AQUARIUS
Farmers as water managers

Danish Pilot Area

Baseline Description

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Auther: Jørgen Bidstrup, Kirsten Broch, Anne Mette Langvad, Flemming Gertz, Irene Wiborg

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Introduction

AQUARIUS is a project within the Interreg IVB North Sea Region Programme with partners from the Netherlands, Germany, Sweden, Norway, Scotland and Denmark. Each partner works in a local pilot area.

The overall purpose of the project is to develop the farmer as water manager to practice sustainable farming under climatic changes with due respect to environmental protection. The learnings from each partner will be disseminated among the other partners.

The Danish partners are the Danish Agricultural Advisory Service (DAAS) and the Danish Ministry of the Environment, Environment Centre Aalborg.

In this report there is a presentation of the Danish pilot area and a baseline description regarding issues as: ecological status, present economical situation and sociological status.

Further information about the project can be obtained at:
http://www.aquarius-nsr.eu/Aquarius.htm

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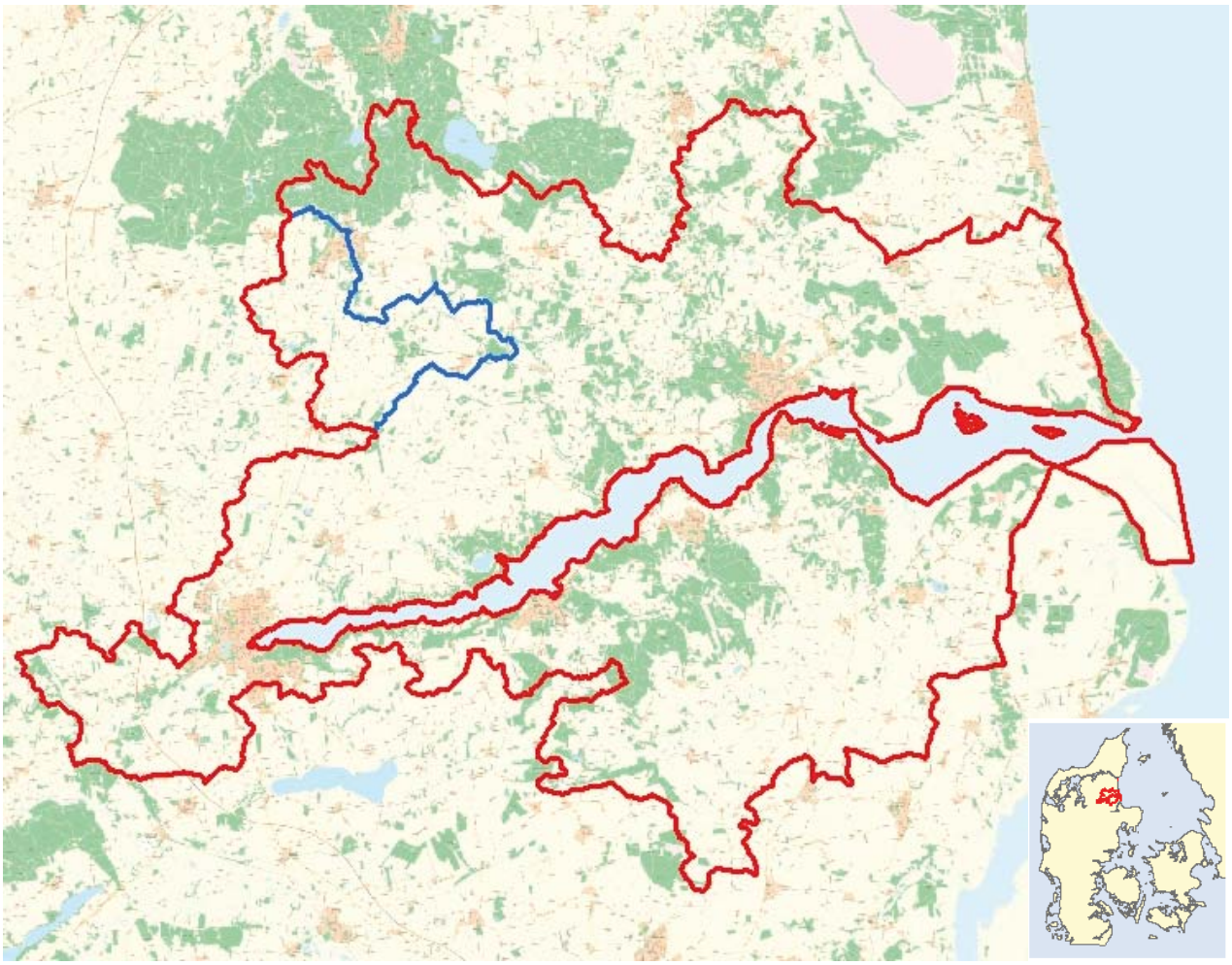
1. Welcome to Danish pilot – Mariager Fjord

1.1 Information about the area



The size of the catchment - Mariager Fjord 572 m² (red line)

The size of subcatchment - River Lundgaards bæk 35 km^2
(blue line)

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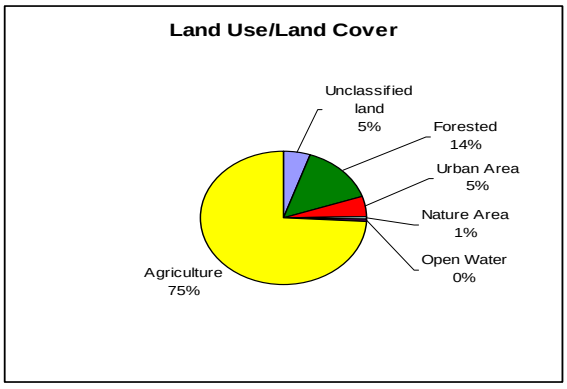
1.2 Land Cover & Land Use in catchment area

Land Use / Land Cover	Km2	%
Unclassified land	29,9	5,2
Forested	82,8	14,5
Urban Area	28,9	5,1
Nature Area	3,5	0,6
Open Water	2,5	0,4
Agriculture	424,7	74,2
Total	572,2	100,0

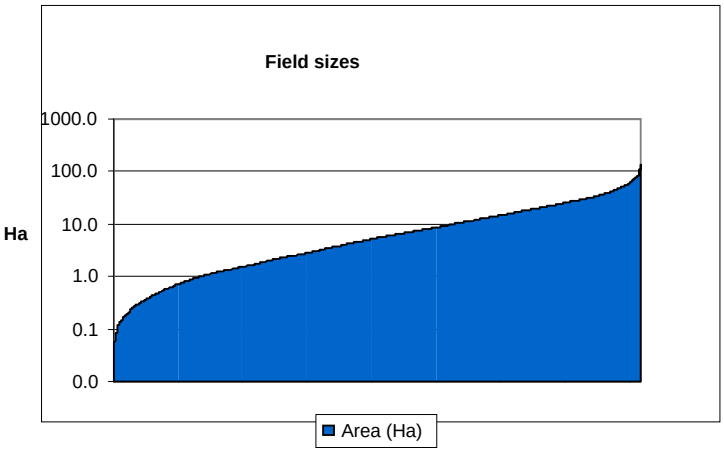
1.3 Population density in the catchment area



1.4 Topography

Field Size

Quartile	Area (Ha)
Median	**5.43**
Q1 (min)	0.02
Q2 (25%)	1.58
Q3 (50%) median	**5.43**
Q4 (75%)	15.67
Q5 (max)	139.35
Average	**11.75**



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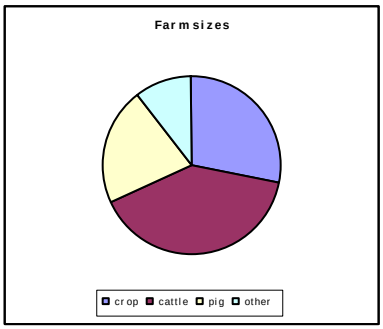
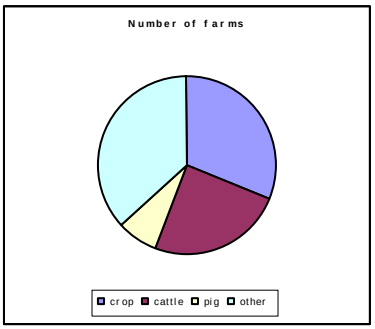
1.5 No. of farms/land based enterprises in the catchment area

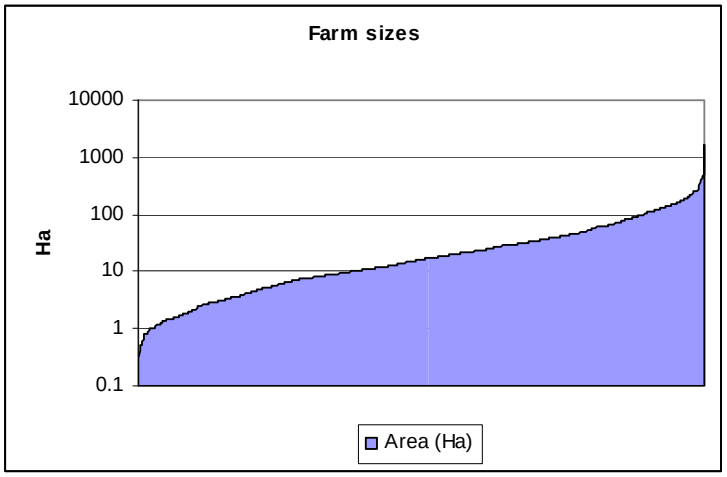
Type of farm	Area(Ha)	%	Number
Crop	11045	28	304
Cattle	15482	40	235
Pig	8389	21	73
Other	4161	11	359
Total	39079		971





1.6 Typical Farm Size

All Quartile	Size (ha)
Q1 (min)	0.3
Q2 (25%)	6.0
Q3 (50%) Median	**16.3**
Q4 (75%)	41.2
Q5 (max)	1643,5
Average	**40.2**



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1.7 Animal density

Livestock Units

In Denmark one Livestock Unit (LSU) correspond to 100 kg Nitrogen pr. year.

Type of live-stock	LSU	Average LSU/Ha
Cattle	11799	0.73
Pig	5979	0.89
Other	1054	0.11
Total	18832	0.29

1.8 Employment in primary, land based sector (including self employment) out of total employment in catchment area

Total number of employees in the Municipality of Mariager Fjord in 2008 is 21926.

Total number of employees in agriculture, horticulture, and forestry (Danish Trade code 0109) in 2008 is 1189. Employment in percentage of total employment is 5.4 %.

Source: Regional arbejdsmarkedsstatistik (Regional Labour Market Statistics): RASB1X www.statistikbanken.dk

1.9 Primary pilot problem

Mariager Fjord is a highly eutrofic fiord with very high production of algae's, low secchi depth and extensive oxygen deficiency. The main problem of the fiord is eutrification due to the high loading of nitrogen and phosphorus from the catchment area. The agricultural losses of nutrients are very highly dependant on climate, and therefore climate changes will have a strong influence on losses. In general, we expect higher losses of nutrients if there are no changes in current agricultural practices. Farmers as water managers are essential for reaching good ecological status.

1.10 Is the catchment similar to other catchments in country

Mariager Fjord is a highly eutrofic fiord with very high production of algae's, low secchi depth and extensive oxygen deficiency. The main problem of the fiord is eutrification due to the high loading of nitrogen and phosphorus from the catchment area. The agricultural losses of nutrients are very highly dependant on climate, and therefore climate changes will have a strong influence on losses. In general, we expect higher losses of nutrients if there are no changes in current agricultural practices. Farmers as water managers are essential for reaching good ecological status.

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Mariager Fjord is a typical Danish fjord and the problems with eutrification are a general problem.

2. Current ecosystem conditions

2.1 Water Quality according to WFD

The WFD plan for Mariager Fjord catchment area includes 319 km rivers, 8 lakes , 3 ground-water waterbodies and the 42 km long marine Fiord

2.2 Water Quality Mariager Fjord

Type of Waterbody: Fiord
Mariager Fjord is a 42 km long fiord. It has a rather narrow, shallow outer part and a deep inner part with a maximum depth of 30 meter. The salinity varies typically from 20 to 30 psu.

Main problem: Eutrophication
Mariager Fjord is a highly eutrofic fiord with very high production of algae's, low secchi depth and extensive oxygen deficiency. The main problem of the fiord is eutrification due to the high loading of nitrogen and phosphorus from the catchment area but also the dimensions of the fjord – depth and stratification – have a big impact on the oxygen deficiency.

What is the ecological status today?

The eutrophication results in a state for the fiord that I quite far from the good ecological status according to the WFD.

Do you expect good ecological status by 2015?

No

What is the impact and importance of agriculture?

In general, the point sources are very well regulated and the impacts limited. Agriculture is the largest source of nutrients to the fiord and a reduction in the loading is essential, if the objective is to be met.

What are the expected impacts of CC?

The agricultural losses of nutrients are very highly dependant on climate, and therefore climate changes will have a strong influence on losses. In general, we expect higher losses of nutrients if there are no changes in current agricultural practices. Farmers as water managers are essential for reaching good ecological status for Mariager Fjord.

2.3 Water Quality Rivers

Type of Waterbody: Rivers
There are 319 km small rivers and brooks in the pilot area.

Main problem:
The main problems in rivers are outlet of organic matter from scattered houses and farms and poor hydro morphological conditions in the rivers.

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What is the ecological status today?

In general we have a good ecological status in the main rivers in the pilot but many of the minor brooks have a moderate ecological status. 23 % don't have a good ecological status and the status is unknown in 28 %. In general we don't have any problems with flooding or streams drying up.

Do you expect good ecological status by 2015?

We expect that about 50 % of the rivers will have a good ecological status in 2015.

What is the impact and importance of agriculture?

Mainly hydromorphological changes due to weed cutting in the water, poor embankments and erosion.

What are the expected impacts of CC?

In general we don't expect any major problems. We expect a bigger difference between water flow in summer and winter and increased erosion and temperature.

2.4 Water Quality Lakes

Type of Waterbody: Lakes
There are 8 lakes larger than 0,5 km^2 in the pilot area.

Main problem:
The main problem of the lakes is eutrification with very high production of algae's and low secchi depths. The problem in lakes is mainly due to the high loading of phosphorus from the catchment area.

What is the ecological status today?

7 out of 8 lakes have a poor ecological status.

Do you expect good ecological status by 2015?

We expect that only 1 lake will have a good ecological status in 2015.

What is the impact and importance of agriculture?

Agriculture is the largest source of nutrients to the lakes and a reduction in the loading is essential, if the objective is to be met.

What are the expected impacts of CC?

The agricultural losses of nutrients are very highly dependant on climate, and therefore climate changes will have a strong influence on losses. In general, we expect higher losses of nutrients if there are no changes in current agricultural practices. Farmers as water managers are essential for reaching good ecological status.

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2.5 Water Quality groundwater

Type of Waterbody: Groundwater
The WFD plan includes 3 groundwater waterbodies. The quality of groundwater is affected by agricultural losses of nitrogen and pesticides.

Main problem:
The main problem is the agricultural losses of nitrogen and pesticides.

What is the ecological status today?
The two waterbodies located near the surface has a poor ecological status while the third waterbody located at a greater depth has a good ecological status.

Do you expect good ecological status by 2015?
We don't expect any changes in the status by 2015.

What is the impact and importance of agriculture?
The main problem is the agricultural losses of nitrogen and pesticides

What are the expected impacts of CC?
The agricultural losses of nutrients are very highly dependant on climate, and therefore climate changes will have a strong influence on losses. In general, we expect higher losses of nutrients if there are no changes in current agricultural practices. Farmers as water managers are essential for reaching good ecological status for Mariager Fjord.

2.6 Water Quantity groundwater

The water quantity has at good status in all 3 groundwater waterbodies.

We don't expect any changes in status by 2015

CC will give a higher quantity of groundwater in the catchment area.

2.7 Water quality (beyond WFD parameters)

There are no problems with flooding in the catchment area.

2.8 Bio-diversity

Natura 2000 is the centrepiece of EU nature & biodiversity policy. It is a EUwide network of nature protection areas established under the 1992 Habitats Directive. The aim of the network is to assure the long-term survival of Europe's most valuable and threatened species and habitats. It is comprised of Special Areas of Conservation (SAC) designated by Member States under the Habitats Directive, and also incorporates Special Protection Areas (SPAs) which they

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designate under the 1979 Birds Directive. The WFD plan for Mariager Fjord catchment area includes 6 Natura2000 areas.

2.9 Biodiversity status

The focus of the effort is to ensure coherent nature of the river valleys of Villestrup and Kastbjerg. Other important areas are water birds in the outer part of Mariager fjord.

It's important to provide open spaces in many Natura2000 habitats and improwed hydrology for many water-dependent habitats. Moreover, there must be an effort to ensure the forests and areas designated species.

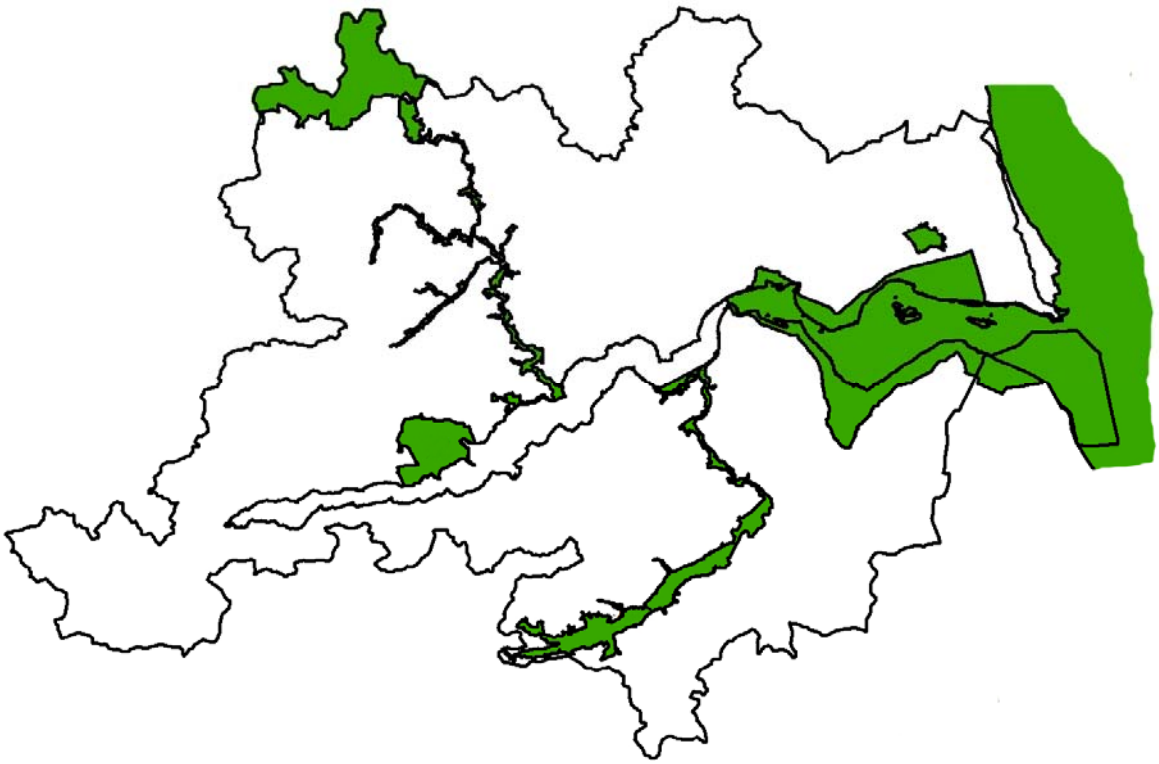
2.10 Bio-diversity (beyond HD parameters)

Not relevant.

2.11 Primary pilot problem

The primary pilot problem is the losses of nutrient from agricultural areas.

2.12 Natura2000 areas



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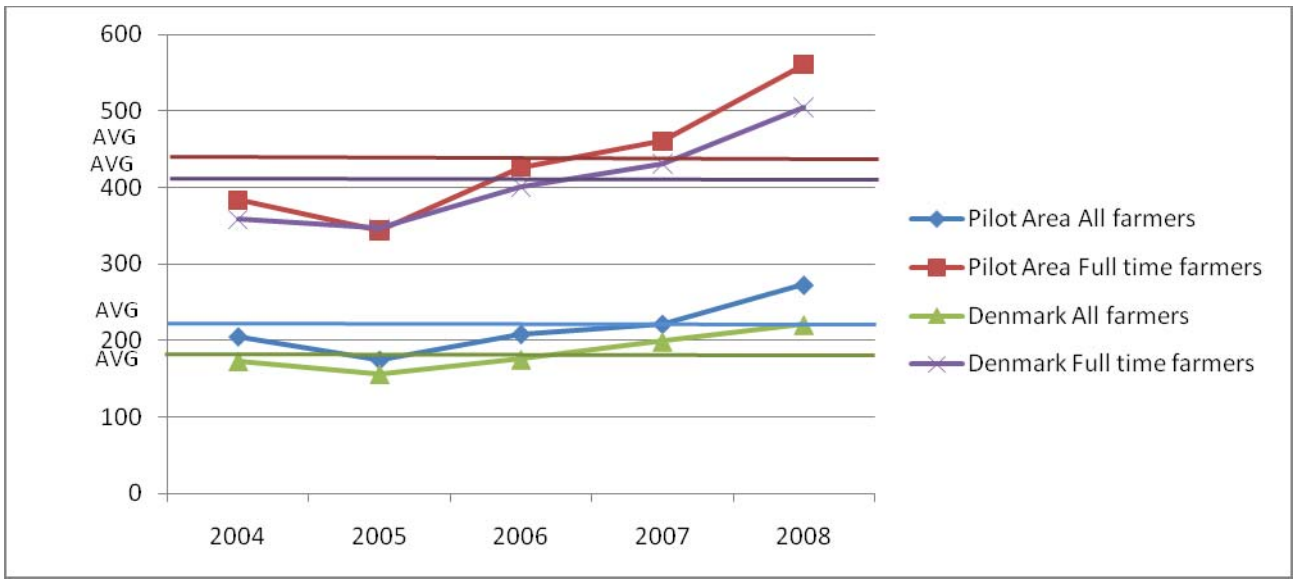
3. Economic baseline for the Danish Pilot

In average the gross output for the holdings is higher in North Jutland than in the rest of Denmark. This is due to a higher animal production and more full time farmers than in the rest of the country.

In 2008 the product prices were very high which gives a peak on the graph.

The
average gross output for the period 2004 – 2008 is 216.500 € in North Jutland.



For full time land based enterprises the average net income consists of Operating Profits, EU subsidies, Wages and other income. But before the interest expenditures are paid.

The net income fluctuates especially among the full time farmers who are more sensitive to changes in product prices.

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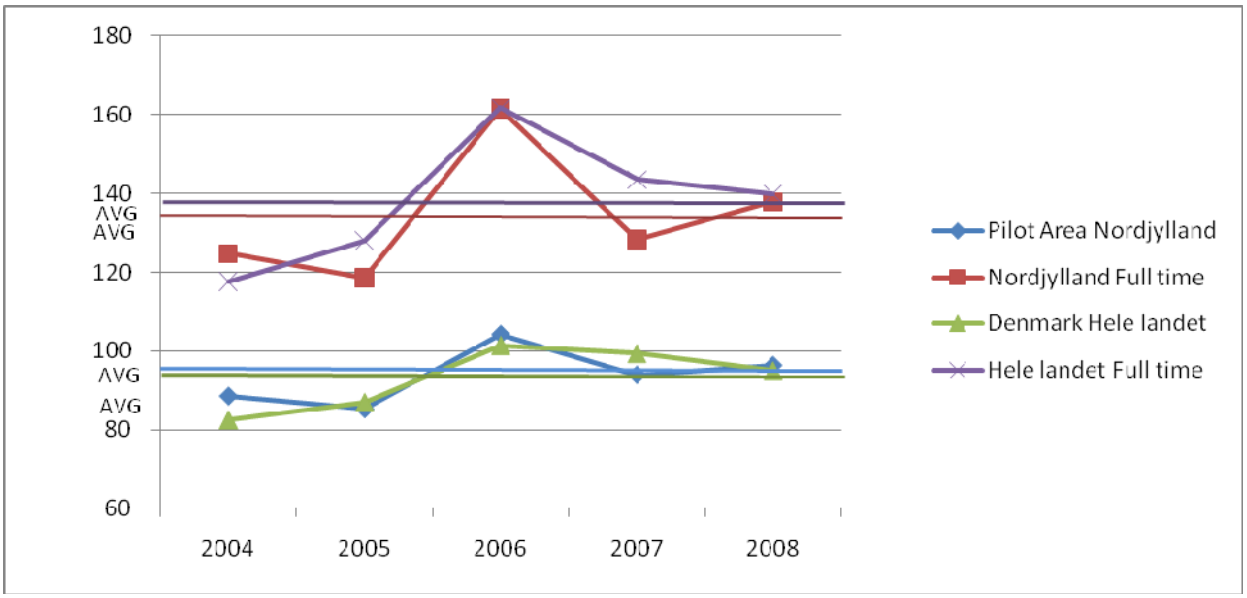

The percentage of part time farmers compared to the total numbers of farmers. In North Jutland in average 56 pct of the farmers are part time farmers whilst in Denmark this percentage is 61 pct.

In other words North Jutland has more full time holdings than the rest of the country in average.

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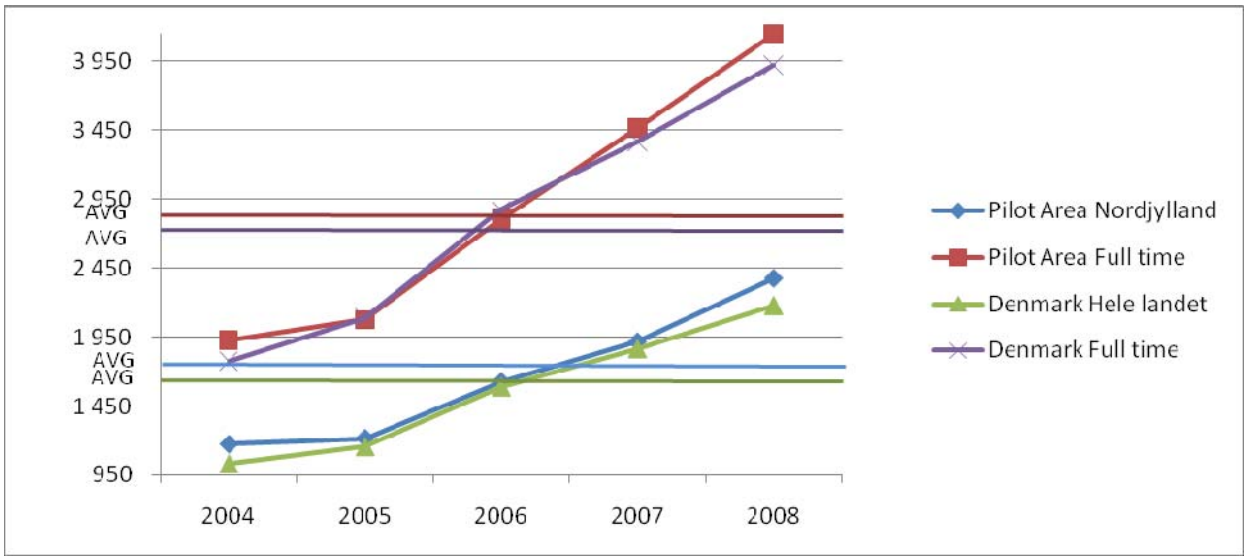
The agricultural assets include the value of the holding including land and buildings (incl. the value of the farmhouse).

The value of the agricultural assets did increase in the period 2004 – 2008. Especially among the full time farmers the increase of the agricultural assets was very high. In North Jutland the agricultural assets increased from € 1,926 in 2004 to €4,144 in 2008. Among the part time farmers the same number was € 577 in 2004 and € 973 in 2008. The increase was due to two factors. The structural development was very high (more animals and more land) and in the same time the value of the land increased very much. Due to the financial crisis the agricultural assets have decreased last year, - especially because the land prices have decreased.



Depending on the individual farmer and on what kind of production he has got the net profit varies. It should be noticed that the net profit is defined as operating profits minus net interest expenditure plus general subsidies. In average the Danish farmers have a very high debt rate which makes them very sensitive to changes in interest rates, etc.

In the graph it can be noticed that the best quartile of the full time farmers are able to make an average net profit in the period 2004 – 2008 on approximately €120,000 whilst the worst quartile had a negative net profit in the period of almost €140,000 in average. In average the full time farmers in the area had a net profit in the period of € 0 with some very high variations from year to year.

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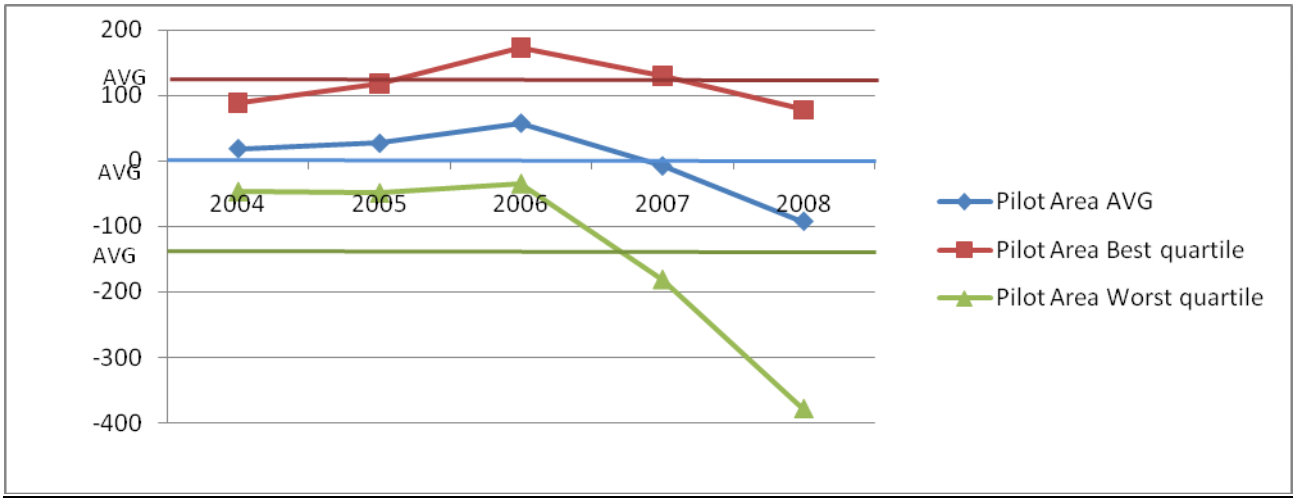
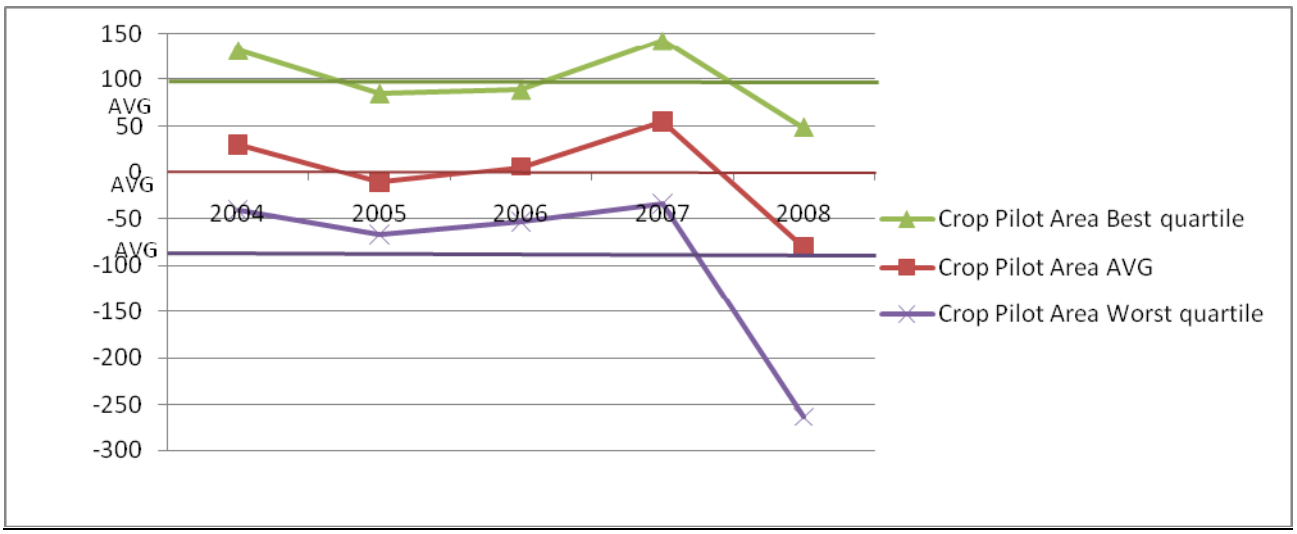
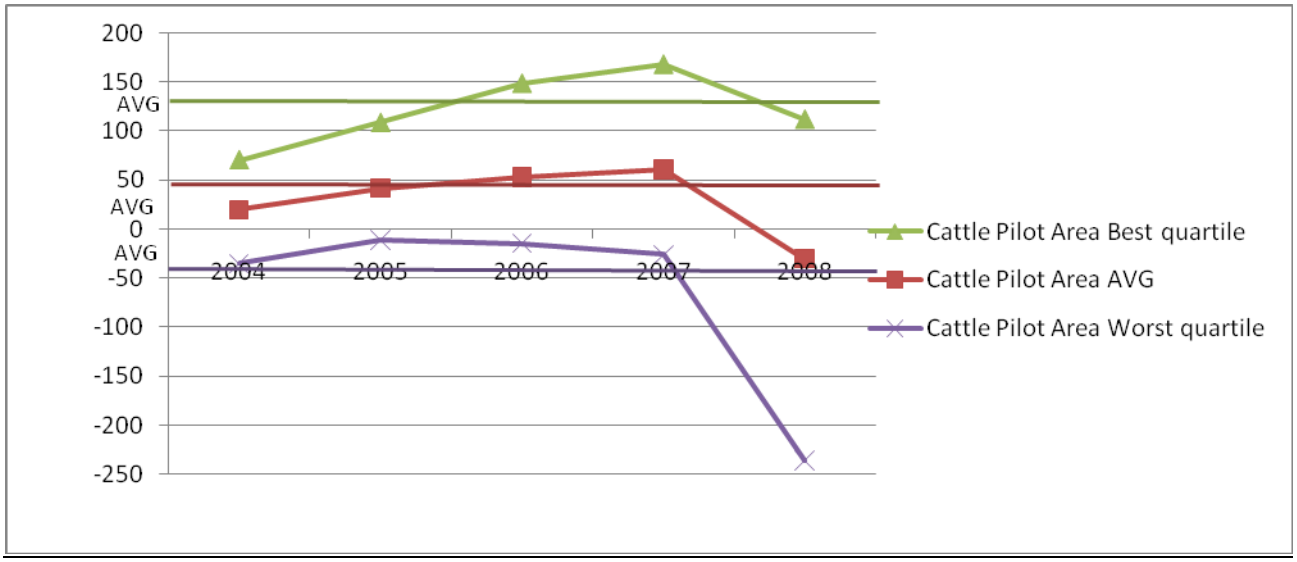


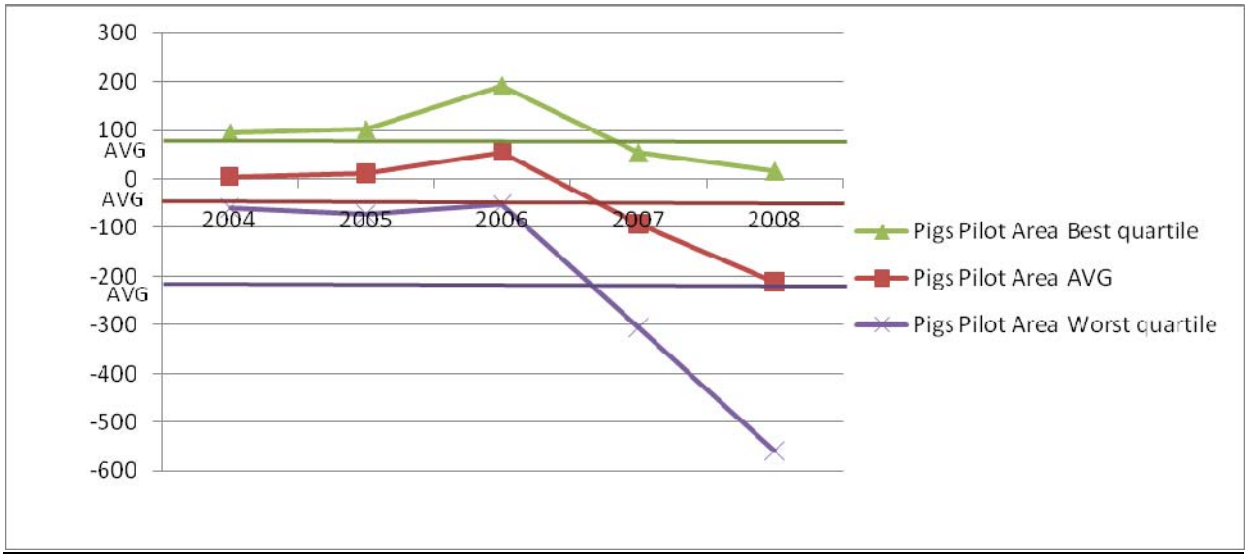
The net profits for full time farmers have been examined in order to see if there are some branches that have performed better or worse than other branches in North Jutland.

	Average	Best quartile	Worst Quartile
Farms in North Jutland	576	117,069	-137,865
Crop farmers	52	99,051	-91,603
Cattle	28,832	121,497	-64,613
Pigs	-46,558	91,891	-209,522
Poultry	2,236	78,744	-98,426
Fur-bearing animals	55,125	152,994	-20,823

For all branches the net profit is quite low in average in the period 2004 – 2008. But the best quartile has been able to generate a net profit which must been considered acceptable while the worst quartile are in a very bad situation.







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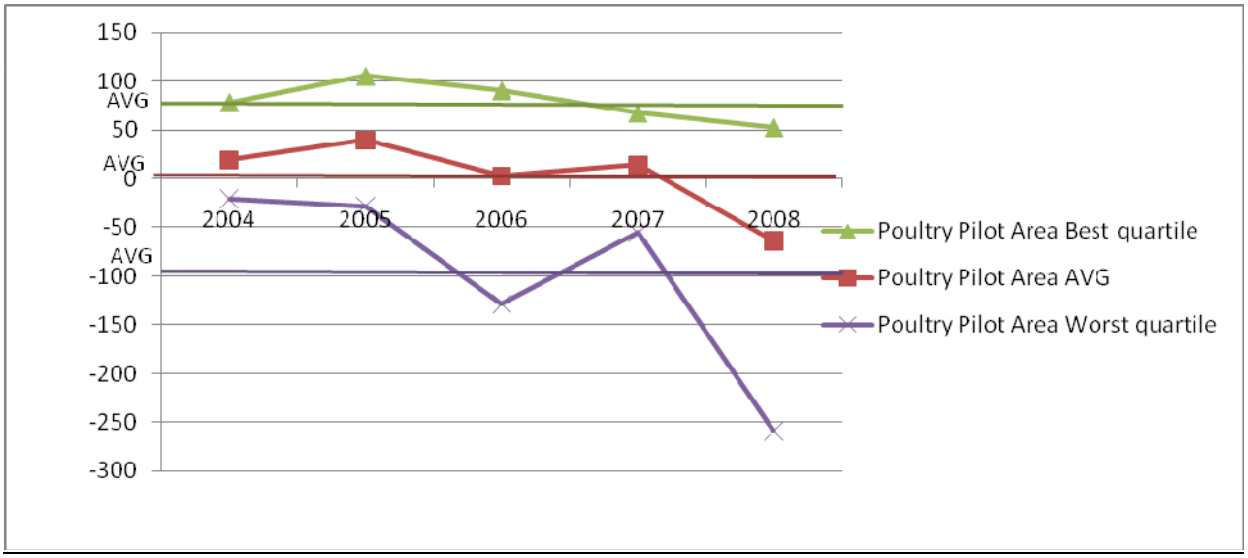

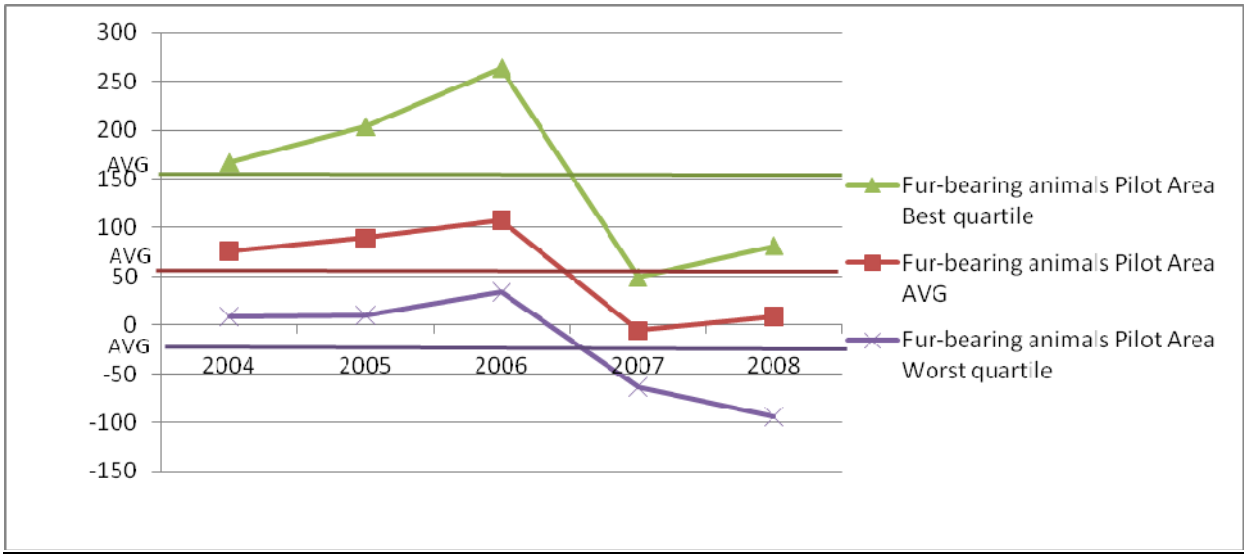

The general subsidies defined as the single payment scheme and other subsidies from primarily improvement schemes for young farmers was in the period 2004 – 2008 in average €25,000 a year in the North Jutland and also in general in Denmark. The full time farmers receive in average €45,000 and the part time farmers receive in average €11,000.

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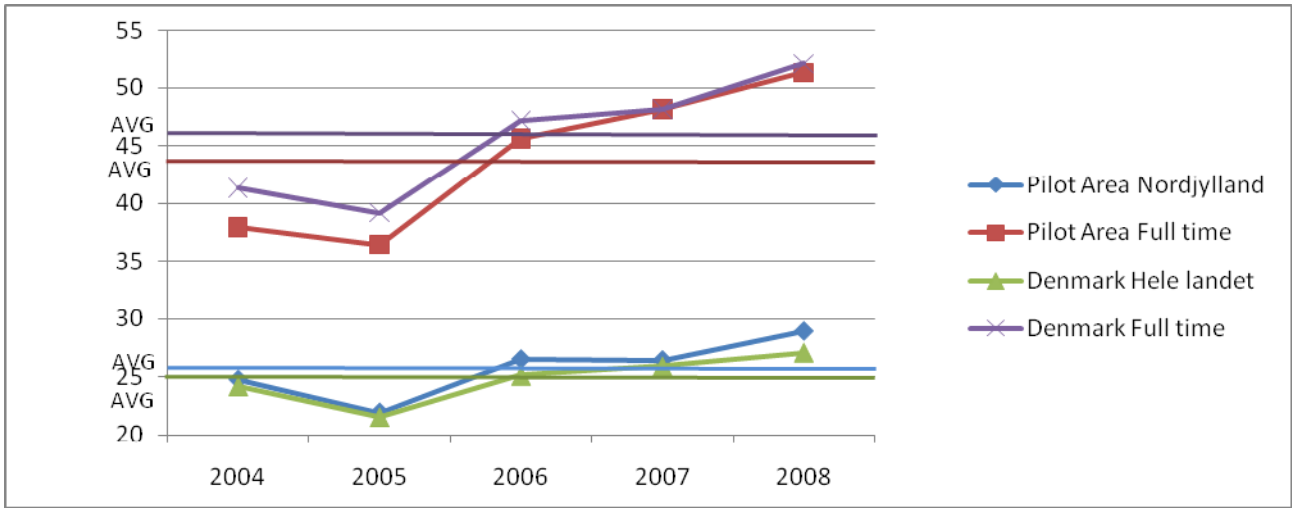
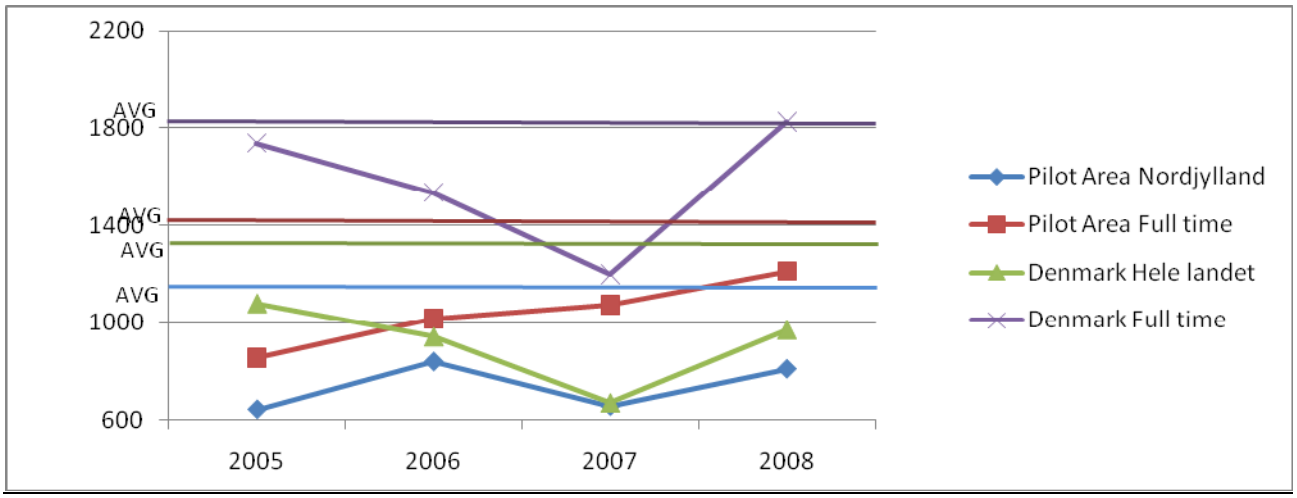


The part of income which is based on EU agri-environmental and national agri-environmental schemes incl. organic production is quite low in Denmark and in the region of North Jutland.



To a large extent the Danish properties are financed by banks or mortgages. Even though the debt percent decreased in the period 2004 – 2008 the actual debt increased for the properties in Denmark and in North Jutland. The farmers financed their expansion by taking more loans. The mortgage institutions and the banks were ready to finance this expansion because the value of the agricultural assets was increasing. This situation has changed dramatically during the past year.

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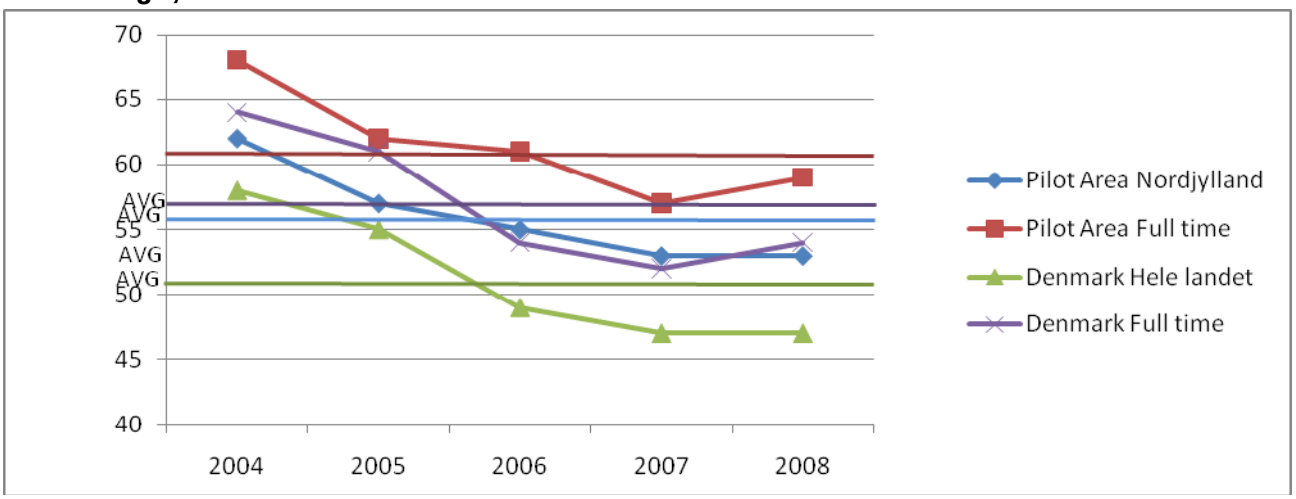
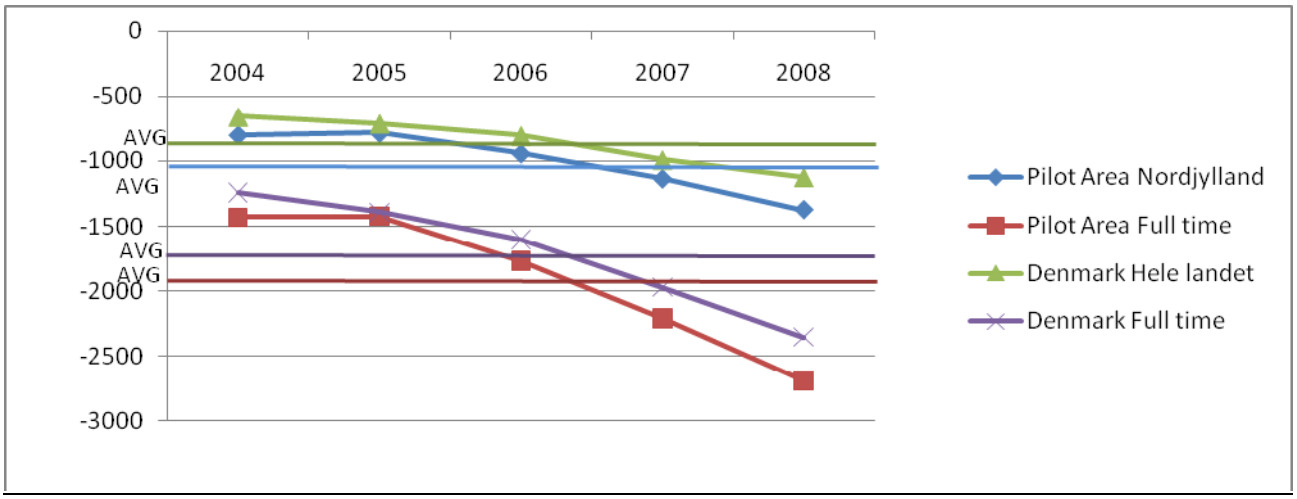
Percentage, %



Amounts, €



General guidelines for how big a part of the property which can be financed by mortgages (pct of value of property).

It is possible to finance up to 70 % of the property value through mortgages. The rest can be financed through bank loans. Besides, there's a state guarantee for young farmers for up to 90 % of the property value (YJ-loan).

There's an YJ-loan, see previous paragraph 10. No further special conditions. One has to loan at market rate, considering both short run and long run.

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The economic conditions for farming in Denmark seem quite insecure at the moment. In the period 2004 to 2008 the interest expenditure was high due to the large part of property financed by banks, mortgages, and other financial sources. In the below pie charts the farmers' income is separated into where the income comes from. It should be noted that 80 pct of this income is used for paying the financial costs at the farms.

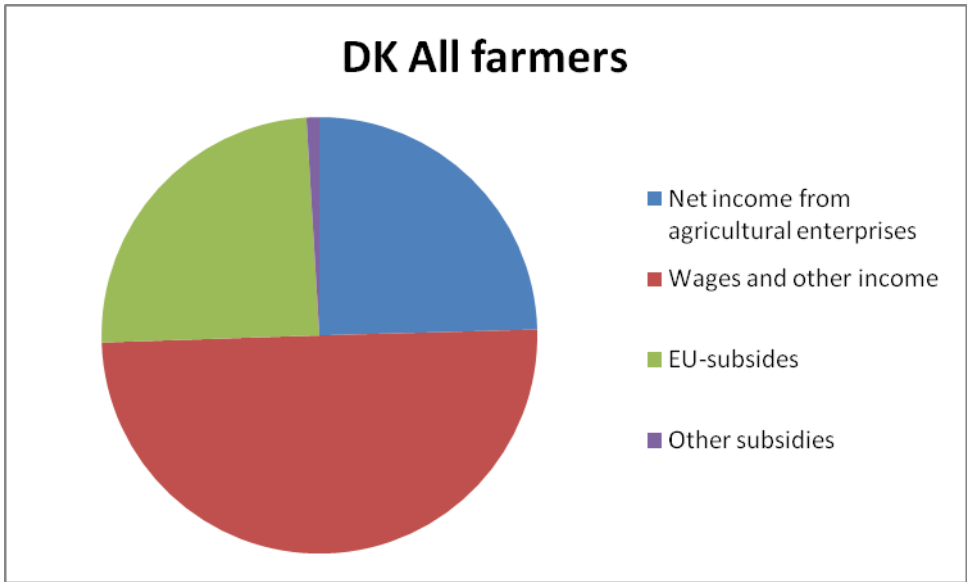
The animal production is very effective and in that way the ability to make a living off the production should exist if a solution can be found for the debt crisis.

A continued structural development must be expected due to the fact that the worst quartile of farmers is not able to make money. The structural development id at the moment stopped due to the fact that almost no farmers are able to finance buying land.

Pie charts

In the below pie charts the farmers income is separated into "net income from agricultural enterprises", "wages and other income from outside the farm", "EU subsidies" and "other subsidies".

As indicated in the below figures there is almost no difference in where the income comes from between farmers from North Jutland and the rest of Denmark.



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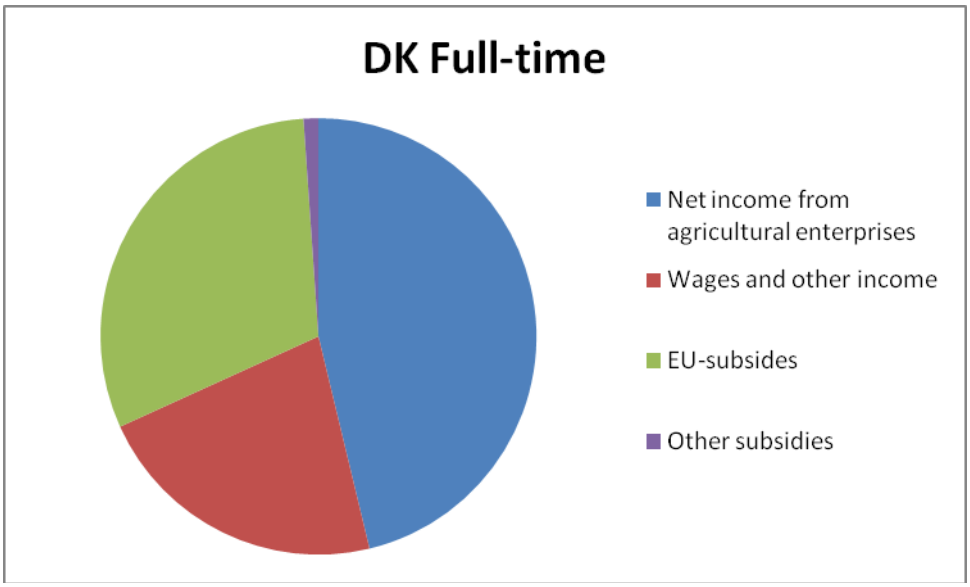

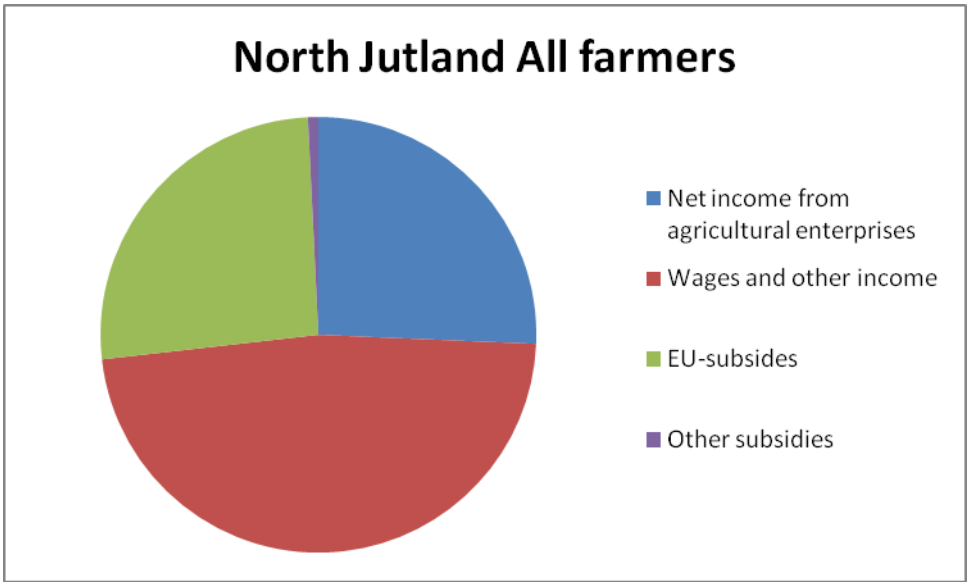

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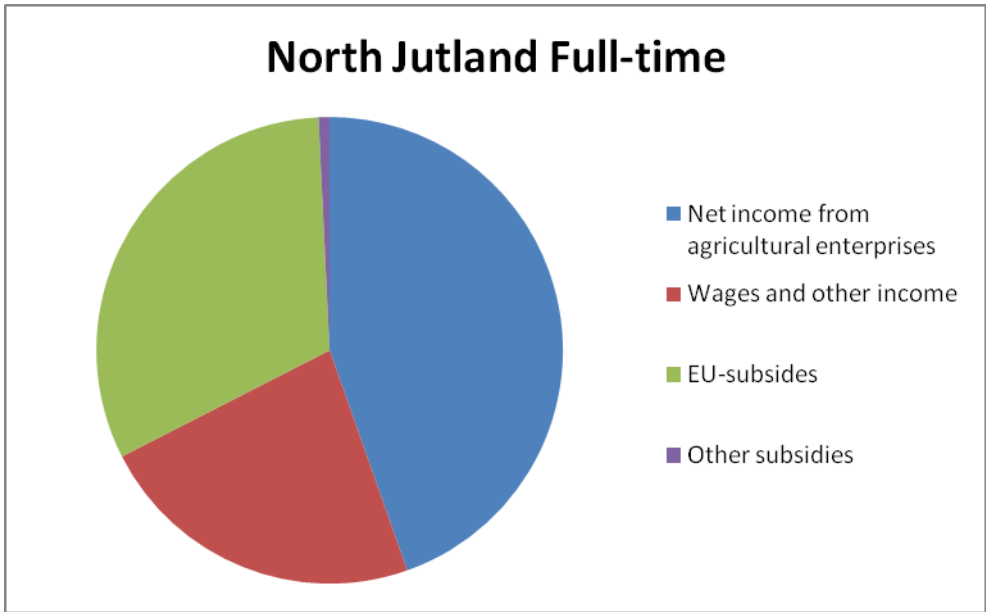

Pie charts are calculated as averages for the four years due to lack of some data from 2004

Sources:

The Danish Agricultural Advisory Service has got a database consisting of 12,000 "profit and loss accountings" including technical information from the individual farms. This covers 1/3 of all Danish Farms (more than 50 pct of the full time farmers and approximately 20 pct of the part time farmers).

Remarks:

In this presentation the sample "Pilot Area North Jutland" consists of data from the Region North Jutland.

Experts from the local advisory service and from the DAAS judge that the Pilot – the catchment of Mariager Fjord is similar to the rest of North Jutland.

* - Consists of Operating Profit, EU subsidies, Wages and other Income

** - Percentage of Part-Time Farmers compared to Total Number of Farmers

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Annex

NB. All numbers in 1,000 Euros, but Table 8:

	€-rate 744,07		Pilot Area All farmers	Part time	Pilot Area Full time farmers		Denmark All farmers	Part time	Denmark Full time farmers
1.	Gross output	2004	205	53	384		173	44	359
		2005	174	40	344		157	35	347
		2006	208	37	427		176	36	401
		2007	222	50	461		199	46	431
		2008	273	46	561		221	46	505
		AVG	217	45	435		185	41	409
					Pilot Area				Denmark
2. *	Net income, full time		Pilot Area		Nordjylland		Denmark		Hele landet
			Nordjylland	Part time	Full time		Hele landet	Part time	Full time
		2004	89	58	125		83	58	118
		2005	85	59	119		87	61	128
		2006	104	59	162		101	64	162
		2007	94	69	128		99	70	144
		2008	96	64	138		95	67	140
		AVG	94	62	134		93	64	138
			Pilot Area				Denmark		
3.**	Percentage of Part-Time Farme		Nordjylland				Hele landet		
		2004	53,9%				58,8%		
		2005	55,8%				61,1%		
		2006	56,0%				61,7%		
		2007	58,2%				60,2%		
		2008	55,9%				61,9%		
		AVG	56,0%				60,7%		
4.	Agricultural assets (1.000 €)		Pilot Area				Denmark		
			Nordjylland	Part time	Full time		Hele landet	Part time	Full time
		2004	1.172	527	1.926		1.031	508	1.775
		2005	1.214	533	2.075		1.155	560	2.087
		2006	1.625	700	2.802		1.587	792	2.871
		2007	1.914	802	3.464		1.865	871	3.365
		2008	2.373	974	4.145		2.177	1.102	3.921
		AVG	1.660	707	2.882		1.563	767	2.804
5.	Net profit		Pilot Area				Pilot Area		
			AVG	Best quartile	Worst quartile		AVG	Best quartile	Worst quartile
		2004	18.680	88.364	-46.706	2004	19	88	-47
		2005	26.906	117.602	-48.681	2005	27	118	-49
		2006	57.808	172.390	-34.328	2006	58	172	-34
		2007	-7.767	129.225	-180.989	2007	-8	129	-181
		2008	-92.746	77.852	-378.723	2008	-93	78	-379
		AVG	576	117.087	-137.885	AVG	1	117	-138

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		Crop					Cattle				
6.	Net profit		Pilot Area					Pilot Area			
			AVG	Best quartile	Worst quartile			AVG	Best quartile	Worst quartile	
		2004	30	132	-41		2004	20	70	-35	
		2005	-11	85	-67		2005	42	109	-11	
		2006	6	89	-53		2006	53	149	-15	
		2007	55	142	-34		2007	60	168	-26	
		2008	-80	49	-263		2008	-30	112	-236	
		AVG	0	99	-92		AVG	29	122	-65	

Pigs					Poultry			
	Pilot Area					Pilot Area		
	AVG	Best quartile	Worst quartile			AVG	Best quartile	Worst quartile
2004	5	95	-59		2004	19	78	-21
2005	12	102	-73		2005	39	105	-28
2006	56	192	-51		2006	3	90	-128
2007	-93	54	-306		2007	14	67	-56
2008	-212	17	-559		2008	-64	52	-259
AVG	-47	92	-210		AVG	2	79	-98

Fur-bearing animals			
	Pilot Area		
	AVG	Best quartile	Worst quartile
2004	76	167	9
2005	89	204	10
2006	108	264	34
2007	-6	49	-63
2008	9	81	-93
AVG	55	153	-21

7.	Total Subsidies		Pilot Area				Denmark		
			Nordjylland	Part time	Full time		Hele landet	Part time	Full time
		2004	25	10	38	2004 ***	24	11	41
		2005	22	10	36	2005	22	10	39
		2006	27	11	46	2006	25	11	47
		2007	26	11	48	2007	26	11	48
		2008	29	11	51	2008	27	12	52
		AVG	26	11	44	AVG	25	11	46

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8.	Environmental and		Pilot Area				Denmark		
	Organic Subsidies		Nordjylland	Part time	Full time		Hele landet	Part time	Full time
		2005	643	476	853		1.081	661	1.739
		2006	837	696	1.016		941	573	1.534
		2007	656	357	1.072		670	319	1.200
		2008	807	488	1.211		970	442	1.825
		AVG	736	504	1.038		915	499	1.574
9.			Pilot Area				Denmark		
			Nordjylland	Part time	Full time		Hele landet	Part time	Full time
		2004	**62**	44	**68**		**58**	43	**64**
		2005	**57**	43	**62**		**55**	42	**61**
		2006	**55**	39	**61**		**49**	37	**54**
		2007	**53**	40	**57**		**47**	34	**52**
		2008	**53**	33	**59**		**47**	31	**54**
		AVG	**56**	40	**61**		**51**	37	**57**
			Pilot Area				Denmark		
			Nordjylland	Part time	Full time		Hele landet	Part time	Full time
		2004	-800	-260	-1.433		-658	-250	-1.241
		2005	-786	-281	-1.424		-712	-279	-1.392
		2006	-943	-292	-1.772		-805	-310	-1.604
		2007	-1.138	-369	-2.209		-990	-339	-1.973
		2008	-1.375	-337	-2.689		-1.124	-365	-2.354
		AVG	-1.008	-308	-1.905		-858	-309	-1.713

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4. Aquarius Sociological Baseline – Survey: Denmark

Quantitative Danish data:

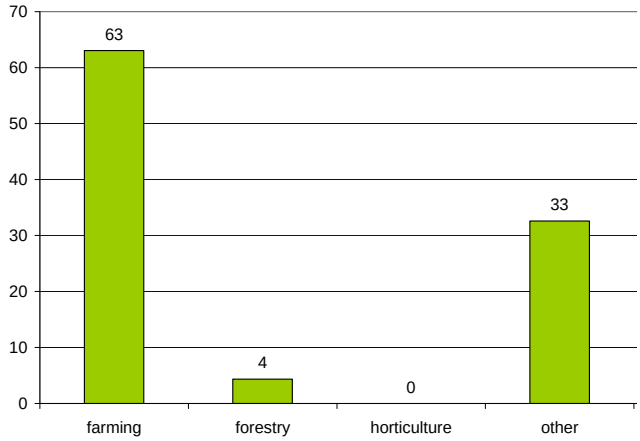
Cf. also the xls. Data file with Danish data and a corresponding file with Norwegian data. You'll find both data, codes and diagrams in the sheets. Data-sheets are locked in order to protect contamination of survey data. Diagrams however are free to use.

Total population within Lundgaard Brook [Danish pilot]: 126 respondents owning >5 ha.
Response Rate: 50 persons = 40 %

The questionnaire was mailed out in mid August and returned by mail as well. In August farmers are at their busiest harvesting. The bad timing may have had a negative influence on the response rate. As we did not keep track of who returned the questionnaires, unfortunately we have not been able to mail out reminders. Total anonymity was assessed to be important at this stage of the Danish process.

4.1 Background information

Q 1 Which of the following is your primary industry



N = 46

Other: 1 white collar worker, 1 abuse advising, 2 not reported, 1 driver, 1 wine sale, 1 banking, 1 all land let on lease, 1 agriculture and forestry (none of them primary), 1 work with power supply, 1 temporary employee, 1 caretaker, 1 fitter, 1 teacher, 1 full time employed outside agriculture/forestry.

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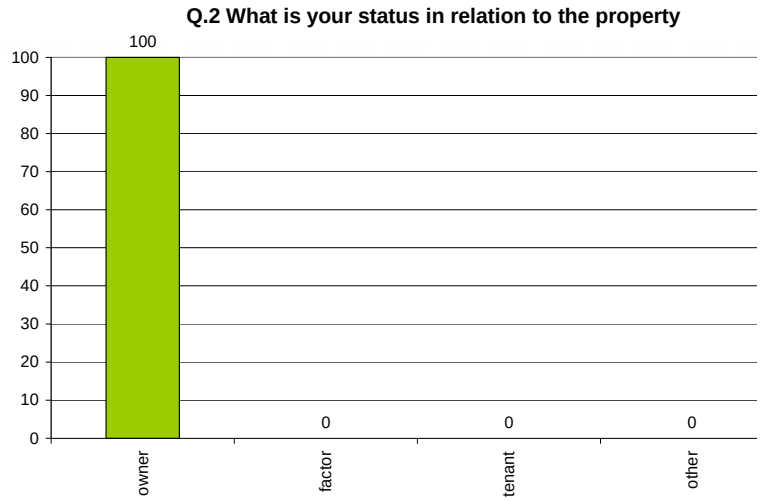
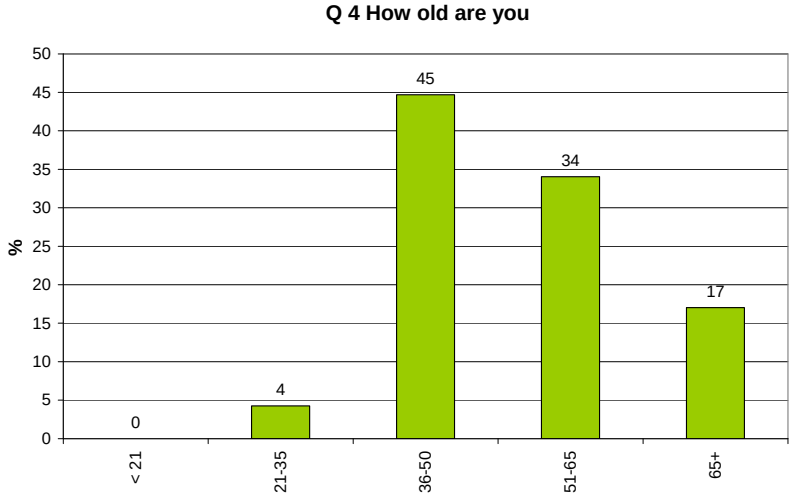


N= 47

Management of hectares

Average Ha owned by respondents = 41,1 ha
Average Ha rented by respondents on a short term basis < 5 years = 6,6 ha
None of the respondents rent land on a long term basis > 5 years

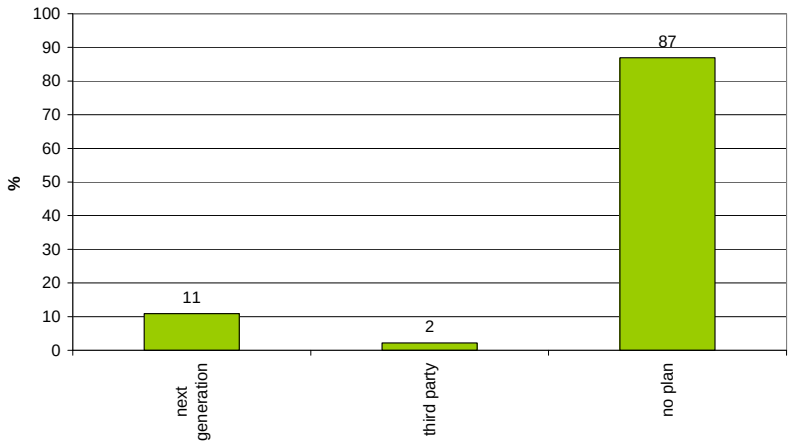
Not all managed Hectares are localized within the pilot area. [1]



N = 47

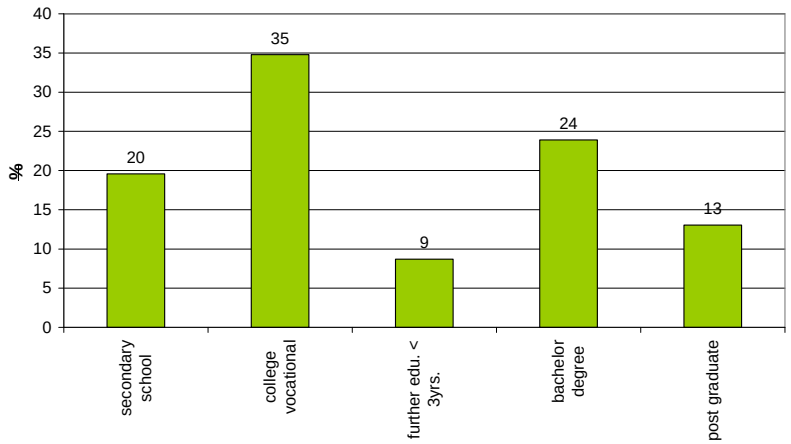
[1] It has to be mentioned that there is an error in the Danish translation of question 3. In Danish it is asked: How many Ha. do you ***have*** and not how many ha. do you ***manage***. Therefore the same hectares may be owned by one and rented on a short term basis by another.

Q 5 In the long term, who do you plan will take over



N= 46

Q 6 What is the highest level of education that you completed?



N= 46

4.2 Decision making on land management

Which of the following environmental measures have you applied to the property

	No	**Yes**	
Environmentally friendly management of run off and drainage water	**35** 80%	**9** 20%	N= 44
Establishment of buffer strips, fiel margins, fences or edges	29 66%	**15** 34%	N= 44
Change in the management of arable land or woodlands	**35** 80%	**9** 20%	N= 44
Extensification of cultivated land	**36** 82%	**8** 18%	N= 44
Working out green accounts or environmentally targeted management plans	**44** 100%	**0** 0%	N= 44
Other	**38** 86%	**6** 14%	N= 44
None	**26** 59%	**18** 41%	N=44

Other = 2 ecologists, 1 change of procedures when spraying, 1 reduced spraying and shielding, 1 4,88 ha. measurement by brook, 1 grazing of fringes, commons, wetlands

To what extent have the following Parites influenced decision-making on uptake of environmental measures on the property?

	None	Minor	Medium	Major	
Family relative	**14** 47 %	**4** 13 %	**8** 27 %	**4** 13 %	N=30 Legally not answered =17
Production/farm business advisor	**19** 63 %	**2** 7 %	**7** 23 %	**2** 7 %	N=30 Legally not answered =17
Environmental advisor	**25** 93 %	**0** 0 %	**1** 4 %	**1** 4 %	N=27 Legally not answered =17
Colleagues in your profession	**19** 68 %	**4** 14 %	**3** 11 %	**2** 7 %	N=28 Legally not answered =17

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Estate management	**22** 79 %	**4** 14 %	**0** 0 %	**2** 7 %	N=28 Legally not answered =17
Members of the local community	**21** 78 %	**3** 11 %	**3** 11 %	**0** 0 %	N=27 Legally not answered =17
Farmers' Unions	**20** 71 %	**4** 14 %	**1** 4 %	**3** 11 %	N=28 Legally not answered =17
NGO's other than farmers' unions	**20** 71 %	**4** 14 %	**1** 4 %	**3** 11 %	N=28 Legally not answered =17
Local authority representatives	**21** 75 %	**4** 14 %	**1** 4 %	**2** 7 %	N=27 Legally not answered =17
Knowledge-based institutions	**20** 74 %	**2** 7 %	**4** 15 %	**1** 4 %	N=27 Legally not answered =17

On average, approximately haw many hours of external advice do you receive per annum?

On average Danish respondents receive 6,7 hours of private production advising (N= 36).

On average Danish respondents receive 1 hour of private environmental advising (N= 31).

In Denmark no public advising exists.

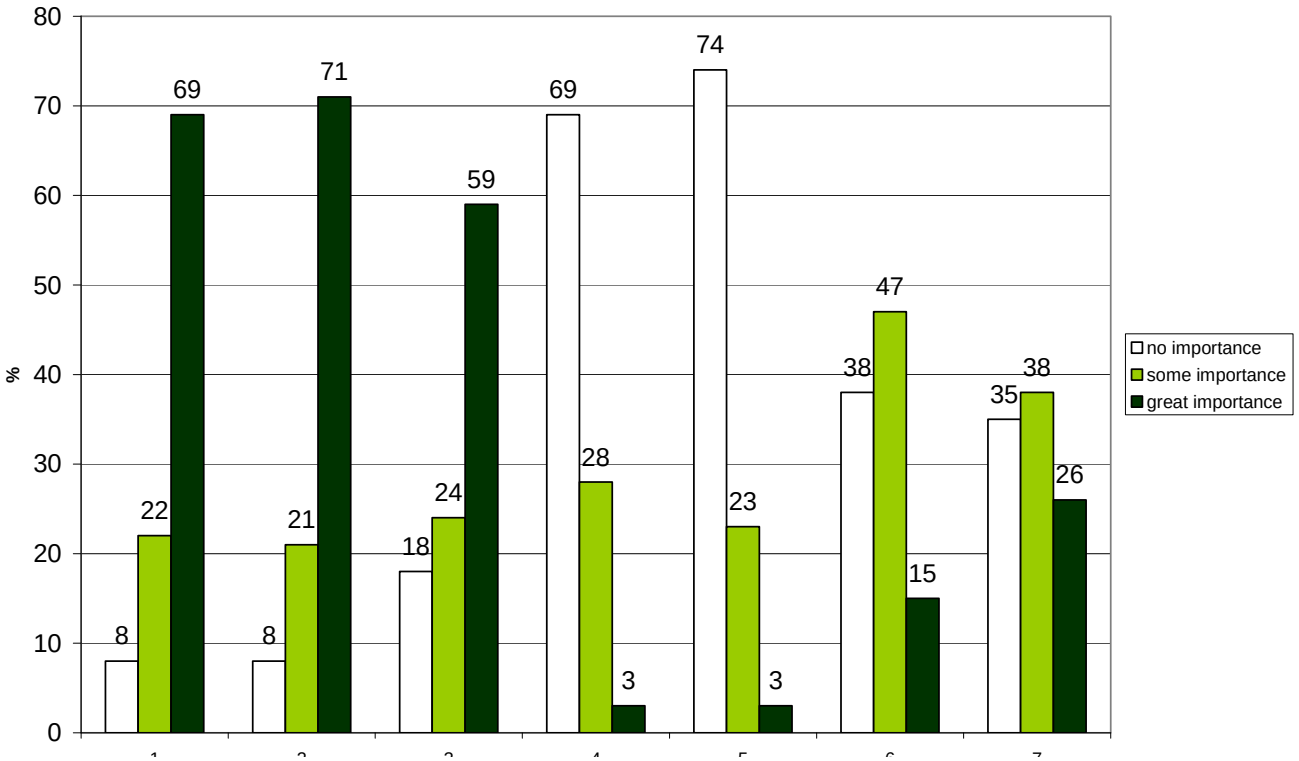
On average, approximately how much do you spend on advising per annum?

On average Danish respondents spend **€ 694,00** on advising per annuum (N= 40).

Lowest amount spent is **€ 0,00**
Higest amount spent is **€ 4.032, 00**

How important are the following when you make choices about haw to manage your land?

Summary Diagram

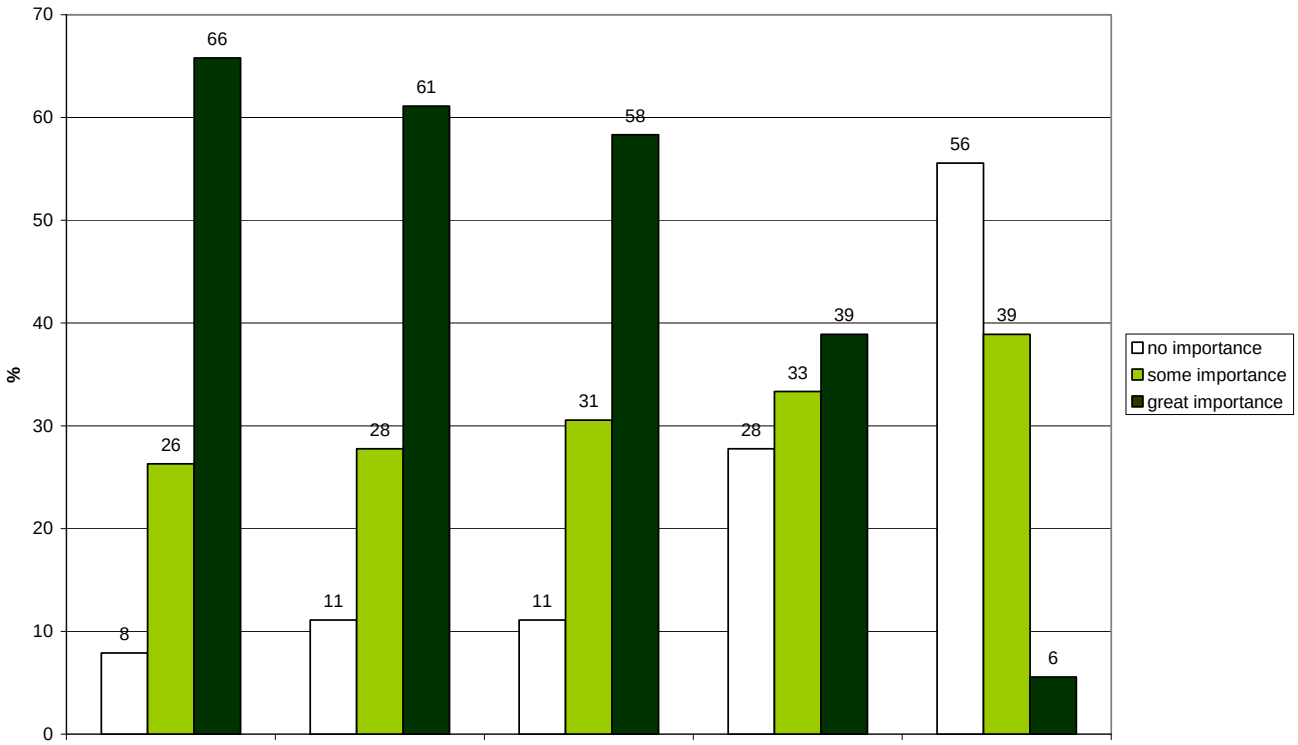


Own observations in field N=36	Timing of management plan N=38	Discussions with advisor N=34	Available machine capacity N=32	Available work force N=31	Experience of colleagues N=34	Published vocational info N=34

Other: 2 "all land has been leased out", 1 "do not apply nutrients", 1 "most of the land is leased out", 1 "only christmas trees are fertilized when needed"

Wath importance do you attach to the following when applying nutrients on the property?

Summary Diagram



Green and healthy crops N=38	Yield opti-mization N=36	contribution margins/cost efficiency N=36	nature - wildlife on property N=36	nature wild-life wider scale N=18

Other: 1 = all land has been leased out, 1= it is all regulated by norms from the Danish Plant Directorate [state] 1= do not apply nutrients.

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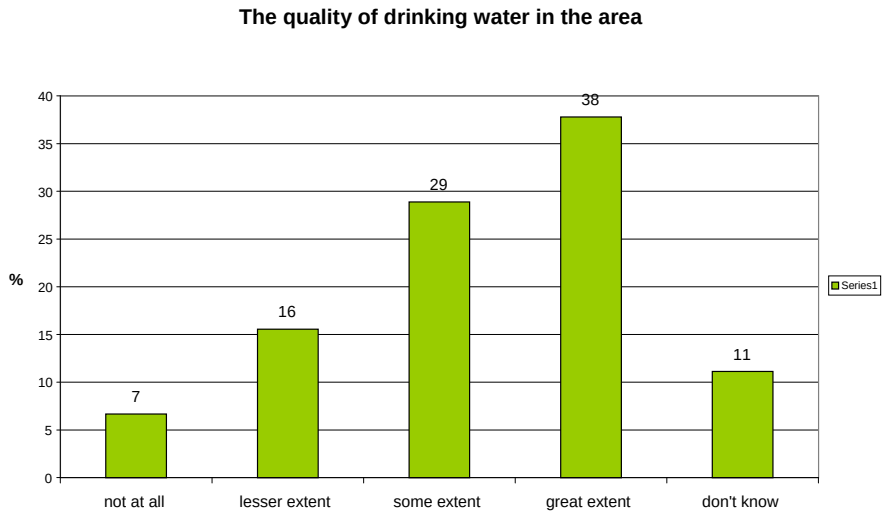
What adjustments related to climate change have you made on the property?

	No	Yes	N
Changed run off, irrgation, drainage water or drinking water	**35** 83 %	**7** 17 %	N=42
Altered rotation cycle	**33** 79 %	**9** 21 %	N=42
Changed livestock type or number	**35** 85 %	**6** 15 %	N=41
Constructed bunds or barriers along watercourses or buildings	**38** 90 %	**4** 10 %	N=42
Changed soil management	**36** 86 %	**6** 14 %	N=42
Other	**39** 93 %	**3** 7 %	N=42
None	**18** 43 %	**24** 57 %	N=42

Other: 1= plowing only 10 cm, 1= Carbondioxide neutral boiler, solar collector, 1= catch crops.

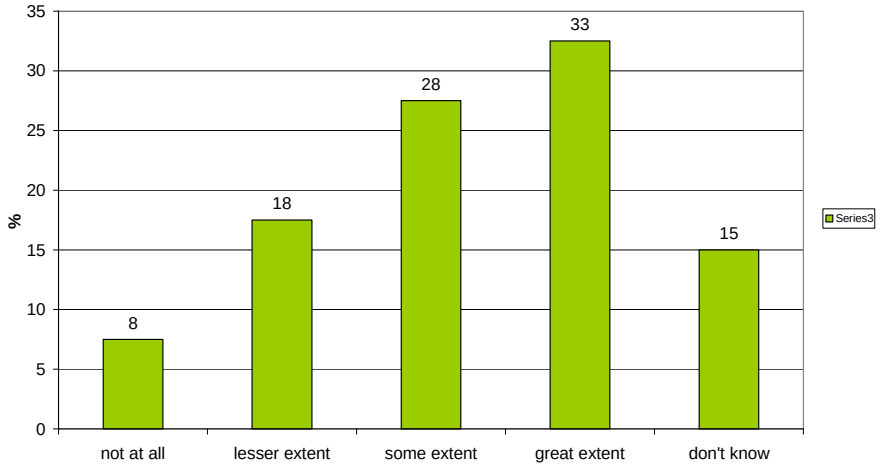
4.3 Assesments of land management's relation to changes in environment and climate

To what extent do you assess land management in your area is connected with



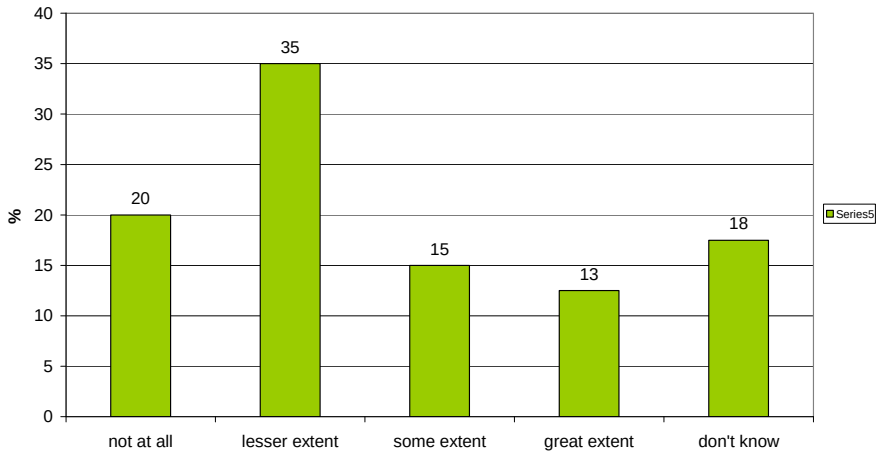
N=45

Variety of plants and animals in water courses



N=40

Flooding/drought problems



N=40

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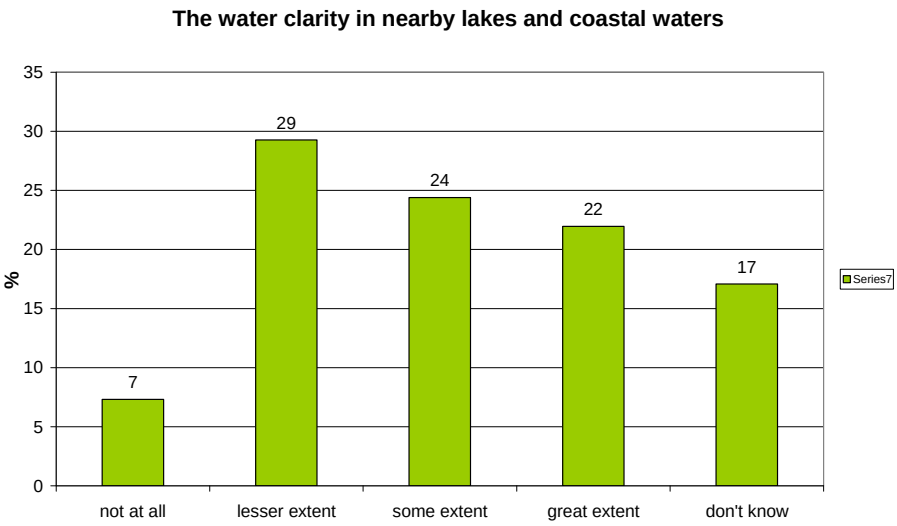
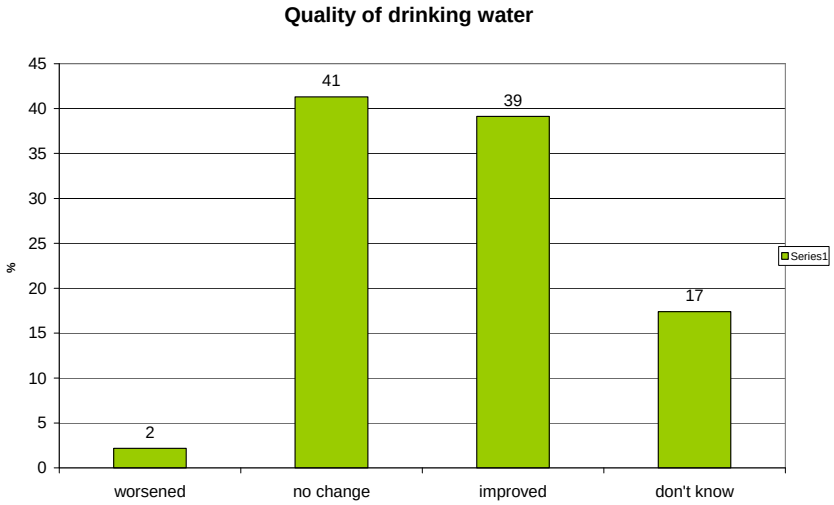


N= 41

During the past 10 years how much have the following changed in your area



N= 46

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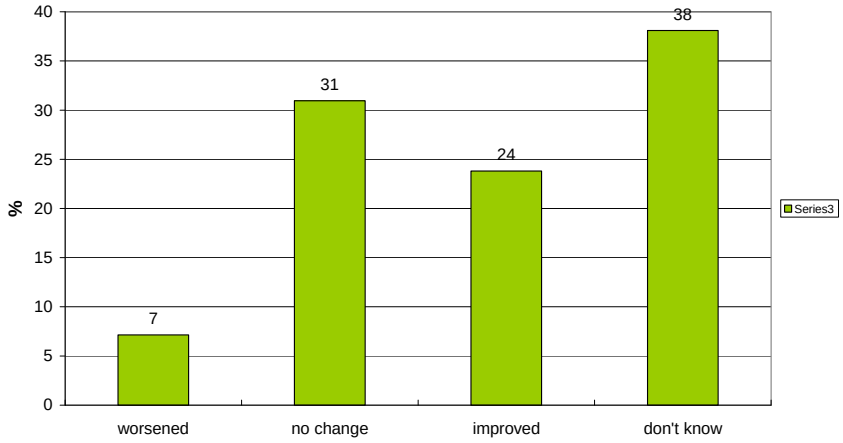
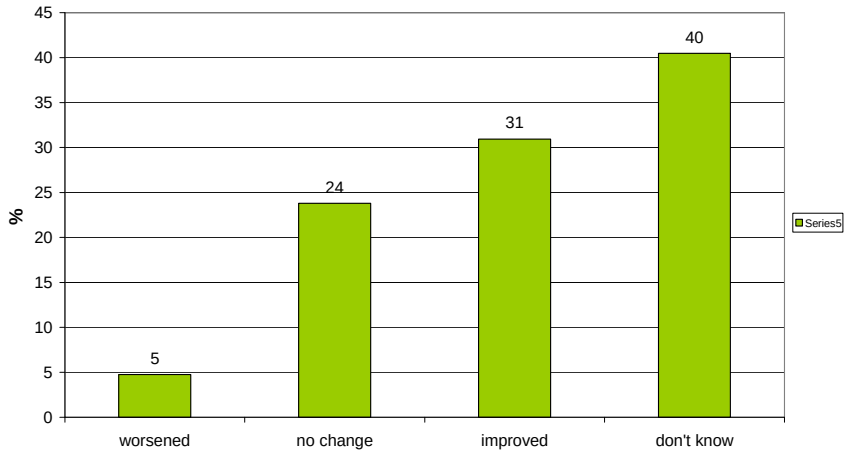
Variety of plants and animals in water courses



N= 42

The water clarity in nearby lakes and coastal waters



N= 42

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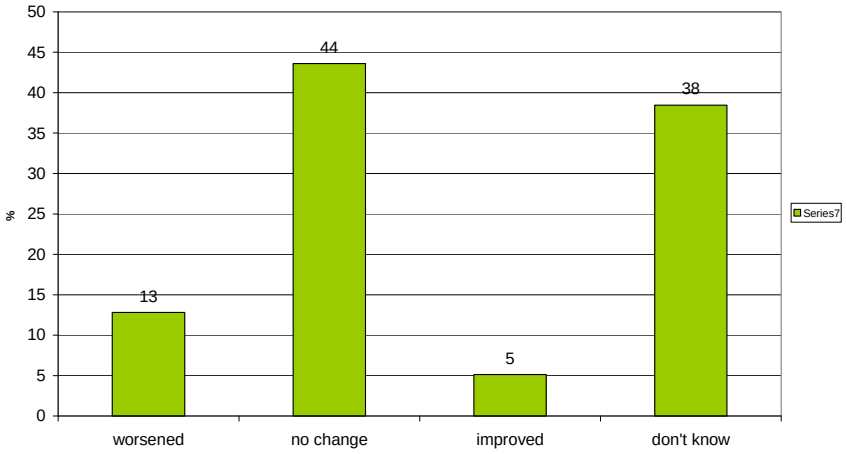
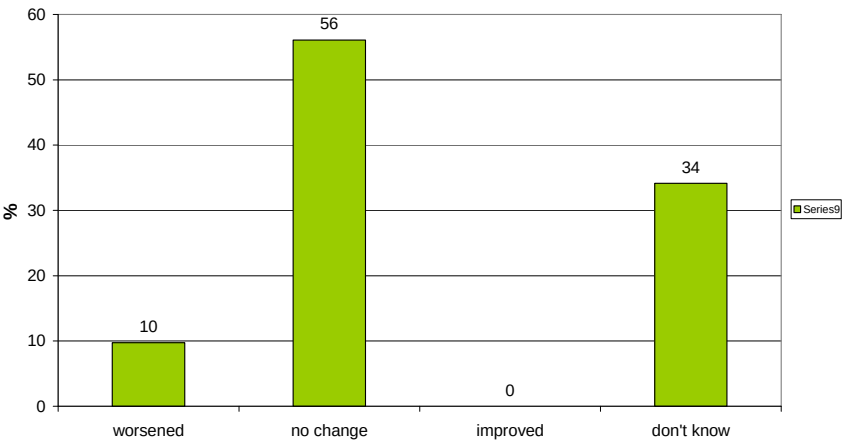
Precipitation and water quantity



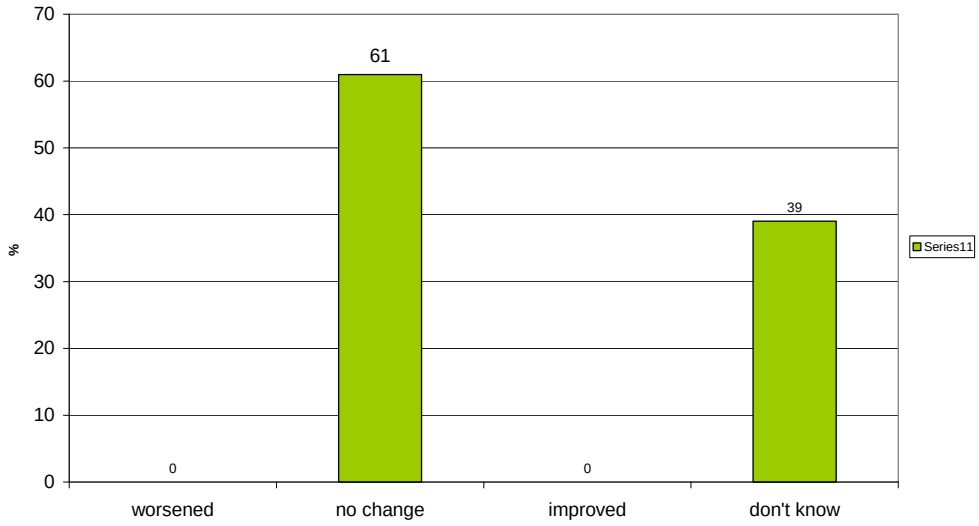
N = 39

Frequency of flood events and erosion



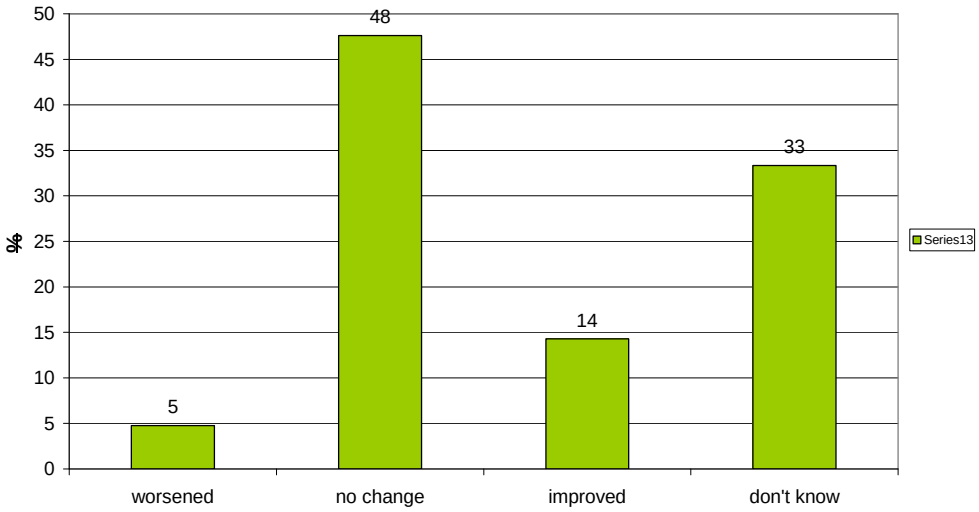
N= 41

Frequency of droughts/drinking water shortage



N= 42

Growing season



N= 42

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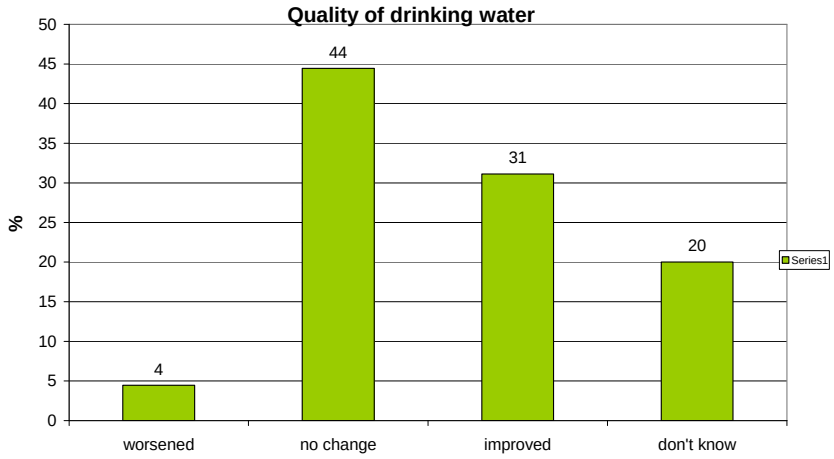
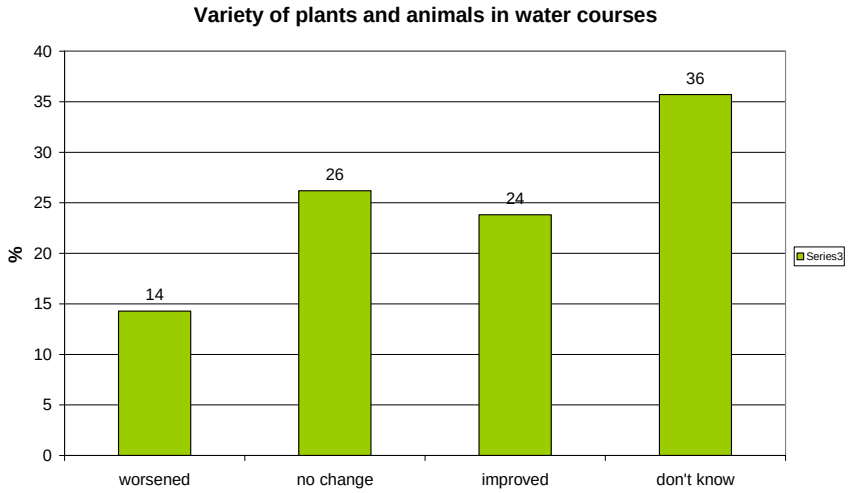
Over the next 10 years, how much do you predict the following will change in your area



N= 45



N=42

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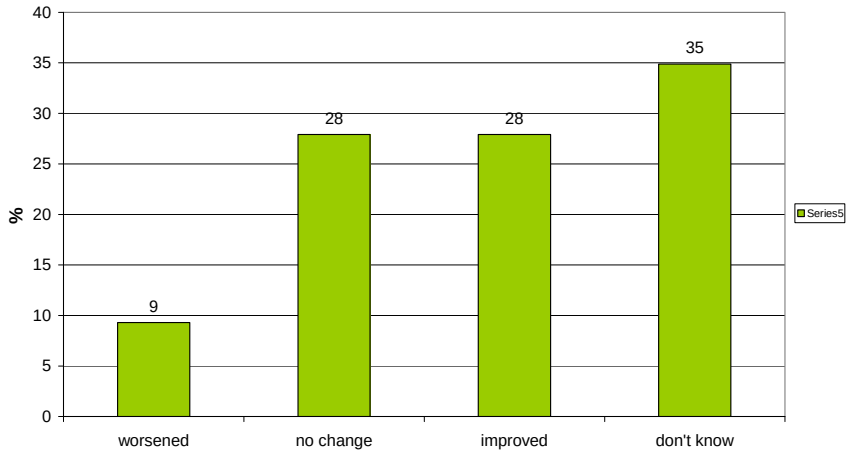
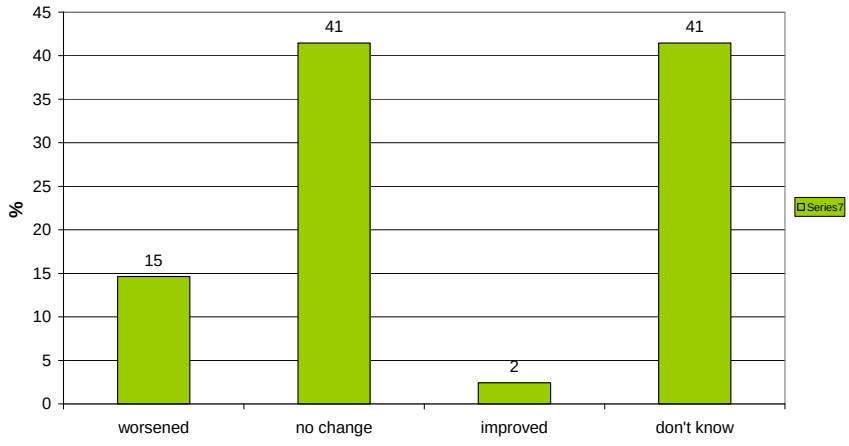
The water clarity in nearby lakes and coastal waters



N=43

Precipitationand water quantity



N= 41

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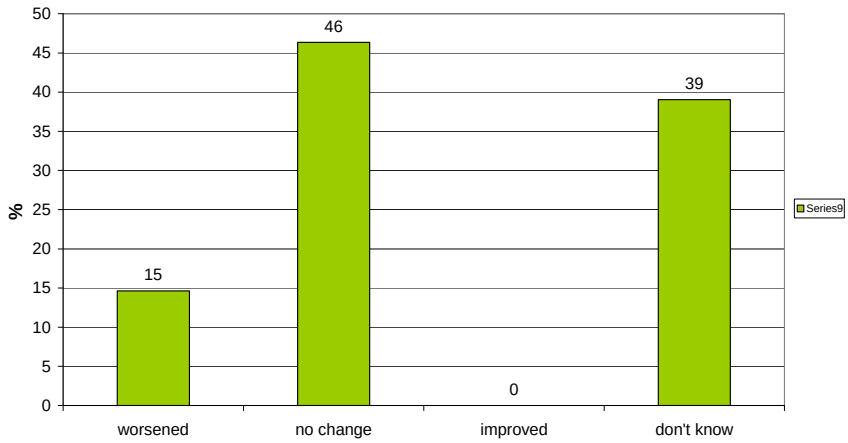
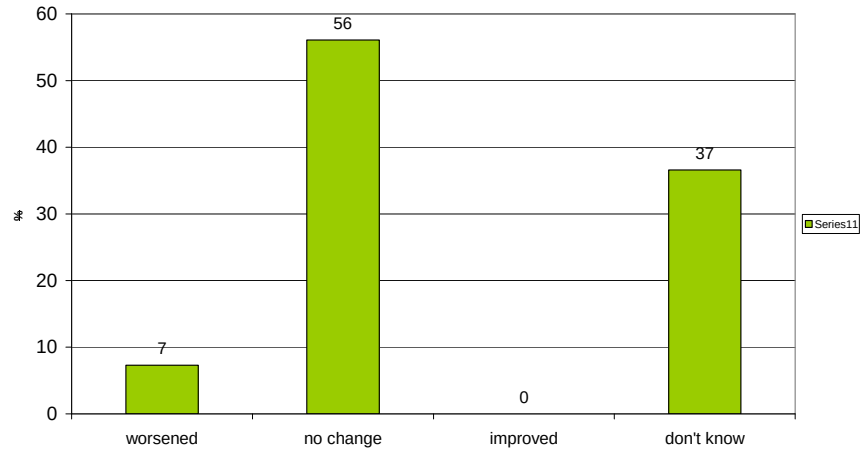
Frequency of flood events and erosion

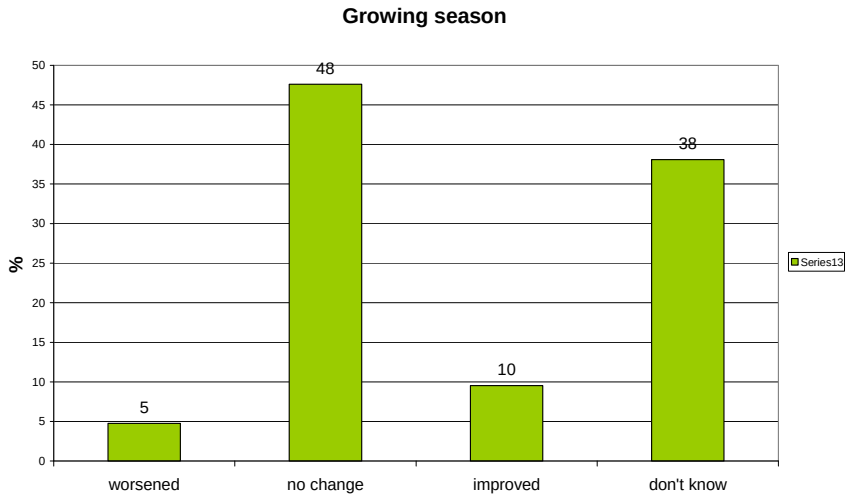


N=41

Frequency of droughts/drinking water shortage



N=41



N=42

Within the next couple of years do you plan to apply any of the following environmental measures?

	No	Yes	N
plan to create buffer strips etc. as measure	37 88 %	5 12 %	N= 42
plan to change arable land or woodland as measure	31 74 %	11 26 %	N=42
plan to extensify as measure	32 78 %	9 22 %	N=41
plan to apply run off and drainage water measure	32 80 %	8 20 %	N=40
plan other measures	44 100 %	0 0 %	N=44

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5. Legislation

Name of Act	Objective	Lead Agency	Scale	Implementation
Act on environmental measures etc. of water bodies and international nature conservation areas LBK nr. 932 af 24/09/2009	Aims to establish a framework for protection of surface and groundwater, and the international nature protection areas	Danish Ministry of the Environment	Danish act for the WFD and Habitats Directive Birds Directive Directive on the quality required of shellfish waters	Ministry of Environment are making water and nature plans that includes an Effort Program and the 98 counties are making actionplans
Nature Protection Act LBK nr. 933 af 24/09/2009	The Act should help to safeguard the country's nature and environment, so community development can happen on a sustainable basis in respect for human living conditions and the preservation of animal and plant life.	Danish Ministry of the Environment	National Habitats Directive Birds Directive Directive on environmental liability	
Environmental Protection Act LBK nr 1757 af 22/12/2006 (with amendtments)	The Act should help to protect nature and environment, so community development can happen on a sustainable basis in respect for human living conditions and the preservation of animal and plant life.	Danish Ministry of the Environment	National Birds Directive EIA-Directive SEA-directive Waste Directive Habitats Directive WFD Etc.	
Watercourse Act LBK nr 927 af 24/09/2009	The law seeks to ensure that water can be used for the drainage of water, particularly surface water, waste water and drainage water.	Danish Ministry of the Environment	National Birds Directive Habitats Directive Directive on environmental liability	
Ochre Act LBK nr 934 af 24/09/2009	The law aims to prevent and combat negative consequences of ochre in streams, lakes or the sea.	Danish Ministry of the Environment	National Birds Directive Habitats Directive	
Water Taxation Act LBK nr 639 af 21/08/1998	Following the decisions of this Act a fee shall be paid to the Treasury from pipelined water consumed in this country.	Danish Ministry of Taxation	National	

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Water Supply Act LBK nr 935 af 24/09/2009	The Act aims to ensure 1) that the exploitation and the associated protection of water bodies occurs after a comprehensive planning and following a comprehensive assessment of the grounds mentioned in § 2, 2) a coordination of the existing water supply for a prudent use of water deposits, 3) a scheduled deployment and operation of an adequate and satisfactory quality of water and 4) the quality of drinking water to protect human health.	Danish Ministry of the Environment	National Birds Directive Habitats Directive Directive concerning the protection of waters against pollution caused by nitrates from agricultural sources Directive on the quality of water intended for human consumption WFD Directive on environmental liability	
Sewage Taxation Act LBK nr 636 af 21/08/1998	Following the decisions of this Act a fee shall be paid to the Treasury for waste water discharged in this country to lakes, rivers or the sea. In addition a payment of tax on waste water seeping or inferred on the fields and the like in order to seepage shall be done.	Danish Ministry of Taxation	National	
Quota Act (CO2) LBK nr 348 af 09/05/2008	The Act aims to promote a reduction of greenhouse gas CO2 and other greenhouse gases in a cost effective manner through a system of tradable allowances and credits.	Danish Ministry of Climate and Energy	National Directive on Qouta (CO2)	
Act of Forests LBK nr 945 af 24/09/2009	The Act aims to preserve and safeguard the country's forests and therefor increase the forest area.	Danish Ministry of the Environment	National Habitats Directive Birds Directive Directive on environmental liability	
Coast Protection Act LBK nr 267 af 11/03/2009	The purpose of coastal protection is to protect people from flooding and property from flooding and degradation of the sea, fjords, or other parts of the territorial sea.	Danish Ministry of Transport	National	

Act on National Parks LOV nr 533 af 06/06/2007	The Act is aimed at establishing national parks to 1) create and make more coherent natural areas and landscapes of national and international importance, 2) preserve and enhance the natural quality and diversity 3) Ensure continuity and opportunities for free dynamic in nature, 4) preserve and enhance the scenic and geological values 5) preserve and make visible the cultural values and diversity of cultural landscape 6) support research and teaching in areas values 7) improve the public an opportunity to use and enjoy nature and landscapes 8) strengthening the dissemination of knowledge about where value and development, 9) support the development of benefit to the community, including industry, while respecting and protecting the interests 10) strengthen the awareness of the area values by involving the population in national parks establishment and development.	Danish Ministry of the Environment	National	
Marine Environmental Act LBK nr 929 af 24/09/2009	The Act should help to protect nature and environment, so community development can happen on a sustainable basis in respect for human living conditions and the preservation of animal and plant life.	Danish Ministry of the Environment	National Various Directives on Harbours and ships Habitats Directive Birds Directive Directive on environmental liability	

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Mining Act LBK nr 950 af 24/09/2009	The Act aims to ensure: 1) that the exploitation of mineral deposits on land and sea happens as part of a sustainable development, following a comprehensive balancing of interests, and after an overall assessment of the societal considerations mentioned in § 3, 2) the reclamation and aftercare are arranged so that the treated area may be part of the second land use, 3) a raw material supply in the longer term, 4) that the raw materials are used in relation to their quality, and 5) the nature captive raw materials wherever possible be replaced by waste products.	Danish Ministry of the Environment	National Habitats Directive Birds Directive Directive on environmental liability Directive on the management of waste from extractive industries	
Fisheries Act LBK nr 978 af 26/09/2008	Legislative objectives are through a management system which ensures the protection and promotion of the living resources of salt and fresh water and protection of other flora and fauna, ensuring a sustainable basis for commercial fishing and related occupations, and the possibility of recreational fisheries.	The Danish Ministry of Food, Agriculture and Fisheries The Department	National Habitats Directive Birds Directive Directive on environmental liability	
Act on the use of agricultural land LBK nr 191 af 12/03/2009	to promote sustainable development of agricultural land by conservation of the productive base and conservation of natural, environmental and landscape values	Ministry of Food	National	Compulsory regulation and possibility of fine

Act on agriculture use of fertilizers and plant cover LBK nr 757 af 29/06/2006	to regulate agriculture use of fertilizers and establish requirements for the establishment of plant cover in order to reduce nitrogen leaching	Ministry of Food	National Nitrate Directive WFD Habitats Directive	Compulsory regulation and possibility of fine
Act on environmental permit of livestock L nr 1572 af 20/12/2006	to safeguard the natural environment and landscape, development of livestock production done on a sustainable basis in respect for people's living conditions and nature	Ministry of Environment	EIA-Directive Habitats Directive WFD Birds Directive Directive on the protection of waters against pollution caused by nitrates from agricultural sources for the period 2000-2003 IPPC-Directive Directive on providing for public participation in respect of the drawing up of certain plans and programmes relating to the environment and amending with regard to public participation and access to justice Council Directives 85/337/EEC and 96/61/EC	Compulsory regulation. Administration of the act is done by the 98 counties according to general rules
Act on the taxation of nitrogen contained in fertilizers LOV nr 418 af 26/06/1998	To reduce the loss of nitrogen from farming	Ministry of tax	National Danish act for the Danish water actions plans???	Compulsory regulation and possibility of fine
Act on tax on mineral phosphorous in feed phosphates LOV nr 469 af 09/06/2004	To reduce the surplus of phosphorus in agriculture	Ministry of tax	National Danish act for the Danish water actions plans???	Compulsory regulation and possibility of fine
Act on tax on pesticides LBK nr 57 af 30/01/2008	to reduce consumption of pesticides in agriculture	Ministry of tax	National	Compulsory regulation and possibility of fine

Act on Environmental Liability LOV nr 466 af 17/06/2008	Directive on environmental liability			Directive on the management of waste from extractive industries
Act on Management of Hunting and Game LBK nr. 930 af 24/09/2009	Directive on environmental liability			Birds Directive Habitats Directive
Act on Environmental Assenssment of Plans and Programms LBK nr. 936 af 24/09/2009	Directive on the assessment of the effects of certain plans and programmes on the environment			

Name	Aim	Funder	Eligibility	Details
Act on the administration of the EU regulations on agricultural products etc. LBK nr 297 af 28/04/2004	To implement the CAP reform in danish regislation	EU and Danish Government	All farmers	
Act on support for agricultural and structural development of organic production in agriculture and fisheries LBK nr 192 af 26/03/1999	To support improvement plans for farms; environmentally friendly farming; organic production and organic products; development of specific rural areas and disadvantaged areas; cooperation between land users	EU and Danish Government	The support is voluntary except for organic production and organic products	
Act on State guarantee loans to young farmers LBK nr 856 af 25/08/2008	to contribute to sustainable rural development	Danish Government	The support is voluntary	
Act on support for environmental improvement investments for small farms, etc. (LBK nr 1172 af 16/12/1992)	To support for investment in plant for the storage of manure needed to meet the requirements of legislation	Danish Government	The support is voluntary	
Law on shelterbelts and subsidy to shelterbelts LBK nr 17 af 18/01/1996	to reduce wind speed over agriculture land (wind erosion)	Danish Government	The support is voluntary	

Name of Act	Objective	Lead Agency	Scale	Implementation
Planning Act LBK nr 937 af 24/09/2009	The Act ensures that the summary planning combines the societal interests in land use and helps to safeguard the country's natural and environmental, so community development can happen on a sustainable basis in respect for human living conditions and the preservation of animal and plant life.	Danish Ministry of the Environment	National Birds Directive Habitats Directive Directive on providing for public participation in respect of the drawing up of certain plans and programmes relating to the environment and amending with regard to public participation and access to justice Council Directives 85/337/EEC and 96/61/EC	

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6. Scenarios for future climate

6.1 Climate changes from past to today

Temperature		
Year	rising	1.5 °C
Summer	rising	
Winter	rising	

Precipitation		
Year	rising	8-11%
Summer	dropping	10-25%
Winter	rising	25-50%

Evaporation		
Year	rising	2-3 %
Summer	Dropping slightly	
Winter	rising	
Stream runoff year	rising	15%

6.2 Climate in different pilots today (2009)

drought in summer - *not important*
drought in winter - *not important*
flooding in summer – *not important*
flooding in winter – *not important*

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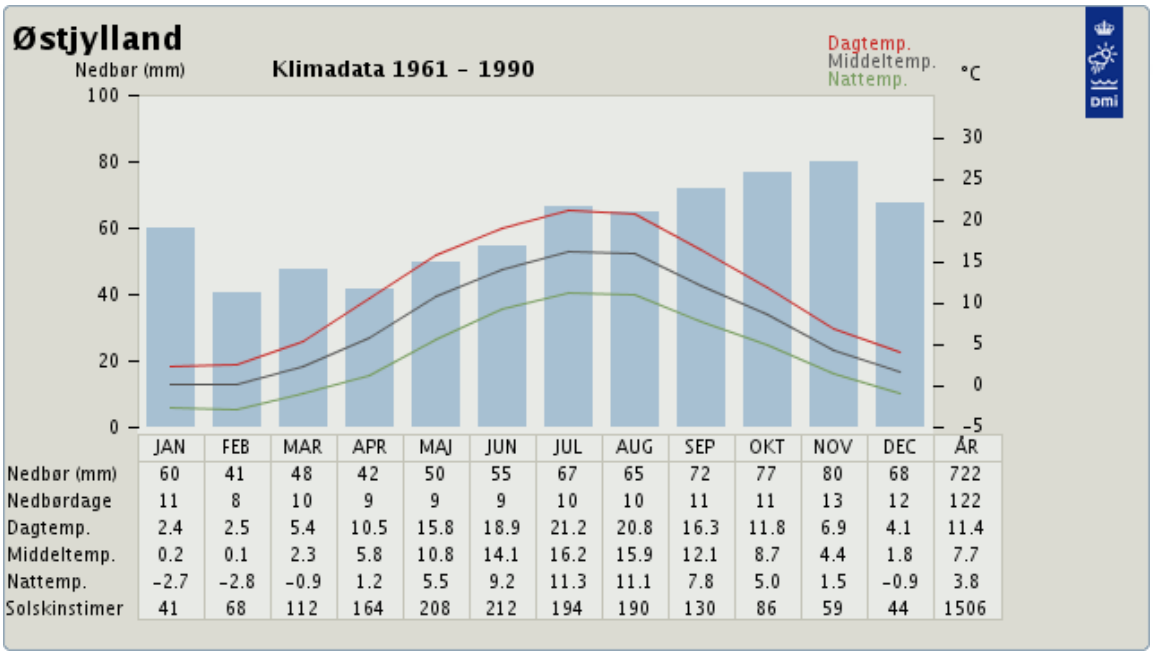

	JAN	FEB	MAR	APR	MAJ	JUN	JUL	AUG	SEP	OKT	NOV	DEC	ÅR
Nedbør (mm)	60	41	48	42	50	55	67	65	72	77	80	68	722
Nedbørdage	11	8	10	9	9	9	10	10	11	11	13	12	122
Dagtemp.	2.4	2.5	5.4	10.5	15.8	18.9	21.2	20.8	16.3	11.8	6.9	4.1	11.4
Middeltemp.	0.2	0.1	2.3	5.8	10.8	14.1	16.2	15.9	12.1	8.7	4.4	1.8	7.7
Nattemp.	-2.7	-2.8	-0.9	1.2	5.5	9.2	11.3	11.1	7.8	5.0	1.5	-0.9	3.8
Solskinstimer	41	68	112	164	208	212	194	190	130	86	59	44	1506

Nedbør = precipitation
Nedbørsdage = number of days with precipitation
Dagtemp. = daytime temp
Middeltemp = day average temp
Nattemp = nighttime temp

Summer months: jun, jul, aug
Winter months: dec, jan ,febr

6.3 Scenarios for climate changes

2070-2100

Precipitation		
Year	rising	10-20%
Summer	dropping	10-20%
Winter	rising	20-40%

year temperature	*rising*	3-4 °C
high temperature in summer	*more often*	
Days with frost	*less often*	
Days with snow	*less often*	
drought in summer	*more often (aug – sep)*	
drought in winter	*not important*	
flooding in summer	*less often*	
flooding in winter	*more often*	

6.4 Describe the area (surface) for which the climate scenario is calculated (regional scale, national scale or transnational scale)

National scale related to IPCC scenario A2 year 2071-2100.

6.5 Climate change – what impact for farmers?

Climate changes gives agriculture benefits.

Growing season 4 weeks longer– starts earlier – ends later - gives a greater potential for crop production.

Opportunities for new crops – maize.

Increased risk of drought in late summer and increased demand for field irrigation.

Increased demands for use of pesticides.

6.6 Climate change – what impact for water management?

Climate change is a disadvantage for the environment.

The agricultural losses of nutrients are very highly dependant on climate, and therefore climate changes will have a strong influence on losses. In general, we expect higher losses of nutrients if there are no changes in current agricultural practices. Farmers as water managers are essential for reaching good ecological status for Mariager Fjord.

We expect higher losses of pesticides from agriculture.

The environment becomes more stressed and sensitive to impacts due to Climate changes. Combined with the increased impact from agriculture the impact of climate changes on water management is serious.

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Conclusion

Ecological status
Mariager Fjord will not achieve good ecological status due mainly to high input of nutrients to the fjord. Agriculture contributes with the largest input of nitrogen. A reduction in the fjord can be expected in connection with implementation of WFD.

Due to a well established monitoring programme in Denmark we have good information about water bodies and sources of nutrients to the recipients. In other words when it comes to water quality matters (nutrients) we have information of where the problems are and where they come from. There is though a lack of knowledge on transport processes from the root zone to the surface waters, e.g. the fjord. This is a challenge when it comes to introducing the most cost effective and targeted actions.

When it comes to water quantities (drought and flooding) this has not been an issue in the Danish baseline description because it has not been a problem in the specific catchment area until now. In the future it might be a problem and it will be considered.

Economy
In Denmark the structural development has been heavy. The income for farm families (full time) from farming is only approximate 25 pct. (pie chart), and 80 pct. of income is used for paying interest rates.

The best quartile of the full time farmers are able to make an average net profit in the period 2004 – 2008 on approximately €120,000 whilst the worst quartile had a negative net profit in the period of almost €140,000 in average. In average the full time farmers in the area had a net profit in the period of € 0 with some very high variations from year to year.

The subsidies from environmental funds count for very low of the total income.

Sociology and legislation
Danish farmers have a comparatively high educational level.

A large part of the Danish farmers recognize the close coalition between the production and the environmental problems. However, they are not sure of the effects of changed climate.

When it comes to the uptake of *environmental* measures on the property farmers are heavily self reliant. Next to the farmer him or herself the farmer relies on his/her family and to a lesser extent on the production consultant. The Danish structure of regulation means that Danish farmers may lower their expectations to having financed their solutions to specific problems. (Cf. also economic conclusion).

Future climate
In the Danish catchment area it seems that we haven't the same problems with droughts and flooding as in the other pilot areas.

Predictions of future climate suggest that there will be benefits to agriculture on the one hand, but on the other hand there will be increasing pressure on nature and water environment. One of the benefits seems to be better conditions for growing crops due to a longer growing season. At the same time more precipitation could lead to increased leaching of nutrients to the

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fjord which together with a warmer climate could lead to increased oxygen deficiency in the fjord. Therefore if a future production should benefit from a warmer climate it needs to be with an even more minimized leaching of nutrients from the fields.

Learnings
A way to involve farmers could be to provide them with measurement tools so they can see the effect on their production behaviour on the environment.

The ways the pilot projects are organized are very different. It seems that there is a lack of knowledge on how the different organizational set ups are in the different pilots.

The fact that we are in very different phases realizing our project objectives should be in focus and we should try to exploit this. We need more common knowledge on implications for crops on different climate issues.

It can be more difficult to make farmers act on environmental fields if there are no funds.

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