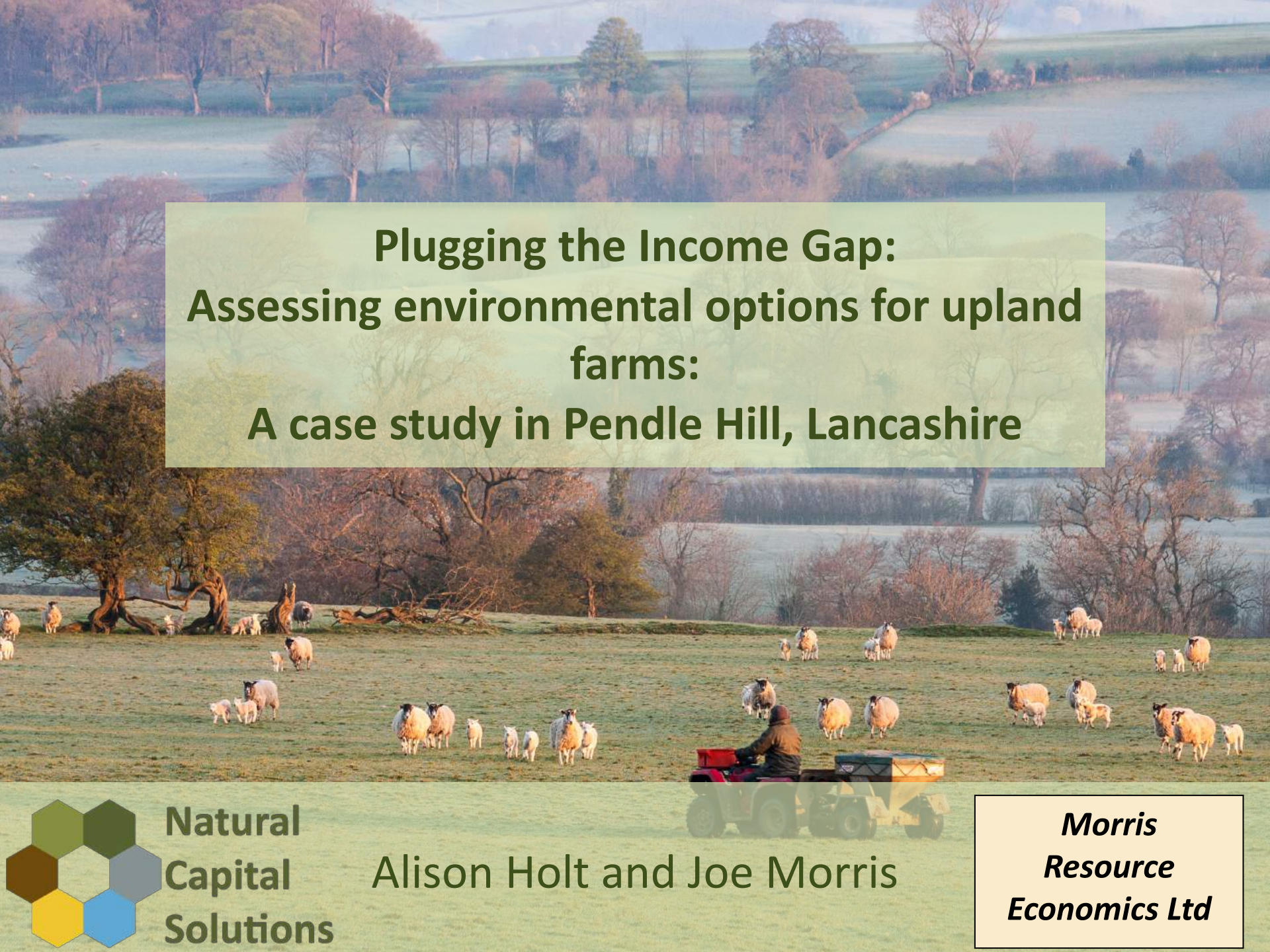


Plugging the Income Gap: Assessing environmental options for upland farms: A case study in Pendle Hill, Lancashire

Natural Capital Solutions

Alison Holt and Joe Morris

Morris Resource Economics Ltd

Contents of the presentation

- Context
- Aims and Objective
- Approach
- Pen Farm Case Study
- Conclusions and Issues
- Q&A/Discussion

Aims

- What public benefits can be provided by upland hill farms under ELMs?

- Can implementing ELMs-type options in upland farms make up for the loss of the basic payment?

Approach

- Policy review
- Case study farms
- Natural capital assessment
- ELMs-type futures
- Farm business assessment
- Generic case

What is natural capital?

Natural Capital is defined as:

"..elements of nature that directly or indirectly produce value or benefits to people, including ecosystems, species, freshwater, land, minerals, the air and oceans, as well as natural processes and functions"

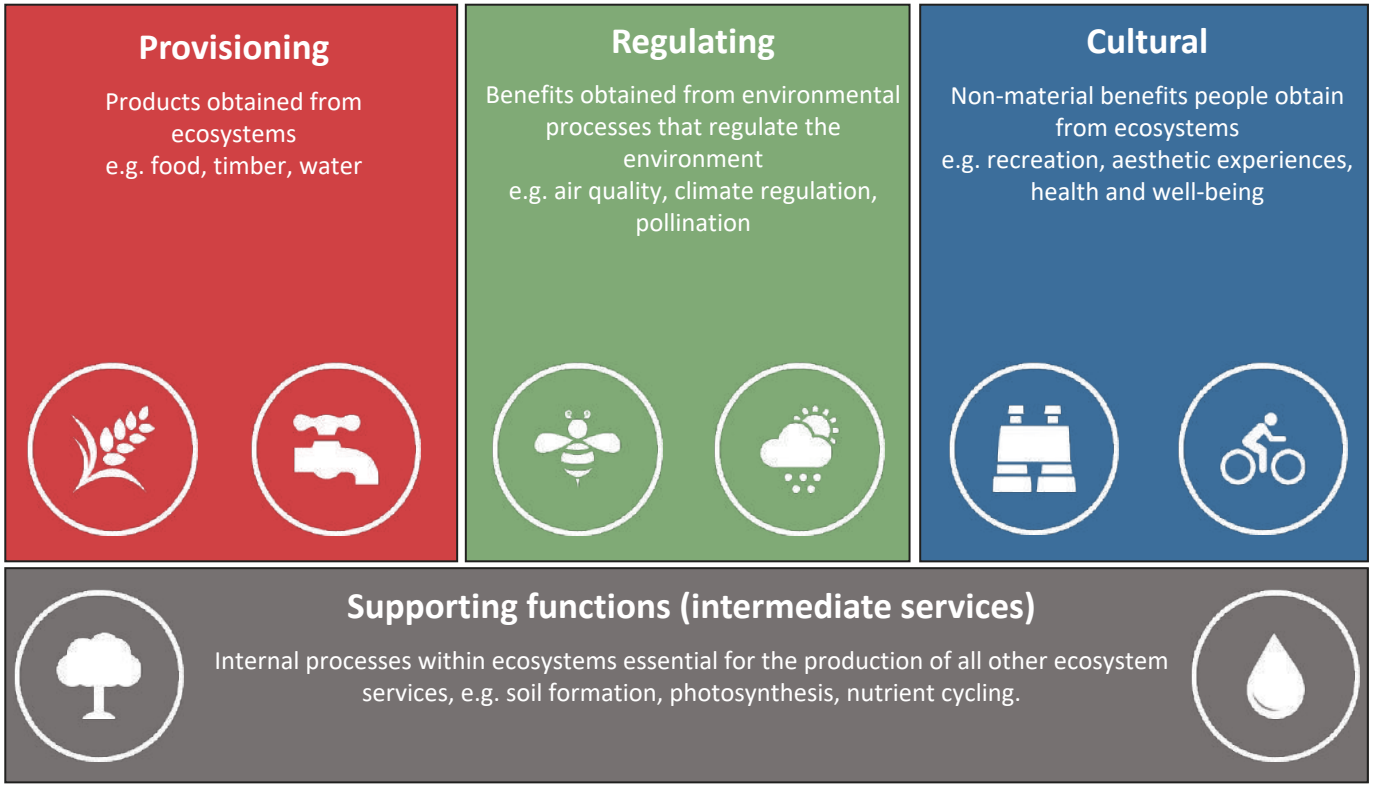
UK Natural Capital Committee 2014






Ecosystem services and benefits

Natural Capital is the stock of natural assets, for example, habitats, soils, water and biodiversity. This natural capital produces a wide range of **ecosystem services** that provide **benefits** to people.



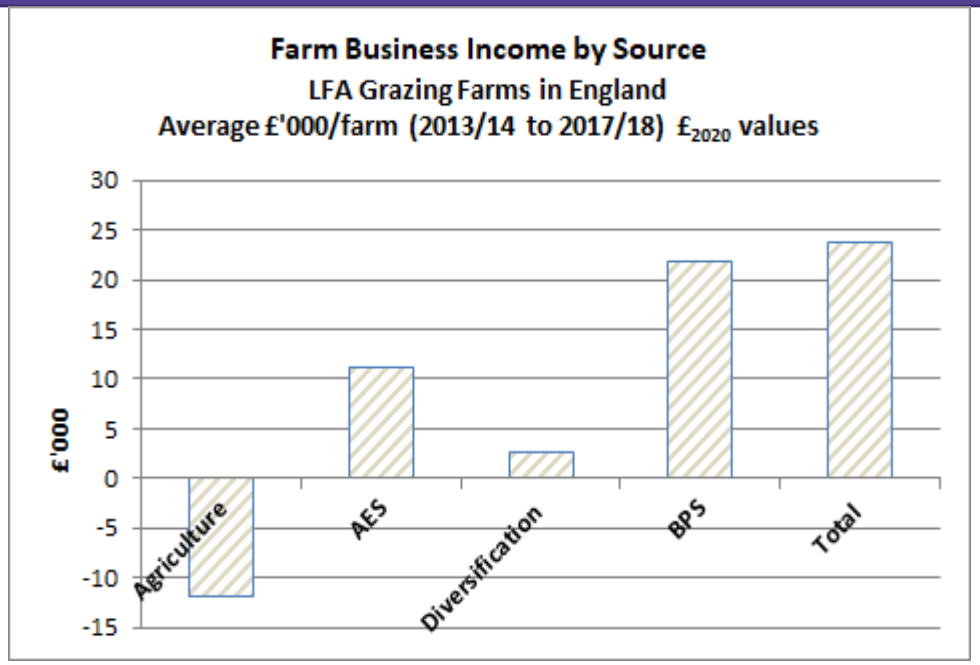
Policy context

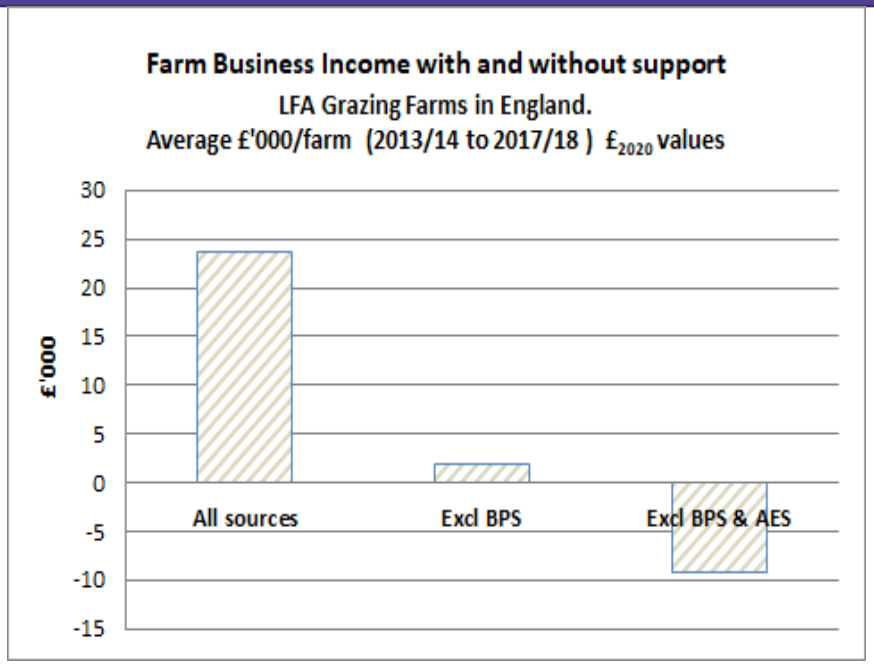
- **Brexit and CAP**
- **The Environment Bill:** includes protection of the natural environment and biodiversity
- **The Agriculture Act 2020**: includes payments for public goods and:
  - Phased withdrawal of Direct Income Support **(BPS)**
  - New Environmental Land Management scheme **(ELMs)**

Main ELMs Themes and Objectives

- **BHE -** Beauty, Heritage and Engagement;
- **CA -** Clean Air;
- **CC -** Mitigation of and adaption to Climate Change;
- **CPW -** Clean and Plentiful Water;
- **HAZ -**Protection from and mitigation of environmental hazards; and
- **TPW –** Thriving plants and wildlife

Implications for the upland sector





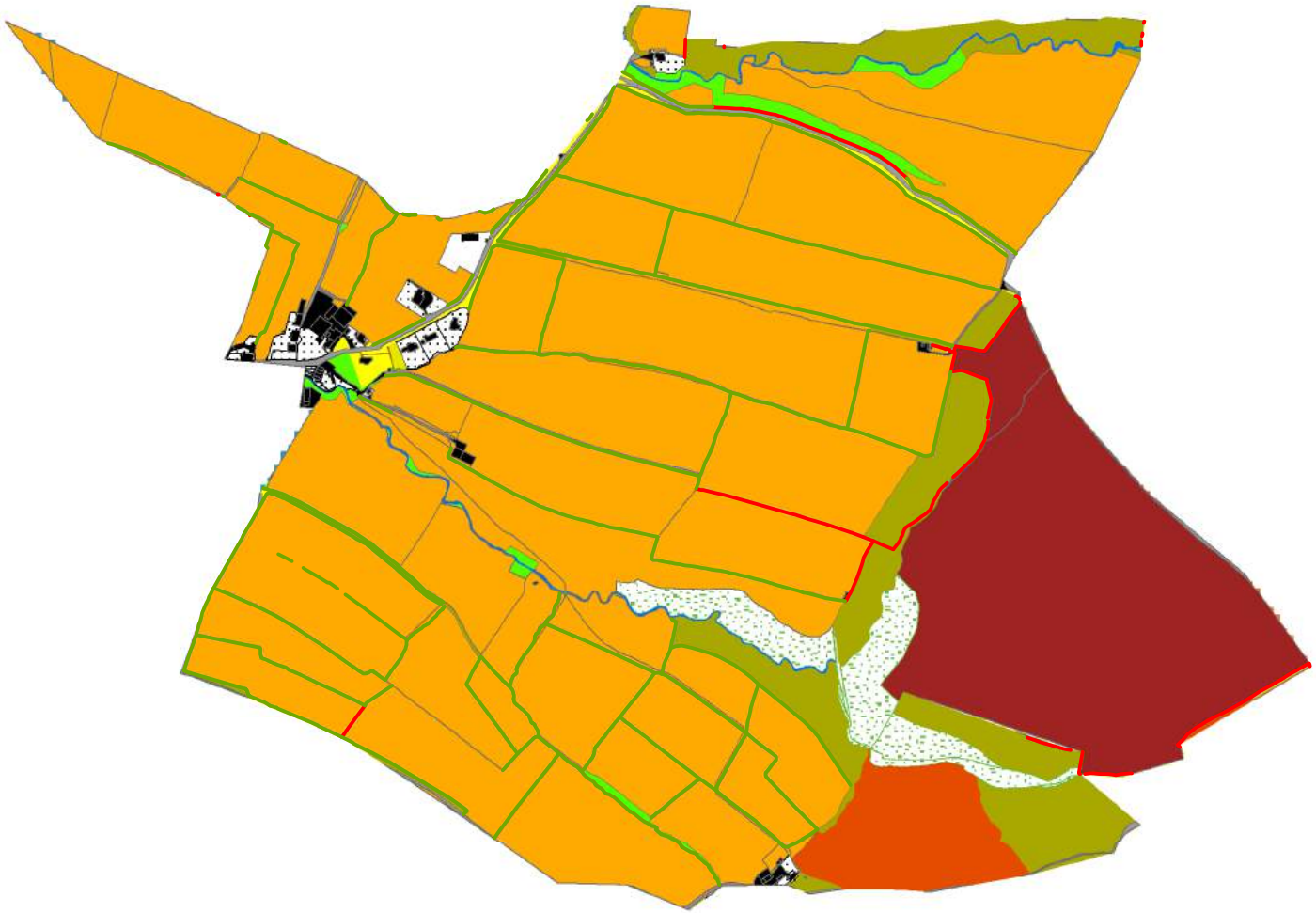
Will environmental payments fill the BPS Gap?

Three farm studies on Pendle Hill explored options and were used to support a generic 'indicative' case: **Pen Farm**

Pen Farm

- Typical upland farm in the Pendle Hill area
- Farm runs down hill with rough grazing at the higher elevation, with improved pastures on lower land towards the valley bottom
- Farm lies within the Less Favoured Area designation, with sections in Disadvantaged and Severely Disadvantaged Areas, including Moorland.
- 146 ha: 139 usable agriculture ha, 111 ‘adjusted agricultural’ ha
- Mainly sheep with a small herd of beef cattle
- Stocking Rate: 0.85 Grazing Livestock Units/ha (adjusted)

Habitats



- Buildings
- Garden
- Amenity grassland
- Improved grassland
- Rushy grassland
- Semi-improved grassland
- Semi-natural rough grazing
- Bracken
- Path
- Roads
- Parkland
- Freshwater
- Broadleaved woodland
- Hedges
- Walls

N

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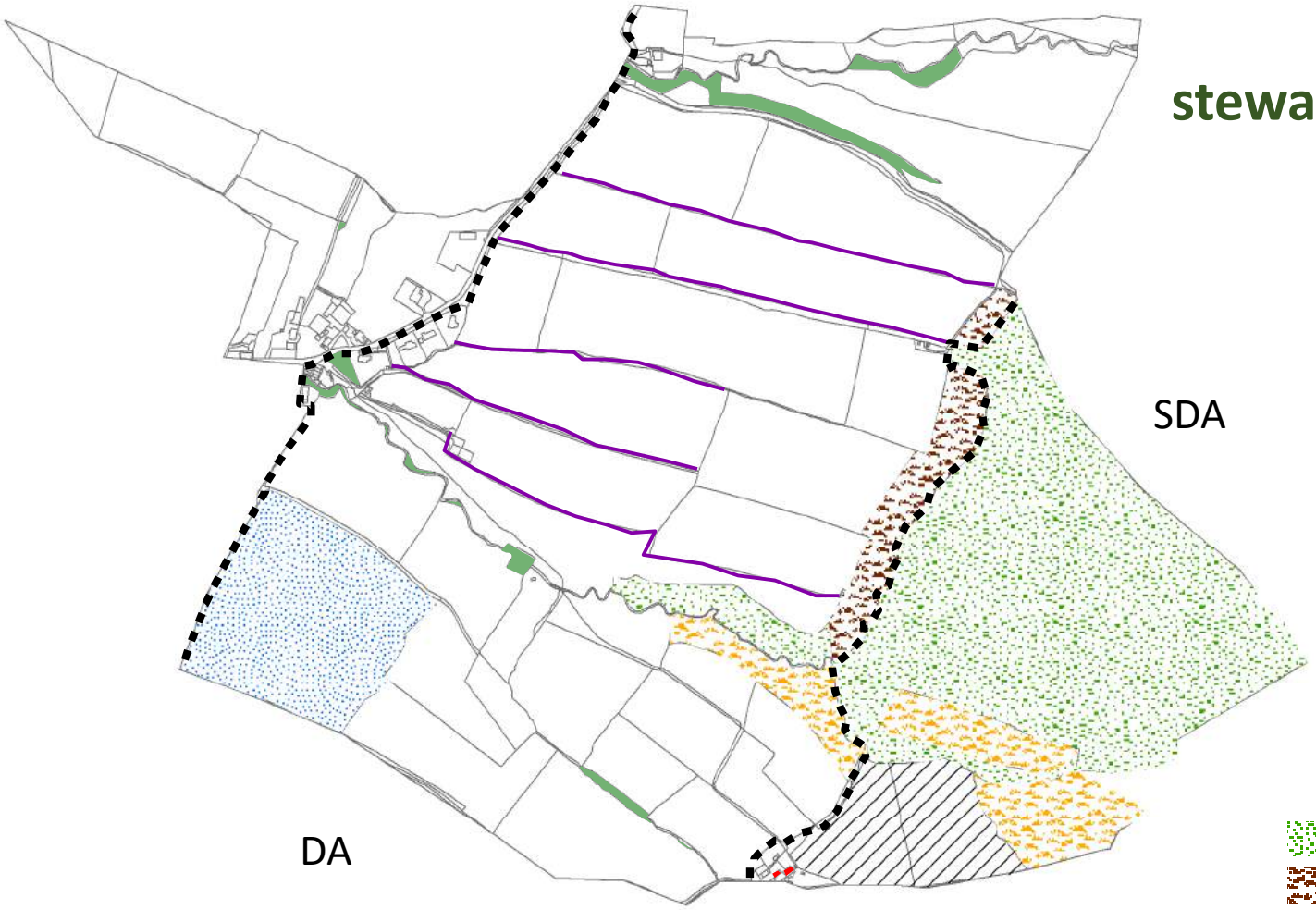
Current stewardship options



N

0 0.25 0.5 Kilometers

GS17 + UP1
GS2
GS5 + GS16 + SP6
GS17 + UP2
GS4
BE3
WD1
HS1
SDA/DA area boundaries

Pen Farm: current farming system & land use

		Baseline		
Stock type	LU/hd	nr	LU	% of LU
Ewe and lamb	0.12	500	57.7	60%
Breeding ewe lambs	0.06	185	11.1	11%
Rams	0.08	10	0.8	1%
Beef cows incl calf	0.9	17	15.3	16%
Beef cattle sold as stores	0.5	22	11.0	11%
Bull	0.65	1	0.65	1%
total LU			96.6	100%

Stocking rates	
Total utilised agricultural area ha (excl common m'lar	138.9
Adjusted agric area ha	110.5
Common Moorland	30.0
Adjusted common moorland	3.0
Adjusted farm area incl moorland ha	113.5
Adjusted farm LU/ha	0.85

Dependencies and impacts

All farms are **dependent** on natural capital assets for food production

Dependencies	Impacts
Local climate regulation	Compaction and erosion
Water quality regulation	Decreased soil quality
Erosion control	Carbon and GHG emissions
Soil quality regulation	Increase flooding
Pest and disease control	Decrease in water quality
Soil quality regulation	Loss of biodiversity
Water flow regulation	

Farming has **impacts** on natural capital and the flow of ecosystem service benefits

Provision of benefits – ecosystem services

Ecosystem service category	Ecosystem service
Provisioning	Food: crop and livestock production Fibre and fuel (timber/woodfuel, wool) Water (drinking, agricultural and industry)
Regulating	Carbon sequestration Local climate regulation Air quality regulation Water quality regulation and erosion control Water flow regulation Pollination Pest and disease regulation Noise attenuation Soil quality regulation Habitat and population maintenance (biodiversity)
Cultural	Aesthetic experiences Education, training and scientific investigation Recreation and tourism Health and well-being Characteristics and features of biodiversity that are valued Spiritual and cultural experiences

Qualitative assessment of benefits

Ecosystem service category	Ecosystem service	Provision score
Provisioning	Food: livestock production	3
	Fibre and fuel (timber/woodfuel, wool)	1
	Water (drinking, agricultural and industry)	1
Regulating	Carbon sequestration and storage	0.5
	Local climate regulation	1
	Air quality regulation	0.5
	Water quality regulation and erosion control	1
		1
	Water flow regulation	1
	Pollination	1
	Pest and disease regulation	0.5
	Noise attenuation	1
	Soil quality regulation	1
	Habitat and population maintenance (biodiversity)	1
Cultural	Aesthetic experiences	2
	Education, training and scientific investigation	2
	Recreation and tourism	2
	Health and well-being	2
	Characteristics and features of biodiversity that are valued	2
	Spiritual and cultural experiences	2

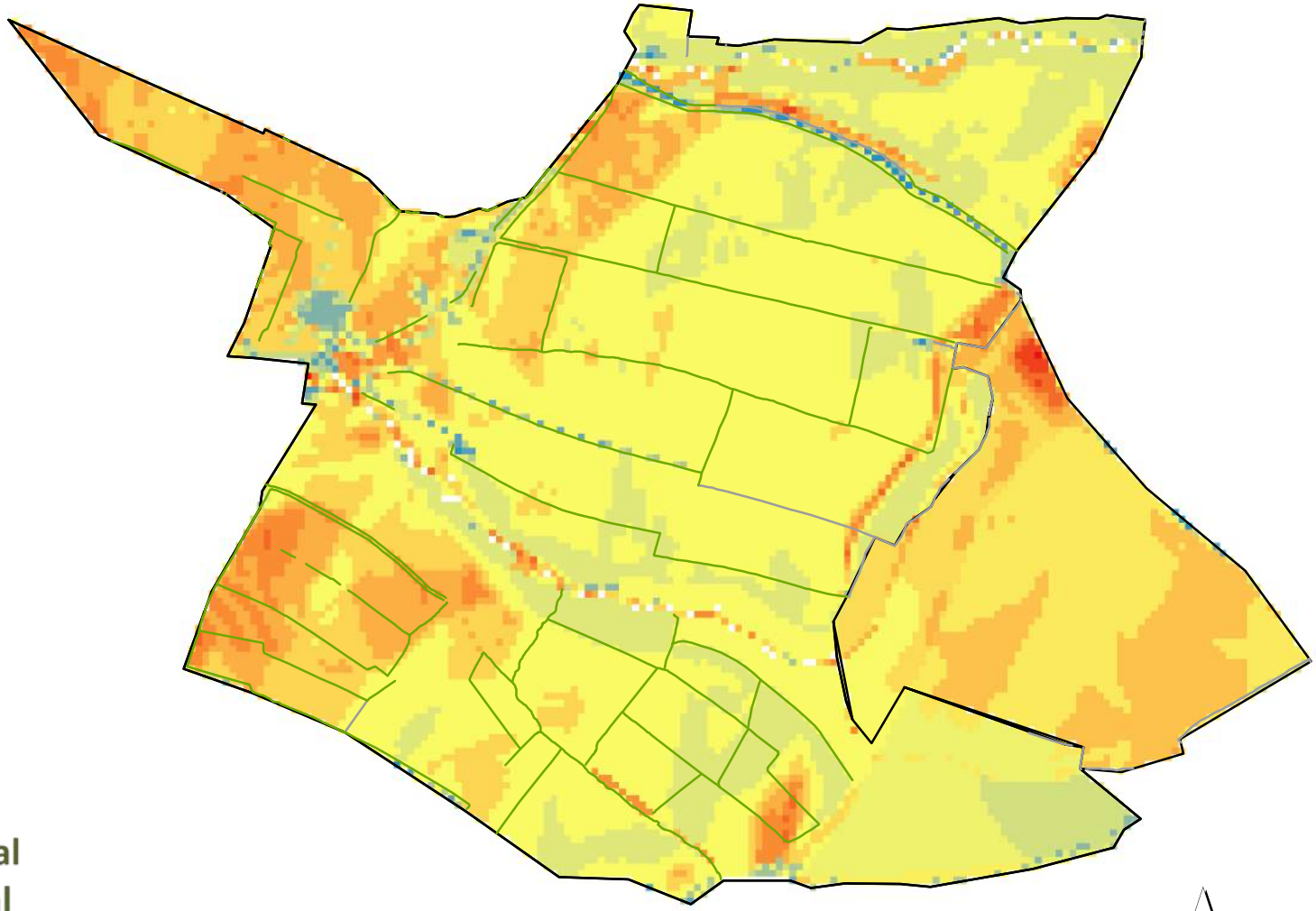
Quantitative assessment of benefits

Ecosystem services/benefits
Agricultural production
Timber production
Carbon storage (this is a stock not a service)
Carbon sequestration by woodland
Air pollution regulation capacity
Local climate regulation / noise regulation capacity
Water flow regulation
Water quality regulation
Access to nature
Dis-benefit GHG emissions from agriculture and peat soils

Carbon storage

Natural Capital Solutions

Water flow



Natural Capital Solutions

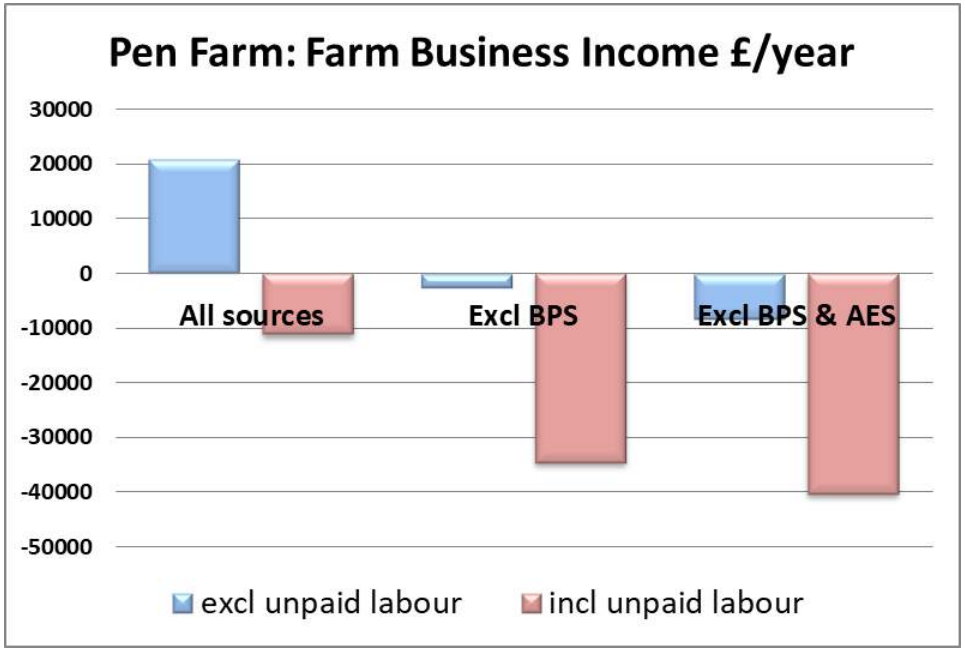
Natural capital account for Pen Farm

Ecosystem service	Baseline	
	Annual physical flow	Annual monetary flow £$_{2020}$ (£PV over 50 years)
Carbon sequestration (trees and hedges) tCO_2e per year	10.9	153 (41,045)
Carbon sequestered by increasing grassland quality tCO_2e per year	27.5	385 (103,553)
Air quality regulation (trees, hedges and grass) $tPM_{2.5}$ per year	0.03	2,289 (84,620)
Timber production m^3per year	6.6	106 (2,705)
Agricultural production Livestock Units	97	-11,322 (-288,953)
GHG emissions from agriculture tCO_2e per year	253	-3,539 (-952,683)
Carbon emissions from peat habitats tCO_2e per year	135	-1,890 (-508,351)

Pen Farm: Farm business income (all sources)

	Pen Farm	LFA Beef and Sheep *
Utilsable agric area (ha)	131	215
Adjusted agric area (ha)	111	146
% of area tenanted	100%	45%
Stocking rate GLU/ha	0.85	0.85
	£/ha	£/ha
Total Ouput	976	1024
Variable Cost	362	407
Total Gross Margin	613	617
Fixed Costs	645	470
Total costs	786	876
Farm Business Income	190	148
Unpaid Labour	290	225
Farm Corporate Income	-100	-77
Interest payments	14	30
Farm Investment Income	-86	-48
Net farm Income	207	69
Management & inv income	-54	-105
* 2018/19 average (Farm Business Survey)		

Farm income support: the challenge

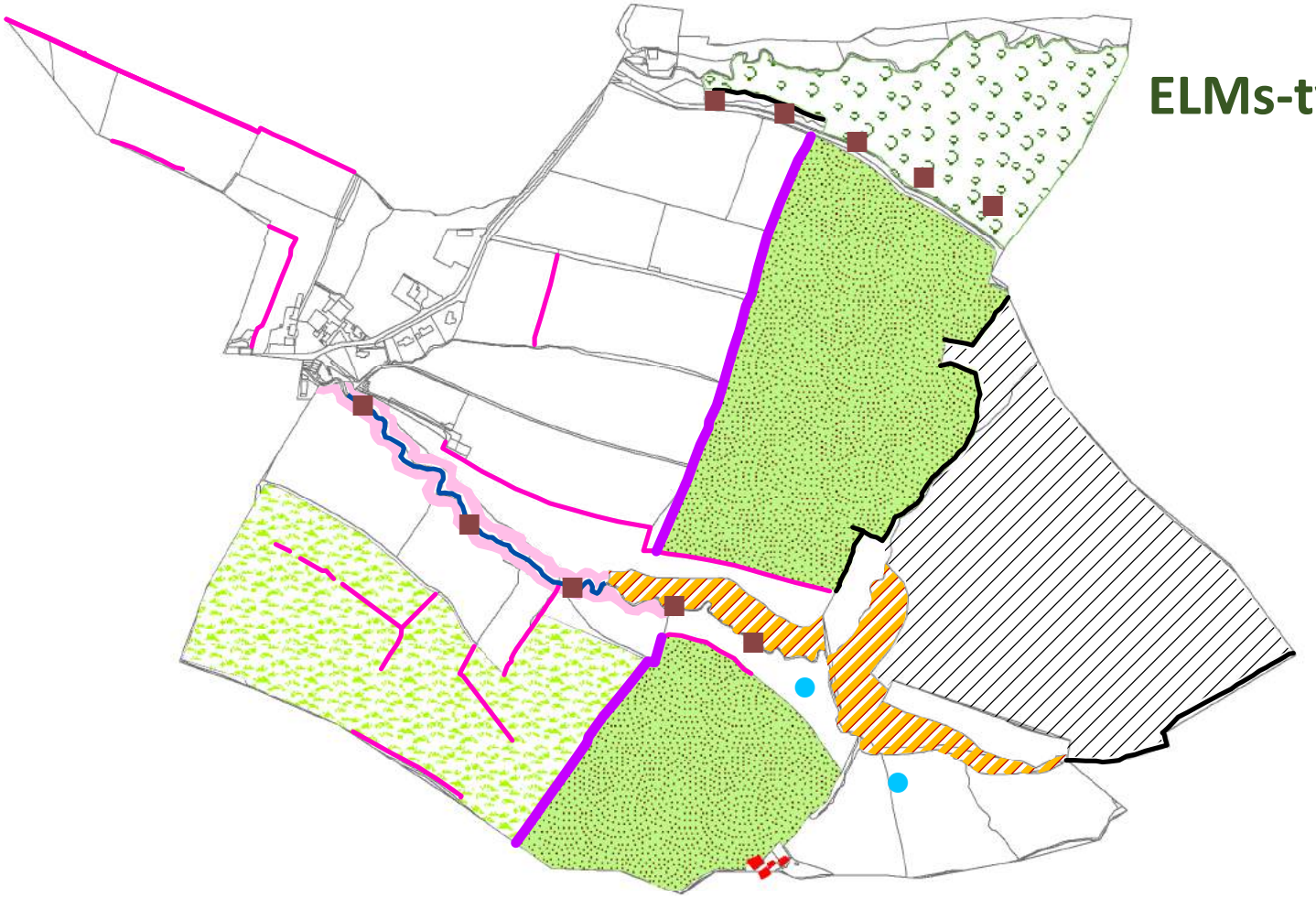


	Agriculture	AES	Diversification	BPS	Total
Pen Farm					
% of Output	65%	7%	3%	25%	100%
% of Farm Bus Inc	-46%	28%	5%	113%	100%
Average for LFA Grazing Livestock Farms (2015-2018)					
% of Output	62%	12%	4%	22%	100%
% of Farm Bus Inc	-50%	47%	11%	92%	100%

Pen Farm ELMs-type options

ELMS Outcome Themes	CC	CPW	HAZ	CA	TPW	TPW	BHE	BHE
Intervention	Carbon sequestration	Water quality	Flood alleviation	Air pollution regulation	Pollination	Habitat restoration /creation	Recreation Health and well-being	Cultural heritage
Woodland	✓	✓	✓	✓			✓	
Wooded shelterbelts	✓	✓	✓	✓	✓	✓		
Riparian woodland/ grassland buffer with scrub	✓	✓	✓	✓	✓	✓	✓	
Ponds and swales		✓	✓			✓		
Woody debris dams		✓	✓			✓		
Increasing grassland quality		✓	✓			✓		
Hedge restoration and creation	✓	✓	✓	✓	✓	✓		
Restoration of heather and dry heath					✓	✓	✓	
Restoration of blanket bog	✓	✓	✓			✓		
Bracken removal, semi-natural grassland restoration and scrub management	✓				✓	✓		
Management of rough grazing for birds						✓		
Fenced watercourses		✓						
Maintenance of traditional farm buildings								✓
Maintenance of stone walls								✓
Improved public access							✓	
Educational visits								✓

ELMs-type options



N

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- Restoration of heather and dry heath
- Bracken management and semi-natural grass restoration
- Riparian buffer with scrub
- Woodland
- Wood pasture
- Maintenance of traditional farm buildings
- Increased grassland quality

- Woody debris dam
- Off-line pond
- Fenced watercourse
- Walls to maintain
- Shelterbelts
- Hedge restoration for NFM

Qualitative assessment of ELMs benefits

Ecosystem service category	Ecosystem service	Delivery score Baseline	Delivery score ELMs
Provisioning	Food: livestock production	3	2
	Fibre and fuel (timber/woodfuel, wool)	0.5	2
	Water (drinking, agricultural)	1	1
Regulating	Carbon sequestration and storage	0.5	2
	Local climate regulation	1	2
	Air quality regulation	0.5	2
	Water quality regulation and erosion control	0.5	2
	Water flow regulation	0.5	2
	Pollination	1	2
	Pest and disease regulation	0.5	2
	Noise attenuation	0.5	2
	Soil quality regulation	1	2
	Habitat and population maintenance (biodiversity)	1	2
Cultural	Aesthetic experiences	2	2
	Education, training and scientific investigation		
	Recreation and tourism	2	3
	Characteristics and features of biodiversity that are valued	2	3
	Spiritual and cultural experiences	2	3

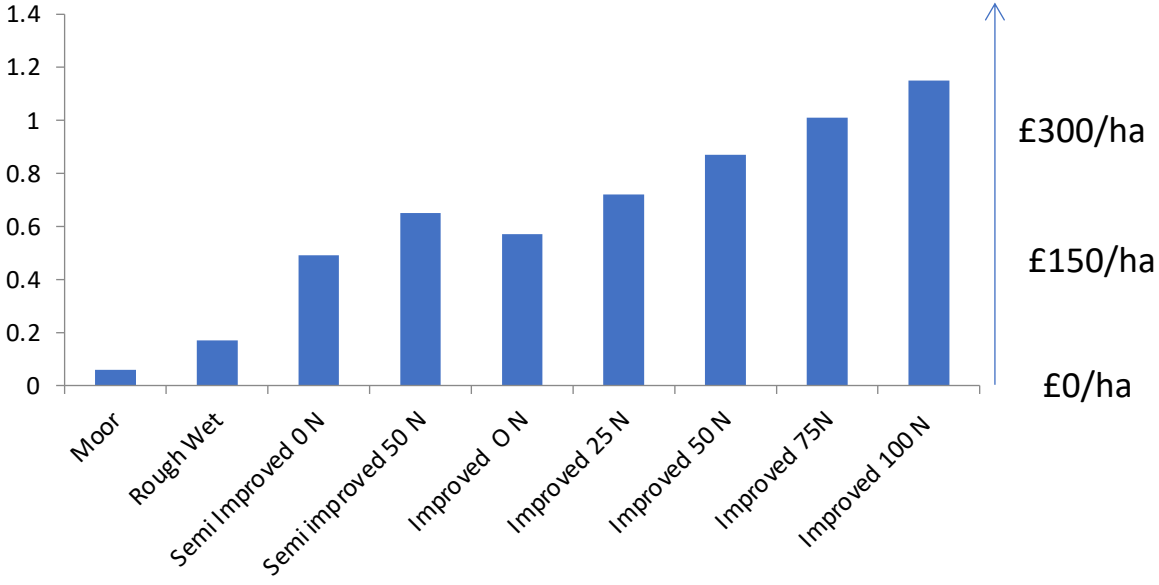
Quantitative assessment of ELMs benefits

Ecosystem service	Baseline		ELMs		Difference	
	Annual physical flow	Annual monetary flow £$_{2020}$ (£PV over 50 years)	Annual physical flow	Annual monetary flow £$_{2020}$ (£PV over 50 years)	Annual physical flow	Annual monetary flow £$_{2020}$ (£PV over 50 years)
Carbon sequestration (trees and hedges) tCO_2e per year	10.9	153 (41,045)	84.7	1,186 (318,943)	+73.8	+1,033 (277,898)
Carbon sequestered by increasing grassland quality tCO_2e per year	27.5	385 (103,553)	179.8	2,517 (677,047)	+152.3	+2,132 (573,494)
Air quality regulation (trees, hedges and grass) $tPM_{2.5}$ per year	0.03	2,289 (84,620)	0.33	24,069 (889,790)	+0.3	+21,780 (805,170)
Timber production m^3per year	6.6	106 (2,705)	61.0	1,007 (25,700)	+54.4	+901 (22,995)
Agricultural production Livestock Units	97	-11,322 (-288,953)	78	-41,179 (-1,050,944)	-19	-29,857 (-761,991)
GHG emissions from agriculture* tCO_2e per year	253	-3,539 (-952,683)	180	-2,522 (-677,803)	+73	+1,017 (274,880)
Carbon emissions from peat habitats tCO_2e per year	135	-1,890 (-508,351)	60	-840 (-225,934)	+75	+1,050 (282,417)

Pen Farm: Grassland options, stocking rates and GM£/ha

Other ecosystem services

Agricultural output



Based on grassland productivity model and site observations

Pen Farm: Extra ELMs type income less BPS income

Δ AES_{net} - Δ BPS_{net}

		£/farm/year			£/ha adjusted*			£/ha ua**
		Revenue	Costs	Net	Revenue	Costs	Net	Net
New AES (ELMs)	a	33,155	9,283	23,871	300	84	216	172
Current AES	b	7,500	1,575	5,925	68	14	54	43
AES Change	a-b	25,655	7,708	17,946	232	70	162	129
BPS	c	27,421	4,113	23,308	248	37	211	168
New AES (ELMs) - BPS	a-c	5,734	5,170	563	52	47	5	4
Extra AES - BPS	(a-b)-c	- 1,766	3,595	- 5,362	-16	33	-49	-39

* adj adjusted 111 ha, ** ua usable agricultural 139 ha, excluding shared moorland

Total costs of existing AES as % of revenue	21%
Total costs of new AES options as % of revenue (incl extra capital	28%
Total cost for BPS as % BPS revenue	15%

Pen Farm: Revenue and Capital Spend by ELMs-type option category

	Annual Revenue	Capital costs	
		Total	Farmer contribution
Average £/ha	£/ha/yr 239	£/ha 148	£/ha 29
% by main option category			
Woodlands/woodpasture	47%	57%	49%
Field management	36%	12%	18%
Water management	6%	11%	16%
Cultural	11%	20%	17%
	100%	100%	100%

Excludes minor capital costs for habitat restoration at £12/ha assumed covered by annual payments

Pen Farm: financial impact of ELMs type options

Δ in Farm Net Income = Δ AES_{net} - Δ BPS_{net} + Δ $Agric_{net}$ + Δ $Diversification_{net}$

Change in AES and BPS support		£/year	£/ha (adj)*	£/ha (ua)**
Extra net income from AES	a	17946	162	129
Loss of net revenue from BPS	b	23308	211	168
Subtotal	a-b =c	-5362	-49	-39
Change in Agricultural Net Income				
Change in Agricultural Gross Margin	d	-6639	-60	-48
Savings in Fixed costs ***	e	5297	48	38
Subtotal	d-e=f	-1341	-12	-10
Total Change in Net Income	c+f	-6703	-61	-48

* adj adjusted 111 ha, ** ua usable agricultural 139 ha, excluding shared moorland

*** includes savings in unpaid family labour valued at employment cost

*** savings as % of total fixed costs = 7%

Av Stocking rate LU/ha (adj) 0.66 original 0.85 reduction 22%

Changes to fill BPS Gap under New ELMs	
Increased ES payments	28%
Total savings in FC (selected)	15%
Total savings in all FC	9%
Reduction in Variable costs	21%
Fall in livestock prices	50%

Not Quite!

Uncertainty:
possible range
+/- 30%

Assumes Countryside Stewardship-based payment rates
Estimates exclude diversification and potential returns from wood products

Agroforestry products

Wood pasture: 10% tree cover: 150 trees/ha, poplar/hazel
Prices (standing): wood fuel: £18/m3, wood chippings £6/m3
Ratio fuel wood to wood chippings : 70%:30%

Years	Biomass m3/tree	Fuel wood £/ha	Wood chippings £/ha	Future value £/ha	Annual equiv * £/ha
10	0.33	891	297	713	59
12	0.47	1269	423	1015	68
15	0.77	2079	693	1663	83
30	2.67	7209	2403	5767	103

*Assumes real discount rate of 4%

£2,200/year equiv on 33 ha, Wood Pasture Capex and Opex already accounted for above

Plus hedgerows cut for chippings: 0.25m^3/m length
15 year cycle on 3,700 m, 62m^3 at £6/m^3, or £18/m^3
home fuel biomass: £400- £1,100/year





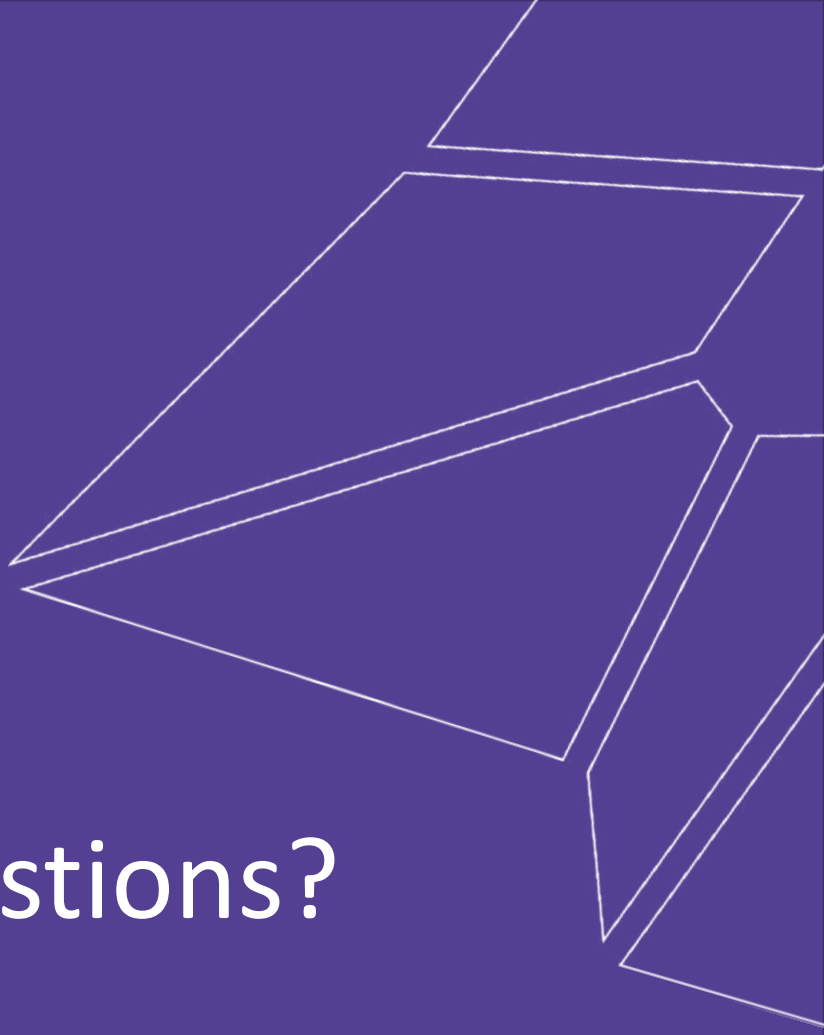
Images from The Agro-Forestry Handbook . 2019. The Soil Association , Bristol

Conclusions

- ELMs-type options can help to provide **multiple public benefits**
- A **natural capital approach** helps to reveal these benefits
- Natural capital assessment **could be improved to suit farm scale application** :
  - Decision support : 'what if?' type assessment of options
  - Farm Plans: including maps and assessment of ELMs opportunities, aligning local priorities and feasibility, collaboration amongst farmers
  - Farm business implications and finance
  - Monitoring ELMs adoption
- Will ELMs close the gap left from loss of BPS? **Yes - but** it depends on the context/farm business

Issues arising

- Harmony and conflict between agriculture and ELMs, and diversification: ‘Sustainable Farming’ and ‘Nature Recovery’
- Forcing efficiency in farming: adding value, reducing costs. More for Less?
- ELMs payments: Compensation or reward? Capital costs?
- Landlord : tenant issues
- New markets and incentives: water markets, carbon markets, biodiversity offsetting
- Multi-farm collaborations: Landscape Recovery
- Guidance, Advice and Support



Thank You: any questions?

Thanks to:

- Pendle Hill Landscape Partnership team
- Pendle Hill case study farmers

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