Living within our means:

Taking account of catchment context

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Associate Professor of Ecosystem Services, UWE

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Taking account of catchment context

- Mining nature
- Regenerative landscapes
- Water transitions
- Living within catchme

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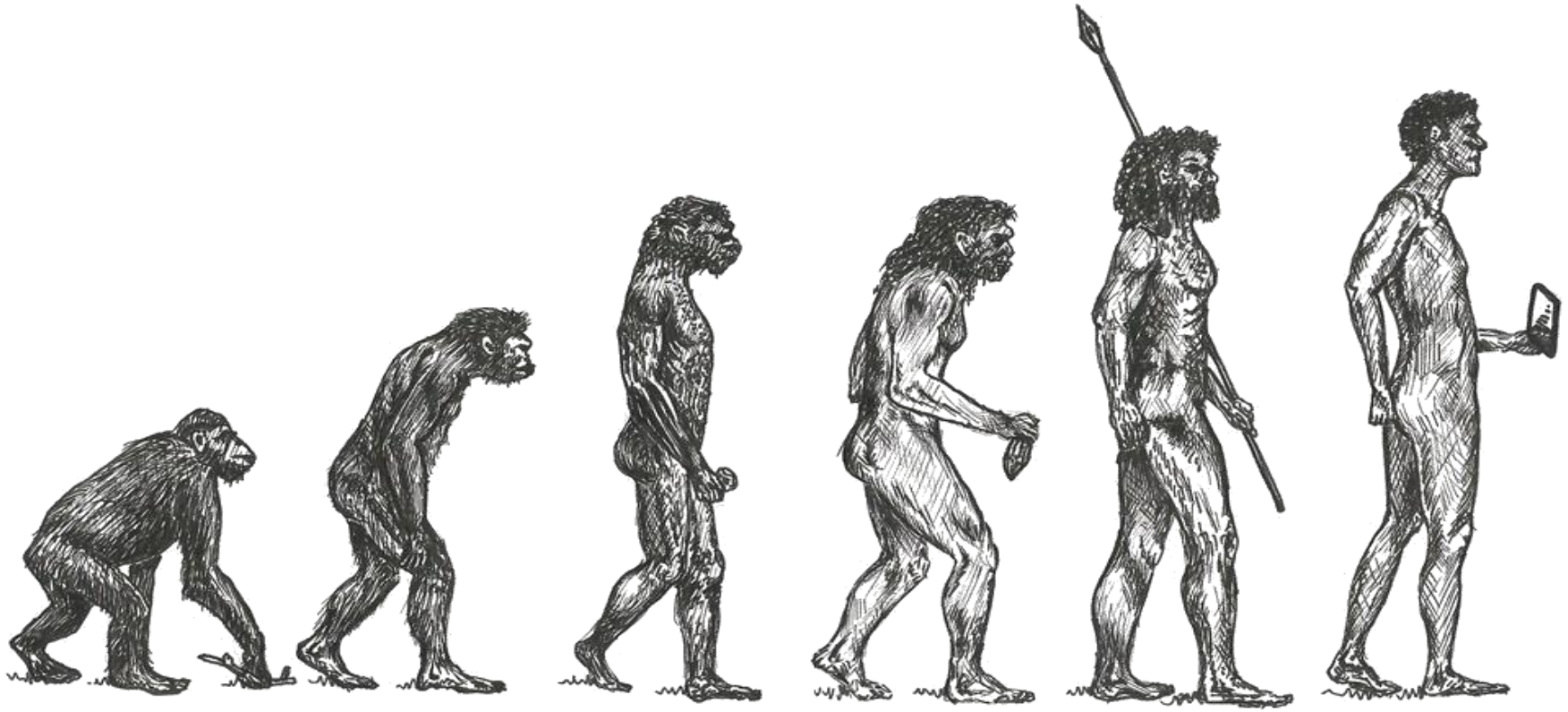
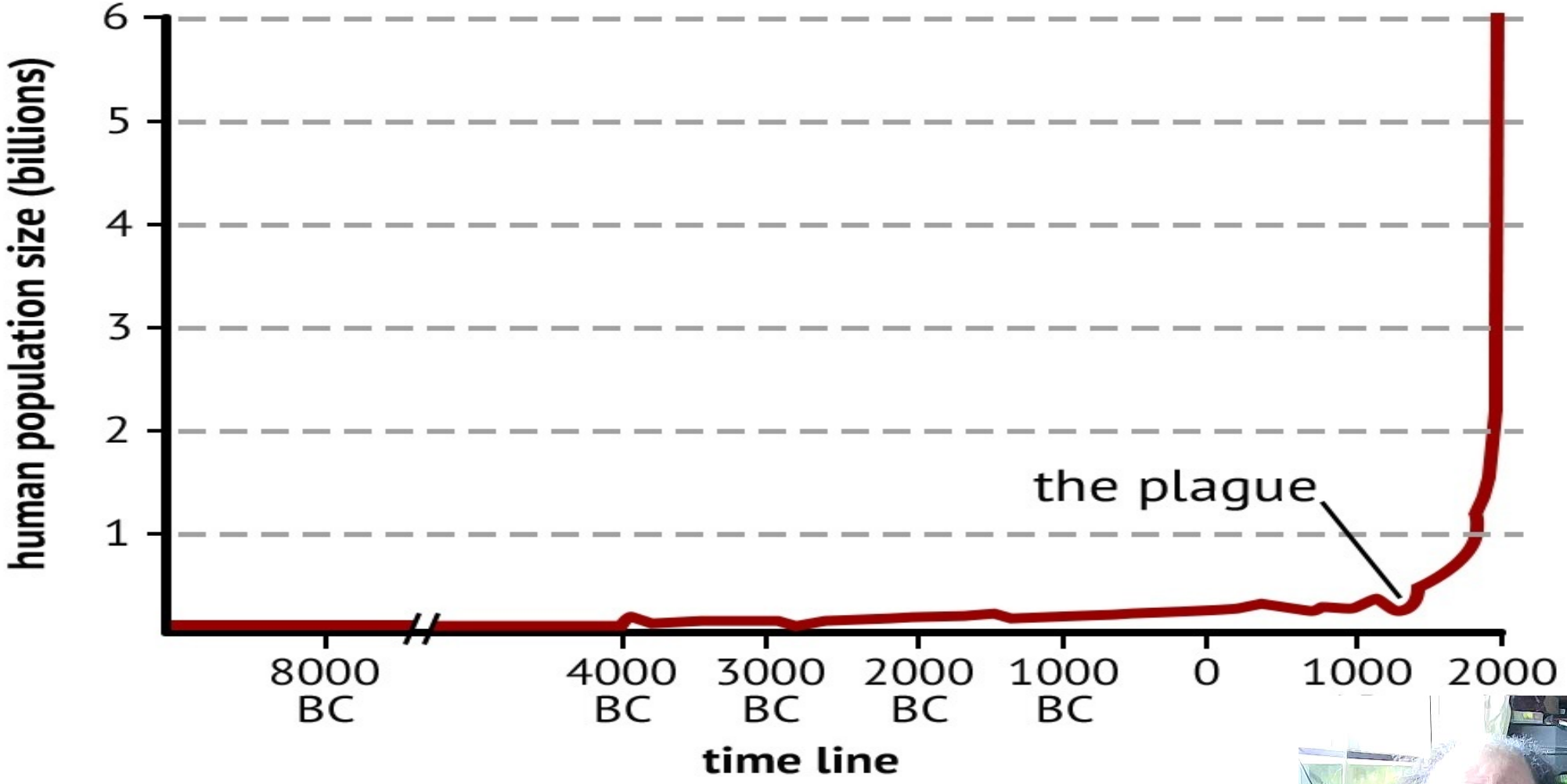
Homo sapiens, the ‘wise man’

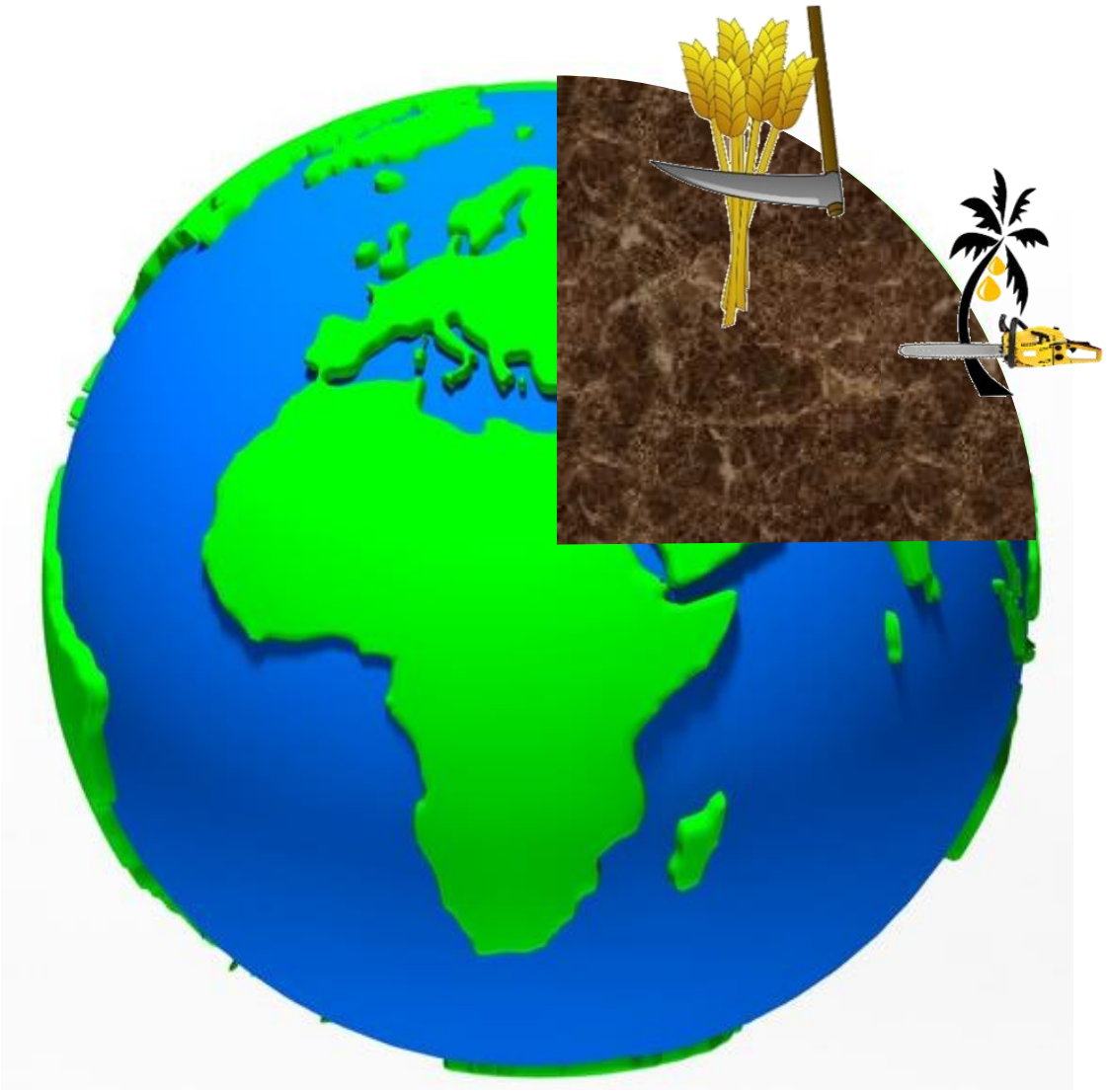


Genesis 1:28

God blessed them and said to them, “Be fruitful and multiply, and fill the earth and subdue it; rule over the fish of the sea and the birds of the air and eve
crawls u



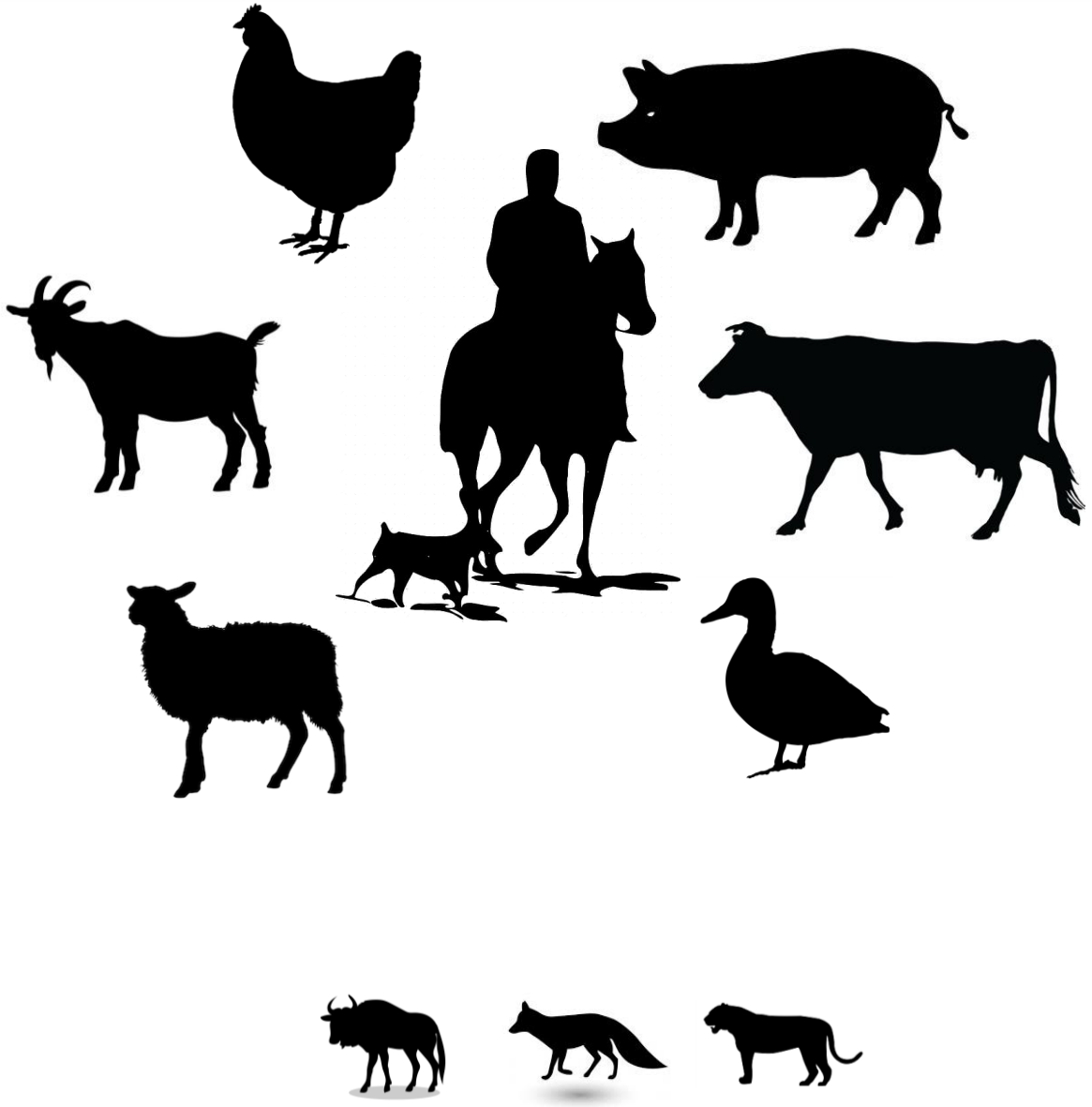
https://www.quora.com/Is-the-present-day-human-population-growth-following-a-J-shaped



Humans appropriation of potential net planetary primary productivity:

- **Doubled in the 20th century**
  - **13% in 1910**
  - **25% in 2013**

Krausmann, K., Erb, K-H., Gingrich, S., Haberl, H., Bondeau, A., Gaube, V., Lauk, C., Plutzar, C. and Searchinger, T.D. (2013). Global human appropriation of net primary production doubled in the 20th century. PNAS, 110 (25), pp.10
https://doi.org/10.1073/pnas.1211

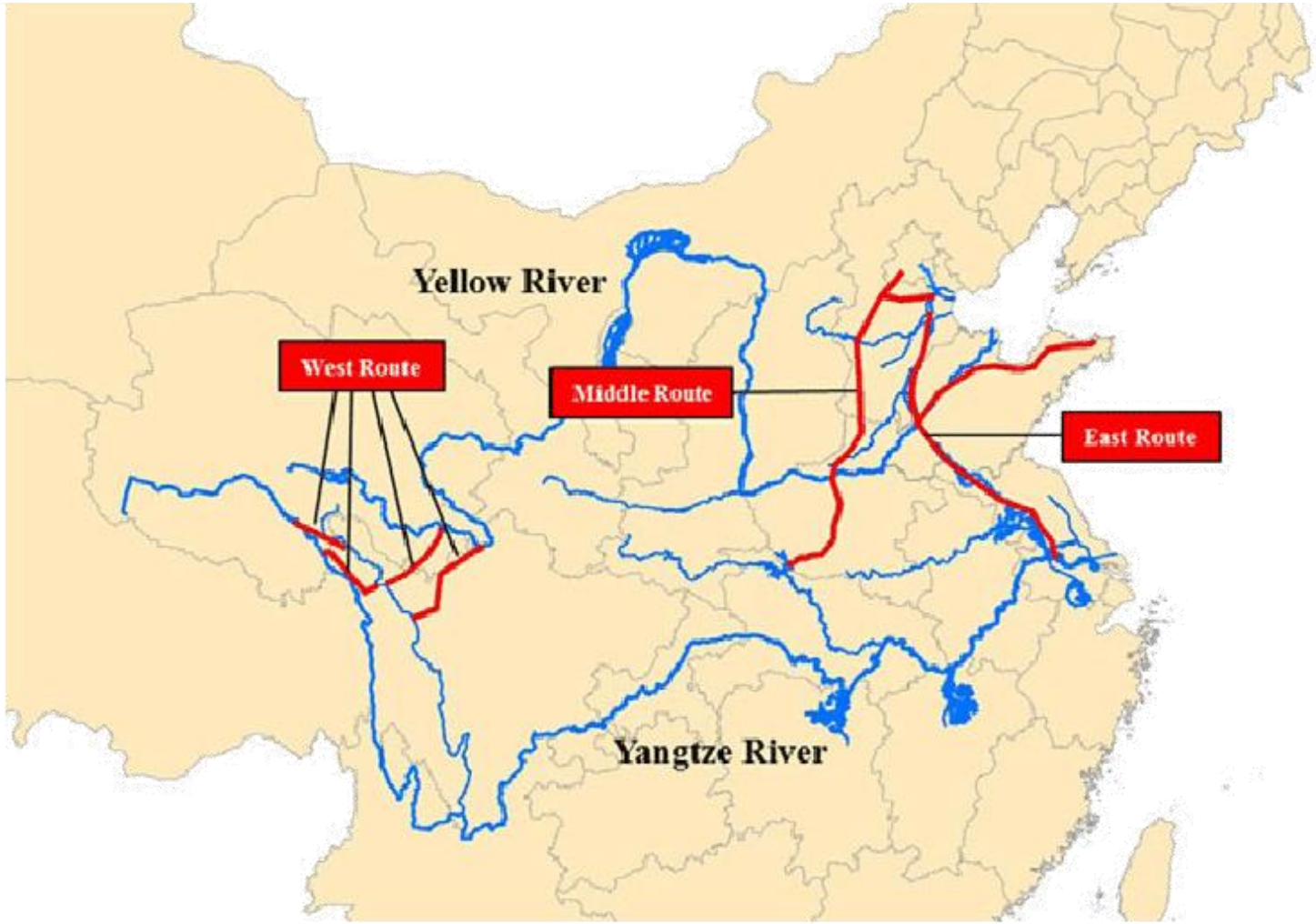


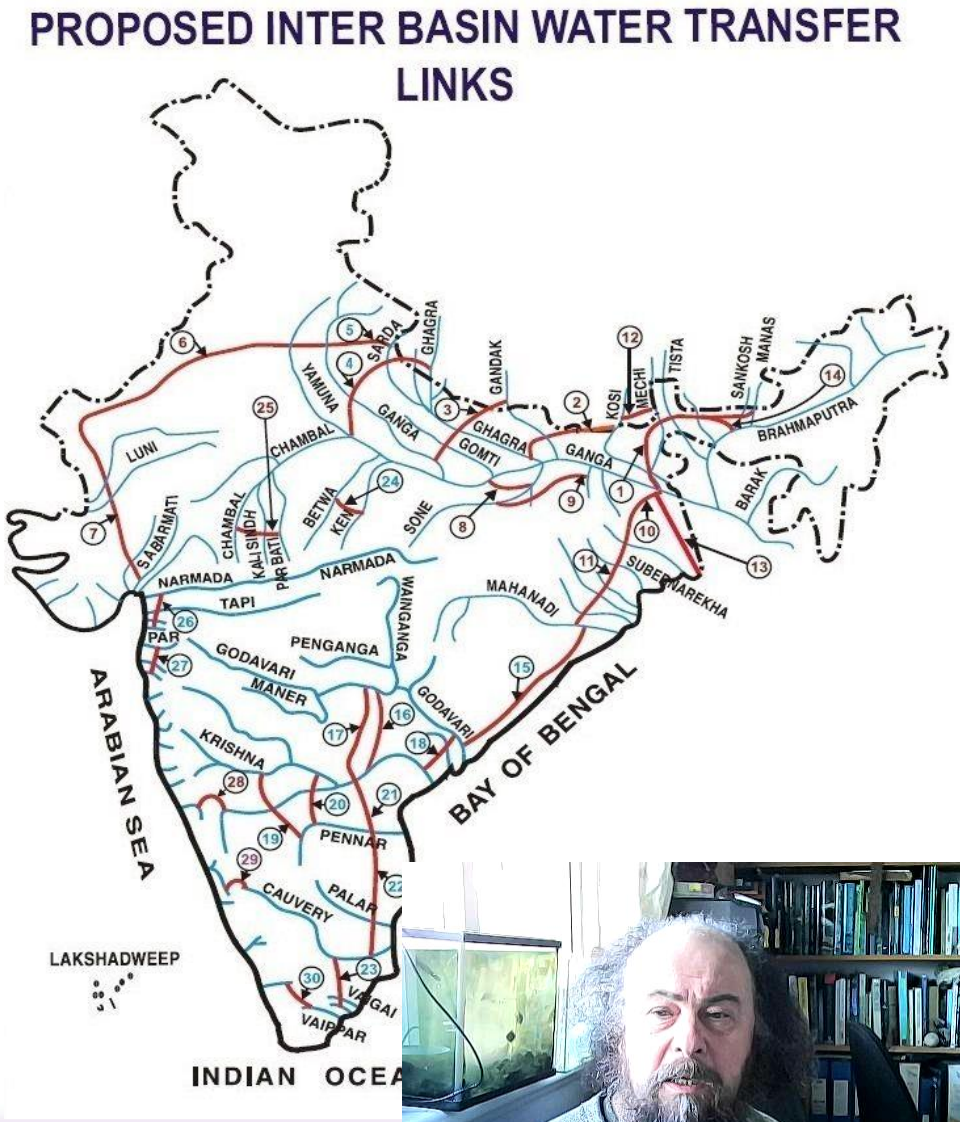
96% of global mammalian biomass comprises humans and their livestock

70% of global bird biomass comprises domesticated poultry

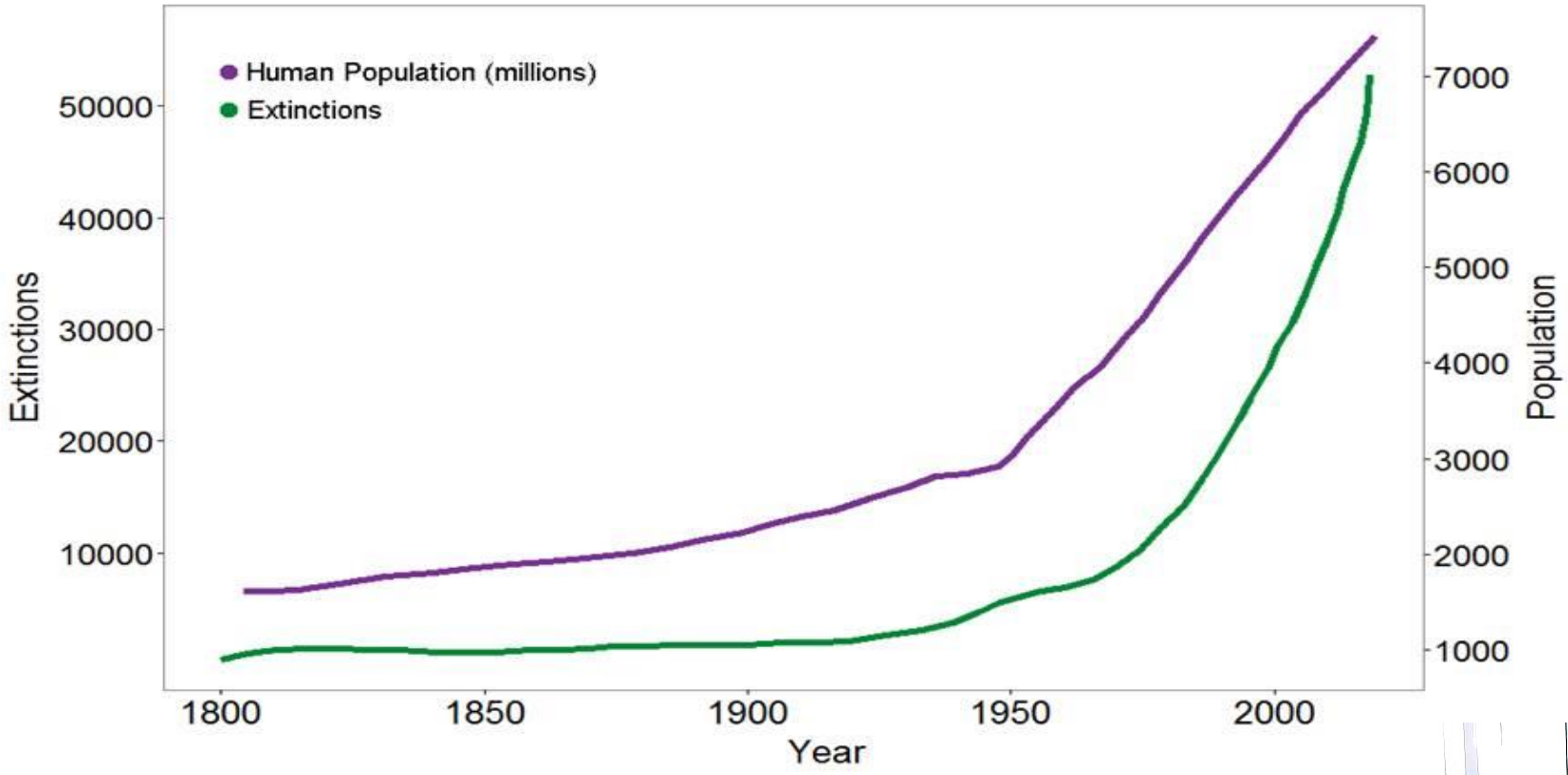
Bar-On, Y.M. and Phillips, R. (2018). The biomass distribution on Earth. *PNAS*, 115(25), pp.6506-6511. DOI: https://doi.org/10.1073

Water as utility, not living resource





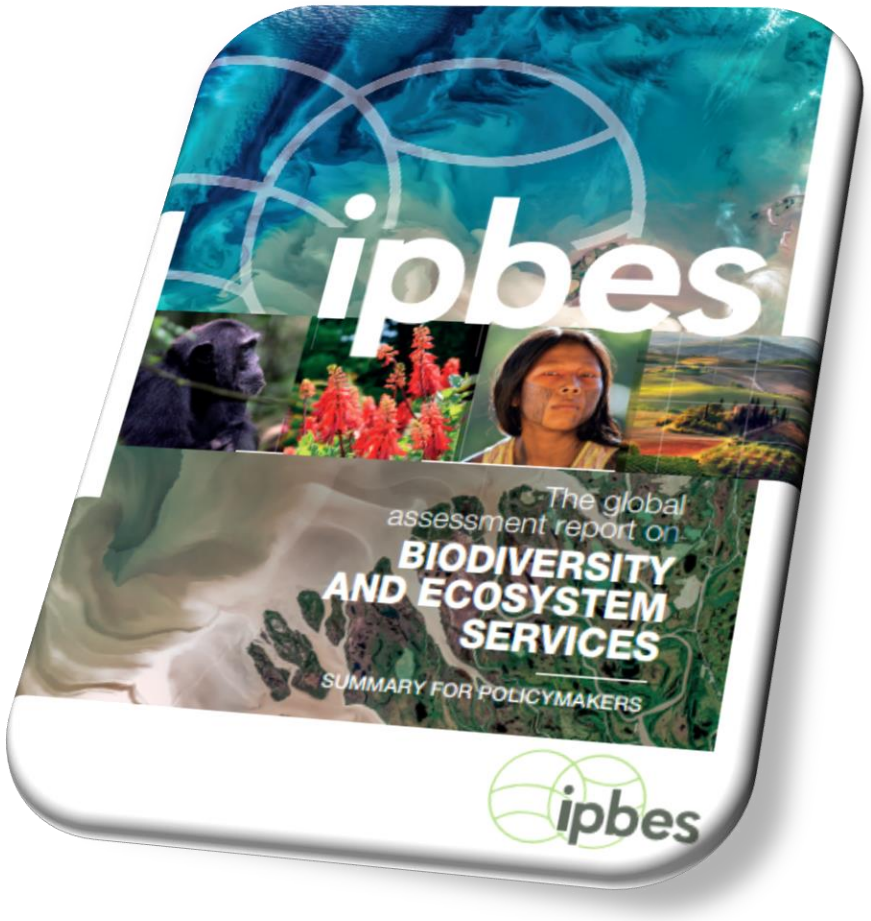
Humans & The Extinction Crisis



Data source: Scott, J.M. 2008. *Threats to Biological Diversity: Global, Continental, Local*. U.S. Geo
Idaho Cooperative Fish and Wildlife, Research Unit, University Of Idaho.

https://www.biologicaldiversity.org/programs/population_and_sustainability/extincti

IPBES (2019): a sobering global overview



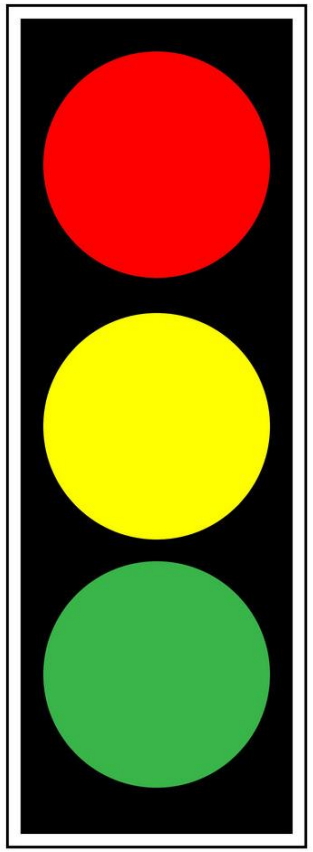
A. Nature and its vital contributions to people, which together embody biodiversity and ecosystem functions and services, are deteriorating worldwide.

B. Direct and indirect drivers of change have accelerated during the past 50 years.

C. Goals for conserving and sustainably using nature and achieving sustainability cannot be met by current trajectories, and goals for 2030 and beyond may only be achieved through transformative changes across economic, social, political and technological factors.

D. Nature can be conserved, restored and used sustainably while other global societal goals are simultan
and concerted efforts fostering transfo

https://ipbes.net/system/tdf/ipbes_global_assessment_report_summary_for_policymakers.pdf?file=1



Provisioning services
Fresh water
Food
Fibre and fuel
Genetic resources
Biochemicals
Ornamental resources
Energy harvesting

Cultural services
Cultural heritage
Recreation and tourism
Aesthetic value
Spiritual and religious value
Inspiration of art, folklore, architecture, etc
Social relations

Regulating services
Air quality regulation
Climate regulation
Water regulation
Natural hazard regulation
Pest regulation
Disease regulation
Erosion regulation
Water purification and waste treatment
Pollination
Salinity control

Land, landscapes and water as critical ‘natural infrastructure’

Supporting services
Soil formation + nutrient cycling + water recycling + provision of habitat
Primary production
Photosynthesis (production of atmospheric oxygen)

Provisioning services
Fresh water
Food
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Regulating services
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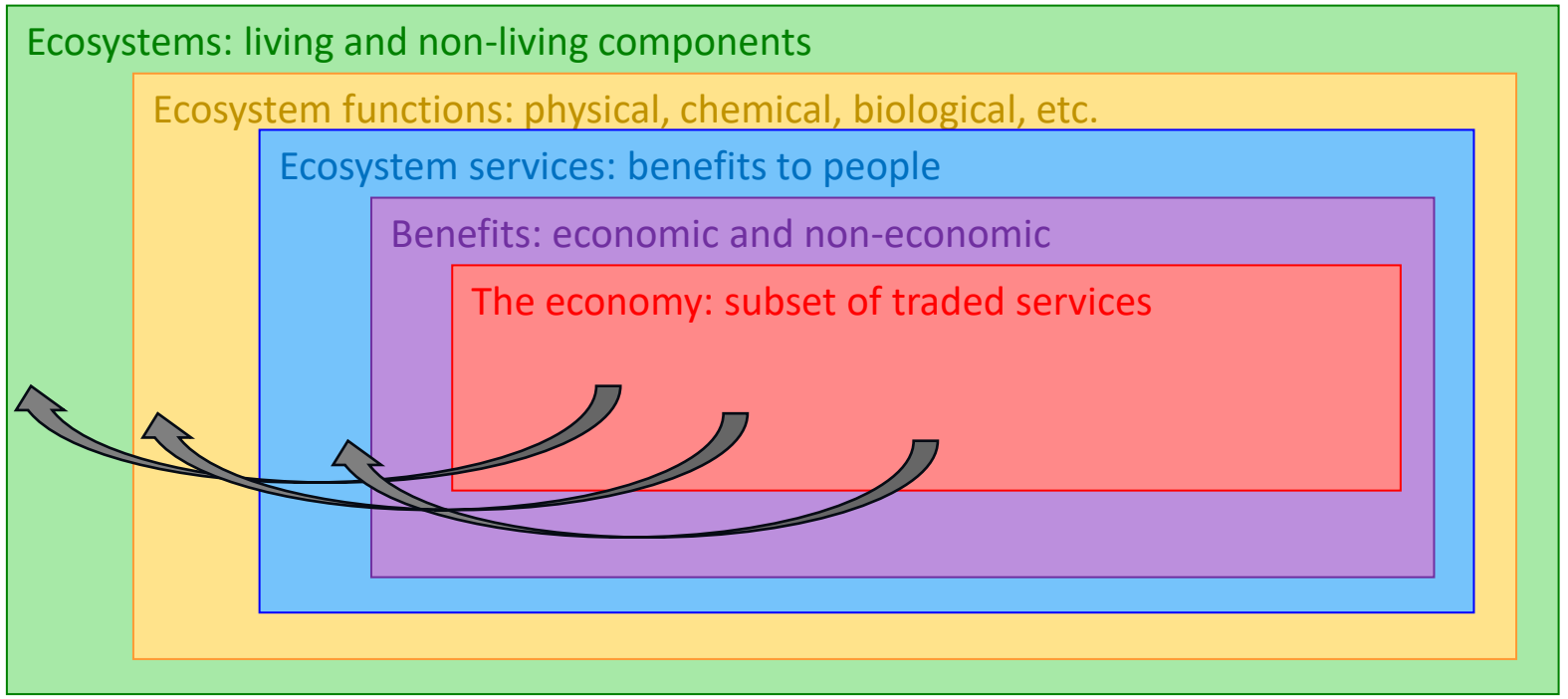
- **Ecological degradation**
  - **Natural capital and Ecosystem services**
- **Social degradation**
  - **Equity between stakeholders and generations**
- **Economic degradation**
  - **Short-term, narrow utility trumps sustainable value**

Supporting services
Soil formation + nutrient cycling + water recycling + provision of habitat
Primary production
Photosynthesis (production of atmospheric oxygen)

All ecosystems services are part of a system



Everard, M. and Quinn, N.W. (2015). Realising the value of fluvial geomo
International Journal of River Basin Management, 13(4), pp.487-500.

Exploitation

Renewability

Unintended consequences

‘Degenerative landscapes’

Focus on exploitation in a linked socio-ecological system

Degrading foundational resources → Declining securit

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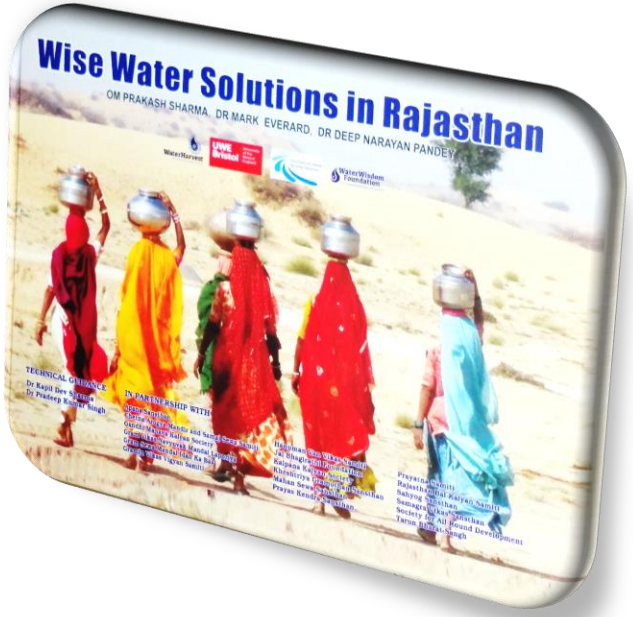


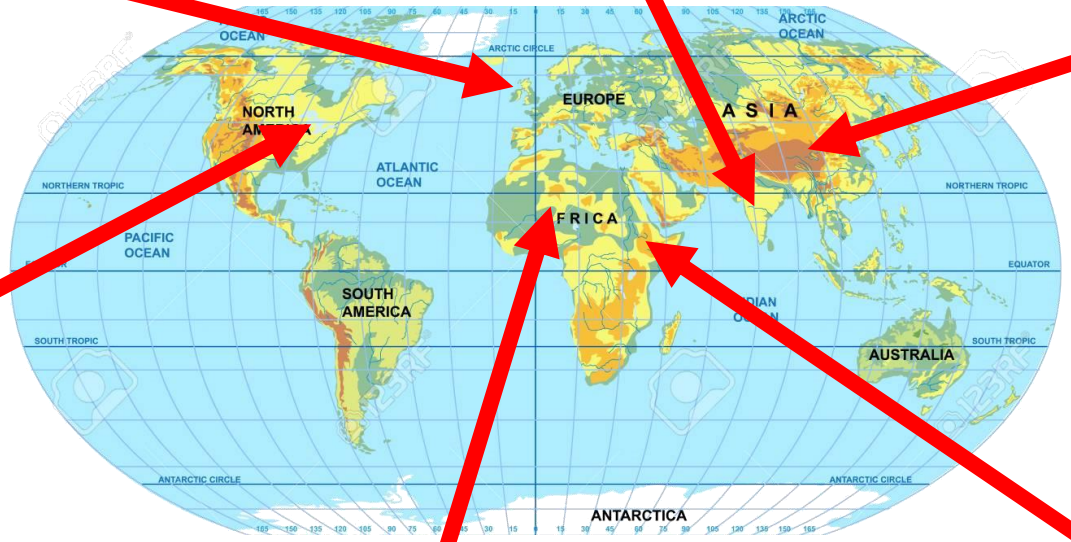
Sharma, O.P., Everard, M. and Pandey, D.N. (2018). Wise Water Solutions in Rajasthan. WaterHarvest/Water Wise Foundation, Udaipur, India.

- 'Phiri Pits' (Zimbabwe)
- *Zaï* (Burkina Faso)
- Bofedales and Qochas (Peru)
- Sand dams (Kenya)
- Terracing (particularly Asia)
- Etc…

Everard, M. (2020).
***Rebuilding the Earth: Regenerating our planet's life support systems for a sustainable future*.**
Palgrave Macmillan.
https://www.palgrave.com/gp/bo

UPSTREAM THINKING

A South West Water Initiative



‘Regenerative landscapes’

Focus on renewability of a linked socio-ecological system

Investment of foundational capital → Increasing secu

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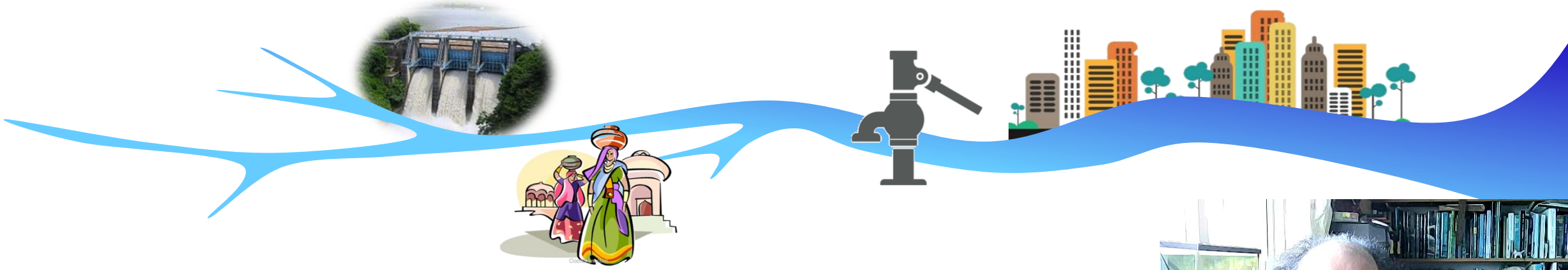
Community and ecosystem-centred

Mechanised and competitive

Technology and policy: The 'civil engineering paradigm'

As cities grow:

- **Engineering-based approach dominates**
  - **Depletion of urban resources**
  - **"…*taking more from further*" resource exploitation**
  - **Conflicts with rural communities denied access to resources**



Barraqué, B., Formiga Johnsson, R.M., and Nogueira de Paiva Britto, A.L. (2008). The development of water services and th
in European and Brazilian cities. *Hydrology and Earth Systems Science*, 12(4), pp.1153-1164. https://www.hydrol-earth-sys

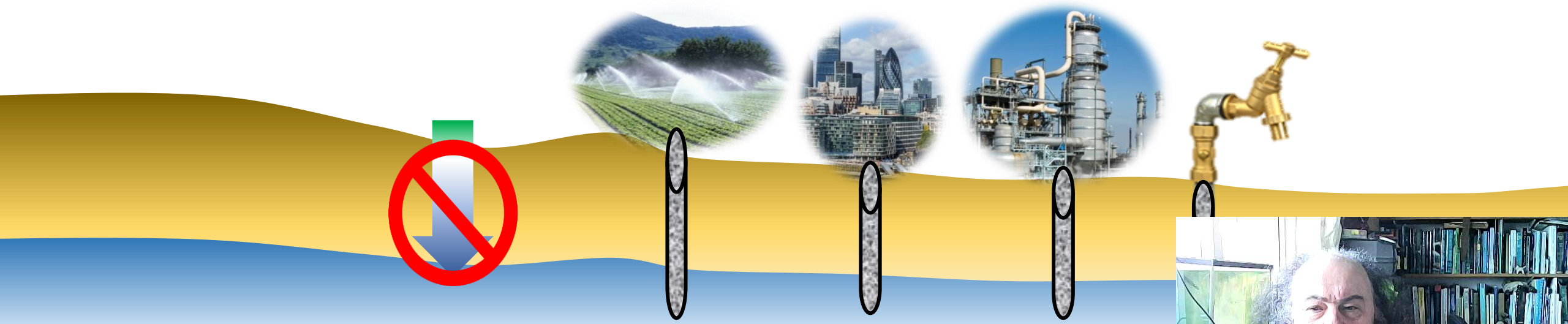
Is IWRM enough? The four 'Dublin Principles' (Input to Rio 'Earth Summit', 1992)

☺

1. Water as a finite, living resources
   - Recognises catchment context
2. Involving multiple sectors of society
3. Specifically role of women
4. Economic contexts (uses)

☹

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



Integrated Water Resource Stewardship (IWRS)

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

- 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 protec
  resource regeneration processes, safeguarding or increasing the resilience and
  socio-ecological systems

Engineering or ecosystems? A false dichotomy

☺	☹	☺	☹
• Urban supply • Reliable flows • Waste removal • Convenience • Established institutional processes	• Energy/chemical inputs • Pipework • Resource diversion • Distributional benefits • Non-focal services?	• Local needs • Low inputs (energy, etc.) • Regenerates resource • Ecosystem resilience • Collateral benefits	• Works at low density • Not industrial scale • May be intermittent

Recognition of the need for more:
- **Nature-based, participatory, etc.**

+ Climate resilience

Recognition of the n
- **Urbanisation, pop**

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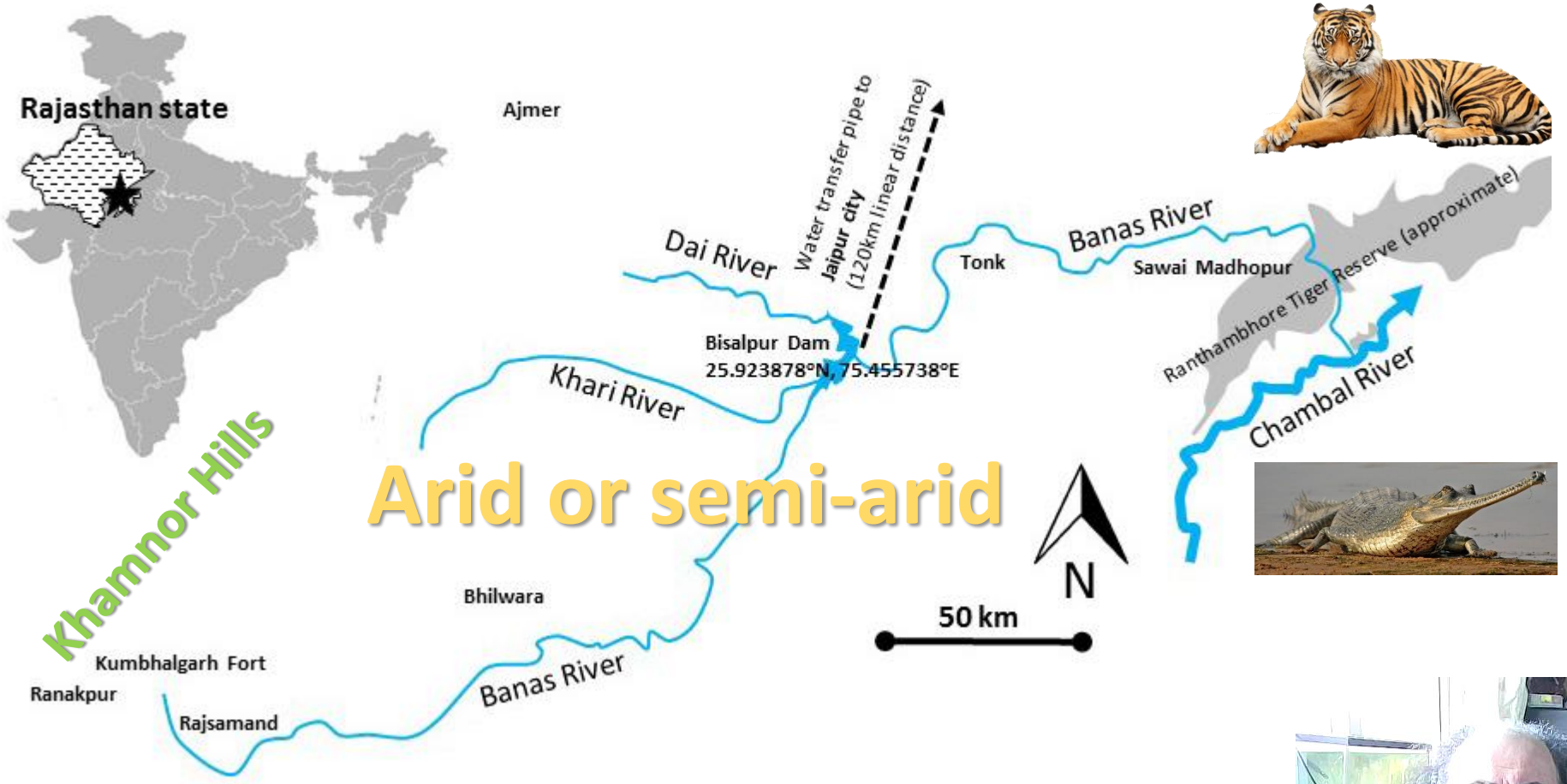
Exploitation | Stewardship | Regeneration

Natural resource degradation — **Ecological** — **Water and soil productivity**

Resource poverty and conflict — **Social** — **Resource security**

Uneven sharing of costs and benefits — **Economic** — **D e**

Living within catchment capacities: the Banas catchment



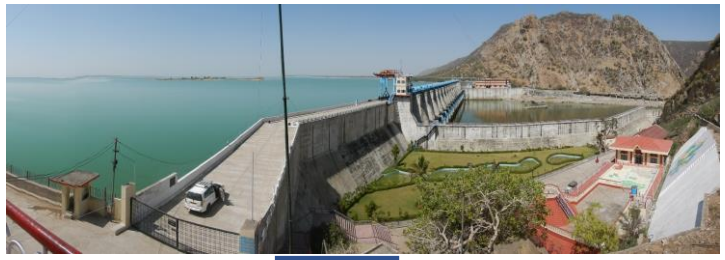
Issues in the rural upper Banas

Upper Banas

- Formerly community recharge
- Increasingly mechanised/competitive
- Village abandonment / fluorosis

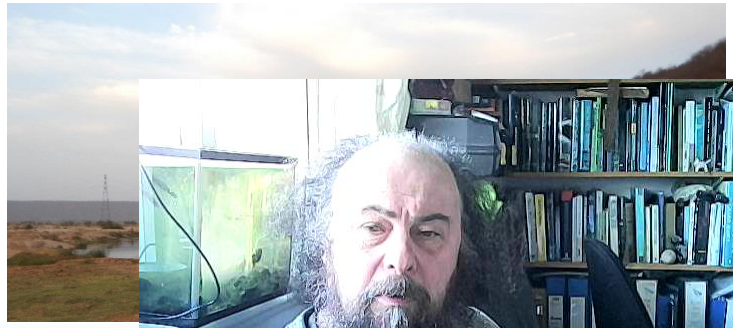
Middle Banas

- Bisalpur Dam: built for local uses (1987)
- Urban appropriation (Jaipur, 2006-9)
- No dam releases

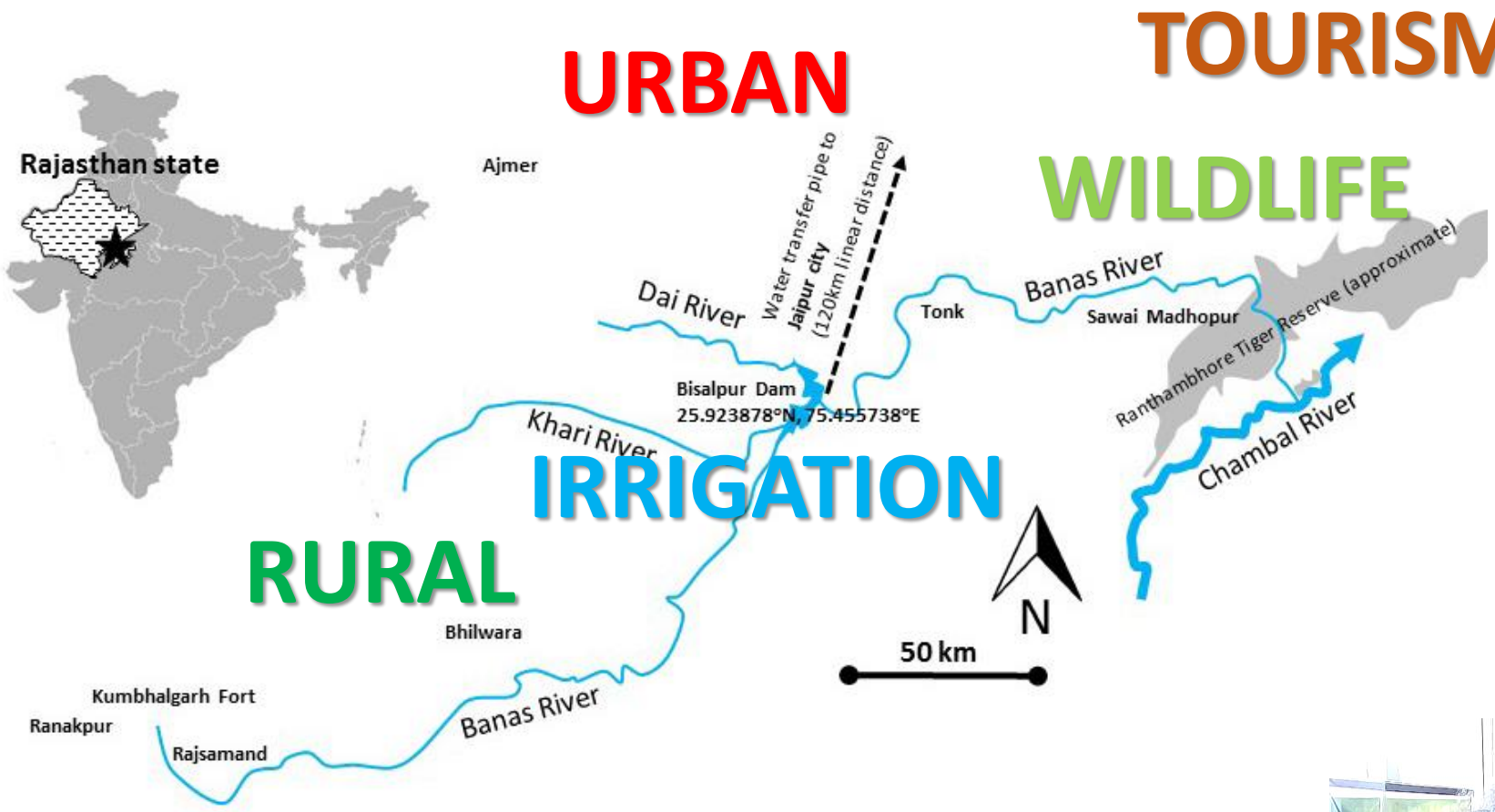


Lower Banas

- Former connectivity
- Fragmentation + depletion
- Inflows to the Chambal



Tightly linked vulnerabilities



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

Hybridising technologies

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
Natural	↑ Provides multiple, linked ecosystem services suiting low demand ↓ Can be over-ridden with increasing demand ✚ Protect, restore or recreate critical habitat to retain or regenerate services
Traditional	↑ Works with natural processes to augment supply of water and related ecosystem services ↓ May require substantial land area, and lack of innovation may not adequately address contemporary lifestyles ✚ Reverse current trends towards abandonment of traditional practices ✚ Innovate novel methods to apply traditional wisdom in modern contexts
'Green'	↑ Emulates natural processes to offset shortfalls in developed environments ↓ Limited opportunities for retrofitting, and needs recognition of the value of services in new build ✚ Requires recognition of the value of ecosystem services on a par with built assets in urban and industrial planning and development
'Hard'	↑ Provides efficient delivery of a limited set of services for dense populations ↓ Tends to create many negative externalities ✚ Narrow presumptions in favour of 'hard' engineering solutions need to be challenged, considering how alternative approaches may provide more sustainable solutions ✚ Where 'hard engineering' solutions best can be achieved by looking upstream to compensating for lost or degraded ecosy

Everard, M. (2019). A socio-ecological framework supporting catchment-scale water resource stewardship. *Environmen*

Treating the catchment as an integrated socio-ecological system

Potential flows to mitigate and generate ecosystem processes generating water security in the Banas catchment:

(A) Mitigation through **compensatory investment** from mainly urban beneficiaries of 'hard' engineering in natural and traditional the upper catchment regenerating resources;

(B) **Enhanced flows** of fresh water replenishing the catchment, dam and associated ecosystem services; and

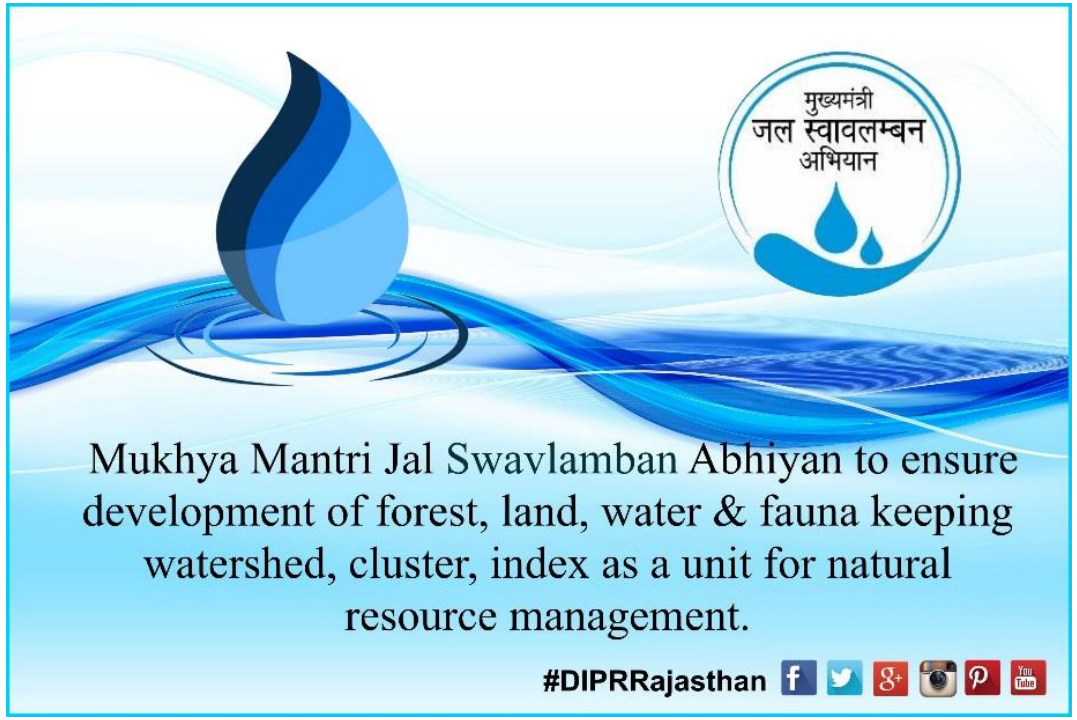
(C) Potential for excess water enabling **'environmental flow'** releases mitigating downstream impacts of water diversion

Everard, M. (2019). A socio-ecological framework supporting catchment-scale water resource stewardship. *Environment*

Building on political levers

How to influence across policy sectors?

Successor schemes to…



2021-2030: the UN Decade on Ecosystem Restoration

https://www.unenvironment.org/news-and-stories/press-release/new-un-decade-ecosystem-restoration-offers-unparalleled-op

- The United Nations General Assembly declared 2021 – 2030 the UN Decade on Ecosystem Restoration.

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