

A joined-up approach to managing the water environment: a research perspective



Richard Allan & Kerry Waylen Richard.Allan@Hutton.ac.uk Kerry.Waylen@Hutton.ac.uk



Introductions







Dr. Richard AllanDr. Kerry WaylenRichard.Allan@Hutton.ac.ukKerry.Waylen@Hutton.ac.ukwww.hutton.ac.uk/staff/richard-allanwww.hutton.ac.uk/staff/kerry-waylen



Joined up approach



- Different types of connection
 - Scientific disciplines
 - Water-Energy-Food
 - Places and cases
 - Science, policy & other stakeholders
- Challenging but worthwhile
 - Societally-engaged relevant science
 - Helps prompt reflection and achieve change



Presentation Agenda



- Introduction to the James Hutton Institute
- Overview of Scottish water policy research
- International projects
- Success in Europe
- Case study: MAGIC





What's in a name?



James Hutton (1726 – 1797)

- Leading figure of the Scottish Enlightenment
- Early career centred on medicine and chemistry; later a farmer and finally became leading geologist
- Connection with great
 Scottish science

Mission Statement



Vision

To be at the forefront of innovative and transformative science for sustainable management of land, crop and natural resources that supports thriving communities.

Mission

To conduct excellent science and engage in new ways of working across disciplines, with business, policy and society, that guide contemporary thought and challenge conventional wisdom, ensure trust and deliver the best outcomes for all.



Discipline diversity

Agro-ecology Analytical chemistry Aquatic ecology Biogeochemistry **Bioinformatics** Biology Chemistry Crop science Ecology **Economics**

Entomology Epidemiology Geo-informatics Genetics Geography Hydrology **Mathematics** Microbiology Mineralogy Molecular biology Pedology

Physics Plant breeding Plant Pathology Plant physiology Psychology Sociology Soil science **Statistics** Systems analysis Virology Zoonoses



Our people



- Around 560 scientists and support staff
- We have 150 PhD students and regularly host visiting researchers and casual workers
- Based across five sites



Our sites





Craigiebuckler, Aberdeen Laboratories



Invergowrie, Dundee Laboratories, glasshouses and arable land



Balruddery Farm, Angus Arable farm Site of the Centre for Sustainable Cropping



Hartwood Research Station, Lanarkshire

350ha rotational and permanent grassland, moor and woodland



Glensaugh, Kincardineshire 865ha rotational grassland, permanent pasture, heather moor and peat



H2O @ Hutton



- Long-standing expertise in catchment sciences
- Multiple sources of funding
- Multiple disciplines



Current strategic research





5 years: 2016-2021

- 1) Water Ecosystem Functions building the evidence base
- 2) Impacts of Change developing models & data analysis tools
- 3) Resilience and Adaptation framework & case studies
- 4) Effectiveness of Management for quality & flow issues

www.hutton.ac.uk/research/srp2016-21/wp12-water



1.2.1. Water and ecosystem functions



....an evidence base for processes and functions

⁶⁶ To what degree do nature based solutions reduce flood peaks, improve morphology, water quality and deliver ecological benefits across scales? ⁹⁹

How can we improve our understanding of
 biophysical and ecological processes in catchments for
 current and emerging pollutants?
 Correct or correct of the second second

1.2.2. Impacts of change on waters



....the models & data analysis tools to evaluate & predict change

- ** Can we characterise Scotland's present day water resources and existing trends in quality, quantity & ecology? **
- How might these pressures and their impacts change in the future? "



1.2.3. Water environment resilience & adaptation to change



....a framework and case studies for evaluating risk and resilience

⁶⁶ Can risk and resilience be evaluated in terms of set of multiple stressor factors interacting negatively & positively, respectively, on water ecosystems? ⁹⁹

⁶⁶ Can we improve the resilience of river ecosystems and drinking water sources to key stressors?
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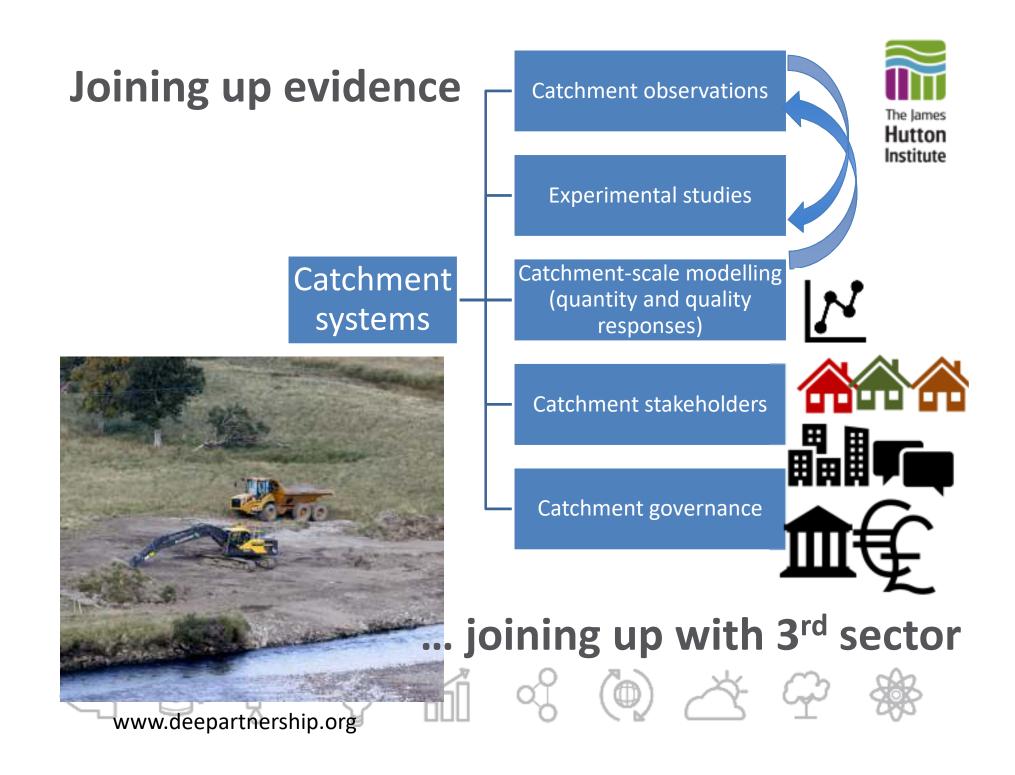


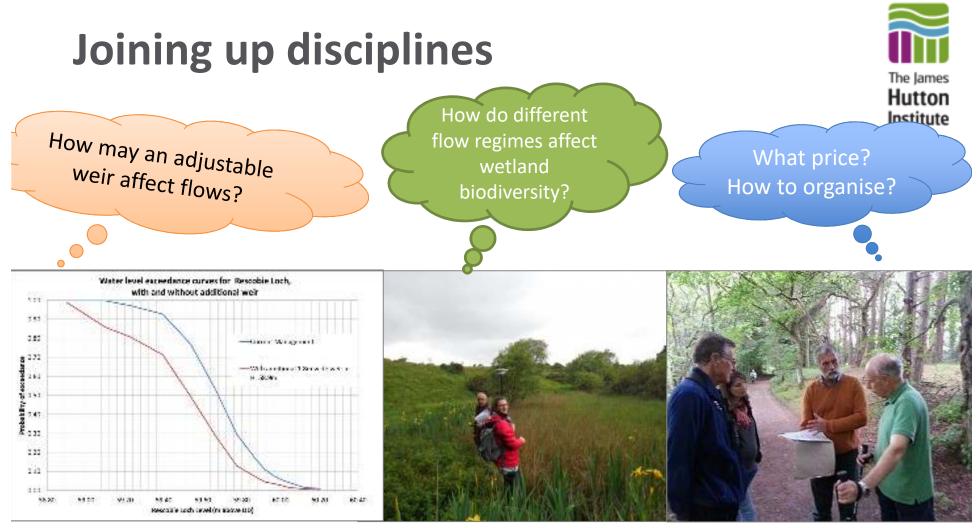
nstitute

....delivering effective measures better ...for water quality and extreme flows

- ⁶⁶ Can we learn from wider experiences of best practice and novel delivery mechanisms? ⁹⁹
- What governance and communication methods improve planning, selection and implementation of measures?

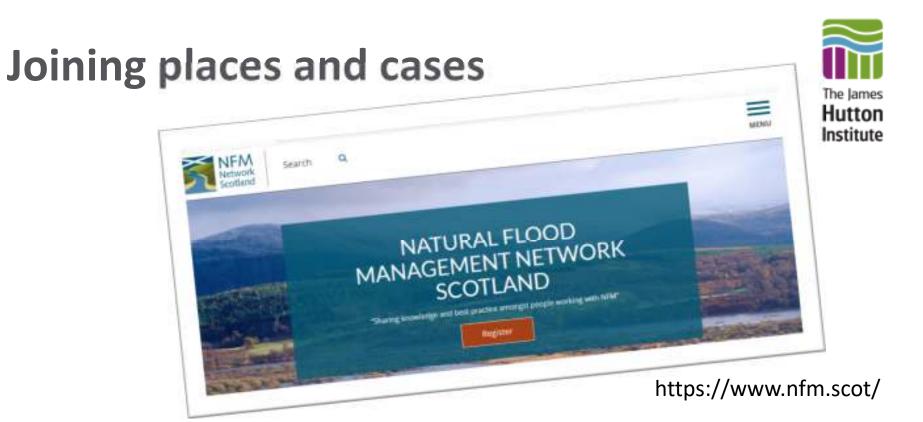






https://www.hutton.ac.uk/research/projects/payments-work-ecosystem-services-lessons

...joining up with local stakeholders 当 合 戸 ᇢ 前 ぷ () べ 空 錄



...joining up with policy stakeholders







Scottish Government funded partnership Hutton/Higher Education Institutes (HEIs)

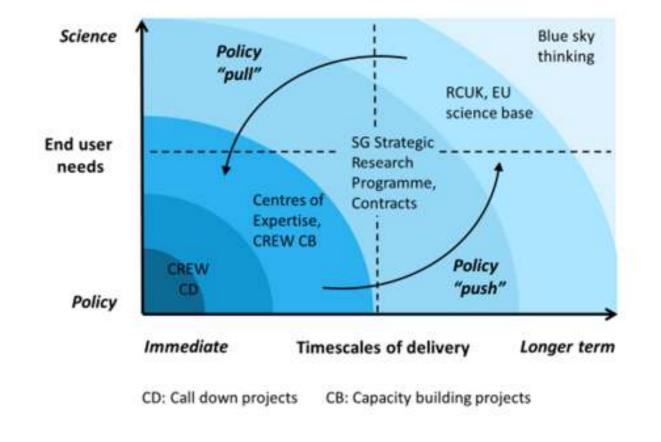




The research/policy landscape

L Q P





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CREW themes

There are four main theme areas for CREW projects:

- Sustainable Communities
- Water Quality
- Flooding and Coastal Erosion
- River Basin Management Plans

Each have theme steering groups representing our principal customers: Scottish Government, SEPA, DWQR, FSS, ZWS, SNH, Scottish Water.

Sustainable Rural Communities

- Rural communities face particular challenges for access to affordable energy, treatment and disposal of waste and drinking water supplies.
- The SRC concept aims to deliver a closed loop system that would be carbon and energy neutral, costeffective and resilient.
- The drivers for this theme include the Hydro Nation Strategy, Scottish Government, DWQR, and Scottish Water objectives and include crosscutting issues e.g. climate change.
- CREW is working with Scottish Government, Scottish Water, DWQR and SEPA.

Drinking Water

- Over 99% of public supplies for drinking water in Scotland complied with current standards.
- In private water supplies, serving 3% of the population, compliance is reduced to 88-94% in some areas.
- Drinking water quality standards in Scotland largely stem from the EU Drinking Water Directive and subsequent enabling legislation.
- CREW is working with Scottish Water and DWQR to address pressures and protect drinking water quality.

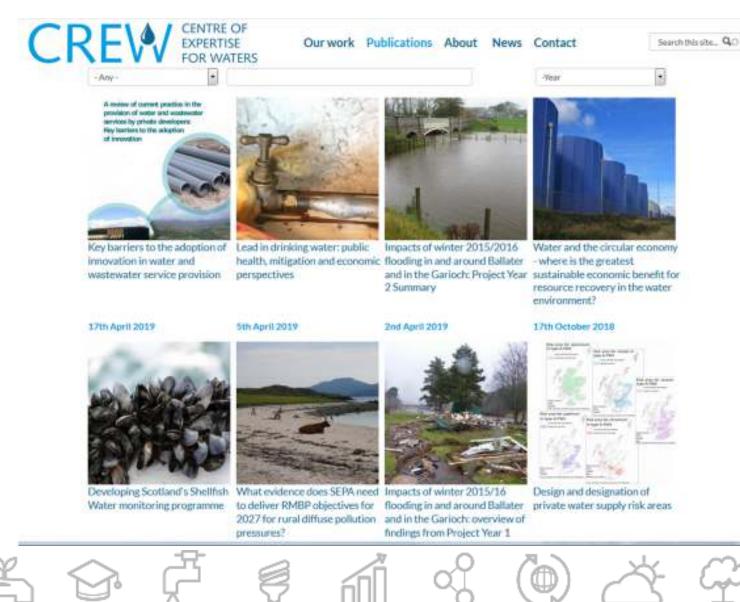
Flooding & Coastal Erosion

- In 2009, Scotland adopted the Flood Risk Management Act to introduce a more sustainable and modern approach to flood risk management, and to better face the impact of climate change.
- Recently, SEPA published their flood risk and hazard maps.
- The final stage is in producing national and local flood risk management plans.
- CREW is working with Scottish Government, SEPA and Scottish Water.

River Basin Management Planning

- River Basin Management Planning is a requirement of the Water Framework Directive which aims to protect and improve water quality across Europe.
- Implemented in Scotland via domestic legislation the overarching aim is to achieve 'good status' in 97% of water bodies by 2027.
- CREW is working with Scottish
 Government, SEPA, SNH and
 Scottish Water on river basin
 management planning challenges
 and opportunities.

CREW reporting







CREW Highlights

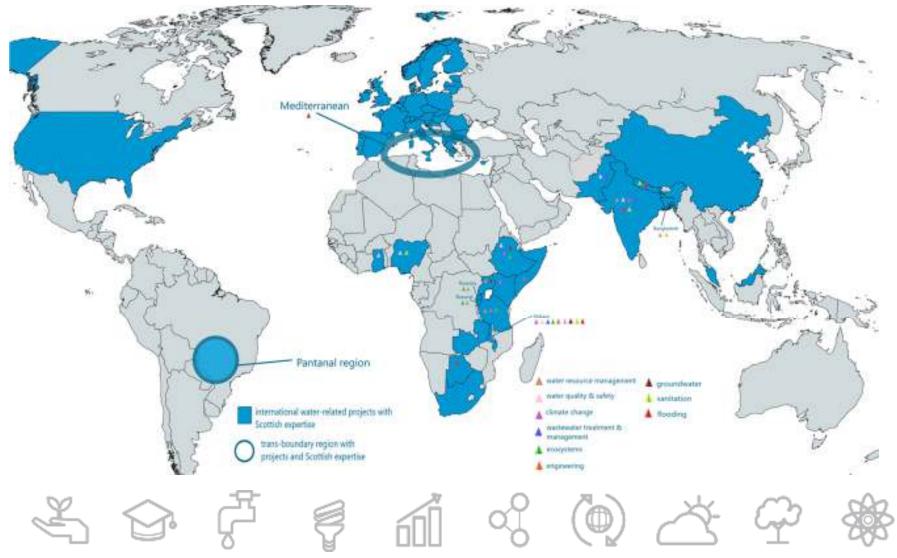






Scotland`s international water research activity





Key Goals of Hydro Nation International



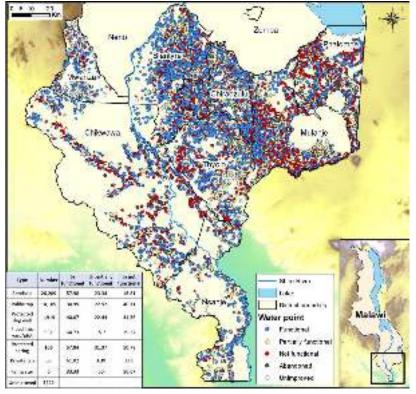
- 1. Realise/maximise Scotland's international water presence.
- 2. Provision of expertise to support the development and delivery of policy to International agendas.
- 3. Realign and refresh the UNESCO Centre as our international reporting portal and educational hub for Scotland's global ambitions.



Shared Learning between Scotland and Malawi

CJF PI: Prof Bob Kalin University of Strathclyde

- Integrated Water Resource Management Southern Malawi
- Climate Justice Fund (CJF) project
- Delivers to Sustainable Development Goal 6
- Support National Malawi Water Resources
 Policy through an integrated water resource
 management approach
- Capacity Building
- Reducing Poverty and Vulnerability

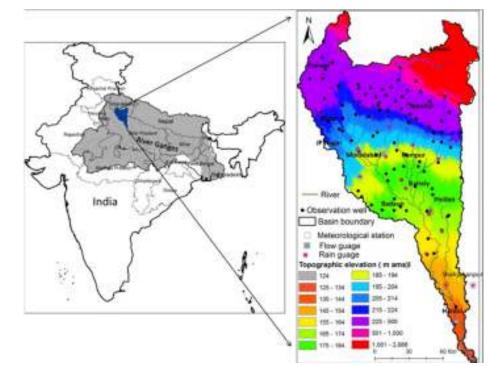




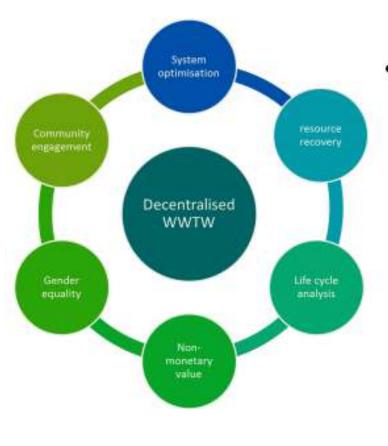


GANGA RIVER HEALTH PROJECT: INDIA

- Interdisciplinary project to inform decision-making in India to reduce impact of pollution on the Ramganga river, taking account of:
- Stakeholder views;
- Governance and financial realities.
- UK and Indian teams (led by Dundee and IIT Kanpur).
- Integration of ecosystem services, water quality and poverty mapping.
- Aligns with many SDG 6 targets.



DECENTRALISED MODULAR WASTE WATER TREATMENT PROJECT: INDIA



- Development of closed loop decentralised wastewater treatment plant at a school in Karnataka
- Addresses problems of:
 - lack of resources, especially in rural areas
 - Unregulated wastewater discharges
 - Risks to environmental quality and public health
 - Poor governance of sanitation services

Coordinated by JHI with input from Uni of Glasgow and Indian partners IISc & ATREE









The system

 Contains a number of established processes that are supplemented with a range of innovative approaches

Novelty and research impact

 Integration of the component parts and engagement with the local community at all stages of the project

Socio-economic assessment

- Adopted a co-creative, demand driven, and gender sensitive approach.
- Awareness of the various socio-cultural and economic factors that shape sanitation behaviours and change.

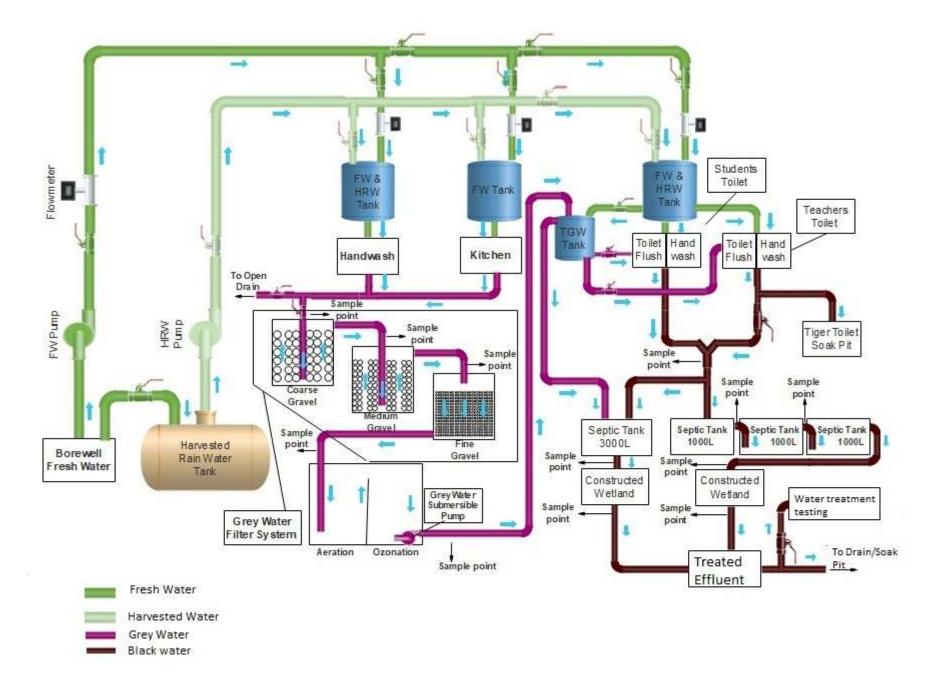


DECENTRALISED WASTE WATER TREATMENT SYSTEM

designed with the local community for a rural school in India



DECENTRALISED WASTE WATER TREATMENT SYSTEM



Research Questions



What is the potential for DWWT systems to deliver multiple benefits to rural communities and enhance rural resilience?

What novel theoretical and methodological tools might be used to enable more meaningful community engagement around the delivery of rural sanitation services?

How does a decentralised approach to wastewater treatment interact with regional and nationalscale sanitation policy and programmes?

Hydro Nation International Hub Objectives



- Consider wider collaborative opportunities for "Scotland plc" including how to optimise resource flow and to seek added value from these collective efforts.
 - Promote the development of the Science : Technology bridge approach and maximise potential
 - Evaluate/map the wider contribution of Scotland's research base in an international context supported by a range of funding opportunities
 - Network with key stakeholders and programmes
 - (e.g. UKCNIH, NMCG, IHP, India-UK Water Centre, UK Water Partnership)
- Develop a communication/dissemination strategy to raise the profile of international activities in target countries.
- Assist in the coordination of International events
 - E.g Stockholm/Singapore/Holland International Water Week







Sands Expo & Convention Centre, Marina Bay Sands, Singapore



The Hydro Nation Family





A new exciting opportunity through Hydro Nation



- 300 academics working in the water sector in Scotland (CREW) and delivering to both the domestic and international objectives of sustainable Development Goal 6.
- We aim to broaden the offering of the Category II centre to UNESCO by <u>including all of the activities delivered by the</u> <u>Higher Education Institutes</u>.



Enhancing Scotland's capacity



- Develop "Associateship" of the UNESCO Centre for leading water Scottish experts;
- Work with others (particularly Hydro National International and CREW) to ensure a collegiate approach to Scottish level reporting to SDG through UNESCO;
- Establish a Scottish post graduate water "college" open to all water related PhDs in HEIs and Institutes to enhance the broader understanding of Hydro Nation (this will be complementary to our flagship Hydro Nation Scholars Programme) and the development of a global water alumni.

H2020 and ERC – Success at The James Hutton Institute

| 2015/16 | 2016/17 | 2017/18 | 2018/19 to date |
|-----------|---------|-----------|-----------------|
| SHUFFLE | RELOCAL | AGRILINK | UNISECO |
| GOODBERRY | GROW | TRUE | SMARTEES |
| PROVIDE | PLAID | SoLACE | PathEVome |
| AQUASPACE | G2P-SOL | TomRes | |
| SENSOILS | MAGIC | RELATE | |
| SIMRA | | NEFERTITI | |
| SALSA | | NEWBIE | |
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Other EU collaborations







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H2020 MAGIC



"Moving Towards Adaptive Governance in Complexity:

Informing Nexus Security" = MAGIC



www.magic-nexus.eu





What is MAGIC?



- How do EU policies & innovations shape the management of socio-ecological systems?
- In terms of 'Water-Energy-Food Nexus'
 = WEF nexus
- Runs 2016-2020: check <u>www.magic-nexus.eu</u>

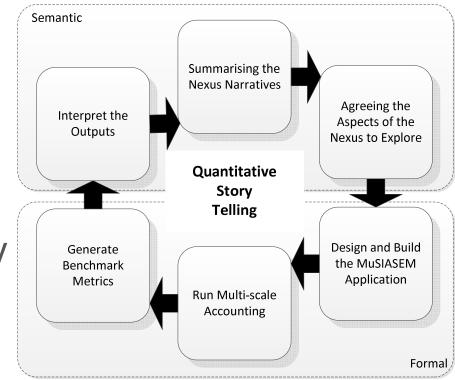


How does MAGIC do this?



- Uses 'Quantitative Story-Telling'
 - Stories or narratives about situation, problems and solutions
 → qualitative 'grammar' of issues to present
 - formal representations and indicators
 → quantitative 'syntax'

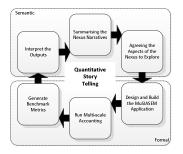
 Mixes disciplinary skills to elicit & quantitatively represent stories



How does MAGIC do this?



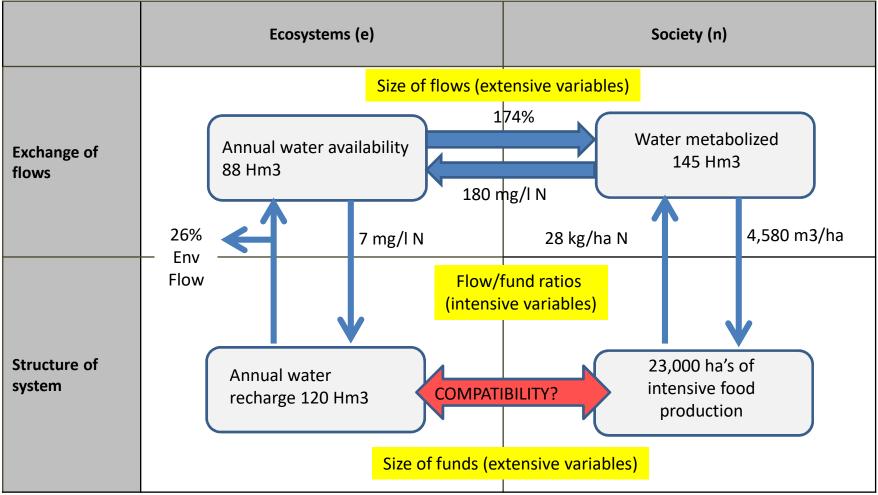
- Focus on case studies
 - 5 sets of EU policies
 - WFD, Natura2000, Energy Strategy, Circular Economy Strategy & Common Agricultural Policy
 - 5 innovation case-studies
 - i.e. Fracking, GMOs, Bio-fuels, Desalinisation and PES
- How?
 - Talk to policy makers and analyse policy docs
 - Analyse issues and themes
 - Discuss new perspectives on existing ideas





How does MAGIC do this?

Considers ecosystems and society together



Example from El Egido (Almeria, Spain)



Example

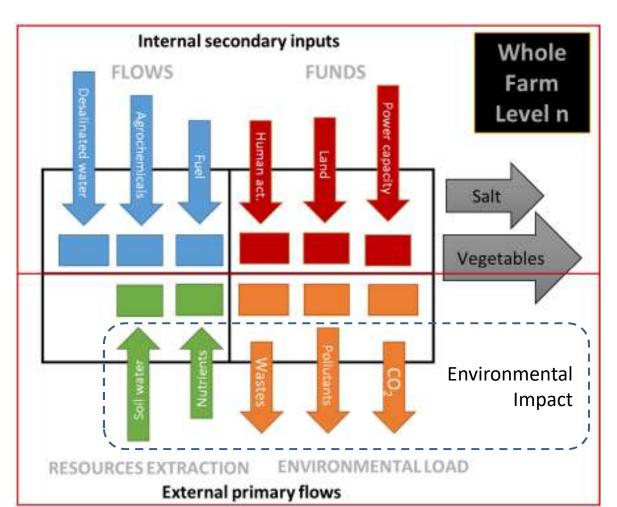


- Quantitative 'societal metabolism' analysis focuses on the flows of human, biophysical resources entering and leaving a system
- Considered for a particular system...
 (e.g. tomato farm in Canary Islands)
- ...and across systems
 (e.g. across all farm types)
 - \rightarrow helps to build 'nexus' perspective



Example – a 'processor'

- Combines funds & flows to show consumption patterns
- Scalable
 - Aggregate
 - Disaggregate
 - Inputs to macroprocesses
- Linkable...





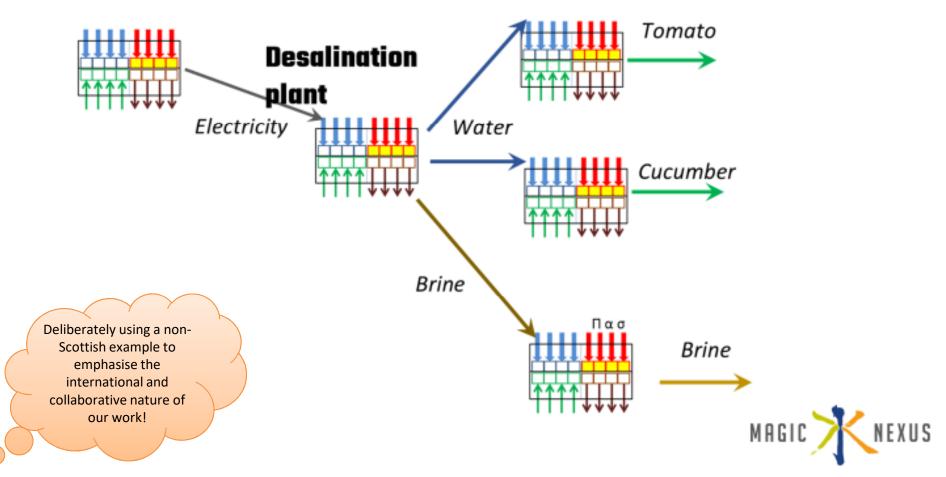
Example - Relational analysis

Representation of the system of interest

Wind farm



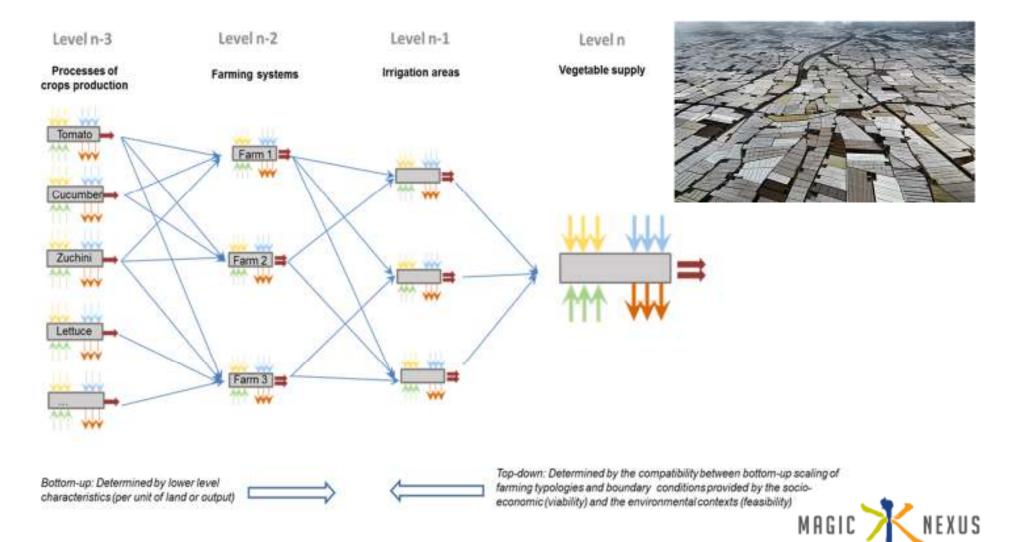
Connecting 'processors' in sequential metabolic pathways



Crops production

Example - Analysis across scales

Non-equivalent perspectives

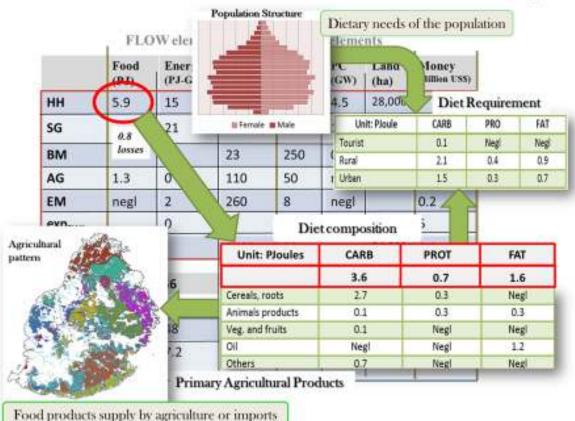




Example – Discussing & reflecting



- Reflect on system performance
- Long-term
 Feasibility what is possible within biophysical limits
- Viability what is possible with current technical and institutional arrangements
- Desirability what are societal limits and preferences (e.g. distributional, ethical outcomes)





MAGIC conclusions



Insights

- Good for modellers to build on policy
- Need to account for external impacts e.g. water footprint of EU agriculture
- Need to change 'silo thinking'
- Challenges
 - Hard to process and present information
 - Uncomfortable reflections are our current policies and initiatives fit to address sustainability challenges?





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The MAGIC-NEXUS Project

Finding new ways to tackle complex policy issues at the nexus between abd food resources

http://magic-nexus.eu/

https://www.facebook.com/MagicNexusEu/



Joint Research Centre





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Yale University External Partner

University of Twente

The Berboriands



#MAGIC_NEX



Joined up approach



- Different connections mutually supportive
 - Disciplines
 - Water-Energy-Food
 - Places & cases
 - Science, policy & other stakeholders
- Challenging but worthwhile
 - Societally-engaged relevant science
 - Helps prompt reflection and achieve change





Thanks to Scotland Europa

Richard.Allan@Hutton.ac.uk Kerry.Waylen@Hutton.ac.uk

More information at:

www.crew.ac.uk www.hutton.ac.uk @H2oHutton
@KerryWaylen
@ScotlandEuropa









