The Impacts of Climate Change on Water for RE Production: the Bioenergy case

Status report on an ongoing R+D project

on behalf of the German **Federal Environment Agency (UBA)**

in cooperation with

Horst Fehrenbach
IFEU Institute for Energy and Environmental Research
Heidelberg - Germany

IEA – Workshop on Renewable Energy & Water
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Background

This presentation reports on current results of an ongoing R+D project*

"Development of strategies and sustainability standards for the certification of biomass for international trade“

Jointly performed by Öko-Institut and IFEU.

The project’s major objectives are:
- to specify some most essential sustainability criteria for bioenergy like as GHG saving, iLUC, biodiversity, and **water**,
- and to support corresponding processes at national and international level.

*Interims Report (R+D-No. 3707 93 100), Environmental Research Plan of the Federal Ministry for Environment, Nature Protection and Nuclear Safety. Commissioned by UBA, Federal Environment Agency of Germany

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Content

1. Biomass production – water – climate change: how are these items connected?
2. Climate change: impact on biomass productivity
3. Water and sustainable biomass production: What are the requirements by the EU RES-D? What does research recommend?
4. What might be an appropriate indicator? How could a scheme look like?

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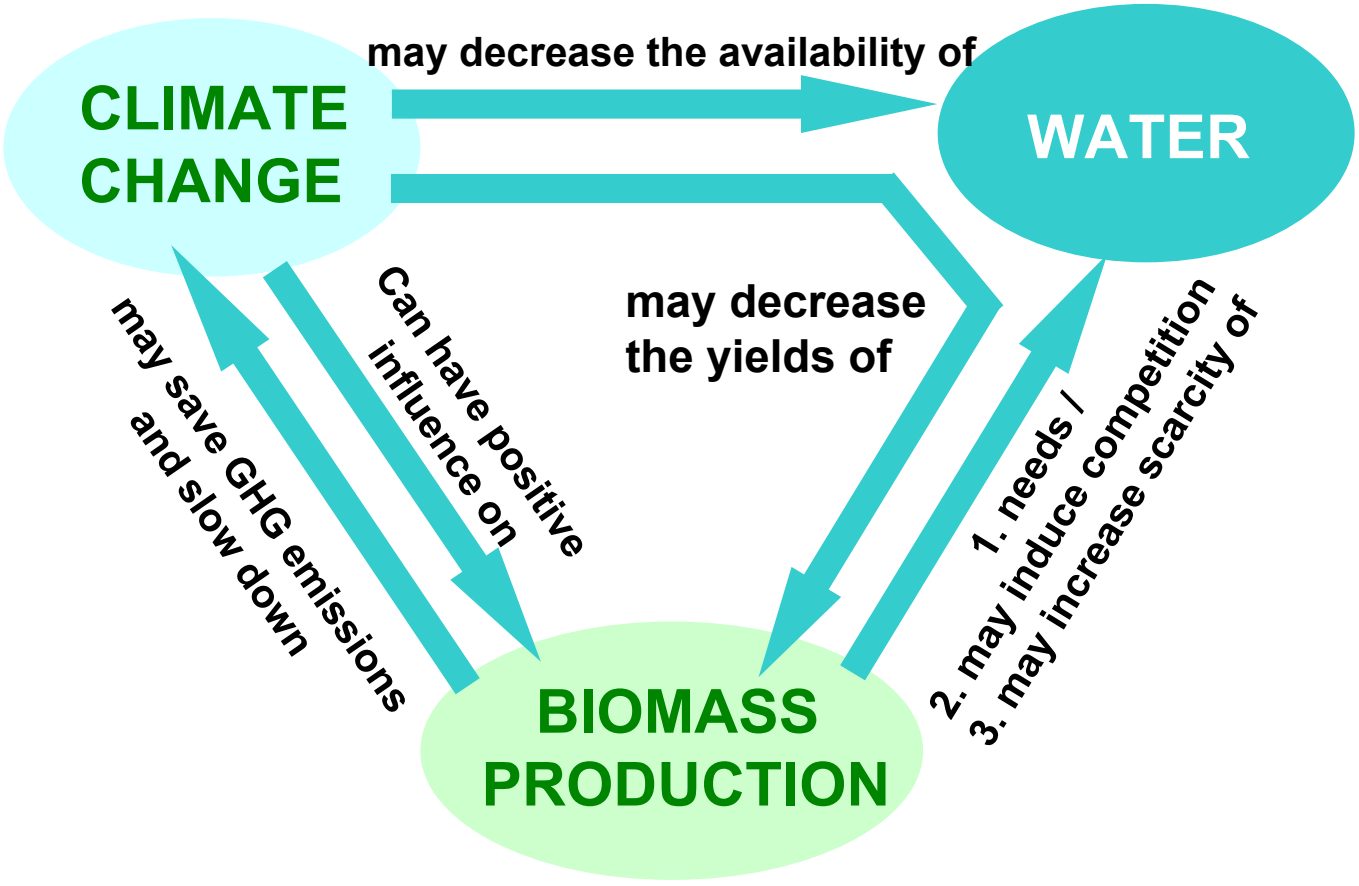
Biomass – water – climate change: how are these items connected?



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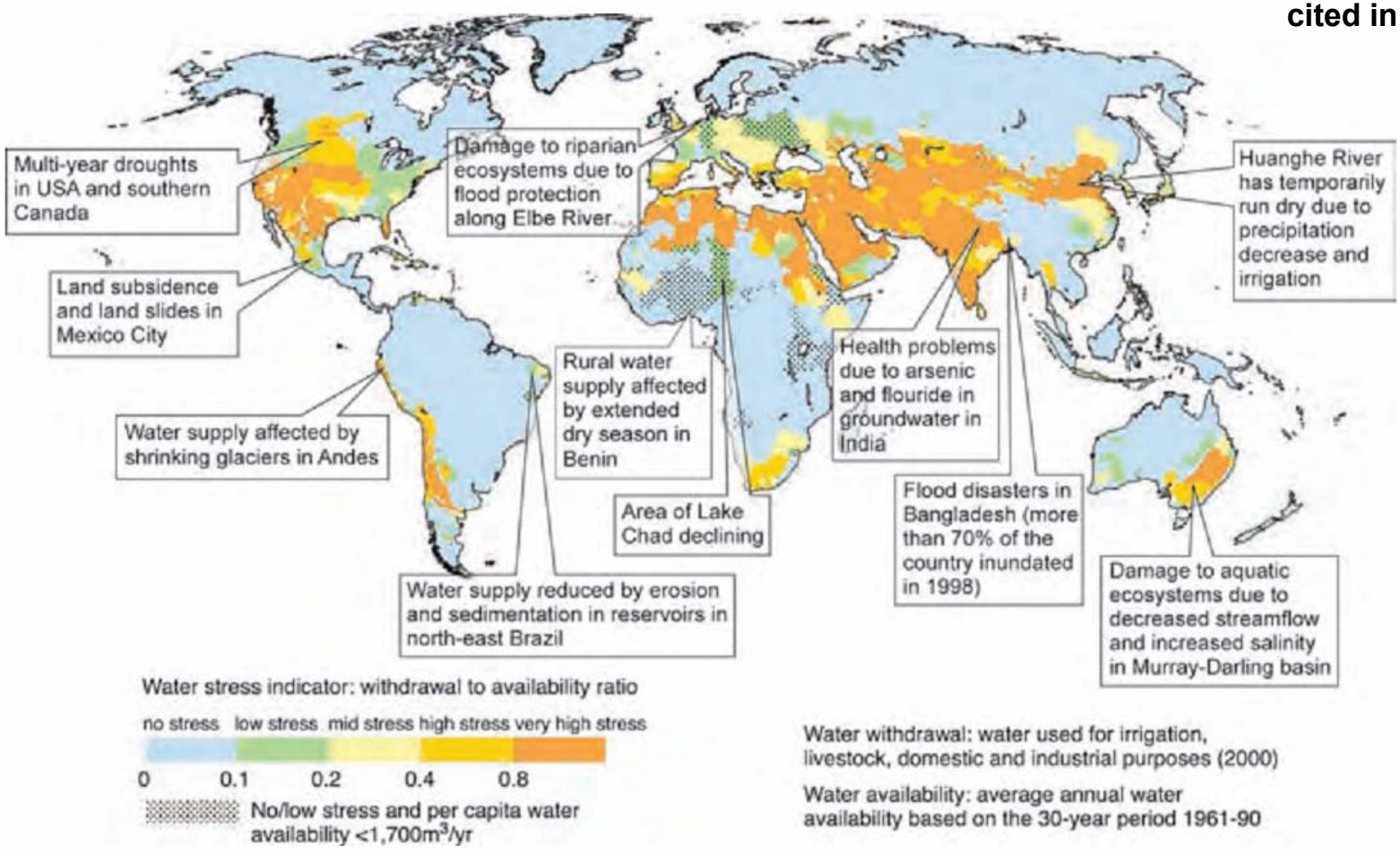
Climate change: impact on biomass productivity

Source: Alcamo et al. 2003 cited in IPCC 2008



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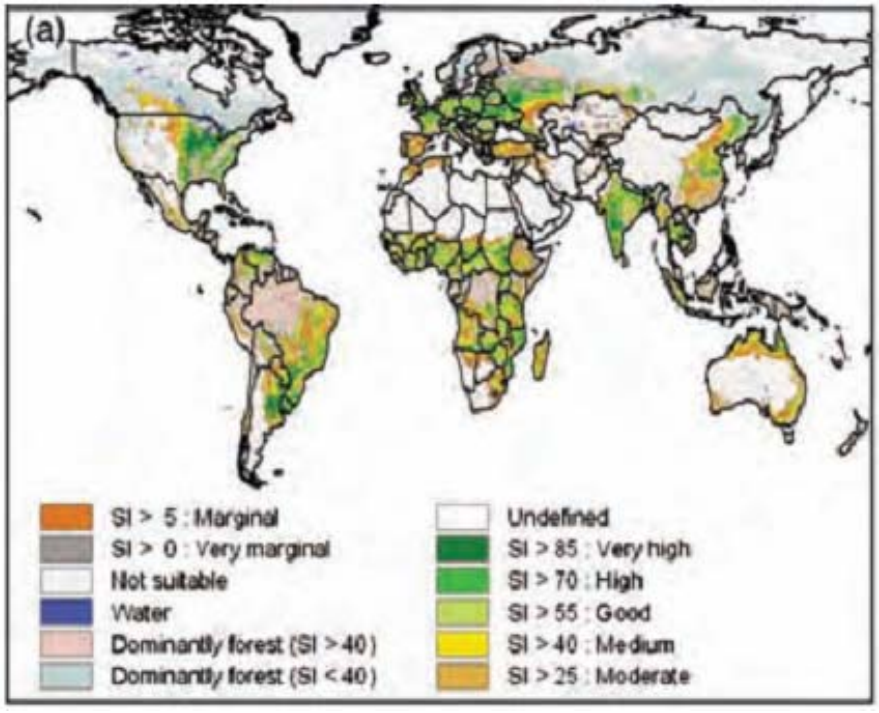
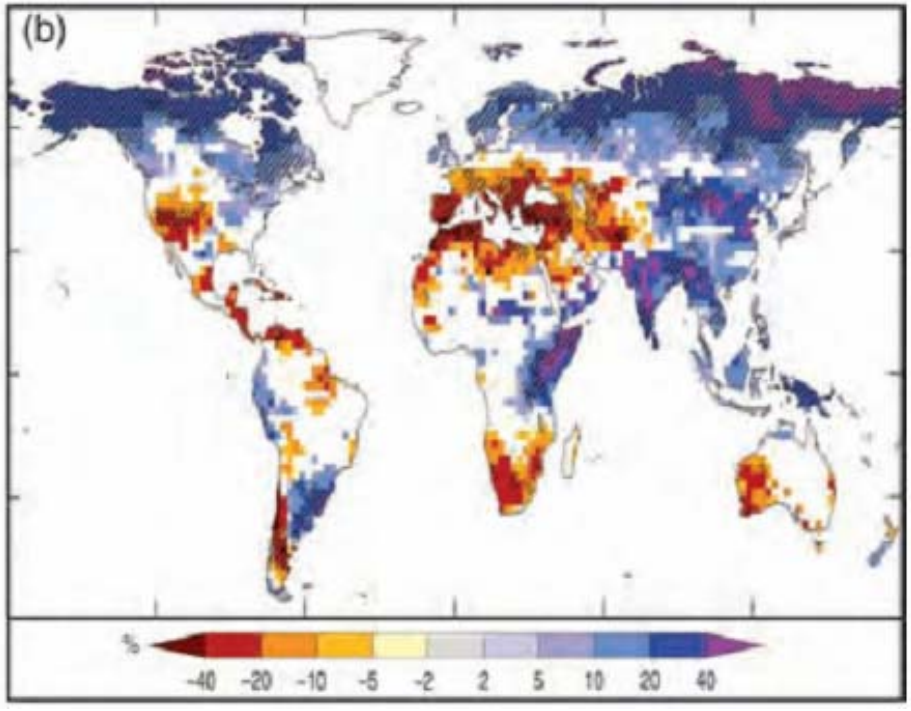
Climate change:
impact on biomass productivity

Source: IPCC 2008
Climate Change and Water



Current suitability for rain-fed crops (excluding forest ecosystems)



ensemble mean percentage projected change in annual mean runoff between the present (1980–1999) and 2090–2099.

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Climate change:
impact on biomass productivity

There is a number of studies

(some Examples cited by IPCC 2008:

- **Döll 2002:** estimated an increase in net crop irrigation requirements of between 5% and 8% globally by 2070, with larger regional signals (e.g., +15%) in south-east Asia.
- **Fischer 2006:** included positive CO_2-effects, however 20% increased need for irrigation by 2080; water stress increased in the Middle East
- **Abou-Hadid 2003:** underlined critical climate change/water dynamics in key irrigated areas, such as northern Africa (increased irrigation requirements)
- **Reilly 2003** and **Thomson 2005**: foresee a decrease in irrigated areas and withdrawals beyond 2030 under various climate scenarios in the USA.
- **FAO:** forsees for developing countries a 14% increase in irrigation water withdrawal by 2030.

Climate change:
impact on biomass productivity

According to the climate models:

→ There are regions with

a.) increasing biomass potential and

b.) many regions with decreasing potential and increasing physical water scarcity.

Water and sustainable biomass production

What are the requirements by the EU RES-D?

"… economic operators shall submit reliable information on measures taken for

- ***measures taken for soil, water and air protection***
- ***and the avoidance of excessive water consumption in areas where water is scarce …"***

(→ RES Directive Article 18, paragraph 3)

→ NO CRITERION, JUST REPORTING!

Central issue

0. *Climate might lead increase of water scarcity and water competition in several regions.*

1. **excessive water consumption by biomass production might worsen water scarcity.**
   → *need for a scheme to identify excessive water consumption*

2. **Areas where water is scarce need to be classified.**
   → *need for an indicator*

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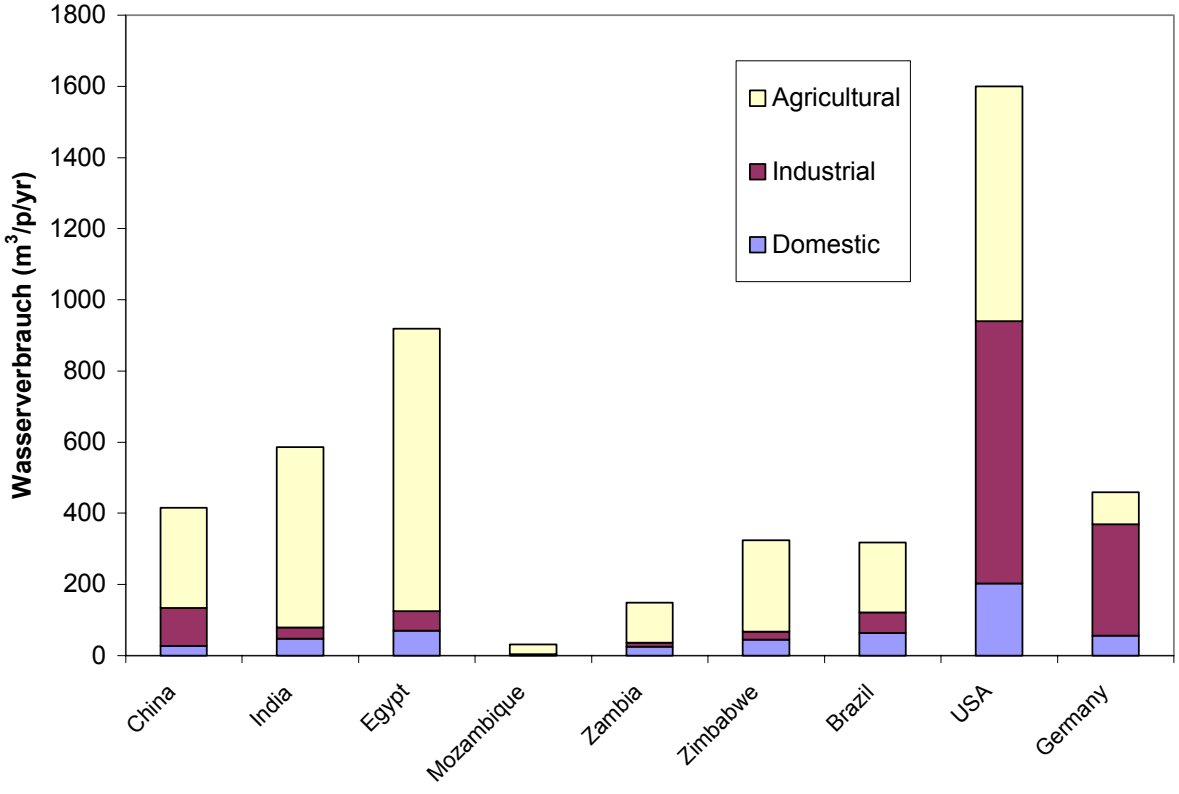
excessive water consumption

What does that means with regard on biomass production?



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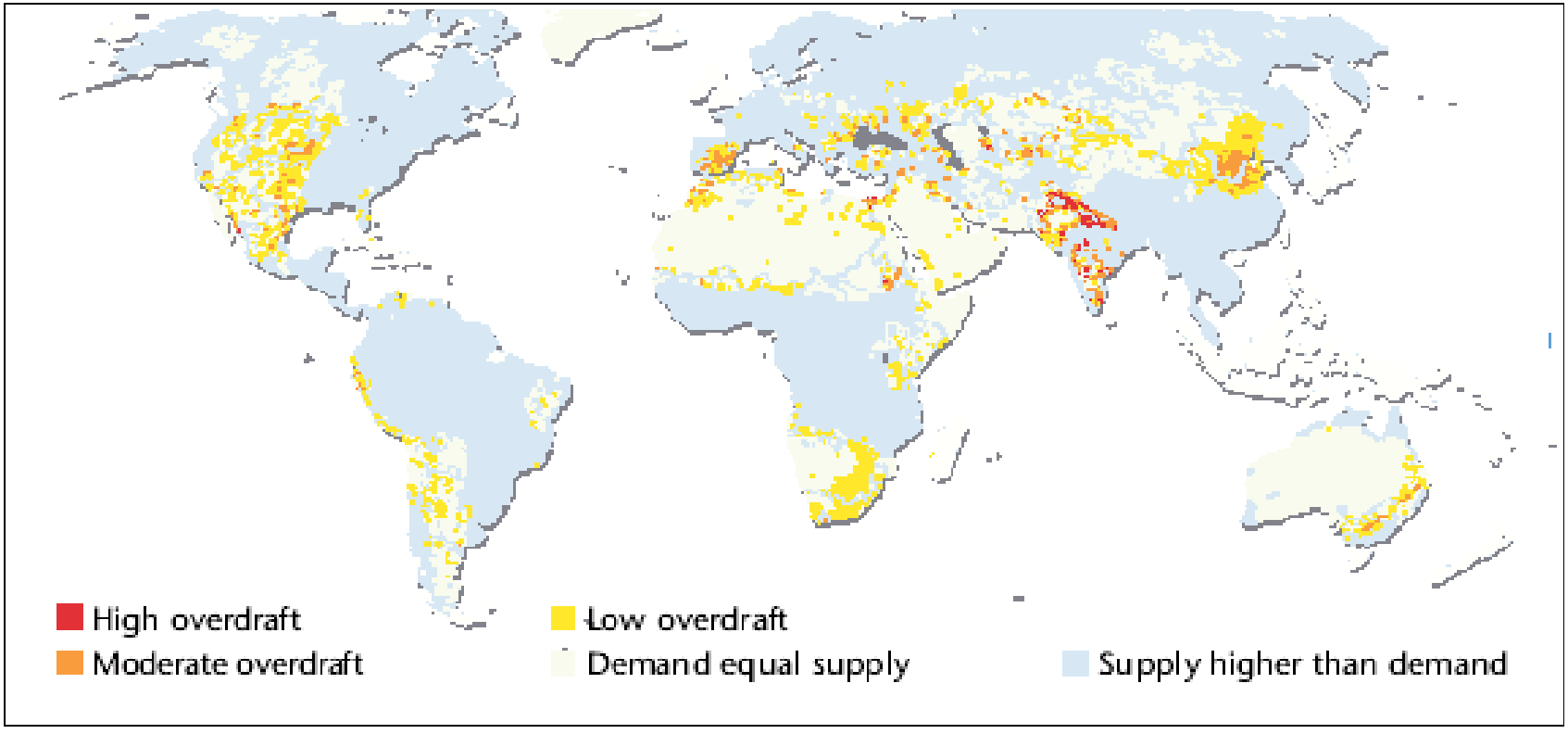
Focus on Irrigation

Regions with water scarcity due to irrigation: „excessive demand!“

according to Millenium Ecosystem Assessment (2005)



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Water scarcity

A useful Indicator is needed

	Falkenmark (1992)
Unit m^3/(pers. x year)	reference: water availability (renewable water resources)
<500	absolute water scarcity
500 to 1.000	chronic water scarcity
1.000 to 1.700	water stress
1.700 to 4.000	occasional water stress
> 4.000	sufficient water resources

Also the UNEP refers to this indicator.

Examples for Indices

Water Availability Index (WAI) (Meigh et al., 1999)

WAI = (R + G – D) / (R + G + D)

R = run-off

G = groundwater resources

D = Sum of consumption by all sectors

applied: Sri Lanka, Palästina

Water Stress Index (Hoekstra, 2003)

WS = (WU / WA) * 100

Ws = national water scarcity (%)

WU = total consumption within country (m^3/a)

WA = national water availibility (m^3/a)

accounts for national water balance

What is the appropriate resolution?

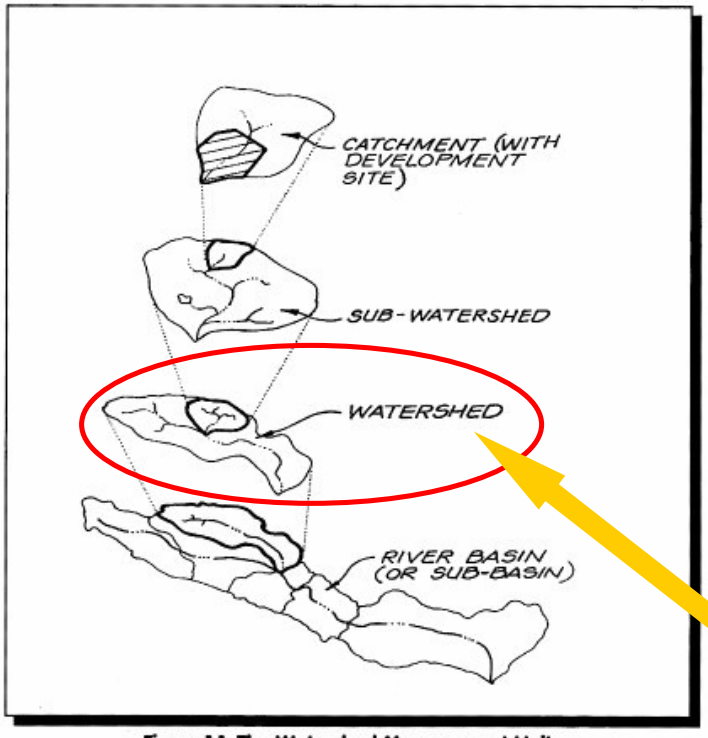

Figure 1.1 The Watershed Management Units
(Adapted from Clements, et al., 1996)

A local watershed may have dozens of individual subwatersheds within its boundaries. A watershed plan tracks the planning and management within individual subwatersheds. Figure 1.2 illustrates this concept of multiple subwatersheds within a larger watershed.

very large units:

a.) National level:
data are available, but not related to hydrological units.

b.) large streams, river basins:
hydrological units too large, not expressive .

small hydrological units:

Expressive, but no data!

Recommendation:

Medium scale with the chance to gain data and to comply with the scientific relevance.

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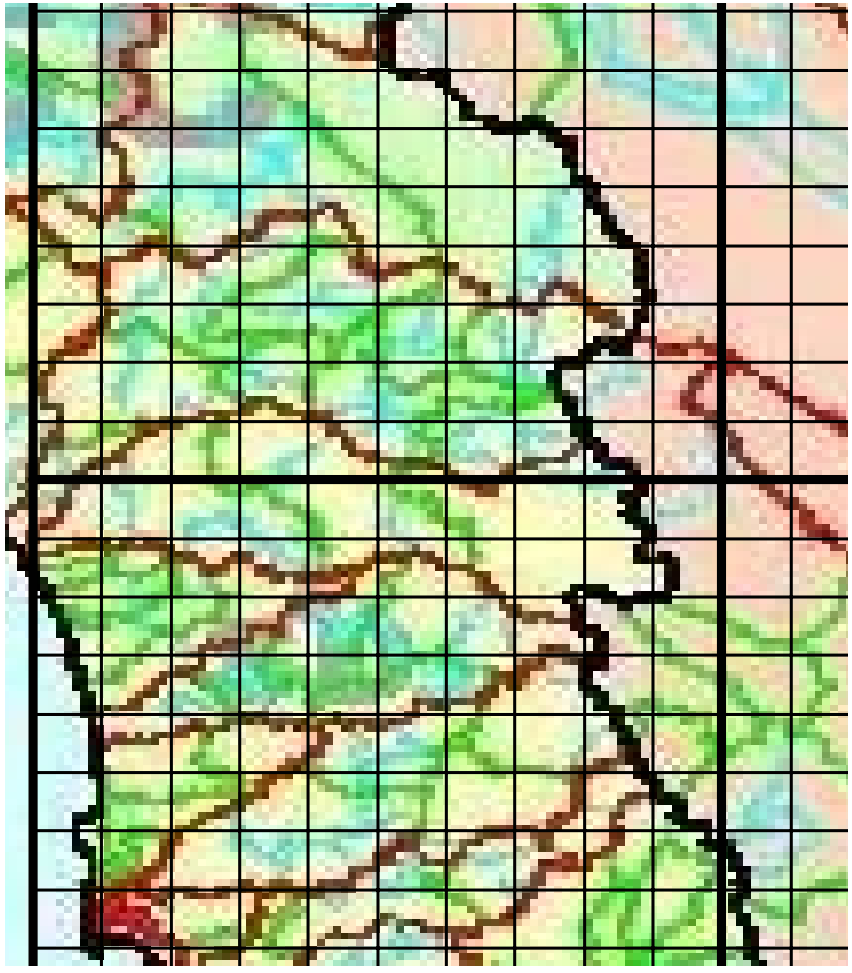
Water shed level…

Example: California



… and 10 km x 10 km grid

Legende
- Hydrologic Region Boundary
- Hydrologic Unit Boundary
- Hydrologic Area Boundary
- Hydrologic Subarea Boundary
  (entspricht **Watershed**, **s. vorne**)
- Super Planning Watershed
- Planning Watershed

Source: www.ca.nrcs.usda.dov

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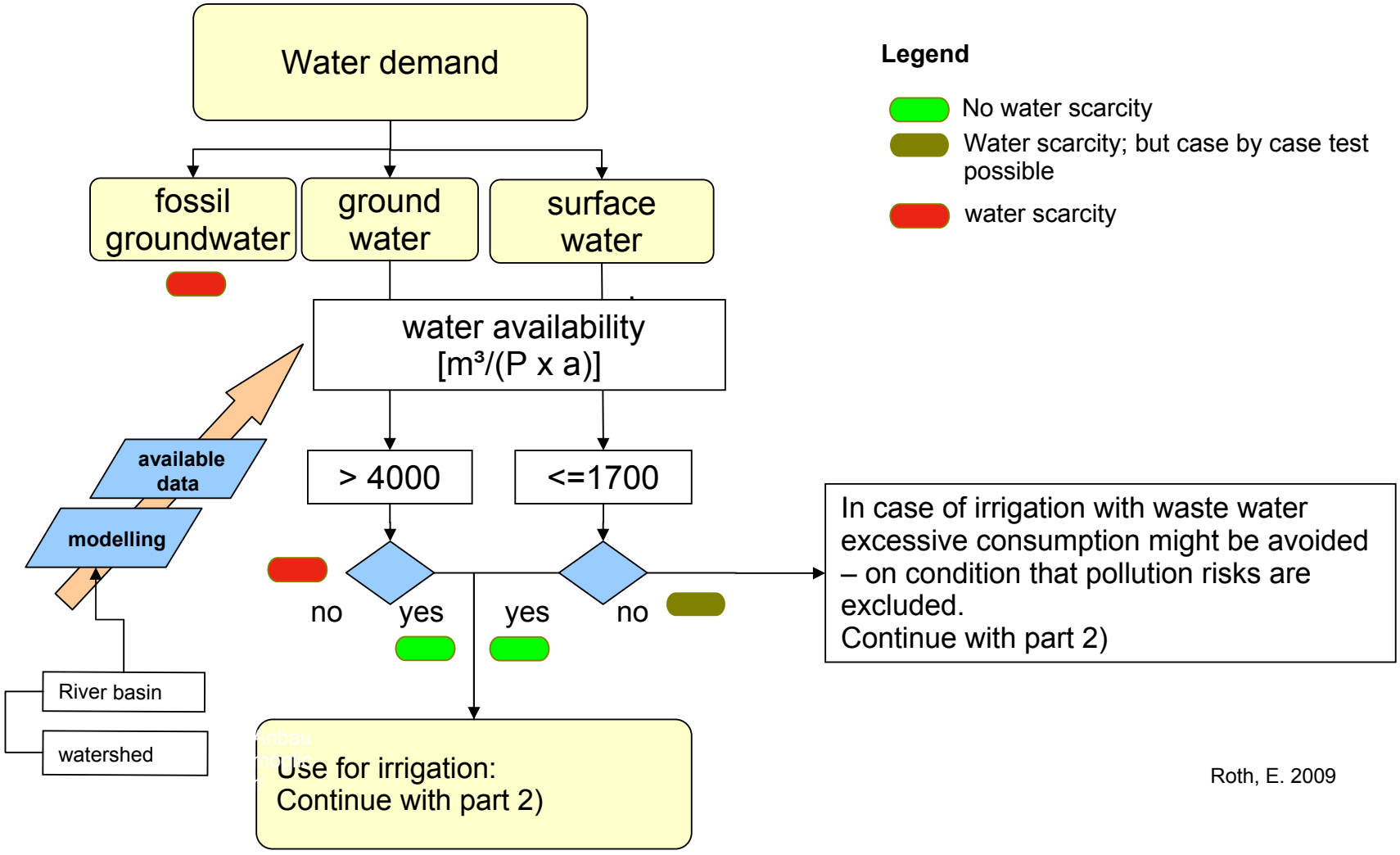
Draft Proposal for a scheme (part 1)



Roth, E. 2009

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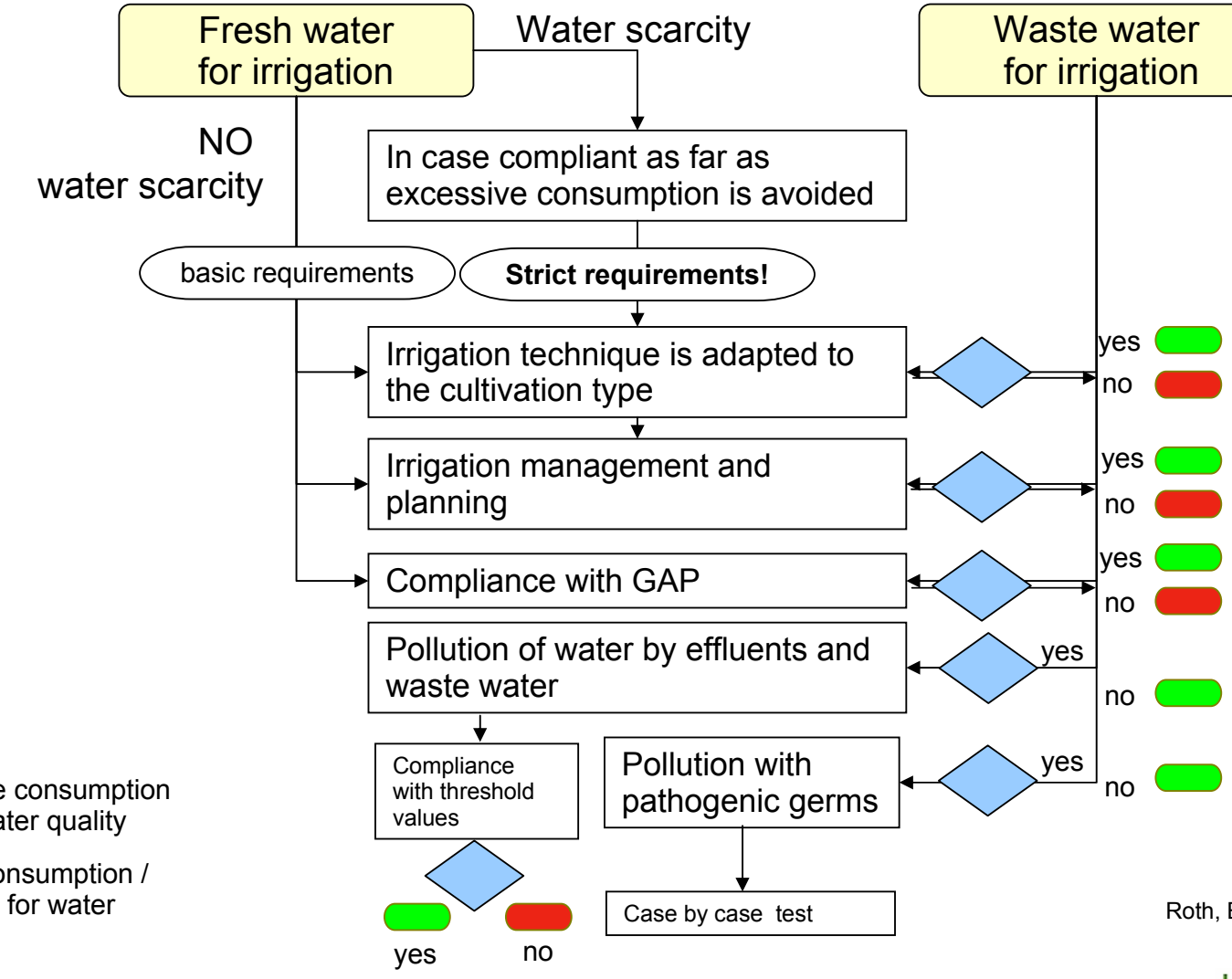
Draft Proposal for a scheme (part 2)



Legend:

- No excessive consumption no risk for water quality
- Excessive consumption / risk potential for water quality

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Summary

- **Climate change will increase water scarcity and decrease the potential for biomass production in some regions.**
- **RES Directive requires reporting on: Excessive water consumption in regions of water scarcity.**

  The German R+D-projects proposes an approach to define and assess water scarcity (indicator) and excessive water consumption (referred to irrigation).

→ **Practical tests will be performed to check the applicability of the approach.**

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Thank you for listening!

Our project team:

Uwe Fritsche - Öko-Institut (coordinator) u.fritsche@oeko.de

Horst Fehrenbach – IFEU (coordinating the water issue) horst.fehrenbach@ifeu.de

Elvira Roth – IFEU elvira.roth@ifeu.de

Kirsten Wiegmann – Öko-Institut k.wiegmann@oeko.de

Klaus Hennenberg – Öko-Institut k.hennenberg@oeko.de

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