

# Assessment of Sustainable Crop Residue Potentials in BioenNW Regions

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The BioenNW Project Final International Conference  
**Bioenergy Networks and Biomass Potentials – Valorising  
European Organic Residues**

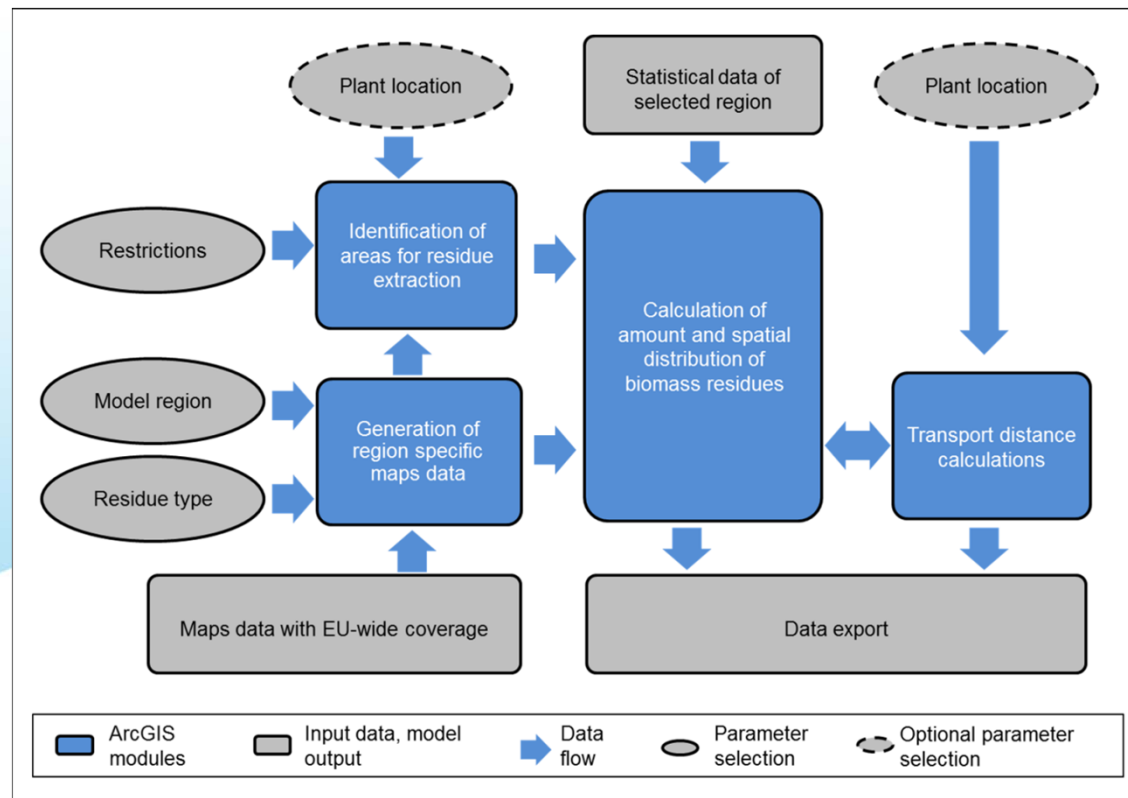
September 24<sup>th</sup> 2015, Brussels

- Introduction
- GIS-based model
  - Overview
  - Model regions
  - Input data
- Selected Results
  - Calculation of cereal straw potential in Wallonia
  - Sustainable crop residue potentials in BioenNW regions
- Conclusions

- Several assessment studies on crop residue potentials exist
  - Mainly for large regions or for distinct regions in one country
  - Mainly for cereal straw
  - Differing underlying methods and assumptions
- Novel GIS-based approach for the assessment of organic residues
  - Spatially high-resolution inventory assessment
  - Consideration of environmental sustainability criteria
  - Uniformly applicable methodology for European regions

- Residue types assessed
  - Agricultural residues
    - Residues from crop production
    - Residues from animal husbandry
    - Surplus grass cuttings (Daniel Ketzer)
  - Urban Waste
    - Green Waste
    - Kitchen Waste
    - Paper waste
    - Wood waste
  - Forest residues
    - Residual forest wood (Dr. Ahssem Almehasneh)

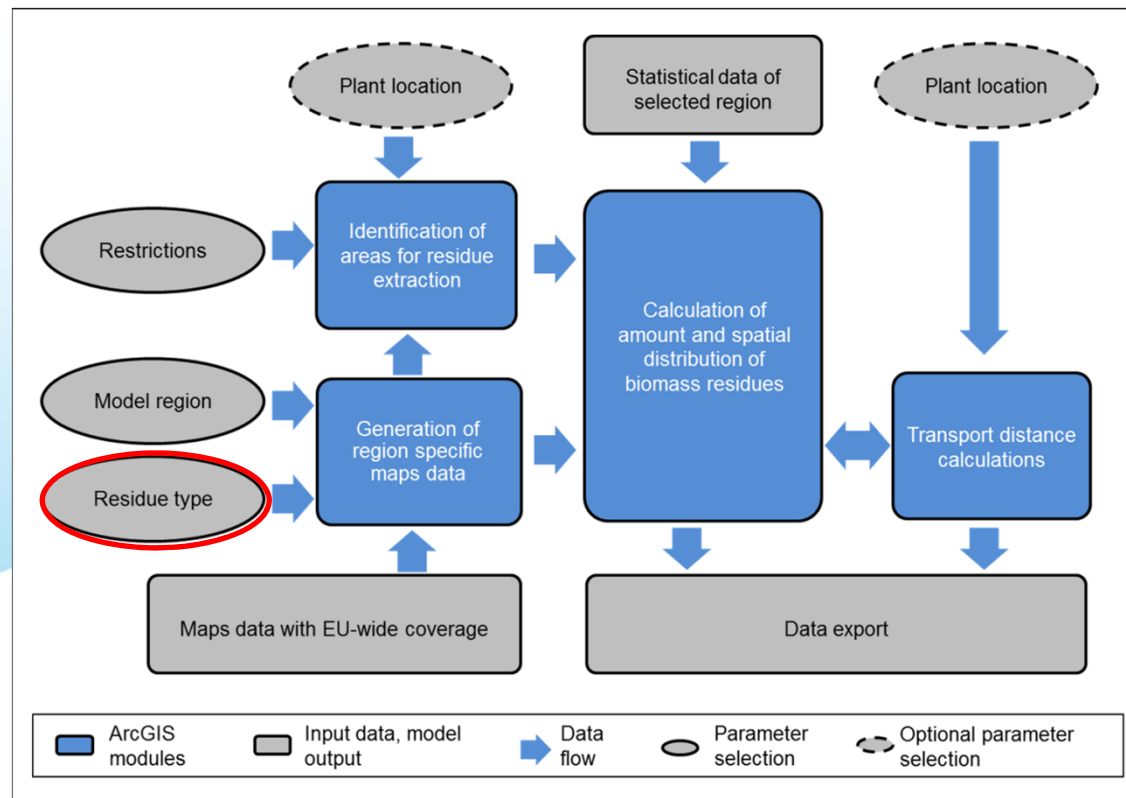
# GIS-based model – Overview



**Fig. 1**

# GIS-based model – Overview

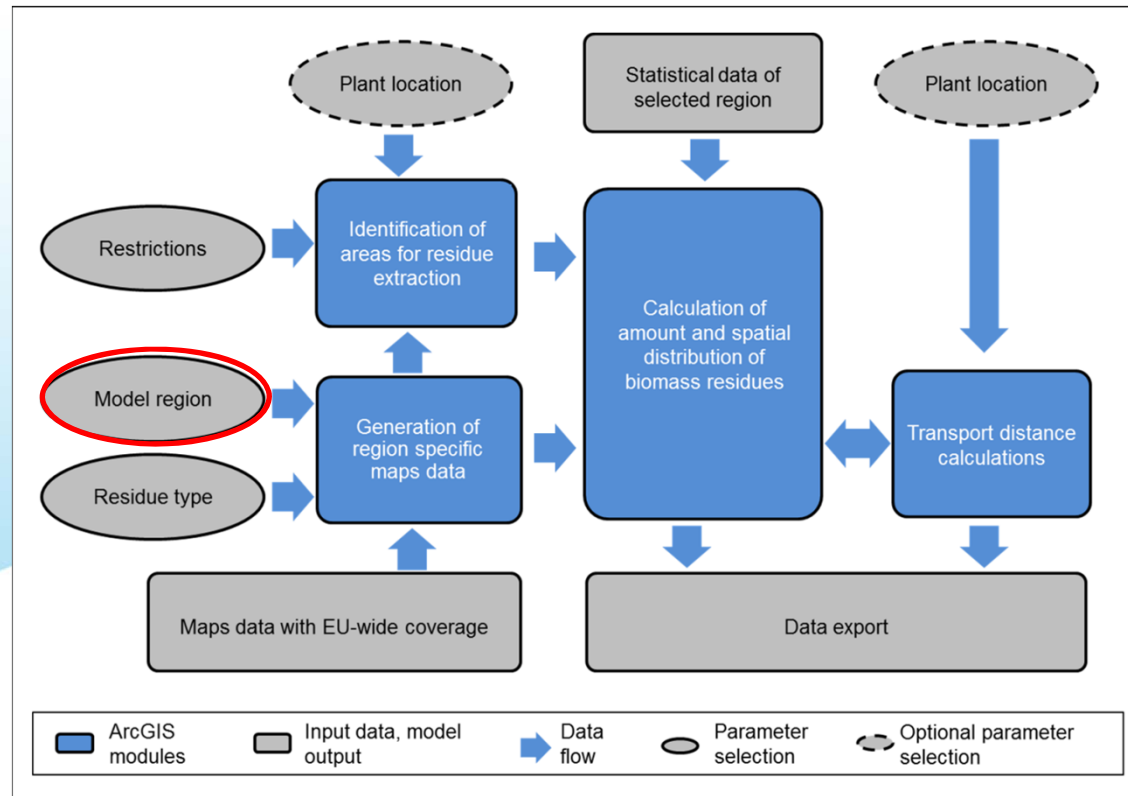
- Agricultural residues



**Fig. 1**

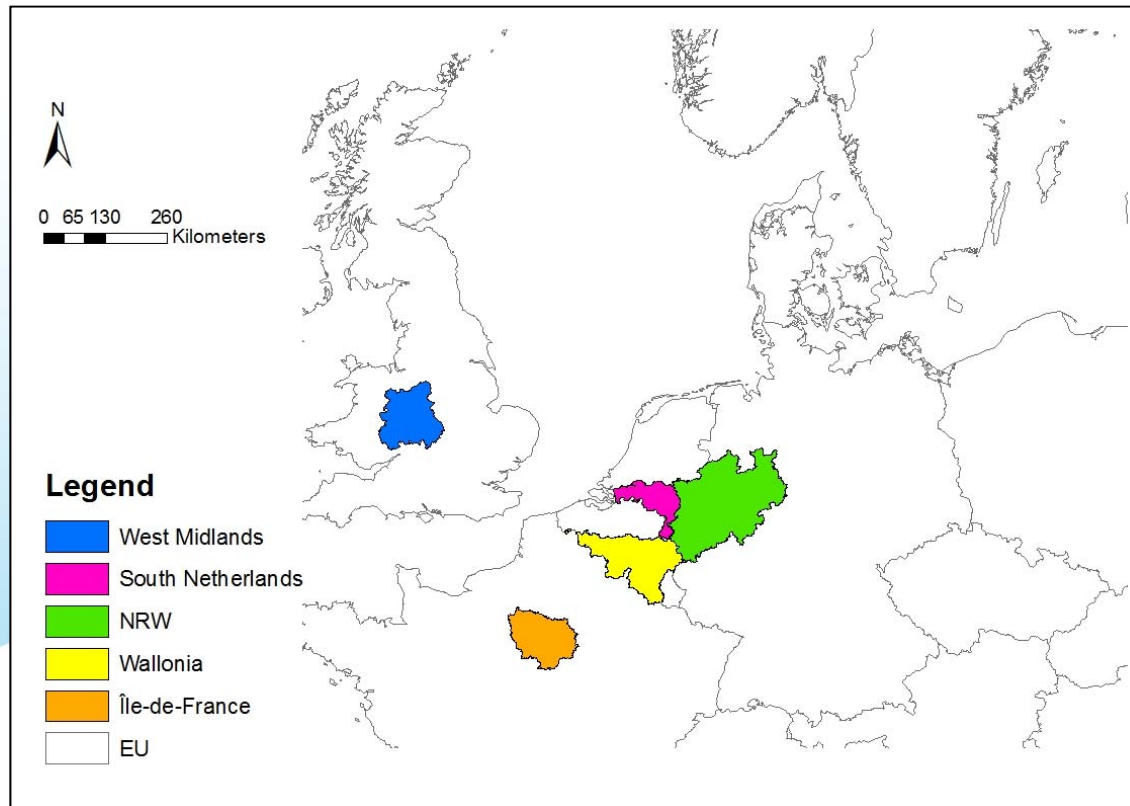
- Residues from crop production
  - Cereal straw
  - Root crop residues
  - Oil plant residues
- Residues from animal husbandry
  - Solid Manure Cattle/Pigs/Shep
  - Liquid Manure Cattle/Pigs
- Residues from pastures
  - Surpluss grass cuttings

# GIS-based model – Overview



**Fig. 1**

# GIS-based model – Model regions (1)

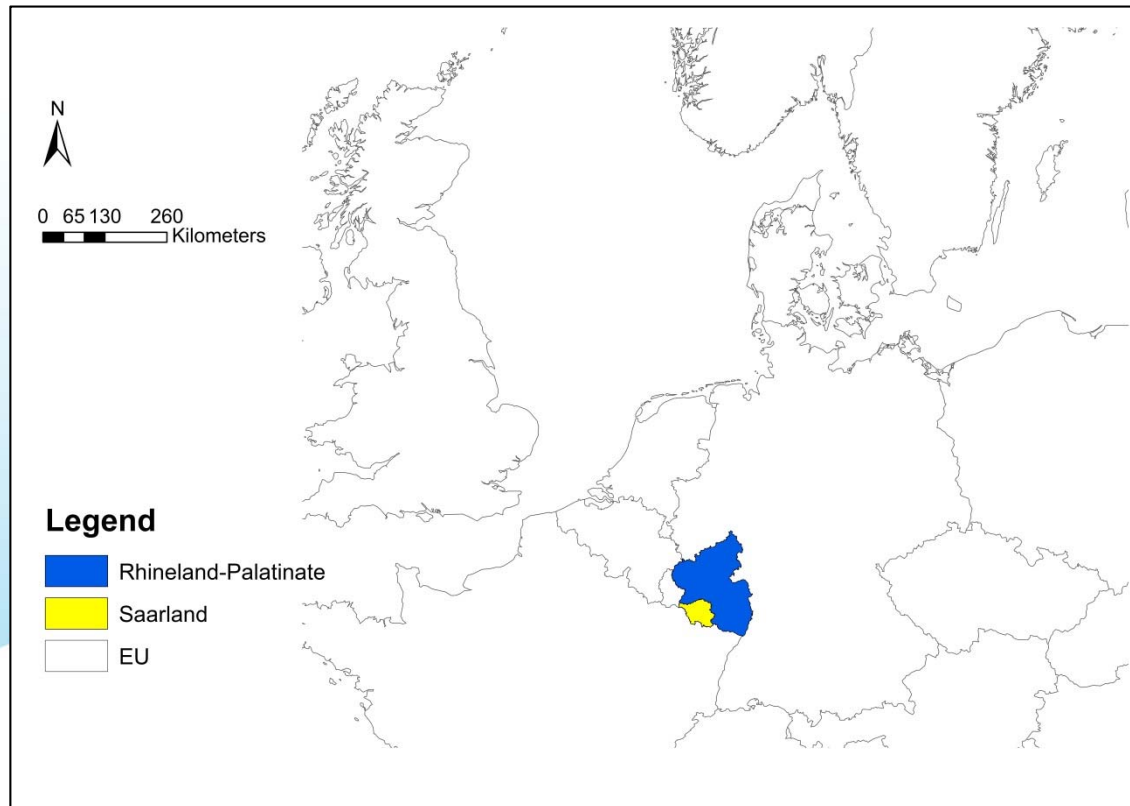


- Model regions (NUTS<sup>1</sup> 1)

**Fig. 2**

<sup>1</sup>Nomenclature of Units for Territorial Statistics

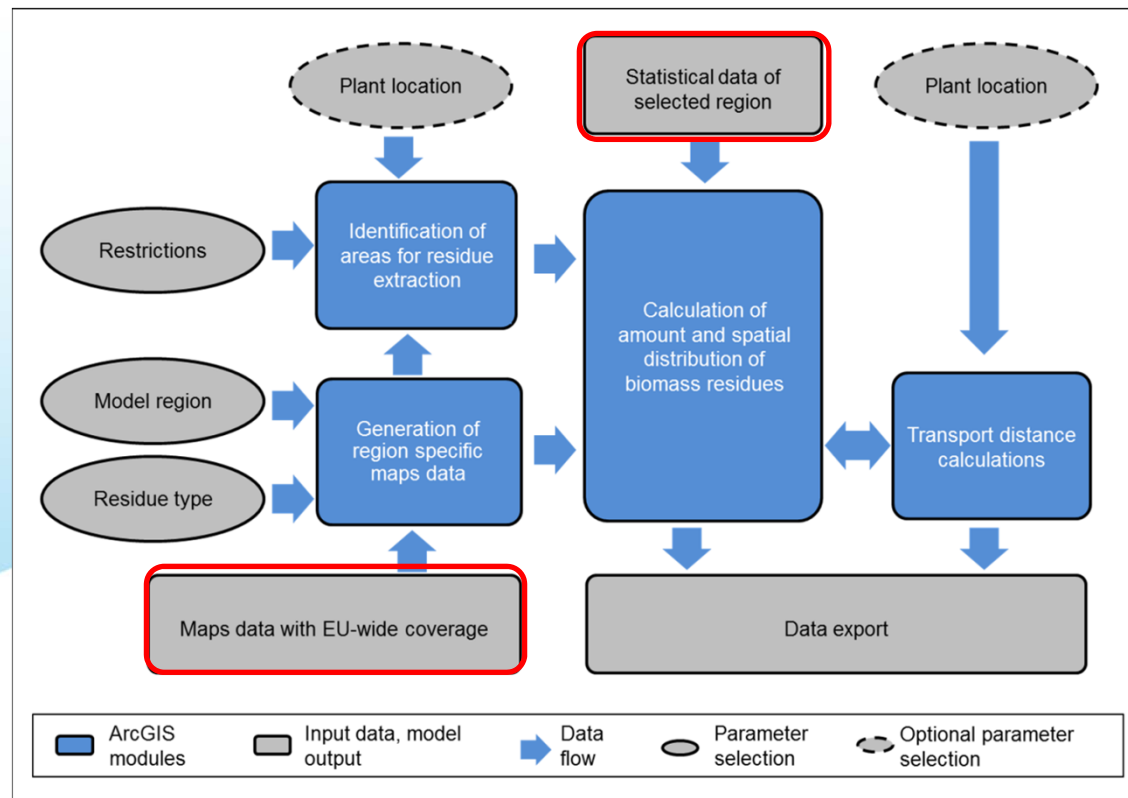
## GIS-based model – Model regions (2)



- Case study regions  
(NUTS<sup>1</sup> 1 level)

**Fig. 3**

# GIS-based model – Overview

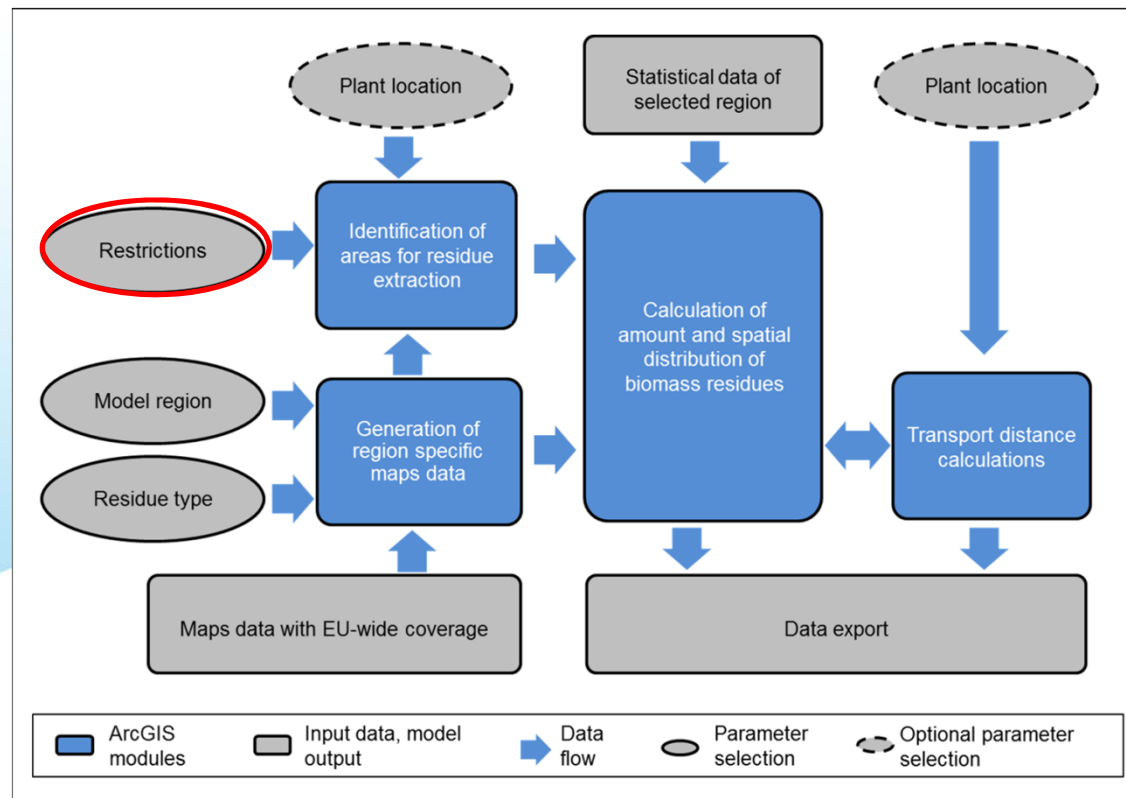


**Fig. 1**

## GIS-based model – Input data

- Statistical data for crop residues
  - Arable area
  - Crop area
  - Crop yield
  - Residue-to-Product-Ratio (RPR)
  - Water content
  - Heating value
- Maps data for crop residues
  - Data on land cover
    - Arable areas,
    - Areas covered with a certain crop
  - Sustainability criteria
    - Soil organic carbon content
    - Soil erodibility
    - Protected areas

# GIS-based model – Overview



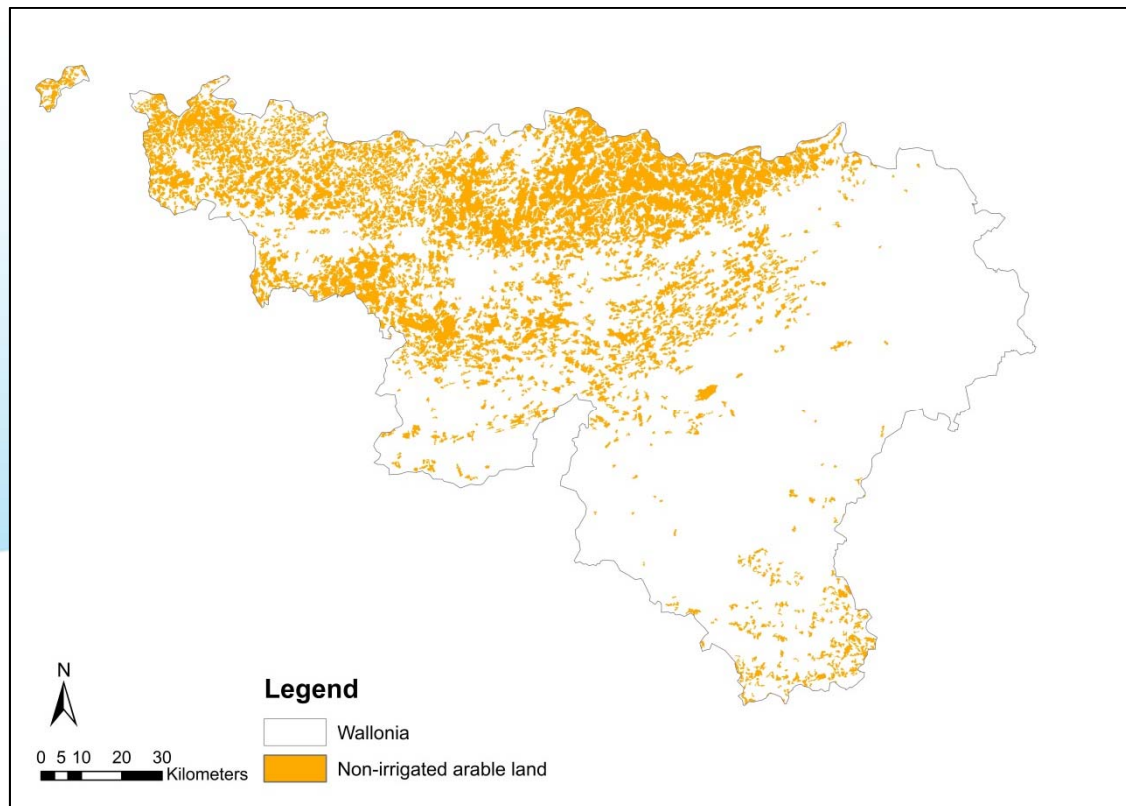
**Fig. 1**

- Restrictions for the calculation of sustainable crop residue potentials

| Scenario Basis                                                                                                                                                                                                                                                                                                 | Scenario Restrict                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Restrictions for residue extraction as a function of organic carbon content in topsoil</p> <ul style="list-style-type: none"> <li>60 % ground cover if <math>C_{org}</math> in topsoil <math>\leq 6</math> %</li> <li>30 % ground cover if <math>C_{org}</math> in topsoil <math>&gt; 6</math> %</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                     |
|                                                                                                                                                                                                                                                                                                                | <p>Exclusion of arable areas for residue extraction</p> <ul style="list-style-type: none"> <li>Exclusion of protected areas (IUCN categories Ia, Ib, II, III, IV)</li> <li>Exclusion of areas with high risk of soil erosion (Erodibility "very strong")</li> <li>Exclusion of areas with organic carbon content (<math>C_{org}</math>) in topsoil <math>\leq 2\%</math></li> </ul> |

# Selected Results – Calculation of cereal straw potential in Wallonia

- Maps data on Arable Areas

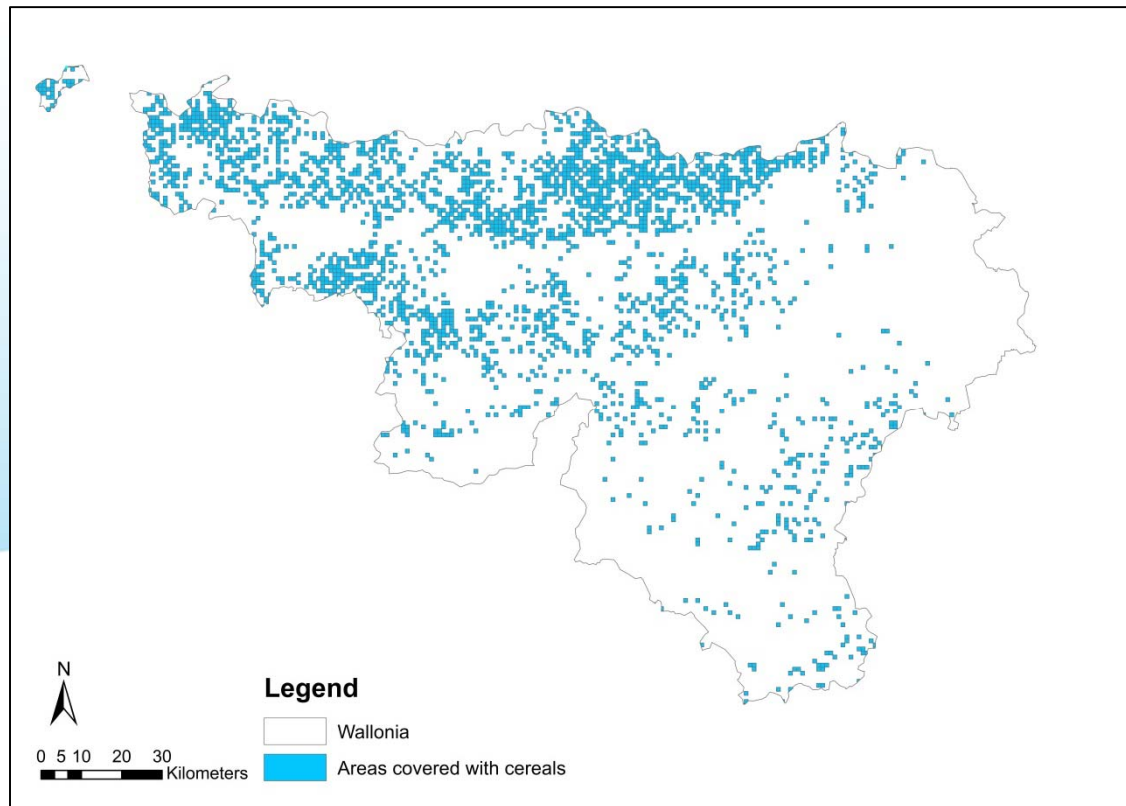


- Data source: CORINE<sup>7</sup> land cover 2006 (EEA)
- Raster data 100 m x 100 m

**Fig. 4**

## Selected Results – Calculation of cereal straw potential in Wallonia

- Maps data on areas covered with cereals

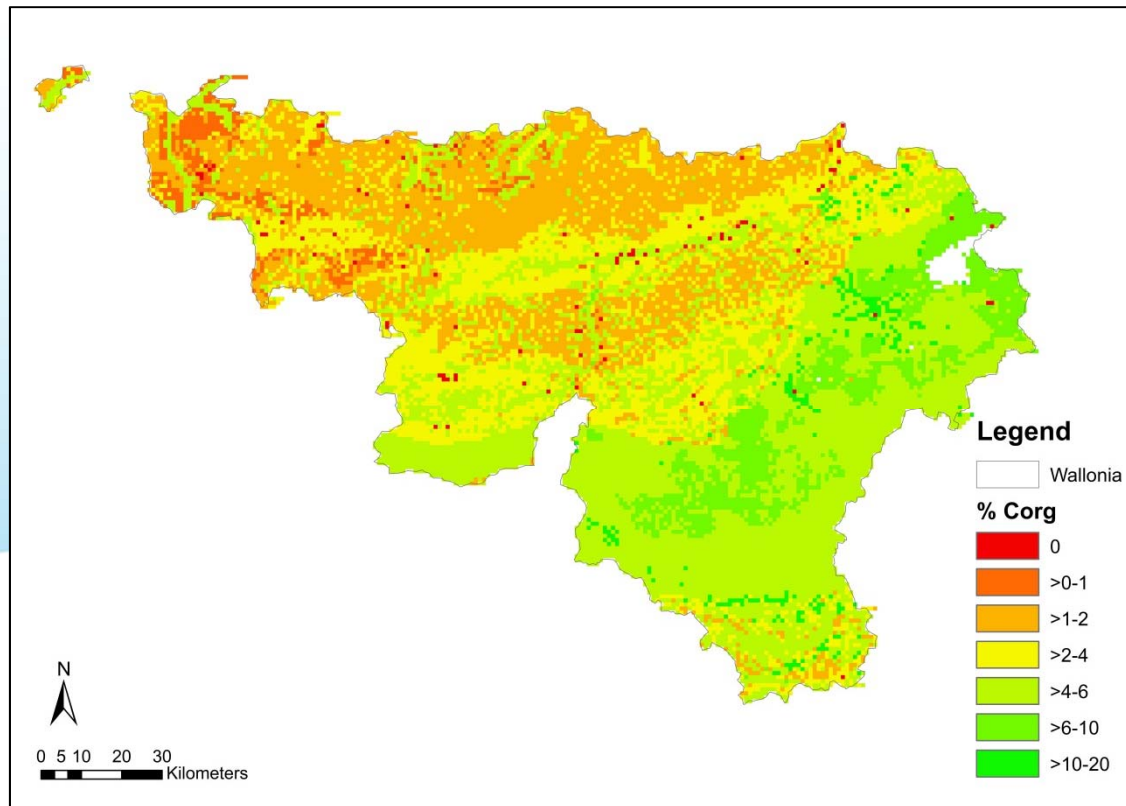


- Data source: Capri<sup>8</sup> crop datasets (EFSA)
- Raster Data 1 km<sup>2</sup>

**Fig. 5**

## Selected Results – Calculation of cereal straw potential in Wallonia

- Maps data on soil organic carbon content (sustainability criteria)

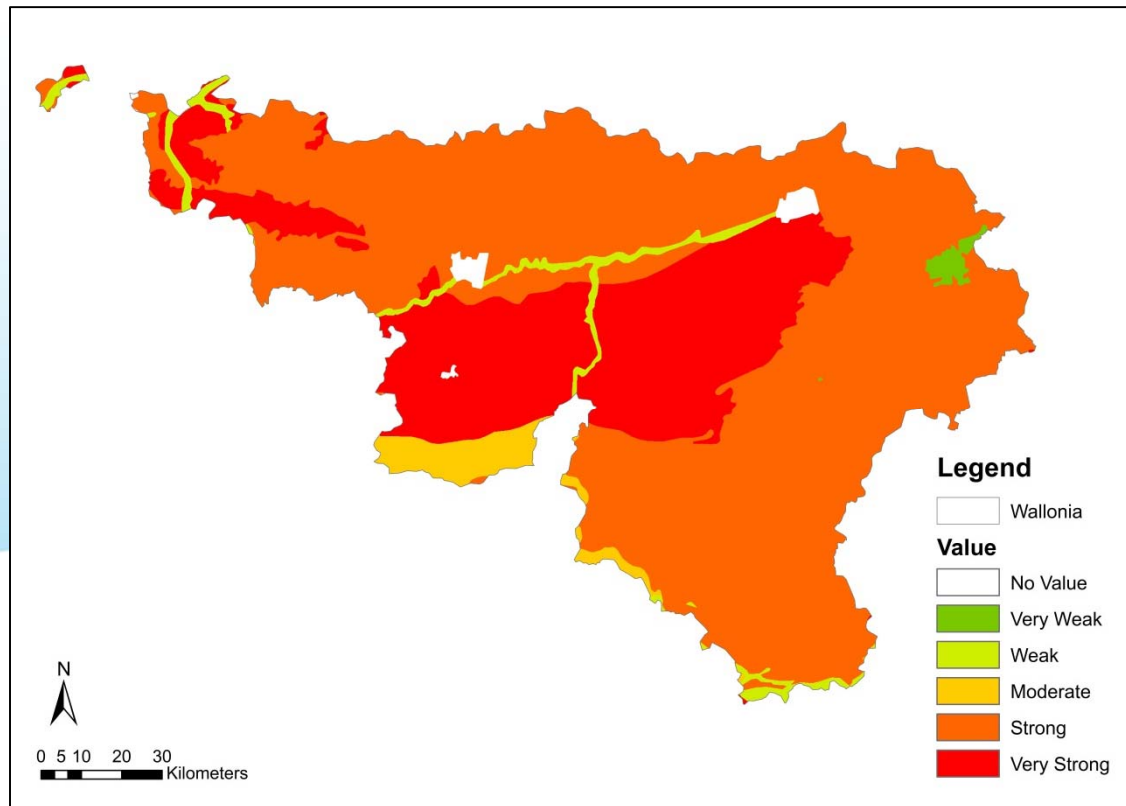


- Data source: European Soil Database (EC, JRC)
- Raster Data 1 km<sup>2</sup>

**Fig. 6**

# Selected Results – Calculation of cereal straw potential in Wallonia

- Maps data on soil erodibility (sustainability criteria)

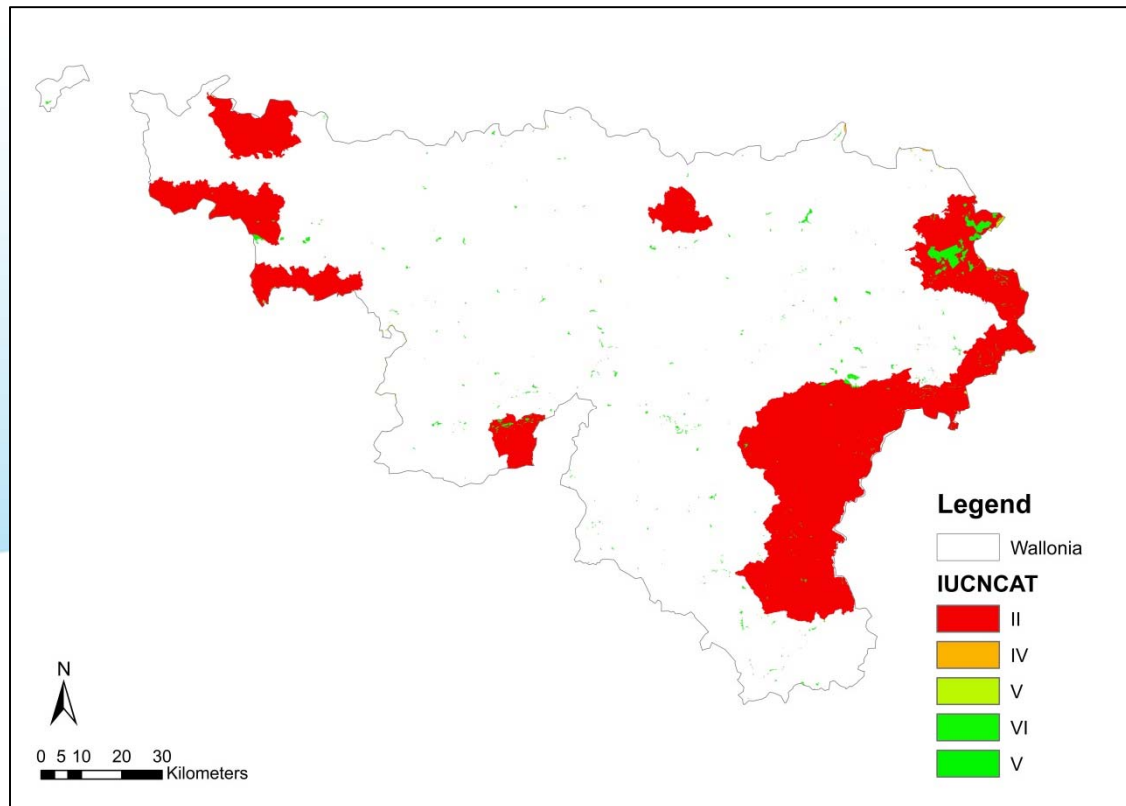


- Data source: European Soil Database (EC, JRC)
- Polygon Data

**Fig. 7**

# Selected Results – Calculation of cereal straw potential in Wallonia

- Maps data on protected areas (sustainability criteria)

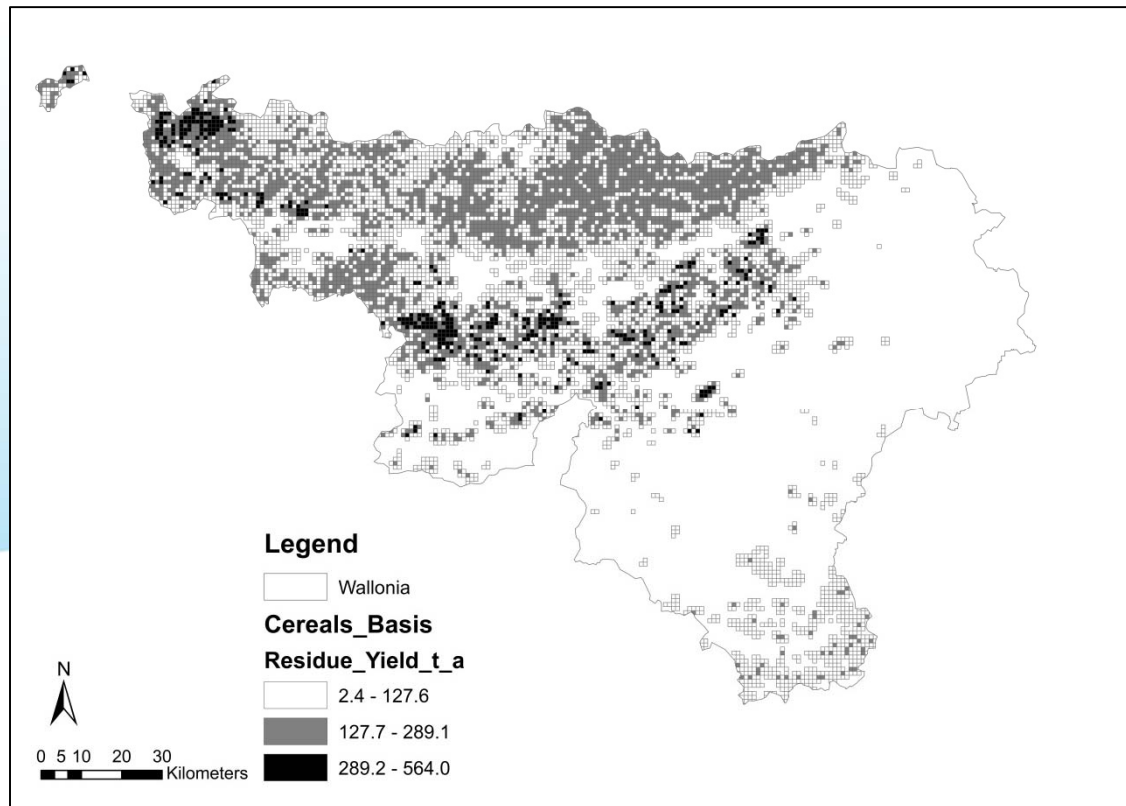


- Data source: Common Database on Designated Areas (EEA, IUCN<sup>9</sup>)
- Polygon Data

**Fig. 8**

# Selected Results – Calculation of cereal straw potential in Wallonia

- Spatial distribution of cereal straw in Wallonia

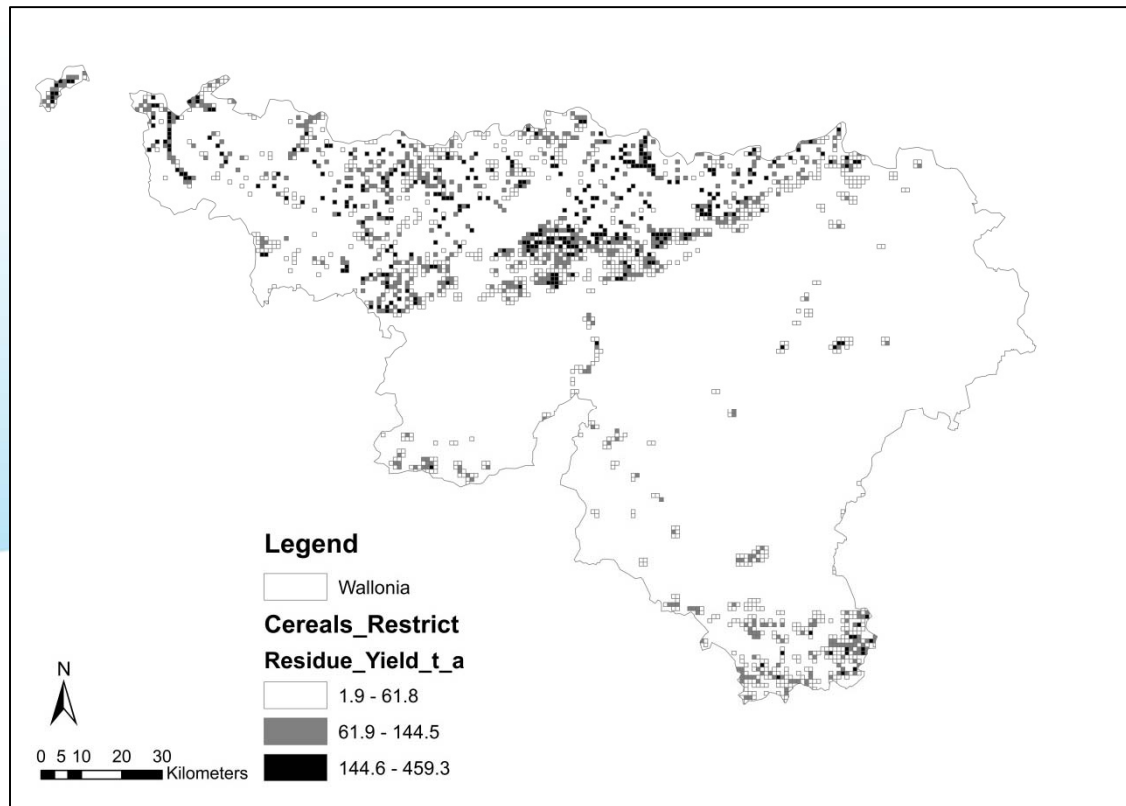


- Scenario Basis
- EEA reference grid (1 km x 1 km grid cells)

**Fig. 9**

# Selected Results – Calculation of cereal straw potential in Wallonia

- Spatial distribution of cereal straw in Wallonia



- Scenario Restrict
- EEA reference grid  
(1 km x 1 km grid  
cells)

**Fig. 10**

# Selected Results – Sustainable crop residue potentials in BioenNW regions

- Results for cereal straw, root crop residues, oil plant residues (Scenario Basis, RPR max)

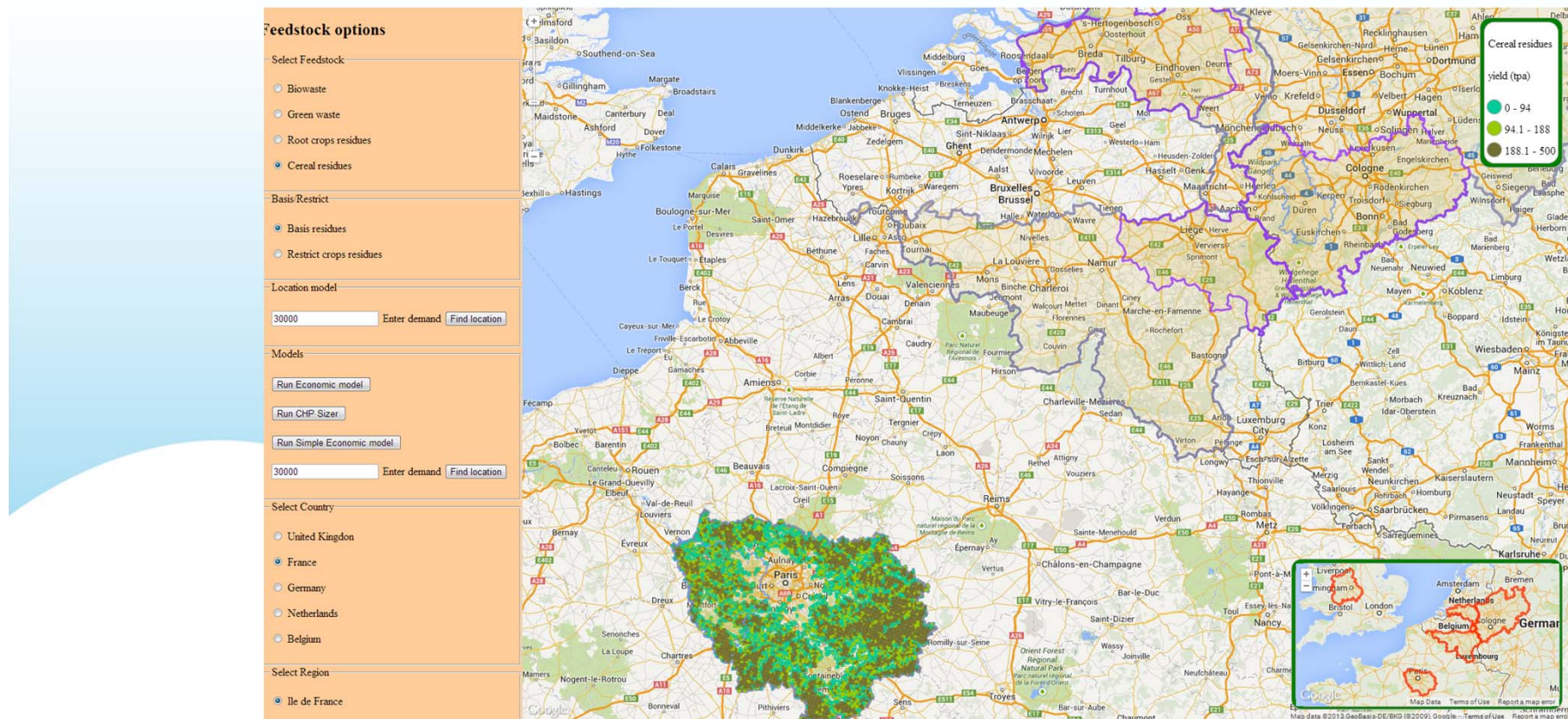
|                          |                     | Wallonia  | NRW       | Île-de-France | West Midlands | South Netherlands |
|--------------------------|---------------------|-----------|-----------|---------------|---------------|-------------------|
| Total area of the region | ha                  | 1,684,400 | 3,409,226 | 1,196,000     | 1,257,200     | 1,043,400         |
| Cereal Straw             | t <sub>wet</sub> /a | 997,074   | 3,234,620 | 1,573,521     | 983,533       | 242,666           |
|                          | GJ/ha               | 8.5       | 13.5      | 18.8          | 11.2          | 3.3               |
| Root Crop Residues       | t <sub>wet</sub> /a | 1,291,838 | 1,384,153 | 994,483       | 241,168       | 600,979           |
|                          | GJ/ha               | 1.3       | 0.7       | 1.4           | 0.3           | 1.0               |
| Oil Plant Residues       | t <sub>wet</sub> /a | 159,716   | 510,911   | 619,471       | 334,171       | 2,105             |
|                          | GJ/ha               | 1.4       | 2.2       | 7.4           | 3.8           | 0.03              |

# Selected Results – Sustainable crop residue potentials in BioenNW regions

- Comparison with existing usage: Cereal straw demand for animal husbandry (specific CSD med 1.4 t/(animal\*a))

|                                                                                   |                     | Wallonia | NRW       | Île-de-France | West Midlands | South Netherlands |
|-----------------------------------------------------------------------------------|---------------------|----------|-----------|---------------|---------------|-------------------|
| Sustainable Cereal straw potential (Scenario Basis)                               | t <sub>wet</sub> /a | 997,074  | 3,234,620 | 1,573,521     | 996,179       | 231,838           |
|                                                                                   |                     |          |           |               |               |                   |
| Cereal straw demand for animal husbandry                                          | t <sub>wet</sub> /a | 794,663  | 645,979   | 11,751        | 498,101       | 593,918           |
|                                                                                   |                     |          |           |               |               |                   |
| Sustainable cereal straw potential available for energy purposes (Scenario Basis) | t <sub>wet</sub> /a | 202,411  | 2,588,641 | 1,561,770     | 498,078       | -                 |
|                                                                                   | %                   | 20       | 80        | 99            | 50            | -                 |

- Model results as input data for decision support tool (DST)
  - Geospatial resource location



- Crop residues for sustainable decentralized energy conversion
- GIS-based approach for biomass potential estimations
  - Amount and spatial distribution of biomass
  - Spatially differentiated sustainability restrictions
  - Identification of suitable biomass plant sites
- Uncertainties for crop residue potentials
  - Variability of Residue-to-Product-Ratios
  - Demand for animal husbandry
  - Soil organic matter content depending on cultivated crop and crop rotation

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