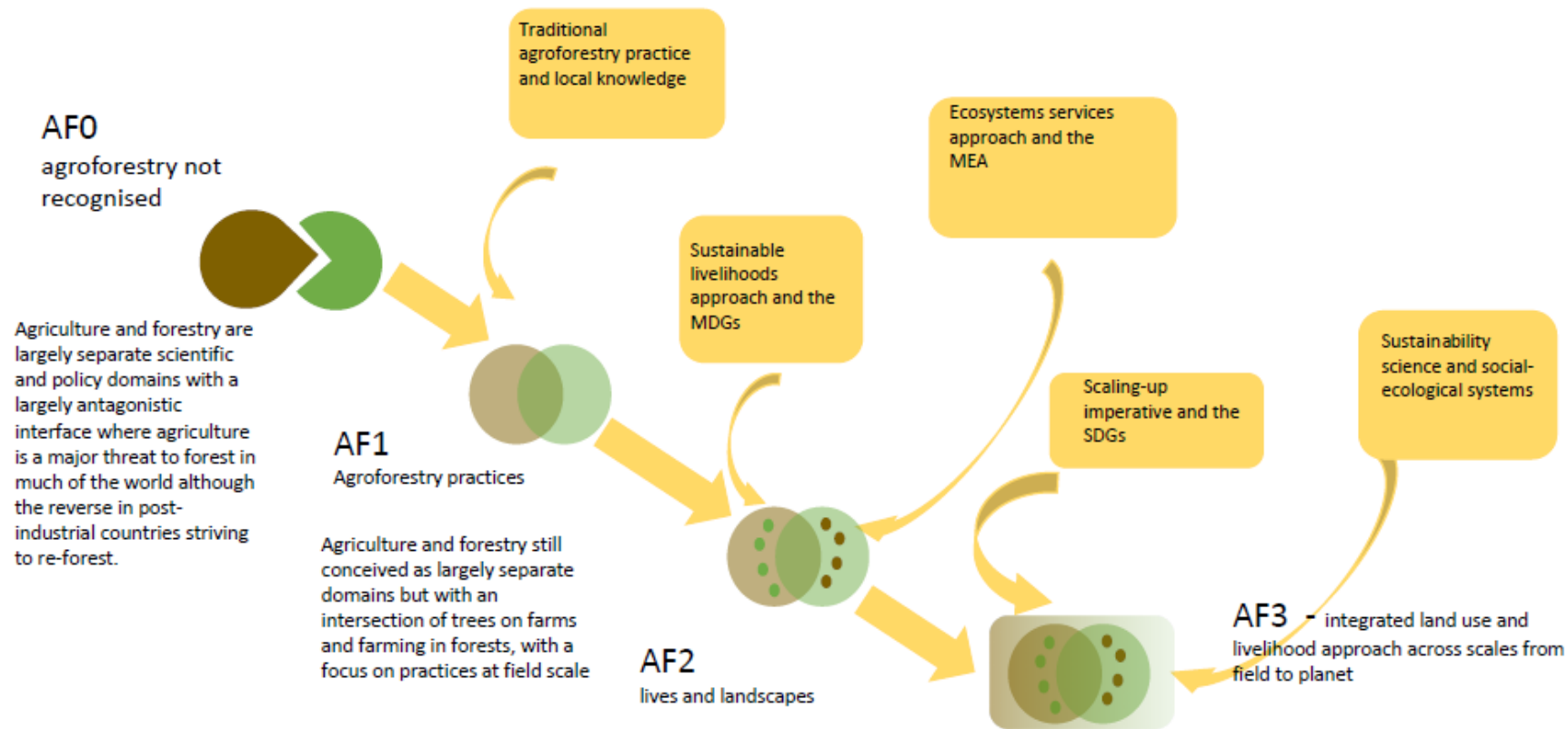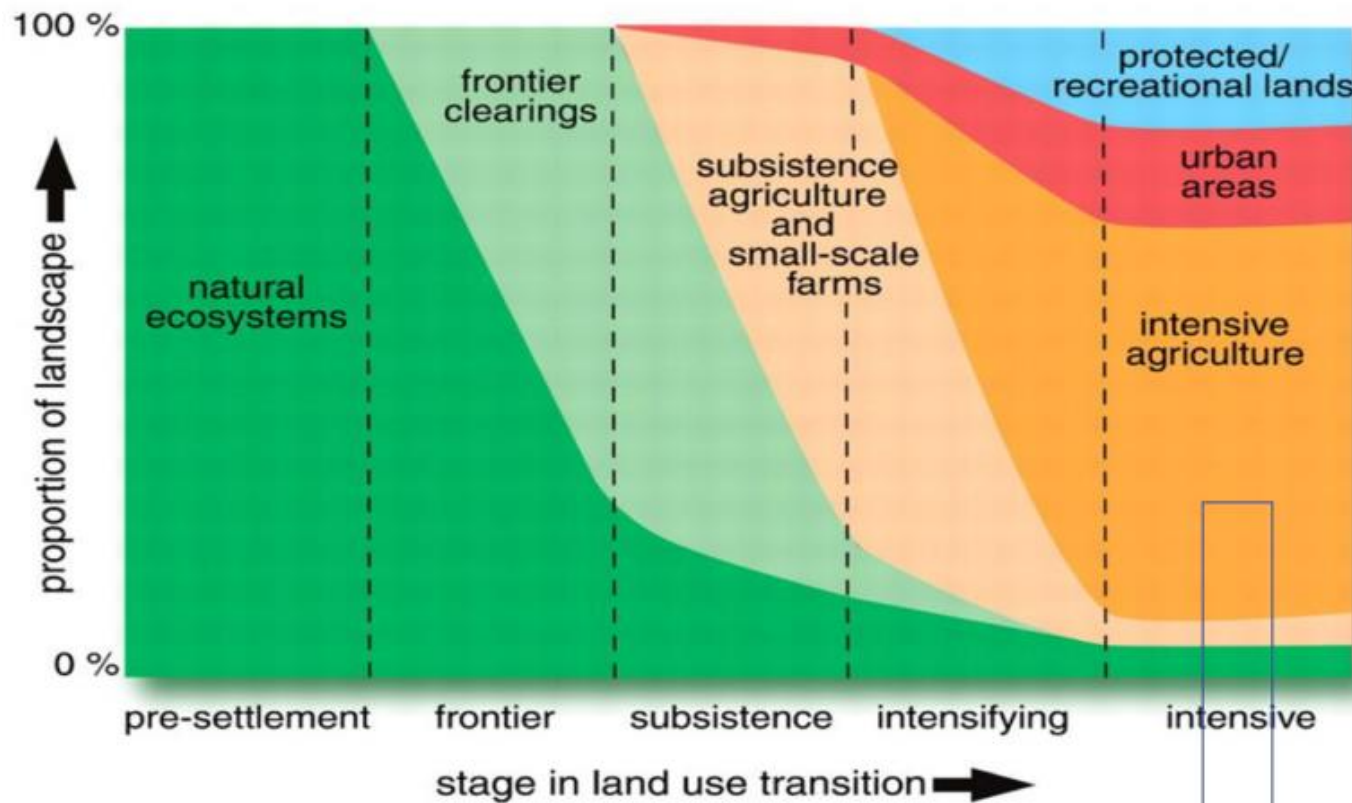# Triggering adoption

What is needed to support greater adoption of agroforestry by farmers and land managers?

Tim Pagella, Bangor University

(with acknowledgements to Fergus Sinclair, ICRAF)

t.pagella@bangor.ac.uk

AF0
agroforestry not recognised

Agriculture and forestry are largely separate scientific and policy domains with a largely antagonistic interface where agriculture is a major threat to forest in much of the world although the reverse in post-industrial countries striving to re-forest.

AF1
Agroforestry practices

Agriculture and forestry still conceived as largely separate domains but with an intersection of trees on farms and farming in forests, with a focus on practices at field scale

AF2
lives and landscapes

Farming livelihoods recognised as going beyond agriculture and agroforestry to encompass mosaic landscapes where interaction of trees (sometimes in forests) occurs across landscapes where many key ecosystem services that tree cover affects first manifest

AF3 - integrated land use and livelihood approach across scales from field to planet

Agroforestry recognised as an umbrella term for all land uses (the union as well as the intersection of agriculture and forestry) and their impact on livelihoods and environment that can be applied across scales (field, landscape, region, markets, policy domains, global change) where trees and agriculture interact at these scales

Traditional agroforestry practice and local knowledge

Sustainable livelihoods approach and the MDGs

Ecosystems services approach and the MEA

Scaling-up imperative and the SDGs

Sustainability science and social-ecological systems

Understanding farmers and landscapes

100 %

proportion of landscape

natural ecosystems

frontier clearings

subsistence agriculture and small-scale farms

protected/ recreational lands

urban areas

intensive agriculture

0 %

pre-settlement   frontier   subsistence   intensifying   intensive

stage in land use transition ➡

Foley, J.A., et. al. 2005. Global consequences of land use. Science, 309(5734), pp. 570-574.

?

Significant loss of ecosystem services

Role of agroforestry?

Achieving sustainable agricultural systems will involve adaptation on a massive scale to meet the future food production challenge at greatly reduced carbon cost

Where are we now?

- Moving towards climate smart agriculture?

- ...If we can't sell farmers the concept of agroforestry after last winter and this summer what's it going to take?

- "Here we evaluate recent progress in agricultural adaptation using surveys in five regions, 21 countries and 45 sites, covering 315 villages and approximately 6300 households.... We find little evidence in the study sites in any region of farming changes at the scale needed to enhance food security of significant proportions of the population"

Thornton et al, 2018

'Smallholder' farmer Livelihood trajectory

Moving Up/Stepping up

Notoriously difficult to measure

Hanging in
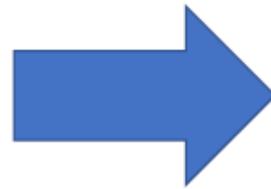
Moving out
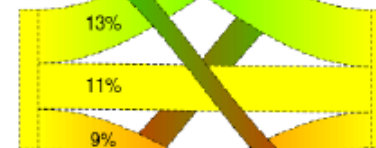
Falling back

First Survey (2012) — All Sites — Second Survey (2015-17)

37% Above Poverty Line — 17% — 13% — 7% — 41% Above Poverty Line
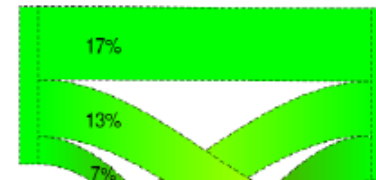
33% Below Poverty Line — 13% — 11% — 9% — 33% Below Poverty Line

30% Below Calorie Line — 11% — 8% — 11% — 27% Below Calorie Line

James Hammond: http://rhomis.net/blog/

Dorward, et al 2009. Hanging in, stepping up and stepping out: livelihood aspirations and strategies of the poor. Dev. Practice 19 (2), 240–247
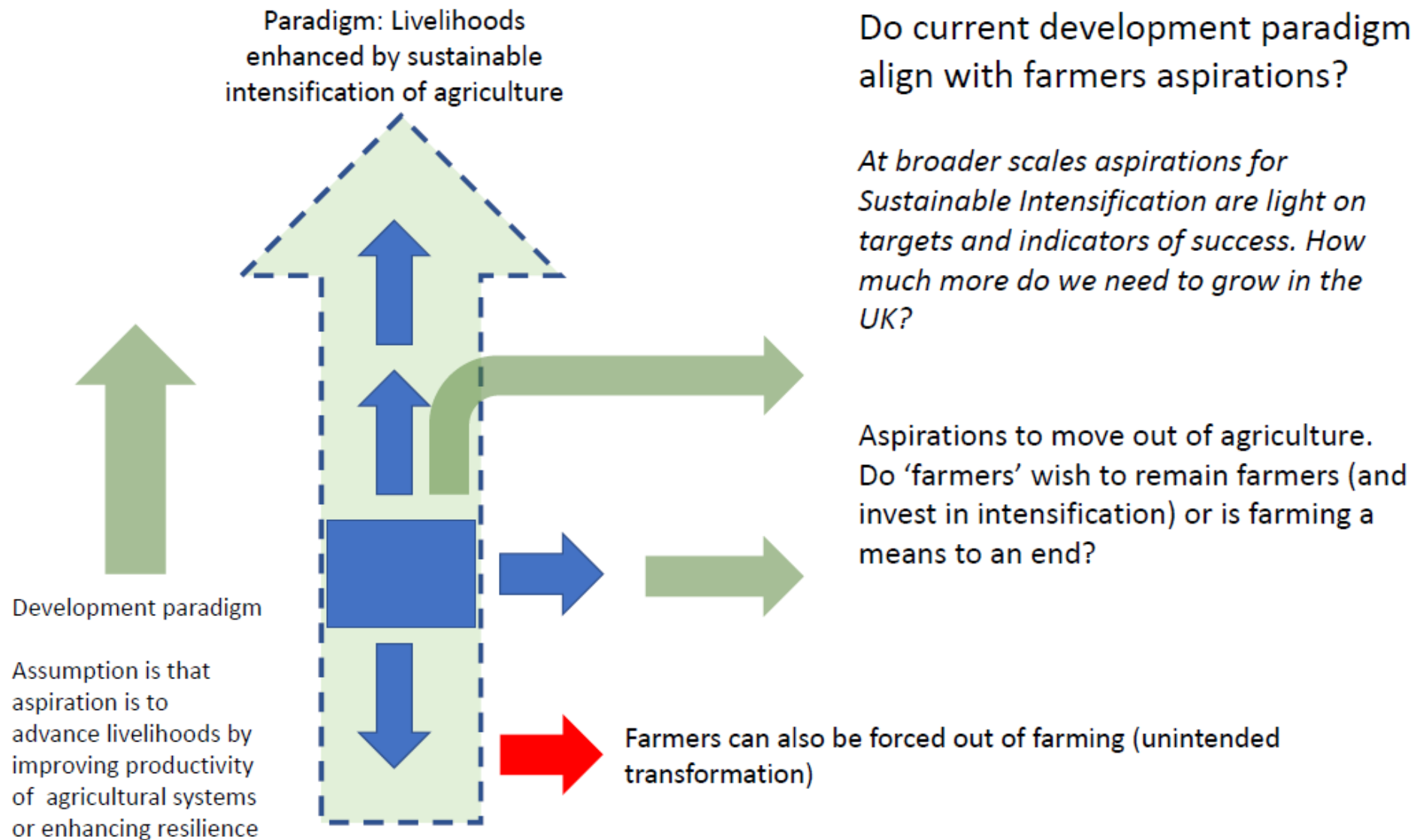
Smallholder farmer Livelihood trajectory

High crop prices

Drought
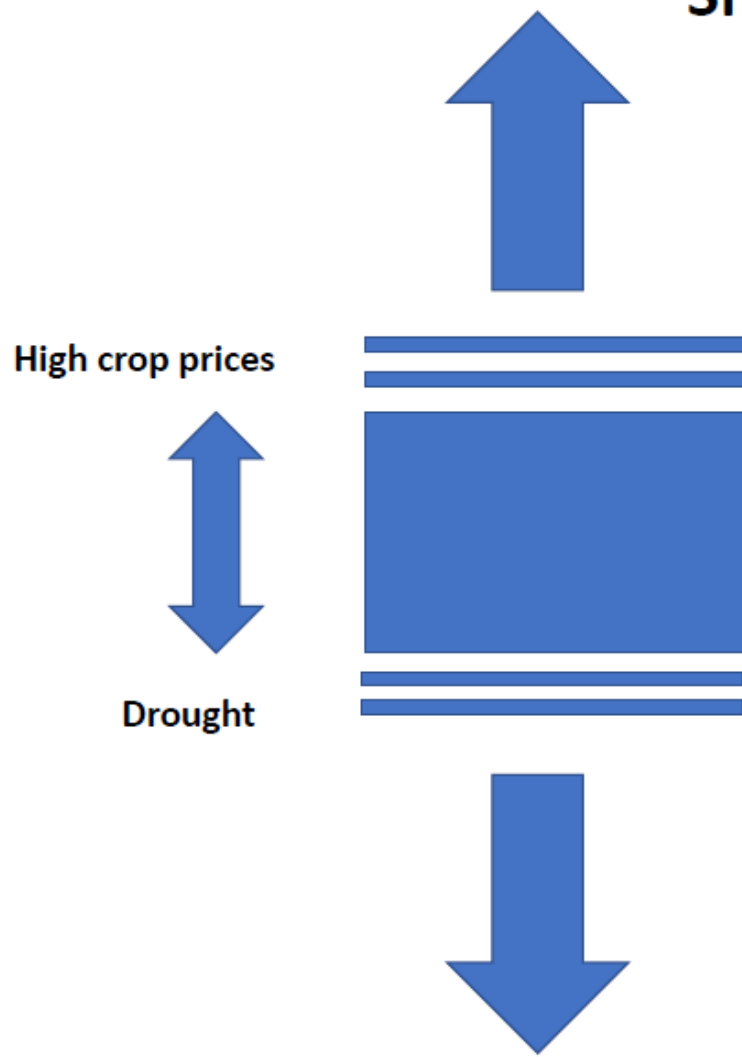
Marginal farmers livelihood systems subject to instability – so likely to be key points where aspirations influence livelihood decisions
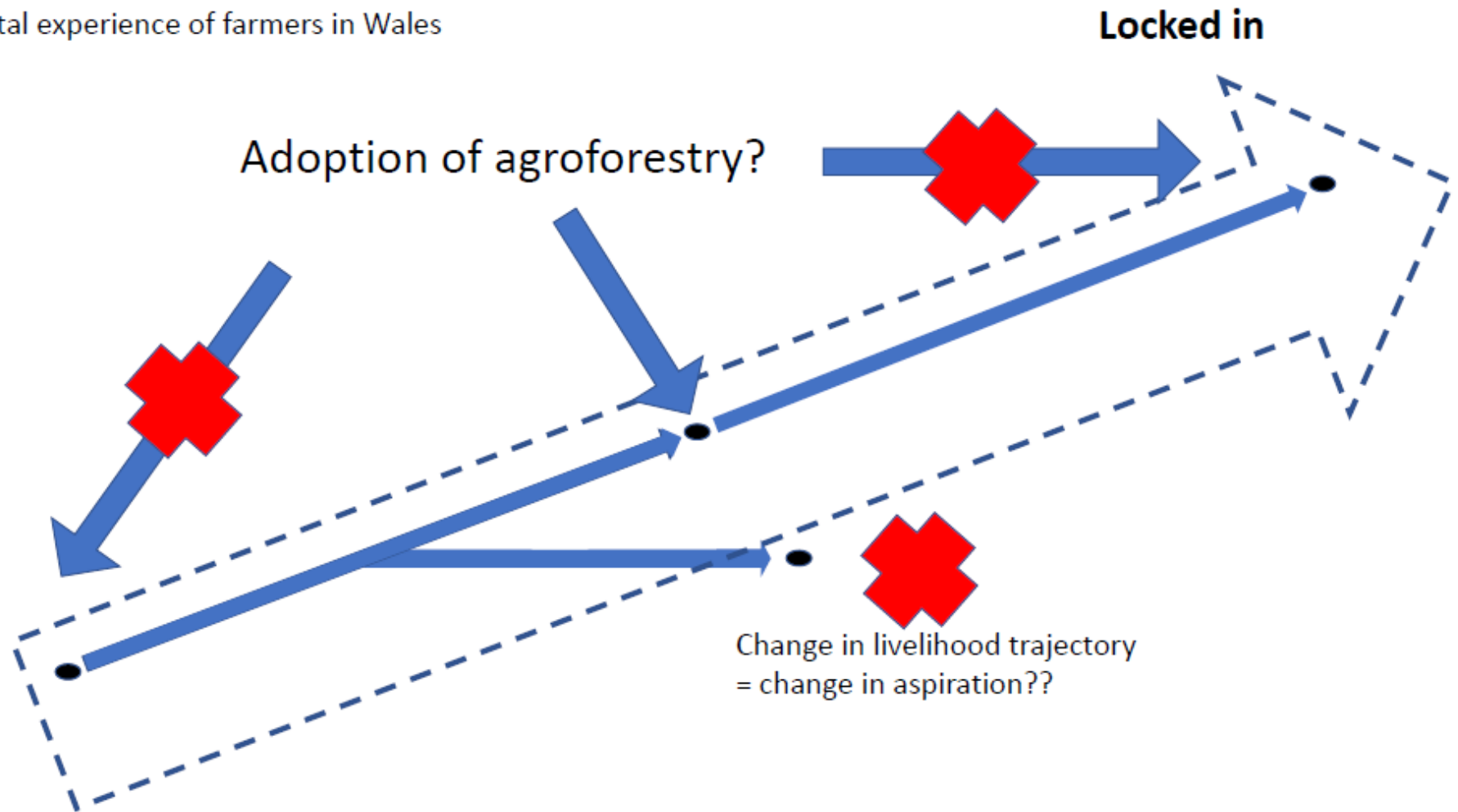
In times of relative stability likelihood of drastic shifts in farming practice is unlikely

Farmer psychology??

Paradigm: Livelihoods enhanced by sustainable intensification of agriculture

Do current development paradigm align with farmers aspirations?

At broader scales aspirations for Sustainable Intensification are light on targets and indicators of success. How much more do we need to grow in the UK?

Aspirations to move out of agriculture. Do 'farmers' wish to remain farmers (and invest in intensification) or is farming a means to an end?

Development paradigm

Assumption is that aspiration is to advance livelihoods by improving productivity of agricultural systems or enhancing resilience

Farmers can also be forced out of farming (unintended transformation)

Understanding Farmer dynamics
Anecdotal experience of farmers in Wales

Locked in

Adoption of agroforestry?

Change in livelihood trajectory
= change in aspiration??

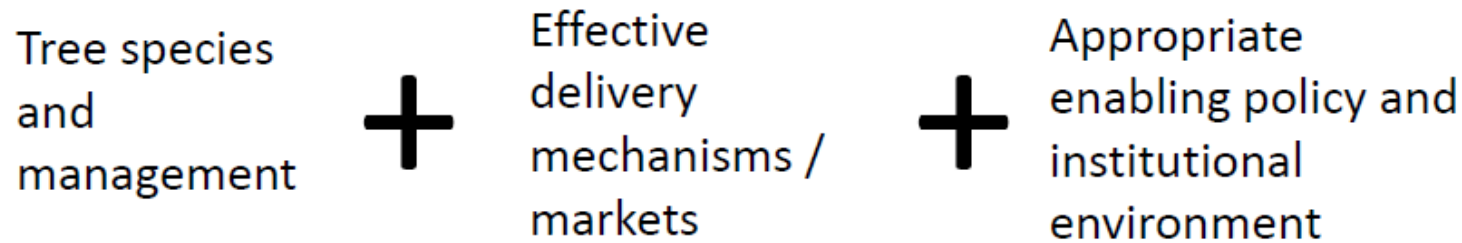# Variation in food security in Lushoto, Tanzania
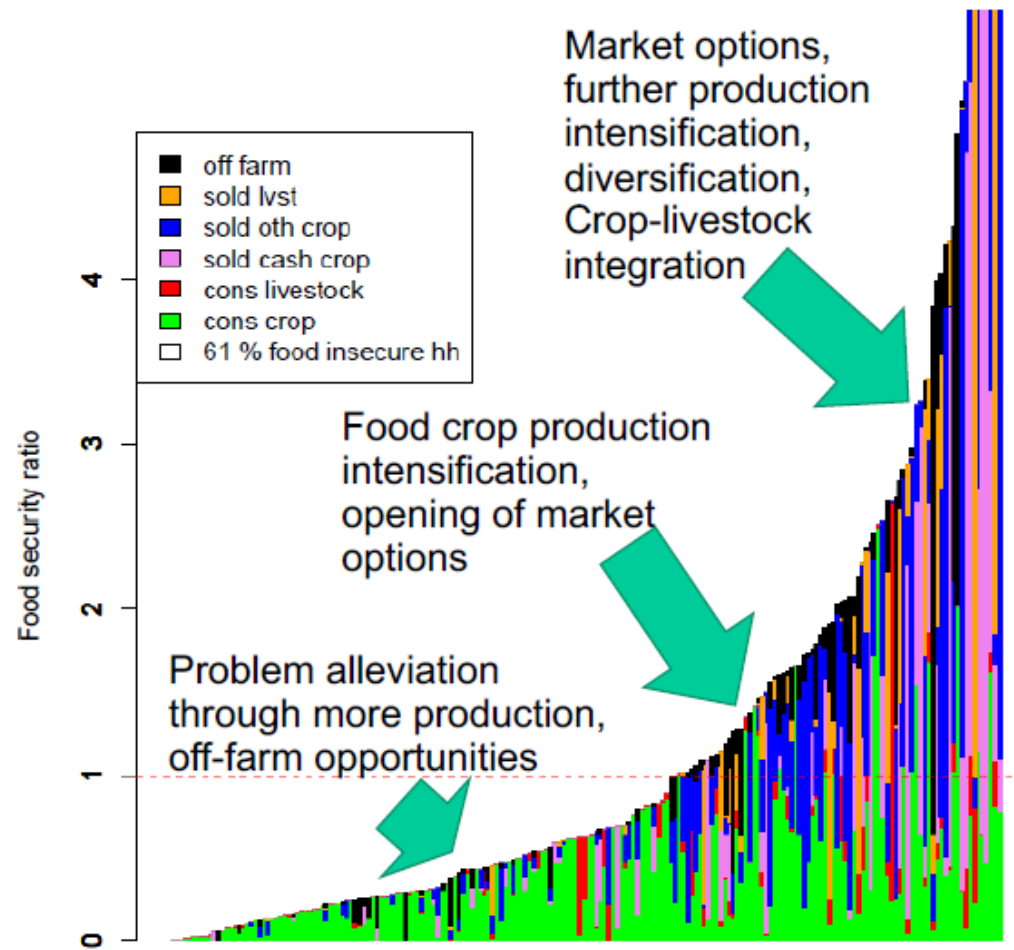
Ritzema et al., 2016. Food Security

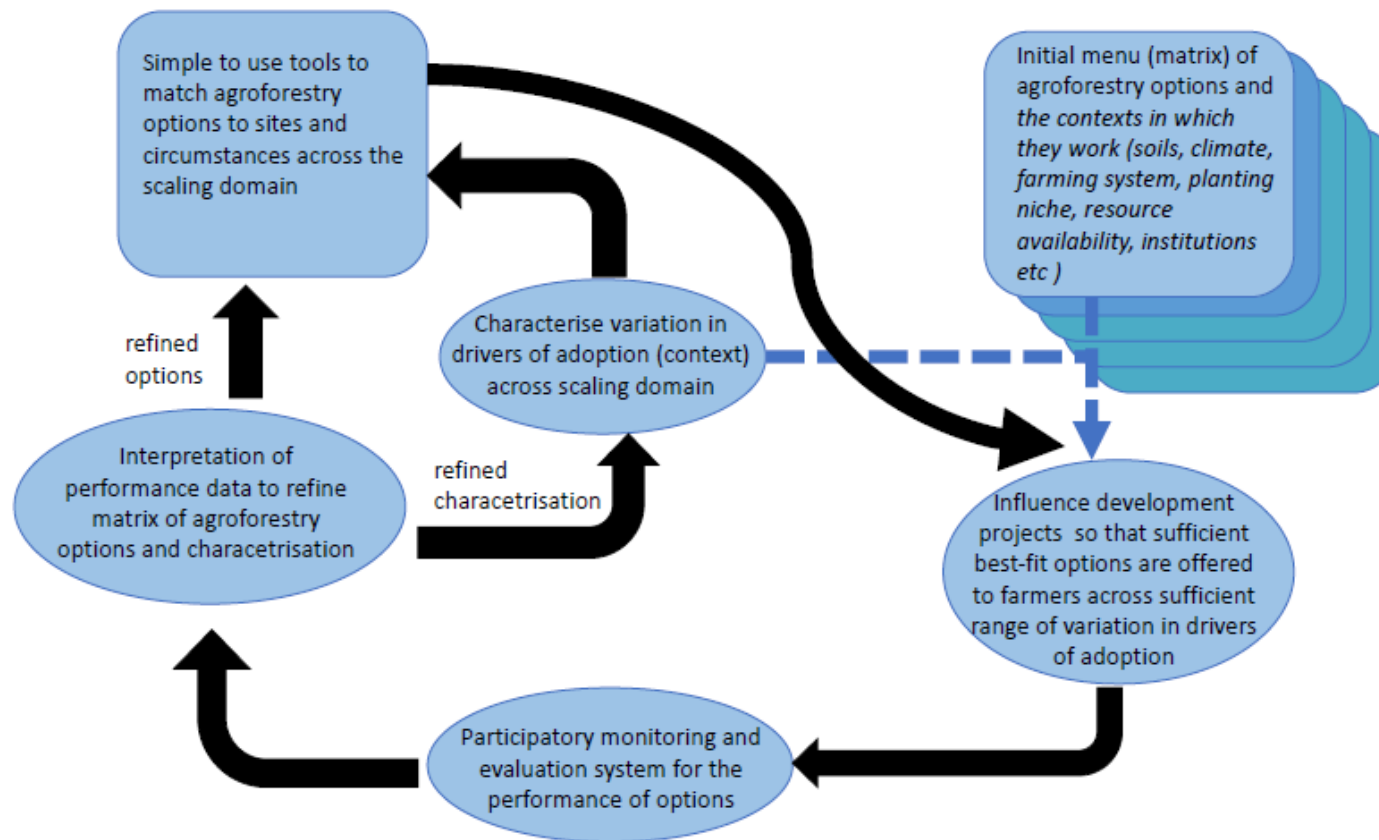# Can trees provide economic solutions for the farming community?

- Alternative markets for farmers to benefit from new woodland
  - Biomass (more immediate returns to farmers?)
  - Firewood (growing industry – requires infrastructure)
  - Timber (provided there are mechanisms for more immediate returns)
  - Ecosystem services (given complexity of trade-offs, direct payment for regulating ecosystem services delivered is likely the most efficient solution: is it achievable?)

- Existing planting figures suggest farmers are most interested in adaptation (agroforestry) rather than conversion
  - Numbers are still small
  - Brexit could change this very quickly
  - What does society need from it's farmed landscapes (not as obvious as it once was)

- Balance of costs and benefits are highly dependent on scale and nature of planting

What is an agroforestry 'option'?

Tree species and management **+** Effective delivery mechanisms / markets **+** Appropriate enabling policy and institutional environment

Ingredients that can be combined in different ways across scales

But outscaling agroforestry options mean we also need to consider <u>Context</u>

Simple to use tools to match agroforestry options to sites and circumstances across the scaling domain

Initial menu (matrix) of agroforestry options and *the contexts in which they work (soils, climate, farming system, planting niche, resource availability, institutions etc)*

Characterise variation in drivers of adoption (context) across scaling domain

refined options

Interpretation of performance data to refine matrix of agroforestry options and characetrisation

refined characetrisation

Influence development projects so that sufficient best-fit options are offered to farmers across sufficient range of variation in drivers of adoption

Participatory monitoring and evaluation system for the performance of options

Co-learning paradigm that offers communities best-fit options now (quite large uncertainty regarding their impact) while capturing experience through research 'in' development to refine matching options to sites and people's circumstances (progressively reducing uncertainty and risk around adoption decisions).

Understanding context

Trees and water - Riparian buffer planting and landscapes

Can trees/shelterbelt systems impact flood risk?

- We (Multiland) and many others are looking at this at the point of provision (changes to ecosystem function).
  - Different trees different hydraulic properties
  - Changes in soil properties
- Many recent studies on NFM do not provide explicit hypotheses for how trees deliver benefits
- For many stakeholders comparisons are with 'end of pipe solutions' instead of alternate land uses *in situ*.

  "Trees cannot protect us the way engineered flood defences do"

  rather than

  "Trees provide substantially more protection to flood risk than improved grassland"
- We want to move this forward

Can trees/shelterbelt systems address flood risk?

- Trees are likely to have an impact in areas
  - Surface run-off is high
  - Where water is not able to access potential storage (normally deeper in the soil)
- Trees cannot create storage - they enable access to it!
- Context variables matter for decision making
- What are the scaling attributes that we need to identify to advise people on the efficacy of planting new shelterbelts to provide **regulating benefits**
  - Acknowledge demand (upland farmers do not benefit from flood risk but they manage water)
  - Identify parameters that manifest as you move from **field to farm to landscape**
  - Current MULTILAND focus: Soil depth (and condition) are critical scaling factors at landscape scales
  - Data problem….

Extent of riparian buffer strips in Wales

- EA study used LiDaR to provide estimate of riparian tree cover

- 15% of channels in England and Wales have riparian trees (defined as vegetation objects greater than 2.5 m high)

- Reasonable variation across Wales

- No data on what species were present!

Per cent riparian tree cover

☐	No Data
🟥	< 5
🟧	5 - 15
🟨	15 - 25
🟩	25 - 35
🟦	35 - 50
🟦	> 50

50 25 0   50 Kilometers

N
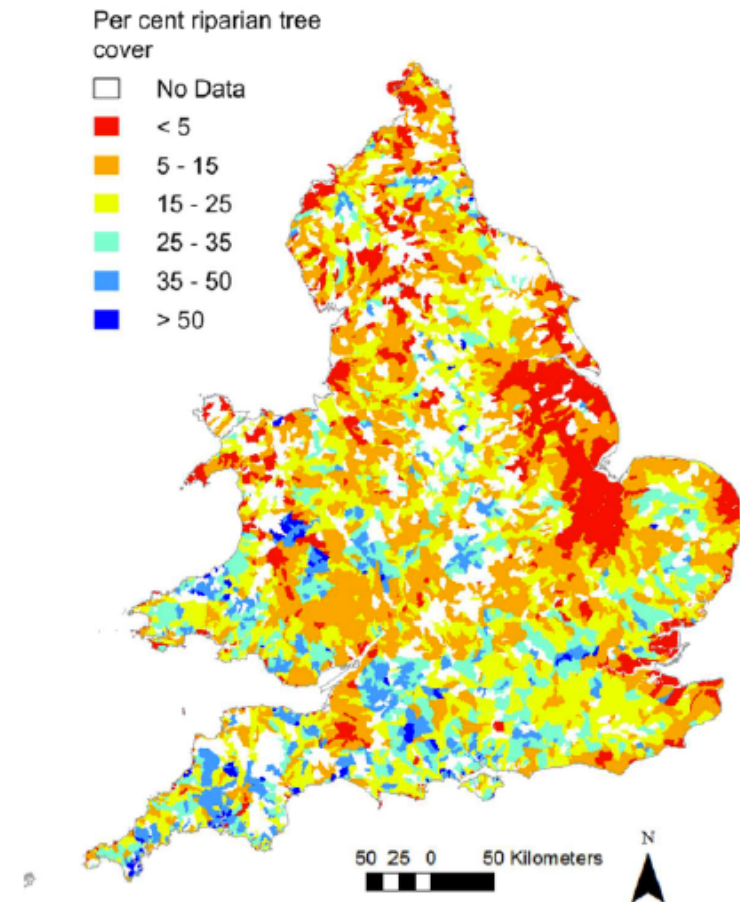
Natural flood management - Riparian woodland opportunities
North West Wales - Gogledd Orllewin Cymru
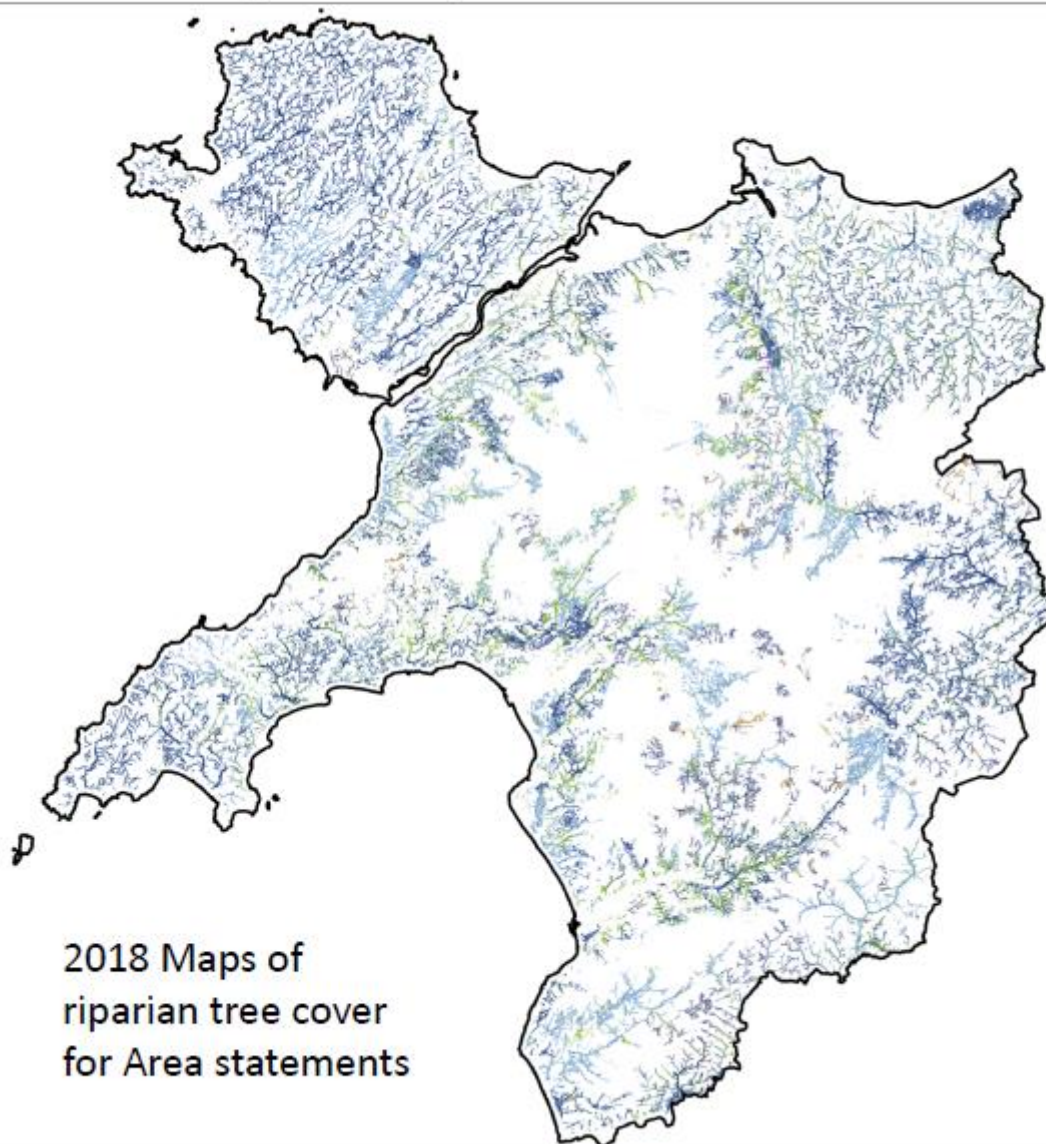
2018 Maps of
riparian tree cover
for Area statements

Legend

☐ Area 1 boundary
🟩 Existing broadleaved woodland in riparian zone
🟪 Existing mixed woodland in riparian zone
🟦 Existing coniferous woodland in riparian zone
🟧 Recently felled woodland in riparian zone
🟦 Opportunity for riparian or drainage channel woodland
🟦 Opportunity for riparian or drainage channel woodland (sensitivity)

What the map shows:
This map shows the opportunity space for planting riparian woodland for NFM benefits. It is important to note that most effective use of these opportunity spaces would be to plant deep-rooting species, particularly broadleaved species, in order to fully realise the NFM potential.

Why this is important:
Flooding has considerable social and economic effects; it can cause human casualties and cost the UK ~£475 million per year. The frequency and severity of flooding events has increased in recent years and under climate change is predicted to continue to do so. Natural flood management is one measure that can be taken to reduce the severity of flooding by enhancing the capacity of the upslope landscape to temporarily store water and release it slowly, thereby spreading out and flattening the flood peak.
Hard engineering solutions are not considered in the map set for natural flood management.
Woodlands, particularly deciduous ones, are one of the habitats with the greatest potential to enhance infiltration into the ground, due to their extensive root network. Understorey species in a semi-natural woodland additionally create a degree of surface roughness that aids in slowing down overland flow. The amount of layered canopy cover from the trees and the understorey species creates a high potential for evapotranspiration.
If planted adjacent to rivers and channels that flow with rain water after severe storm events, woodland belts can provide a last barrier to overland flow and hence reduce the severity of river swelling.

How the map has been created:
The suitability for woodland planting has been established using ALC data split into different attributes (soil depth, climate, stoniness, slope, drought and wetness), as well as the current land cover; these datasets were used to identify where it is biophysically possible to plant trees.
To identify opportunities for new woodland adjacent to waterways, areas within 50m of rivers or 30m of drainage channels were considered; within this opportunity space, sensitivities were identified and constraints applied. The constraints to riparian planting are presented in a separate map and included areas within 500m of the coast, areas that are scheduled ancient monuments, and areas on climate change-resilient peat.
The opportunity space for riparian woodland is less constrained than the opportunities for floodplain woodland or wider catchment woodland. This is because the scale of riparian planting is much smaller, and can often be achieved without changing the overall existing land use or character of an area. For example, it may be possible to carry out riparian planting on existing agricultural land, within certain designated sites (if the site is big enough and planting would be compatible with the site conservation objectives).
For a detailed description of datasets included in the model, and how they have been scored, please refer to the full project technical report.

Data gaps and limitations:
• National Phase 1 dataset is likely out of date in many places.
• Taking the first 500m from the coastline out of the opportunity space is a rough approximation of a complex problem. Ideally, all areas would be taken out that do not have areas at risk of flooding downslope from them or are too close to the area at risk of flooding to have a noticeable effect on the extent of river swelling.
• The extent of Fridd has been modelled; therefore, it can neither be guaranteed that all Fridd will be included, nor that all land found to likely contain Fridd actually contains Fridd of high biodiversity value. The model created is likely to over-classify Fridd, and its purpose is to highlight areas in which field surveys to confirm the presence of peat would be useful prior to planting decisions being made. It is not a definitive map showing where Fridd habitats occur.

For a detailed description of datasets included in the model, and how they have been scored, please refer to the full project technical report.

WWNP Riparian Woodland Potential - Wales

Natural Resources Wales
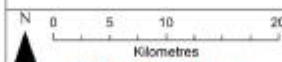
Summary   **Preview**   Endpoints (2)   Downloads (1)   Metadata (1)

© Crown Copyright and database right 2018. Ordnance Survey 100021874
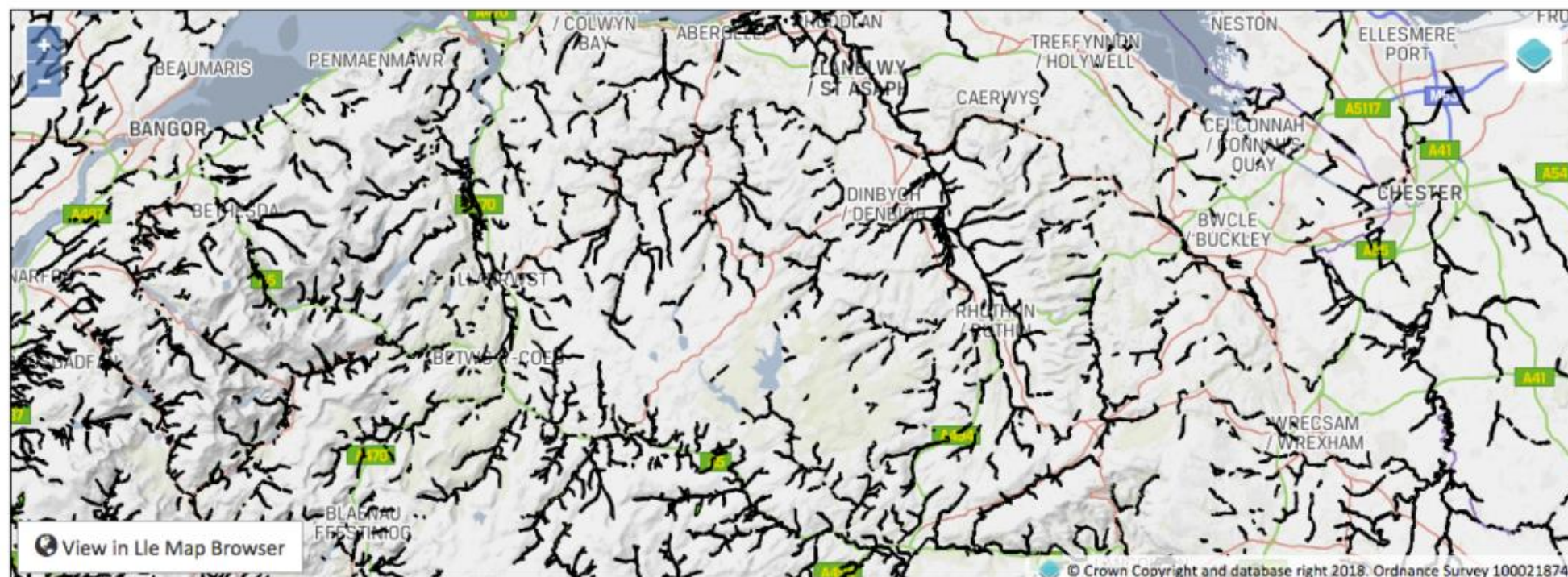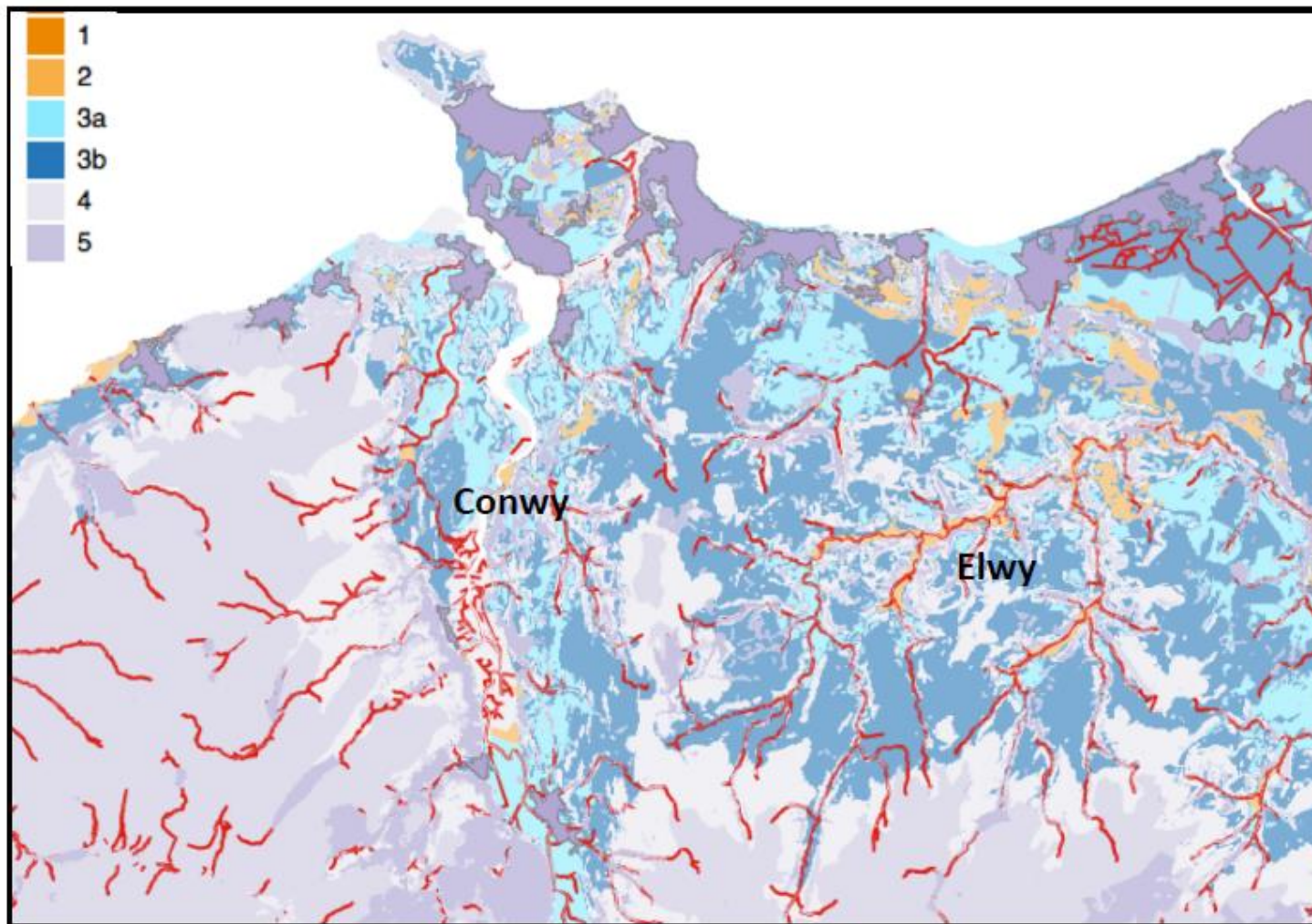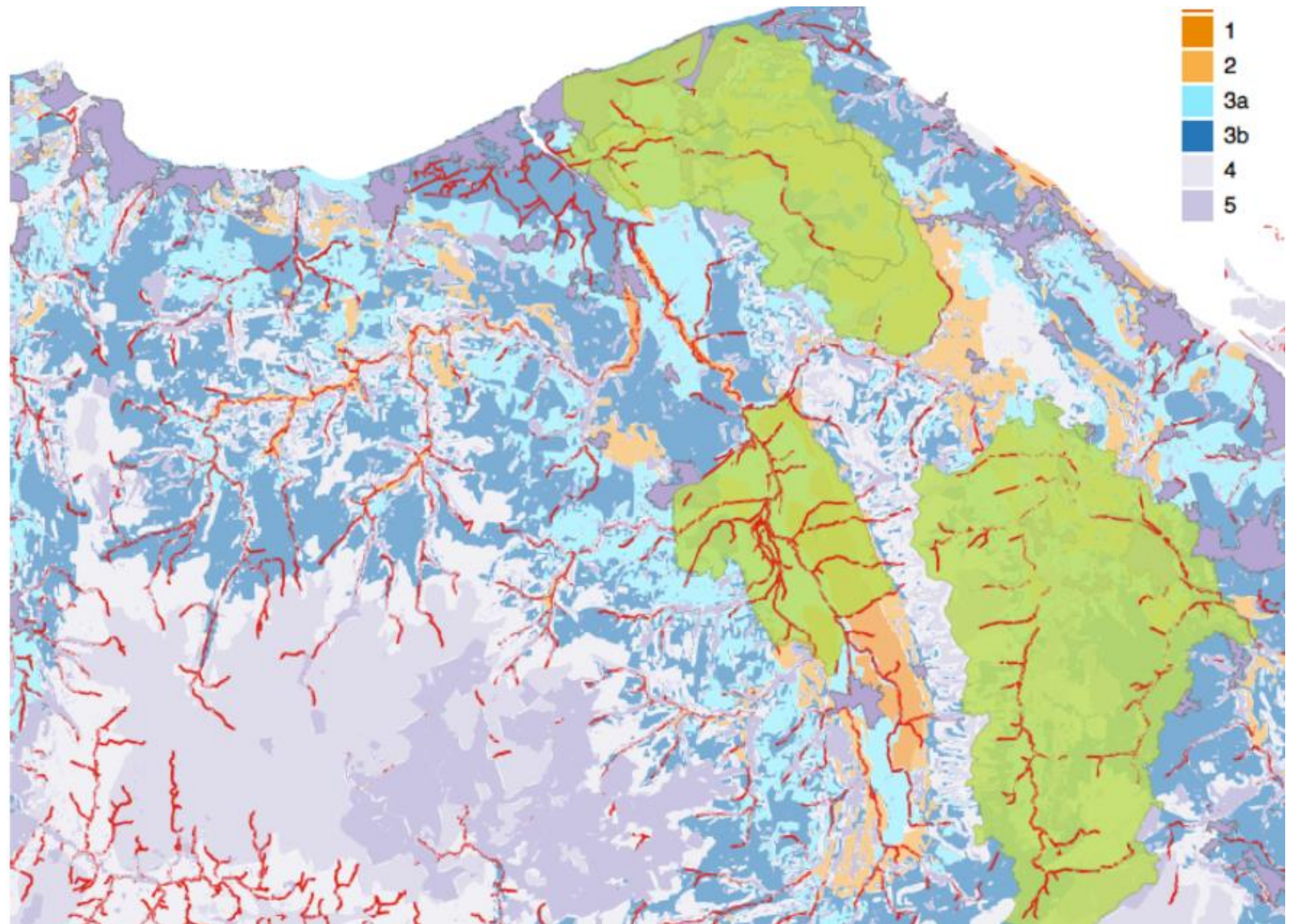
Riparian woodland potential maps combined with 2017 Agricultural land classification data for Wales

Opportunities for riparian planting in the Clwyd?

Nitrate Vulnerable Zone (identified in Green)

Areas where there is currently no riparian tree cover in red

Conclusions

- Farm household characterization to is required to inform (climate smart) agricultural interventions

- Key role for research to understand and characterize farmers' drives and aspirations (and see how agroforestry fits – it may not!)

- In developing a suite of agroforestry 'options' we should also characterise context (critical for informing scaling out)

- Farmer engagement needs to return to being a (more) active process

- Scaling should inform farm priorities and design of options