

# Land Use

Alessandro Gimona  
[& many others]



Scottish Government  
Riaghaltas na h-Alba  
gov.scot



# Brief overview



- People
- Biophysical
- Tools & data

See contact email address at bottom of slides

# Greenspace and mental health



Greenspace in urban areas can contribute to people's **physical and mental health**, reducing the burden on the NHS

Our research found a **significant relationship** between **reduced prescriptions** for mental health medication and **greenspace** in areas with higher deprivation

This outcome was also found for **areas with higher black and minority ethnic populations**

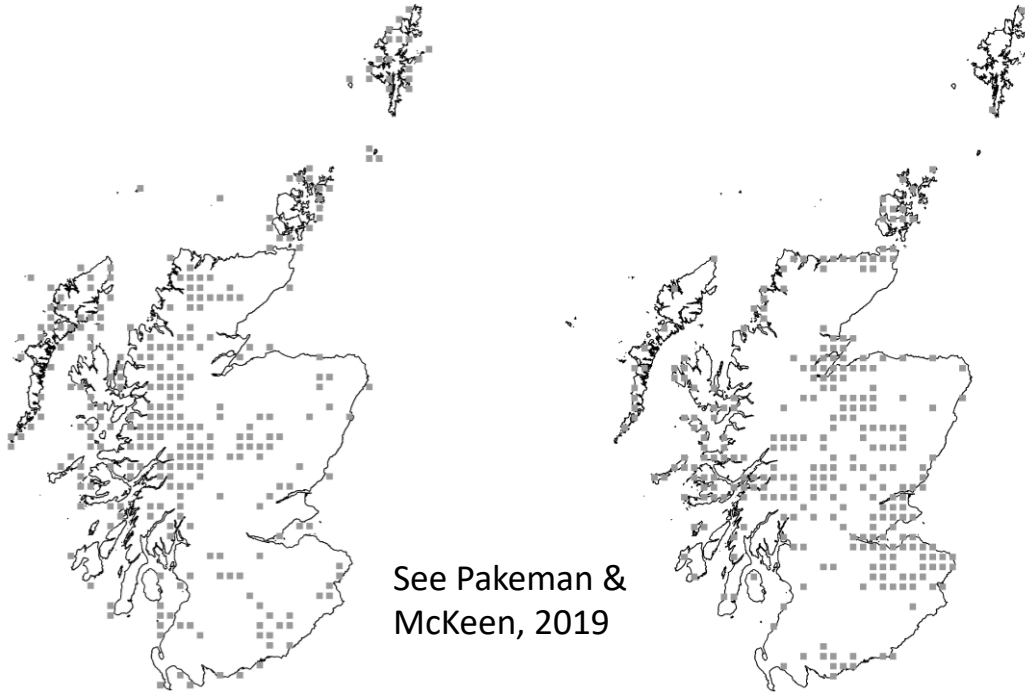
The results highlight the benefits of providing greenspace **close to populations who may otherwise engage less with nature**

Contact: [Alistair.McVittie@sruc.ac.uk](mailto:Alistair.McVittie@sruc.ac.uk)

# Targeting of agro-environmental incentives - Biodiversity

Weighted by rarity

Minimum number of sites  
to represent all species



See Pakeman &  
McKeen, 2019

Contact: [Robin.pakeman@hutton.ac.uk](mailto:Robin.pakeman@hutton.ac.uk)

How to prioritise?

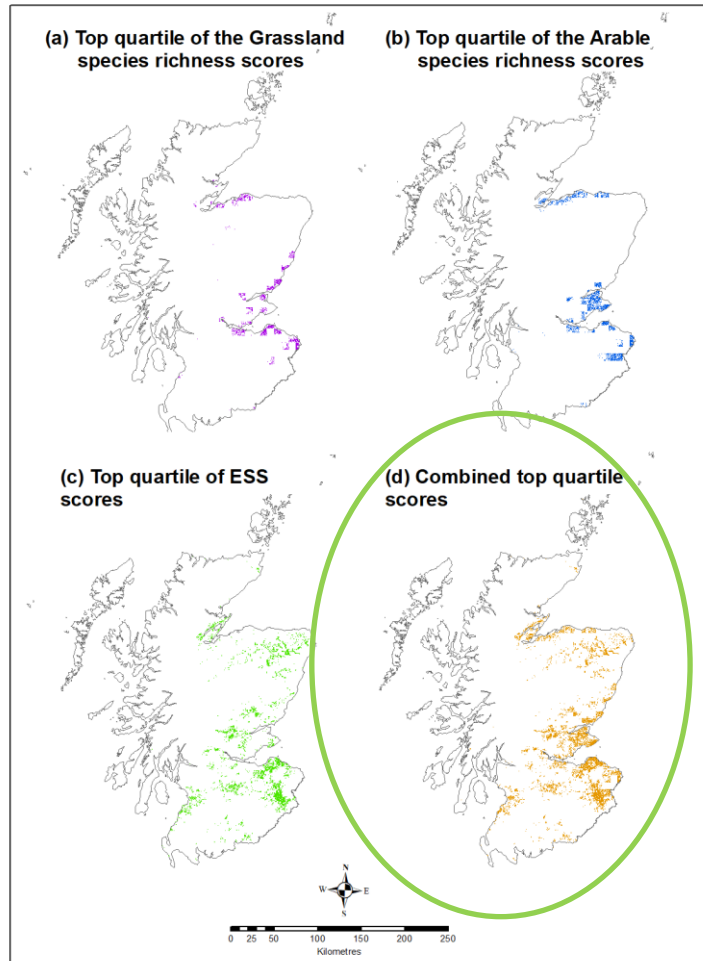
Based on the Scottish Biodiversity List (priority by the SG) + **short list by experts, based on relevance to agri-env. schemes**

Some 80+ spp selected (**vertebrates, invertebrates, plants**)

Choice of metric depends on whether **full coverage preferred** or more weight is given to the **species with smaller ranges**.

Approach **easily generalized** to other countries and extended

# Targeting of agro-environmental incentives – Biodiversity + ESS



Same species list + **4 ecosystem services:**  
Pollination, Carbon Storage, Nutrient Retention, Sediment Retention

Spp. distribution **data downscaled** at 100 m (by land cover )

**ESS and Biodiversity are complementary**  
for targeting incentives

## How to incentivise farmers to adopt agri-environmental practices at the landscape scale?



Re-orientation of agri-environmental policy **from individual level** support to collective (**landscape**) scale support? (Kuhfuss et al. 2019)

Underlying factors for successful collective approaches: **combination of existing social capital and provision of external support** (facilitation and funding)

# How to incentivise farmers to adopt agri-environmental practices at the landscape scale?



## Incentivising collection action around environmental objectives

### i. Creating and supporting institutions

Building on **existing local institutions** to design incentives

Supporting **farmers groups**

Supporting the organisation of **partnerships between farmers and public or private entities**

### ii. Adapting the design of Agri-environmental Schemes

A range of tools proposed and assessed in the literature (**collective payments, bonuses, auctions, collective result based schemes**)

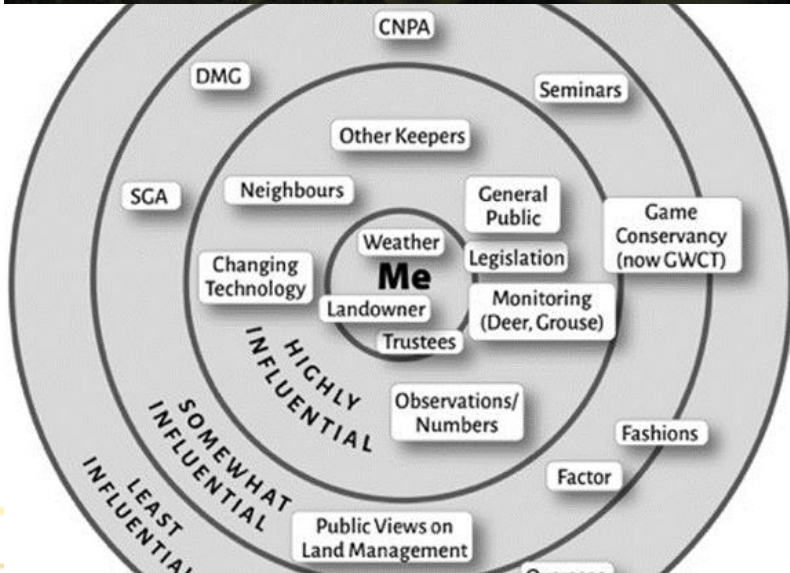
These can be **combined and used to best suits local social and environmental characteristics**

Example: collective **result-based payment schemes** appear to work best in regions with high social capital and environmental results are easily identifiable (Lozada-Ellison et al. 2021)



Contact: [Laure.Kuhfuss@hutton.ac.uk](mailto:Laure.Kuhfuss@hutton.ac.uk)

# Landscape partnership research - Lessons learnt



Successful partnerships **seek new knowledge and understanding**

Successful partnerships **need time for relationships and networks to build**

Lack of trust is a **key barrier** to learning

**Understand reasons** behind the lack of engagement



# Landscape partnership research - Lessons learnt



Level out **power dynamics**

Building **connections** with communities **needs £££**

**Targeted funding** can catalyse new partnerships

**Capture** learning outcomes.

Contact: [antonia.eastwood@hutton.ac.uk](mailto:antonia.eastwood@hutton.ac.uk)

# Exploring Catchment Partnerships



**Partnerships have to ‘navigate’** multiple policy and funding priorities to realise multiple-benefits

**Partnerships need coordination, and coordinators need resourcing.** Integration is done by people who invest significant effort in networking and communicating – it doesn’t just happen.

**It’s not one size fits all.** Some coordinators take a steering and coordinating role, others manage and deliver projects. **What is important is to reflect on this over time.**

**Questions remain over private sector partners and innovative hybrid financing.** Private sector seems increasingly relevant but most partnerships still mainly involve public bodies & NGOs.

# Exploring Catchment Partnerships



**Capitalise on existing experience** to inform new partnerships and processes (e.g. RLUPs, Riverwoods, LENS initiatives)

**Provide opportunities to network and to learn** on partnership working – *it is valued*

**Catch 22** - partnerships can help us achieve holistic environmental management, but **integration is needed of environmental policy implementation processes.**

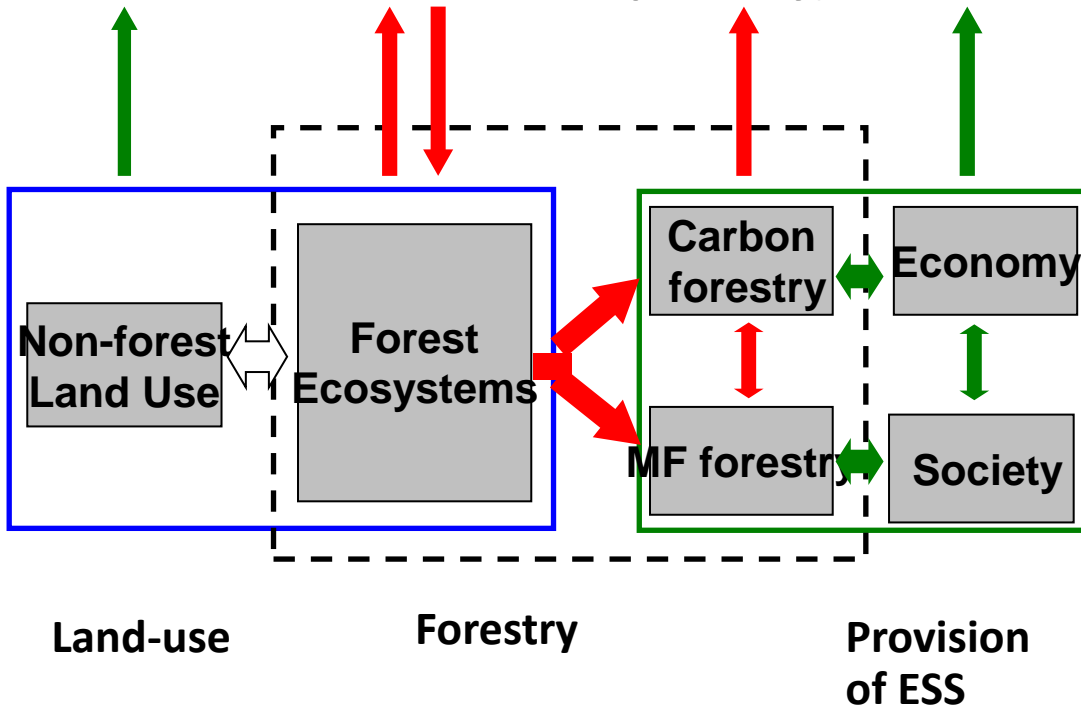
Outputs:

<https://www.hutton.ac.uk/research/projects/water-integration> slides, papers, video, reports & briefings.

# Social Innovation for Sustainable Environmental Management



Minimizing net emissions: living within ENV limits (resilience, innovation and adaptability)



Acquired knowledge for advising on **resilient interventions for attaining multiple benefits** from using natural assets in economically efficient & socially acceptable ways & managing trade-offs

Empirical evidence e.g., from economic & institutional analyses **of afforestation in landscapes**

Improved understanding of **good practices & lessons learned** derived from projects **enabled us to advise on reinforcing of sustainability** associated with **human-environmental interactions**

# Social Innovation for Sustainable Environmental Management



Clarified **how SI can be initiated, developed & spread** and what can be its diverging developing pathways  
how SI can be enhanced & what can be its impacts on the ground & how these can be assessed

**Potential of SI for transformative changes to help revive communities & bring prosperity to rural areas**

**Created a unique database of 450 examples of SI with 243 validated, with over 30 examples in rural Scotland**

**What Makes Social Innovation Possible?**

EU H2020 RIA No 677622

Scottish Government Rìghdhalas na h-Alba gov.scot

The James Hutton Institute

**Dedicated volunteers with a vision**

**Seed and matched funding**

Skills e.g. a full time Community Development Officer, Knowledge, strong Networks & Community engagement

**Opportunities !!!**

**Alternative business models**

SRDP Scottish Rural Development Programme

LOTTERY FUNDED

LOCKCARRON COMMUNITY FUND

BONNEALS CHOIRIACHANACH LOCHCARRANN

LCDC is a registered Scottish charity, No SC280350.

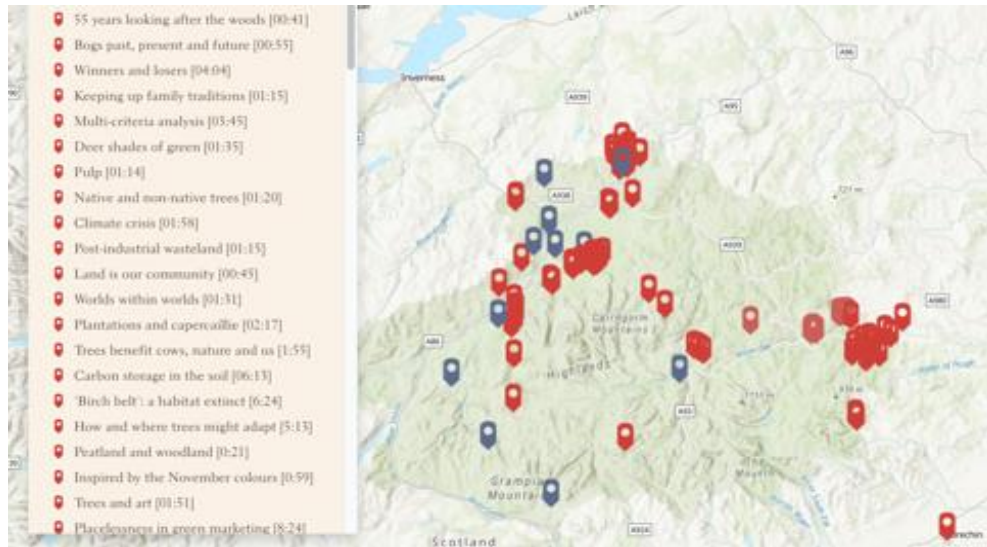
The Strathcarron Artisan Dairy Project.

Contact: [Maria.nijnik@hutton.ac.uk](mailto:Maria.nijnik@hutton.ac.uk)

# Digital Storymapping with video is a useful deliberation tool for linking past, present & future land uses



- We recorded and mapped video stories with diverse stakeholders exploring what constitutes 'The Right Tree in the Right Place, then tested with workshops.



**Empathy-building between stakeholders;** especially learning about experiences, methods & knowledge outside of usual 'silos' & comfort zones

**Understanding the geographical contingencies of stakeholder experiences & values**

**Potential of Storymapping for deliberating e.g. around spatial dimensions of responding to climate change** (e.g. species/habitat migration, ways of reaching net zero)

Contact: [Katrina.brown@hutton.ac.uk](mailto:Katrina.brown@hutton.ac.uk)

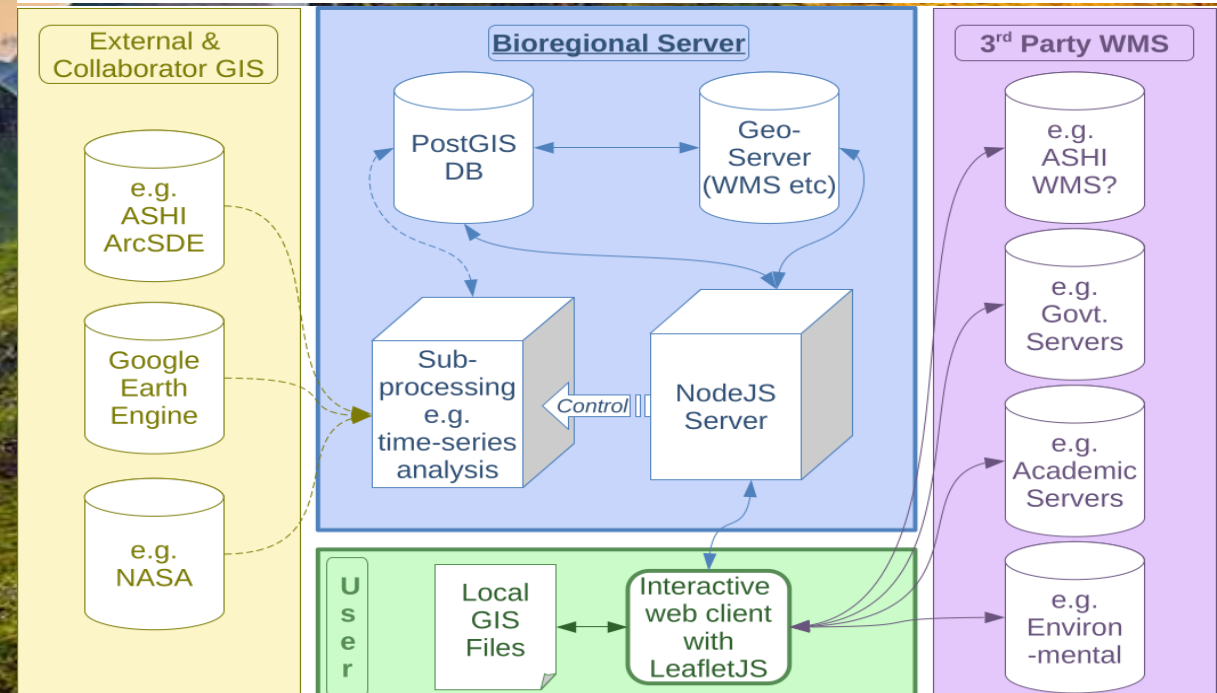
# Bioregional Mapper

The Bioregional Mapper is:

- ▶ a web-based mapping/GIS editing utility,
- ▶ a communication tool for stakeholder engagement,
- ▶ a citizen science data gathering tool,
- ▶ Tool for future-state visioning,
- ▶ a PPGIS tool for land-use monitoring and land-use change.

<https://vimeo.com/643920114>

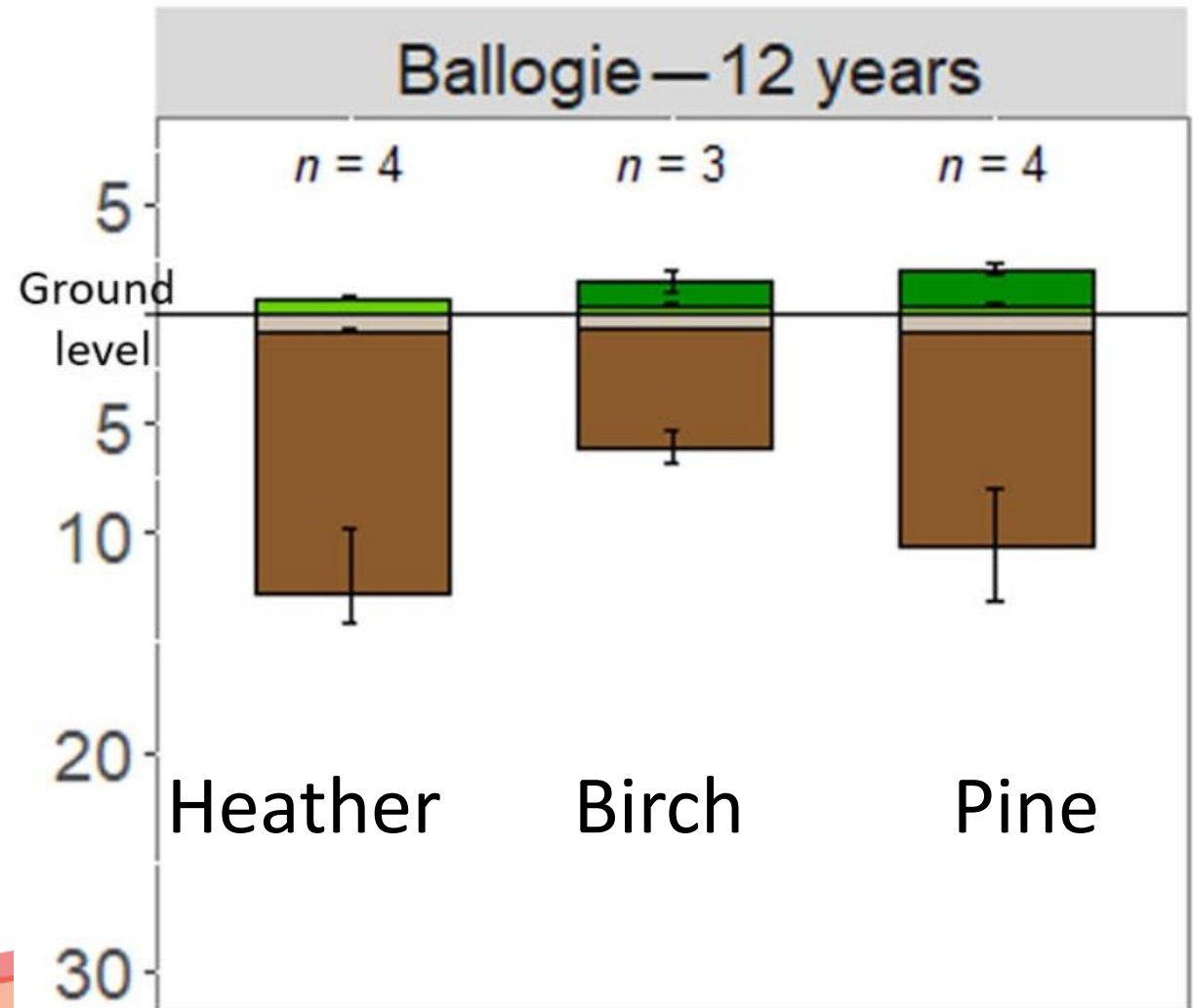
Contact: [Jonathan.ball@hutton.ac.uk](mailto:Jonathan.ball@hutton.ac.uk)



# Natural regeneration: better for carbon storage?



No net C gain on decadal timescales on organic rich soils  
Changes in soil microbial community driving soil C losses?





# Woodland Expansion – options for 500K ha

## Focused: Carbon

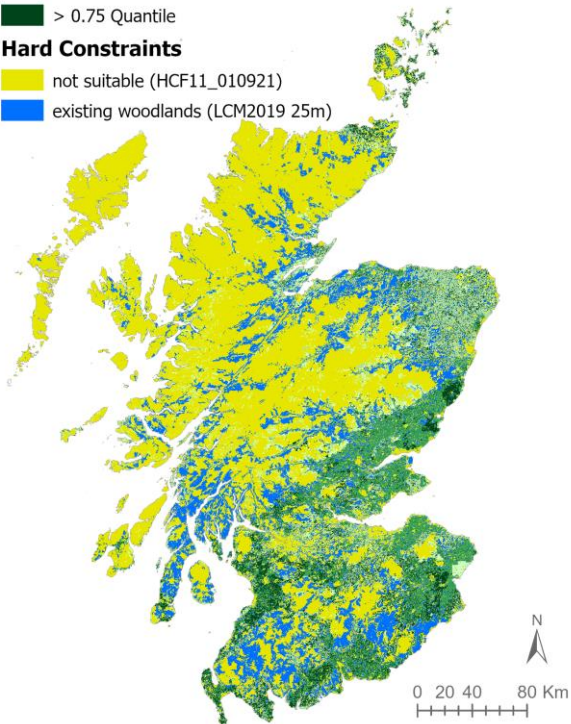
### MCA Focus: Carbon

F\_Carbon\_Rescaled\_HC11\_setnull.tif

- < 0.25 Quantile
- 0.25-0.5 Quantile
- 0.5-0.75 Quantile
- > 0.75 Quantile

### Hard Constraints

- not suitable (HCF11\_010921)
- existing woodlands (LCM2019 25m)



## Focused: Biodiversity

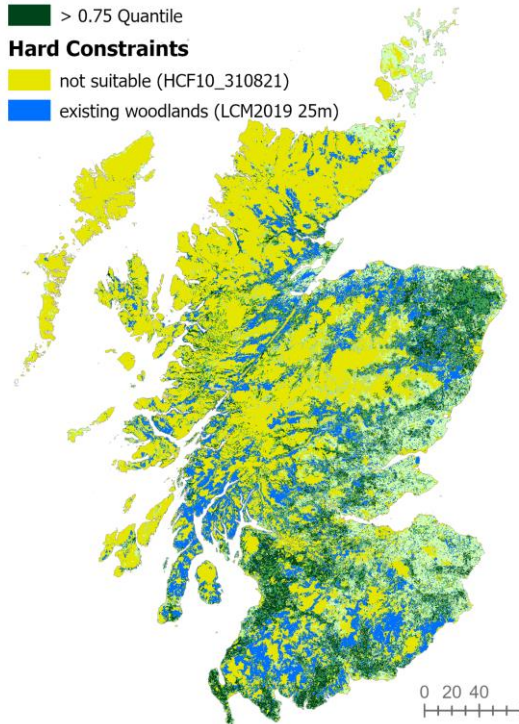
### MCA Focus: Biodiversity

F\_Biodiv\_Rescaled\_HC10\_setnull.tif

- < 0.25 Quantile
- 0.25-0.5 Quantile
- 0.5-0.75 Quantile
- > 0.75 Quantile

### Hard Constraints

- not suitable (HCF10\_310821)
- existing woodlands (LCM2019 25m)



## Multi-Functional

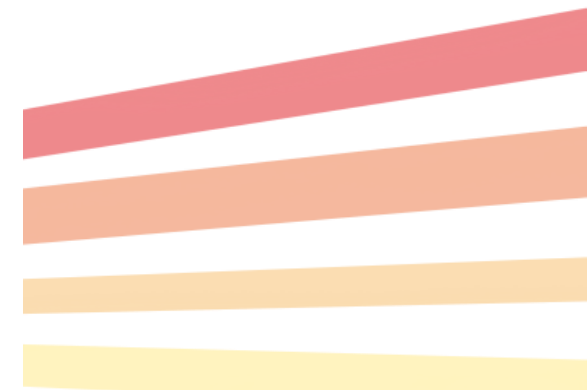
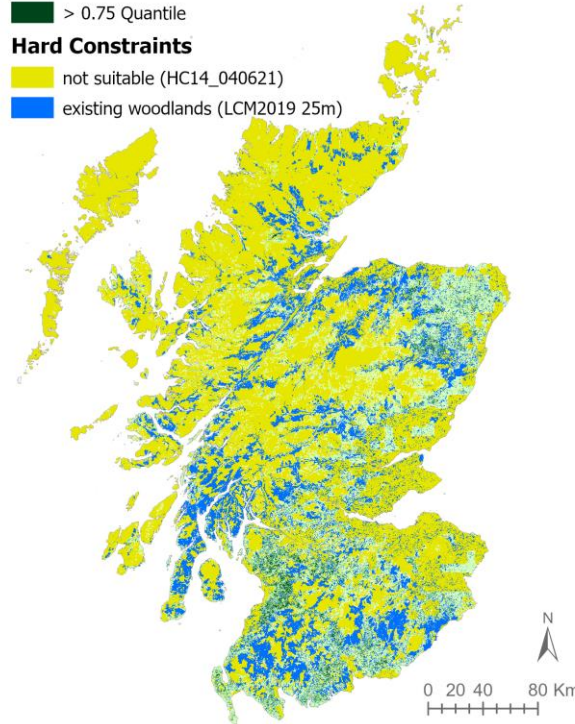
### MCA multi-functional

MCA\_tPN090621r\_HC14\_setnull.tif

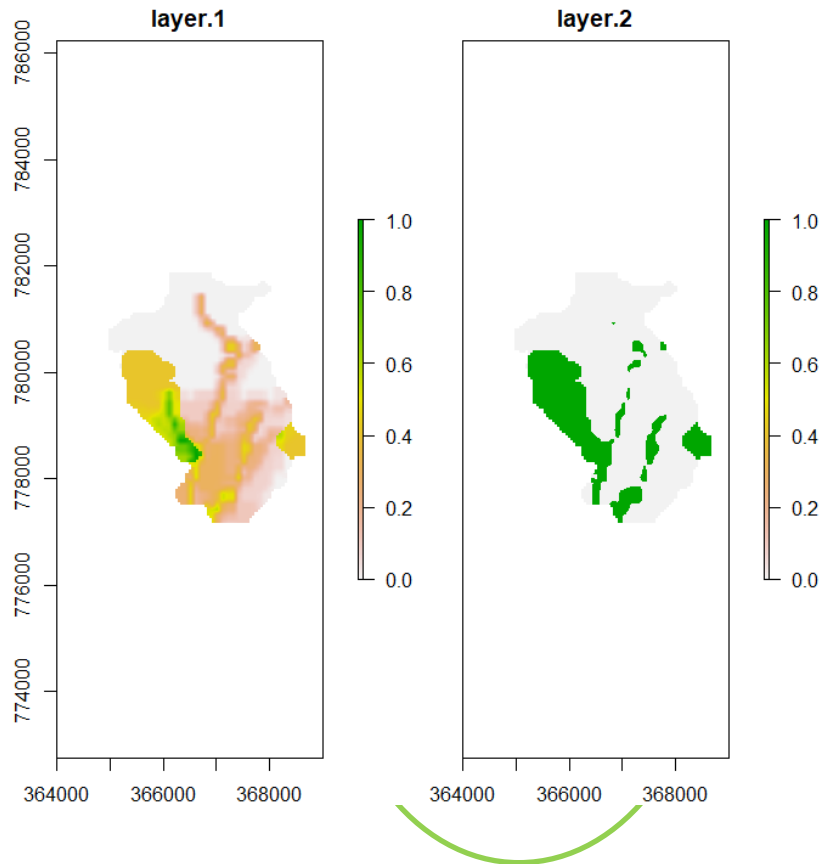
- < 0.25 Quantile
- 0.25-0.5 Quantile
- 0.5-0.75 Quantile
- > 0.75 Quantile

### Hard Constraints

- not suitable (HC14\_040621)
- existing woodlands (LCM2019 25m)



# Visualisation of future scenarios of woodland expansion



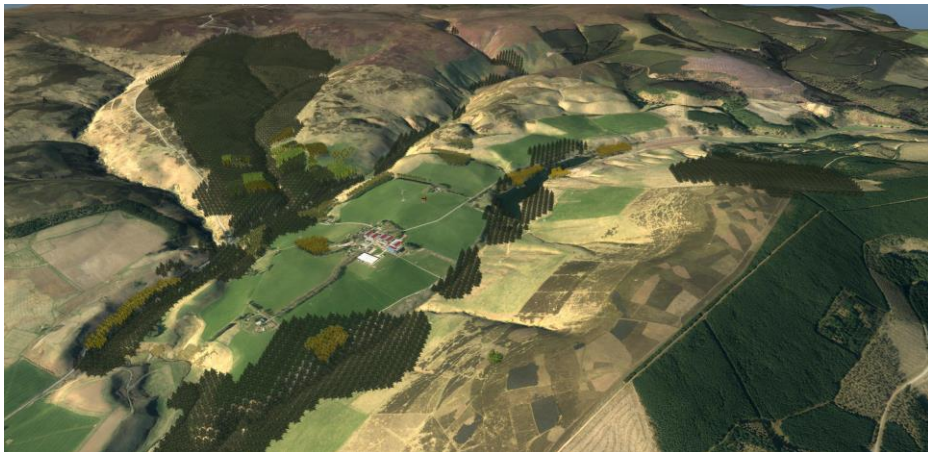
Based on spatial MCA

Carbon Nutrient retention+  
economic viability

## Visualisation of future scenarios of woodland expansion



Native Scenario with Scots pines and Birch



Commercial Scenario with Sitka spruce

Based on spatial MCA

Carbon Nutrient retention+  
economic viability

Contact: [Chen.wang@hutton.ac.uk](mailto:Chen.wang@hutton.ac.uk)

# Exploring options for sustainable Land Use Management –



## SLM-OT (landsFACTS)



Tool interface  
within ArcGIS Pro

- SLM-OptionsTool.pyt
- 0\_ Choose project
- 0b\_ Create new project
- 0c\_ Create subset project
- 0d\_ Create clip project
- 1\_ Landscape LUC matrix
- 2\_ Land Capability (in progress)
- 3a\_ES General
- 3b\_ES LUC matrices - create from LU Scores
- 3c\_ES LUC matrices - View/Import/Export
- 3d\_ES Add spatial data
- 4\_ Priority areas for change
- 5\_ Target land use proportions
- 6\_ Simulation parameters
- 7\_ Run LandSFACTS model
- 8a\_ Outputs statistics
- 8b\_ Outputs to shapefiles
- tool\_ Raster to polygons
- tool\_ Text file to shapefile

## Inputs

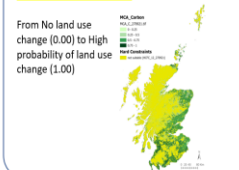
Land use changes benefitting  
Ecosystem Services

for each Ecosystem Service

Land use transitions matrix using Scores

From \ To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Broadleaved mixed forest	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Conifer forest	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arable	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
High grassland	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neutral grassland	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acid grassland	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heather dwarf shrub	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heather grass	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heath	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mire	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

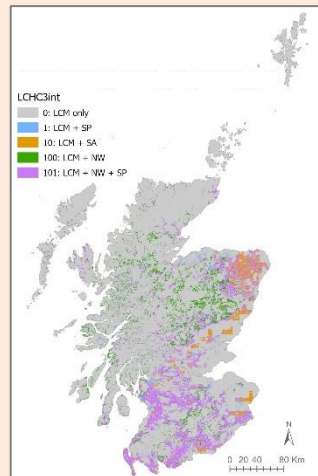
An Opportunity map



Weight of this ES  
in comparison  
to others

4 ES	Short name	Weight
Biodiversity_ES_for_Open_Habitats	BiodiversityOpenHab	0.25
Carbon_ES_for_tree_planting	CarbonTree	0.25
Carbon_ES_for_grassland_desintensification	CarbonDesIntense	0.25
Pollination_ES	Pollination	0.25

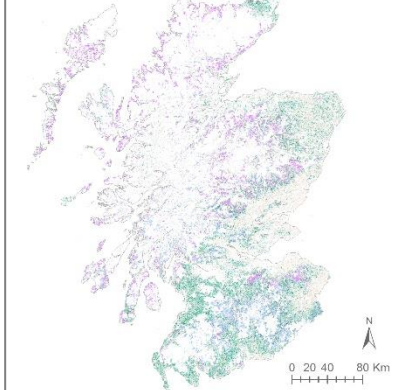
Potential LU change



Targets  
hectares

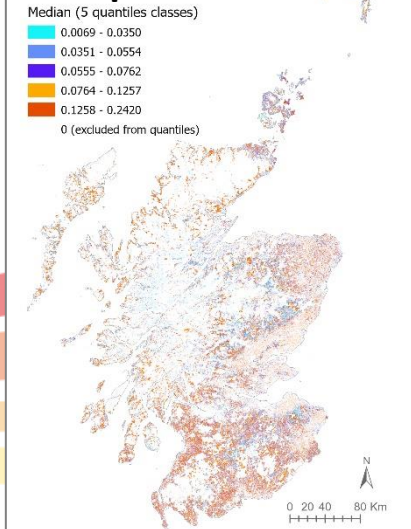
Scenario(s) of  
Land uses change

- 4-Improved grassland-NonIntensive
- 5-7-Semi-Natural grasslands-NonIntensive
- 9-10-Heather(s) grasslands-NonIntensive
- 31-New woodland
- 32-Silvo-Arable
- 33-Silvo-Pastoral



Rapid assessments  
of impacts on ES

- Median (5 quantiles classes)
- 0.0069 - 0.0350
  - 0.0351 - 0.0554
  - 0.0555 - 0.0762
  - 0.0764 - 0.1257
  - 0.1258 - 0.2420
  - 0 (excluded from quantiles)



# Habitat connectivity: Lemmings tool

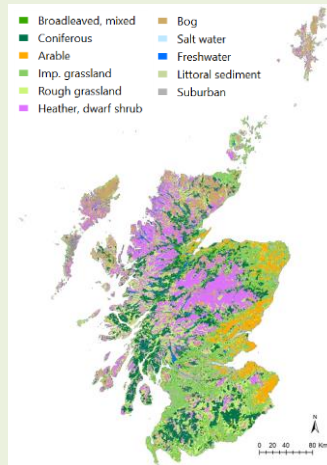
Individual movements through the landscape

## Main inputs

### Per land use / habitat:

- Seeded (start)
- Energy gained/lost
- Crossability

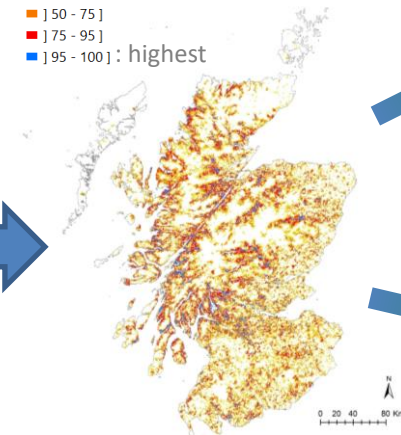
### Land use map



## Connectivity (individuals' traffic)

NbUniLemNQ

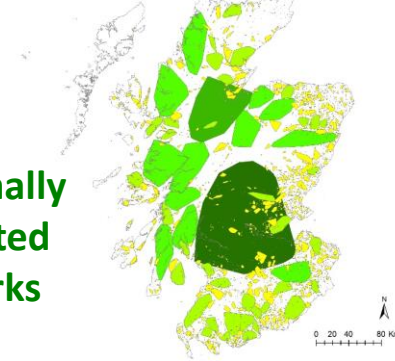
- 10 - 51 : lowest
- 5 - 25
- 25 - 50
- 50 - 75
- 75 - 95
- 95 - 100 : highest



## Functionally connected networks

AREAHA

- 4 - 712
- 713 - 3,664
- 3,665 - 11,040
- 11,041 - 18,388
- 18,389 - 69,808

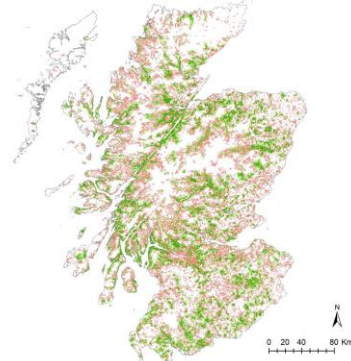


: less connectivity

RO1MR00

- 1130 - -10
- 9 - 0
- 1 - 20
- 21 - 110
- 111 - 1620

: more



## Comparing connectivity between land use scenarios



# Interactive Web Tool – Prioritise Woodland Expansion



[? Help](#)

## Criteria Weights

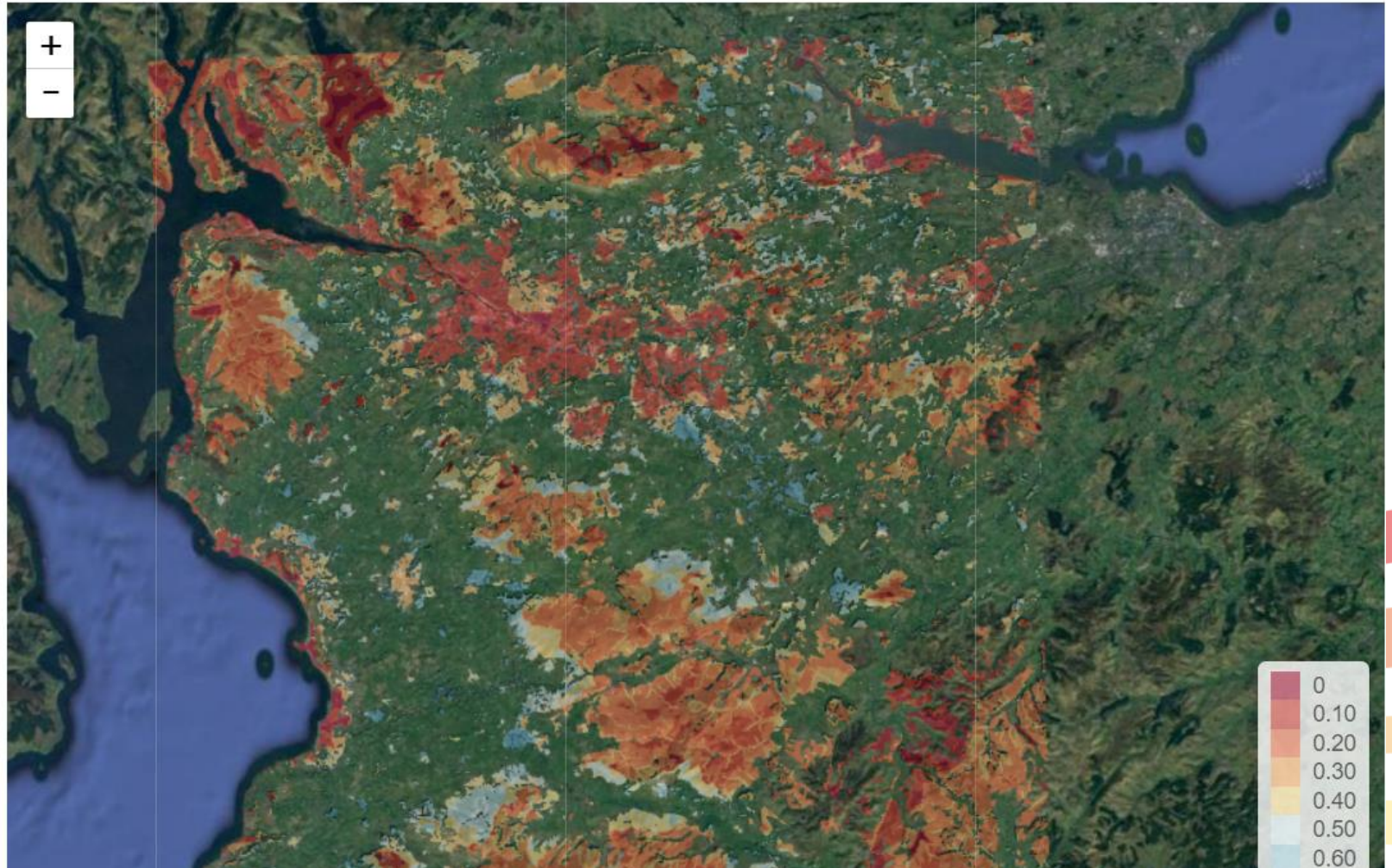
For each selected criteria, choose its weight between 0 and 1 and the method you want. Then press Go!. If you want to store a combination, press Save!. If you want to store your final combination press Save for real

### Criteria

- [POS] PositiveCarbonBudget**  
Slider: 0 to 1, value set to 1
- [POS] DistanceFromBroadleaves**  
Slider: 0 to 1, value set to 0.48
- [POS] NutrientExport**  
Slider: 0 to 1, value set to 0.74
- [POS] FluvialRisk**  
Slider: 0 to 1, value set to 0.72
- [POS] RiverShading**  
Slider: 0 to 1, value set to 0.82

## Mapping area

The best value is 1 (blue) and the worst 0 (red) for the project chosen Expansion considering these criteria, the weights selected and the chosen method



# Prioritising Areas For New Riparian Woodlands



Contribution to:

## Riverwoods

Creating a network of thriving riverbank woodlands and healthy river systems across Scotland.

### A decade to make a difference

The UN Decade on Ecosystem Restoration runs from 2021 to 2030. It is a rallying call for the protection and revival of ecosystems all around the world, for the benefit of people and nature.

With Scotland's streams and rivers covering an amazing 125,000km (12.5 times the length of the country's coastline), improving riparian habitat has the potential to create transformative change that will deliver significant



**Collaboration. Innovation. Action.**

# Interactive web tool – Prioritise Peatlands Restoration



Contact: [Alessandro.gimona@hutton.ac.uk](mailto:Alessandro.gimona@hutton.ac.uk)

[Help](#)

## Criteria Weights

For each selected criteria, choose its weight between 0 and 1 and the method you want. Then press Go!. If you want to store a combination, press Save!. If you want to store your final combination press Save for real

Criteria

**[POS] Carbon**  
0  1

**[POS] Condit**  
0  1

**[NEG] Dom**  
0  1

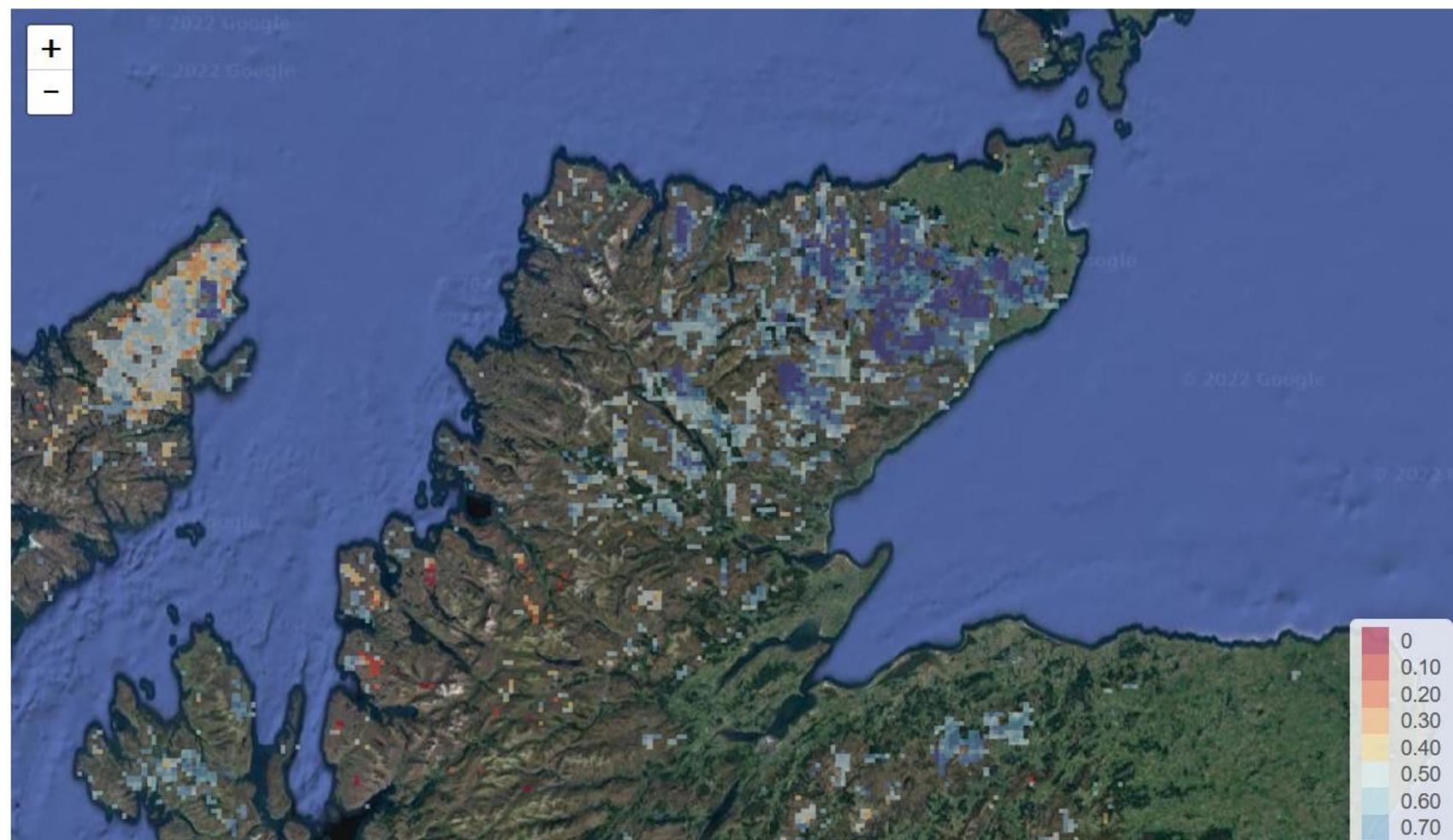
**[NEG] Eros**  
0  1

[Go](#)

[Download Raster](#)

## Mapping area

The best value is 1 (blue) and the worst 0 (red) for the project chosen Expansion considering these criteria, the weights selected and the chosen method





# Natural Asset Register: Data Portal



The screenshot shows the SEFARI Data Portal interface. At the top left is the SEFARI logo with the text "NATURAL ASSET REGISTER DATA PORTAL". To the right are navigation links for "Datasets", "Organizations", "Groups", and "About", along with a search bar containing the text "Search" and a magnifying glass icon. Below the navigation is a large search area with the heading "Search for research data to view or download". It features a search input field with the placeholder text "E.g. environment" and a magnifying glass icon. Below the search field is a "Popular tags" section with several buttons: "uk", "Provisioning", "agriculture", "AECS", "species richness", "SRDP", "Prov.-Nutrition", "soil", "water", "Regulation and Main...", "forestry", and "water quality". Below the tags is a box stating "Datasets currently loaded: 44". On the right side of the search area, there is a dark grey box with white text: "This tool is for sharing spatial data. Click on 'Data' or one of the other buttons to see what is available. We recommend using the Chrome or Firefox browser." Below the search area is a section for a dataset entry. It features the CREW logo and the text "CREW The Centre of Expertise for Waters: CREW is a...". Below this is the title "Areas of likely high exposure to radon in groundwater drinking water supplies..." and a short description: "The map and data indicate areas in Scotland where there is high likely of exposure to radon in drinking water from...". To the right of this entry is a larger grey box with the heading "A Natural Asset Register Data Portal, funded by Scottish Government" and a paragraph of text: "This data portal is part of the Scottish Government's RESAS research programme: Work Package 1.4, Research Deliverable 1.4.1. The portal is designed to make scientific data created using public funding readily available and easy to view and download. Click [here](#) for our contact details and more information on this project."

# Natural Asset Register: Data Portal

A screenshot of the Natural Asset Register Data Portal interface. It features a grid of six data provider cards. Each card includes a logo, the provider's name, a brief description, and the number of datasets available. The providers shown are CREW (1 Dataset), Natural Asset Register (26 Datasets), NatureScot (1 Dataset), SEFARI (0 Datasets), The James Hutton Institute (15 Datasets), and The Royal Botanic Garden Edinburgh (0 Datasets).

**CREW** CENTRE OF EXPERTISE FOR WATERS  
**CREW**  
The Centre of Expertise for Waters: CREW is a Scottish Government funded...  
**1 Dataset**

natural-asset-register  
**Natural Asset Register**  
A register of datasets describing Scotland's natural assets. This is part of...  
**26 Datasets**

**NatureScot**  
NatureScot: Scotland's Nature Agency (Formerly Scottish Natural Heritage).  
**1 Dataset**

**SEFARI**  
SEFARI, the Scottish Environment, Food and Agriculture Research Institutes, ...  
**0 Datasets**

**The James Hutton Institute**  
The Institute combines strengths in crops, soils and land use and...  
**15 Datasets**

**Royal Botanic Garden Edinburgh**  
The Royal Botanic Garden Edinburgh is a world-renowned scientific centre for...

<https://openscience.hutton.ac.uk/>  
or <https://nar.hutton.ac.uk>

44 datasets with almost 120 individual resources (downloads & web services)

Research data describing soils, water, cultural services and more

Contact: [David.donelly@hutton.ac.uk](mailto:David.donelly@hutton.ac.uk)

**Thanks for your attention**

