



Prioritizing Woodland Expansion with ECOFOREST: A Web-Based Tool for Ecosystem Service-Based Spatial Targeting

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marinescotland
science



Main Features

- **Interactive web-based tools** that aid in the decisions on where to plant woodlands in the landscape (ECOFORREST) or only riparian woodlands (RIVERTOOL)
- Based on several input maps of **benefits/ecosystem services**
- Grid cells are scored 0-1 based on models for suitability to enhance certain benefits (e.g. alleviation of diffuse pollution, enhancement of connectivity.. Etc..)
- **Mapped criteria** given different –or equal - importance and combined into a final priority map





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Why interactive tools?

Participatory Spatial Multicriteria Analysis

Decision support method that **integrates** Geographic Information Systems (GIS) with Multicriteria

Spatial representation **and integration** of multiple criteria, e.g. referring to pollution, biodiversity, climate mitigation.

Participatory It actively involves stakeholders in the decision-making process, ensuring that diverse perspectives are considered and valued



Beyond Monetary Values in Decision Making



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Multi-criteria analysis

Multi-criteria analysis, sometimes called multi-criteria decision analysis, is a general framework for supporting complex decision-making situations with multiple and often conflicting objectives that stakeholder groups or decision makers value differently. The basic idea of multi-criteria analysis is to evaluate the performance of alternative courses of action with respect to criteria capturing the key dimensions of the decision-maker preferences for option performance under each criterion. Multi-criteria decision analysis does not produce final 'optimal' outcomes, but rather is a decision-support and sounding board tool.

Multi-criteria decision analysis is typically used in participatory processes to facilitate dialogue between experts, stakeholders and decision-makers. It can facilitate value integration by combining and structuring diverse information including multiple criteria, different types of data, and diversity of actor perspectives and value judgements. It can be used as a value elicitation method to cover a broad range of values, including ecological and economic values, as well as social and cultural values. Its main output is a preference ordering of alternatives according to different value positions and worldviews.

Multi-criteria analysis methods are also suited for illustrating distributional impacts but not all of them can address incommensurable criteria such as rights and duties. However, some approaches such as social multi-criteria analysis can better accommodate incommensurable criteria that are difficult to trade-off against each other.

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Intergovernmental Science-Policy Platform
on Biodiversity and Ecosystem Services

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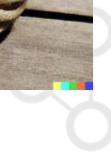
IPBES Secretariat
10th floor
Platz der Vereinten Nationen 1
53113 Bonn (Germany)



Intangible Values

Flexibility in Criteria Consideration

From quantifiable metrics like land values to qualitative aspects like cultural and biological significance, aesthetic value, or social impact.



Enhancing Confidence in the Decision Process

Transparency and dialogue foster confidence

Visualisation of criteria and outputs

Interactive inclusion/exclusion

Interactive **change** in their importance



Active Role of Citizens

Stakeholder Inclusivity & values integrations

Potential to promote the active involvement of various stakeholders in the decision-making process



Enhanced Dialogue

Conflict Resolution

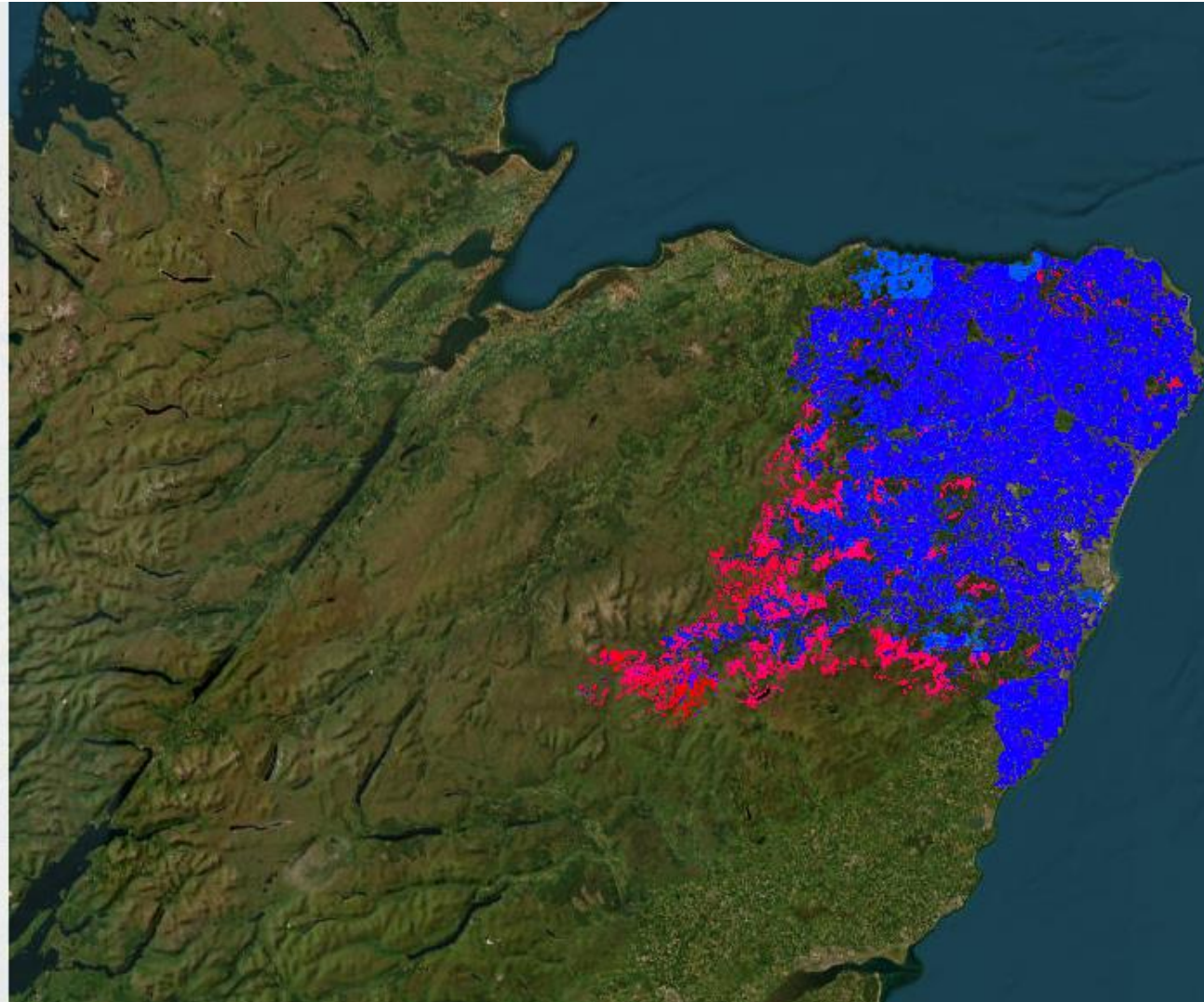
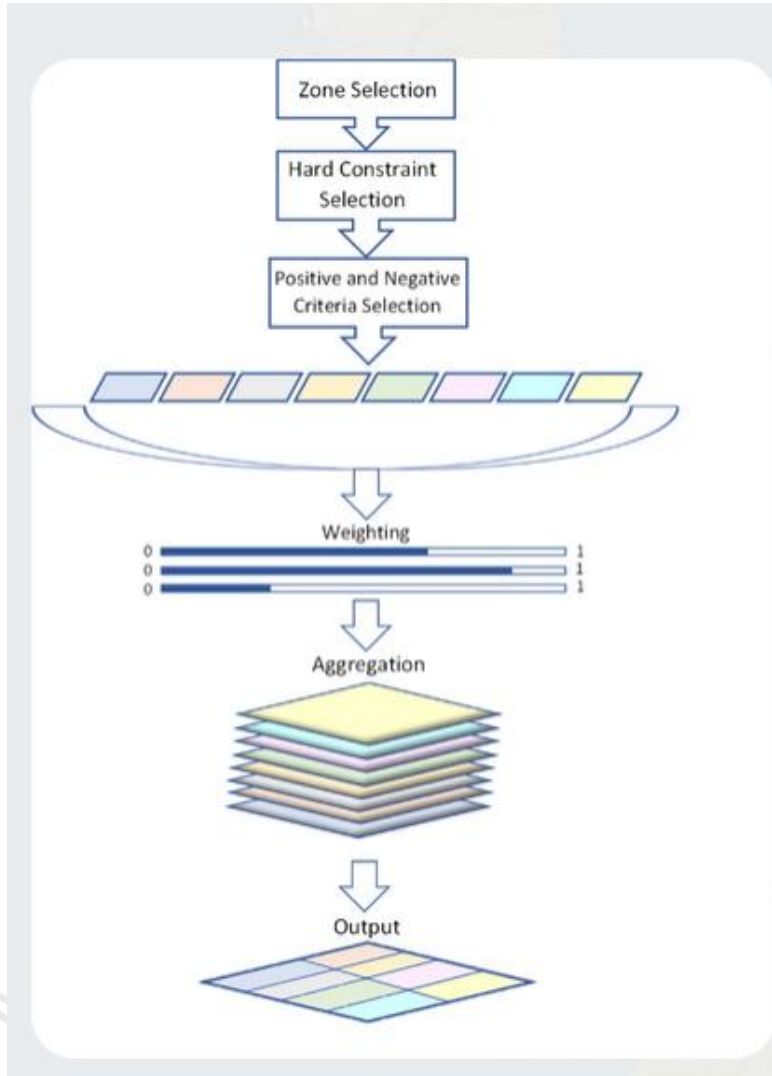
Environmental decisions can often lead to conflicts among stakeholders with differing priorities. S-MCA provides a platform for dialogue, helping stakeholders understand different viewpoints and working towards co



Stages of Analysis in Each Tool



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Criteria

- Diffuse Pollution

Nitrogen & Phosphorus



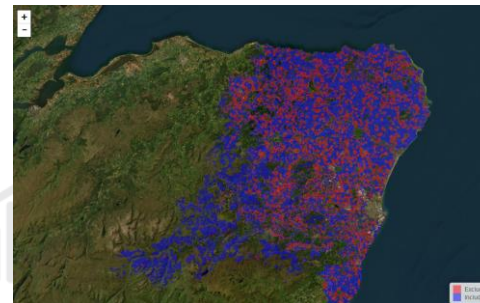
- Mitigation of Climate effects

Carbon & Temperature (shading)



- Biodiversity Conservation

Woodland Connectivity
& Protection of Open-ground Species



18 mapped criteria



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Excluded areas

Where **NOT** to plant trees

11 maps then combined into a single layer



Physical Restrictions (high altitude & too exposed)

Policy restrictions (Peatlands, Archeological areas ..)

Biodiversity Conservation (Waders in protected areas, SSIs)

Existing Woodland



Spatial Criteria



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10 Positive and 6 negative

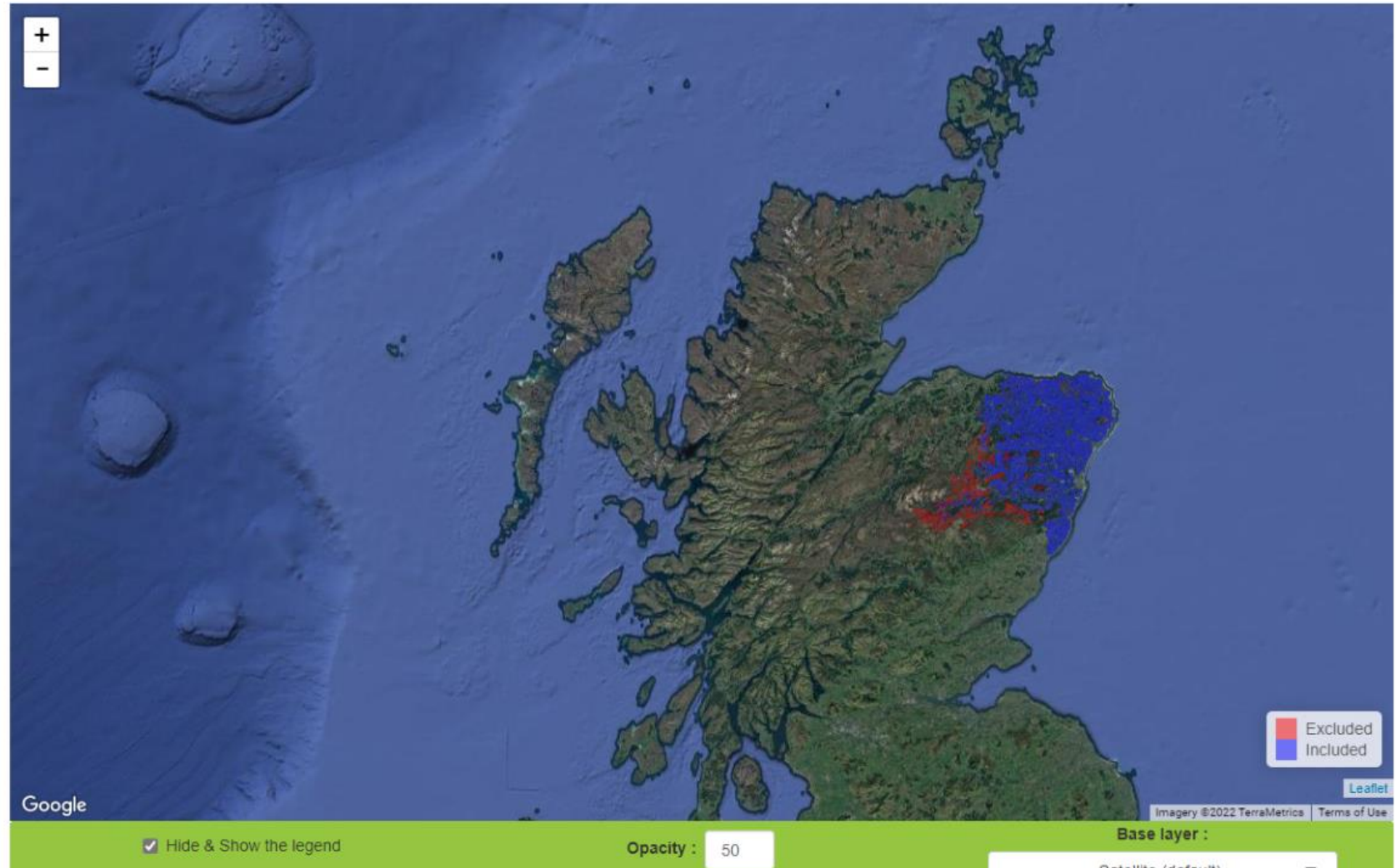
[? Help](#)

List of criteria

[Make change](#)

criteria
PositiveCarbonBudget
DistanceFromBroadleaves
OvergrazedGrassland
ScotPinesConnectivityCorridors
NutrientExport
FluvialRisk
LowPollinationAreas
RiverShading
SedimentExport
BroadleavesConnectivityCorridors
NegativeCarbonBudget
ArableConservation
GrassConservation
PrimeLand
HighConnectivityMoorland
WadersOutsideConservationAreas

Negative criteria
 Positive criteria



RIVERTOOL – example : River Shading

12 Positive and 2 negative

Help

List of criteria

Make change

criteria
CarbonGain
DistanceFromBroadleaves
BroadleavesConnectivityCorridors
RiverFloodRisk
LowPollinationAreas
RiverShading
SedimentExport
GroundwaterProtection
RiparianVegImprovement
RiskPhosphorusLoss
SEPARuralDiffusePollution
WildlifeConConCatchment
CarbonLossRisk
WadersOutsideConservationAreas

Negative criteria

Positive criteria

Choose a criteria to display:

RiverShading



Data from Faye Jackson and Iain Malcolm, Marine Scotland, see *Jackson et al. 2021*

RIVERTOOL: Planting for Diffuse Pollution



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List of criteria

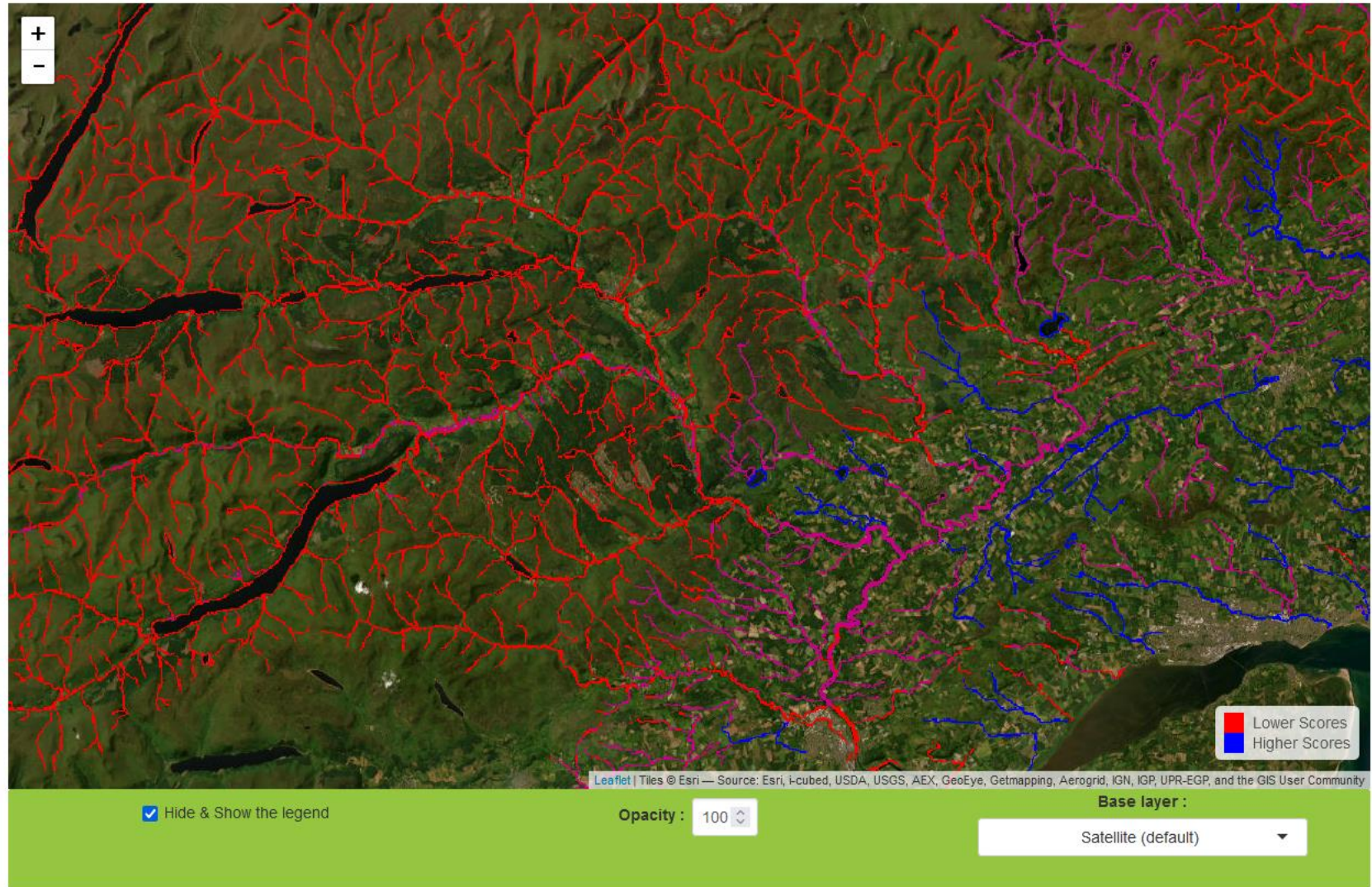
Make change

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SedimentExport
GroundwaterProtection
RiparianVegImprovement
RiskPhosphorusLoss
SEPARuralDiffusePollution
WildlifeConConCatchment
CarbonLossRisk
WadersOutsideConservationAreas

Negative criteria (Blue background)
Positive criteria (Orange background)

Choose a criteria to display:

SEPARuralDiffusePollution



ECOFORREST : Planting for Diffuse Pollution



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List of criteria

Make change

criteria

CarbonGain

DistanceFromBroadleaves

OvergrazedGrassland

ScotPinesConnectivityCorridors

SEPARuralDiffusePollution

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RiparianVegImprovement

GroundWaterProtection

CarbonLossRisk

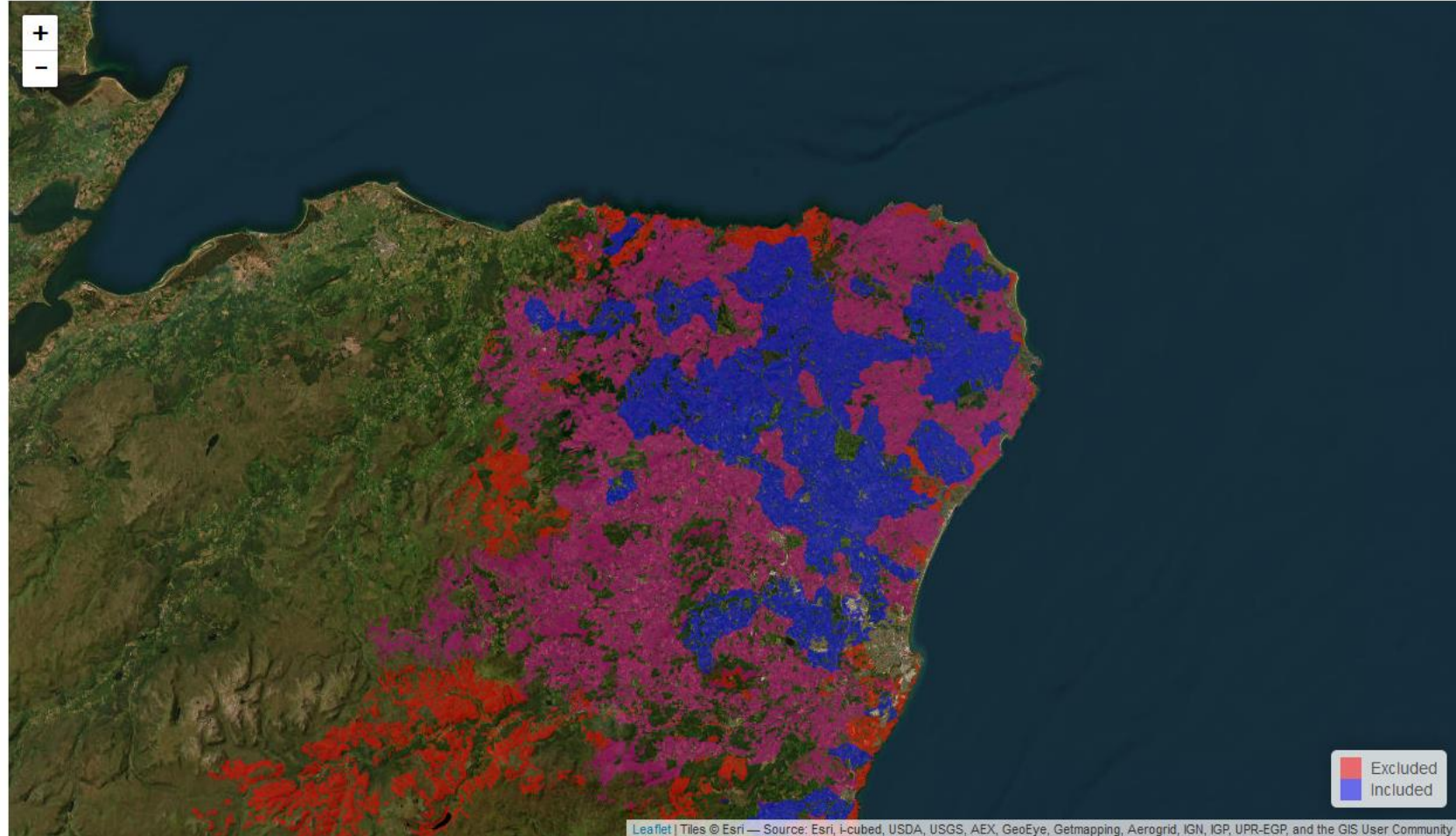
ArableConservation

GrassConservation

PrimeLand

HighConnectivityMoorland

WadersOutsideConservationAreas



Leaflet | Tiles © Esri — Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, AeroGrid, IGN, IGP, UPR-EGP, and the GIS User Community

Hide & Show the legend

Opacity : 50

Base layer :

Satellite (default)



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Set Importance 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



[POS] DistanceFromBroadleaves



[POS] OvergrazedGrassland



[POS] ScotPinesConnectivityCorridors



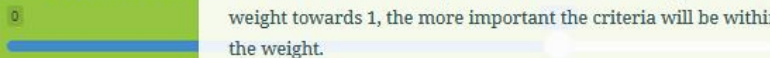
[POS] NutrientExport



[POS] FluvialRisk



[POS] LowPollination



[POS] RiverShading



[POS] SedimentExport



Criteria Weights

For each selected criteria, the user will choose a weight value between 0 and 1. The closer the weight towards 1, the more important the criteria will be within the analysis and the 'heavier' the weight.

Then press go!

You will then be presented with a map with a new layer on it. The best areas to be considered for new trees will be given the value of 1 (blue) and the worst will be 0 (red).

You can choose to download this map as a GeoTIFF before progressing to the next step.



Selecting Top Scoring Locations

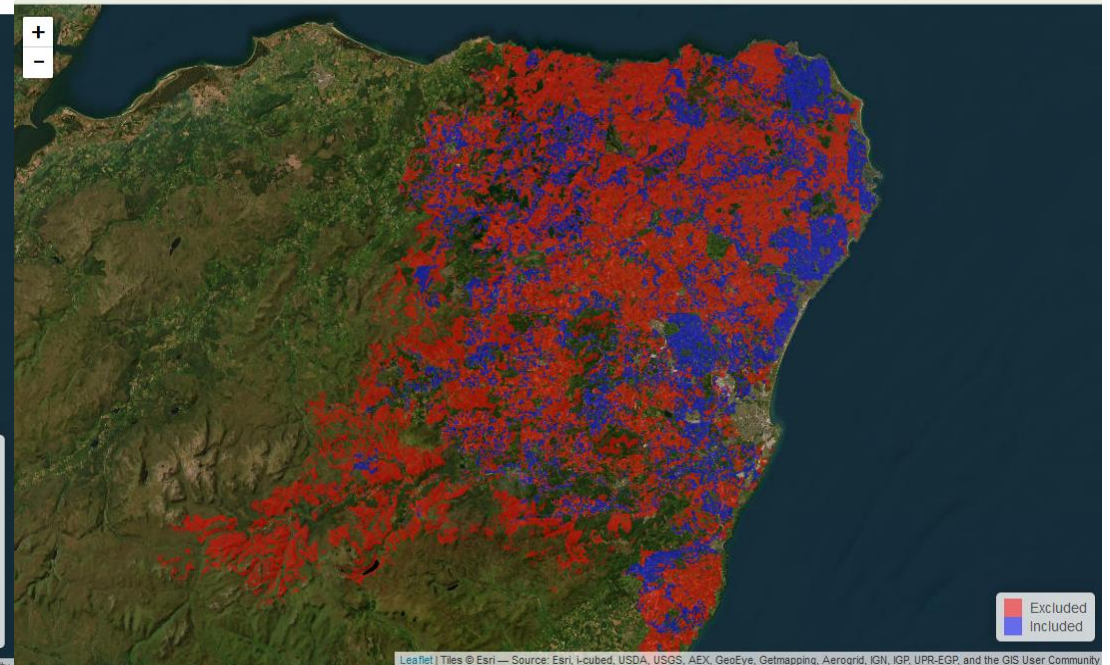
Mapping area

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



Mapping area

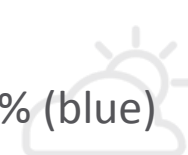
Best pixels under the threshold are in blue, the others are in red.



Full domain



Top 30% (blue)



Organisations Interested in Using the Tools




Bioregioning Tayside

"Bioregioning reframes the way we see the places where we live and work, helping us reconnect to and restore the ecological systems of which we are a part and upon which we all depend."

Clare Cooper, co-initiator Bioregioning Tayside



Limitations



CAUTION

- **Data Quality:** The effectiveness of interactive tools is inherently tied to the quality of the data they utilise.
- **Data Availability:** Not all relevant data may be readily available or accessible
- **Mapping Constraints:** Not every aspect of land use or environmental concerns can be mapped. Some nuances or intangible factors might be overlooked



Advantages

- **Engagement:** Interactive tools can engage citizens, making complex land use topics more accessible and understandable
- **Visualization:** spatial tools provide a clearer picture of potential outcomes, helping citizens grasp the implications of various decisions
- **Feedback Loop:** Interactive platforms allow for real-time feedback, making it easier for citizens' voices to be heard and integrated into the decision-making process



On-line Story maps

ECOFORREST <https://bit.ly/3RAIOUq>

RIVERTOOL <https://bit.ly/46QvwqT>

Description of methods & data; Tutorial

RIVERTOOL

(Riparian Vegetation Ecosystem Services-based Ranking Tool) Methods, Tutorial, Data

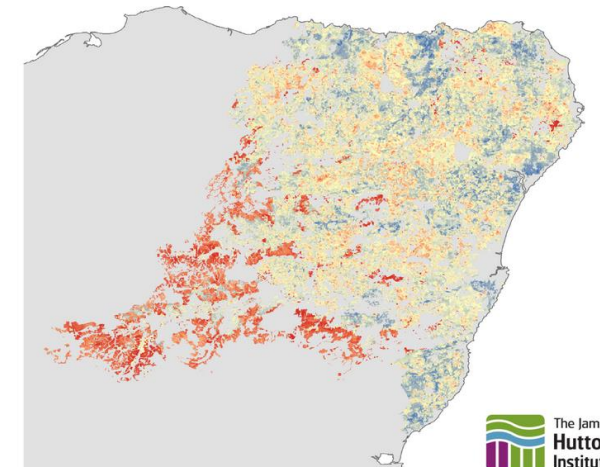
Alessandro Gimona, Marie Castellazzi, Bethany Wilkins, Andrea Baggio Compagnucci
3 April 2023



ECOFORREST

Spatial Multi-Criteria Analysis to prioritise planting at the landscape level Metadata and Further Information

Alessandro Gimona, Marie Castellazzi, Bethany Wilkins, Andrea Baggio Compagnucci
2 December 2022



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Story maps

ECOFORREST <https://bit.ly/3RAIOUq>

RIVERTOOL <https://bit.ly/46QvwqT>

