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# Water, Society and Sustainability

## Lecture No 1: Setting the Context

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# What is water?

*A transparent and nearly colorless chemical substance that is the main constituent of Earth's streams, lakes, and oceans, and the fluids of most living organisms.*



Is it only H<sub>2</sub>O?

Does water have important social, historical, and local dimensions?



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	BOUNDARY	WHERE WE ARE TODAY
1. Climate change	Atmospheric concentrations of carbon dioxide at no more than 350 ppm	Carbon dioxide levels are at 400 ppm and climbing
2. Lost biodiversity as species become extinct	Maintain 90% of biodiversity	Biodiversity has dropped to 84% in parts of the world such as Africa
3. The addition of phosphorus, nitrogen (and other elements) to the world's crops and ecosystems	Worldwide use per year of about 11 teragrams (Tg) of phosphorus and 62 Tg of nitrogen	Up to about 22 Tg per year of phosphorus and 150 Tg of nitrogen
4. Deforestation and other land use changes	Maintain 75% of the planet's original forests	Down to 62%
5. Emission of aerosols (microscopic particles) into the atmosphere that affect climate and living organisms	Global boundary unknown, but regional effects (such as on the South Asian Monsoon) occur when Aerosol Optical Depth (AOD) is more than 0.25	Up to 0.30 AOD over South Asia, but probably well inside (or below) the boundary over most of the globe
6. Stratospheric ozone depletion	Less than 5% below pre-industrial level of about 290 Dobson Units (DU)	Still safely inside the boundary except over Antarctica during spring, when levels drop to 200 DU
7. Ocean acidification	When the oceans become acidic enough that the minerals sea creatures need to make shells, such as aragonite, begin to dissolve	Still within the boundary, which won't be crossed if we can stay within the climate boundary of 350ppm of CO <sub>2</sub> in the atmosphere
8. Freshwater use	Can use up to 4000km <sup>3</sup> of freshwater a year	We use around 2600 km <sup>3</sup> of freshwater per year
9. Dumping of organic pollutants, radioactive materials, nanomaterials, micro-plastics, and other novel or man-made substances into the world's environment	Unknown	Unknown



**Johan Rockström**

The nine planetary boundaries framework

Stockholm Resilience Centre



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- Floods
- Droughts
- Pollution
- Privatization
- Challenges in Water distribution and sharing

**Quantity  
Quality  
Access**



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# Is water a fundamental human right?

The “thirst economy” (Sainath)

“...the two greatest crops in the world are not rice and wheat, they are hunger and thirst and more revenue is made out of them than any other crop in history...”

- borewell bankruptcies
- bottled water industry

**IPL can afford water and Latur farmer cannot!**



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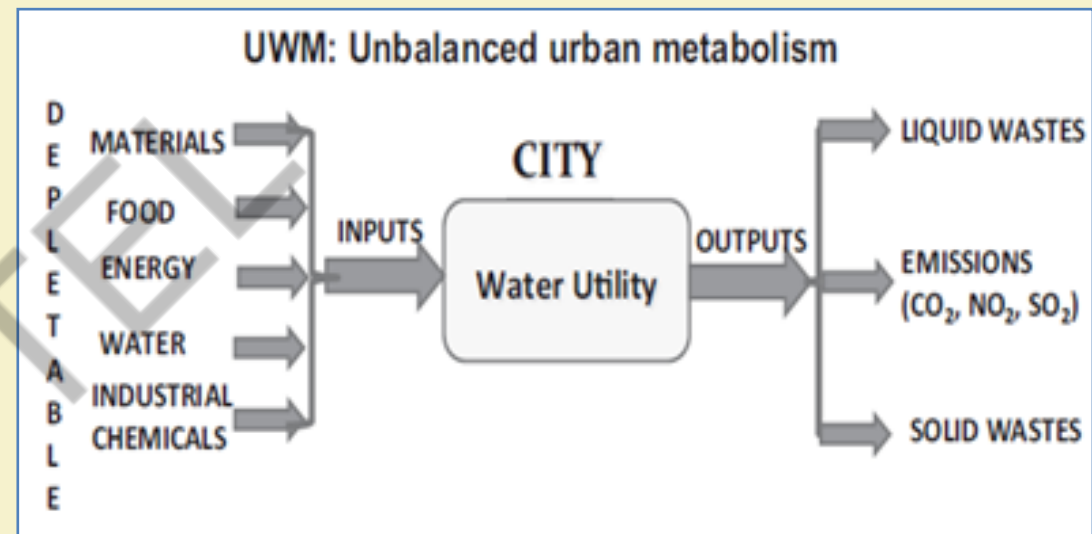
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# The urban context

2007: the landmark demographic change

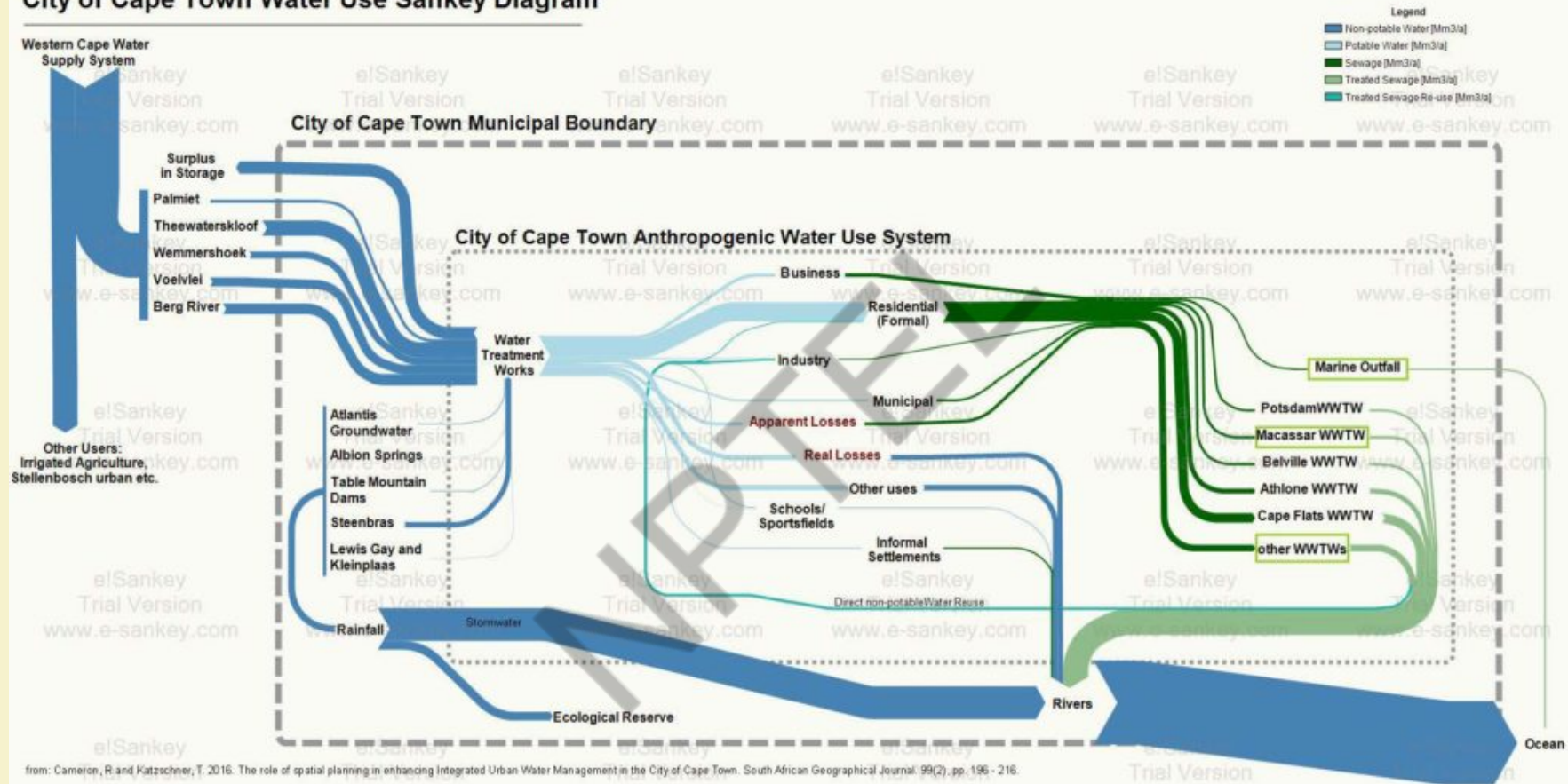
- Conversion of water bodies; real estate speculation
- Implications on water consumption
- Pressure on infrastructural networks, water utilities



**Who gains who loses?**



## City of Cape Town Water Use Sankey Diagram



<http://www.sankey-diagrams.com/cape-town-water-use-sankey-diagram/>



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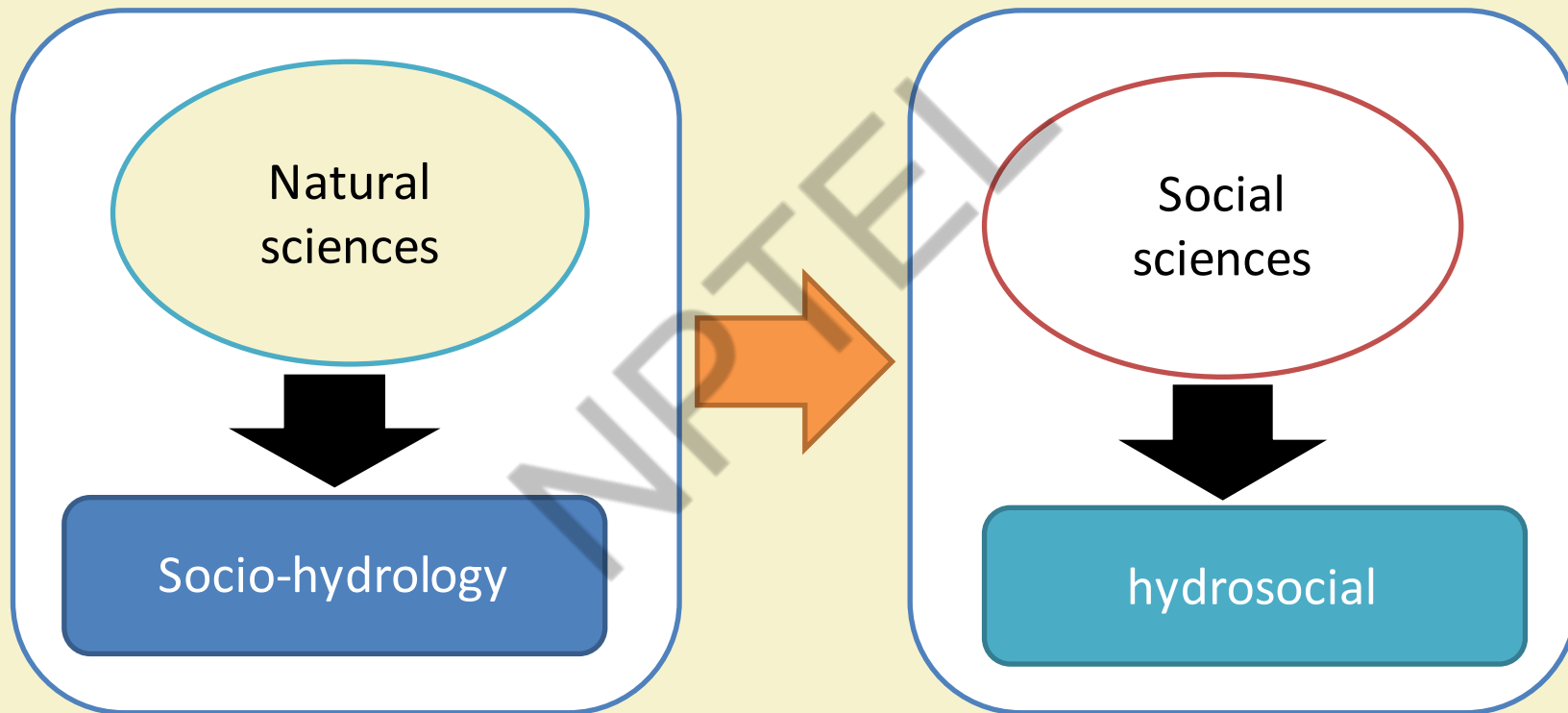


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# Beyond H<sub>2</sub>O: The Social Science of Water

Should water be a transdisciplinary concern?





# Overview of Course Outline

## Theoretical Frameworks

- Socio-hydrology
- Hydrosocial
- Critical Physical Geography

## Empirical Cases

- Dams and development in contemporary India
- Water justice in peri-urban global south
- Community water conservation initiatives, India

## Planning and implementation tools

- IWRM
- Eflows

## Discussion and Conclusion

- Radicalizing water research



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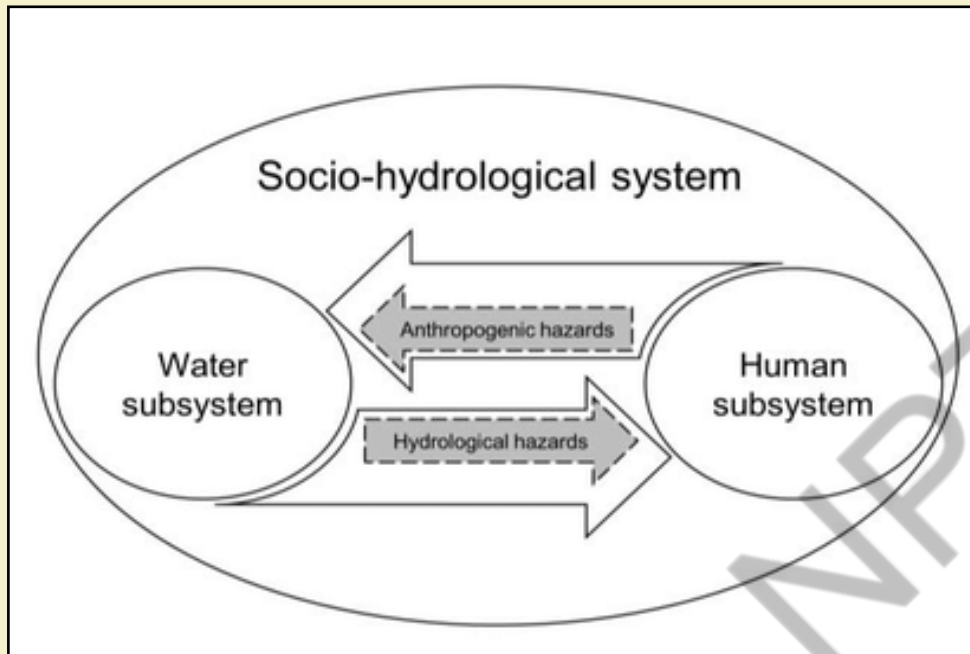
# Water, Society and Sustainability

## Lecture No 2: Beyond hydrology

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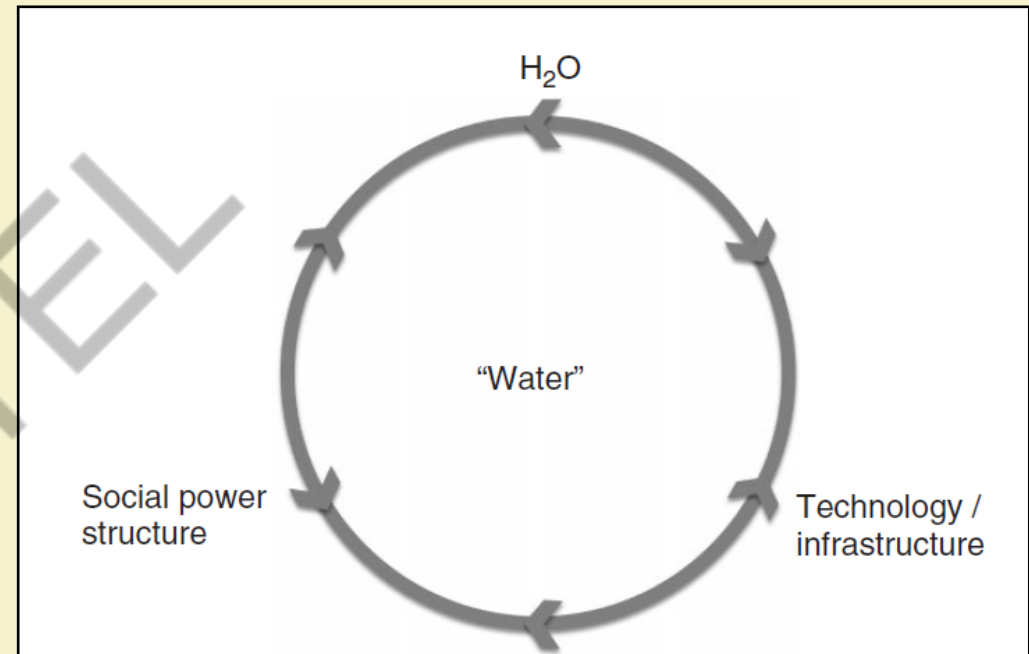
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# Socio-hydrology and Hydrosocial



## Human Water Coupling

Source: Mao et al. 2016: 23



## The hydrosocial cycle

Source: Linton & Budds 2014: 116



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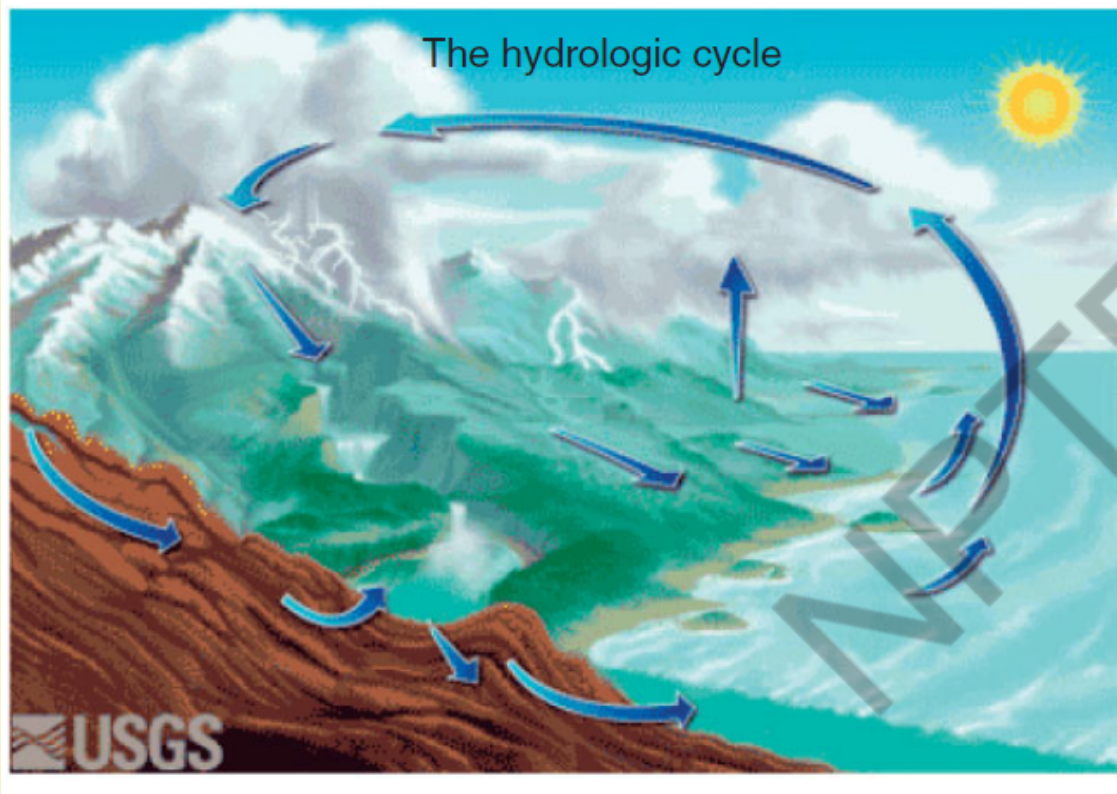


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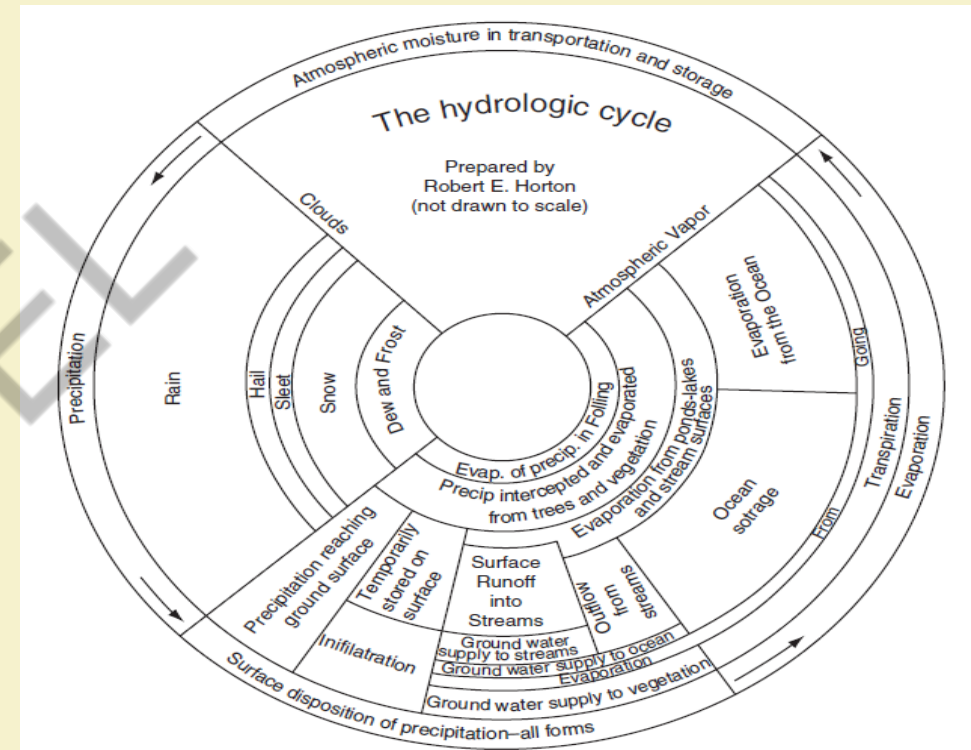
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# The hydrological cycle



Source: National Atlas of the US



## Horton's Hydrologic Cycle

Source: cited in Linton & Budds 2014: 112



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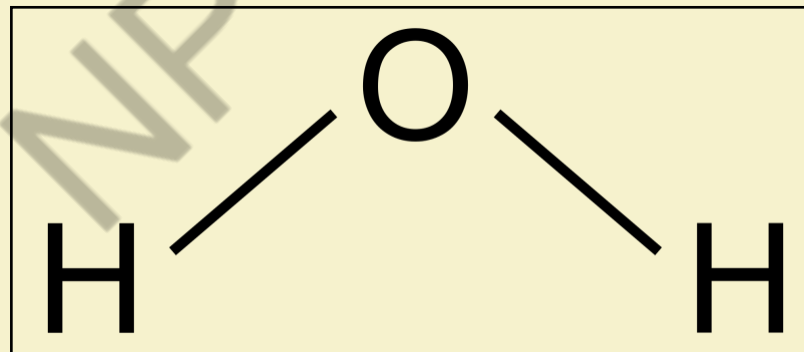
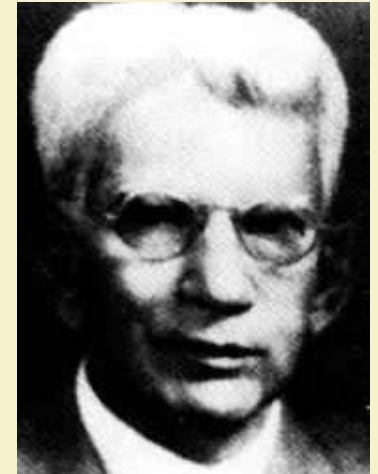
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## 'Modern water' emerges...

1930s: **Robert Horton**

17<sup>th</sup> c.: scientific revolution

Mid-18<sup>th</sup> c.: **Antoine Lavoisier** (compound of hydrogen and oxygen)



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# Implications and legacy

Water as a 'resource' to be 'managed', 'controlled' and hence 'quantified'!

**State-hydraulic paradigm**  
(Bakker 2003)



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## Major shortcomings

Hydrology – an ‘orthodox science’; water reduced to its material composition

‘different’ waters homogenized

hydrological knowledge – partial, situated, hence limited as a basis for policy and decision making





# Homogenization of waters

16<sup>th</sup> c. and 17<sup>th</sup> c.: The great 'hydraulic' transition in Europe

Soil-liquid hybrids considered as treacherous

Use of scientific techniques – pumps, dredging devices, locks, sluices, etc.

Conversion of once soluble and precarious waterscapes into durable landscapes



# The great land-water divide

**River as resource** and land to own (D'Souza 2009)

“Land exorcised of water was transformed into property...**Flowing waters** telescoped into contained channels...were revealed principally as **engineering visions**” (D'Souza 2009: 3)





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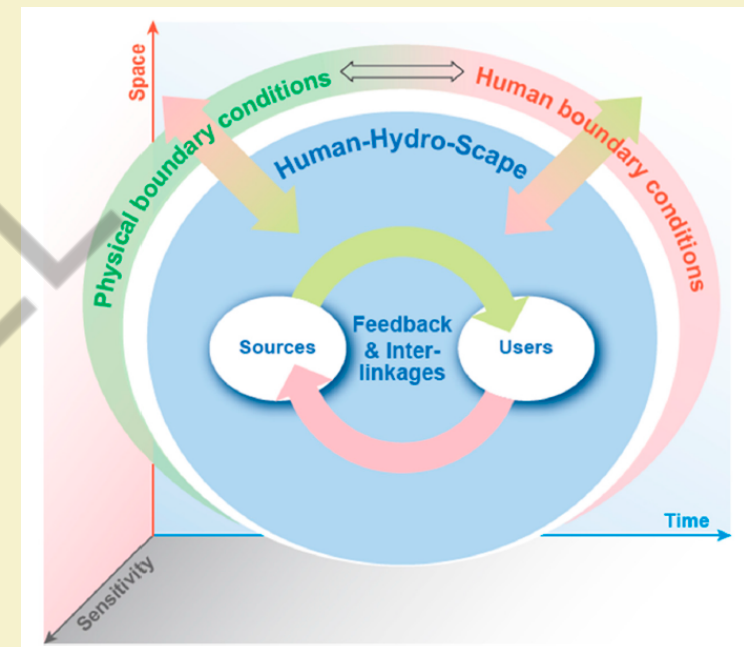
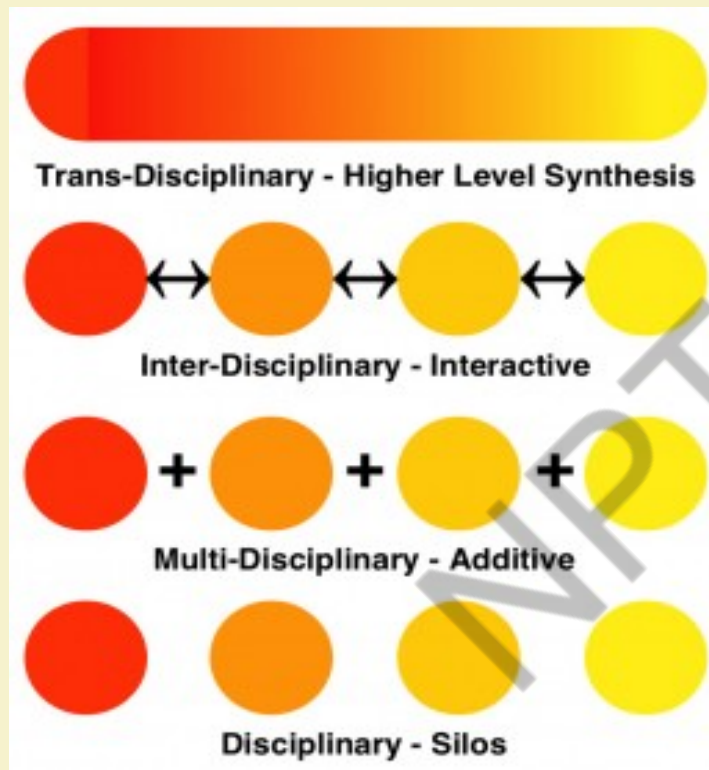


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# Beyond reductionism...

Entanglement of water,  
ecology and human society



**The Pluralistic Water Research**

Source: Evers et al. 2017: 6



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## Lecture No 3: Socio-hydrology

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# The Murrumbidgee River Basin Story...



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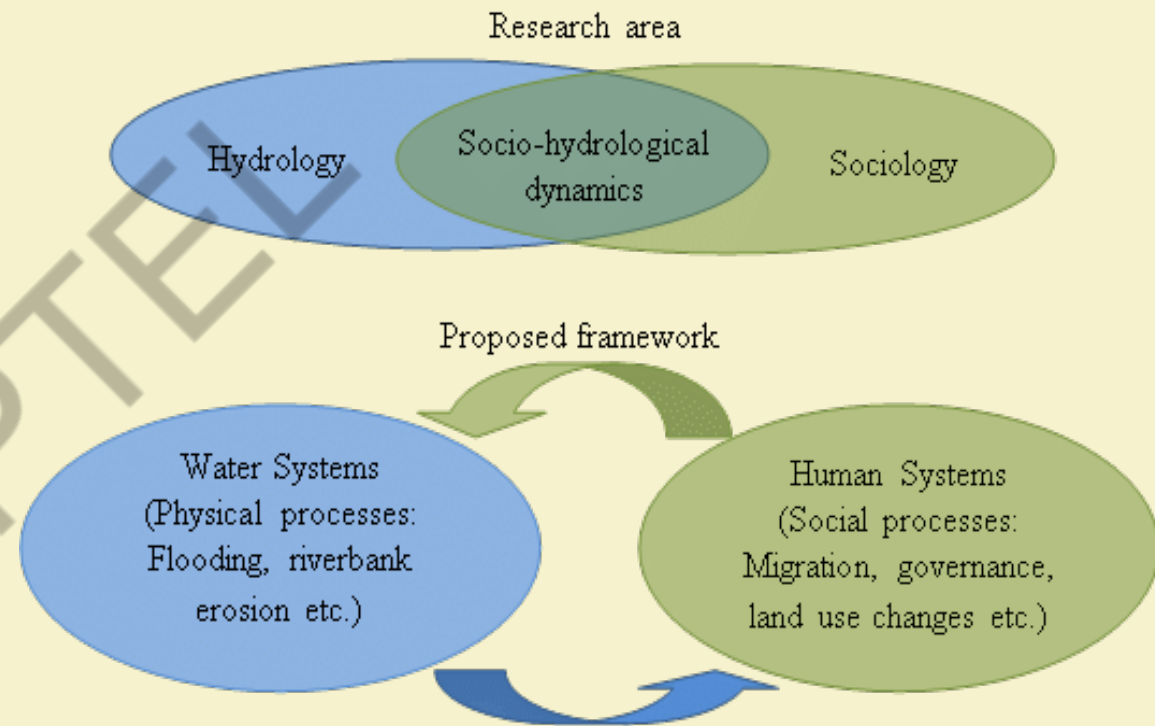
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# What is socio-hydrology?

Is prediction of **water cycle dynamics** over **long timescales** feasible without including the **interactions and feedbacks with human systems**?

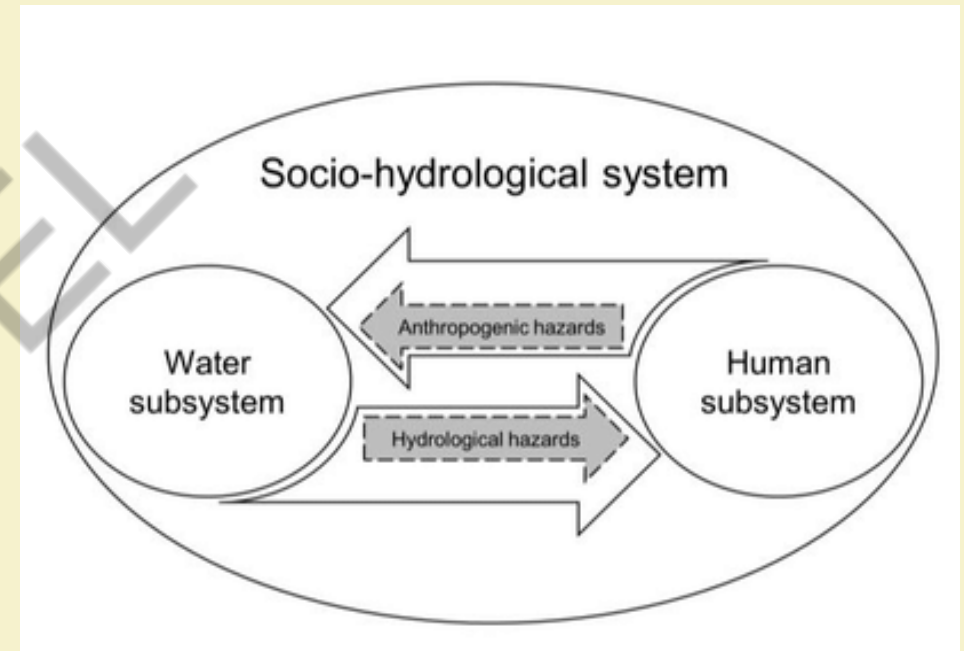
Socio-hydrology – the science of **people and water**, aimed at understanding the dynamics and **co-evolution of coupled human-water systems**



## Contd.

Socio-hydrology - the research theme for the current decade (2013–2022) to “advance the science of hydrology for the benefit of society” (Montanari 2013:1257)

how water interacts across both **biophysical** and **societal** processes



### Human Water Coupling

Source: Mao et al. 2016: 23



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## Socio-hydrologic processes

Which way the water is flowing? Why?

Streams flow in response to topographic gradients, and evaporation occurs due to humidity gradients. Water flows downhill.

But it can be **pumped** uphill.

People - endogenous part of the water cycle, interacting with the system in multiple ways (Sivapalan et al. 2011).

the migration and resettlement of populations from flood risk areas...



## Socio-hydrologic focus

IWRM: coordinated development and management of water, land and related resources, to maximize economic and social welfare and equity without compromising the sustainability of vital ecosystems

SH: observing, understanding and predicting future trajectories of co-evolution of coupled human-water systems

“socio-hydrology is the fundamental science underpinning the practice of IWRM” (Sivapalan et al. 2011: 1271)



### General framework of IWRM

Source: GWP



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# Methods and Methodology

## Quantitative science

### Evaluating flood investment strategy



## Case Studies

interrelationship in the use of water resource from downstream to upstream, **Murrumbidgee River (Van Emmerik et al. 2014)**

human–hydrology interactions at the broader catchment system scale (**Elshafei et al. 2014**)

catchment hydrology, population, economics, environment, socioeconomic sensitivity and collective response

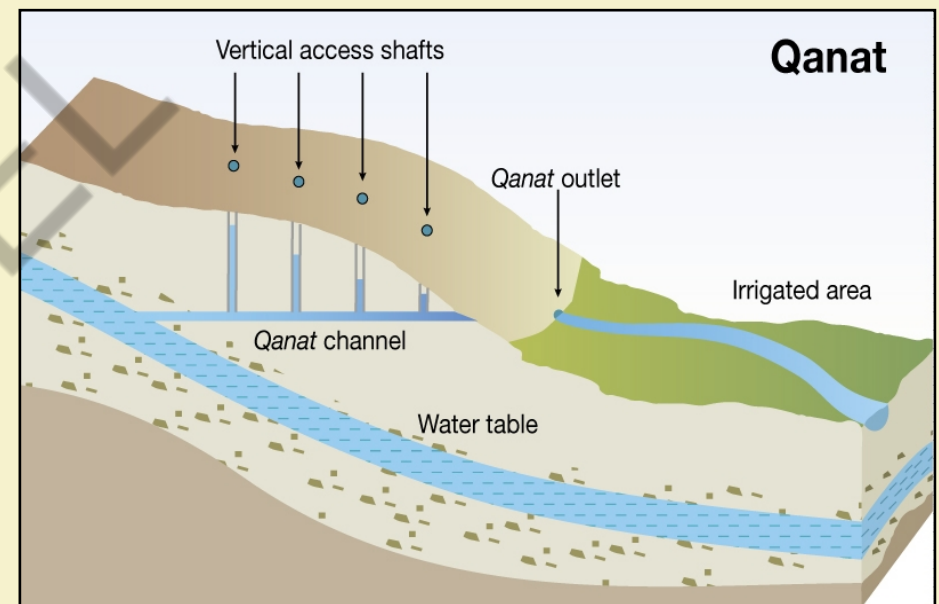
Socio-hydrology of floodplains: the ‘adaptation effect’ and the ‘levee effect’ (**Di Baldassarre 2015 et al. 2013, 2014, 2015; Viglione et al. 2014**)



# Three avenues in socio-hydrology

Sivapalan 2012:

- Historical socio-hydrology
- Comparative socio-hydrology
- Process socio-hydrology



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## Challenges

Can **quantitative modeling** address:

- plurality of human values?
- differing human agency?
- societal (power) relations?

Perceptions  
Adaption  
Resilience



# Oppositional Challenges

How to capture heterogeneity among agents?

Troy et al. 2015:

**the desire to be quantitative**

vs.

**the need to incorporate qualitative  
knowledge from social science  
disciplines**

**the need to base analyses on empirical  
facts**

vs.

**the attempt to develop generalizable  
understanding**

**How to reconcile numerical data with descriptive histories?**



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# Water, Society and Sustainability

## Lecture No 4: Political Ecology of Water

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# Public versus Private



*versus*



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# Is scarcity real or manufactured?



Not an  
'apolitical'  
but  
a **political**  
approach!



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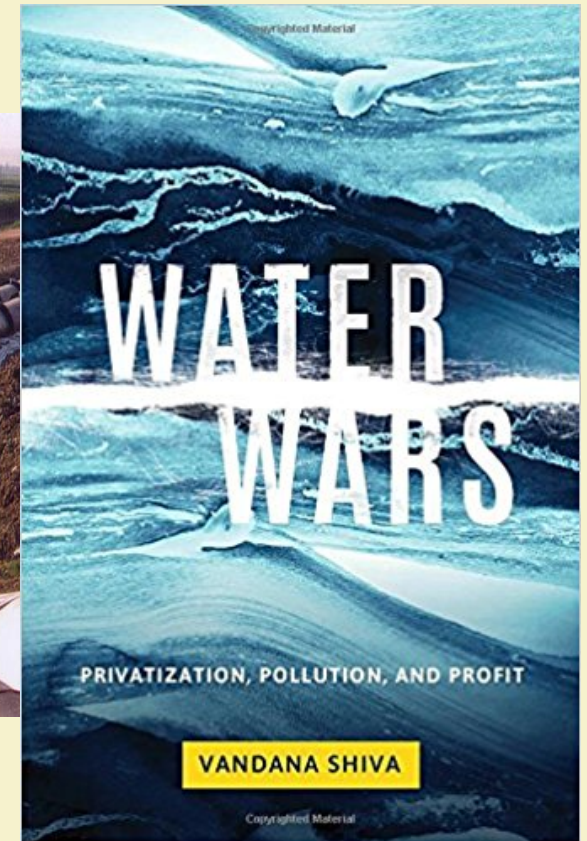


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# Quantity, Quality and Access



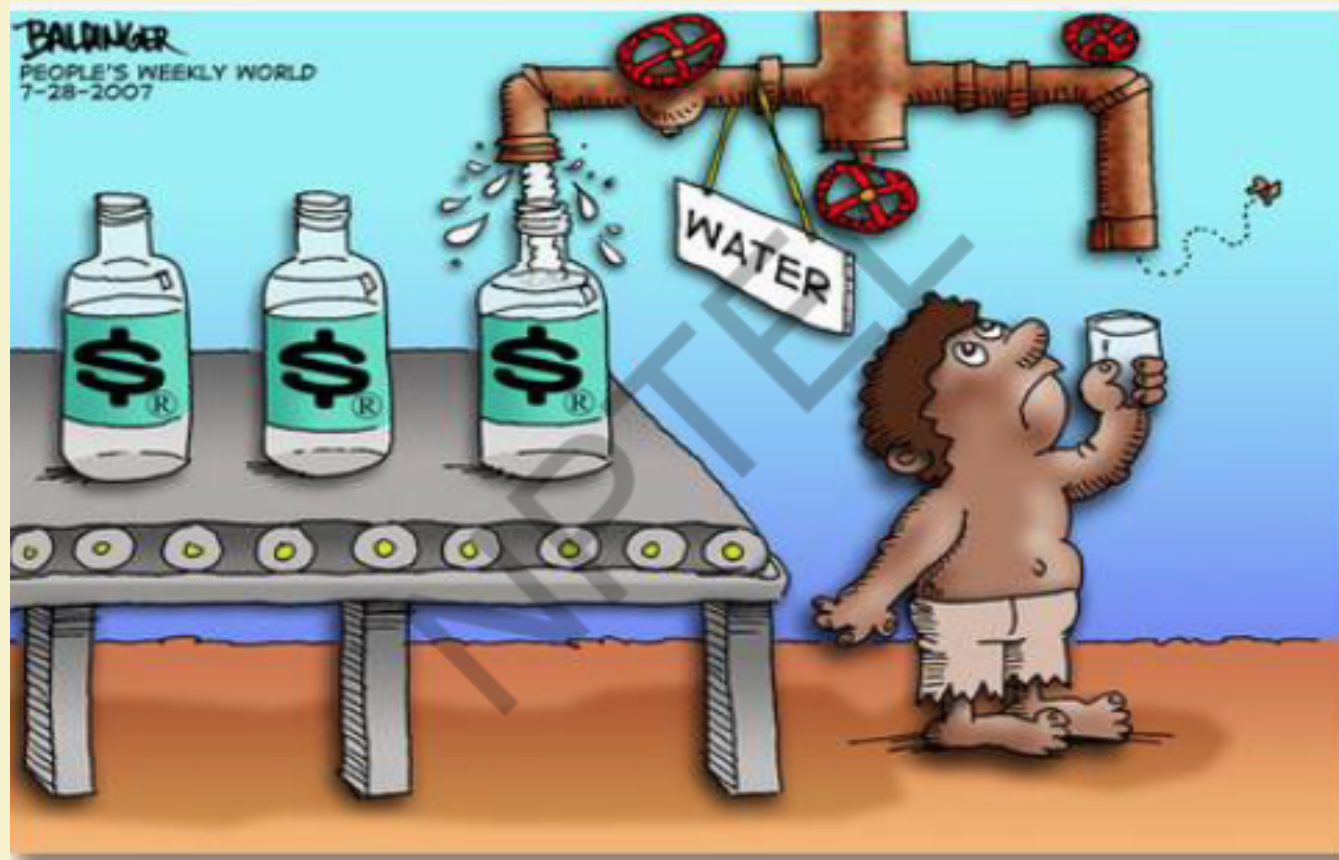
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# Political Ecology of Water



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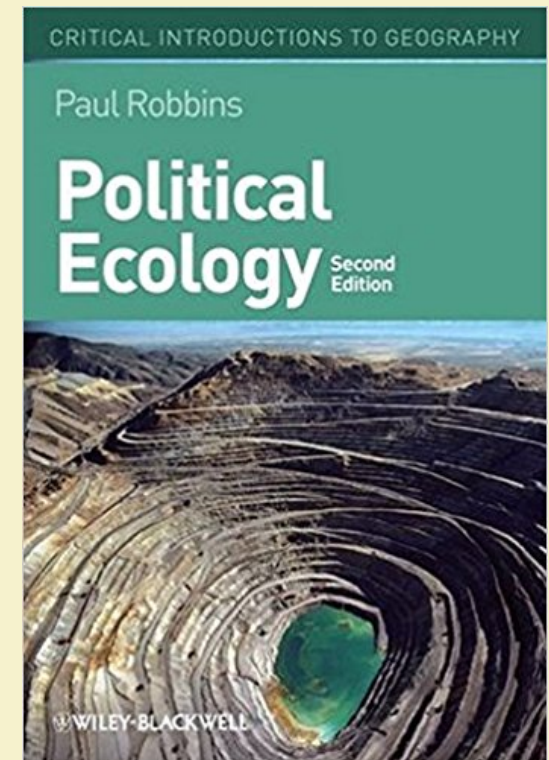
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# Political Ecology

- any tug on the strands of the global web of human–environment linkages reverberates throughout the system as a whole
- Interdisciplinary; not a discipline but a ‘community of practice’
- “the hatchet and the seed” (Robbins 2012)



# Beyond the Malthusian prism

*Essay on the Principle of Population* (1793)

Ecoscarcity or capitalist consumption patterns?

<i>Resource</i>	<i>India</i>	<i>United States</i>
Meat (kg, 2002)	5	125
Paper (kg, 2005)	5	297
Water (m <sup>3</sup> )	633	1,687
Energy (kg oil equivalent, 2005)	514	7,921
Carbon emissions (tonnes, 2005)	1	20

Source: World Resources Institute 2010



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## Five Theses of Political Ecology

<i>Thesis</i>	<i>What is explained?</i>	<i>Relevance</i>
Degradation and marginalization	<i>Environmental conditions</i> (especially degradation) and the reasons for their change	Environmental degradation, long blamed on marginal people, is shown in its larger political and economic context.
Conservation and control	<i>Conservation outcomes</i> (especially failures)	Usually viewed as benign, efforts at environmental conservation are shown to have pernicious effects, and sometimes fail as a result.
Environmental conflict and exclusion	<i>Access to the environment and conflicts over exclusion from it</i> (especially natural resources)	Environmental conflicts are shown to be part of larger gendered, classed, and raced struggles and vice versa.



## Contd.

Environmental subjects  
and identity

*Identities* of people and social  
groups (especially new or  
emerging ones)

Political identities and social  
struggles are shown to be  
linked to basic issues of  
livelihood and environmental  
activity.

Political objects and  
actors

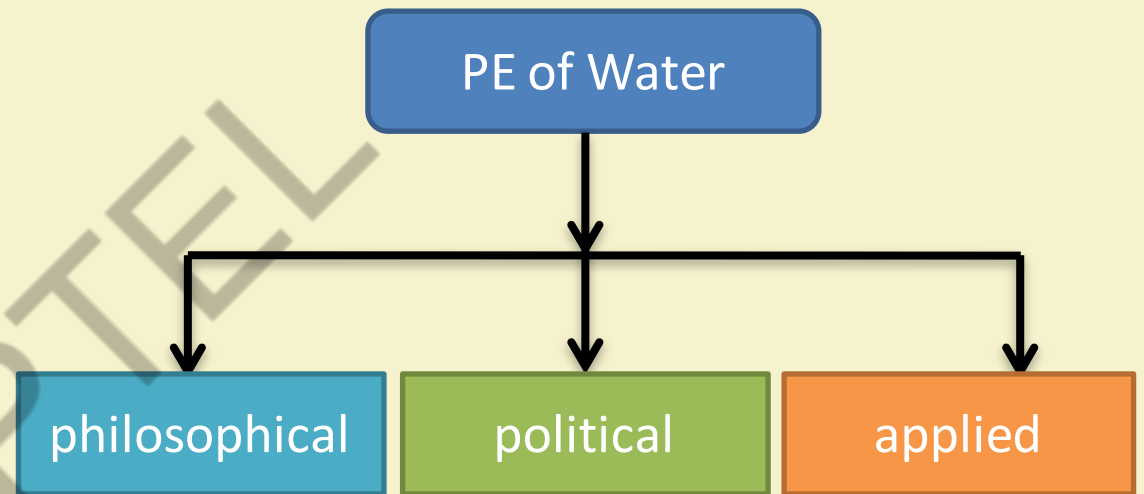
*Socio-political conditions*  
(especially deeply structured  
ones)

Political and economic systems  
are shown to be underpinned  
and affected by the non-  
human actors with which they  
are intertwined.



# Political Ecology of Water

- a critical literature that studies and analyzes **the social and political dimensions of water** (Loftus, 2009)
- intertwined and uneven flows of water and power relations (Budds et al., 2014)



Source: Lafaye de Micheaux and Kull 2016





# Human Dimensions of Water Scarcity

Water scarcity not only reflects the relative aspects of supply (the conditions and actions that affect quantity and quality) and demand (intended and projected use), but the relative aspects of how water is valued (the cultural meanings as well as economic values), relative levels of access and patterns of use, and the relative degrees of control over water resource management and distribution. Thus, scarcity might reflect the economic ability to pay for water, or, the customs, social conditions, and relationships that privilege access to some while withholding access to others.

Johnston 2003: 74



# Exponential Growth versus Ecological Sustainability



Economic  
Development



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# Development for Whom? At What Cost?

## Impacts of Dams



Source: <https://www.internationalrivers.org/problems-with-big-dams>



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# Urban Political Ecology of Water: Potable Water

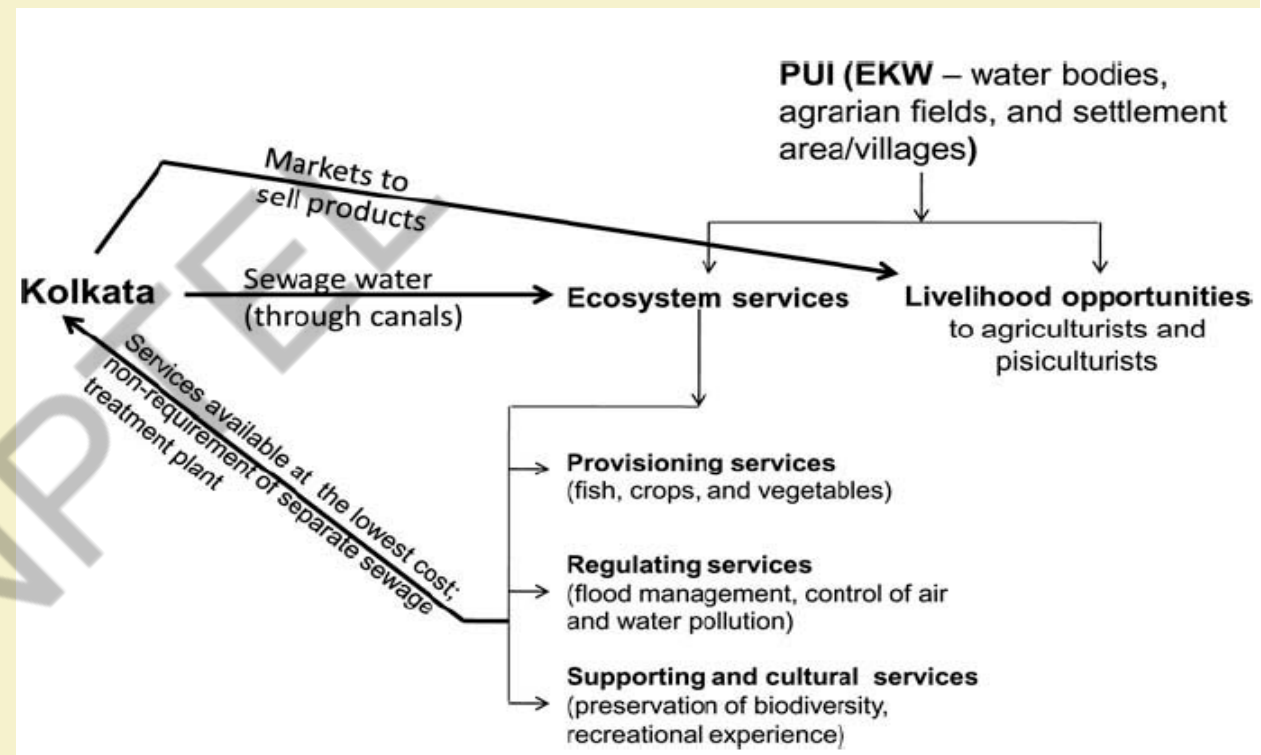
- **potable water supply**; urban infrastructures (Swyngedouw 1997; 2009; Loftus 2009; Acharya, 2015)
- the choreographies of power that influence **how much water flows through urban infrastructure? where it flows?** (Rusca et al. 2017)
- “for the urban elite, water supply is often relatively abundant, and relatively cheap. For the urban poor, the scarcity of potable water is a daily hardship” (Bakker 2003: 333)
- **water quality** (Rusca 2017)



# Urban Political Ecology of Water: Beyond Potable Water

## Third World Urban Water Political Ecology

- Baviskar 2011 (Delhi)
- Sundaresan 2011 (Bangalore)
- Coelho & Raman 2013 (Chennai)
- Mukherjee 2015, 2015a 2016 (Kolkata)
- Cornea et al. 2016 (Burdwan)
- Singh 2018 (Udaipur)



Sustainable flows between Kolkata and its peri-urban interface



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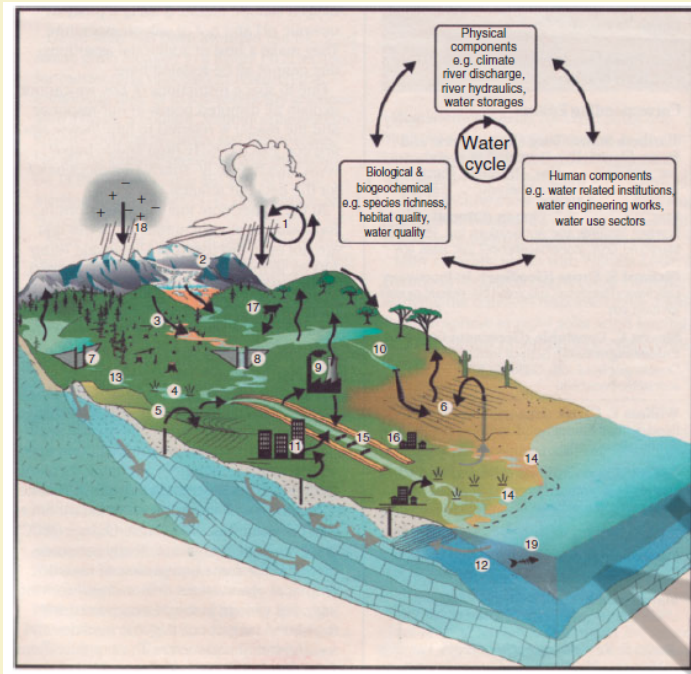
# Water, Society and Sustainability

## Lecture No 5: Hydrosocial (HS)

Jenia Mukherjee

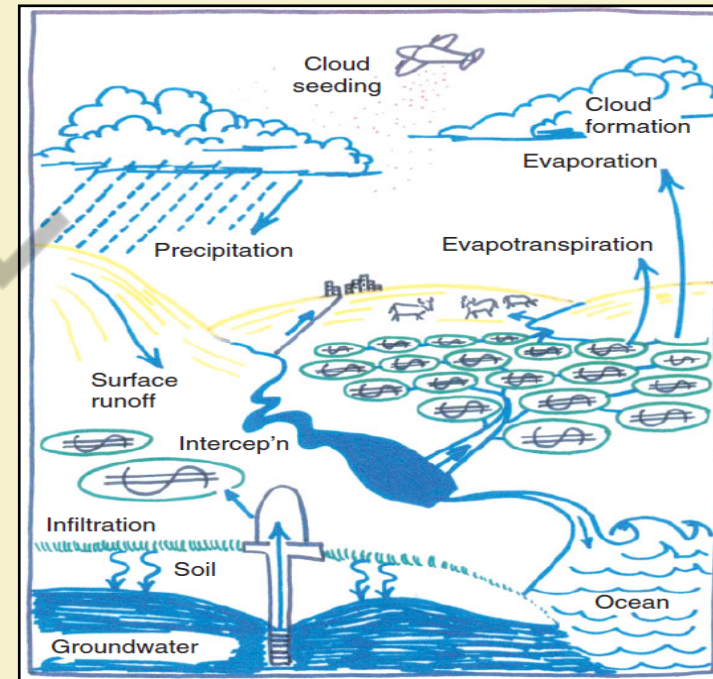
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# 'Water System' + differentiated humanity



## The Global Water System Project

Copyright 2004 American Geophysical Union



## Water Flows to Money!

Source: cited in Linton & Budds 2014: 115



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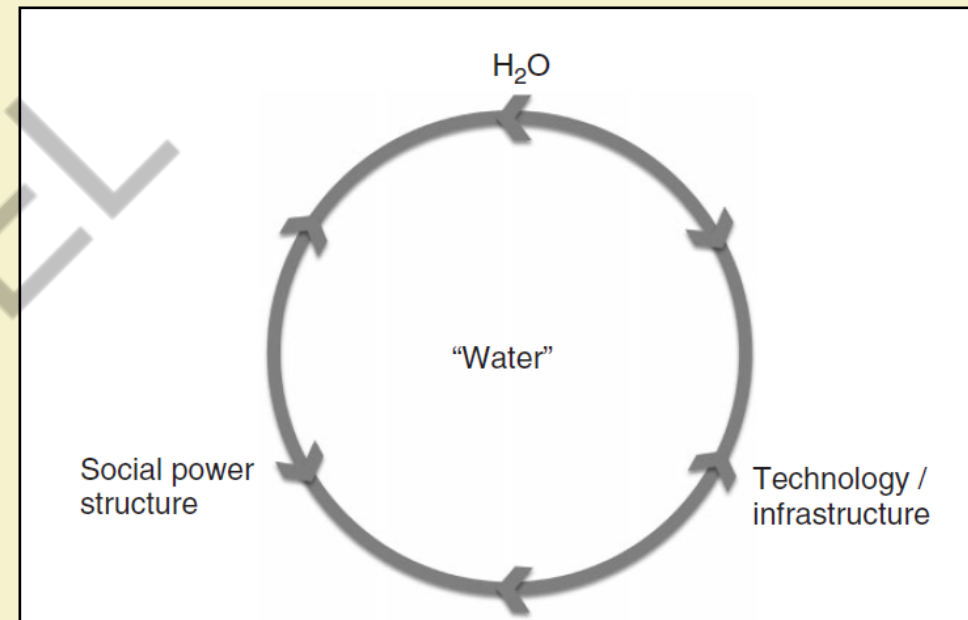
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# The HS cycle

Hydrosocial cycle – social and political dimensions of water (Swyngedouw 2004, 2004a, 2006, 2009)

socio-natural process “by which water and society make and remake each other over space and time” (Linton & Budds 2014: 175)



**The hydrosocial cycle**

Source: Linton & Budds 2014: 116



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# From hydrological cycle to HS cycle

Hydrological cycle: 'old' water paradigm  
(Gleick 2000); water supplies and the role of  
the state

**From state > all relevant stakeholders**

**From water management > water  
governance**

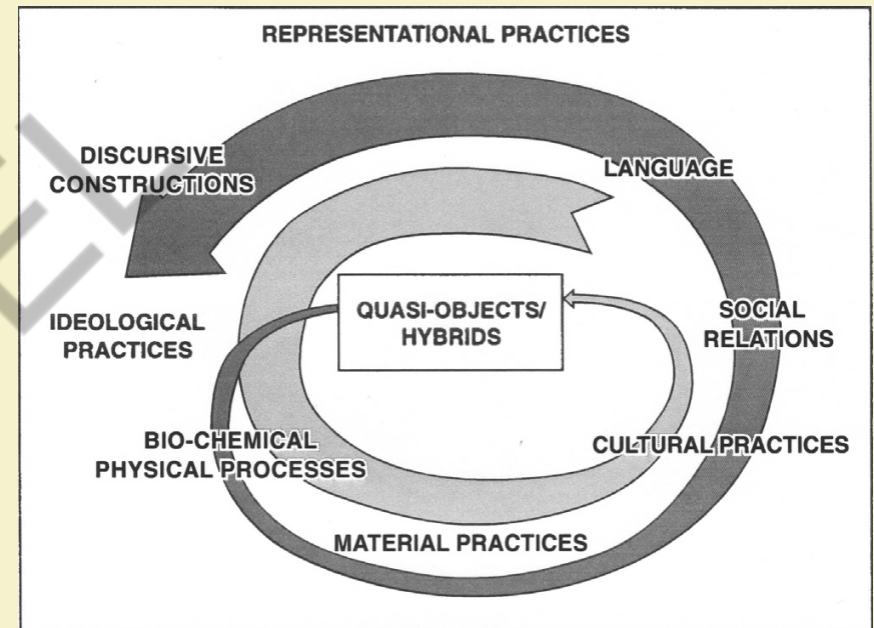
**Water is  
everybody's  
business!**



# Hybrids

water and society are related  
**internally** (Swyngedouw)

relations between things to the  
relations constituting things



**The production of socio-nature**

Source: Swyngedouw 2004



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# Dam



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# Desalinated water



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# Groundwater



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## The larger picture

addressing sediments...

*muddyscapes* (Mukherjee and Lafaye de Mischeaux 2016)

from the HS to the  
**hydro(sediment)social** [HSS]  
cycle



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# Towards 'agonistic' transdisciplinary water research

HS does not push a transdisciplinary research program (Krueger 2016)

the physical takes a backseat

it creates the perspective for action; not radically directed towards concerted actions

*While case studies of the cultural and political economy of water knowledge exist, we need **more empirical evidence** on how exactly culture, politics, and economics have shaped this knowledge and how and at what junctures this could have turned out differently. We may thus channel the coproductionist critique productively to bring perspectives, alternative knowledges, and implications into water politics where they were not previously considered; in an attempt to counter potential lock-in to particular water policies and technologies that may be inequitable, unsustainable, or unacceptable.*

- Krueger et al. 2016: 369





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# Thank You!!



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