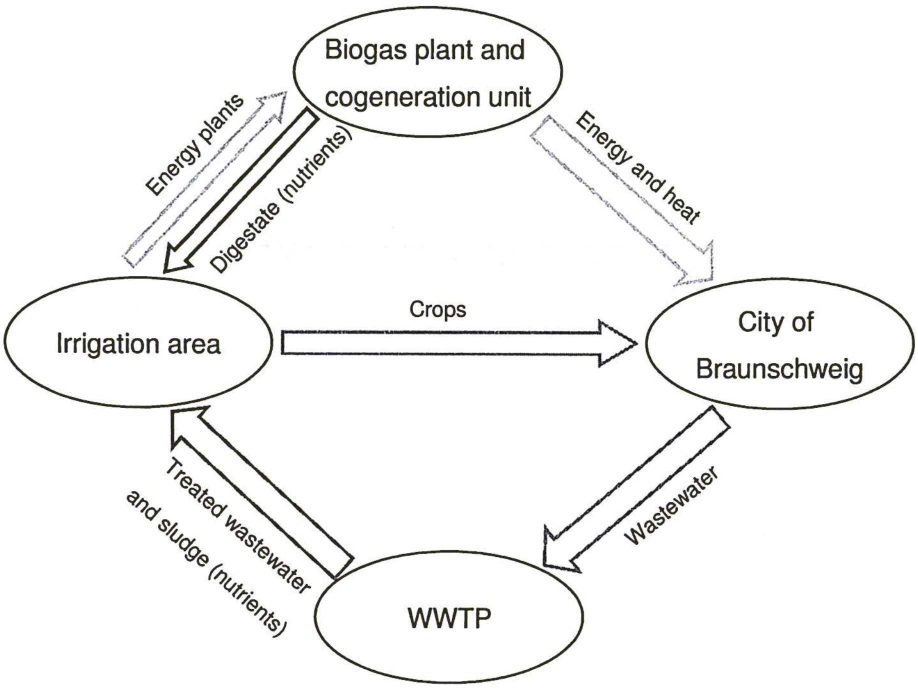
- gas pipe of 20 km to central co-generation unit in Braunschweig
- energy for 3,800 households
- heat for ~1,000 households



Picture: W. Küchenthal

source: Hartmann; IFAT (2010)

Overview: Nutrient, water and energy cycles



High quality wastewater and sludge reuse: Advantages for...

the operators of the WWTP:

- sludge disposal
- post-treatment of water, buffering

farmers:

- nutrient and C-application
- balance of water deficits

the environment:

- protection of N- and P-resources
- protection of the recipient river
- groundwater recharge instead of groundwater withdrawal
- saving of energy (production of artificial fertiliser)
- production of renewable energy

Future of wastewater treatment and reuse in Braunschweig

WWTP - future concept

aims:

- ensure effluent quality (wintertime)
- response to legislative developments
- specific and improved nutrient recovery (fertilizer products)
- ↑sewer sludge quality (dewatering capability), so ↓ polymer consumption
- energy output

WWTP - future concept

planned enhancemends:

- MAP (magesium ammonium phosphate) precipitation
- ammoniac stripping
- thermal desintegration system

- start of construction: 2013/ 14
- building time: 3 years
- investment cost: 9 Mio. € (gross)

WWTP - future concept

After the optimisation of nutrient reuse and energy production …

… the topic “**pharmaceutical residues in the wastewater**“ has to be discussed and measures have to be implemented.

➢ Additional treatment step and / or prevention at source ?

The AVB is currently involved in studies as part of a research program.

SUMMARY

The sewage system in Braunschweig has grown historically.
Hence, it is currently one of a kind in Germany.

In future the unique characteristic (sustainable sewage and recycling management) will improved and expanded.

Thus, from a pragmatic approach a forward-looking concept will be developed. Which should serve as a model nationwide.

Abwasserverband Braunschweig

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VEOLIA ENVIRONNEMENT

Thank you for your attention!

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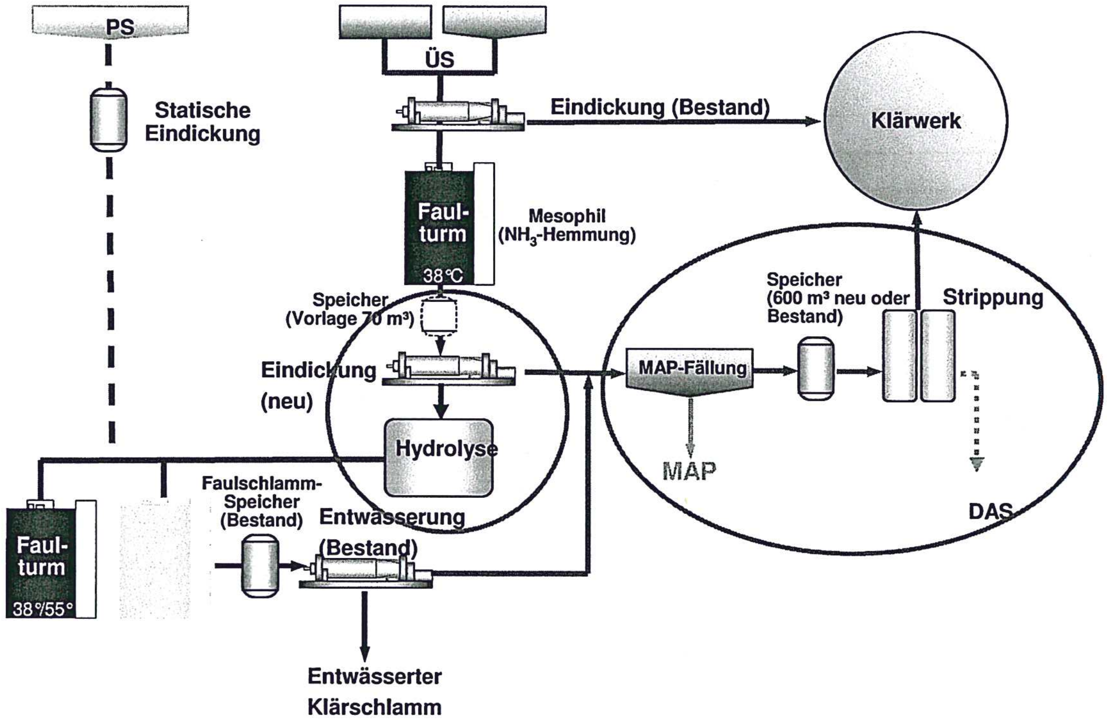
www.stadtentwaesserung-braunschweig.de

www.veoliawasser.de

BACKUP

WWTP - future concept



Legal framework of water/sludge reuse: Europe

Element	86/278/EG (Year 1986) [mg/kg TS]	Proposed values (revision) [mg/kg TS]	[mg/kg P]
Cd	20-40	10	250
Cr	-	1.000	25.000
Cu	1.000-1.750	1.000	25.000
Hg	16-25	10	250
Ni	300-400	300	7.500
Pb	750-1.200	750	18.750
Zn	2.500-4.000	2.500	62.500

Trace. Organics	Proposal [mg/kg TS]
AOX	500
LAS	2.600
DEHP	100
NPE	50
PAK	6
PCB	0,8
PCDD/F*	100

Planned revision of sludge directive:

- (slightly) stricter limits for heavy metals
- new limits for trace organics
- pathogens: Reduction of *E. coli* to < $5*10^2$ KBE/g; no *Salmonella ssp.* in 50 g of sludge (...; depending on the sludge treatment technology)

But: ***Adapted*** reuse of sludges is intended

Legal framework of water/sludge reuse: Germany

Element/ Substance	AbfKlärV (1992) [mg/kg TS]	2nd Working Paper Revision (2010)	
		< 5% P_2O_5 [mg/kg TS]	> 5% P_2O_5 [mg/kg TS]
Cd	10	2.5	3
Cr	900	100	120
Cu	800	700	850
Hg	8	1,6	2
Ni	200	80	100
Pb	900	120	150
Zn	2,500	1,500	1,800
AOX	500	400	
B(a)P	-	1	
PCB	0.2	0.1	
PCDD/PCDF*	100	30	
PFT**	-	0.1	

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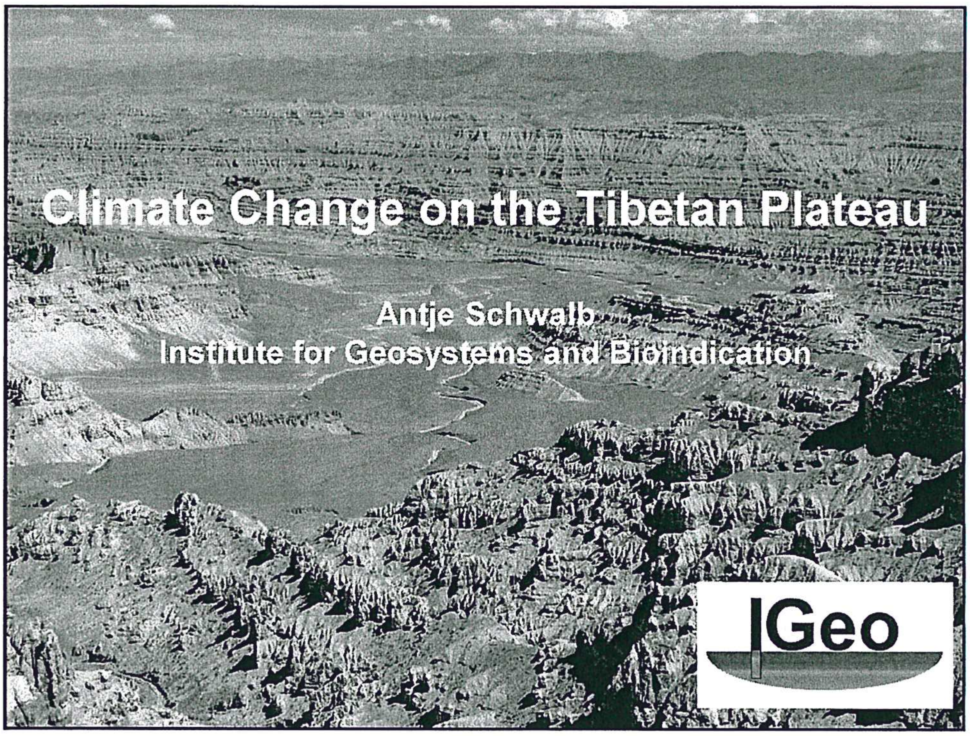
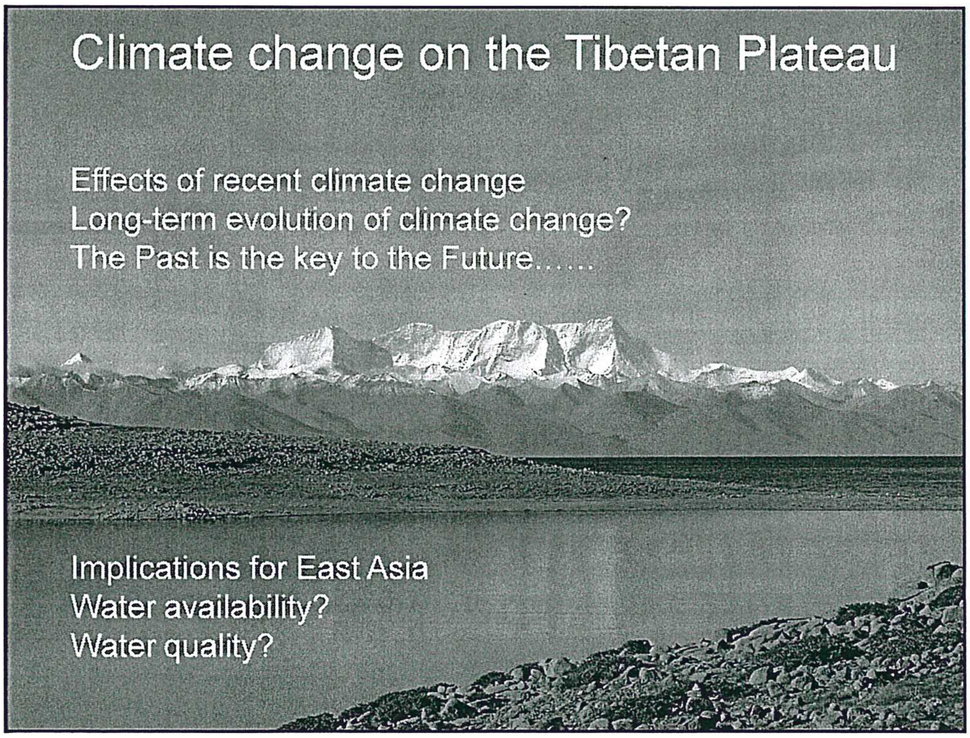

Climate Change on the Tibetan Plateau
Antje Schwalb
Institute for Geosystems and Bioindication
IGeo


Climate change on the Tibetan Plateau
Effects of recent climate change
Long-term evolution of climate change?
The Past is the key to the Future......
Implications for East Asia
Water availability?
Water quality?

Global Warming

„hockey stick"

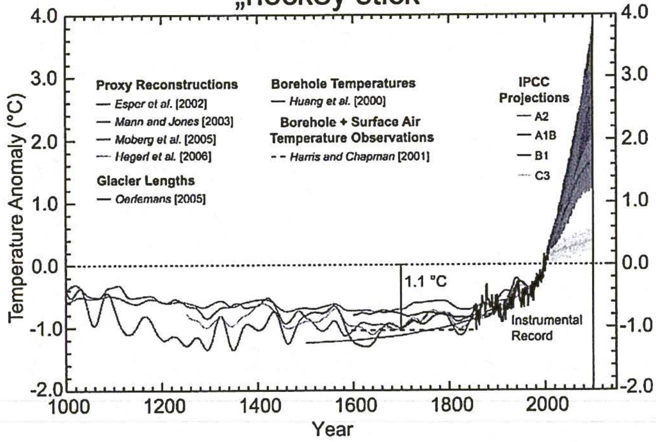


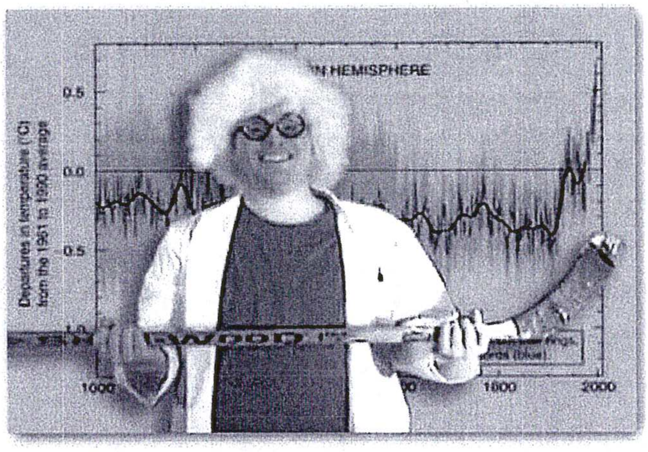
Fig. 1. Views of temperature change in the next century are informed by temperature changes in the past. For illustrative and educational purposes, three sets of surface temperatures have been assembled: 1000-year reconstructions of past temperature change based on proxies (tree rings, corals, etc.), glacier lengths, and borehole temperatures; the instrumental record; and Intergovernmental Panel on Climate Change (IPCC) projections for temperature change from 2000 to 2100. Figure modified from National Research Council *[2006] and* IPCC *[2007].*

Chapman & Davis 2010

3

Global Warming

„hockey stick"

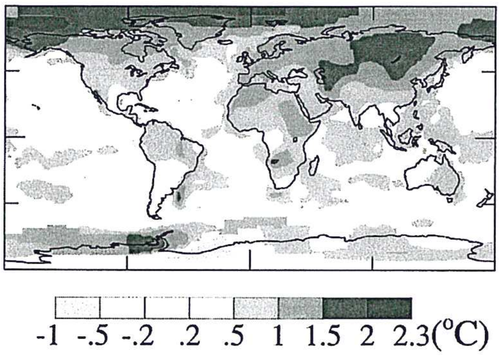


A music video parodied the 'hockey-stick' temperature graph.

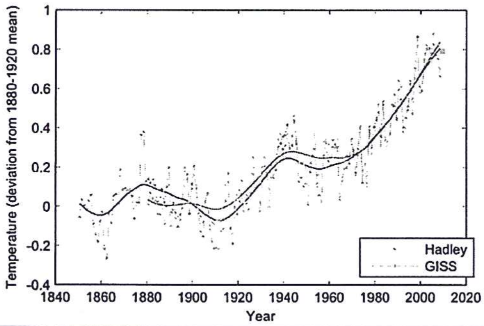
Tollefson 2010

4

Temperature change 1950-2000



Average global temperature since 1850



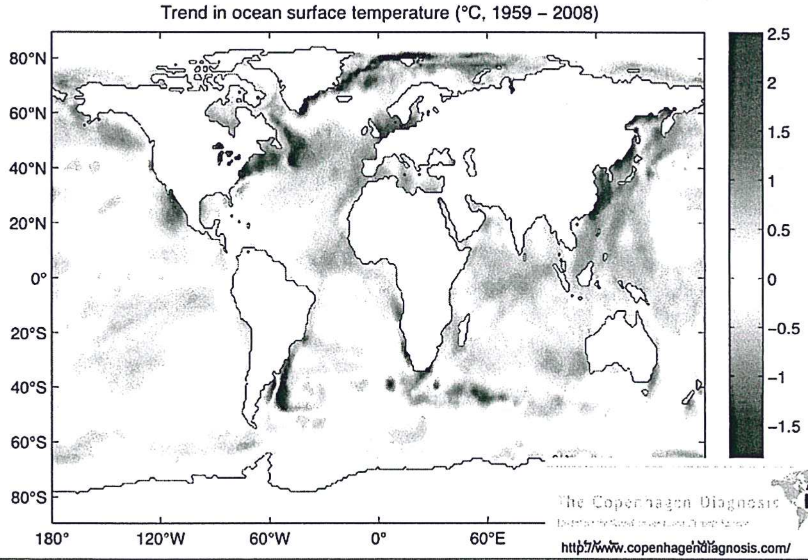
The Copenhagen Diagnosis

http://www.copenhagendiagnosis.com/ 5

06.11.12
EXCEED

Ocean temperatures

1959-2008



The Copenhagen Diagnosis

http://www.copenhagendiagnosis.com/ 6

Figure 15

IGeo Institute for Geosystems and Bioindication
Technische Universität Braunschweig

06.11.12
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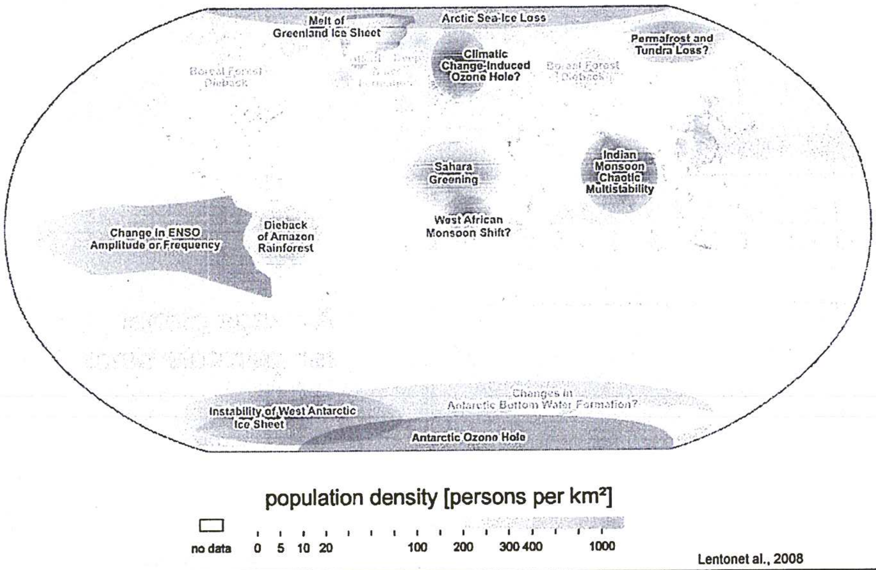
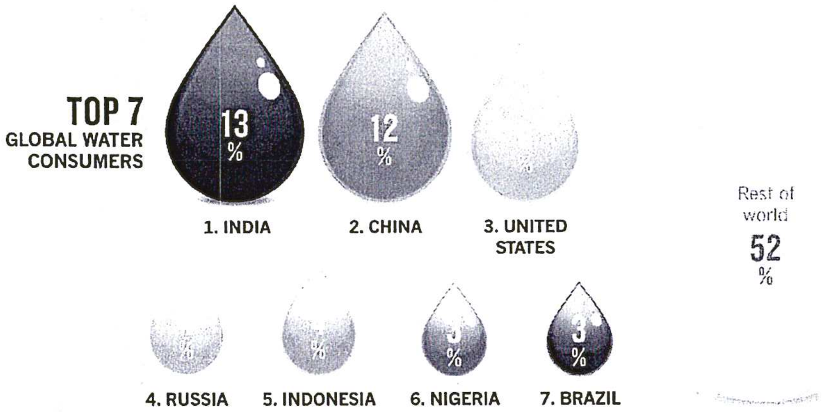
Tipping Points



Lentonet al., 2008

WORLD'S THIRSTIEST

Just three nations — India, China and the United States — together use about one-third of the roughly 4,000 km³ of water extracted globally each year. In general, water demands in developed countries have been declining during the past 20 years, mostly as a result of more efficient use of water resources.



Gilbert 2012

Tibetan Plateau
Air masses, glaciers, lakes

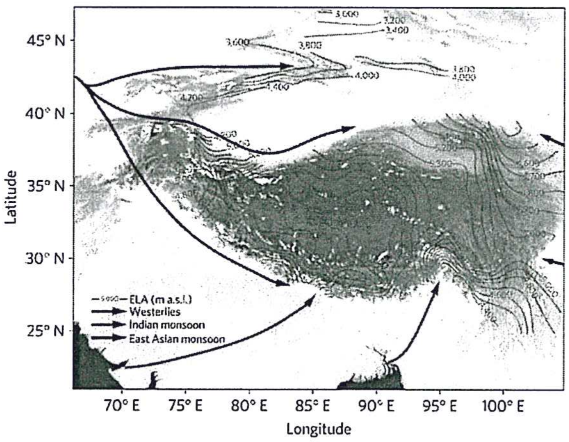
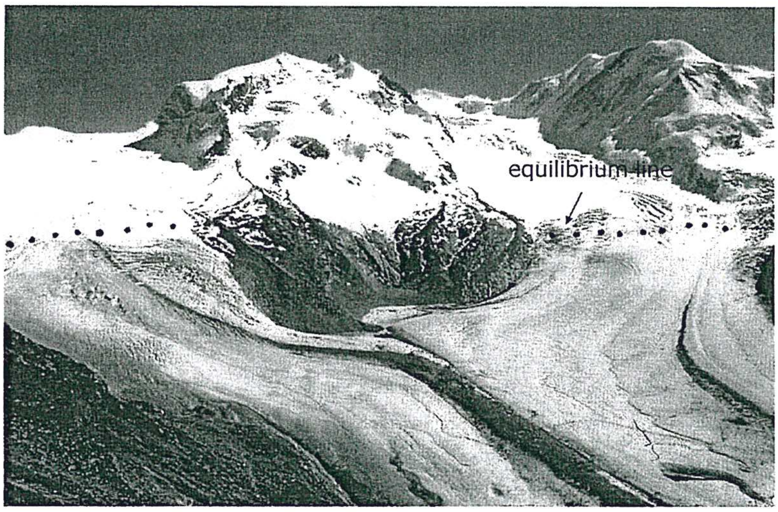


Figure 1 | Distribution of glaciers and ELAs in and around the TBP[11], which are mainly under the dominance of the Indian monsoon and westerlies, with limited influence from the East Asian monsoon. Note the increased glacier concentration and lower ELAs in the monsoon-dominated southeastern TBP and the westerlies-dominated Pamir regions, compared with the sparse glacial distribution and high ELAs in the continental-climate-dominated interior.

Yao et al., 2012

Glaciers
Equilibrium Line Altitude



Andersen & Borns 1994

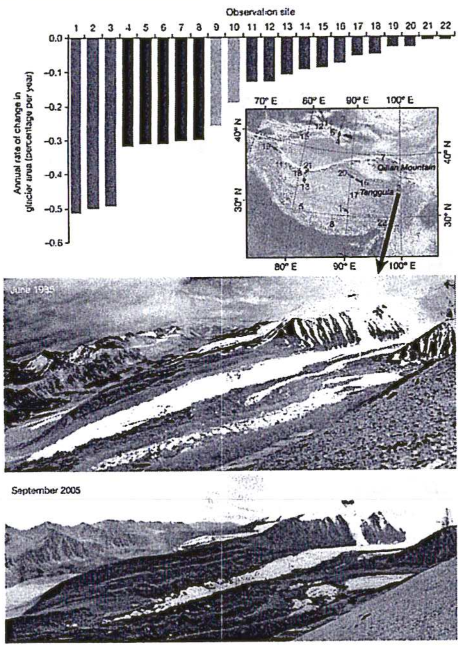


Figure 3 | Observed annual rate of change in glacier area at 22 monitoring stations in western China over the past 30–40 years. A negative rate indicates a shrinking glacier[12-14]. Each glacier location is shown on the map inset. The photographs show examples of glacier retreat between 1985 and 2005 due to increased melting at Mount Anyemaqen, Qinghai (one of the sacred mountains in the Tibetan ethnic area of China). Top image by Matthias Kuhle; bottom image by John Novis for Greenpeace (reproduced with permission).

Shrinking glaciers

Piao et al. 2010

LETTERS

NATURE CLIMATE CHANGE DOI: 10.1038/NCLIMATE1580

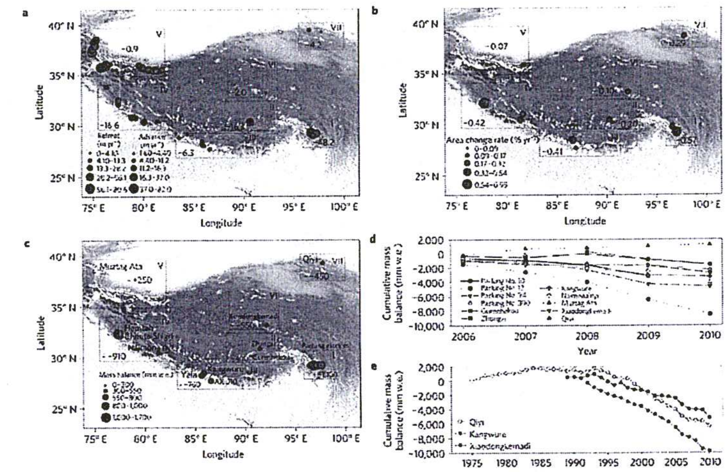


Figure 2 | Spatial and temporal patterns of glacier status in the TBP and surroundings. a, Glacier retreat for 82 glaciers (Supplementary Table S4). b, Area reduction for 7,090 glaciers (Supplementary Tables S2 and S3 and Fig. S1). c, Mass balance for 15 glaciers (Supplementary Table S5). Glaciers are categorized into seven regions and marked clockwise with Roman numerals in a–c. d, Cumulative mass balance for 11 glaciers in 2006–2010 (Supplementary Table S6 and Figs S3–S13). e, Cumulative mass balance for the three longest time series of glacier mass-balance measurements along transect 1 (Supplementary Table S7 and Figs S14 and S15).

Yao et al., 2012

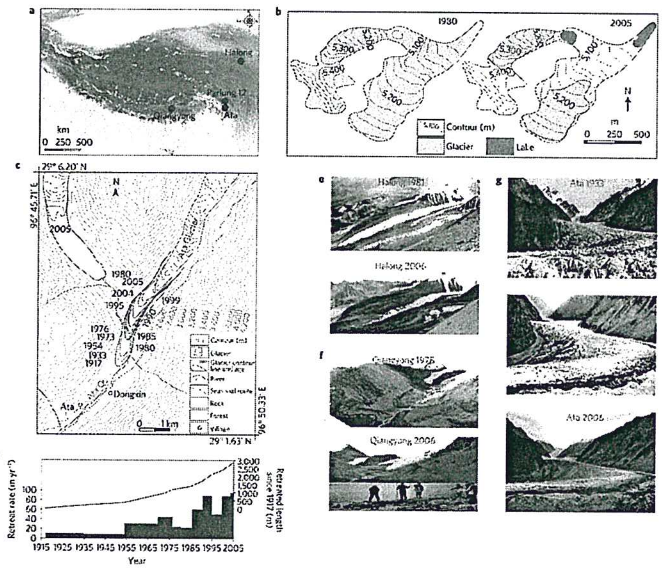
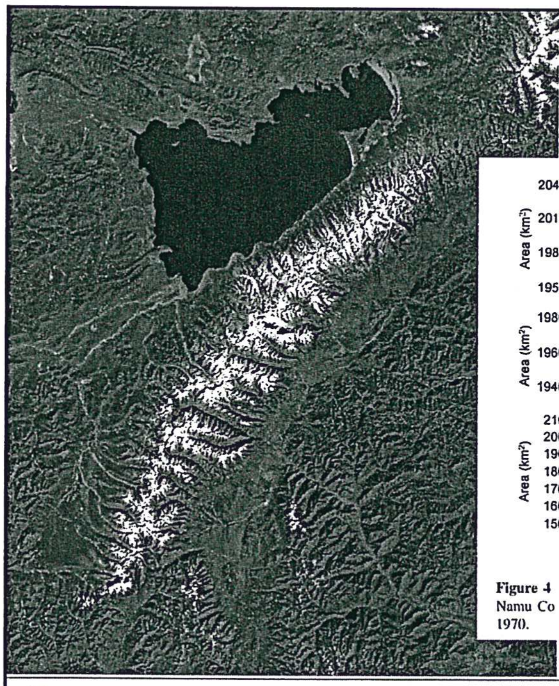


Figure 3 | Case studies of glacial retreat. a, The locations of studied glaciers. **b**, Area reduction of the Parlung No. 12 Glacier. **c,d**, Variations of the Ata Glacier since 1917. **e–g**, Glacial variation from comparison of photos of the Halong, Qiangyong and Ata glaciers, respectively. Panel **e**: top image © 1981 courtesy of Matthias Kuhle; bottom image © 2005 Greenpeace/Dan Novis; Panel **g**: top image reproduced with permission from ref. 21, © 1933 Wiley.

Yao et al., 2012



Glaciers vs Lakes

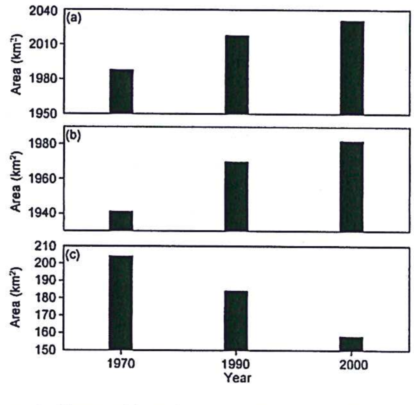


Figure 4 Changes of the total area of all the lakes (a), the area of the Namu Co Lake (b) and the glacial area (c) in the Namu Co basin since 1970.

Yao et al., 2010

Lake level trends

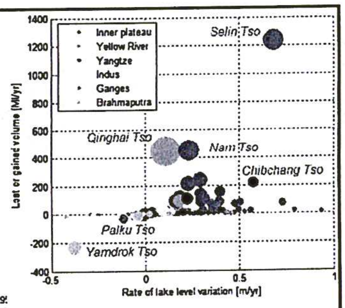


Fig. 7. Distribution of gained or lost water volume colored by basin.

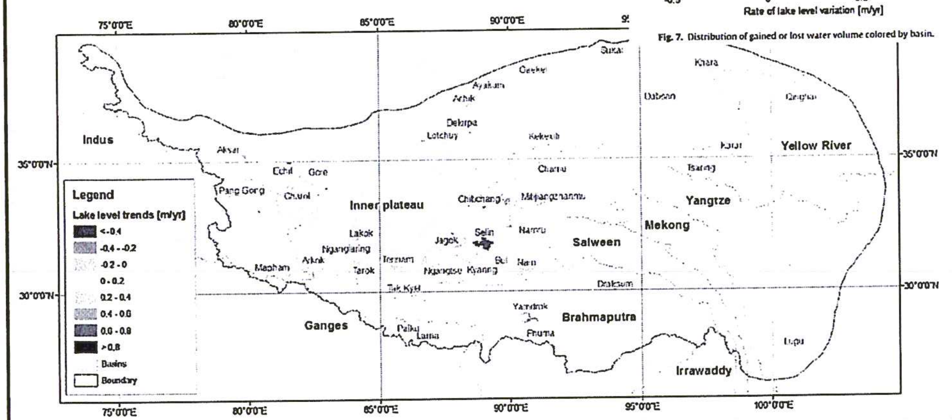
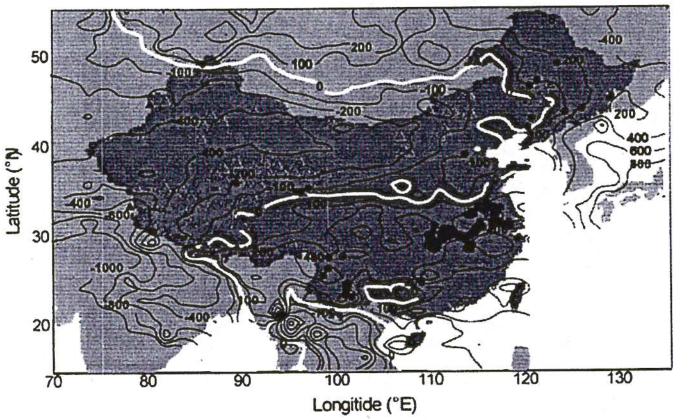


Fig. 6. Lake level trends on the Tibetan plateau between 2003 and 2009.

Phan et al. 2012

Lake status records from China

Distribution of saline and freshwater lakes vs mean annual P-E



459 lakes > 10 km²

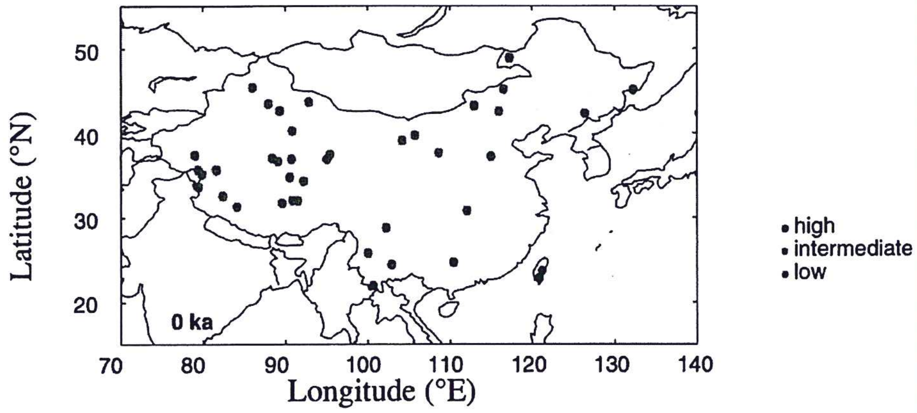
white line: P-E = 0

Yu et al., 2001

16

Lake status records from China

today

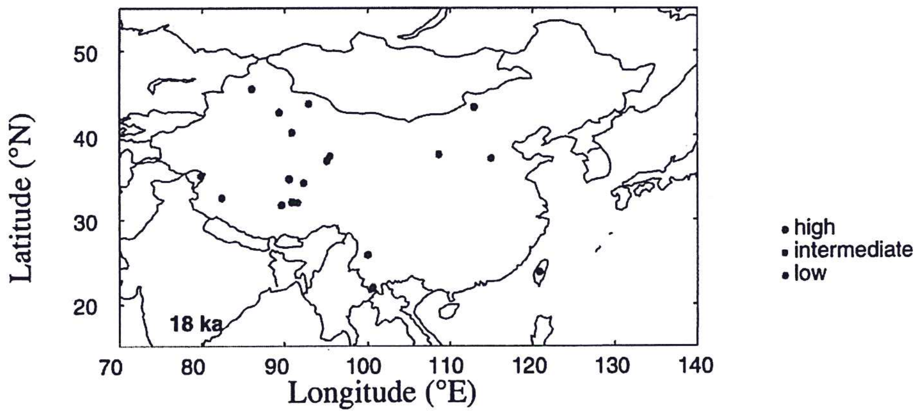


Yu et al., 2001

17

Lake status records from China

18 ka

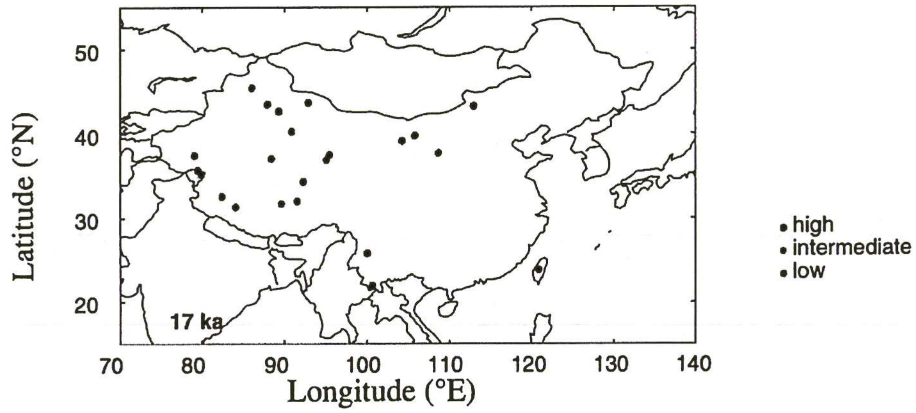


Yu et al., 2001

18

Lake status records from China

17 ka

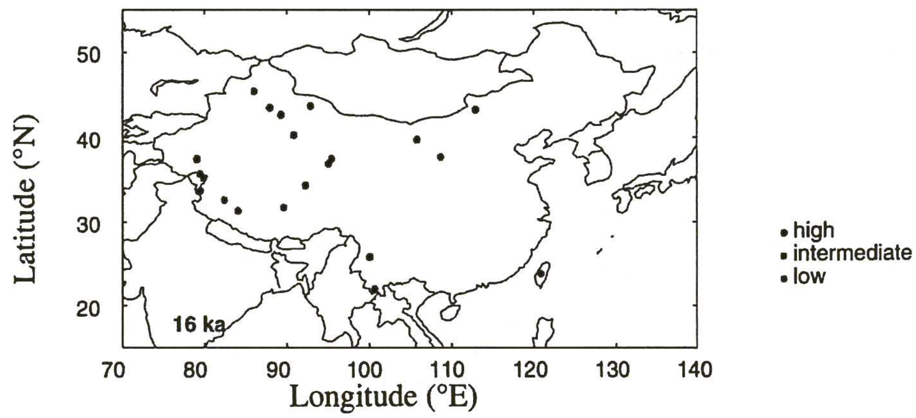


Yu et al., 2001

19

Lake status records from China

16 ka

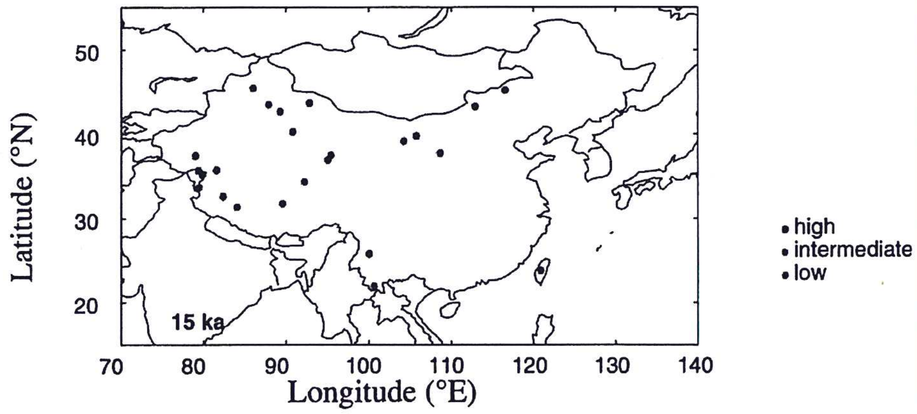


Yu et al., 2001

20

Lake status records from China

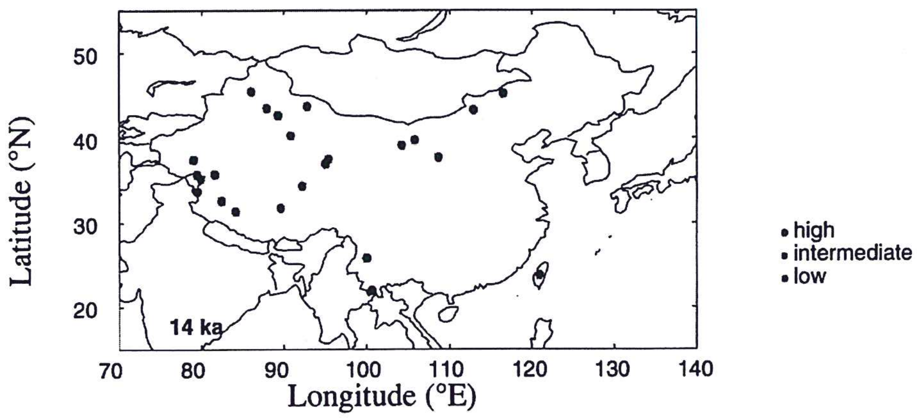
15 ka



Yu et al., 2001

Lake status records from China

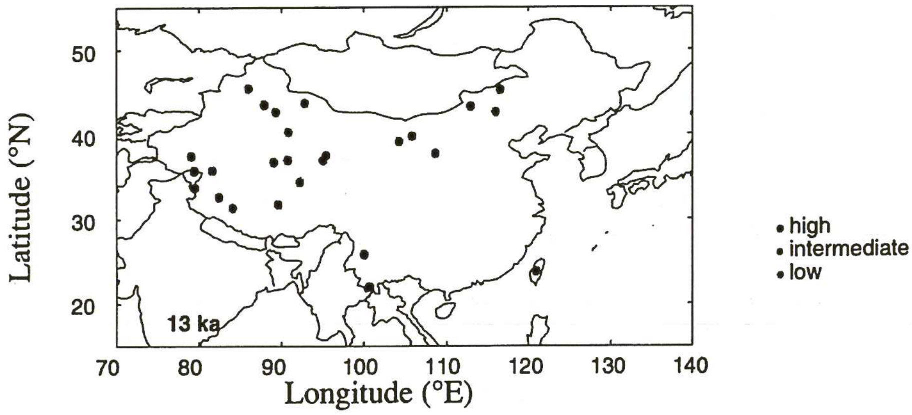
14 ka



Yu et al., 2001

Lake status records from China

13 ka

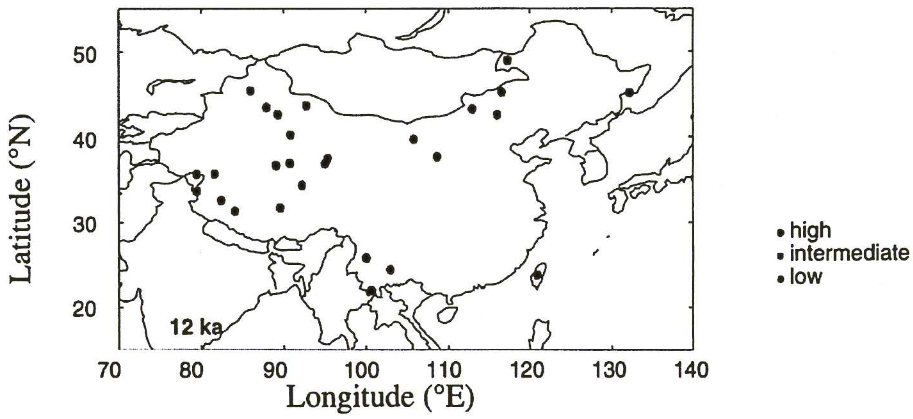


Yu et al., 2001

23

Lake status records from China

12 ka

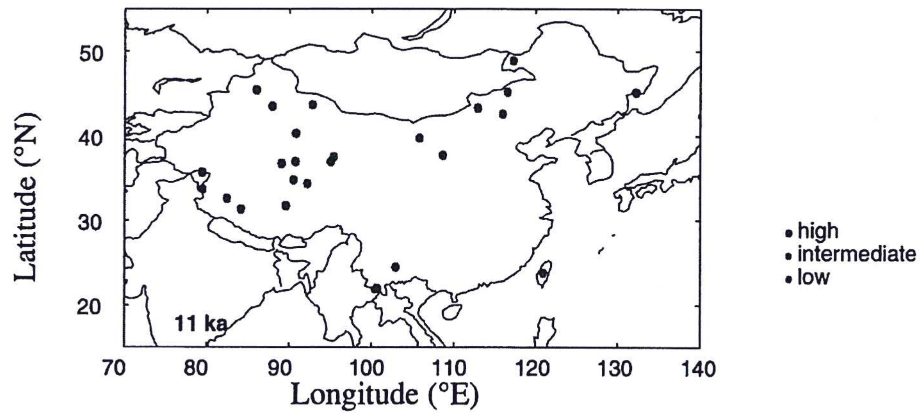


Yu et al., 2001

24

Lake status records from China

11 ka

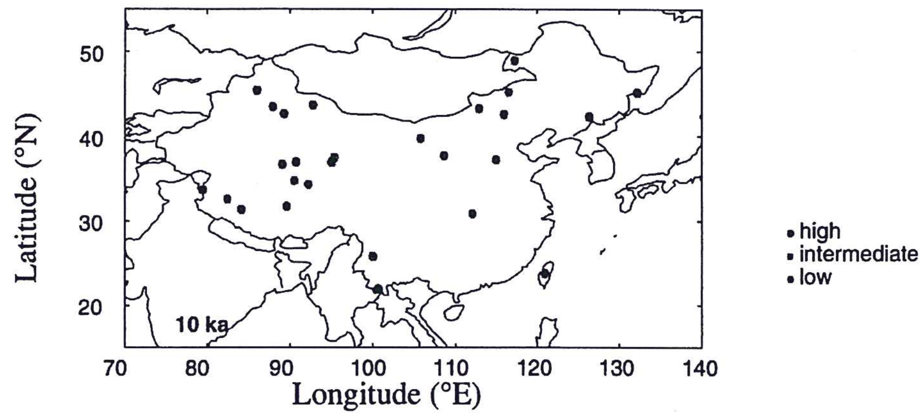


Yu et al., 2001

25

Lake status records from China

10 ka

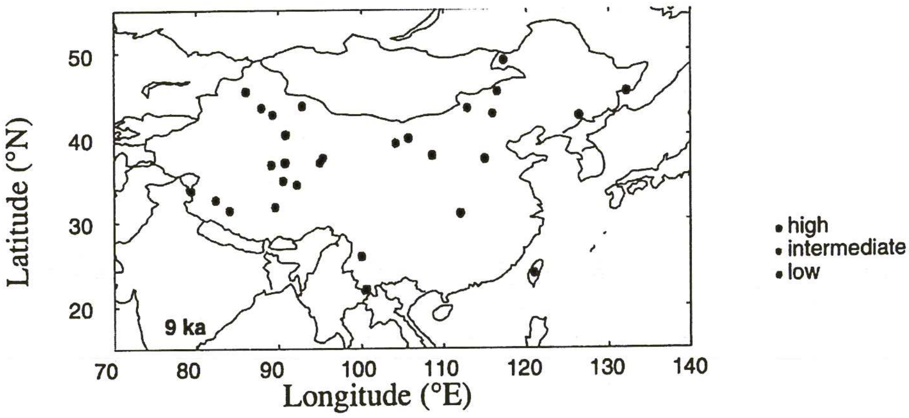


Yu et al., 2001

26

Lake status records from China

9 ka

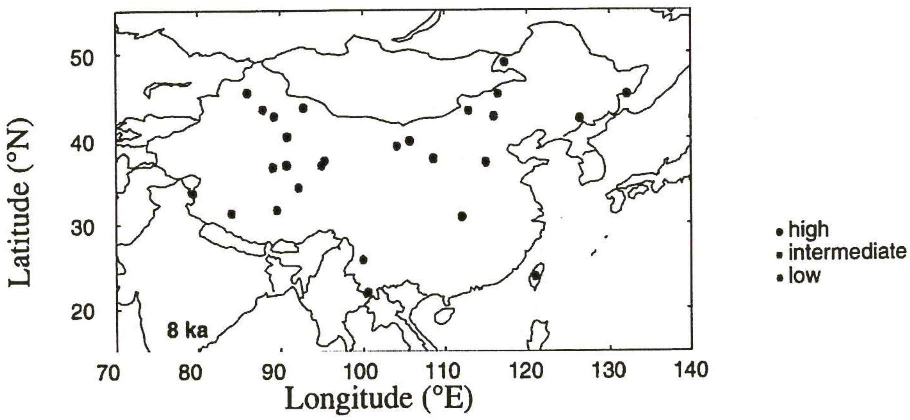


Yu et al., 2001

27

Lake status records from China

8 ka

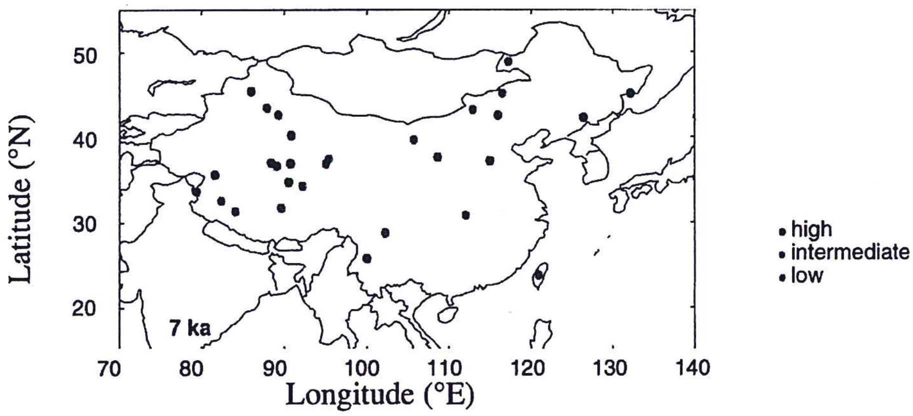


Yu et al., 2001

28

Lake status records from China

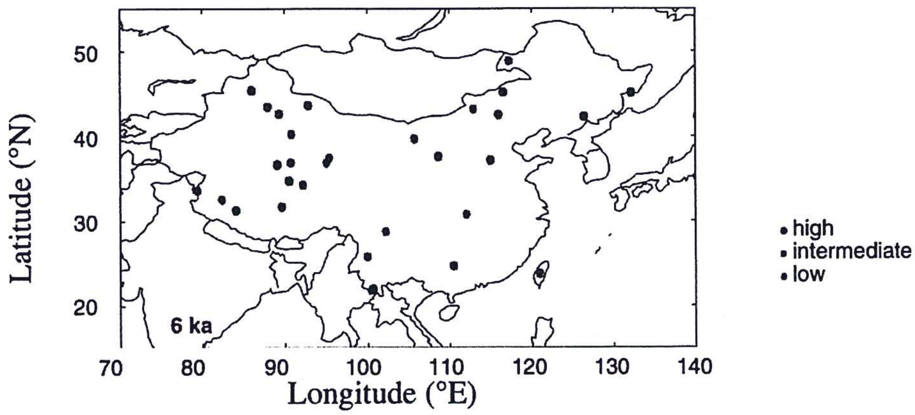
7 ka



Yu et al., 2001

Lake status records from China

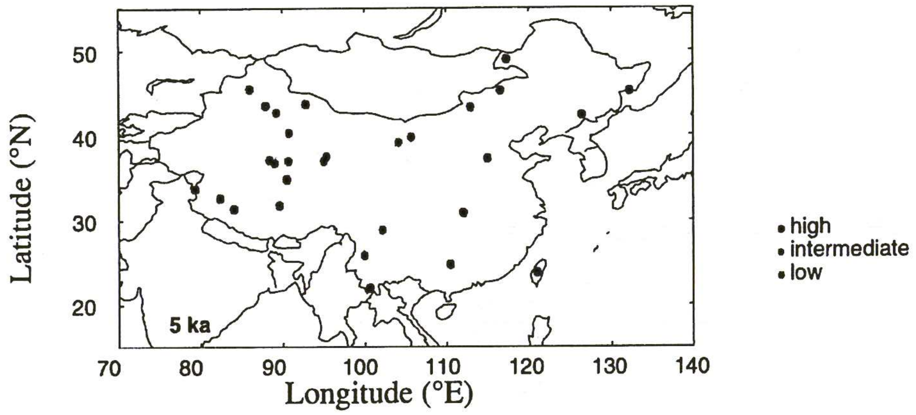
6 ka



Yu et al., 2001

Lake status records from China

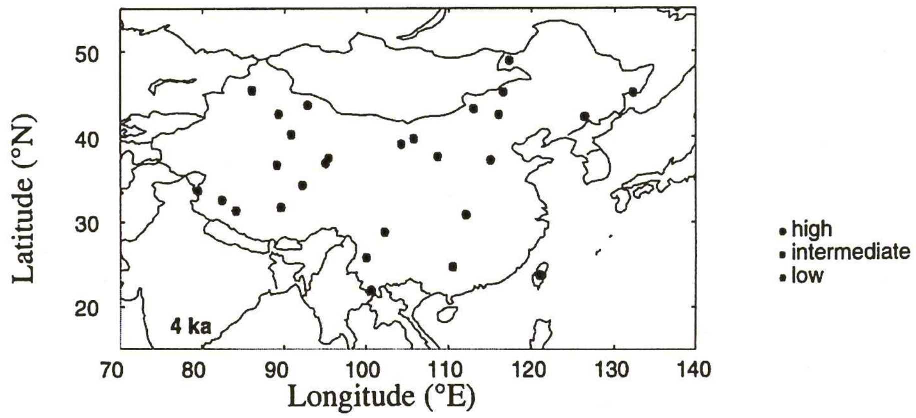
5 ka



Yu et al., 2001

Lake status records from China

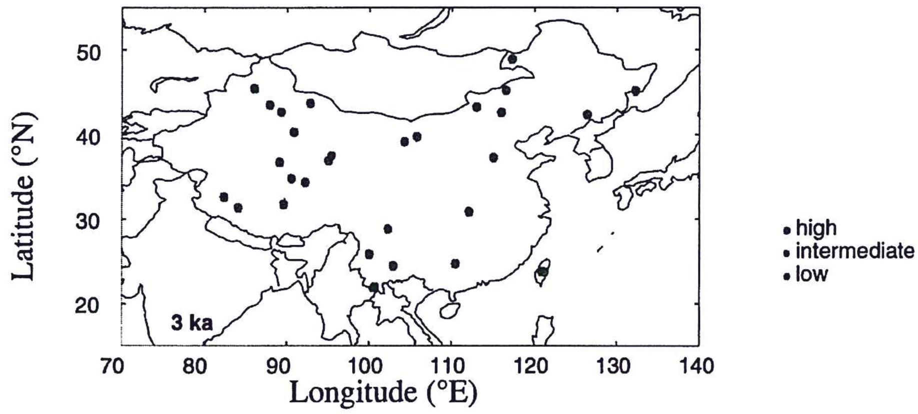
4 ka



Yu et al., 2001

Lake status records from China

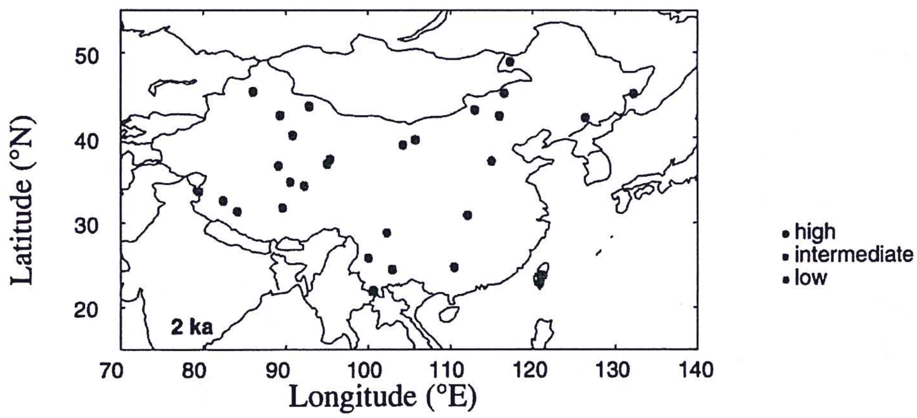
3 ka



Yu et al., 2001

Lake status records from China

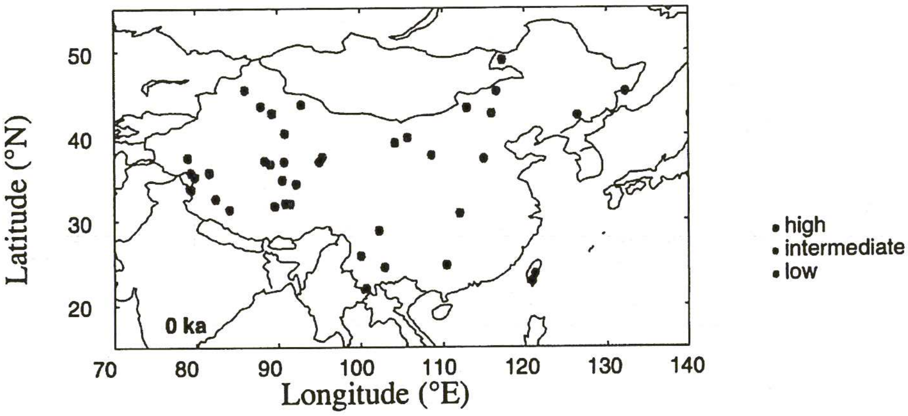
2 ka



Yu et al., 2001

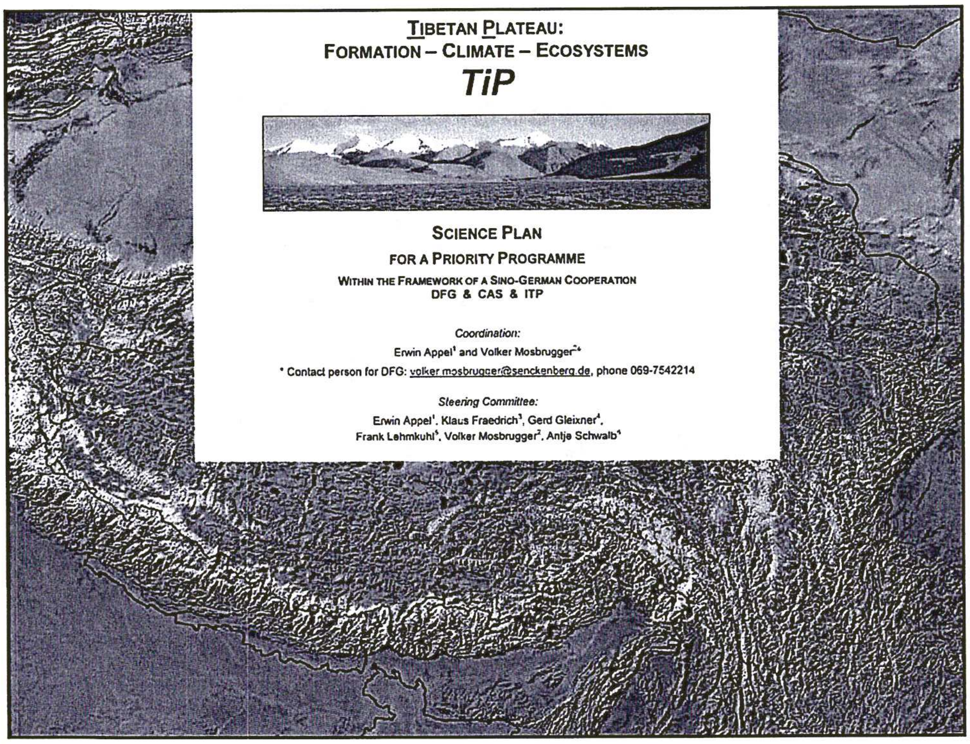
Lake status records from China

today



Yu et al., 2001

35



TIBETAN PLATEAU:
FORMATION – CLIMATE – ECOSYSTEMS

TiP

SCIENCE PLAN
FOR A PRIORITY PROGRAMME
WITHIN THE FRAMEWORK OF A SINO-GERMAN COOPERATION
DFG & CAS & ITP

Coordination:

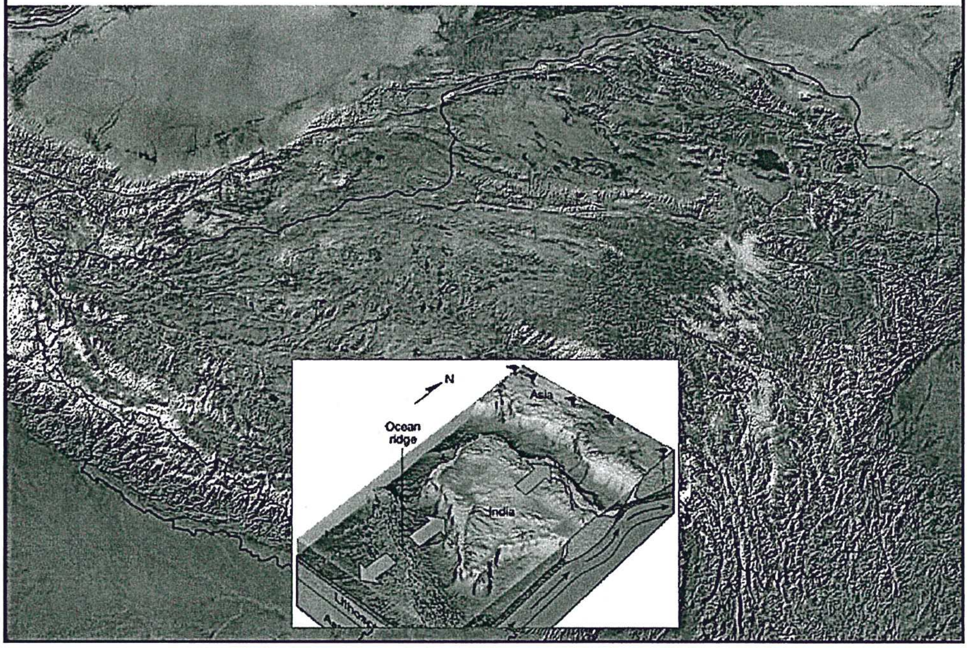
Erwin Appel[1] and Volker Mosbrugger[2*]

* Contact person for DFG: volker.mosbrugger@senckenberg.de, phone 069-7542214

Steering Committee:

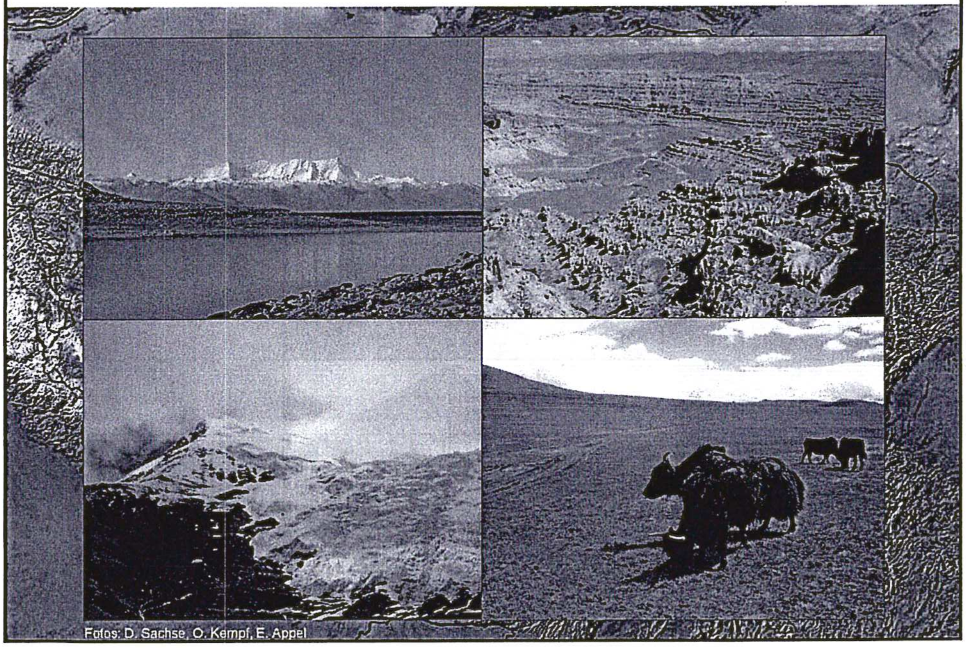
Erwin Appel[1], Klaus Fraedrich[3], Gerd Gleixner[4], Frank Lehmkuhl[5], Volker Mosbrugger[2], Antje Schwalb[6]

Formation – Climate - Ecosystems



Formation - Climate - Ecosystems

Formation - Climate - Ecosystems



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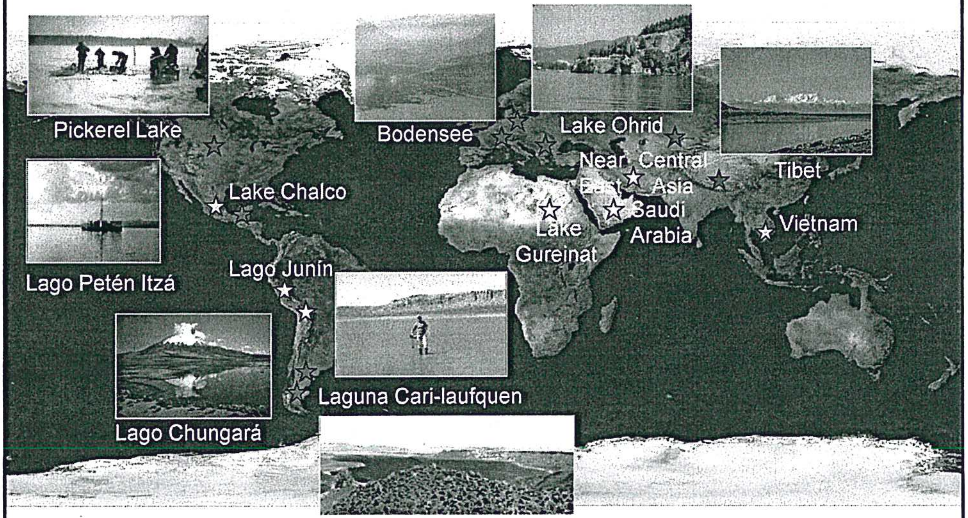
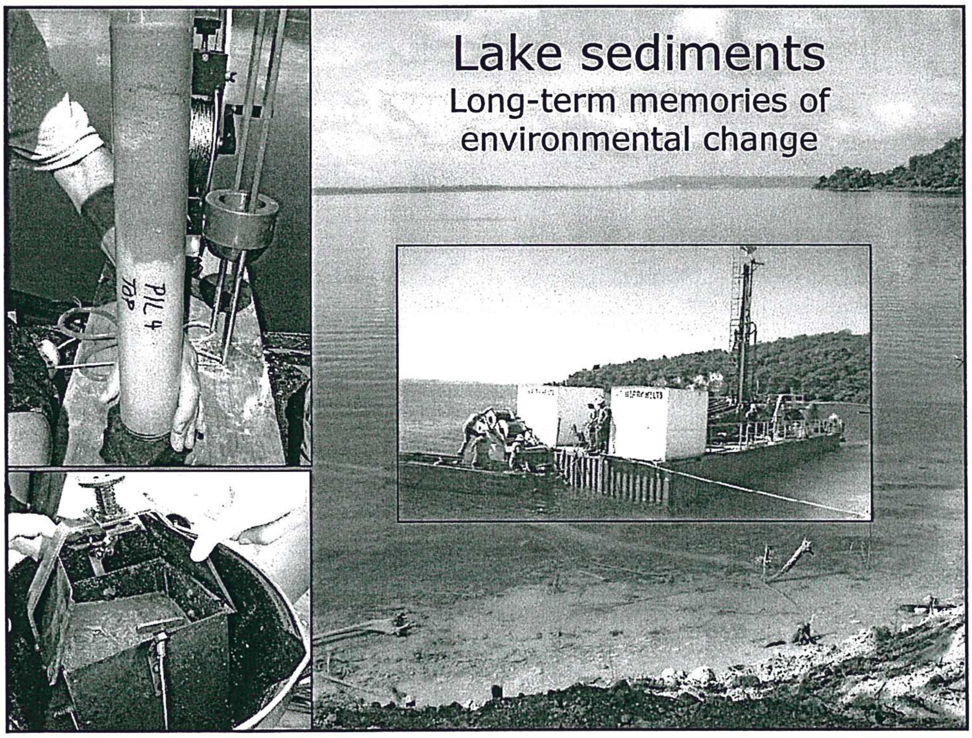
Weather reports from the bottom of lakes

Lake sediments as environmental archive



★ PI ☆ contribution to cooperation ☆ new cooperations 41

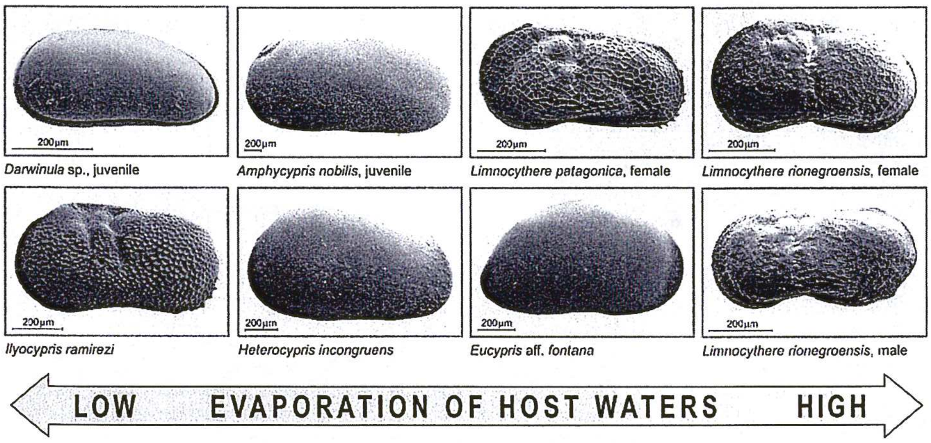


Research Questions

- Regional expression of global climate change?
- Mechanisms and processes in lake systems?
- Climate patterns and extremes (droughts and floods)?
- Teleconnections and causes of climate change through data-model-comparisons?
- Causes of speciation and history of ancient lakes?
- Interaction between humans, climate and environment?
- Recovery of lake ecosystems from geological events and anthropogenic impact?

Bioindicators

Ostracodes as salinity indicators



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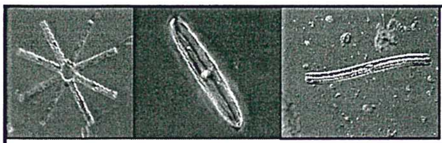
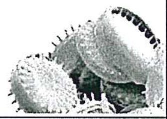


Dr. Anja Schwarz
Diplom-Biologin

Diatoms as bioindicators

- Water quality analysis and bioindication:
  - Determination of nutrients and chlorophyll a
  - Microscopic algae analysis (mainly diatoms) for bioindication
  - Application of the German assessment system for the benthic flora (diatoms) according to EU Water Framework Directive and diatom indices
- Paleolimnology:
  - Microscopic diatom analysis (determination, diatom concentration)
  - Application of diatom transfer functions („moving window“, HÜBENER et al., 2008)



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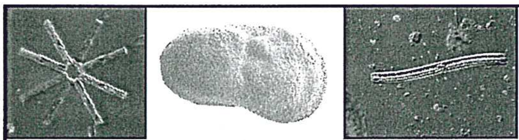
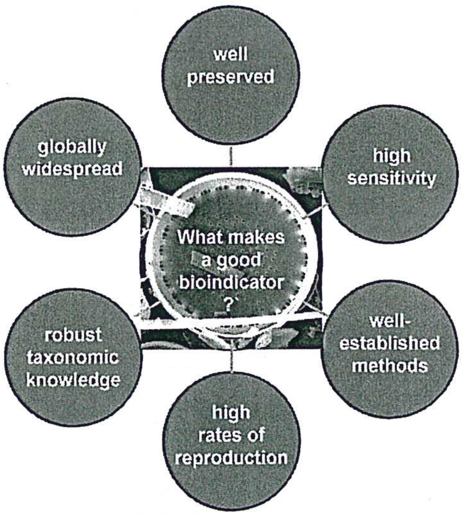


Bioindicators



46

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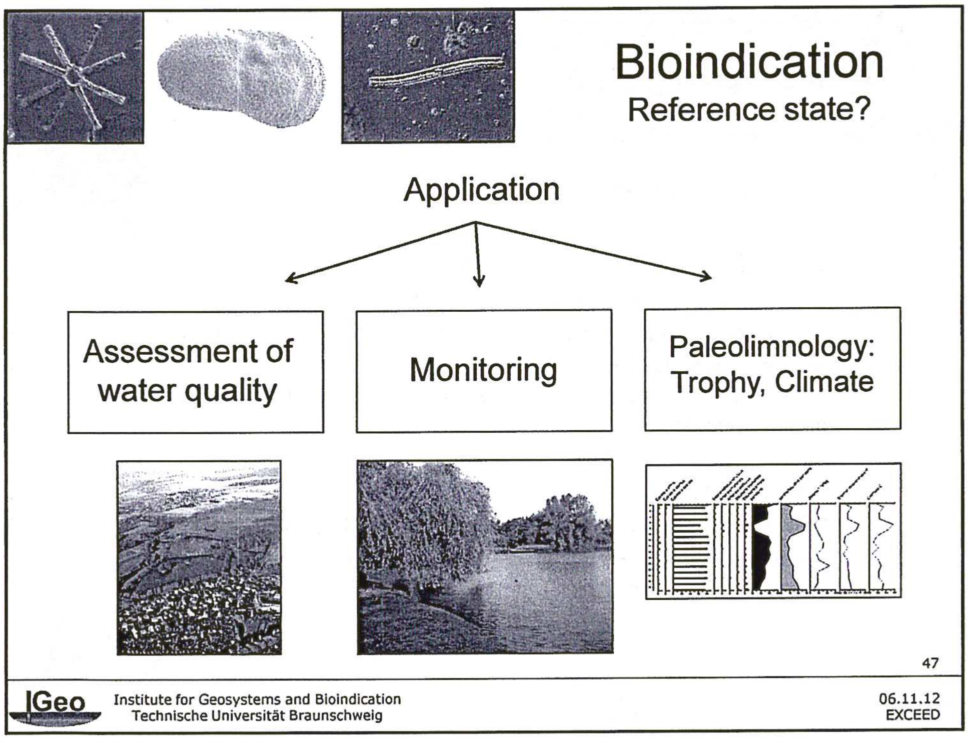
Bioindication
Reference state?
Application
Assessment of water quality
Monitoring
Paleolimnology: Trophy, Climate
47
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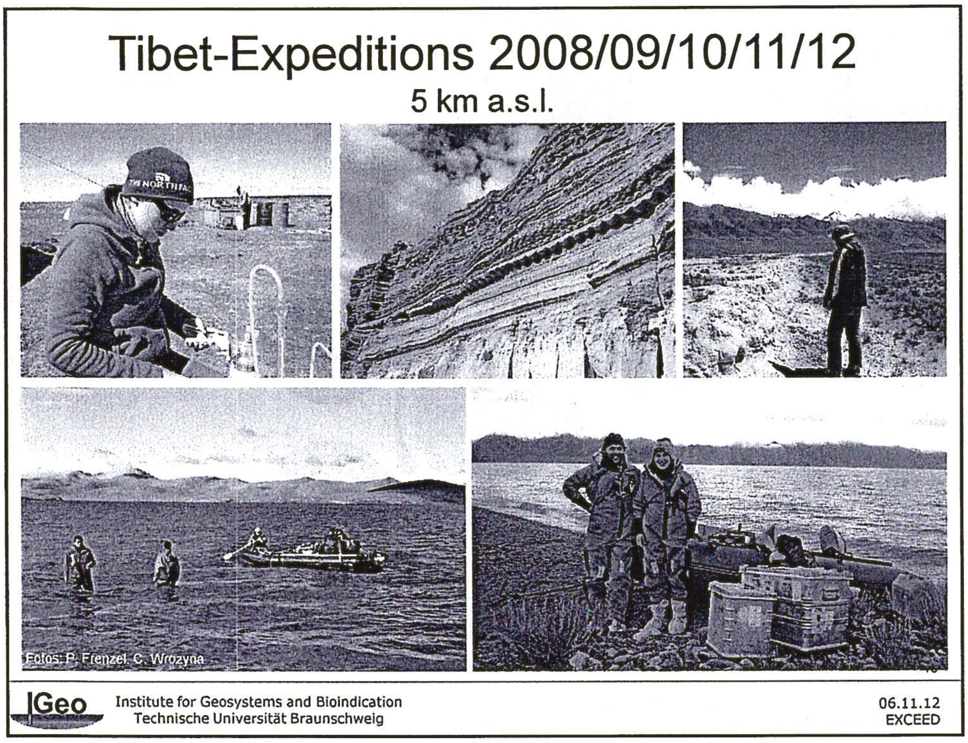
Tibet-Expeditions 2008/09/10/11/12
5 km a.s.l.
Fotos: P. Frenzel, C. Wrozyna
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Technische Universität Braunschweig
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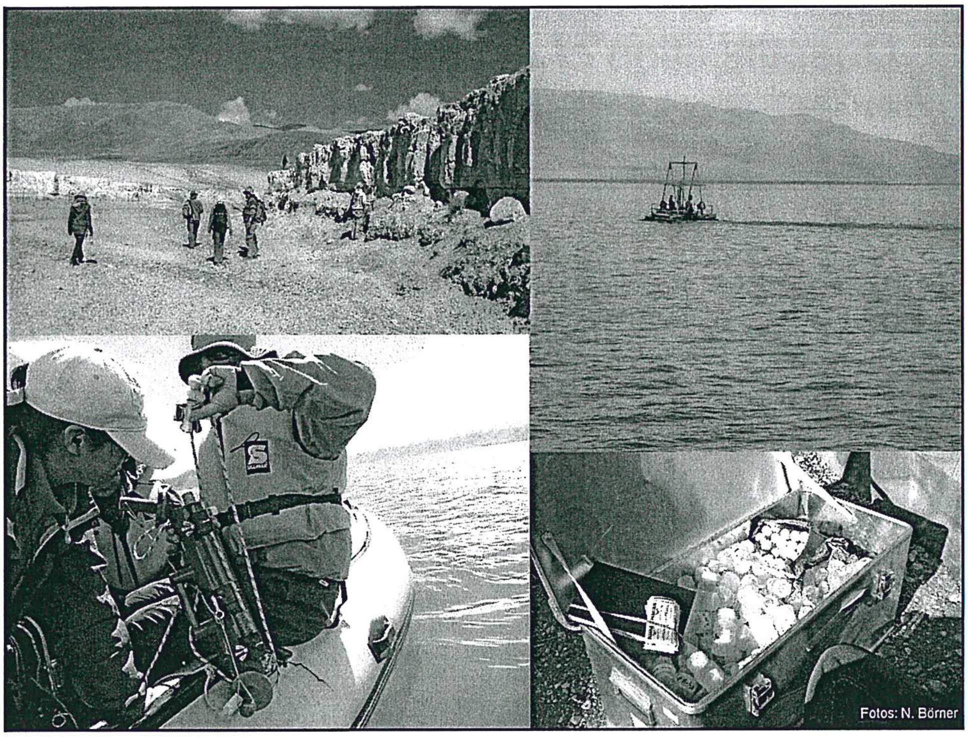
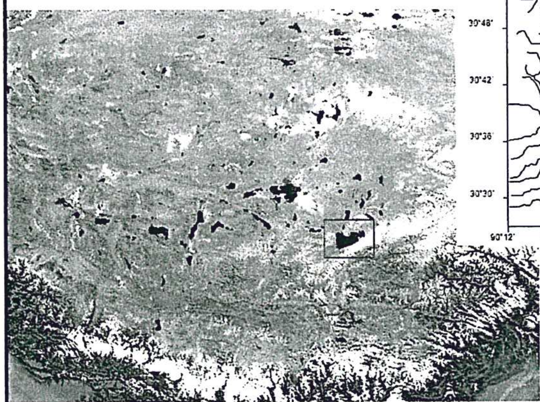
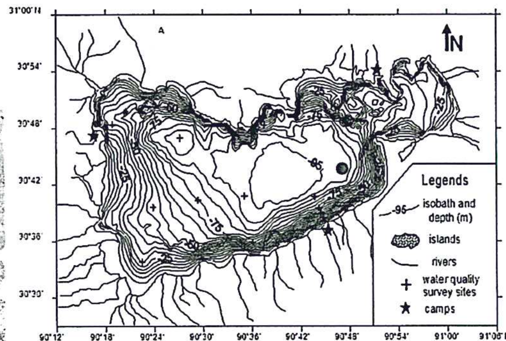


Nam Co, SE Tibet

4719 m, 1962 km², 99 m, 1,3 ‰





Bathymetric map of Lake Nam Co including coring position of core NC 08/01 (red dot; WANG et al. 2009, modified by DOBERSCHÜTZ).

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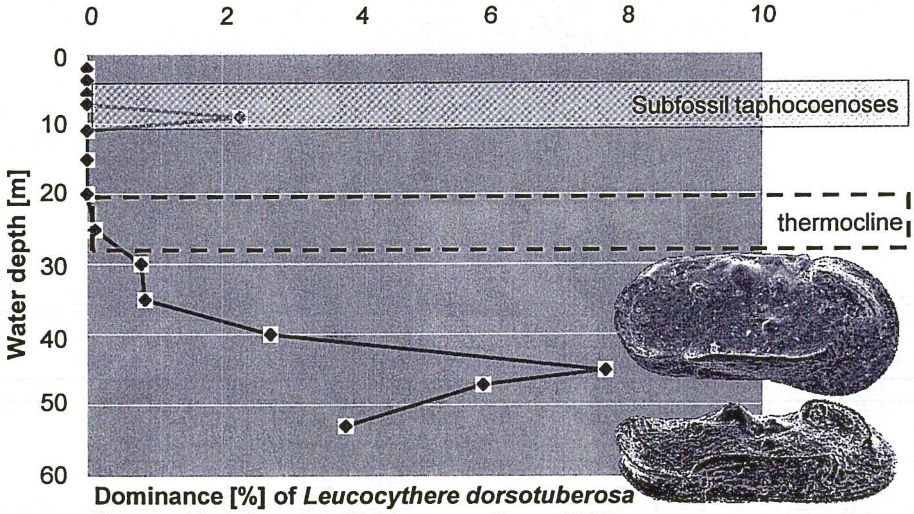
Quantification of environmental proxies

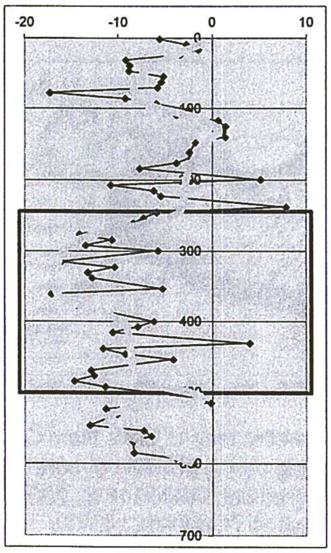
Water depth related distribution of Ostracodes in Nam Co, Tibet



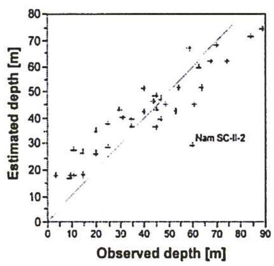
Dominance [%] of *Leucocythere dorsotuberosa* Huang, 1982, var. postilirata sensu Pang 1985

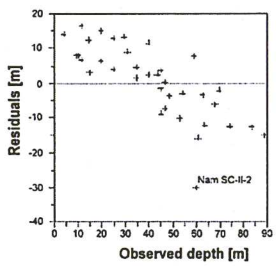
Quantification of environmental proxies

Transfer function for water depth



36 surface samples calibration model
Depth range: WA-PLS performance
3.7 – 89.3 m regression r^2: 0.91

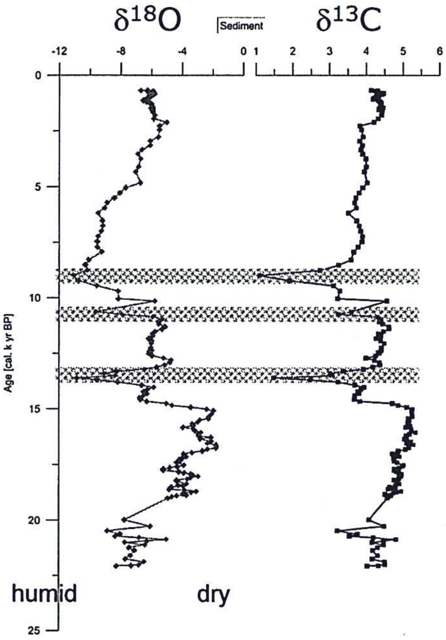




„Little Ice Age“

Core Nam Co 4-2 from 49.2 m water depth

Frenzel et al. 2010

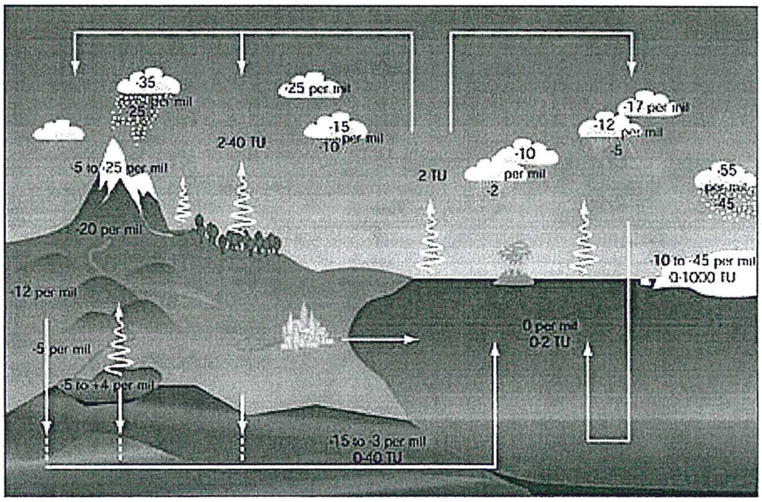


Nam Co, SE Tibet

Climate change during the past 23.000 years from lake carbonates

melt water events

Isotopes in the hydrological cycle

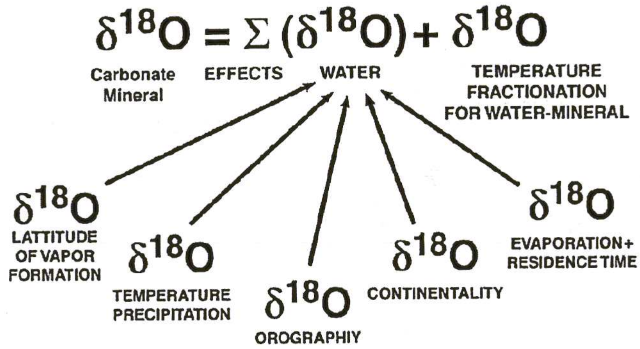


The isotopes of the water molecule, tritium, deuterium and oxygen-18 label the global water cycle: Origin, age, temperature, precipitation, evaporation infiltration...

http://isohis.iaea.org/userupdate/description/1stpage.html

Stable isotope signatures from lake carbonates

OXYGEN ISOTOPE RATIOS
in lacustrine carbonates

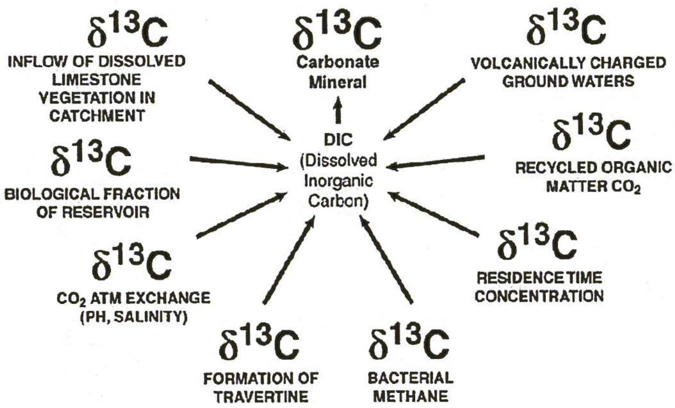


Schwalb 2003

55

Stable isotope signatures from lake carbonates

CARBON ISOTOPE RATIOS
in lacustrine carbonates

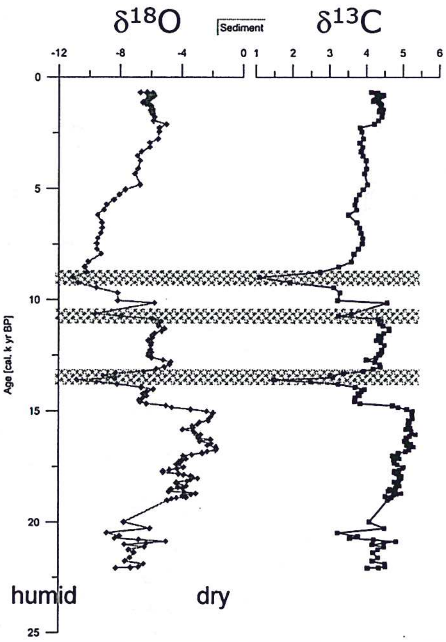


Schwalb 2003

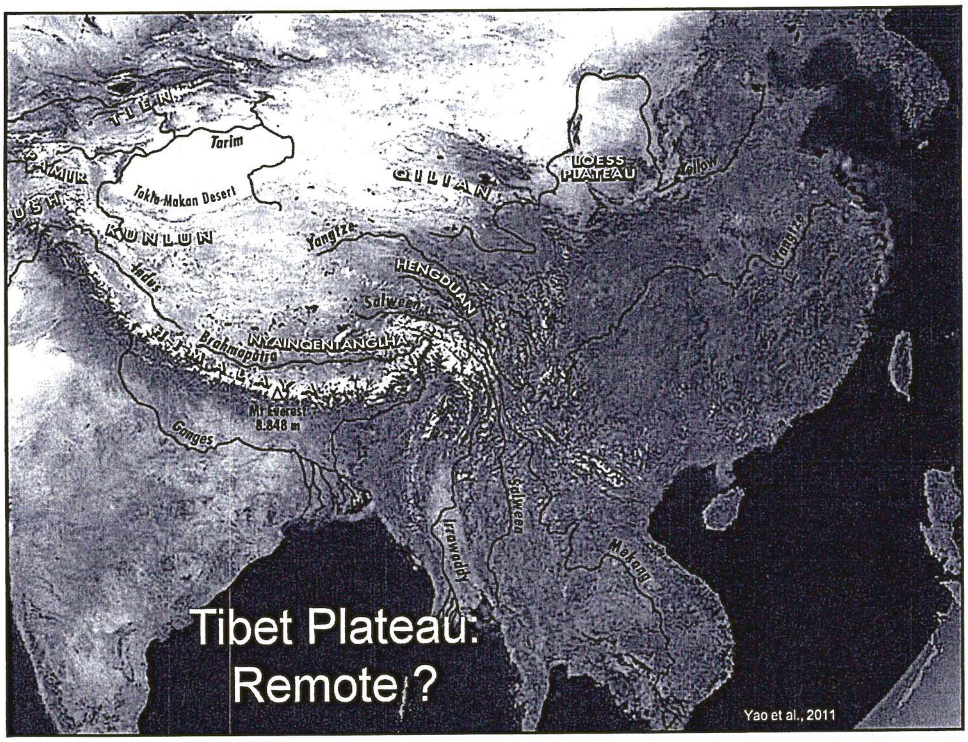
56

Nam Co, SE Tibet

Climate change during the past 23.000 years from lake carbonates



melt water events



Major Rivers

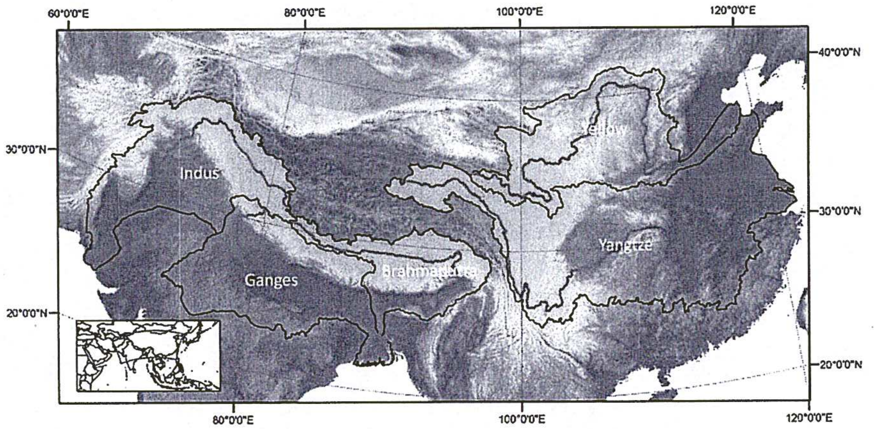


Fig. 1. Basin boundaries and river courses of the Indus, Ganges, Brahmaputra, Yangtze, and Yellow rivers. Blue areas denote areas with elevation exceeding 2000 masl. The digital elevation model in the background shows the topography ranging from low elevations (dark green) to high elevations (brown).

Immerzeel et al. 2010

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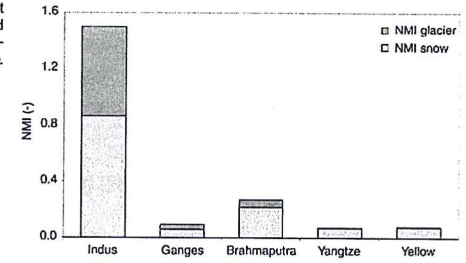
Fig. 2. Normalized melt index (NMI) for snow and glacier melt for the present (2000 to 2007) climate.

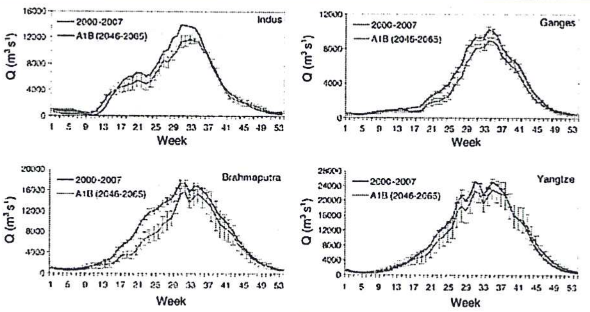


Major Rivers

Table 1. Characteristics of the five major Southeast Asian basins. Population data (2005) are based on the GPWv3 dataset [http://sedac.ciesin.columbia.edu/gpw (9 March 2009)]; precipitation data (average from 2001 to 2007) are based on (10); glacier areas are based on a dataset [http://glims.colorado.edu/glacierdata (9 March 2009)] provided by the Global Land Ice Measurements from Space (GLIMS) project (9). Irrigated areas and net irrigation water demand are based on (11). Upstream refers to the area > 2000 m.

Parameter	Indus	Ganges	Brahmaputra	Yangtze	Yellow
Total area (km^2)	1,005,786	990,316	525,797	2,055,529	1,014,721
Total population (10^3)	209,619	477,937	62,421	586,006	152,718
Annual basin precipitation (mm)	423	1,035	1,071	1,002	413
Upstream area (%)	40	14	68	29	31
Glaciated area (%)	2.2	1.0	3.1	0.1	0.0
Annual upstream precipitation (%)	36	11	40	18	32
Annual downstream precipitation (%)	64	89	60	82	68
Irrigated area (km^2)	144,900	156,300	5,989	168,400	54,190
Net irrigation water demand (mm)	908	716	480	331	525

Immerzeel et al. 2010



Major Rivers

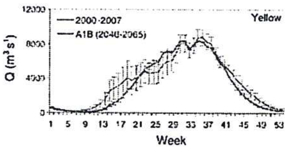
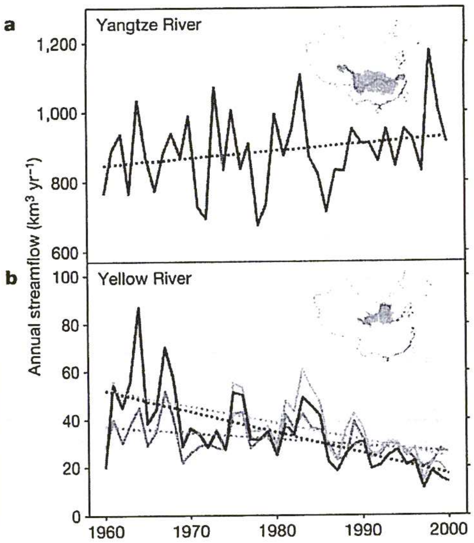


Fig. 3. Simulated mean upstream discharge for the present (2000 to 2007) and future climate for the A1B SRES scenario [A1B (2046 to 2065)]. Glacier size in 2050 is based on a best-guess scenario (13). Most critical to projected changes in discharge are future precipitation and temperature and the melt characteristics of snow and glaciers, here modeled using degree-day factors (DDFs). To account for the uncertainty in future precipitation and temperature, the best-guess scenario was run with five different GCMs (CCMA-CGCM3, GFDL-CM2, MPIM-ECHAM5, NIES-MIROC3, UKMO-HADGEM1). For the upper Indus basin, the ice and snow DDFs are constrained by observed runoff. No runoff observations were available for the other upper basins so that DDFs from the Indus were used. To account for this additional uncertainty, we performed a first-order-second-moment analysis (13). Vertical error bars ($\pm 1\sigma$) from the Indus thus include only the uncertainty about future climate, whereas the projected discharge of the other basins includes uncertainty about both future climate as well as basin-specific DDFs (assumed Gaussian with mean snow DDF = 4 mm $°C^{-1}$ day^{-1}, mean ice DDF = 7 mm $°C^{-1}$ day^{-1}, and both with σ = 1 mm $°C^{-1}$ day^{-1}). Vertical error bars around present discharge are due to uncertainty about snow and ice DDFs only.

Immerzeel et al. 2010

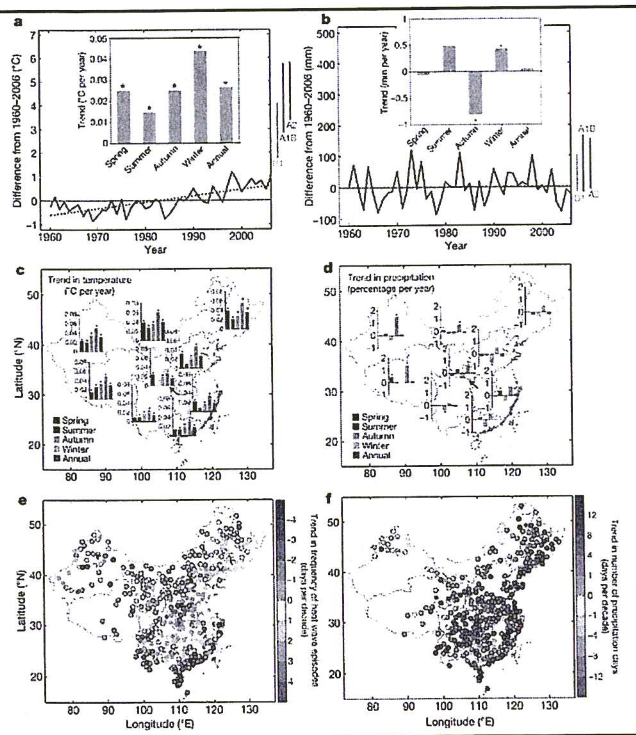


River Runoff

Inter-annual variation

Figure 2 | Observed inter-annual variation in annual runoff in two major Chinese rivers. a, Observed inter-annual variation in the Yangtze River annual runoff at the Datong station (red dot on China map in inset; grey shading indicates the area of the Yangtze River basin) from 1960 to 2000. The red dotted line is the fit to the Datong data: $y = 2.05x - 3{,}172$ ($R^2 = 0.05$, $P = 0.16$). **b,** Observed inter-annual variation in the Yellow River annual runoff at the Lanzhou (upper basin), Huayuankou (lower basin), and Gaocun (lower basin) stations (green, blue and red dots on China map in inset; grey shading indicates the area of the Yellow River basin) from 1960 to 2000. The green dotted line is the fit to the Lanzhou data: $y = -0.27x + 560$ ($R^2 = 0.19$, $P < 0.01$). The blue dotted line is the fit to the Huayuankou data: $y = -0.7x + 1{,}434$ ($R^2 = 0.31$, $P < 0.01$). The red dotted line is the fit to the Gaocun data: $y = -0.87x + 1{,}764$ ($R^2 = 0.44$, $P < 0.01$). The decreasing trend in Yellow River annual runoff is at least partially induced by climate change (see text). A linear regression t-test was conducted to determine whether the slope of the regression line differed significantly from zero.

Piao et al. 2010



Climate Trends

Precipitation and temperature

Piao et al. 2010

Consequences for Agriculture

Floods, droughts, deseases, grain yield

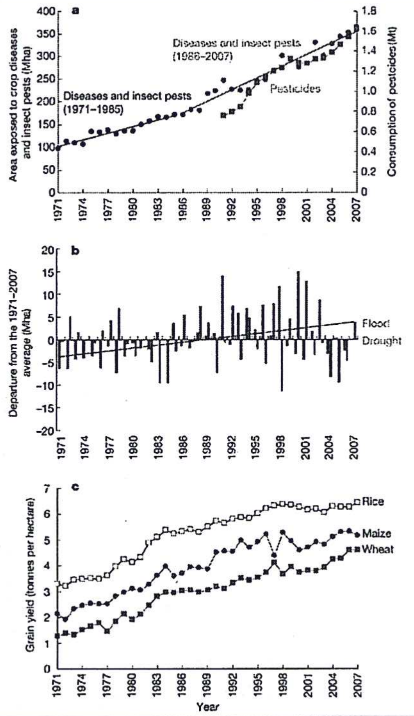


Figure 4 | Observed expansion of crop pests and diseases, and changes in flooding and droughts during the period 1971-2007. **a,** Arable land area exposed to crop pests and diseases during the period 1971–2007. The increase is partially induced by climate warming (see text). The consequences of pesticide use are shown by the red curve. The black line is a fit to the 1971–1985 data: $y = 4.9x - 9{,}495$ ($R^2 = 0.92$, $P < 0.001$). The blue line is a fit to the 1986–2007 data: $y = 8.6x - 16{,}918$ ($R^2 = 0.94$, $P < 0.001$). **b,** Changes in cropland areas affected by flooding and droughts, expressed as a deviation from the 1971–2007 average. The blue line is a fit to the flood data: $y = 0.208x - 3.95$ ($R^2 = 0.20$, $P = 0.006$). The red line is a fit to the drought data: $y = -0.030x + 0.58$ ($R^2 = 0.00$, $P = 0.759$). **c,** Changes in cereal yields during the period 1971–2007, expressed as grain yield per unit area rather than total grain production because of interannual variation in the planted area. These data come from China's agricultural statistics[72,99].

Piao et al. 2010

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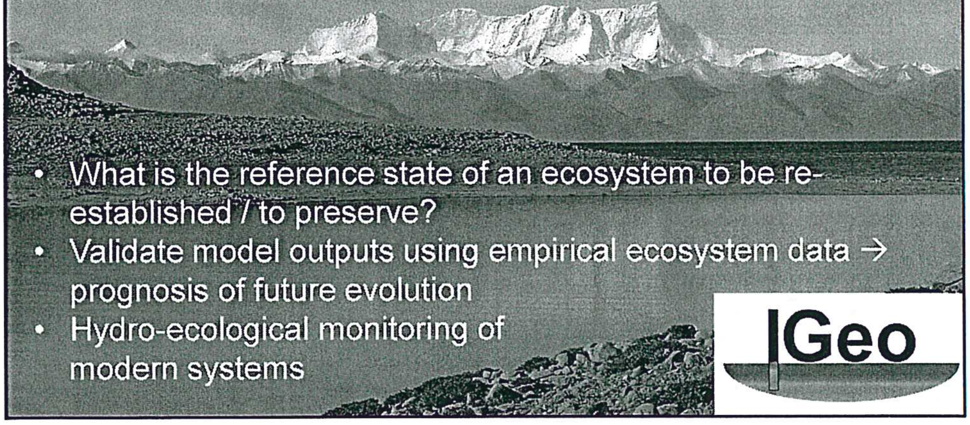
06.11.12
EXCEED

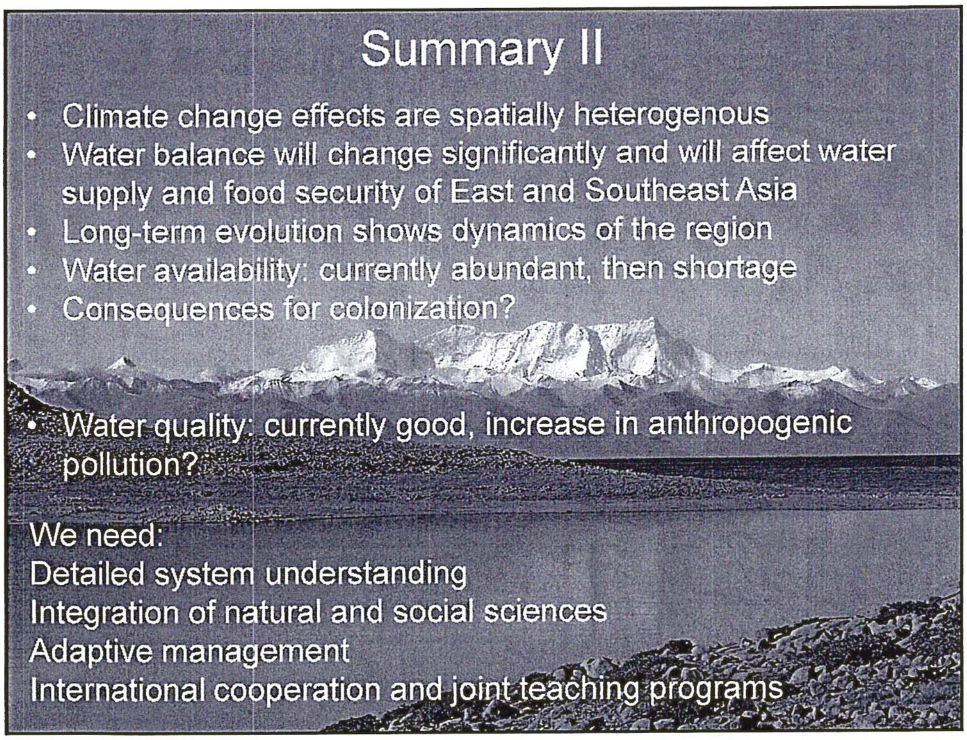
Summary I

- Environmental management needs a sound understanding of the history of a landscape
- Lakes as sensors of global climate change
- Past, present and future of aquatic ecosystems?
- Impact of pollution on aquatic biodiversity through time?



- What is the reference state of an ecosystem to be re-established / to preserve?
- Validate model outputs using empirical ecosystem data → prognosis of future evolution
- Hydro-ecological monitoring of modern systems

IGeo


Summary II
• Climate change effects are spatially heterogenous
• Water balance will change significantly and will affect water supply and food security of East and Southeast Asia
• Long-term evolution shows dynamics of the region
• Water availability: currently abundant, then shortage
• Consequences for colonization?
• Water quality: currently good, increase in anthropogenic pollution?
We need:
Detailed system understanding
Integration of natural and social sciences
Adaptive management
International cooperation and joint teaching programs


Thank you!

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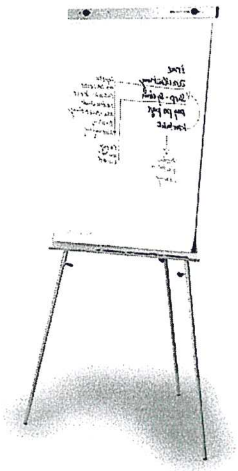
Water Disputes in the Jordan River Basin and the Role of the Middle East Conflict

Lecturers: Karsten Breßler and Matthias Berthold
Within the EXCEED Summer School on Climate Change and Global Water Problems
November 04-11, 2012, Braunschweig, Germany

Structure of the presentation

1. Hydrogeography of the Jordan River Basin
2. Historical development of the water situation
3. Current water situation
4. Political situation
5. Conclusion
1. Discussion



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November 7th, 2012 | Karsten Breßler and Matthias Berthold | EXCEED Summer School on Climate Change and Global Water Problems | Slide 2

1. Hydrogeography of the Jordan River Basin

Catchment area: 18,194 km²

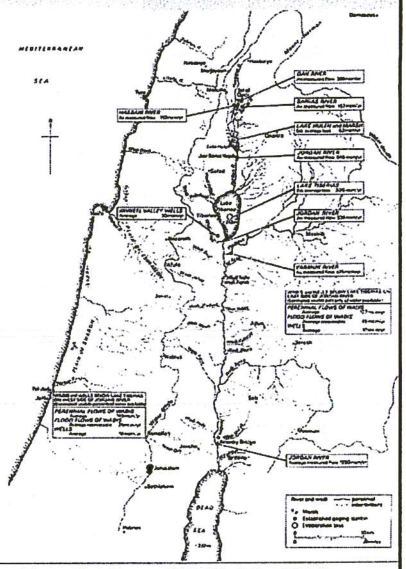
Riparian parties: Lebanon, Syria, Israel, Jordan, West Bank

Main river: Jordan River with length of about 250 km

Terminus: Dead Sea (414 m bmsl)

Total annual flow: 1300 – 1500 mcm

Main elements:
- Upper Jordan River
- Lake Tiberias
- Yarmouk River
- Lower Jordan River
- Dead Sea



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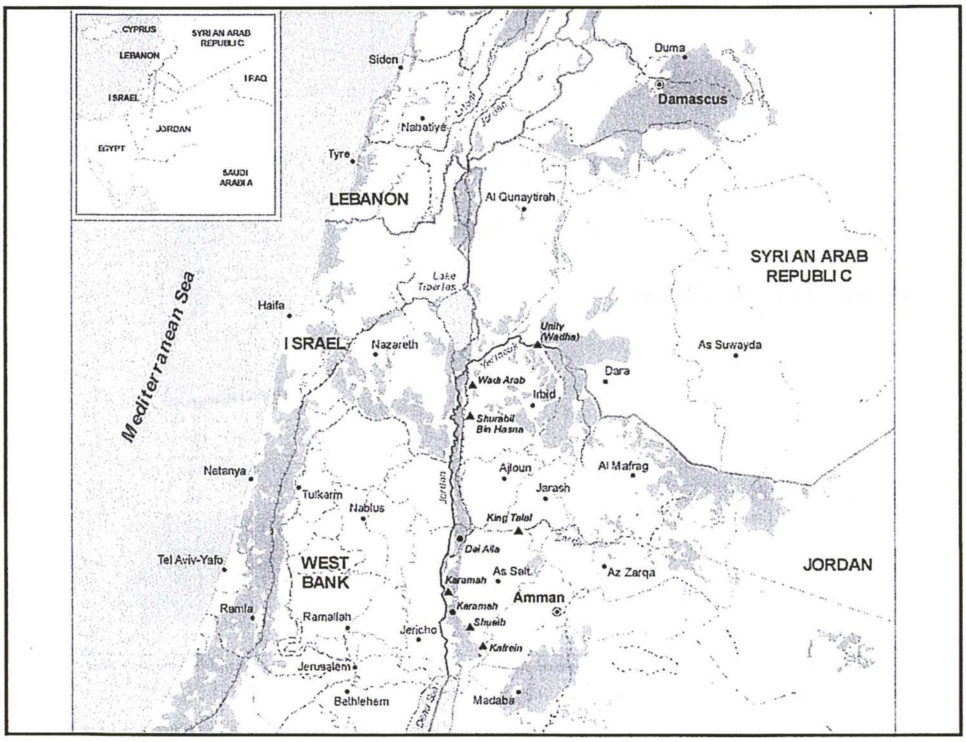


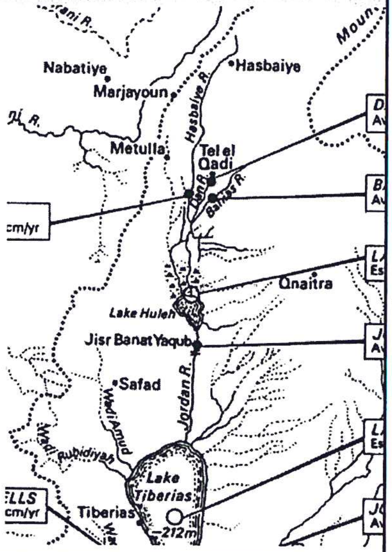
1. Hydrogeography of the Jordan River Basin

Upper Jordan River

Three main tributaries:

- Dan (Israel), 258 mcm/y av.
- Banias (Syria, Golan Heights), 157 mcm/y av.
- Hasbani (Lebanon), 157 mcm/y av.

→ joining 6km south of Mt. Hermon
→ additional about 360 mcm/y from side wadis

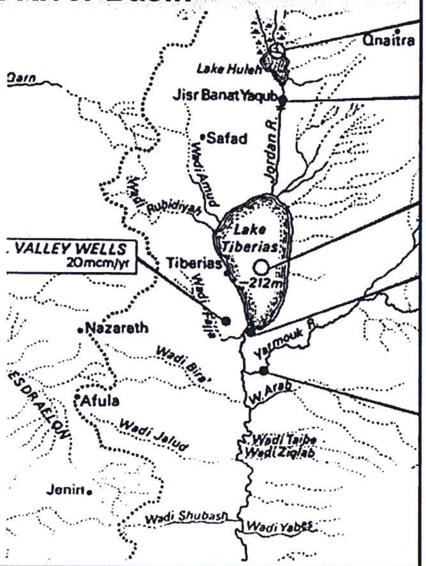


1. Hydrogeography of the Jordan River Basin

Lake Tiberias

→ main fresh water body inside Israel

- about 160 km²
- capacity of 4000 mcm
- average inflow of 640 mcm/y (after evaporation)



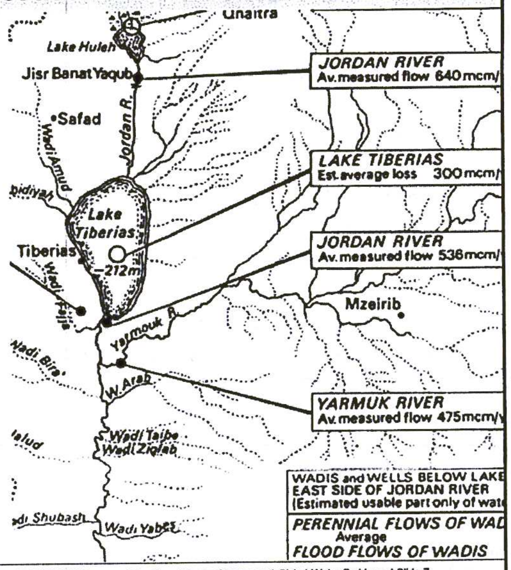
1. Hydrogeography of the Jordan River Basin

Yarmouk River

Main tributary of the Jordan River

- catchment area: 6,790 km²
- length: 75 km
- av. annual flow: 400 – 500 mcm
- highly dependent on precipitation

→ Riparians are Syria, Jordan and Israel



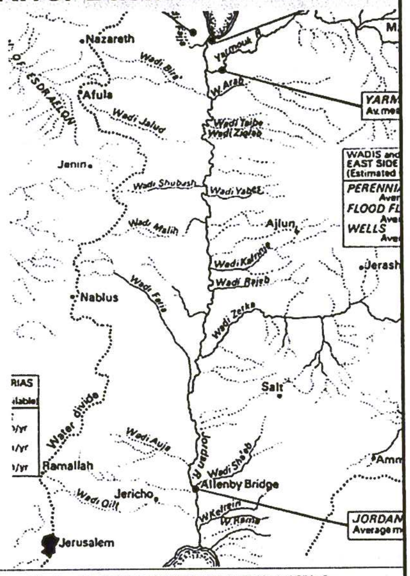
1. Hydrogeography of the Jordan River Basin

Lower Jordan River

Consisting of:

- outflow of Lake Tiberias
- Yarmouk River
- other tributaries mainly from Jordan

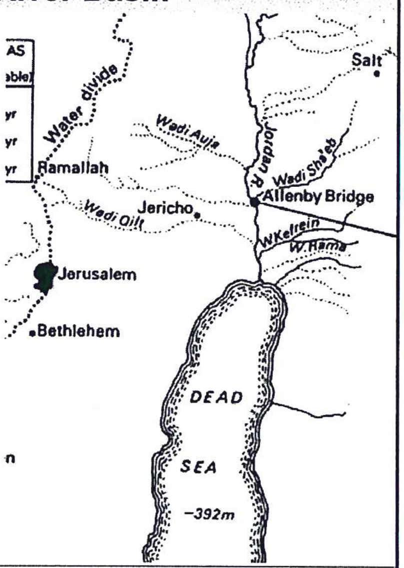
→ Natural flow of about 1,400 mcm/y



1. Hydrogeography of the Jordan River Basin

Dead See

- terminus of the Jordan River
- lowest point on earth with orig. 392 m bmsl
- surface of originally 1010 km²
- salt content of 250.000 ppm



2. Historical development of the water situation

1948
- Foundation of Israel & subsequent arab-israeli war
- New actor
- Palestinian refugees
- Start of unilateral projects

early 1950s
- Israeli plans to divert parts of the Upper Jordan River
- Rising tensions between Syria and Israel
- Intervention by UN and USA

1953
- Agreement between Jordan and Syria about Yarmouk
- Building dam and limiting Syrian usage of the Yarmouk
- Protest from Israel

1955
- USA becomes involved
- Shuttle Diplomacy
- Johnston Plan
- Accepted technically but never politically

2. Historical development of the water situation

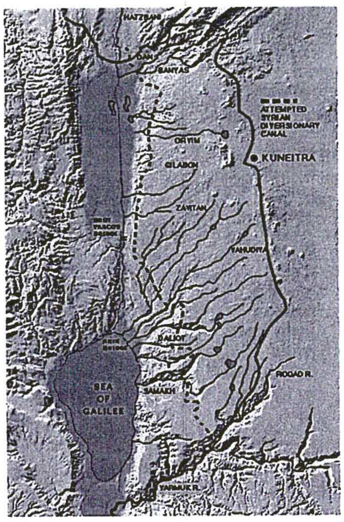
1961
- Jordan implements East-Ghor-Canal
- Irrigation of the Jordan Valley
- Socio-economic stabilization

1964
- Israeli implements National Water Carrier
- Consuming 400-500 mcm/y of Upper Jordan River

1965-1967
- Rising tensions because of water projects
- Diversion plan by Syria and Jordan of Hasbani and Banias

June 1967
- Six-Days-War
- Israel controls Golan Heights
- Also controls West-Bank
- Total control of Upper Jordan River incl. Banias

2. Historical development of the water situation



2. Historical development of the water situation

1978
- Operation Litani
- Temporary control of Hasbani by Israel

1989
- Second agreement between Syria and Jordan
- Implementation took till 2007

1994
- Jordanian-Israeli Peace Treaty
- Distribution of the Jordan and Yarmouk Waters

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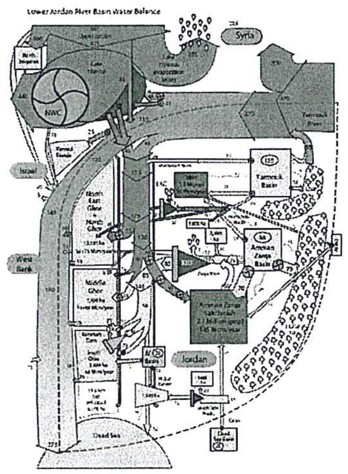
3. Current water situation



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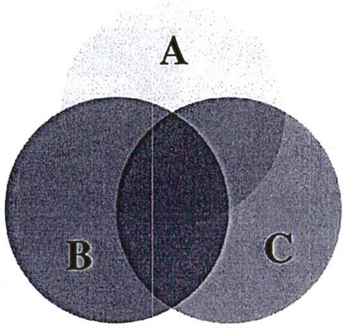
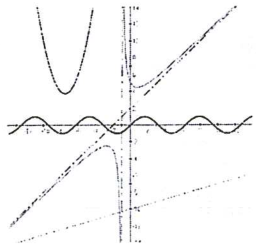
3. Current water situation

Facts and Figures





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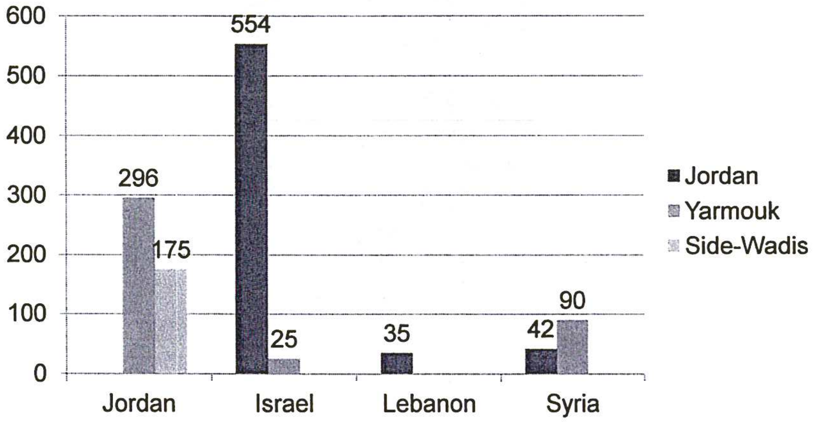
3. Current water situation

Water distribution according to the Johnstonplan (MCM/yr)



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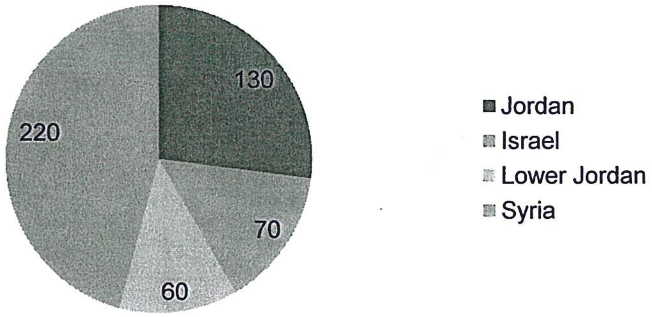
3. Current water situation

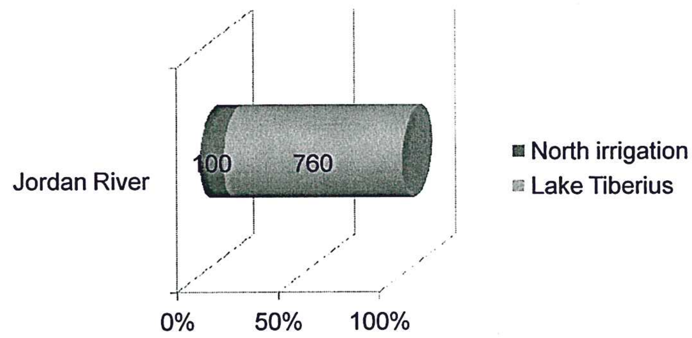
Yarmouk River

Water Distribution (MCM/yr)



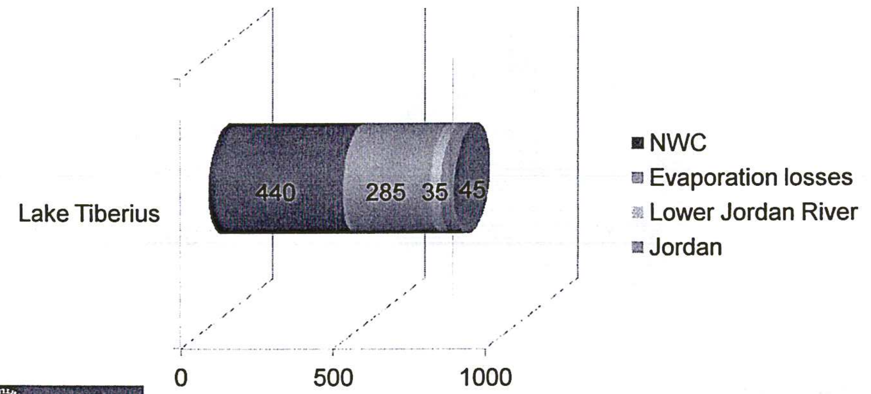
3. Current water situation

Upper Jordan River



3. Current water situation

Lake Tiberius

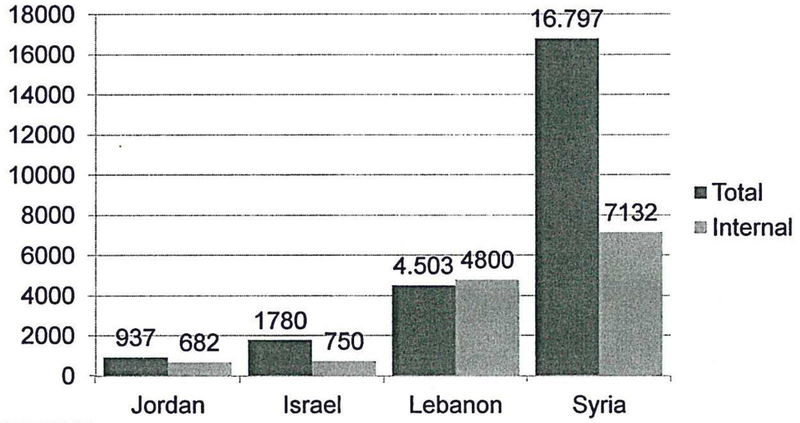


3. Current water situation

The Riparian water budget

3. Current water situation

Renewable water resources MCM/yr



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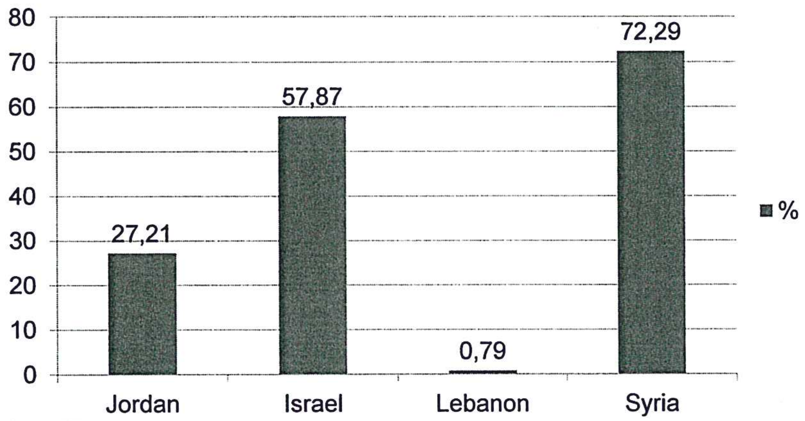
3. Current water situation

Dependency ratio



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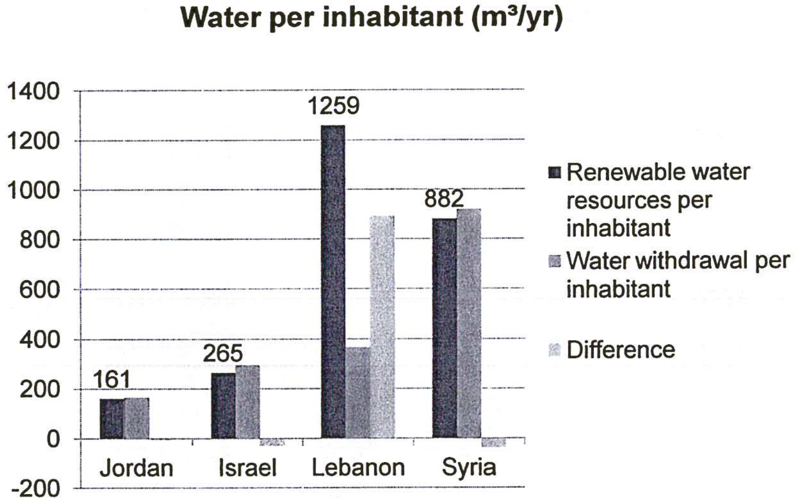
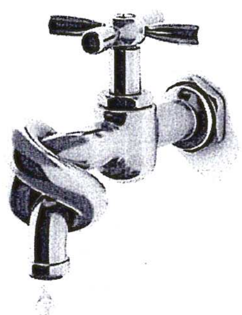
3. Current water situation



4. Political Situation



4. Political Situation

Water Dependency

- Jordan, Israel and Syria are highly dependent on the water coming out of other countries.
- For Israel the 440 MCM from the Lake Tiberius are almost one third of their total water budget.

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4. Political Situation

- For Syria, the water from the Yarmouk river is only a very small percentage of the water budget. It has only regional importance.

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4. Political Situation

- Jordan is highly dependent on the water of the Yarmouk and the Jordan River.
- The water from the Jordan river is used for irrigation in the Jordan valley region and the water of the Yarmouk is the main source for surfacewater in Jordan. This water is also used for the water supply of the capital Amman(50%).

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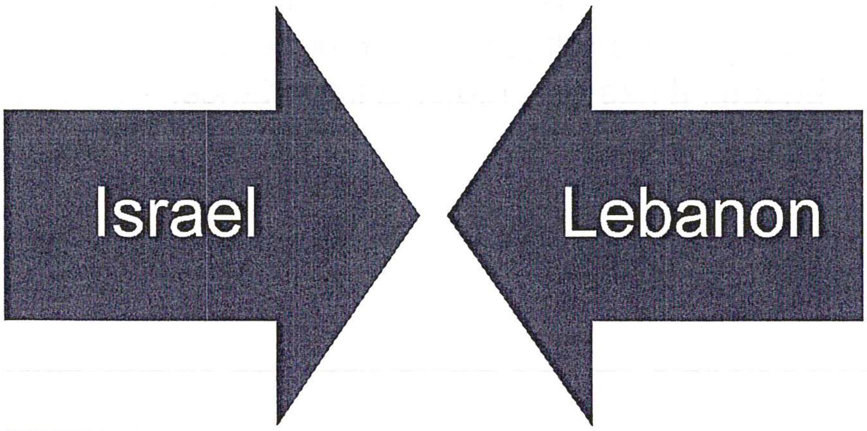
4. Political Situation

Conflicts related to water



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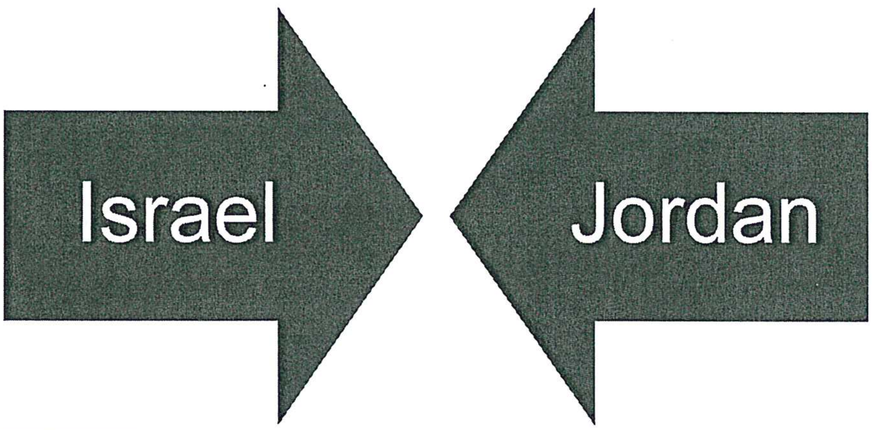
4. Political Situation

- Israel is defending its share of the Hasbani River, if it has to also militarily.
- Ongoing provocations from both sides lead to tensions.

4. Political Situation

Conflicts related to water



4. Political Situation

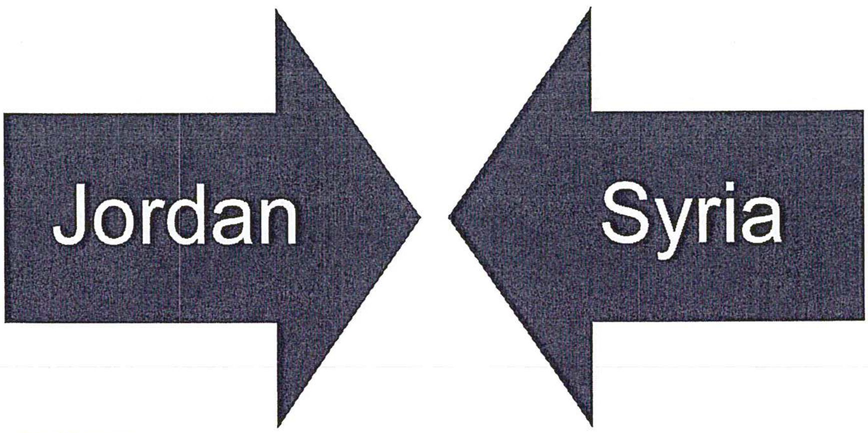
Peace Treaty

- Israel gets 25 MCM/yr from the Yarmouk River
- Jordan gets 80 MCM/yr from the Lake Tiberius and other waterressources.

- **Both sides adhere to the treaty (besides some seasonal differences)!**
- **Water conflicts are negotiated!**

4. Political Situation

Conflicts related to water



4. Political Situation

- According to the contracts of 1953 and 1987 Syria is allowed to take 170 MCM/yr from the Yarmouk River.
- But it takes **more than 220 MCM/yr**.
- According to the groundwater flowing from Syria to Jordan, there no existing contract and Syria is pumping a huge amount of this water.

5. Conclusion

- Waterscarcity in the region led to conflicts among the riparians
- Those conflicts interact with the Middle-East conflict
- Also today water conflicts are on the spot, but are negotiated
- Other measures have to be adopted to bring water into the region

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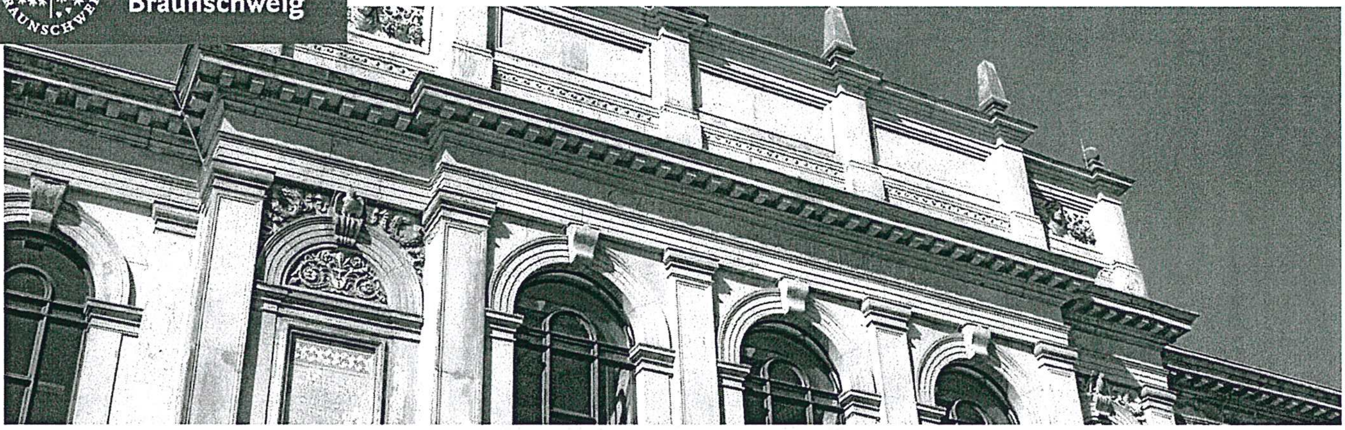
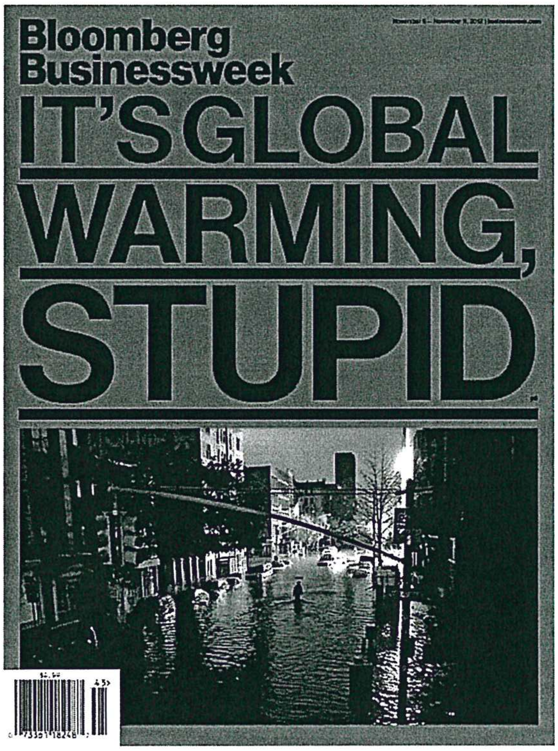


Climate Change, Drought and Social Conflict

Sören Köpke M.A., November 7, 2012

Climate Change: There's no denial!



Source: Bloomberg Businessweek, November 5-11, 2012

Climate Change: Feedback cycles between nature and humanity

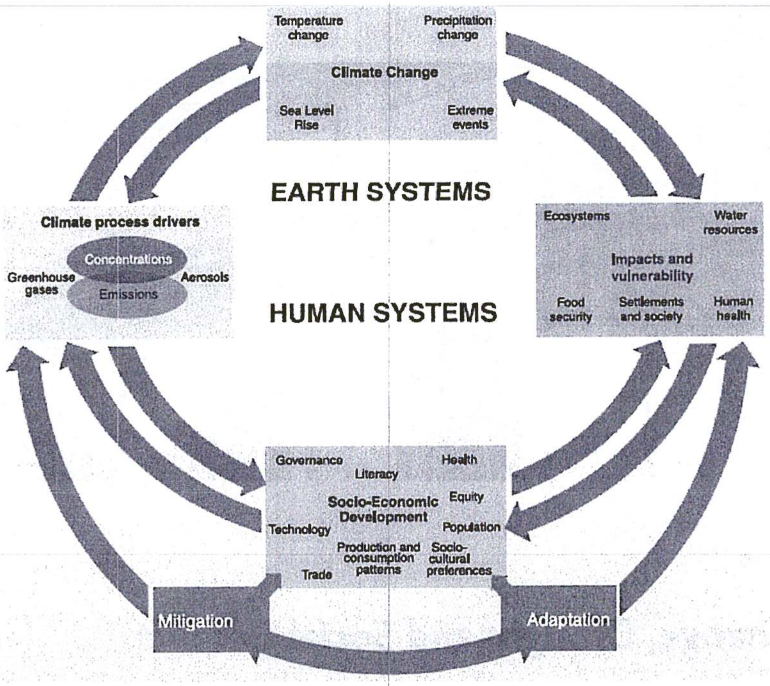
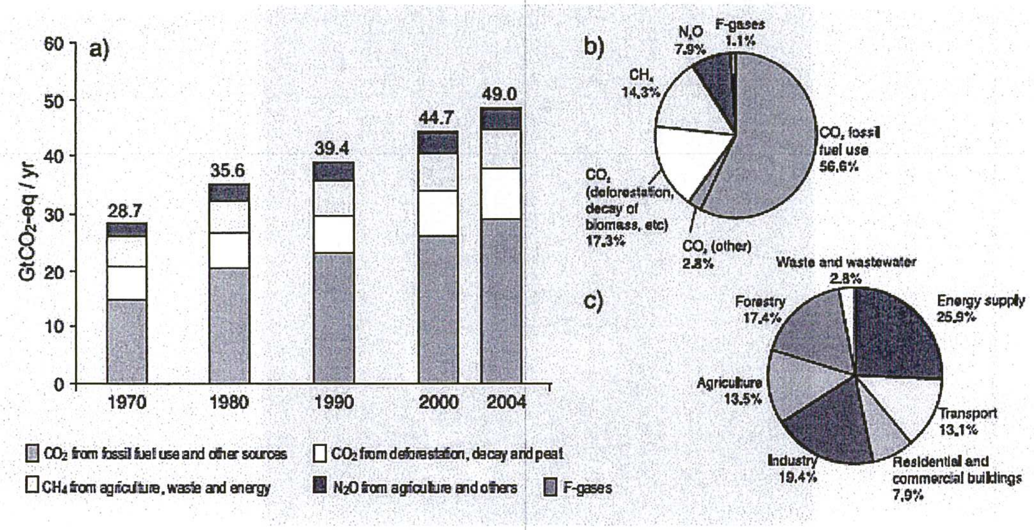


Figure I.1. Schematic framework representing anthropogenic drivers, impacts of and responses to climate change, and their linkages.

Source: IPCC (2007)

Climate Change: Anthropocene causes



Source: IPCC (2007)

Climate Change and Social Conflict: Scientific Prognosis

- Boko et.al. (2007) expect climate change to have negative impacts on livelihoods in Sub-Sahara Africa, for example through consequences on access to water, health, housing, infrastructure, natural resource use and economic growth
- Climate change enhances the probability of extreme weather events
- Until 2020, 75 to 250 million people will be affected by heightened water stress
- 2020, yields in some countries could decrease up to 50%, food production and access to food could be seriously affected, with negative impacts on nutrition an food security.
- Rising sea levels to the end of the 21st century will have serious consequences for coastal areas, damaging national economies to an unknown extent
- Arid and semi-arid land in Africa could increase 5% to 8%

Climate Change and Conflict: Main Threats

Four Critical Areas in Africa (Brown and Crawford 2009)

- Water Scarcity
- Reduced yields and soil erosion
- Mass migration
- Combination of the above

Arrival at Daadab refugee camp, Kenya *Source:*WFP.org, 2012

Climate Change and Conflict: Theoretical Approaches

- The last years have seen a growing literature on Climate Change and Conflict:
  - H.Welzer (2010): *Klimakriege* (= Climate Wars)
  - G. Dyer (2010): *Climate Wars*
  - WBGU (2007): *Climate Change as a Security Risk*
- Many seem to take an alarmist stance
- Environmental determism is to be avoided
- *Securization* of Climate Change discourses

Climate Change, Drought and Conflict: Hypothesis

CC → Drought → Conflict

Independent var ***Intermed. Var.*** ***Dependent var.***

Climate Change and Conflict: Theoretical Approaches

„Each case of environmentally induced conflict is complex and unique: each has a specific ecosystem, history, culture, economy, set of actors, and and set of power relations among these actors."

–(Homer-Dixon 1999)

Climate Change and Conflict: The Migration Link

Direct Effect

Environmental stress → Migration from Region A → Conflict in Region B

Indirect Effect

Environmental stress → Conflict in Region A → Migration from Region A → Conflict in Region B

Source: Gleditsch et al.: *Climate Change and Conflict: The Migration Link (2007)*

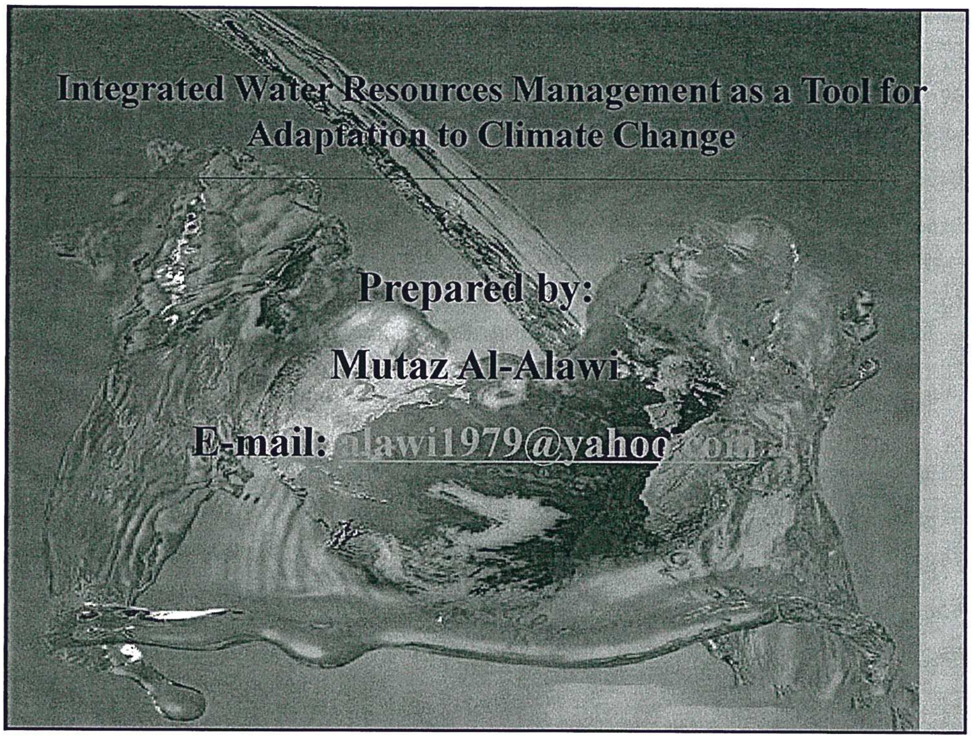
Climate Change and Social Conflict: Case Studies

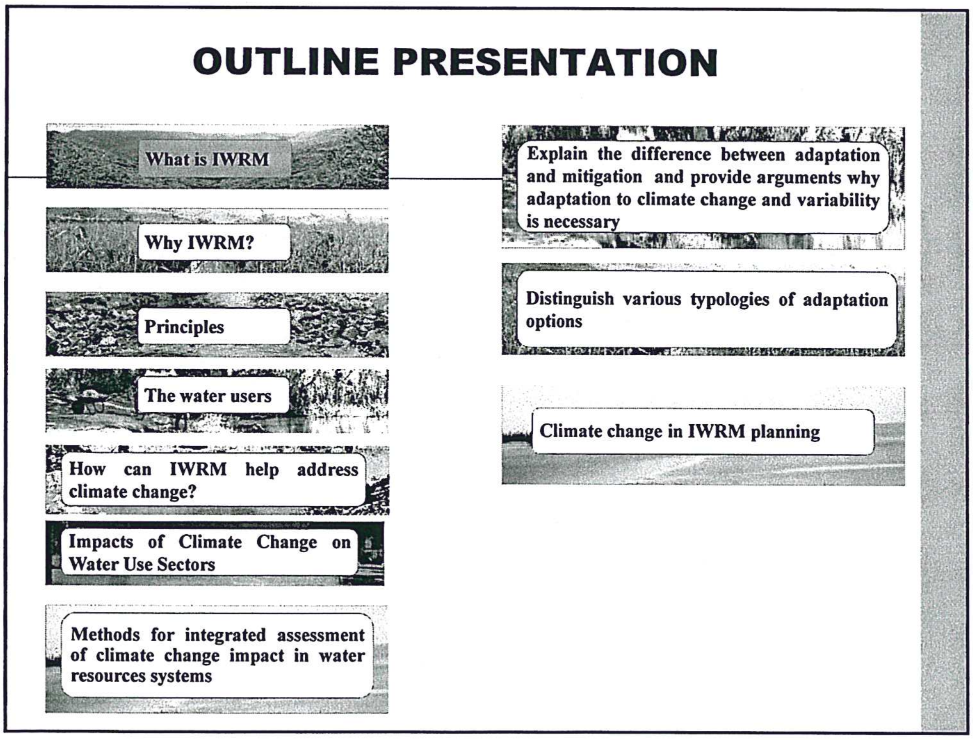
- **Western Sahel:** Trouble in Mali
- **Eastern Sahel:** Darfur/Sudan – The First Climate War?
- **Horn of Africa:** Drought and Civil War
- **Mongolia:** Mining Boom and Climate Change and their effect on livelihoods
- **Classical Maya Civilization:** Collapse due to Climate Change?

Climate Change and Social Conflict: Tasks for your working groups.

- Describe some general, important features of the societies/states in your case study.
- How does climate interact with the livelihoods of the people? In which ways do people depend on stable climate patterns?
- Explain the conflict history and background – which social cleavages breed conflict (social, economic, ethnic, religious,... etc.)?
- Name some other factors that may have impacts on peace and stability in the region.
- Which is the specific role of drought or mismanaged water in the conflict?
- What do you identify as a research gap? (optional)
- Conclusions to wether your case displays the climate change/conflict nexus or not?

Poster Session – Meet again at 16:30h for presentation and discussion.

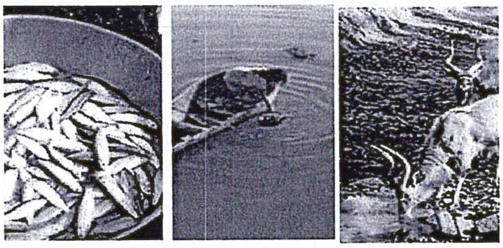

Integrated Water Resources Management as a Tool for
Adaptation to Climate Change
Prepared by:
Mutaz Al-Alawi
E-mail: alawi1979@yaho


OUTLINE PRESENTATION
What is IWRM
Why IWRM?
Principles
The water users
How can IWRM help address climate change?
Impacts of Climate Change on Water Use Sectors
Methods for integrated assessment of climate change impact in water resources systems
Explain the difference between adaptation and mitigation and provide arguments why adaptation to climate change and variability is necessary
Distinguish various typologies of adaptation options
Climate change in IWRM planning

What is INTEGRATED WATER RESOURCES MANAGEMENT (IWRM)?

Integrated: means that all the different uses of water resources are considered together. Water allocations and management decisions consider the effects of each use on the others.

Management: it emphasises that we must not only focus on development of water resources but that we must manage water development in a way that ensures long term sustainable use for future generations.



The need to consider the different uses of water together

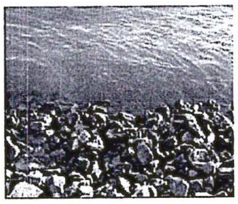
Why IWRM?

Urgency for action

Water is important for human survival, health and dignity and a fundamental resource for human development. The world's freshwater resources are under increasing pressure.

Water governance crisis

Sectoral approaches to water resources management have dominated in the past and are still prevailing. This leads to fragmented and uncoordinated development and management of the resource. IWRM brings coordination and collaboration among the individual sectors, plus stakeholder participation.



Increased competition

Increased competition for the finite resource is aggravated by inefficient governance.

Why IWRM? -2-

Securing water for people

One fifth of the world's population is without access to safe drinking water and half of the population is without access to adequate sanitation.

Securing water for food production

Over the next 25 years, food will be required for another 2–3 billion people. IWRM offers the water conservation and recycling and reuse of wastewater for irrigation.

Water management principles

The Dublin principles have formed the basis for much of the subsequent water sector reform.

Fresh water is a **finite and vulnerable** resource, essential to sustain life, development and the environment.

Water development and management should be based on a **participatory approach**, involving users, planners and policy makers at all levels.

Women play a central part in the provision, management and safeguarding of water.

Water has an economic value in all its competing uses and should be recognised as an **economic good**.

The water users

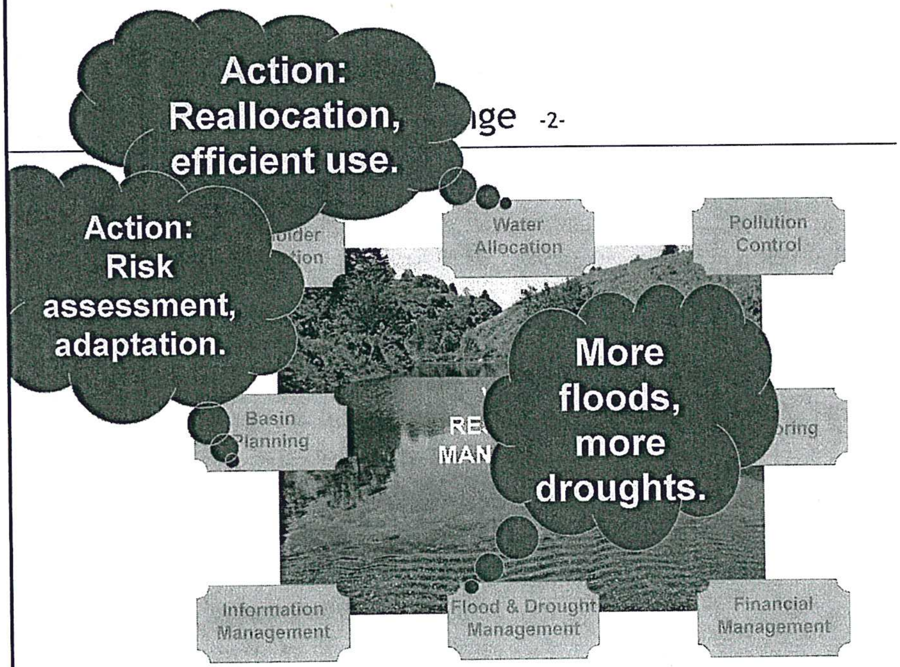
- Agriculture
- Water supply and Wastewater
- Mining and Industry
- Environment
- Fisheries
- Tourism
- Energy
- Transport

Impacts of the water use sectors on water resources

Environment	▪Purification ▪Storage ▪Hydrological cycle	
Agriculture	▪Return flows ▪Increased infiltration ▪Decreased erosion ▪Groundwater recharge ▪Nutrient recycling	▪Depletion ▪Pollution ▪Stalinization ▪Water logging ▪Erosion
Water supply & sanitation	▪Nutrient recycling	▪High level of water security required ▪Surface and groundwater pollution

How can IWRM help address climate change?

IWRM can assist in coping with climate chnage through Key Water Resources Management Functions. For example:



Impacts of CC on Agriculture

✓ **Positive impacts of climate change could increase growth rates because of increased CO_2 concentrations and length of growing season.**

✓ **More than 80 percent of global agricultural land is rain-fed, production will be very affected by climate change. Thus, global food production depends both on precipitation and, increasingly, on the availability of water resources.**

✓ **On the other hand, extreme precipitation events could lead to excessive soil moisture, soil erosion, and direct damage to plants, all of which disrupt food production.**

Impacts of CC on food production

Biophysical	Socio-economic
✓ Physiological effects on crops, pasture, forests, livestock (quantity, quality) ✓ Changes in land, soil, water resources (quantity, quality)	✓ Decline in yields and production ✓ Fluctuations in world market prices ✓ Changes in geographical distribution of trade regimes ✓ Increased number of people at risk of hunger and food insecurity ✓ Migration and civil unrest.

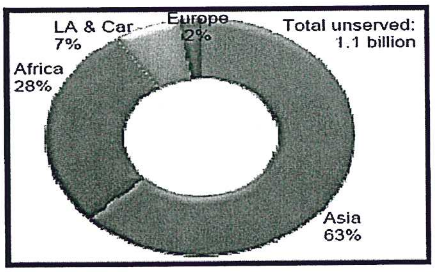
Impacts of CC on Fisheries

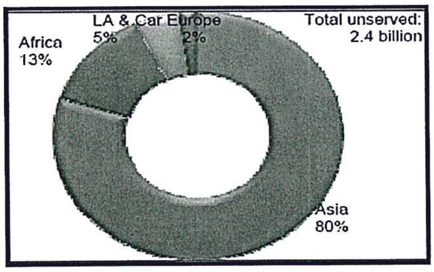
✓Increased stress on fish populations due to:

- Higher temperatures > less oxygen available
- Increased oxygen demand
- Deteriorated water quality

Impacts of CC on water supply

Distribution of the global population without access to an adequate water supply (left) and adequate sanitation (right)





✓Increased salinity water resources because of lower stream flows .

✓Higher rainfall > more pressure on sewerage systems > more overflows> spreading diseases.

✓Higher temperatures stimulate the spread of many diseases. Moreover, increases in temperature could also introduce new diseases into areas previously unaffected. Overall, the incidence of diseases is expected to increase.

Impacts of CC on energy sector

✓*Hydropower* generation is sensitive to the amount, timing and geographical patterns of precipitation.

✓Hydropower production decreases with decreased flows.

✓In the Colorado River (USA) a 10 percent decrease in run-off is estimated to reduce power production by 36 percent (Kabat and van Schaik, 2003).

Impacts of CC on transportation

✓ Implications of climate change

❖ Reduction in the flow quantity over the year shall result in reduced river levels

✓ Big boats cannot be used thus more boats are required for the same loads, increasing cost, energy use and emissions

❖ Increase in the rainfall intensity can severely damage the transportation infrastructure due to exposure to higher flooding than the infrastructure is designed for.

Methods for integrated assessment of climate change impact on water resources systems

A more recent approach that is being applied in climate change assessment studies is based on a holistic integrated simulation of the physical, management and social aspects of water resources systems. This approach views water resource management not as a supply problem, but also as one where demand management and economic efficiency are important issues that need to be considered.

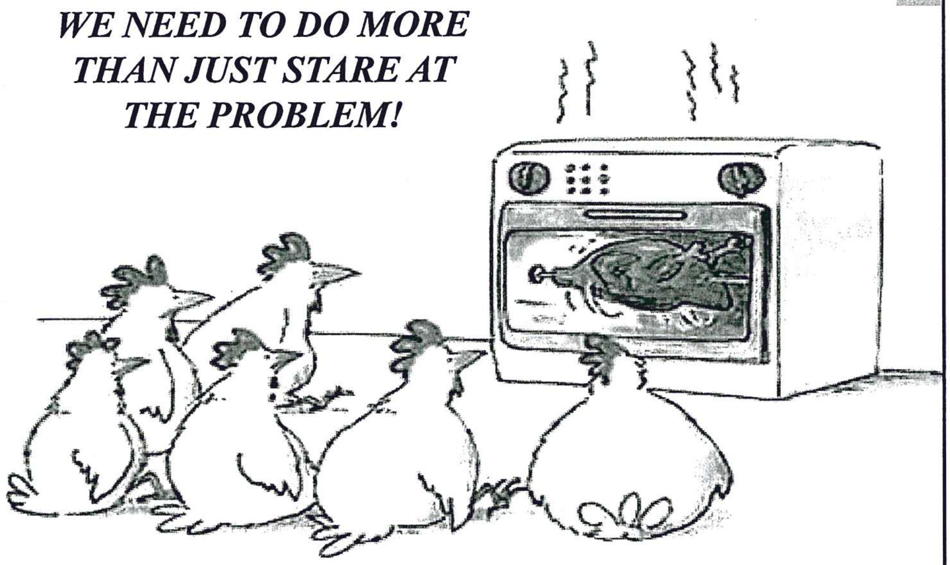
✓**WEAP**: water supply, demand management and policy analysis model;

✓**SWAT**: a water balance and crop growth model mainly used to simulate agricultural activities;

❖ One of the leading water resource system simulation models is the Water Evaluation and Planning (WEAP) Model. In contrast to most simulation models, WEAP represents water demand alongside water supply elements and provides an extensive policy and economic analysis tools. WEAP21 was applied as the principle tool in a major climate change impact assessment study authorized by the state of California (Purkey et al., 2008).

The basic premise . . .

Climate change is a global phenomenon, but the problems will be very local and we will have to adapt and plan locally.



Adaptation

Prevent **Mitigate ...** **... *and* adapt!**

What is adaptation?

✓ **According to IPCC (2001), adaptation can be defined as "Adjustment in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts."**

✓ **Different from *mitigation*, which is: "an anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gasses."**

Why is it needed?

✓ To deal with impacts from past climate change
✓ To deal with future climate change
✓ To reduce **vulnerability to extremes**

❖ Mitigation is costly
❖ Time needed for mitigation measures to become effective.

General typologies of adaptation measures

Autonomous adaptation–Planned adaptation

✓Autonomous adaptation: adaptation that occur spontaneously, depending on the individual needs and capacities of a given sector of society

✓Planned adaptation: adaptation that results from decisions that have been made based on the awareness that conditions have changed, or are about to change

Reactive adaptation –Anticipatory adaptation

✓Reactive adaptation: Adaptation occurs after the impacts of climate change have become apparent

✓Anticipatory adaptation: Adaptation occurs before the impacts of climate change have become apparent

Why is it important to address climate change manifestations in water management?

✓Impacts of climate change on freshwater systems

✓Climate change affects the function and operation of existing water infrastructure

✓The number of people in severely stressed river basins is projected to increase significantly

Possible Management Measures to Address Climate Change Manifestations

In a situation of water stress:

- ❖Water pricing
- ❖Seasonal water rationing during times of shortage
- ❖Adapt industrial and agricultural production to reduce water wastage
- ❖Increase capture and storage of surface run-off
- ❖Reuse or recycle waste water after treatment
- ❖Rainwater harvesting.

Possible management measures

In a situation of water quality risks:

- ❖Improvements to drainage systems
- ❖Upgrading or standardizing of water treatment
- ❖Better monitoring

How to incorporate the climate change dimension into national IWRM plans?

When viewing the IWRM planning process as instrumental for adaptation to changing climatic conditions, the following may be considered:

Climate change in IWRM planning

When initi… planning proc… change impact… integrated in …

In the vision and policy development phase, adaptation to climate change is an ad… … repl…

In the "Situation analysis" step, the use of climate … and impact …

… "Strategy choice" … anticipatory and … ary principle as … of strategies for …

During evaluation, results must be measu… indicators, ta… consideration … adaptation … proposed in the plan

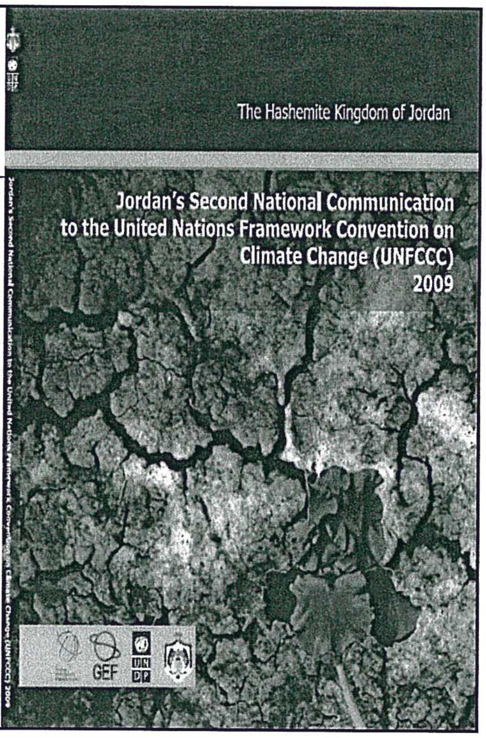
Throughout the cycle, continuous consultation with stakeholders is essential

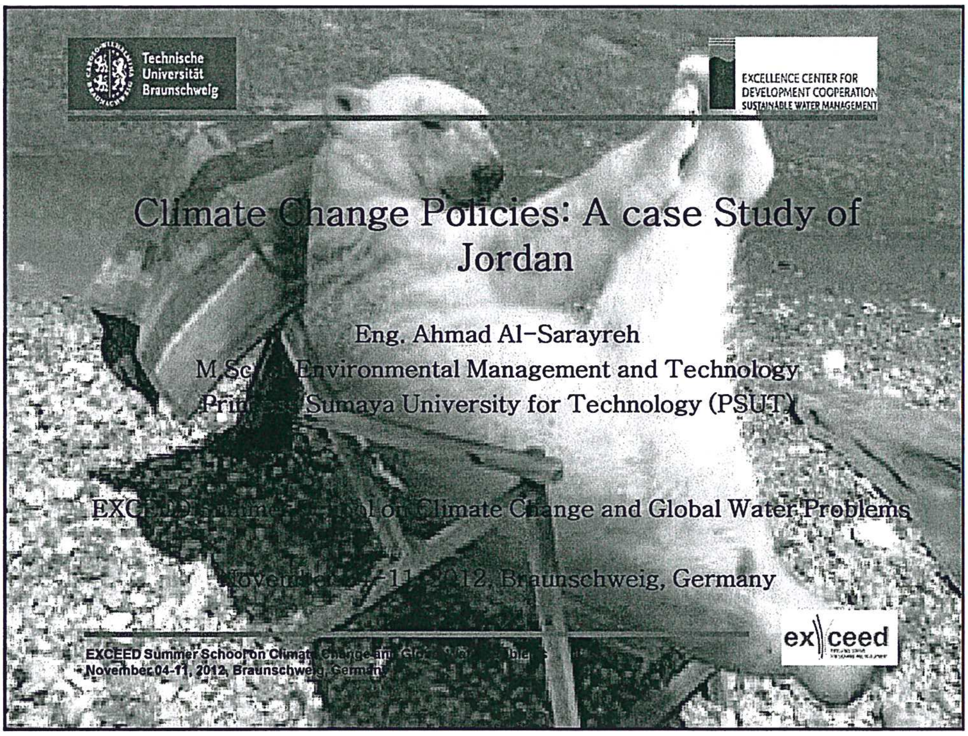
… ions roles in IWRM and are decisive in how it contributes to climate change adaptation

… on strategies in a … hen drafting an … plan

Mitigation projects in wastewater treatment plants (Jordan)

Project name	Total emission reductions (thousand tonnes CO_2 eq)	Reduction unit Cost (JD/t CO_2eq)
Aqaba tertiary DWWTP	296,877	32.12
As-Samra DWWTP	14,115,146	5.51
Baqa'a tertiary DWWTP	741,016	19.29
Madaba DWWTP	288,316	29.38
Ramtha DWWTP	397,842	25.05
Salt DWWTP	305,676	30.06
Wadi Arab DWWTP	1,716,800	13.75
Total	17,861,673	

Jordan's Second National Communication (SNC) to the United Nations Framework Convention on Climate Change (UNFCCC) 2009	
Although Jordan does contribute a mere 20.14 million tons of Carbon dioxide equivalent, it maintains strong commitment to the objectives developed by the international community for the integrated environmental and economic response to the threat of climate change. **http://www.undp-jordan.org/index.php?page_type=publications&press_id=163**	



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Introduction to Climate Change

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- ***Human activities are releasing greenhouse gases (GHG) into the atmosphere***
- ***Climate change is a global issue:***
  1 tCO2 emitted in Jordan = 1 tCO2 emitted in Germany
- ***Rising levels of greenhouse gases are already changing the climate***
- ***Climate models predict the global temperature will rise by about 1.4 to 5.8 degrees by 2100***
- ***Climate change is likely to have a significant impact on the global environment, economy and society***

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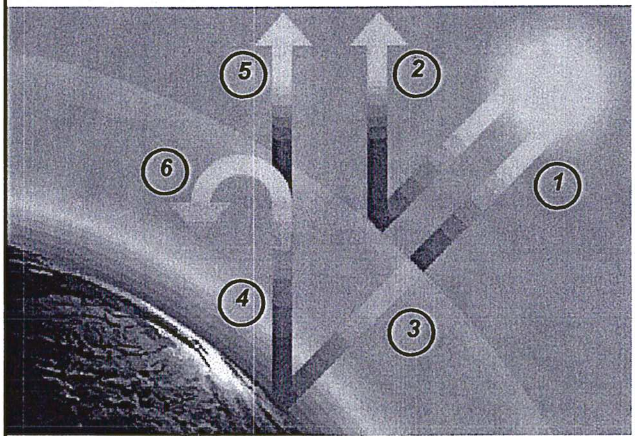

1) Solar radiation

2) Reflected back to space

3) Absorbed by atmosphere

4) Infra-red radiations emitted from Earth

5) Some of the IR passes through the atmosphere

6) Some is absorbed and re-emitted by greenhouse gas molecules

→ *The effect is increasing temperatures on Earth*

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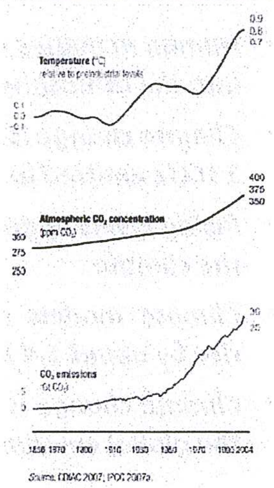
- *In the past 100 years the earth has warmed 0.70C*
- *Atmospheric concentrations of CO2 are increasing at 1.9 ppm each year. It reached 379 ppm in 2005 compared to a pre-industrial value of 280 ppm.*
- *The CO2 concentration of 2005 is higher than the average over the last 650,000 years(180-300ppm)*
- *Between 2000 and 2005 an average of 26 Gt of CO2 was releases into the atmosphere each year.*



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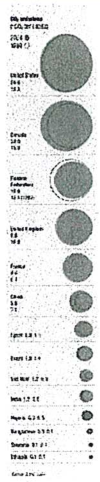
Some people walk more lightly than others

- *The UK (population 60 million) emits more CO2 than Egypt, Nigeria, Pakistan and Vietnam (total population 472 million)*
- *The 19 million people living in New York have a deeper carbon footprint than the 766 million people living in the 50 least developed countries*
- *The distribution of current emissions points to an inverse relationship between climate change vulnerability and responsibility. The poorest billion people are highly exposed to climate change threats for which they carry negligible responsibility.*



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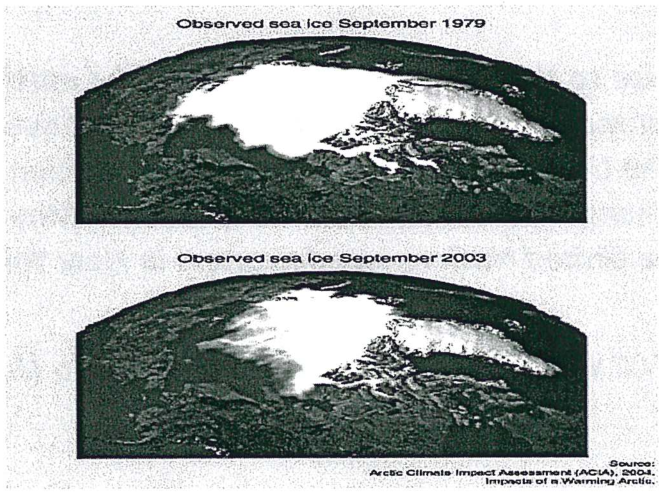

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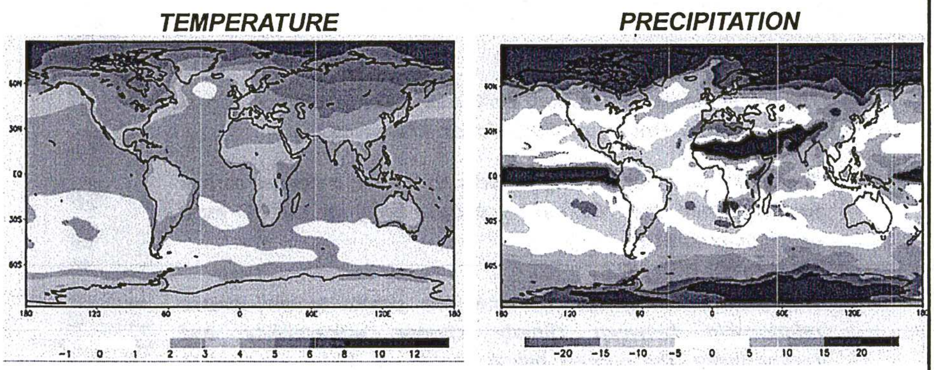

*Models' forecasts : **+1.4** to **+5.8 degrees** by 2100.*

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United Nations Framework Convention on Climate Change

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- ***In response to the scientific findings that the earth is getting warmer and may lead to irreversible adverse impacts, the United Nations Framework Convention on Climate Change (UNFCCC) was adopted on May 9, 1992 at the United Nations Headquarters in New York.***

- ***The UNFCC was signed in Earth Summit" in Rio (June 1992)***

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United Nations Framework Convention on Climate Change

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CONVENTION'S OBJECTIVE

Seeks to stabilize atmospheric concentration of greenhouse gases " at a level that would prevent dangerous anthropogenic [human-induced] interference with the climate system".

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GENERAL COMMITMENT

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All Parties to develop "national communications" containing inventories of GHG emissions by source and GHG removals by sinks.

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United Nations Framework Convention on Climate Change

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- ***Contains 2 annexes:***

Annex 1: countries with obligations to take measures to mitigate the effects of climate change

Annex 2: countries with obligations to provide financing to developing countries for their obligations under UNFCCC

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THE KYOTO PROTOCOL

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- *A global legal instrument (international agreement) to protect the climate system and stabilize GHG emissions*
- *Adopted at third Conference of Parties (COP) to the UNFCCC in Kyoto in 1997*
- *Comes into force when 55% of the global CO2 emissions are covered by Kyoto-ratifying countries*

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THE KYOTO PROTOCOL

THE KYOTO PROTOCOL FLEXIBILITY MECHANISMS

- *EMISSIONS TRADING*
- *JOINT IMPLEMENTATION*
- *CLEAN DEVELOPMENT MECHANISM*

What Annex I countries can do

4 options

1/ Pay expensive fines.

2/ Carry out carbon reduction through processes improvement.

3/ Buy emissions credits on the CO_2 market (ETS).

4/ Carry out carbon reduction through technology transfers in CDM or JI project.

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Emissions Trading (ET)

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Permits countries to transfer parts of their "allowed emissions" (assigned amount units)

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Joint Implementation (JI)

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Allows countries to claim credit for emission reductions that arise from investment in other industrialized countries, which result in a transfer of equivalent "emission reduction units" between the countries.

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Clean Development Mechanism (CDM)

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Allows emission reduction projects that assist in creating sustainable development in developing countries to generate "certified emission reductions" (CERs) for use by the investor.

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How the CDM Works

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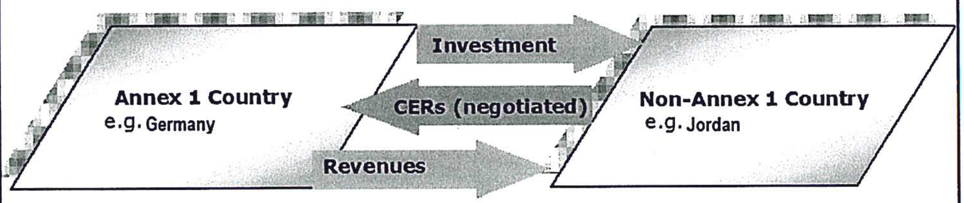
- *Annex I country invests in GHG reduction project in non-Annex I country*
- *Annex I country receives CERs*
- *Non-Annex I country receives revenues from CERs*



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Objectives of the CDM

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- *Assists non-Annex 1 countries in achieving their sustainable development objectives*
- *Enables Annex 1 parties in achieving compliance with their quantified emissions limitation and reduction commitments (QELRC)*
- *Investors benefit by obtaining GHG emission reduction credits*

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Objectives of the CDM

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- *Host countries benefit in the form of investment, access to better technology, and local sustainable development*
- *Developing countries will benefit from the project activities resulting in certified emission reductions (CERS) and developed countries will benefit by using the CERs to meet their commitments.*

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A Case Study of Jordan

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Overview

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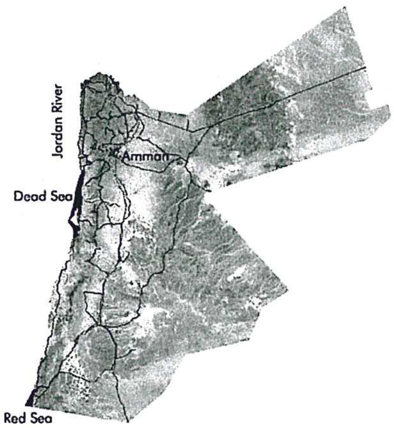

- ***Area: 92,300 km2***
- ***Population: 6.4 million (2010)***
- ***Growth Rate: 3.6%***
- ***Percent of Youth: 70% (less than 30 yr)***
- ***Climate: Mediterranean to Arid***

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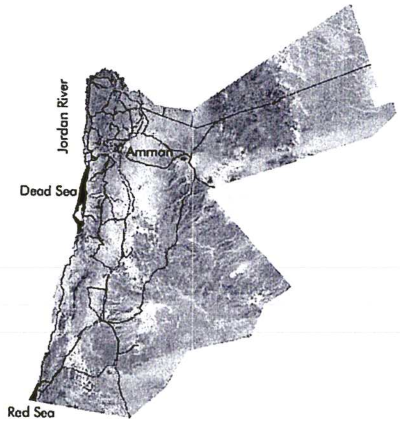

- ***Rainfall: 80% of the country receiving less than 100 mm of rain annually***
- ***Evaporation: 92.5% of water is lost to evaporation***
- ***Water Scarcity: Jordan is a "Water Scarce" country***
- ***Water Scarce Country is one with less than 1000 cubic meters of fresh water per person per year (FAO,1997)***

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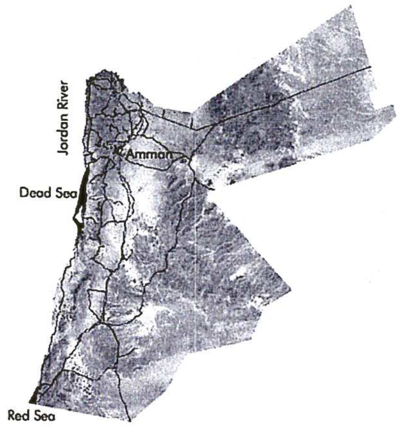

- ***Jordan is recognized as one of the ten most water deprived countries in the world.***
- ***Total water withdrawal per capita: Water withdrawal is the quantity of water removed from available sources for use in any purpose***
- ***Comparison: (Per Capita Use)***
  - ***Jordan : 140 m3 /c/year***
  - ***USA : 1,550 m3 /c/year***

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Overview of country's GHG emissions

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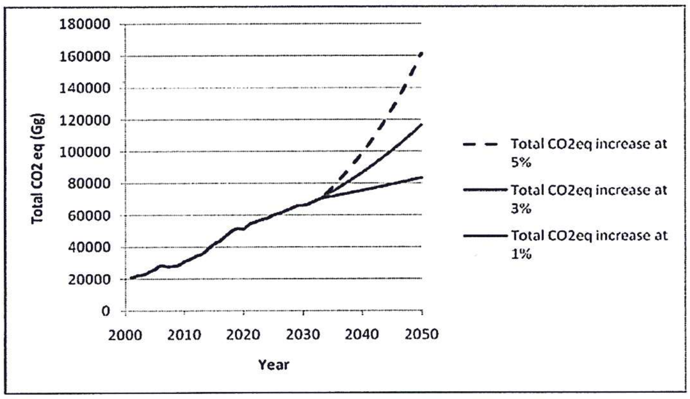

Projected greenhouse gases that will be emitted by all sectors in Jordan up to the year 2050

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Overview of country's GHG emissions

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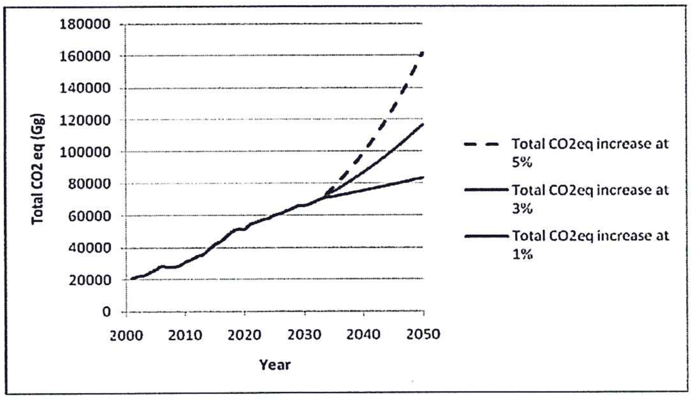

The mid scenario is based on the assumption that the emissions will continue increasing at the current rate

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Overview of country's GHG emissions

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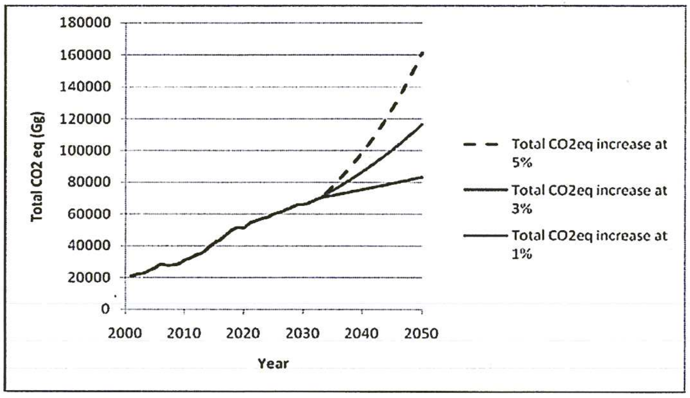

the upper bound scenario assumes that the economic growth will take place at a higher rate from the current which will be reflected on the emissions level

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Overview of country's GHG emissions

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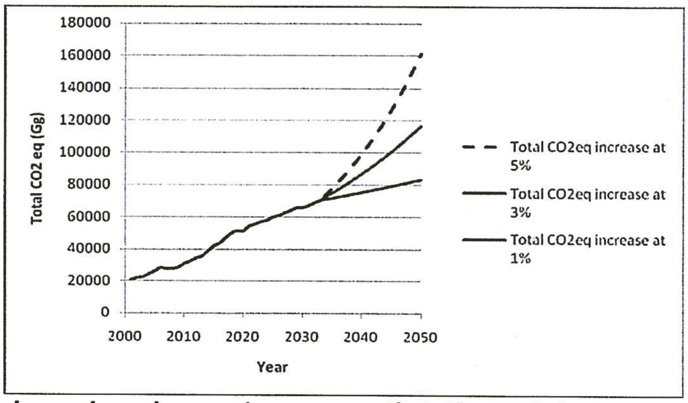

The lower bound scenario assumes that the emissions rates will be decreased as a result of economic recession and adoption of mitigation measures

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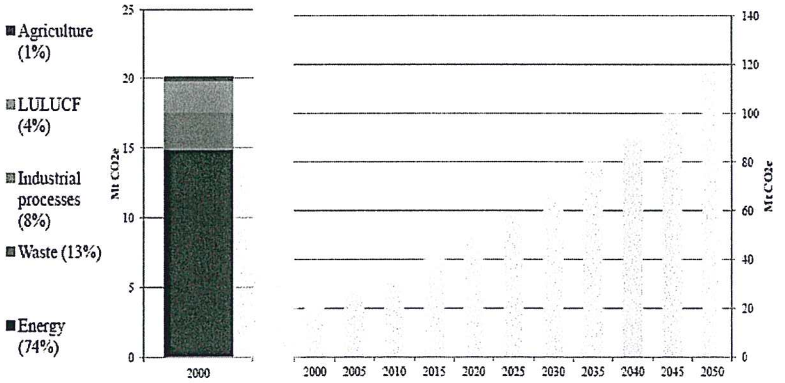

At current emissions growth rate (3%), emissions will quadruple by 2050

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Overview of country's GHG emissions

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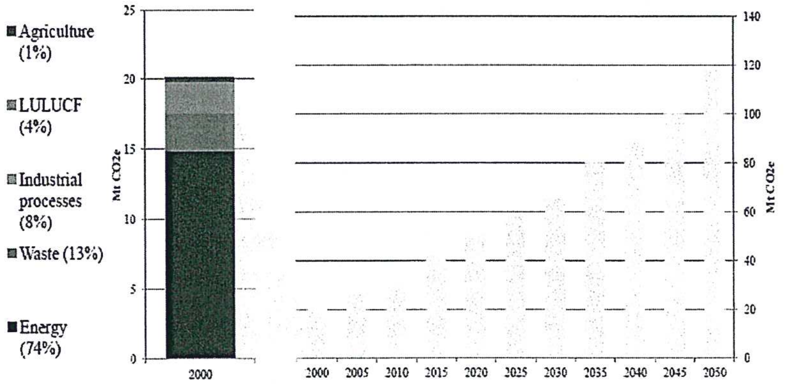

The energy sector is most important contributor to GHG emissions

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Overview of country's GHG emissions

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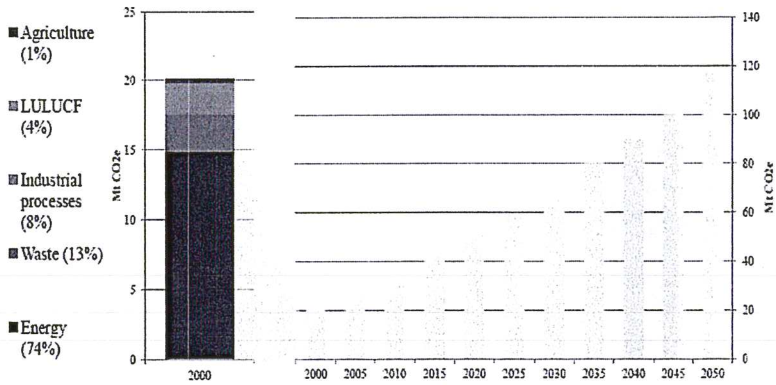

Water Authority is the largest electricity consumer in Jordan, consuming approximately 14% of total electricity consumption

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Climate Change Policy context in Jordan

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Date	Milestones
12 November 1993	Signature of the United Nations Framework Convention on Climate Change (UNFCCC)
1997	Submission of the 1st National Communication
17 January 2003	Ratification of the Kyoto Protocol
2005	Creation of the Designated National Authority (DNA)
2009	Submission of the 2nd National Communication
2010	National Environmental and Economic Development Study (NEEDS) for Climate Change -Baseline until 2050, mitigation costs, barrier analysis
by end-2013	3rd National communications to the UNFCCC - Updated inventory

Main Institutional Stakeholders

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The Ministry for Environment (MoE)

The DNA and its organization

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Main Institutional Stakeholders

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The Ministry for Environment (MoE):

- *Established in the year 2003*
- *Main governmental body concerned with the development and implementation of environmental policy in Jordan*
- *The MoE considers itself as a partner to the Clean Development Mechanism CDM projects, as 15% of the CERs generated from the project are directed to the Ministry's Environment Protection Fund.*

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Main Institutional Stakeholders

Technische Universität Braunschweig

EXCELLENCE CENTER FOR DEVELOPMENT COOPERATION SUSTAINABLE WATER MANAGEMENT

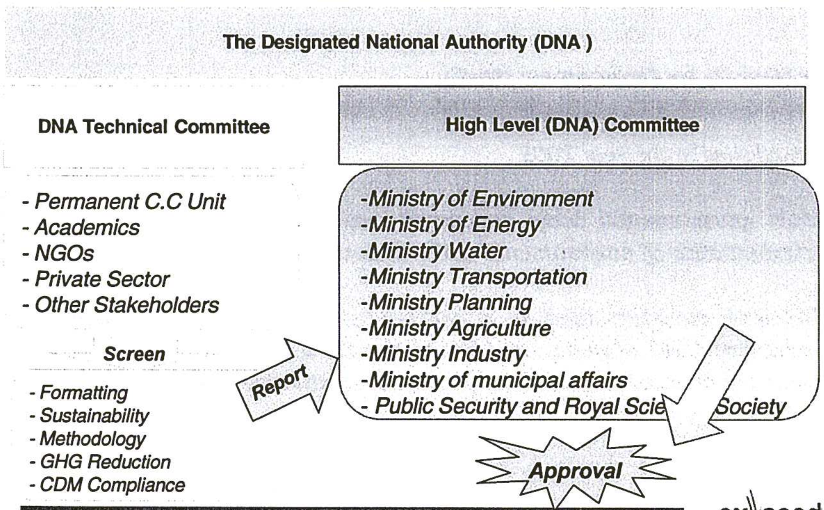
The DNA and its organization:

- *Identifying and approving CDM projects*

Main Institutional Stakeholders

Technische Universität Braunschweig

EXCELLENCE CENTER FOR DEVELOPMENT COOPERATION SUSTAINABLE WATER MANAGEMENT



Current CDM Status in Jordan

Technische Universität Braunschweig

EXCELLENCE CENTER FOR DEVELOPMENT COOPERATION SUSTAINABLE WATER MANAGEMENT

There has been no specific work on CDM potential estimation in Jordan, But there are 5 areas for GHG mitigation:

- *Renewable energy*
- *Primary energy*
- *Energy efficiency*
- *Waste*
- *Agriculture*

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Energy efficiency

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Carried out by the Ministry of Energy and Mineral Resources (MEMR) and the National Energy Research Centre (NERC)

- *Industrial*
- *Commercial*
- *Residential*

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Energy efficiency

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Yearly emission reduction potential for EE projects

Project name	Emission reduction per year (1000 tCO_2e)	Unit Cost (JD / tCO_2e)
Ceramic factories	17	-245
Food factory	176	-125
Insulation/food factory	31	-251
Waste heat rec./hotel	31	-251
Winter pool/hotel	16	-259
Medical factory/ballast	88	-160
Canning factory/compressed air	139	-68
Solar heating/hotel	13	-234
CF lamps/residential	427	-55
Variable speed drive in pumps/paper factory	73	-74
Steel factory/reg. burners	220	-98
Mining industry/heat recovery	408	-61
Total	1,639	-90

Source: Expert estimation from the 2nd national communication, 2010

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Renewable energy

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Yearly emission reduction potential for RE projects

Project name	Emission reduction per year (1000 tCO_2e)	Unit Cost (JD / tCO_2e)
Aqaba wind farm	117	89
Kamsha wind farm	78	88
Al-Hareer wind farm	520	70
Ibrahimya wind farm	65	101
Fujaij wind farm	275	98
Ma'an wind farm	328	95
Solar water heaters	72	-189
Total	1,453	72

Source: Expert estimation from the 2nd national communication, 2010

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Primary energy consumption

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Yearly emission reduction potential for primary energy projects

Project Name	Emission reduction per year (1000 tCO_2e)	Unit Cost (JD[18]/ tCO_2e)
Demand side management	299	-28
Natural gas network/Aqaba	107	-6
Natural gas network/Zarqa	250	-5
Natural gas network/Amman	275	-7
Conversion of Samra power plant to combined cycle	128	-26
Total	706	-14

Source: Expert estimation from the 2nd national communication, 2009

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Current CDM Status in Jordan

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Cumulated emission reduction potential during the period 2009-2033

Sector	Emission reduction (1000 tCO_2e)	Emission reduction (%)
Primary energy (fuel switch)	21,181	21.0%
Energy efficiency	32,758	32.5%
Renewable Energy	27,068	26.9%
Waste water	17,862	17.7%
Municipal solid waste	1,670	1.7%
Agriculture	190	0.2%
Total	100,729	100%

Source: RECREE calculation from the 2nd national communication, 2009

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Legal, financial and institutional barriers

EXCELLENCE CENTER FOR DEVELOPMENT COOPERATION SUSTAINABLE WATER MANAGEMENT

- *Insufficient awareness of CDM. For example, there is no national dedicated Website for CDM that can promote the CDM project pipeline, give information to potential project holders on the opportunities given by CDM, explain the development procedures of the CDM projects, etc.*
- *Lack of trust from potential project holders on CDM*
- *Lack of capacities and financial sustainability of DNA*
- *No real economic incentives that promote CDM (e.g. tax exemptions, fiscal benefits, etc.). Moreover, there is a tax of 15% on CDM revenues, which limits additionally the attractively of CDM for project holders*

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Legal, financial and institutional barriers

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- *In addition to the capacity building requirements, to overcome these barriers it is necessary to:*

- Strengthen the capacity of the DNA towards better responsiveness, sustainability, efficiency and transparency

- Reform of the legal and institutional framework of the CDM

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Legal, financial and institutional barriers

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- Remove the CDM revenues tax (15%) to make CDM more attractive for project holders; and

- Promote the development of EE and RE strategies so as to encourage CDM expansion.

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Working Group "Water Reuse, New Sanitation Systems and Climate Change"

Daniel Klein

Given is an imaginary country with the following characteristics:

1) Demographic data & background

- Population: 25 Mio.; 75% living in cities; 25% living in rural areas and towns
- Area: 500.000 km²;
- Population density high in and around bigger cities; very low (< 10 Inh./km²) in rural areas
- Rapid urbanisation/city growth within the last 15 years (increase of urban population from 45% to 75%)
- No "megacities", but some cities with 1-2 Mio. Inh.
- Work situation: 35% industry, 50% service, 15% agricultural sector

- Agricultural production focused on supply of the own population, almost no export of "cash crops". Most of the country is semiarid; water is needed for artificial irrigation in summer
- Annual rainfall: 350 mm in winter (3-4 months), no rainfall in summer
- Temperatures: Hot and dry in summer; temperate-warm in winter

2) Water supply

Cities:

- Water supply by surface water, mainly barrages (collection and storage of rainwater)
- Existing (old) water network in the inner cities; no network in the growing suburban areas
- In general, water availability for households is sufficient, but...
    - Water losses due to leaks in the water network
    - Illegal water withdrawal from the network, especially in the suburbs
- Water quality: Sufficient/good

Rural areas:

- No organised water supply. Some towns already have a water network; if not, water supply by wells, rainwater collection, river water etc.
- Water use conflicts households <> agriculture
- Water quality problems (pollution due to wastewater discharge, agriculture...), health problems

3) Wastewater situation

Cities:

- Existing sewage system in the cities. Wastewater discharge into the sea
- Apart from some pre-treatment facilities, ponds and wetlands, no organised wastewater treatment. Biological WWTP are currently constructed or planned in the main cities.
-

Rural areas:

- No "organised" wastewater collection and treatment. Some low-tech solutions for single households and towns (including sewer systems); but in general, wastewater is not treated and used directly in agriculture or discharged into the next river, causing eutrophication, health problems , pollution of the aquifers etc

4) Outlook until 2050

- Population growth: 1,5%/year
- Ongoing urbanisation process (from 75% to 90% in 2020)
- Higher standards of living in the urban areas
- Climate change: Slight increase of the temperatures in summer and winter
- Reduction of the average annual precipitation (about 15-20%) + higher variability of annual rainfall predicted

5) If the description of the imaginary country is incomplete, feel free to take additional assumptions, if needed!

Working Group:

There are 4 workshop groups, each focusing on one of the following "water-related" topics:

Group 1) Water supply in rural areas
Group 2) Wastewater treatment in rural areas
Group 3) Water supply in urban areas
Group 4) Wastewater treatment in urban areas

Each group shall discuss the following aspects and make a poster. The discussion should always be focused on the specific topic of your group!

- Description of the situation in the county with regard to the specific topic of your group
- Analysis of the situation: Is the situation stable/unstable/good/bad...? Is it comparable to own experiences? Are there additional aspects not mentioned in the text that are important?
- What are the (potential) consequences of the given situation, e.g. with regard to health, economy, ecology, social aspects...
- How do demographic and climatic changes during the next decades influence the situation? Will the situation improve? Will there be additional problems?
- ...
- **What strategies do you propose to improve the current/the predicted situation? What are the advantages and disadvantages? Do you prefer low-tech- or high-tech solutions? What has to be done concerning education, public awareness...? Do you have any own experiences?**

11.00 – 12.30: Discussion in 4 groups
14.00 – 15.30: Discussion and poster preparation
15.30 – end: Discussion of posters

Braunschweig Water Declaration for Middle East Countries

- November 2002 -

Experts from Middle East Countries and Germany held a workshop at the Technische Univesität Braunschweig from October 28 to November 1, 2002 in order to discuss and to develop appropriate solutions for urgent problems of water management in the Middle East Region. The following twelve items are proposed as an alternative approach to current strategies dealing with water related issues. For this, an intense dialogue is necessary between western and eastern experts in charge with development cooperation in all terms of technological, scientific, economic, political, social and education aspects.

I - Present Situation

1. Due to regional and climatic conditions the water supply in most of the Middle East Countries is very critical.
2. The population growth, rural exodus, and the resulting urbanization aggravate the problem. Therefore, in some of these countries the water crisis becomes serious.
3. Besides, water is unevenly distributed in global, regional, and local terms. The situation becomes dramatic through the sectoral shift of water use as a consequence of increasing production of cash crops in agriculture, industrialization, and increasing domestic consumption.
4. Due to these reasons, distribution conflicts evolve that can be of transnational, social, and trans-sectoral dimensions.
5. The existing systems of water recovery, distribution, treatment, and disposal are not only insufficient, but also outdated. This is why additional losses occur through evaporation and leakages.
6. The present strategies to mitigate the water scarcity are pointed either towards development of fossil water resources through deep well drilling or towards collection of surface waters by dams and canal systems, which are transported even over long distances. This strategy often leads to aggravating the already existing water distribution conflict.

II - Proposal for a sustainable problem solution

7. Besides the sustainable utilization of fresh water, a partial solution strategy of the above mentioned problems could be an appropriate collection, treatment, and reuse of reclaimed wastewater.
8. Considering the limited financial resources, it is often not advisable to invest in the most advanced wastewater treatment plants, but instead to use less expensive technologies that are best adopted to the conditions of the countries. Even though these wastewater treatment plants may not produce drinking water quality, in many cases this water is sufficient for irrigation purposes in agriculture.
9. The prerequisite for this alternative strategy of enhancing the available fresh water volume is a comprehensive infrastructure planning that considers water supply as well as wastewater treatment and reuse equally.
10. This alternative strategy provides many advantages. In terms of economic aspects, a less expensive contribution to mitigate the problems of water scarcity is made; in terms of sanitation, the hygienic situation is improved; from the viewpoint of sustainability, the overexploitation of fossil groundwater is reduced. Furthermore, sewage sludge produced can be used as fertilizer and soil conditioner. Last but not least, an important contribution to overcome social conflicts of distribution of scarce resources can be reached.

11. In order to successfully introduce the strategy of multiple use of water, supporting measures must be taken as well. Policy objectives must be developed towards ensuring that interests of the stakeholders of the outdated system of water provision and distribution do not prevent the introduction of multiple use measures. It has to be taken into account that considerable profits are made in the water sector. Prices must reflect the production costs of the reclaimed wastewater. That does not exclude that different pricing could be made for different qualities and varying use pattern. An appropriate education of operators of reclaimed wastewater facilities must be ensured. Finally, issues of sustainability and environmental awareness must be disseminated among the people. For doing this, programs for further education and trainings as well as environmental classes in primary and secondary schools must be developed and applied.

12. The following items should be ensured over short-, middle-, and long-term:
    - Transfer of efficient, less expensive, and sustainable technologies;
    - Political and juridical solutions for the above mentioned problems on international, national, regional, and local levels;
    - Establishment of a market-oriented water management system;
    - Declaration of water as an international common good that is limited and, therefore, has to be protected and preserved.

The "Braunschweig Water Declaration" was approved by the participants of the International and Interdisciplinary Workshop on "Intercultural Problems of Technology Transfer to the Middle East, exemplified on Water and Wastewater Issues" on October 28, 2002 at the Technische Universität Braunschweig.

Prof. Dr. Hisham Aly (Egypt), Prof. Dr. Mahmoud Alawi (Jordan), Assoc. Prof. Dr. Mehmet Emin Aydin (Turkey), Mufeed Batarseh, MSc (Germany/Jordan), Prof. Dr. Müfit Bahadir (Germany), Prof. Dr. Nasim Barham (Jordan), Prof. Dr. Norbert Dichtl (Germany), Dr. Isam El-Laythy (Sudan), Prof. Dr. Hasim Karpuz (Turkey), Prof. Dr. Ulrich Menzel (Germany), Dr. Uwe Moshage (Germany), Dr. Fawzy Naji (Germany), Assoc. Prof. Dr. Gernot Strey (Germany), Dr. Abdul-Karim Thabet (Yemen)

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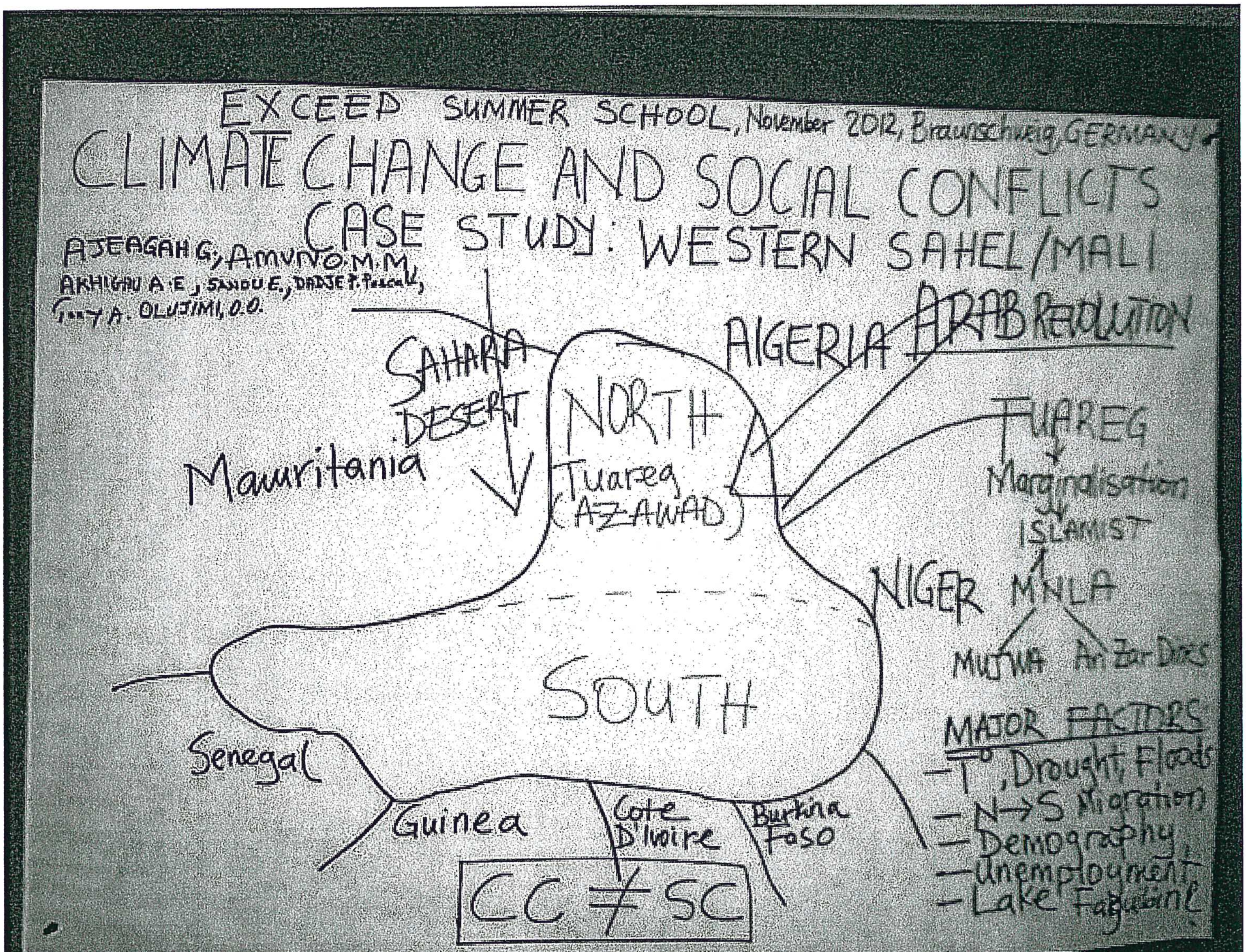
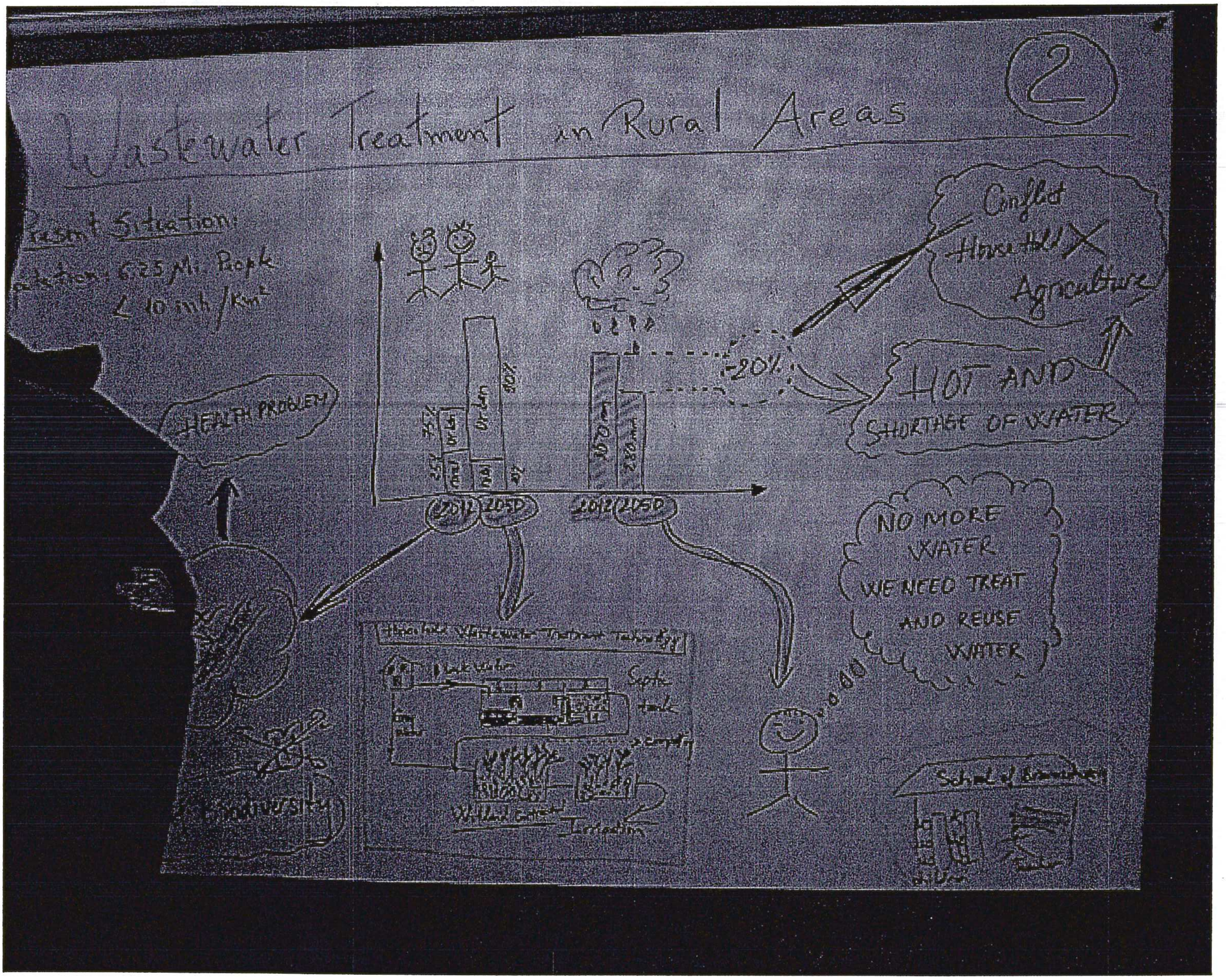
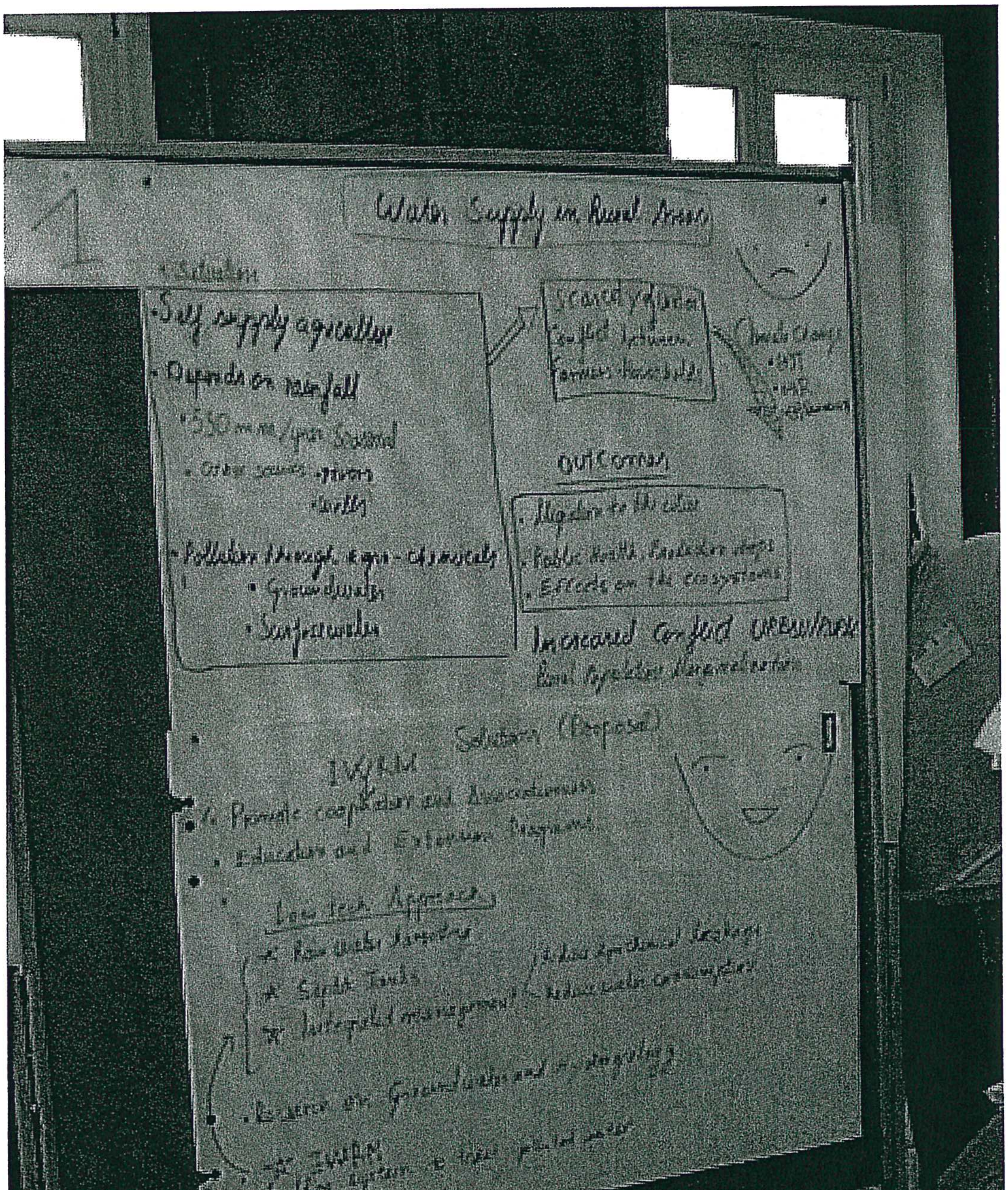


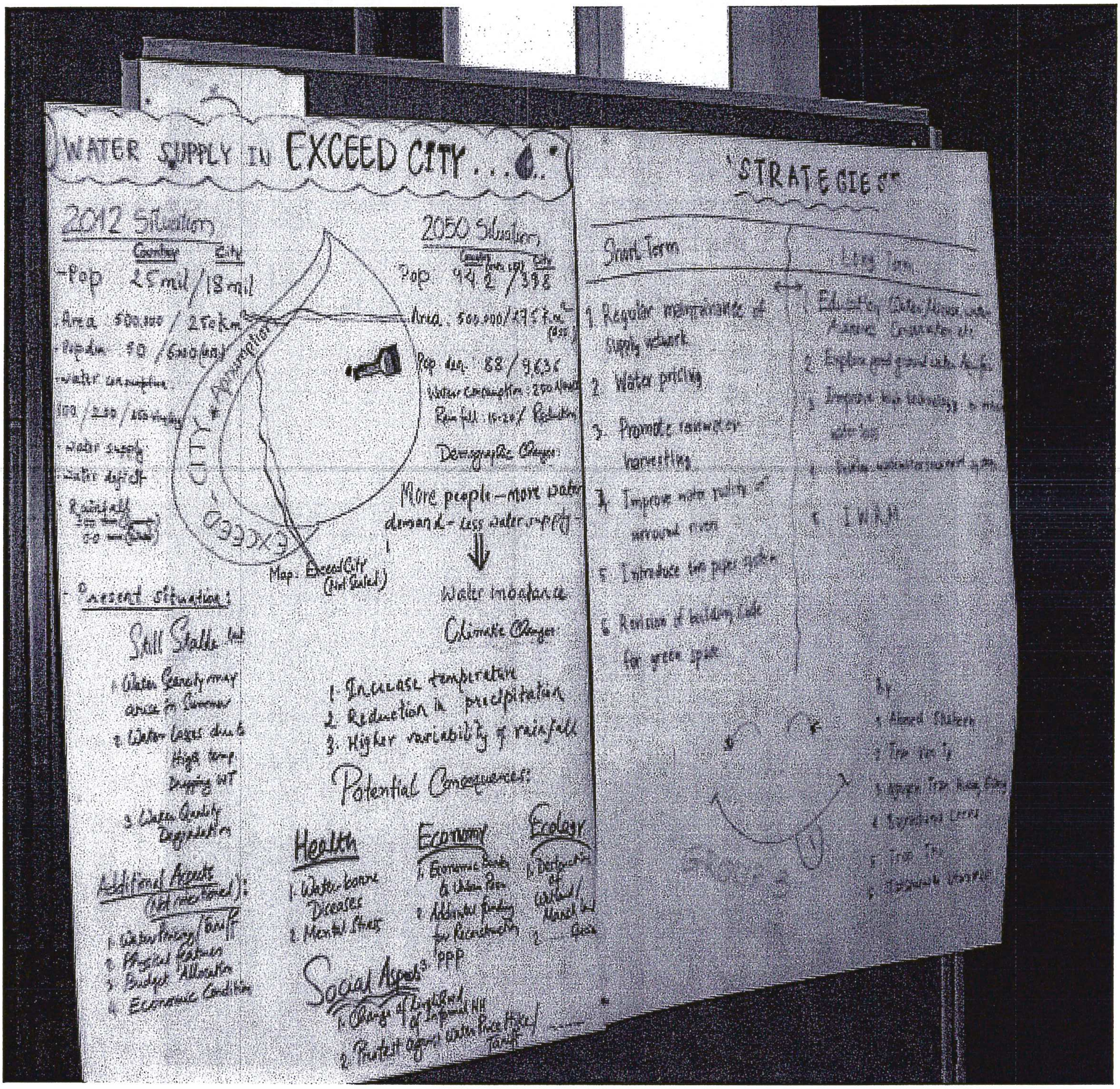
EXCEED SUMMER SCHOOL, November 2012, Braunschweig, GERMANY
CLIMATE CHANGE AND SOCIAL CONFLICTS
CASE STUDY: WESTERN SAHEL/MALI
AJEAGAH G., AMUVNO M.M, AKHIGHU A.E., SANOU E., DADJE
OLUJIMI, O.O.
SAHARA DESERT
ALGERIA
ARAB REVOLUTION
NORTH
Tuareg (AZAWAD)
Mauritania
TUAREG
Marginalisation
ISLAMIST
NIGER
MNLA
SOUTH
MAJOR FACTORS
- T°, Drought, Floods
- N→S Migration
- Demography
- Unemployment
- Lake Faguibine
Senegal
Guinea
Cote D'Ivoire
Burkina Faso
CC ≠ SC



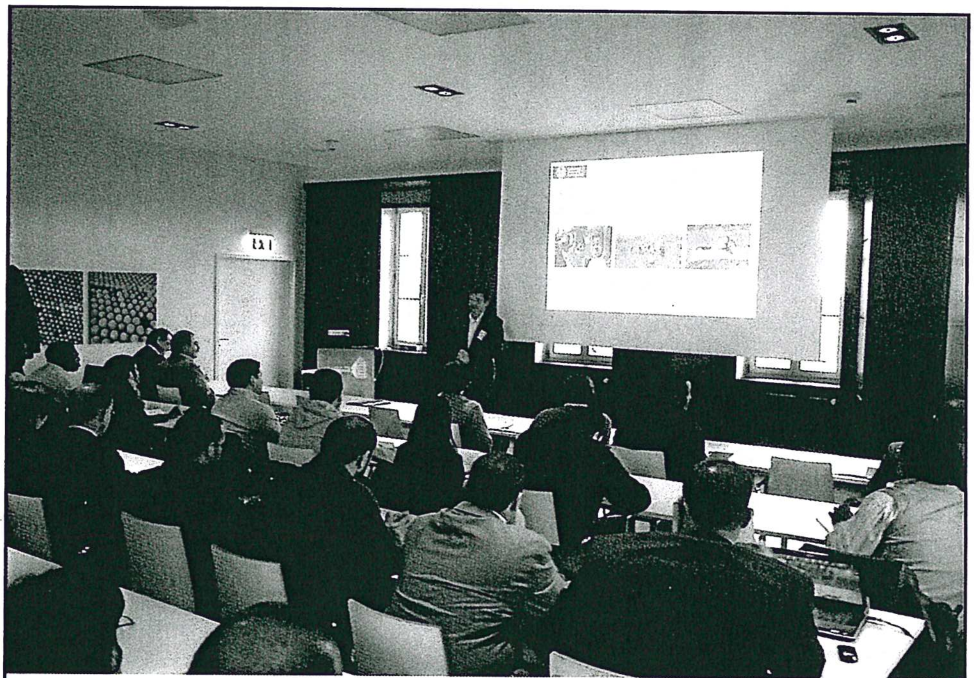
Wastewater Treatment in Rural Areas
2
Present Situation:
Conflict
House Hold X Agriculture
-20%
HOT AND
SHORTAGE OF WATER
HEALTH PROBLEM
2012
2050
2012
2050
NO MORE
WATER
WE NEED TREAT
AND REUSE
WATER



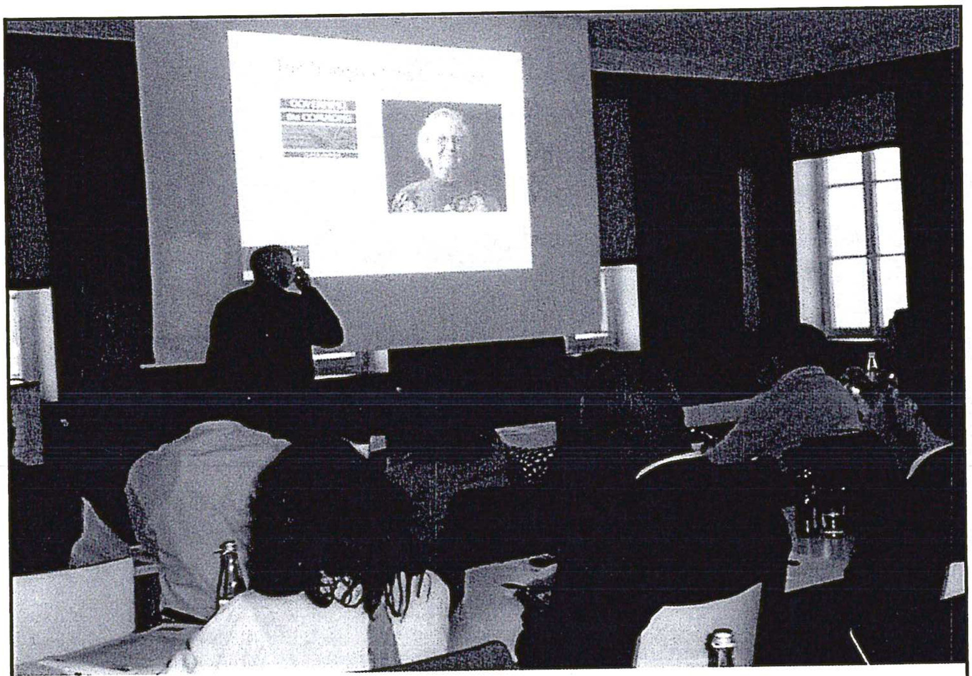
Water Supply in Rural Areas
Situation
Self supply agriculture
Depends on rainfall
550 mm/year Seasonal
Other sources
Wells
Groundwater
Surfacewater
Outcomes
Effects on the ecosystems
Increased Conflict
Solutions (Proposal)
IWRM
Education and Extension Programs
Low tech Approach
Septic Tanks
IWRM


WATER SUPPLY IN EXCEED CITY ...
2012 Situation
Pop 25 mil / 18 mil
2050 Situation
STRATEGIES
Short Term
Long Term
1. Regular maintenance of supply network
2. Water pricing
3. Promote rainwater harvesting
4. Improve water quality of surround river
5. Introduce two pipe system
6. Revision of building code for green space
5. I.W.R.M.
More people - more water demand - less water supply
Water imbalance
Climate Changes
1. Increase temperature
2. Reduction in precipitation
3. Higher variability of rainfall
Potential Consequences:
Health
1. Water-borne Diseases
2. Mental Stress
Economy
Ecology
Social Aspects
Present Situation:
Still Stable but
Additional Aspects
1. Water Pricing / Tariff
2. Physical Features
3. Budget Allocation
4. Economic Condition
Map: Exceed City (Not Scaled)
EXCEED CITY
Demographic Changes

Opening Ceremony 5.11.2012 (left Prof. Jahn, right Prof. Bahadir)

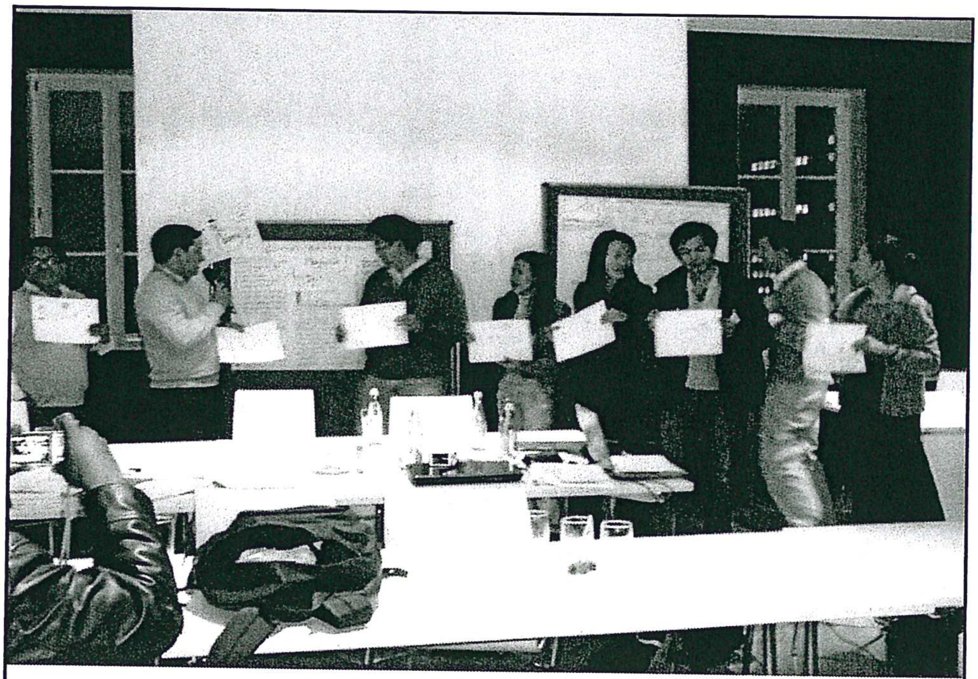


Opening Ceremony 5.11.2012 (infront Dr. Andreas Haarstrick)

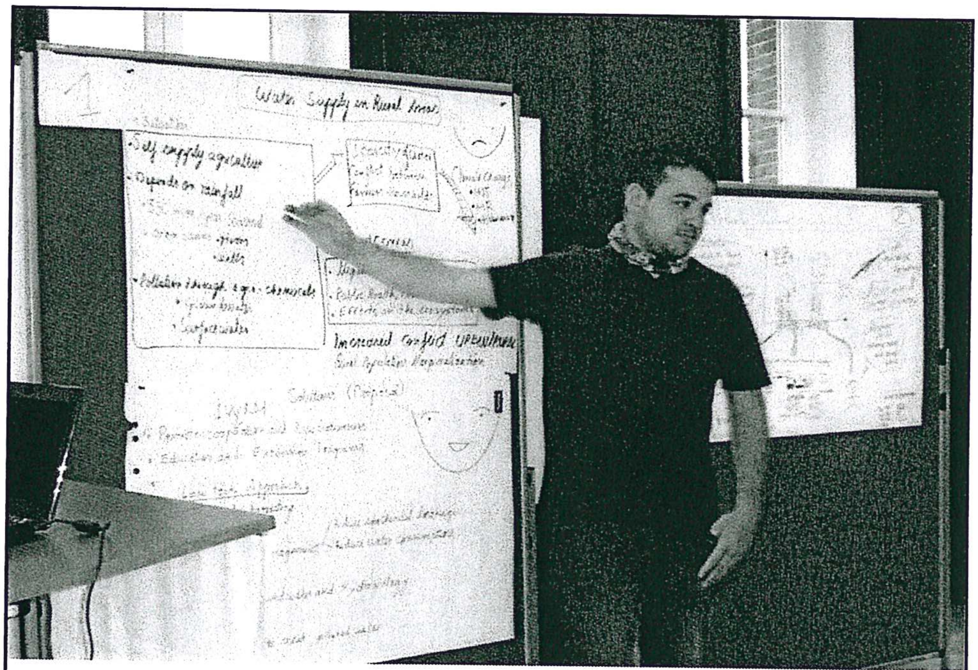


The Tragedy of the Commons 5.11.2012 (infront Prof. Menzel)

Working Group 7.11.2012

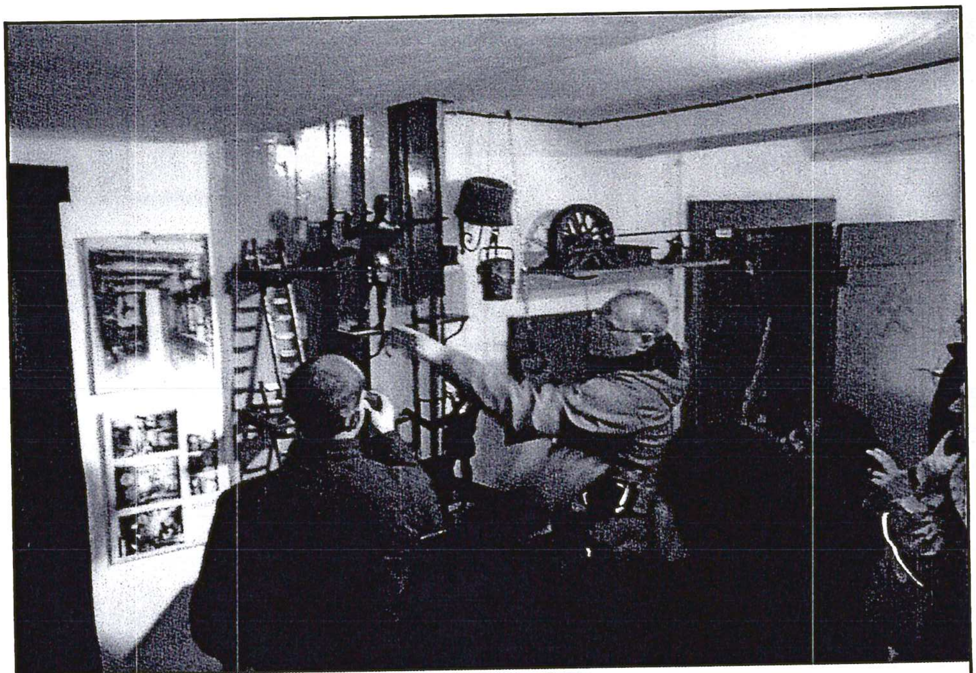


Working Group 7.11.2012

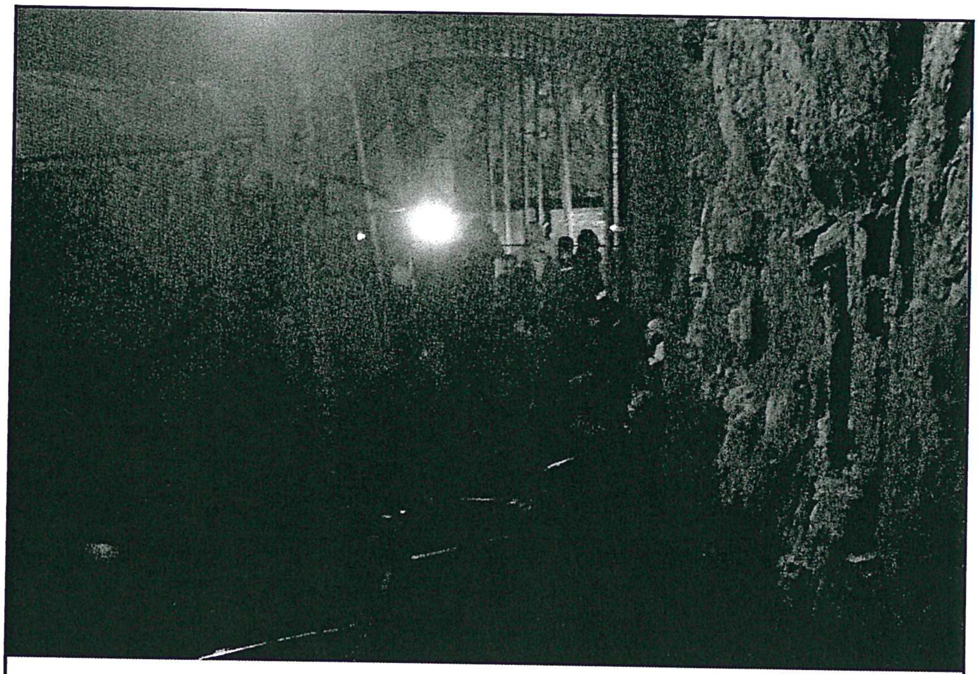


Working Group 7.11.2012

Harz Excursion 10.11.2012



Harz Excursion 10.11.2012



Harz Excursion 10.11.2012

Harz Excursion 10.11.2012

FORSCHUNGSBERICHTE
aus dem Institut für Sozialwissenschaften (ISW)

Das Institut für Sozialwissenschaften gibt Forschungsberichte heraus, die die Forschungsarbeiten der Mitarbeiter und Mitarbeiterinnen dokumentieren. Die Nummern 1-15 sind als Forschungsberichte des Seminars für Politikwissenschaft und Soziologie erschienen.

1. Krieger, Ingrid/Lompe, Klaus: Zur Lebenslage von Frauen in Arbeitsbeschaffungsmaßnahmen - ein Ost-West-Vergleich. Erste Interpretation empirischer Ergebnisse und Konsequenzen für die Instrumente des „zweiten" Arbeitsmarktes. November 1993. 2. Aufl. April 1994. 52 S.
2. Lompe, Klaus (Hrsg.): "Von der Automobilregion zur Verkehrskompetenzregion". Die Region als politisches und ökonomisches Handlungsfeld für die Steuerung politischer, sozialer und technologischer Innovationen. Januar 1994. 3. Aufl. April 1994. 52 S.
3. Vogel, Ulrike: Fachengagement und Studienerfolg bei Ingenieurstudentinnen und -studenten. Zur Entwicklung verallgemeinerungsfähiger Aussagen in einer qualitativen Studie. April 1994. 30 S.
4. Menzel, Ulrich: Der Flug des Drachen. Nachholende Modernisierung in Ostasien aus entwicklungspolitischer Perspektive. Mai 1994. 83 S. (vergriffen)
5. Lompe, Klaus/Blöcker, Antje/Lux, Barbara/Syring, Oliver: Neue Formen der Kooperation und der wissenschaftlichen Politikberatung in der Region - Wirkungen und Folgeaktivitäten des HBS-Projektes: "Regionale Bedeutung und Perspektiven der Automobilindustrie" unter besonderer Berücksichtigung der Gewerkschaften als regionale Akteure der Wirtschafts- und Strukturpolitik in Südostniedersachsen. September 1994. 125 S.
6. Hummel, Hartwig: Weltmacht wider Willen? Japan in der internationalen Politik der neunziger Jahre. Januar 1995. 40 S.
7. Lompe, Klaus (Hrsg.): "Perspektiven der Regionalisierung der Strukturpolitik in Niedersachsen". Dokumentation eines Workshops am 21.10.1994 in Braunschweig. Februar 1995. 103 S.
8. Lompe, Klaus/Warnecke, Dirk: "Die Verarbeitung von nachwachsenden Rohstoffen als Diversifikationsstrategie zur Beschäftigungssicherung in der Region Südostniedersachsen? - Dokumentation eines Symposiums am 9.2.1995 in Wolfsburg/Fallersleben. Juni 1995. 100 S.
9. Vogel, Ulrike: Zur Qualifikation von Studentinnen und Studenten der Ingenieurwissenschaften. Empirische Ergebnisse. September 1995. 40 S.
10. Gambe, Annabelle/Hummel, Hartwig/Menzel, Ulrich/Wehrhöfer, Birgit: Die Ethnisierung internationaler Wirtschaftsbeziehungen und daraus resultierende Konflikte. Entwurf eines Forschungsprojekts. Oktober 1995. 32 S. (vergriffen)
11. Hummel, Hartwig/Wehrhöfer, Birgit: Geopolitische Identitäten. Kritik der Ethnisierung einer sich regionalisierenden Welt als paradigmatische Erweiterung der Friedensforschung. Januar 1996. 33 S.
12. Lompe, Klaus/Mangels-Voegt, Birgit/Düsing, Ralf/Fricke, Gerald/Vlcek, Olaf: Zur Diskussion abnehmender Handlungsfähigkeit des Zentralstaates und der Rolle neuerdezentraler Verhandlungssysteme. Februar 1996. 136 S.
13. Menzel, Ulrich: Lange Wellen und Hegemonie. Ein Literaturbericht. Februar 1985. 2. Aufl. November 1996. 58 S.
14. Gambe, Annabelle: Overseas Chinese Entrepreneurship in Southeast Asia. November 1996. 145 S.
15. Vogel, Ulrike/Capello, Claudia: Zur Steigerung der „Attraktivität" des Ingenieurstudiums. Vorarbeiten zu einem empirischen Projekt. Dezember 1996. 45 S.
16. Hummel, Hartwig: „Japan Bashing". Die Ethnisierung der Handelsbeziehungen zu Japan im politischen Diskurs der USA. Februar 1997. 68 S. (vergriffen)
17. Wehrhöfer, Birgit: Der französische Migrationsdiskurs als Beitrag zur ethnischen Grenzziehung Europas. Februar 1997; 2. Aufl. Juli 1998. 87 S.
18. Menzel, Ulrich: The West Against the Rest. Samuel Huntingtons Rekonstruktion des Westens. Mai 1997; 3. überarb. u. erw. Aufl. August 2003. 42 S.
19. Lompe, Klaus/Schirmacher, Andrea/Warnecke, Dirk: Regionales Risikokapital und Existenzgründung. September 1997. 185 S.
20. Menzel, Ulrich unter Mitarbeit von Katharina Varga: Theorie der Internationalen Beziehungen: Einführung und systematische Bibliographie. Oktober 1997. 3. Aufl. Oktober 1998. 151 S.
21. Hummel, Hartwig: Der neue Asianismus. Die Ethnisierung der Handelsbeziehungen zu den USA im politischen Diskurs Japans. November 1997. 76 S.
22. Gambe, Annabelle: Competitive Collaboration: Western Liberal and Overseas Chinese Entrepreneurship in Southeast Asia. November 1997. 101 S.
23. Wehrhöfer, Birgit: Das Ende der Gemütlichkeit. Ethnisierung im deutschen Migrationsdiskurs nach dem Ende des Ost-West-Konflikts. November 1997. 121 S. (vergriffen)
24. Gambe, Annabelle/Hummel, Hartwig/Menzel, Ulrich/Wehrhöfer, Birgit: "Kampf der Kulturen" in den internationalen Wirtschaftsbeziehungen? Februar 1998. 2. Aufl. Oktober 1998. 95 S.

25. Vogel, Ulrike/Capello, Claudia/Meinel, Tanja/Brants, Oliver/Carsten, Ingo: Zum Interesse am Technikstudium bei Gymnasiastinnen und Gymnasiasten. April 1998. 91 S. (vergriffen)
26. Lompe, Klaus (Hrsg.): Verbundspezifische Projekte im Rahmen regionalisierter Strukturpolitik in Nordrhein-Westfalen. Dokumentation eines Workshops am 12.11.1998. Januar 1999. 59 S.
27. Dietz, Bernhard/Menzel, Ulrich: "Brandstifter" oder Anwälte des demokratischen Friedens? Die Rolle der Medien in bewaffneten Konflikten. Untersucht anhand politischer Entscheidungsprozesse der deutschen Bundesregierung in ausgewählten militärischen Konflikten der 1990 Jahre. Entwurf eines Forschungsprojekts. März 1999. 2. Aufl. Februar 2001. 34 S.
28. Vogel, Ulrike/Capello, Claudia /Meinel, Tanja/Brants, Oliver/Carsten, Ingo: Zur Steigerung der Attraktivität des Ingenieurstudium. Bericht über Maßnahmen im Studium. März 1999. 127 S.
29. Okfen, Nuria: Das Asia-Europe-Meeting – Eine neue Partnerschaft? März 1999. 2. Aufl. Januar 2000. 95 S.
30. Menzel, Ulrich: Jenseits des Staates oder Renaissance des Staates? Zwei kleine politische Schriften. März 1999. 2. Aufl. Januar 2000. 59 S.
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