

Agriculture and Peri-urban Issues

International Workshop

Montpellier

May 16th – 17th 2024

The economics of flooding and agriculture
in England and Wales

Joe Morris

Emeritus Professor, Cranfield University

j.morris@cranfield.ac.uk



Overview - context and purpose :

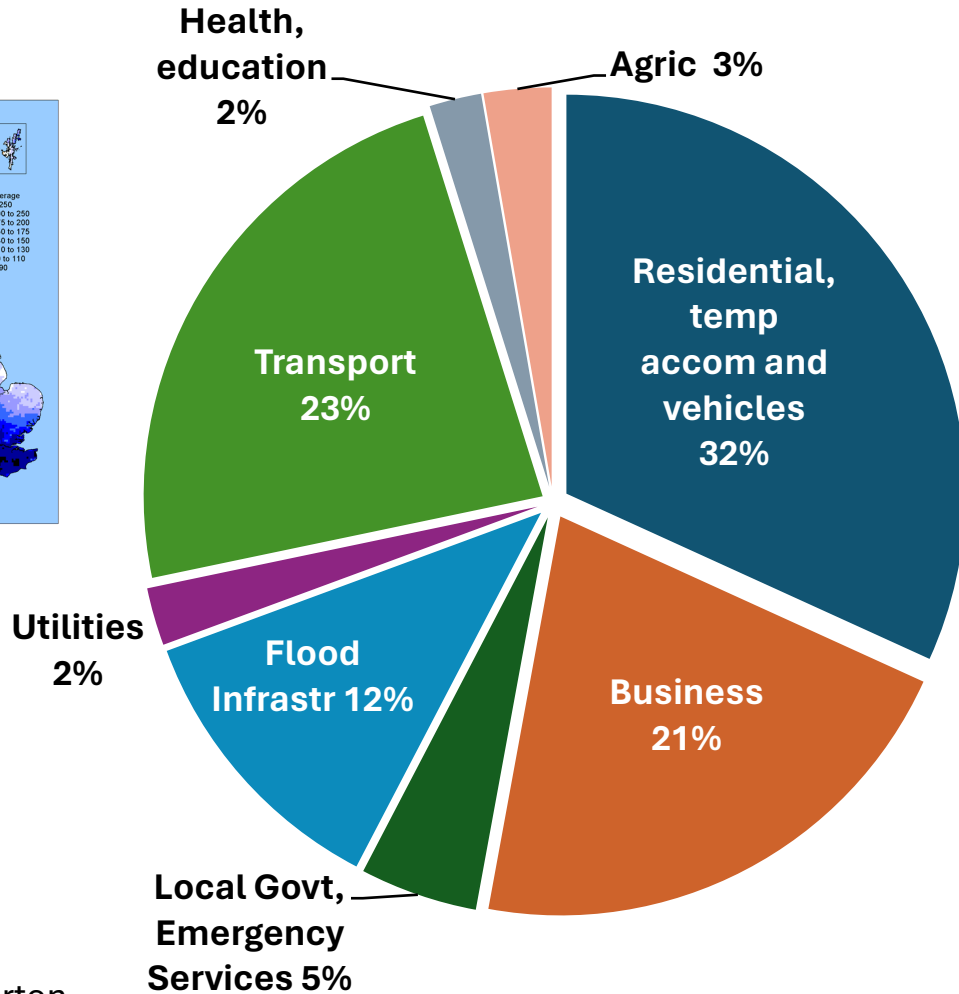
- Flood and Coastal Erosion Risk Management (FCERM) and Agriculture in England and Wales (and UK)
- Climate change, food security , livelihoods, sustainability and resilience
- Focus here on :
 - Systematic review of flooding and agriculture interactions
 - Guidance for economic appraisal
 - Peri-urban cases and issues



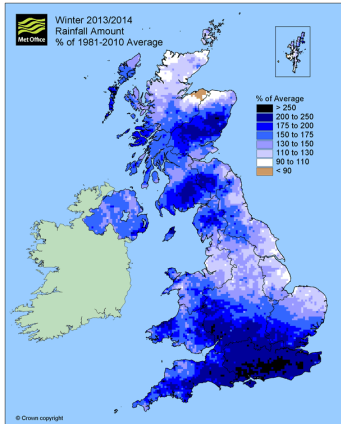
Profile of Flood Costs: winter 2013/14

England and Wales

% total costs: £1.3 billion*



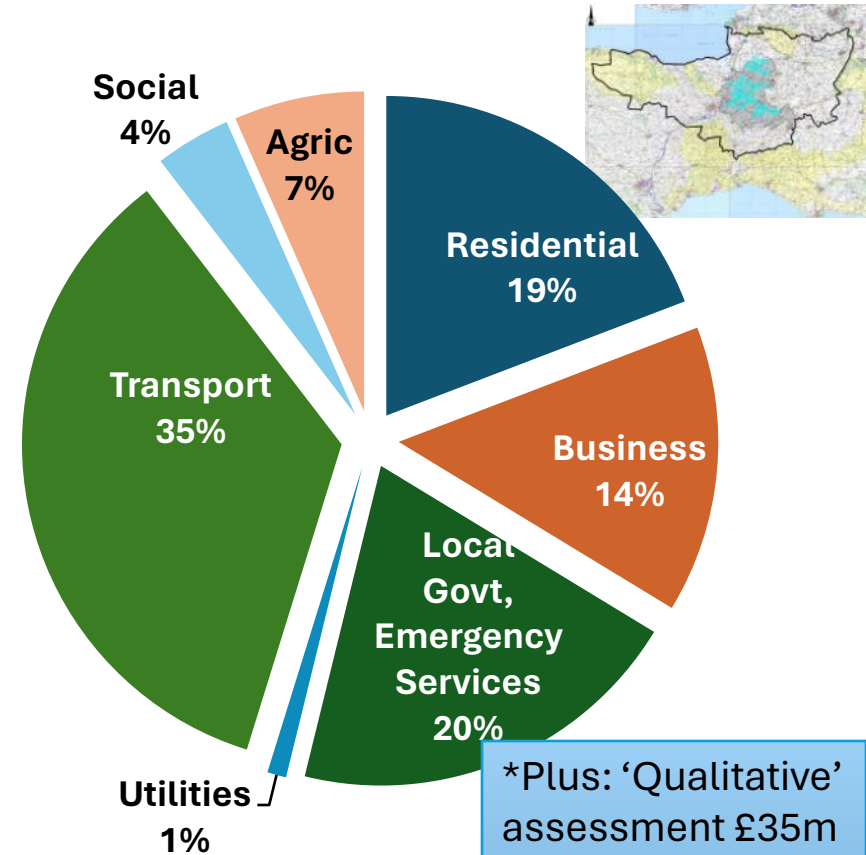
*Central estimate



Source : Chatterton et al, 2016

Local Impacts: Somerset

% total economic costs: £84m*



*Plus: 'Qualitative' assessment £35m (extra 40%)

Source: Parsons Brinkerhoff, BV and Somerset Rivers Authority. 2016

FCER and Agriculture: Systematic Review

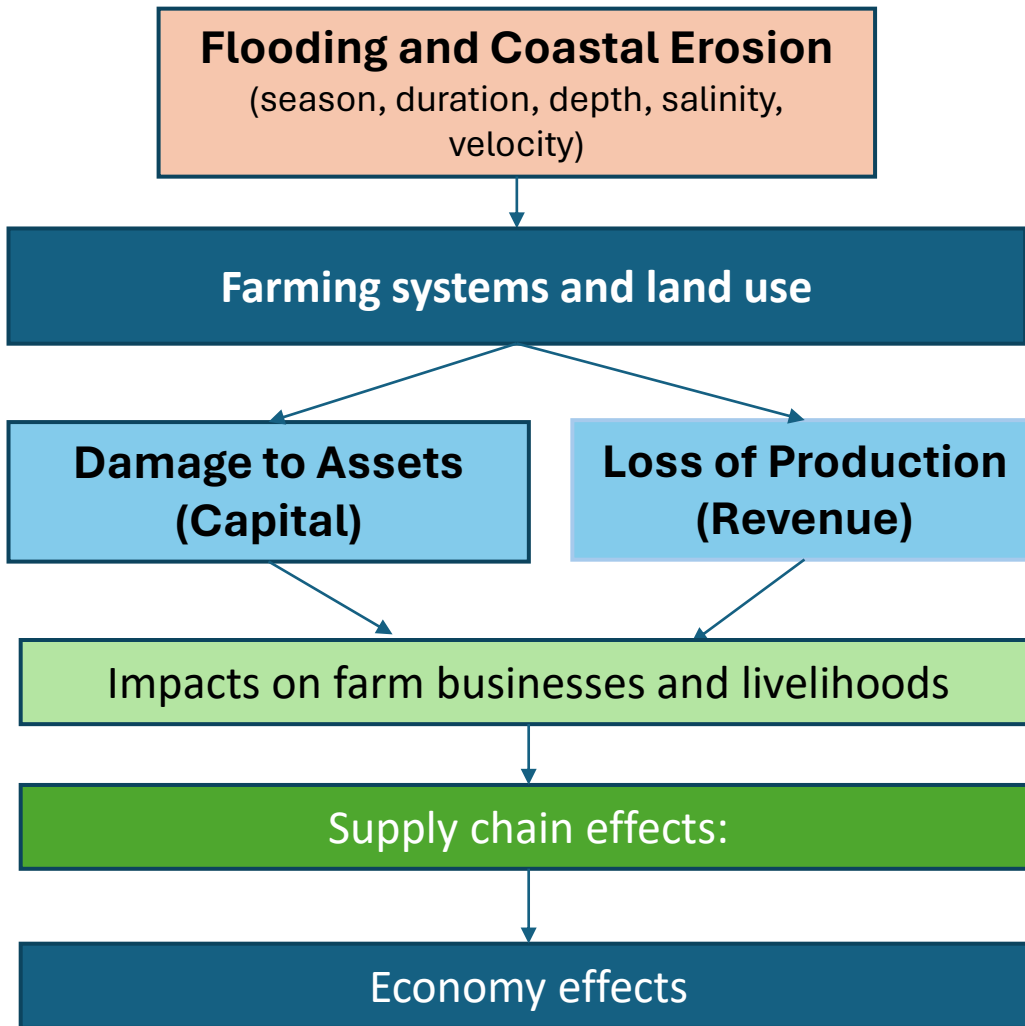
Two separate Qs for England and Wales:

- Q 1 what are the impacts and effects of flooding and coastal erosion risks and events on agricultural land and businesses
- Q 2 what are the quantified costs and benefits of past, present and potential future flooding and coastal erosion mitigations on agriculture land and businesses

	Q1	Q2
Population	Agricultural land, assets and people businesses	
Exposure	FCER	FCERM measures
Comparator	Without FCER (events)	Without FCERM measures
Outcome	Quantified financial and economic costs and benefits	

Source: Hess et al, 2023

Q1: Flood Impacts on Agriculture, E&W ?

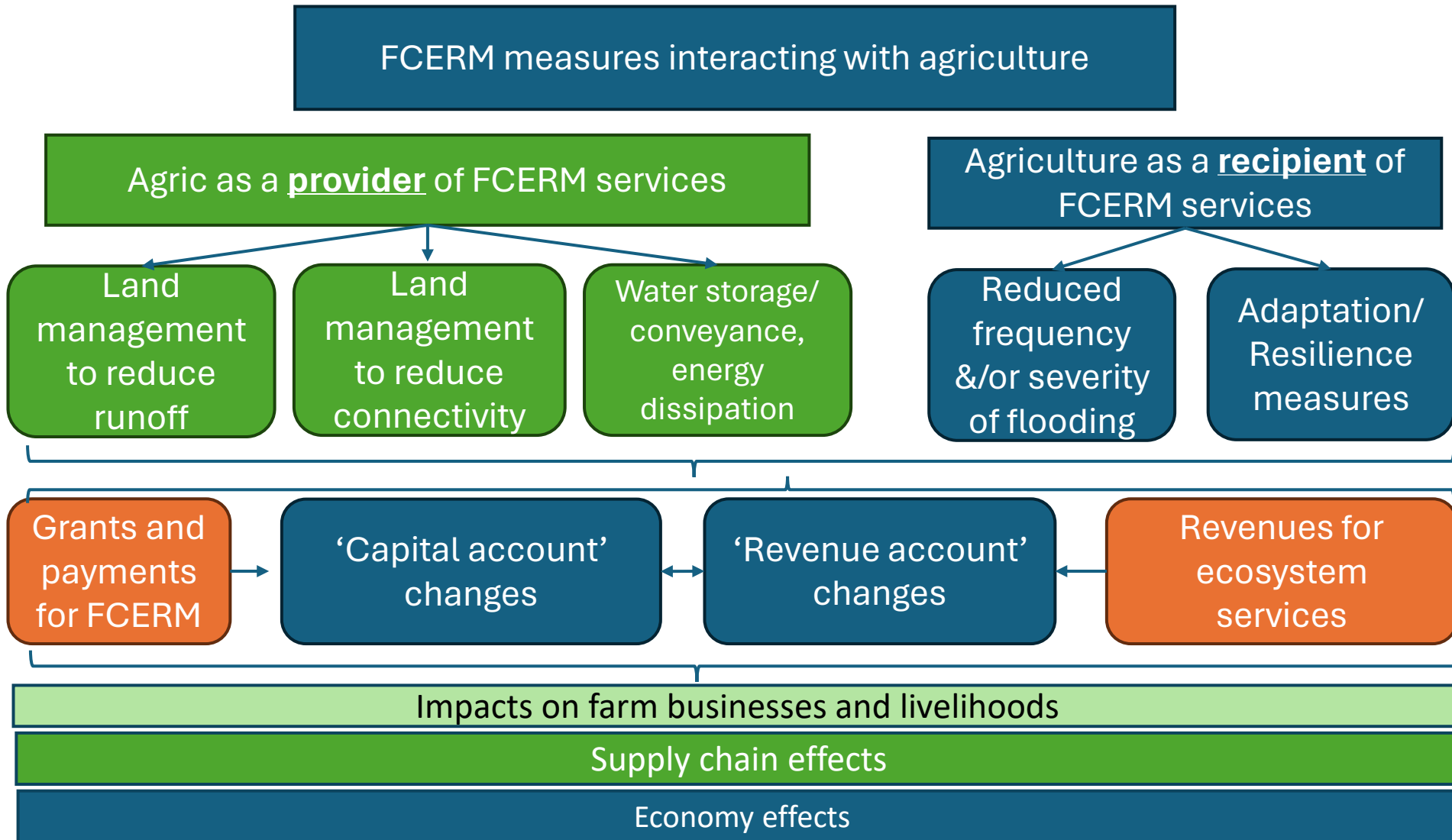


Q1: Evidence of Flood Impacts on Agriculture, E&W

	£/ha costs (2022 prices)
Vegetables & Horticulture	~ £10,000
Arable (mainly cereals) cropping	~£1,000 to ~ £2,000
Hay/Silage	~£400 to ~£600
Grazing	~£100 to ~ £600
Winter flooding	£440 (all land uses)
Summer flooding	£1,680 (all land uses)

- Financial impacts (£/ha) vary
 - Land use and crop type
 - Seasons and crop/livestock 'calendars'
 - Duration of flooding
 - Quality of the floodwater (especially saline/freshwater)
- Impacts on farm business (£/farm) vary
 - Proportion of farm affected
 - Contractual obligations
 - Insurance
 - Vulnerability
- Limited evidence of supply chain and economy impacts

Q2: Impact of FCERM mitigation measures on farm businesses



Agriculture as a Provider of FCERM services

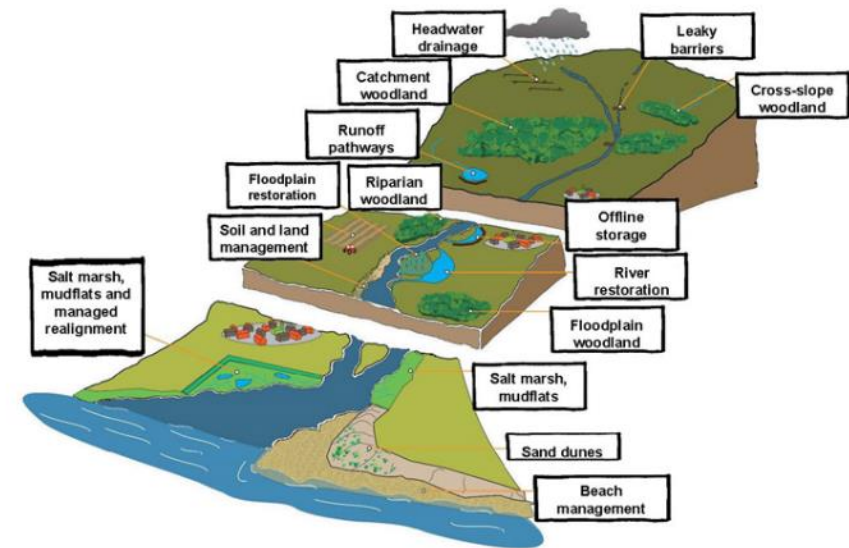
Increased use of FCERM measures on farmland that incorporate Natural Flood Management solutions, harnessing natural processes to modify the runoff and connectivity of potential flood waters in the farmed landscape.

FCERM/NFM measures on farmland usually classified by hydraulic function and position in the landscape

The effect of FCERM/NFM measures on farm incomes varies according to :

- changes in land management practices,
- changes in land use,
- withdrawal of land from agricultural use

FCERM/NFM interventions in the landscape

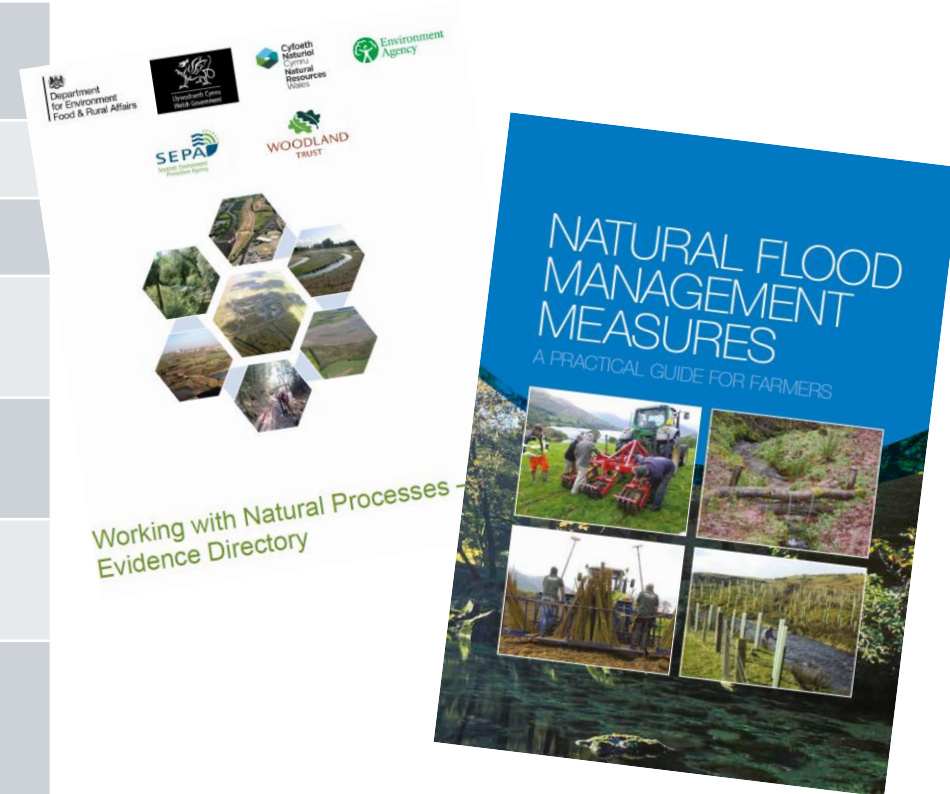


Source: Burgess-Gamble et al., 2018

Impact of FCERM mitigation measures on farm businesses

Intervention	Costs	Benefits (revenue and savings)
Floodplain land management	£360/ha capital	£250-£400 /ha/year (AgEnv)
Soil conservation		£15 to £34/ha/year
Floodplain storage	£30 – £200/ha/year	£168-£420/ha/year
Wetlands/ponds	£183 to £1,115/ha year	Variable according to eligibility
Coastal managed realignment	£20 to £100/ha/year	£75 to £180/ha/year
Woodlands	£0 to £606/ha/year depending on land use	£74 to £369/ha/year depending on eligibility
Managing Connectivity (channel works)	£50 to £600/ha /year depending on land use	Variable according to land use and eligibility

(2022 prices)



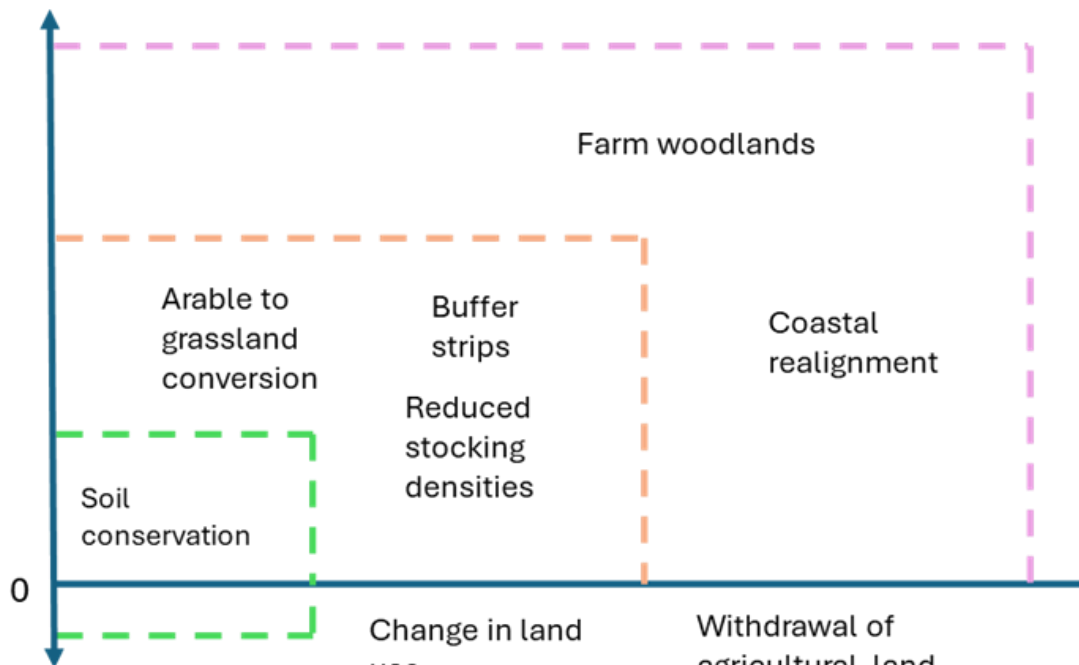
Agriculture as provider of FCERM services – Range of costs to farmers

Typical costs to farmers £/ha/year

High, £300 - £1,000 depending on land use

Medium £100 - £400

Low < £100, or negative cost <-£50



Credits: EA and NE

Need for Compensation



Low

High

Ecosystem co-benefits



Agriculture as a recipient of FCERM Services

Flood protection and land drainage schemes

Diverse benefits and costs to farmers reflecting the avoidance of flood impacts on farmland but also the potential to take up benefits that were not feasible prior to protection

Measures: mainly engineered solutions including embankments, channel works, structures, pumps, removal of constrictions.

Policy Drivers

Past: agricultural enhancement

Present : securing FCERM services against climate change effects in strategic areas

Future: policy integration, climate change, food security, environmental objectives

Great Ouse Fens : FCERM and agriculture



Q2: Agriculture as a recipient: evidence

Capital works	£/ha/year	Context
Severn Trent (Midlands) region (1960s to 1980s)	£309 (average) £163 - £970 range	Mainly grassland, include land drainage: moderate farmer response
English Regions (1960s to 1980s)	£657 (average) £458 - £1044 range	High farmer uptake of benefits: land use change and land drainage improvement
Great Ouse (Cambridge Fens) (2020s)	£736 (average) £510 - £1,100 range	Prime Agricultural land
River maintenance		
England and Wales (1990s)	£106 - £154	Mainly drainage benefits
Rural flood prone areas(1990s)	£266 (average) £73- £415 range	Mainly flood control

Reduction in the costs of flooding to existing land use

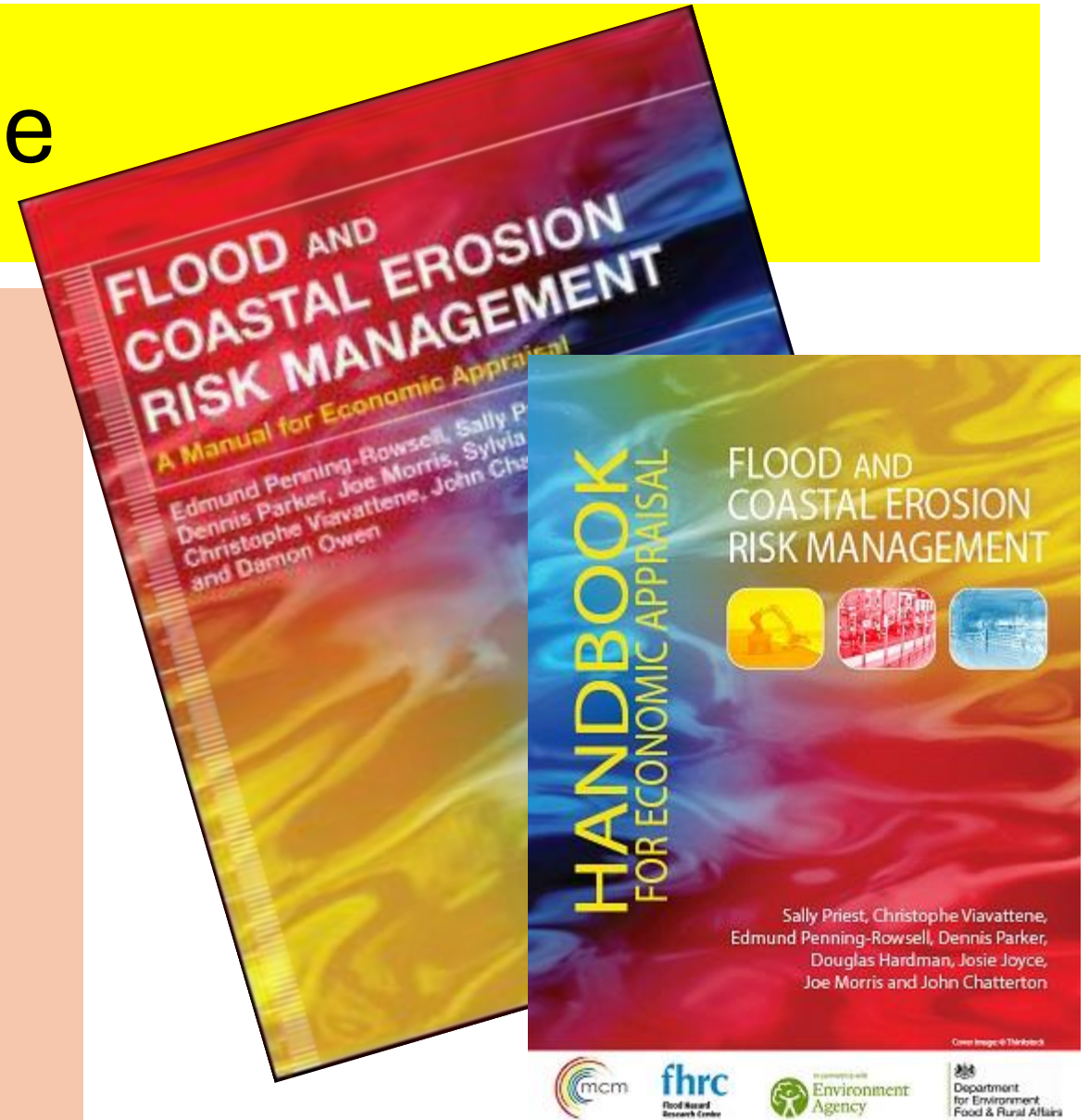
Extra benefits from more intensive, higher value crop and livestock land use

Associated land drainage benefits often linked to land use change

Maintenance of standards of FCERM service

Appraisal and Guidance

- Financial (farmer)
- Economic (national economy)
- Wider 'Business Case'
- After a flood (assessing actual costs)
- Before a flood (predicting likely costs)
- Futures?



Estimating Agricultural Flood Costs

FCERM Scenarios: land loss, one-off event, change in flood attributes

Flood attributes

- Frequency
- Season
- Duration
- Depth
- Velocity
- Water Quality

Land use attributes and farming systems:

- Arable
- Grassland
- Livestock
- Other, perennial

Loss of production

Damage to assets

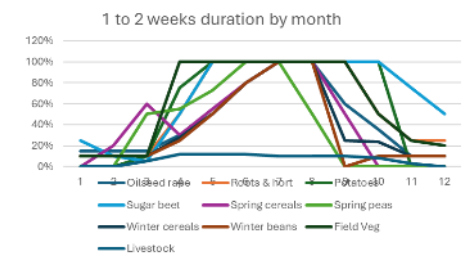
Yield and output loss, Extra costs

'Write off', Degradation, Repair/restoration Replacement

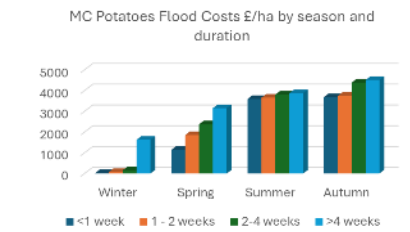
Decision support : Agriculture as a FCERM recipient or provider ?



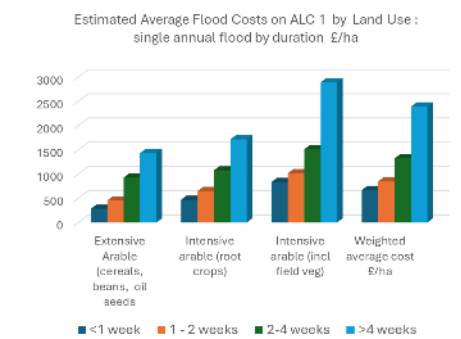
Loss and damage functions £/ha



By crop and season



By crop and duration



By farming system and land quality

Agriculture and flooding in peri-urban areas

- Peri-urban? Agriculture-urban interface
- Agriculture & Flooding: pathway or receptor?
- Ecosystems approach : service flows, synergy and trade-offs?
- Scenario and decision analysis
- Policy implications

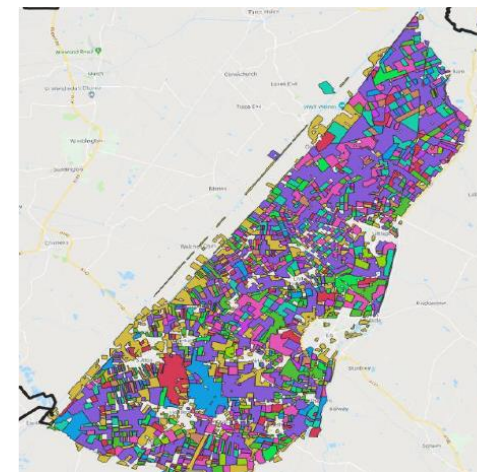
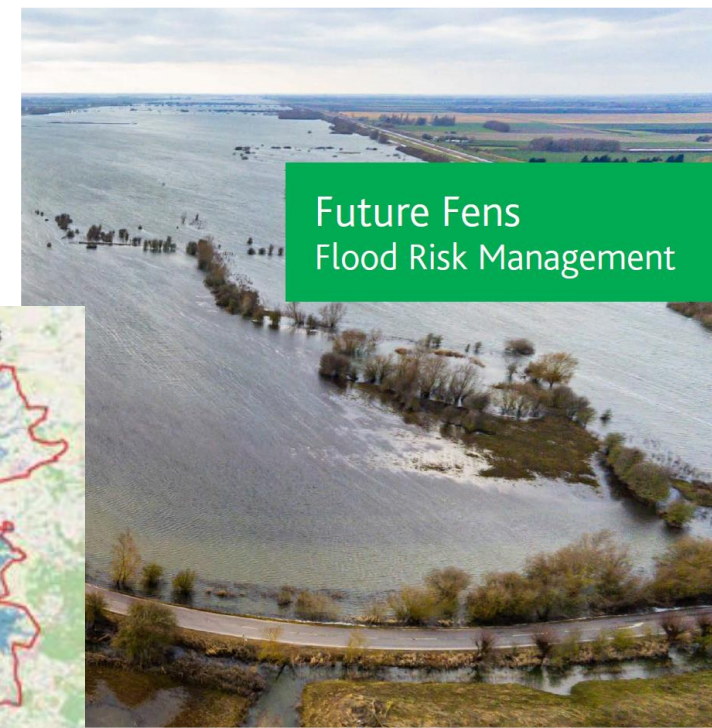
Three cases :

- 1 Great Ouse: lowland
- 2 Humber: coastal
- 3 Sheffield peaks; upland



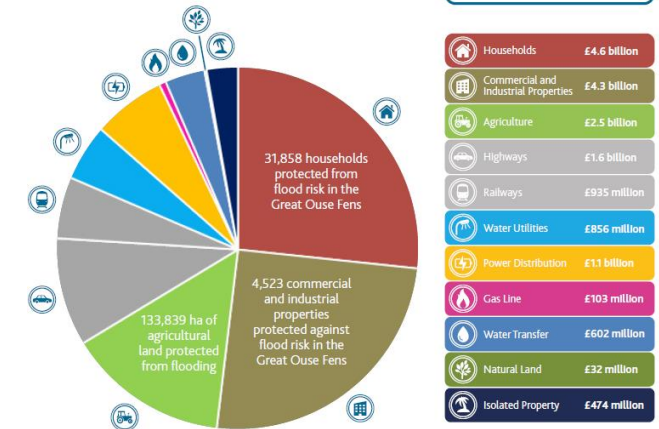
Great Ouse : Cambridgeshire

- Context: history, strategic assets, CC and food security, development pressure, wetlands
- Agric land as recipient and a provider
- Refit of FRCEM assets
- 185,000 ha agric land, 80% prime agric land, 70% at risk of flooding
- Scenario appraisal of investment options
- Agric benefits £700 - £900/ha/year, c£120 mn/year, Agric economy associated with £1.9 billion/year
- £2.5 bn Present Value,
- About 15 % of total project benefits
- Important wetland sites



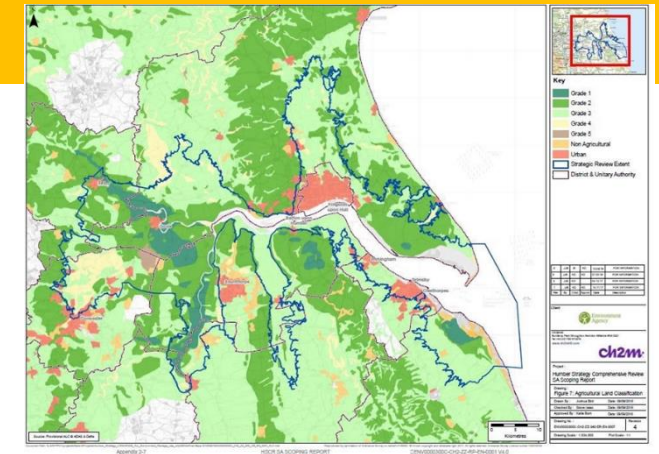
Flood Risk Management Benefits

Total: £17.1 billion



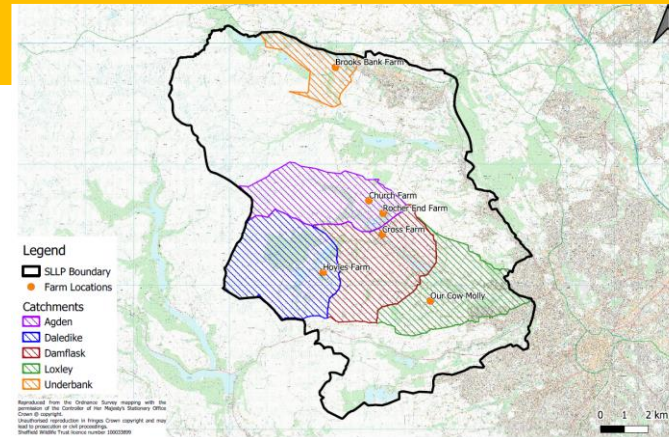
Humber Estuary : peri-urban coastal communities

- Context: CC, sea level rise, tidal and estuarine flooding, coastal erosion, risk to coastal urban settlements, wetlands
- Flood December 2013: 1,100 properties, 7,000 ha agric land flooded
- Agricultural areas: FCERM provider and beneficiary roles
- Estimation of flood costs by Land Grade:
- Prioritization - prime agricultural land, coastal margins,
- Managed realignment: impact on agriculture, wetland creation
- Ecosystem service : co-delivery and funding ?



Sheffield Peak District: land management options

- Context: Alternative futures for upland farms under policy change
- Scenarios:
 - 1 Baseline,
 - 2 Regenerative farming
 - 3 Restoration
- Ecosystem Services, including flood regulation
- Natural Flood Management interventions and benefits: potential for reducing peak flows by 5 % to 10% , £17 - 37/ha/year estimated benefits
- Overall +ve economic B:C ratios, potential flood and water benefits ~10% of total benefits
- Who pays? Blended funding opportunities



Ecosystem services	Baseline	Scenario 1	Scenario 2	Scenario 3	
Air Quality	£/ha/yr *	107	112	244	202
	Extra £/ha/yr **		5	137	95
Net carbon	£/ha/yr	72	42	348	417
	Extra £/ha/yr		-30	276	345
Agric	£/ha/yr	-201	-212	-239	-284
	Extra £/ha/yr		-11	-38	-83
Timber	£/ha/yr	25	28	85	66
	Extra £/ha/yr		3	60	41
Flood reduction	£/ha/yr	15	17	33	37
	Extra £/ha/yr		2	18	22
Water Quality	£/ha/yr	23	25	43	34
	Extra £/ha/yr		2	20	10
Total	£/ha/yr	41	11	514	471
	Extra £/ha/yr		-30	473	430
BNG ***	£/ha/year			175	

development for total 264 ha, ** Relative to baseline *** Scenario 2B only - BNG over 30 yrs at 3.5%



Agriculture and FCERM : Implications for Policy and Practice

- Gaps in the evidence
 - Impacts
 - Mitigation measures
 - Synergies and trade-offs
 - Land manager incentives & responses
- Policy and practice
 - Risk, adaptation and resilience
 - Strategic issues - integration
 - Maintenance of FCERM assets
 - Finance
 - Decision support/Guidance



References

Hess, T.M., Morris, J. and Ponchet, M., Bethel, A. and Storer, C. 2023. Rapid Evidence Assessment of Flooding and Coastal Erosion on Agricultural land and Businesses in England and Wales. WSP, Cranfield University & Exeter University. Project FD2737 Report (Four Annexes) to Department for Environment and Rural Affairs (Defra) , London

Holt, A., Morris, J. ,Riley, J., Bridge, J., Johnson, N. and Tomkins, K. 2023. Exploring environmental land management options and blended finance on farms in the Sheffield Peak District. Defra Test and Trial Project 333 Report, Department for Environment and Rural Affairs (Defra) , London

Morris, J. 2024. Appraisal of Flood Risk for Agriculture. Chapter 9 in Priest, S. et al. 2024. Flood and Coastal Erosion Risk Management: A Handbook for Economic Appraisal, Routledge, Abingdon, Oxford

Penning-Rowsell, E., Priest, S., Parker, D., Morris, J., Tunstall, S., Viavattene, C., Chatterton, J. and Owen D. 2013. Flood and Coastal Erosion Risk Management: A Manual for Economic Appraisal, Routledge, Abingdon, Oxford