

# 9 *Appraisal of flood risk management for agriculture*

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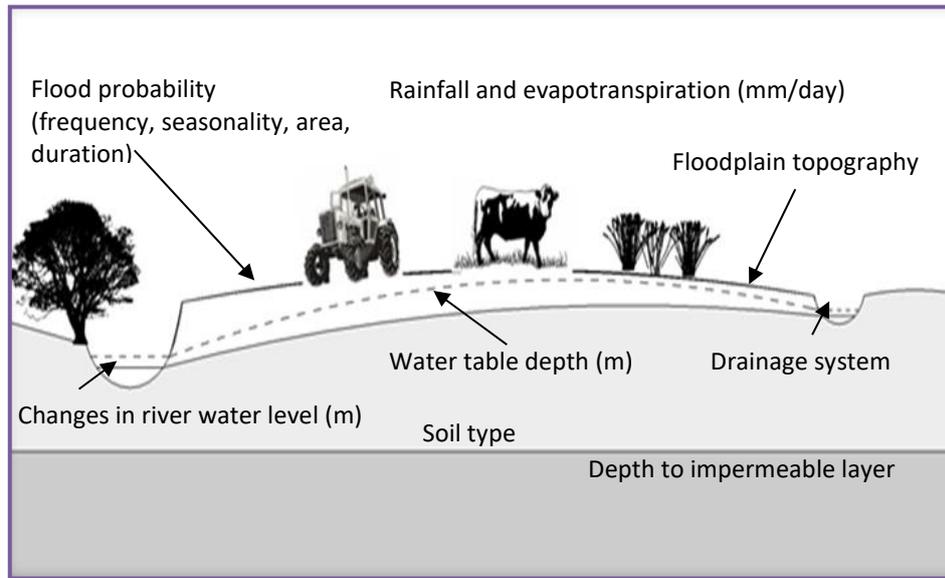
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**Figure 9.1** Flooding and drainage factors influencing agricultural productivity on floodplains in England and Wales



**Table 9.1** General tolerance of flooding by agricultural land use in England and Wales

Agricultural land use Type	Common minimum acceptable flood frequency: annual probability	
	Whole Year	April-October
Horticulture and field scale vegetables	5%	1%
Intensive arable including sugar beet and potatoes	7%-10%	4%
Extensive arable: cereals, beans, oil seeds	10%-15%	7%-10%
Intensive grass: improved grass, usually dairying	50%	20%
Extensive grass, usually cattle and sheep	≥100%	33%

**Table 9.2** Drainage conditions for agriculture and water levels in fields and ditches In England and Wales

Agricultural drainage condition	Agricultural productivity class	Depth to water table from surface	Springtime freeboard <sup>1</sup> in water-courses (natural drainage)	Springtime freeboard <sup>1</sup> in water-course (field drains)
Good: 'rarely wet'	Normal, no impediment imposed by drainage	0.5 m or more	1 m sands	1.2m clays to 1.6m sands (0.2m below pipe outfall)
			1.3 m peats	
			2.1 m clays	
Bad: 'occasionally wet'	Low, reduced yields, reduced field access and grazing season	0.3 m to 0.49 m	0.7 m sands	Temporarily submerged pipe outfalls
			1 m peats	
			1.9 m clays	
Very bad: 'commonly or permanently wet'	Very low, severe constraints on land use, much reduced yields, field access and grazing season: mainly wet grassland	Less than 0.3 m	0.4 m sands	Permanently submerged pipe outfalls
			0.6 m peats	
			1 m clays	

**Notes to table:**

1. Freeboard refers to the mean difference between water level and adjacent field level

**Table 9.3** Common farming performance and field drainage conditions in England and Wales (these 2025 values are based on £2024 derived estimates uplifted using ONS GDP deflator)

£ 2025 Values	Field Drainage Conditions		
	Good	Bad	Very Bad
<b>Arable</b>			
Yield as % of 'good' category			
Winter wheat and barley	100	80	50
Spring wheat and barley	100	90	80
Oil seed rape	100	90	80
Potatoes, Peas, Sugar Beet	100	60	40 <sup>1</sup>
Wheat financial gross margin <sup>2</sup> £/ha/year	£1238-£1547	£825-£1031	£340-£443
<b>Grassland</b>			
Typical nitrogen use kg N/ha/year	150 - 200	50 – 75	0 - 25
Grass conservation	2 cut silage	1 cut silage or graze	1 cut hay or graze
Typical stocking rates <sup>3</sup> ; Livestock units/ha/year	1.7 - 2.0	1.2 - 1.4	0.7 - 1.0
Typical livestock type	Dairy, intensive beef and sheep	Beef cows, 24-month beef, sheep	Fattening of 'store' cattle, and sheep
Financial gross margins <sup>2</sup> £/ha/year (after forage costs)	£2,269-£3,095 (dairy) £619-£980 (intensive beef/sheep)	£443-£650	£257-£443
Days reduction in grazing season compared to 'good' category <sup>4</sup>	none	Spring: 14 to 21 Autumn: 14 to 21	Spring: 28 to 42 Autumn: 28, no stock out in winter

**Notes to table:**

1. Not grown if persistently 'very bad'.
2. Gross Margins estimates based on Defra Farm Business Survey data 2018/19 to 2022/23, weighted by GDP deflators to 2024 and 2025 prices, see Table 9.5
3. Livestock units (Lu): dairy cow, 1 Lu; beef cow, 0.8 Lu; 24-month beef, 0.7 Lu; sheep plus lambs, 0.14- 0.17 Lu.
4. A grazing day is worth about £3.2/Lu in spring/summer, £1.6/Lu in autumn, and £0.8/Lu in winter in terms of savings in housing costs and feed conservation costs.

**Table 9.4** The Impacts of flooding on farmland by type of agricultural land use and the seasonality of flooding in England and Wales

	Spring	Summer	Autumn	Winter
	March – May	June- August	September – November	December – February
<b>Horticulture (soft fruits, salad crops)</b>	Complete loss of soft fruits and winter /spring salads	Complete loss of annual production, possible loss of perennial stock	Loss of late season harvest, possible loss of perennial stock: replanting/reseeding	Damage to standing crops, annuals /perennials
<b>Intensive Agriculture (including field vegetables &amp; roots)</b>	Delay in planting or loss of established crops	Likely complete loss of standing root crops eg potatoes/onions/carrots	Loss of unharvested autumn crops, notably potatoes. Delayed planting or loss of winter crops, substituted by spring sown crops	Possible loss of winter harvest crops (sprouts, and sugar beet). Yield loss on autumn sown crops
<b>Extensive arable (cereals and oil seeds)</b>	Loss or delay of spring sown cereals, yield loss on winter sown cereals, delayed spring treatments	Complete or partial loss of unharvested crops	Loss of unharvested autumn crops. Delayed planting or loss of winter crops, substituted by spring sown crops	Yield loss on autumn sown crops, reseeding with spring sown crops if severe damage
<b>Grassland: intensive (mainly dairy)</b>	Loss of grass yields, delayed stock turnout, delay fertiliser applications. Grass reseeding if long duration flooding	Loss of grass yields, partial or complete loss of hay/silage crop, loss of grazing, stock morbidity/mortality. Grass reseeding if long duration flooding	Loss of autumn grazing, stock relocation /housing. Possible reseeding if long duration.	Loss of winter ‘accommodation’ pasture.
<b>Extensive (mainly beef and sheep)</b>	Loss of grass yields, delayed stock turnout, delayed fertiliser applications.	Loss of grass yields, partial or complete loss of hay/silage crop, loss of grazing, stock morbidity/mortality.	Loss of autumn grazing, stock relocation /housing.	Limited impact on flood tolerant grass swards

**Table 9.5** Estimated Financial and Economic Gross Margins and Net Margins (£/ha/year, 2025 prices) for wheat and selected farm types in England (these 2025 values are based on £2024 derived estimates uplifted using ONS GDP deflator)

	£ 2025 values		Winter Wheat <sup>3</sup>	Cereals (Extensive Arable)	General Cropping (Intensive Arable)	Dairy (Intensive Grass)	Lowland Grazing (Extensive Grass)
<b>Financial assessment</b> <sup>1,2</sup>							
<b>a</b>	Gross Output	£/ha/year	2,016	1,498	1,968	4,945	1,019
<b>b</b>	Variable Costs	£/ha/year	646	608	851	2,588	531
<b>c</b>	Gross Margin (a-b)	£/ha/year	1,369	889	1,117	2,356	488
<i>Fixed Costs (including rent, excluding unpaid labour)</i>							
<b>d</b>	Semi-fixed Costs	£/ha/year	315	257	344	618	211
<b>e</b>	Total Fixed Costs	£/ha/year	873	730	963	1758	606
<i>Financial Net Margin</i> <sup>4</sup>							
<b>f</b>	After semi fixed costs (c-d)	£/ha/year	1,053	631	772	1,738	276
<b>g</b>	After full fixed costs (c-e)	£/ha/year	495	158	153	598	-119
<b>Adjustment to Financial Net Margin</b> <sup>5</sup>							
<b>h</b>	Plus Farm rents	£/ha/year	131	109	158	257	86
<b>i</b>	Less unpaid family labour	£/ha/year	173	144	109	406	376
<b>j</b>	Subtotal (h-i)	£/ha/year	-44	-37	49	-149	-290
<b>Adjusted Financial Net Margin (excluding income subsidies)</b>							
<b>k</b>	after semi fixed costs (f+j)	£/ha/year	1010	595	822	1590	-14
<b>l</b>	After full fixed costs (g+j)	£/ha/year	451	122	203	449	-408
<b>Economic Assessment</b> <sup>6</sup>							
	Adjustment for high value crops and dairy		None	None	High value crop area treated as wheat	Dairy area treated as wheat	None
	Gross Margin (c weighted by wheat area)	£/ha/year	1,369	889	1,167	1,192	488
<b>Net Margin</b>							
	After semi fixed costs (k weighted by wheat area)	£/ha/year	1010	595	859	804	-14
	After total fixed costs (l weighted by wheat area)	£/ha/year	451	122	252	279	-408
	Range high <sup>7</sup>	£/ha/year	677	184	379	419	-205
	Range low	£/ha/year	225	61	126	140	-612

**Notes to table:**

1. Estimated mean annual values in 2024 prices derived from Regional Farm Business Survey (FBS) mean annual values, for England (all farms by type) 2018/19 to 2022/23. weighted by GDP deflators (ONS, 2025)

2. Farm type classifications are based on the proportion of Total Output by value attributable to given enterprises, where more than 67% of total output by value is attributable to particular crop or livestock enterprises, namely Cereals (cereals and

combinable crops such as field peas and beans, and oils seeds), General Cropping (arable crops including field scale vegetables), Dairy (milk production) and Grazing Livestock (beef and sheep).

3. Wheat: average yields 8.6 t/ha (2018/19 - 2022/23), average price 2024 (weighted) £217/t. The 10-year (2014/15-2023/24) GDP weighted price for wheat is £212/t in 2024 prices. Average total fixed costs (£/ha/year) for Winter Wheat are about 20% higher than the overall average for Cereals farms based on FBS crop production data.

4. Net margins here are the same as the Farm Business Income estimates derived by the Farm Business Survey and used in reporting Farm Incomes (Defra, 2024a). Net margins here show the financial returns generated by 'agricultural' activities, excluding income from subsidies and other sources, including land rents paid and paid wages and salaries but excluding charges for family labour. Basic Payment Scheme direct income subsidies averaged £117/ha/year in 2024 for eligible land. Agri-environment payments currently average about £40/ha/year on Lowland Grazing Livestock Farms.

5. For economic analysis, land purchase and/or rental costs are excluded, and unpaid familiar labour is included at equivalent cost. No deduction has been made here for National Insurance costs on labour, averaging about 10% of labour costs.

6 For economic analysis, the areas given to high value cropping and dairy production are treated as equivalent areas of a wheat crop. About 20% of cropping on General Cropping farms comprises high value root and field vegetable crops. About 80% of the area on Dairy farms directly supports milk production with the balance is for livestock rearing and fattening. These proportions can be treated as wheat equivalents. Detailed assessment of enterprise types and performance is recommended to allow for local variation.

7. The high to low range in estimated Net Margin is approximately +/-50% of the central estimate reflecting top and bottom quartile means and variations of between a 12% and 15% change in either Gross Output or Total Costs (£/ha/year).

**Table 9.6** Defra guidance for the appraisal of alternative agricultural FCERM scenarios <sup>1</sup>

	Scenario I	Scenario II	Scenario III
	Land lost to agriculture	Temporary, one-off loss of agricultural output	Permanent change in the value of agricultural output
All agricultural land use	Loss equivalent to market value of land less £600/ha (2008 prices) <sup>2</sup> to reflect 'single payment' subsidies where received (no adjustment on land for fruit and vegetables)		
<b>Crops:</b> Cereals; oilseeds; beans/peas. <b>Grassland:</b> Beef and sheep		Loss of Gross Margins £/ha/year (adjusted for possible savings in costs), plus clean-up costs	Change in Net Margins £/ha/year associated with change in flood and land drainage conditions
<b>Other:</b> Dairy; sugar beet; potatoes; high value fruit/vegetables		As above, treated as though area occupied by wheat	As above, treated as though area occupied by wheat

**Notes to table:**

1. Following Defra (2008) Guidance (See also Tables 9.4 and 9.5 above)
2. £902/ha in 2025 prices

**Table 9.7** Estimated economic cost of freshwater and saline flooding (£/ha in 2025 prices) for a single event of a given duration in weeks by land use and associated farm types in England (these 2025 values are based on £2024 derived estimates uplifted using ONS GDP deflator)

Land Use Type <sup>1,2</sup>	Drainage condition	Freshwater flooding and duration <sup>3</sup>		Saline flooding and duration <sup>2</sup>	
		1 to 2 weeks	2 to 4 weeks	1 to 2 weeks	2 to 4 weeks
1. Extensive Grass. Lowland Grazing livestock	Good	77	280	372	911
	Bad	66	239	344	848
	Very Bad	40	167	102	236
2. Intensive Grass. Mainly Dairy	Good	117	418	451	1,125
	Bad	80	364	395	1,040
3. Grass/Cereal Rotation. Dairy/Cereal mixed	Good	366	850	708	1,423
	Bad	236	569	518	1,102
4. All Cereal	Good	614	1280	966	1,722
	Bad	391	774	642	1,165
5. Extensive Arable, crops harvested by combine harvester	Good	620	1305	966	1,704
	Bad	400	805	686	1,206
6. Intensive Arable with root crops (sugar beet and potatoes)	Good	959	1,623	1,272	2,649
7. Intensive Arable with specialist root crop and field scale vegetable production	Good	2,384	3,320	3,685	6,564

**Notes to table:**

1. Indicative associated Agricultural Land Classification Grade (ALC) by land use are as follows. Land use 1: ALC 4. Land use 2 and 3: ALC 3a and b. Land use 4 and 5: ALC 3a. Land use 6: ALC 2. Land use 7: ALC 1.
2. Average arable crop yields for land use and ALC associations are assumed relative to ALC 3, at + 15% for ALC 1, +10% for ALC 2 and -15% for ALC 4, but local conditions vary substantially and should be checked.
3. Assumes monthly distribution of flood probability for all England, with weighted monthly flood costs that vary according to land use and estimated monthly loss and damage to crops and livestock according to production cycles

**Table 9.8** Estimated economic cost of flooding (£/ha in 2025 prices) in England for a single event of a given duration in weeks by Agricultural Land Classification (ALC) Grade and associated agricultural land use (these 2025 values are based on £2024 derived estimates uplifted using ONS GDP deflator)

ALC grade <sup>1</sup>		Intensive Arable with root and vegetable crops	Intensive Arable with root crops (sugar beet and potatoes)	Extensive Arable: mainly cereals and oils seeds	Intensive Grass: mainly Dairy	Extensive Grass: mainly beef and sheep	Average Flood costs £/ha/event <sup>2</sup>
1	% of area	15	75	10			
	1 to 2 weeks	£2,383	£1,000	£686			£1,176
	2 to 4 weeks	£3,322	£1,686	£1,465			£1,805
2	% of area	5	60	35			
	1 to 2 weeks	£2,280	£959	£665			£923
	2 to 4 weeks	£3,177	1,619	£1,403			£1,645
3a	% of area		30	70			
	1 to 2 weeks		£887	£619			£701
	2 to 4 weeks		£1,496	£1,305			£1,361
3b	% of area			50	50		
	1 to 2 weeks			£588	£134		£361
	2 to 4 weeks			£1,227	£474		£851
4	% of area			20	40	40	
	1 to 2 weeks			£557	£118	£77	£185
	2 to 4 weeks			£1,155	£423	£278	£510
52	% of area					100	
	1 to 2 weeks					£41	£41
	2 to 4 weeks					£165	£165

**Notes to table: (estimates are rounded)**

- Broad indicative associations of land use and farm type by ALC Grade for England are assumed that should be verified locally. Flood costs (£/ha) reflect difference in normal yields by ALC Grade relative to ALC Grade 3, namely: ALC Grade 1, 115%; Grade 2, 110%; Grade 3, 100%; Grade 4, 85%.
- Monthly distributions of flood probability for all England are assumed, with weighted monthly flood costs that vary according to land use and crop, grassland and livestock production cycles.

**Table 9.9** A simple example of the economic assessment of flood induced agricultural land use change (these 2025 values are based on £2024 derived estimates uplifted using ONS GDP deflator)

		Existing FCERM service	Future FCERM options	
			Option 1: Do Minimum	Option 2: Do Nothing
<b>Flood return period (years) <sup>1</sup></b>		20	8	1
<b>Land Use</b>		General Cropping	Extensive Arable	Extensive Grass
<b>Drainage condition</b>		Good	Good	Bad
<b>Net Margin <sup>2</sup></b>	£/ha/year	252	122	-408
<b>Flood cost <sup>3</sup></b>	£/event	959	614	66
<b>Annual flood cost <sup>4</sup></b>	£/ha/year	47	77	66
<b>Net Margin less flood costs</b>	£/ha/year	205	46	-474
<b>Change in net benefits relative to Existing FCERM service <sup>5,6</sup></b>	£/ha/year		-159	-679

**Notes to table:**

1. Based on Table 9.1
2. Based on economic Net Margins by land use in Table 9.5
3. Based on Table 9.7, single annual event, duration 1 to 2 weeks
4. A simple average cost for a single flood event is assumed for illustrative purposes rather than a complete estimate of Average Annual Damage (AAD) costs
5. Indicative changes in net annual economic benefits to agriculture at full implementation of FCERM scenario
6. Extensive Grassland Net Margin excludes potential annual agri-environment benefits that should be factored in.

**Table 9.10** Weights applied to central estimates of the cost of a single flood occurring in a year (£/ha) to derive estimates of the seasonal cost of flooding on agricultural land in England and Wales

Flood season <sup>1</sup> and duration	Intensive and Extensive Arable		Intensive and Extensive Grass		Rough Grazing	
	Freshwater	Saline	Freshwater	Saline	Freshwater	Saline
<b>1 to 2 weeks</b>						
Winter	0.47	0.71	0.44	1.20	0.49	0.74
Spring	1.21	1.15	2.50	1.76	1.18	2.00
Summer	2.71	1.91	1.75	1.21	1.28	1.12
Autumn	1.38	1.19	1.07	1.37	0.42	0.80
<b>2 to 4 weeks</b>						
Winter	0.69	0.81	0.52	1.18	0.42	0.63
Spring	1.31	1.20	2.32	1.86	1.20	1.79
Summer	1.69	1.45	2.13	1.41	1.00	1.00
Autumn	1.21	1.12	0.80	1.29	0.42	0.63

**Notes to table:**

1. Winter: December to February inclusive. Spring: March to May. Summer: June to August. Autumn: September to November.