Marginal lands for biomass in the EU

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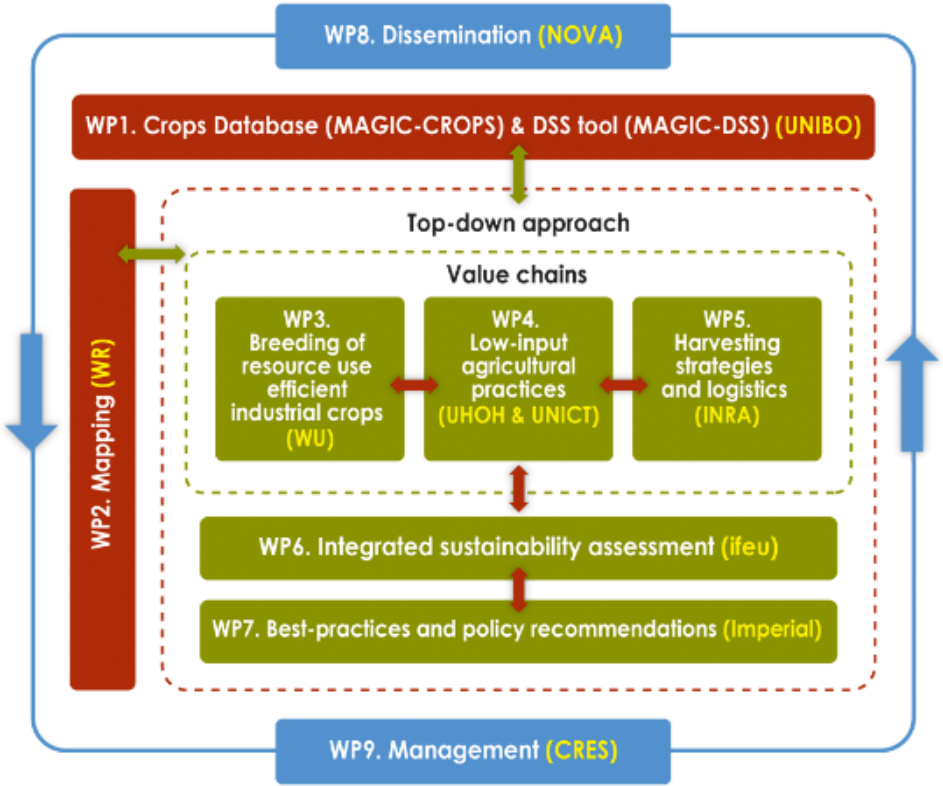
Magic

Aim of the MAGIC project: identification of marginal lands to support the development of sustainable best-practice options for industrial crops in Europe



This presentation:

- Mapping Marginal lands
- Characteristics of marginal lands in EU
- What does it mean for biomass cropping opportunities?
- Outlook

Starting points for mapping marginal lands

Additional requirements for mapping and classifying marginal lands:

- Focus at the minimum on the **biophysical constraints** (JRC proposes ‘natural constraints’ to identify lands in CAP).
- **Indirect land use effects** and **competition with food production should be avoided**: marginal lands need to be classified in used and unused marginal lands
- Lands where the **biophysical limitations no longer apply** because of improvement measures facilitating productive agriculture should be **excluded**
- **Adverse effects on ecosystem services** should be avoided at the minimum.
- Search for **win-win options** where industrial cropping takes place while at the same time improving the ecosystem service delivery.

Mapping marginal lands: steps taken

- Biophysical factors have been identified for the classification of severe limitations; 18 single factors, grouped into 6 clustered factors:

1. Adverse climate
2. Excessive wetness
3. Low soil fertility
4. Adverse chemical conditions
5. Poor rooting conditions
6. Adverse terrain conditions

- Correction for improvement to high productive lands
- Focus on: agricultural mask (Corine Land Cover agricultural 1990-2012)

Thresholds based on:

- JRC work on identifying **areas of natural constraints** (Van Oorschoven et al., 2014 and Terres et al., 2014) *CAP category*
- Several land evaluation systems for agronomic suitability (e.g. USDA-Land Capability Classification System (LCC) , Muencheberg classification by Mueller et al., 2010 and Soil Quality Rating by Shepherd, 2000)

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1. Adverse climate

Property	Criteria/thresholds
Low Temperature	Length of Growing Period (number of days) defined by number of days with daily average temperature > 5°C (LGPt5) OR
	Thermal-time sum (degree-days) for Growing Period defined by accumulated daily average temperature > 5°C.
Dryness	Ratio of the annual precipitation (P) to the annual potential evapotranspiration (PET)

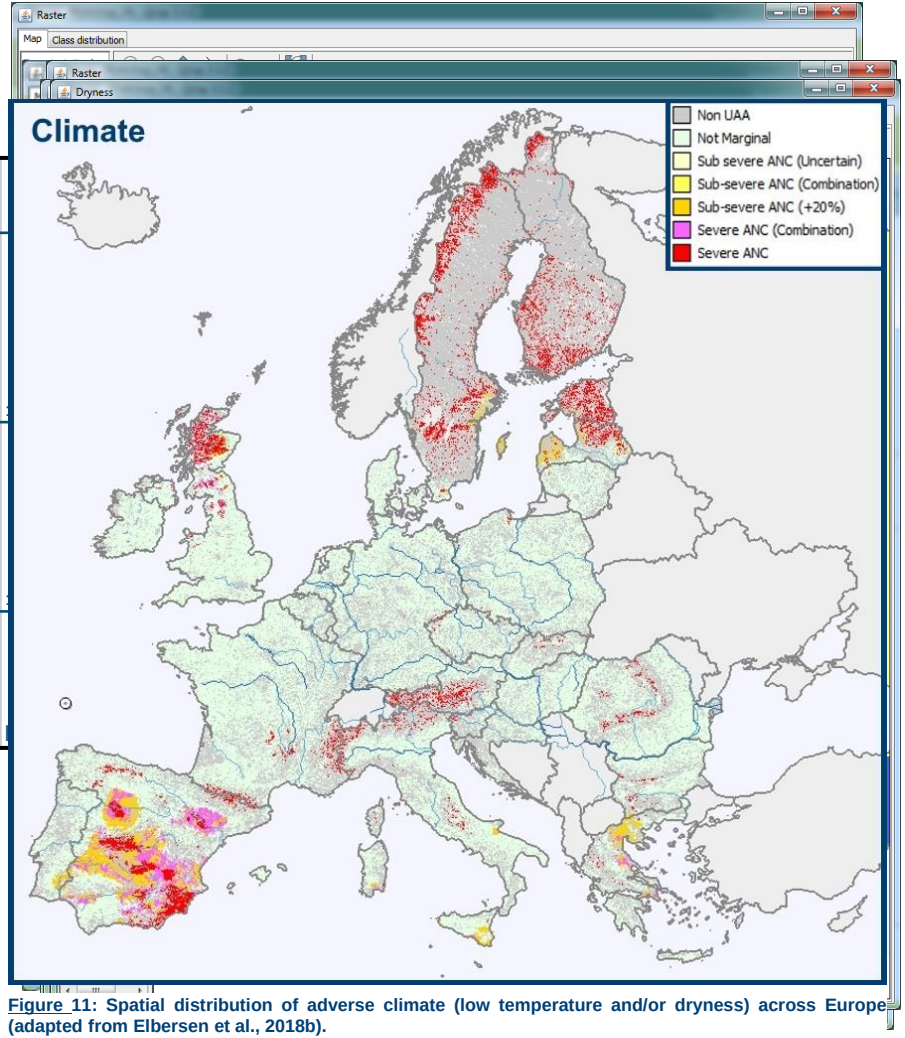


Figure 11: Spatial distribution of adverse climate (low temperature and/or dryness) across Europe (adapted from Elbersen et al., 2018b).

2. Excessive wetness

Property
Excess soil Moisture
Poor drainage
Limited Soil Drainage

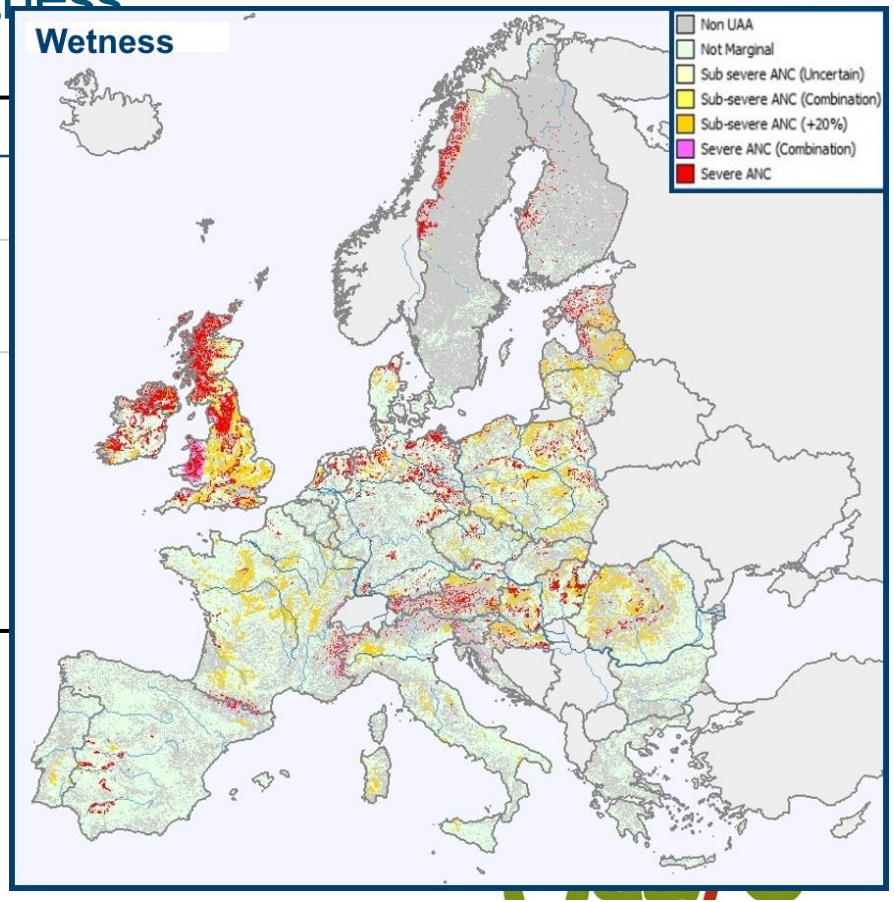
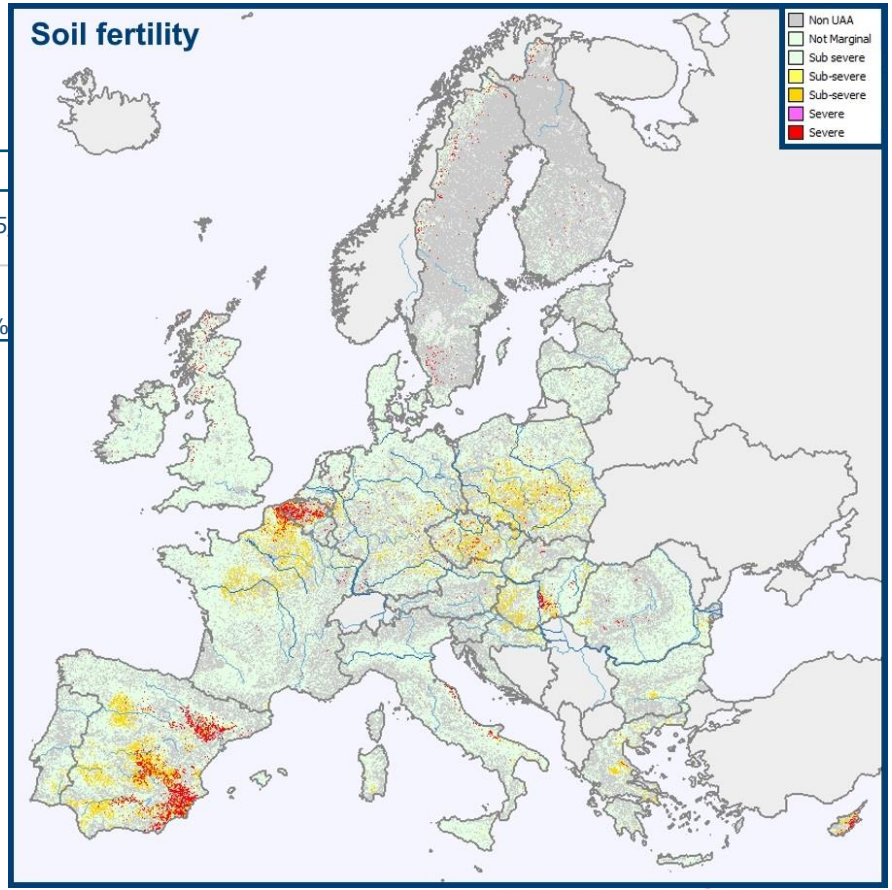


Figure 12: Spatial distribution of excess soil wetness (excess soil moisture and/or poor soil drainage) across Europe (adapted from Elbersen et al., 2018b).

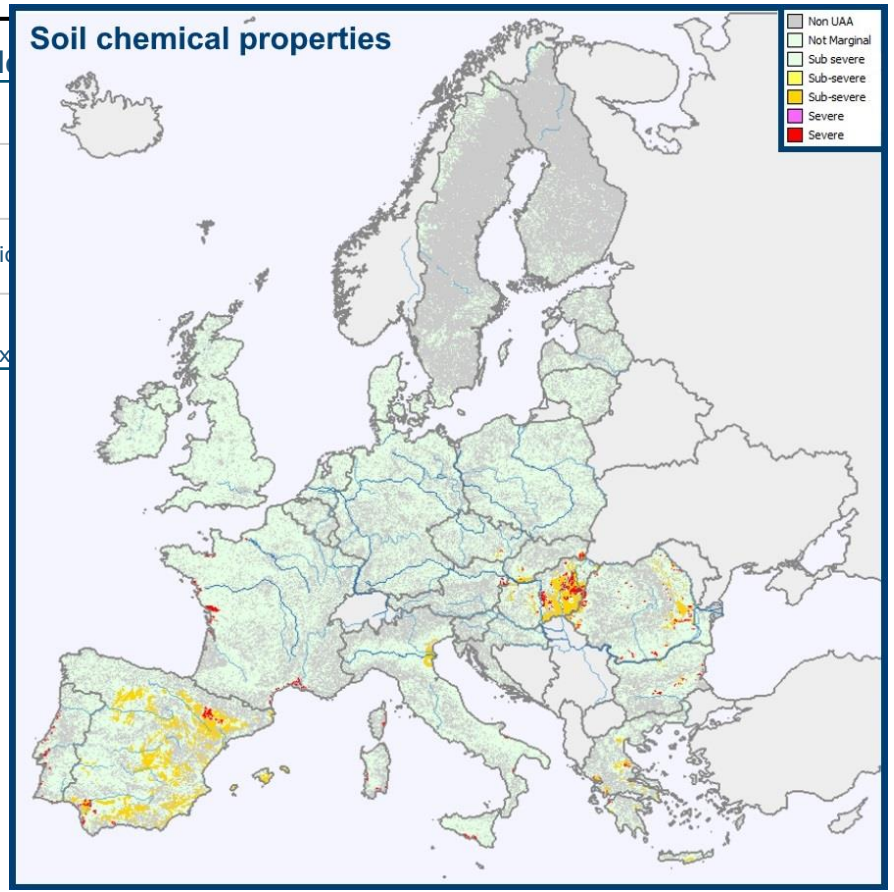
3. Low soil fertility

Property	Criteria	
pH-H2O	Acidity/ alkalinity	<4.5 8
SOC	Organic matter level	<1%



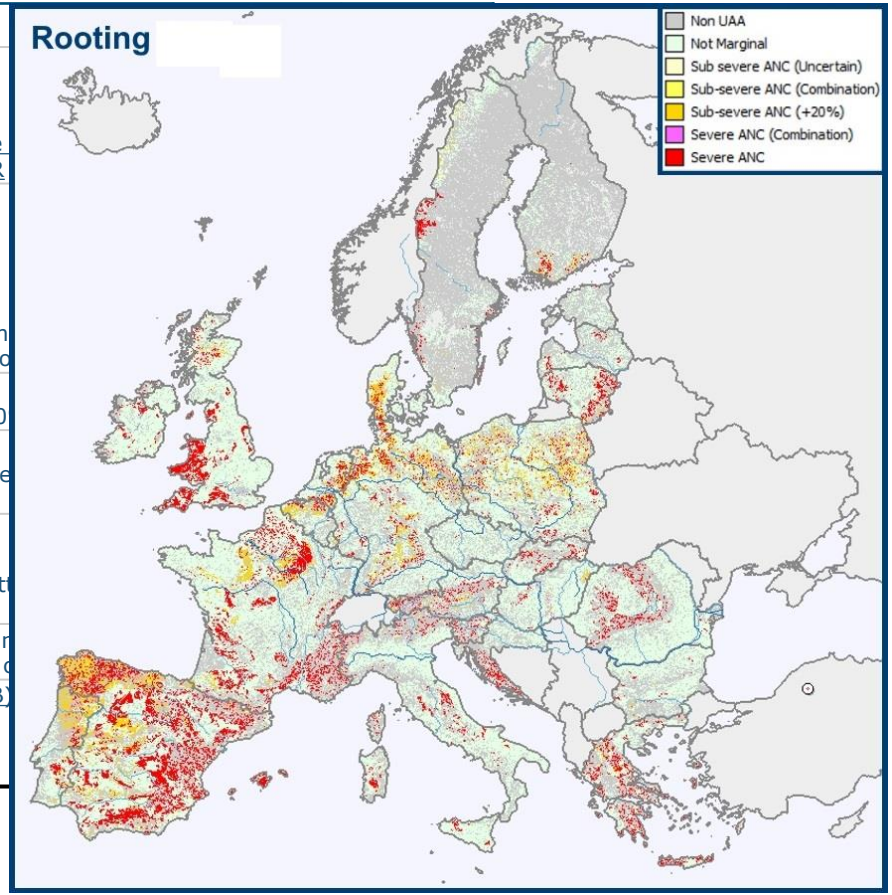
4. Adverse chemical conditions

Property	Threshol
Salinity (Ec)	>16
Sodicity (Na/ESP)	>25%
Toxicity natural	Soils with Thi qualifier
Toxicity pollutants	Soils with Tox



5. Poor rooting conditions

Property	Criteria/threshold	
Unfavourable Texture and Stoniness*	Relative abundance of clay, silt, sand, organic matter (weight %) and coarse material (volumetric %) fractions	> 15% of topsoil volume rock outcrop, boulder OR
		Texture class in half or m cm soil surface is sand, lo
		silt% + (2 x clay%) ≤ 30
		Topsoil texture class is he (> 60% clay) OR
		Organic soil (organic matt OR
		Topsoil contains 30% or r properties within 100cm c
Shallow Rooting Depth	Depth (cm) from soil surface to coherent hard rock or hard pan.	< 30cm; Leptosols (WRB)



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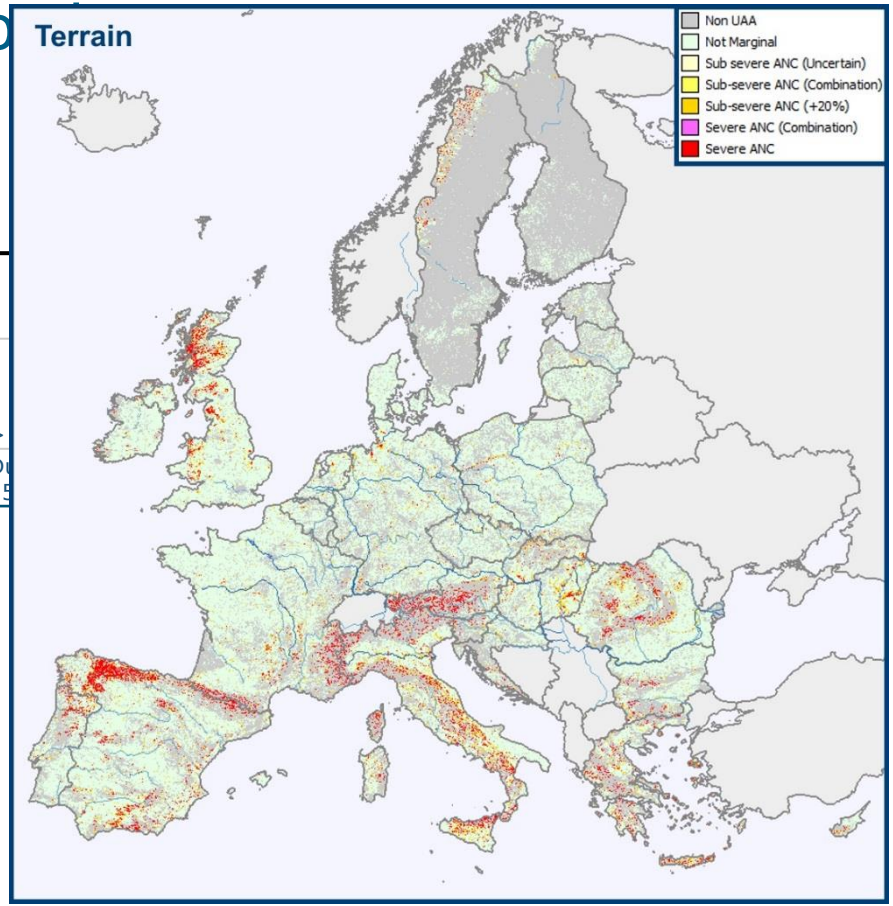
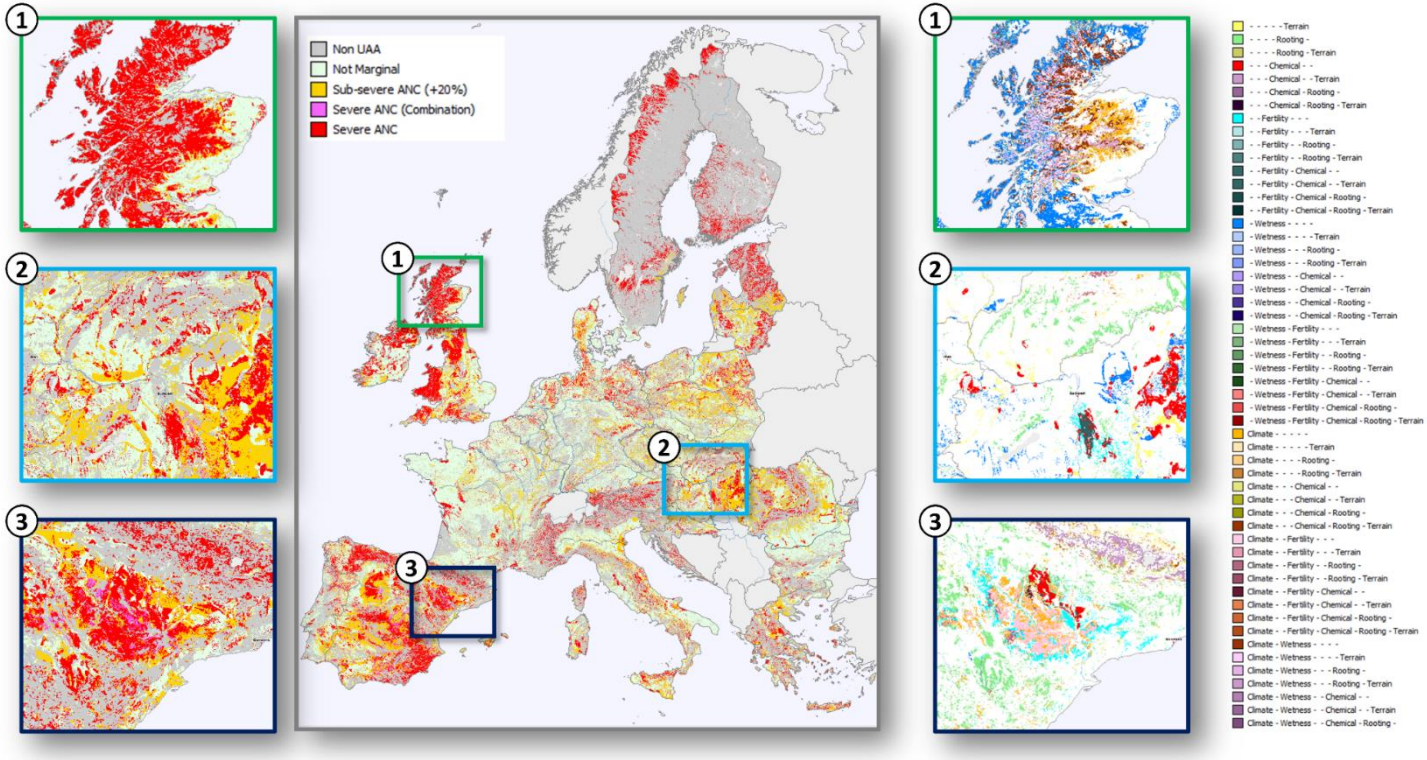
6. Adverse terrain co

Property	Criteria/Thre shold	
Steep slope	Change of elevation with respect to planimetric distance (%).	>
Flooding risk	Annually/ once 2-5 years	Du 15



Final M-AEZ



1) Scotland; excessive wetness, climate, limitations in rooting.
2) Hungary: multiple limiting factors salinity, fertility, excessive wetness and rooting limitations.
3) Ebro Valley: large concentration of multiple overlapping limitations (all six factors).

Final M-AEZ

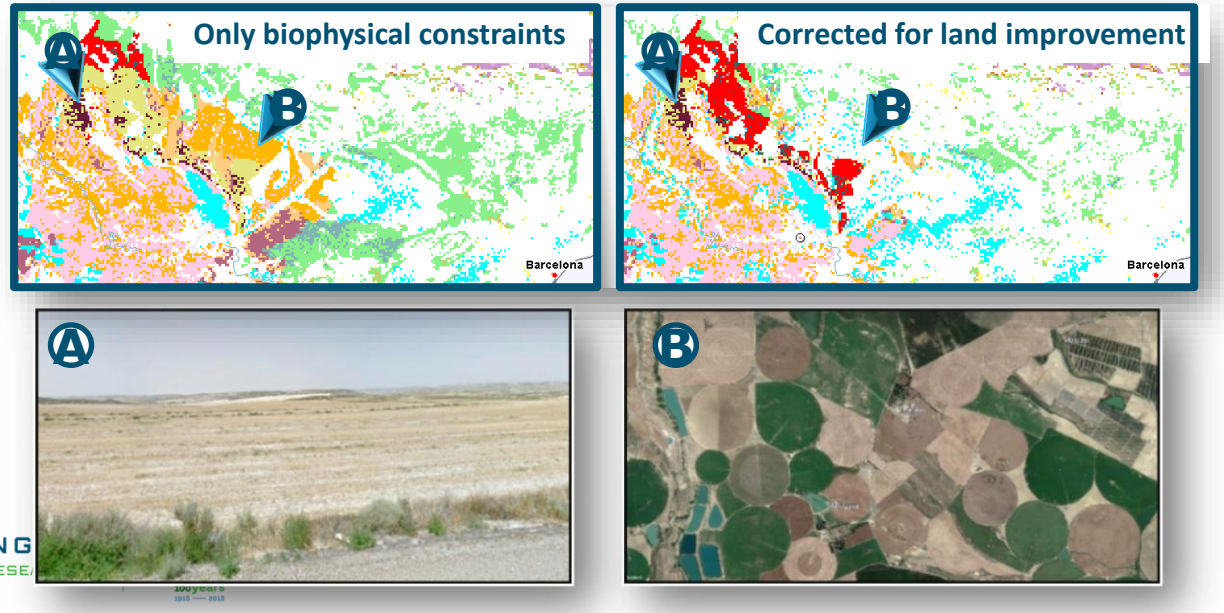
- In total 29% of the agricultural area is marginal in EU-28.
- The most common are rooting limitations (12% of agricultural area after correction for improvement), adverse climate and excessive soil moisture (11% and 8% of the agricultural land).
- The largest share of marginal lands is defined by one of the six clustered limitations, while in a much smaller share multiple limitations occur.

	1. Adverse climate	2. Excessive soil moisture	3. Adverse chemical comp.	4. Low soil fertility	5. Adverse rooting cond.	6. Adverse terrain	Marginal	Not marginal
Alpine	40%	21%	0%	2%	45%	47%	**61%**	39%
Atlantic	4%	14%	1%	1%	12%	5%	**26%**	74%
Continental	1%	5%	2%	1%	5%	2%	**14%**	86%
Mediterranean	13%	1%	1%	6%	18%	9%	**34%**	66%
North	62%	14%	0%	3%	13%	3%	**71%**	29%
Grand Total	**11%**	**8%**	**1%**	**2%**	**12%**	**6%**	**29%**	**71%**

Evaluation (18 sites)

Evaluation

Validation with the help of Google Street View in the Ebro Valley (Spain). Area “A” remains marginal with salinity, fertility, and rooting limitations, while the dryness in area “B” is neutralized by large scale center-pivot irrigation.



Other characteristic of Marginal lands

Overlap marginal lands with High Nature Value farmland

	Marginal land	Non-marginal land
Env. Zone:	% HNV farmland	% HNV farmland
ALPINE	75%	61%
ATLANTIC	33%	6%
CONTINENTAL	34%	15%
MEDITERRANEAN	40%	30%
NORTH	8%	7%
Total	34%	17%

Overlap marginal lands with areas with high risk for soil threats (erosion)

	Marginal land		Non-marginal land	
Env. Zone:	% sensitive to erosion by water	% sensitive to erosion by wind	% sensitive to erosion by water	% sensitive to erosion by wind
ALPINE	22%	11%	18%	2%
NTIC	7%	6%	12%	8%
INENTAL	11%	7%	20%	12%
TERRANEAN	33%	27%	32%	17%
H	2%	4%	3%	2%
	16%	13%	20%	12%

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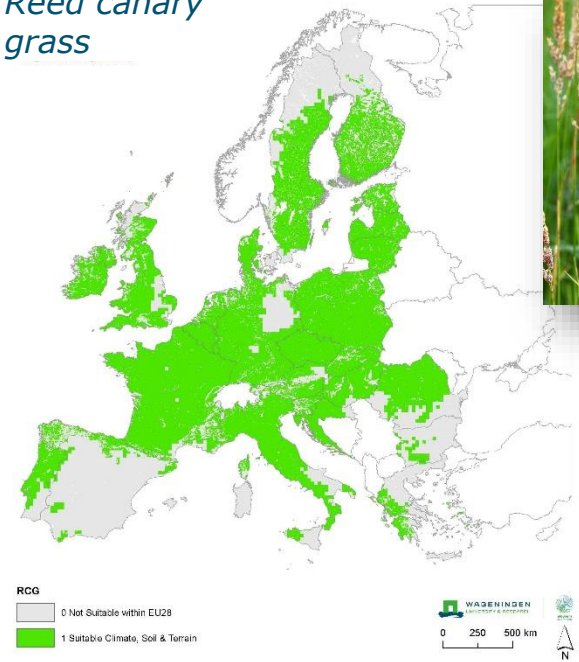
Selection of crops for marginal lands

suitability according to climate & soil

Giant reed

Reed canary grass



Suitability on both marginal and non-marginal land across Europe (EU-28)

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Selection of crops for marginal lands
in three environmental zones

Growth-suitabilities of the pre-selected industrial crops across MAEZ per AEZ under consideration of both climatic and soil conditions. All values are colorized separately for each AEZ. The crops are divided into four types (L= lignocellulosic crops, M= multipurpose crops, O= oil crops, W= woody species).

Mediterranean (AEZ 1)				Atlantic (AEZ 2)				Continental & Boreal (AEZ 3)			
Crop	Type	km²	%	Crop	Type	km²	%	Crop	Type	km²	%
Tall wheatgrass	L	211,255	96	Tall wheatgrass	L	151,166	79	Tall wheatgrass	L	172,355	86
Switchgrass	L	160,238	73	Reed canary grass	L	124,821	65	Reed canary grass	L	147,470	74
Miscanthus	L	130,634	60	Miscanthus	L	83,820	44	Miscanthus	L	88,010	44
Giant reed	L	129,501	59	Switchgrass	L	19,732	10	Switchgrass	L	26,628	13
Wild sugarcane	L	46,768	21	Giant reed	L	2,459	1	Giant reed	L	1,173	1
Reed canary grass	L	45,863	21	Wild sugarcane	L	252	0	Wild sugarcane	L	0	0
Lupin	M	201,888	92	Hemp	M	80,422	42	Cardoon	M	83,249	42
Biomass sorghum	M	193,118	88	Cardoon	M	71,822	37	Lupin	M	37,162	19
Cardoon	M	172,804	79	Lupin	M	36,790	19	Hemp	M	17,392	9
Hemp	M	162,794	74	Biomass sorghum	M	31,322	16	Biomass sorghum	M	6,323	3
Crambe	O	216,577	99	Camelina	O	186,018	97	Safflower	O	208,154	100
Camelina	O	209,761	96	Crambe	O	175,244	91	Camelina	O	183,667	92
Pennycress	O	208,388	95	Safflower	O	145,382	76	Crambe	O	130,959	66
Ethiopian mustard	O	184,988	84	Pennycress	O	64,812	34	Pennycress	O	76,465	38
Castor bean	O	160,990	74	Ethiopian mustard	O	43,177	23	Ethiopian mustard	O	10,111	5
Safflower	O	15,660	7	Castor bean	O	10,658	6	Castor bean	O	3,412	2
Siberian elm	W	179,148	82	Willow	W	164,191	86	Poplar	W	150,428	75
Willow	W	56,880	26	Poplar	W	159,930	83	Willow	W	119,536	60
Poplar	W	48,166	22	Siberian elm	W	20,611	11	Siberian elm	W	28,261	14

Development of a spatially explicit data base (MAGIC-MAPS, MAGIC Crops, MAGIC DSS)

http://magic-h2020.eu/

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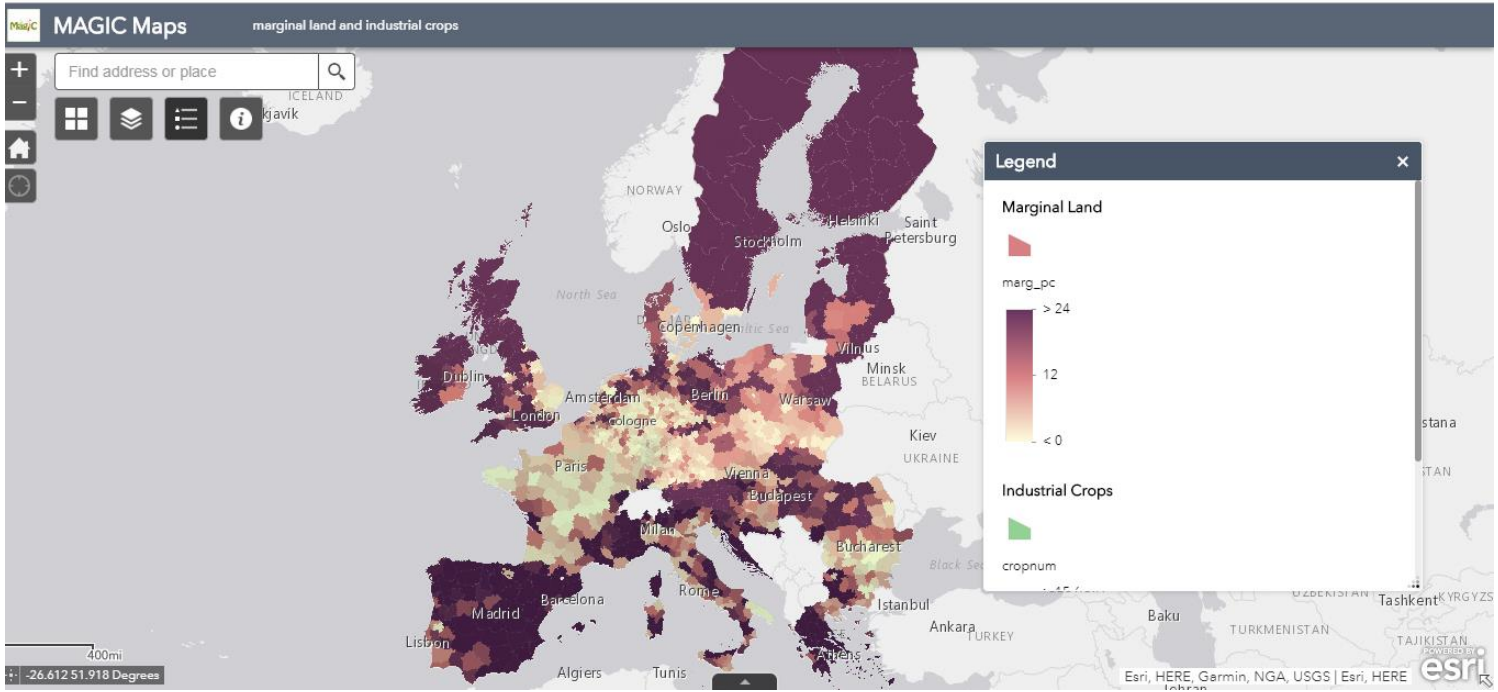
Development of a spatially explicit data base MAGIC MAPS



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Development of a spatially explicit data base (MAGIC CROPS)

Industrial Crops

This contains the descriptive table of the MAGIC industrial crops.

For more information, visit the MAGIC homepage.

Download

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727698.

Common Name: All | Lead Partner: All | Main Product: Lignocellulose

Show 10 entries | Search:

	Lead.partner	Latin.name	Common.name	Other.names	Short.description	Pathway
1	UNIBO	Panicum virgatum L.	Switchgrass		Erect and caespitose plant, 1-3 m tall. Associated to their latitudinal origin, cultivars of switchgrass can placed into two distinct ecotypes: upland and lowland. Upland ecotypes are better adapted to the drier and colder habitats, while lowlands tends to thrive in warmer, wetter habitats.	Perennial herbaceous warm-season grass (C4) native to Northen America.
6	UHOH	Miscanthus x giganteus	Miscanthus		Miscanthus x giganteus is presently the only commercially grown miscanthus genotype. It is a triploid, sterile hybrid between Miscanthus sinensis and Miscanthus sacchariflorus.	Perennial rhizomatous grass native to East Asia. High biomass yield potential dur to C4 photosynthetic mechanism.
7	UNICT	Arundo donax L.	Giant reed	Common reed, Giant cane	Erect and caespitose plant, 2-5 m tall. Sterile plant, propagate exclusively by vegetative propagules (rhizomes, stem cuttings, node cuttings). Small degree of genetic variation due to clonal reproduction, but phenotypic variation has observed between the A. donax ecotypes according to their colonization sites. It is able to thrive in hot, drought prone environments, as well as wetter habitats, under salinity, steep slopes, poor soil texture and contaminated soil .	Perennial herbaceous warm-season grass (C3) native to Asia, endemic in Mediterranean areas.
8	CIEMAT	Agropyron elongatum (Host.) Beauv.	Tall wheatgrass		The plants commonly known as "agropiros" belong to several genera: Agropyron, Pascopyrum, Thinopyrum, Elymus, Elytrigia. Perennial herbaceous plants of gramineas family, adapted to a wide variety of soils and arid regions of cold climate, herefore they have great resistance to dry climates and extreme	

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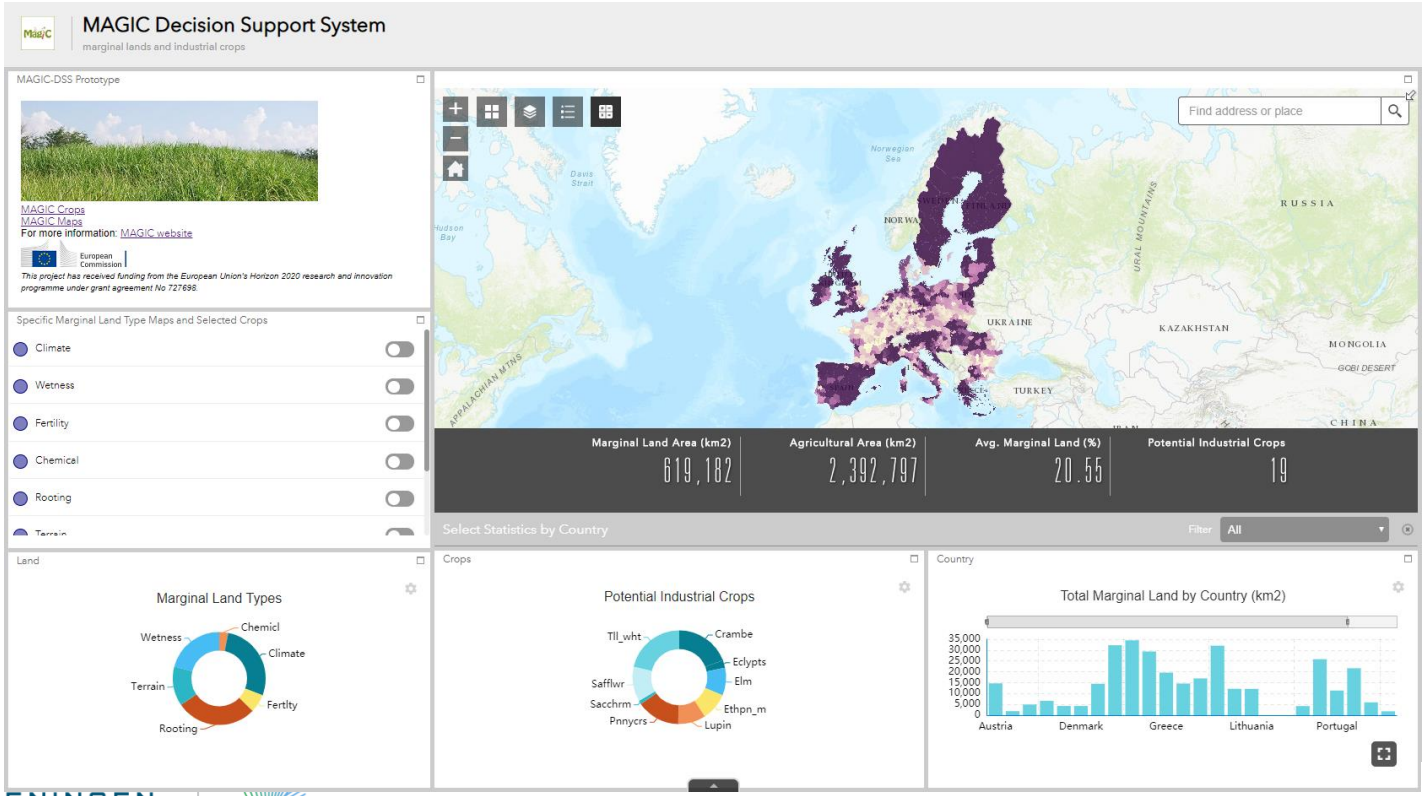
Development of a spatially explicit data base (MAGIC DSS)



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Thank you for your attention!

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To explore the potential of nature to improve the quality of life