

Understanding and managing the whole hydrological cycle: some invisible and silent issues

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Climate & Groundwater in Africa Conference
Kampala June 2008

Purpose

To highlight some major water resources that escape the attention of water scientists and water managers attempting to address water security and sustainable water management

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To highlight some major water resources that escape the attention of water scientists and water managers attempting to address water security and sustainable water management

and

show how many economic and political processes are also invisible and silent but of determining importance and why their existence should be recognised by water scientists and professionals

Three parts

Whose sustainability - plural definitions and the different 'ways of thinking'?

Including all the water

The case of the Nile Basin

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Whose sustainability - plural definitions and the different 'ways of thinking'?

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The case of the Nile Basin

Conceptualising the trajectory of water use

defined by

Society and water managing professionals
and policy-makers
- POLITICAL PROCESSES

Ecosystem scientists and economists
- UNDERLYING FUNDAMENTALS

Water
resource use

The discursive political process that could lead to the convergence of the trajectories. Socio-economic development & politics are the means that change the trajectory

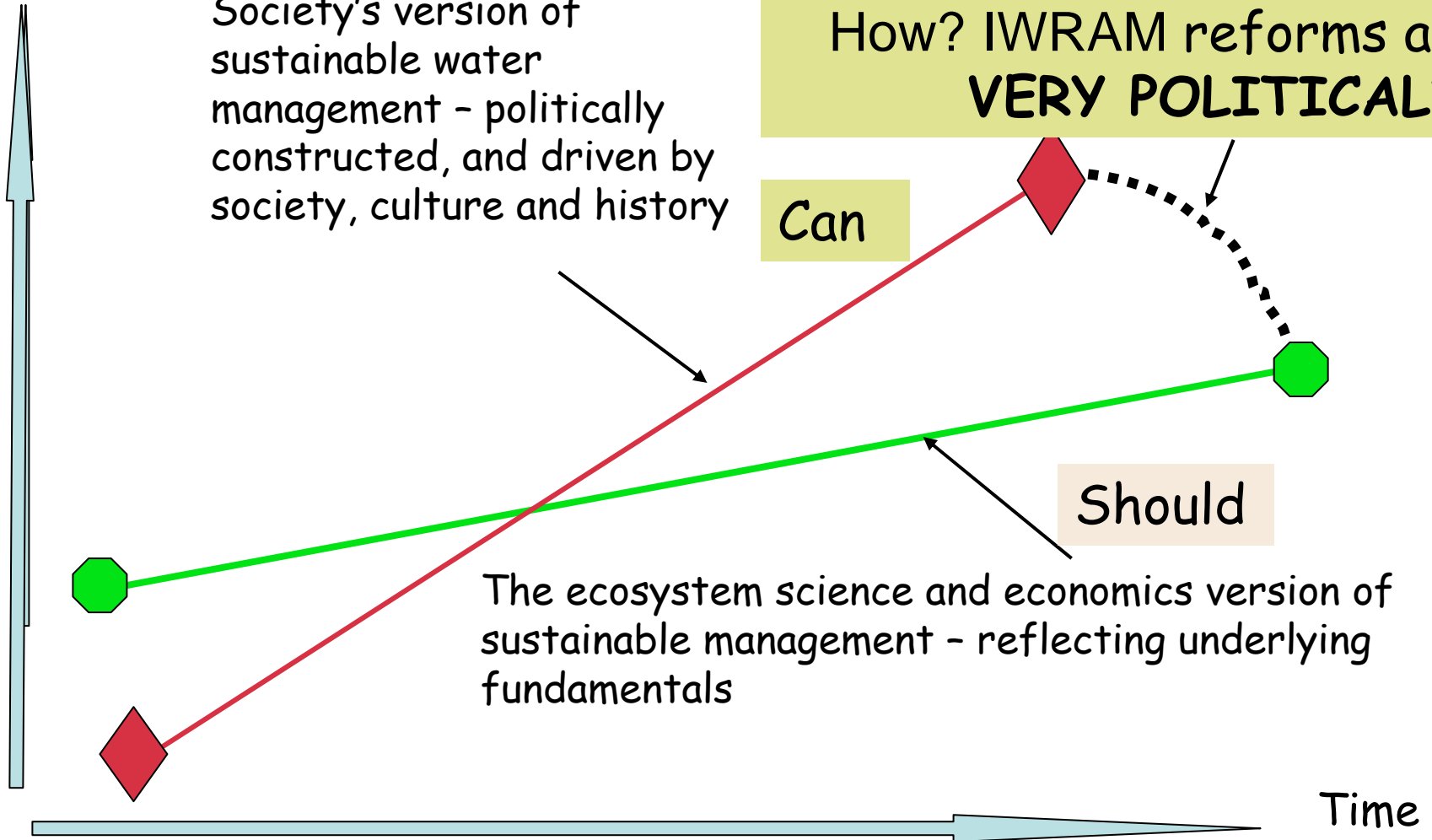
Society's version of sustainable water management - politically constructed, and driven by society, culture and history

How? IWRAM reforms are **VERY POLITICAL??**

Can

Should

The ecosystem science and economics version of sustainable management - reflecting underlying fundamentals



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who have beliefs and expectations
that are based
on experience, cultural preferences, history
and NOT on science

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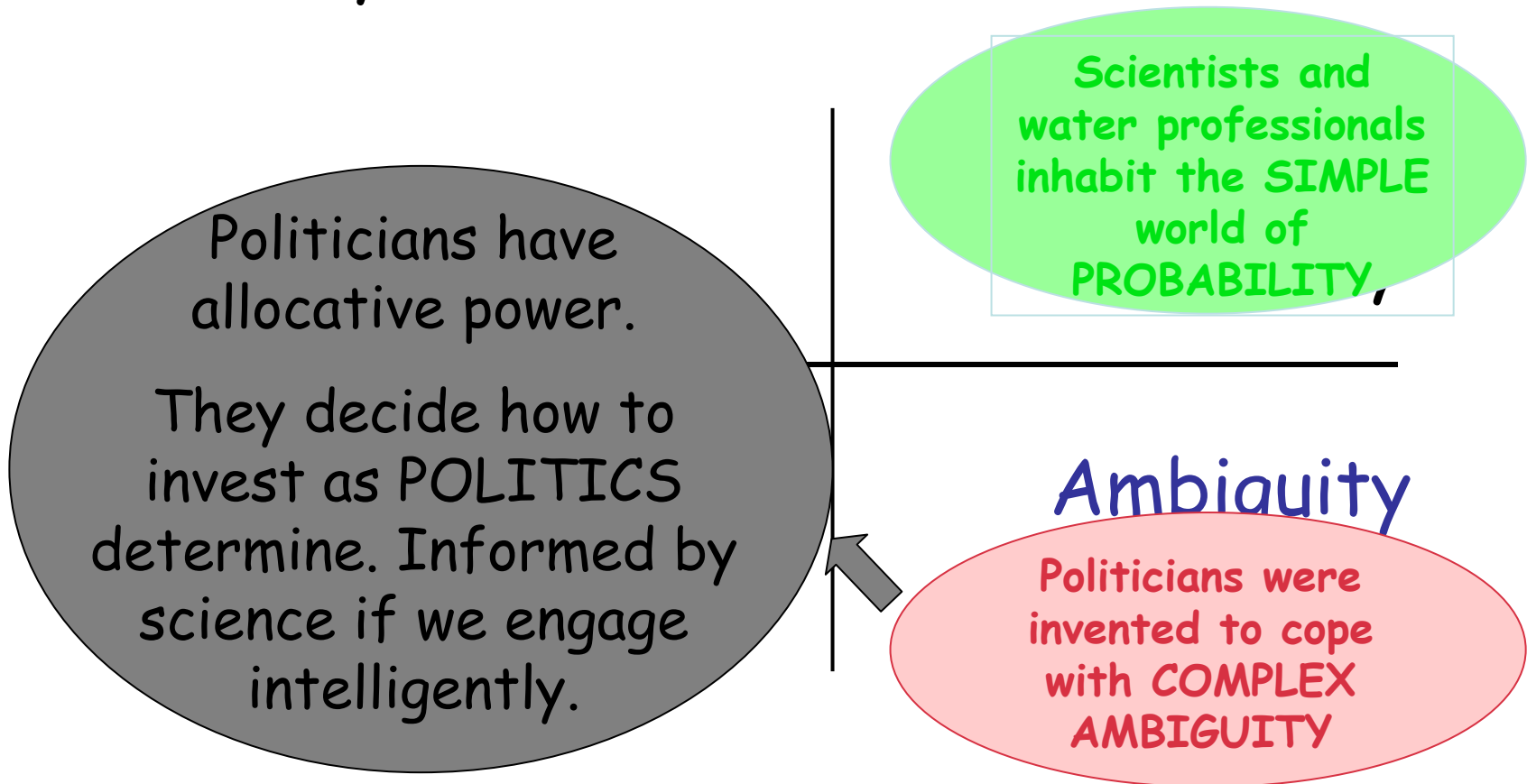
How do we [here] get the underlying
fundamentals of hydro-hydrogeology,
the value of water and of
the environmental services of water
into policy

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who have beliefs and expectations
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How do we [here] get the underlying
fundamentals of hydro-hydrogeology,
the value of water
and of the environmental services of water?

**into the beliefs of
water users & policy-makers.**

It also helps to know the issue we are addressing exists in the analytical domain of risk or uncertainty?



What is the role of science?

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Prediction

What is the role of science?

Prediction

Explanation

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Prediction

Explanation

To influence the behaviour of society
& its political classes

What is the role of science?

Prediction

Modelling Sciences

Explanation

Social & politics theory

To influence
the behaviour
of society & its
political classes

Activist science

Different assumptions of the 3 types of science

Relevance

Method

Truth

Significance of precision and accuracy

Knowledge **Observed** versus constructed

As **constructed knowledge** will always overwhelm **observed science** we here should recognise the nature of the game - if we want to engage intelligently

The **abstract** always overwhelms the **concrete**.

Reason cannot prevail
against
the juggernaut of emotion

The voters revealing their addiction. What do Presidents & PMs do?

**It must be easier for leaders
of authoritarian governments
than for leaders of
neo-liberal industrialised
political economies. The
electorate is ignorant, willful
& unforgiving?**

The voters revealing their addiction. What do I

Corporations
serving the
addictions of
society

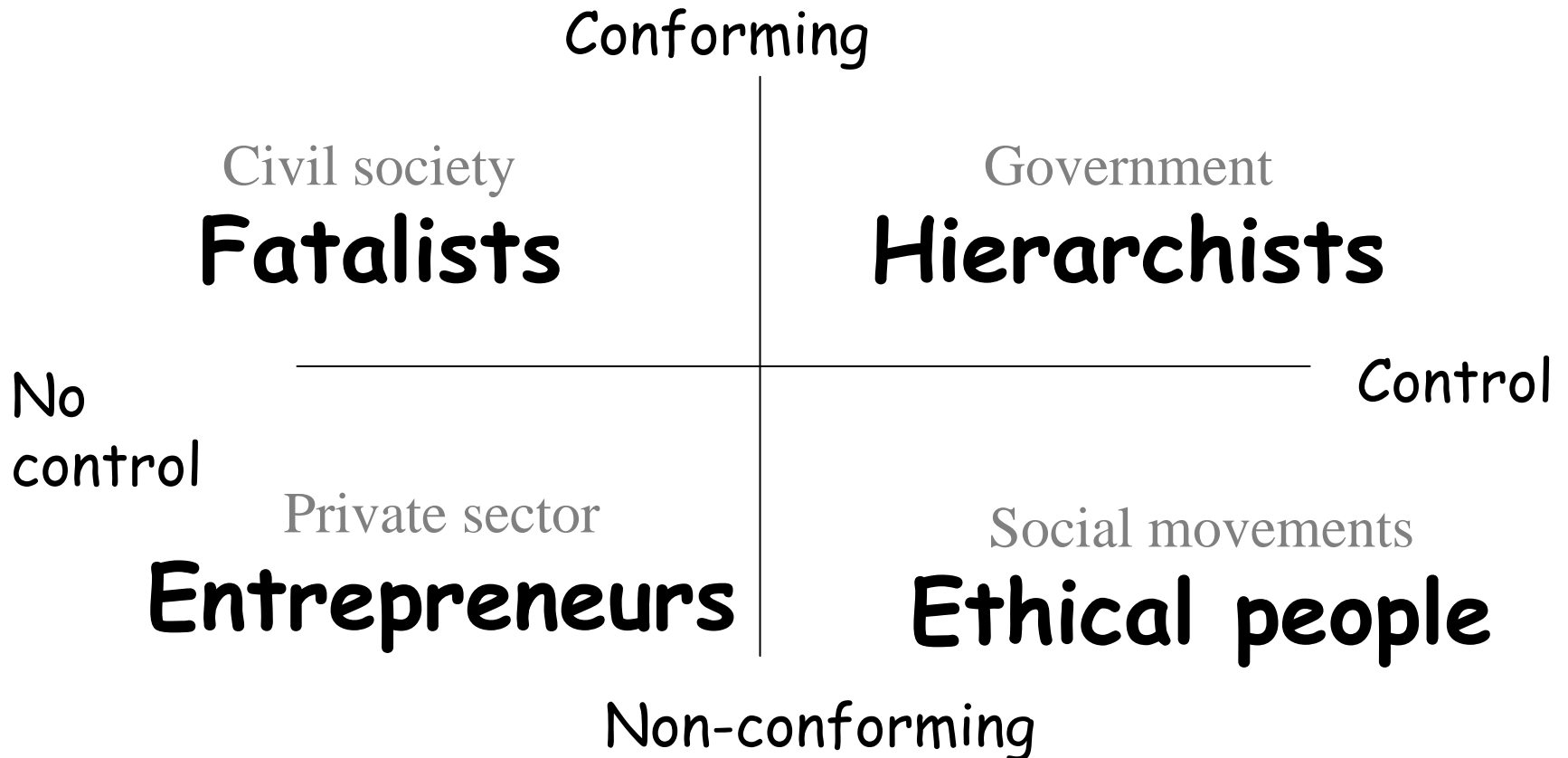
Racing to
deplete the
second Trillion
Barrels

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

And there are
different different ways of knowing

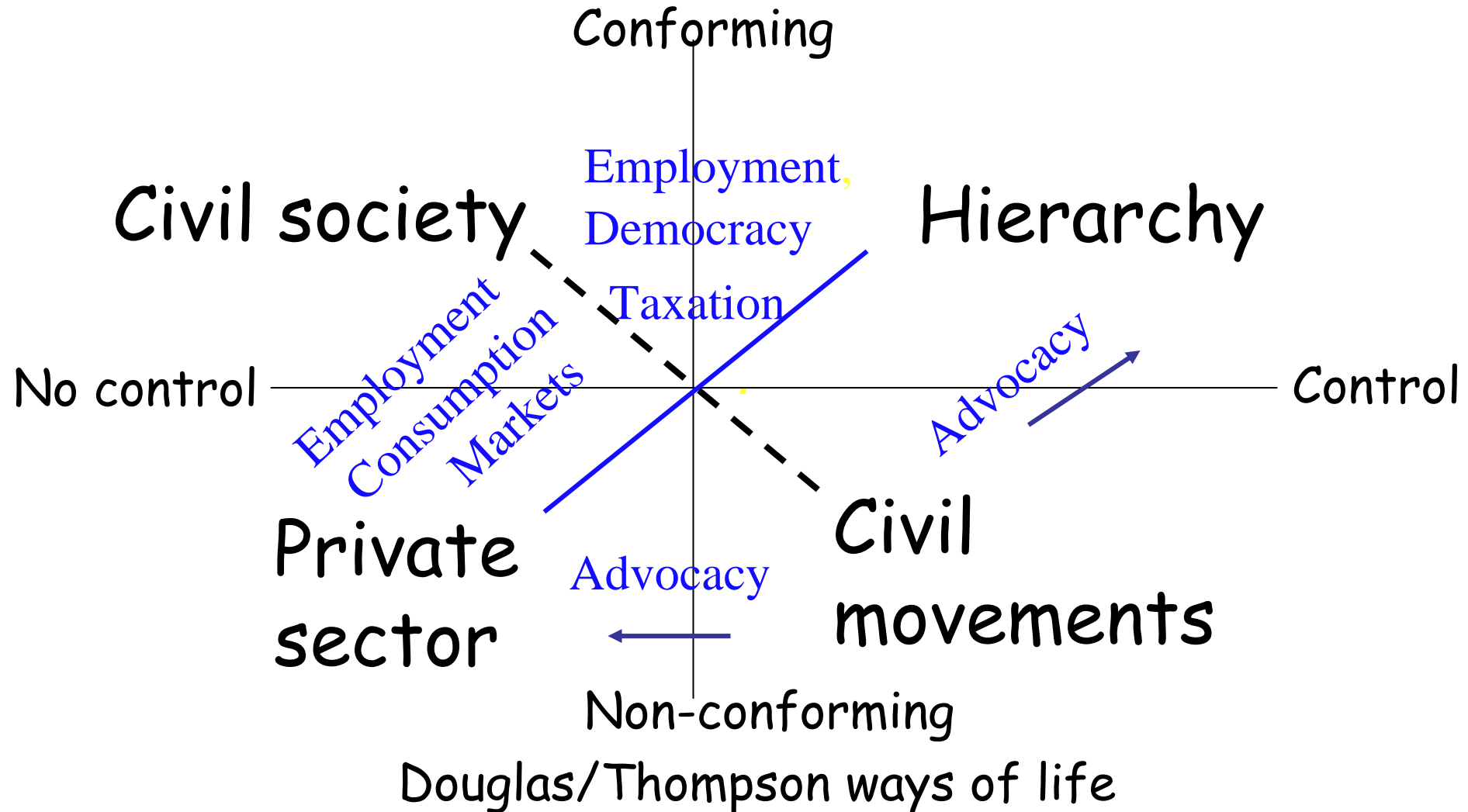
The four ways of life; ways of knowing

Douglas et al.



Douglas/Thompson - 'ways of life'

The four ways - Douglas et al.



.???
Fatalists

.gov
Hierarchists

.com
Entrepreneurs

.org
Ethicists

Douglas/Thompson - 'ways of life'

The policy-making contribution of the three contributing social solidarities on for example 'risk'



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Douglas/Thompson - 'ways of life'

What is the difference between

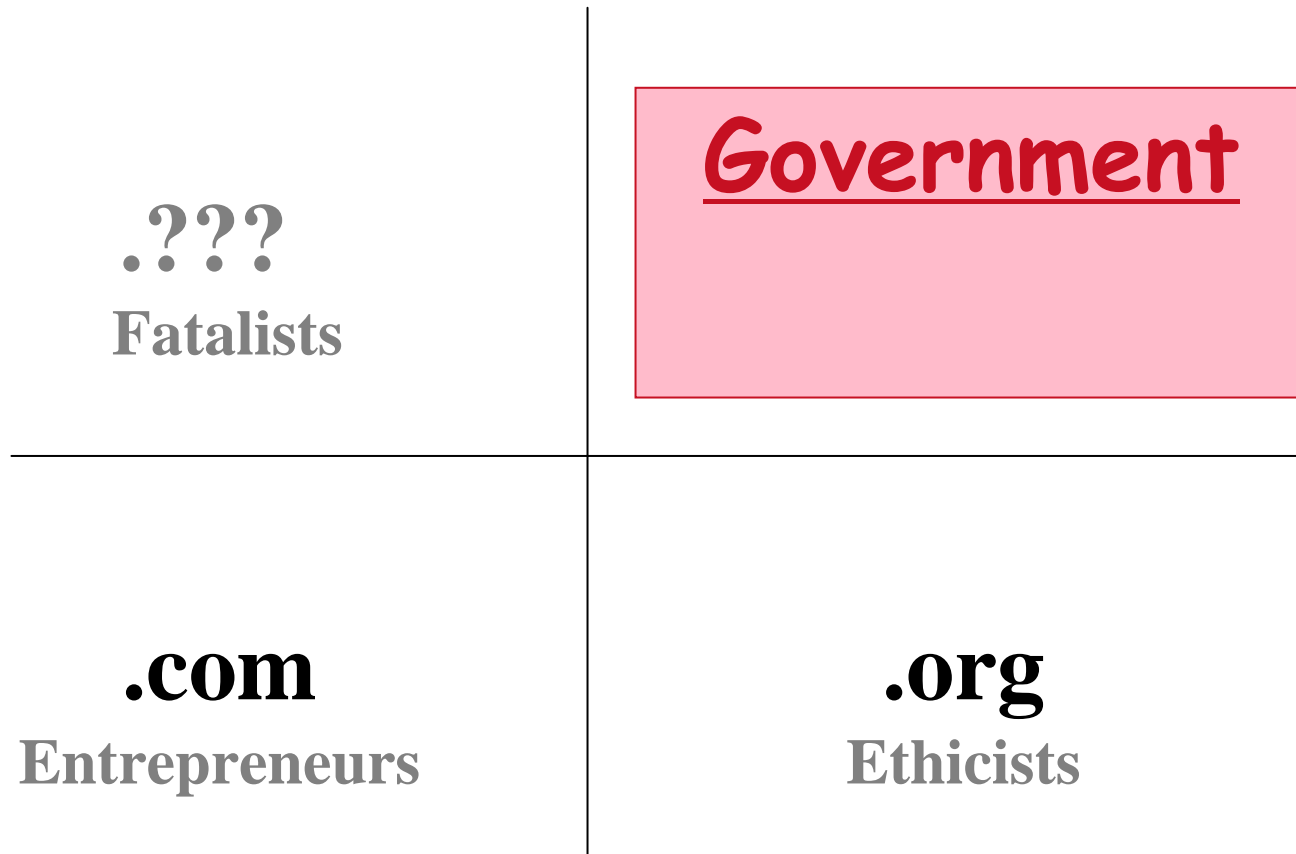
Government

and

constructively engaged

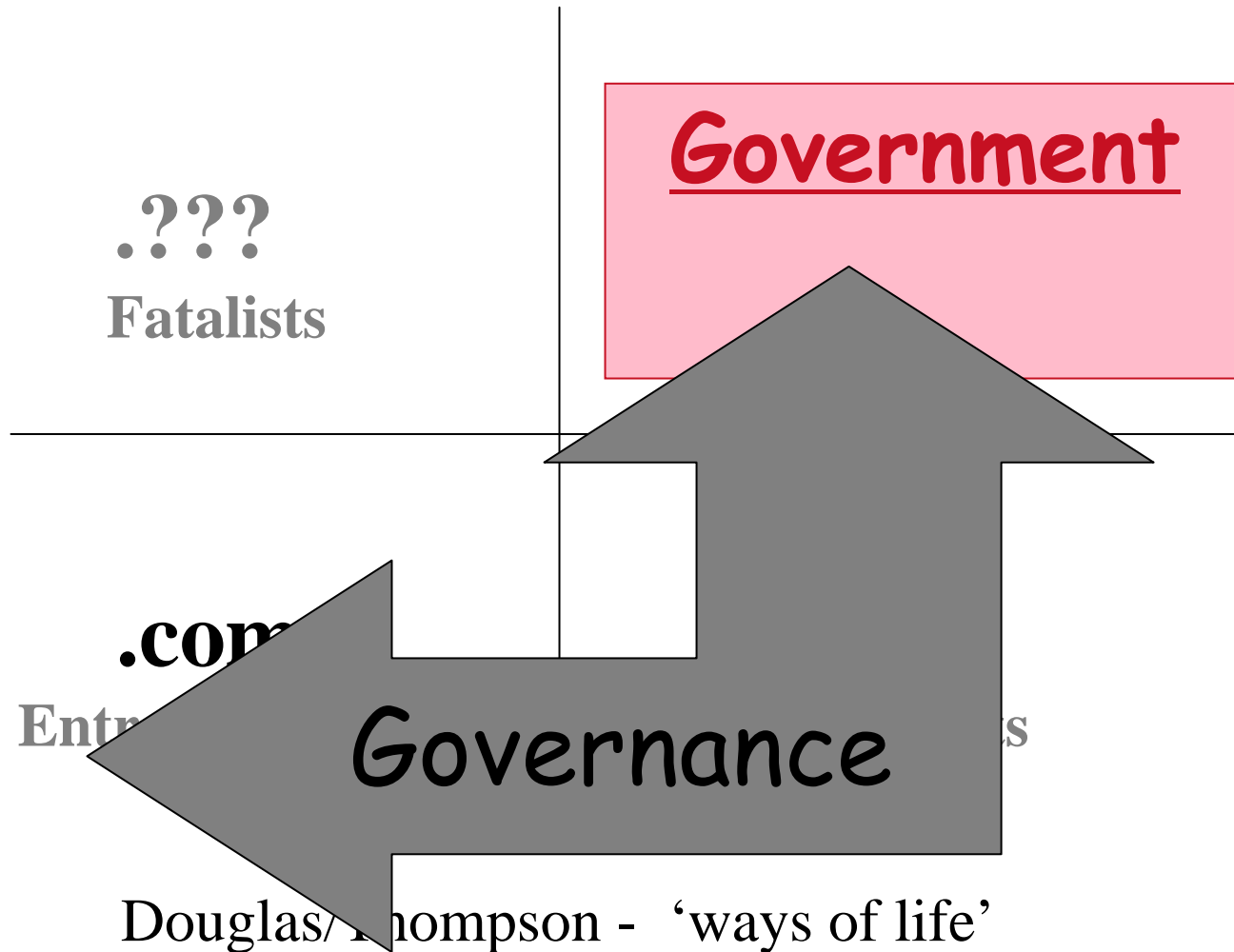
Governance?

What is the difference between **Government** & constructively engaged **Governance**



Douglas/Thompson - 'ways of life'

What is the difference between **Government** & constructively engaged **Governance**

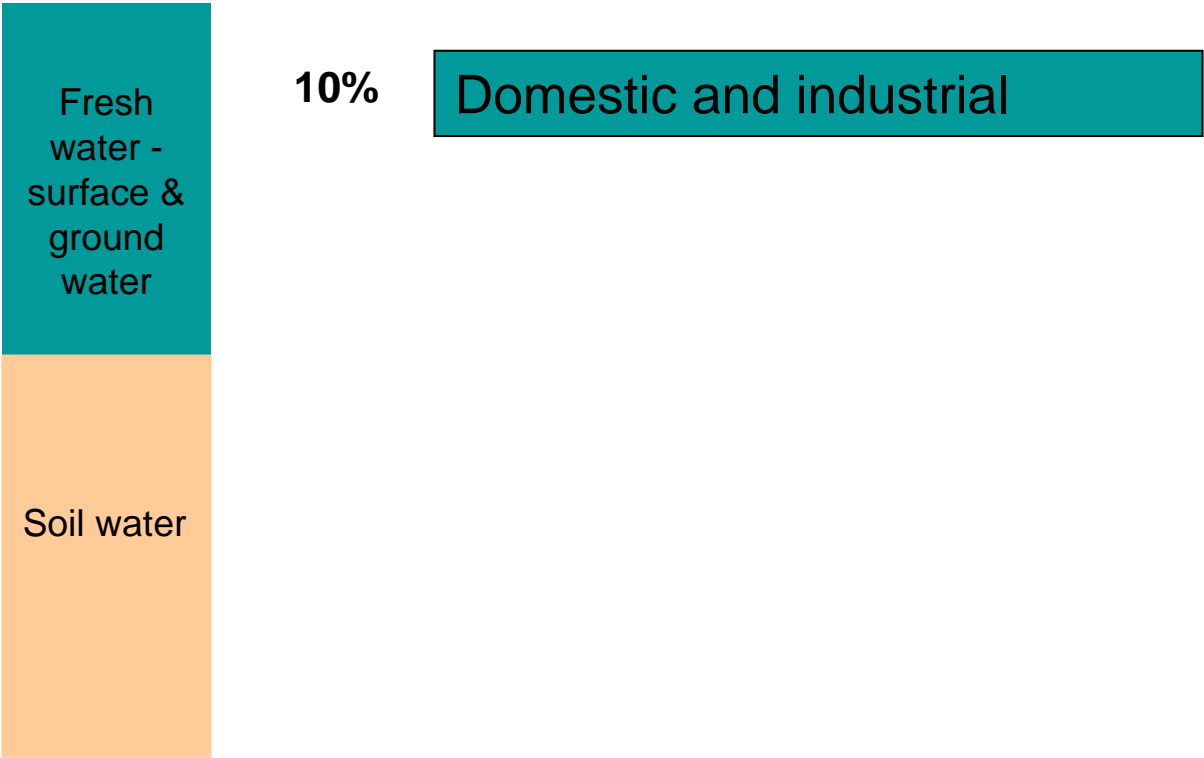


Three parts

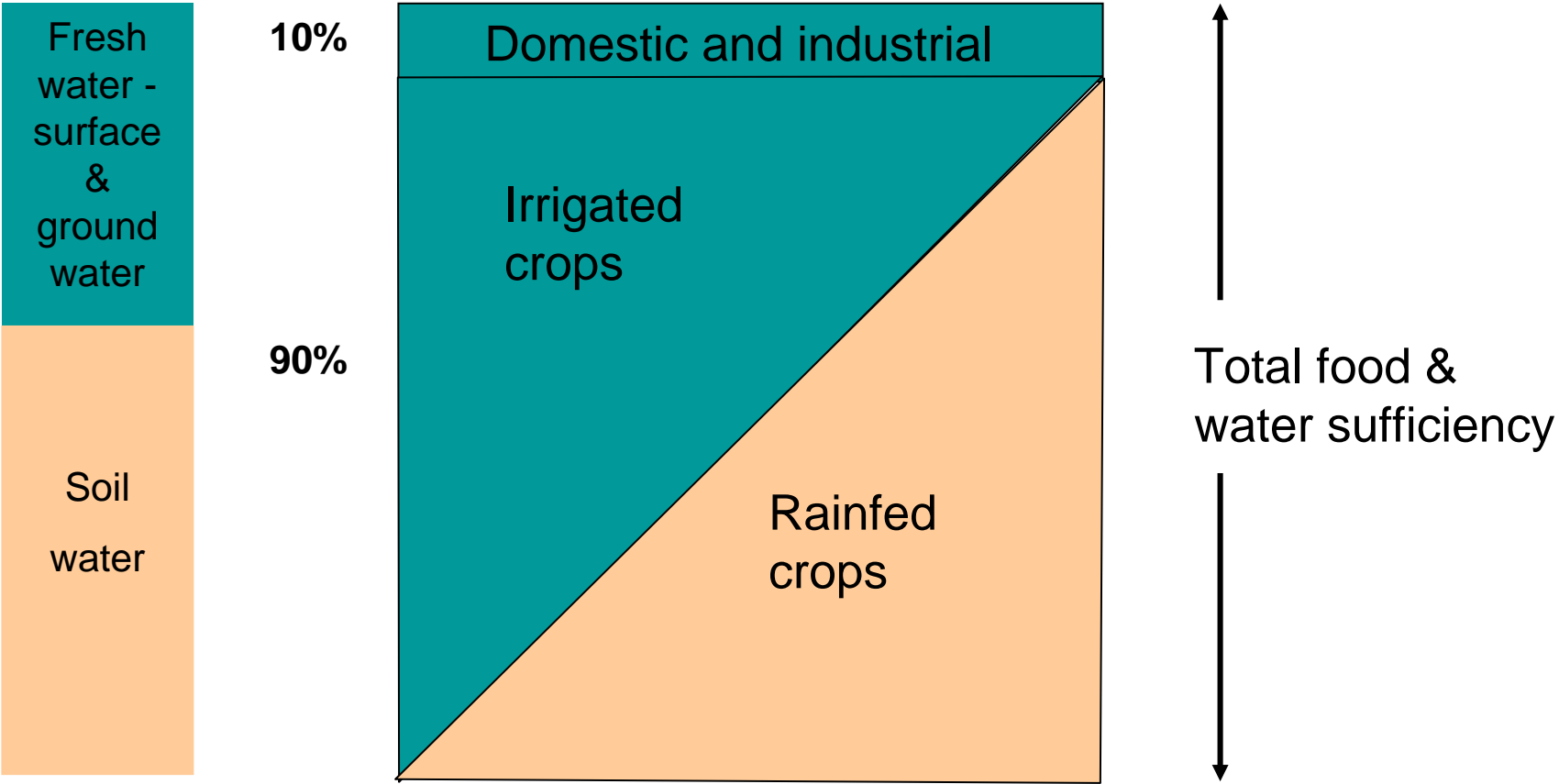
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Including all the water

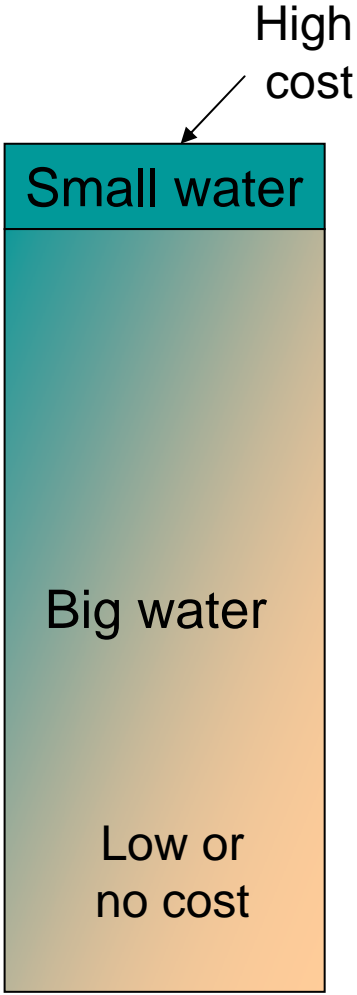
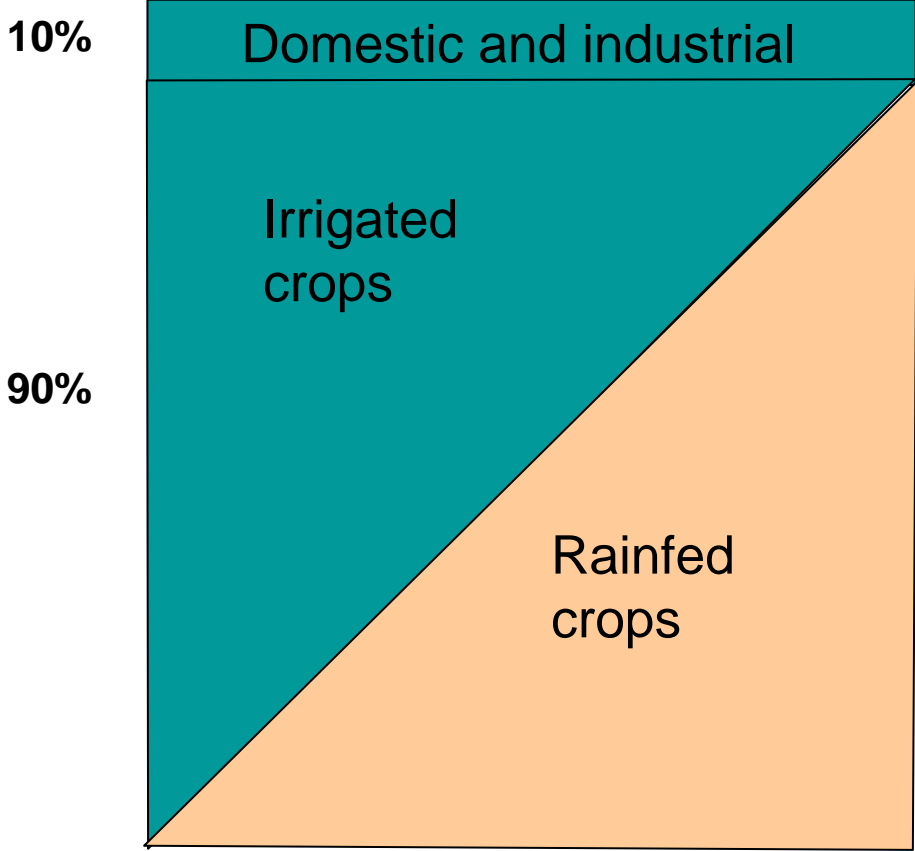
Types of water



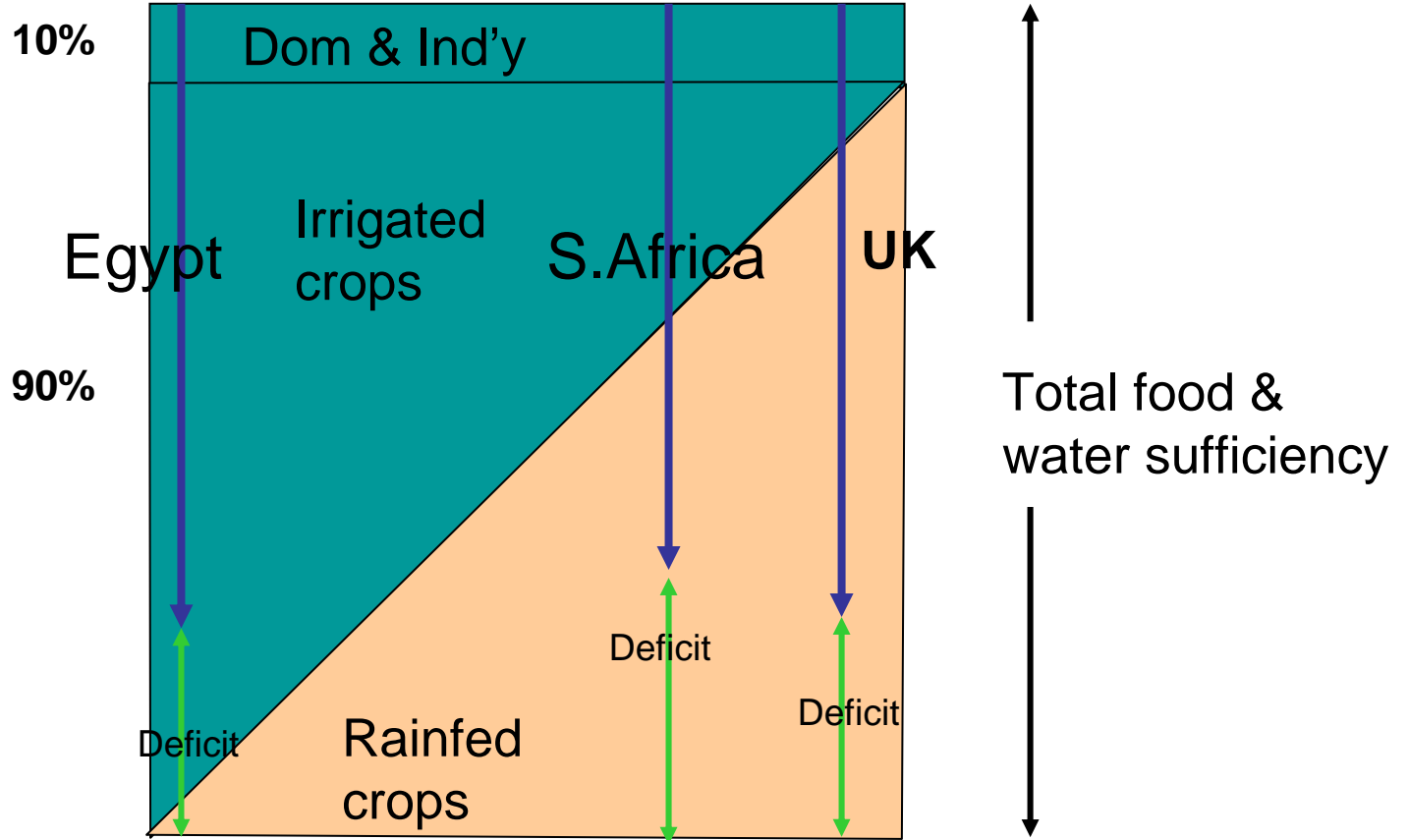
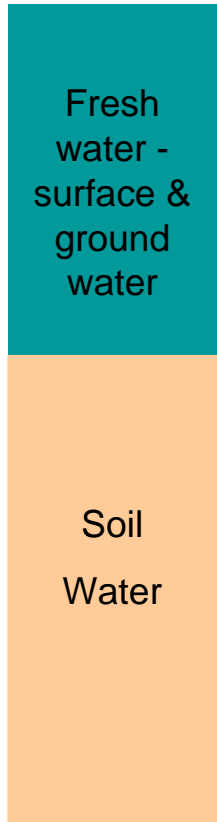
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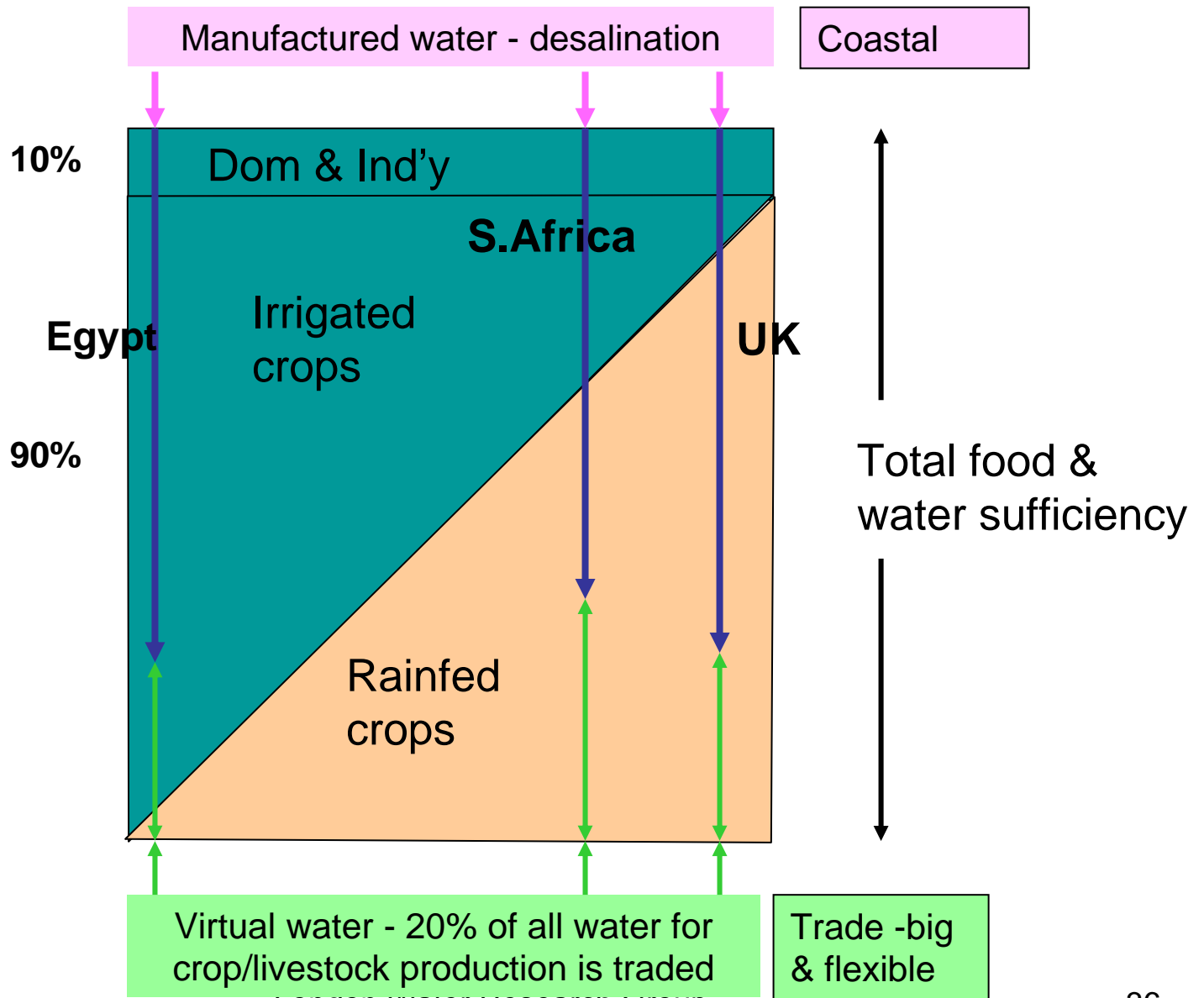
Types of water



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Types of water



London water Research Group

Virtual water [in the global system]

Is the water embedded in food & other commodities via agriculture, industry & services -
1000 tonnes [m³] water to produce 1 tonne wheat;
16000 t water for 1 t beef

Commodities move easily to where needed - water does not - 20% of food is traded internationally.

No engineer could devise an alternative solution.

It is mainly soil water [90% ??] that produces the food commodities traded internationally
- wheat, maize, sugar.

In Nile Basin - tea, coffee & livestock traded in the basin & from the basin and grain & livestock imports are important from outside the basin

Water security via a threefold
synergy
—
Security
is achieved in the problemshed
as well as in the watershed

There are
three invisible hydro-economic processes
that enable water short economies such
as some African economies and those of
The Middle East
where inexpensive water
is increasingly scarce
to be secure:

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- 1 Soil water in other catchments**
- 2 International trade in staple food commodities: virtual water**

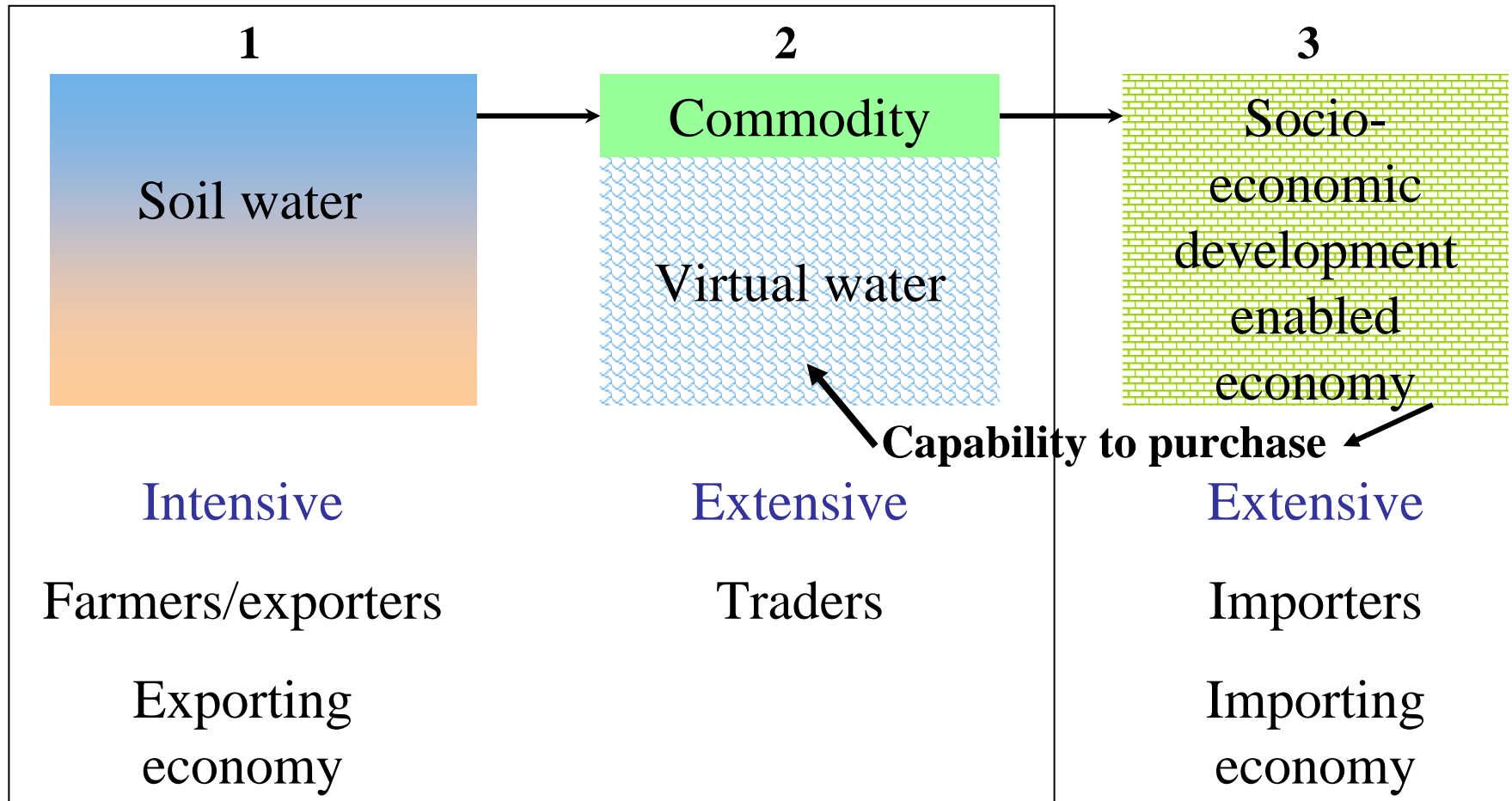
There are
three invisible hydro-economic processes
that enable water scarce economies to be secure:

- 1 Soil water in other catchments**
- 2 International trade in staple food commodities: virtual water**
- 3 Socio-economic development which enables politically feasible water re-allocation**

The threefold synergy

- economically invisible & politically silent.

No water resources professionals or scientists here.



Virtual water in international trade
is unmatched in the volumes of
water 'mobilised' by long distance
movement.

More important it is unmatched in its:

- flexibility of sourcing
- flexibility of the delivery of remedies to distant regions enduring water deficits, including groundwater basins

Engineered local storage and distribution cannot match these qualities.

Virtual water:
is economically invisible and
politically silent

These qualities give it
a very special role
in water policy-making
and reform

The water footprint is a related and very valuable concept developed by Arjen Hoekstra et al

It is a method of providing comparative estimates of the levels of water use of individuals, nations, corporations.

It helps communication with society and policy-makers

FIGURE 11. Water embedded in foods, per calorie of food.
Data from: Chapagain and Hoekstra 2004 and the author's own calorie estimates.

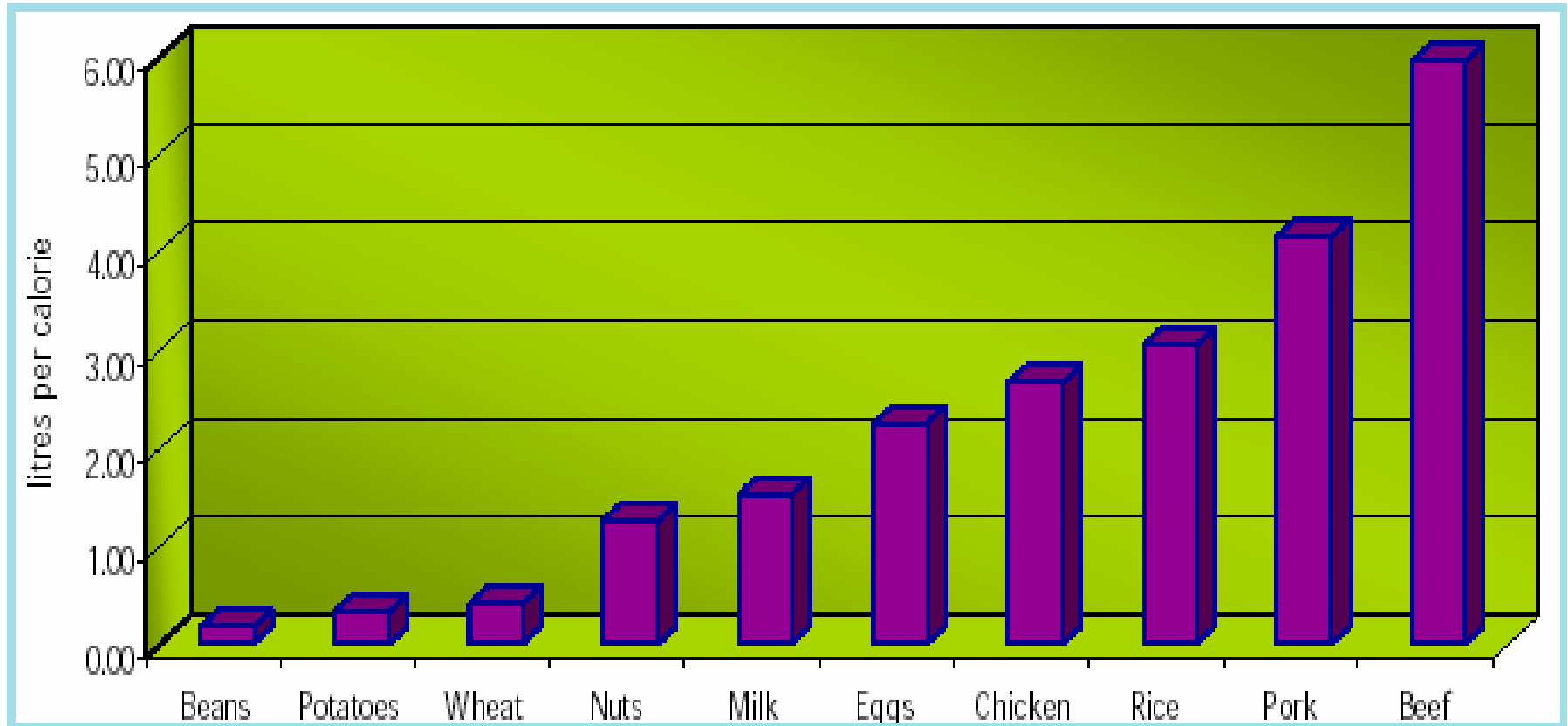
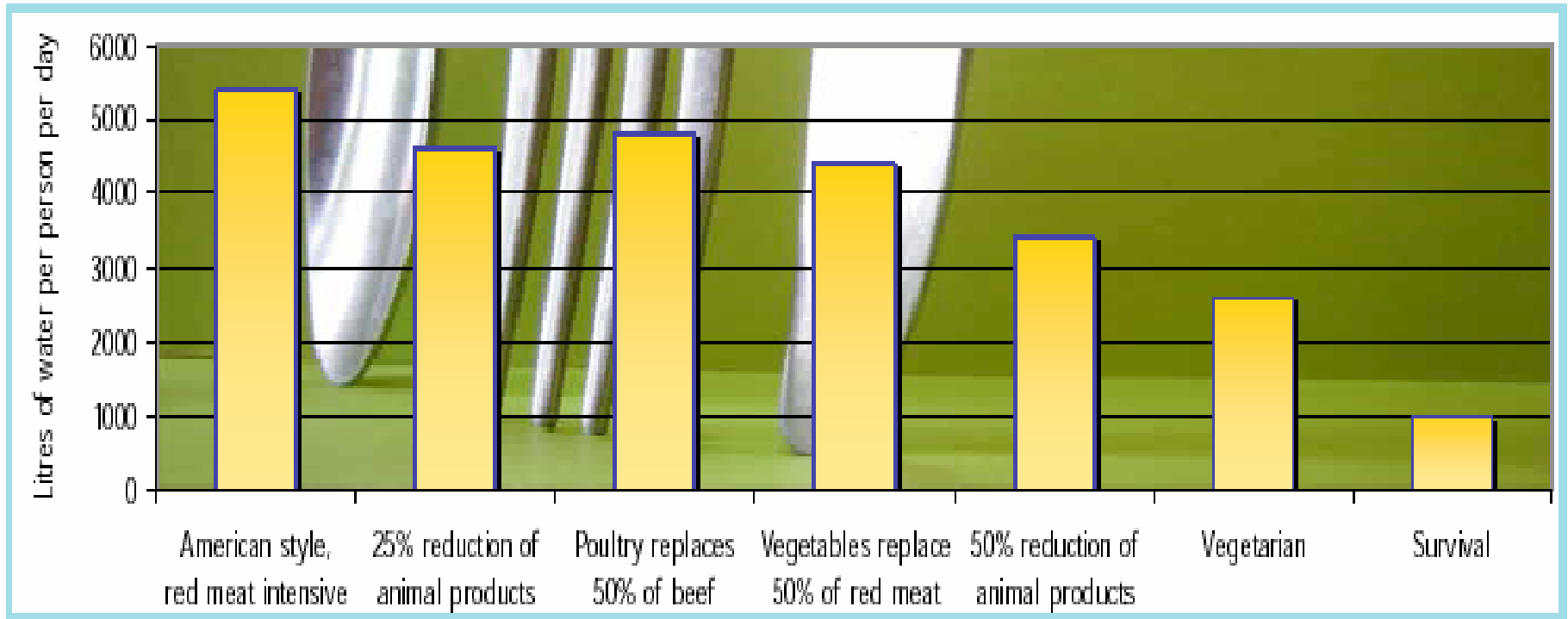


FIGURE 10. Water intensity comparison of various diets. After: Renault and Wallender 2000.



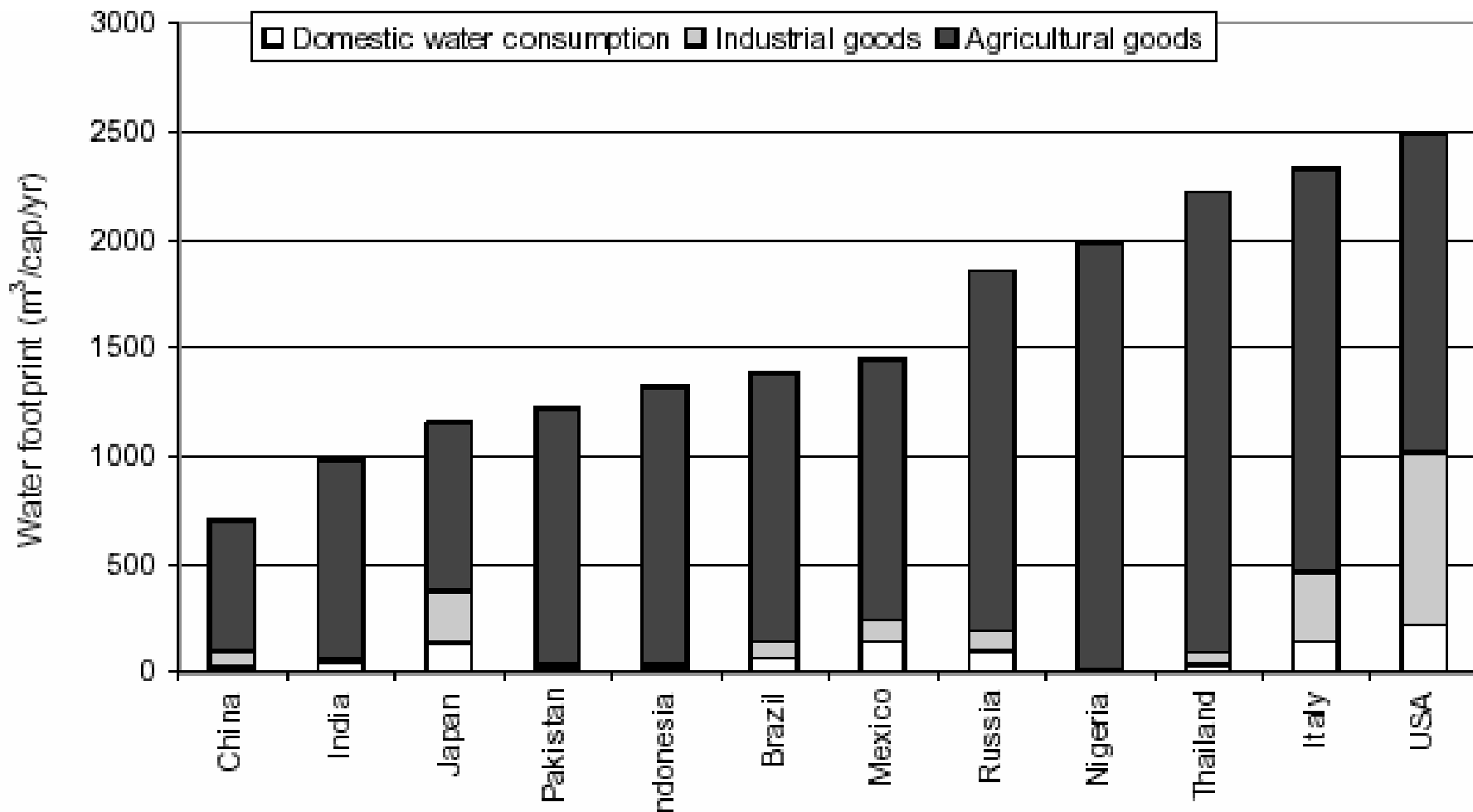


Figure 5.5. The national water footprint per capita and the contribution of different consumption categories for some selected countries.

Three parts

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Including all the water

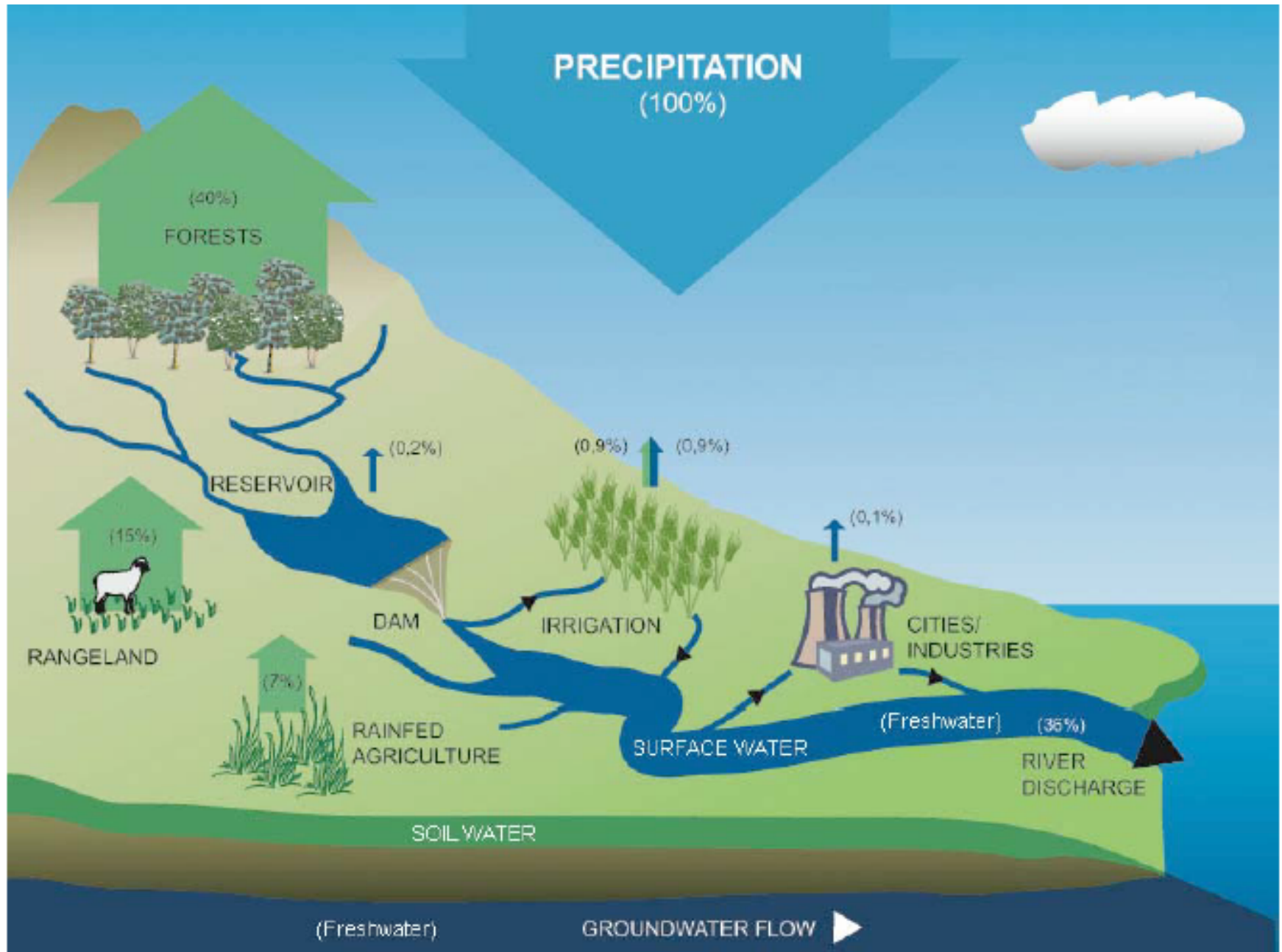
The case of the Nile Basin and the water and food security of its riparians
- and distinguishing
the roles of green and blue water

The Nile Basin boundaries and countries

Map 67



Illustrating green water & blue water



Soil water **Green water** [Nile Basin] is

- 1 Water in soil profiles used by plants/crops
 - it is non-evident

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- 5 An important component of the water resources of a nation or a river basin especially in higher rainfall regions
- 6 Ignored by engineers & economists & in most water resources planning & policy-making

Table 2.2 Freshwater Flows in the Nile, from Upstream to Downstream.

Livestock not included

	Average Annual Precipitation (mm)	Nile River Freshwater Flows*		Soil Water Consumption** (for agriculture) (Mm3/y)	Groundwater Production*** (Mm3/y)
		Inflow (Mm3/y)	Outflow (Mm3/y)		
DR Congo	1,245	0	1,500	31,909	421,000
Burundi	1,110	0	1,500	6,132	2,100
Rwanda	1,105	1,500	7,000	11,000	3,600
Tanzania	1,015	7,000	10,700	31,583	30,000
Kenya	1,260	0	8,400	20,386	3,000
Uganda	1,140	28,700	37,000	45,804	29,000
Eritrea	520	0	2,200	843	-
Ethiopia	1,125	0	80,100	31,075	40,000
Sudan	500	117,100	55,500	50,313	7,000
Egypt	15	55,500^	< 10,000 (to sea)	0	1,3000
Total in System		approx. 100,000		approx. 229,000	

* Evaporation from natural & constructed storage not accounted. **2002 soil water data based on Nile Basin Dataset (FAO 2006a – see also Appendix B). The figures do not include soil water used by natural vegetation.

*** Aquastat *production* figures. Groundwater *availability* data are not available. No production data available for Eritrea. ^Allocation to Egypt after deduction of evaporation from Lake Nasser, according to 1959 Sudan-Egypt Nile Basin Treaty. Precipitation and freshwater data from FAO (1997: Table 20). Evaporation from Lake Nasser is currently high because the level of the lake is high after almost two decades of above average rainfall in Ethiopia. Evaporation fell to between five and six cubic kilometres in the drought years of the mid-1980's (Stoner 1995).

Table 2.3 Rainfed and Irrigated Agriculture of all Nile Basin States (includes activity outside the basin itself).

	Total	Rainfed	Irrigated
Area of Land Farmed (1,000 ha)	52,449	46,020 (87%)	6,429 (13%)
Crop Production (MT per annum)	172,107	96,811 (56%)	75,301 (44%)

(FAO 2006a). The table includes all of the agriculture that occurs outside of the Nile Basin, which is particularly significant in Kenya, Tanzania and the Democratic Republic of the Congo (roughly 98% of agricultural activity in this latter occurs outside of the Nile Basin).

**Some key conference issues & questions in
relation to:**

climate, water & food production

Nile Basin big picture issues and questions

Surface water

Water re-use in irrigation

High crop yields

Soil water

Low rainfed crop yields

Questions

- 1 Can rainfed crop yields be doubled ?
- 2 Will increased rainfed crop yields impact groundwater recharge and surface flows in the Nile Basin ??
- 3 What would be the impact of climate change on evapo-transpiration and soil water availability ??

A selection of
virtual water 'trade' movements
in the Nile Basin

Distinguishing green and blue
water 'movements'.

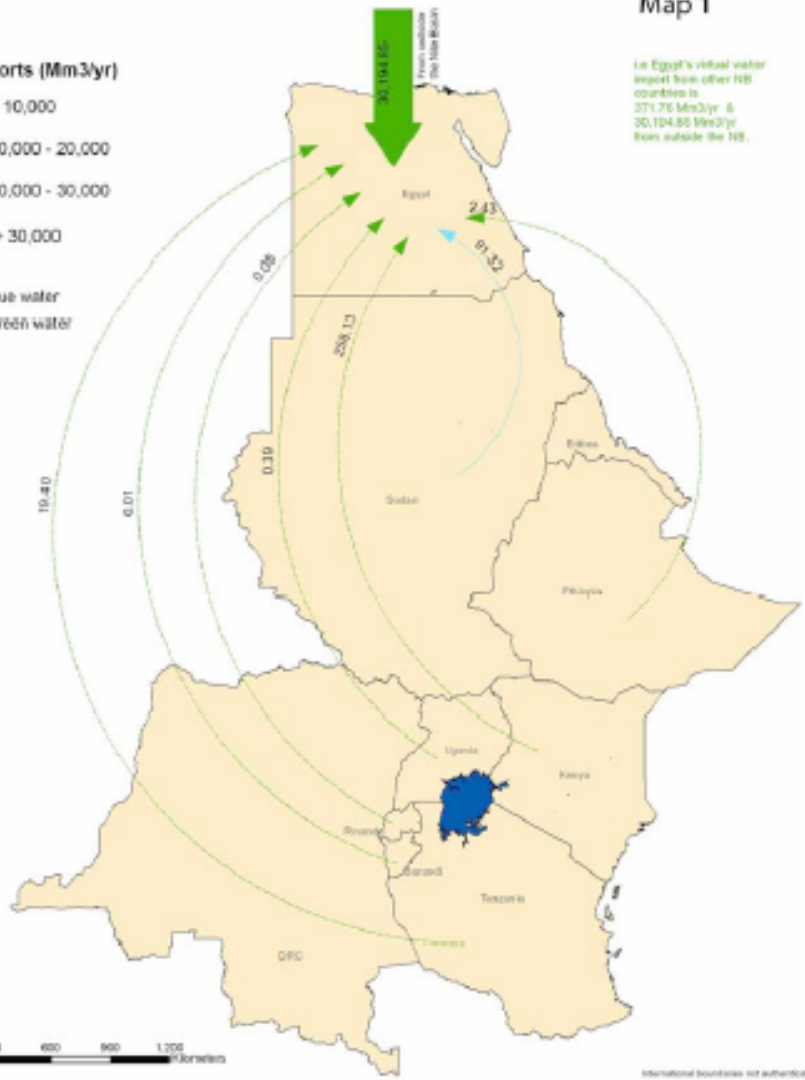
Egypt: virtual water imports in crops (1998-2004)

Map 1

VW imports (Mm³/yr)

-  < 10,000
-  10,000 - 20,000
-  20,000 - 30,000
-  > 30,000
-  Blue water
-  Green water

↳ Egypt's virtual water import from other NB countries is 371.76 Mm³/yr & 30,104.85 Mm³/yr from outside the NB.



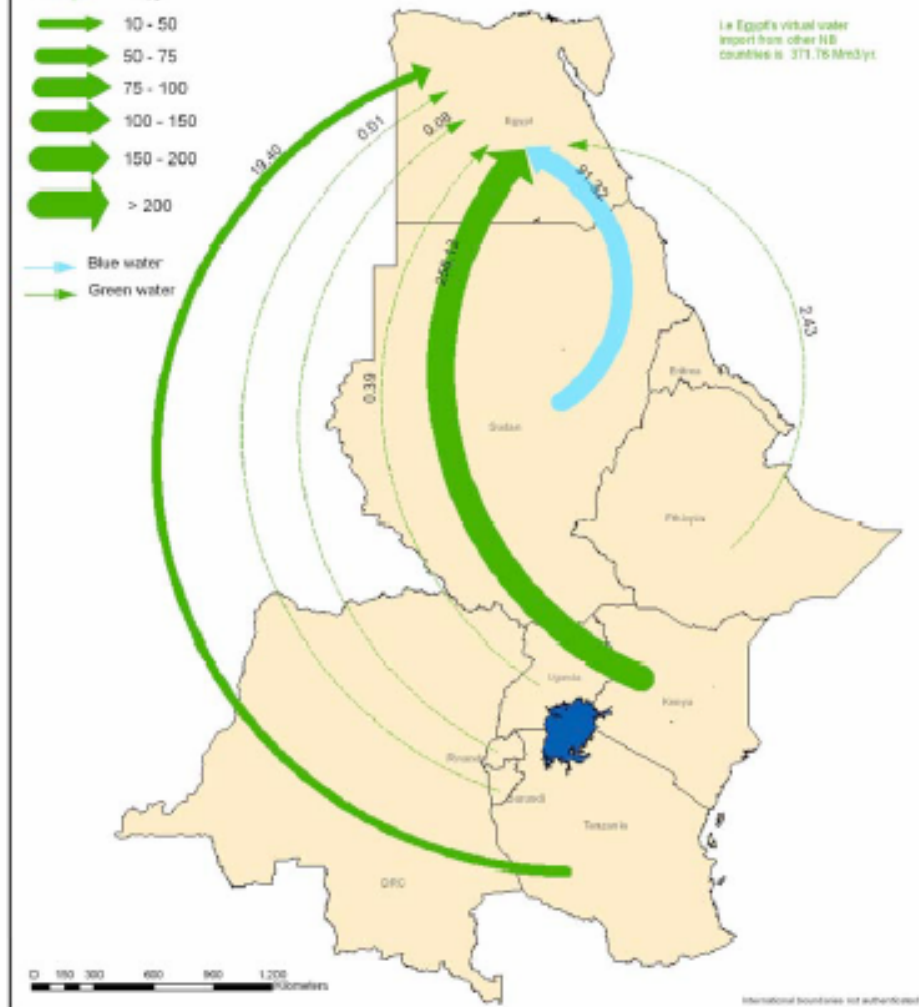
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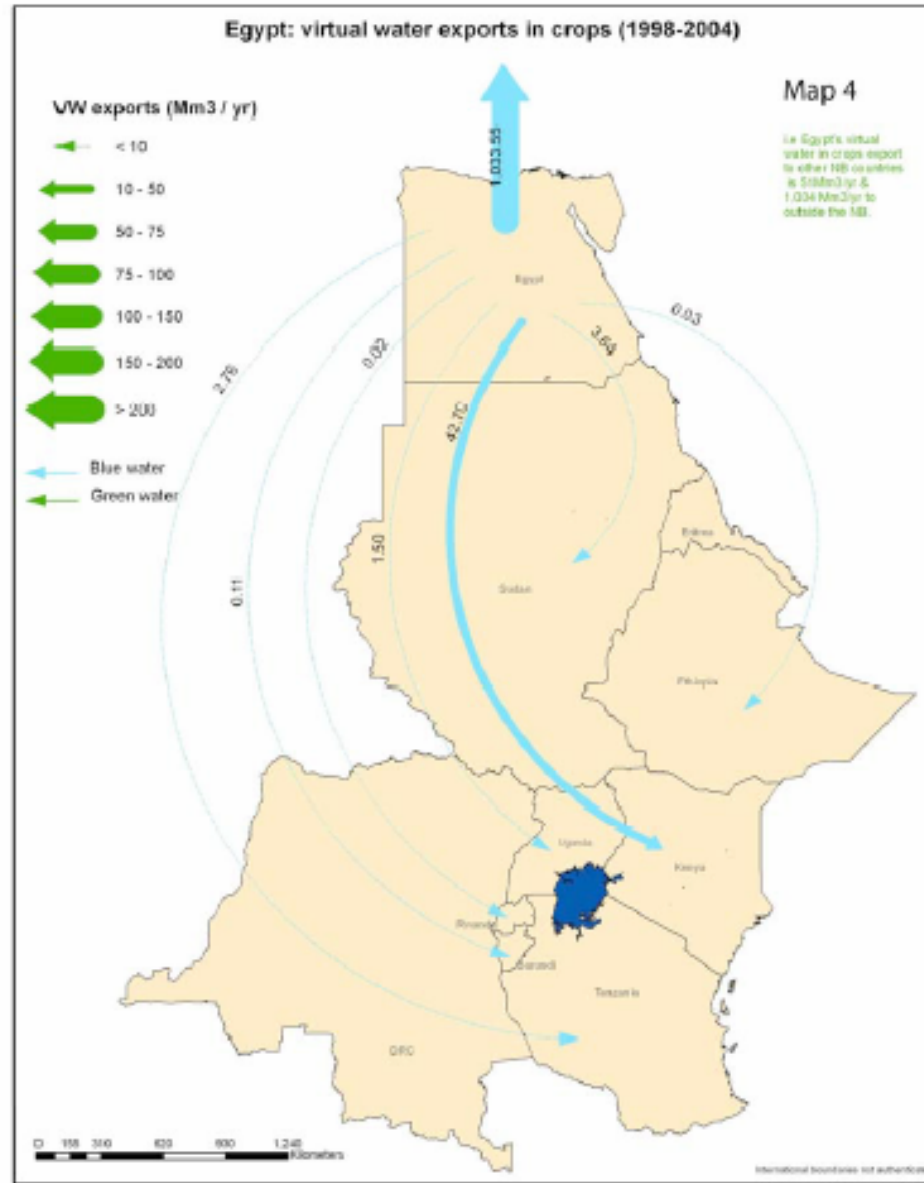
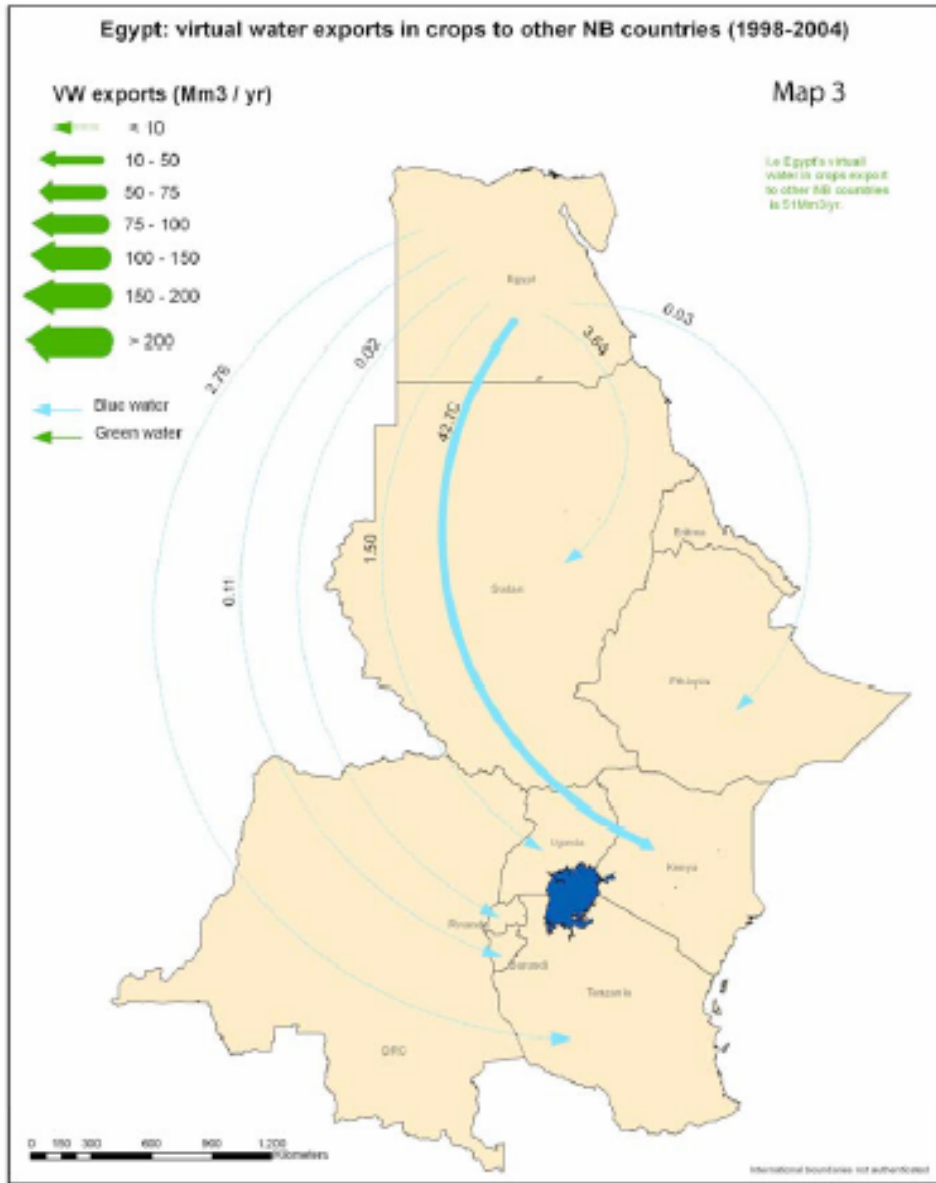
Map 2

VW imports (Mm³ / yr)

-  < 10
-  10 - 50
-  50 - 75
-  75 - 100
-  100 - 150
-  150 - 200
-  > 200
-  Blue water
-  Green water

↳ Egypt's virtual water import from other NB countries is 371.76 Mm³/yr





Kenya: virtual water imports in crops from NB countries (1998-2004)

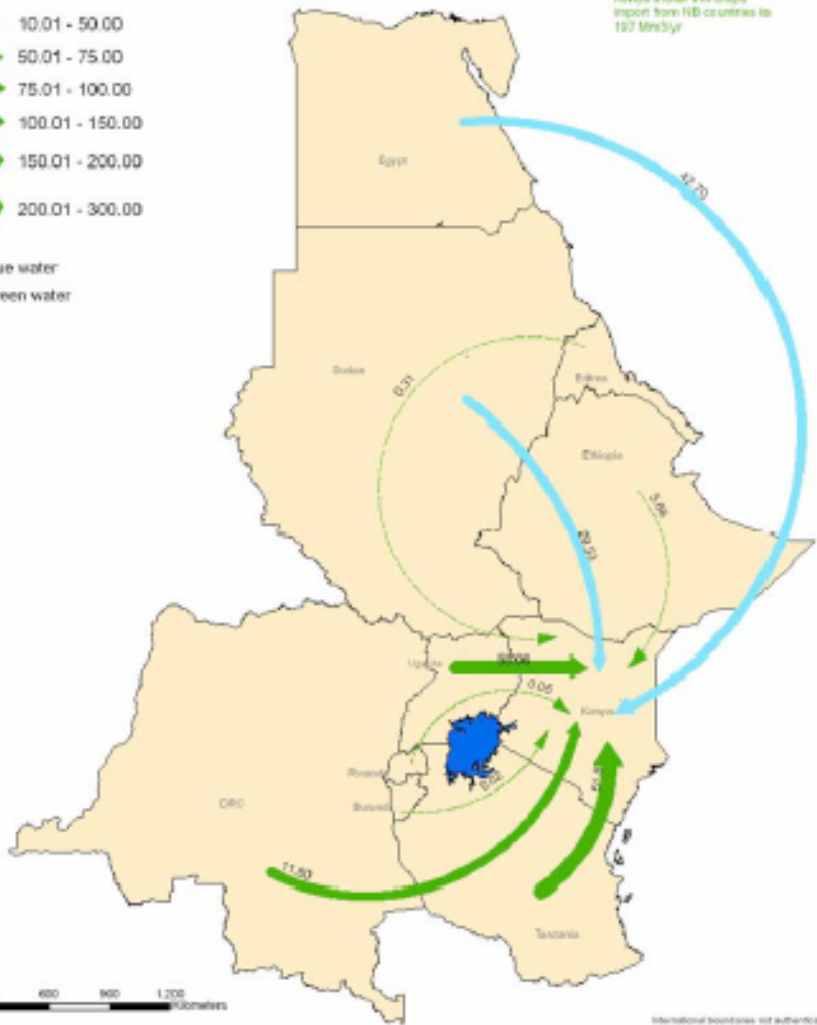
Map 24

VW Imports (Mm³ / yr)



Blue water
Green water

Kenya's total VW crops import from NB countries is 197 Mm³/yr



Kenya: virtual water imports in crops (1998-2004)

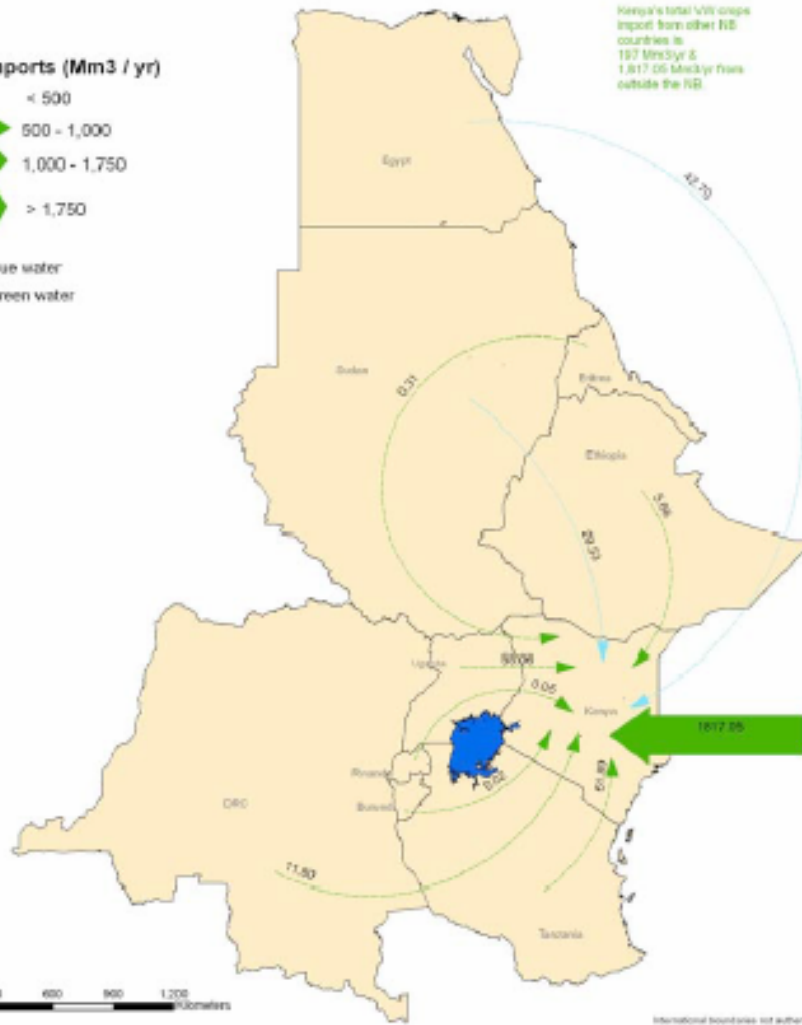
Map 25

VW Imports (Mm³ / yr)



Blue water
Green water

Kenya's total VW crops import from other NB countries is 197 Mm³/yr & 1,817.05 Mm³/yr from outside the NB



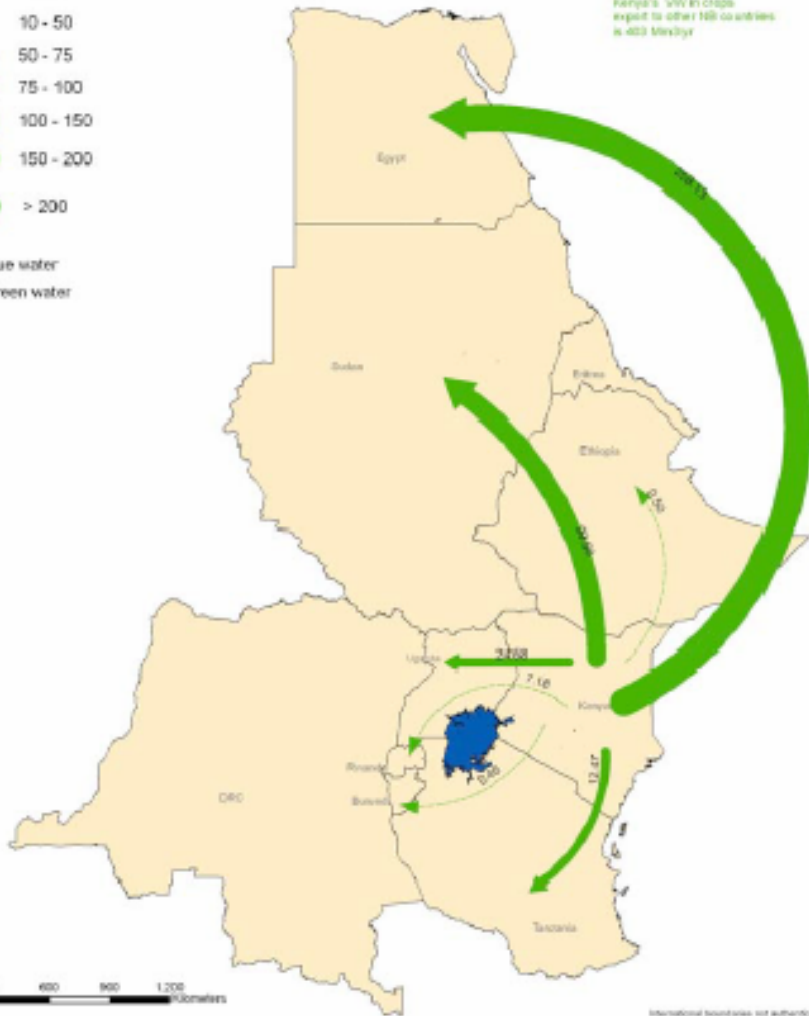
Kenya: virtual water exports in crops to other NB countries (1998-2004)

Map 26

VW exports (Mm³ / yr)



Kenya's VW in crops export to other NB countries is 403 Mm³/yr



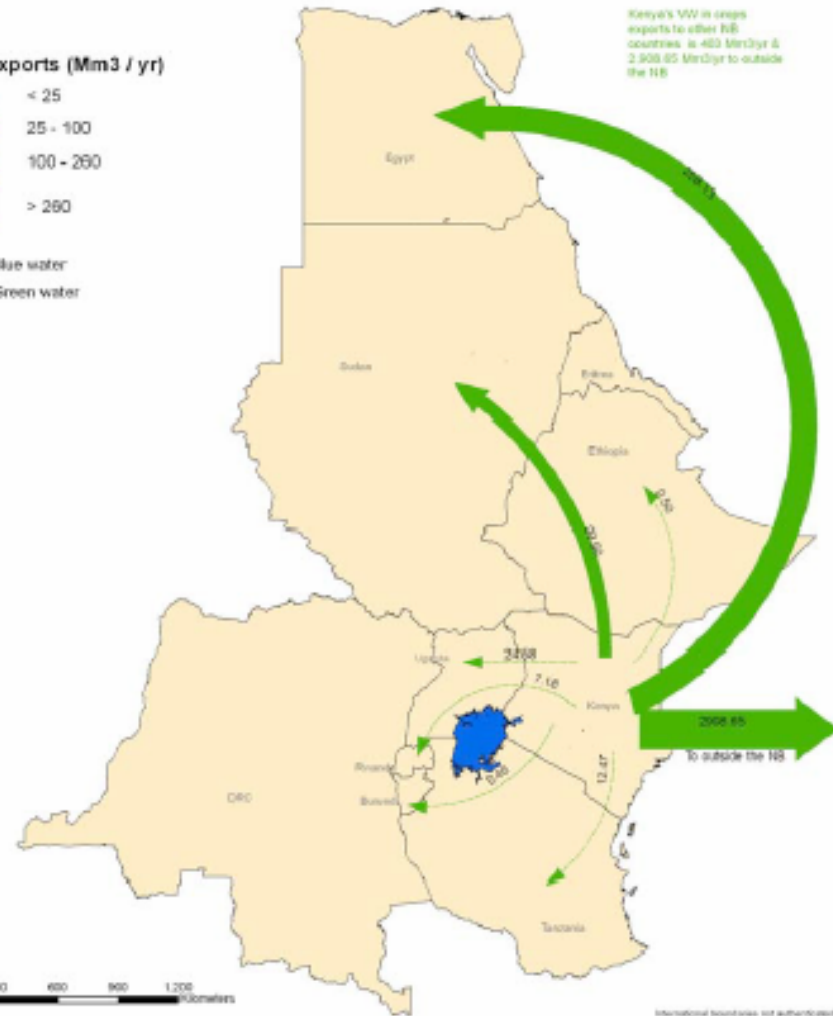
Kenya: virtual water exports in crops (1998-2004)

Map 27

VW exports (Mm³ / yr)



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Summary

Modellers - don't forget:

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Constructed Knowledge**

Summary Modellers - don't forget:

1 the agronomically and economically invisible and politically silent evapotranspiration, soil/green water, trade and socio-economic development

2 the juggernauts of emotion and distinguishing Underlying Fundamentals & Constructed Knowledge

3 that water flows uphill to money and power
- knowledge and engineering serve the powerful when they choose to listen

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1 the agronomically and economically invisible and politically silent - evapotranspiration, soil/green water, trade and socio-economic development

2 the juggernauts of emotion and distinguishing Underlying Fundamentals & Constructed Knowledge

3 that water flows uphill to money and power - knowledge and engineering serve the powerful when they choose to listen

The importance of

4 Getting the powerful to engage with our science is more important than good science

Please help us
to know what should be done
And what can be done
But above all help us
to know the difference

Thank you

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