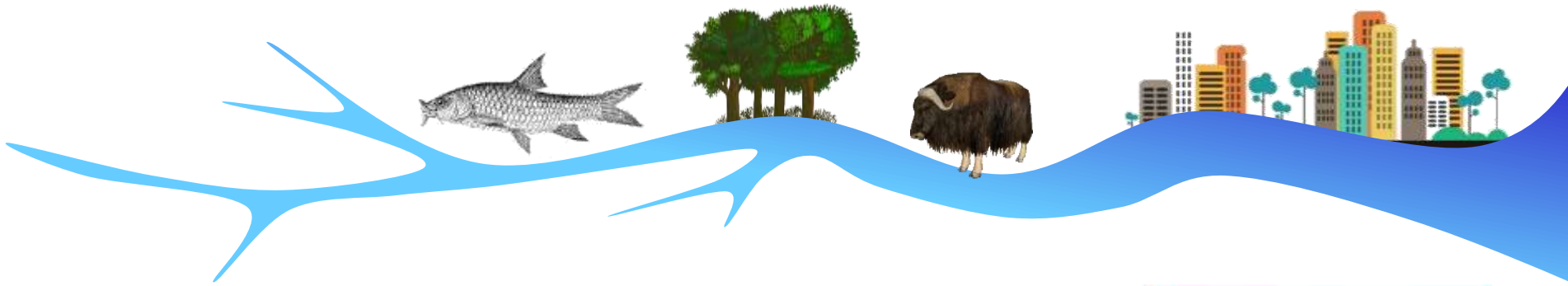


# NBS ↔ WRM


**Reintegrating nature-based solutions  
into water resource management**



**Dr Mark Everard**



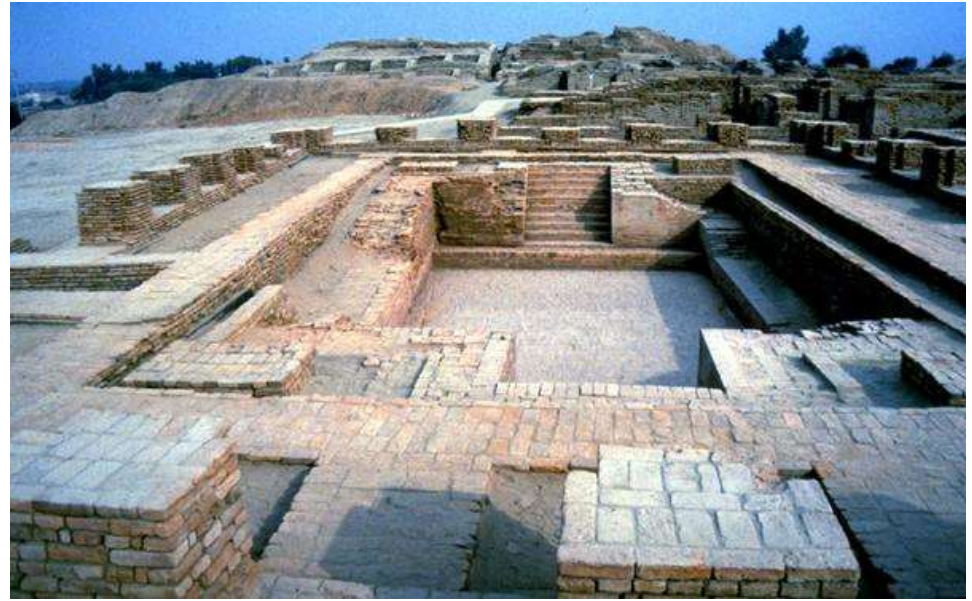
**Associate Professor of Ecosystem Services, UWE**



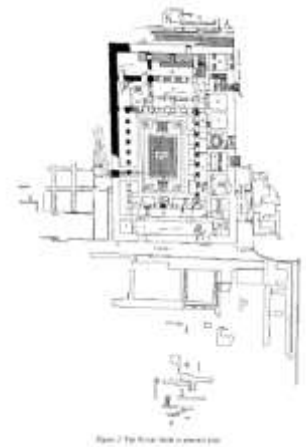
# NBS ↔ WRM

- **India's traditional water history**
- **Centralisation and energisation**
- **SES regeneration is possible**
- **The Banas catchment**

# Dholavira: Indus Valley Civilisation



- In modern-day Kutch District, Gujarat
- Bronze Age civilisation (3300–1300 BCE)
- Systems of water harvesting and drainage





# Traditional Indian water management



**Johad**



**Anicut**



**Step well**



**Rehat**

- **4.5 millennia of innovation in water management:**
  - Traditional wisdom as adaptation to monsoon rains
  - Community-based governance, working with natural processes



**Taanka**



**Beri**



**Naadi**



**Chauka**

[illegible]

**Nature-based solutions for water security, CSE Nimli** Dr Mark Everard, 28<sup>th</sup> November 2018



# Ancient wisdoms; traditional solutions



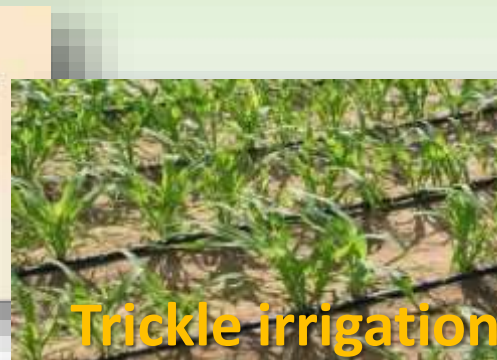
## Ancient wisdoms; modern solutions



Taanka




Roof harvesting



Trickle irrigation



Channel lining



# NBS ↔ WRM

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# Centralisation



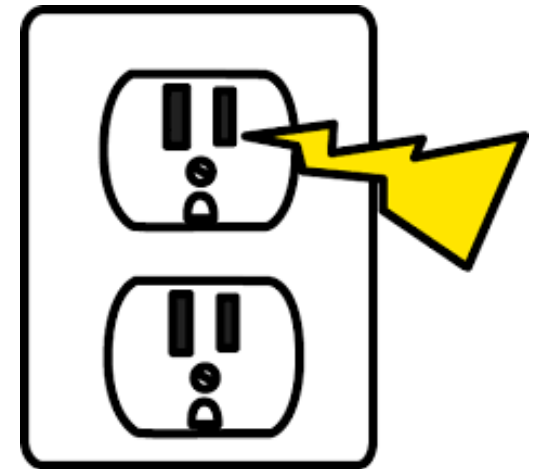
- **State ownership of water and its management**
- **State control of water management**
  - **Dispossession from local people**
  - **Collapse of traditional, local management and community collaboration**
  - **Loss of traditional knowledge**



# Technology and economics

## Tube wells and energisation

- Private exploitation of water
  - Receding aquifers
  - Those with resources pump deepest
- Cheap/free electricity to farmers
  - Absurd economically and equitably
- No incentive for recharge
  - Cycles of socio-ecological degradation
  - Village abandonment
- Competition, not collaboration



# Outcomes for catchment functions (STEEP)



## Political (governance)

- Economic stimuli
- No permitting / auditing

## Technology

- Tube wells replace recharge
- Energy costs low
- Ready access
- Deeper withdrawals

## Social

- Abandonment of recharge
- Loss of community cohesion
- Loss of traditional wisdom
- Drying wells
- Fluorosis, As and saline water
- Village abandonment
- Urban / irrigation vulnerability

## Environmental

- Declining aquifers
- Contaminated water
- Fragmented rivers
- Drying reservoir
- Biodiversity loss

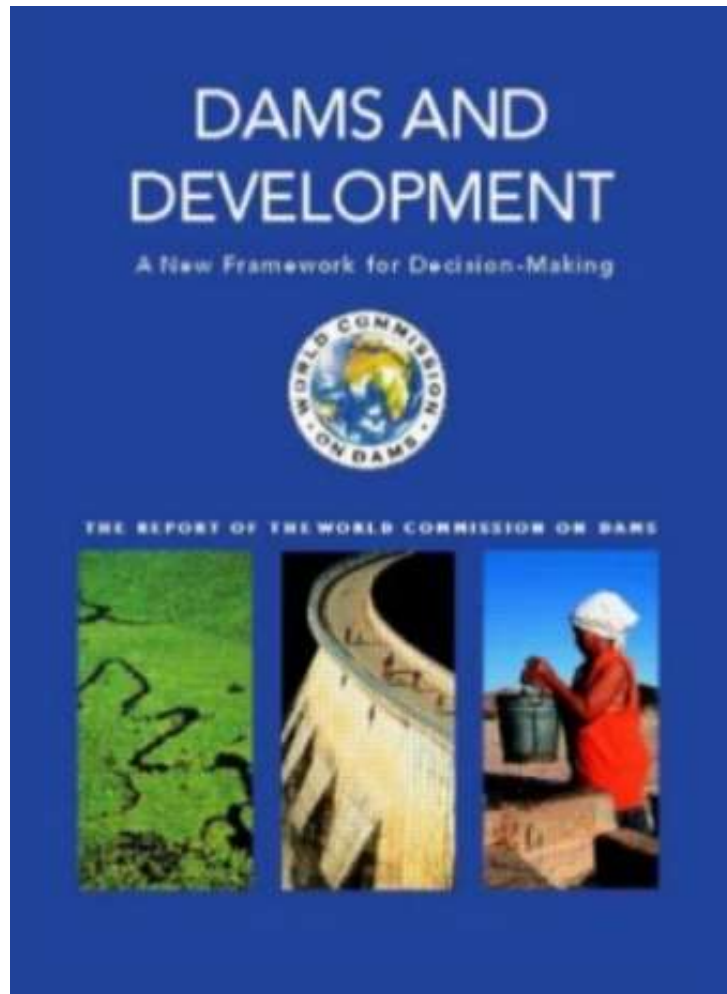
## Economic

- Short-term stimuli
- Long-term vulnerabilities

FCI

A degrading socio-ecological cycle

# The World Commission on Dams (2000)



## 'Dams and Development' findings:

- *"...significant contribution to human development"*
- *"...too many cases an unacceptable and often unnecessary price... especially in social and environmental terms"*
  - Displacement (40-80 million people worldwide)
  - Downstream communities
  - Taxpayers
  - Waterborne diseases
  - The natural environment
  - Uneven benefits and costs

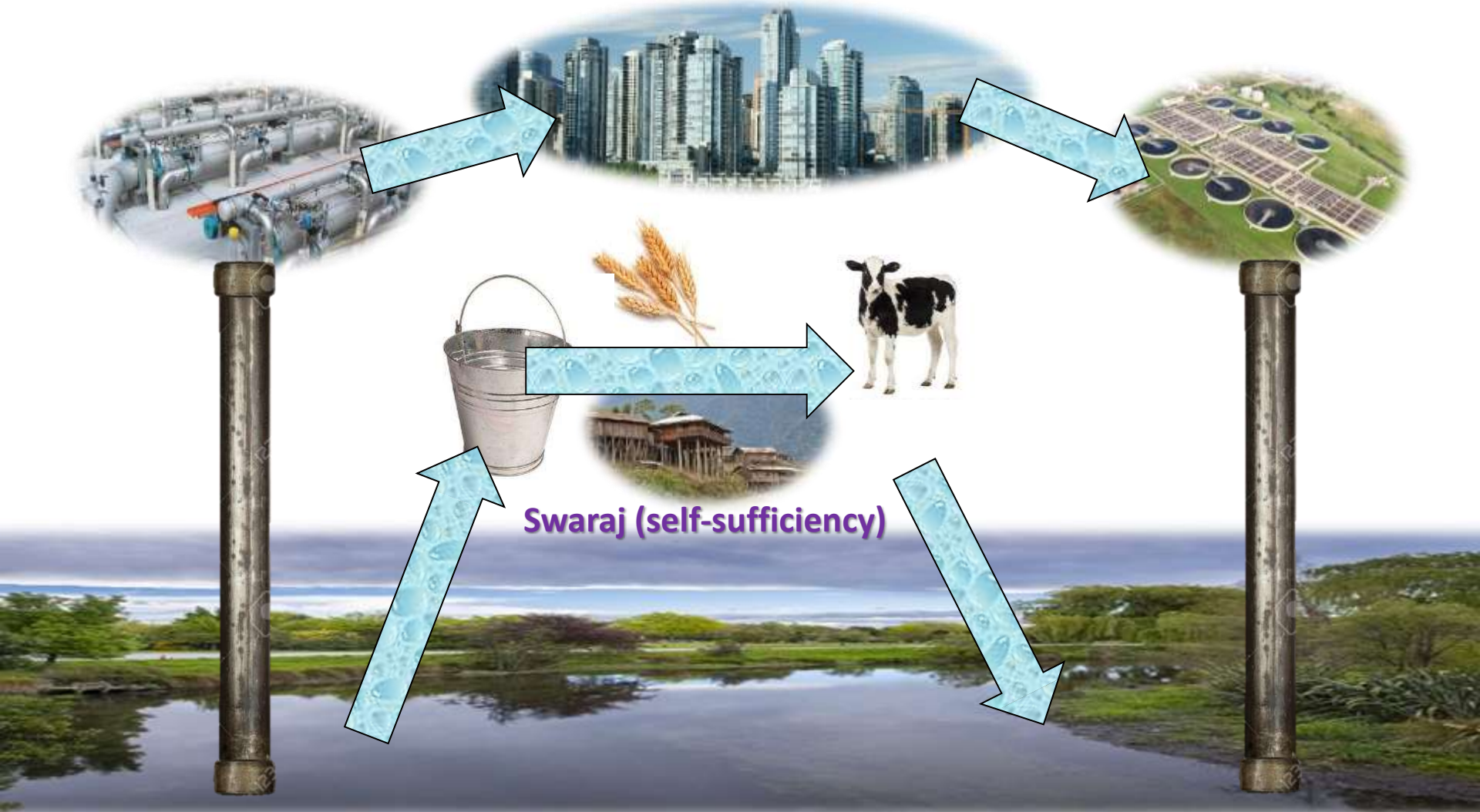
## Systemic effects and challenging presumptions


[https://www.internationalrivers.org/sites/default/files/attached-files/world\\_commission\\_on\\_dams\\_final\\_report.pdf](https://www.internationalrivers.org/sites/default/files/attached-files/world_commission_on_dams_final_report.pdf)



# Connections and disconnections

Environmentally, Socially, Economically





# NBS ↔ WRM

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# SES regeneration is possible



Gopalpura



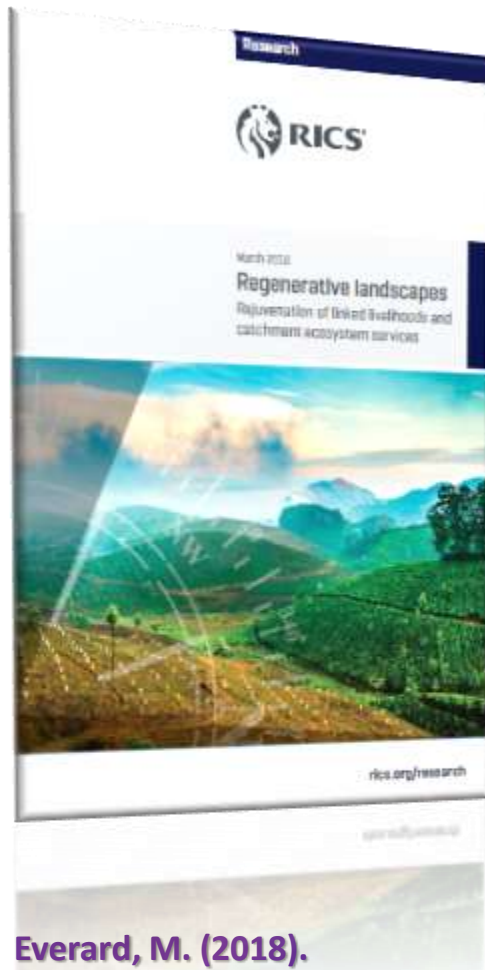
Jabar Sagar



Rudmal Meena, headman, Harmeerpur village



# 'Regenerative landscapes'



## Global examples...

- **India /Asia:** TBS, Pitchandukulam, +
- **Africa:** Ethiopian Highlands, Zephania Phiri, +
- **Americas:** Conservation reserve Programme, +
- **Europe:** Integrated Constructed Wetlands, +
- **Australasia:** New Zealand forestry, +

...from history and the present

Everard, M. (2018).

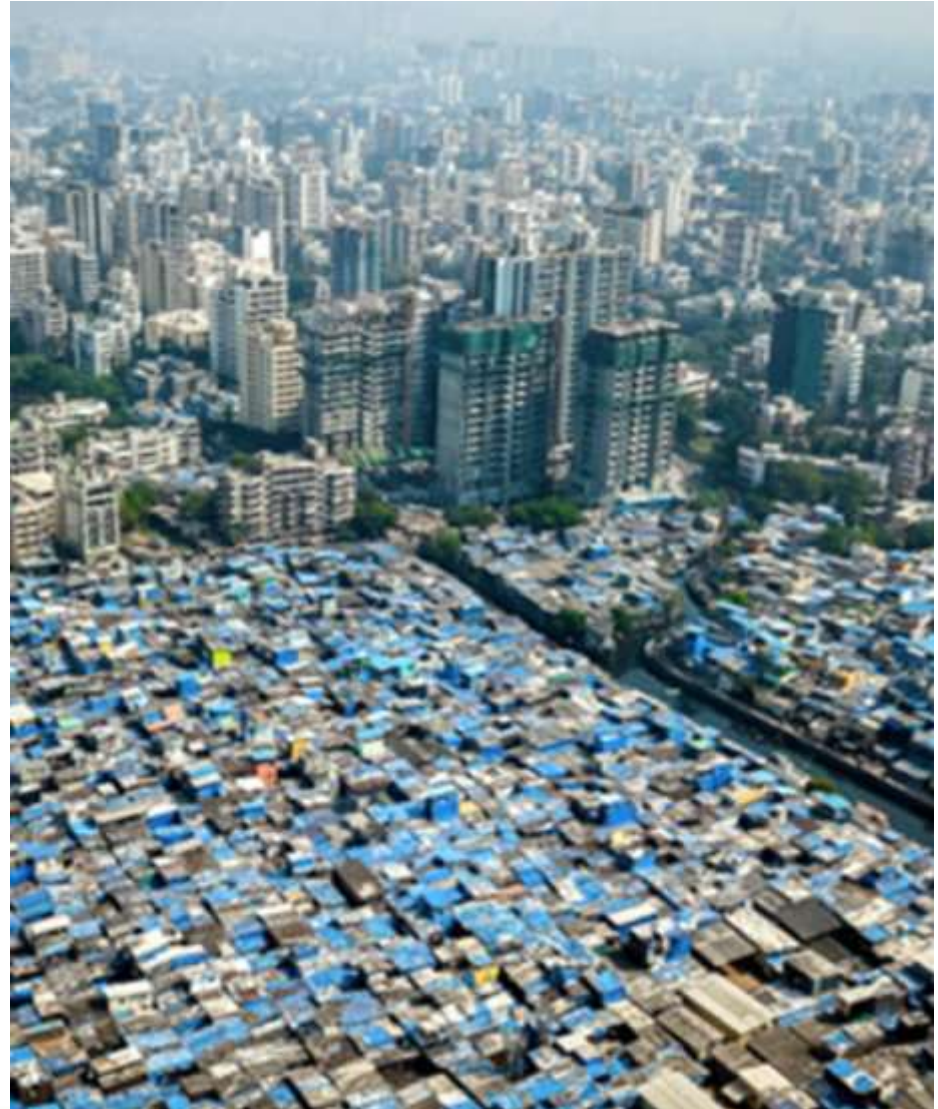
*Regenerative landscapes: Rejuvenation of linked livelihoods and catchment ecosystem services.*

RICS Research, London.

# But we need big engineering too!

## The pressures of the modern world

- Demographics
  - 7.6 billion people today
  - 9.5-10.5 people by 2050
- Urbanisation
- Industrialisation
- Land uses
- Mechanisation
  - Greater intensity
  - Different crops
- Mechanisation
  - Tube wells
  - Dam-and-transfer
- Marketisation
- Governance
- Economics
- Climate change



# How to upscale into a complex catchment?

## A global challenge!





# Contrasting approaches to WM

## Nature-based solutions

Community-based management

Rural focus

Emphasis on stewardship

Valuing every drop: physically, spiritually

## Technocentric solutions

Centralised management

Urban/industrial focus

Emphasis on efficient extraction

Profligate

Developing world trends:

- Urbanisation, population, technology

Developed world trends:

- Nature-based, participatory

**Complex urban-rural catchments with contested resource rights  
(India, Peru, Burkina Faso, etc.)**

# Some problems with IWRM

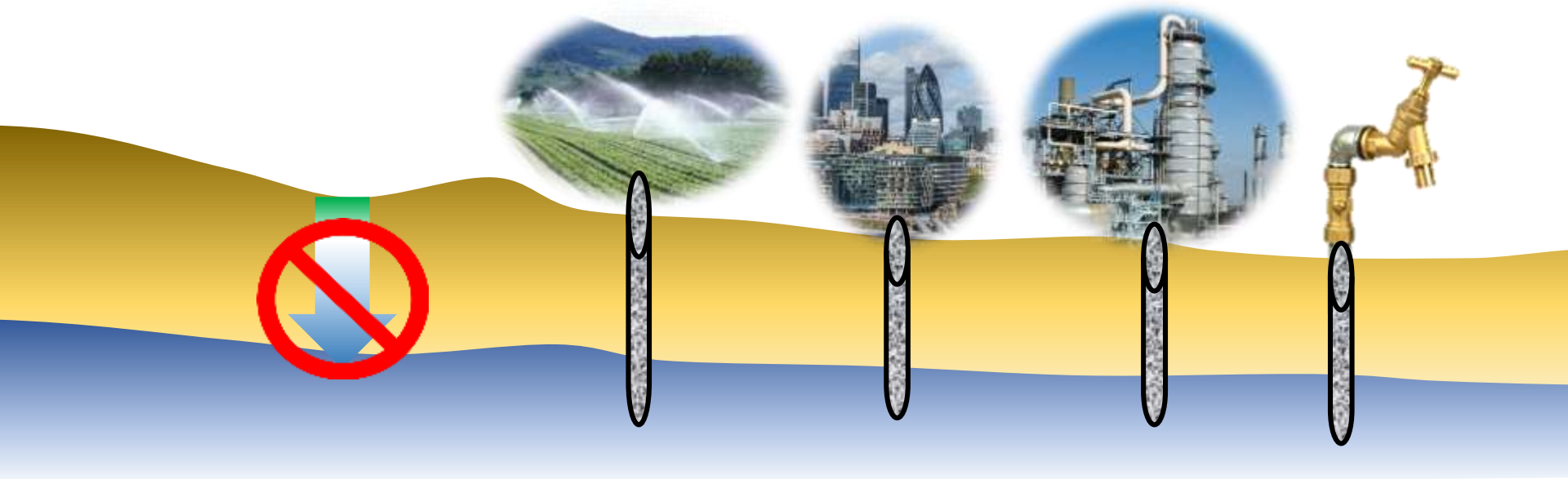


## The 'Dublin Principles' (1992)

- Water as a finite, living resources
- Involving multiple sectors of society
- Role of women
- Economic contexts (uses)



- Perceived as promoting industry interests
- 'Non-use' values are not explicit
- **Stewardship** = **recharge** + exploitation




# Integrated Water Resource Stewardship (IWRS)

**Stewardship** = **recharge** + **exploitation** (like a bank account!)

- Principle No.1: Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment
- Principle No.2: Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels
- Principle No.3: Women play a central part in the provision, management and safeguarding of water
- Principle No.4: Water has an economic value in all its competing uses and should be recognized as an economic good
- Principle No.5: Sustainable stewardship of fresh water systems includes protection or enhancement of resource regeneration processes, safeguarding or increasing the resilience and capacities of integrated socio-ecological systems

Everard, M. (2019). A socio-ecological framework supporting catchment-scale water resource stewardship. *Environmental Science and Policy*, 91, pp.50-59.

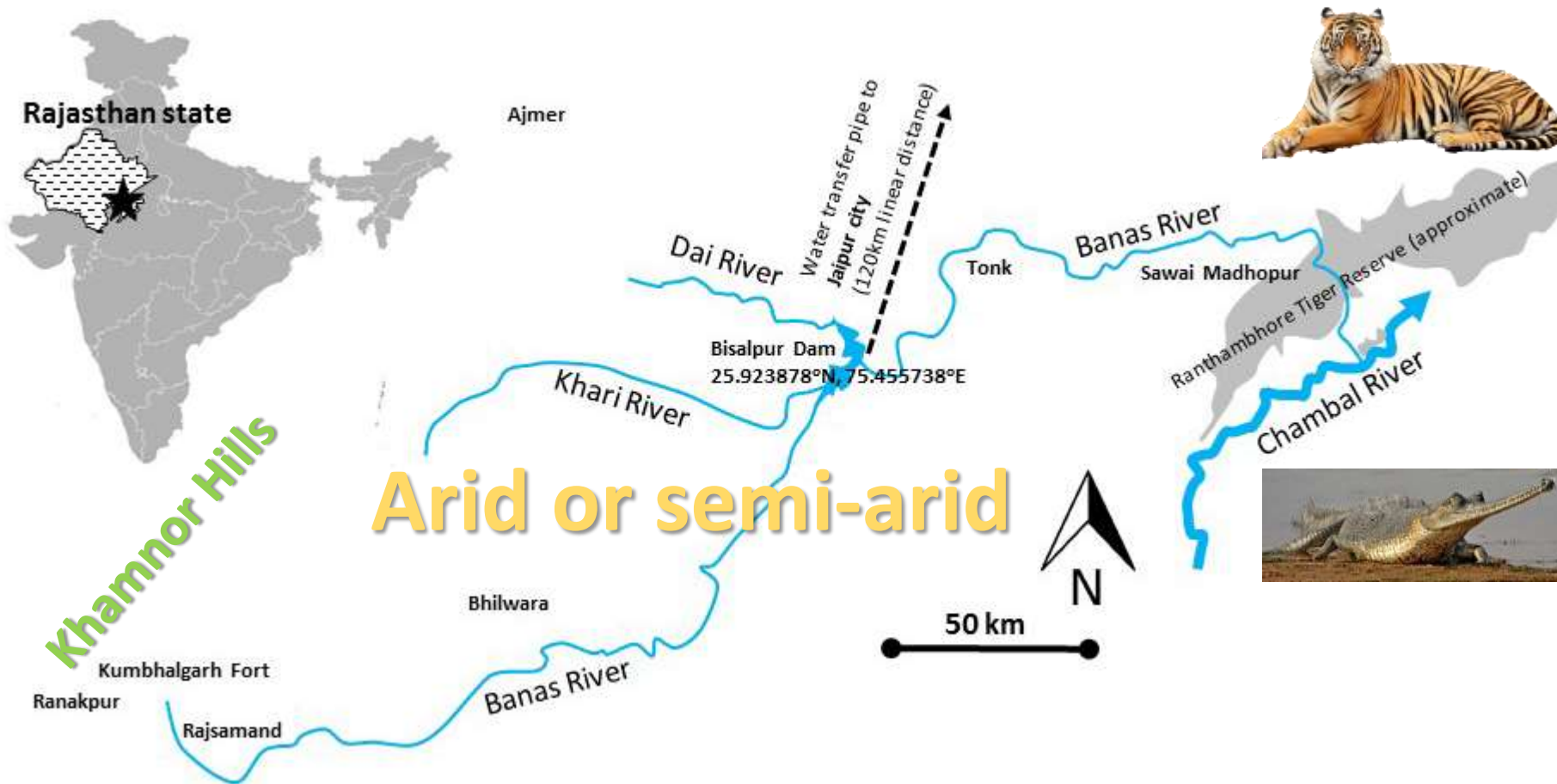




# NBS ↔ WRM

- India's traditional water history
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- **The Banas catchment**

# What and where is the Banas?



Arid or semi-arid



# Issues in the rural upper Banas



- **Formerly community recharge**
  - **Mechanised tube wells**
  - **Resort development**
  - **Inaccessible water**
  - **Fluorosis and salinity**
  - **Village abandonment**





# Bisalpur Dam on the middle Banas



- **Built for local uses (1987)**
  - **Urban appropriation (2006-9)**
  - **Habitat fragmentation**
  - **Urban and rural vulnerability**
  - **No dam releases**
  - **Declining quantity/quality**



# Jaipur City's thirsty history

- Ramgarh Reservoir, 32 km to NE
- Built 1897 for local supply, irrigation, fishery
- Diverted to Jaipur 1952, enlarged in phases
- Ramgarh Lake dry since 2000



- Semi-arid zone of Rajasthan
- 3.5 million now, 4.2 million by 2025
- Over-abstraction depresses groundwater
- Contamination of local sources

- Bisalpur Dam, 120km to SW
- Built 1987 for local irrigation and supply
- Diverted to Jaipur 2006-2009, enlarged in phases
- Rarely fills, rising fluoride and salt concentrations



**Where next? A broken model, with serious linked vulnerabilities**



# Impacts on the lower Banas

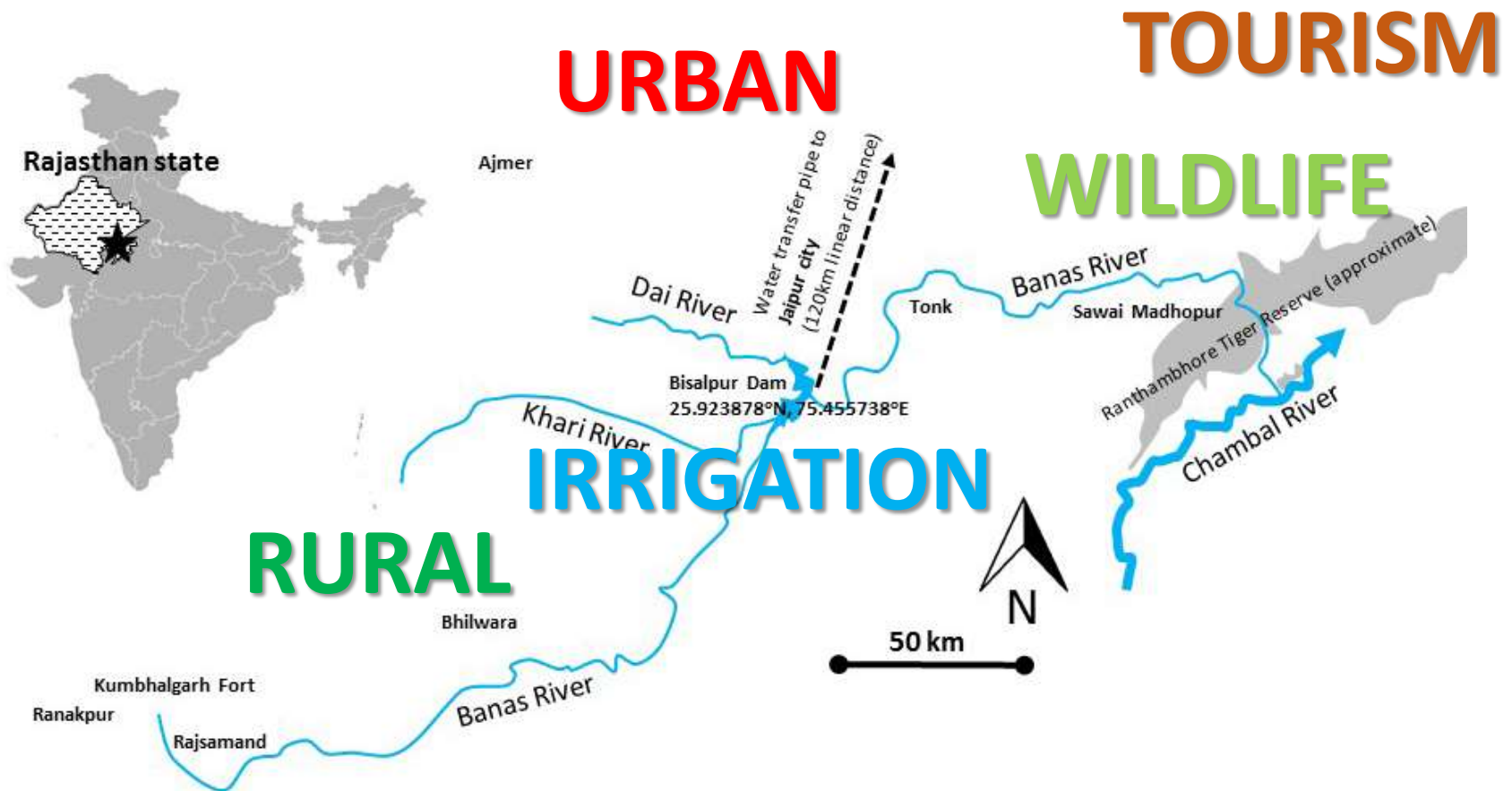


- **Formerly connected**
  - **Water insecurity**
  - **Food insecurity**
  - **Wildlife-human conflict**
  - **Reduced flow to Chambal**
  - **River fragmentation**





# Tightly linked vulnerabilities

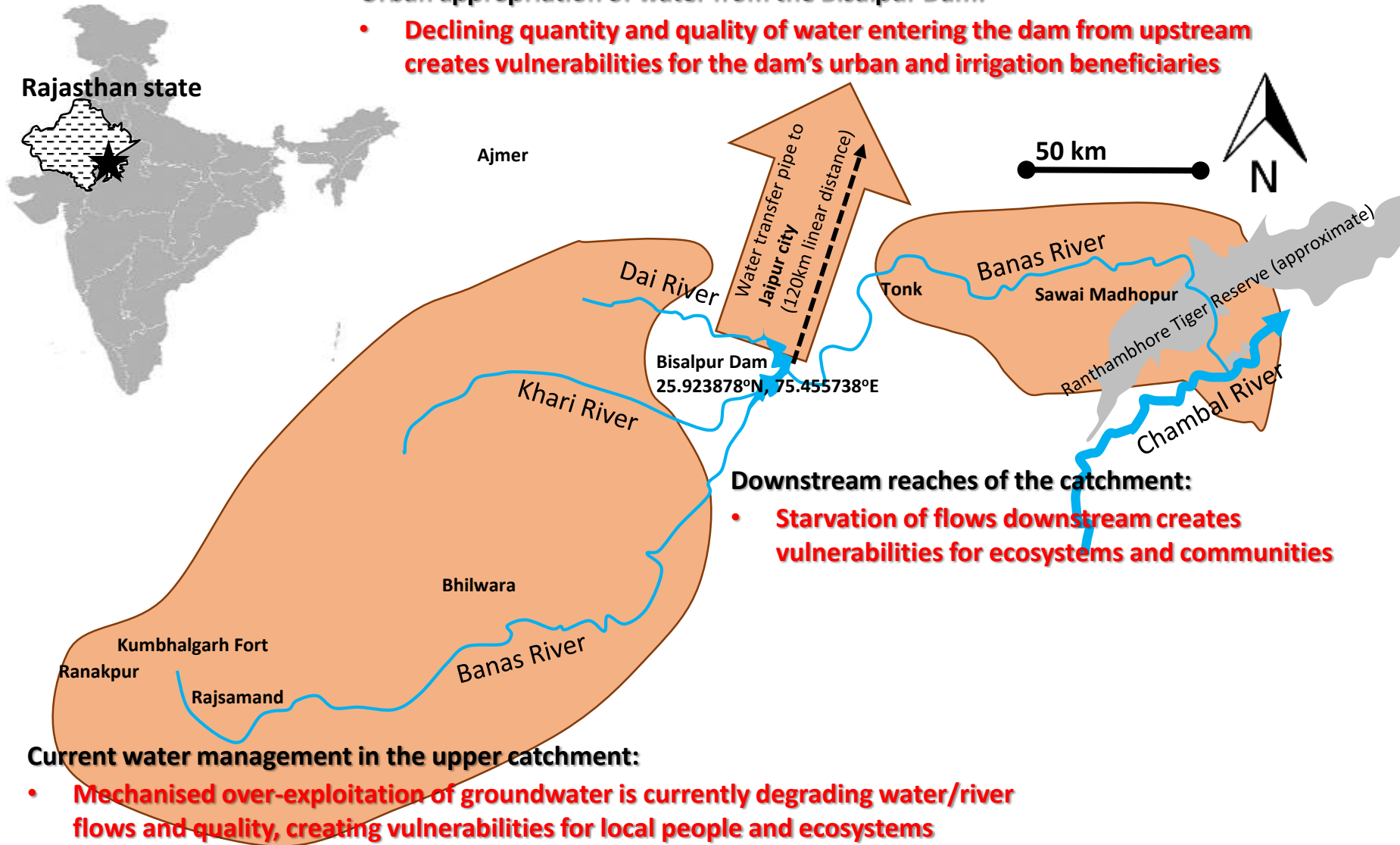


All facets of a tightly linked, multi-faceted socio-ecological system (SES)

# A degenerative socio-ecological cycle

## Urban appropriation of water from the Bisalpur Dam:

- Declining quantity and quality of water entering the dam from upstream creates vulnerabilities for the dam's urban and irrigation beneficiaries





# Benefits, externalities and mitigation

Ecosystem service provision by different types of water management infrastructure

↑ **Strengths**

↓ **Shortfalls**


⊕ **Mitigation measures**

Type of infrastructure	Strengths and mitigation measures relating to ecosystem service provision	
<b>Natural or traditional</b> 	<p>↑ Provides multiple, linked ecosystem services suiting low demand</p> <p>↓ Can be over-ridden with increasing demand</p>	<p>⊕ Protect or restore critical habitat to enhance services</p>
<b>'Hard'</b> 	<p>↑ Efficient delivery of a subset of services for dense populations</p> <p>↓ Create many externalities</p>	<p>⊕ Challenge automatic presumptions in favour of 'hard' engineering</p> <p>⊕ Look upstream to restore catchment-scale processes mitigating lost or degraded ecosystem services</p>

Everard, M. (2019). A socio-ecological framework supporting catchment-scale water resource stewardship. *Environmental Science and Policy*, 91, pp.50-59.



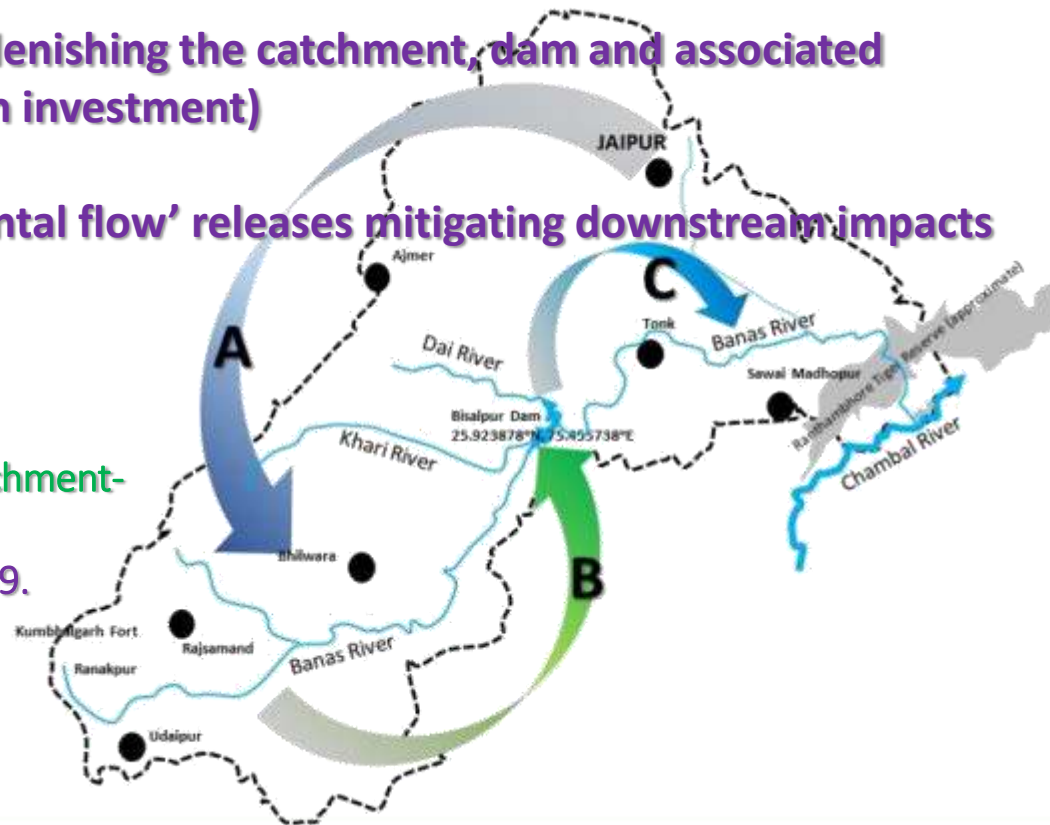
# Investment in resilience: Money follows the water cycle

- (A) Urban investment from beneficiaries of 'hard' engineering into natural and traditional management in the upper catchment (restoring recharge)
- (B) Enhanced flows of fresh water replenishing the catchment, dam and associated ecosystem services (paying back on investment)
- (C) 'Excess' water enables 'environmental flow' releases mitigating downstream impacts of water diversion
- 

Everard, M. (2019).

## A socio-ecological framework supporting catchment-scale water resource stewardship.

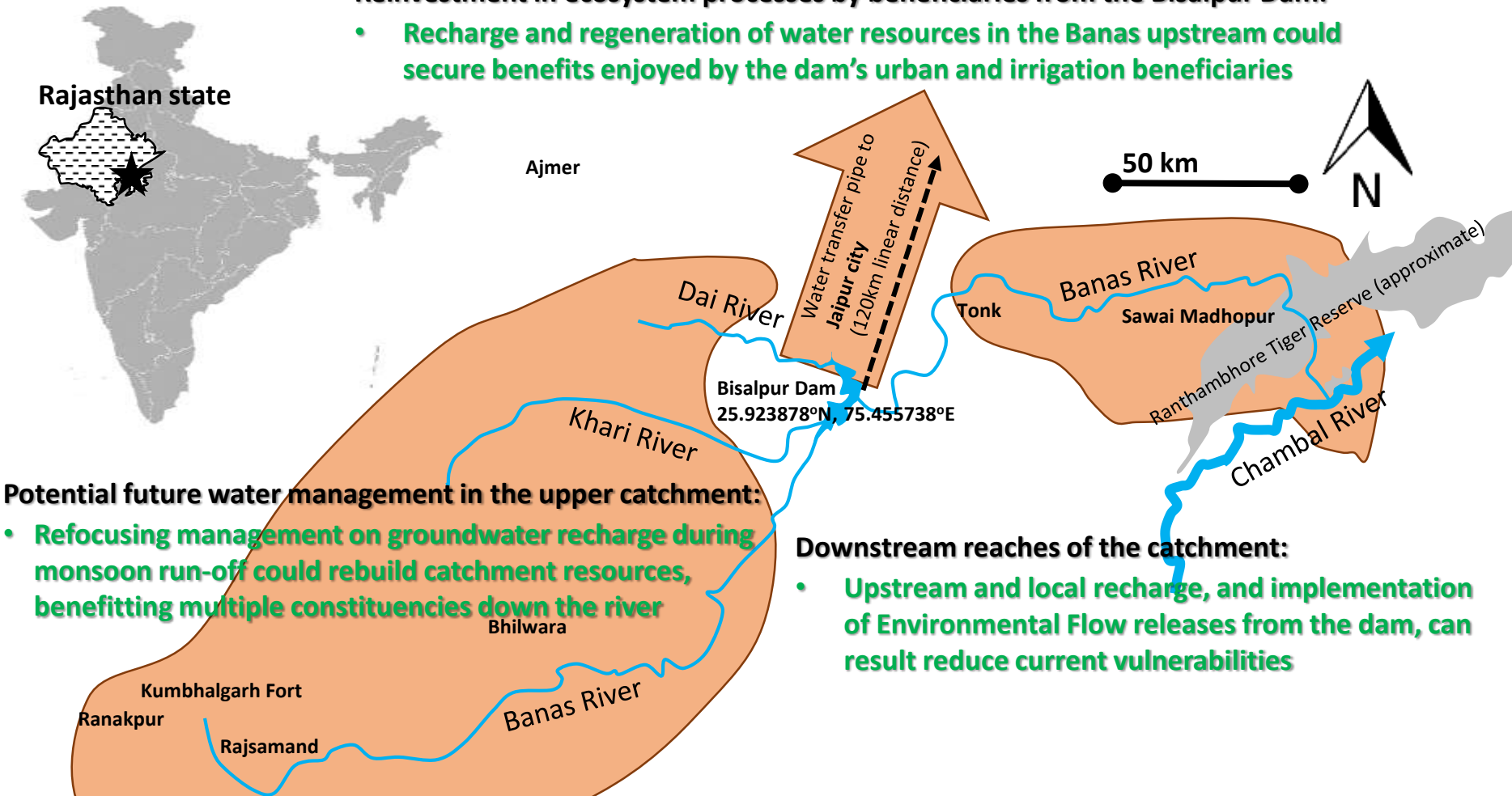
*Environmental Science and Policy*, 91, pp.50-59.



# Creating a regenerative socio-ecological cycle

Reinvestment in ecosystem processes by beneficiaries from the Bisalpur Dam:

- Recharge and regeneration of water resources in the Banas upstream could secure benefits enjoyed by the dam's urban and irrigation beneficiaries



Potential future water management in the upper catchment:

- Refocusing management on groundwater recharge during monsoon run-off could rebuild catchment resources, benefitting multiple constituencies down the river

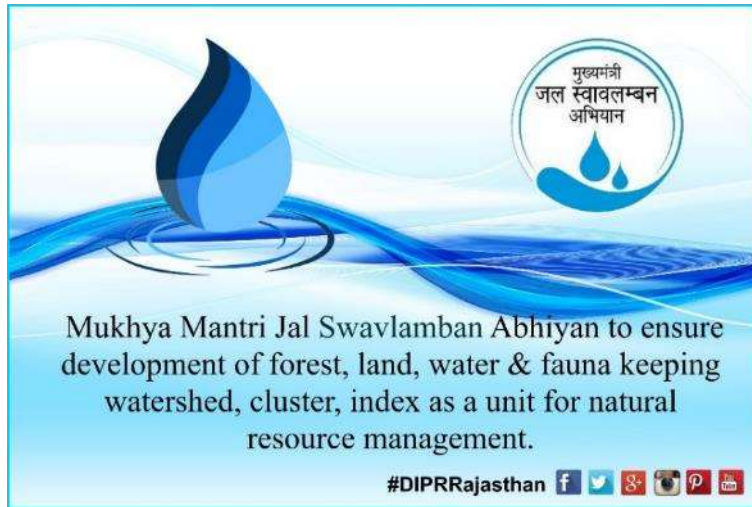
Downstream reaches of the catchment:

- Upstream and local recharge, and implementation of Environmental Flow releases from the dam, can result reduce current vulnerabilities

Everard, M., Sharma, O.P., Vishwakarma, V.K., Khandal, D., Sahu, Y.K., Bhatnagar, R., Singh, J., Kumar, R., Nawab, A., Kumar, A., Kumar, V., Kashyap, A., Pandey, D.N. and Pinder, A. (2018). Assessing the feasibility of integrating ecosystem-based with engineered water resource governance and management for water security in semi-arid landscapes: a case study in the Banas Catchment, Rajasthan, India. *Science of the Total Environment*, 612, pp.1249-1265. <http://www.sciencedirect.com/science/article/pii/S0048969717322726>.

# Building on political levers

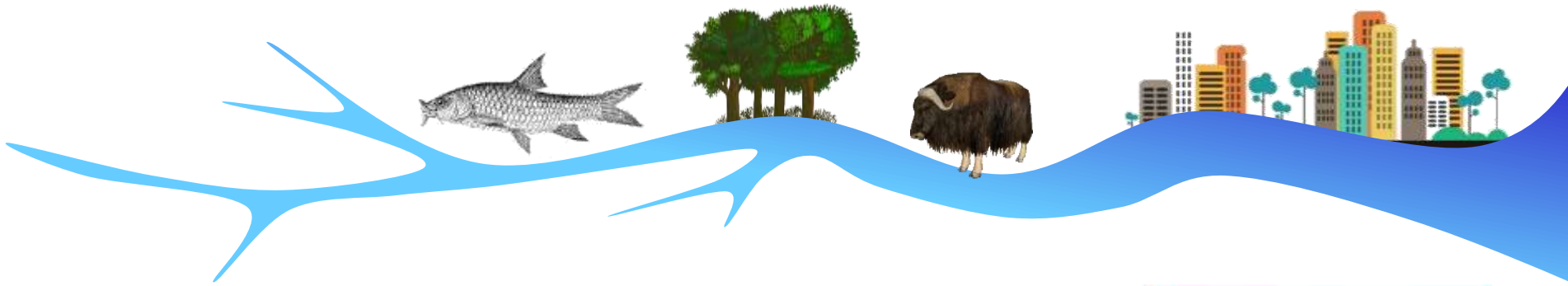
## Adding value across policy sectors?





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**Dr Mark Everard**



**Associate Professor of Ecosystem Services, UWE**