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

Objectives:

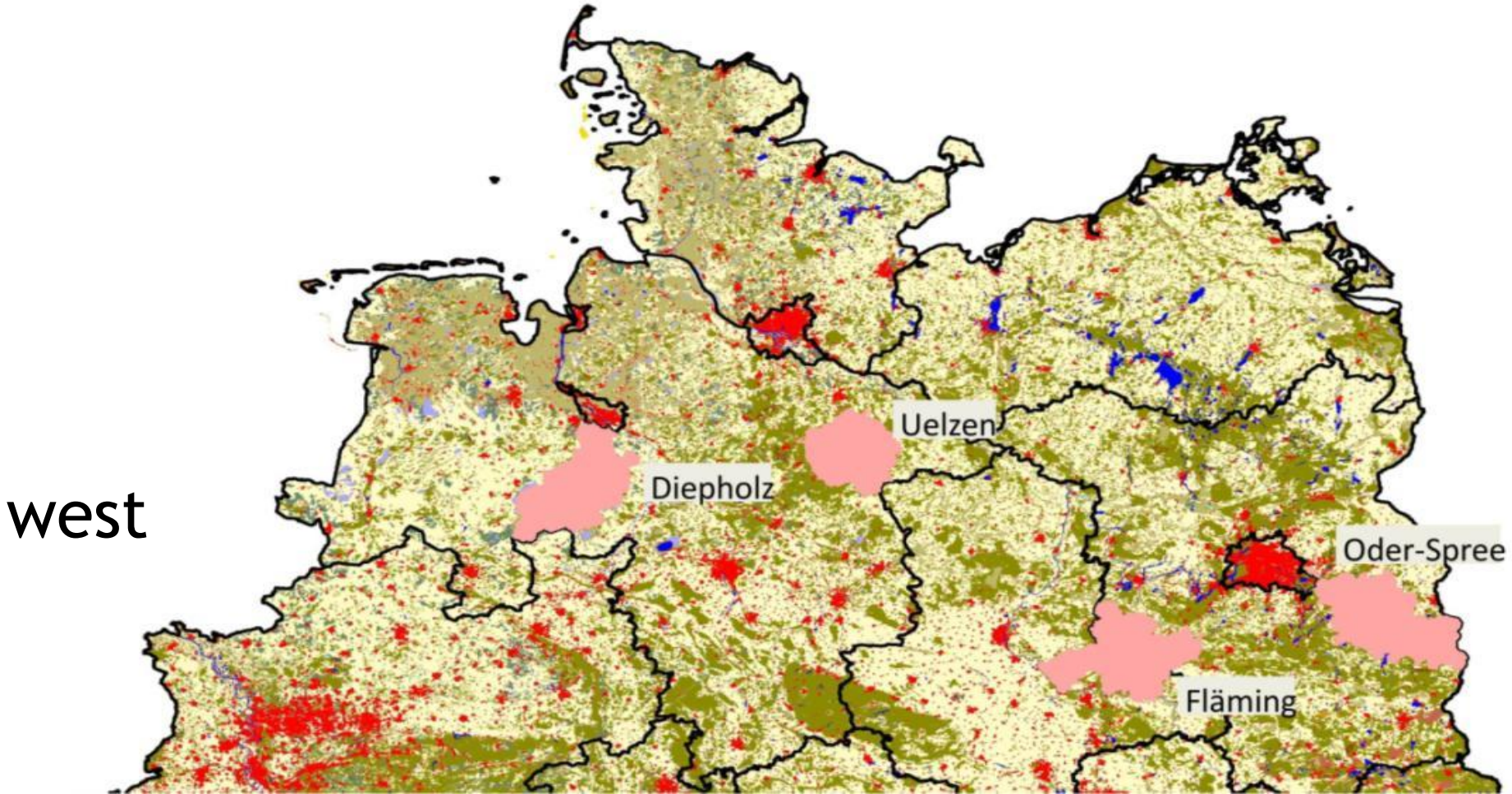
- analyse climate change mitigation and adaptation strategies
  - for agricultural and forestry land use
  - under policy scenarios
  - for 4 case study regions in Northern Germany (NUTs 3)
- and discuss resulting land use change and environmental impacts

Approach:

- linear programming farm modelling approach
- prices taken from trade models
- ecological evaluation by bio-physical models
- expert assessments for management options and yields

Four case study regions (NUTs-3) => different with respect to farm size, climate and soil and specialisation

Region:	Diepholz	Uelzen	Fläming	Oder-Spree
Typical:	lifestock	irrigation	grassland	arable land



west east

Scenarios

	2010 (1992-2010)	2020	2040	2060
Business as usual (BAU)		• linear yield projections • price projection by CAPRI price factors (2030 used for 40 & 60) • Premiums: actual area payments plus greening		
Biodiversity (BDIV)	• 10% of arable land in specific measures	⇩	⇩	⇩
Climate mitigation and adaptation (CLIM)	• reduced nitrogen use at farm level (20% legumes) • Transforming of degraded arable fen area into permanent extensive grassland • airwashing filters and age specific feeding in pig production (ammonia)	⇩	⇩	⇩

prices as taken from CAPRI baseline

(Gömann, Kreins TI, Braunschweig)

	price factor 2020	price factor 2030
Crop production		
potatoe	1,13	1,27
sugar beet	1,35	1,29
rape seed	1,01	1,23
barley	0,86	1,09
triticale	0,87	1,12
rye	0,87	1,12
winter wheat	0,86	1,15
Lifestock		
beef	1,02	1,45
milk	1,02	1,37
pork	1,27	1,48

cereals are disadvantaged especially in 2020 with largest impact on eastern regions

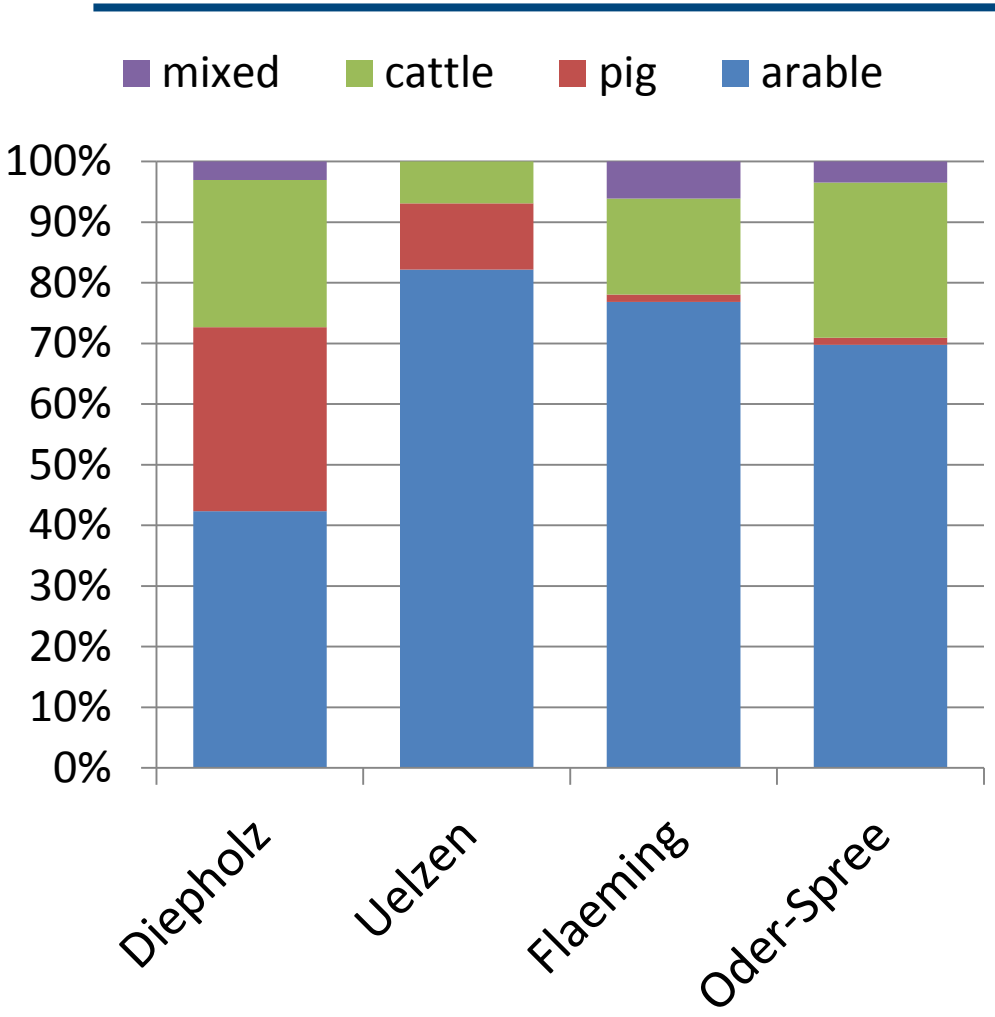
➔ Pig production favoured in 2020

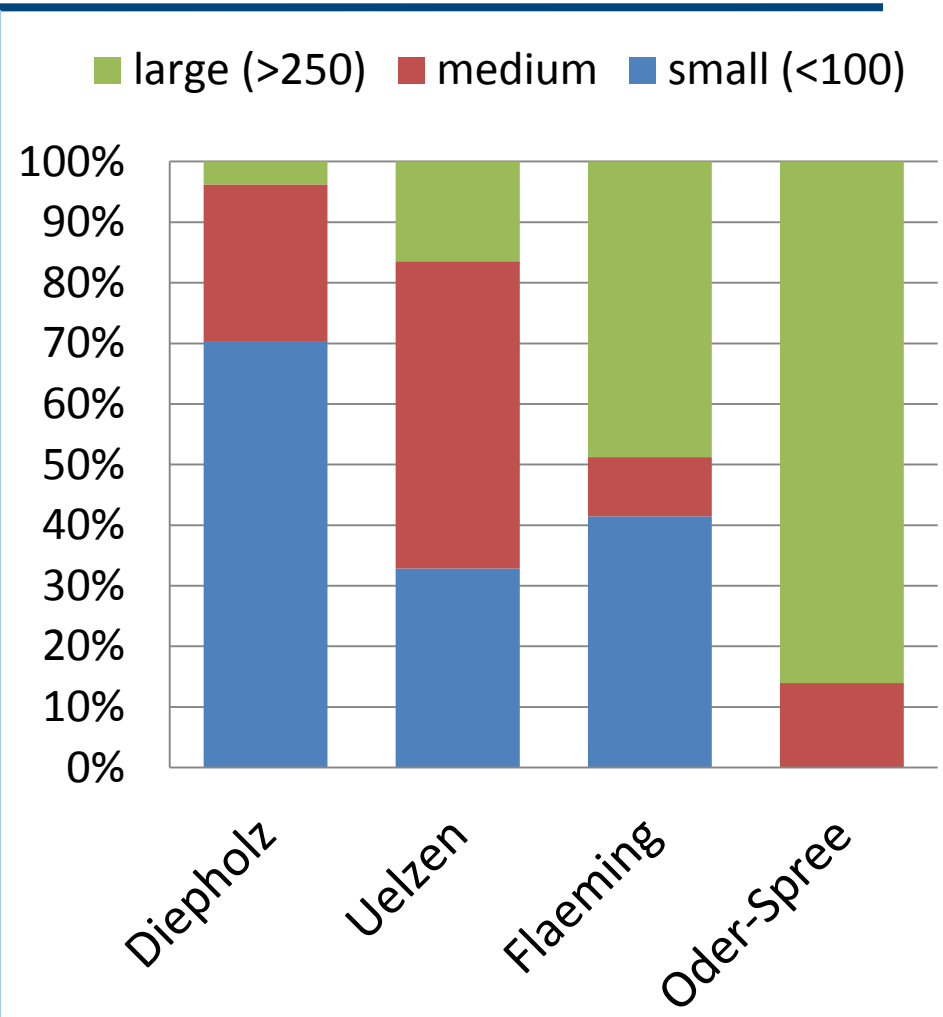
Results

- Results are presented at three levels of aggregation
  - Overall aggregation per region
  - Aggregation per production orientations: arable, dairy, pig fattening
  - Aggregation per farm size type: small, medium and large

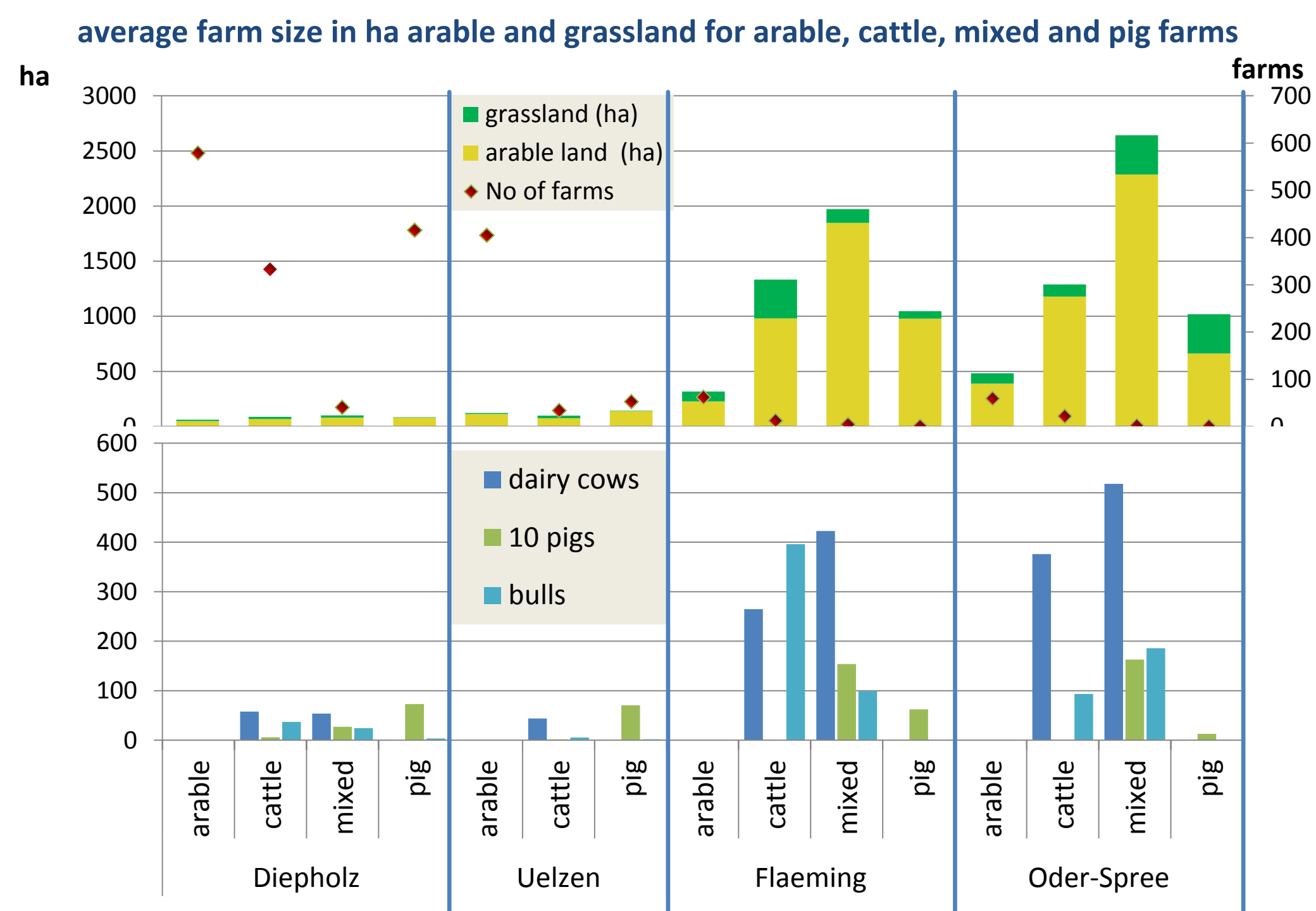
- Results are shown for
  - average costs and benefits per region
  - income indicators at all three aggregation levels:
    - income/ha,
    - income/labourer,
    - subsidies in relation to …
  - land use distribution per region

Number of farms represented per farm type and region

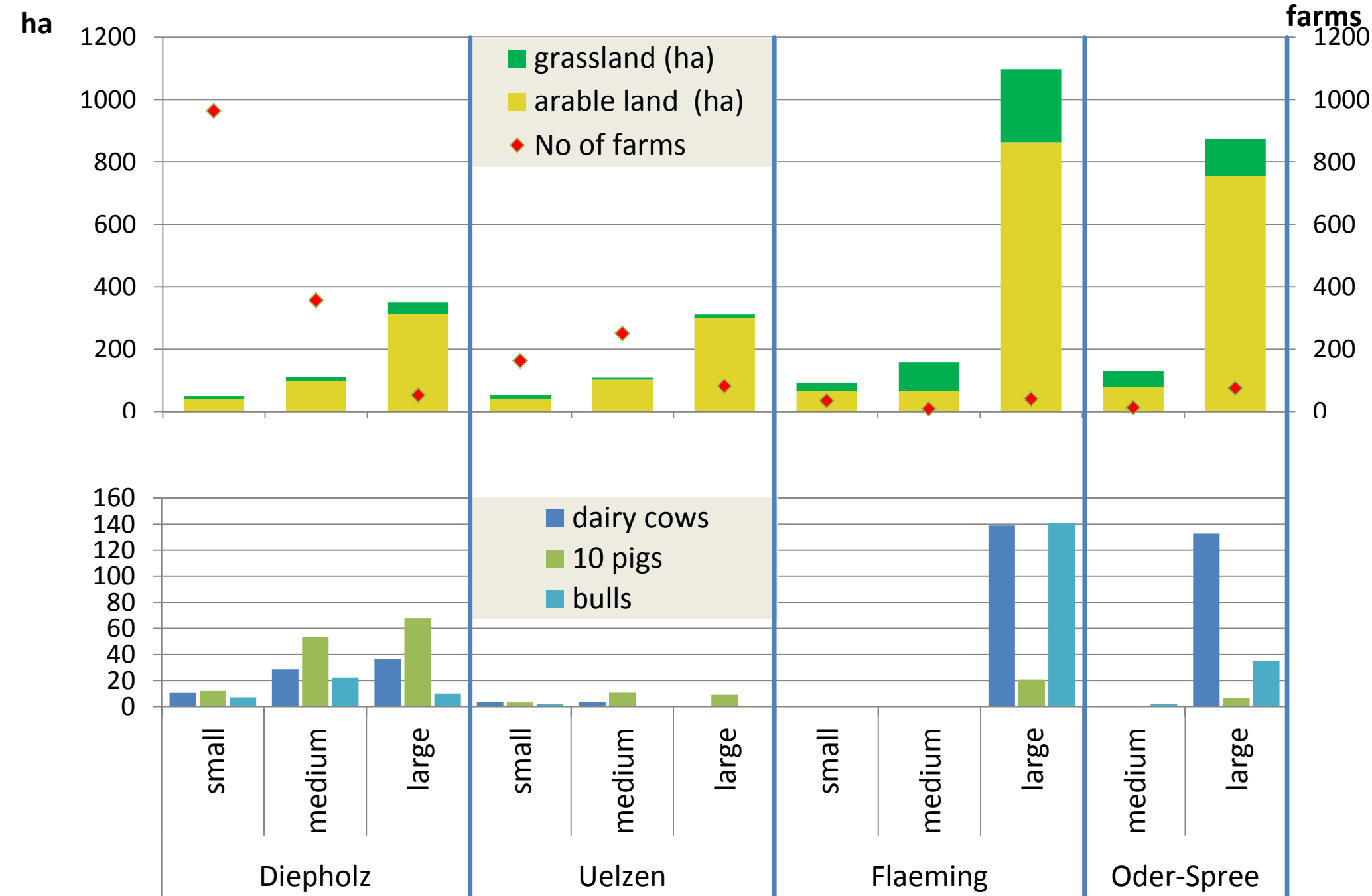




region	Diepholz	Uelzen	Flaeming	Oder-Spree
no. of farms	1371	493	82	86


average farm size in ha arable and grassland for arable, cattle, mixed and pig farms
ha
farms
grassland (ha)
arable land (ha)
No of farms
dairy cows
10 pigs
bulls
arable
cattle
mixed
pig
Diepholz
Uelzen
Flaeming
Oder-Spree

average farm size in ha arable and grassland for small (<100 ha), medium and large (>250 ha)



Results

- Results are presented at three levels of aggregation
  - Overall aggregation per region
  - Aggregation per production orientations: arable, dairy, pig fattening
  - Aggregation per farm size type: small, medium and large

- Results are presented as
  - revenues versus all costs per region
  - farm income indicators at all three aggregation levels:
    - income/ha,
    - income/labourer,
  - land use distribution per region

Legend explanation - and level of revenues

- area costs
- depreciation livestock stables
- fixed costs mashinery
- overhead material costs
- labour costs management
- labour costs production
- variable costs mashinery (€/a)
- direct costs

long term investment

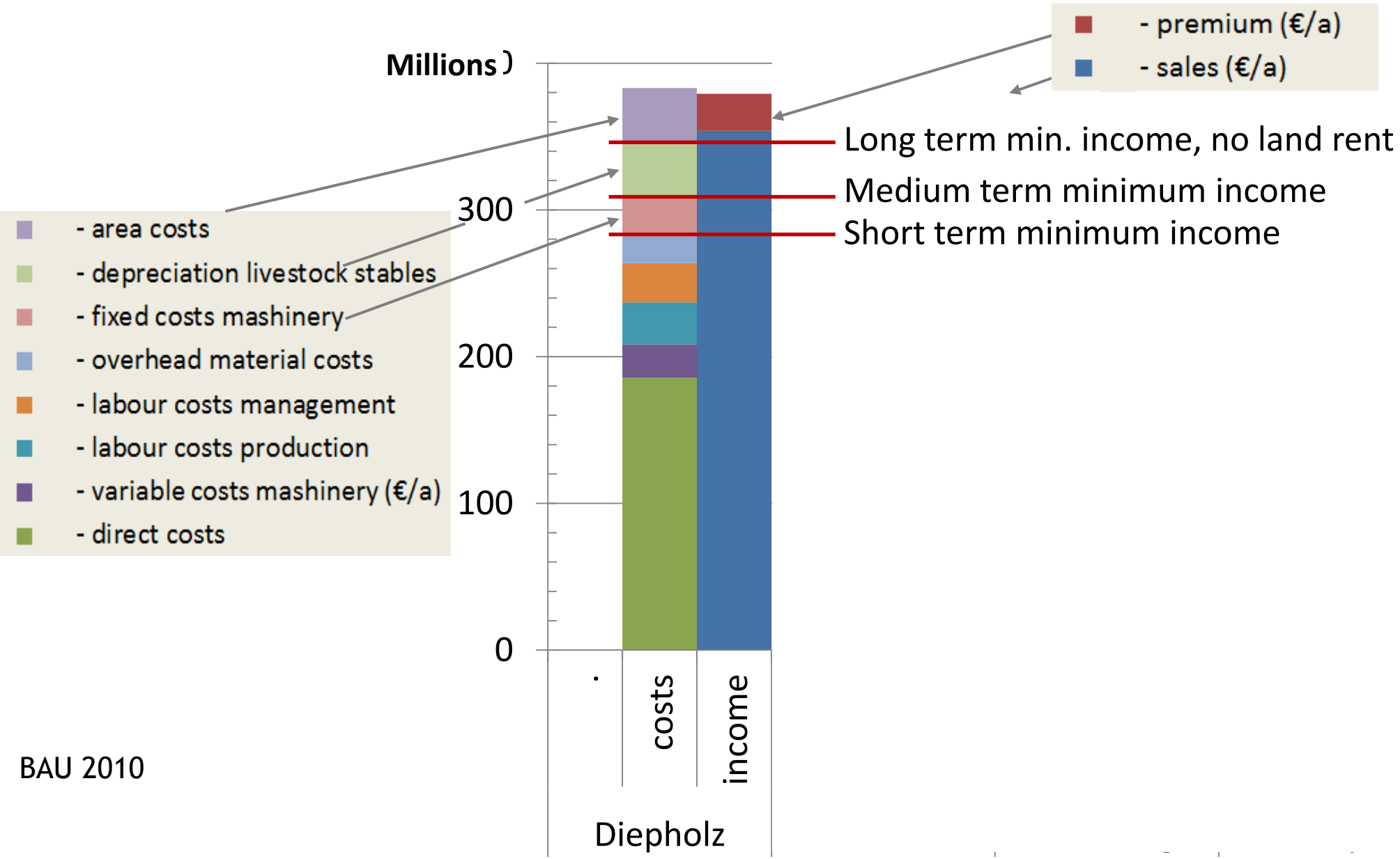
medium term investment

overhead

production costs

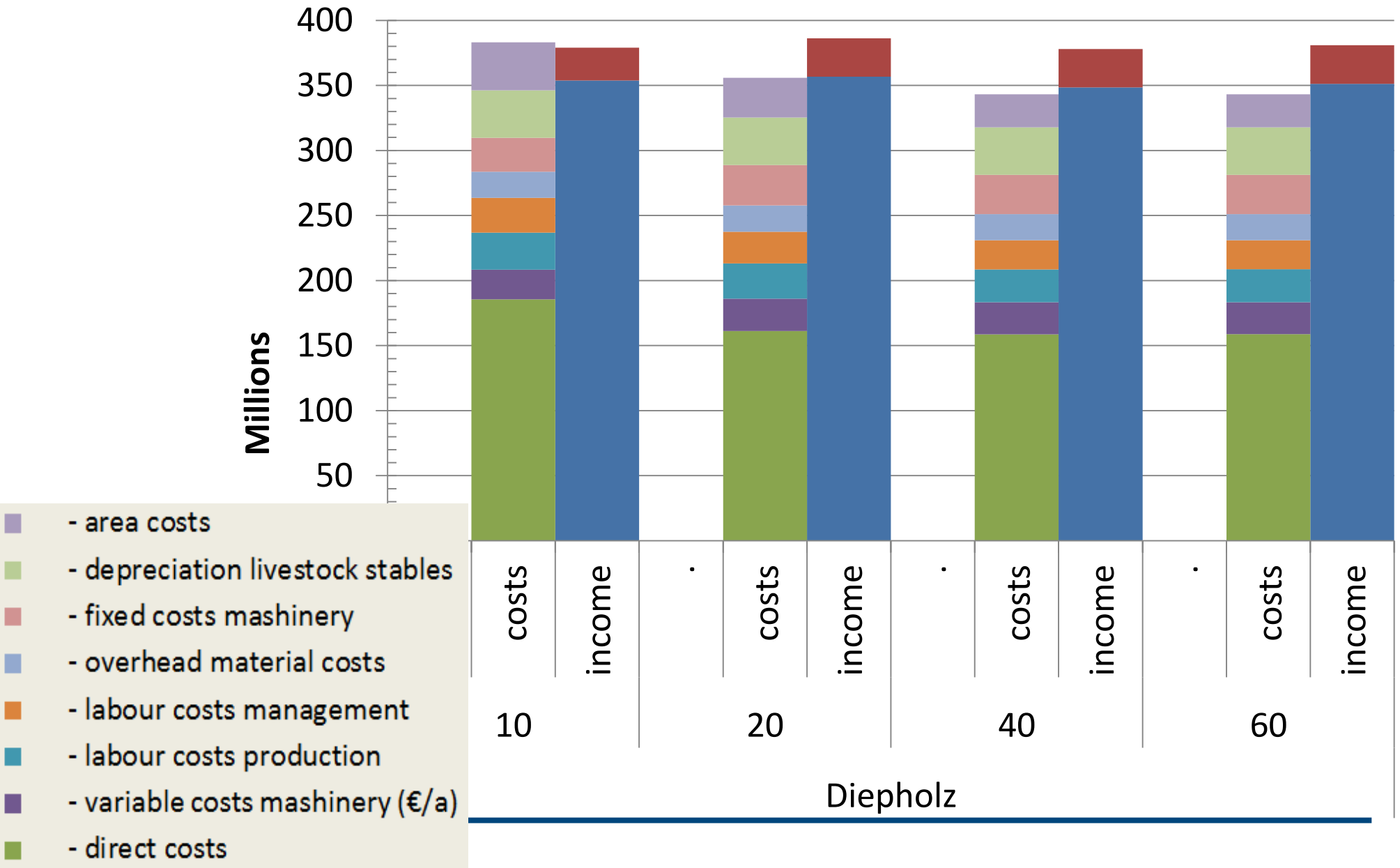
Farm income: sales + premiums – all variable and fixed costs (without land and labour costs)

Revenues versus total costs

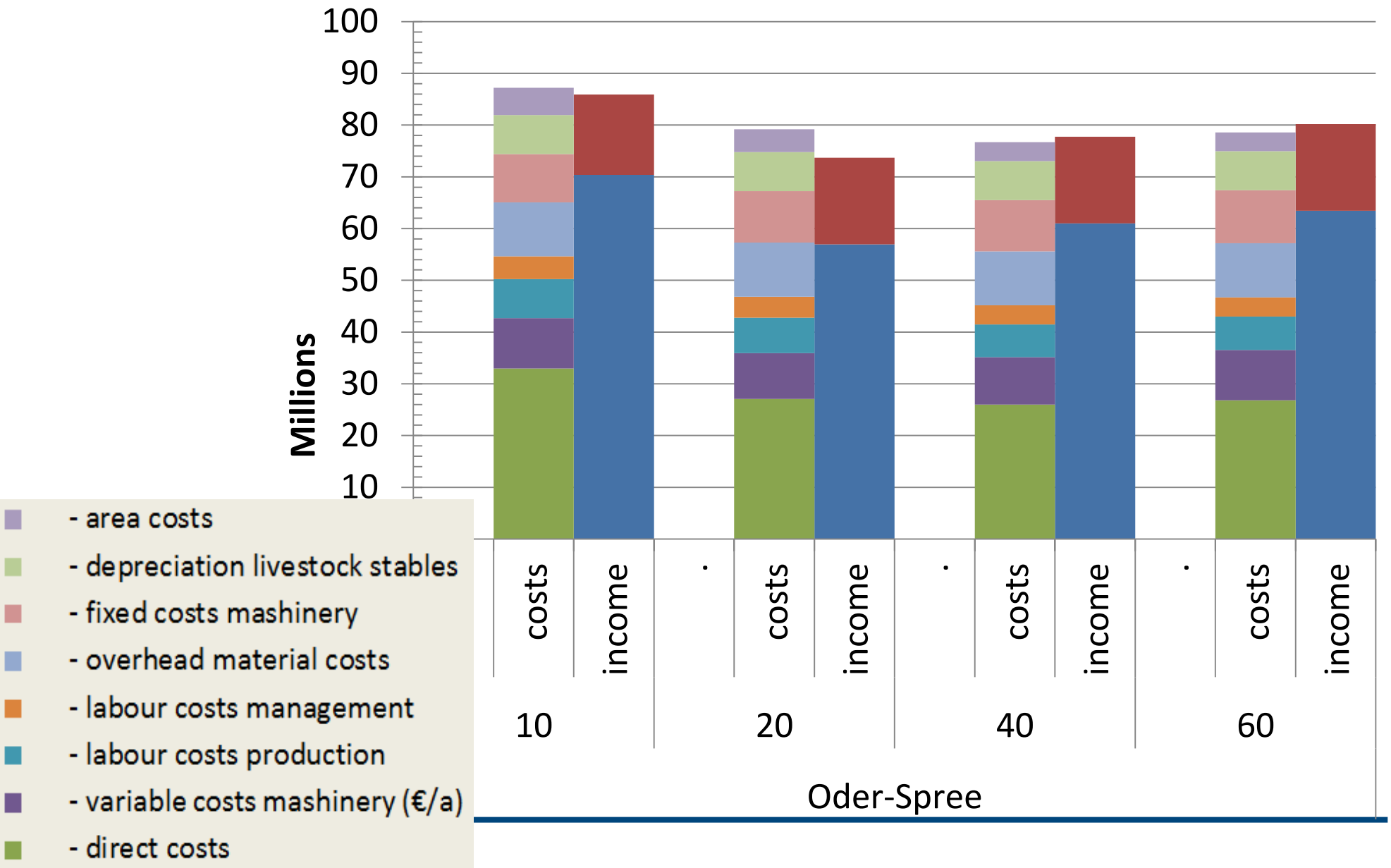


BAU 2010

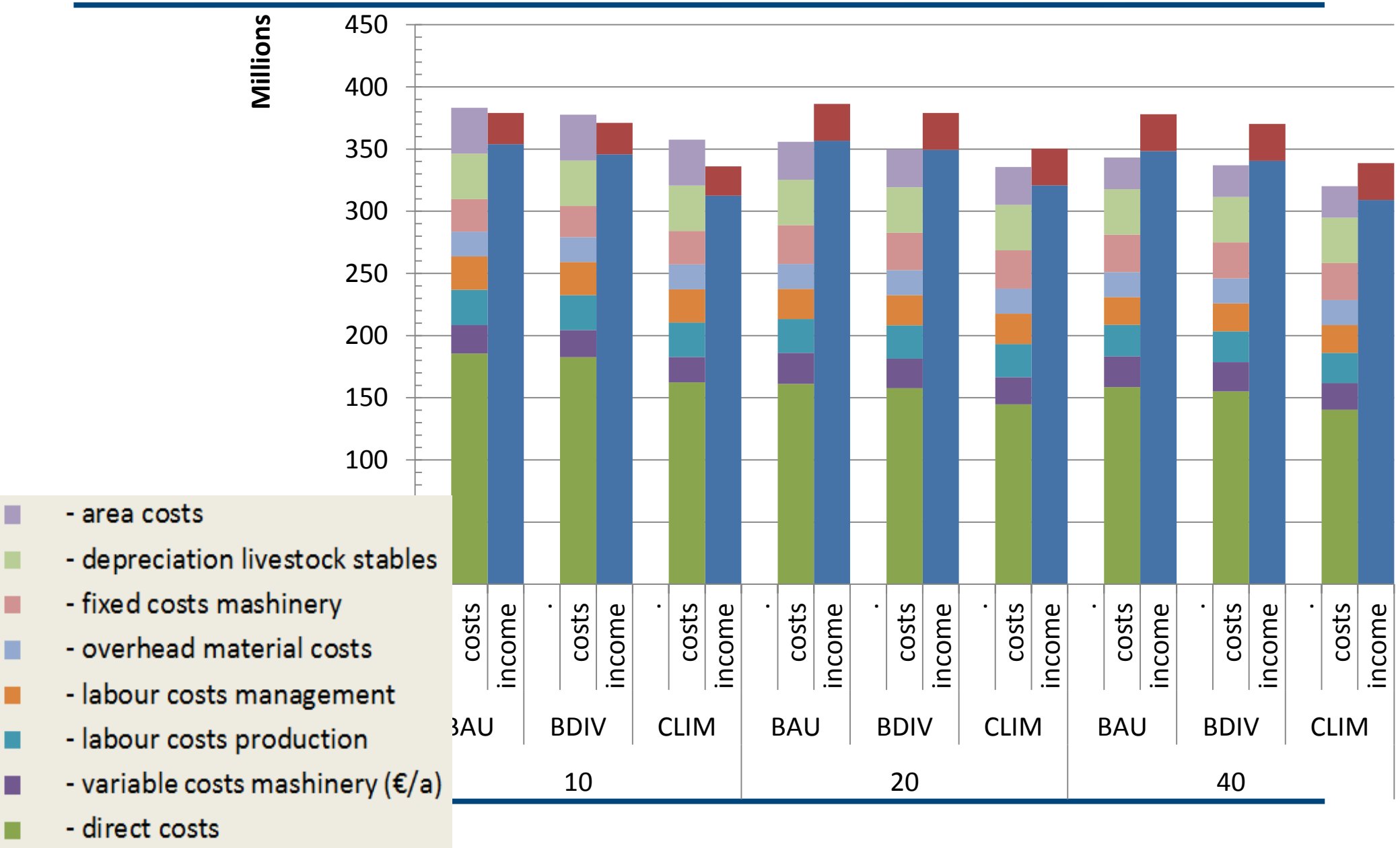
Business as usual (BAU): changes over time - Diepholz (west)



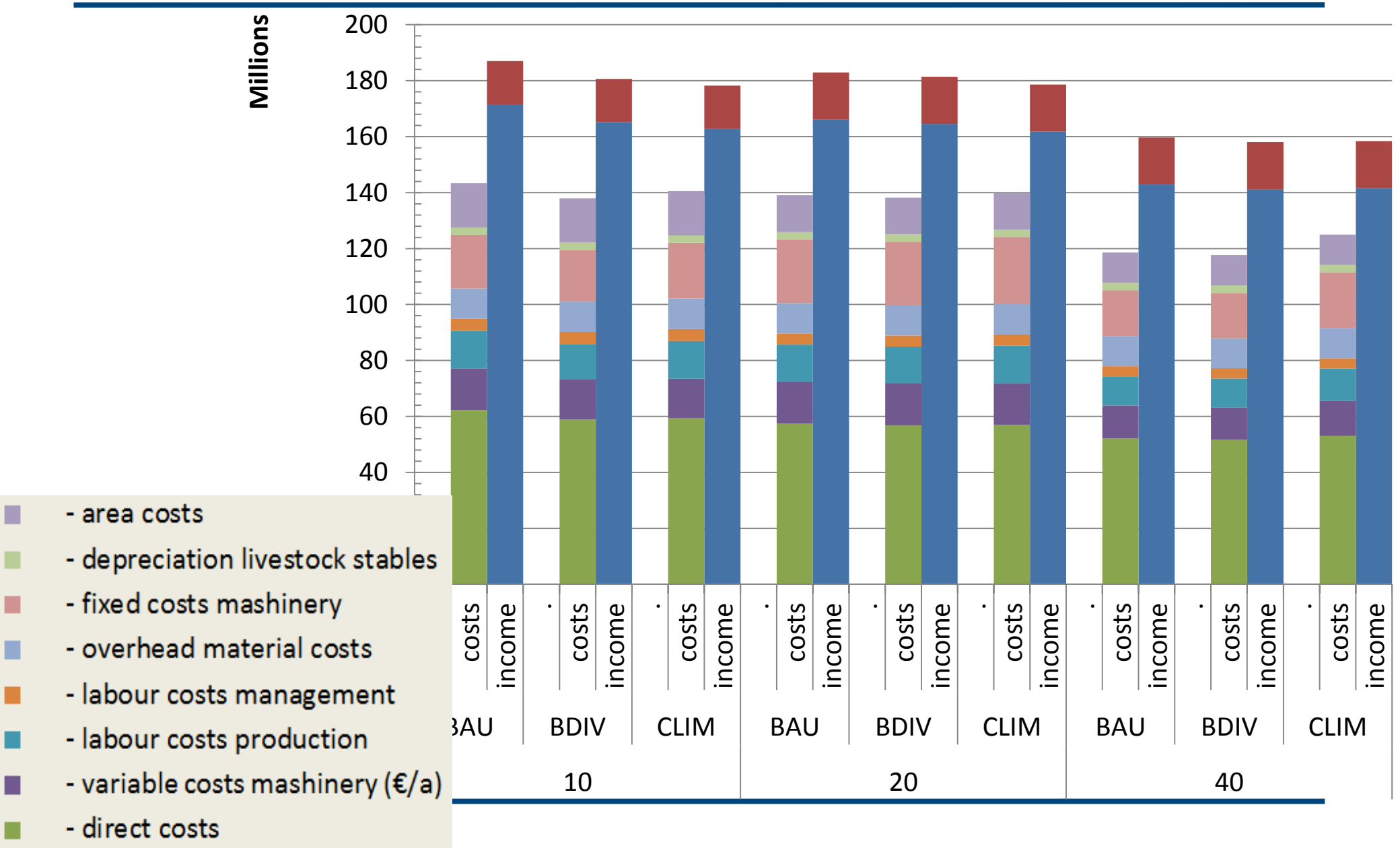
Business as usual: changes over time - Oder Spree (east)



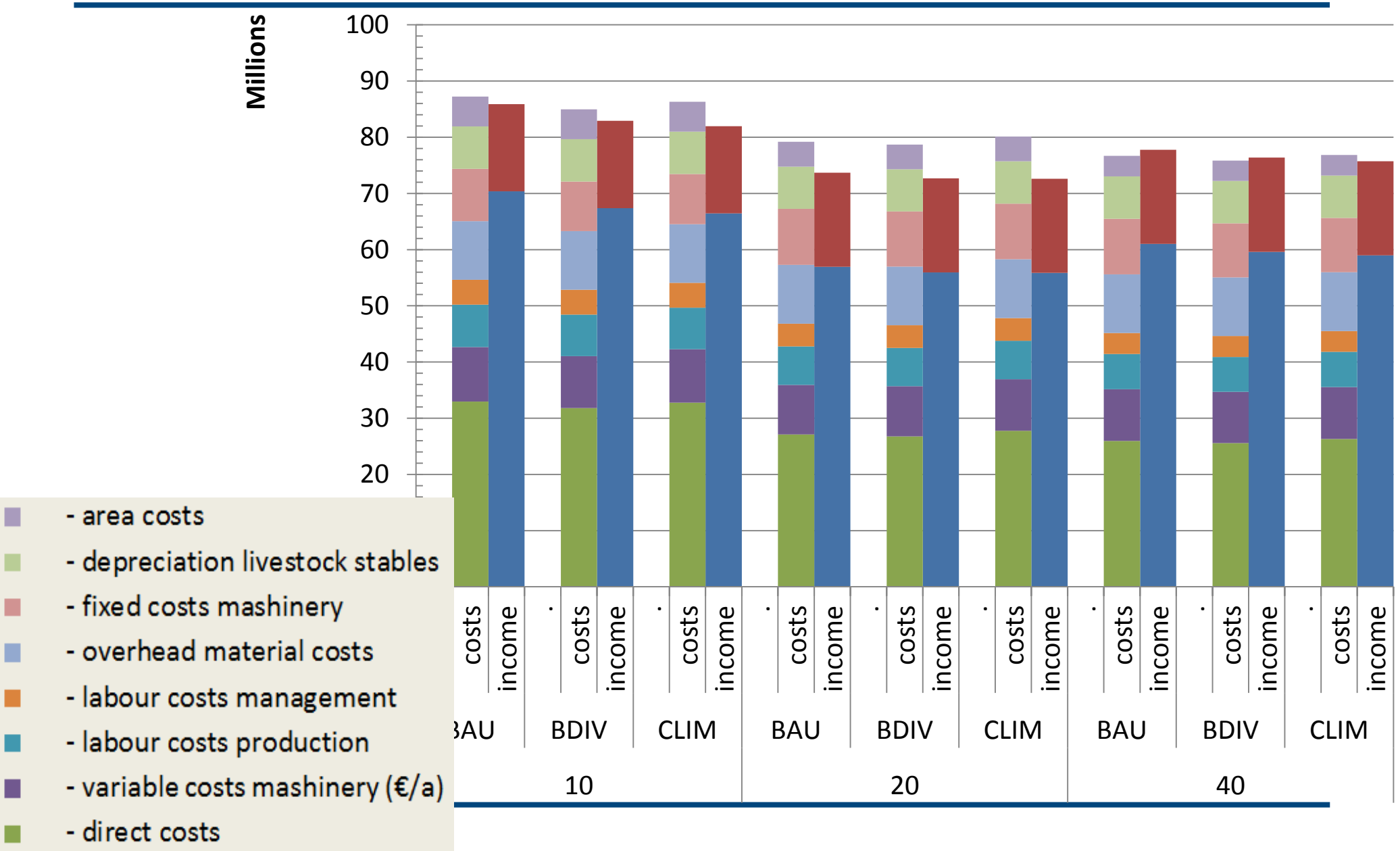
Scenarios over time - Diepholz (west)



Scenarios over time - Uelzen (west)



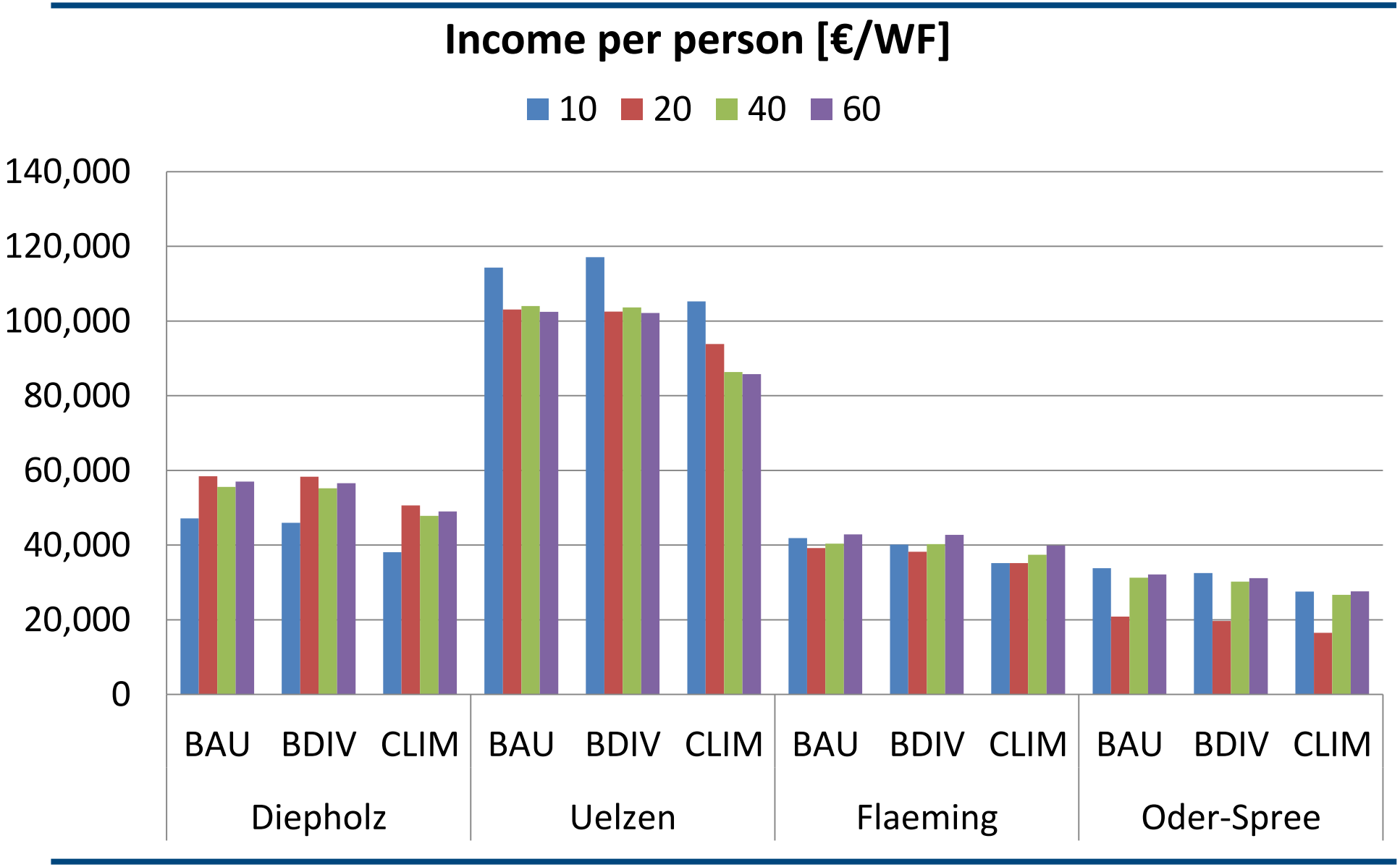
Scenarios over time - Oder Spree (east)



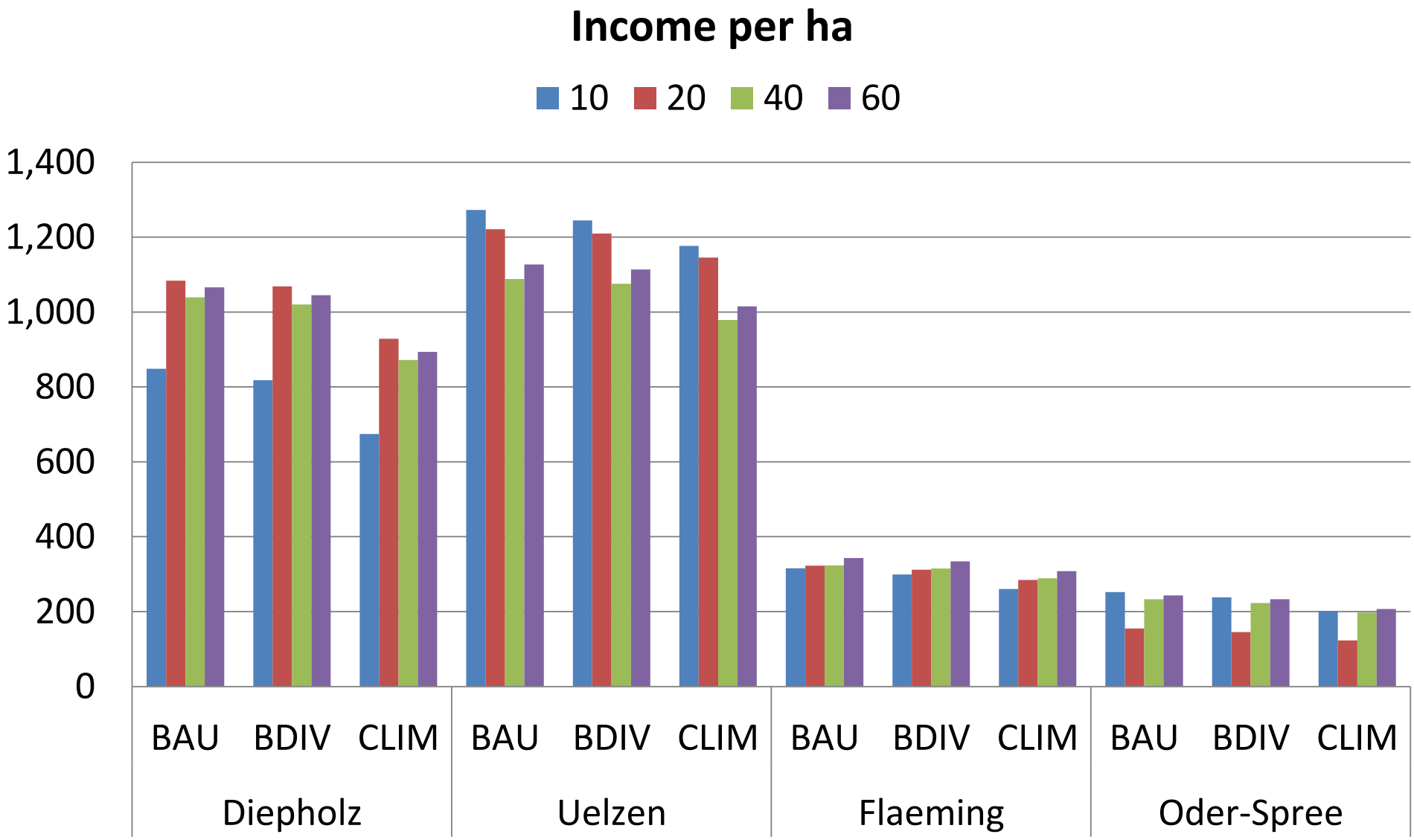
Results per region

farm income per person resp. per ha

Results per region

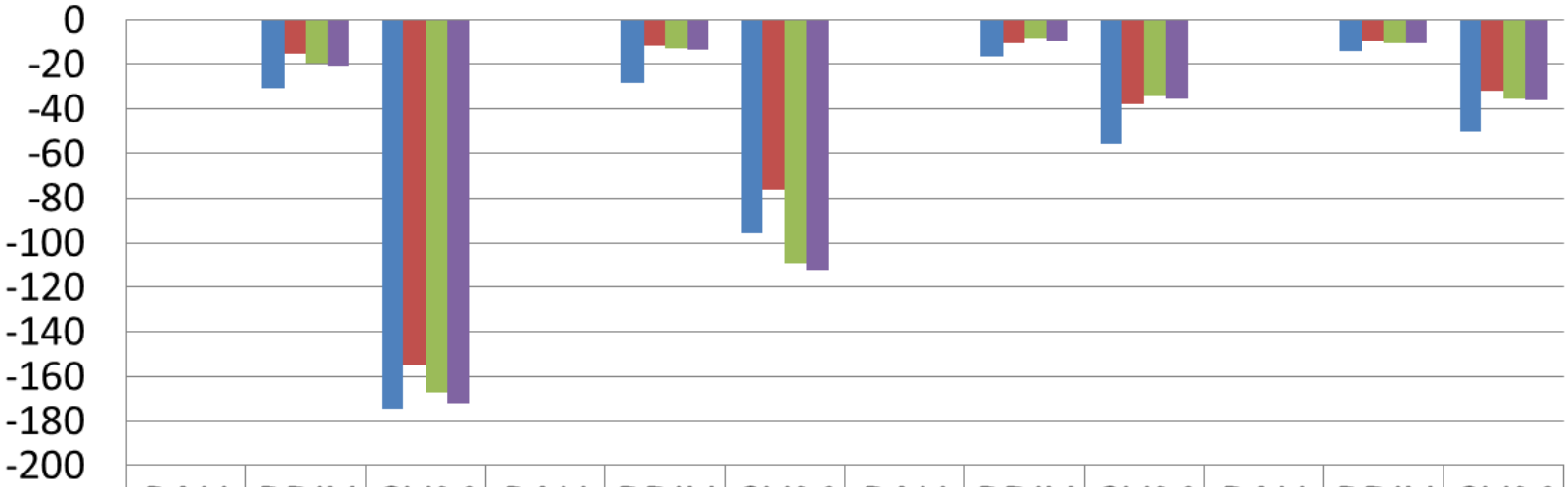


Results per region



Results per region

Income losses per scenario compared to BAU (€/ha)

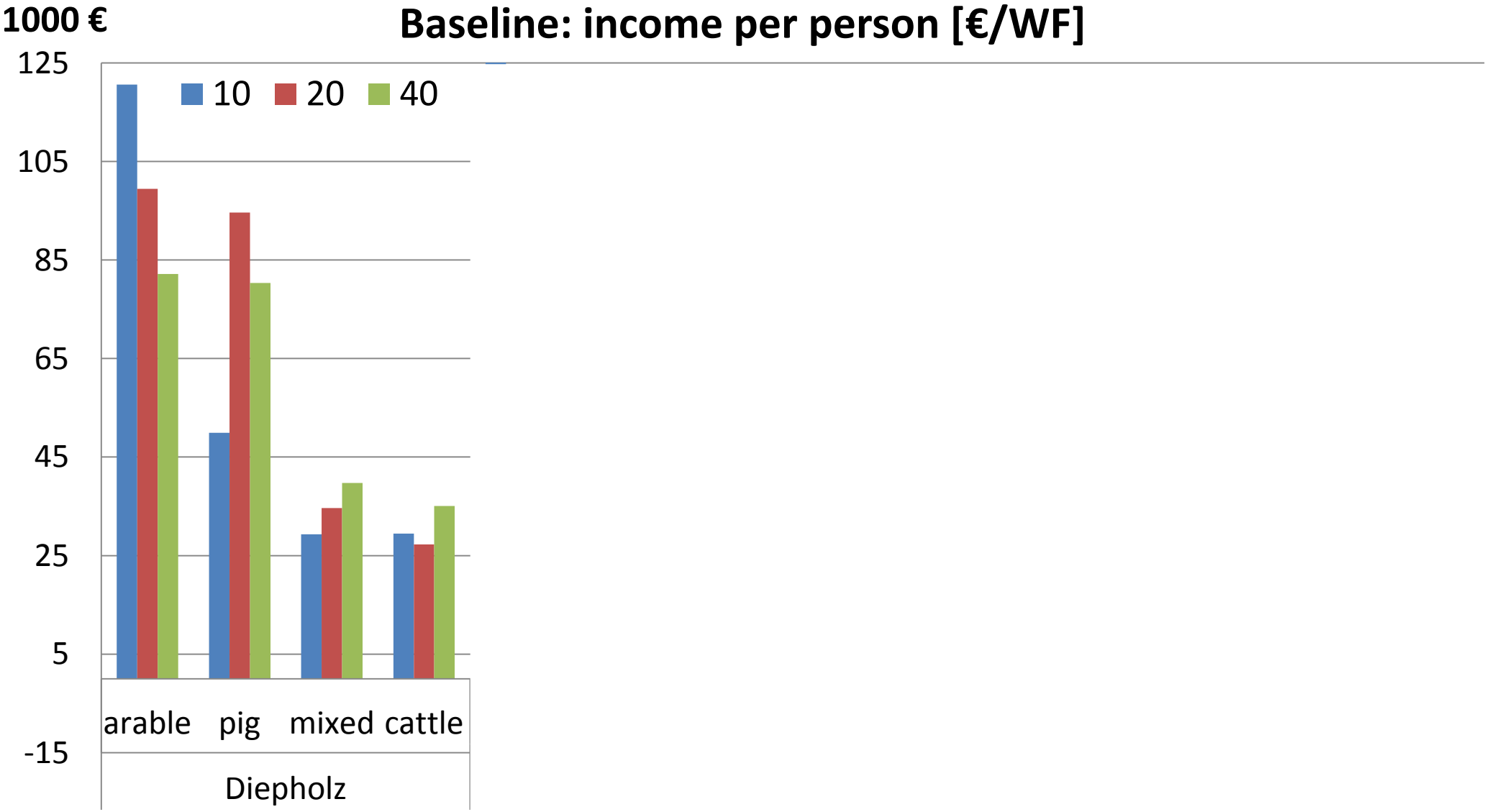


	BAU	BDIV	CLIM	BAU	BDIV	CLIM	BAU	BDIV	CLIM	BAU	BDIV	CLIM
	Diepholz			Uelzen			Flaeming			Oder-Spree		
10		-31	-175		-28	-96		-16	-55		-14	-50
20		-15	-155		-12	-76		-11	-38		-9	-32
40		-19	-167		-13	-109		-8	-34		-10	-36
60		-20	-172		-13	-112		-9	-35		-10	-36

Results per specialisation:

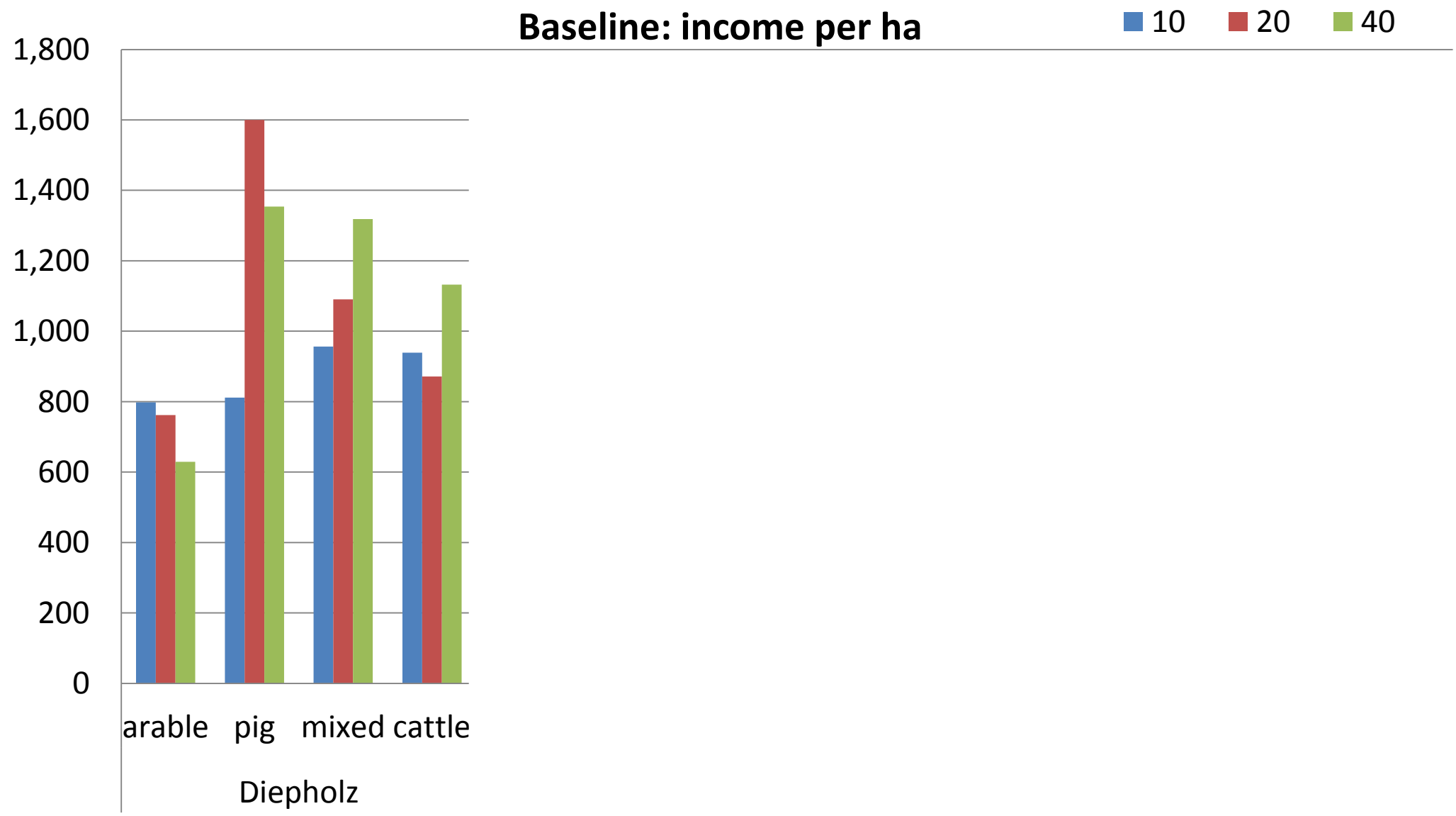
arable, pig, mixed and cattle (dairy&bull fattening) farms

Results for arable, pig, mixed and cattle (dairy&bull fattening) farms

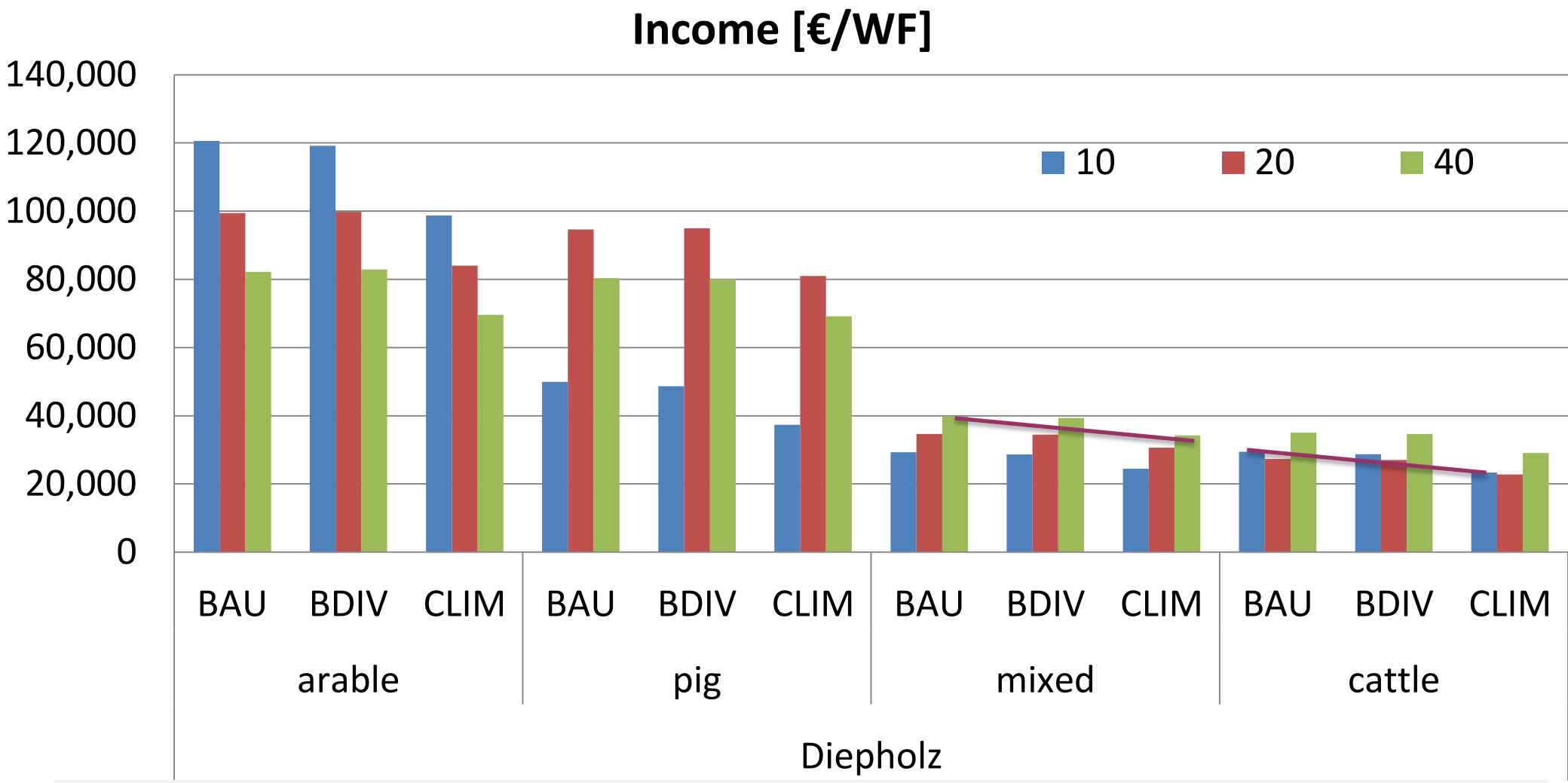


Livestock farmers profit over time while arable farmer see reduced incomes

Results for arable, pig, mixed and cattle (dairy&bull fattening) farms

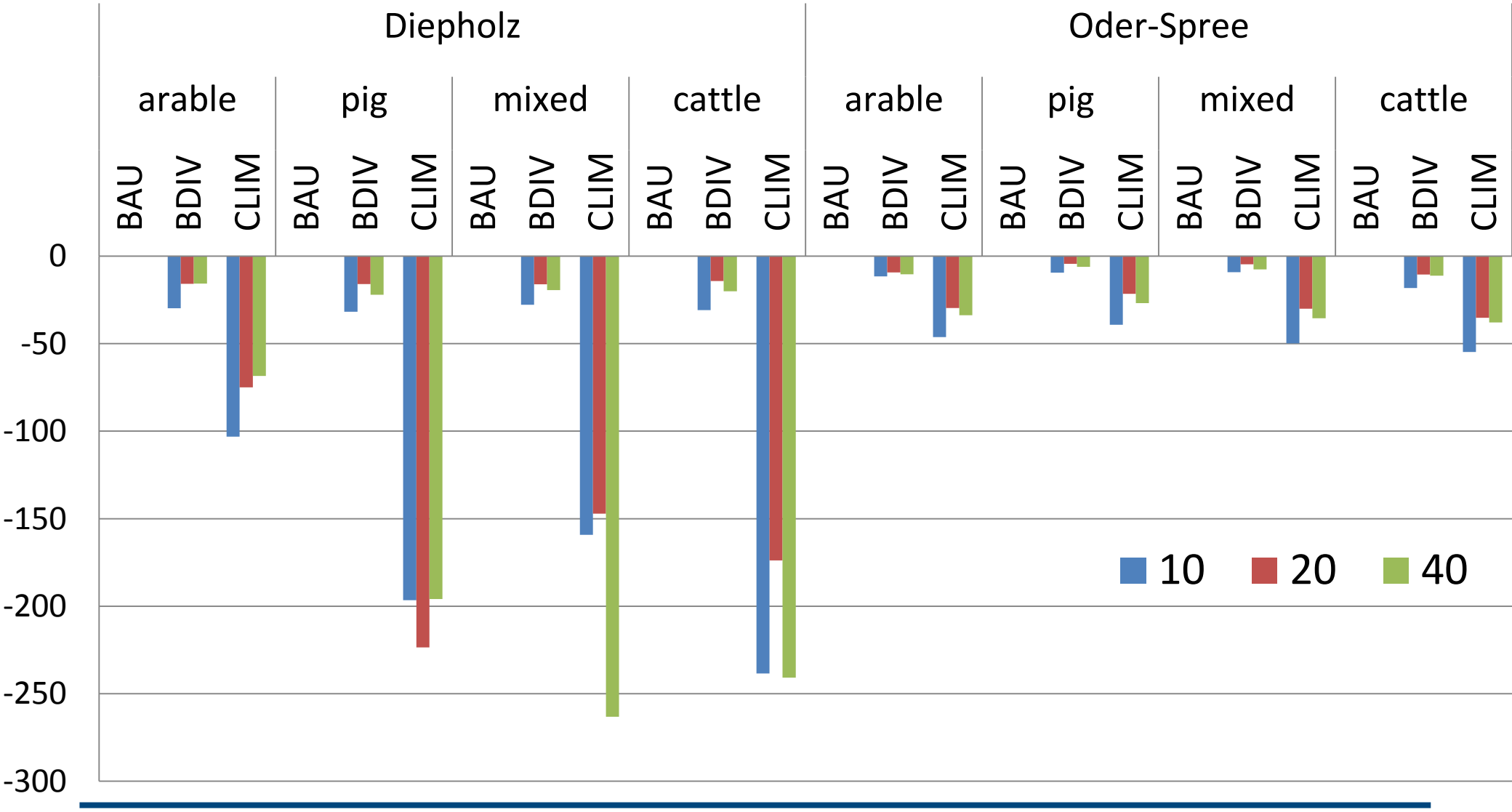


Scenario impact on farm types in Diepholz



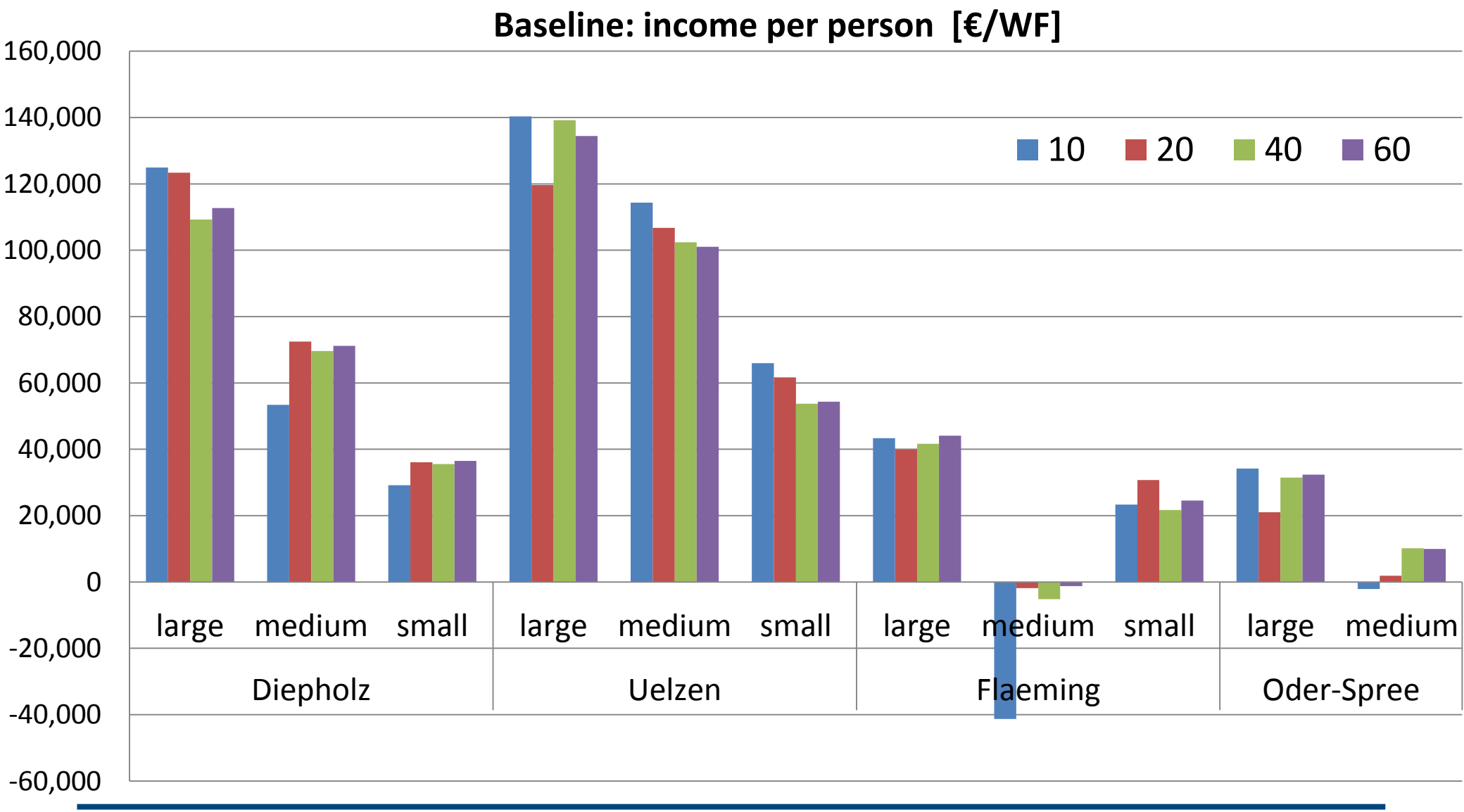
- Income goes down with the scenarios
- clim more than bdiv - allways same pattern as in bau in all regions

Income losses by farm type per scenario compared to BAU (€/ha)

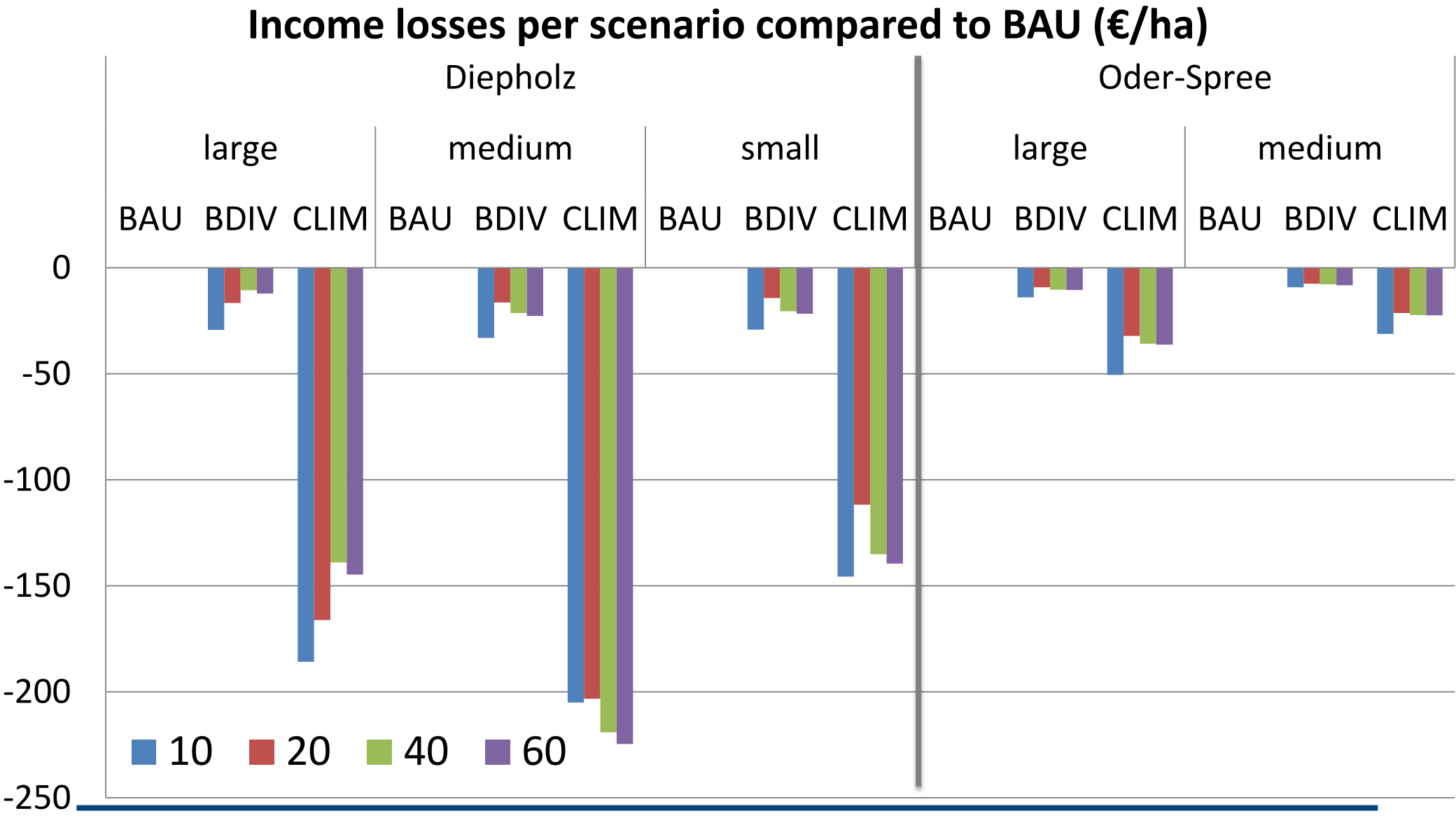


Results for small, medium and large farms

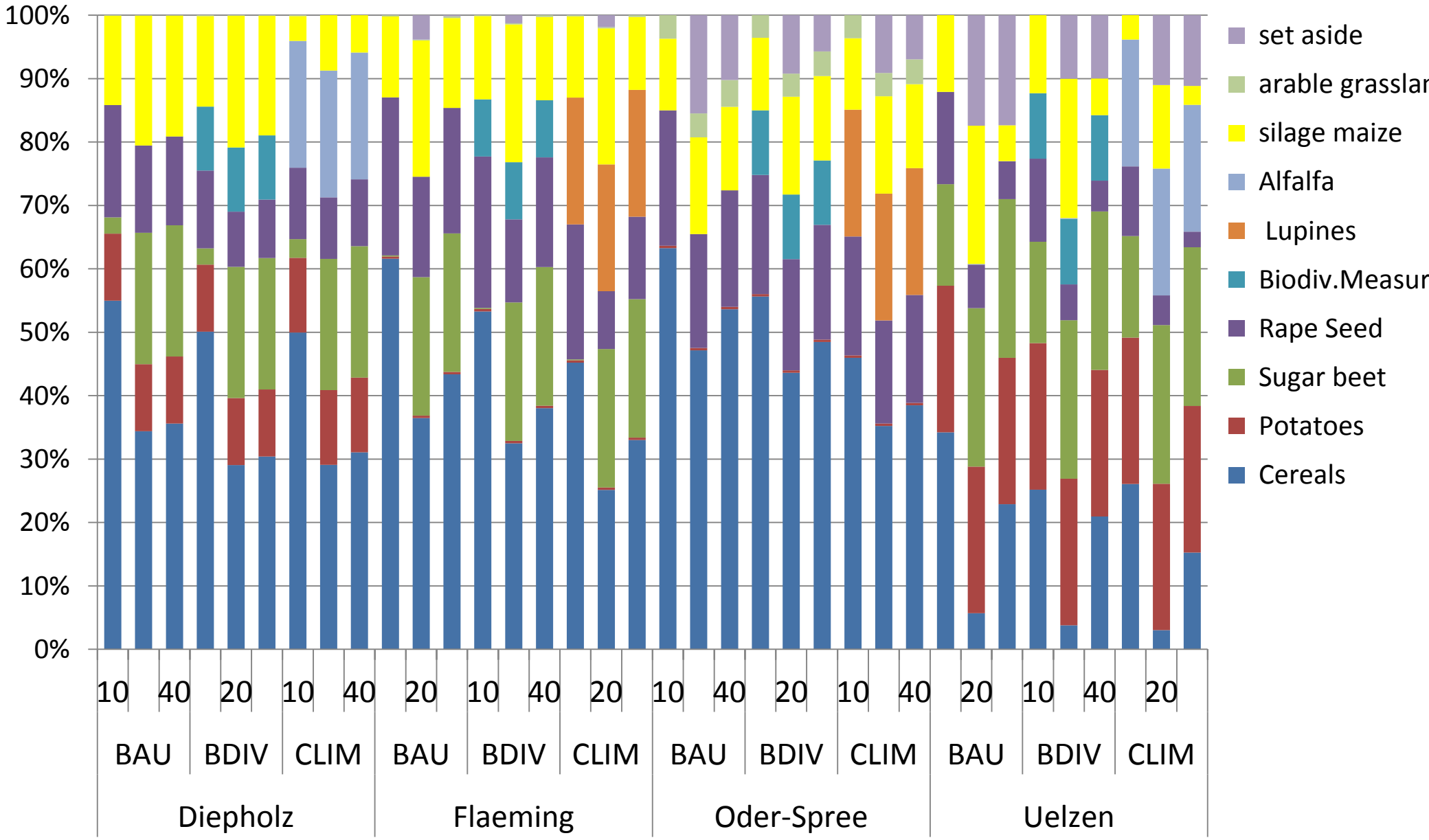
Results for small, medium and large farms



Results for small, medium and large farms



Land use


100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
set aside
arable grasslar
silage maize
Alfalfa
Lupines
Biodiv.Measur
Rape Seed
Sugar beet
Potatoes
Cereals
10 40 20 10 40 20 10 40 20 10 40 20 10 40 20 10 40 20
BAU BDIV CLIM BAU BDIV CLIM BAU BDIV CLIM BAU BDIV CLIM
Diepholz
Flaeming
Oder-Spree
Uelzen

Land use

cereals

- are reduced in 2020 and a bit less in 2040

maize production

- increases with higher bioenergy production from 2020 onwards

set aside

- Oder-Spree and Uelzen show larger shares of set aside in 2020 and a bit less also in 2040
- Less in biodiv and clim scenarios, due to conservation areas there

sugar beet production

- increases up to the rotational restrictions => market effect?

Conclusion

- The model reacts sensible
  - to resource endowment of a farm type
  - price changes
  - available production options
  - policy instruments

- Ecological evaluation of land use change is still under work
  - Nitrogen leaching
  - GHG
  - Biodiversity indicators

Conclusion

- business as usual scenario show income losses for 2020 and again for 2040 (CAPRI 2030) for most farm types and regions.
  - Diepholz farms can compensate through high bioenergy production levels
  - pig farms also high income increase for 2020 due to the specific price structure
- arable farms have in general highest incomes, followed by pig farms and then by mixed and dairy and bull fattening farms .
- arable farms suffer under future price development while livestock farms profit from projected prices.
- biodiversity scenario results in losses of 10 to 30 €/ha
- climate mitigation scenario causes high losses especially for livestock farms (in western region between 150 and 200 €/ha)
- farms in Oder-Spree rely most on subsidies for mid and long term success

Methodological questions

- Why not use FADN data and PMP?
  - First assumption was: climate adaptation will need new crops and production techniques => not suited for PMP
  - Costs and benefits would change through climate impact and not be reflected by statistical data: therefore expert/model based production practices and costs calculations based on standard data for applied technologies

- Why should we?
  - Difficulties to calibrate, as several attractive crops are limited due to contract based cultivation (e.g. potatoes in Uelzen “the potatoe mafia”)
  - Standard cost calculations seem to overestimate production costs, as larger farms have purchasing and selling mechanisms that result in more favourable prices.

Outlook and improvements planned

- Integration of ecological evaluation results
- Elaboration of a more efficient premium structure for both scenarios.

- In context of MACSUR we will link up with HERMES (Kersebaum) and look at irrigation as one adapation measure.

Thank you for listening