



The potential of short rotation willow coppice on agricultural land in Northern Europe based on empirical data

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General Approach

AREA PLANTED

PRODUCTIVITY

Emprical basis

**Extrapolations &
Projections**

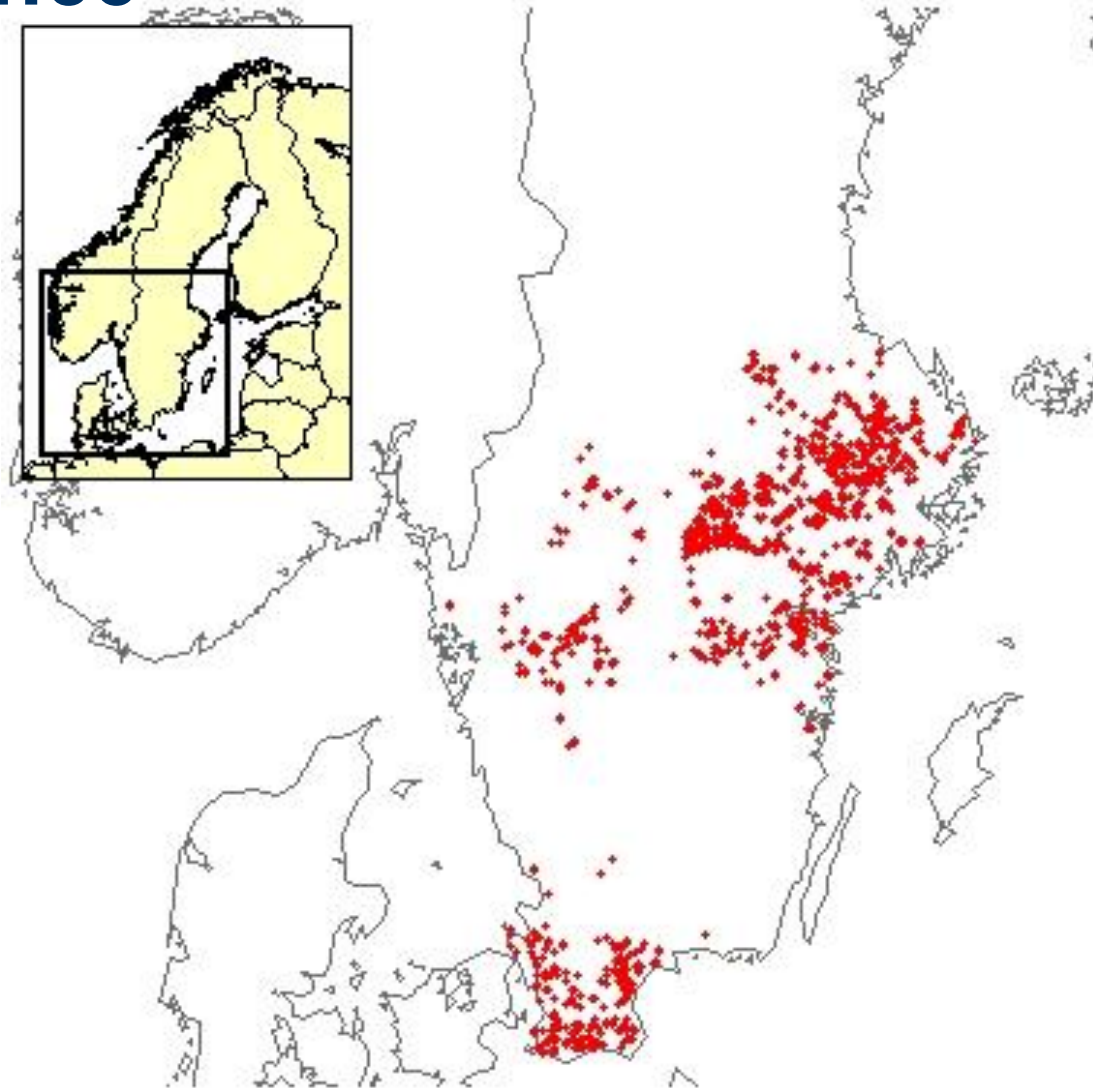


Swedish Experience

Between 14000 and 16000 ha have been planted with short rotation willow plantations in Sweden.

Period: 1986-2006.

Areas planted included most of the traditional agriculture lands of the country.

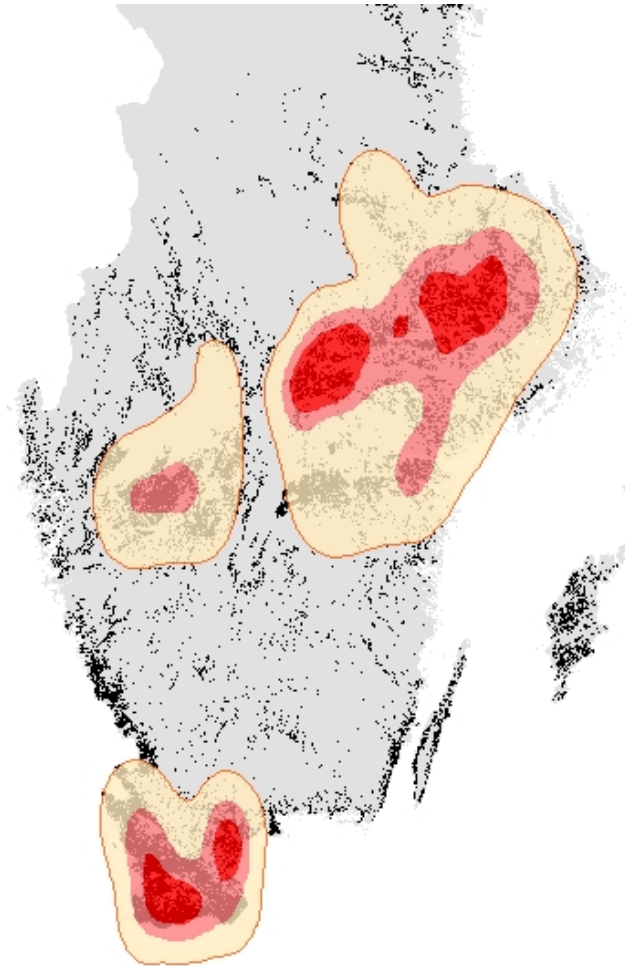


Where SRF is planted?

Method based in kernel analysis

Areas in red contain 30% of all the plantation area in Sweden.

The line defines the 90% of all the area.

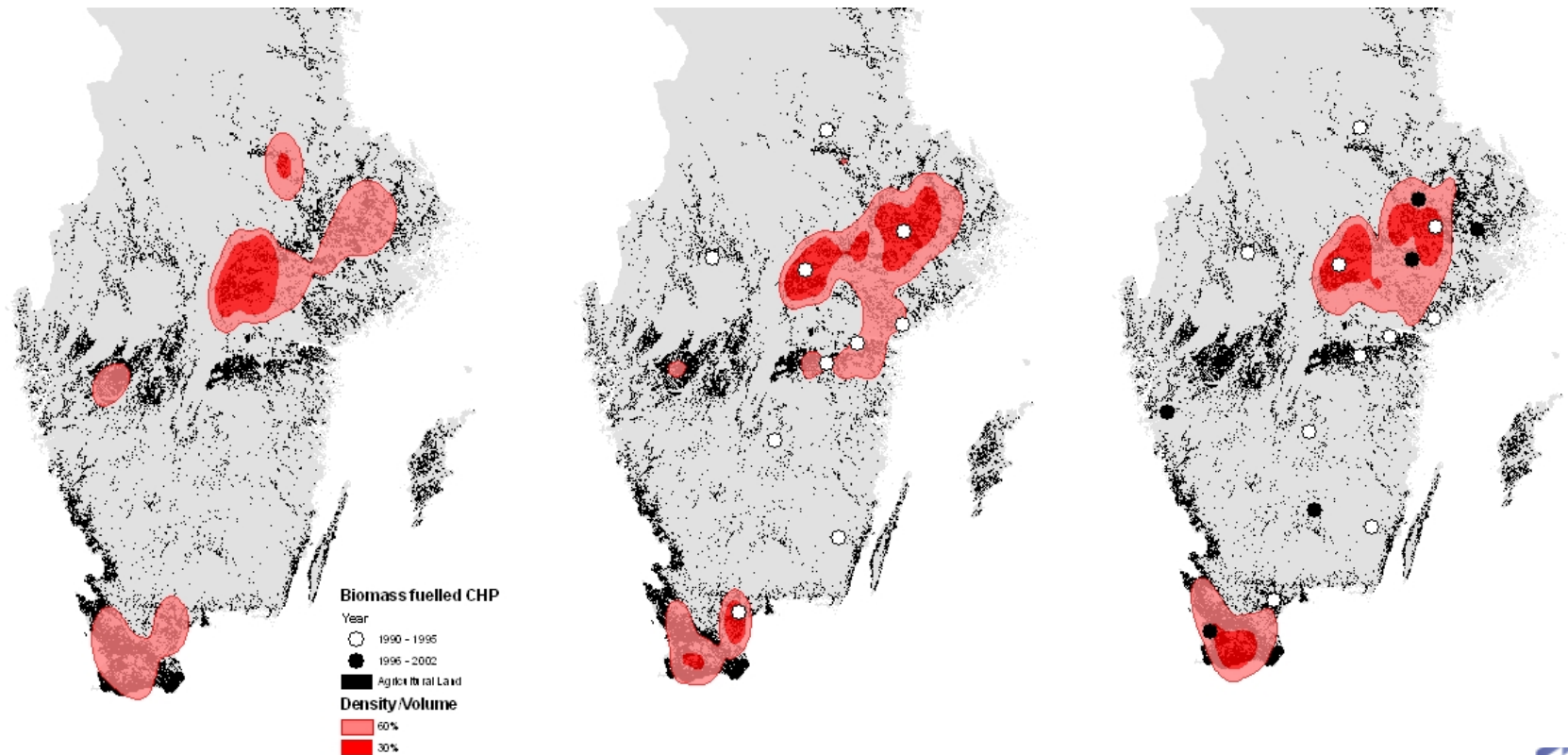


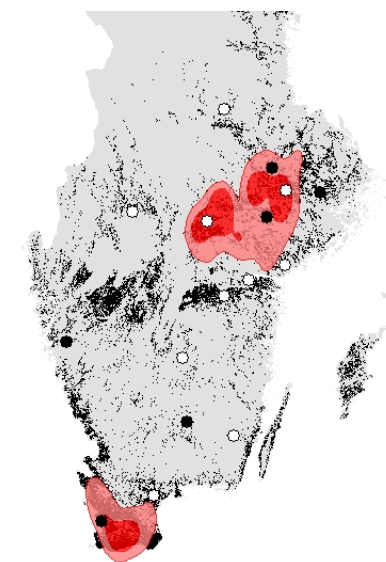
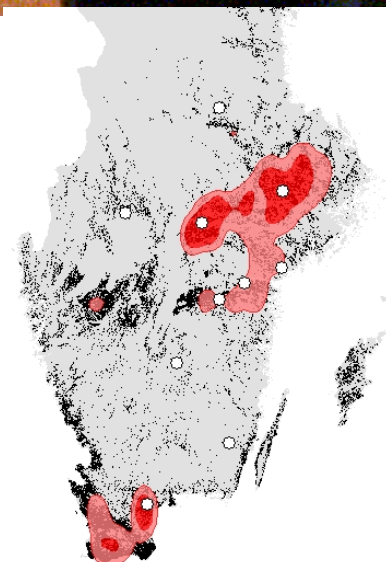
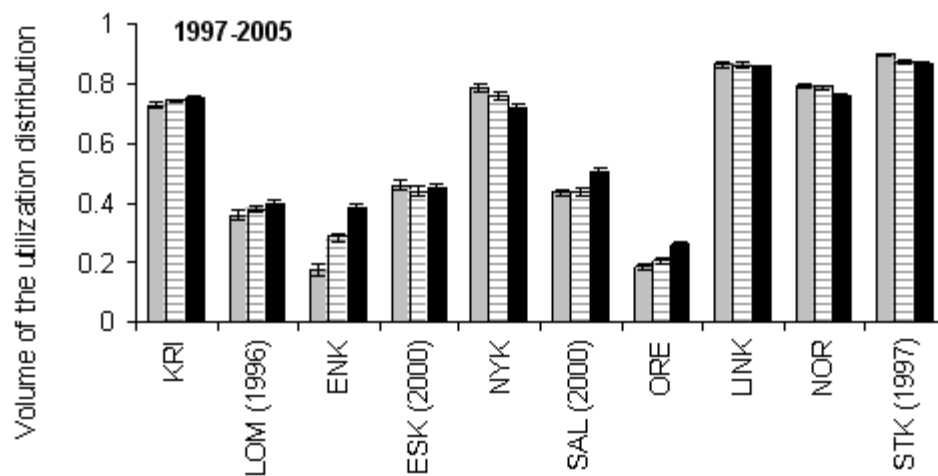
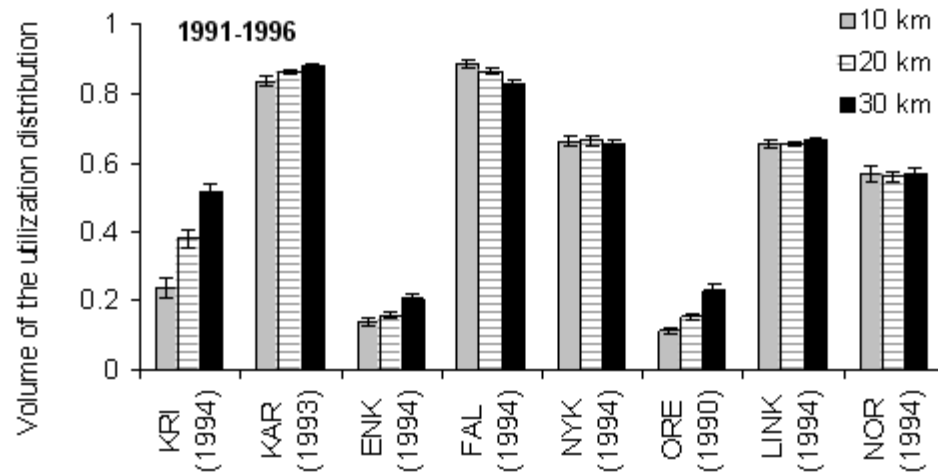
Changes along time

1986-1990

1991-1996

1997-2005







Productivity

- Since 1975, research on willow has been given priority in Sweden, and thanks to the Swedish experience, it is now one of the most developed energetic crops in Europe.
- During this time, numerous studies have revealed the high potential productivity of willow for bioenergy and shown the feasibility of average annual growth of 10-20 oven dry tonnes (odt) per hectare during the first cutting cycle.
- The studies on willow have also contributed to a better understanding of the establishment and tending of the commercial plantations, as well as the breeding programmes carried out during the last 20 years.
- The more recent plantings included the newer varieties, more vigorous than the older clones, which resulted in shorter rotations and more resistance to frost and diseases.



Modelling the trends

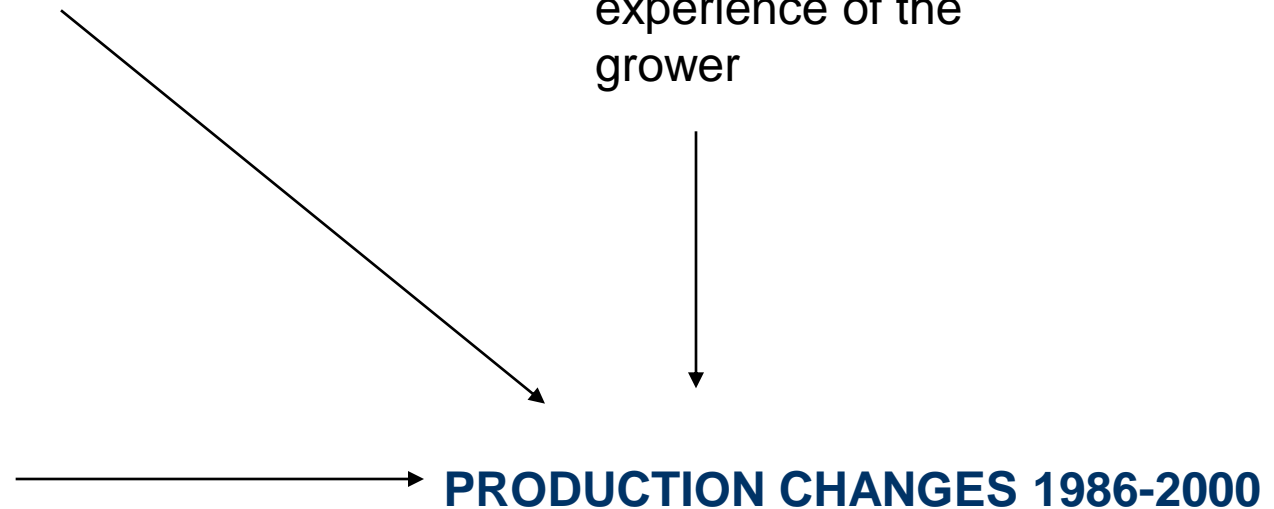
Management: 4
categories of equal
number of growers,
according to their
performance

(I, II, III, IV)

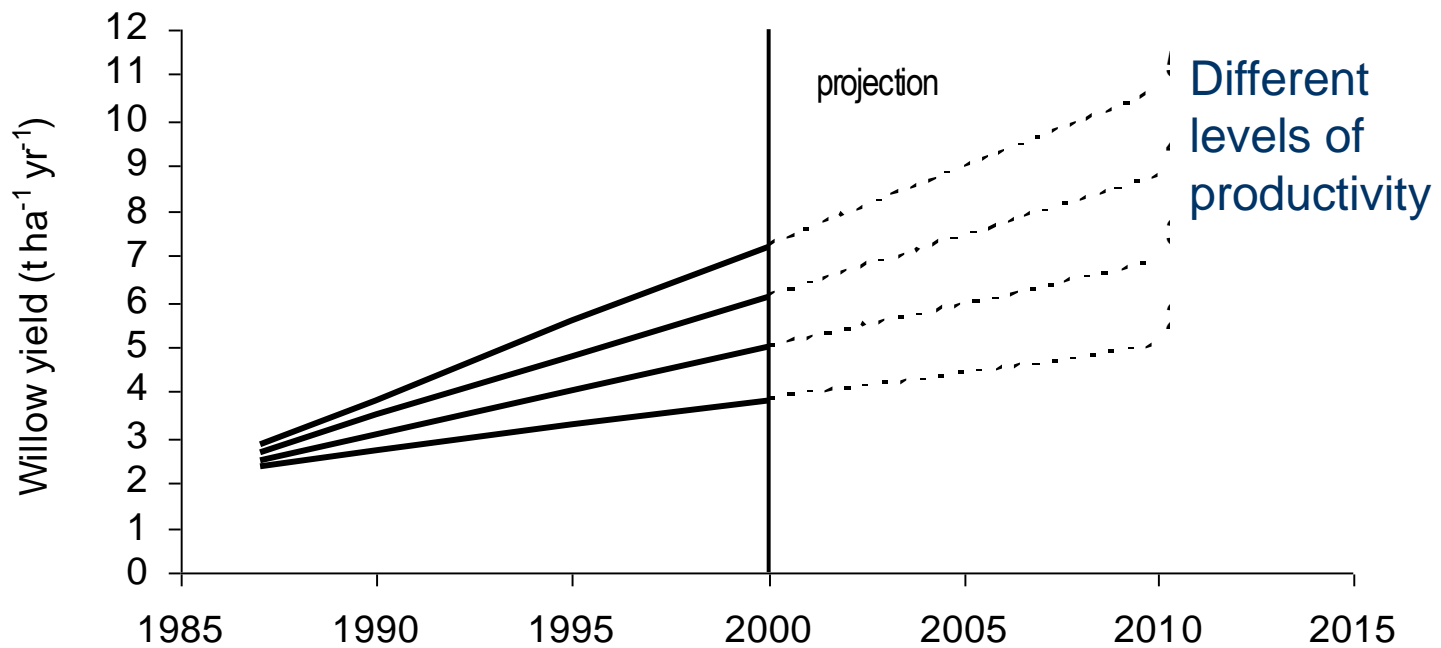
Site areas: using the
local production of
cereal as indicator

Experience:

The plantations were
classified according
to the previous
experience of the
grower



Projections & trends



Extrapolations

Trends of SRF productivity

Empirical yields from plantations

Proxis for extrapolations

Regional Simulations of plantations growth

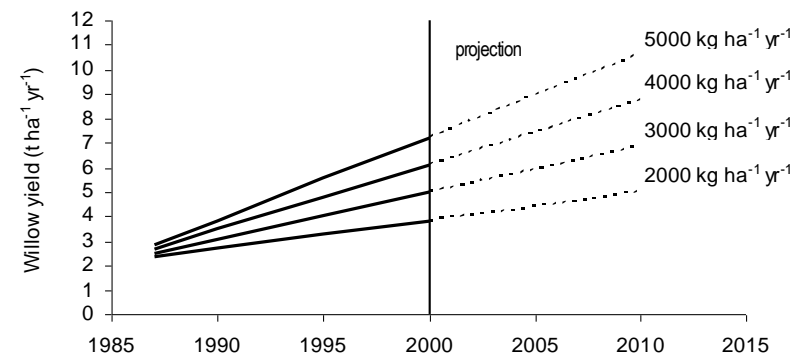
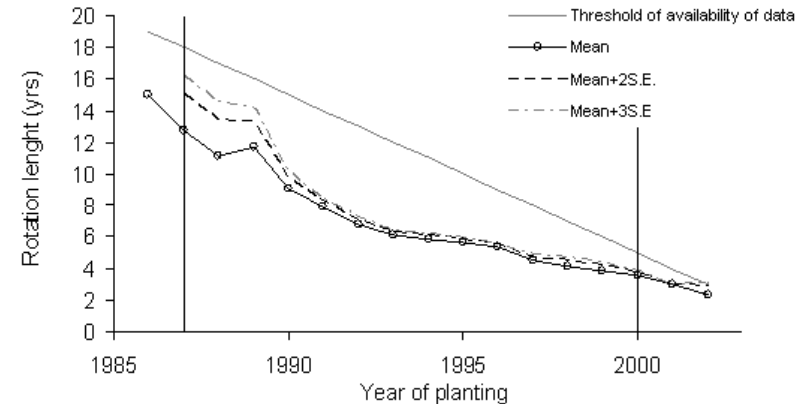
Different scenarios:

Average management (50%)

Good management (25%)

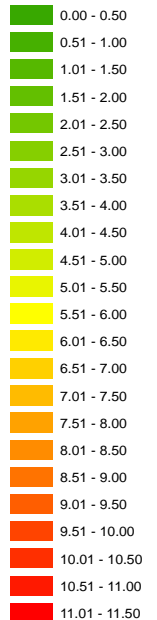
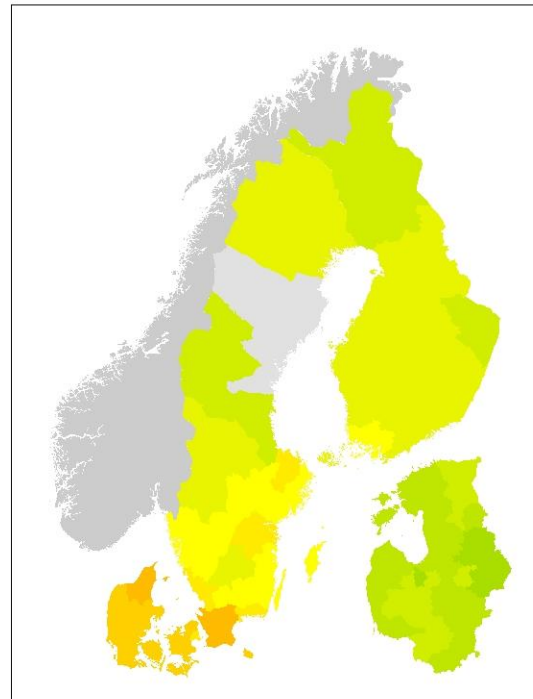
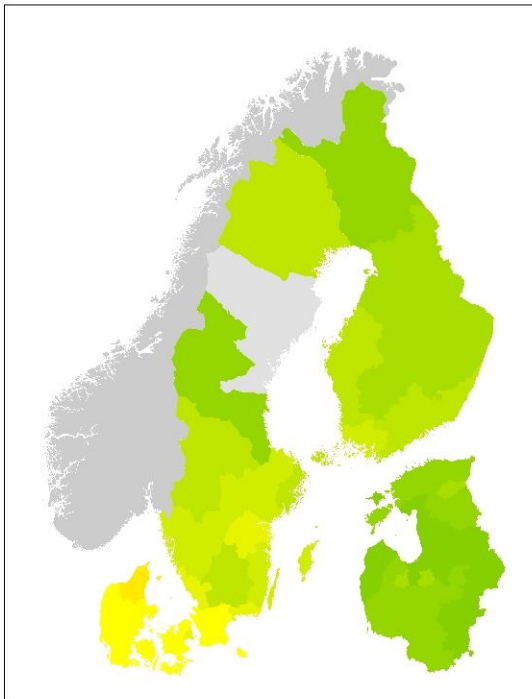
Time projections: 2000, 2010

(new varieties, new techniques)



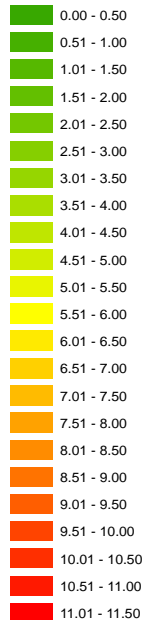
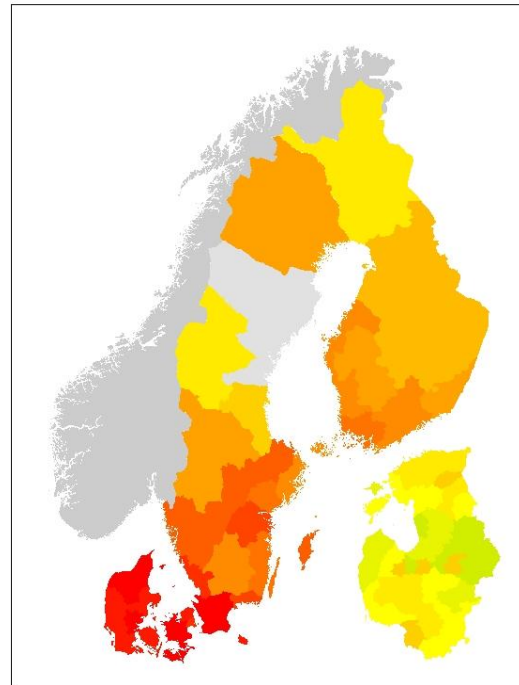
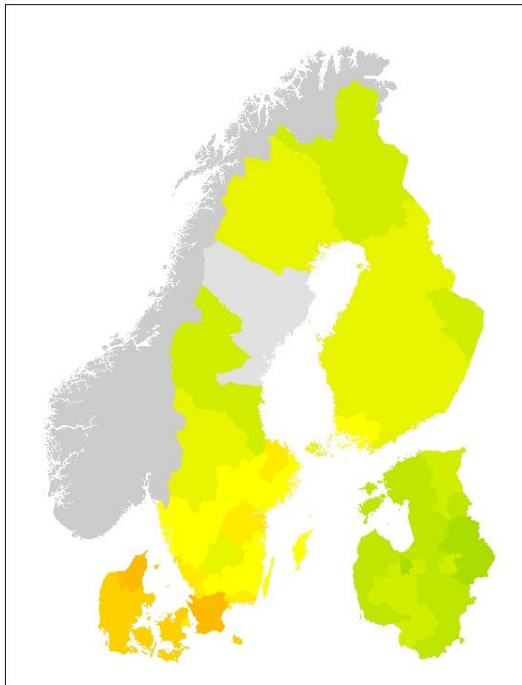
Projections & trends

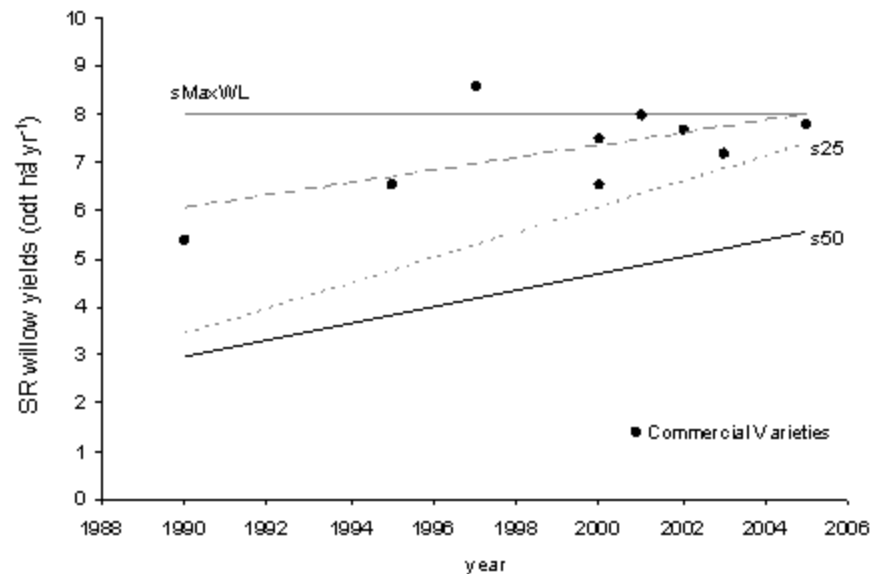
Average growers, changes in 10 years



Projections & trends

Best growers, changes in 10 years



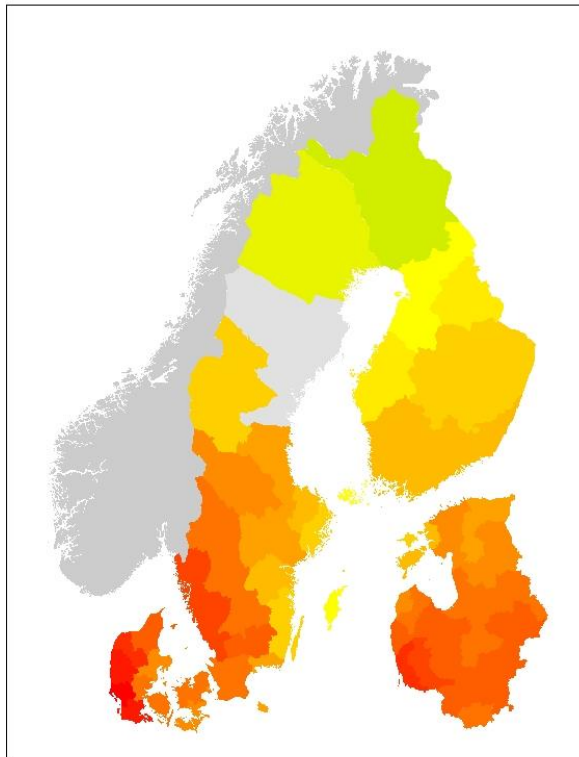


Yield predictions for the first cutting cycle in central Sweden compared to the performance of the willow varieties released in the Swedish market (Larsson and Dobrzaniecki, 2004). The time refers to the year the variety was released to the market (dots), or when the commercial plantations were established (lines). The predictions refer to the maximum annual productivity on the basis of water limitation (*sMaxWL*), and for the 25% and 50% best growers (*s25* and *s50* respectively), calculated for central Sweden (Örebro county) during the period 1990-2005.



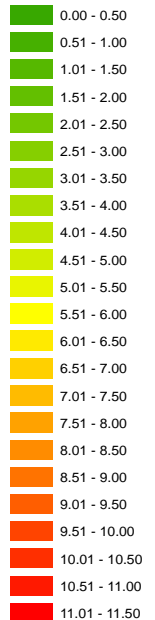
Projections & trends

Maximum estimates excluding management

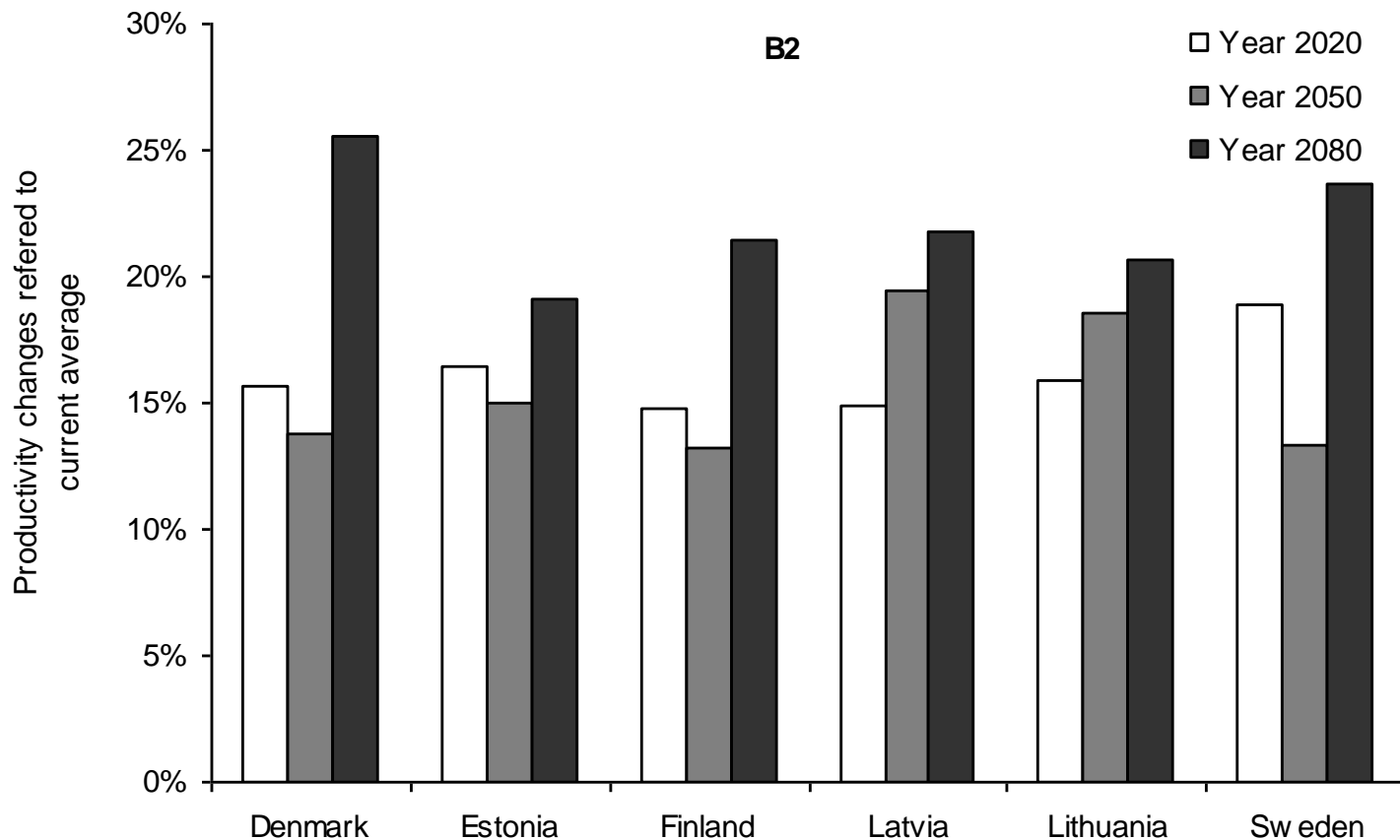


Projections based on the model of Lindroth and Bath (1999)

Climate averages 1960-1990



Projections & trends



projections based on the model of Lindroth and Bath
(1999) & HADCM3 for IPCC scenario B2



Projections & trends

Table 2. Average yield estimates (odt ha⁻¹ yr⁻¹) for the countries studied, according to the different scenarios proposed.

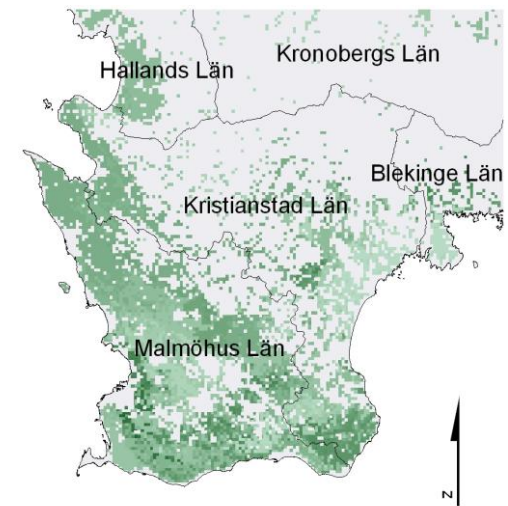
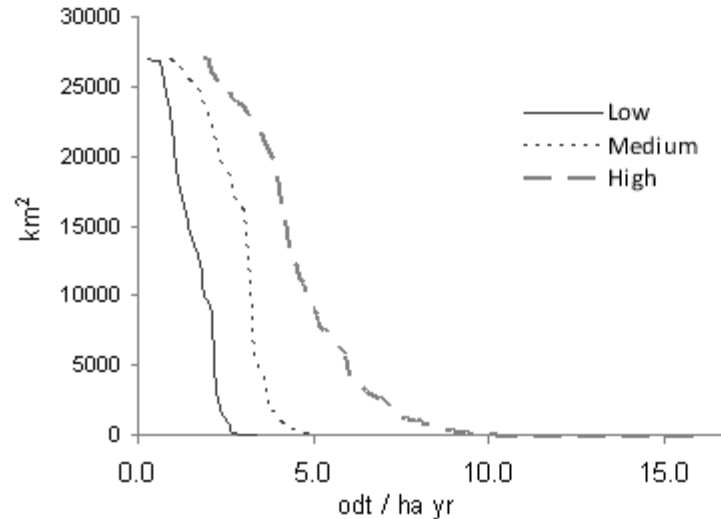
	<i>s50t2000</i>	<i>s50t2010</i>	<i>s25t2000</i>	<i>s25t2010</i>	<i>sMaxWL</i>
Estonia	3.14	3.44	4.85	6.29	7.9
Latvia	2.82	2.87	4.58	5.79	9.0
Lithuania	3.10	3.37	4.81	6.22	9.3
Sweden	5.29	7.20	6.83	9.77	8.0
Finland	4.48	5.80	6.06	8.44	6.8
Denmark	6.44	9.16	7.93	11.65	9.5

s25t2000 and *s25t2010*: High productivity scenarios based on the performance of 25% of the best farmers, for years 2000 and 2010, respectively. Analogously, *s50t2000* and *s50t2010*: good productivity scenarios based on 50% of the best farmers. *sMaxWL*: projections only defined by water limitation, excluding the effect of management.



Projections: alternatives

"Downscaling" by k-nn methods (Sweden)



Areas and productivity of short rotation willow plantations on agricultural land in south and central Sweden. The areas are presented aggregated under different productivity values, for the low, medium and high performance groups, according to the estimations.



Short Conclusions

There are important factors in the adoption of willow by local farmers that must be taken into account ("demand" effects rather than "offer" effects)

There is a significant and constant improvement of the varieties used that will result in good yields.

However, good management is a key factor! (socio-economic restrictions).

