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Using evidence from floodplain ecosystems to re-consider land use and management

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Natural capital of floodplain land uses

1. Stock of different land uses in English and Welsh floodplains (how much is there?)
2. What benefits do we get from different land uses
3. Value of benefits (some examples of £££ valuation)
4. Evidence gaps
5. Key messages



The extent (km²) of different land uses within the floodplain (Flood zone 2).

Land Use	England*		Wales#		Total	
	extent	% cover	extent	% cover	extent	% cover
<i>Arable and Horticulture</i>	2350	35.6	114	9.3	2464	31.5
<i>Improved Grassland</i>	2200	33.3	613	49.9	2813	35.9
<i>Broadleaved, mixed and yew woodland</i>	450	6.8	130	10.6	580	7.4
<i>Coniferous woodland</i>	30	0.5	12	1.0	42	0.5
<i>Neutral Grassland</i>	200	3.0	19	1.6	219	2.8
<i>Fen, Marsh and Swamp</i>	20	0.3	25	2.0	45	0.6
<i>Urban & suburban</i>	650	9.8	98	8.0	748	9.6
Total floodplain	6600		1229		7829	

Land use categories are from the CEH Land Cover Map 2015.

* Data from England is based on 2007 data, from Heritage & Entwistle, 2017.

Data from Wales, unpublished data, Floodplain Meadow Partnership.



- Floodplains naturally cover over 1.6 million hectares in England and Wales
- **BUT** 42% of floodplains are no longer connected to the river system (Maltby *et al.*, 2011)
- **AND** the level of connectivity between rivers and their floodplain varies considerably between rivers (Heritage *et al.*, 2016).



Maltby E., Ormerod S., Acreman, M., Blackwell, M., Durance, I., Everard, M., Morris, J. & Spray, C. (2011). *Freshwater – Openwaters, Wetlands and Floodplains*. In: The UK National Ecosystem Assessment Technical Report. UK National Ecosystem Assessment, UNEP-WCMC, Cambridge.

Heritage, G., Entwistle, NS. & Bently S., (2016). Floodplains: the forgotten and abused component of the fluvial system. 3rd European Conference on Flood Risk Management. E3S Web Conferences **7**, 13007.

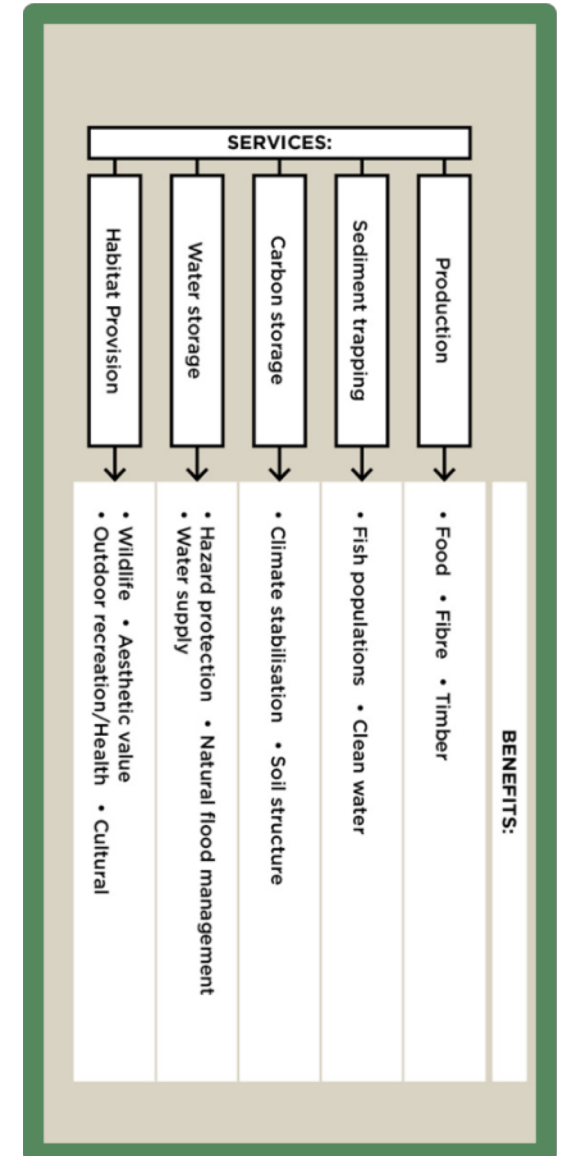
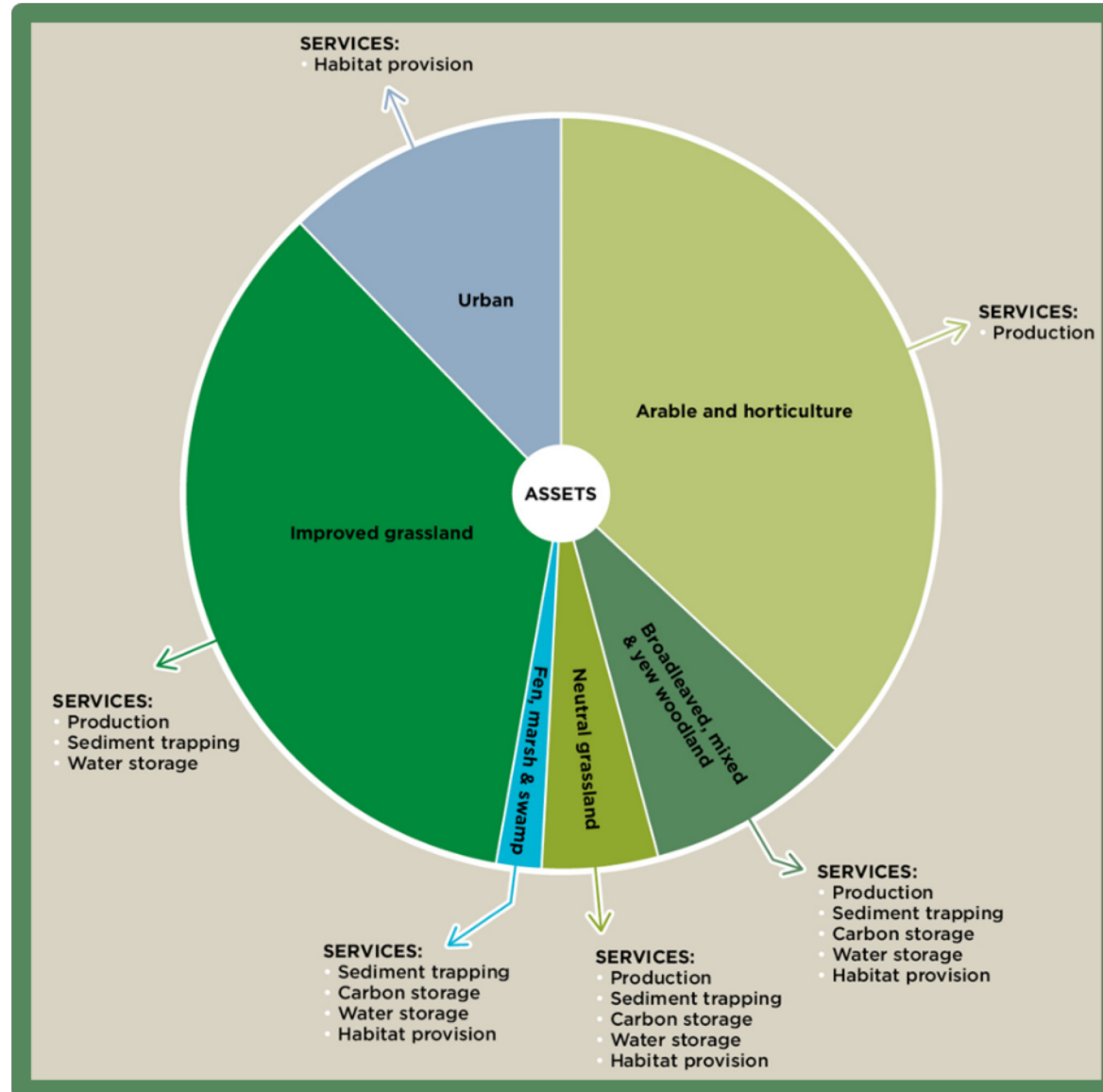


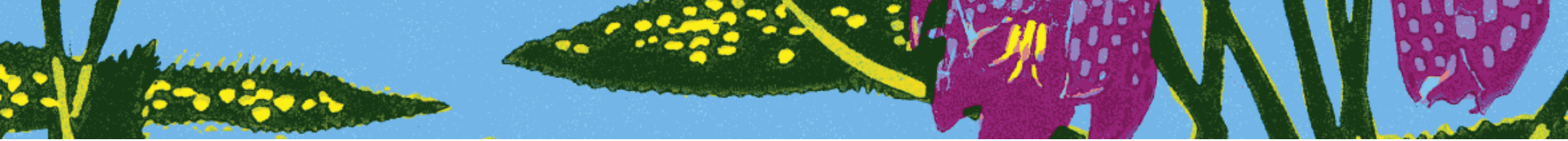
The variety of ecosystem services supplied by different land uses on floodplains

Ecosystem services provided by floodplains	Description of environmental or social goods and services	Land Use					
		Arable and Horticulture	Improved Grassland	Broadleaved Woodland	Coniferous Woodland	Neutral Grasslands	Fen, Marsh and Swamp
Food	Agriculture; crop and livestock production	+	+			+	
Fibre	Timber production, reeds & osiers			+	+		+
Climate Regulation	Carbon sequestration and storage	-		+	+	+	+
Pollination	Habitat for pollinating insects			+		+	+
Water quality	Sediment trapping	-	+	+	+	+	+
Natural Hazard Regulation	Flood storage	+	+	+	+	+	
Biodiversity	Species-rich habitats – high diversity and rare species			+		+	+
Nutrient cycling	Nutrient Management	-		+		+	
Soil formation	Soil development			+		+	+
Cultural history	Strong 'sense of place' and social history			+		+	+
Aesthetic	Enhancement of the landscape, intrinsic appeal			+		+	+
Recreation	Enjoyment of the outdoors	+	+	+	+	+	+

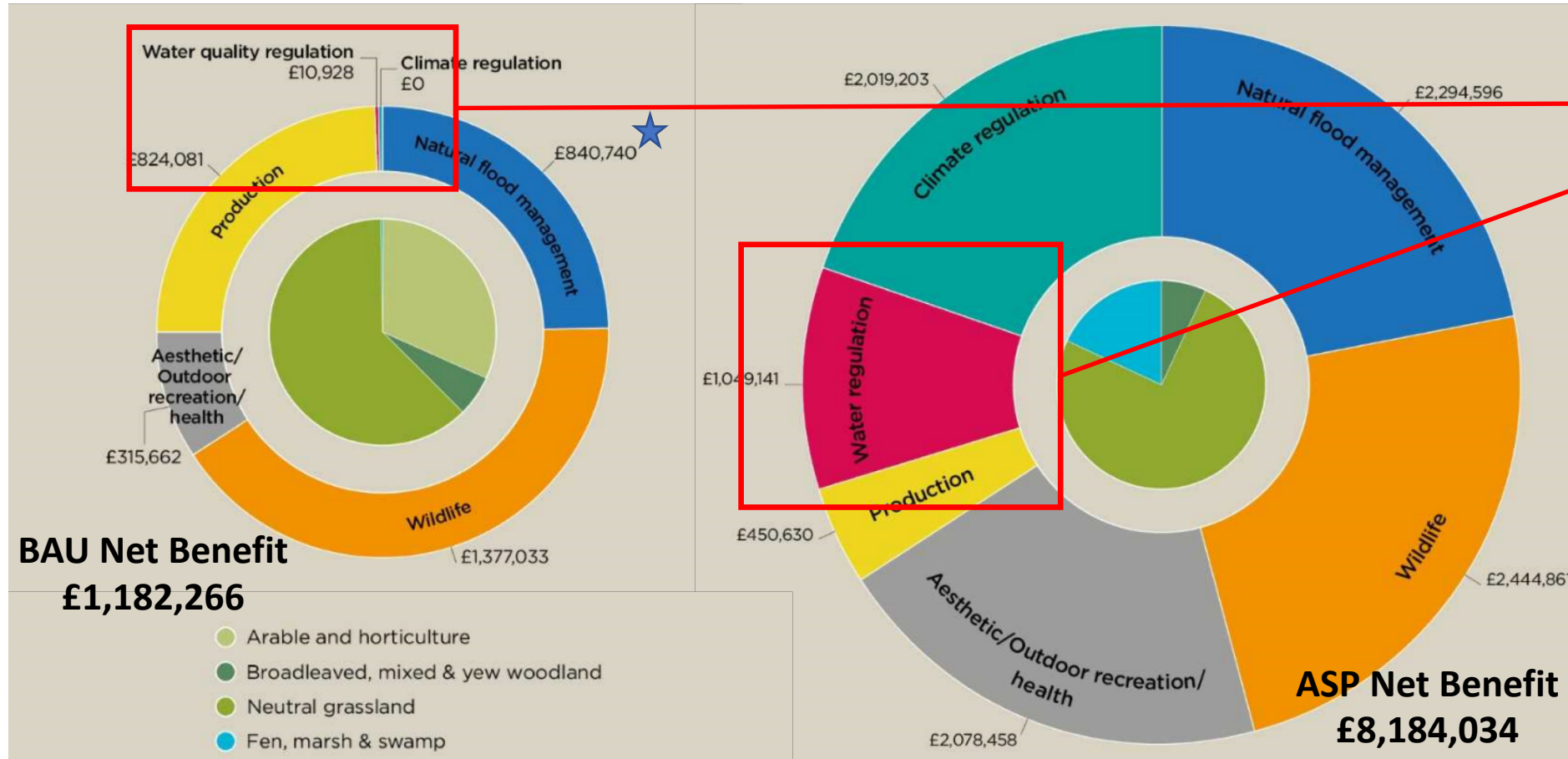


Extent of delivery of different services is dependent on extent of land use





Chimney Meadows NNR (Oxfordshire): from commercial farm (BAU) to extensively managed nature reserve (ASP)*



Water quality regulation services of wetland habitats (floodplain grazing marsh, reedbeds and swamp) only, as relevant data for other habitat types was lacking or missing. Based on the benefit transfer function provided by Brander et al. 2008**.

★ Flood risk benefits provided by arable habitats were not quantified (not enough data)

*Hölzinger, O. & Haysom, K.A., (2017) Chimney Meadows Ecosystem Services Assessment. BBOWT, Oxford

**Brander, L. M., A. Ghermandi, O. Kuik, A. Markandya, P. Nunes, M. Schaafsma, and A. Wagtendonk. 2008. Scaling up ecosystem services values - methodology, applicability and a case study.

Benefit provided by floodplain	Description of the service delivering the benefit	North Meadow quantities	Value per unit	North Meadow total value
Food	Agriculture; crop and livestock production Hay values	Hay yield 4 t ha ⁻¹ yr ⁻¹	Gross margin = £40/t	£6,216
	Grazing land value	0.4 LU ha ⁻¹	£2.50 LU ⁻¹ week ⁻¹	£375
Climate Regulation	Carbon sequestration (t/c/ha/yr)	Variable with season. Hay yield 4 t ha ⁻¹ yr ⁻¹ ; Carbon content of 47.5% = 1.9 t C ha ⁻¹ yr ⁻¹ = 7.0 t CO ₂ e ha ⁻¹	£66 tCO ₂ e ⁻¹ (DECC non-traded carbon price, 2018) £459.80 ha ⁻¹	£20,415
Climate Regulation	Carbon storage below ground (soil, t C ha ⁻¹)	Soil carbon = 109.4 t ha ⁻¹ =4857.4 t C top 10 cm	No equivalent £ values	Not known
	Carbon storage (above ground t C ha ⁻¹)	Variable with season, no long-term store		£0
Pollination	Habitat for pollinating insects	44.4 ha	£29.14 ha ⁻¹	£1,294
Water quality	Sediment trapping	0.8 m ³ ha ⁻¹	£13.83 m ³	£491
Air quality	Removal of atmospheric pollutants	No data		
Natural Hazard Regulation	Flood storage (above ground)	44.4 ha	£197	£8,746
Biodiversity	Species-rich habitats – high diversity and rare species.	44.4 ha	£499 ha ⁻¹	£22,156
Cultural history	Strong 'sense of place' and social history	44.4 ha of historic landscape	£203.4 ha ⁻¹	£9,013
Aesthetic	Enhancement of the landscape, intrinsic appeal	No data		
Recreation	Enjoyment of the outdoors	15,000 visitors yr ⁻¹	£500 ha ⁻¹ yr ⁻¹	£22,200
Health		2 km of path with 50 m wide buffer either side = 20 ha	£433 ha ⁻¹	£8,660

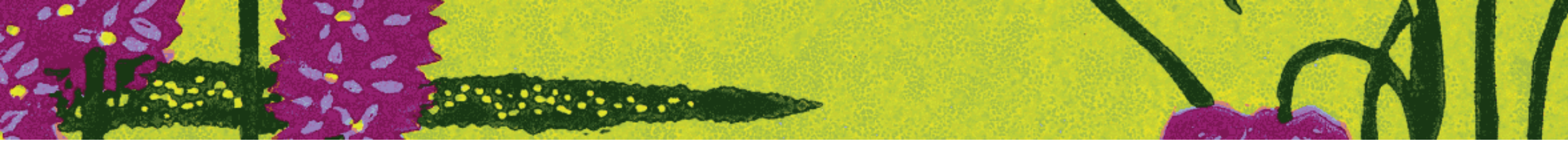


Broads Authority Sediment Management Strategy, 2007

Figure from Holzinger and Haysom, 2017, adapted from Christie *et al*, 2011



Description of environmental or social goods and services	Management options for floodplain grasslands to maximise benefits			
	Supply of surplus nutrient via artificial fertilizers	Drainage designed to relieve waterlogging within three days	Sufficient stocking to maintain year round sward height below 5 cm	Harvesting hay at peak-protein (typically mid-June to first week of July)
Agriculture; crop and livestock production	↑	↑	↑	↑
Carbon sequestration and storage	↓	↑	↓	↑
Habitat for pollinating insects	↓	↑	↓	↑
Sediment trapping	-	↑	↓	↑
Flood storage	-	↑	-	-
Species richness	↓	↑	↓	↑
Nutrient capture	↓	↑	↓	↑
Soil development	↓	↑	↓	↑
Strong 'sense of place' and social history	-	↑	↓	↑
Enhancement of the landscape, intrinsic appeal	↓	↑	↓	↑
Enjoyment of the outdoors; health and well-being	-	↑	↓	↑



Evidence gaps

- Flood reduction (above ground and below ground) for different land use types (but PhD)
- Soil structure and water storage/aquifer recharge in floodplain soils
- Soil carbon processes
- Value of soil carbon storage (large in extensive grassland systems, but no valuation method)





Key Messages

Floodplains are special environments in terms of the variety and extent of services they offer – their uniqueness needs to be reflected in ELMS and other policies.

A natural-capital perspective can be used to inform and compare land-use decisions.

Enormous potential to increase the extent of floodplain habitats that can provide us with multiple benefits – reconnecting rivers and floodplains, restoring semi-natural habitats

There are data gaps, but these should not stop us making the case to re-connect rivers and floodplains



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