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Supplement of

AGRIDE-c, a conceptual model for the estimation of flood damage to crops: development and implementation

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1. Structure of the Supplement

The Supplement includes, for each principal crops in the Po Plain:

- average yield and price in the Province of Lodi over the last five years;
- distribution of production costs over the year in the case that no flood occurs (i.e. Scenario 0);
- implemented physical model;
- yield reduction and change in production costs on the basis of damage alleviation strategies;
- relative damage for the different combinations of times of flood occurrence (i.e. month), flood intensities (i.e. water depth and flood duration) and damage alleviation strategies

in case of conventional and minimum tillage, when both techniques are possible. Concerning maize crops, only data related to conventional tillage are reported, being those related to minimum tillage included in the main manuscript.

2. Maize crops

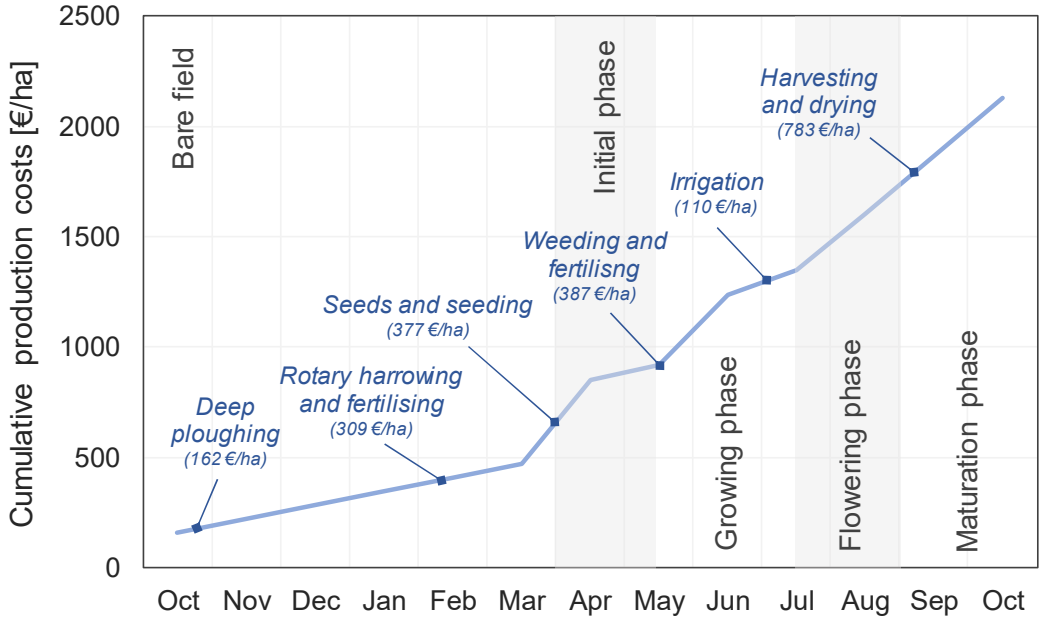

Figure S.1. Distribution of production costs over the year in the Scenario 0 for maize crops, in the case of conventional tillage

Table S.1. Yield reduction and change in production costs on the basis of damage alleviation strategies for maize crops, in case of conventional tillage

Time of the flood	Vegetative stage	Alleviation strategy	Yield reduction [%]	Additional costs	€/ha	Avoided costs	€/ha
November - March	Bare field	Continuation	0	Soil restoring (sediment removal and terrain levelling)	500		
				Deep ploughing	162		
April - May	Initial phase	Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Weeding and fertilising	387
						Irrigation	110
						Harvesting and drying	783
		Reseeding	0	Soil restoring (sediment removal and terrain levelling)	500		
				Rotary harrowing and fertilising	309		
				Seeds and reseeding	377		
June	Growing phase	Continuation	see Fig. 4 of the paper	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Irrigation	110
						Harvesting and drying	783
		Reseeding	0	Soil restoring (sediment removal and terrain levelling)	500		
				Rotary harrowing and fertilising	309		
				Seeds and reseeding	377		
July - August	Flowering phase	Continuation	see Fig. 4 of the paper	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Irrigation	55
						Harvesting and drying	783
September - October	Maturation phase	Continuation	see Fig. 4 of the paper	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Harvesting and drying	783

Water depth < 130 cm		Strategy	Flood duration [days]								
			<5	5	6	7	8	9	10	11	>11
Bare field	Jan	c	60%								
		r	-								
		a	-								
	Feb	c	60%								
		r	-								
		a	-								
	Mar	c	60%								
		r	-								
		a	-								
Initial phase	Apr	c	-								
		r	129%								
		a	261%								
	May	c	-								
		r	129%								
		a	261%								
Growing	Jun	c	60%	104%	149%	193%	237%	282%	326%	371%	-
		r	129%								
		a	-	308%							
Flowering	Jul	c	60%	149%	237%	326%	-				
		r	-								
		a	-	314%							
	Aug	c	60%	149%	237%	326%	-				
		r	-								
		a	-	314%							
Maturation	Sep	c	60%								
		r	-								
		a	-								
	Oct	c	60%								
		r	-								
		a	-								
Bare field	Nov	c	60%								
		r	-								
		a	-								
	Dec	c	60%								
		r	-								
		a	-								

Water depth ≥ 130 cm		Strategy	Flood duration [days]								
			< 5	5	6	7	8	9	10	11	>11
Bare field	Jan	c	60%								
		r	-								
		a	-								
	Feb	c	60%								
		r	-								
		a	-								
	Mar	c	60%								
		r	-								
		a	-								
Initial phase	Apr	c	-								
		r	129%								
		a	261%								
	May	c	-								
		r	129%								
		a	261%								
Growing	Jun	c	60%	104%	149%	193%	237%	282%	326%	371%	-
		r	129%								
		a	-	308%							
Flowering	Jul	c	-								
		r	-								
		a	314%								
	Aug	c	-								
		r	-								
		a	314%	314%	314%	314%	314%	314%	314%	314%	314%
Maturation	Sep	c	60%				149%	237%	326%	-	
		r	-								
		a	-				321%				
	Oct	c	60%				149%	237%	326%	-	
		r	-								
		a	-				321%				
Bare field	Nov	c	60%								
		r	-								
		a	-								
	Dec	c	60%								
		r	-								
		a	-								

Figure S.2. Po Plain case: relative damage (Eq. 2 in the paper) to maize crops (in case of conventional tillage) for different combinations of times of flood occurrence (i.e. month), flood intensities (i.e. water depth and flood duration) and damage alleviation strategies ("c"=continuation; "r"=reseeding; "a"=abandoning). Results for the "r" option are obtained by assuming a null yield penalty for late (re-)planting.

3. Wheat crops

Table S.2. Average yield and price for wheat in the Province of Lodi over the last five years

Yield [q/ha]	75
Price [€/q]	23

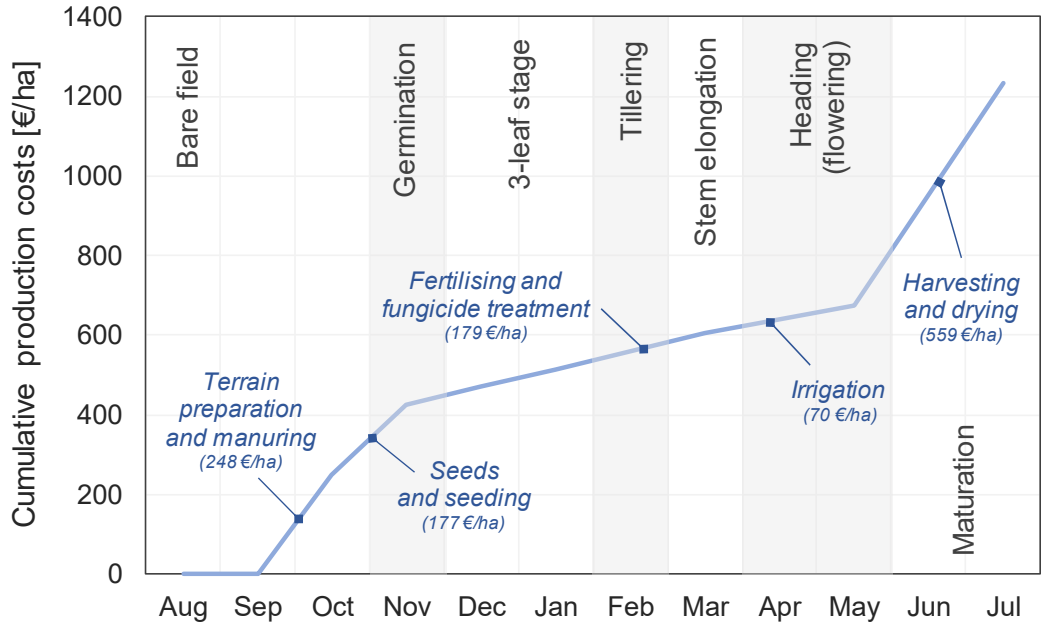

Figure S.3. Distribution of production costs over the year in the Scenario 0 for wheat crops, in case of minimum tillage

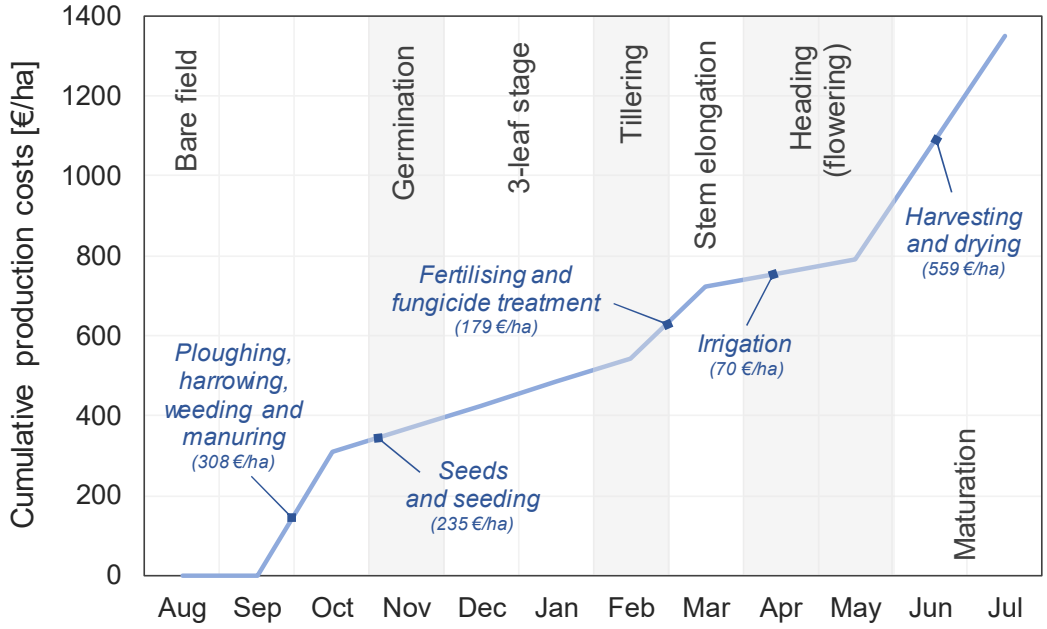

Figure S.4. Distribution of production costs over the year in the Scenario 0 for wheat crops, in case of conventional tillage

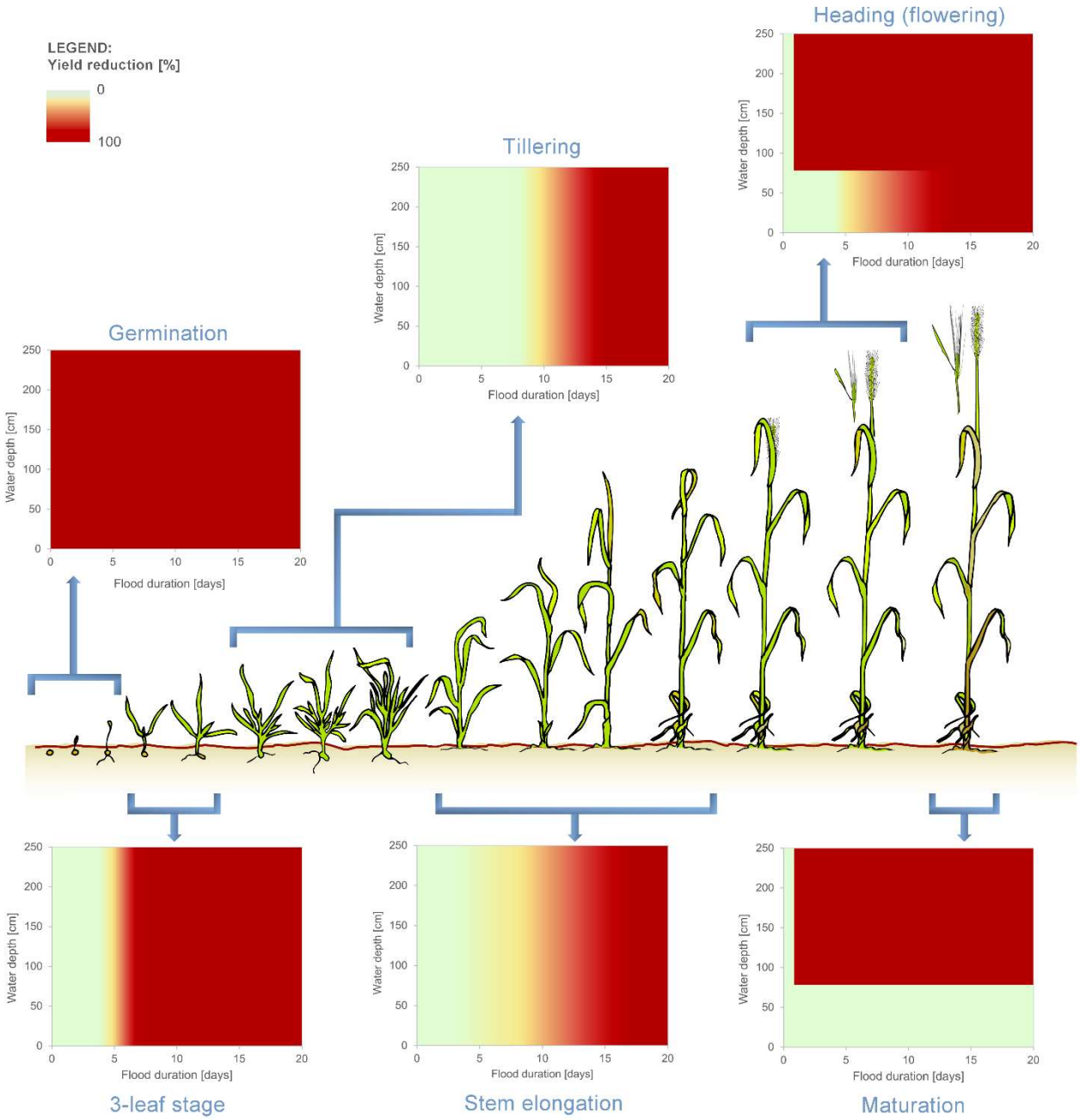

Figure S.5. Physical damage to wheat and barley as a function of vegetative stage, flood depth and duration (adapted from Agenais et al., 2013)

Table S.3. Yield reduction and change in production costs on the basis of damage alleviation strategies for wheat crops, in the case of minimum tillage

Time of the flood	Vegetative stage	Alleviation strategy	Yield reduction [%]	Additional costs	€/ha	Avoided costs	€/ha
August - October	Bare field	Continuation	0	Soil restoring (sediment removal and terrain levelling)	500		
November	Germination	Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Fertilising and fungicide treatment	179
						Irrigation	70
						Harvesting and drying	559
		Reseeding	0	Soil restoring (sediment removal and terrain levelling)	500		
				Seeds and reseeding	177		
December - January	3-leaf stage	Continuation	see Fig. A.5	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Fertilising and fungicide treatment	179
						Irrigation	70
						Harvesting and drying	559
		Reseeding	0	Soil restoring (sediment removal and terrain levelling)	500		
				Seeds and reseeding	177		
February	Tillering	Continuation	see Fig. A.5	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Fertilising and fungicide treatment	179
						Irrigation	70
						Harvesting and drying	559
		Reseeding	0	Soil restoring (sediment removal and terrain levelling)	500		
				Seeds and reseeding	177		
March	Stem elongation	Continuation	see Fig. A.5	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Irrigation	70
						Harvesting and drying	559
April - May	Heading (flowering)	Continuation	see Fig. A.5	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Harvesting and drying	559
June - July	Maturation phase	Continuation	see Fig. A.5	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Harvesting and drying	559

Table S.4. Yield reduction and change in production costs on the basis of damage alleviation strategies for wheat crops, in the case of conventional tillage

Time of the flood	Vegetative stage	Alleviation strategy	Yield reduction [%]	Additional costs	€/ha	Avoided costs	€/ha
August - October	Bare field	Continuation	0	Soil restoring (sediment removal and terrain levelling)	500		
November	Germination	Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Fertilising and fungicide treatment	179
						Irrigation	70
						Harvesting and drying	559
		Reseeding	0	Soil restoring (sediment removal and terrain levelling)	500		
				Seeds and reseeding	235		
December - January	3-leaf stage	Continuation	see Fig. A.5	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Fertilising and fungicide treatment	179
						Irrigation	70
						Harvesting and drying	559
		Reseeding	0	Soil restoring (sediment removal and terrain levelling)	500		
				Seeds and reseeding	235		
February	Tillering	Continuation	see Fig. A.5	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Fertilising and fungicide treatment	179
						Irrigation	70
						Harvesting and drying	559
		Reseeding	0	Soil restoring (sediment removal and terrain levelling)	500		
				Seeds and reseeding	235		
March	Stem elongation	Continuation	see Fig. A.5	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Irrigation	70
						Harvesting and drying	559
April - May	Heading (flowering)	Continuation	see Fig. A.5	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Harvesting and drying	559
June - July	Maturation phase	Continuation	see Fig. A.5	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Harvesting and drying	559

Water depth < 60 cm		Strategy	Flood duration [days]													
			<5	5	6	7	8	9	10	11	12	13	14	15	16	>16
3-leaf	Jan	c	59%	109%	240%	-										
		r	79%													
		a	-	166%												
Tillering	Feb	c	59%						109%	144%	180%	215%	250%	-		
		r	79%													
		a	-						166%							
Stem el.	Mar	c	59%	84%	99%	114%	129%	144%	159%	175%	190%	205%	220%	235%	250%	-
		r	-													
		a	-	187%												
Flowering	Apr	c	59%	84%	106%	128%	151%	173%	195%	218%	240%	-				
		r	-													
		a	-	195%												
	May	c	59%	84%	106%	128%	151%	173%	195%	218%	240%	-				
		r	-													
		a	-	195%												
Maturation	Jun	c	59%													
		r	-													
		a	-													
	Jul	c	59%													
		r	-													
		a	-													
Bare field	Aug	c	59%													
		r	-													
		a	-													
	Sep	c	59%													
		r	-													
		a	-													
	Oct	c	59%													
		r	-													
		a	-													
Germin.	Nov	c	-													
		r	79%													
		a	166%													
3-leaf	Dec	c	59%	109%	240%	-										
		r	79%													
		a	-	166%												

Water depth ≥ 60 cm		Strategy	Flood duration [days]													
			< 5	5	6	7	8	9	10	11	12	13	14	15	16	>16
3-leaf	Jan	c	59%	109%	240%	-										
		r	79%													
		a	-	166%												
Tillering	Feb	c	59%						109%	144%	180%	215%	250%	-		
		r	79%													
		a	-						166%							
Stem el.	Mar	c	59%	84%	99%	114%	129%	144%	159%	175%	190%	205%	220%	235%	250%	-
		r	-													
		a	-	187%												
Flowering	Apr	c	-													
		r	-													
		a	195%													
	May	c	-													
		r	-													
		a	195%													
Maturation	Jun	c	-													
		r	-													
		a	195%													
	Jul	c	-													
		r	-													
		a	195%													
Bare field	Aug	c	59%													
		r	-													
		a	-													
	Sep	c	59%													
		r	-													
		a	-													
	Oct	c	59%													
		r	-													
		a	-													
Germin.	Nov	c	-													
		r	79%													
		a	166%													
3-leaf	Dec	c	59%	109%	240%	-										
		r	79%													
		a	-	166%												

Figure S.6. Po Plain case: relative damage (Eq. 2 in the paper) to wheat crops (in case of minimum tillage) for different combinations of times of flood occurrence (i.e. month), flood intensities (i.e. water depth and flood duration) and damage alleviation strategies ("c"=continuation; "r"=reseeding; "a"=abandoning). Results for the "r" option are obtained by assuming a null yield penalty for late (re-)planting.

Water depth < 60 cm		Strategy	Flood duration [days]													
			<5	5	6	7	8	9	10	11	12	13	14	15	16	>16
3-leaf	Jan	c	114%	213%	470%	-										
		r	168%													
		a	-	324%												
Tillering	Feb	c	114%						213%	282%	351%	421%	490%	-		
		r	168%													
		a	-						324%							
Stem el.	Mar	c	114%	164%	193%	223%	253%	282%	312%	342%	371%	401%	430%	460%	490%	-
		r	-													
		a	-	365%												
Flowering	Apr	c	114%	164%	208%	251%	295%	338%	382%	426%	470%	-				
		r	-													
		a	-	381%												
	May	c	114%	164%	208%	251%	295%	338%	382%	426%	470%	-				
		r	-													
		a	-	381%												
Maturation	Jun	c	114%													
		r	-													
		a	-													
	Jul	c	114%													
		r	-													
		a	-													
Bare field	Aug	c	114%													
		r	-													
		a	-													
	Sep	c	114%													
		r	-													
		a	-													
	Oct	c	114%													
		r	-													
		a	-													
Germin.	Nov	c	-													
		r	168%													
		a	324%													
3-leaf	Dec	c	114%	213%	470%	-										
		r	168%													
		a	-	324%												

Water depth ≥ 60 cm		Strategy	Flood duration [days]													
			< 5	5	6	7	8	9	10	11	12	13	14	15	16	>16
3-leaf	Jan	c	114%	213%	470%	-										
		r	168%													
		a	-	324%												
Tillering	Feb	c	114%						213%	282%	351%	421%	490%	-		
		r	168%													
		a	-						324%							
Stem el.	Mar	c	114%	164%	193%	223%	253%	282%	312%	342%	371%	401%	430%	460%	490%	-
		r	-													
		a	-	365%												
Flowering	Apr	c	-													
		r	-													
		a	381%													
	May	c	-													
		r	-													
		a	381%													
Maturation	Jun	c	-													
		r	-													
		a	381%													
	Jul	c	-													
		r	-													
		a	381%													
Bare field	Aug	c	114%													
		r	-													
		a	-													
	Sep	c	114%													
		r	-													
		a	-													
	Oct	c	114%													
		r	-													
		a	-													
Germin.	Nov	c	-													
		r	168%													
		a	324%													
3-leaf	Dec	c	114%	213%	470%	-										
		r	168%													
		a	-	324%												

Figure S.7. Po Plain case: relative damage (Eq. 2 in the paper) to wheat crops (in case of conventional tillage) for different combinations of times of flood occurrence (i.e. month), flood intensities (i.e. water depth and flood duration) and damage alleviation strategies ("c"=continuation; "r"=reseeding; "a"=abandoning). Results for the "r" option are obtained by assuming a null yield penalty for late (re-)planting.

4. Barley crops

Table S.5. Average yield and price for barley in the Province of Lodi over the last five years

Yield [q/ha]	70
Price [€/q]	19

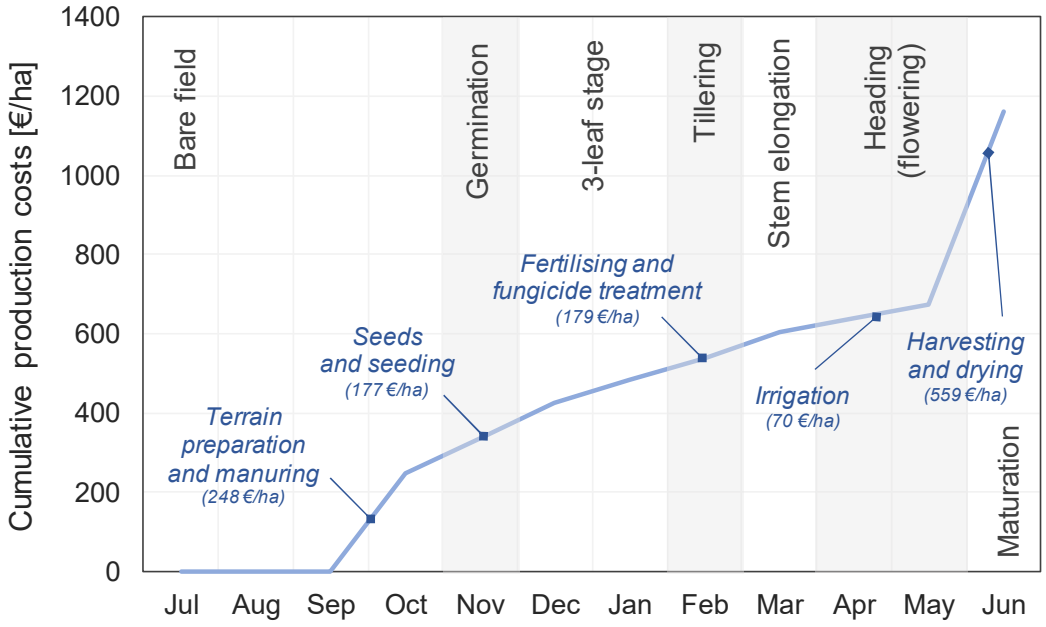

Figure S.8. Distribution of production costs over the year in the Scenario 0 for barley crops, in case of minimum tillage

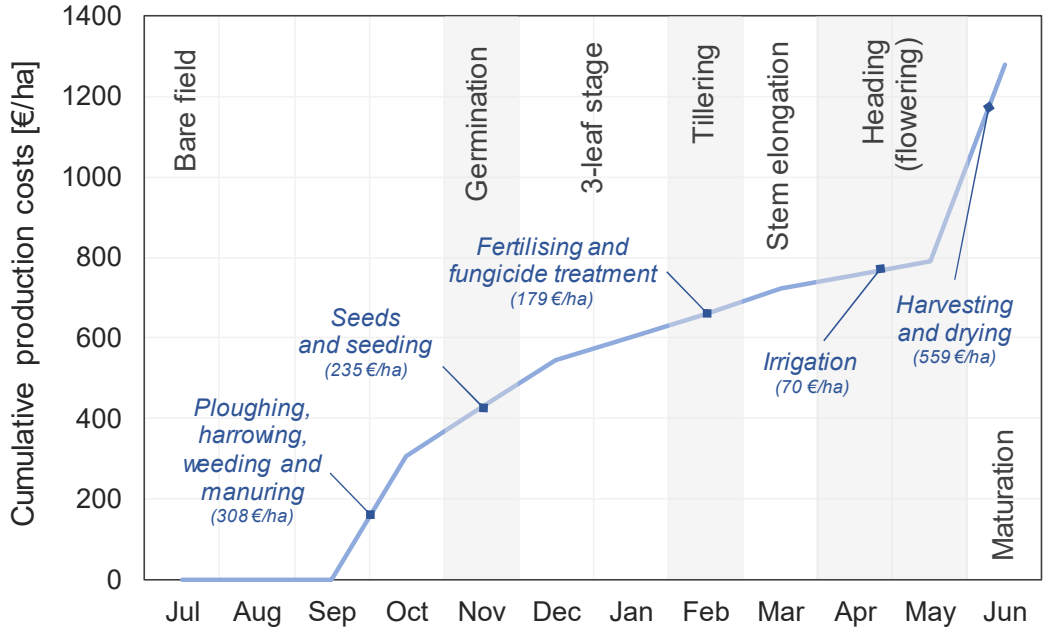

Figure S.9. Distribution of production costs over the year in the Scenario 0 for barley crops, in case of conventional tillage

Table S.6. Yield reduction and change in production costs on the basis of damage alleviation strategies for barley crops, in the case of minimum tillage

Time of the flood	Vegetative stage	Alleviation strategy	Yield reduction [%]	Additional costs	€/ha	Avoided costs	€/ha
July - October	Bare field	Continuation	0	Soil restoring (sediment removal and terrain levelling)	500		
November	Germination	Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Fertilising and fungicide treatment	179
						Irrigation	70
						Harvesting and drying	559
		Reseeding	0	Soil restoring (sediment removal and terrain levelling)	500		
				Seeds and reseeding	177		
December - January	3-leaf stage	Continuation	see Fig. A.5	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Fertilising and fungicide treatment	179
						Irrigation	70
						Harvesting and drying	559
		Reseeding	0	Soil restoring (sediment removal and terrain levelling)	500		
				Seeds and reseeding	177		
February	Tillering	Continuation	see Fig. A.5	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Fertilising and fungicide treatment	179
						Irrigation	70
						Harvesting and drying	559
		Reseeding	0	Soil restoring (sediment removal and terrain levelling)	500		
				Seeds and reseeding	177		
March	Stem elongation	Continuation	see Fig. A.5	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Irrigation	70
						Harvesting and drying	559
April - May	Heading (flowering)	Continuation	see Fig. A.5	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Harvesting and drying	559
June	Maturation phase	Continuation	see Fig. A.5	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Harvesting and drying	559

Table S.7. Yield reduction and change in production costs on the basis of damage alleviation strategies for barley crops, in the case of conventional tillage

Time of the flood	Vegetative stage	Alleviation strategy	Yield reduction [%]	Additional costs	€/ha	Avoided costs	€/ha
July - October	Bare field	Continuation	0	Soil restoring (sediment removal and terrain levelling)	500		
November	Germination	Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Fertilising and fungicide treatment	179
						Irrigation	70
						Harvesting and drying	559
		Reseeding	0	Soil restoring (sediment removal and terrain levelling)	500		
				Seeds and reseeding	235		
December - January	3-leaf stage	Continuation	see Fig. A.5	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Fertilising and fungicide treatment	179
						Irrigation	70
						Harvesting and drying	559
		Reseeding	0	Soil restoring (sediment removal and terrain levelling)	500		
				Seeds and reseeding	235		
February	Tillering	Continuation	see Fig. A.5	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Fertilising and fungicide treatment	179
						Irrigation	70
						Harvesting and drying	559
		Reseeding	0	Soil restoring (sediment removal and terrain levelling)	500		
				Seeds and reseeding	235		
March	Stem elongation	Continuation	see Fig. A.5	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Irrigation	70
						Harvesting and drying	559
April - May	Heading (flowering)	Continuation	see Fig. A.5	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Harvesting and drying	559
June	Maturation phase	Continuation	see Fig. A.5	Soil restoring (sediment removal and terrain levelling)	500		
		Abandoning	100	Soil restoring (sediment removal and terrain levelling)	500	Harvesting and drying	559

Water depth < 60 cm		Strategy	Flood duration [days]													
			<5	5	6	7	8	9	10	11	12	13	14	15	16	>16
3-leaf	Jan	c	91%	151%	307%					-						
		r								91%						
		a	-							219%						
Tillering	Feb	c				91%					151%	193%	235%	277%	319%	-
		r								123%						
		a				-							219%			
Stem el.	Mar	c	91%	121%	139%	157%	175%	193%	211%	229%	247%	265%	283%	301%	319%	-
		r								-						
		a	-							231%						
Flowering	Apr	c	91%	121%	147%	174%	201%	227%	254%	280%	307%			-		
		r								-						
		a	-							243%						
	May	c	91%	121%	147%	174%	201%	227%	254%	280%	307%			-		
		r								-						
		a	-							243%						
Matur.	Jun	c								91%						
		r								-						
		a								-						
Bare field	Jul	c								91%						
		r								-						
		a								-						
	Aug	c								91%						
		r								-						
		a								-						
	Sep	c								91%						
		r								-						
		a								-						
	Oct	c								91%						
		r								-						
		a								-						
Germin.	Nov	c								-						
		r								123%						
		a								198%						
3-leaf	Dec	c	91%	151%	307%					-						
		r								91%						
		a	-							219%						

Water depth ≥ 60 cm		Strategy	Flood duration [days]													
			< 5	5	6	7	8	9	10	11	12	13	14	15	16	>16
3-leaf	Jan	c	91%	151%	307%					-						
		r								91%						
		a	-							219%						
Tillering	Feb	c				91%					151%	193%	235%	277%	319%	-
		r								123%						
		a				-							219%			
Stem el.	Mar	c	91%	121%	139%	157%	175%	193%	211%	229%	247%	265%	283%	301%	319%	-
		r								-						
		a	-							231%						
Flowering	Apr	c								-						
		r								-						
		a								243%						
	May	c								-						
		r								-						
		a								243%						
Matur.	Jun	c								-						
		r								-						
		a								243%						
Bare field	Jul	c								91%						
		r								-						
		a								-						
	Aug	c								91%						
		r								-						
		a								-						
	Sep	c								91%						
		r								-						
		a								-						
	Oct	c								91%						
		r								-						
		a								-						
Germin.	Nov	c								-						
		r								123%						
		a								198%						
3-leaf	Dec	c	91%	151%	307%					-						
		r								91%						
		a	-							219%						

Figure S.10. Po Plain case: relative damage (Eq. 2 in the paper) to barley crops (in case of minimum tillage) for different combinations of times of flood occurrence (i.e. month), flood intensities (i.e. water depth and flood duration) and damage alleviation strategies ("c"=continuation; "r"=reseeding; "a"=abandoning). Results for the "r" option are obtained by assuming a null yield penalty for late (re-)planting.

Water depth < 60 cm		Strategy	Flood duration [days]													
			<5	5	6	7	8	9	10	11	12	13	14	15	16	>16
3-leaf	Jan	c	371%	619%	1261%						-					
		r								546%						
		a	-							898%						
Tillering	Feb	c	371%	371%	371%	371%	371%	371%	618%	791%	964%	1137%	1310%		-	
		r								546%						
		a				-					898%					
Stem el.	Mar	c	371%	495%	569%	643%	717%	791%	866%	940%	1014%	1088%	1162%	1236%	1310%	-
		r								-						
		a	-							946%						
Flowering	Apr	c	371%	495%	605%	713%	823%	932%	1041%	1151%	1261%			-		
		r								-						
		a	-							998%						
	May	c	371%	495%	605%	713%	823%	932%	1041%	1151%	1261%			-		
		r								-						
		a	-							998%						
Matur.	Jun	c								371%						
		r								-						
		a								-						
Bare field	Jul	c								371%						
		r								-						
		a								-						
	Aug	c								371%						
		r								-						
		a								-						
	Sep	c								371%						
		r								-						
		a								-						
	Oct	c								371%						
		r								-						
		a								-						
Germin.	Nov	c								-						
		r								546%						
		a								813%						
3-leaf	Dec	c	371%	619%	1261%						-					
		r								546%						
		a	-							898%						

Water depth ≥ 60 cm		Strategy	Flood duration [days]													
			< 5	5	6	7	8	9	10	11	12	13	14	15	16	>16
3-leaf	Jan	c	371%	619%	1261%						-					
		r								546%						
		a	-							898%						
Tillering	Feb	c	371%	371%	371%	371%	371%	371%	618%	791%	964%	1137%	1310%		-	
		r								546%						
		a				-					898%					
Stem el.	Mar	c	371%	495%	569%	643%	717%	791%	866%	940%	1014%	1088%	1162%	1236%	1310%	-
		r								-						
		a	-							946%						
Flowering	Apr	c								-						
		r								-						
		a								998%						
	May	c								-						
		r								-						
		a								998%						
Matur.	Jun	c								-						
		r								-						
		a								998%						
Bare field	Jul	c								371%						
		r								-						
		a								-						
	Aug	c								371%						
		r								-						
		a								-						
	Sep	c								371%						
		r								-						
		a								-						
	Oct	c								371%						
		r								-						
		a								-						
Germin.	Nov	c								-						
		r								546%						
		a								813%						
3-leaf	Dec	c	371%	619%	1261%						-					
		r								546%						
		a	-							898%						

Figure S.11. Po Plain case: relative damage (Eq. 2 in the paper) to barley crops (in case of conventional tillage) for different combinations of times of occurrence of the flood (i.e. month), flood intensities (i.e. water depth and flood duration) and damage alleviation strategies ("c"=continuation; "r"=reseeding; "a"=abandoning). Results for the "r" option are obtained by assuming a null yield penalty for late (re-)planting.

5. Grassland

Table S.8. Average yield and price for grassland in the Province of Lodi over the last five years

	Tot.	*I mow.*	*II mow.*	*III mow.*	*IV mow.*
Yield [q/ha]	120	60	20	20	20
Price [€/q]	15.4				

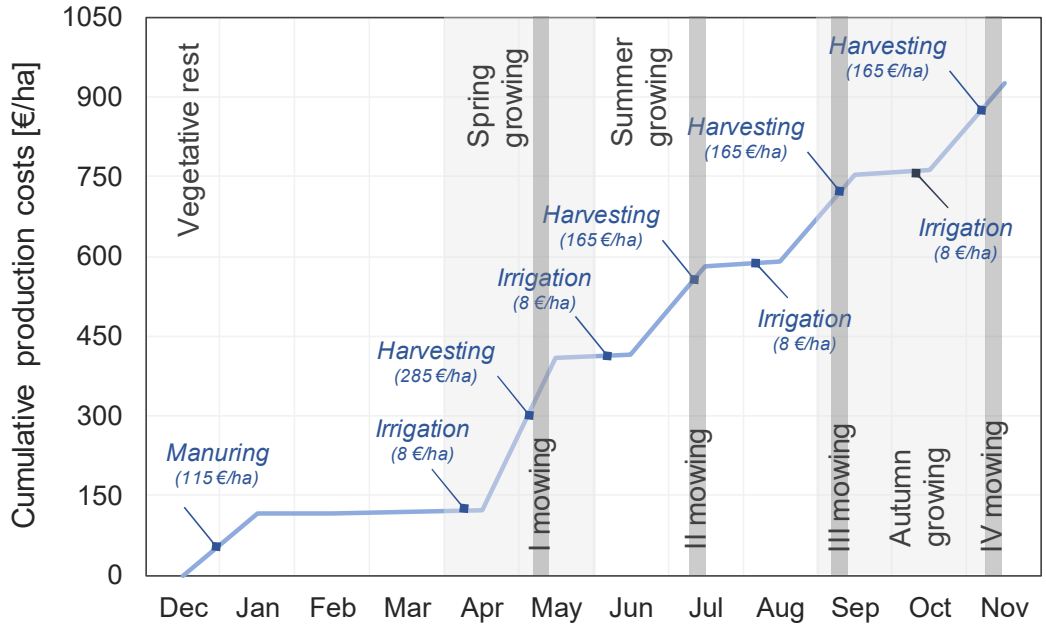

Figure S.12. Distribution of production costs over the year in the Scenario 0 for grassland

Assumptions for calculation of flood damage to grassland:

- Abandoning is not considered among the different alleviation strategies, as grassland is a perennial crop (i.e., if production is abandoned, the flood will impact on farmer's revenues also in the following years);
- The impact of the flood has influence only on the forthcoming harvest and not on successive ones;
- In case of flood, a reduction in the selling price is expected due to a lower quality harvest, as a function of flood duration and days remaining to the forthcoming harvest (see Figure A.14).

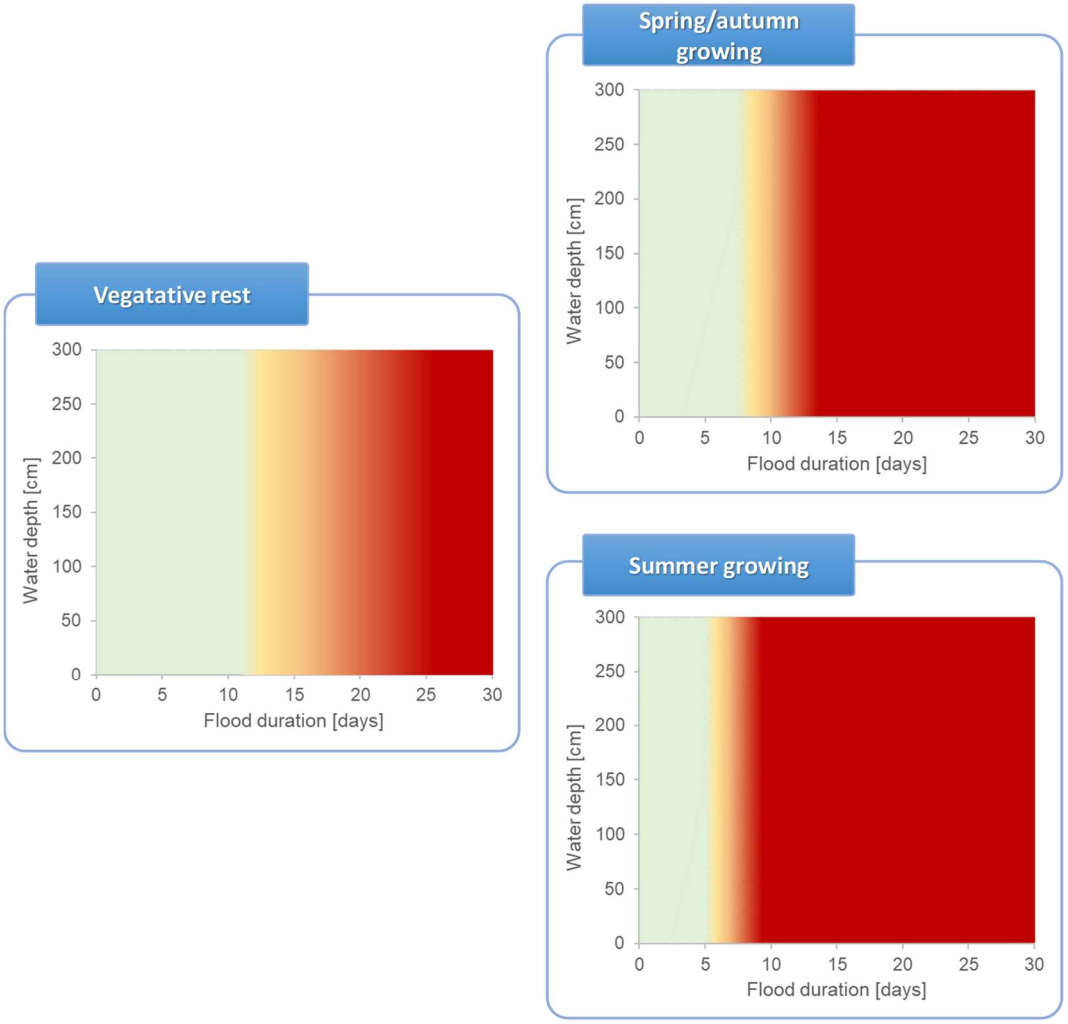

Figure S.13. Physical damage to grassland as a function of vegetative stage, flood depth and duration (adapted from Agenais et al., 2013)

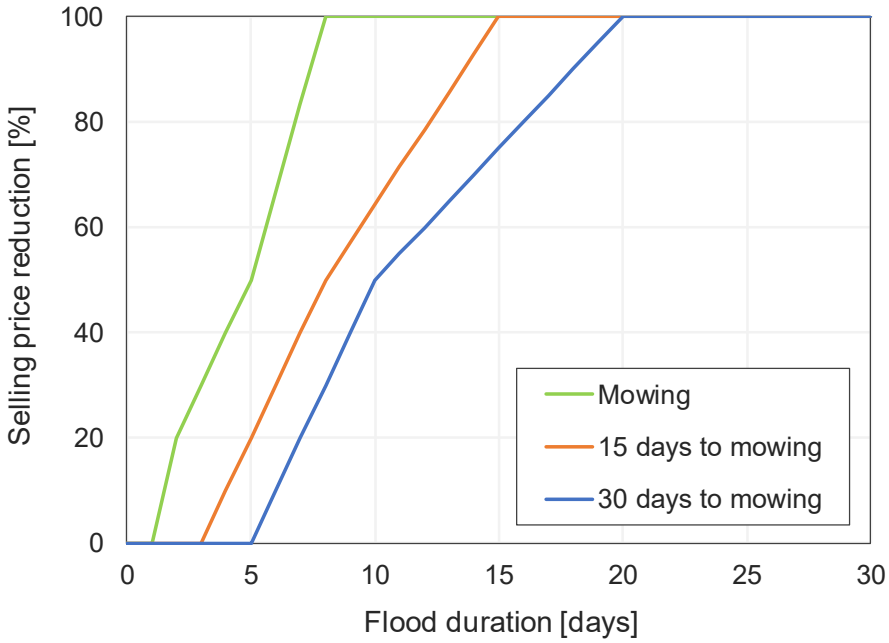

Figure S.14. Selling price reduction for different times of flood occurrence: mowing, 15 days to mowing and 30 days to mowing (adapted from Agenais et al., 2013)

Table S.11. Yield reduction and change in production costs on the basis of damage alleviation strategies for grassland

Time of the flood	Vegetative stage	Alleviation strategy	Yield reduction [%]	Additional costs	€/ha	Avoided costs	€/ha
November - March	Vegetative rest	Continuation	see Fig. A.13	Soil restoring (sediment removal and terrain levelling)	500		
		Reseeding	0	Soil restoring (sediment removal and terrain levelling)	500		
				Seeds and reseeding	89		
April - May	Spring growing	Continuation	see Fig. A.13				
		Reseeding	Only 1st harvest lost	Soil restoring (sediment removal and terrain levelling)	500	I mowing *(if the flood occurs before it)*	285
				Seeds and reseeding	89		
June - August	Summer growing	Continuation	see Fig. A.13				
		Reseeding	2nd or 3rd harvest lost	Soil restoring (sediment removal and terrain levelling)	500	II mowing *(if the flood occurs before it)*	165
				Seeds and reseeding	89	or III mowing *(if the flood occurs before it)*	165
September - October	Autumn growing	Continuation	see Fig. A.13				
		Reseeding	Only 4th harvest lost	Soil restoring (sediment removal and terrain levelling)	500	IV mowing *(if the flood occurs before it)*	165
				Seeds and reseeding	89		

		Strategy	Flood duration [days]										
			<5	7	9	11	13	15	17	19	21	23	>25
Vegetative rest	Jan	c	60%			67%	82%	96%	110%	124%	139%	153%	-
		r	-			-*							71%
	Feb	c	60%			67%	82%	96%	110%	124%	139%	153%	-
		r	-			-*							71%
	Mar	c	60%			67%	82%	96%	110%	124%	139%	153%	-
		r	-			-*							71%
Spring grow.	Apr	c	45%		71%	93%	107%	-					
		r	-		-*			148%					
	May	c	45%		71%	93%	107%	-					
		r	-		-*			148%					
Summer growing	Jun	c	4%	24%	34%	-							
		r	-	-*		88%							
	Jul	c	4%	24%	34%	-							
		r	-	-*		88%							
	Aug	c	4%	24%	34%	-							
		r	-	-*		88%							
Aut. grow.	Sep	c	4%	15%	23%	31%	36%	-					
		r	-	-*				88%					
	Oct	c	4%	15%	23%	31%	36%	-					
		r	-	-*				88%					
Veget. rest	Nov	c	60%			67%	82%	96%	110%	124%	139%	153%	-
		r	-			-*							71%
	Dec	c	60%			67%	82%	96%	110%	124%	139%	153%	-
		r	-			-*							71%

- Strategy not possible
-* Reseeding is considered only in case of a 100% physical damage

Figure S.15. Po Plain case: relative damage (Eq. 2 in the paper) to grassland for different combinations of times of flood occurrence (i.e. month), flood intensities (flood duration) and damage alleviation strategies ("c"=continuation; "r"=reseeding). Results refer to a flood occurring before harvest has been made (under the hypothesis of 15 days remaining to mowing).