

Natural Capital and Payments for Ecosystem Services



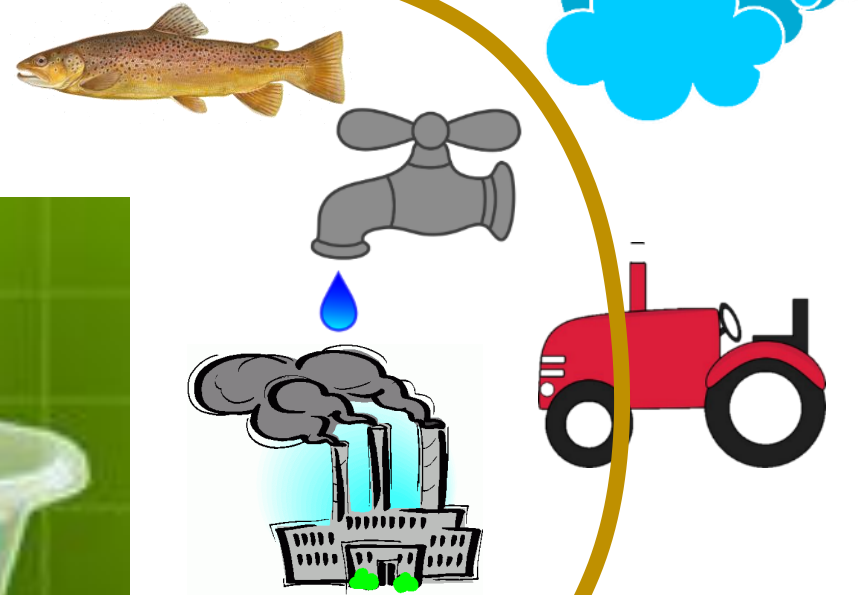
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Capital and services

(Natural) regenerative capacities



Resource uses
and management

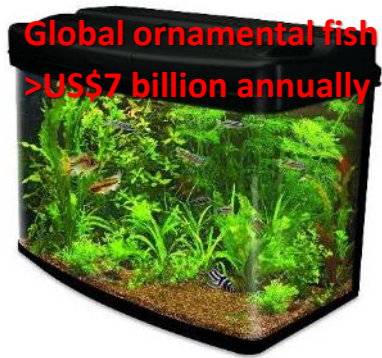
(Ecosystem service) flow



What's a fish worth?



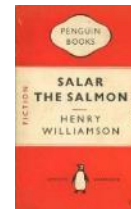
- Primary protein for 1 billion people
- Global production exceeds poultry, beef or pork
- \$US274 billion to global GDP



Global ornamental fish
>US\$7 billion annually



Worth £ billions
in UK alone



CONSERVATION (inherent value)

- ~20% global 10,000 freshwater species threatened, endangered or extinct





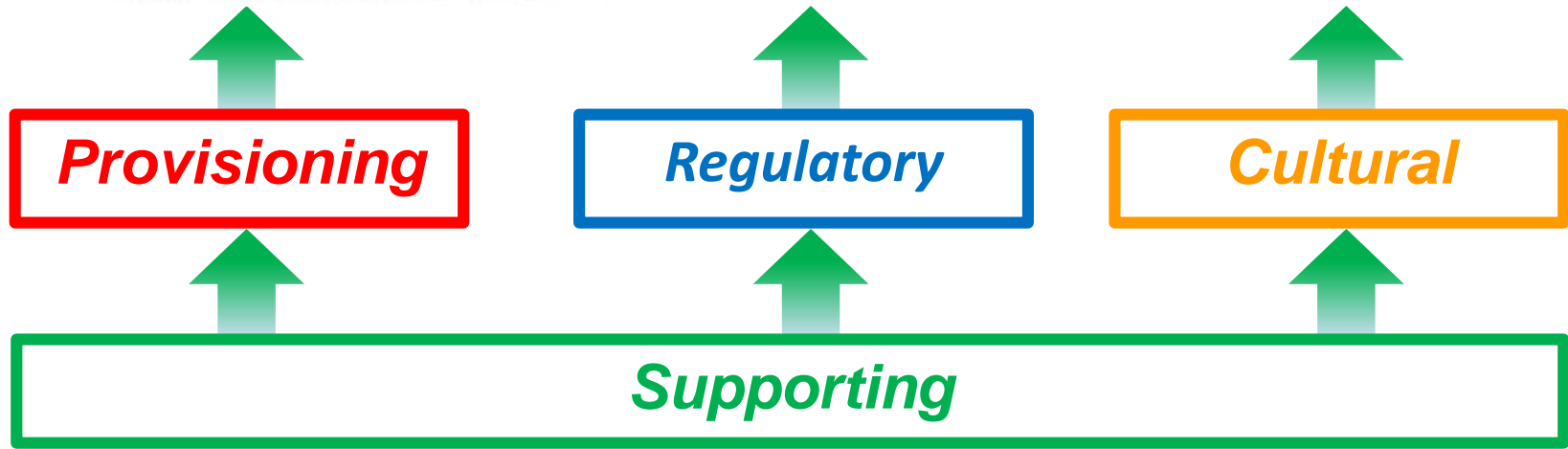
C



A cock-eyed view of 'infrastructure'



Ecosystem services → benefits from nature to people



Provisioning services
Fresh water
Food (eg crops, fruit, fish, etc)
Fibre and fuel (eg timber, wool, etc)
Genetic resources
Biochemicals, natural medicines, pharmaceuticals
Ornamental resources (eg shells, flowers, etc)

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

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

Supporting services
Soil formation
Primary production
Nutrient cycling
Water recycling
Photosynthesis
Provision of habitat

Systemically interconnected value systems

'Cherry picking' ecosystem services

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

Regulatory 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

- **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 + photosynthetic oxygen production
Photosynthesis (production of atmospheric oxygen)

The Fertile Crescent: Mesopotamia

- **Oldest recorded civilisation, Uruk**
 - 9,000 years ago, 8,000 year-old water channels
 - Food security, settled society, social differentiation, millions of people



- **The decline of Mesopotamia**
 - Progressive salinization and loss of fertility
 - Wheat → barley → crop failures
 - Population pre-Mesopotamian by time of British occupation

New Orleans, Hurricane Katrina 2005

Storm surge inundates 80% of New Orleans by up to 4.6m:

- \$108 billion damage, death toll of 1,464
- America's greatest 'natural' disaster



Vanishing delta

The combination of building levees along the Mississippi River, dredging canals and drilling for gas and oil, and climate change have conspired to erode the delta along the lower Mississippi River. Here's how much has disappeared in the last seven decades.



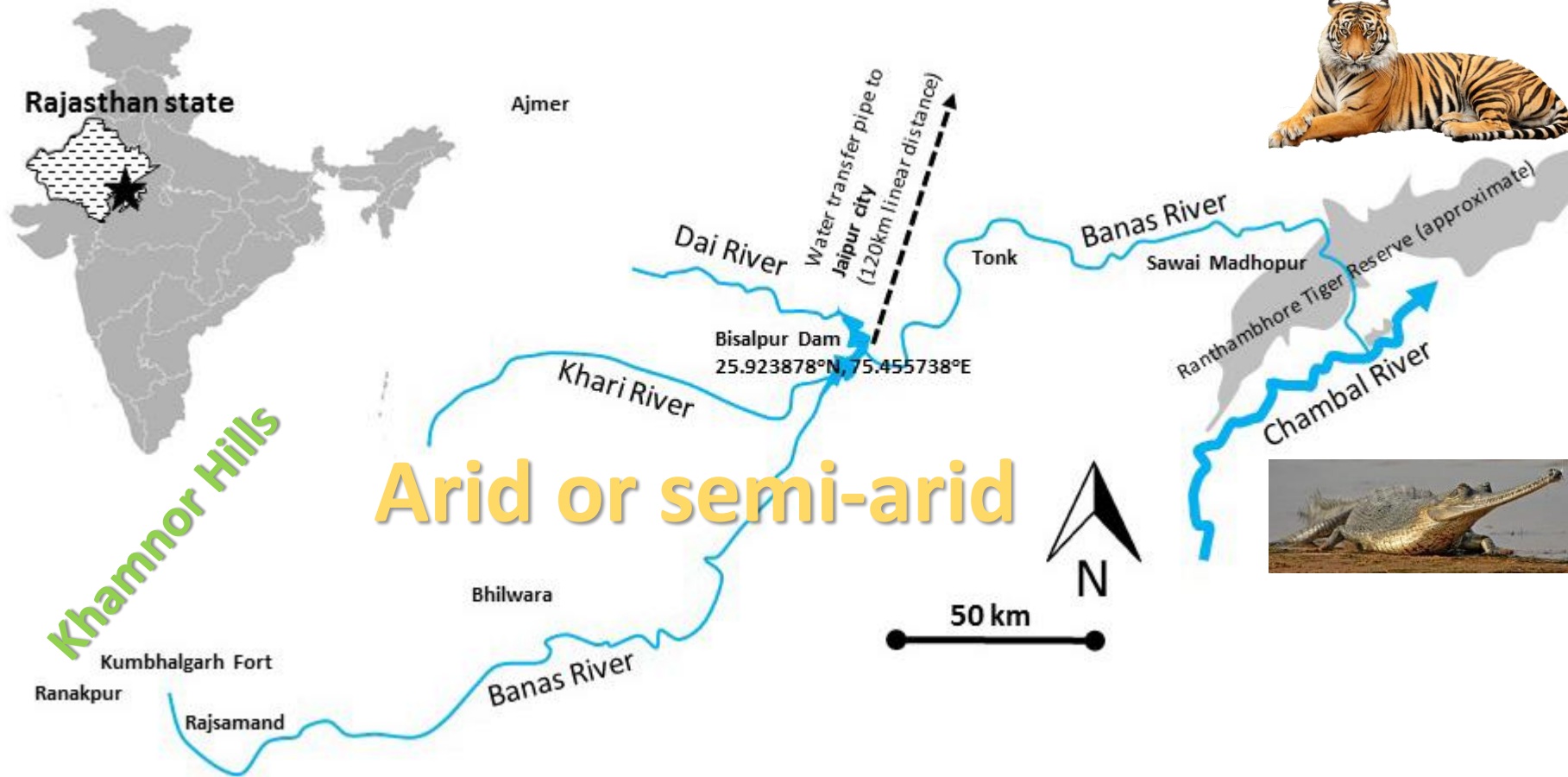
Source: U.S. Geological Survey, NASA

Advocate graphic

Costanza, R., Day, J.W. and Mitsch, W.J. (2006). A new vision for New Orleans and the Mississippi delta: applying ecological economics and ecological engineering. *Frontiers in Ecology and Environment*, 4(9), pp.465–472.

- Conventional rebuilding can't avert future 'natural disasters'
- Wetland restoration is cheaper, more sustainable, delivers more service benefits

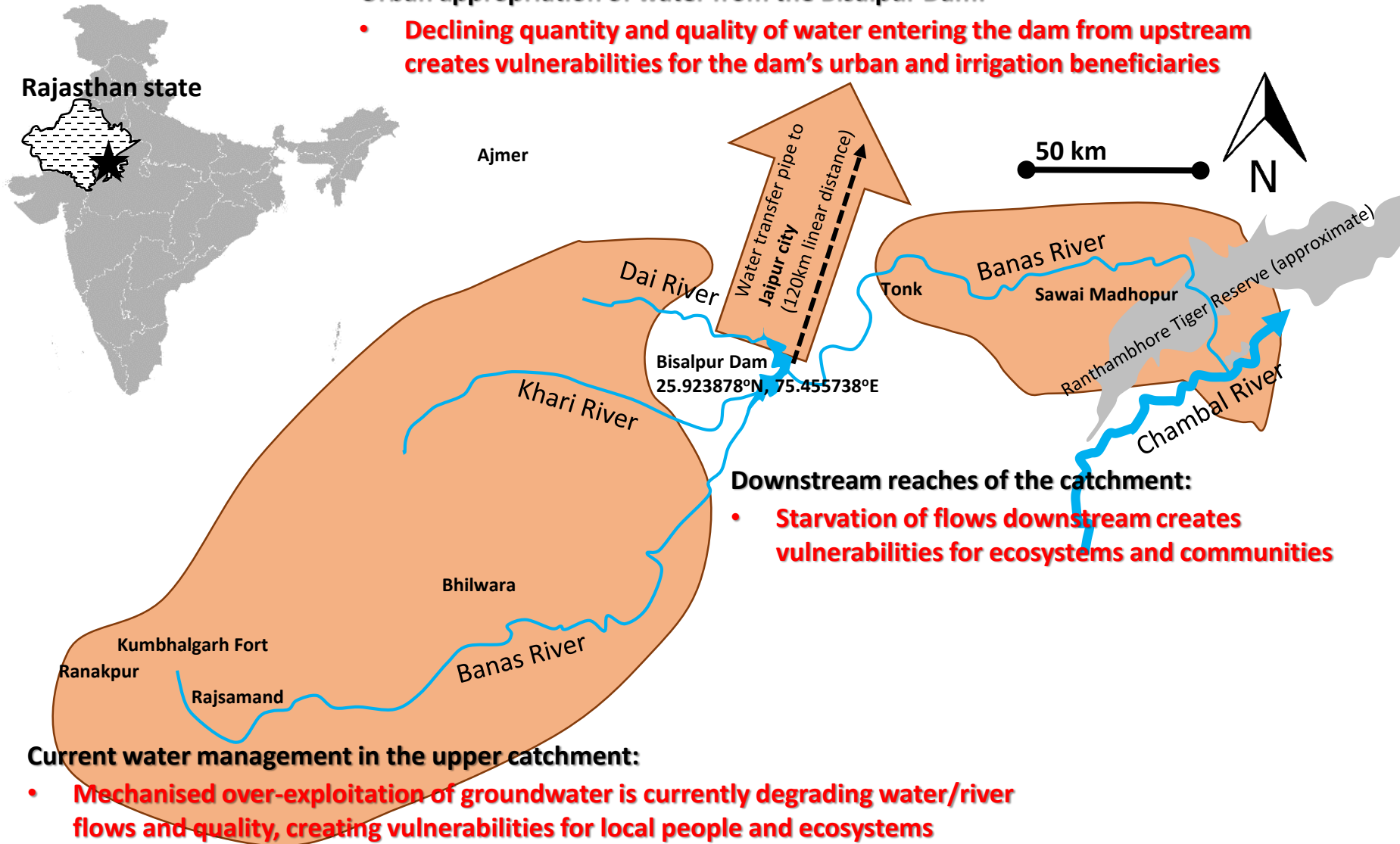
The Banas catchment, Rajasthan



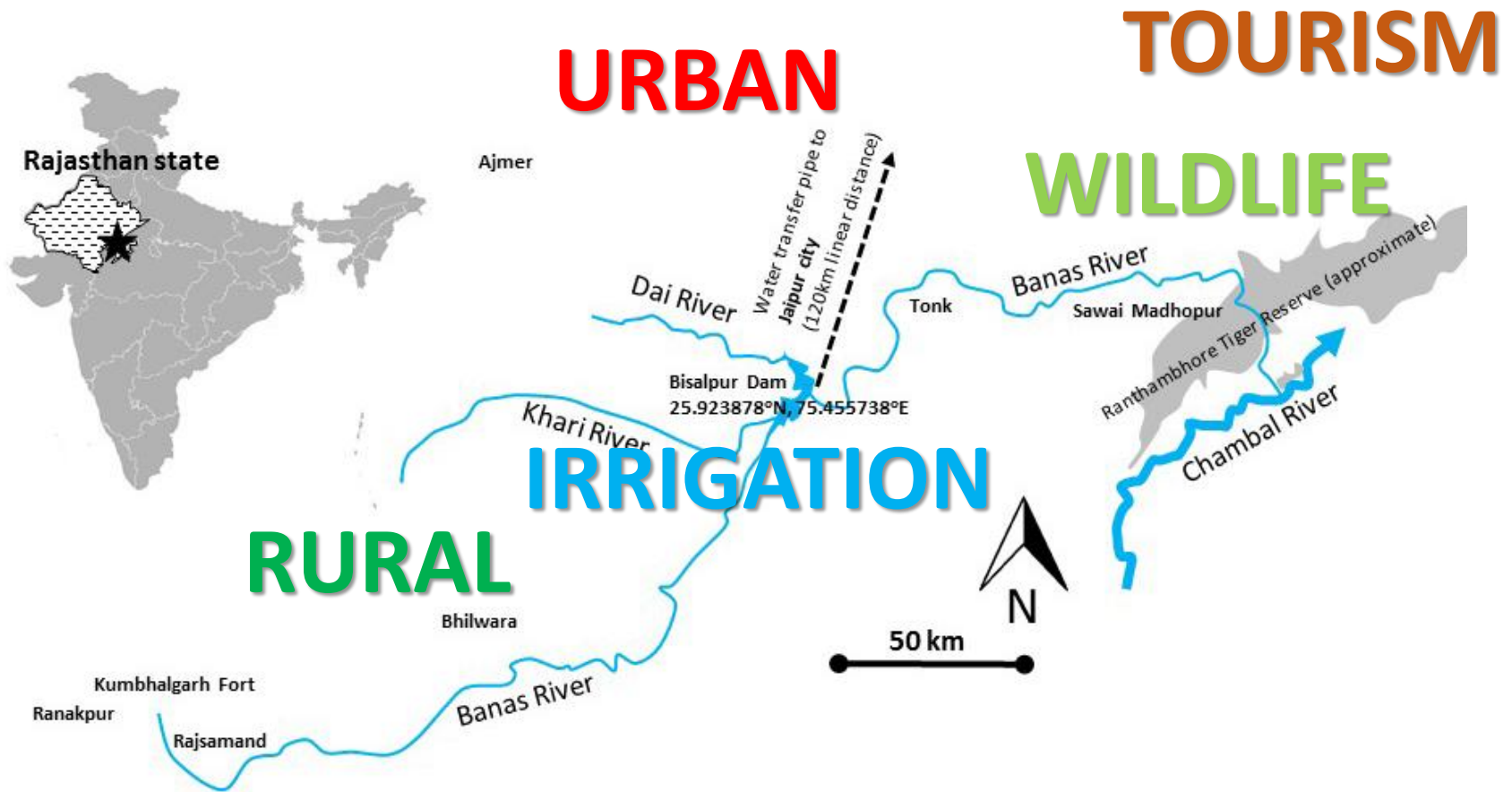
A degenerative socio-ecological cycle

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

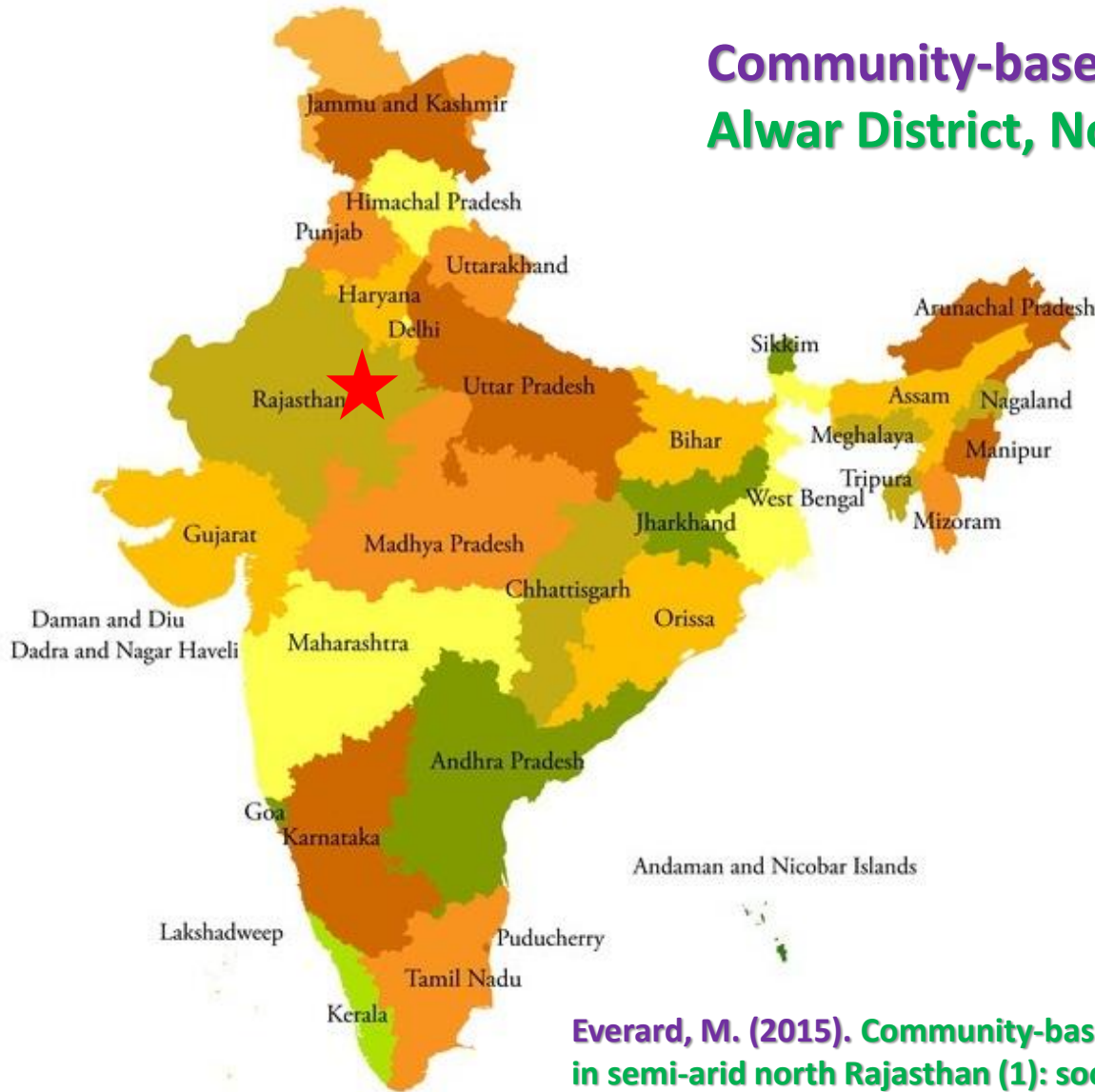


Tightly linked vulnerabilities



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

Community-based catchment restoration Alwar District, North Rajasthan



Everard, M. (2015). Community-based groundwater and ecosystem restoration in semi-arid north Rajasthan (1): socio-economic progress and lessons for groundwater-dependent areas. *Ecosystem Services*, 16, pp.125–135.











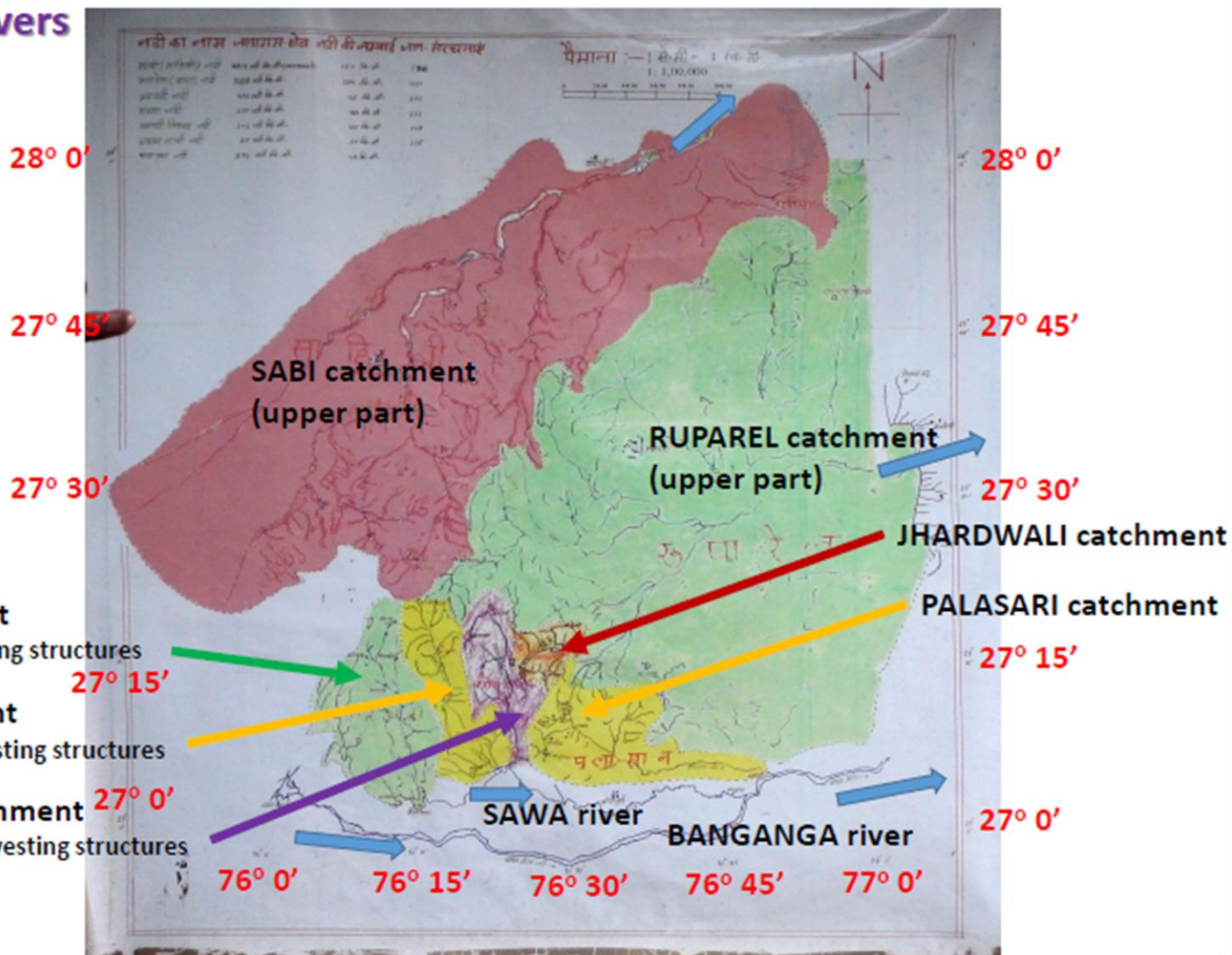






Seven restored rivers in Alwar District, Rajasthan

Flow →



ARVARI catchment

- 402 water-harvesting structures

SARSA catchment

- 270 water-harvesting structures

BAGHANI catchment

- 120 water-harvesting structures



Gopalpura



Chabutra Wala





Tilda



Rudmal Meena, headman, Harmeerpur village



Jabar Sagar



Jabar Sagar



Mandalwass



Tilda



Mandalwass, lower impoundment



Tilda



Golakabass



Tilda



Science & Environment

'Water man of India' Rajendra Singh bags top prize

By Roger Harrabin
BBC environment analyst

© 21 March 2015 | Science & Environment

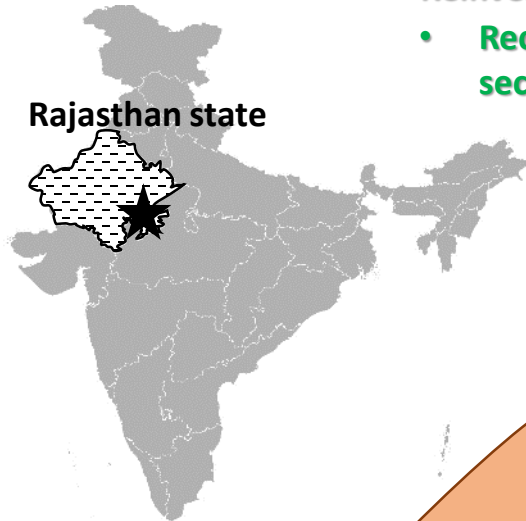


Creating a regenerative socio-ecological cycle

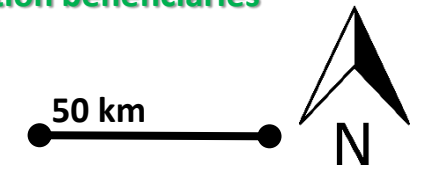
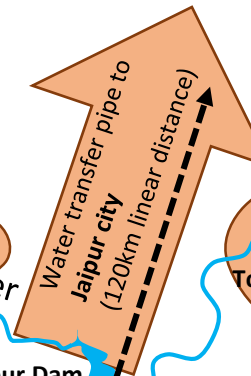
Reinvestment in ecosystem processes by beneficiaries from the Bisalpur Dam:

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

Rajasthan state



Ajmer

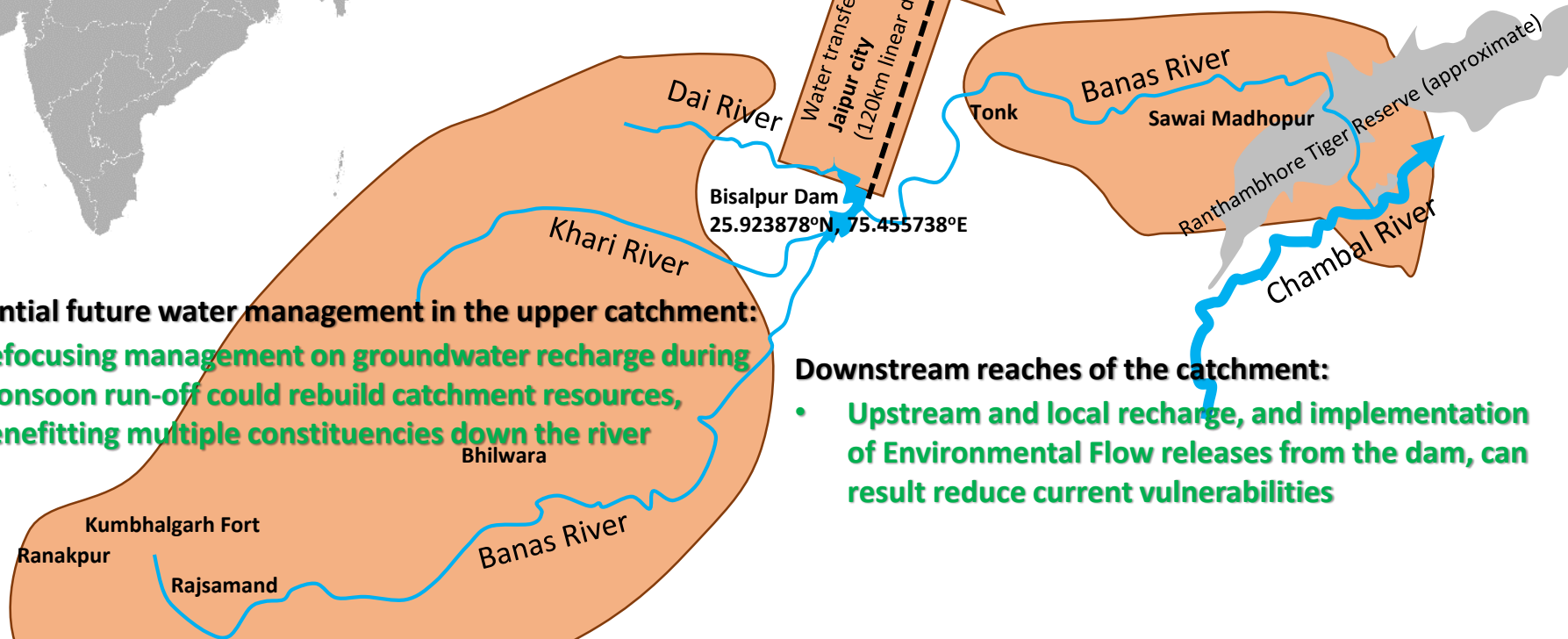


Potential future water management in the upper catchment:

- 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>.

So how might this work at home?

Historic tendency

Principal driver

- Commercial use
- Policy priority
- Etc.



Disciplinarily focused

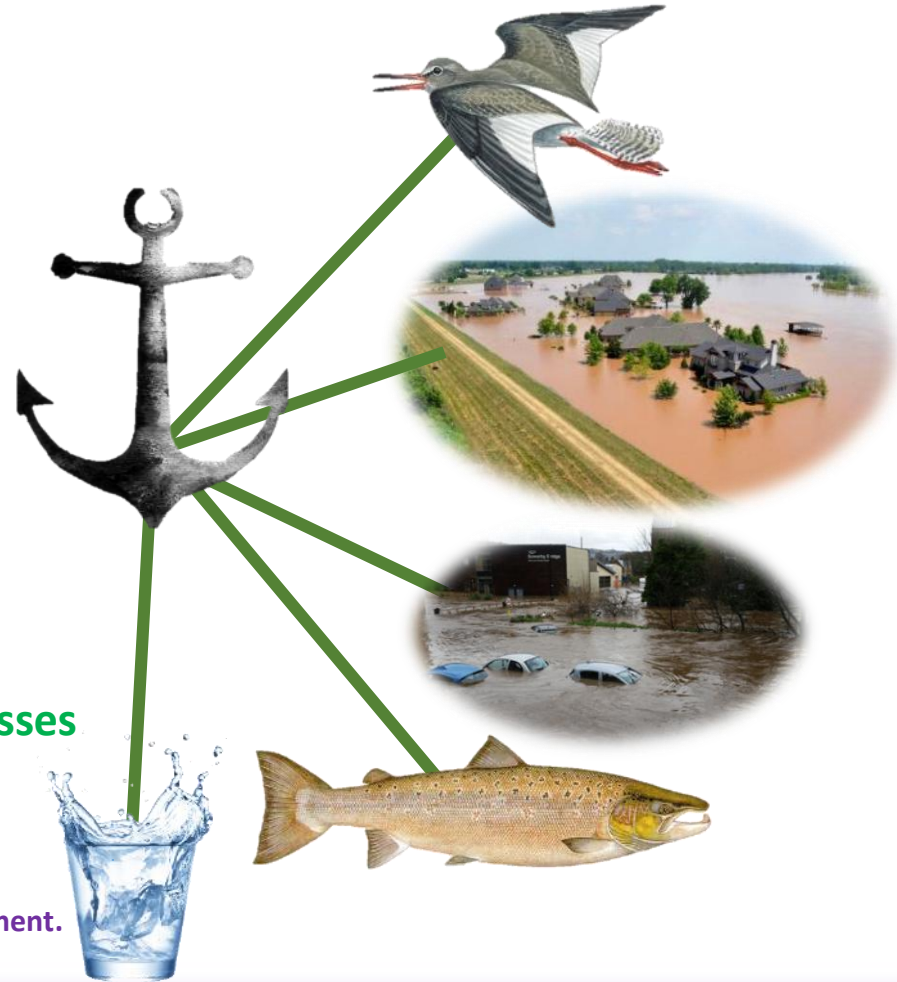


So how might this work at home?

Anchor services

Principal driver

- Commercial use
- Policy priority
- Etc.



Systemic solutions:

- “...low-input technologies using natural processes to optimise benefits across the spectrum of ecosystem services and their beneficiaries”

Everard, M. and McInnes, R.J. (2013).

Systemic solutions for multi-benefit water and environmental management.

The Science of the Total Environment, 461-62.

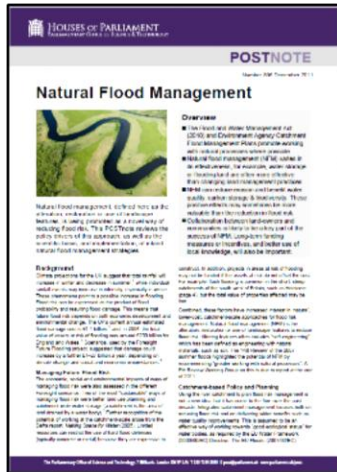
We are making stepwise progress, for example:

Natural Flood Management

Natural Flood Management. (2011).

Parliamentary Office of Science and Technology, POSTNOTE 396

<http://researchbriefings.files.parliament.uk/documents/POST-PN-396/POST-PN-396.pdf>



Managed realignment

Everard, M. (2009).

Ecosystem services case studies.

Environment Agency Science report SCHO0409BPVM-E-E.

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/291631/scho0409bpvm-e-e.pdf



Integrated constructed wetlands (ICWs)

Everard, M., Harrington, R. and McInnes, R.J. (2012).

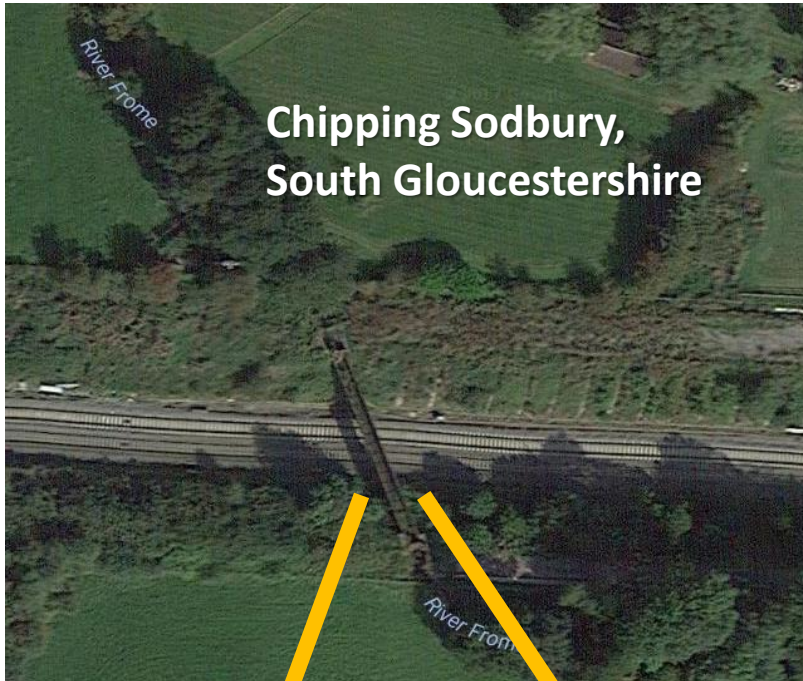
Facilitating implementation of landscape-scale integrated water management: the integrated constructed wetland concept.

Ecosystem Services, 2, pp.27–37.



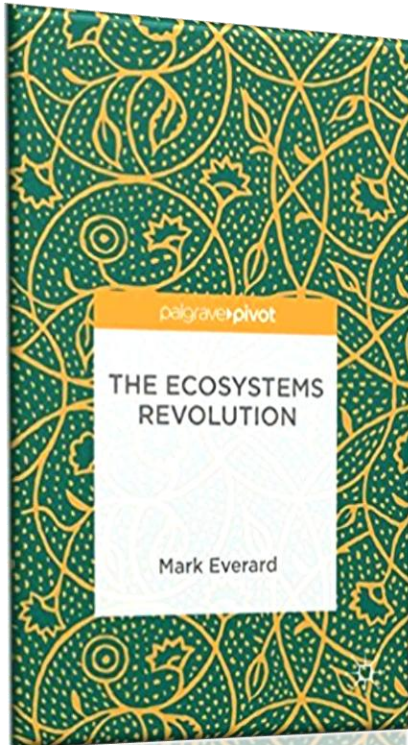
Green infrastructure

But substantial obstacles remain



- Ignorance about natural capital
- Narrow technical solutions
- Simplistic modelling assumptions
- Siloed departments
- 'Ring-fenced' budgets
- Narrowly framed legislation
- Blinkered fiscal measures
- Power asymmetries
- Entrenched rights
- Risk aversion
- Institutional memory
- Etc...

Ecosystem services add value to every department



Everard, M. (2016).

*The Ecosystems Revolution:
Co-creating a Symbiotic Future.*

Palgrave PIVOT series.

Ecosystem services already support:

- Transport
- Education
- Defence
- Trade and Industry
- Health
- Culture
- Exiting the EU (discuss!)
- Etc...

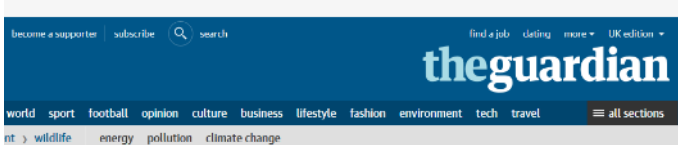
...and how they could add further value

Scenario 1: Market-driven Armageddon

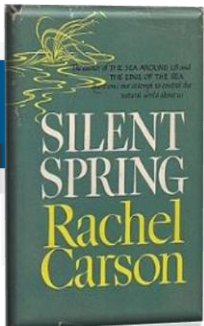


Nature as commodity

Liquidation for short-term profit



Warning of 'ecological Armageddon' after dramatic plunge in insect numbers



Scenario 2: Integrating natural capital and services



Sustainable, multi-beneficial uses



"Carefully planned investments in natural capital, targeted at the best locations, will deliver significant value for money and generate large economic returns. These are competitive with the returns generated by more traditional infrastructure investments."

Natural Capital Committee. (2015). *Protecting and Improving Natural Capital for Prosperity and Wellbeing: Third 'State of Natural Capital' report*. Natural Capital Committee, HM Government, London.

Some take-home messages

- **Capital and services**
 - **Need protection and reinvestment**
- **Services are as plural as human value systems**
 - **Decisions-making needs to be inclusive**
- **All services are interconnected**
 - **Consider the whole system for net value and sustainability**
- **Degenerative or regenerative socio-ecological systems**
 - **Systemic overview and nested governance is vital**
- **An 'anchor services' and 'systemic solutions' approach**
 - **Primary drivers will always be narrow, but solutions needn't be**
- **We are making fragmented progress**
 - **We need to be vocal about this and transfer lessons to other areas**
- **Alternative futures**
 - **Seeded in the decisions and actions we make right now**



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