Leibniz-Zentrum für Agrarlandschaftsforschung (ZALF) e.V.

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Leibniz Centre for Agricultural Landscape Research

Modelling regional agricultural land use and climate change adaptation strategies in 4 case study regions Northern Germany

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Objectives and approach

- analyse climate change mitigation and adaptation strategies for agricultural and forestry land use and
- develop sustainable land use strategies for
- 4 case study regions in Northern Germany (NUTs 3)
- analyse adaptation options under different policy scenarios
- and resulting land use change and environmental impacts

- based on a farm modelling approach
- embedded in trade models and bio-physical models
- using expert assessments for management options and yields

Scenarios

- stakeholders were involved in the development of a common vision for each of the regions
- 3 scenarios were developed in parallel
  - three climate change scenarios provided by PIK
    - **Based on climate change RCP 8.5**
  - three global change scenarios from external trade models
    - **Based on CAPRI Baseline 2020 / 2030**
  - **three regional development scenarios**
    - **Business as usual**
    - **Biodiversity**
    - **GHG mitigation**
  - **Three time steps: ⇨ 2020, 2040, 2060**

Links to project external models

model | **project**

- DART - global CGE
  ↓
- CAPRI - partial equilibrium model (NUTs2)
  ↓
- RAUMIS - supply model for Germany, based on NUT3-level regions that are considered as regional farms (NUTs3)

GLUES

CCLandStraD

***price vector** is taken over in farm and forestry models*

- MODAM - Bio-Economic Farm Modelling approach IACS based farm typology
  ↓

regional land use distribution

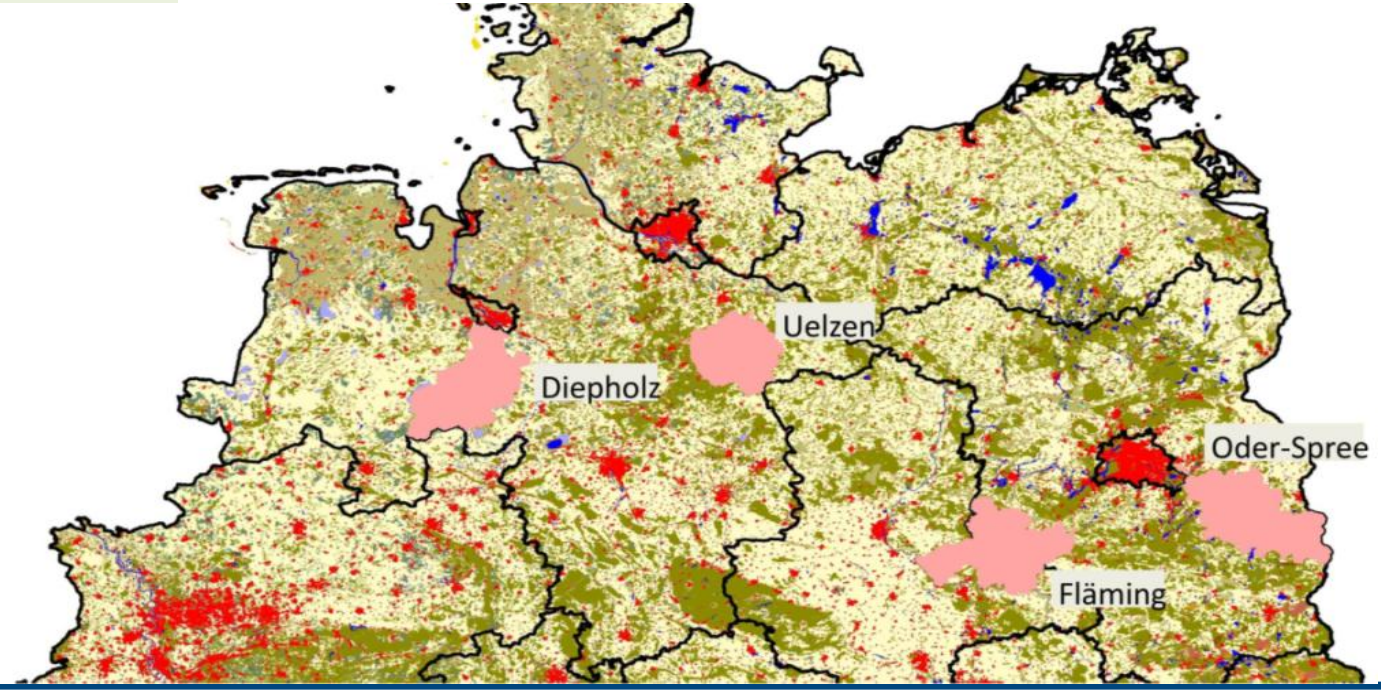
- SWAT, WASMOD, REPRO ....
  (N, P, groundwater, further environmental issues)

NaLaMa-nT

Four selected NUTs 3 case study regions

Differ with respect to farm size, climate and soil and specialisation

	West			East
Region:	**Diepholz**	**Uelzen**	**Fläming**	**Oder-Spree**
typical:	livestock	irrigation	grassland	arable land



Actual crop production in the 4 case study regions

	West			East
Crop	Diepholz	Uelzen	Flaeming	Oder-Spree
arable grass	4%	1%	7%	7%
perm. grassland	15%	9%	22%	16%
potatoes cons.	2%	11%	0%	0%
potatoes starch	7%	7%	0%	0%
grain legumes	0%	0%	2%	3%
maize silage	20%	8%	15%	14%
set asisde	0%	2%	4%	4%
barley	10%	9%	5%	4%
rapeseed	7%	4%	6%	7%
winter rye	15%	8%	27%	27%
winter wheat	13%	16%	5%	7%
sugarbeet	1%	13%	0%	0%
rest	6%	10%	6%	10%
sum	100%	100%	100%	100%
total agric.land (ha)	**128,978**	**73,550**	**58,488**	**78,996**

Scenario definition

	2010 (1992-2010)	2020	2040	2060
Business as usual (BAU)		• linear yield projections • price projection by CAPRI price factor (2030) used for 40 & 60		
Biodiversity (BDIV)	• 10% of arable land in specific measures	⇩	⇩	⇩
Mitigation (CLIM)	• reduced nitrogen use at farm level (legumes) • rewetting of degraded arable fen area => used as permanent extensive grassland • airwashing filters in pig production (ammonia)	⇩	⇩	⇩

Adaptation options

Crop production intensity

- irrigation in Brandenburg (eastern regions)
- has been part of the former GDR production systems, but abandoned after 1990

Crop rotation

- cultivation of oil radish to reduce nematode populations, depending on share of potatoes (Uelzen)
- possibility to grow rapeseed after wheat increases probably

Lifestock

- No cc adaptations necessary – heat impact on dairy production is checked

Modelling agriculture

80% of agricultural area is covered by selected farm types

Farm typology build on the basis of IACS data

- Size classes reflecting differences in cost structure for
  - Area
  - Dairy cows
  - Suckler cows
  - Bull fattening
  - Pig fattening
  - Sows

Region	number types	number farms	number types	number farms
Oder-Spree	24	85	62	323
Flaeming	21	82	58	227
Diepholz	49	1412	180	2419
Uelzen	15	493	75	823

Relative change of input and product prices from CAPRI

(CCLandStraD - TI, Peter Kreins / Horst Görmann)

Input_group	PriceCf 2020	PriceCf 2030
Fertilizers	1.21	1.46
Fuel	1.21	1.21
Water	1.00	1.00
ServiceCosts	1.00	1.00
Seeds	1.21	1.46
Pesticides	1.21	1.46

	2020/2010	2030/2010
bareley	0.86	1.09
rapeseed	1.01	1.23
rye	0.87	1.12
winter wheat	0.86	1.15
sugar beet	1.35	1.29
potatoes	1.13	1.27

Production activities

- 3-4 soil types with specific yield potential per region
- Crop production practices assessed by project partners
  - Gross margins calculated with KTBL data
  - Yields forecasted by linear projections (model results in preparation
  - Fertilizers adapted to yield increases
  - Pest management in work
- Lifestock activities assessed by project partners
  - Gross margins calculated with KTBL data

Yields dt/ha for 2010 2020 2040 for soil classes per region

Region group	DH				FL				OS			UE			
	1		2		1		2		1	2		1		2	
soil class	2	3	4	5	2	3	4	5	3	4	5	2	3	4	5
SMA															
2010	588	578	574	540	420	412	408	385	365	361	341	596	586	582	547
2020	609	598	595	561	440	433	429	406	386	382	362	617	606	603	568
2040	650	640	636	602	482	475	471	448	427	424	404	659	648	644	610
WRA															
2010	39	37	35	32	41	37	30	23	31	26	19	38	36	34	31
2020	42	40	38	35	44	40	34	26	34	29	22	41	39	37	34
2040	48	46	45	41	51	46	40	32	40	35	28	47	45	43	40
WWE															
2010	83	77	72	65	84	67	51	20	59	45	20	81	74	70	63
2020	94	87	83	75	94	77	62	30	70	56	30	91	85	81	73
2040	115	108	104	96	115	98	82	51	91	77	51	112	106	102	94
SB															
2010	607	575	571	531	541	498	495	460				618	585	581	540
2020	657	625	621	580	591	548	545	510				668	635	631	590
2040	757	725	720	680	691	648	644	609				768	735	731	690
Pot															
2010	408	438	431	408	415	382	356	298	325	303	253	422	453	446	422
2020	447	477	471	447	455	421	395	337	364	342	292	462	492	486	461
2040	526	556	549	526	533	499	474	415	442	421	371	540	571	564	540
RYE															
2010	74	67	63	59	66	57	47	32	48	39	26	72	65	61	58
2020	81	74	70	66	73	64	54	39	55	46	33	79	72	68	65
2040	95	88	84	81	87	78	68	53	69	60	47	93	86	82	79

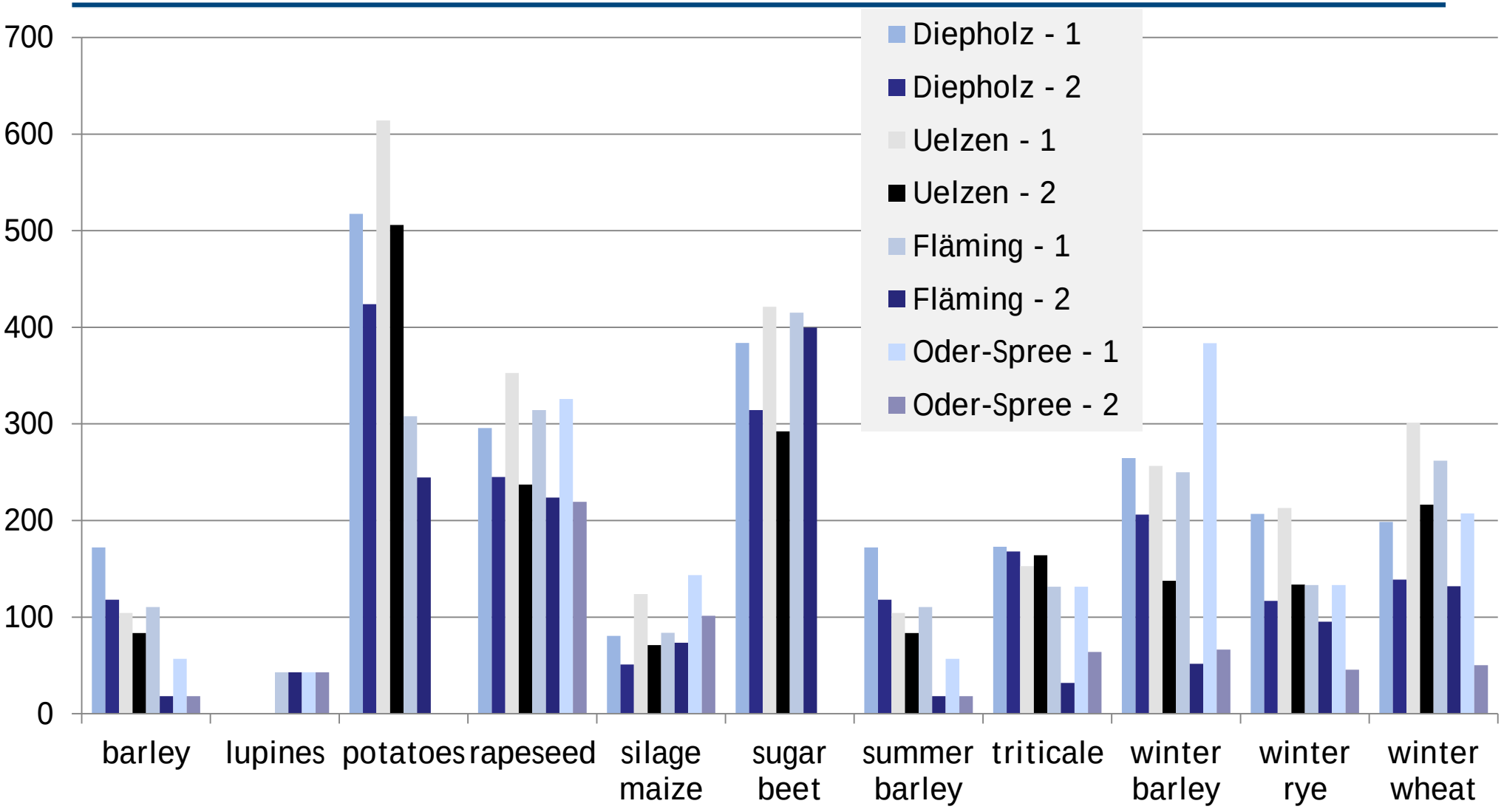
Gross margins

		Diepholz				Flaeming				Oder-Spree			Uelzen							
		EK2	EK3	EK4	EK5	EK2	EK3	EK4	EK5	EK3	EK4	EK5	EK2		EK3		EK4		EK5	
Crop_g	Dr	rain	rain	rain	rain	rain	rain	rain	rain	rain	rain	rain	irri	rain	irri	rain	irri	rain	irri	rain
KARi	M	649	851	807	649	542	335	171	-202	-656	-150	-466		548		686		627		471
	O	913	1134	1086	914			389	-11	188	37	-309		803		959		896		726
KARs	M	1789	2081	2013	1789	1870	1549	1294	728	1006	790	302		1821		2067		2086		1848
LUP	M					-295	-295	-317	-294	-295	-295	-295								
LUZ	M	-153	-147	-177	-280									-44		-71		-101		-199
ORE	M																			
SGEb	M	503	467	428	391	441	310	123	-137	192	44	-181	540		380		299		215	
SGEf	M	181	157	131	106	143	57	-67	-239	-16	-114	-263	205		136		62		-16	
	O	294	267	238	210	251	154	16	-178	70	-40	-207	322		249		173		91	
SMA	M	448	427	419	347	109	93	84	36	8	-1	-43	465		276		201		75	
	O	833	806	805	712	391	369	367	305	255	253	126	855		660		612		419	
SSS	M	62	49	49	54	-160	-160	-160	-160	-147	-147	-147	60		-114		-115		-109	
	O	508	492	483	494	54	36	54	54	67	67	67	507		319		319		234	
TRI	M	293	210	213	165	214	118	15	-148	75	-17	-169	294		180		194		31	
	O	451	358	355	301	359	253	130	-55	201	91	-81	451		329		276		167	
WGE	M	132	52	126	65	126	58	19	-120	-58	-67	-176	128		11		28		-90	
	O	277	187	252	184	268	190	105	-53	57	30	-94	288		220		168		42	
WRA	M	226	178	227	157	285	193	121	-40	62	43	-126	204		156		205		133	
	O	400	343	390	308	467	361	267	81	210	174	-17	374		320		364		282	
WRO	M	109	43	56	17	48	-37	-78	-219	-106	-141	-263	91		-4		-40		-120	
	O	246	171	178	135	175	78	23	-137	-3	-49	-188	225		121		80		-5	
WWE	M	422	352	315	232	451	242	73	-307	156	12	-293	429		287		188		67	
	O	594	513	470	375	623	388	195	-232	290	125	-219	567		399		308		175	
WWR	M																			
ZRU	M	773	686	675	565	565	487	480	413				803		507		447		291	
	O	1040	940	928	803	801	713	704	595				1074		766		704		533	

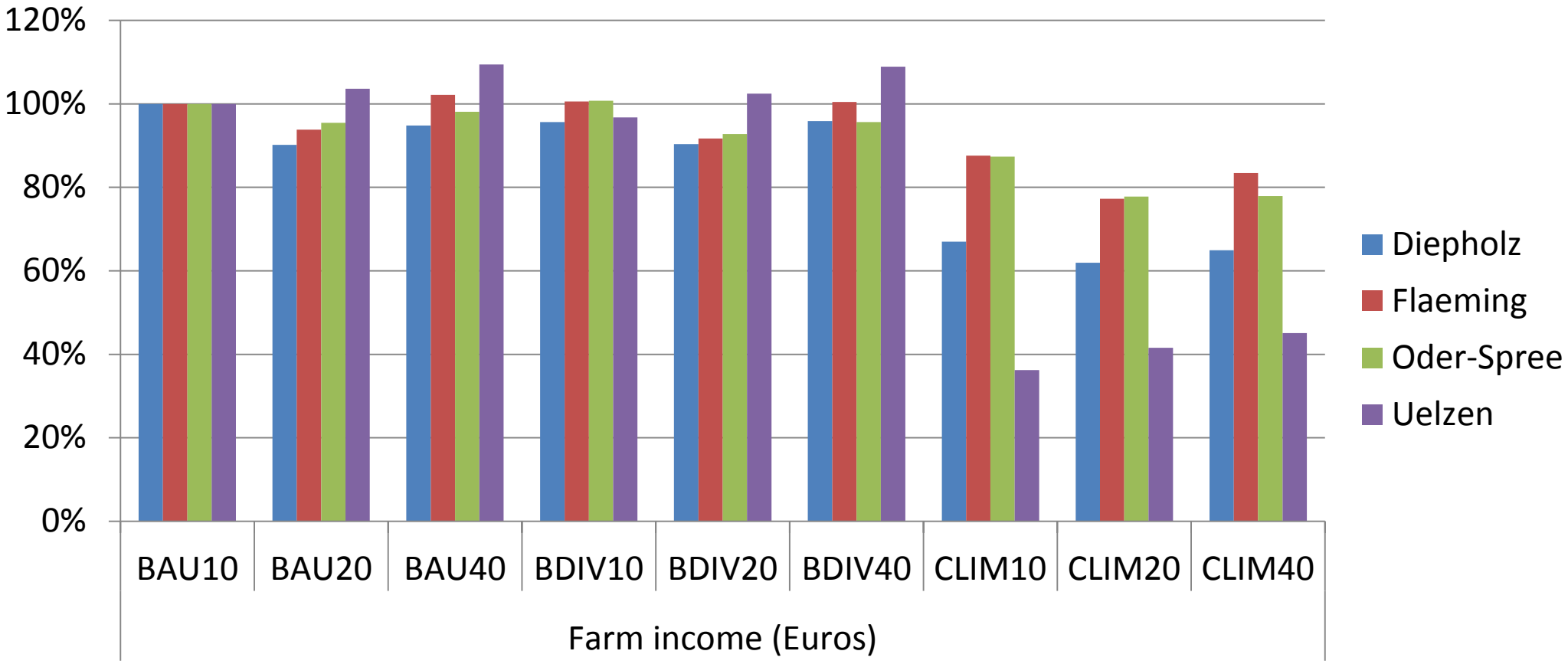
Speisekartoffeln, Pflanzenschutz

Nach Expertenschätzung				Uelzen intensiv					Uelzen extensiv					Fläming intensiv				
		Menge kg o. l		€/ha			Menge kg o. l		€/ha			Menge kg o. l		€/ha			Menge kg o. l		€/ha
Karate Zeon	I	0,075	l	8,96	Sencor WG	H	0,3	kg	10,20	Cato	H	0,025	kg	20,51	Boxer	H	3	l	30,90
Decis flüssig	I	0,2	l	6,06	Cato	H	0,03	kg	24,61	Sencor WG	H	0,25	kg	8,50	Sencor WG	H	0,5	kg	17,00
Phytophthora	F	1	U	26,74	Sencor WG	H	0,2	kg	6,80	Cato	H	0,025	kg	20,51	Ridomil Gold MZ	F	2	kg	30,60
Phytophthora	F	1	U	26,74	Acrobat Plus WG	F	2	kg	24,40	Sencor WG	H	0,2	kg	6,80	Acrobat plus	F	2	kg	24,40
Phytophthora	F	1	U	26,74	Decis flüssig	I	0,2	l	6,06	Electis	F	1,5	kg	20,85	Infinito	F	1,5	l	27,75
Phytophthora	F	1	U	26,74	Valbon	F	1,6	kg	23,52	Acrobat plus	F	1,25	kg	15,25	Shirlan	F	0,25	l	16,70
Phytophthora	F	1	U	26,74	Shirlan	F	0,4	l	26,72	Karate Zeon	I	0,075	l	8,96	Shark	F	1	l	45,20
Phytophthora	F	1	U	26,74	Tamaron	F	1,66	kg	58,60	Acrobat plus	F	1,25	kg	15,25	Ranman	F	0,2	l	14,74
Phytophthora	F	1	U	26,74	Acrobat Plus WG	F	0,4	kg	4,88	Acrobat plus	F	1	kg	12,20	Tanos	F	0,7	kg	24,92
breitblättrige Unkrä	H	1	U	56,25	Shirlan	F	0,2	l	13,36	Decis	I	0,3	l	9,09	Shark	F	1	l	45,20
Reglone	H	1	l	19,30	Valbon	F	0,26	kg	3,82	Reglone	H	1,5	l	28,95	Durano TF	H	4	l	22,80
Reglone	H	1,5	l	28,95	Dantop	F	0,04	kg	10,36	Reglone	H	1	l	19,30					
					Shirlan	F	0,3	l	20,04										
					Valbon	F	1,6	kg	23,52										
					Karate Zeon	I	0,075	l	8,96										
					Ranman	F	0,2	l	14,74										
					Ranman	F	0,2	l	14,74										
					Dantop	F	0,13	kg	33,66										
					Shirlan	F	0,4	l	26,72										
					Reglone	H	2	l	38,60										
					Shirlan	F	0,2	l	13,36										
					Reglone	H	2	l	38,60										
					Shirlan	F	0,2	l	13,36										
					Reglone	H	1,5	l	28,95										
					Shirlan	F	0,15	l	10,02										
Summe PSM				306,70	Summe PSM				498,59	Summe PSM				186,17	Summe PSM				300,21
Überfahrten		12		117,60	Überfahrten		15		147,00	Überfahrten		7		68,60	Überfahrten		8		78,40
Gesamt PS				**424,30**	**Gesamt PS**				**645,59**	**Gesamt PS**				**254,77**	**Gesamt PS**				**378,61**

Crop protection costs per crop, soil class and region



First results – to be corrected



To do

- Explore further adaptation options in crop production
- Simplification of farm typology
- Farm size specific costs
- Finalize mitigation scenario
- Analyse results in detail

…

- Integration of results of crop model HERMES (yield, water requirements, timing for climate scenarios)

Thank you for listening