JHI-C3-1 Land Use Transformations: Resilience and Adaptation Framework

Mike Rivington, Mohamed Jabloun, Emmanuel Udugbezi

End of Year 4 Project meeting, Saughton House 21st April 2026

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Scottish Government
Riaghaltas na h-Alba

Context: Land Use Transformations for Net Zero and Multi-functional landscapes

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- *"Understanding the degree to which landscapes are multi-functional and their resilience at field, business, landscape and regional scales, and how applicable are management or technological changes to enhance resilience and the degree of adaptation that could be required in Scotland by indirect consequences of changes in agri-food systems".*
- *"Multifunctional landscapes are typically characterized by diversified land use and complex landscape structure, thereby potentially covering many, often competing interests of different stakeholder groups*

Adapting and growing resilience to what?

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Climate change impacts interacting with:

- Environment – economy – policy – behaviour changes

Resilience or *Resistance*?

- Resilience through adaptation and mitigation… or Resistance to change to maintain Business as Usual
- Need for stability during a transition
- Risk Perception: understanding threats and our willingness to change

What will farmers need to prepare for?

- **Some good growing seasons**
- **More severe extremes** but also good conditions for agriculture.
- Heavier precipitation, more intense storms
- Longer, hotter heatwaves and droughts
- ***"Two bad years in a row, do something different"***
- Global: impacts elsewhere, food security, price spikes and food inflation risks.
- **Key issue: water availability**

What will farmers need to prepare for?

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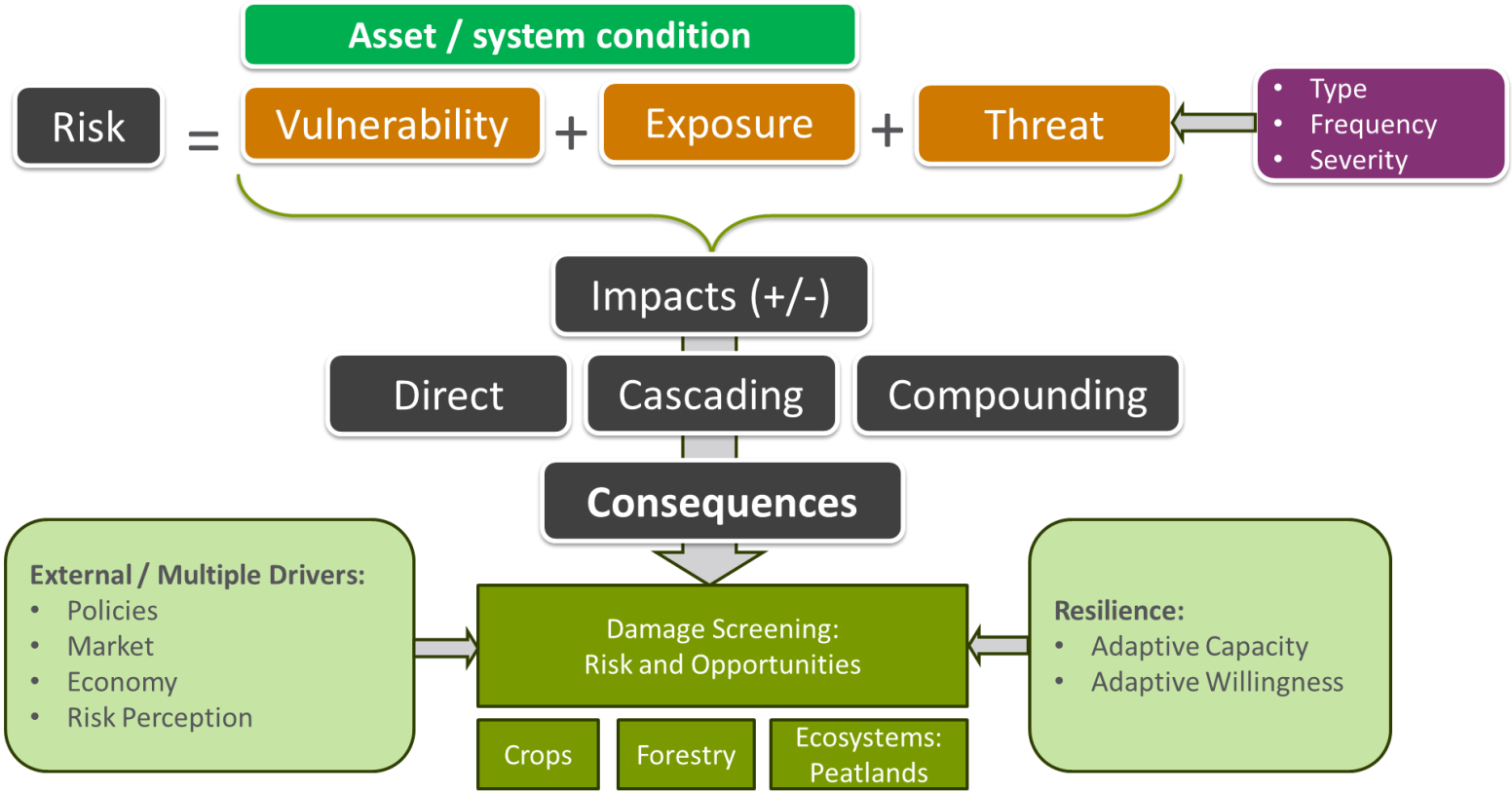
Practical challenges:

- Workability issues due to waterlogged soils
- Drier soils in spring, summer and autumn
- Opportunities for irrigation and drainage management.
- Storm damage: wind, flooding and erosion


Credit; Richard Dorrell


Credit; Shutterstock

Damage Screening



Crops example: Barley and spring drought

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Risk: Low spring barley yield

Vulnerability: Sensitivity to spring drought
Exposure: Wide spatial distribution, including soils with low surface horizon water holding capacity
Threat: Prolonged hot dry period from seedling emergence

Two years in a row

Impacts (Direct):
- Reduced leaf area
- Reduced tillering
- Impeded biomass accumulation

Impacts (Cascading):
- Yield reduction
- Below malting quality
- Farmer stress

Impacts (Compounding):
- Reduced multi-year revenue to farmer
- Farm business viability
- Shortage of malting quality barley

Consequences: Possible shift away from barley in Vulnerable and exposed locations; Intensification elsewhere

Drivers:
- High fertiliser price
- Heavy previous winter rain flushing nutrients from soils

Damage Screening:
- Maps of where Risk and Impacts are most likely
- Effects on supply chain
- Opportunities to reduce Vulnerability

Resilience:
- Integrated water management
- Financial support

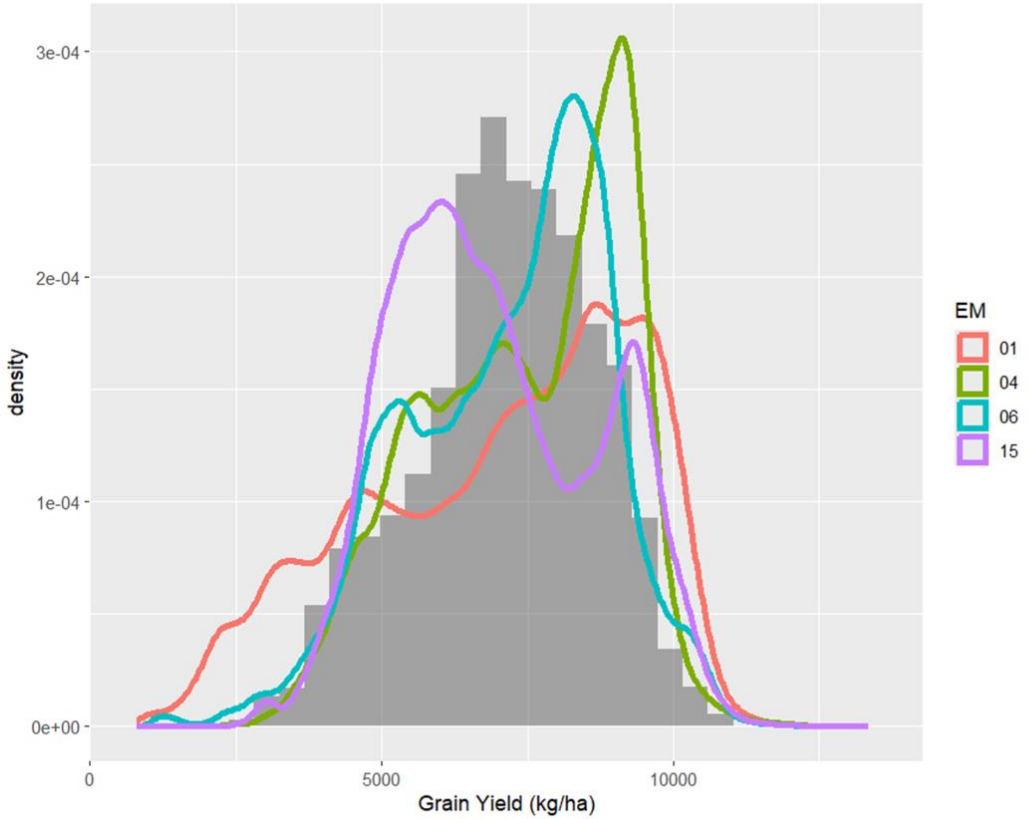
Spring barley yield variation per climate projection

Spring Barley Yield

Scotland

Baseline period: 2010-2019

Future period: 2045-2054



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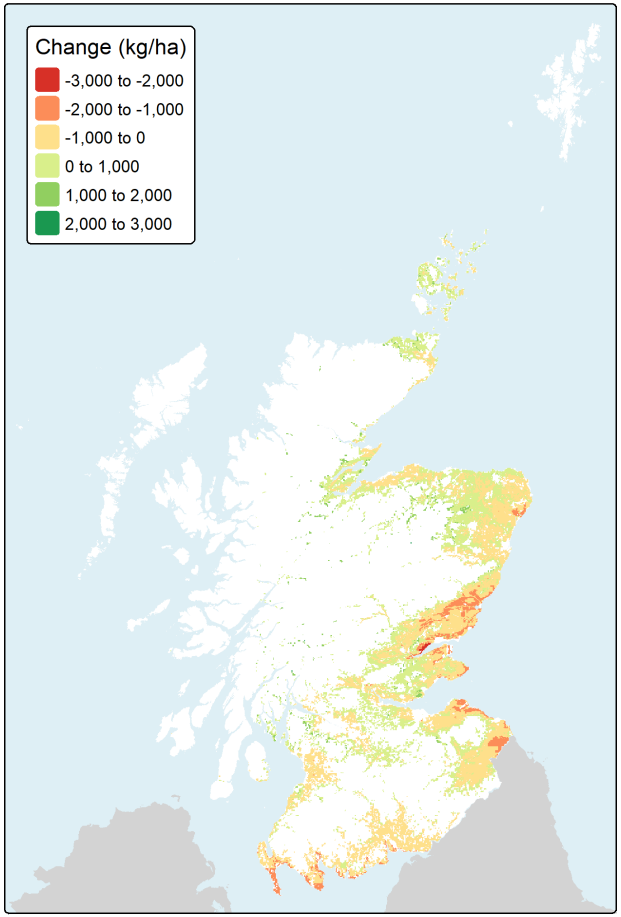
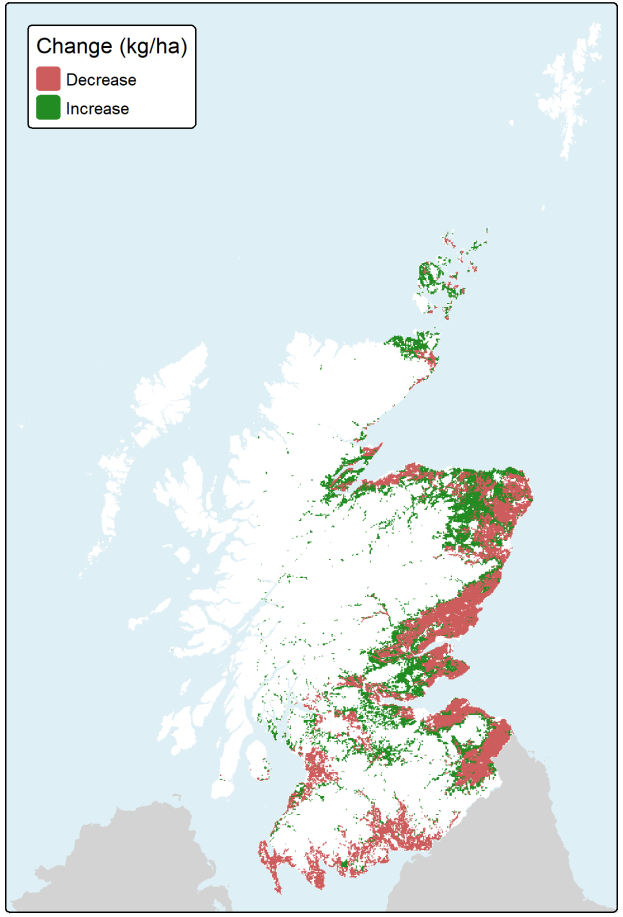
Grain Yield Change for Ensemble Member 01



Grain Yield Change for Ensemble Member 01



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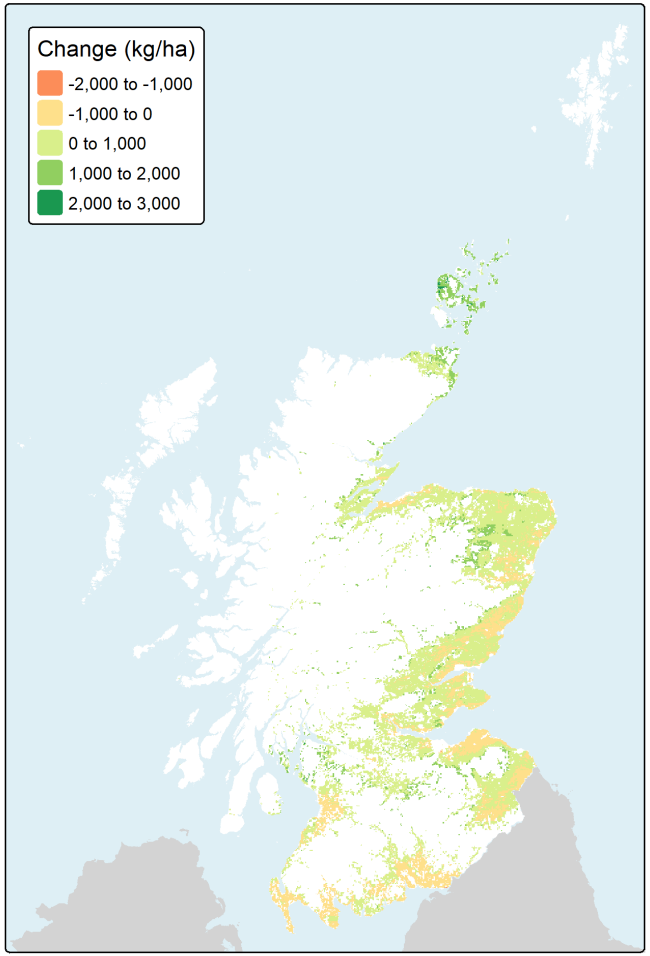
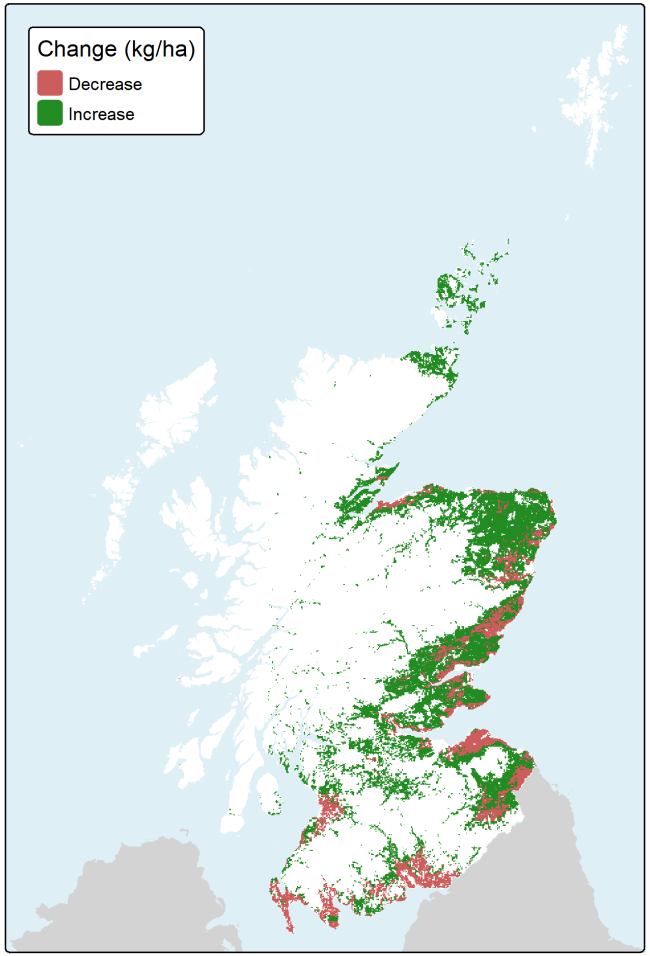
Spring Barley yield response to climate change (EM1)

Grain Yield Change for Ensemble Member 04



Grain Yield Change for Ensemble Member 04



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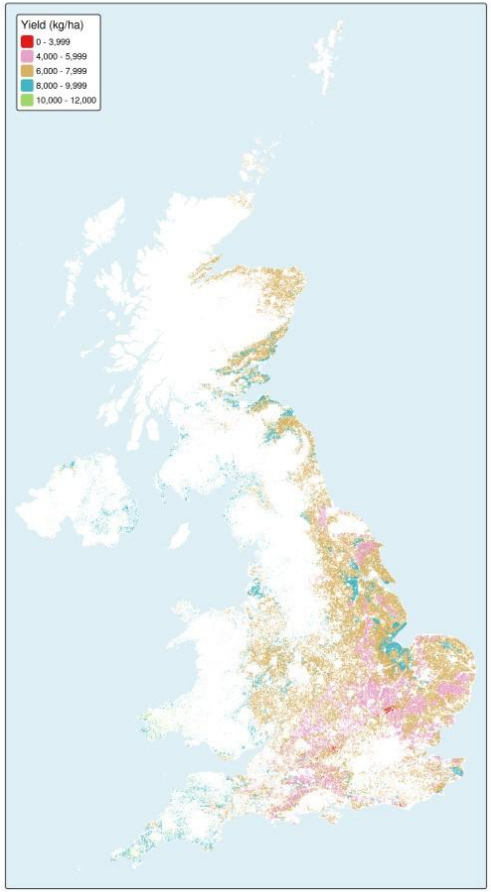
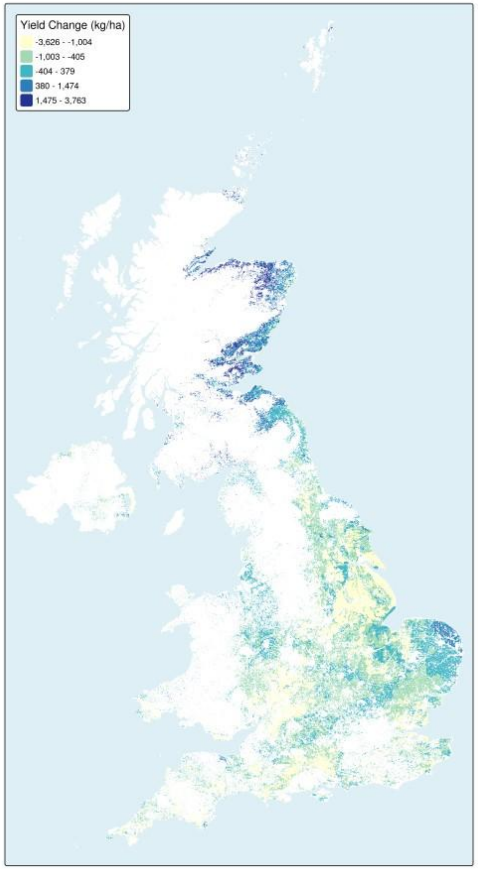
Spring Barley yield response to climate change (EM4)

Spring Barley: change in yield

Grain Yield for the Baseline: 2010-2019



Grain Yield Change between 2045-2054 and the Baseline: 2010-2019
Ensemble Member: 01



Grain Yield Change Direction between 2045-2054 and the Baseline: 2010-2019
Ensemble Member: 01

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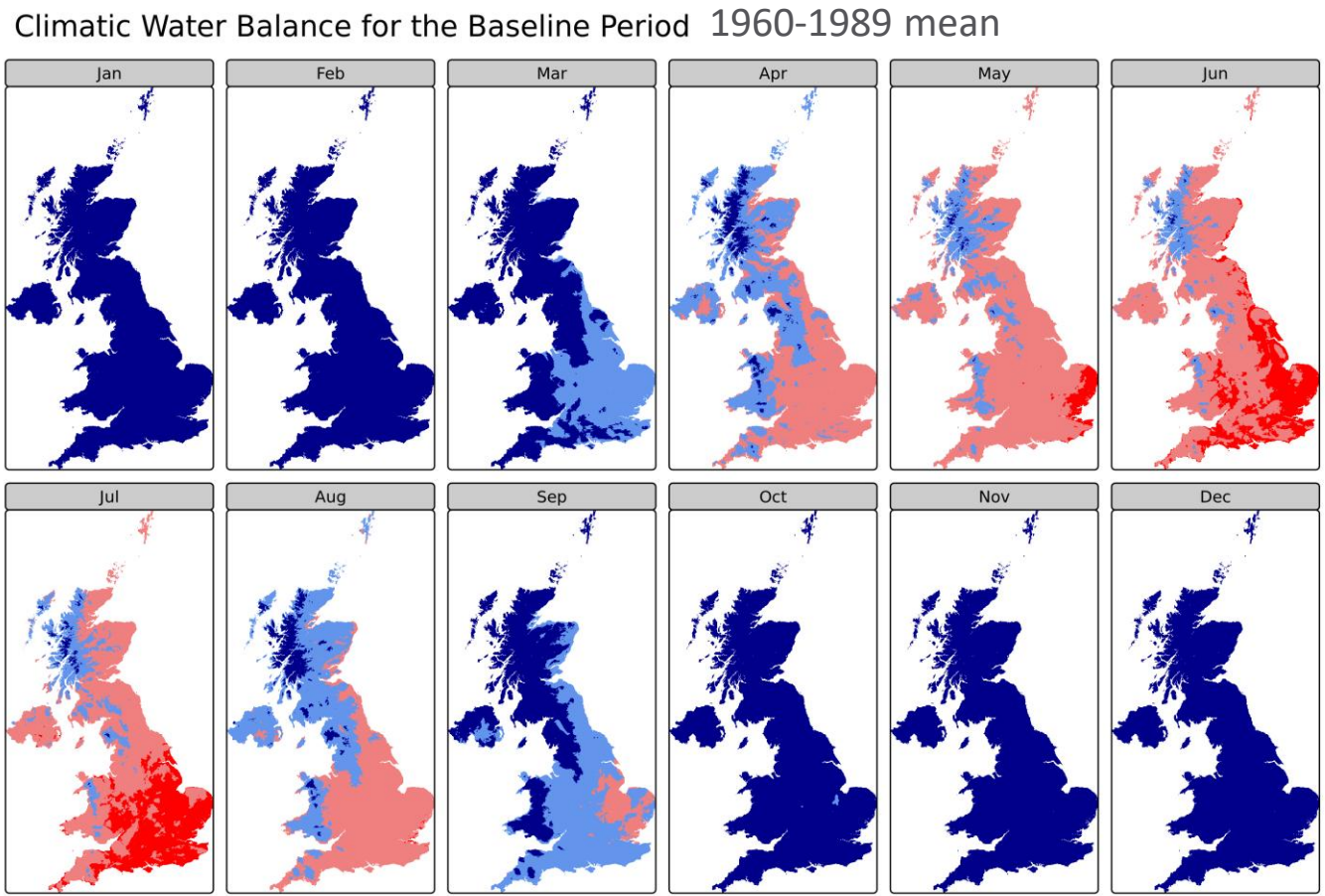
Changes in meteorological water availability



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Climatic Water Balance Ratio ($CWB\ ratio$ = **(**P / $ET0$ **)** ratio of Precipitation (P) to Evapotranspiration (ET0).

Strong Deficit; precipitation covers only 50% or less of ET0 demand.

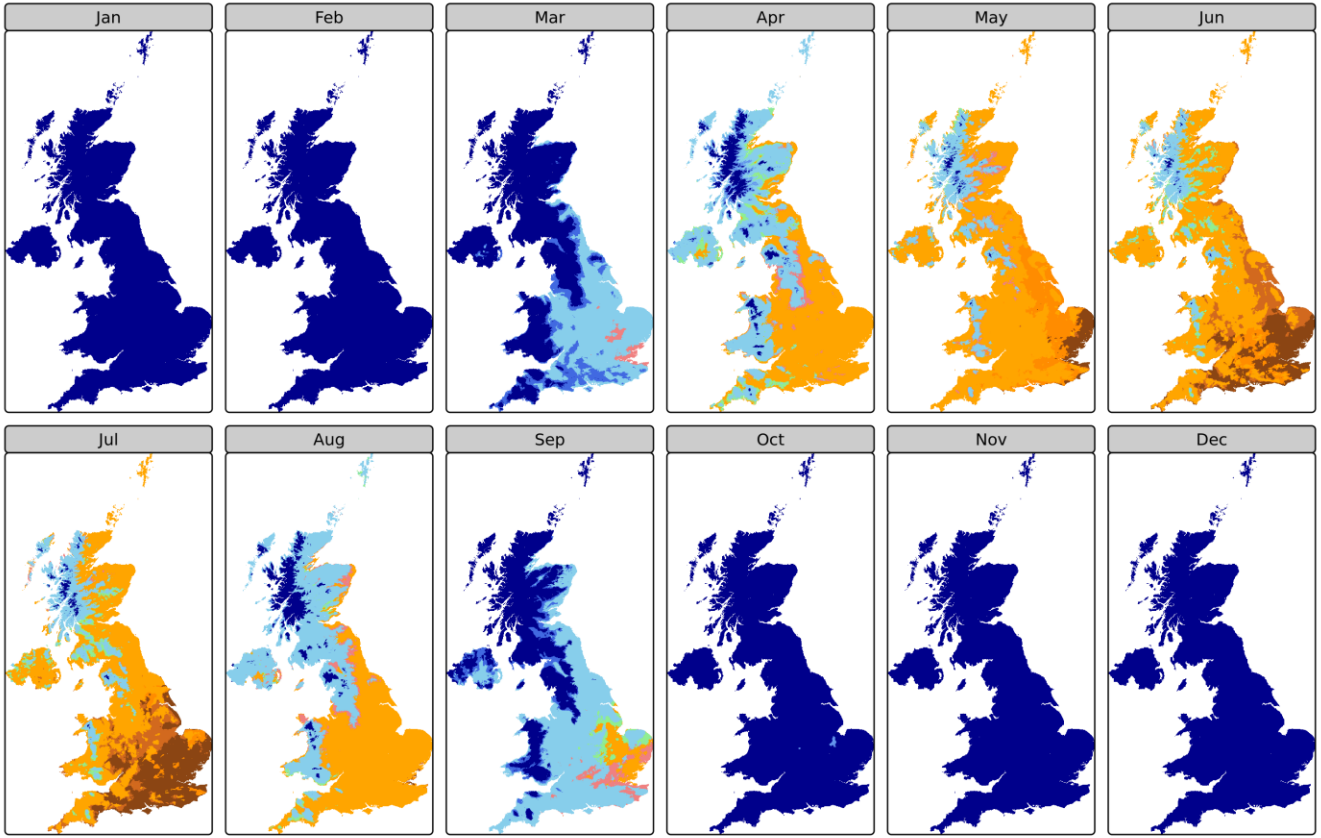
Moderate Deficit; precipitation covers 50 to 100% of the ET0 demand.

Moderate Surplus; precipitation is 0 to 50% greater than the evapotranspiration demand.

Strong Surplus; where precipitation is 100% or more greater than the ET0 demand.

Changes in mean meteorological water availability: baseline to 1990-2019

Climatic Water Balance Change for the Period 1990-2019 compared to 1960-1989 baseline



Water Balance Change

▲ SURPLUS TO DEFICIT ▼
- Strong Surplus → Strong Deficit
- Strong Surplus → Moderate Deficit
- Moderate Surplus → Strong Deficit
- Moderate Surplus → Moderate Deficit

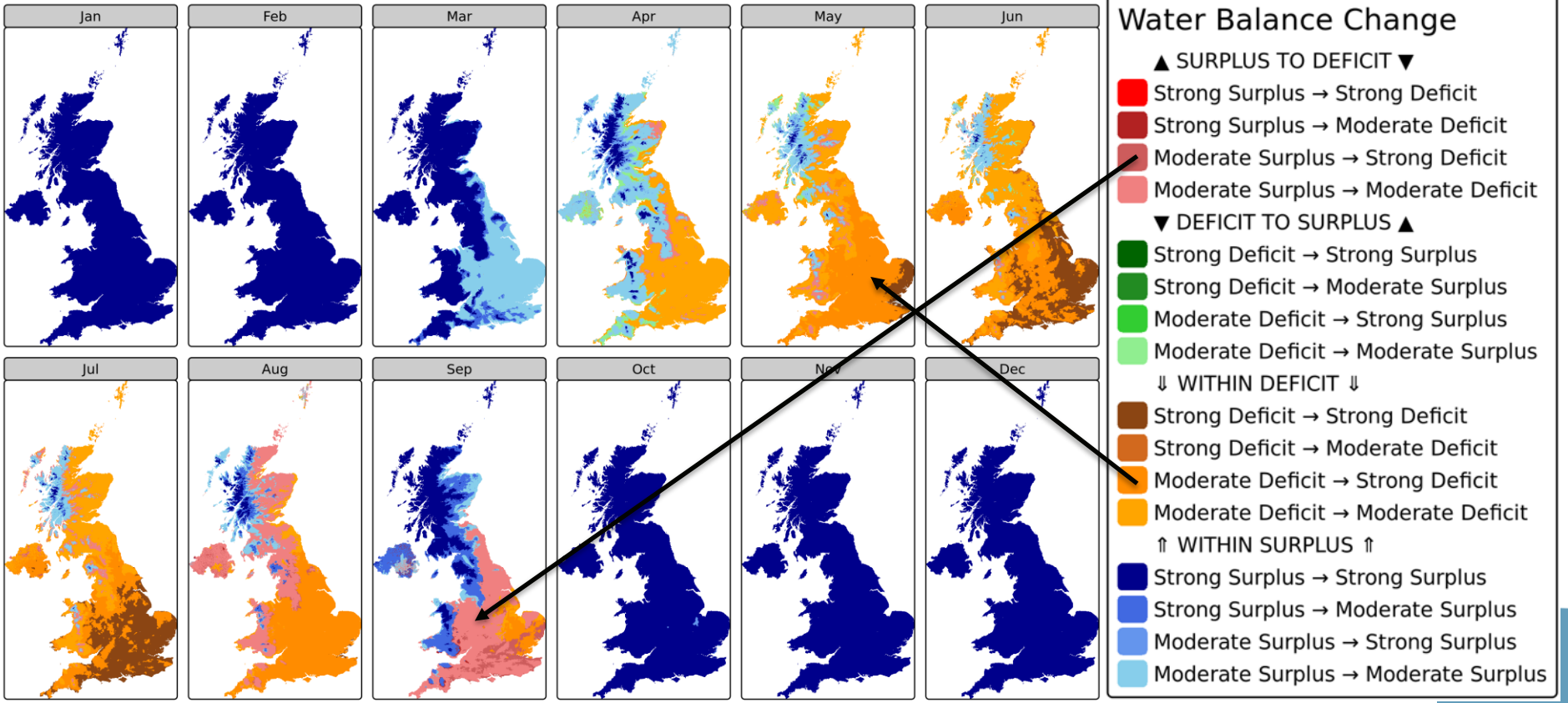
▼ DEFICIT TO SURPLUS ▲
- Strong Deficit → Strong Surplus
- Strong Deficit → Moderate Surplus
- Moderate Deficit → Strong Surplus
- Moderate Deficit → Moderate Surplus

⇓ WITHIN DEFICIT ⇓
- Strong Deficit → Strong Deficit
- Strong Deficit → Moderate Deficit
- Moderate Deficit → Strong Deficit
- Moderate Deficit → Moderate Deficit

⇑ WITHIN SURPLUS ⇑
- Strong Surplus → Strong Surplus
- Strong Surplus → Moderate Surplus
- Moderate Surplus → Strong Surplus
- Moderate Surplus → Moderate Surplus

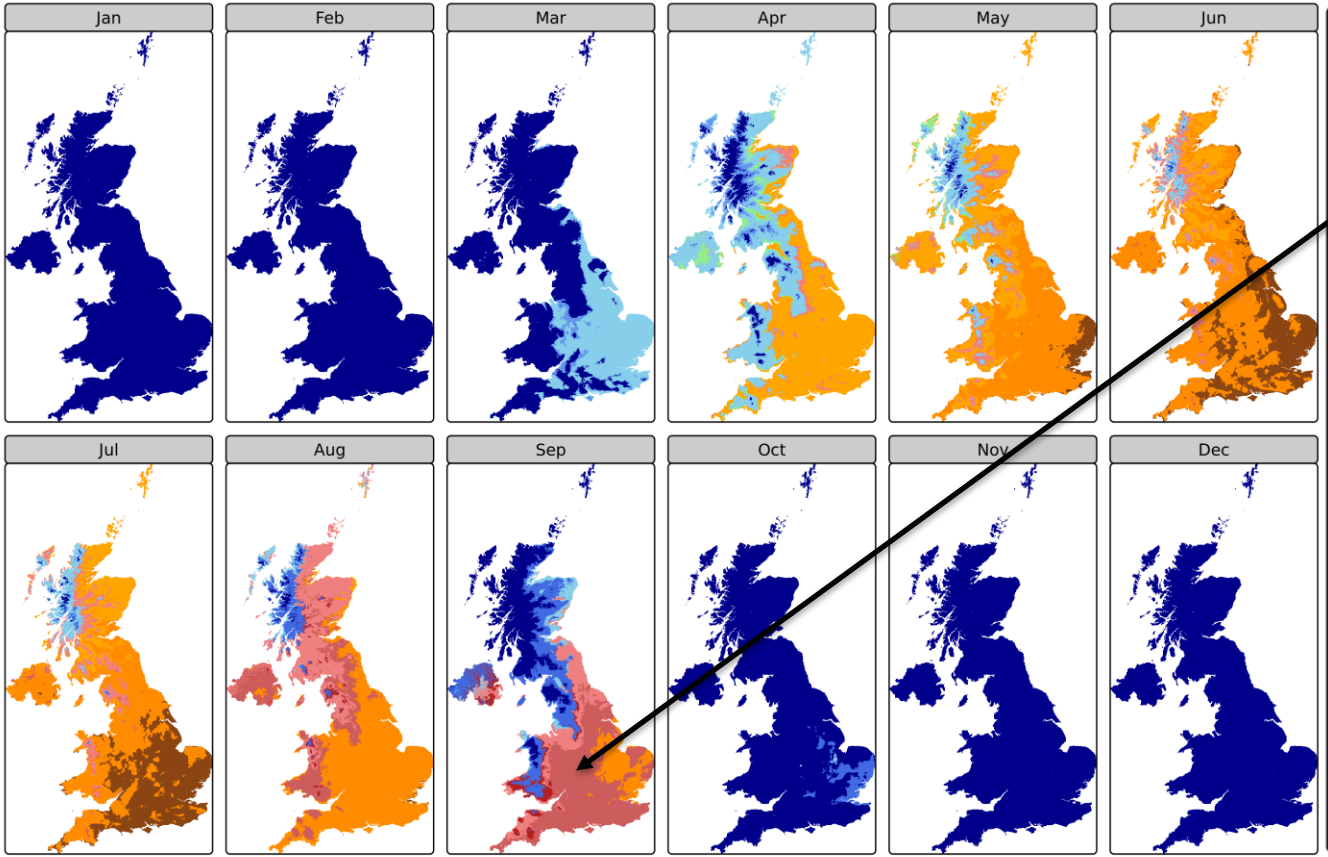
Changes in mean meteorological water availability: baseline to 2020-2049

Climatic Water Balance Change for the Period 2020-2049 - Ensemble Member 06 (2°C warmer, 2% wetter)



Changes in meteorological water availability: baseline to 2050-2079

Climatic Water Balance Change for the Period 2050-2079 - Ensemble Member 06 (2°C warmer, 2% wetter)



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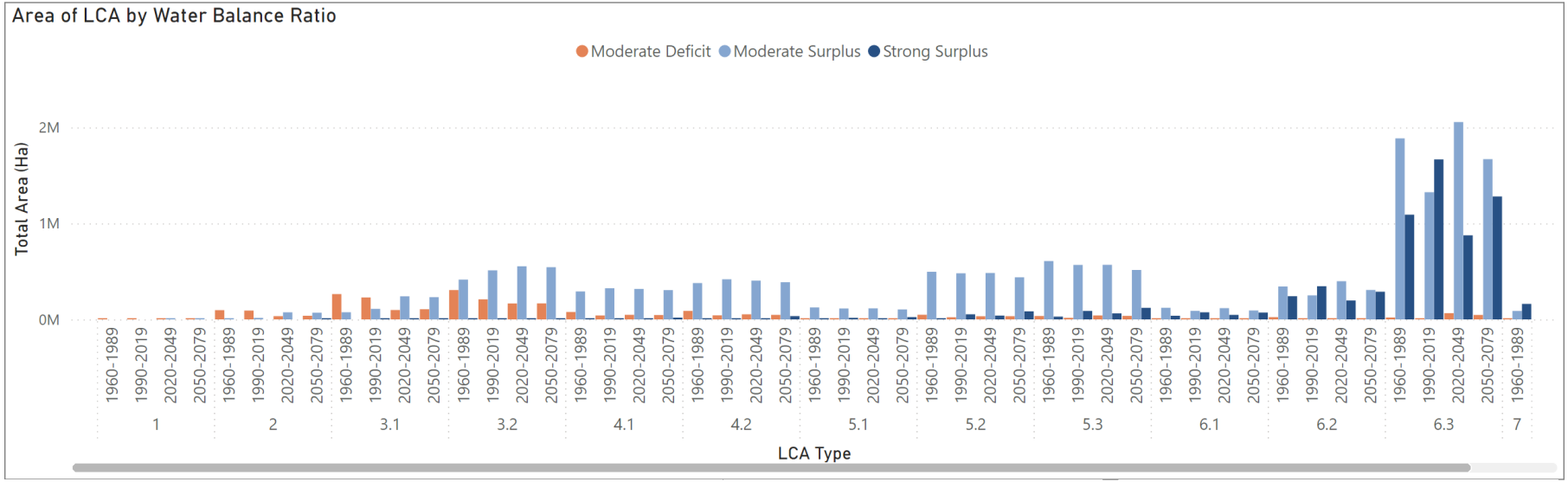
Land Capability for Agriculture (LCA) by Climate Water Balance Ratio



lccode	Argyll & Bute	Ayrshire	Clyde Valley	Dumfries & Galloway	East Central	Eilea
1						
2		2,104.35	564.54	1,175.09	771.58	
3.1	1,031.36	11,830.09	9,360.21	14,716.51	5,727.07	
3.2	4,291.67	39,158.61	41,595.99	67,891.91	35,881.93	
4.1	13,333.52	36,868.28	44,783.26	47,217.62	11,169.26	
4.2	17,356.22	43,423.15	36,100.49	65,402.70	17,899.42	
5.1	19,230.46	6,000.31	9,021.78	27,585.70	2,208.79	
5.2	37,418.42	21,253.11	23,430.05	75,659.96	19,748.99	
5.3	56,132.19	25,551.90	35,383.70	75,214.56	25,159.96	
6.1	49,711.19	7,952.45	6,256.84	20,133.67	8,150.29	
Total (Ha)	**668,212.18**	**317,841.72**	**270,597.79**	**623,152.31**	**240,394.76**	**2**

Region Selector

Ag Regions | Local Authority

Deselect all | Argyll & Bute | Ayrshire | Clyde Valley | Dumfries & Galloway | East Central | Eileanan an Iar | Fife | Highland | Lothian | North East Scotland | Orkney | Scottish Borders | Shetland | Tayside

ET Method

Penman-Monte... | Priestley Taylor

Period

1960-1989 | 1990-2019 | 2020-2049 | 2050-2079

Ensemble

1	9
4	10
5	11
6	12
7	13
8	15

Month

1	7
2	8
3	9
4	10
5	11
6	12

Data and visualisation integration

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- Dashboard Demo:
- Farm Type Table CWR - ClimaticWaterRatio_20251001 - Power BI