

# Biodiversity impacts of enhanced energy crop production in EU farmland areas

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# Project consortium

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  - Rob Bakker & Wolter Elbersen (A&F)
- Berry Meuleman (ECOFYS)
- Peter Carey (Centre for Ecology and Hydrology, UK)
- Erling Andersen (The Danish Forest and Landscape Research Institute)
- Adriaan Guldemonnd & Anton Kool (Centre for Agriculture and Environment (CLM), The Netherlands)

The conclusions and recommendations presented today do not necessarily reflect the views of the EEA, they are entirely the opinions of the researchers

# Overall objective of study:

to assess the potential impact of agricultural biomass production on biodiversity, given a number of storylines within the EU wider renewable energy targets by 2010-2020



do's and don'ts in relation to biodiversity in energy crop production

# Policy targets used:

## 2010:

- EU White Paper on Renewable Energy Sources COM(97)599: *12% RES energy of total energy Consumption*
- Directive on Renewable Electricity (2001/77/EC): *21% share of RES electricity in gross electricity consumption*
- Transport Biofuel Directive (2003/30/EC): *Market shares in the European Union of 5,75% per MS*

## 2020:

- Transport fuels: *Market shares in the European Union of 5,75% per MS*
- Res-electricity and Heat: *the electricity produced from biomass sources (biomass, biogas and biowaste) in the EU25 will increase from 37 TWh in 2001 to 305 TWh in 2020.*

Future situation uncertain in  
2010 and 2020  
(How many ha?? Where? Which  
crops? Specified per country)



*3 Storylines (scenarios): Low-→high impact*

*Not describe most likely future, but rather  
describe storylines which have diverging  
implications for future land use*

# Important storyline specifications

## Biofuels:

- Policy targets will be met in every MS
- Imports from outside
  - high impact storyline 0-10%
  - low impact specific per country 20-50%
- Cross border imports 0-10%
- Transport fuel mix (diesel/petrol: diesel/ethanol)
- Crop mix (existing crop mix)
- Yields
- Conversion technology (2010: 5% ligno/2020: 30% ligno)
- Conversion efficiency

# Important storyline specifications

Res electricity and heat:

- Policy targets will be met
- agricultural residues are not expected to require additional arable land
- energy crops are expected to remain the most expensive biomass source and therefore the least attractive option in the biomass supply curve of each MS



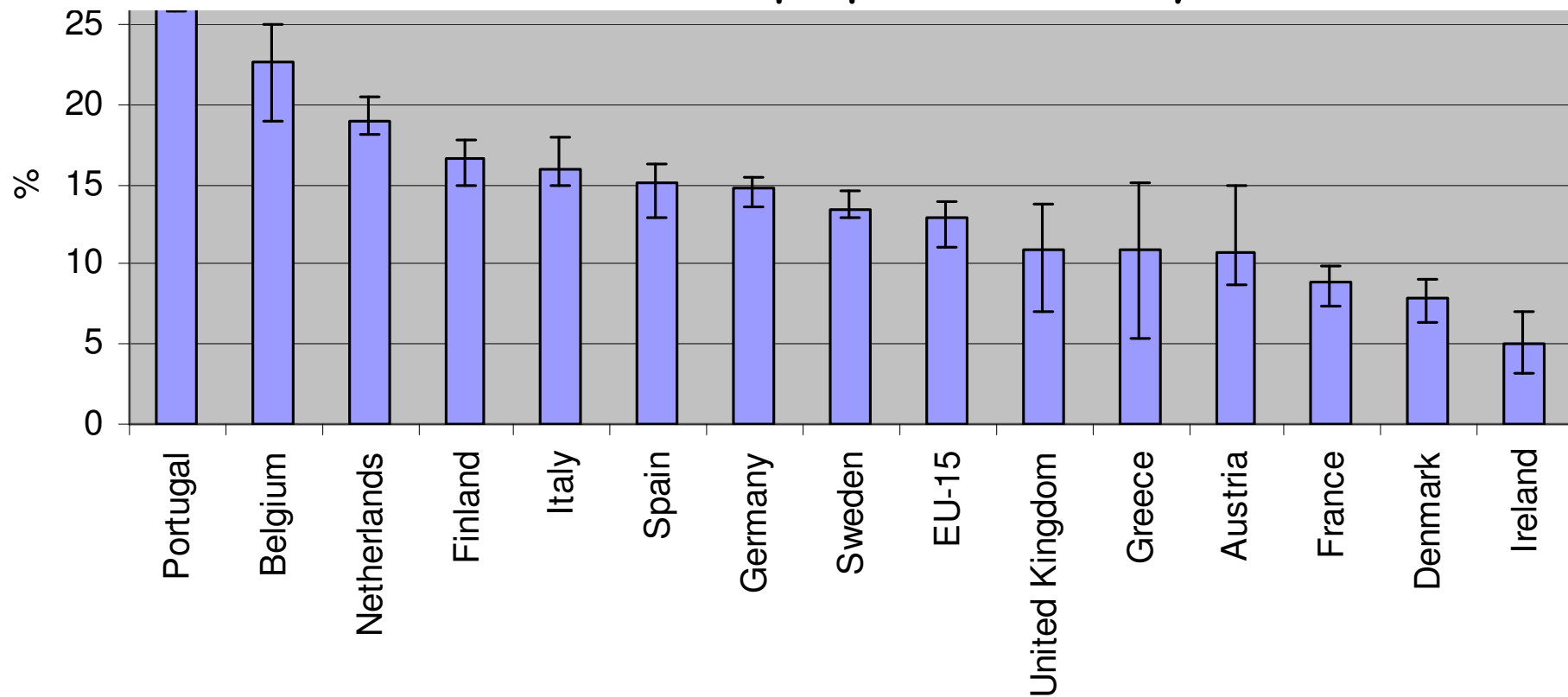




**Linking storylines to land use**

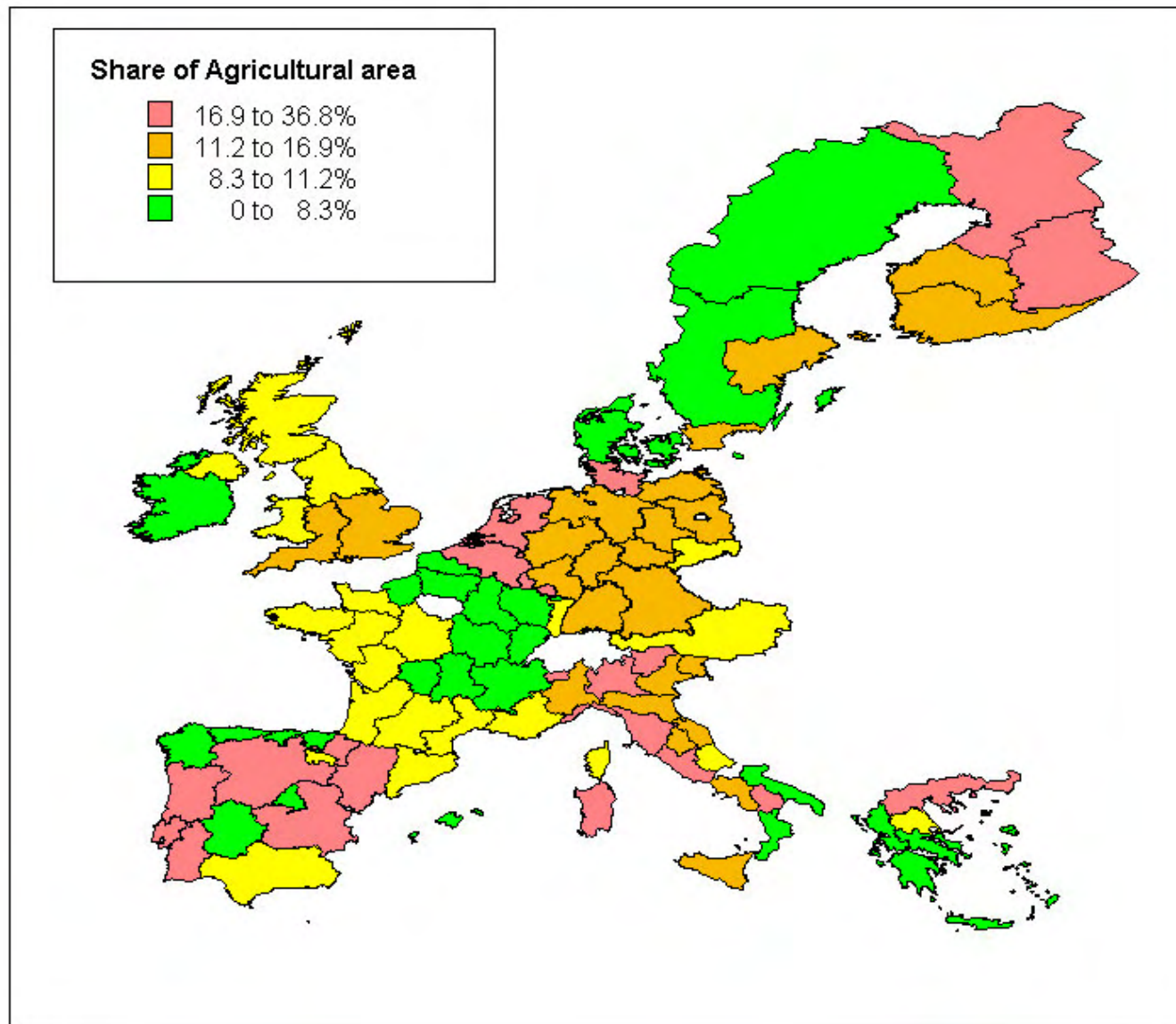
# The share of the agricultural area projected to be used for biomass crops in 2010 in EU-15 according to the storylines.

In average 13% of the Utilised Agricultural area is expected to be needed for biomass crops production by 2010



Error bars show land requirements for low and high storyline results

# % UAA per region expected to be used for biomass crops 2010 EU-15 (medium impact storyline)



Effects on biodiversity







# Biodiversity impacts depend on:

- Extent of land use requirements?
- Types of biomass crops?
- Types of land use conversions?
- Effects on types of biodiversity (Soil organisms, birds, mammals, invertebrates and plants)
- Effects on water and soil quality
- Effects on landscape diversity and habitat fragmentation



# Three groups of biomass crops

Biofuel energy crops:

- 1) Sugar/starch: sugar beet and potatoes
- 2) Oil-starch: sun-flower, Rape, cereals, sorghum

Ligno-cellulose crops:

- 3) Short Rotation Coppice and perennial biomass grasses (myscanthus, Switchgrass, Reed Canary grass)

Effects of these 3 groups of biomass crops on biodiversity are different!

# Three groups of biomass crops

## Biofuel energy crops:

1) Sugar/starch: sugar beet and potatoes, fodder maize

Similar to conventional crops: high input use

2) Oil-starch: sun-flower, Rape, cereals, sorghum, corn maize

Similar to conventional crops: low input use

## Ligno-cellulose crops:

3) Short Rotation Coppice and perennial biomass grasses (myscanthus, Switchgrass, Reed Canary grass)

Low input use, low mechanisation, important landscape structural impacts

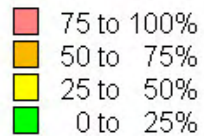
# Types of land use conversions most likely to affect biodiversity in either positive or negative way

- Conversion of extensive land use categories to arable land. e.g.
  - Fallow/set-aside → arable
  - Permanent grass → arable
  - Dehesa/montado → arable
  - Abandoned land → arable
  - Wetland → Drained arable land
- Changes within arable land e.g.
  - Intensive crops → extensive biomass crops (SRC)
  - Extensive crops (spring cereals) → intensive biomass crop (e.g. root crops)
  - Intensive crops → intensive crops
  - Decreased/increased crop diversity

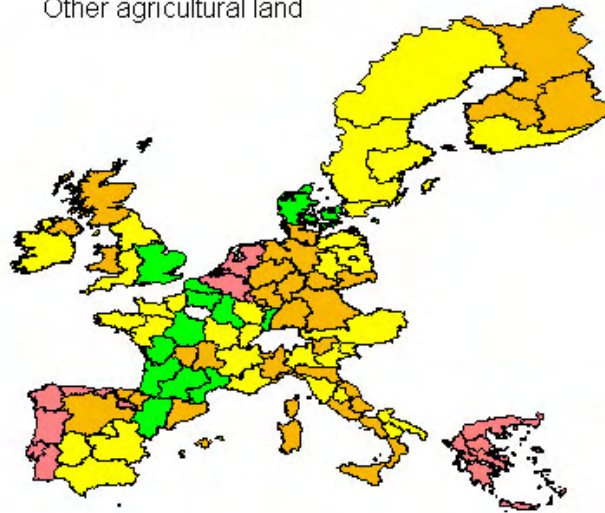
<i>Drivers:</i>	<i>Pressures:</i>	Water	Soil	Soil organism	Birds	Mammals	Inverts	Plants
rotation widening/ less pesticides/ less fertilisers	extensification	+	+	+	+	+	+	+
clearing abandoned land	Re-using abandoned land, increase landscape diversity	-	-	-	+	+/-	+/-	+/-
drain land/ bring land under irrigation	Drainage/ irrigation	-	-	-	-	-	-	-
enlarging plots/ remove hedges, tree lines etc	Habitat fragmentation	0	0	0	-	-	-	-
more tillage/ploughing removal biomass	Erosion/ disturbance	-	-	-	-	-	-	-
More N-application	Eutrophication, Acidification	-	-	-	+/-	0	-	-
More pesticides	pollution	-	-	-	-	-	-	-
Ploughing-up of perm. grassland/Dehesas	Habitat destruction	-	-	-	-	-	-	-

# Types of land use conversions expected for biomass crop production

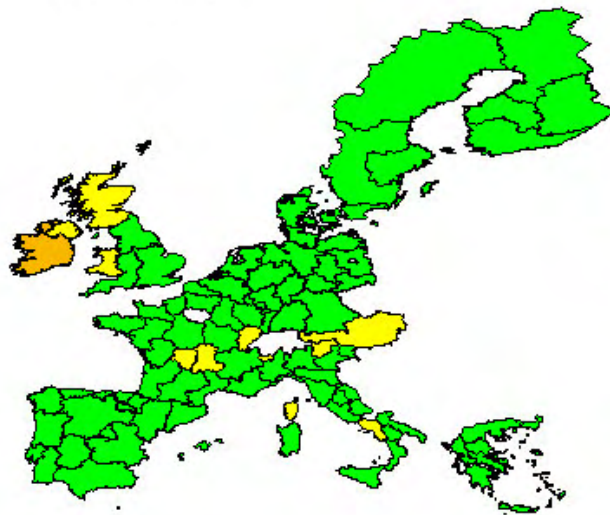
## Share of area of BFCs



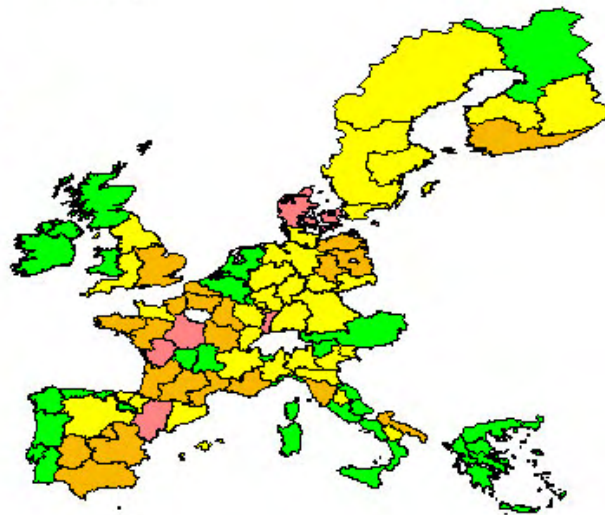
Other agricultural land



Released land

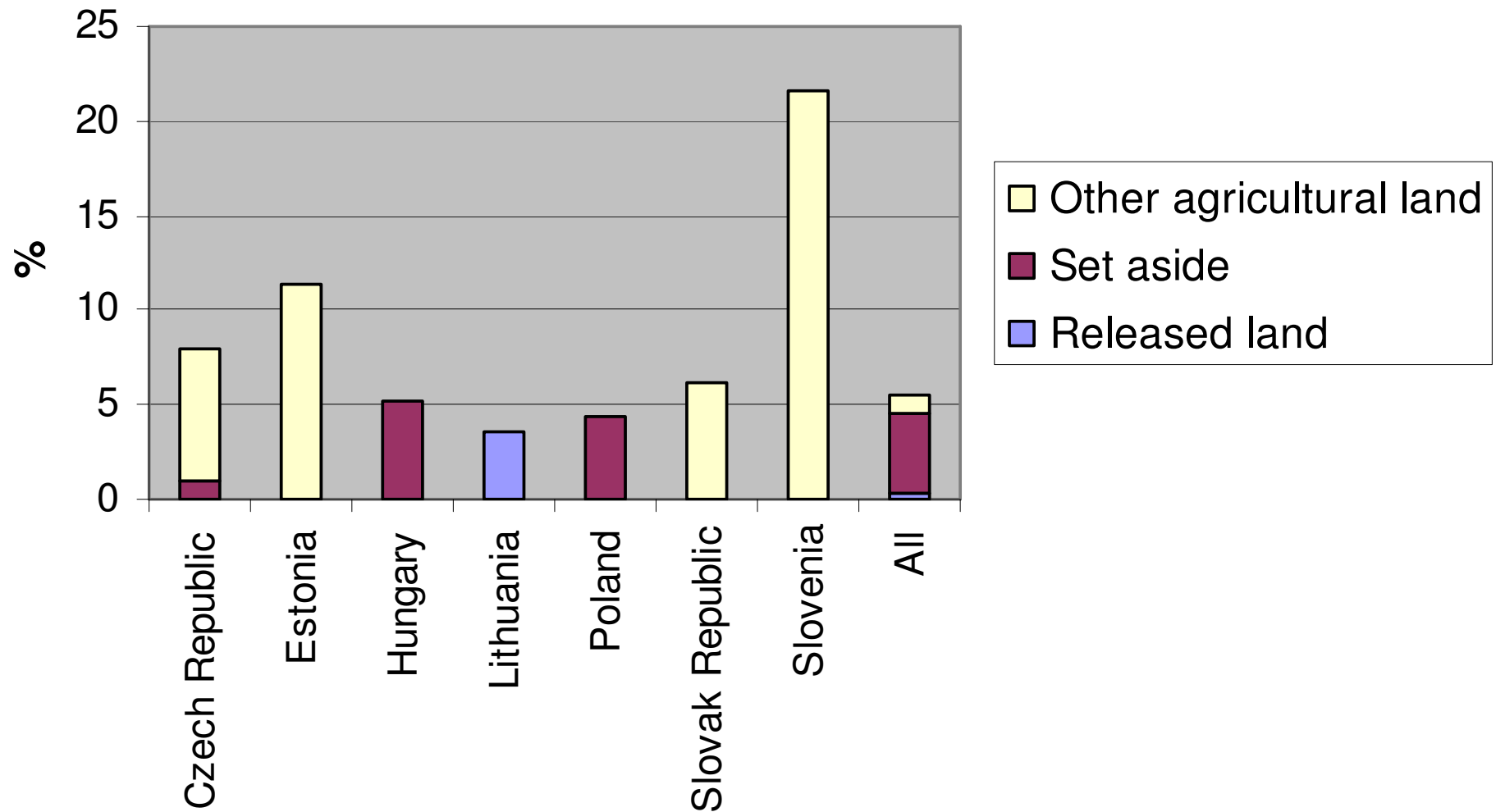


Set aside

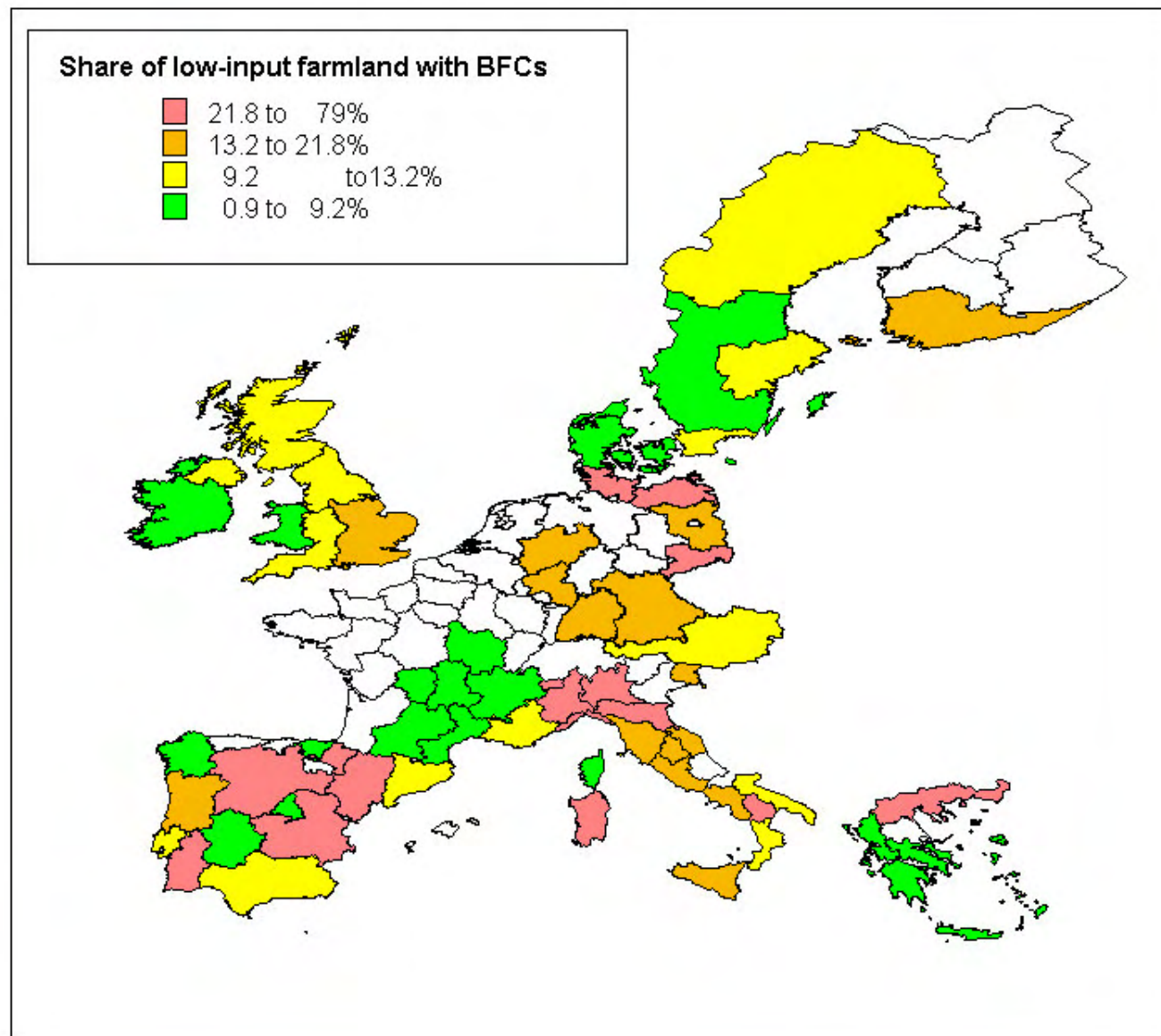


The maps show the % of the area substituted by Biomass Crops that otherwise (BAU storyline) would be set aside, released from agricultural production or other agricultural land

# Types of land projected to be substituted by biomass crops in EU10

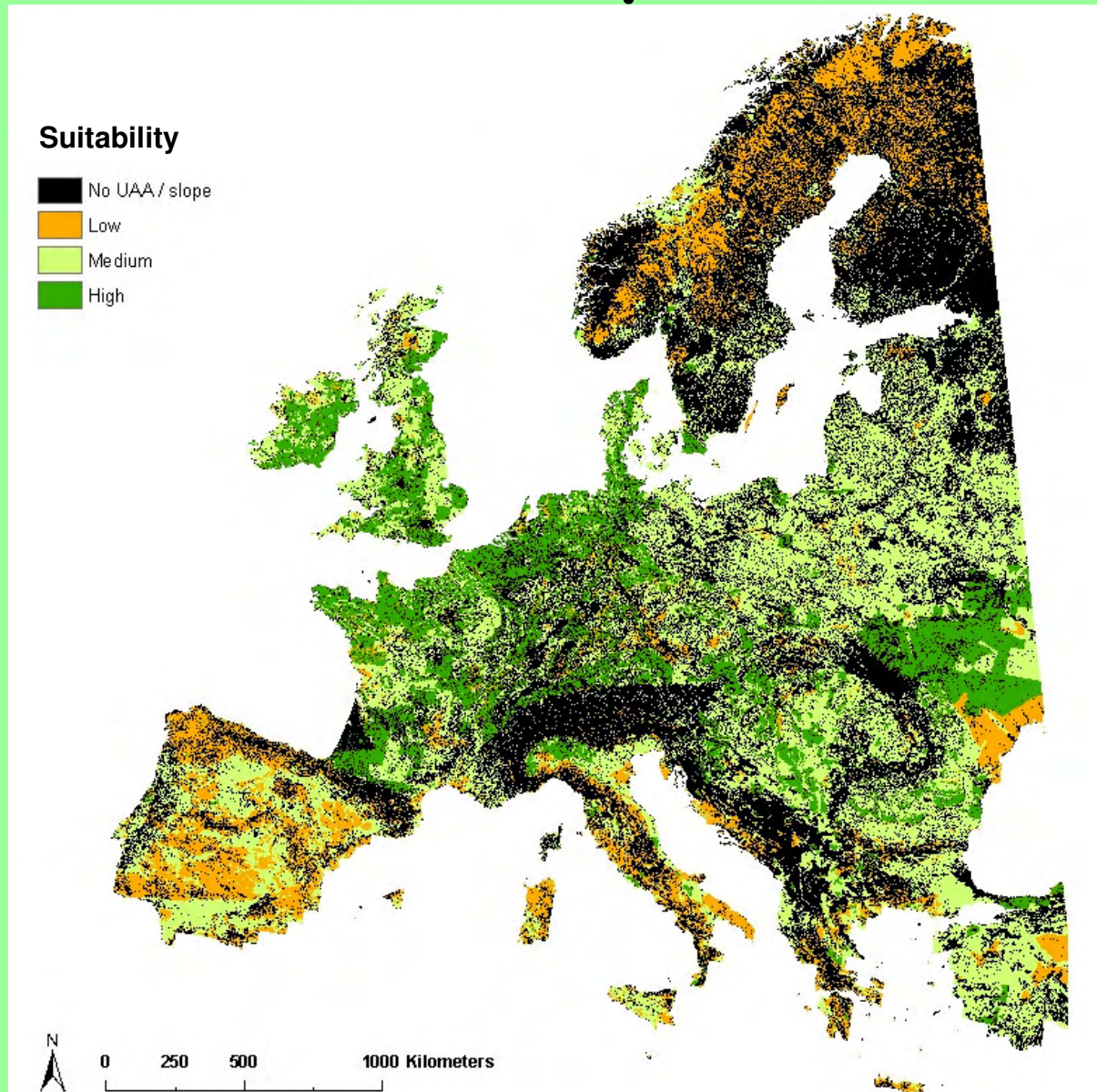


# % of (former) low-input farmland that is likely to be used for biomass crops 2010





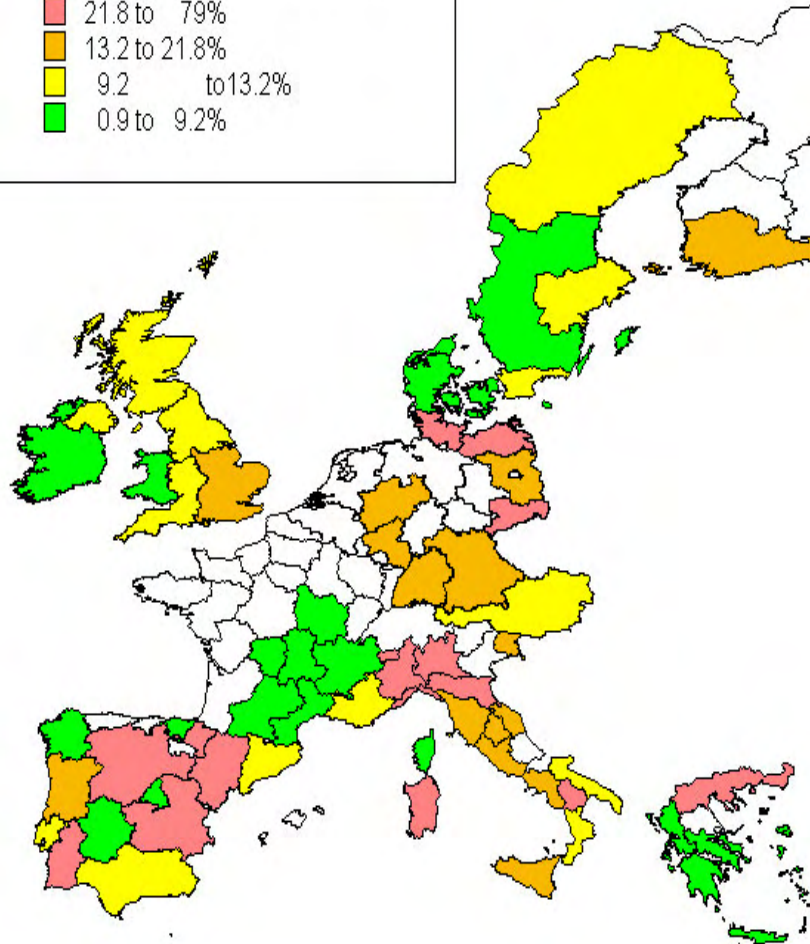
# Soil-climate suitability for perennial biomass crops



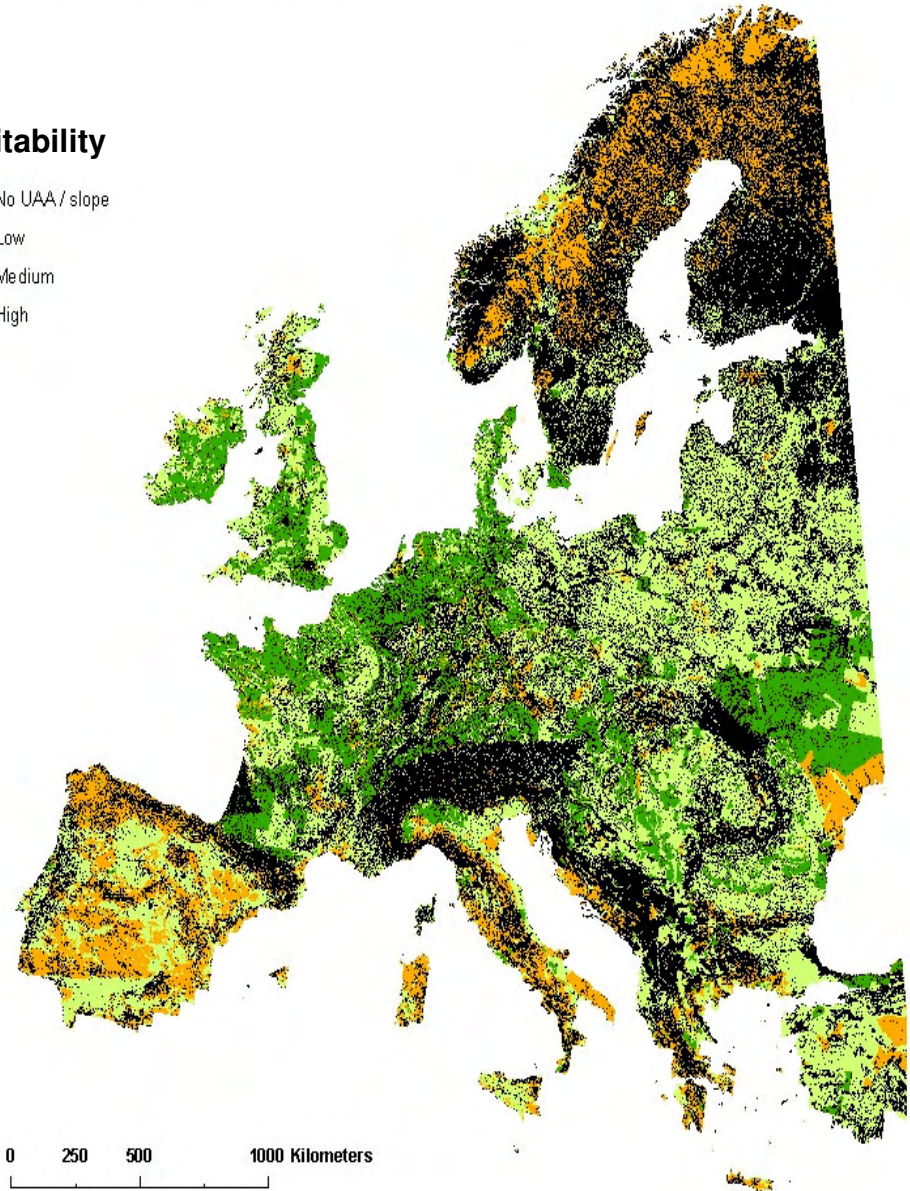


# Overlap with sensitive areas

Share of low-input farmland with BFCs



Suitability



0 250 500 1000 Kilometers

# Estimation of biodiversity effects

Combining:

- Land requirements (Storylines)
- Expected land use changes
  - Types of land use released in future (BAU):
    - Set aside/fallow
    - Land released from agriculture
    - Arable land (food/feed → biomass crop)
- Suitability of land (where?/How much?)
- Expected % of low input farmland potentially used for biomass crop production
- Expected % of other sensitive areas potentially used for biomass crop production

# Results

- In Portugal, Italy, Spain, Slovenia, Estonia and Bulgaria largest % of UAA at risk of a loss in biodiversity.
- because:
  - Large % of set aside/fallow converted to biomass crops
  - Large % of low input farmland
  - Large % of UAA required for Biomass crop production

# Initial conclusions (I)

- Pressures for change from increased biomass demand on land use are not equally distributed over EU27
- More pressure on land in Portugal, Belgium, The Netherlands, Italy and in New MS: Malta and Slovenia.
- Overall however, changes in land use for satisfying demand for biomass from agriculture are expected mainly in intensive farming areas

# Initial conclusions (II)

- Biodiversity impacts from increased biomass demand are likely to be relatively small except in countries where there is large proportion of Low intensity farmland
- Therefore; possible negative effects on biodiversity are larger in Southern Europe (Portugal) and some CEEC.
- Also: in countries with large share of high intensity farmland increased biomass demand can provide opportunities to increase biodiversity

# Initial conclusions (III)

- In CEEC biomass demand impact is not as important as the expected impact on farmland biodiversity from the present intensification of agriculture (autonomous process)
- Abandoned grasslands in CEEC can provide opportunity for nature conservation/bio-energy synergy by harvesting of grass for biofuel production
- In this study the effects were determined following the storyline assumptions! From these assumptions possible effects were investigated to identify the 'do's and don'ts'.



# Do's and don'ts (I)

- Choose the right biomass crop → depends on what land is being converted
  - Do not choose a more intensive crop (so oil crop above root crop, Perennial biomass grass/SRC above arable crop)
- Avoid monotonisation of the landscape
  - Try to introduce a mix of biomass crops (landscape diversity)
- Avoid converting low intensity farmland to biomass crops
- Possible gain for biodiversity in intensive arable land
- Explore win-win solutions for grassland management
- For choice of crops need to take local biodiversity stock into account (what biodiversity value can be reached?)