CECAN Webinar Systems Approaches to Water Management and Infrastructure Planning for Zero-Pollution Targets

17th June 2021 13:00 - 14:00 BST

Welcome to our CECAN Webinar.

All participants are muted. Only the presenter Dr Ana Mijic Co - Director of the **Centre for Systems Engineering and Innovation** (CSEI) will be heard.

The webinar will start at 1pm. The presenter will to talk to you for around 45 mins and will then select questions to answer.

Please submit your **questions** at any point during the webinar **via the Zoom panel Q&A box only**,.

Todays webinar will be recorded and will shortly available on the CECAN website, along with the presentation slides.

For further details of CECANs work :-

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Systems Approaches to Water Management and Infrastructure Planning for Zero-Pollution Targets

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CECAN seminar, 17 June 2021
#CASYWat

…. which we can address using systems approaches

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We face multiple challenges …

- Climate crises and environmental degradation
- The role of infrastructure and built land for human flourishing and managing natural environment
- The role of system use, operation and evidence-based decision-making

…. which we can address using systems approaches

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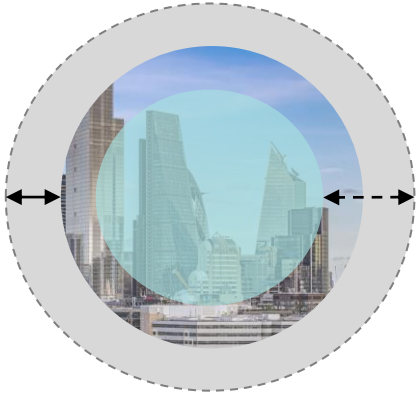
Zero-Pollution Infrastructure concept

- ‘Zero-pollution infrastructure’ (ZPI) is an adaptive system of systems intrinsically linked to people and the natural environment
- The ZPI thinking will help to:
  - better understand targets for offsetting environmental impacts
  - improve resilience, safety and sustainability through policy, technology and behaviour change options
  - set development goals within the capacity of natural systems

…. which we discuss through water management systems analysis



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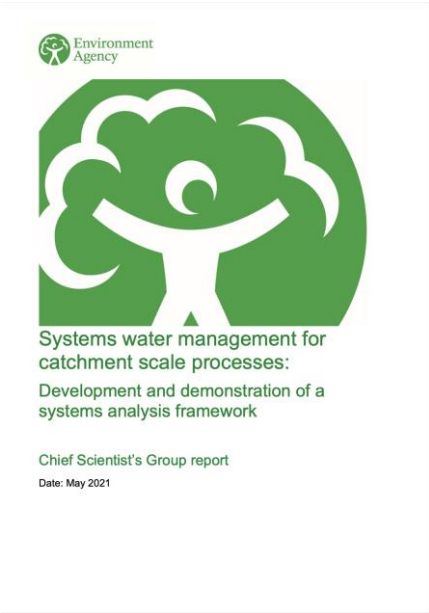
CASYWat project objectives

- To develop a novel concept of Systems Water Management (SYWM) in the context of a 25YEP as a framework for understanding system complexity in the context of water planning
- To propose a generic approach to SYWM mapping and showcase the value of a systems-level analysis
- To inform the Environment Agency and its stakeholders about lessons learnt, the potential of the work and future improvements



https://www.gov.uk/government/publications/a-systems-based-approach-to-catchment-water-management

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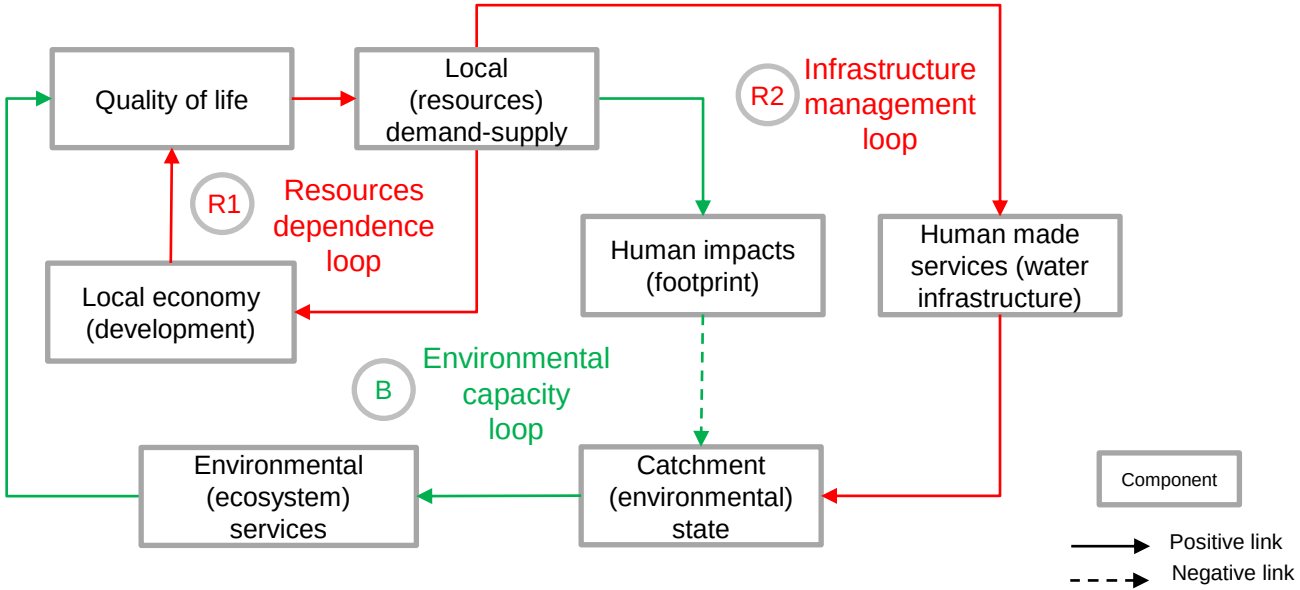
Systems water management (SYWM) meta-model



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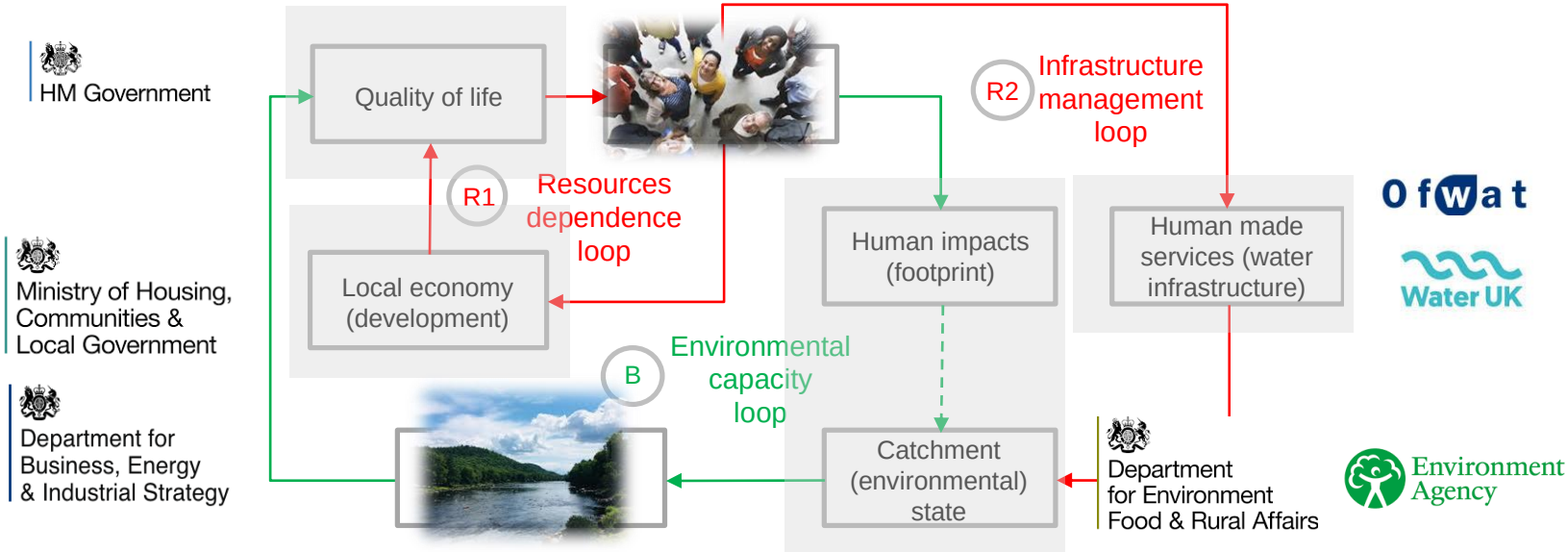
Who is responsible for the system?



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SYWM approach

Catchment state (CS)	Environmental services (ENS)	Human impacts (HI)
CS1 – Hydrological processes CS2 – Climate processes CS3 – State of water (water quantity and quality) CS4 – State of land (natural and human habitat capital)	ENS1 – Water availability ENS2 – Environmental flows ENS3 – Water purification capacity ENS4 – Flood regulation capacity	HI1 – Water pollution (treated and untreated discharges) HI2 – Land impacts (sedimentation, erosion) HI2 – Physical modifications HI4 – Ecological (land) footprint
Human made services (HMS)		
HMS1 – Water abstractions HMS2 – Water supply infrastructure HMS3 – Wastewater infrastructure HSM4 – Flood infrastructure	HMS5 – Crop production HMS6 – Livestock farming HMS7 – Natural land management HMS8 – Recreational land management	HMS9 – Urban land management HMS10 – Urban infrastructure HMS11 – Service infrastructure HSM12 – Industry infrastructure
Local demand-supply (LDS)	**Quality of life (QoL)**	**Local economy (LE)**
LDS1 – Population growth LDS2 – Water and food demand LDS3 – Infrastructure planning or land development LDS4 – Human behaviour and decisions	QoL1 – Regional sustainable development QoL2 – Economic growth QoL3 – Role of imports and exports QoL4 – Local development plans	LE1 – Economic activities and sectors LE2 – Employment LE3 – Providers, users and beneficiaries LE4 – Embodied environmental impacts

Application case studies

Steps	Regional water management system	Lake water quality system
1. Understanding: Review of high-level information, scientific papers and reports to understand…	…the overall context of the water management system	…the specific selected environmental problem (for example, lake water quality)
2. Structuring: Defining second-tier variables and their links to create systems map that…	… will give a high-level structure of the interdependences that influence water management	…will contain the same information as the high-level regional systems map, but with more detail linked to the specific problem analysed
3. Analysing: Mapping the feedback loops and finding patterns defined by the SYWM meta-model to…	… discuss management goals and understand which processes need to be coordinated to enable the agreed systems level water management balance	… map a range of possible systems level interventions (leverage points) that could enable local development without environment degradation

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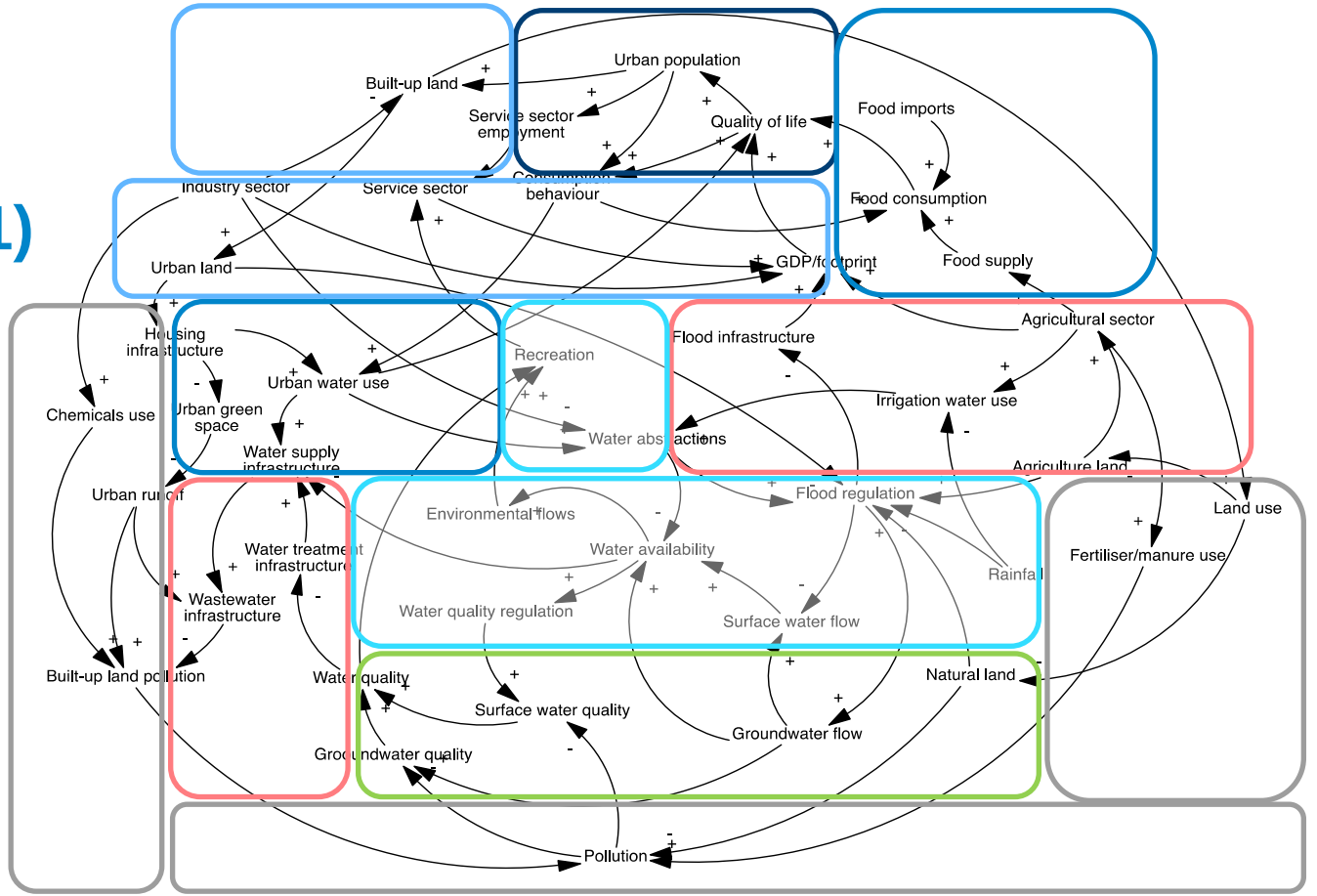
SYWM maps (1)

Regional water management (RWM) systems map



- Quality of life
- Level of development
- Resources demand-supply
- Water infrastructure
- Environmental footprint
- Ecosystems services provision
- Environmental state

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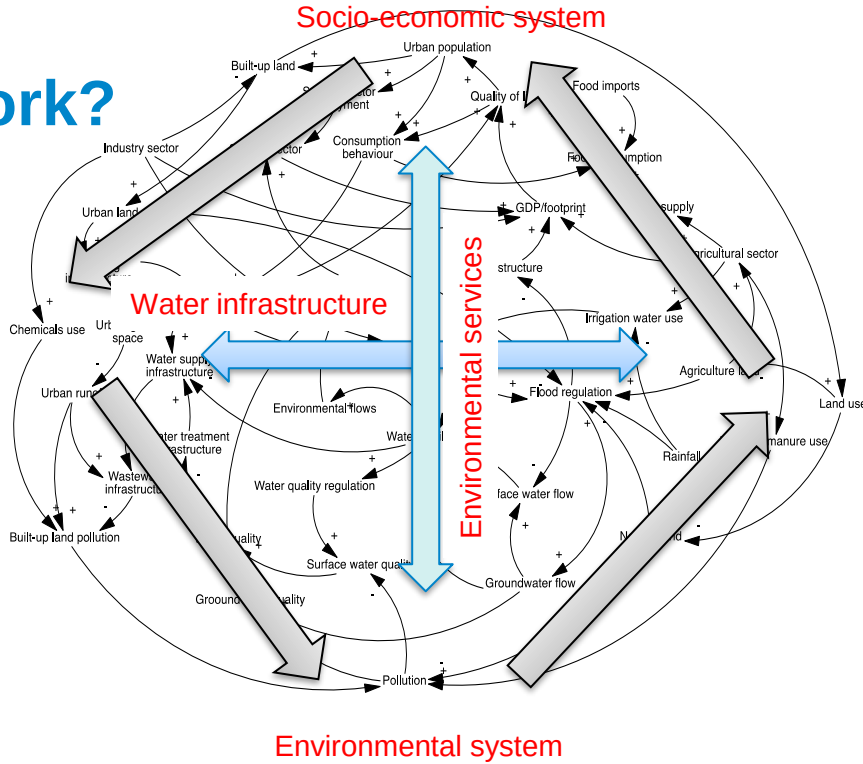
Does natural capital concept work?

- Revaluing of land-dependent and other economic sectors
- Including built-up land in the natural capital analysis
- Redefining the role of environmental services



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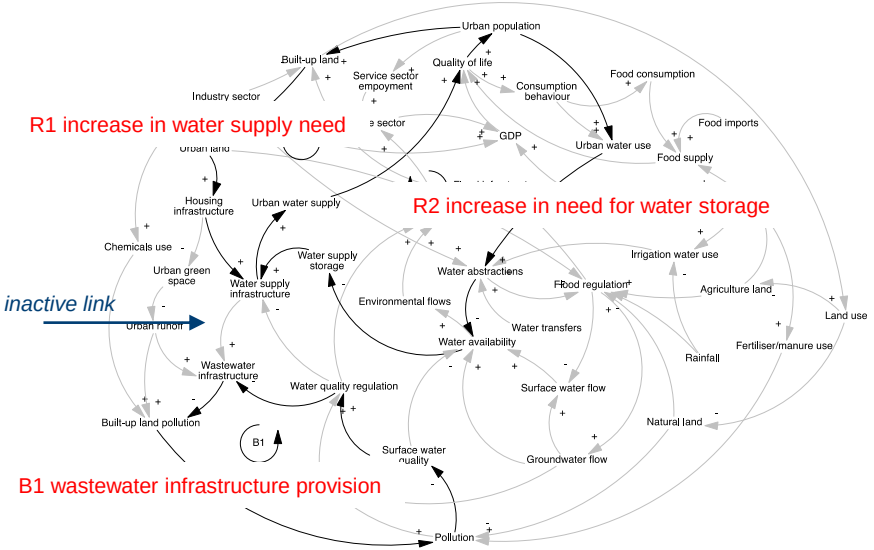
Implications for water management planning (1)

Demand and integrated planning

- need for coordination between the water and housing/urban planning sectors
- role of urban water use and consumption behaviour



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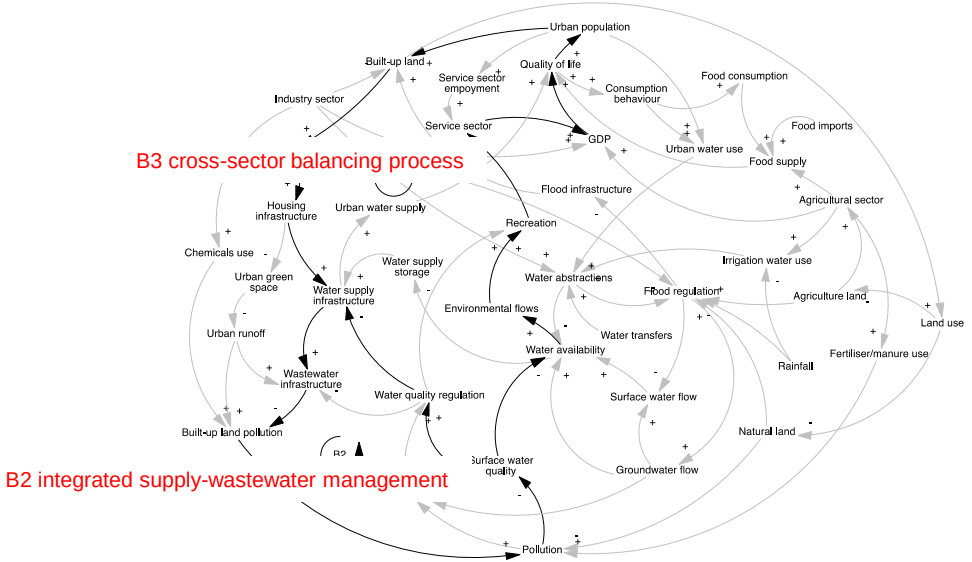
Implications for water management planning (2)

Coordinated decisions

- use of water quality indicator for water infrastructure planning and operation
- maximising the use of natural systems (e.g., river water flows) in ES provision



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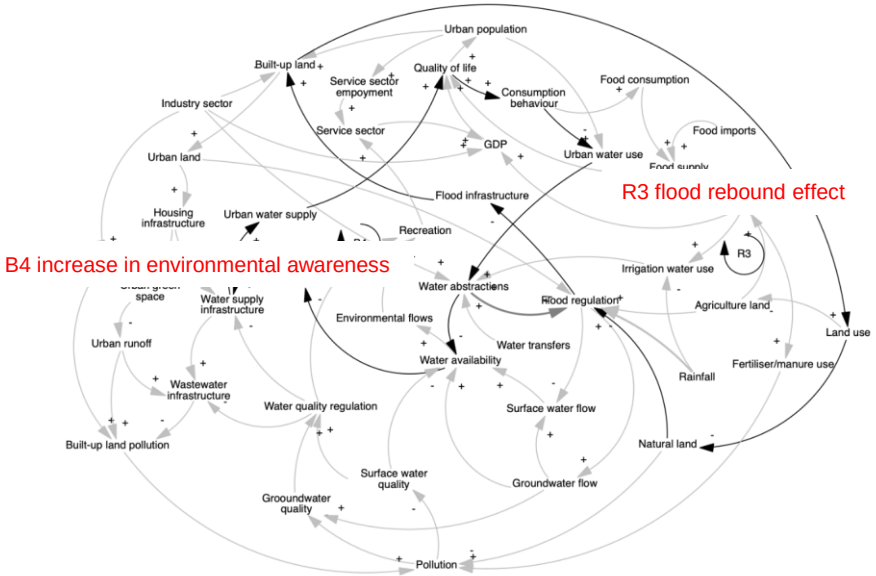
Implications for water management planning (3)

Unintended consequences

- interactions between flood management, urbanisation and consumption behaviour
- potentially leading to an increase in flood risk if water demand reductions result in decreases in abstractions and increases in environmental flows



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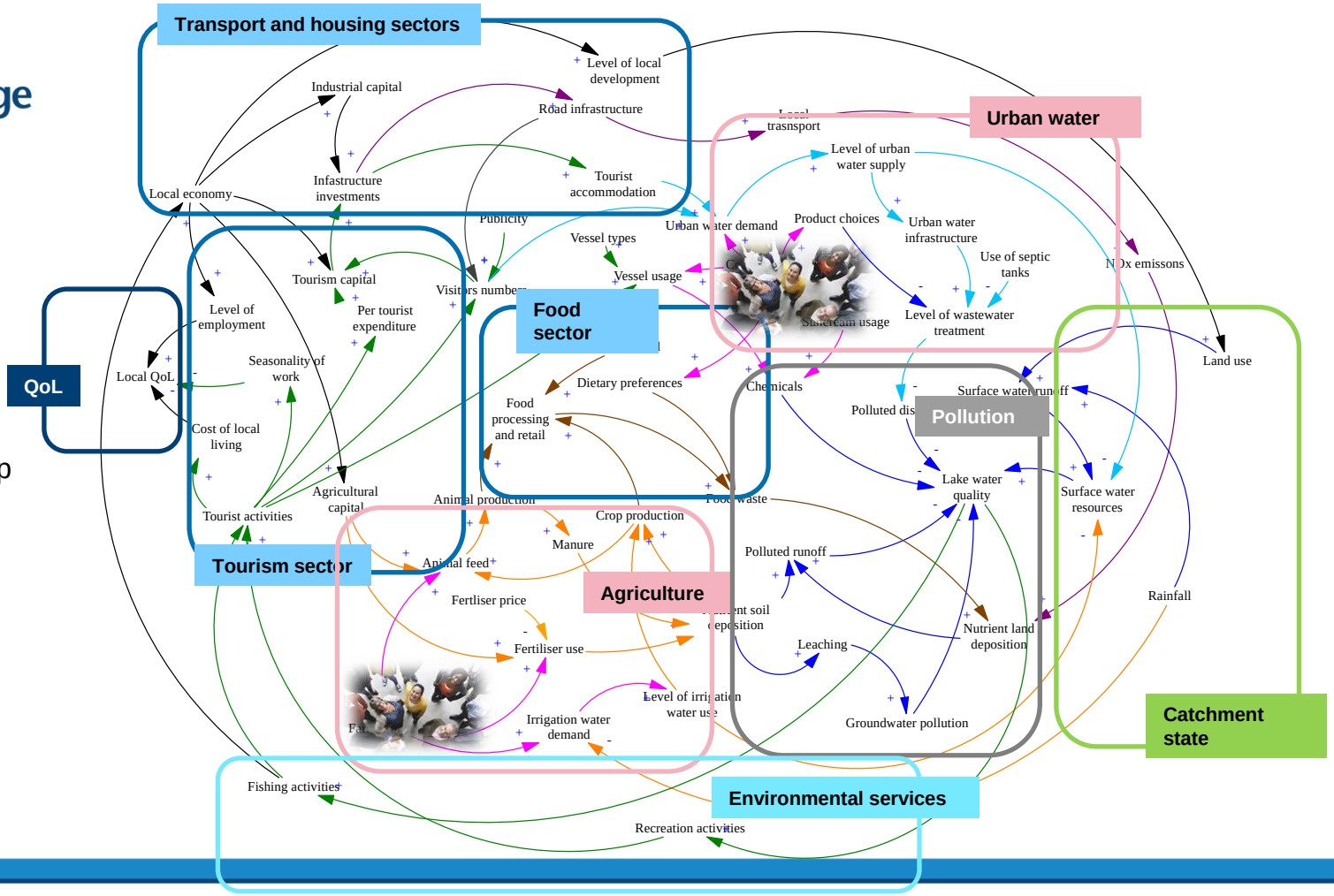
SYWM maps (2)

Lake water quality (LWQ) systems map for Windermere



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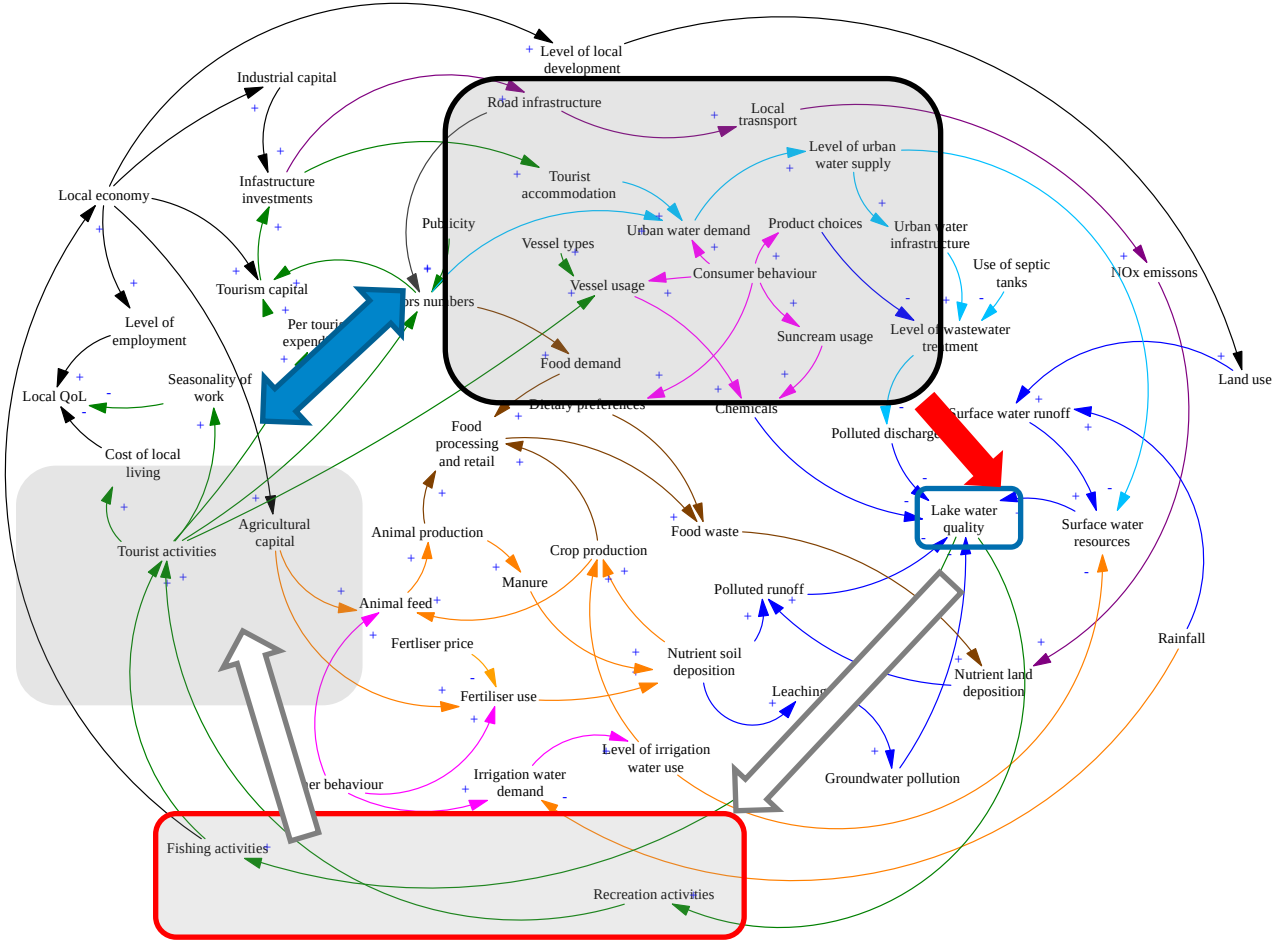
Insights (1)

The role of lake environmental services

- Direct provision of benefits relevant for local tourism
- Need to minimise impacts from the business operation and activities to maintain the future sustainability of the business



Local collaboration and coordination

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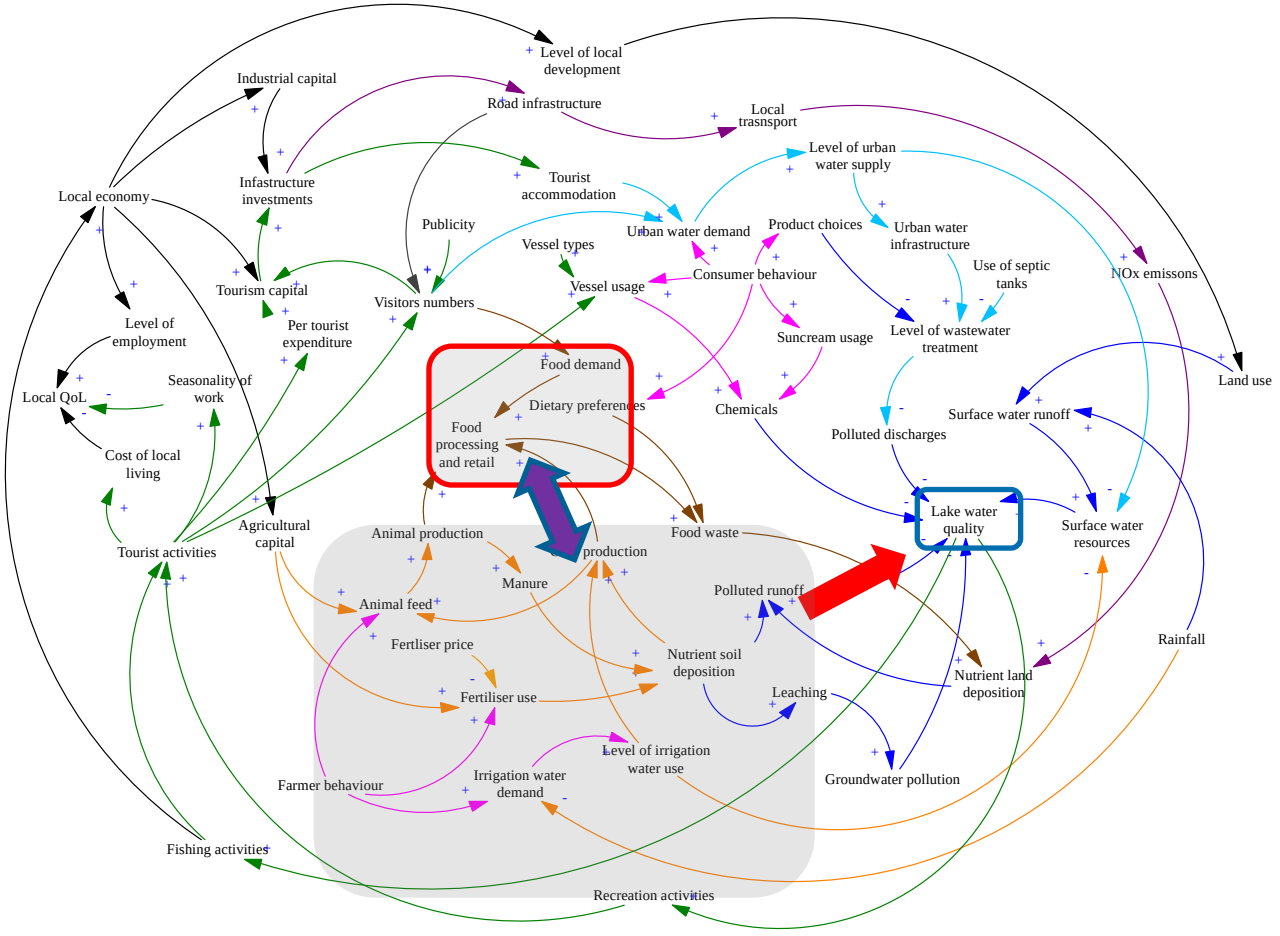
Insights (2)

Link between the local food supply and use

- Local decoupling of agriculture activities and food supply (and hence tourism) could give a false view of the security



New business models?

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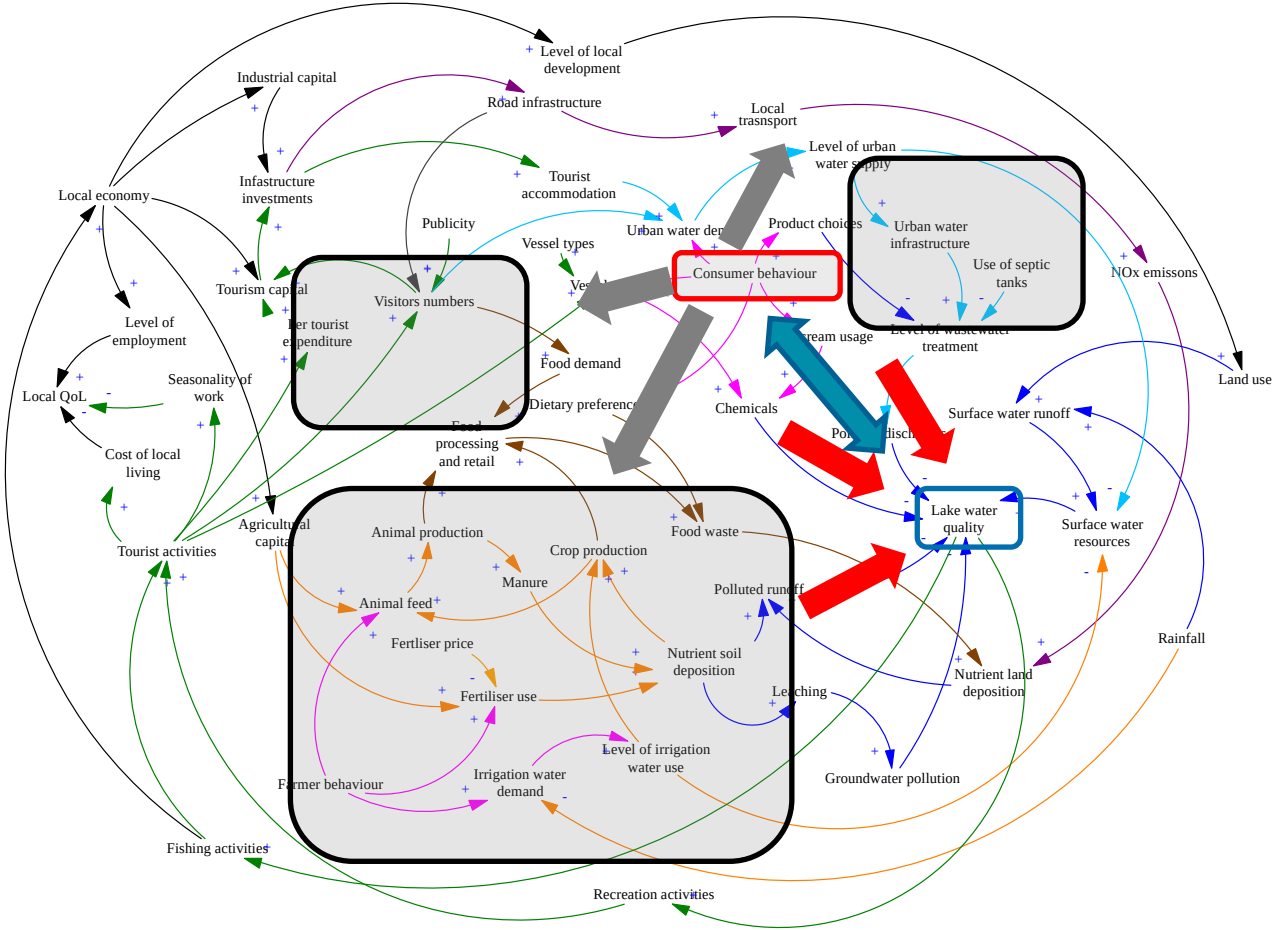
Insights (3)

The role of consumer behaviour

- Driving demand and hence creating a link between food production and retails sectors and provisional services
- Driving the tourist sector decisions and influencing a range of activities



Education and information

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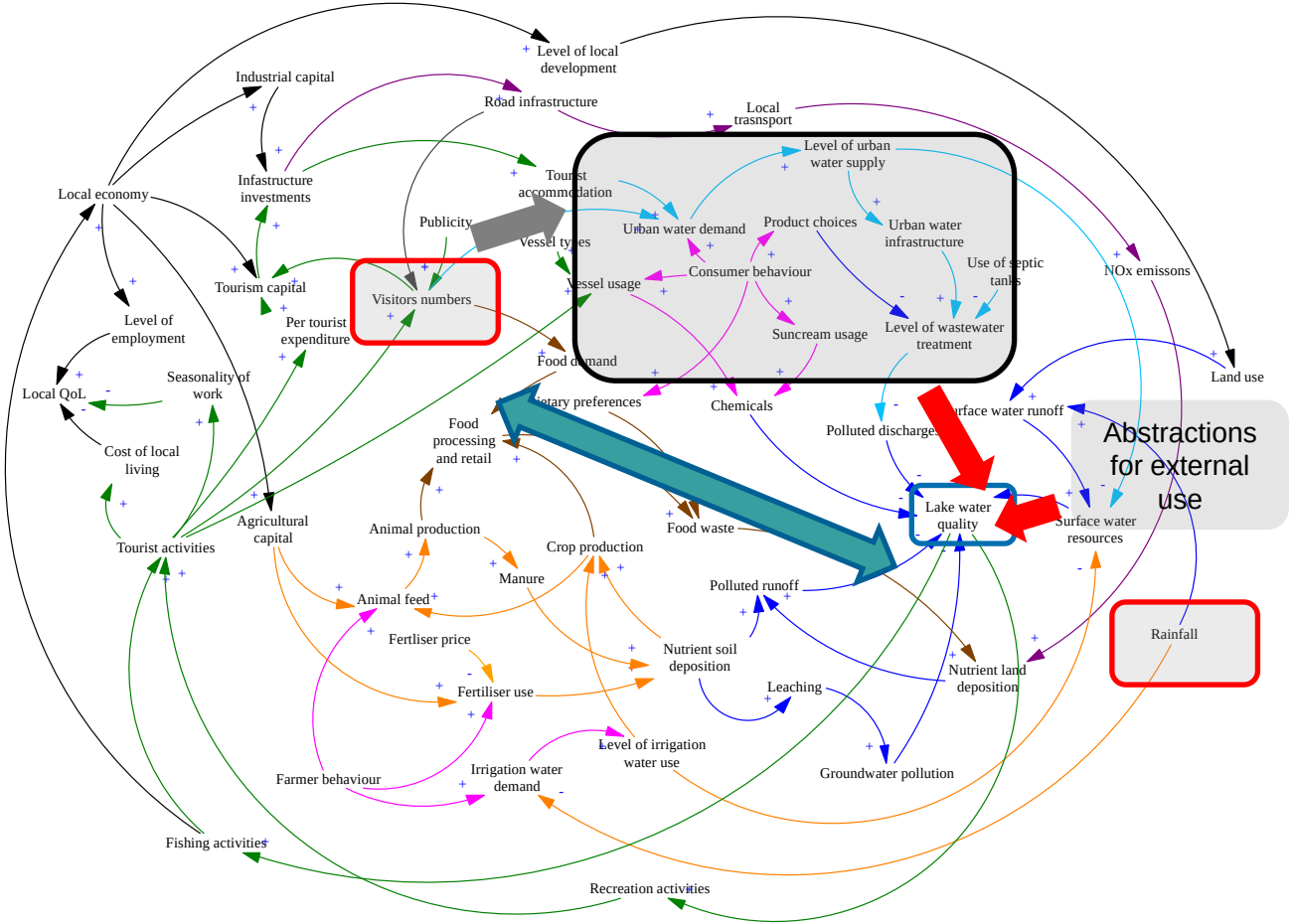
Insights (4)

Integrated system management

- Highly seasonal demand and pressures on the system linked with the natural availability of water supply
- The role of water abstractions in influencing water levels in the lake, and hence the ability of the lake to self-purify



Regional collaboration and coordination

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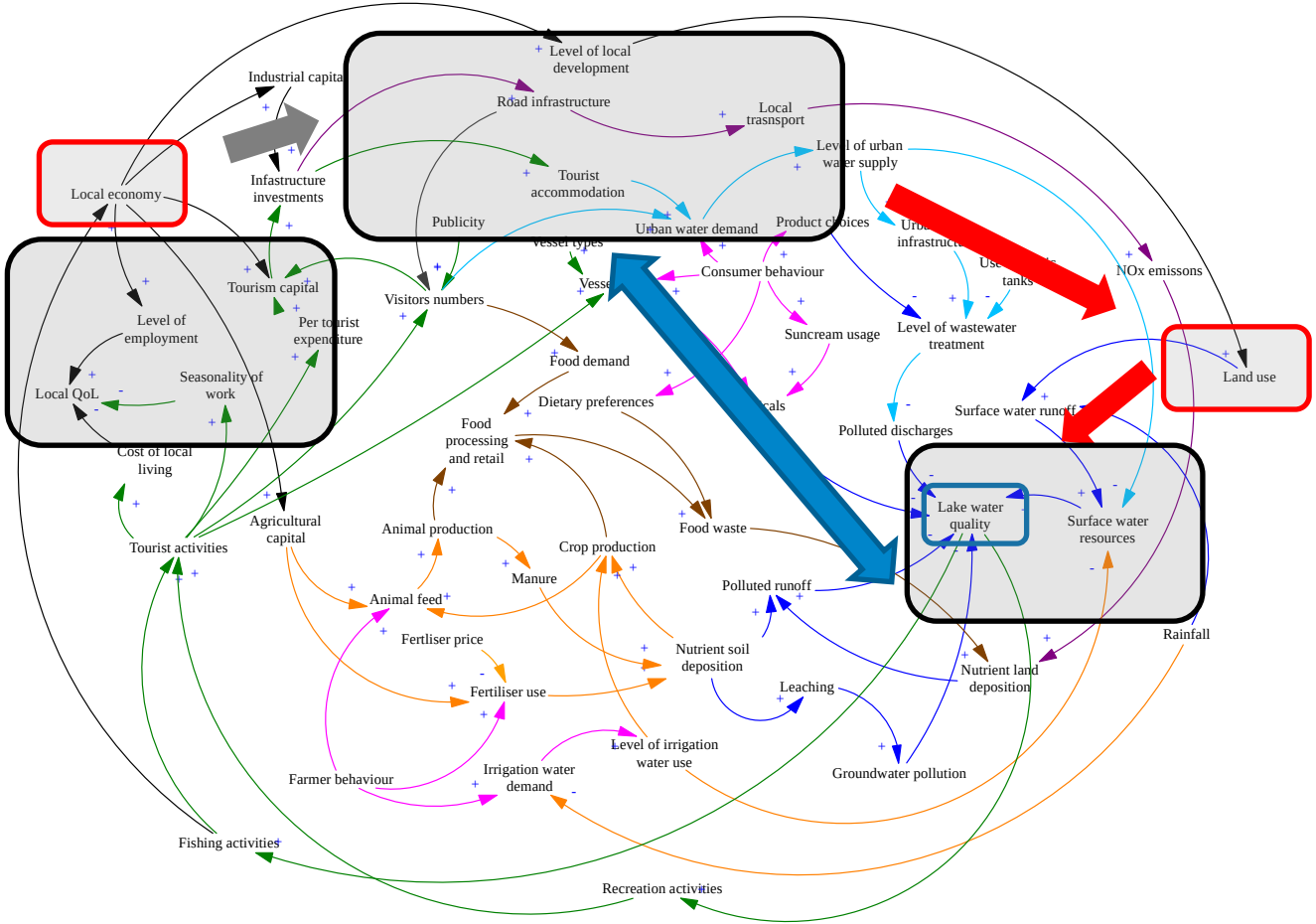
Insights (5)

Link between the local economy and land decisions

- Highly seasonal demand and pressures on the system
- The role of water abstractions in influencing water levels in the lake
- Increased risk of flooding



Local collaboration and coordination

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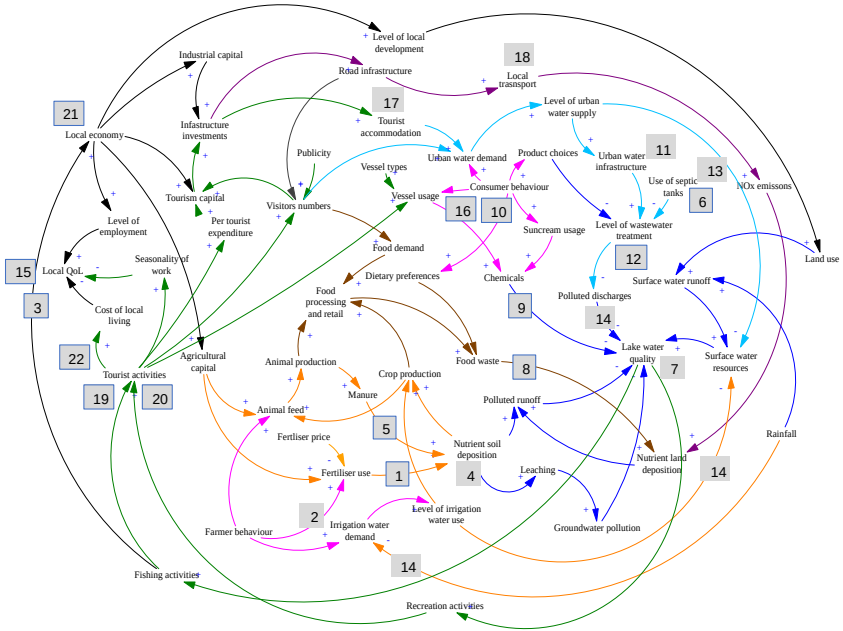
LWQ leverage points*



Level	Type of intervention in the system (in increasing order of effectiveness)	Application for the LWQ management and control	Intervention/policy option [numbers correspond with notation from Appendix C
11	Introducing new standards	Managing direct impact on lake water quality	Limit pollution loads [1, 8, 9]
10	Increasing buffering capacity	Adding new elements in the system that increase the system capacity to manage pollution	Increase wastewater treatment capacity, reduce direct pollution or enhance self-purification [2, 4, 5, 6, 7, 12]
9	Changing the system structure	Adding new elements in the system that reduce/minimise environmental impacts	Upgrade of septic tanks, adopting green infrastructure, N recycling, sustainable transport and green hotels [11, 13, 17, 18]
8	Providing timely information	Information that can positively influence consumer behaviour change	Food labelling and promoting local consumption [10, 16]
7	Designing positive feedback loops	Maximising the link between the local environment and people who live there and care about it	Education activities and local employment [19, 20]
6	Reducing the strength of the reinforcing loop	Multifunctional solution that targets multiple stocks and flows in the system	Wastewater recycling and reuse [14]
5	Enhancing information flows	Providing information at a system level that can be used for collaborative decisions	Develop nutrient-balance programmes and participatory approaches [3, 15]
4	Changing the system rules	Direct impact on all components in the system	Introduce new environmental and visitor taxes [21,22]
3	Improving the system's capacity to self-organise	Shifting the decision focus onto the local quality of life and adjusting the local economy to the level of local ESS provision	Participatory integrated catchment management [15]

Technical interventions

Information sharing interventions

Large-scale interventions socio-technical interventions

Whole-system restructuring

Meadows, D.H., 1999. Leverage points: Places to intervene in a system.

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What we have learnt

- The value of systems approach is to showcase the complexity and open a dialogue – a SYWM (or any other) meta-model could be a good starting point
- Systems maps are useful to communicate key interdependences and summarise intervention across a socio-technical domain
- The work is by no means comprehensive, and it should be expanded to include other systems and sectors
- A true value of the approach will be proven by bringing it in front of actors, decision makers and citizens to co-design the maps and discuss solutions

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