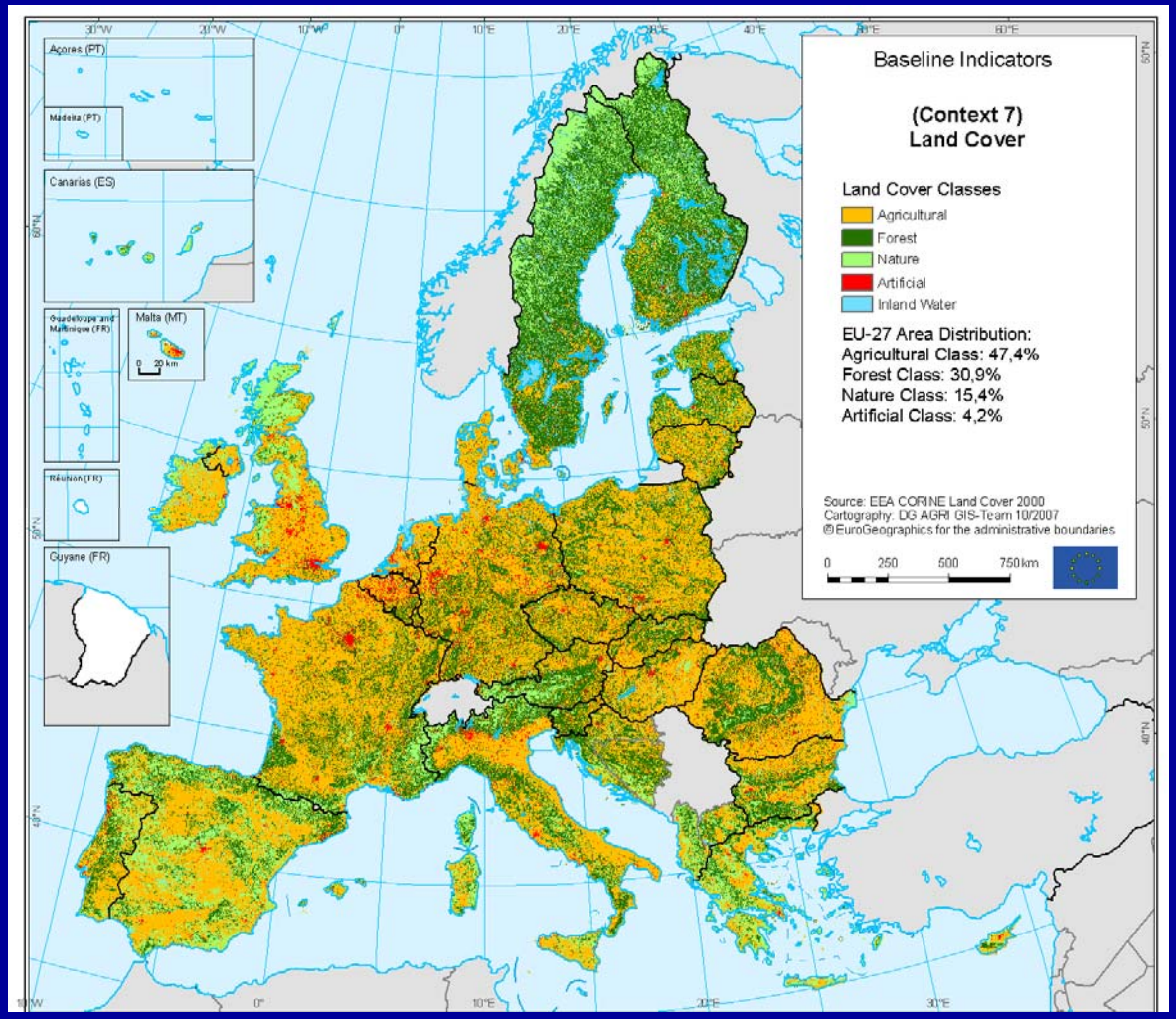
Università degli Studi d
Udine
Dipartimento di Biologia e Protezione
delle Piante

Giuseppe Parente

The multifunctional role of grasslands in Europe. Challenges and perspectives for the future

Krtiny, 4 may 2011

Land cover in EU



EC 2008. Rural development in the EU

Forage categories

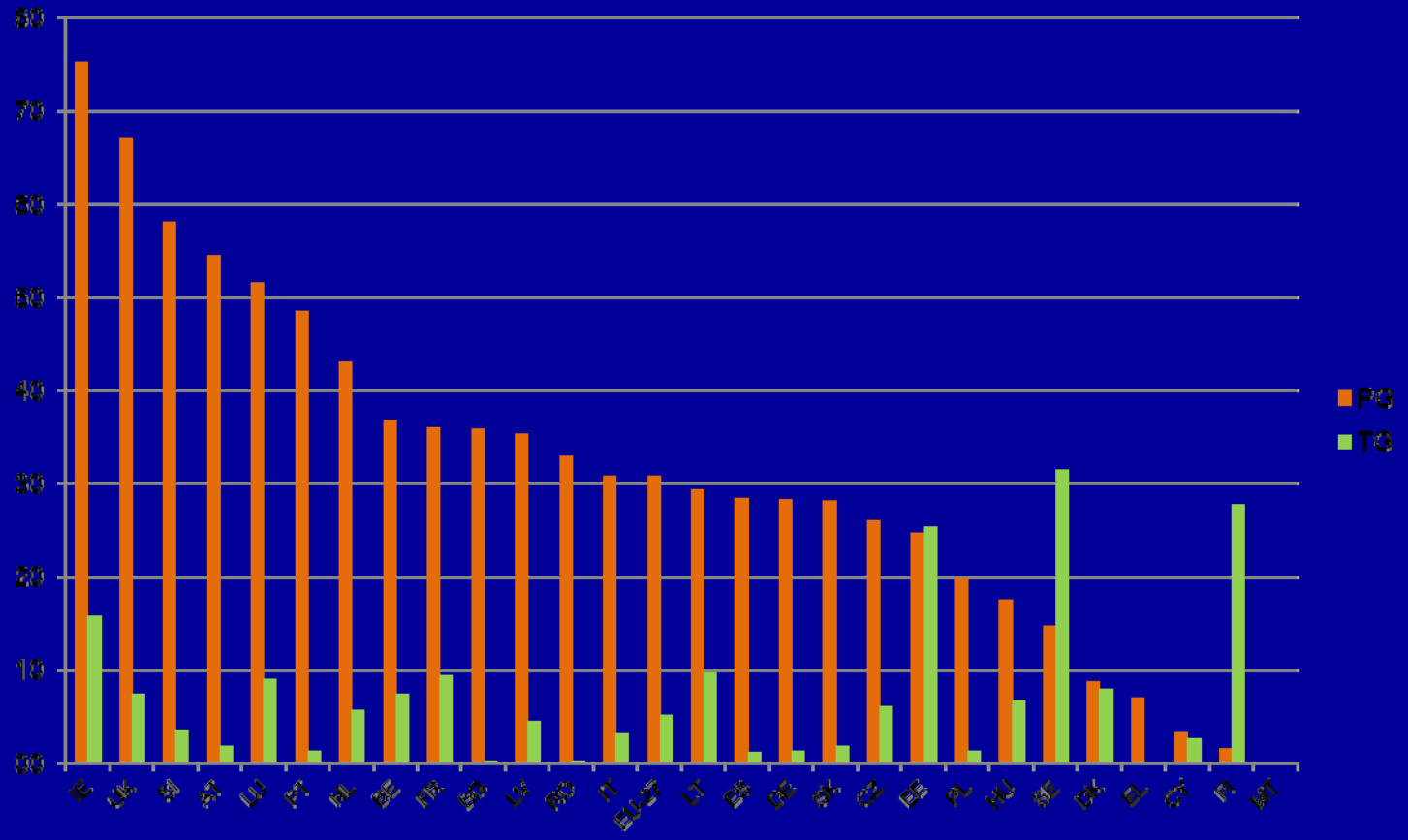
EUROSTAT definitions of forage categories (Eurostat, 2001)

Forage plants	Green fodder from arable land	Annual green fodder	Fodder maize	
			Other annual green fodder	Fodder beets
				Other root crops
		Perennial green fodder	Temporary grasses and grazings	Temporary grasses
				Temporary grazings
			Clover and mixtures	
			Lucerne	
			Other legumes	
	Green fodder from permanent grassland	Permanent pastures	Herbages	
			Rough grazings (natural grasslands)	
		Permanent meadows		

Multisward .EU project

Distribution of grasslands in EU

Permanent and temporary grasslands in EU (% UAA)



Source: Agricultural Statistics. Main results 2007-2008 (Eurostat pocketbook)

Other forage crops

- Forage maize : 3%UAA in EU 27 / Germany (1.7 millions ha); France (1.5 millions ha); Italy (280000 ha)
- Clovers (mixtures): variable importance / lack of good data – confusion with temporary grass mixtures
- Lucerne: Italy (700000 ha/ 5%UAA); Romania (323000 ha/ 2,4%UAA); Spain and France (240000ha/1%UAA)
- Sainfoin, sweet clover: Romania (146000 ha); Greece (133000ha); Latvia (100000ha); Spain (73500ha)
- Fodder beet: marginal area in every country
- Whole crop cereal silage: Northern Europe

Comeback of the legumes: home grown legume based protein source!

Grassland DM productivity

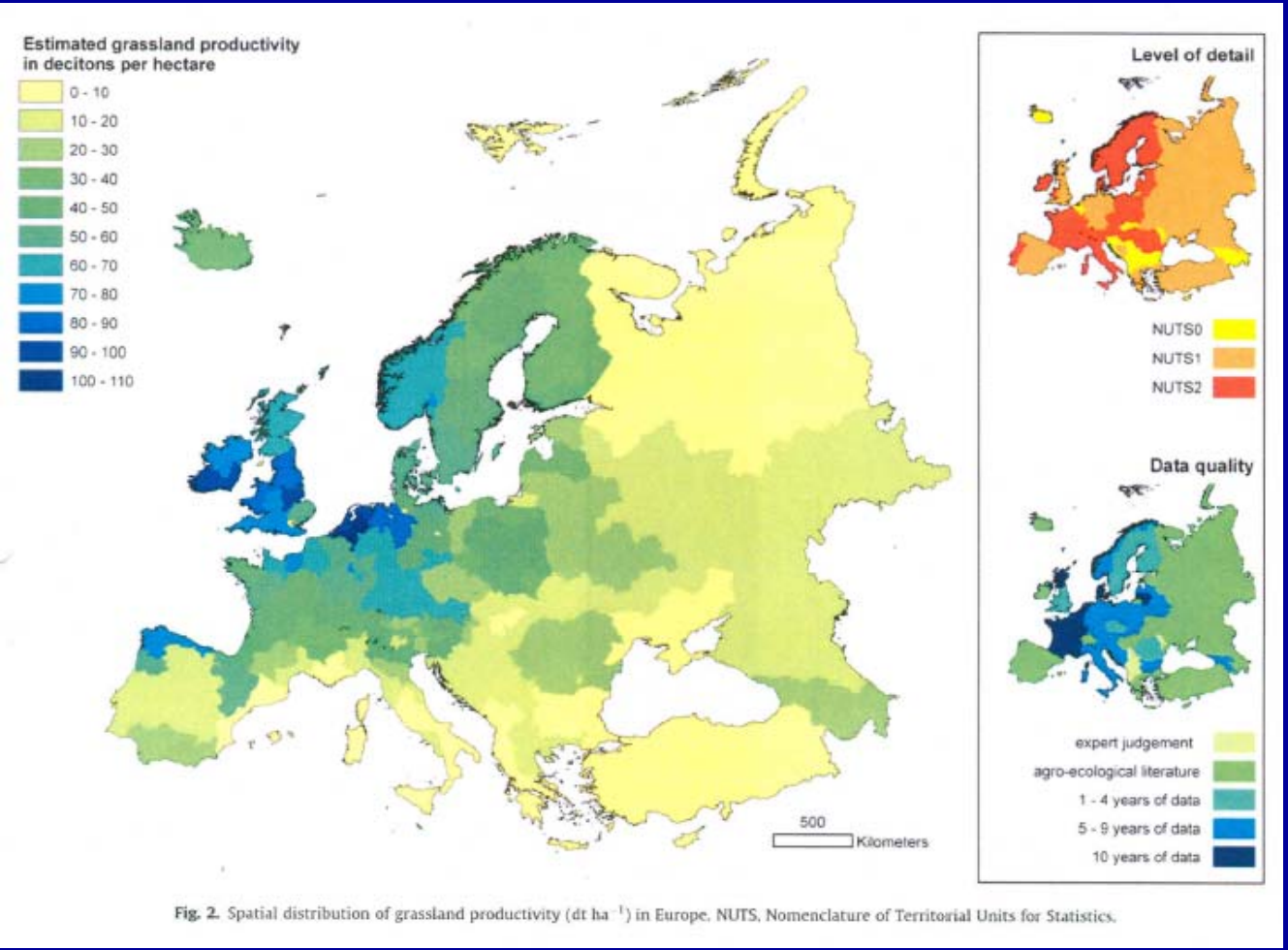
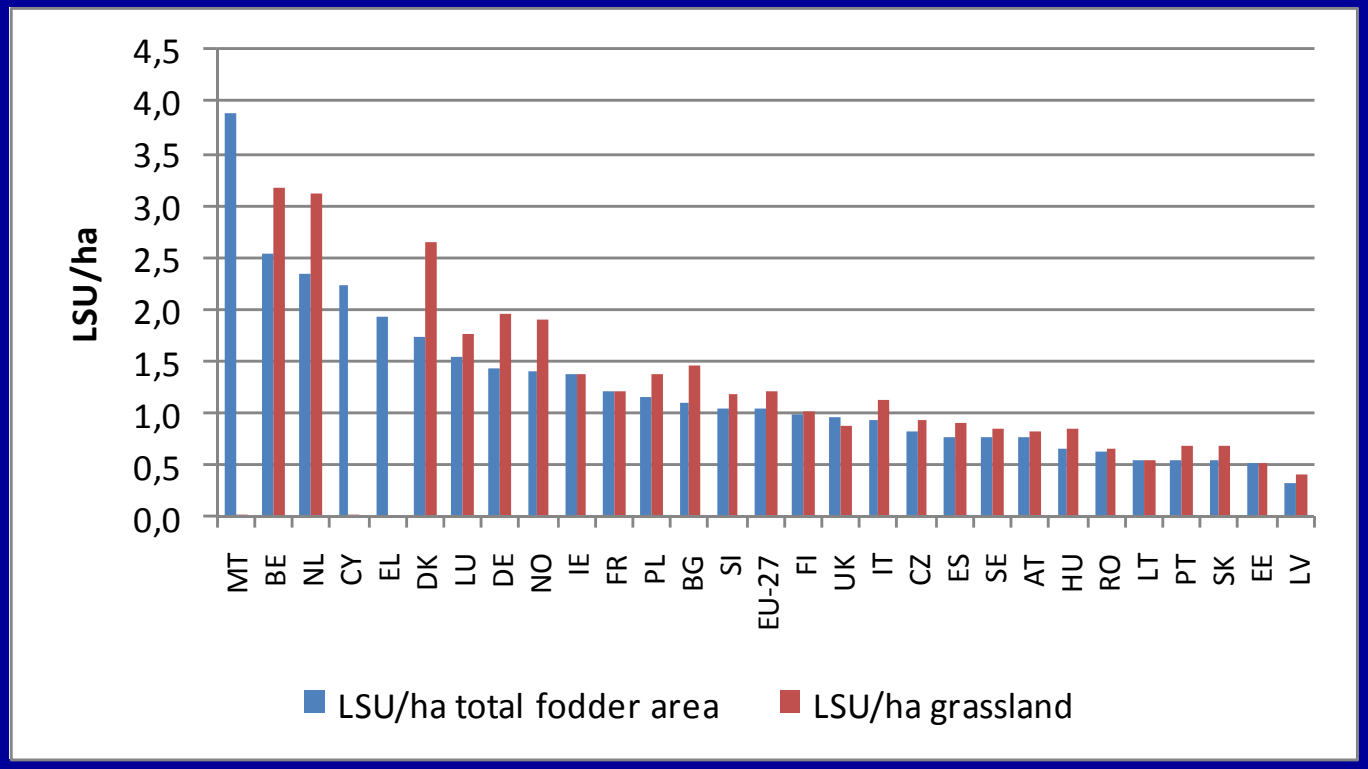


Fig. 2. Spatial distribution of grassland productivity (dt ha $^{-1}$) in Europe. NUTS, Nomenclature of Territorial Units for Statistics.

Smith *et al.*, 2008)

Animal production: cattle density



Multisward project

Agro fuel production

Grassland biomass transformation to energy

1. Methane production by anaerobic fermentation (+ slurry)
    - Methane production/kg OM, OM yield/ha
    - Growing stage more important than species
    - Maize > grass → grass only in marginal conditions
2. Combustion
    - C4 (e.g. Miscanthus) better than C3
    - Acidification: SO_2, No_x, HCl emissions !
3. Gasification
    - >700°C, pyrolysis
    - Syngas production
    - Transformation or combustion
    - Research effort needed

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Green biorefinery

Fractionation of grass:

- Liquid:
  lactic acids (bio degradable plastic, solvents)
  amino acids (cosmetics, food fermentation)
  protein pellets …
- Solid (press cake):
  grass fibres → a wide range of applications: construction, insulation plates, energy, paper, …

Promising, but still a long way to go!

Overview research activities: O'Keefe et al. (2009)

Multisward EU project

1 maize with no crops alternating ; 2 maize with crops alternating ; 3 intensive management ; 4 reasoned fertilisation ; 5 wet or dry meadows ; * little impact ; **** h

Grassland related to ecology and landscape

Type of grass	Practices	Biodiversity	Landscape effect	Water quality	Erosion prevention	Carbon storage	Product quality
Annual fodder	1	*	*	*	*	*	*
	2	*	*	**	*/**	*	*
Temporary	3	*	**	*/**	**	**	**
meadows	4	*/**	**	***	***	**	***
Permanent	3	**	***	**	**	***	**
meadows	4	***	***	***	***	***	***
Grasslands with	5	*/***	****	***	***	****	****
ecologic sensibility							

1 maize with no crops alternating ; 2 maize with crops alternating ; 3 intensive management ; 4 reasoned fertilisation ; 5 wet or dry meadows ; * little impact ; **** high impact

Institut de l'élévage, 2007"

Multisward project

1 maize with no crops alternating ; 2 maize with crops alternating ; 3 intensive management ; 4 reasoned fertilisation ; 5 wet or dry meadows ; * little impact ; **** h

Grassland related to ecology and landscape

Permanent grassland and extensively managed, low input grasslands perform better in fulfilling the ecological requirements!

Threats:

- Intensification of grassland use
- Conversion to arable land
- Abandonment

EU policy: efforts to maintain the permanent grassland area and to stimulate the ecological management of the semi-natural grasslands

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2010

1 maize with no crops alternating ; 2 maize with crops alternating ; 3 intensive management ; 4 reasoned fertilisation ; 5 wet or dry meadows ; * little impact ; **** h

Grassland related to greenhouse gas (GHG) balance

Share of agriculture in total EU GHG-production:

- 2% of CO_2
- 50% of N_2O
- 45% of CH_4

Main N_2O and CH_4 production pathways in agriculture:

- Fermentation in ruminant animals: 72% of CH_4- production
- Manure decomposition: 27% of CH_4 and 12% of N_2O- production
- Soil denitrification: 88% of N_2O- production

➔ GHG production closely related to cattle husbandry and grassland use

Multisward project

1 maize with no crops alternating ; 2 maize with crops alternating ; 3 intensive management ; 4 reasoned fertilisation ; 5 wet or dry meadows ; * little impact ; **** h

Grassland related to greenhouse gas (GHG) balance

Balance: GHG production and carbon sequestration

Grassland can act as an important carbon sink and counterbalance GHG production:

- CH_4 and N_2O emissions are compensated by 70-80% of the EU grassland carbon sink (Ciais et al., 2010)

Janssens *et al*., 2005 published country specific carbon balances (grassland – forest – arable land – peatland)

Grassland related to green house gas (GHG) balance

SOC content (0-30 cm):

arable land<temp.grassland< perm. grassland < forest

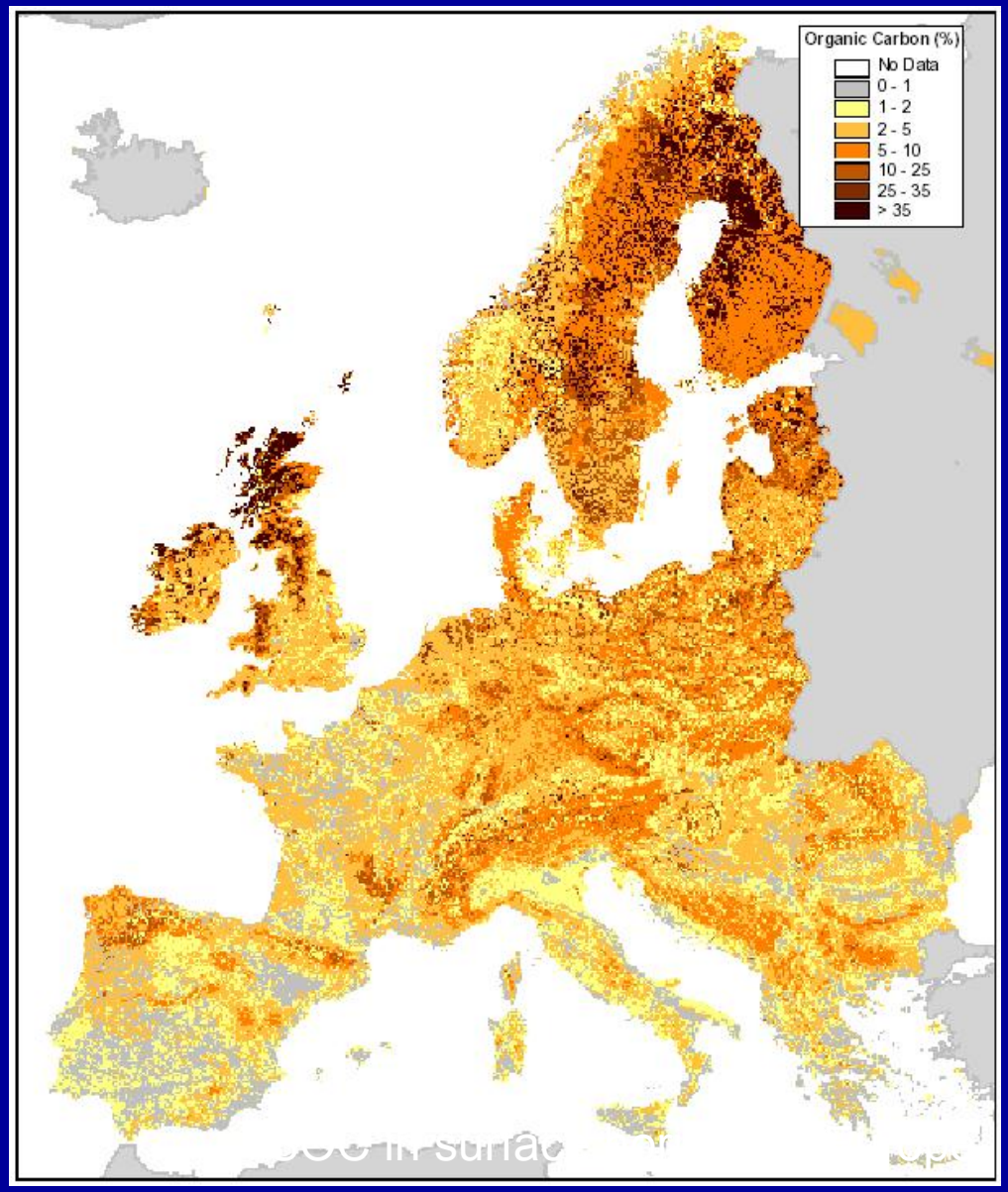
Permanent grassland: + 0.52 ton/ha/y
Arable land: - 0.84 ton/ha/y

Conversion to arable land: SOC losses happen faster than built up when establishing grassland!

- No convertion of permanent grassland
- Frequency or resowing as low as possible

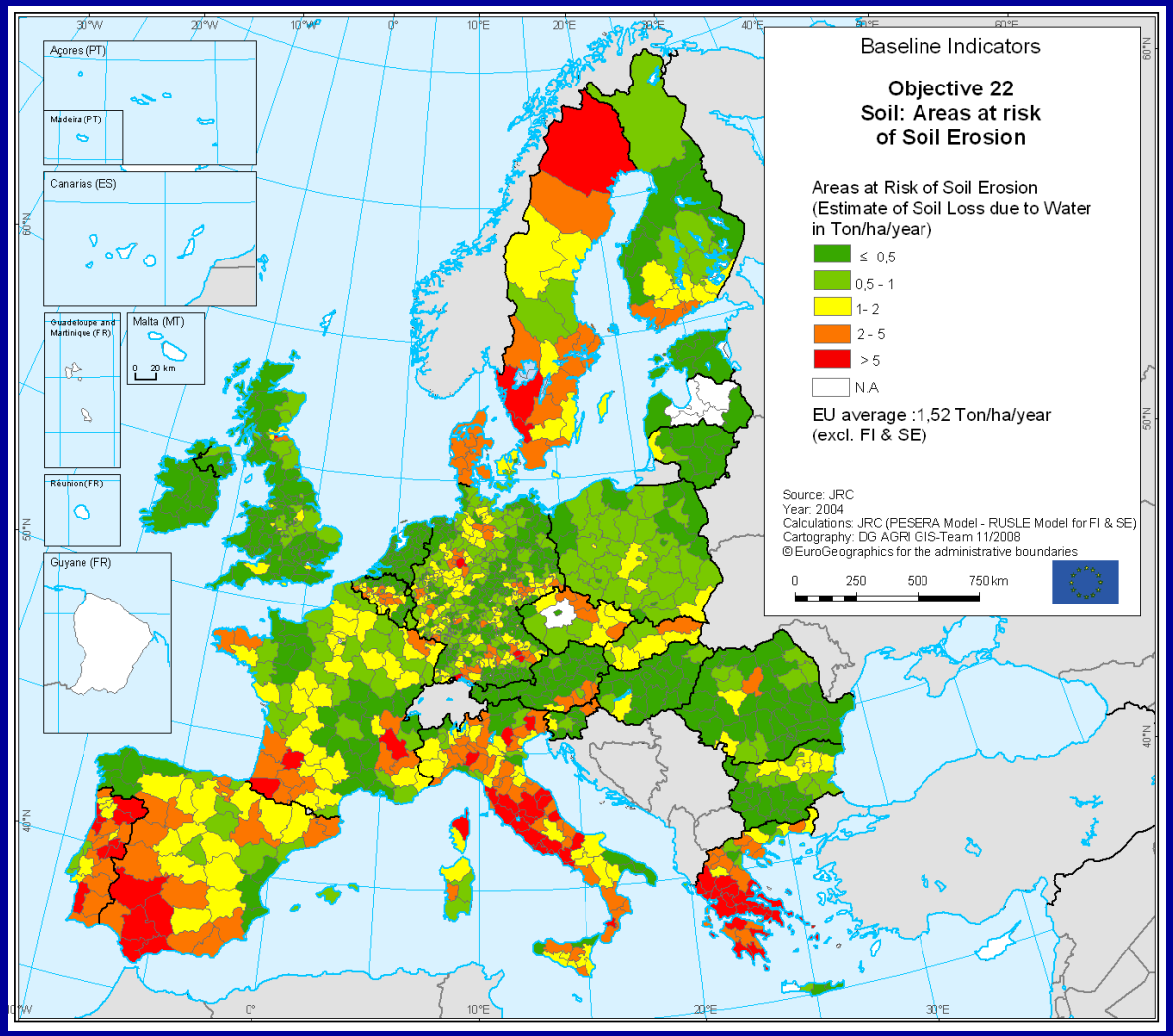
.

Source: http://eusoils.jrc.ec.europa.eu/esdb_archive/octop/octop_download.html



High SOC:
- Forest
- Perm. Gr
- Semi-nat. Gr.
- Peatlands

Soil erosion



Source: Rural development in the EU (Report 2008)

Soil erosion: water and wind

A problem in many countries and regions in EU!

- Grassland
  Permanent cover
  Dense rooting system

- Conversion to grassland is a solution
  total /buffer strips depends on the slope

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Mitigation of pollution

- Low use of pesticides on grassland

- Less transfer to surface waters

- Quick decomposition by the intensive biological activity of the soil micro-organisms

- P and nitrate N: be careful with fertilisation

- Grassland is a biological filter and a barrier for migration of various chemicals towards surface and ground water!

Grassland & biodiversity

Semi-natural grasslands with an unique and high species diversity are crucial for maintaining biodiversity!

These grasslands are the most vulnerable ecosystems (abandonment, intensification) and are protected in many ways by EU-directives and national agro-environmental schemes

Intensified grasslands are considered positive for biodiversity compared to (annual) forage and arable crops

Biodiversity: plant and animal species! Above and in the soil

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Grassland & biodiversity

Vegetation:

Species rich grassland:

- >150 species/100 m^2 Alps
- >80 species/ 100 m^2 Estonia
- 60 species/ 100 m2 Slowakia

Management is extremely important:

(N) fertilisation; resowing, use of species poor mixtures, cutting frequency and timing, …

Restoration: extensification of management

Grassland & biodiversity

Vegetation:

Abandonment :

- rural/parcels of little agricultural value
- encroachment of shrubs and woody species
- competition and disappearance of typical grassland species
- landscape change

About 50% of the total EU grassland area is ‘natural grassland’ (Soussana *et al*., 2004)

Grassland & biodiversity

Fauna:

Farmland birds: (526 species in EU)

- different habitat requirements
- 30% of the birds species associated with grassland
- negative relationship between agric. intensity and bird occurence
- Birds Directive (1979) was the start of nature legislation

Grassland & biodiversity

Fauna:

Butterflies

- specialist species rely on one or a few host plant species and are related to certain plant communities

- relationship between extensive managed grassland and butterfly diversity is not so clear: not always a higher diversity in extensive managed grassland

- Small mammals, snails, insects,…

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Grassland & biodiversity

Soil ecosystem (soil food web):

(Permanent) grassland compared to arable land

- more organic matter
- much more diverse earthworms
- much more diverse nematodes
- more fungi, less bacterial communities
- 50% more microbial biomass

-Management: fertilisation, soil cultivation!

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Grassland & landscape

Grassland provide an attractive landscape: open or surrounded by hedgerows or wooded edges

Grasslands are perceived as a rather ‘natural’ element of the landscape

Semi-natural grasslands show more colour and structure, score higher for ‘naturalness’

Landscape management and planning becomes more and more important in rural develoment (e.g. recreation, tourism)

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THE CASE OF THE ALPS AND OTHER EUROPEAN MOUNTAINS

AGRICULTURE OF ITALIAN ALPS

AUS	1.369.865 ha (30% totale alpino)
- AUS > 10 ha	15 % (Switzerland 70%)
Number of farms	247.1110 (ca. 500.000 in alps)
Employees	5,4 %
- full time	27%
- age	78,8% > 45y
Grasslands	85,6 %
Arable crops	6,3 %
Permanent crops	6,4 %

data 1998

Alpine grasslands

Natural grasslands

Secondary grasslands

Artificial grasslands

} 1 mil ha

Firmetum

Poor grasslands on calcareous substr.

Diffused on cold and windy sub-nival slopes

On calcareous and gravel; shallow soils with high level of calcium carbonate and low humus content

Low growth, on eroded turfs

Caricetum firma

Firmetum

Carex firma

Firmetum

Gentiana clusii

Anthyllis vulneraria subsp. *alpestris*

Dryas octopetala

Elinietum

Poor grassland
Calcareous substr.

Diffused on cold and windy sub-nival slopes

Adaptable to pH from weakly basic to quite acid

Low growth, on humus but with carbonates
Evolution from pioneer communities

Elyna myosuroides

Fonte: www.botany.cz

Elinietum

Leontopodium alpinum

Senecio abrotaniufolius

Seslerio-Semperviretum

Poor grasslands on calcareous soils

The most diffused on Alps, calcareous substr. or dolomia. Its the classic grazed grassland.

On warm slopes with a southern exposure, it expands at low altitudes fading into pine-forest.

Species consolidating slopes subject to landslides, tick roots and large tufts of average quality.

Sesleria caerulescens

Seslerio-Semperviretum

Nigritella rubra

Carex sempervirens

Fonte: www.commons.wikimedia.org

Ranunculus hybridus

Seslerio-Semperviretum

Achillea clavenae

Gentiana verna

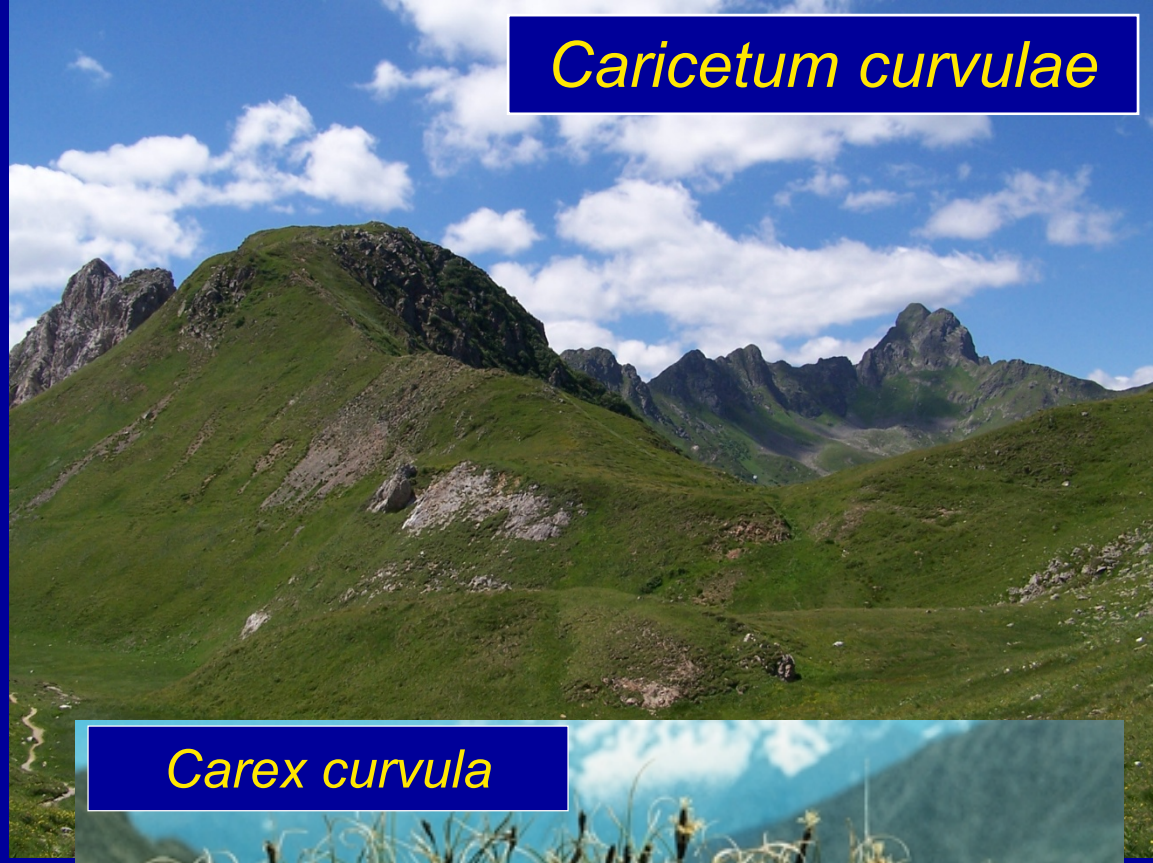
Caricetum

Primary grassland
on acid substr.

Siliceous and acidified soils of the alpine and subnival horizon

On gentle slopes and on soils rich in humus

The most diffused primary grassland on Italian Alps



Caricetum curvulae

Carex curvula

Fonte: www.wwmm.org - foto di M. Ferranti

Caricetum

Primula glutinosa

Fonte:farm4.static.flickr.com

Soldanella alpina

Festuceto

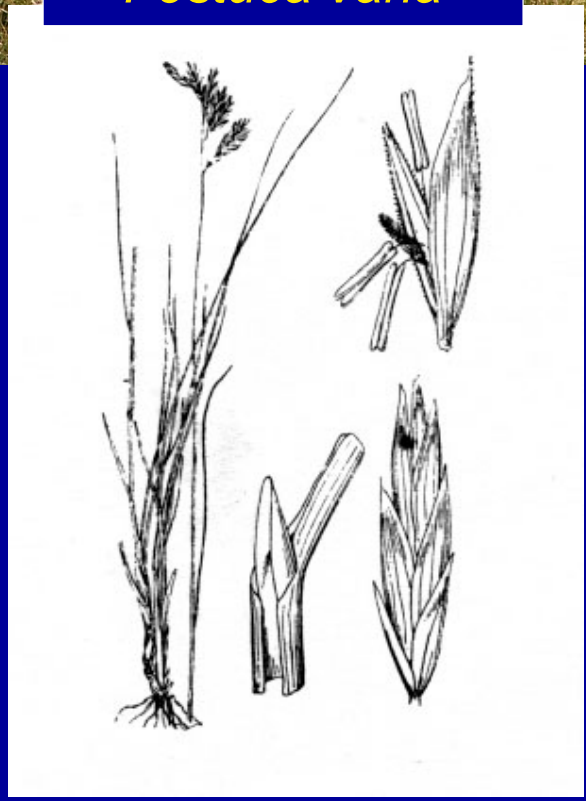
Grasslands on acid substratum

Diffused on sunny slopes of internal Alps with continental climate

Grasslands rich with species, of high pasture value

Festucetum varie

Festuca varia



Festucetum

Gentiana kochiana

Potentilla aurea

Nardetum

Grassland on acid substratum

Diffused from mountain to subalpine horizon

Siliceous substratum or poor by calcium washing out

Poor quality, low palatibility and poor in species but possible to be improved with appropriate management

Nardetum strictae

Nardus stricta

Nardetum

Campanula barbata

Arnica montana

Poetum

Fat pastures on acid substratum

Diffused from montaneous to sub-mountainous level

Luxuriant and abounding with species grasslands; pastures of high value

Crepis aurea

Poa alpina

⟶ Grasslands on dry soils (Festuco-Brométea)

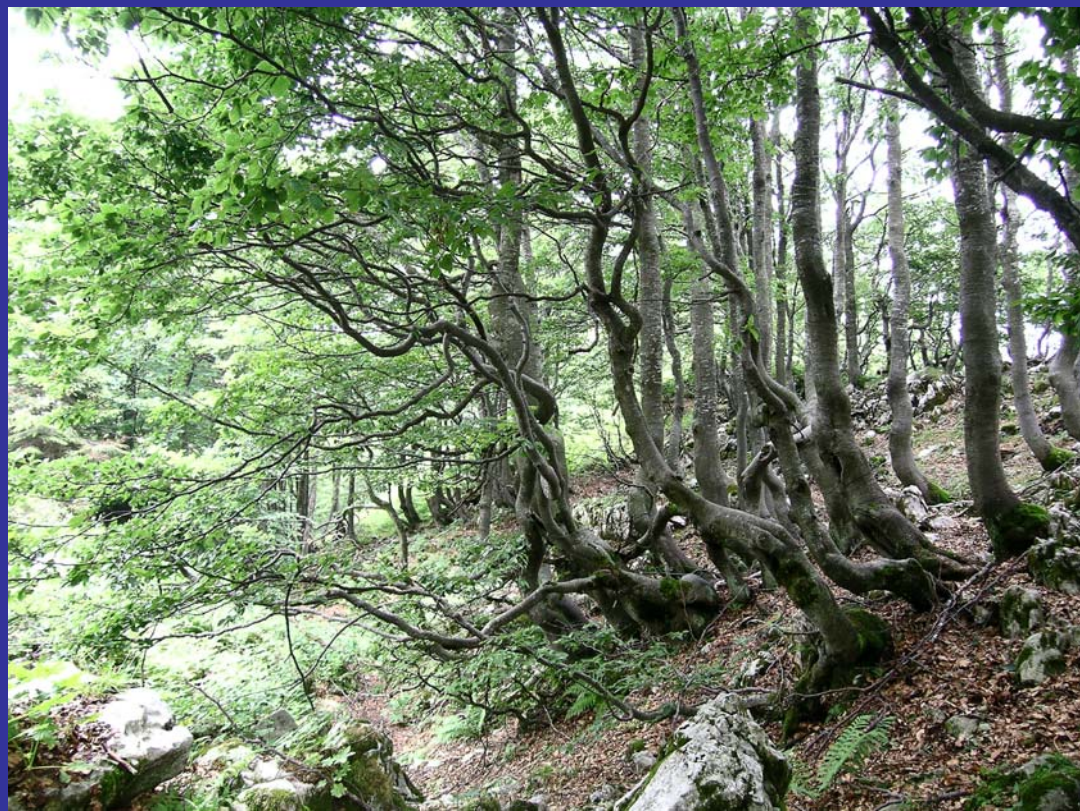
Rich in rare species derive from beech forests growing in mild areas of central and southern Europe.

⟶ Grasslands on humid soils (Nardo-Callunétea)

Derive from more or less humid and acid soils, originally covered by oaks, birches and firs

⟶ Coltivated grasslands (Molinio-Arrhenathéretalia)

- Arrhenatherum elatius from oaks and beech trees
- Arrhenatherum elatius and Phleum pratense from Molinia coerulea
- Trisetum flavescens from mixed forests with beech trees



Arrhenatheretum

Fat grasslands indifferent to substr.

Diffused from plain to mountains

Tipical nitrophilus mown grasslands

Carum carvi

Arrhenatherum elatius

Brometum

Poor grasslands

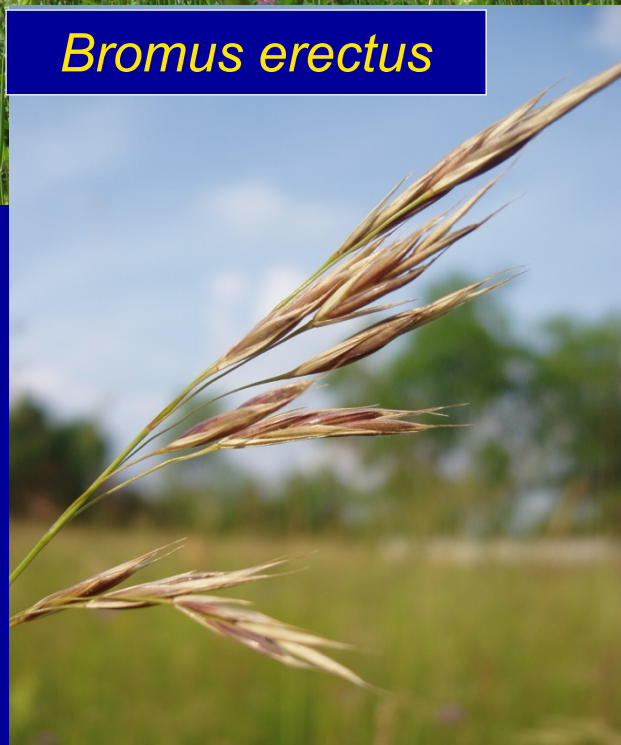
Diffused from plain to mountains

Tipical poor grasslands on neutro-basifilous substr.

High species biodiversity

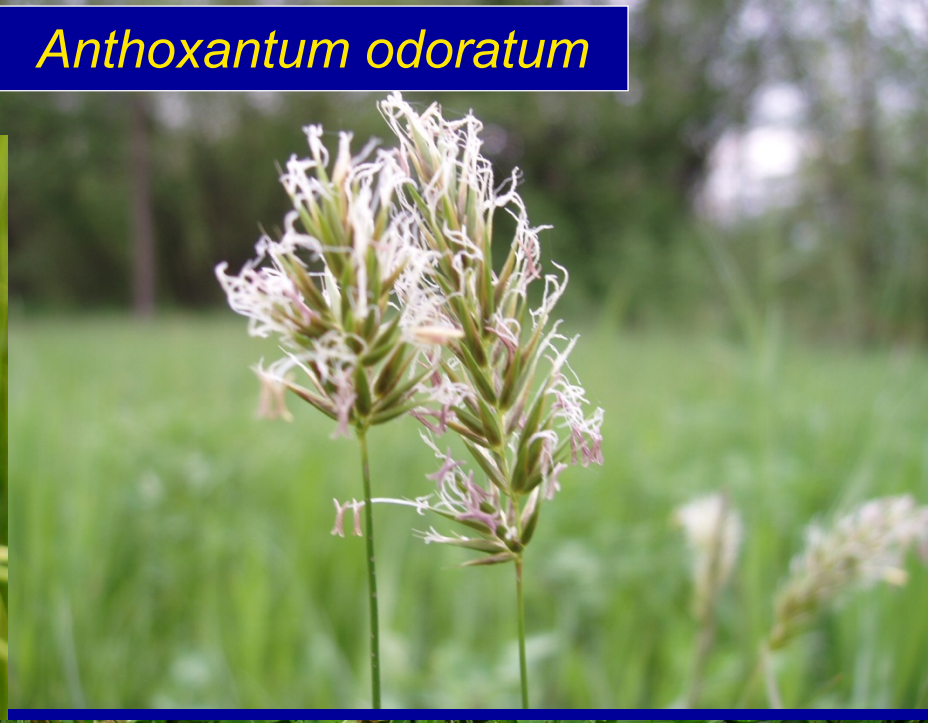
Dactylorhiza sambucina

Bromus erectus



Artificial grasslands

Anthoxantum odoratum



Phleum alpinum

Trifolium repens

Trifolium pratense

SITUATION AND TREND

Progressive depopulation

Riduction in farms number

Progressive reduction in bred animals

Pasture decline

Reduction in small permanent stock-farms

Strong increase in average herd size

Pastures abandonment

Strong landscape decay

E.g. in FVG inizi '900 → 426 malghe → 87 units

ANIMAL BIODIVERSITY IN ITALY

3 breeds represent 90% dairy cows in EU !!!

150 authocthonous breeds (cattle, sheep, horses, goats and pigs) several are under risk of extintion

29 cattle – 11 under risk (25 extinted)

20 horses – 14 under risk (6 extinted)

59 sheep – 31 under risk (31 extinted)

36 goats – 15 under risk (4 extinted)

6 pigs (33 extinted)

FAO data 2008










ENVIRONMENTAL AND TURISTIC VALUE

- Reduce fire events in forests
- Indirect defence against erosion risks
- Indirect defence against overshadow risks
- Farmers clean ditches and canals, regulate surface waters, are guards of the territory
- Animals as elements characterizing the territory
- Sale of quality products from authocthonous breeds i.e. milk, cheeses and meat
- Breeds under risk of extintion
- Socio-cultural events (e.g.:shepherd fair)
- Museums of farmers history
- Overnight stay in refuges and agro-turistic facilities

Mountain agriculture may survive only if human being will be able to valorize its

multifunctionality

where besides foodstuff production, will garantue landscape and cultural heritage conservation

On-going EU Projects

- Multisward http://multisward.eu

11 Partners from NL,B,F,Sw,N,IT,PL,UK

The objective is to support developments and innovations in grassland use and management in different farming systems

- Salvere http://salvereproject.eu

8 Partners from IT,AT,PL,CZ,SK,D

Want to promote HNVF with its biodiversity as valuable resource to support sustainable rural development


Thanks for your attention
We are multifunctional