Environmental Impact Assessment of Energy crops production in Europe

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Successful scenarios for the establishment of the non-food crops in EU27
FCT/UNL, 19th November 2010

Scope of the study

⇨ *to evaluate the environmental effects due to the production of different energy crops in Europe*

Why?

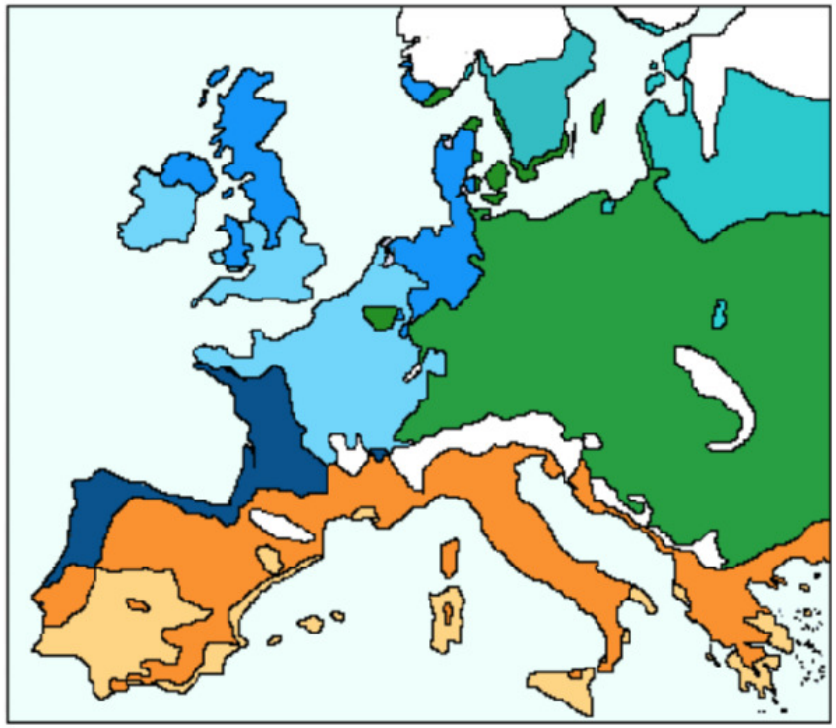
⇨ **Energy crop systems**

- ✓ **Intensive use of land**
- ✓ **Pressure on natural resources**
  - ❖ **biodiversity, water, soil**
- ✓ **Increment of agrochemicals inputs**

Methodological approach

- ⇨ 15 energy crops have been allocated to the climatic regions of Europe most suited for their development
- ⇨ 2 food crops, wheat and potato, where also analysed
  - ❖ Traditional crops, will serve for comparison
- ⇨ Grass fallow – reference system

Methodological approach



Nemoral (NEM)
Rape seed, hemp, reed canary grass, poplar, wheat, potato, fallow

Continental and Pannonian (CON)
Rape seed, sugar beet, flax, miscanthus, willow, wheat, potato, fallow

Atlantic North (ATN)
Rape seed, hemp, miscanthus, switchgrass, willow, wheat, potato, fallow

Atlantic Central (ATC)
Rape seed, sugar beet, flax, miscanthus, switchgrass, poplar, wheat, potato, fallow

Lusitanian (LUS)
Rape seed, sweet sorghum, hemp, miscanthus, willow, eucalyptus, wheat, potato, fallow

Mediterranean North and Mediterranean Mountains (MDN)
Sunflower, sweet sorghum, hemp, giant reed, poplar, wheat, potato, fallow

Mediterranean South (MDS)
Ethiopian mustard, sweet sorghum, flax, cardoon, eucalyptus, wheat, potato, fallow

Oil crops || Sugar crops || Fiber crops || Lignocellulosic crops
Woody crops || Food crops || Reference crop

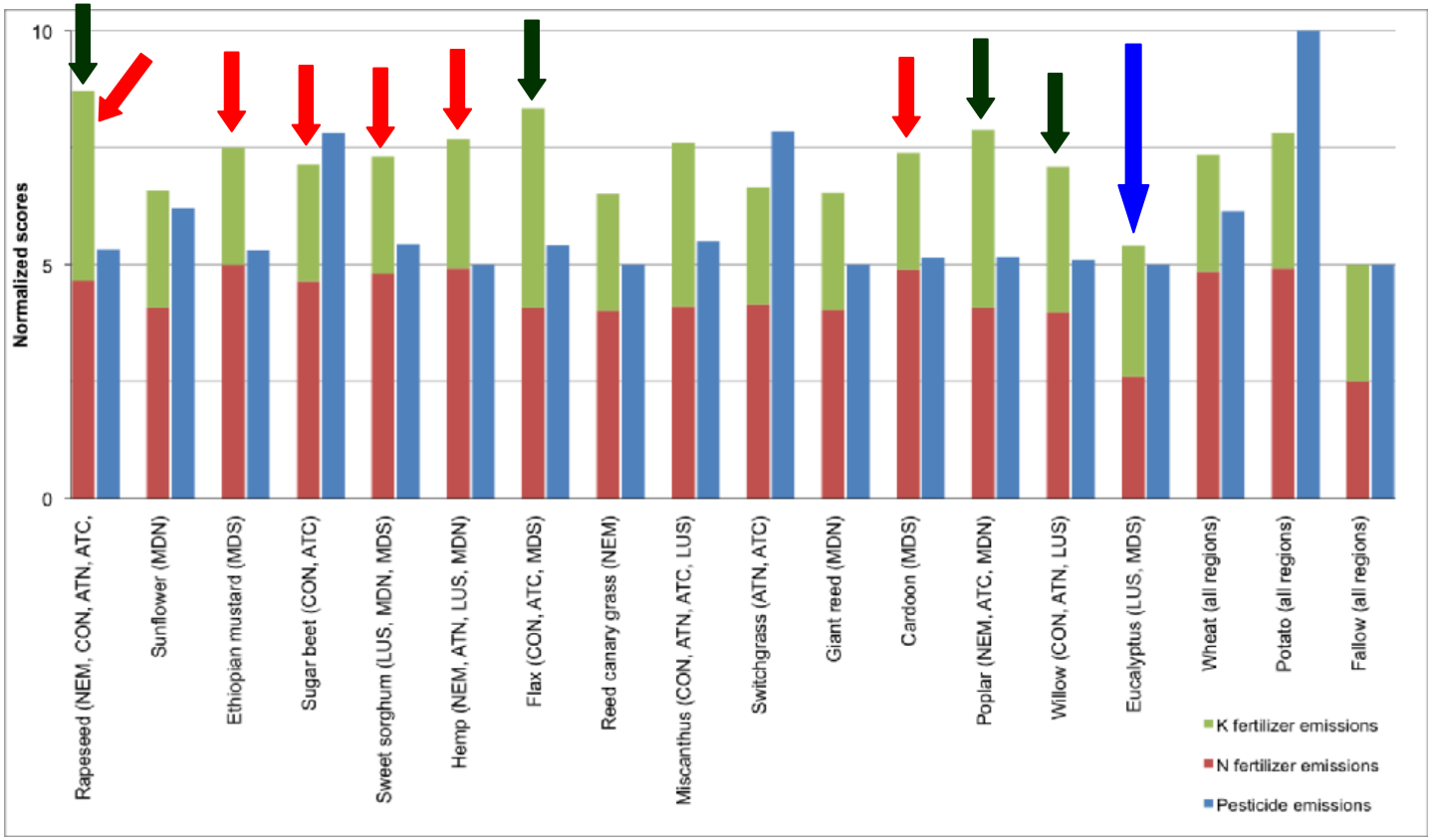
Methodological approach

- **EIA categories**
  - **Emissions to soil, air and water**
  - **Impact on soil**
  - **Impact on mineral and water resources**
  - **Waste production and use**
  - **Implications on Biodiversity and Landscape**

Methodological approach

- ⇨ **Categories results were normalized**
- ⇨ **scaled**
  - ⇨ **from 0 (lower impact)**
  - ⇨ **to 10 (higher impact)**
  - ⇨ **against fallow (with a score of 5)**

Emissions to soil, air and water



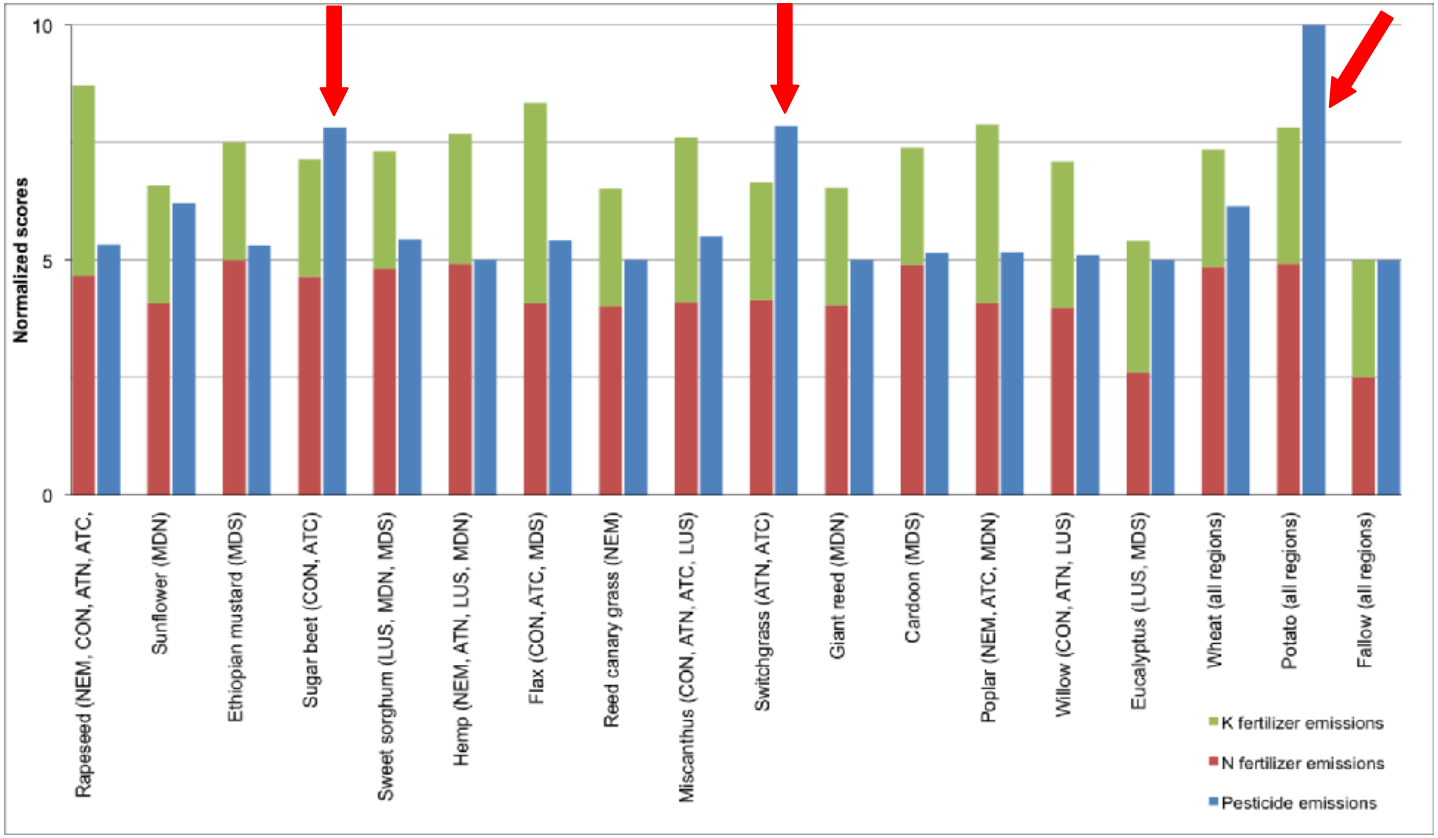
Fertilizer emissions:

⇨ **K surplus**

⇨ **high N emissions**

⇨ **balanced K application and low N input**

Emissions to soil, air and water

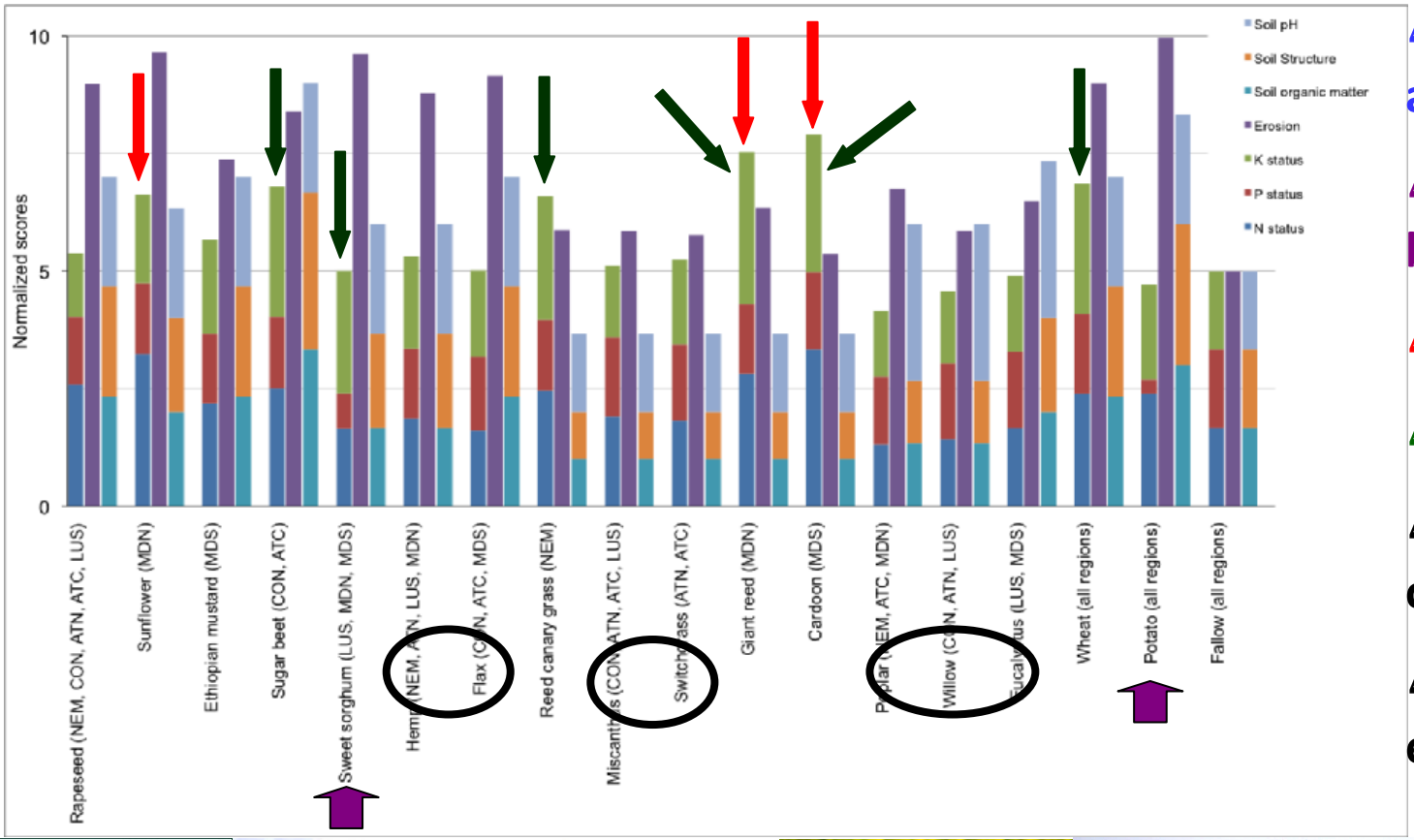


Pesticide emissions:

⇨**Most crops, low impact due to low pesticide application**

⇨ **crops penalized**

Impact on Soil – Nutrient Balances



⇨ all crops, P soil accumulation

⇨ less P should be applied

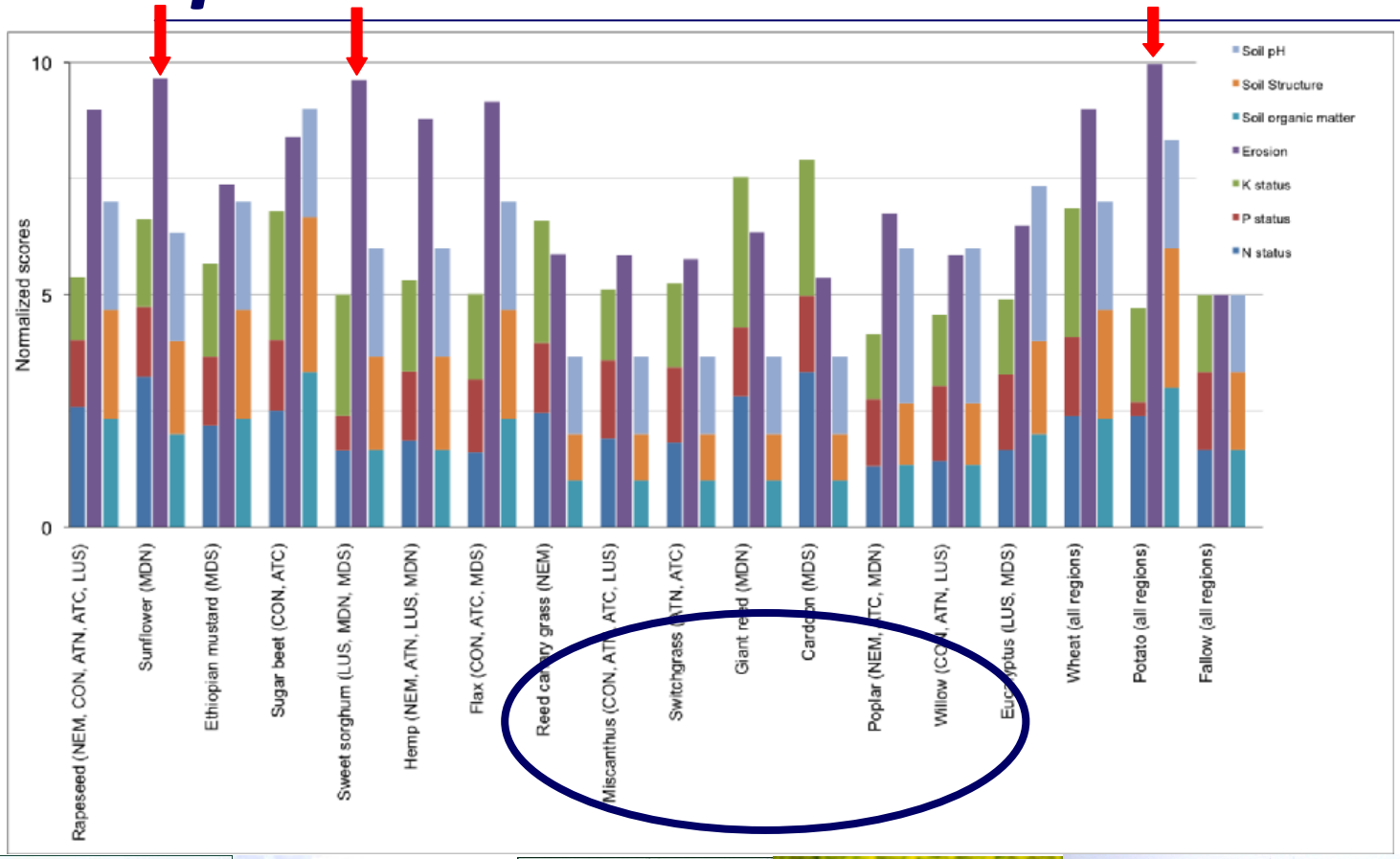
⇨N deficits

⇨K deficits

⇨Harvest litter/ compensation

⇨Least exhausting

Impact on Soil - Erosion



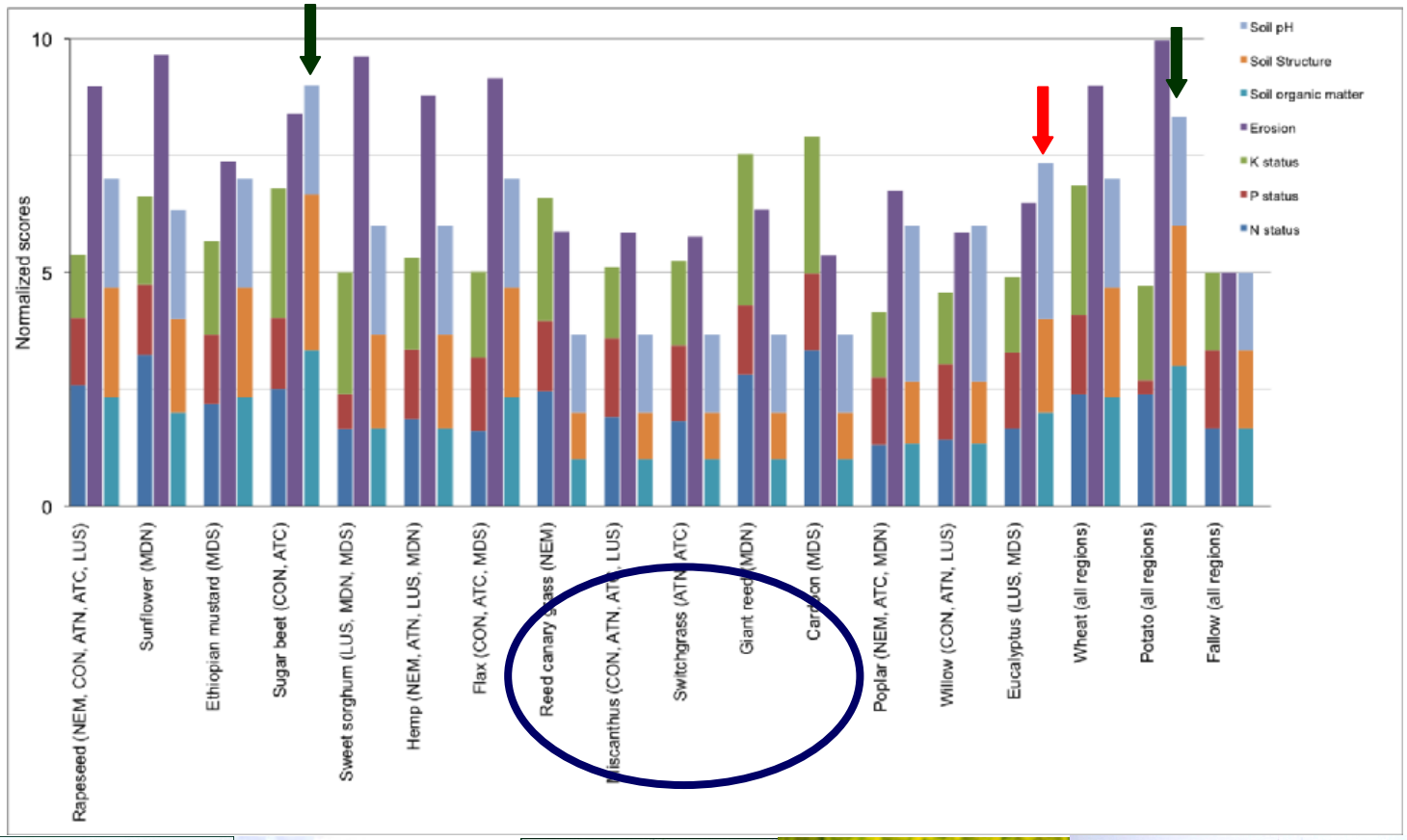
⇨ lower erosion

> rainfall interception, > surface cover, longer time

⇨Higher erosion risks

annuals

Impact on Soil – Soil Properties



⇨ higher SOM

⇨Better structure

permanence, residues, roots

⇨ allelopathy, reduction of vegetation

⇨ harvest removes soil

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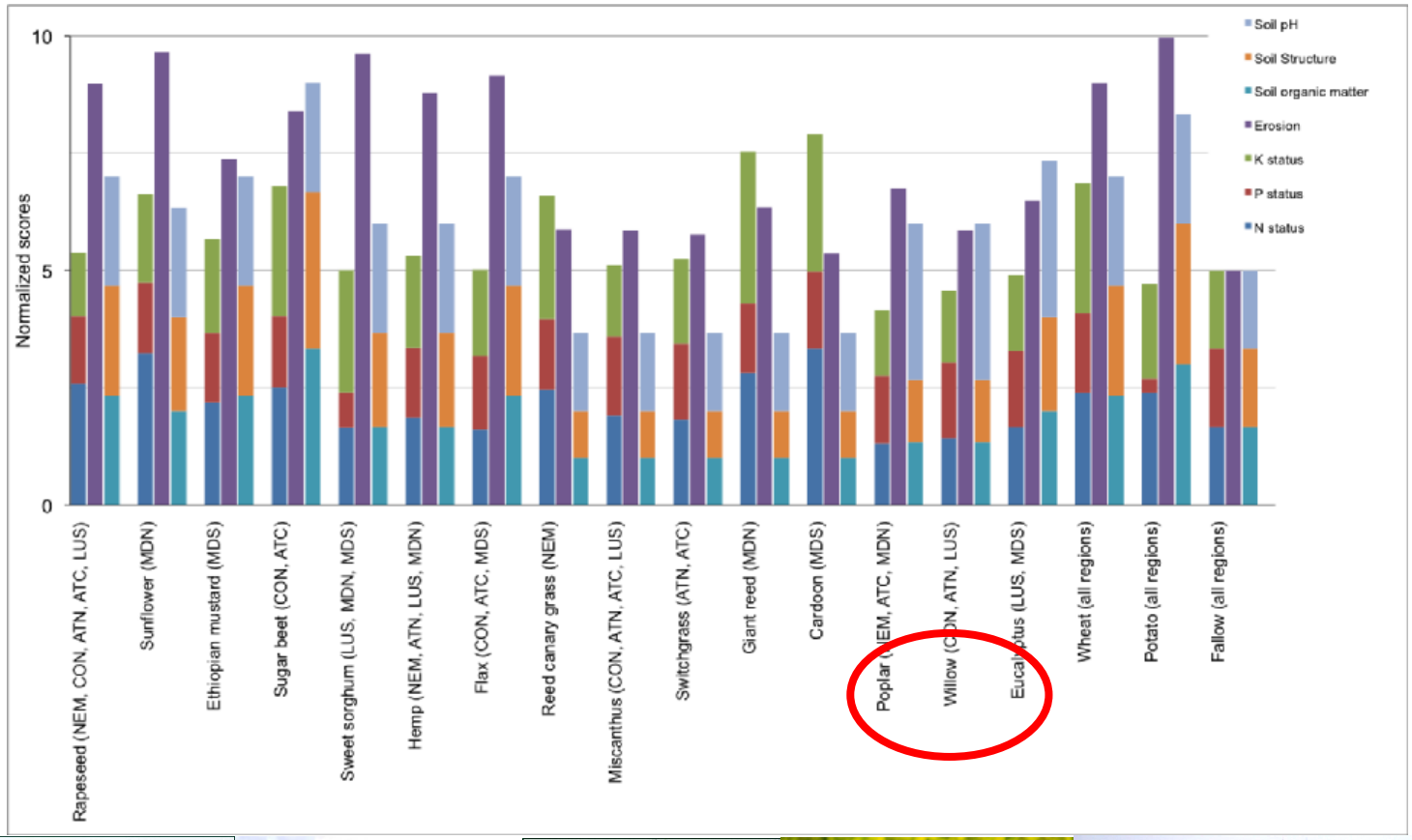
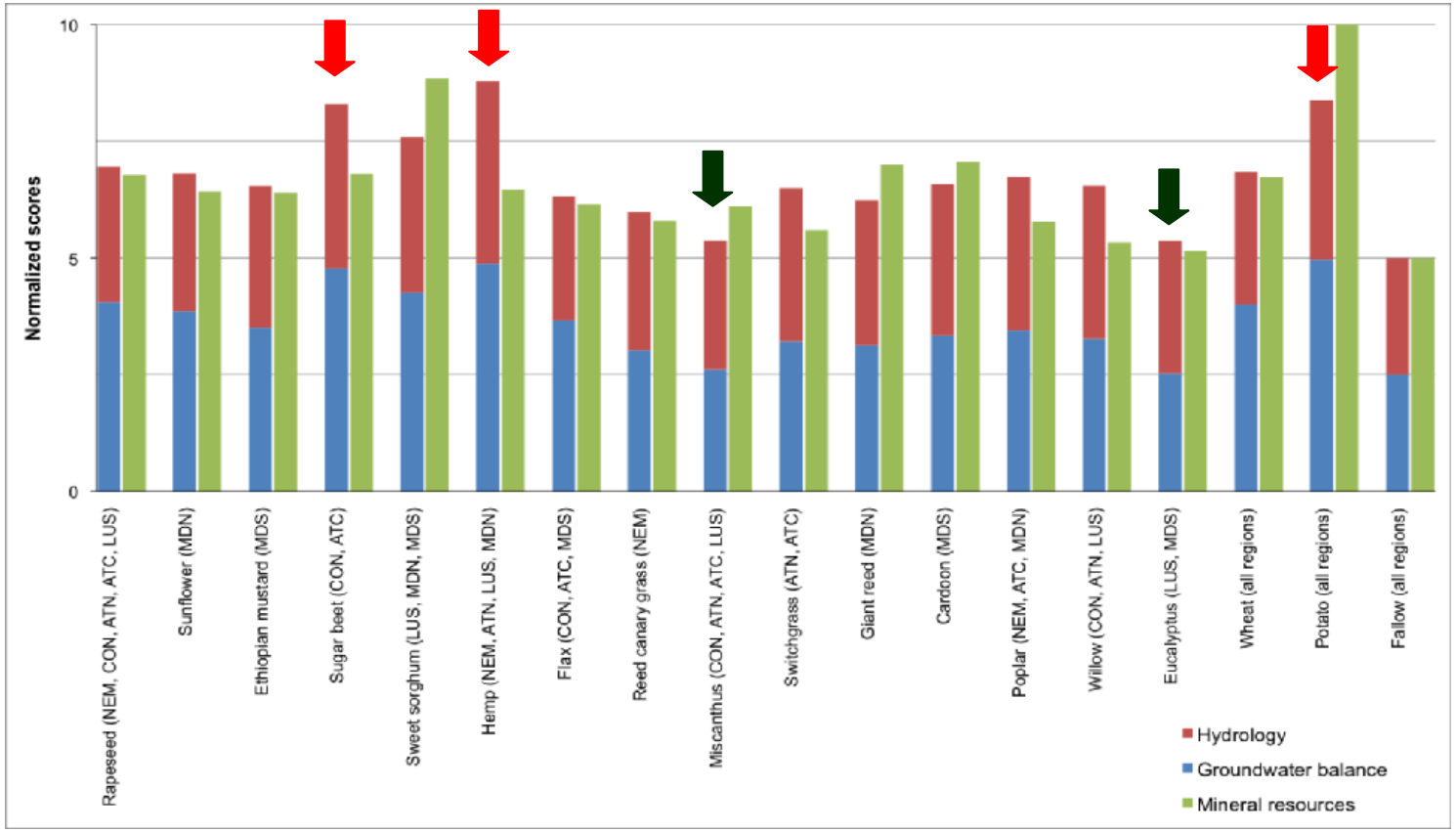
Impact on Soil – Soil Properties



⇨ **woody crops increase soil acidity**

Impact on water resources – water balance



⇨Most crops sufficed by rainfall

⇨ water depletion

⇨lowest impact

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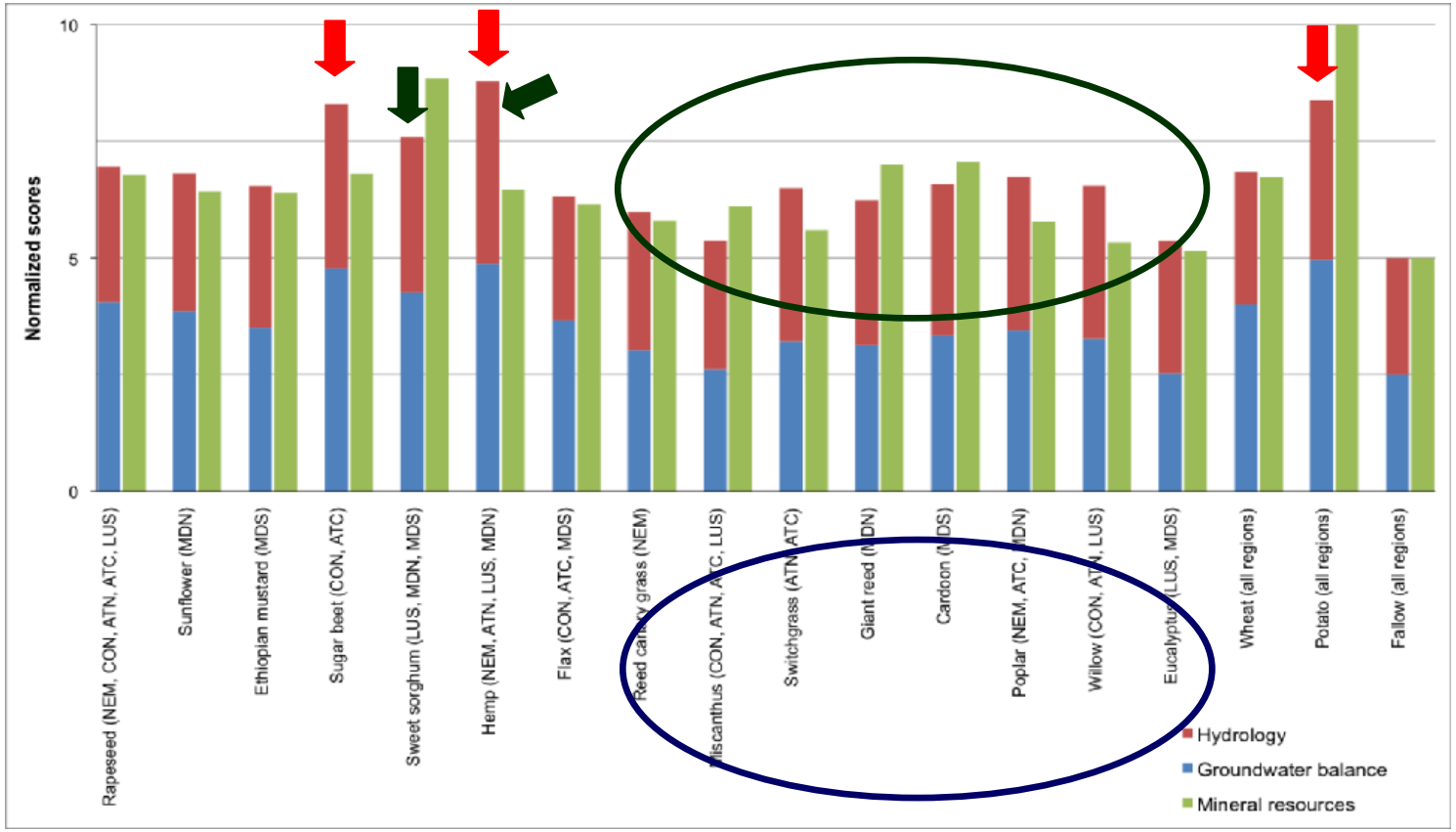
Impact on water resources - Hydrology



⇨ soil cover minimizes run-off

⇨ aquifer refilling:

⇨ high water needs

⇨ deeper roots

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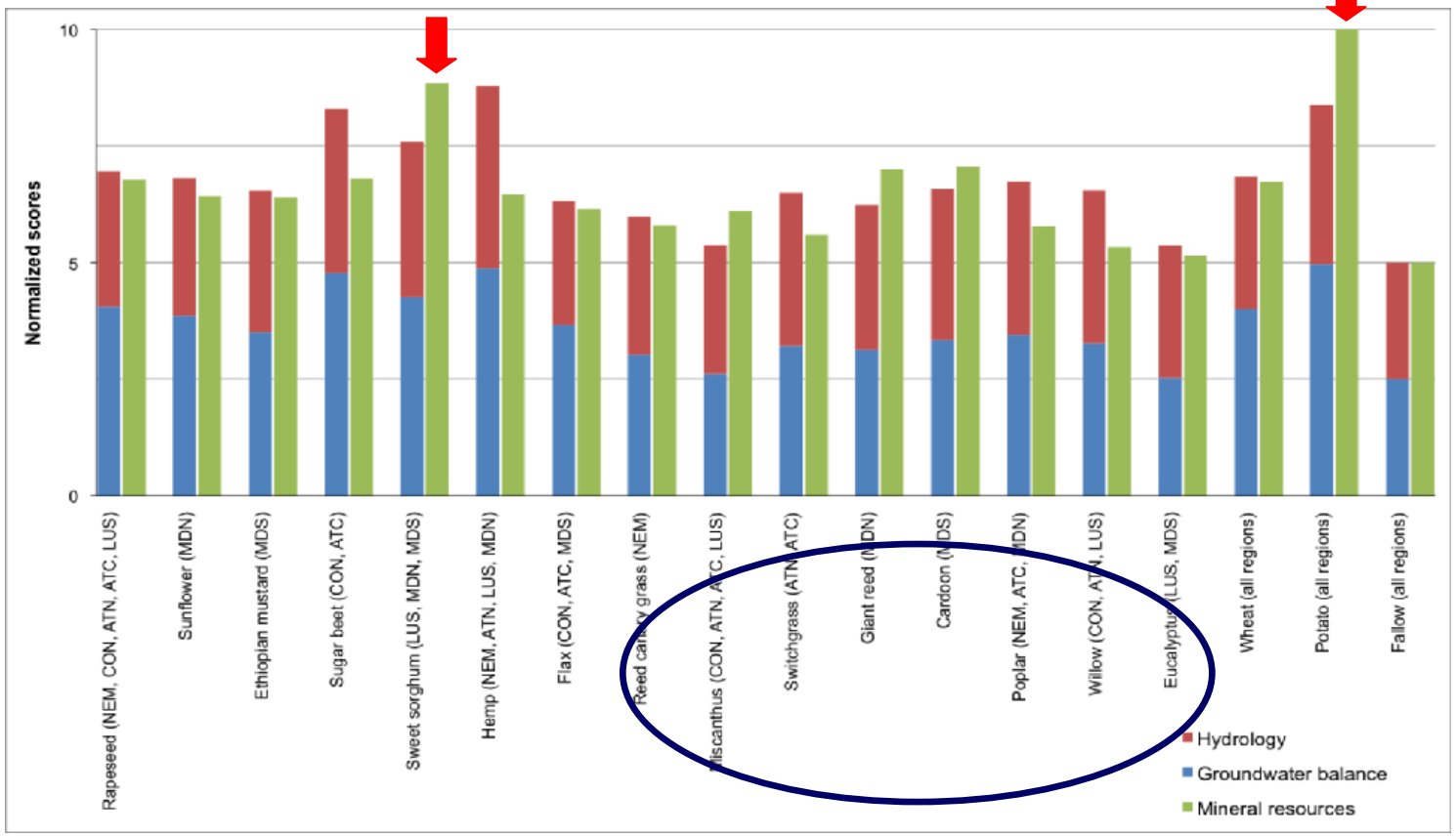
Impact on mineral resources



⇨less P and K demanding

⇨Differences to annuals not so significant

⇨ higher risk

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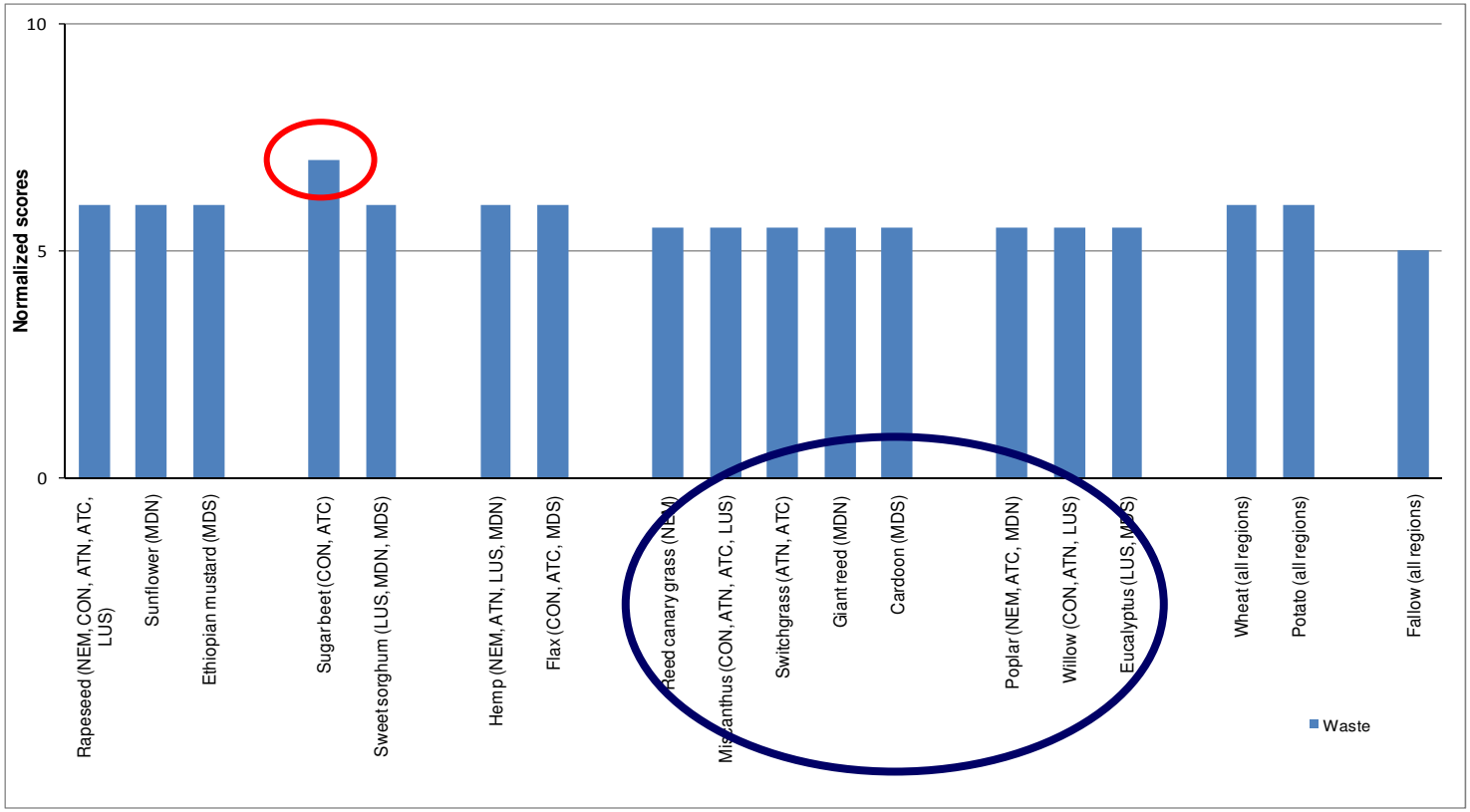
Waste production and use

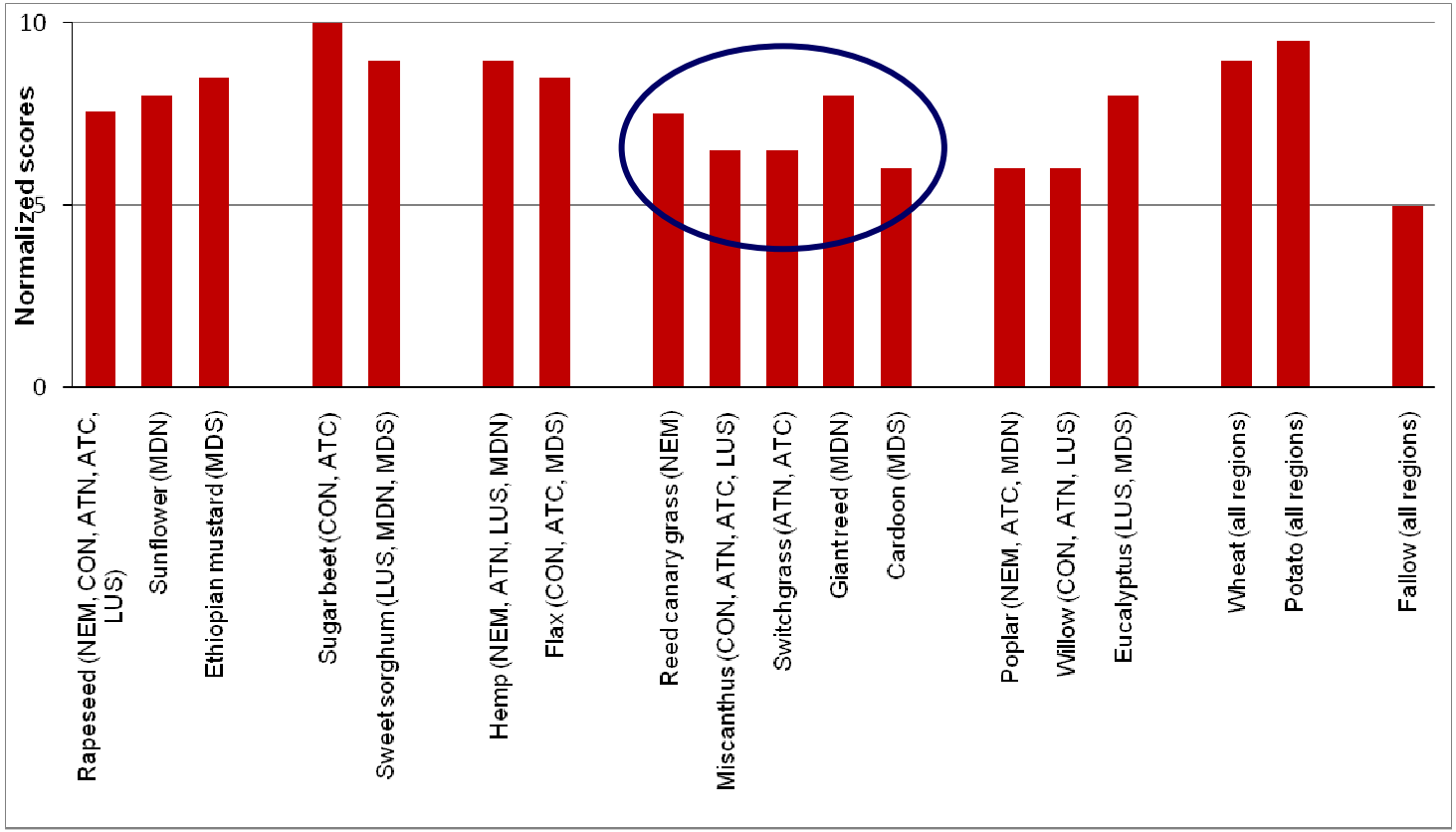


⇨ less waste, because less management intensive

⇨higher risk, soil sticking during harvest

⇨ all, apt remediators

Biodiversity

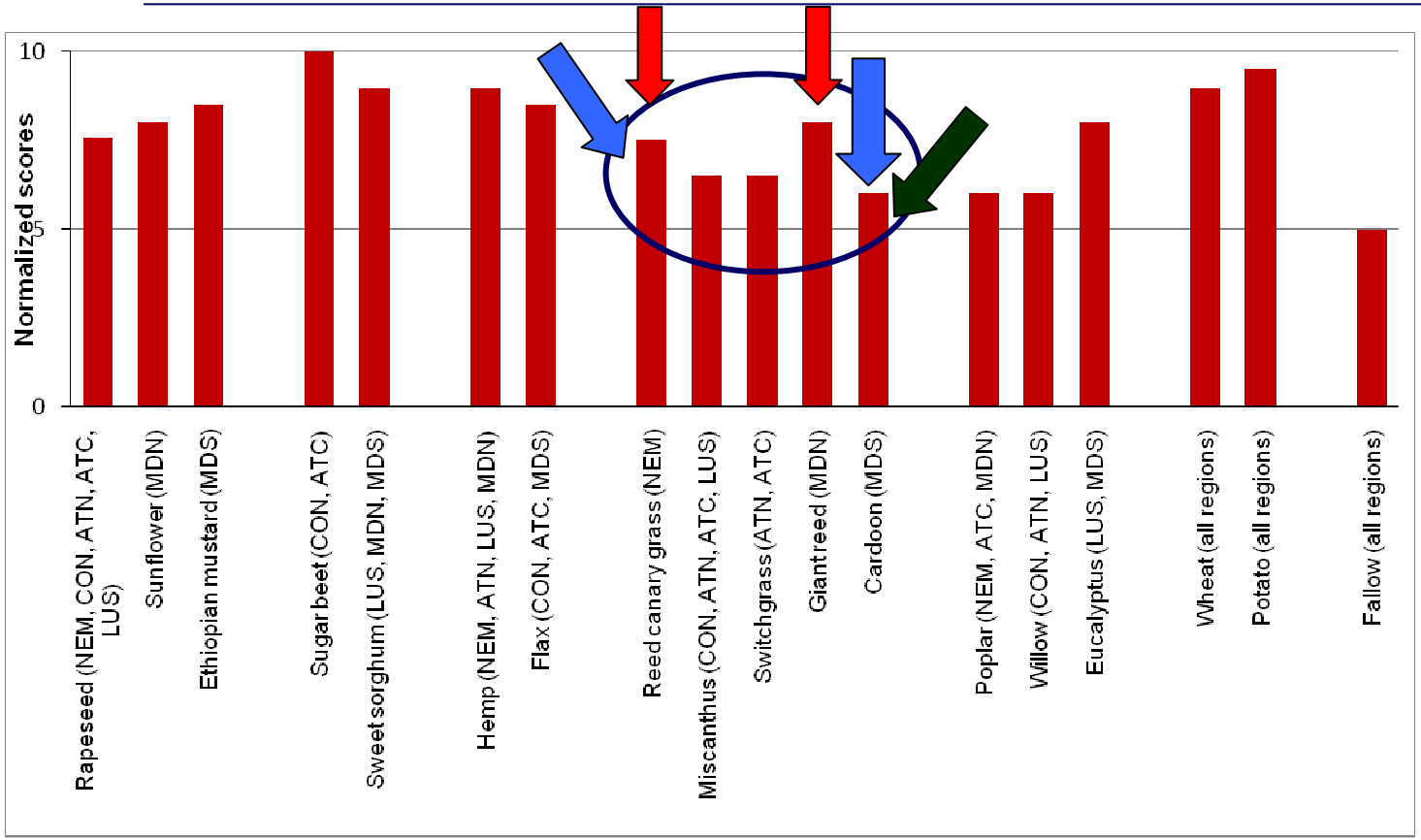


⇨ all crops, monoculture, infringement to biodiversity

⇨ reduced soil tillage, agrochemicals, high biomass

⇨ favors soil microfauna, gives shelter to invertebrates and birds

Biodiversity



⇨ aggressive

⇨ benefits from being native

⇨Blossoming give benefits

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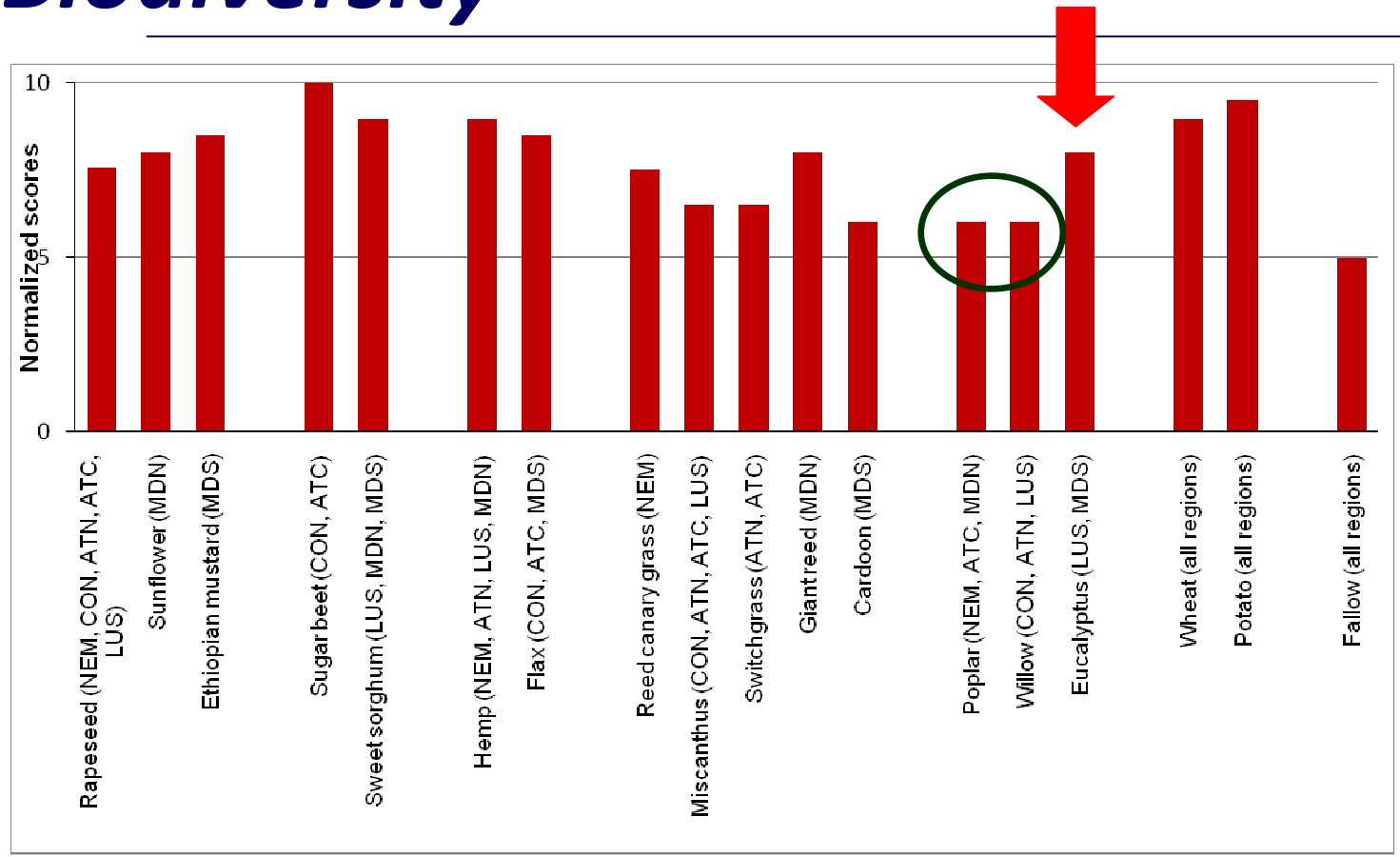
Biodiversity



⇨ reported to support more biodiversity then perennial herbaceous

⇨ Longer life cycle, structure

⇨ aggressive management and behavior, allelopathy

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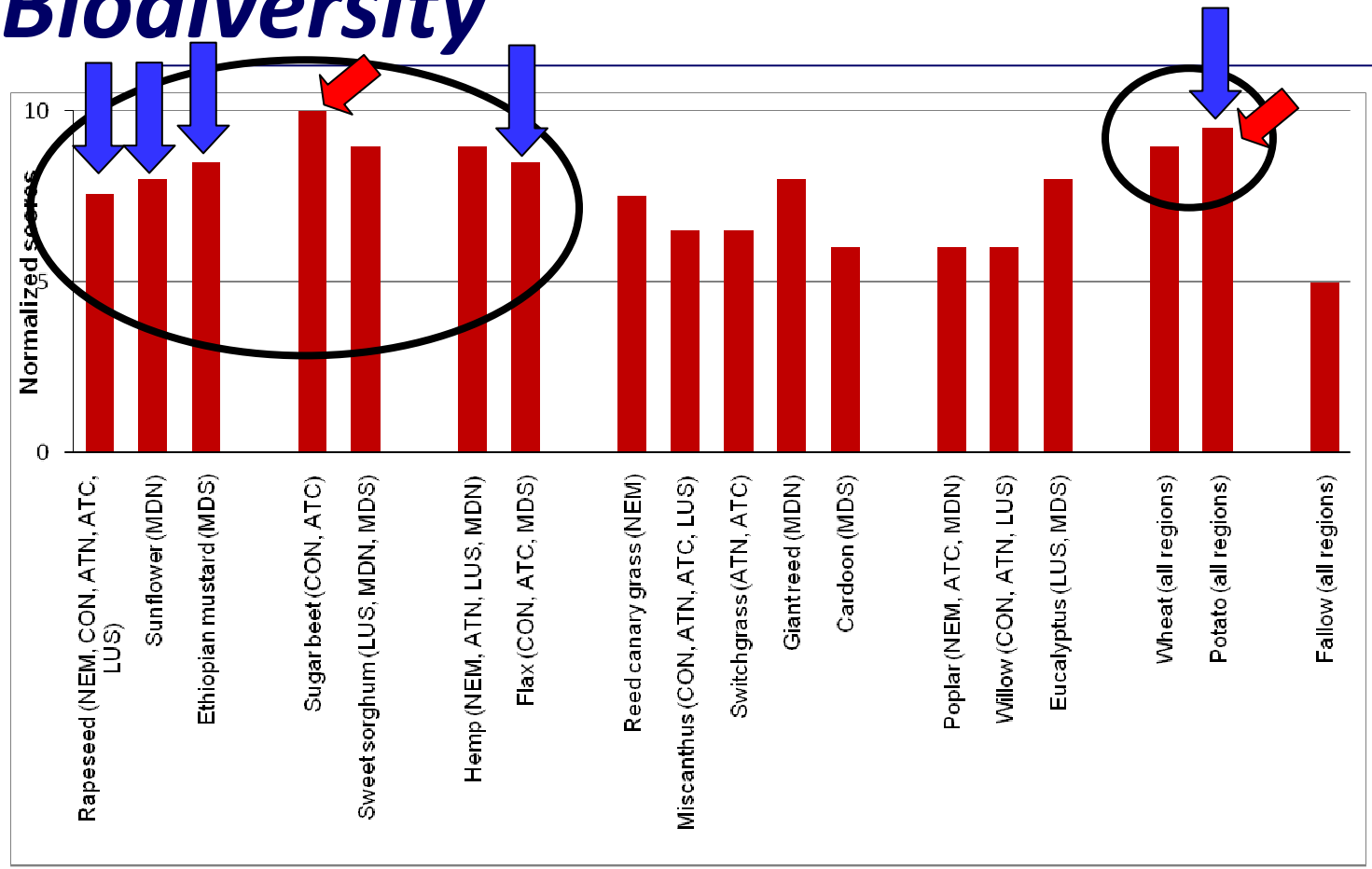
Biodiversity



⇨ annuals, biodiversity loss

⇨ short permanence on soil, intensive management

⇨Benefits from blossoming

⇨soil cover removal during harvest

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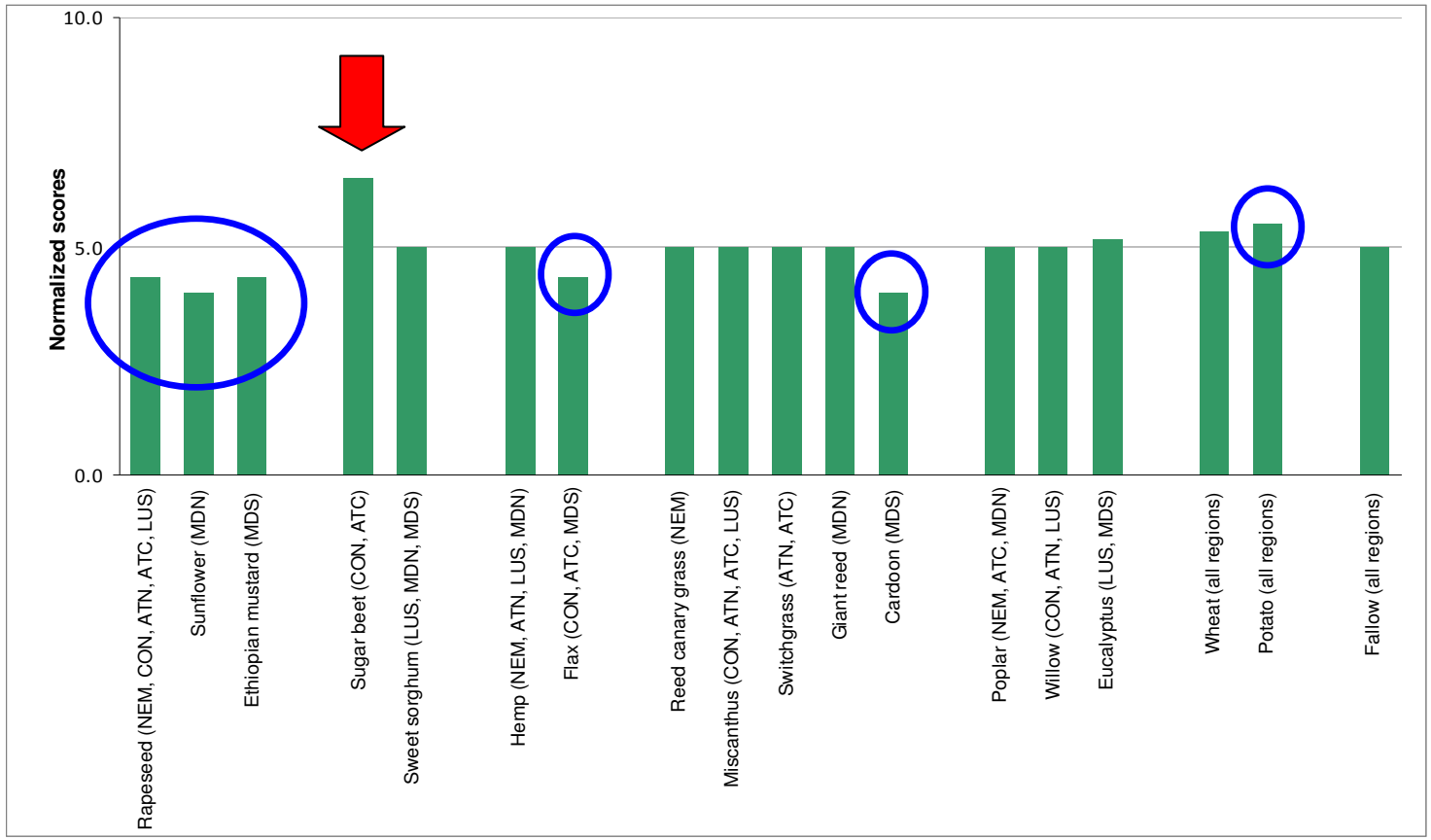
Landscape



⇨Structure

⇨Color

⇨blossoming crops - benefits

⇨highly uniform, ground-hugging crop

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Overall results - weighting

⇨ **WS1 - all indicators have the same weight**

⇨ **WS2 - greater emphasis on GHG emission drivers, namely N-fertilizer related emissions and soil degradation**

⇨ **WS3 - greater emphasis on biodiversity**

Highlited by EU policies

Overall results - weighting

⇨ **Erosion**

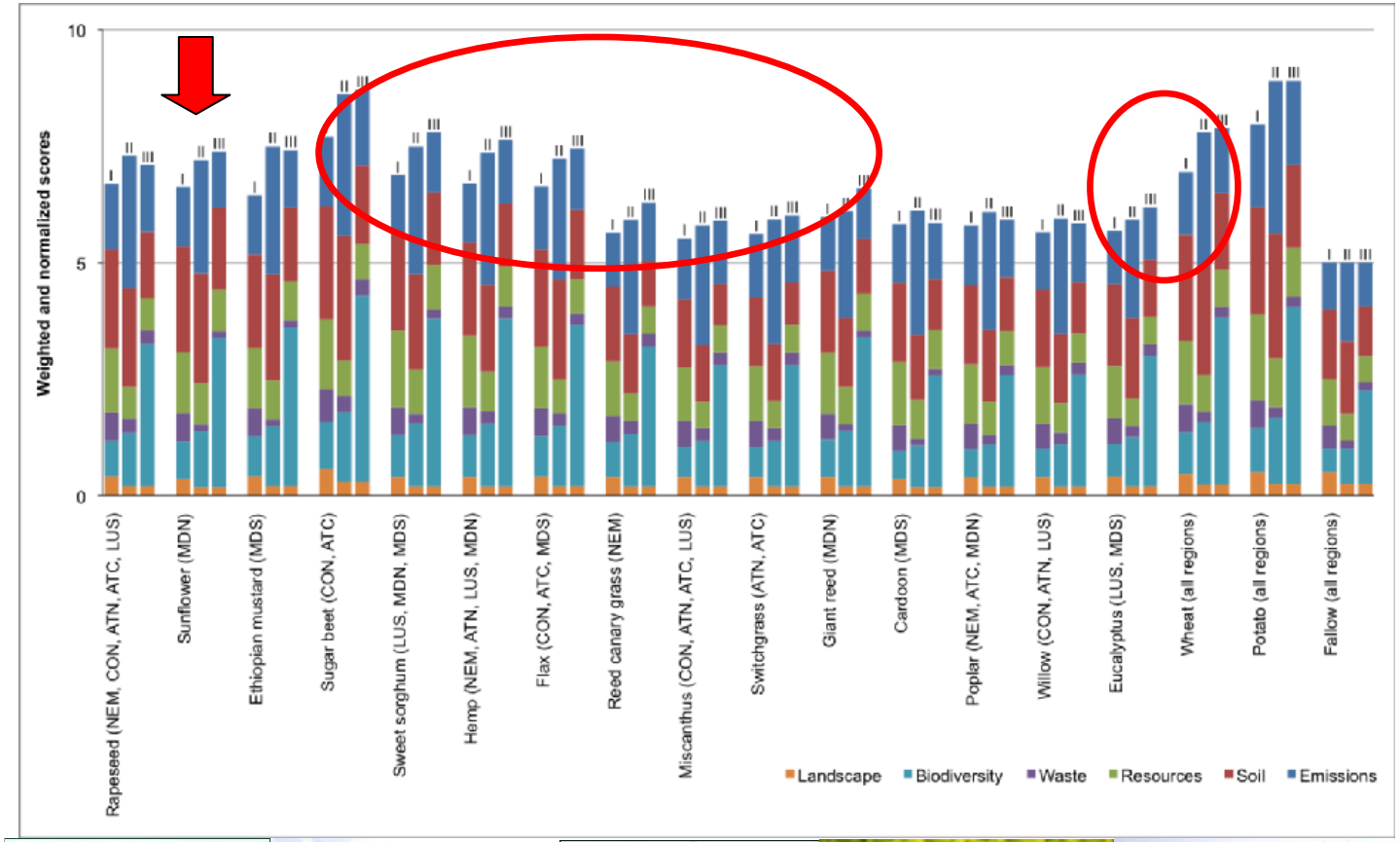
⇨ **Water availability**

} **Greater concern in the Mediterranean**

⇨ **Fertilizer emissions**

} **Deeper impacts in northern Europe**

Overall results



⇨ application of WS2 and WS3

⇨ aggravates de impact score of crops

⇨Emphasis on biodiversity inflicts higher impact

⇨But, weighting does not influence relative position of each crop

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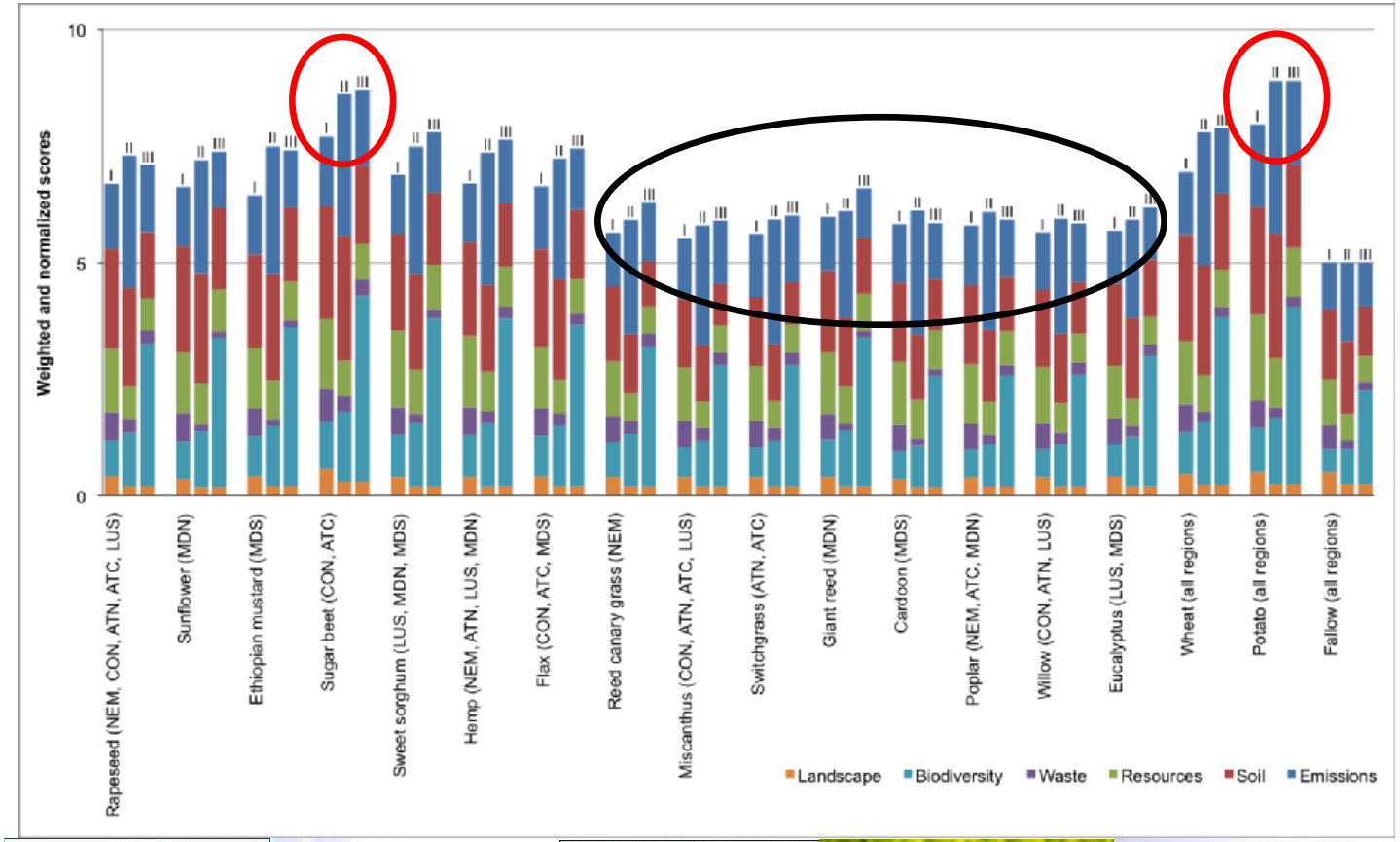
Overall results



⇨ lower overall impact

⇨crops with highest impact

⇨All, lower impact then potato

⇨All, but sugarbeet, lower impact then wheat

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Conclusions

⇨ growing energy crops does not inflict higher impact on the environment

⇨compared to wheat and potato farming for food, traditional crops in Europe

(Regarding the studied categories)

Conclusions

⇨ Annual crops

⇨ More impact on the environment

⇨ markedly due to biodiversity and erosion

⇨ Annual and woody crops

⇨ more damaging to soil quality

⇨ Differences among crop types, not so evident for the remaining categories

Conclusions

⇨ Impact reduction strategies

⇨ Limited to crop management options

⇨ Influences emissions, nutrient status and mineral ore depletion

⇨ Other, are site-specific dependent

⇨ Intertwined with crop traits

⇨ Adequacy crop-location – important issue

Thank you

for your attention