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The ERAMMP Integrated Modelling Platform (IMP) Overview for SFS Stakeholders Meeting

28th July 2021

Professor Paula Harrison

UK Centre for Ecology & Hydrology

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Llywodraeth Cymru Welsh Government

Canolfan Ecoleg a Hydroleg y DU
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The complexity of environmental challenges

MULTIPLE DRIVERS

COMPLEX INTERACTIONS

- Between Drivers
- Between Sectors
- Across Space

COMPLEX CHALLENGES … AND OPPORTUNITIES

- How to incentivise change?
- How to maximise synergies …
- … and avoid unexpected trade offs!

Scenario and modelling platforms

Scenarios: Combine consistent changes in multiple drivers to portray a range of plausible futures for a region.

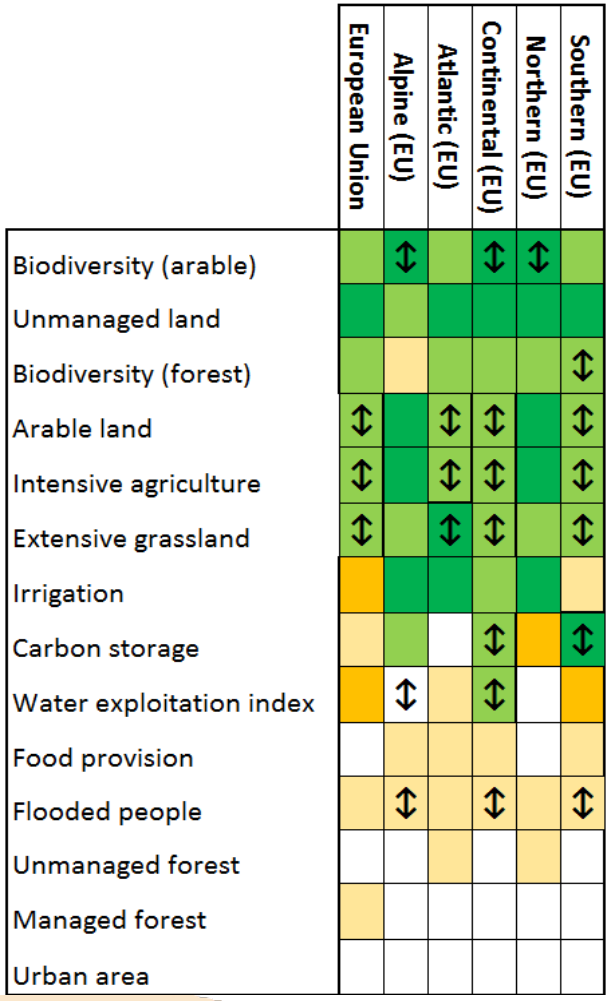
Models: Simulate consequences of scenarios and enable exploration of the effectiveness of policy options and management strategies.

Integrated Modelling Approaches:

- Single sector models may misrepresent the **direction, magnitude and spatial pattern** of impacts because they omit the complex interdependencies within human-environmental systems.
- Integrated models **build understanding of these interdependencies** and allow exploration of responses that are robust to multiple uncertain futures and avoid unintended trade-offs.

Benefits of integrated cross-sectoral modelling

Differences between single sector and integrated models by regions within the EU:



Change > 100%	
Change > 50%	
Change > 25%	
Change > 5%	
Change < 5%	

↕ Direction of change differs between single sector and integrated models

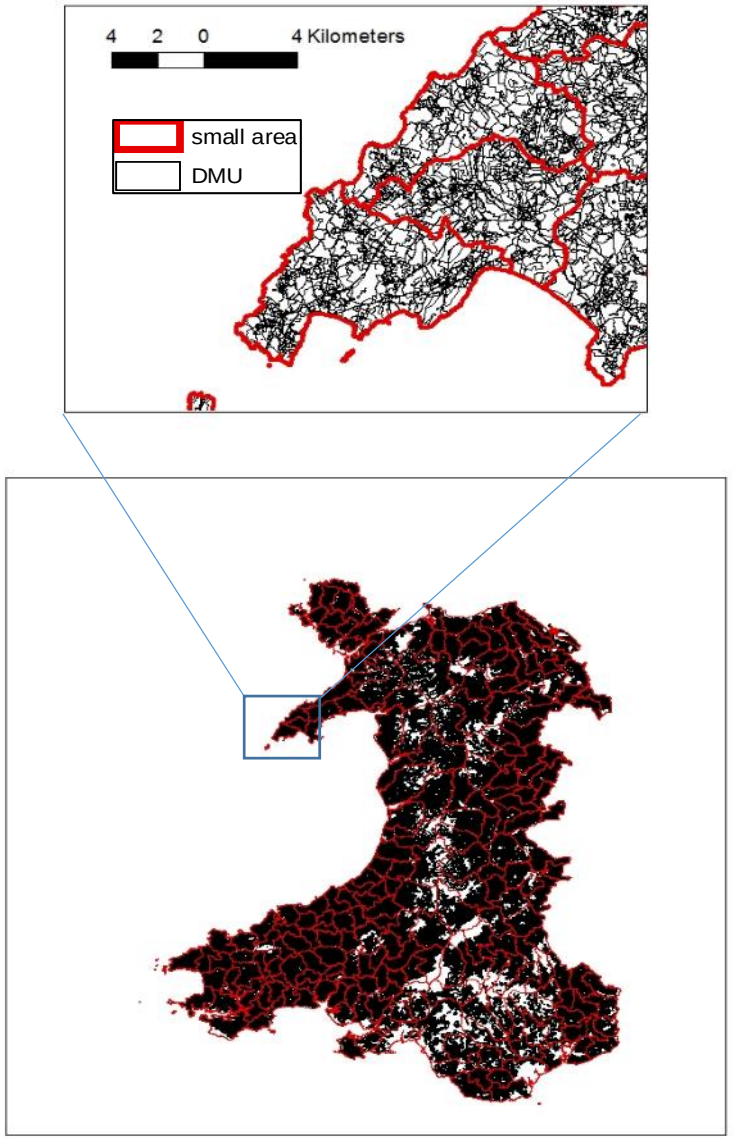
Harrison et al. (2016). Climate change impact modelling needs to include cross-sectoral interactions. *Nature Climate Change*, 6(9): 885-890.

What is the ERAMMP IMP?

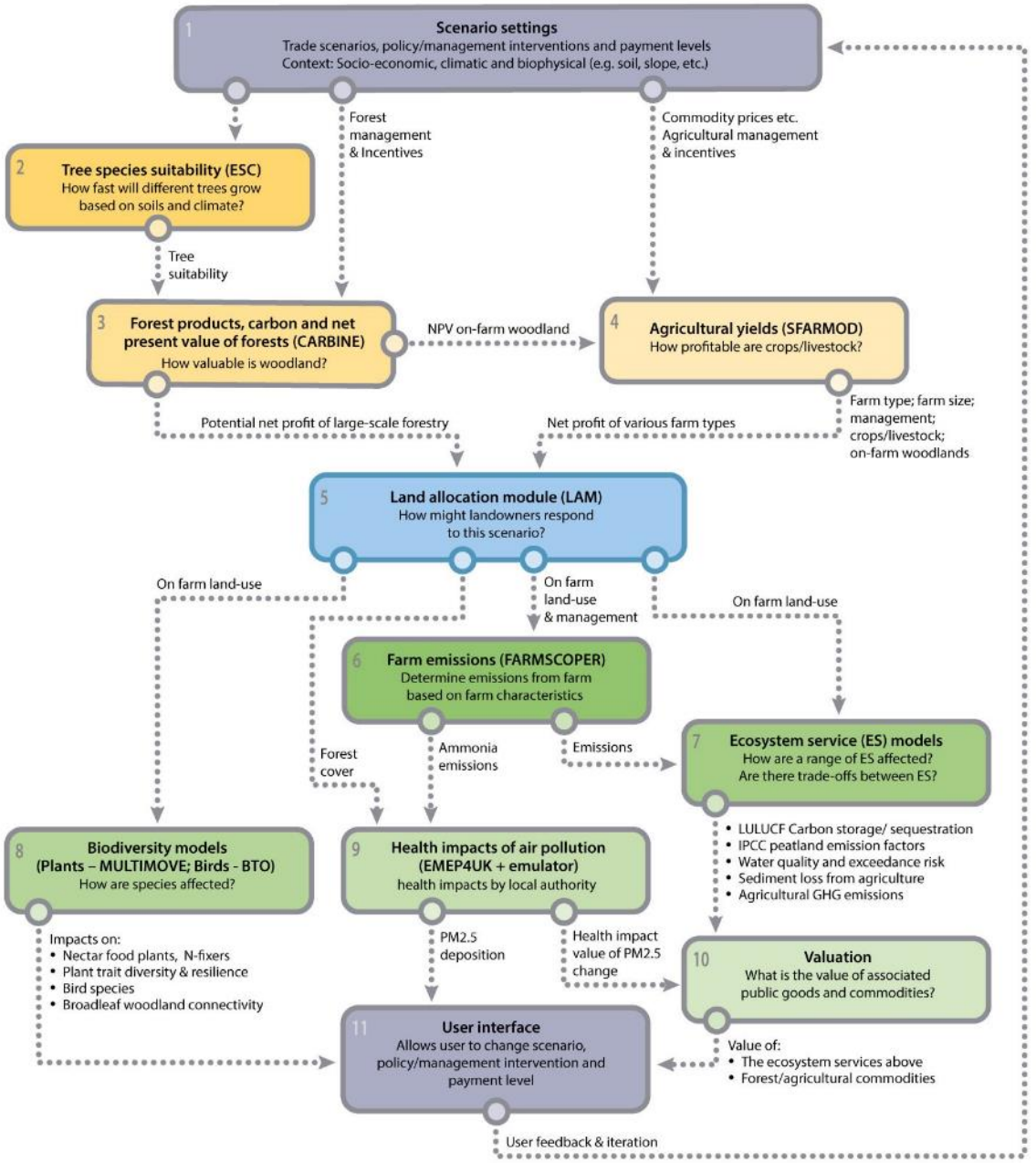
- A tool for rapid exploration of the effects of policy and management interventions on farm viability, land use and public goods in Wales.
- It takes an integrated approach, recognising that policy effects in one sector have indirect effects in other sectors.
- It comprises a chain of specialised, state-of-the-art models covering agriculture, forestry, land use allocation decisions, water, air, soils, biodiversity, ecosystem services and valuation.
- User specified interventions and model outputs are aligned where possible to support and inform policy development:
    - Post EU Exit trade deals
    - Implications of the Sustainable Farming Scheme (Ongoing)

What is the ERAMMP IMP?

- **It is highly spatially resolved:**
  - The IMP operates at various spatial resolutions depending on what scale is most appropriate for the indicator being simulated.
  - The finest spatial resolution is used for simulating farm type and land use transitions is the Decision-Making Unit (DMU).
  - A DMU is sub-farm (often field-scale) defined as a managerially homogenous cluster of soil type, rainfall and land cover.

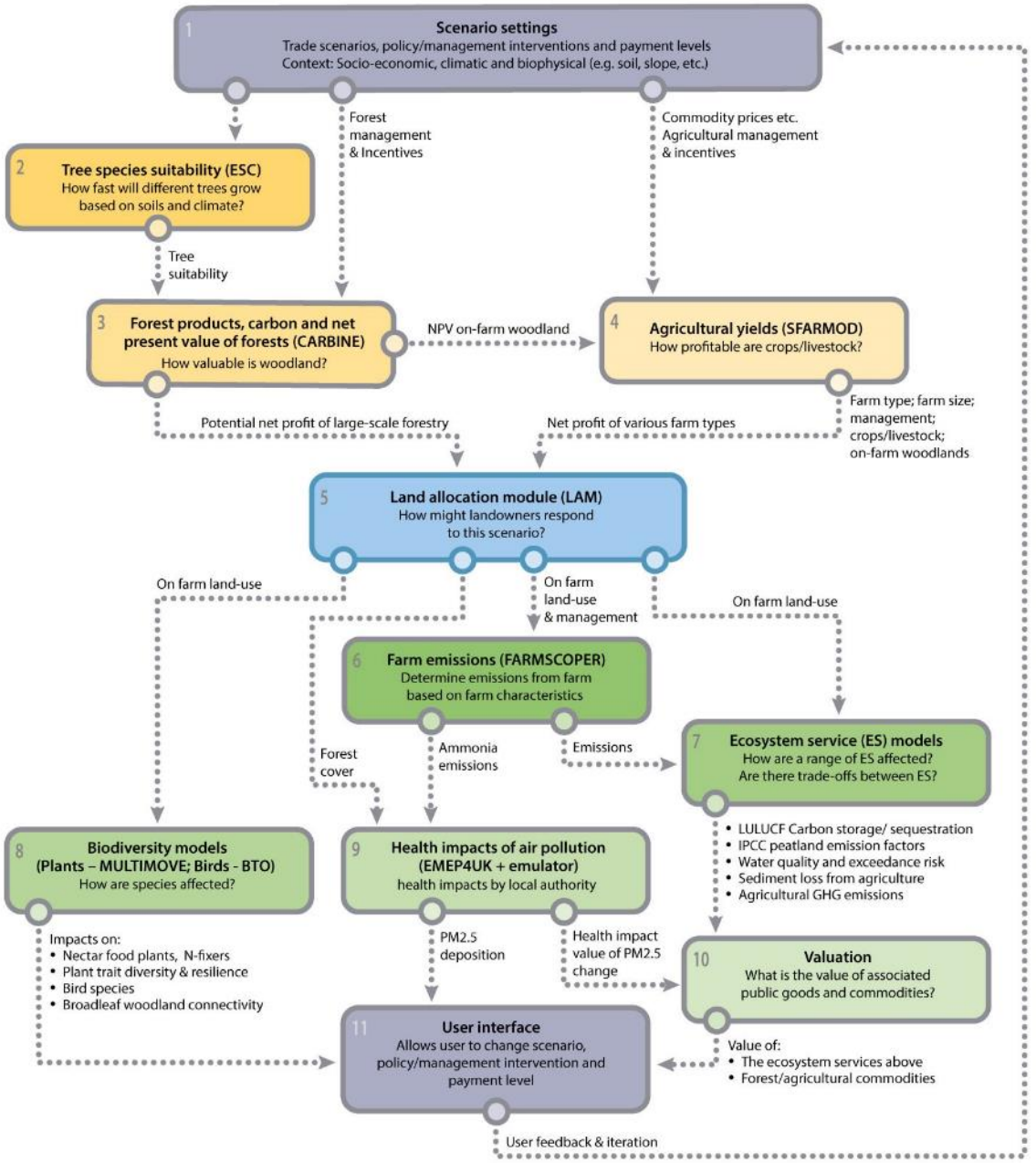


IMP schematic



- Scenario settings co-created with Welsh Government
- Over 10 linked models
- Each model is run for multiple scenario settings to build up a data cube
- Data is passed between models to represent interdependencies between sectors
- Interface to present/access data

IMP schematic



Scenario settings co-created with Welsh Government

Top of modelling chain:

- Simulates land use and land management change

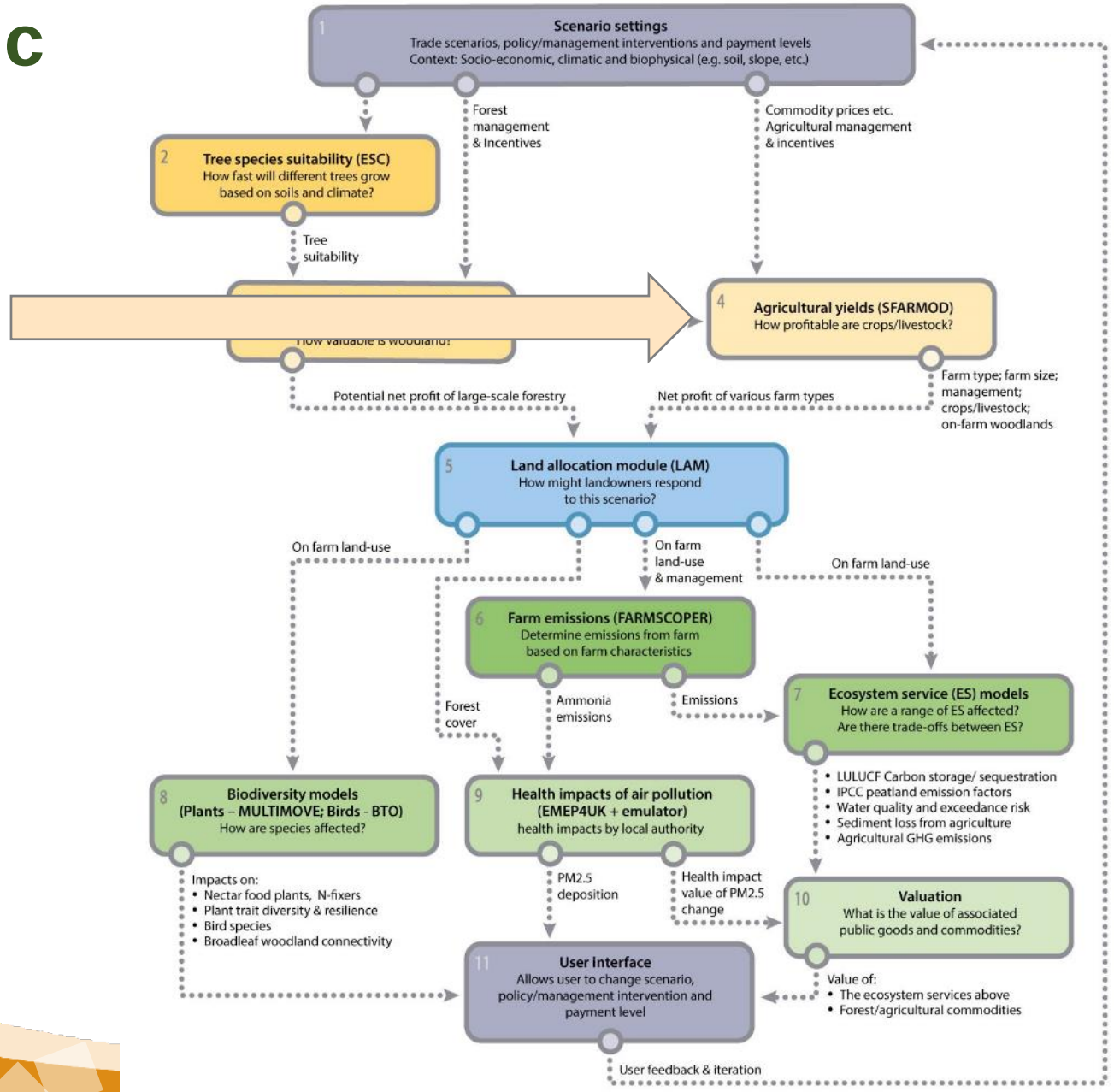
Bottom of modelling chain:

- Simulates consequences of land use and land management change on biodiversity and ecosystem services

IMP schematic

Farm-scale model:

- Decisions based on profitability (considering climate, soils, management and incentives)



Scenario settings co-created with Welsh Government

Top of modelling chain:

- Simulates land use and land management change

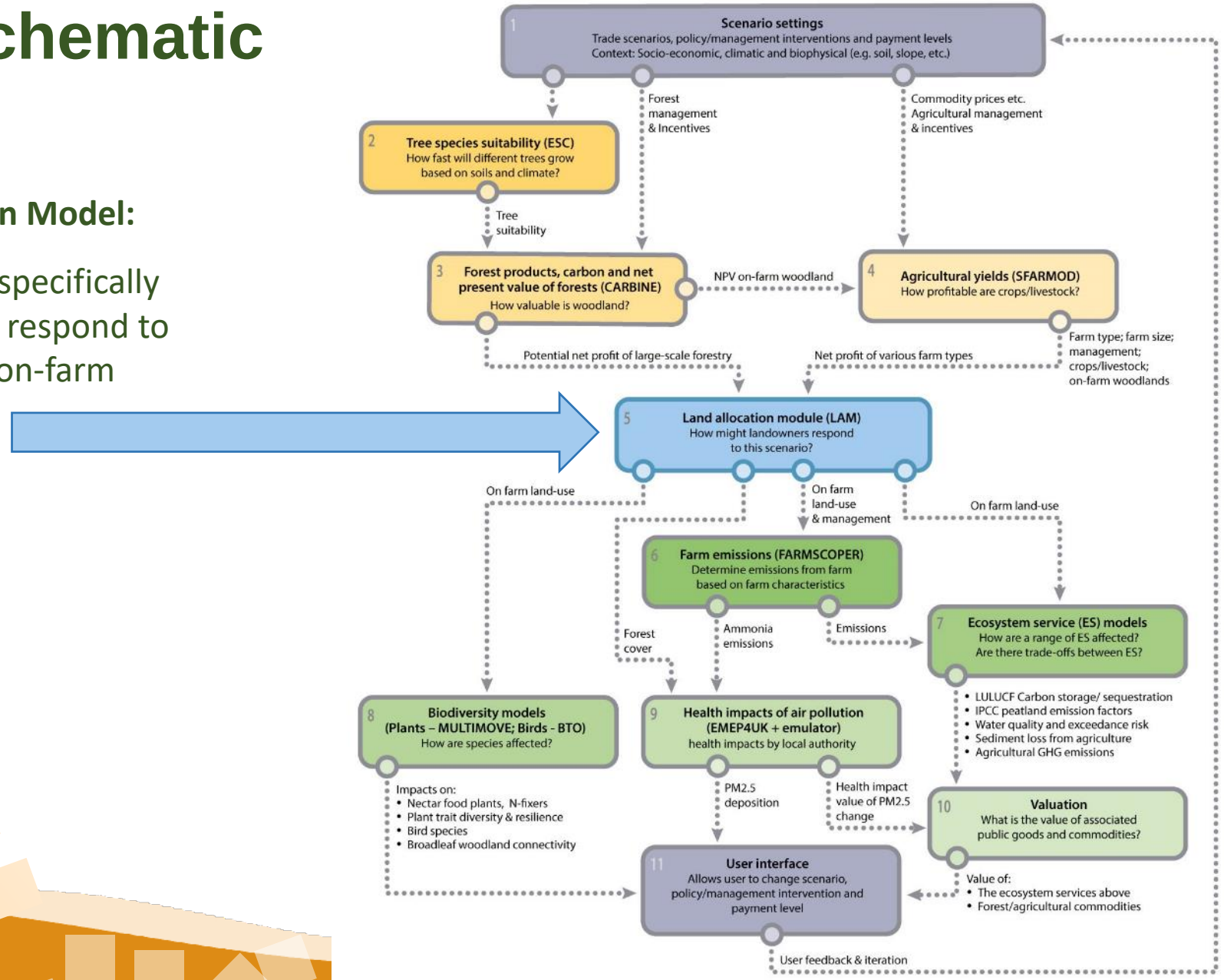
Bottom of modelling chain:

- Simulates consequences of land use and land management change on biodiversity and ecosystem services

IMP schematic

Land Allocation Model:

- Developed specifically with WG to respond to changes in on-farm income



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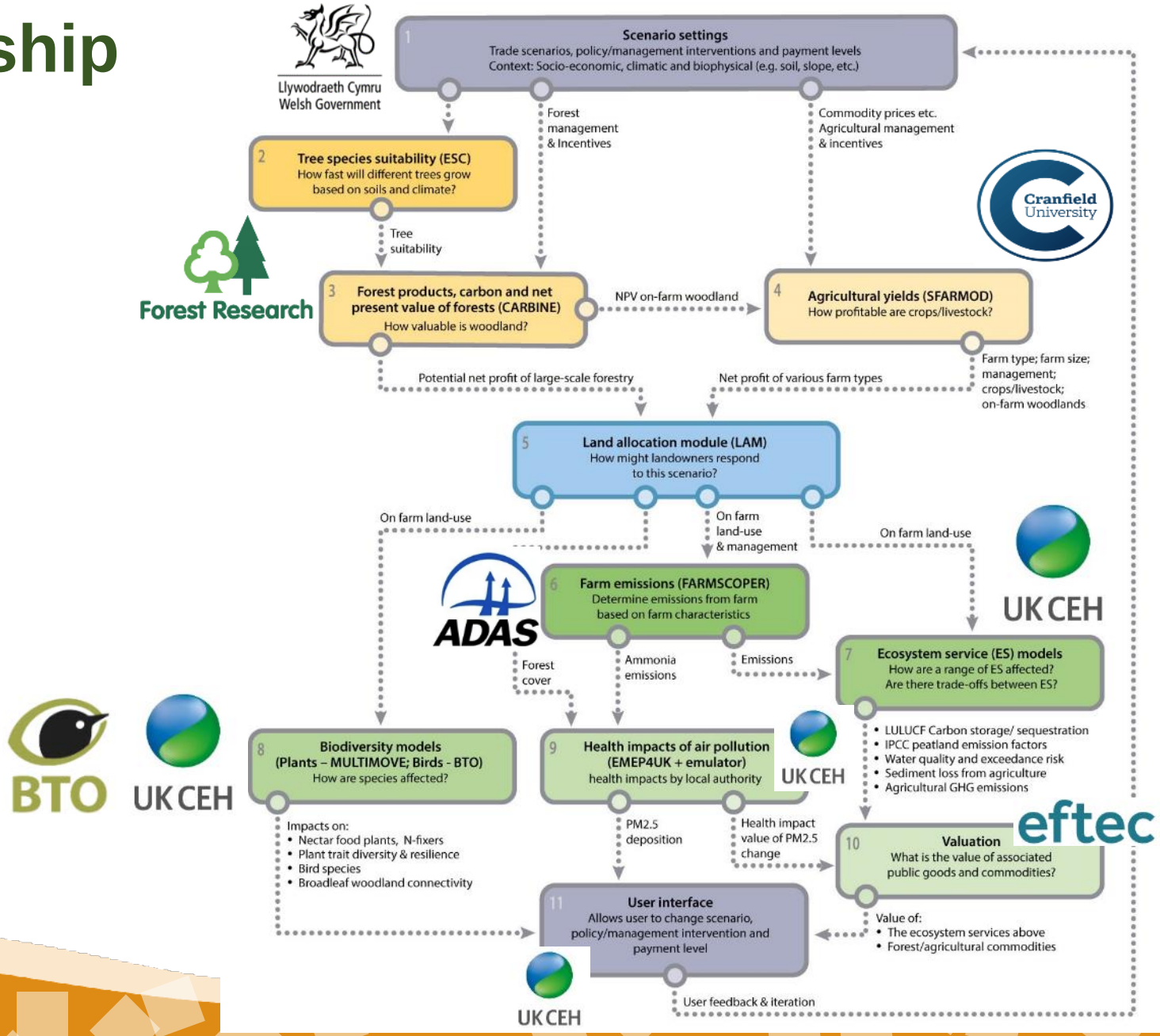
A partnership approach



Aqua Book Compliance

RIGOUR:

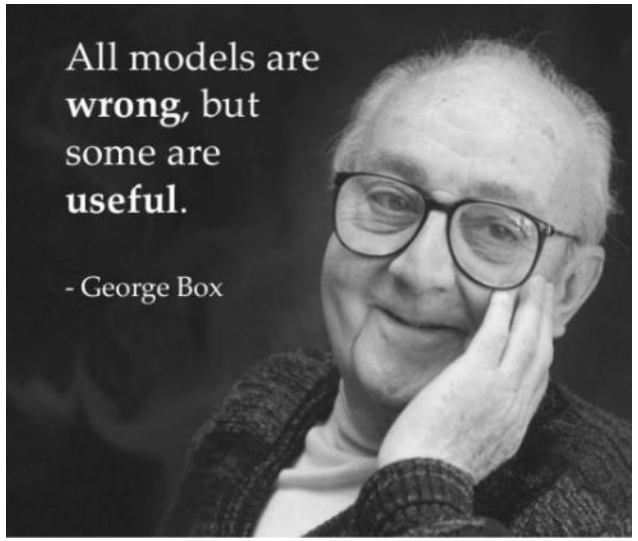
- **R**epeatable**:** Same inputs/ constraints → same outputs.
- **I**ndependent: Free of prejudice or bias.
- **G**rounded in reality**:** Connections made between the analysis and its real-world consequences.
- **O**bjective: Effective engagement and suitable challenge reduces potential bias.
- **U**ncertainty-managed: Uncertainties identified, managed and communicated.
- **R**obust: Result provided in the context of residual uncertainty and limitations in order to ensure it is used appropriately.

- **Assumptions detailed and agreed**
- **QA performed and documented**
- **Uncertainties explored**

IMP limitations and assumptions (examples)

Models are a simplification of reality, but they can provide useful insight when used for a particular purpose … all models have limitations and make simplifying assumptions, e.g.

- The IMP is applied to only ‘full-time farms’ (> 1 FTE labour).
- Changes in land use are driven by on-farm economics and land suitability. They do not take into account skills or cultural and behaviour responses.
- As a simplification, the biodiversity and ecosystem service models in the IMP assume that a farm that comes under economic pressure will leave agriculture in the short-term, with the land undergoing natural regeneration or being afforested.



ERAMMP IMP outputs

- Outputs are **both graphical and spatial** and have been provided to WG as **annotated slide packs.**

- Slide notes contain an assessment of how the results can be interpreted including any **uncertainties**, **limits to knowledge** and implications of **assumptions** made within the modelling.

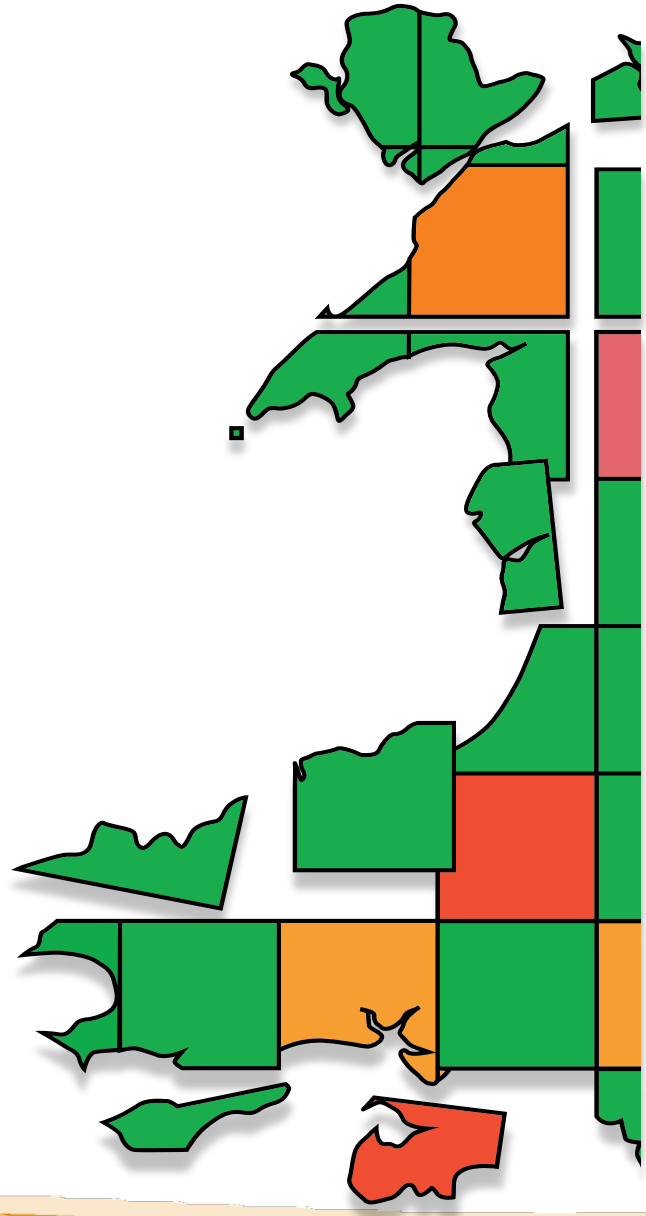
Iterative exploration of SFS bundles

- The IMP is being adapted to model some potential components of the SFS starting with:
  - Habitat management bundle
  - Woodland and hedgerow creation bundle
  - Land/nutrient management bundle
- Highly exploratory and iterative process -> learning from 1st phase will inform additional runs
- Inputs: range of payment levels associated with changes in management practices
- Outputs:
  - Cost and uptake of the scheme components for different payment levels
  - Environmental and economic outcomes for full-time farms, biodiversity and public goods, including public good values for carbon, water quality and air quality.

ERAMMP IMP: Summary

- The IMP provides a new **policy-relevant, integrated modelling tool** that can provide scientific evidence to inform rapidly evolving policies across sectors.
- Particularly important to its development and its application to the SFS are:
  - **Co-design** through a long-term partnership between WG and the IMP team;
  - **Transparency** of the model and its assumptions (following Aqua book);
  - **Iterative approach:** builds trust and understanding in the results;
  - **Flexible:** can be adapted quickly to changing WG needs;
  - **Timely:** model runs delivered at a pace that is able to inform quickly evolving policy needs.
- The IMP is able to rapidly explore costs, benefits and impacts of scheme components, but this work is still in progress and will continue to be iterated with WG.

Diolch yn fawr iawn



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