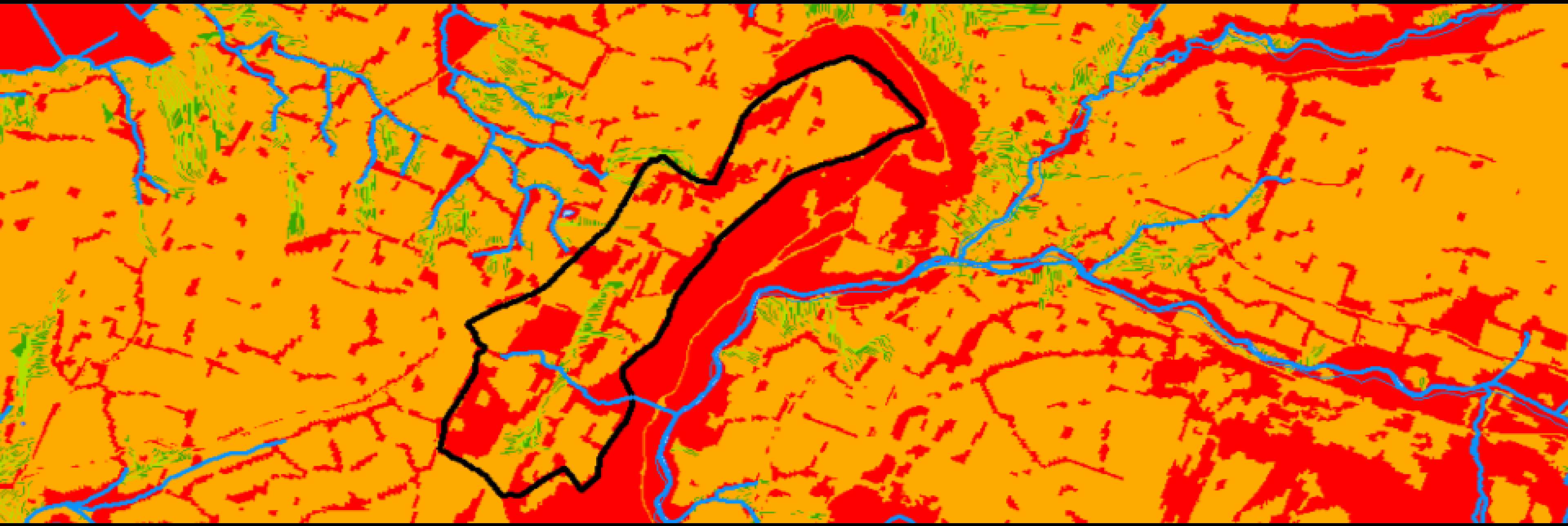
Polyscape

Participatory approaches to spatial planning using visual tools



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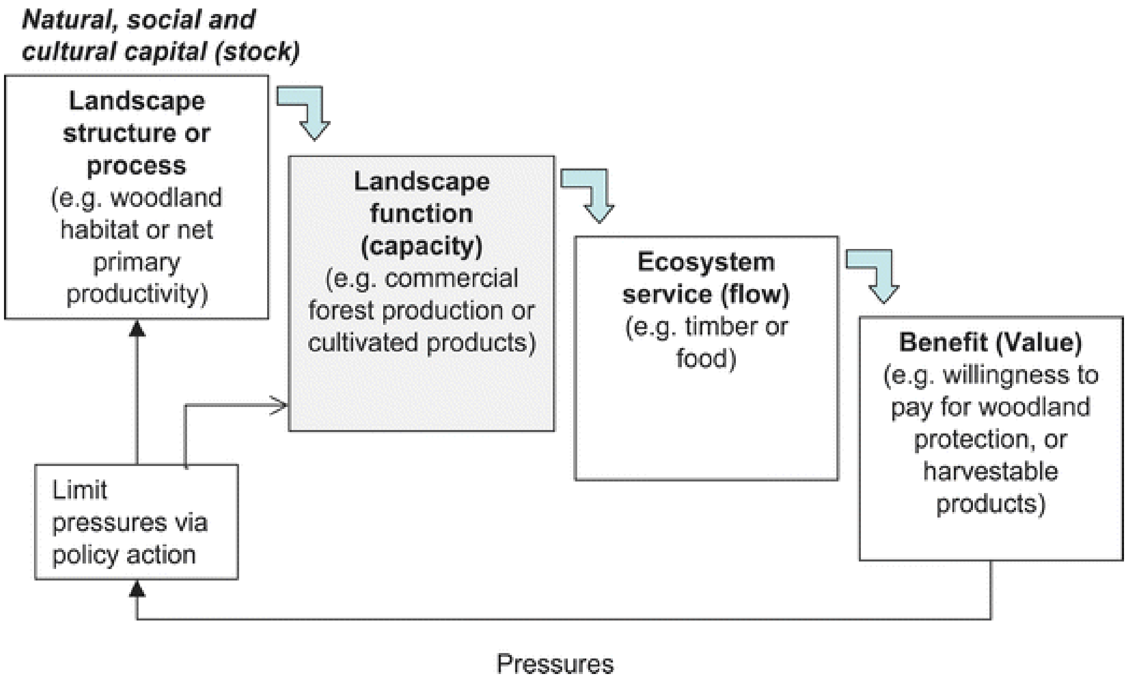
Outline

- Why is mapping ecosystem services is important?
- The Polyscape approach
- Examples from the Cambrian Mountains

Land Use Consultants and **Bangor University** working with
The Countryside Council for Wales and the **Cambrian Mountains Initiative**

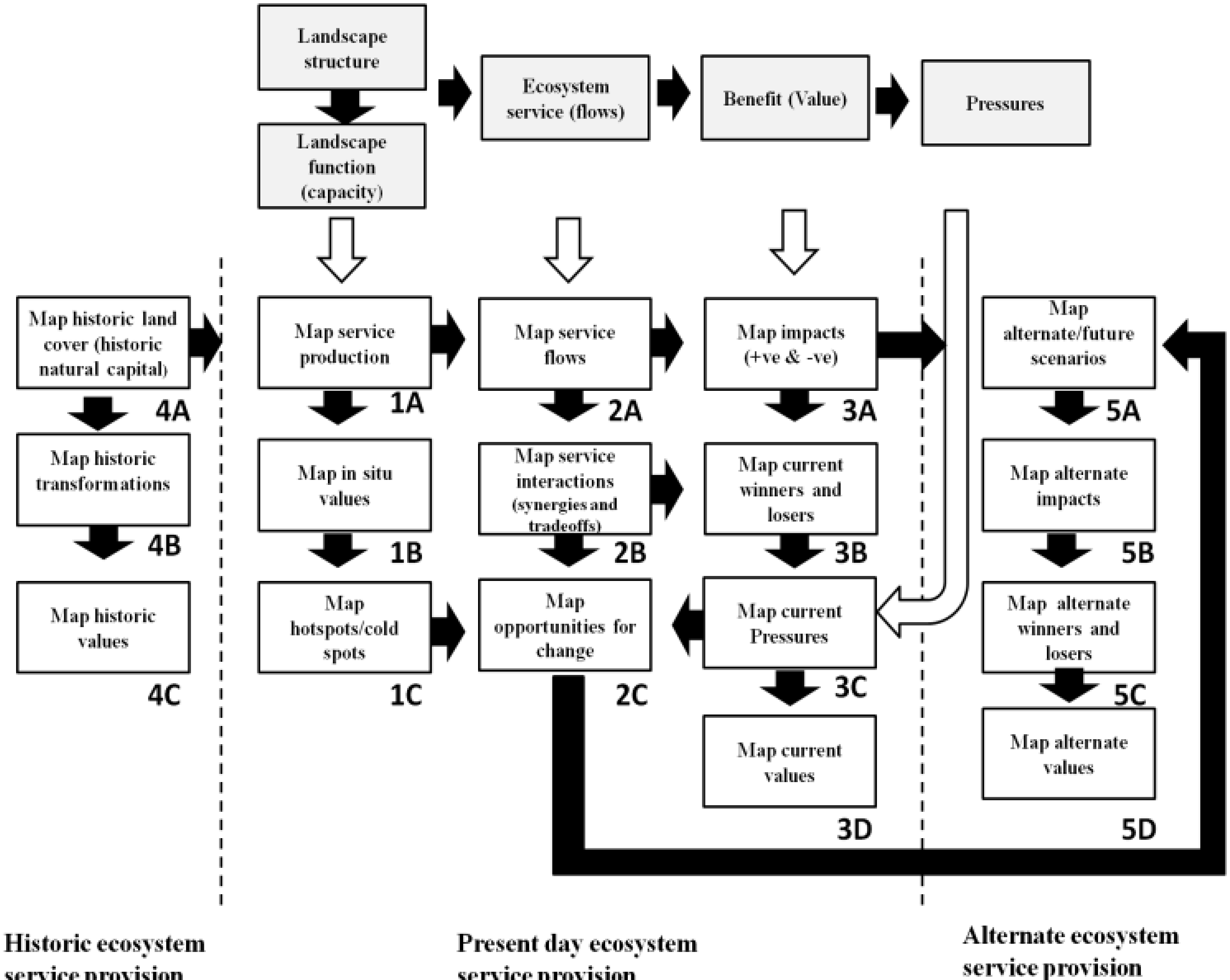
Spatial dimensions of Ecosystem services



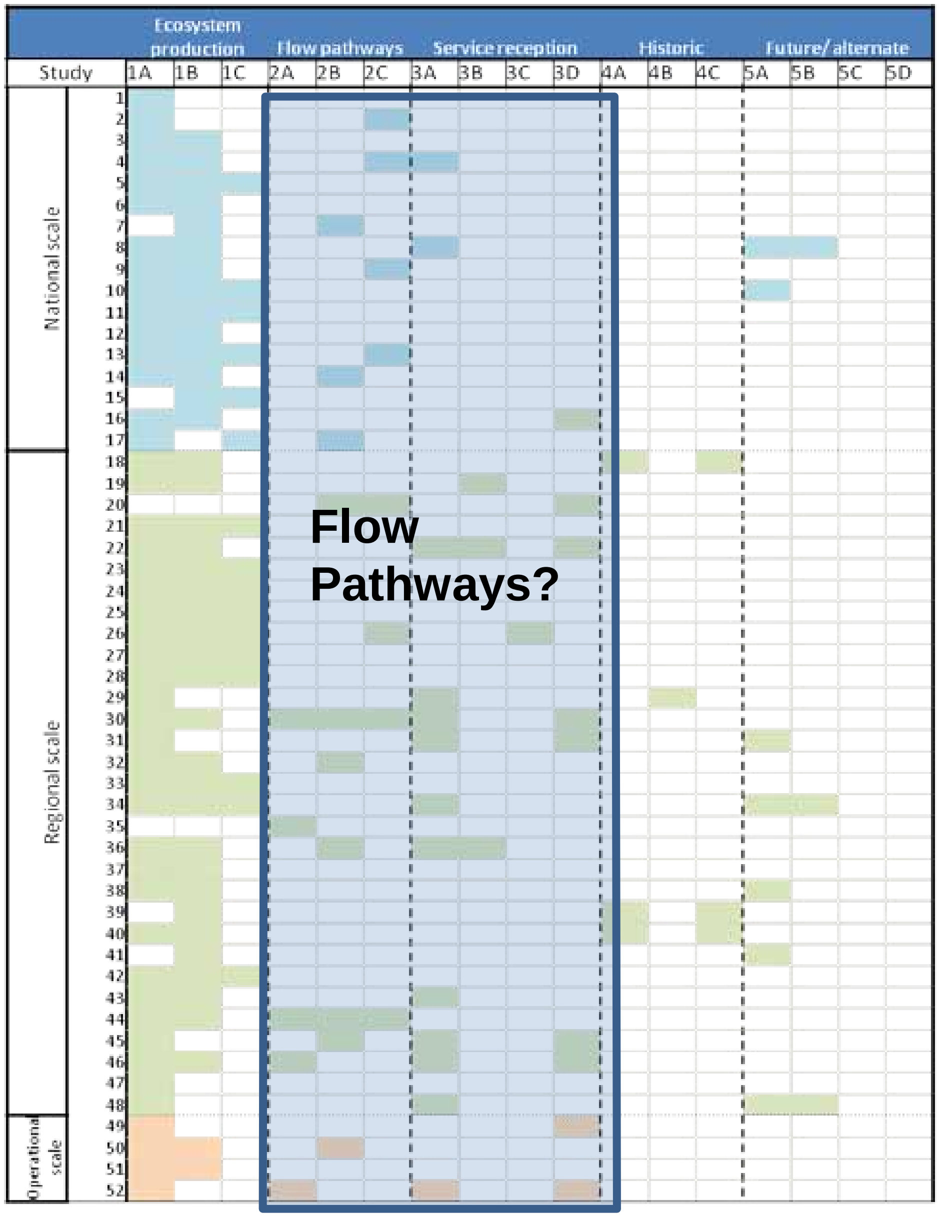
Generation → **Reception**

Ecosystem services often involve stocks and flows of material or individuals across landscapes: water, soil, carbon, organisms

Mapping requirements for assessing ecosystem service requirements



What methodologies are available now?



50% of studies in last two years

The studies are disaggregated by scale where blue = national scale, green = landscape scale and orange = local scale).

Changing state?

Spatial dimensions of Ecosystem services

The areal extent and spatial configuration of landscape features (trees, ponds, wetlands) affect the flow and the provision of services

Change in land use or management and the presence of landscape features affect multiple ecosystem services simultaneously

Requirements for Polyscape

Incorporate alternative land management options at field and farm scales

Show REGULATING services manifest at larger landscape scales.

- Enable land users to take into consideration the broad spectrum of ecosystem services potentially affected by their management decisions
- Guide the implementation of agri-environmental policy at landscape scales

Stakeholder Negotiation - Background

- Engagement of local people in ecosystem management is fundamental to making operational approaches viable.
- Development of decision support systems capable of operating in complex, data sparse non-linear multi-component systems is challenging.

Polyscape - Initial Specification

- The mapped output needed to integrate across scales from field to ‘landscape’.
- The output needed to be spatially explicit
- Multiple services need to be mapped together
- To be useful in any landscape the tool must be able to utilise generally available data in the first instance.
- Integrate scientific evidence with **local knowledge**.
- The output should support the implementation of policy at landscape scales.

Polyscape specification

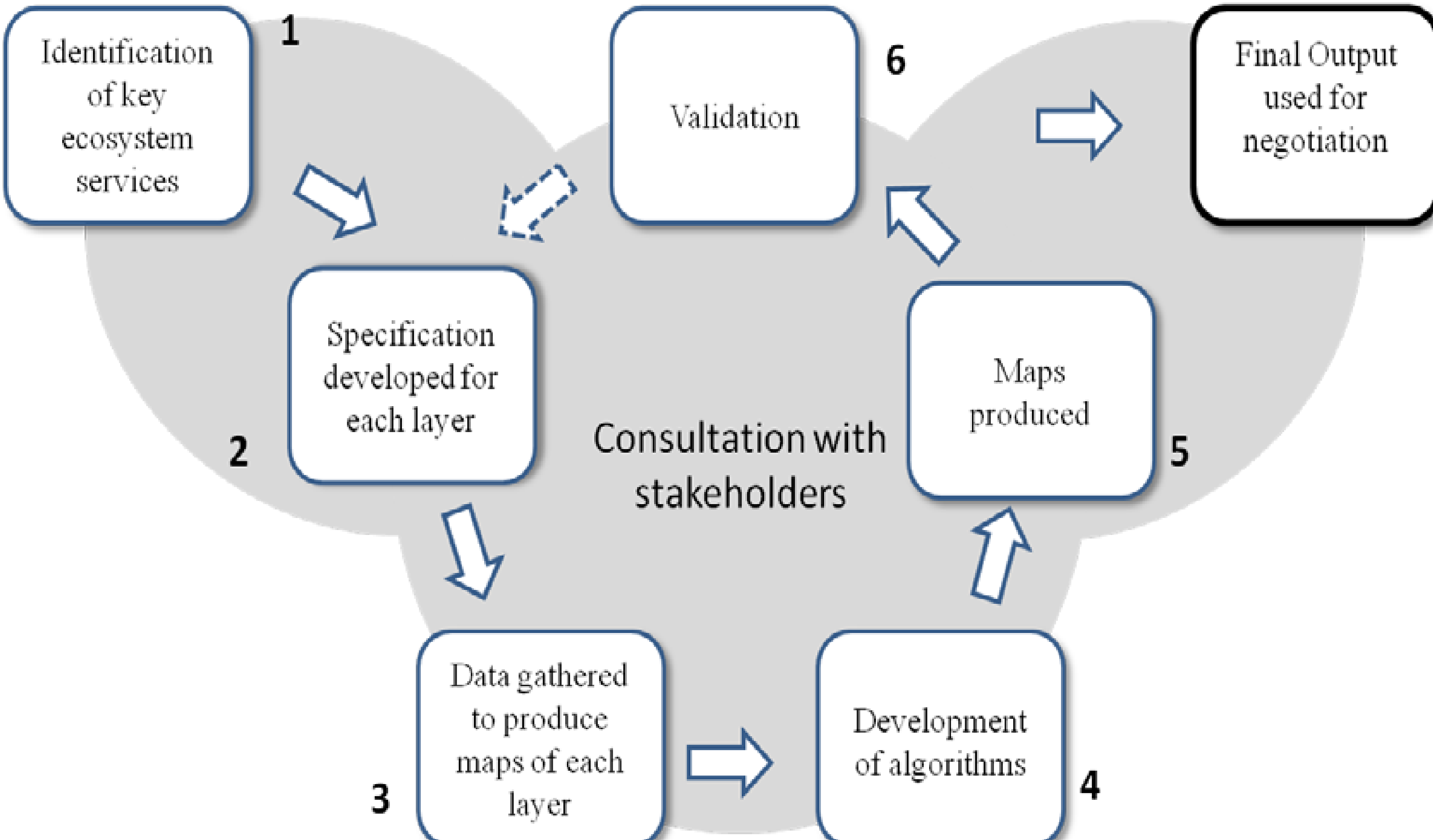
- Designed as a negotiation tool not as a prescriptive model
- Works for any landscape, embracing the reality of 'data sparse' environments, using national scale digital elevation, land use/cover and soil data
- Algorithms for each layer run quickly in real time so that scenarios can be explored with stakeholders
- Works at **local** scales with resolution appropriate for field decisions considering small (10 km^2) to medium (1000 km^2) landscape contexts

Polyscape - a multiple criteria GIS toolbox

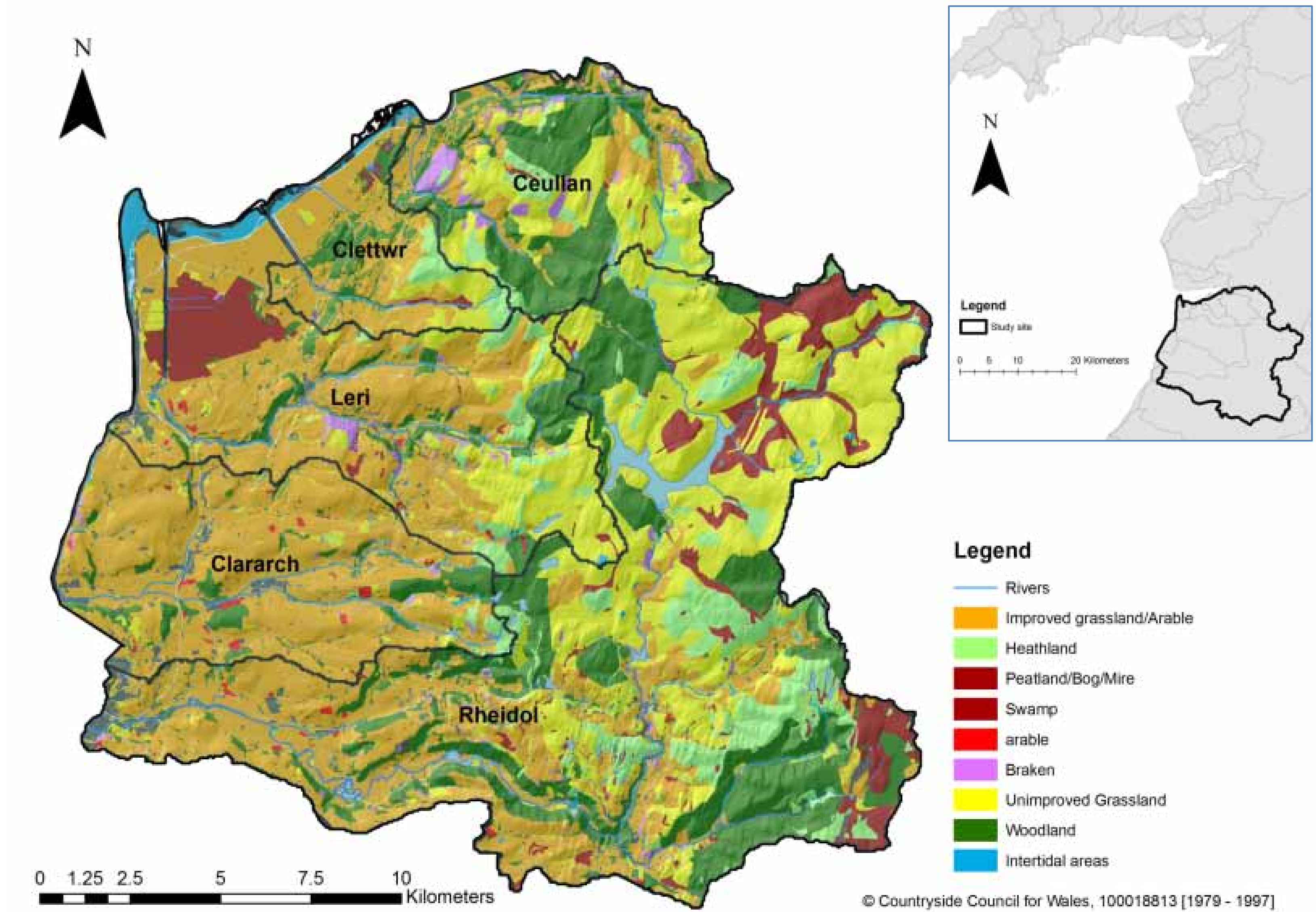
- Spatially explicit evaluation of synergies and trade-offs in the location of trees on **water regulation**, **farm productivity**, ***sediment transport*****, carbon storage** and **biodiversity** (woodland habitat connectivity/priority habitat)

- Incorporates participatory validation and **local knowledge** about where farmers do and do not want trees or other features
  - *ensures local engagement and ownership*.

Participation and Knowledge Exchange



Cambrian Mountains



Polyscape traffic lights – What single layer colours mean?

Areas with priority for maintaining current land use

- High
- Moderate

Areas with moderate or unknown potential for land use change

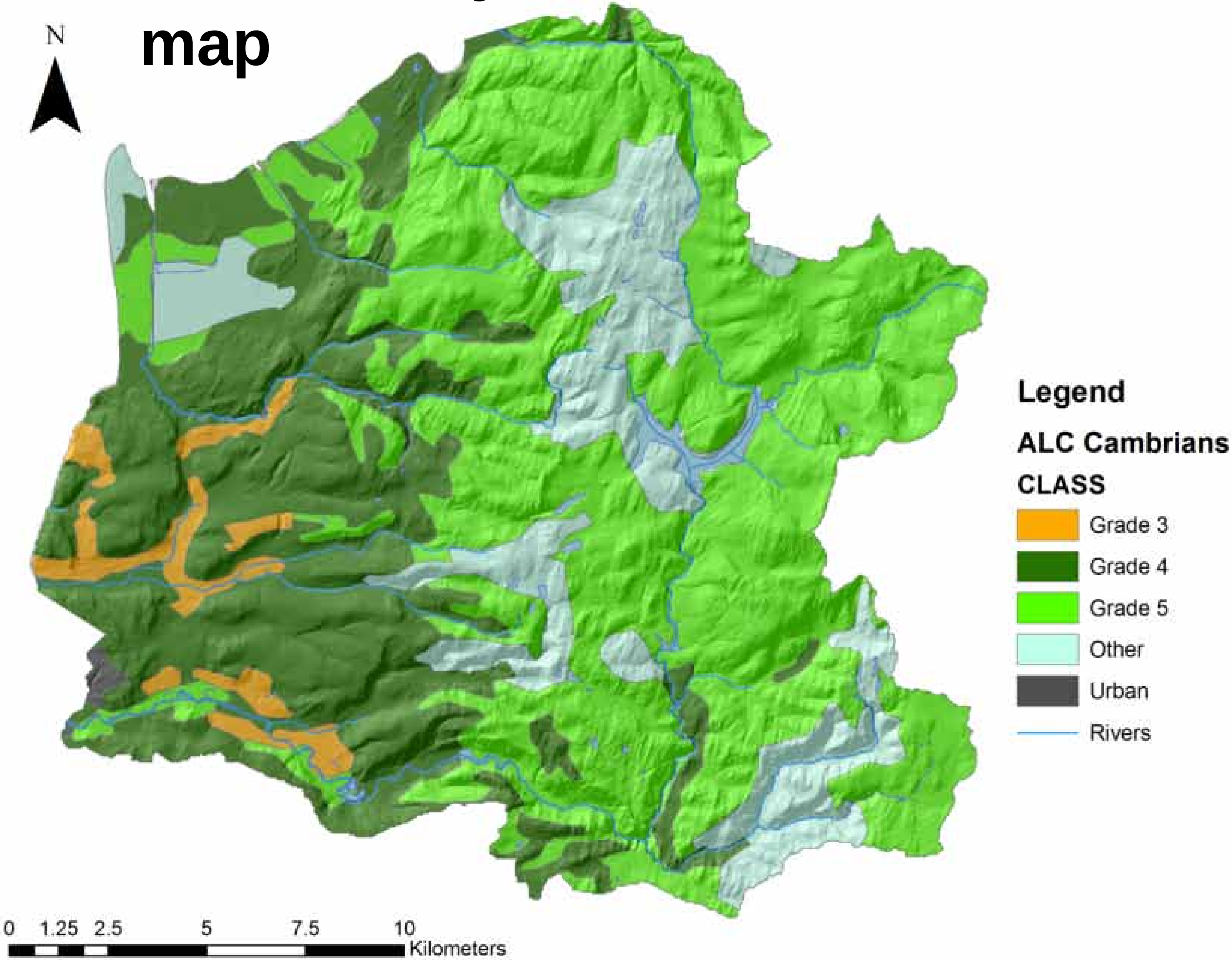
Areas with high priority for land use change

- Moderate
- High

Farm productivity

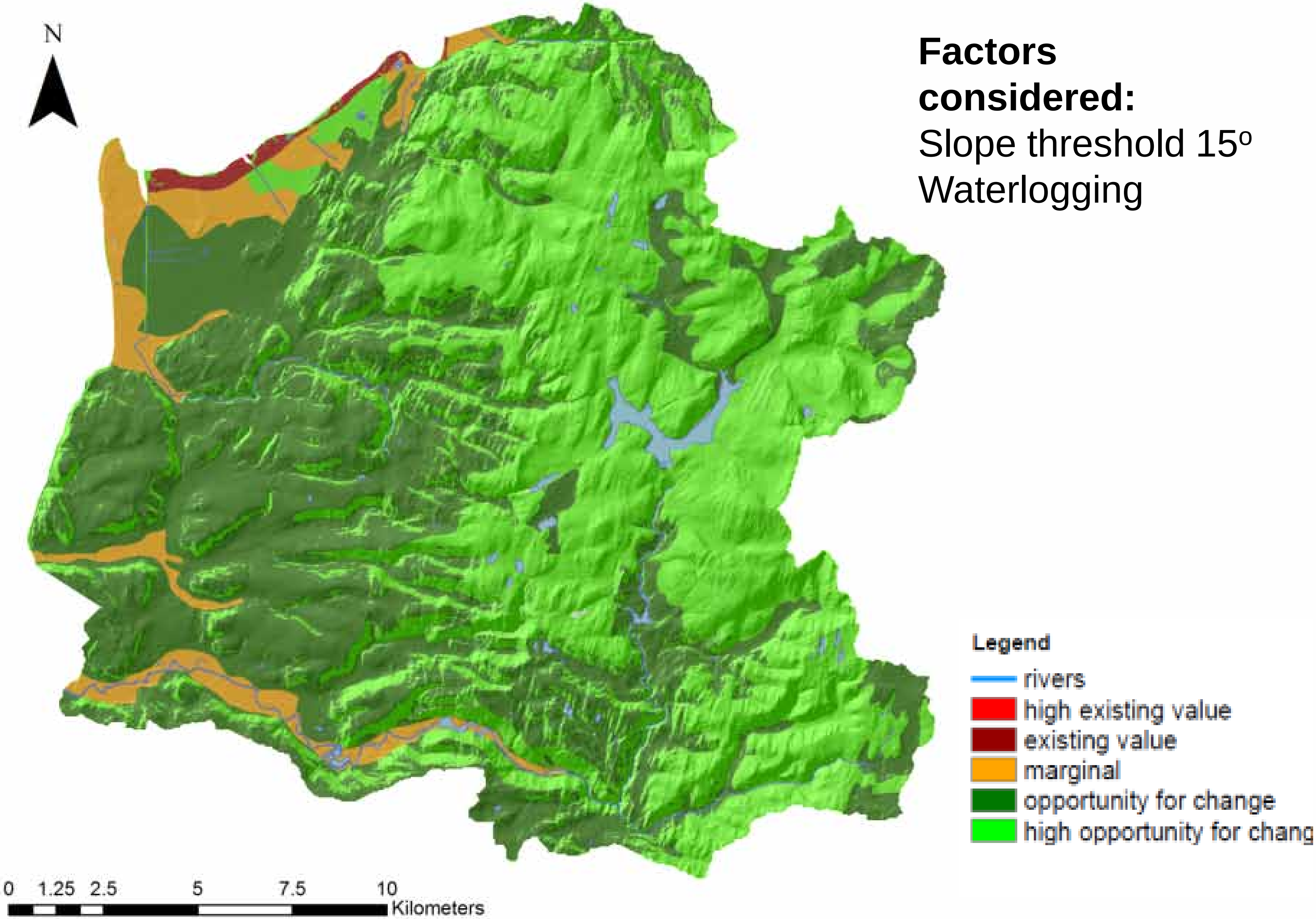
- The base layer (represents farmers' livelihoods)
- Difficult to represent all decisions (idiosyncratic behaviour)
- Inputs are digital elevation, soil type, and critical slope values
- The algorithm categorises land value according to its degree of waterlogging, fertility and slope

Soil Fertility map

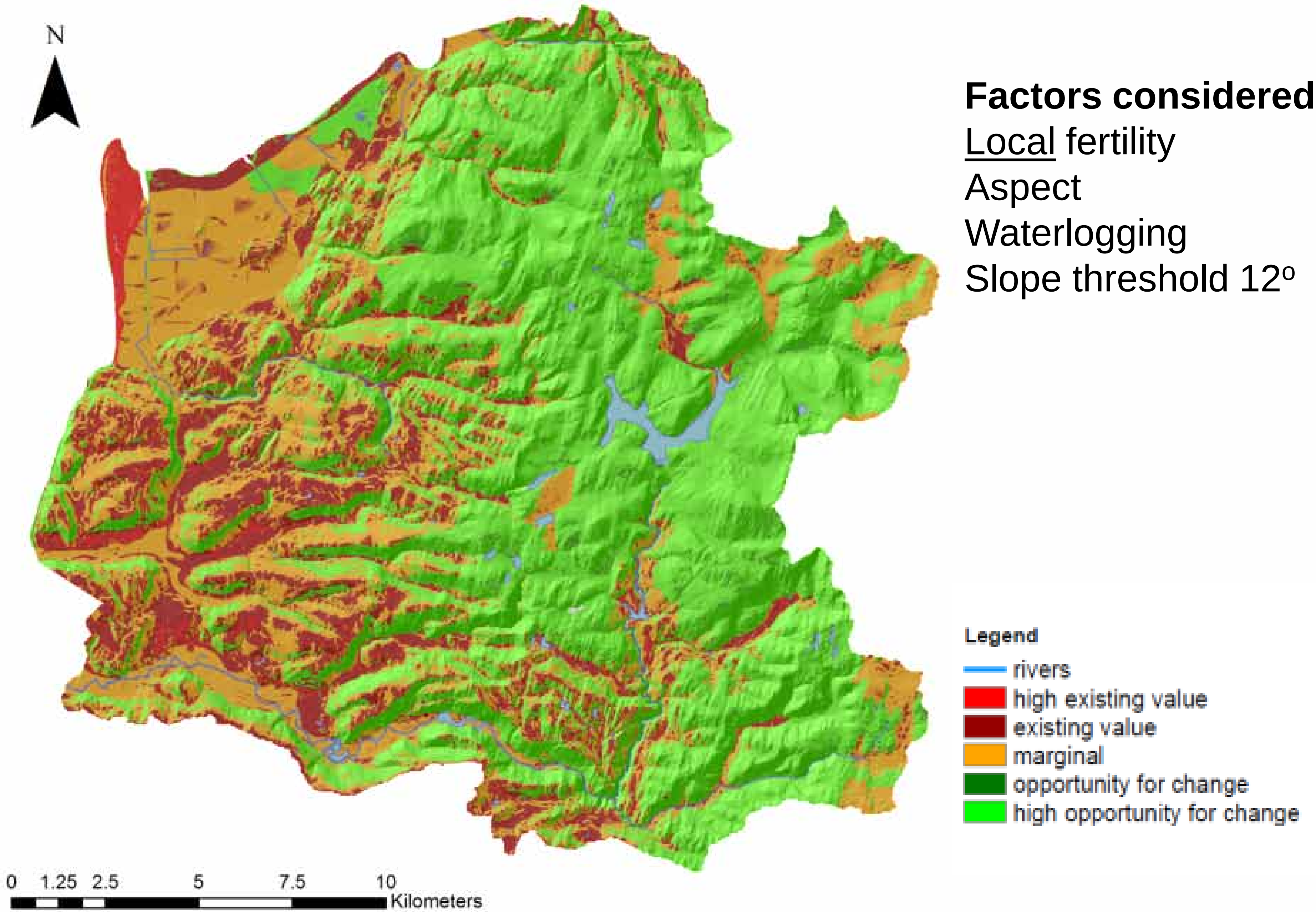


Development of an Agricultural layer

Factors considered:
Slope threshold 15º
Waterlogging



Agricultural impact – farmer reality



Factors considered:

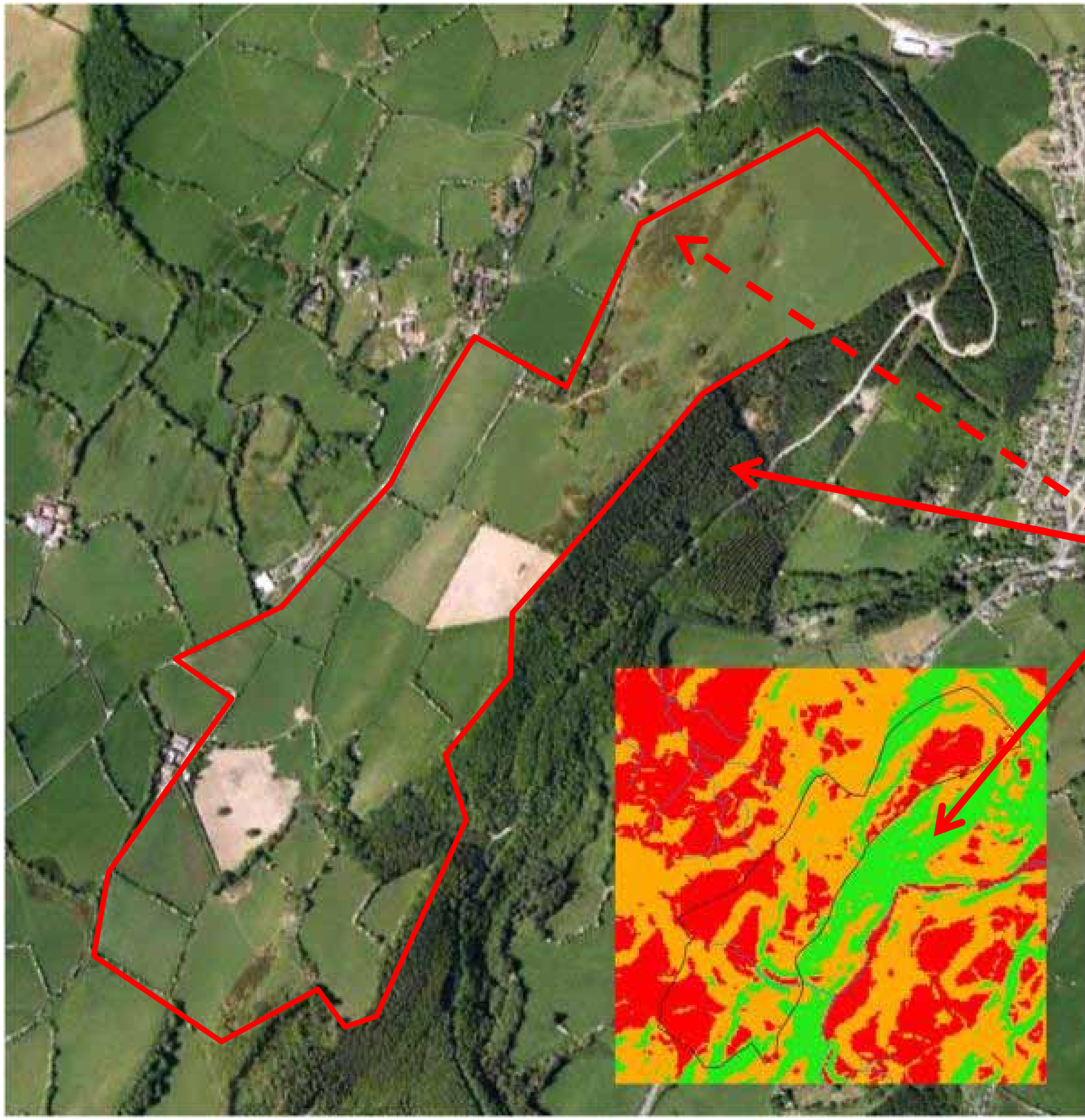
Local fertility

Aspect

Waterlogging

Slope threshold 12º

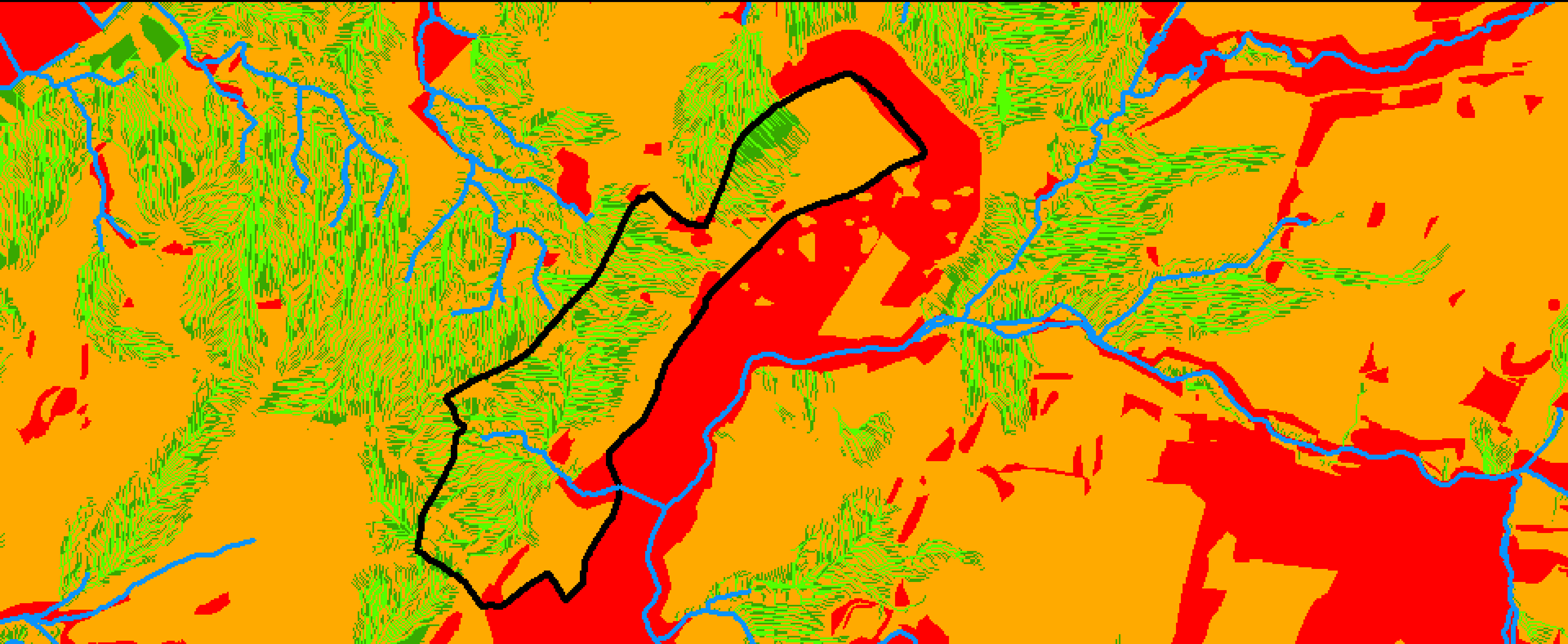
Ground truthing with land owner



Low value to agriculture

Water Regulation

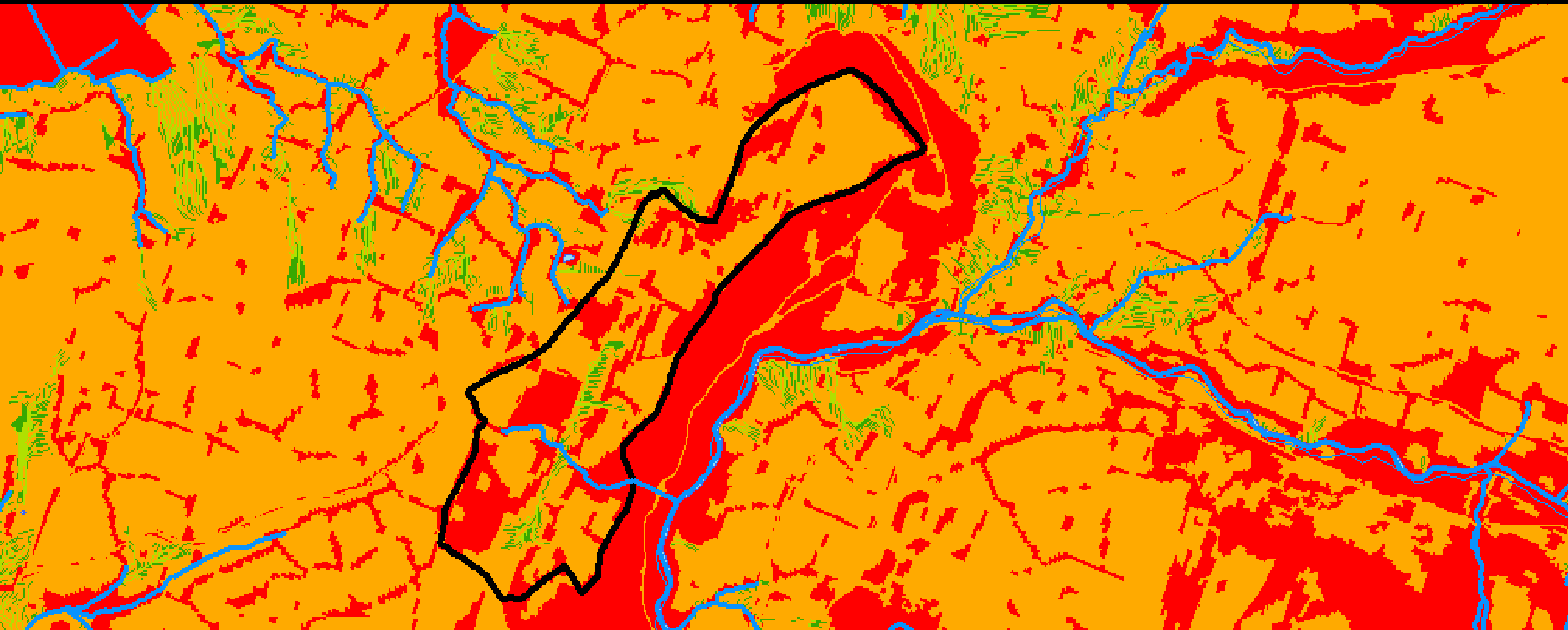
Opportunities for tree planting because high flow (grassland with > 500 m^2 contribution, green); Moderate Flow 100 – 500 m^2; negligible flow, with <100 m^2 contribution (orange); already has trees or other flow sinks (red).



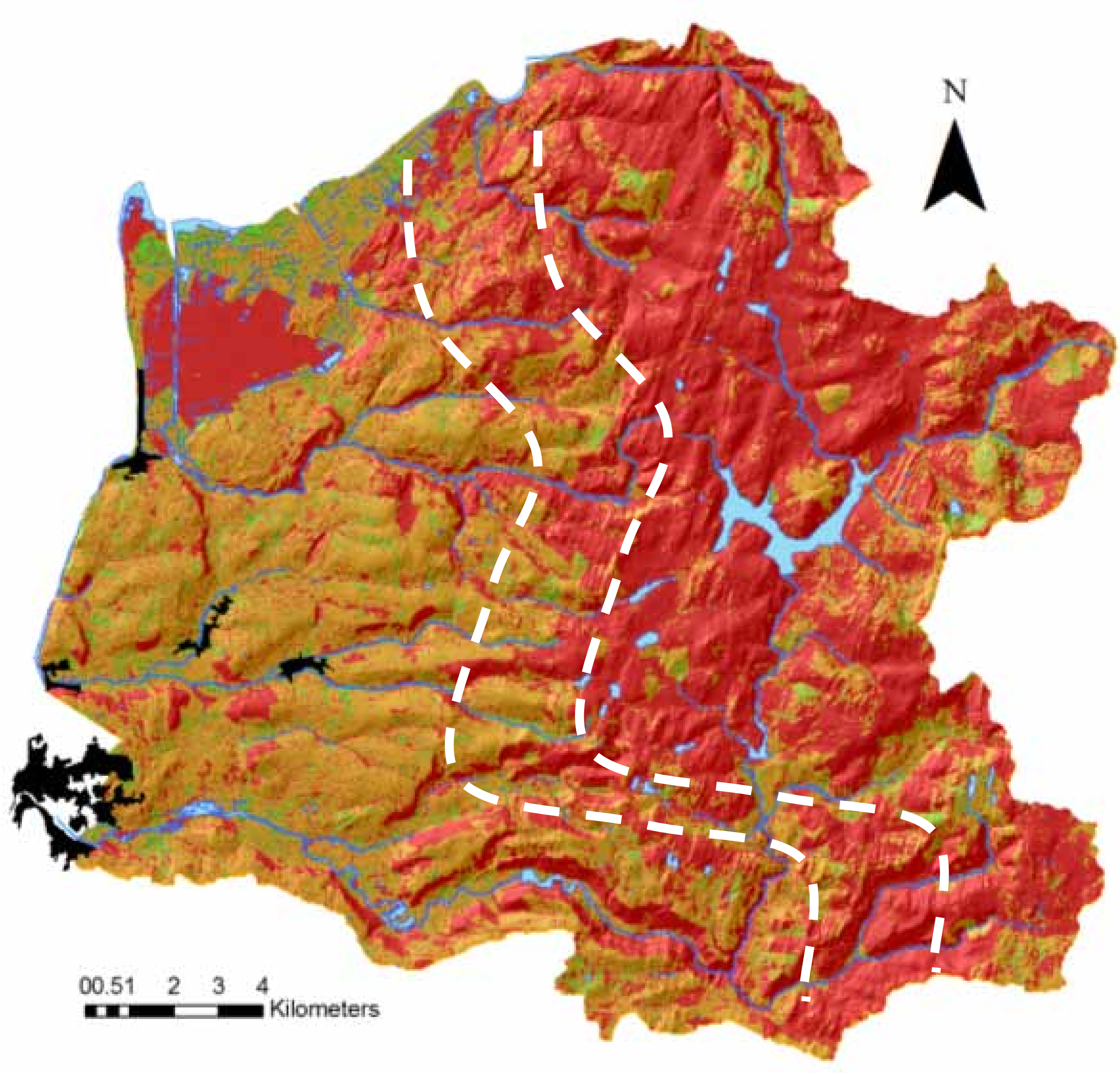
Water Regulation

Cambrian Mountains – Access to remote sensed land use data

Incorporation Higher Resolution Data

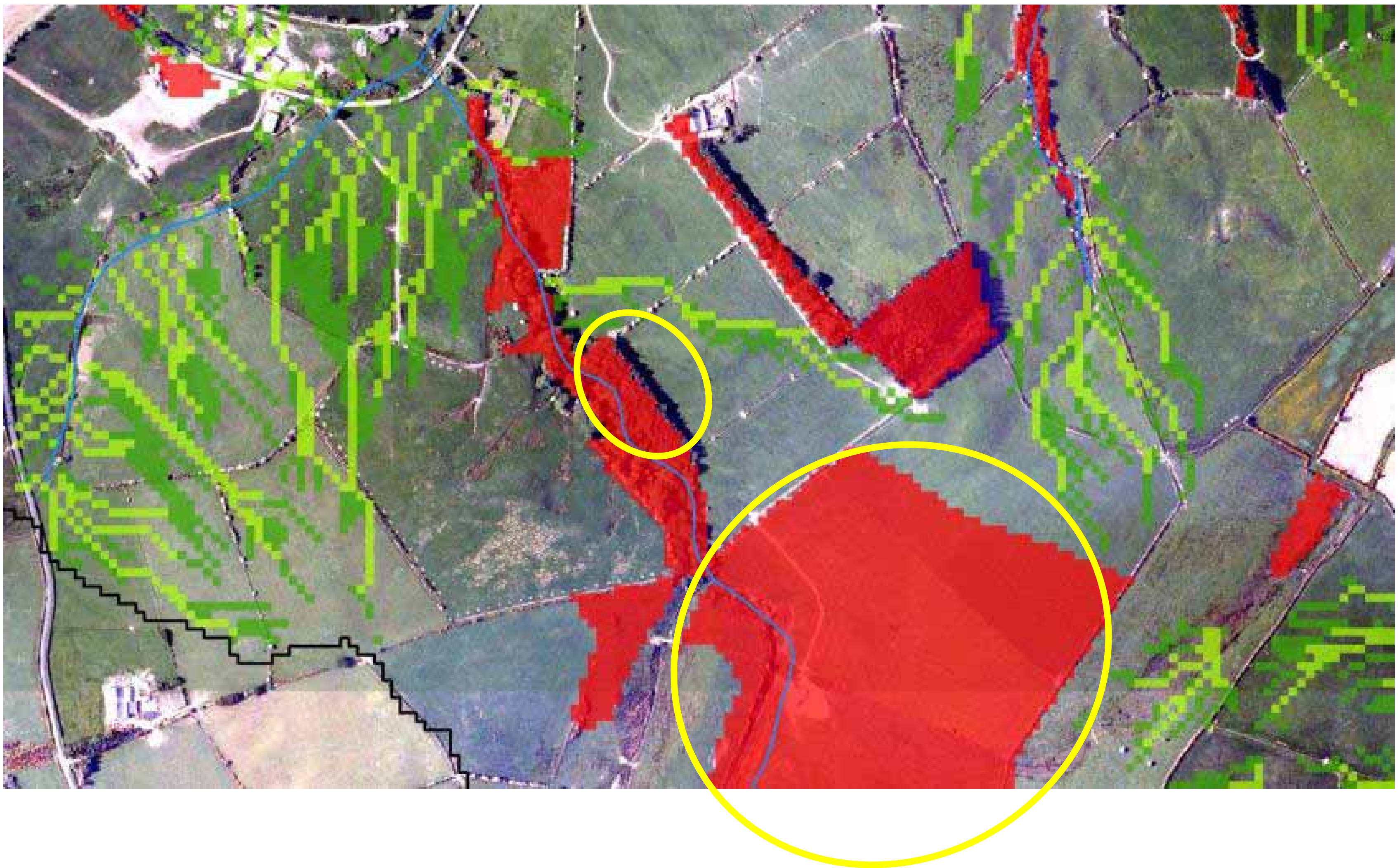


Opportunities for run-off reductions

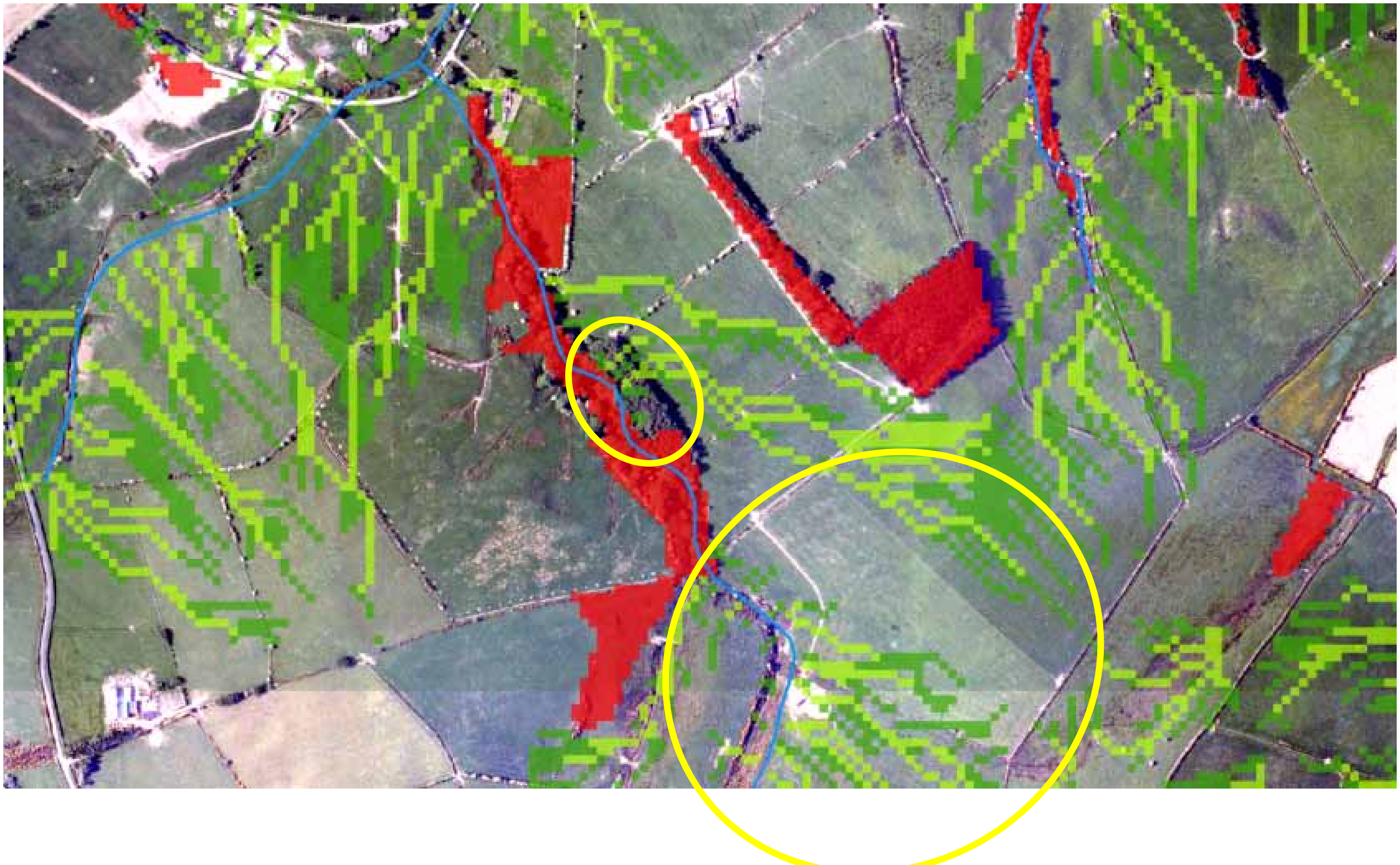


- Areas of peat soils and most of upland headwaters shown as ‘sinks’ or ‘stores’ of run-off.
- Greatest opportunity for interventions to reduce run-off are on impervious soils on steep slopes.

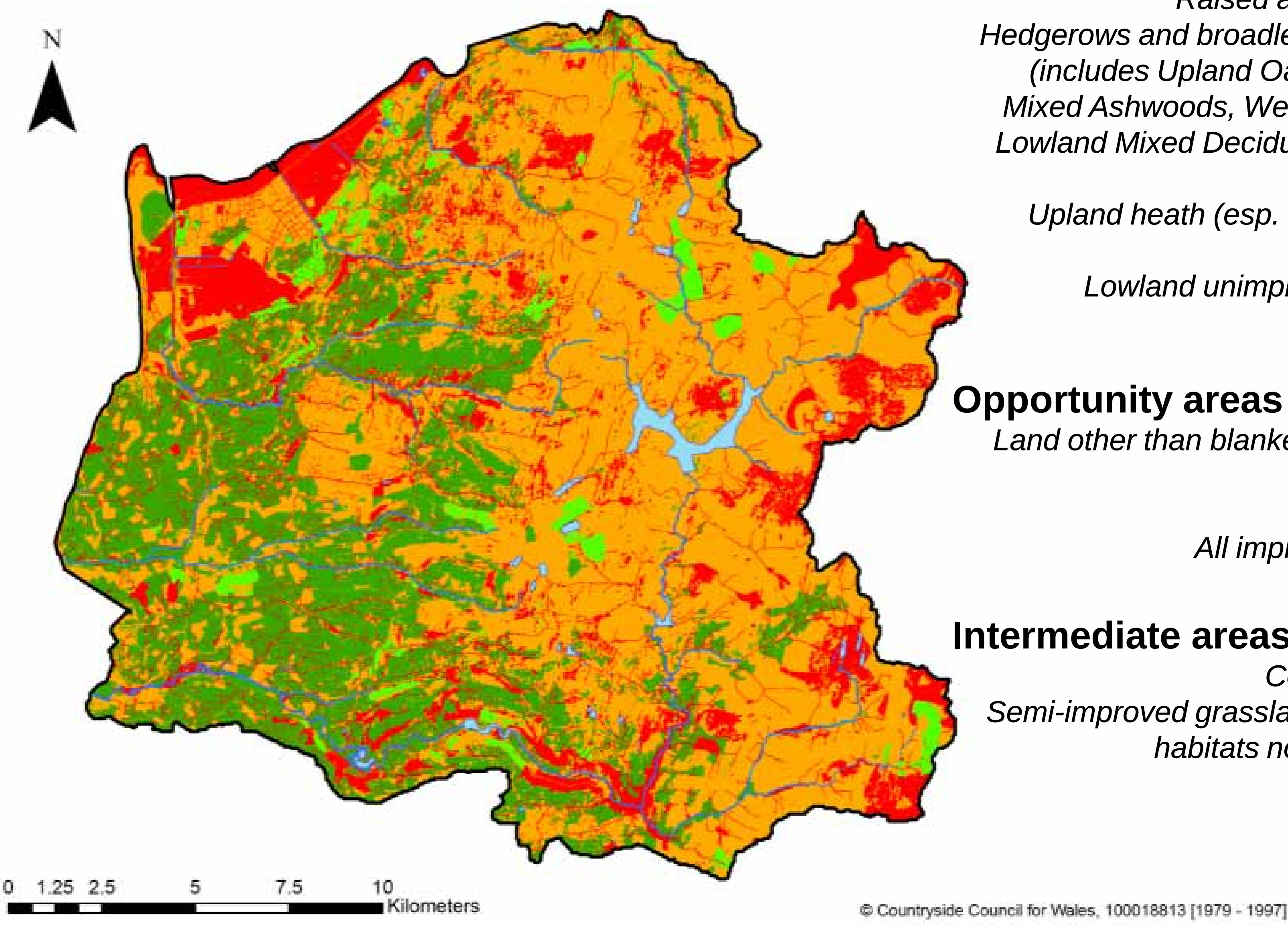
Before ground truthing – large red wetland



After ground truthing – wetland converted to field and coniferous riparian woodland cut



Biodiversity



Safeguarded sites and habitats

Raised and blanked bog
Hedgerows and broadleaved woodland (includes Upland Oakwood, Upland Mixed Ashwoods, Wet Woodland and Lowland Mixed Deciduous Woodland)
Lowland heath
Upland heath (esp. adjacent to acid grassland)
Lowland unimproved grassland
Saltmarsh
River corridors

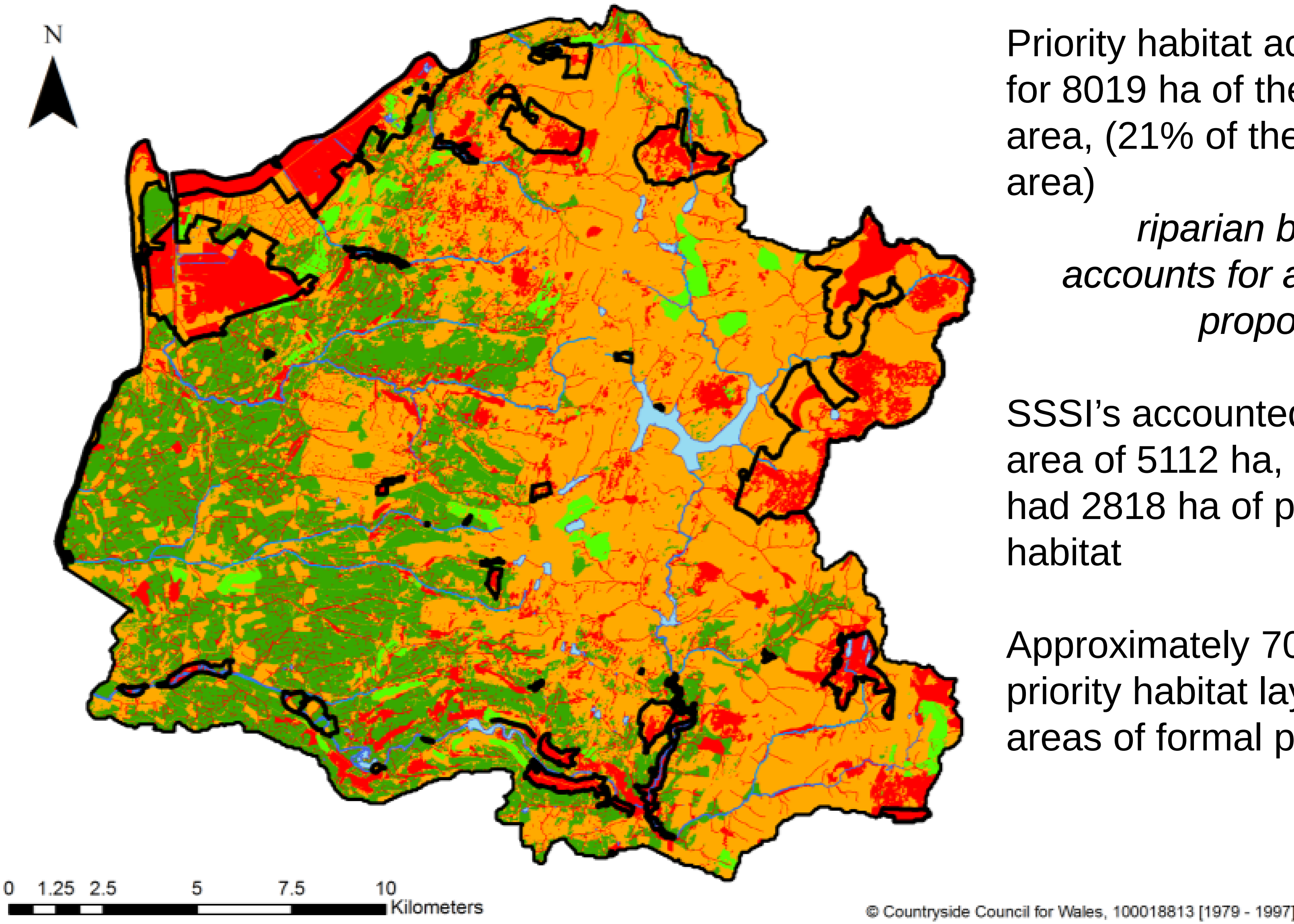
Opportunity areas

Land other than blanket bog over peat soils
PAWS
All improved grassland

Intermediate areas

Conifer woodland
Semi-improved grassland and all other habitats not accounted for

Biodiversity



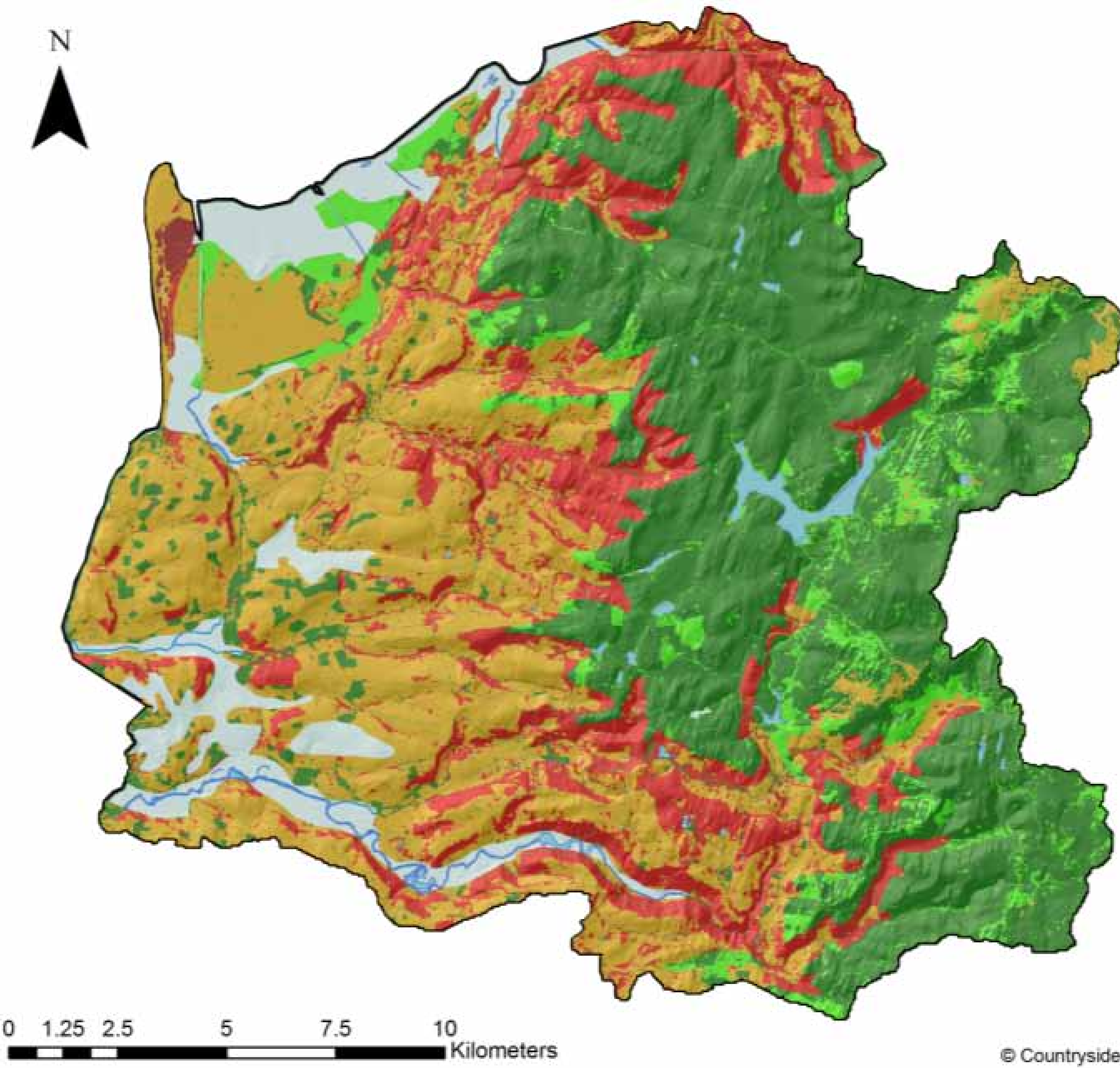
Priority habitat accounted for 8019 ha of the study area, (21% of the total area)

riparian buffer (10m) accounts for a significant proportion of this

SSSI's accounted for an area of 5112 ha, but only had 2818 ha of priority habitat

Approximately 70% of the priority habitat lay outside areas of formal protection.

Carbon Storage



Based on reasonable but crude approximations of soil carbon stocks in the catchment

Second figure:
Show areas where carbon is in a steady state in the catchment (orange) and areas that are actively storing (red) or potentially losing carbon (green)

Trade-off layer

Numerical score allocated to each zone

Combining layers in Polyscape

-2	-1	0	1	2

Additive approach taken to combining layers

Example

Layer A	-1	=	1	Combined layer
+ Layer B	2			

Combining layers in Polyscape

What trade-off layer colours mean?

1. A 'Conservative' approach:

Layer A -1

\+ Layer B 2

= -1 Combined layer

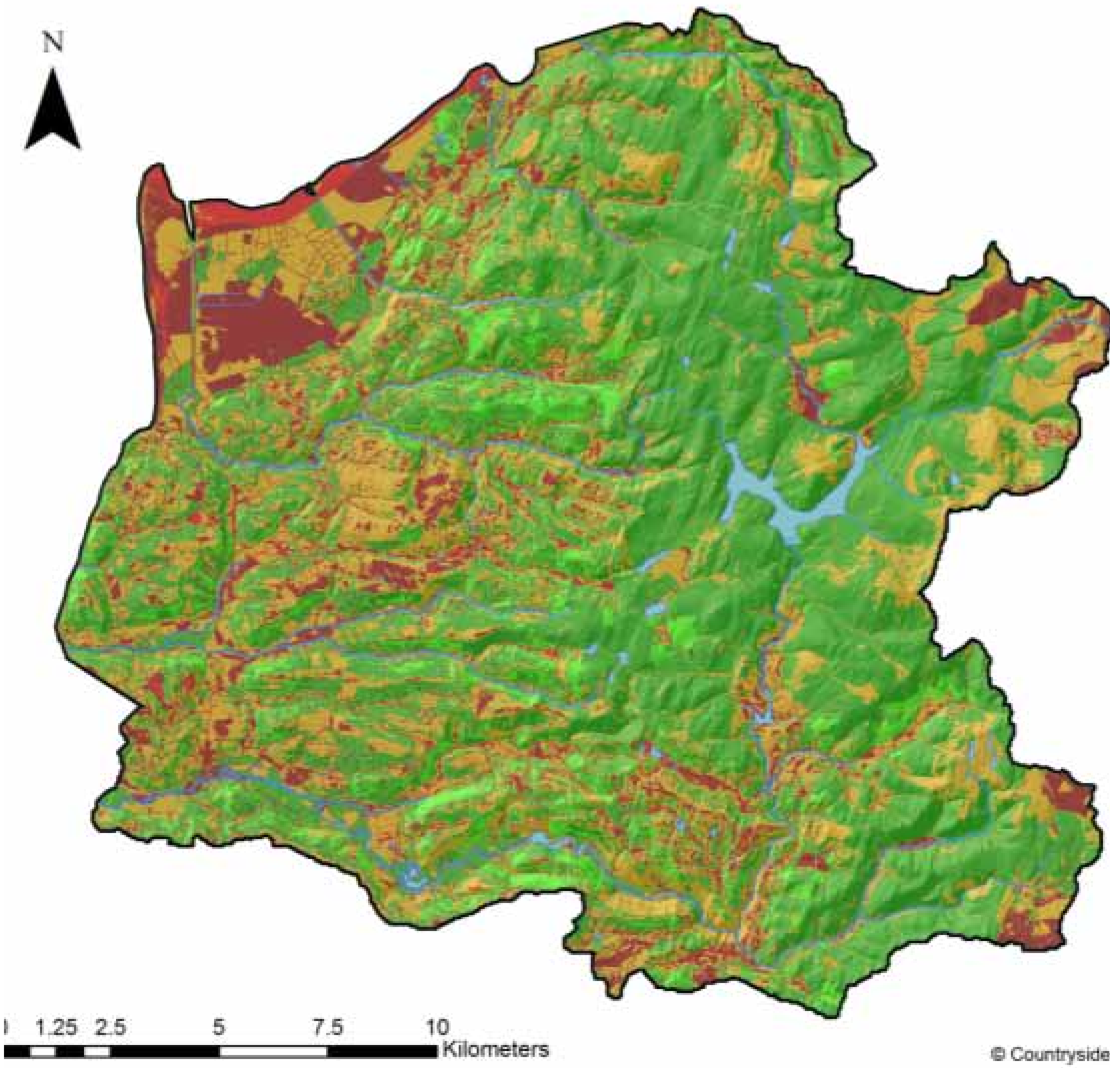
2. A 'Opportunistic' approach:

Layer A -1

\+ Layer B 2

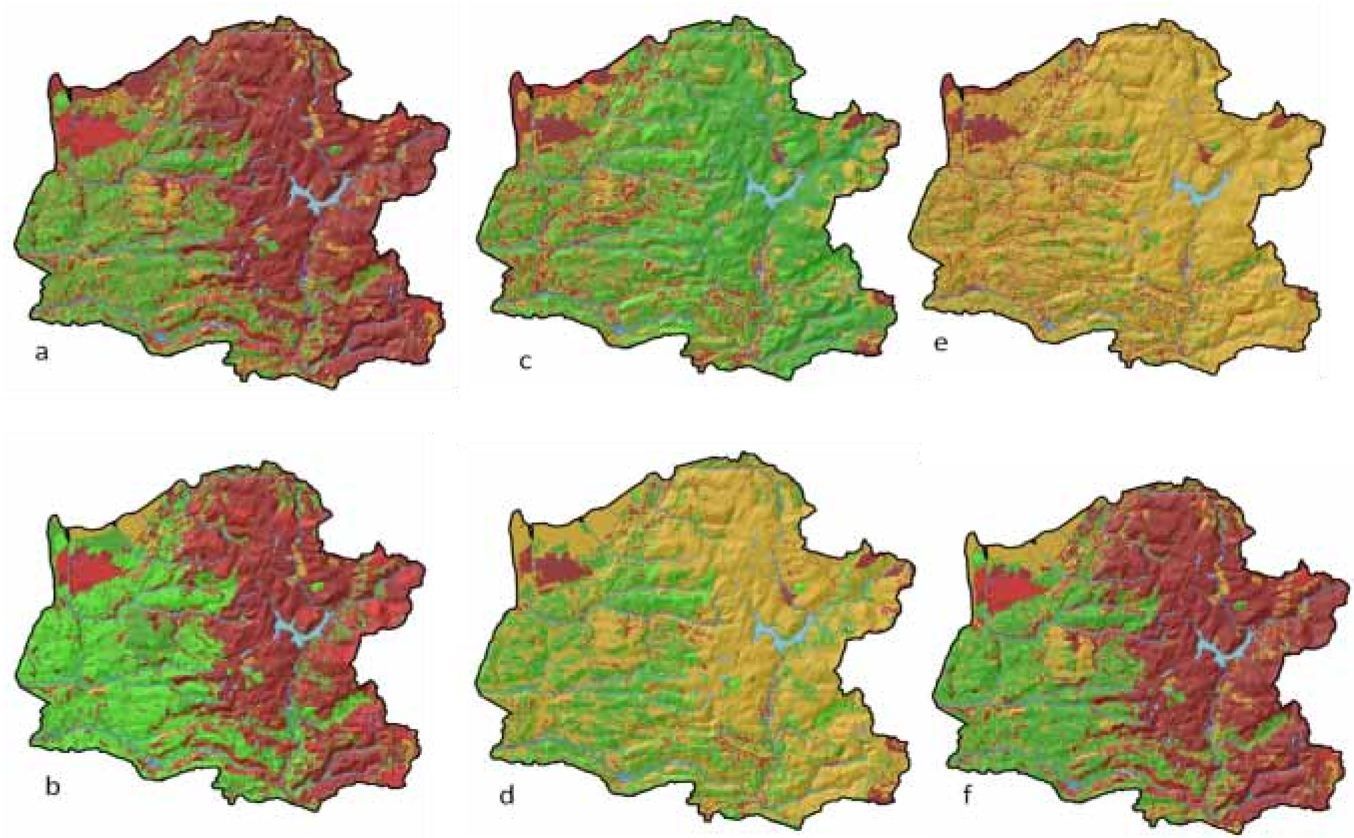
= 2 Combined layer

Trade-off between agricultural impact and habitats



Green areas identify synergies amongst ecosystem services (light green areas are positive for both services, and dark green are positive for one and neutral for the other) while red areas indicate tradeoffs.

Trade off maps



(a) habitat vs. water regulation; (b) habitat vs. carbon sequestration; (c) habitat vs. agriculture ; (d) habitat vs. agriculture vs. carbon sequestration (e) habitat vs. agriculture vs. water regulation and (f) habitat vs. water regulation vs. carbon.

Synergy amongst ecosystem services

Area (ha)	Ecosystem Services						
	H & A	H & WR	H & CS	H, A & CS	H, A & WR	H, WR & CS	Trade all
Total win-win area	2096	759.2	9191.2	1779	108.8	758.8	102.5
Win-win area inside SSSI	44.8	13.2	124.9	33.6	2.5	13.1	2.3
Win-win outside protected areas	**2051.2**	746	9066.3	1745.4	106.3	745.7	100.2

Key: H = Habitat; A = Agriculture; WR = Water Regulation; CS= Carbon sequestration

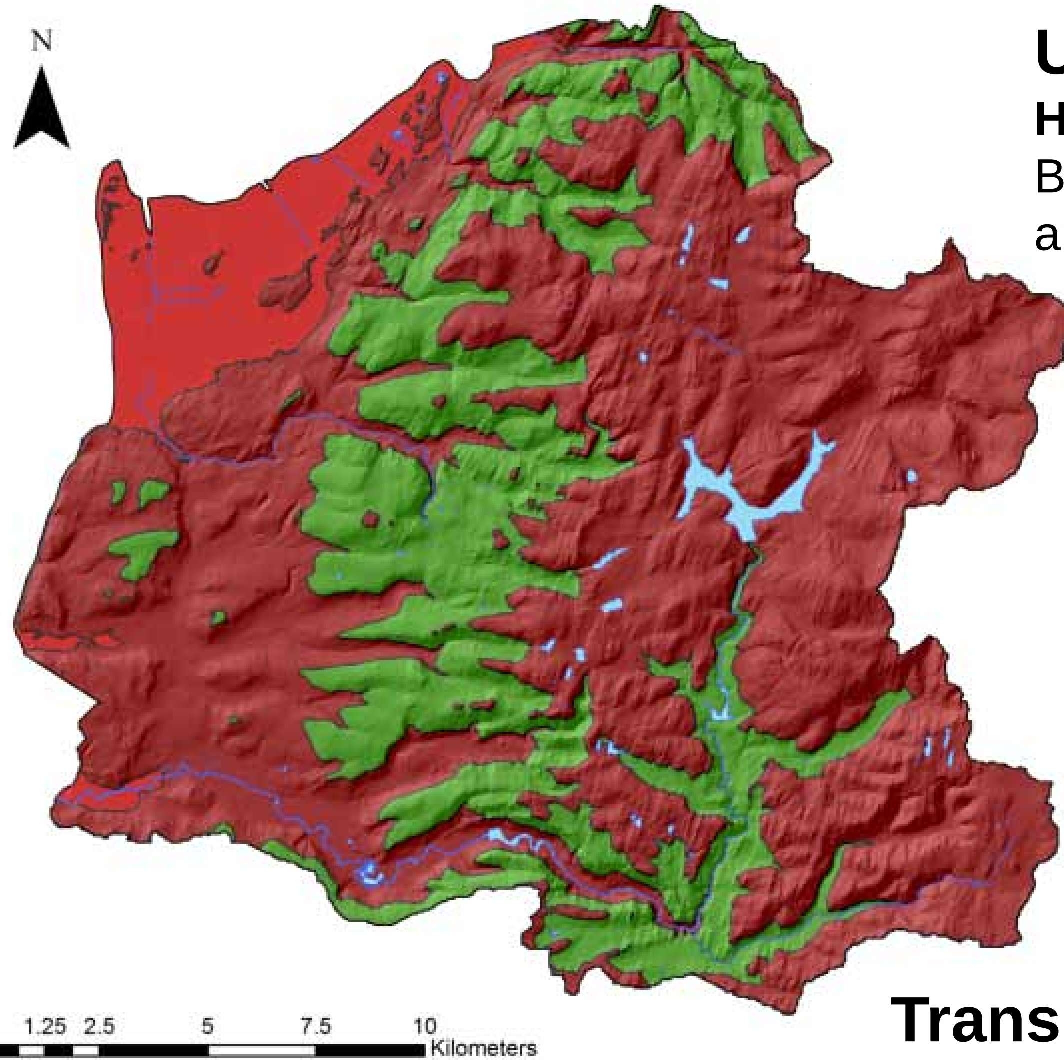
2051 ha of land was identified as of low value to farming but as high value as priority habitat.

Approximately half of this area (488 ha) falls within the high priority for change category of the first habitat map

Transition Zone

Coastal areas
New rules?

Lowlands
High value for Agriculture, biodiversity and Carbon



Uplands
High value for Biodiversity, Carbon and Water regulation

Transition
(Ffridd)
Area of opportunity?

Key findings

The real value of the approach documented here (and noted by all stakeholders) was the **process of map development** rather than the ‘final’ output produced.

The iterative cycle of discussion and collective analysis associated with creating Polyscape layers allows stakeholders a platform to debate issues on relatively equal footing.

Given the uncertainties the output from Polyscape should not be used for proscriptive decision making in isolation (although it should inform that process and clearly has a role for identifying key knowledge gaps)

The farmers who participated in the evaluation were satisfied that the maps provided a representative version of ‘their’ landscape that could be used as the basis for further negotiation
(*with a major caveat that soil data needed improvement*).

Conclusions

- There is a strong need to implement policy at local scales for effective ecosystem management.
- This requires methodologies and tools that produce mapped output as a basis for collective decision taking (and assessment of impacts of taking decisions and making change)
- Decentralised and integrated governance structures amongst agencies and training in participatory methodology are also required.
- Polyscape provides a tangible framework for doing this could be central plank in shifting implementation of land use policy towards locally relevant and integrated ecosystem service provision.