First Annual Report 2008-2009

Future Crops for Food, Feed, Fiber and Fuel 4F Crops

Dipartimento di Scienze Agronomiche, Agrochimiche e delle Produzioni Animali Università degli Studi di Catania, Italy (UNICT)

DRAFT

Task 1.2 Evaluation of the restricting factors for the EU agriculture (UNICT, UNIBO)

WP1. Input demands: fertilizers, agrochemicals, soil tillage

1. Land Use in EU 27 (EC BREC)

2. Intensive cultivation of food crops

3. Yield in relation to nitrogen inputs and crop nitrogen use

4. Nutrient consumption in EU bioclimatic zones

5. Chemical and manure nitrogen fertilization

6. Potential soil nitrogen losses

7. Pesticide use in EU bioclimatic zones

8. Biodiversity

9. Mediterranean soil erosion

10. Irrigation demand and WUE (Water Use efficiency)

11. Environmental zone characteristics

1. Land use in European countries EU27

The land area in the European Union (27 European countries) is 540 millions of hectares. Within this area the forest area is of 152 M ha and the agriculture land is extended 194 M ha, of which arable land 111 M ha, irrigable area 15 M ha, permanent grassland 54 M ha, temporary grassland 8.5 M ha, and set- aside 5.3 M ha (Tab. 1). Within arable land intensive cultivation of food crops is widespread. The most important crops are wheat, barley, maize, rapeseed, triticale, sugar beet and pea.

Tab. 1 - Land use in European countries (M ha)

European land area (M ha)	540
of which	
Forest area:	152
Agriculture land:	194
of which	
Arable land	111
Irrigable area	15
Permanent grassland	54
Temporary grassland	8.5
Set-aside	5.3

Source EUROSTAT

1.1 Bioclimatic areas

According to climatic requirements, mainly temperatures, the cultivated crops are widespread in different areas of cultivation. This area of cultivation sometimes does not fit in the geographical distribution. Moreover, the climatic conditions affect growth and production of each crop, which behaves differently according to climatic zones.

For this reason the bioclimatic zones, as described by Metzger et al. (2005) were taken into consideration and the countries as part of the countries were included in each climatic zone. The countries distribution in each climatic area is reported in table 2.

Tab. 2 - Partitioning of European countries in bioclimatic zones

Bioclimatic zones	**European countries**
Nemoral	South Sweden, Estonia, Latvia, Lithuania, Finland
Continental	South-Eastern Germany, South Belgium, Poland, Czech Republic, Austria, Slovenia, Slovakia, Romania, Hungary, Denmark and Bulgaria
Atlantic central	South United Kingdom, Central and West Ireland, North-Eastern France, North Belgium, Netherlands, Germany, North Westphalia
Atlantic north	North United Kingdom, North Ireland, Denmark, Central and North Germany, Netherland
Lusitanian	Western France zone, North Portugal, North Spain
Mediterranean north	North Italy, North and Eastern zones Spain, South and Eastern Greece zones, East Portugal, France Camargue
Mediterranean south	South Italy (Sicily and Sardegna), South Spain, South Greece, South Portugal, Cyprus, Malta.

1.2 European agriculture land partitioning in bioclimatic zones

The figure 1 shows how agriculture land is distributed in each bioclimatic zone as described in table 2. A great part is arable area: Continental area (around 38 M ha), Central Atlantic (20 M ha) and Mediterranean North (16 M ha). With exception to Nemoral zone, other bioclimatic areas are extended 8-9 M ha.

The most part of irrigable area is in Mediterranean area (from 3 to 6 M ha), followed by Atlantic zone, with about 2 M ha, whilst all the other areas report less than 2 M ha. The lowest rate is observed is in the Nemoral zone.

Forest area extension is present in the Continental area (33 M ha), Mediterranean North (21 M ha), Atlantic Central (15 M ha) and Nemoral zone (14 M ha); lower forest land cover is in Lusitanian, Atlantic North and Mediterranean South (from 5 to 10 M ha).

Permanent grassland, more widespread than temporary grassland, are concentrated mainly in Central Atlantic and Continental area (around to 15 and 13 M ha, respectively) and in Mediterranean North (about 2 M ha). The Nemoral zone presents about 2 M ha of permanent grassland (fig.1). The set aside is no representative, because no required.

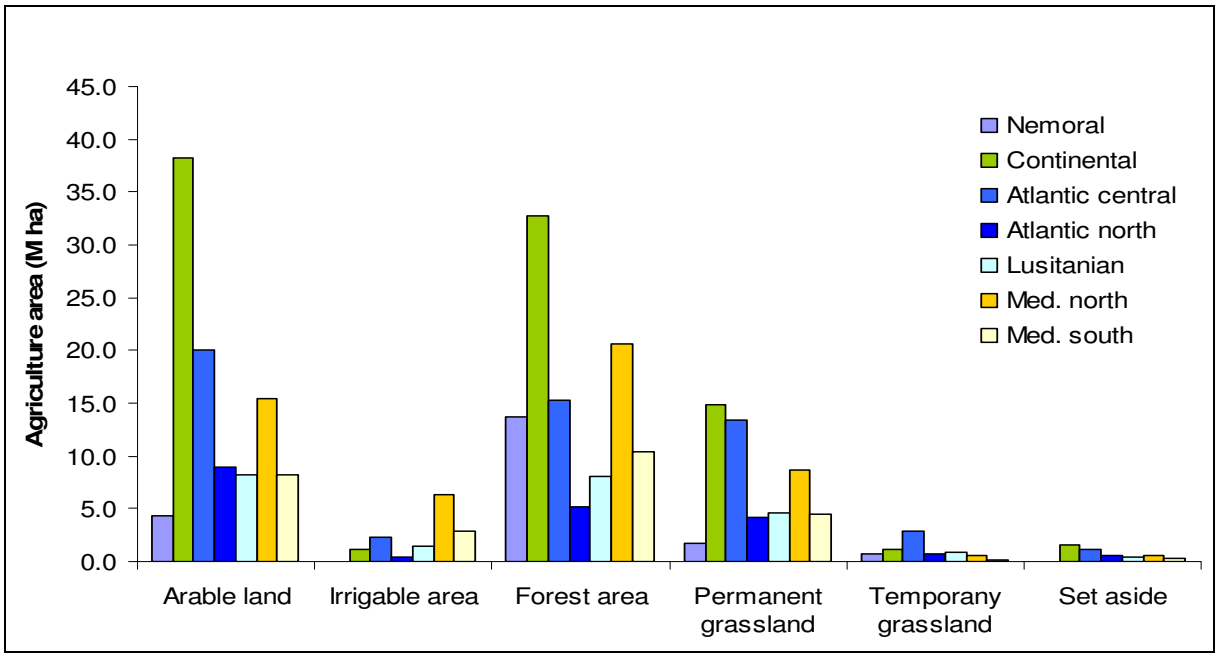


Fig. 1 - Agriculture land partitioning in bioclimatic zones

2. Intensive cultivation of food crops

According to FAOSTAT database within the arable area the most widespread crops are wheat, cultivated on 23,467,112 ha, barley on 13,278,222 ha, maize on 7,748,457 ha, rapeseed on 6,406,792 ha, triticale 2,471,522 ha, sugar beet 1,786,205 and pea 599,590.

In table 3 crop temperature requirements are shown; crop cultivation and production are affected by climatic parameters.

In Continental area we can find the greatest area cultivated with wheat (9293804 ha), barley (4014272 ha), maize (4499327 ha), triticale (1727125 ha), sugar beet (615187 ha), rapeseed (2744407 ha). Maize production is the highest in this area with 18826957 t.

The best yields are obtained in Atlantic Central area with wheat (6.6 t ha^{-1}), barley (5.8 t ha^{-1}) and pea (3.6 t ha^{-1}); we also observed the best production of sugar beet with 39298728 t.

In Atlantic North zone we observed the best yield of triticale (5.4 t ha^{-1}) and rapeseed (3.3 t ha^{-1}).

In Med. South area maize has the highest yield (9.2 t ha^{-1}). Sugar beet obtained the best yield in Lusitanian zone (81.5 t ha^{-1}).

2.1 - European crop cultivation areas and crop production in bioclimatic zones

Wheat is considered one of the most important food crops in the world: the area actually cultivated reaches about 25 M ha in Europe. It is more widespread in Continental area (38%), in the Atlantic Central (22%), Atlantic North (10%) and Mediterranean South (12%) zones; it is less extended in the other bioclimatic zones.

Tab. 3 - Main crops in arable lands and their germination and growth temperature requirements

Main crops	**Temperature**		**Cultivation period**
	Germination	Growth	
Wheat	Min 5°C Opt 20°C Max 35°C	15-24°C	winter
Barley	Min 5°C Opt 20-22°C Max 35°C C	15-24°C	winter
Maize	Min. 12°C; Opt. 25°C; Max 40°C	22-24°C°C	summer
Triticale	Min 5°C Opt 20°C Max.35°C	10-20°C	winter
Rapeseed	Min 5°C Opt 20°C Max.35°C	22-24°C	winter
Sugar beet	Min 10-12°C Opt. 25°C	16-24 °C	summer
Pea	Min 4°C Opt 18-20°C Max.35°C	15-18°C	winter

Wheat production is estimated around 119.3 million tonnes and in the Continental zone and in Atlantic Central there are the major wheat production areas (around 30% for each one). Atlantic North (15%), Lusitanian (10%), Mediterranean North (8%), Mediterranean South (4%) and Nemoral (3%) zones follow.

In order of importance, there is barley with a cultivation area around 14 M ha, according to FAO World Census of Agriculture. Its distribution is mainly on the Continental area (29%) and Atlantic Central area (15%), but also in Atlantic North and Mediterranean North zones (13 and 15%, respectively), whilst in other bioclimatic areas its presence is limited by climatic conditions.

Barley with a production of 57.5 million tonnes can be considered the most important cereal crops after wheat in European countries. In relation to the different bioclimatic areas, in Atlantic Central and Continental zone barley is cultivated for 22 and 26%, respectively, followed by Atlantic North and Mediterranean North (16 and 12%, respectively), whilst in other areas it is present below 10%.

In Europe maize cultivated area is equal to 8 M ha, with the most spread in Continental area (57%). It is present in Atlantic Central (14%) and Mediterranean North areas (16%). It is present

below to 10% in the other European areas, with the exception to Nemoral zone and Atlantic North area, where air temperature does not permit maize cultivation.

Grain maize production is around 50.0 million tonnes, distributed as follows: Continental (39%), Atlantic North (23%) Atlantic Central (19%), Lusitanian (10%) and Mediterranean South (8%).

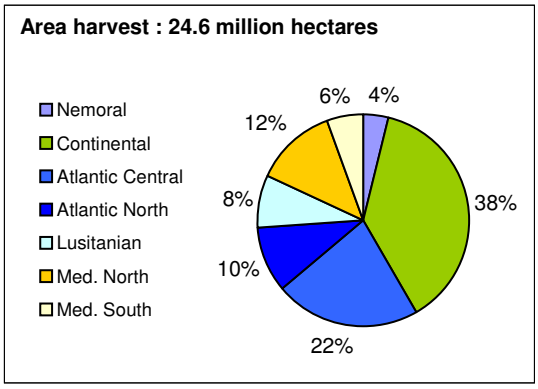
Rapeseed is the most important oleaginous crop in Europe with a cultivation of 7 M ha. It is more widespread in the Continental zone (43%), but it is well represented in Atlantic North (27%) and Lusitanian (8%) areas. This crop grows in Atlantic North and Nemoral zones due to its resistance to low temperatures. Rapeseed production was around 18 million tonnes. This crop was considered for sustainable biofuel production. The best part of production is concentrated in Continental and Atlantic Central areas (40 and 29%, respectively). A good rapeseed production is from Atlantic North (18%) too, because this crop is resistant to winter cold; Lusitanian contributes with around 8%.

In Europe triticale area cultivation is evaluated around to 1.5 M ha. It is more present in Continental zone (70%). It is also spread in Atlantic North and Central areas (6 and 13%, respectively) and it is little represented in the other bioclimatic zones. Triticale reaches productions about 9.6 million tonnes of grain. The highest production is obtained in the Continental zone (64%), followed by Atlantic Central (16%), Atlantic North and Lusitanian (6-9%). In Mediterranean and Nemoral bioclimatic zones lower triticale productions are observed.

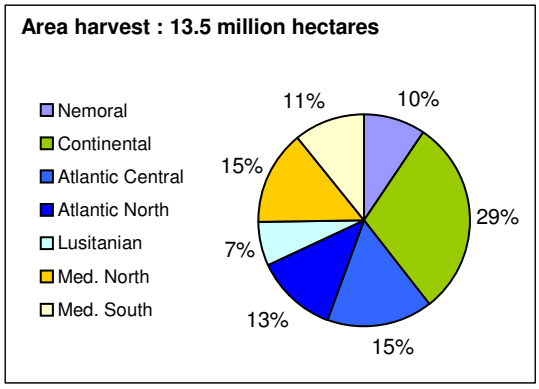
Sugar beet is one of the most important crop for the food and no food production. Approximately area cultivated in Europe is 1.8 M ha, distributed largely in Continental area (35%), Atlantic Central (30%) and North (12%) area. In other bioclimatic zones as Lusitanian, Mediterranean North and South were found lower values. Sugar beet occupies an important strategic position in EU markets with 111.5 million tonnes, due to potential sugar or ethanol production. Around 65% of production is obtained in Continental area, instead 16% in Atlantic Central and 10 - 12% in Atlantic North and Lusitanian zone.

Pea crop have a small area cultivated about 0.6 M ha, but it is well distributed in the climatic zones. Its importance is mainly due to the high protein content (source FAOSTAT). Total peas production is equal to 1.5 million tonnes. The highest production was obtained in the Atlantic Central, which contributes with 36% on total production; followed by. Continental (23%) Lusitanian (15%), Atlantic and Mediterranean North (from 8 to 10%) (Figg. 2-3).

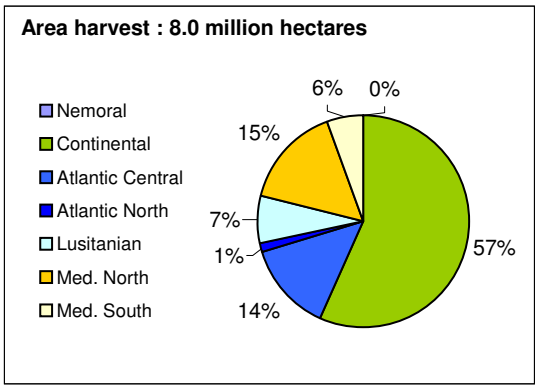
WHEAT



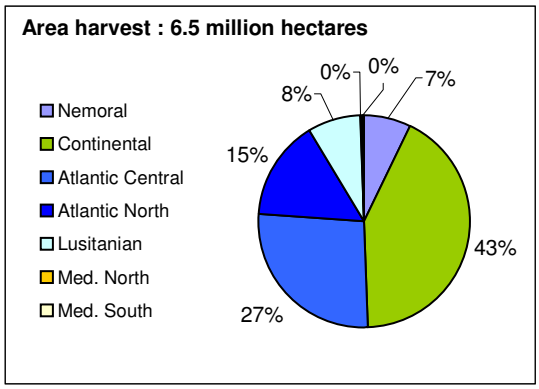
BARLEY



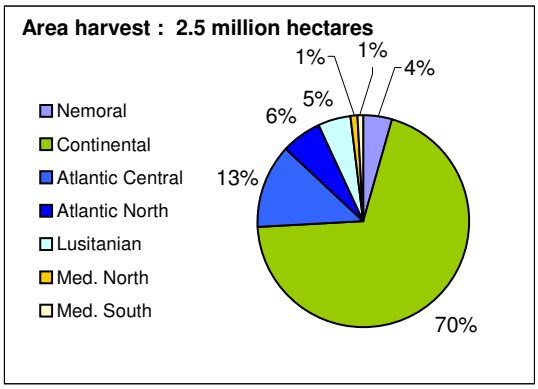
MAIZE



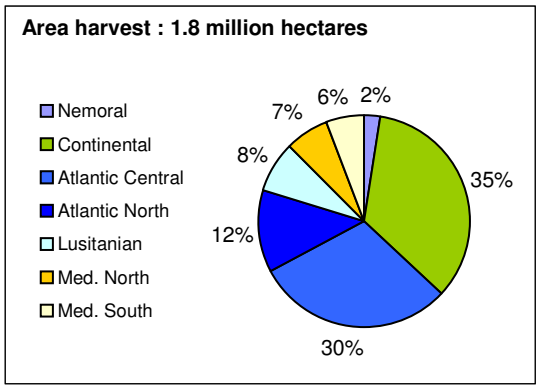
RAPESEED



TRITICALE



SUGAR BEET



PEA

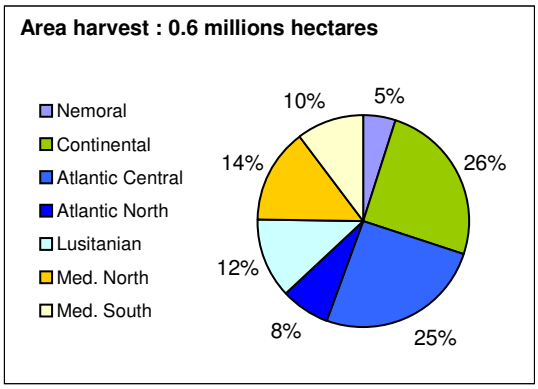
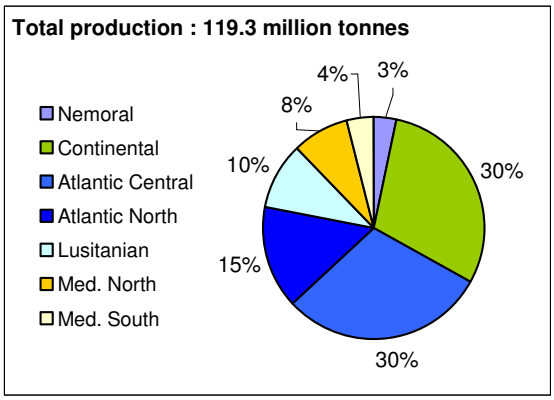
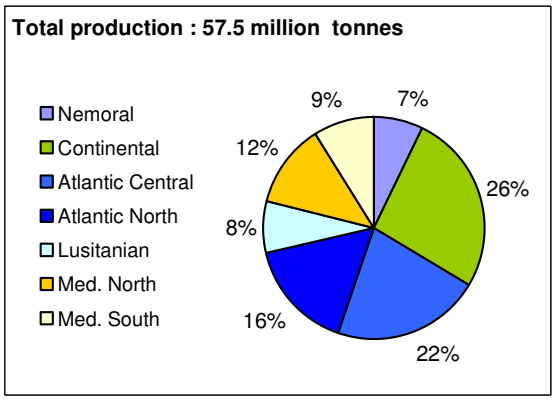


Fig. 2 – Europe partitioning area in bioclimatic zones

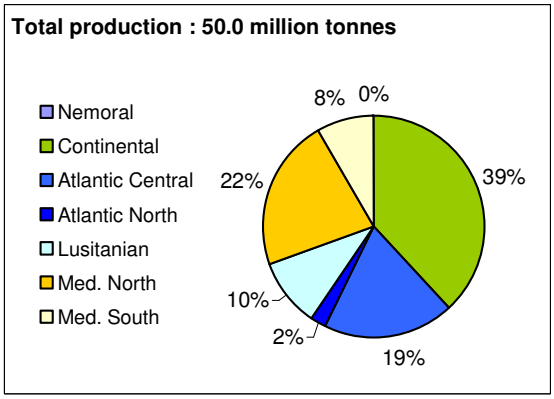
WHEAT



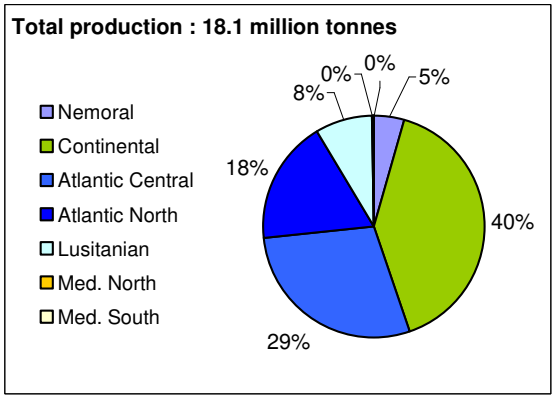
BARLEY



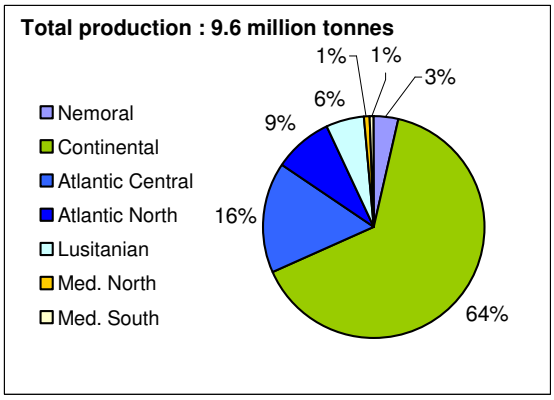
MAIZE



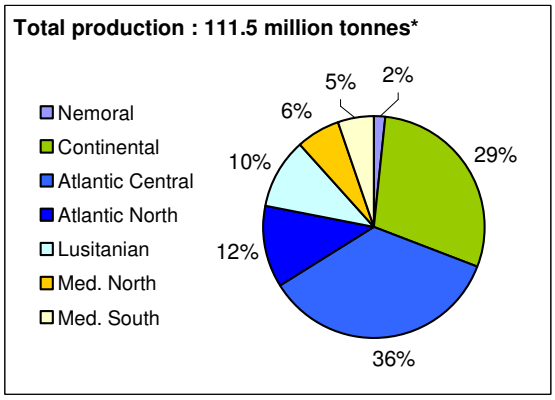
RAPESEED



TRITICALE



SUGAR BEET



*Fresh weight

PEA

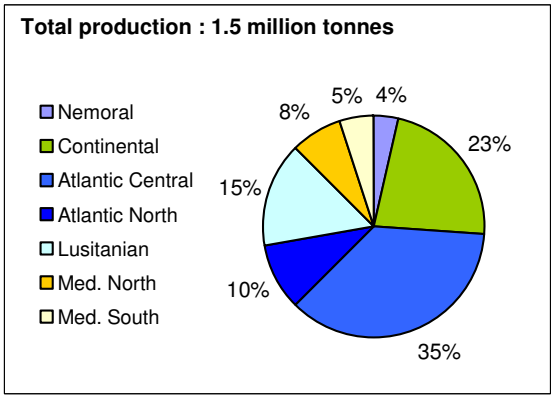


Fig. 3 – Total production per area (million tonnes) in relation to crops and bioclimatic zones

3. Yield in relation to nitrogen inputs and crop nitrogen use

In Atlantic North, Atlantic Central and Lusitanian zone there are the highest wheat yields (in order 7.1, 6.6 and 5.9 t ha^{-1}), whilst the other bioclimatic areas showed values between 3.3 and 4.0 t ha^{-1}. In the Atlantic area elevated consumptions of nitrogen fertilizer are observed (from 161 to 174 kg ha^{-1}). In this area high yields are also obtained.

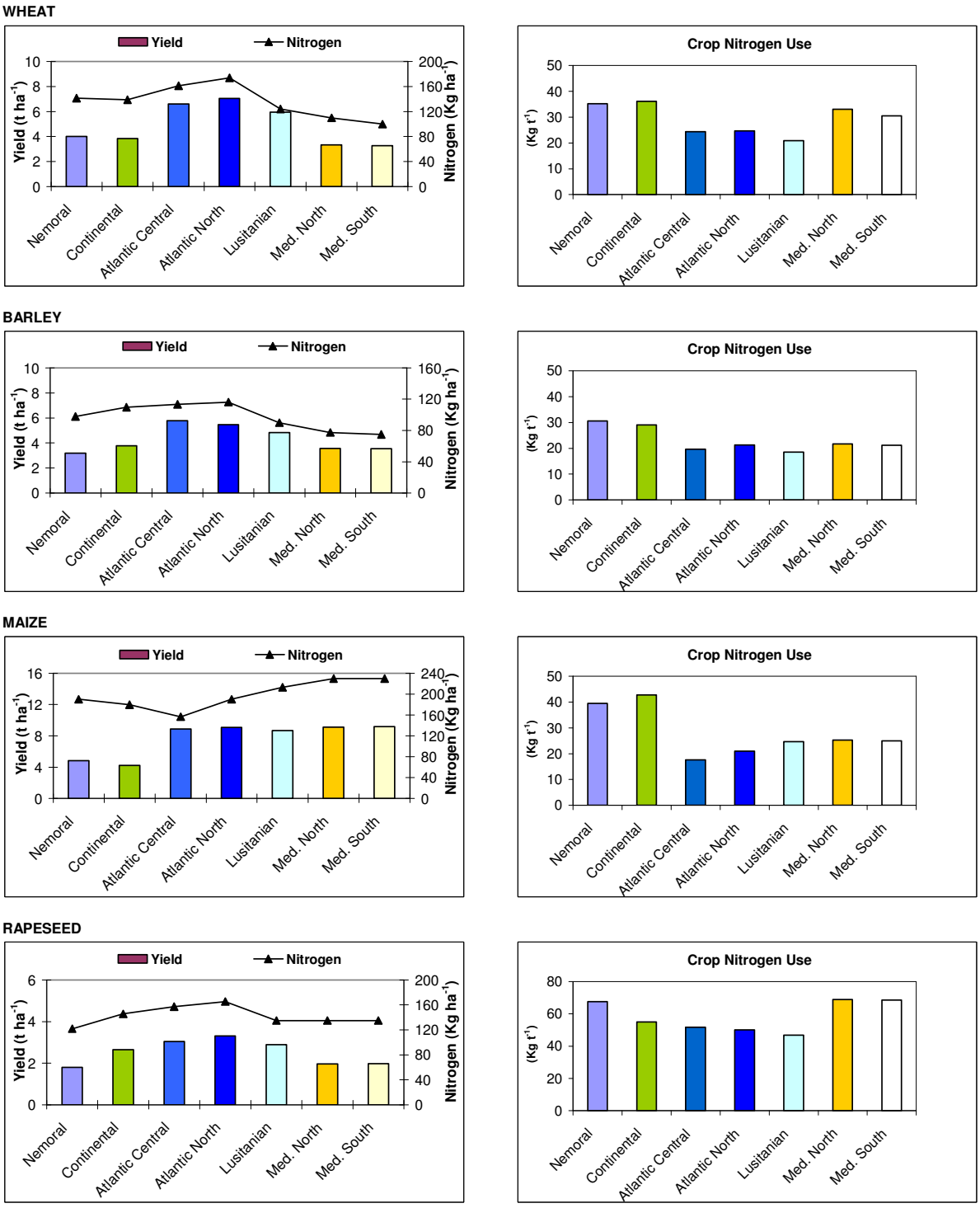


Fig 4 –Crop yield, N fertilizer (kg ha^{-1}) and crop nitrogen use (kg t^{-1}) in relation to European bioclimatic zones

In Continental, Nemoral and Mediterranean areas there no relation between yield and nitrogen fertilization, probably due to precipitation and temperature, not appropriate to crop requirements. Nitrogen use efficiency shows high levels in these areas (from 31 to 36 kg t^{-1}).

About barley, a correlation was observed between yield and nitrogen inputs, excluded Continental and Nemoral zone, where the amount of nitrogen per unit of product was significantly high (from 29 to 31 kg t^{-1}).

In maize a good productive response (around 9 t ha^{-1}) is observed using 157 kg ha^{-1} of N in the Atlantic Central and Atlantic North, Lusitanian and Mediterranean areas, where the same yields are obtained by using higher doses of nitrogen fertilizer (from 190 to 230 kg ha^{-1}). Nemoral and Continental areas show the lowest production with the use of high inputs of nitrogen, causing a significant increase of amount of nitrogen applied per tonne (around 40 kg t^{-1}).

In Continental area, Atlantic and Lusitanian zones, rapeseed yield was elevated (from 2.6 to 3.3 t ha^{-1}), utilizing nitrogen inputs from 135 to 165 kg ha^{-1}, whilst in the other regions where low nitrogen inputs (122-135 kg ha^{-1}) are supplied, yields show values about 2.0 t ha^{-1}. Nitrogen use efficiency resulted high in the Mediterranean and Nemoral areas (about 69 kg t^{-1}), whilst in the other ones it is around 50-55 kg t^{-1}.

In Lusitanian yield of sugar beet reached 81.5 t ha^{-1} by using 177 kg ha^{-1} of N; in Atlantic zone 66.1 t ha^{-1} by using a lower nitrogen input (128.5 kg ha^{-1}, on the average). Apart from colder zones (Nemoral), where the yields are affected by nitrogen fertilizer consumption, in the other areas, however, the great amount of nitrogen used does not produce a yield increase and determine a low nitrogen use efficiency.

In pea cultivation nitrogen supplying has starter function. Total production registered in Europe amounts about 1.5 million tonnes. The highest yield levels, such as sugar beet, are found in the Atlantic and Lusitanian zones (from 3.2 to 3.6 t ha^{-1}), followed Nemoral (1.9 t ha^{-1}) and Continental areas (2.3 t ha^{-1}), whilst in Mediterranean zone a value over 1.0 t ha^{-1} is found. In this area low nitrogen use efficiency (about 22-25 kg ha^{-1}) is recorded (Figb. 4-5).

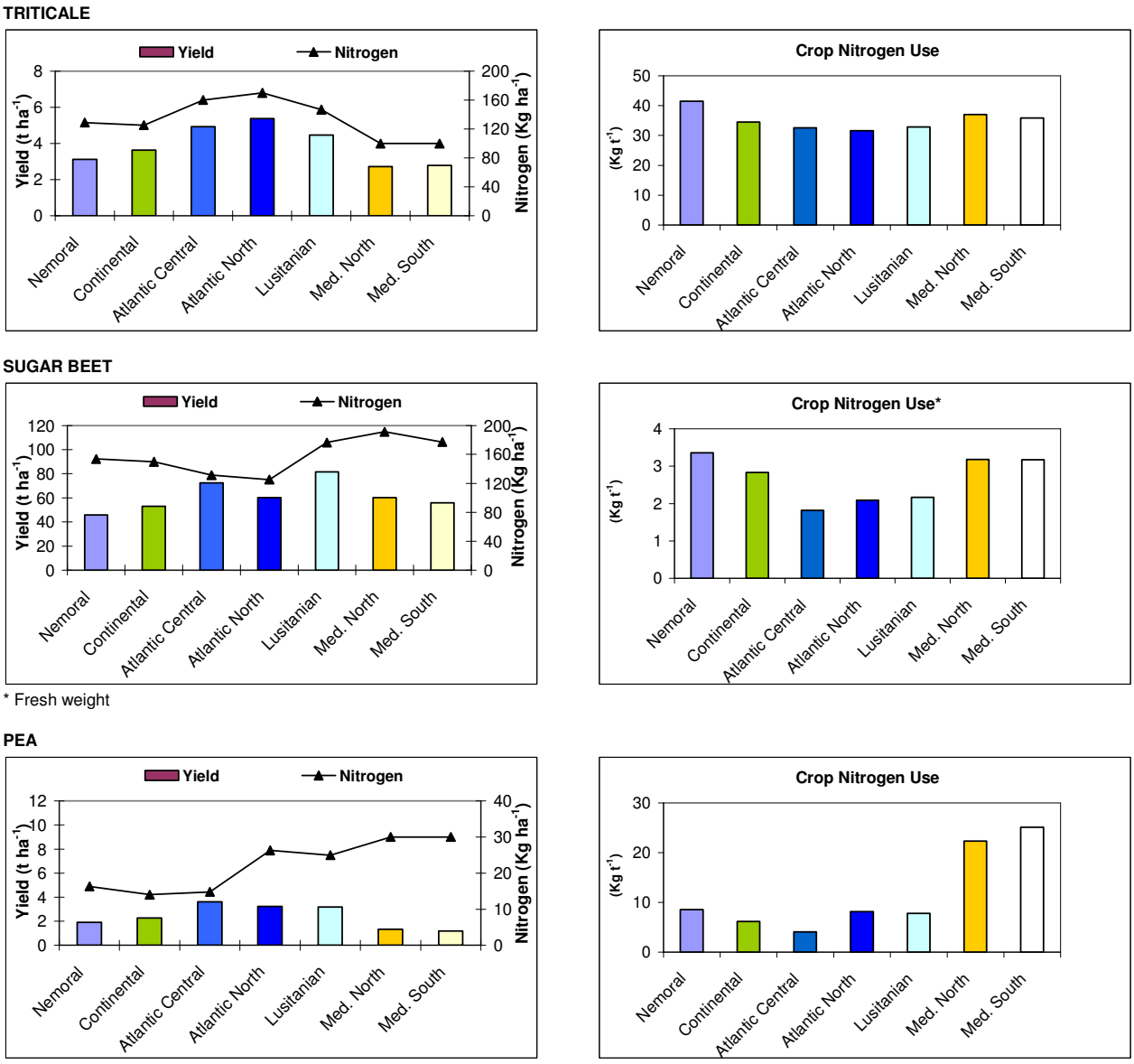


Fig. 5 –Crop yield, N fertilizer (kg ha^{-1}) and crop nitrogen use (kg t^{-1}) in relation to European bioclimatic zones

4. Nutrient consumption in EU bioclimatic zones

Fertilizer use (NPK) is large in Atlantic Central area (about 8 million tonnes), followed by: Continental zone (around 7 million tonnes), Lusitanian (6 million tonnes) and Atlantic North (around 4.9 million tonnes). In the Mediterranean area fertilizer consumption was around 4 million tonnes, whilst the lowest value (around 1 million tonnes) is found in Nemoral area, where cultivation area is little extended. The highest consumption of mineral fertilizers is observed in France (3.8 million tonnes), Poland (around 2.6 million tonnes), Germany (2.3 million tonnes) and Spain (2.0 million tonnes). Netherlands, Italy and UK have values between 1.3 and 1.6 million tonnes. The other countries consume fertilizers below 0.6 million tonnes per year (Figg. 6-7).

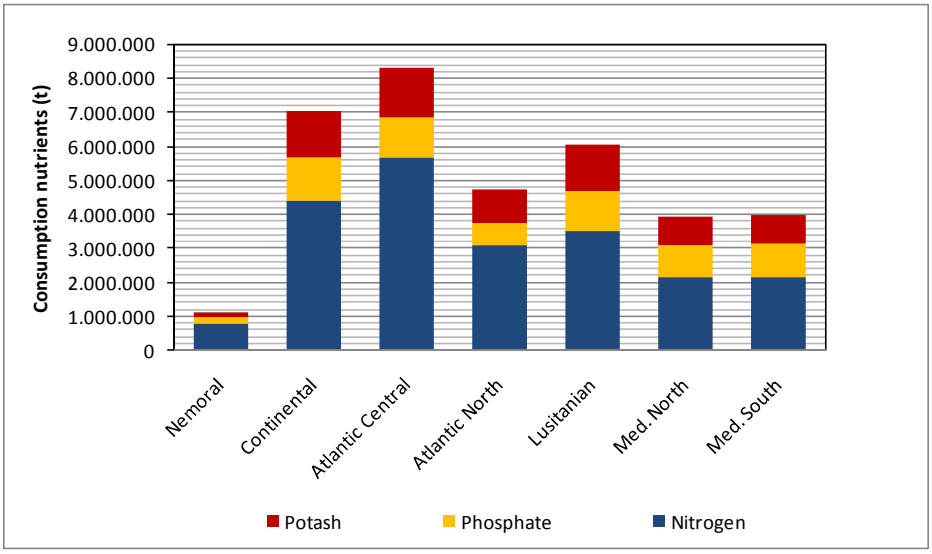


Fig. 6 - Nutrient consumption (t) in relation to EU bioclimatic zones (**Source:** Faostat 2007, OECD Environmental Data 2008)

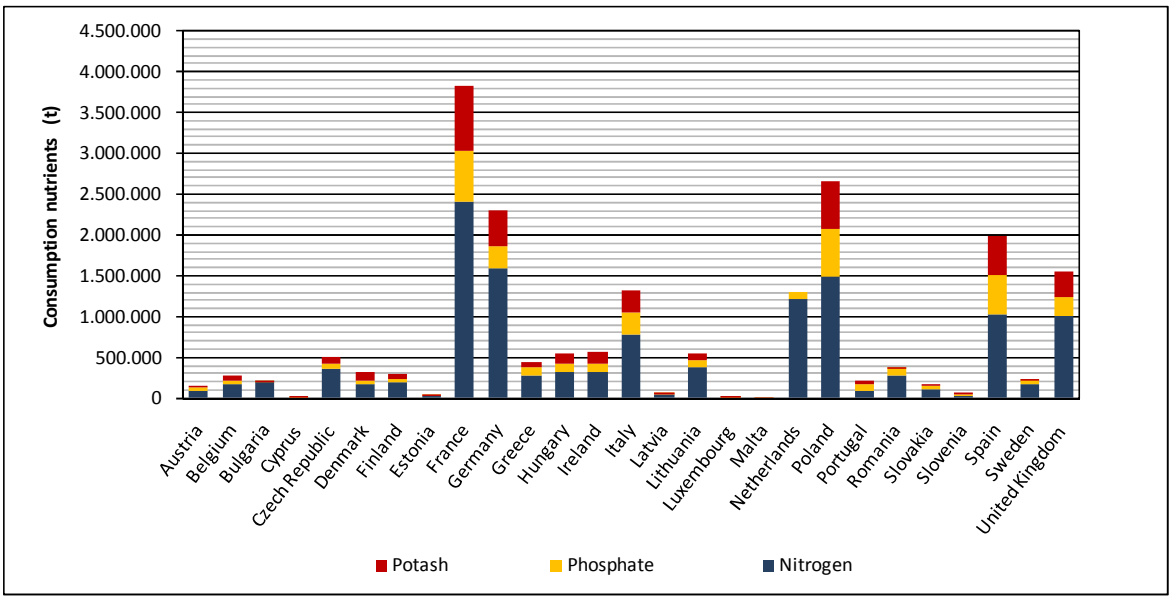


Fig. 7 - Nutrient consumption (t) in relation to European countries

5. Chemical and manure nitrogen fertilization

CEE Directive 91/676/EEC concerns protection of water against pollution caused by nitrates from agricultural sources.

Denmark introduced a limit of 140 kg N ha^{-1} from poultry manure in 2004 and further increased requirements on manure nitrogen efficiency. The Netherlands in 2005 approved a programme where the limit of 170 kg ha^{-1} of nitrogen from livestock manure, minimum requirement on manure nitrogen efficiency, is introduced. The Austrian action programme contains limit for total nitrogen application for both grass and arable land.

Ireland approved in 2006 the first action programme, establishing a legally binding obligations for farmers relating to fertilization practices and including prohibition periods for manure and chemical fertilizer application and minimum distances from water courses for the application of fertilizers. Moreover, the Irish action programme sets out the limit of 170 kg N per hectare for the application of livestock manure and limits both nitrogen and phosphate supplying.

Germany revised the fertilizer ordinance in 2006 ensuring compliance with the limit of 170 kg ha^{-1} nitrogen from livestock manure and including detailed binding provisions, for instance, on nitrogen balance in fertilization, on application of fertilizer on slopes and near water bodies and legally binding values for nitrogen in manure and nitrogen losses. Moreover a minimum storage capacity of six months was established.

Belgium, in addition to the NVZ (Nitrate vulnerable Zone) designation, revised action programmes, including all the measures containment on the nitrates Directive, for instance manure nitrogen and total nitrogen limits, compliance with the limit of 170 kg nitrogen per hectare from livestock manure, minimum storage capacity of six month. All the recently revised action programmes contain obligations for farmers regarding record keeping, sanctions for non-compliance and obligation of control on the competent authorities. New action programmes have also been recently established in specific Regions in Italy, Spain and Portugal.

Commission Decisions a temporary derogation was granted to Denmark (Commission Decision 2002/915/EC1). The derogation allowed the application up to 230 kg ha^{-1} nitrogen in cattle farms. The Commission Decision established detailed conditions regarding fertilization manure and other fertilizer applications, obligations on soil analysis, land cover.

This derogation was renewed until 31 July 2008 (Commission Decision 2005/294/EC of 5 April 2005), following the adoption of an updated action program by Denmark, taking into account the results of evaluation of the Second Action Plan on aquatic environment, which showed the achievement of the reduction target of 48% for nitrate leaching in the period from 1985 to 2003.

Derogations were also granted to Netherlands up to 250 kg per ha year nitrogen from grazing livestock manure.

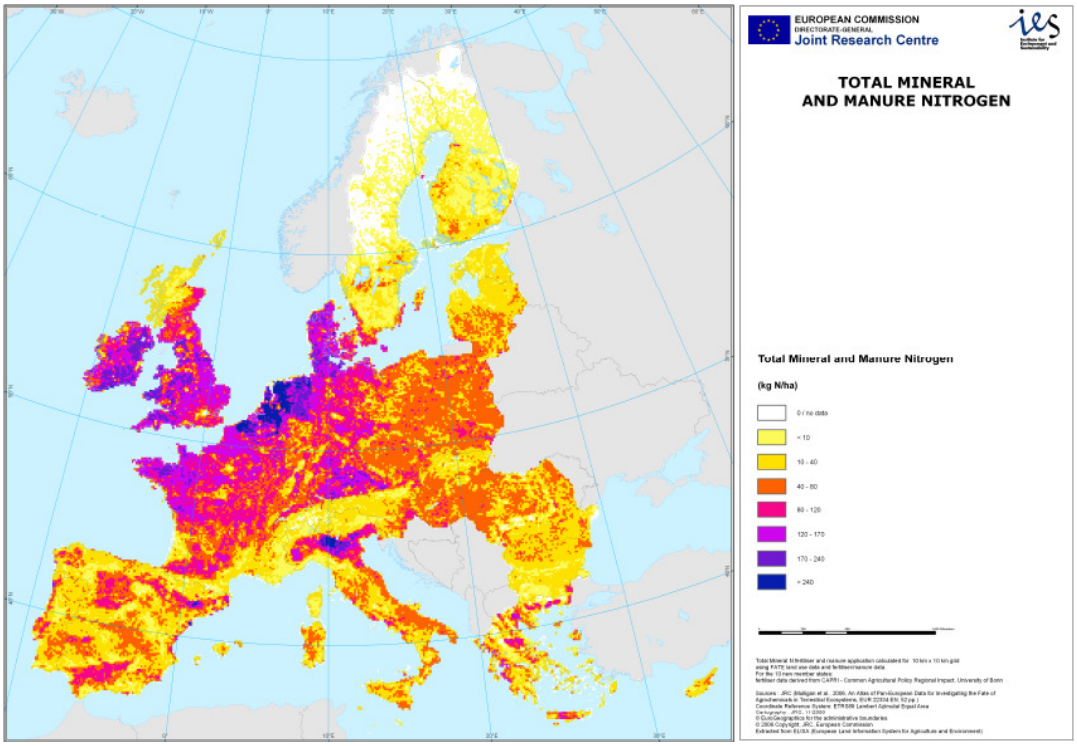


Fig. 8 - Total nitrogen application, manure and chemical fertilizer (source : JRC, Mulligan et al., 2006)

6. Potential soil nitrogen losses

Agricultural activities are one of the most sources of nitrogen pollution, and quality of water is one of the most important environmental issues in areas with a high density of livestock per hectare. Within the EU, mineral (commercial) fertilizers are the largest source of nitrogen applied to agricultural soils, mainly nitrogen fertilizers as calcium ammonium nitrate and ammonium nitrate. Nitrogen in commercial fertilizer is particularly soluble to facilitate uptake by crops, but this also determines the run-off after rainfall and the leaching to groundwater (Eurostat 2000).

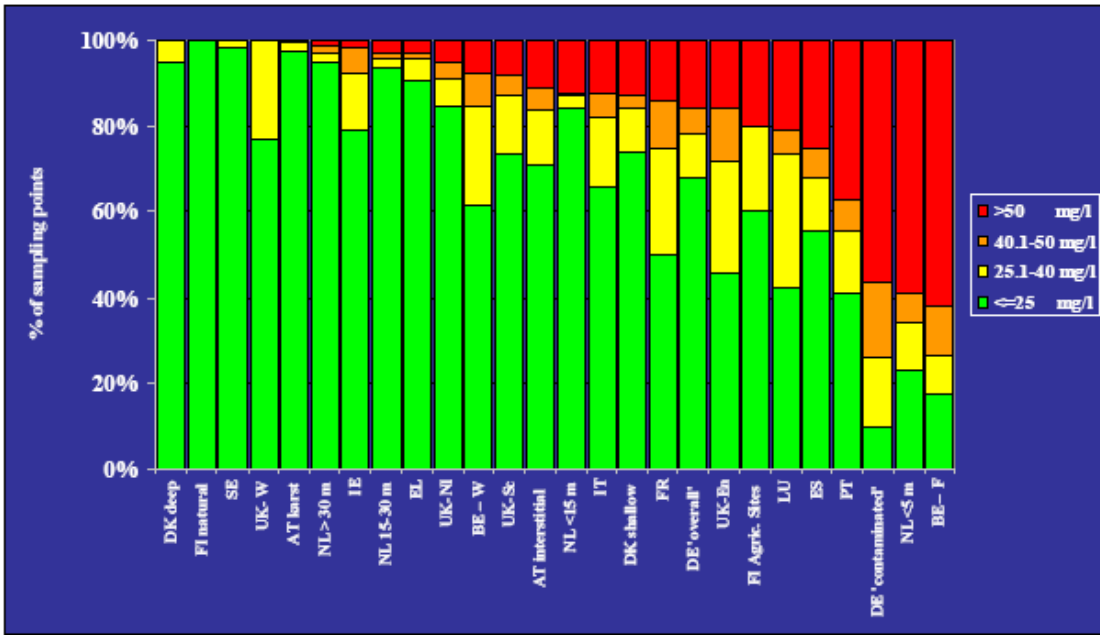
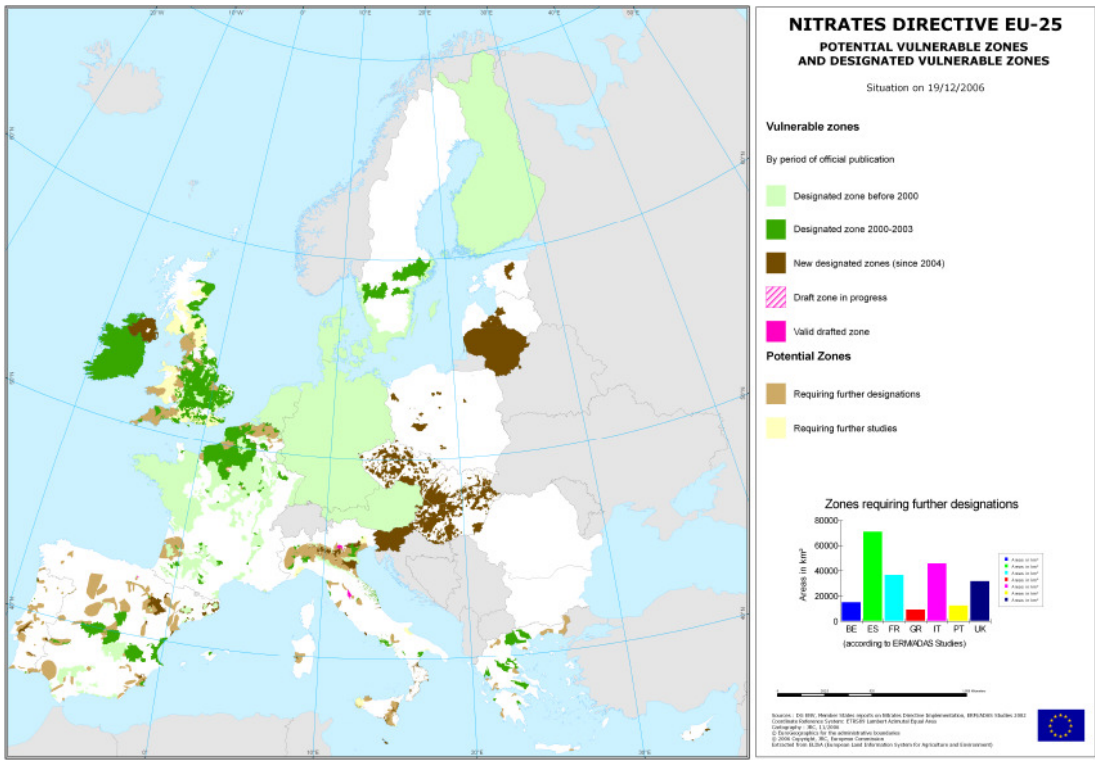


Fig. 9 – Concentration of nitrogen-nitrates in the soil in different locations in Central Europe

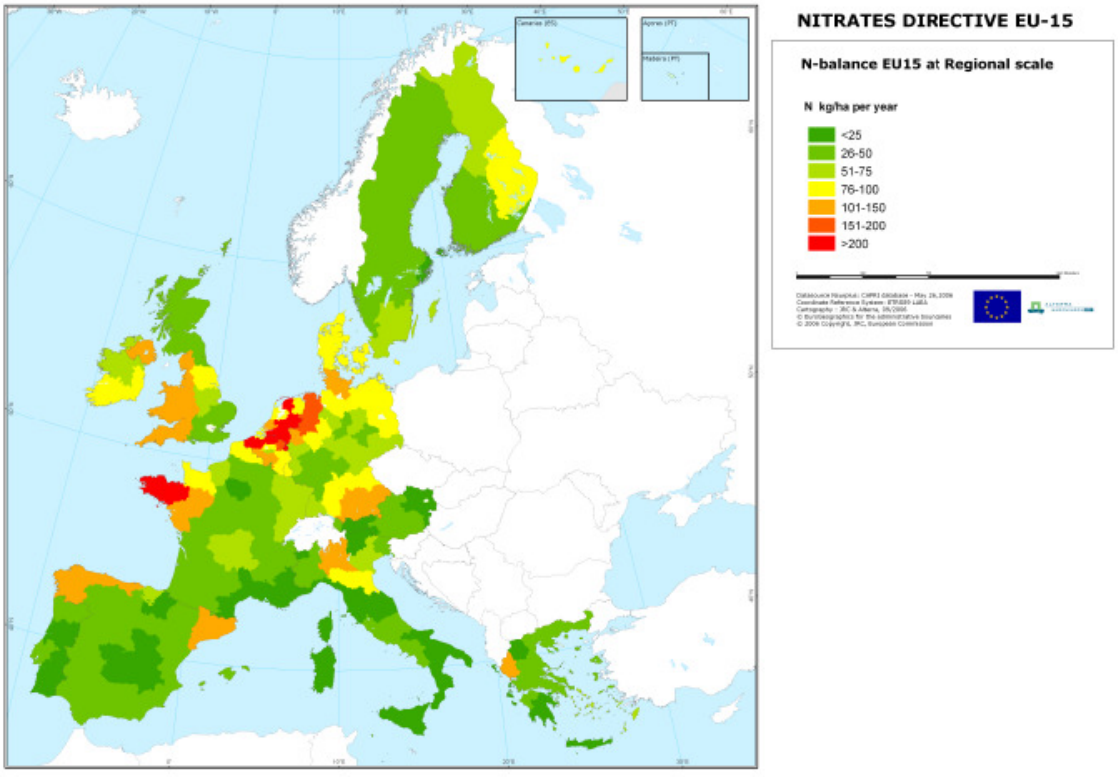
Application of fertilizers is a contributory factor to increased potential losses through leaching of nitrate and phosphate. The intensity of fertilizer use has implications for agricultural production and for the environment. In particular, problems arise when more fertilizers are used than needed. On the other hand, fertilizers and soil improvers are important inputs for agricultural production.

MAP 15. Nitrate Vulnerable Zone designation EU 25 (year 2006) and area requiring designation according to Commission assessment

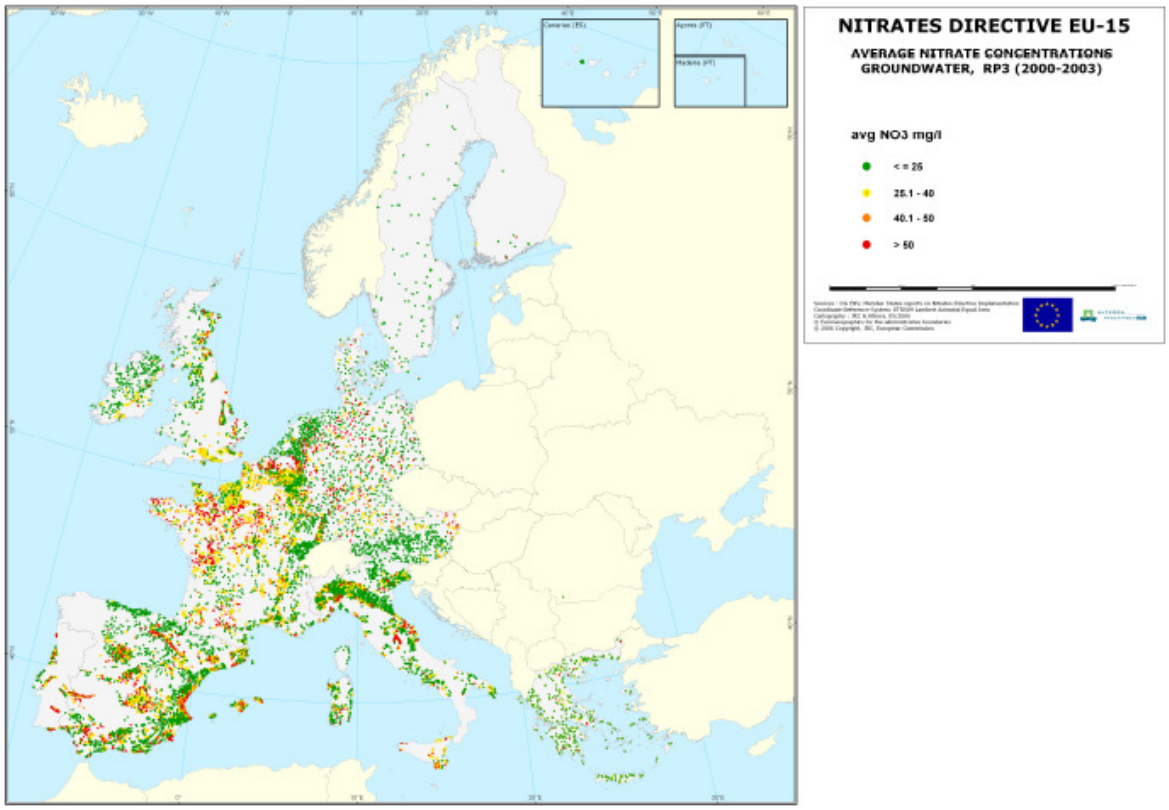


**Designated nitrates vulnerable zones after 2003 are based on information made available to the Commission in digital form. The estimate of designated area does not include some designations communicated in paper form only*

MAP 5. Nitrogen surplus in the EU 15 at regional scale (Source: Capri database). Reference year: 2001.



MAP 7. Average nitrate concentrations in groundwater stations, reporting period 2000-2003



7. Pesticide use in EU bioclimatic zones

In the Atlantic central area annual herbicides use to weeds control is around 44.000 tonnes; Continental area shows a lower consumption, about 28.000 t, although the increasing of agricultural land (around 30%). In the other bioclimatic zones, there is a consumption below 20.000 t. The lowest consumption was recorded in the Mediterranean South and Nemoral zone (in order, around 7800 and 1100 t). The highest consumption of herbicides in the European countries is found in France (31.500 t), United Kingdom (22.900 t), Germany (16.600 t), Spain (12.100 t) and Italy (about 9400 t). High consumption in Belgium and Netherlands (around 5200 and 3600 t, respectively) is observed, whilst in other countries, except Poland and Romania, below 3000 t per year (Figg. 10-11).

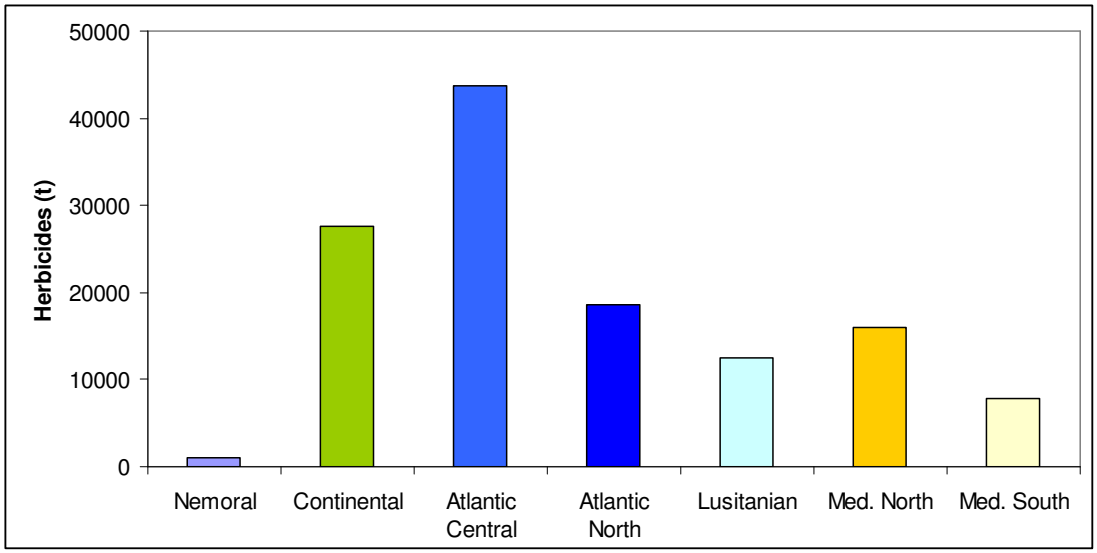


Fig. 10 – Herbicides consumption (t) in relation to European bioclimatic zones

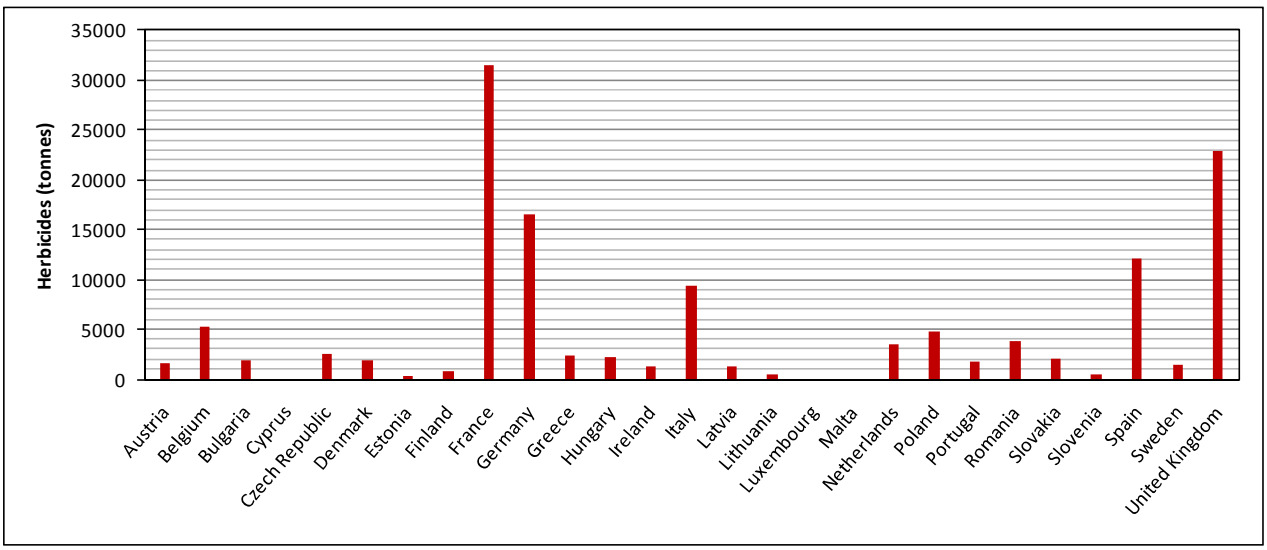


Fig. 11 - Herbicides consumption (t) in EU countries.

The following table shows trend in the consumption of agricultural pesticides in selected countries. Pesticides are grouped into four categories: total pesticides, insecticides, fungicides and herbicides. There are additional data for "other pesticides", which include fumigants, rodenticides and anti-coagulants. Trend data refer to pesticide consumption relative to a base year (Tab. 4).

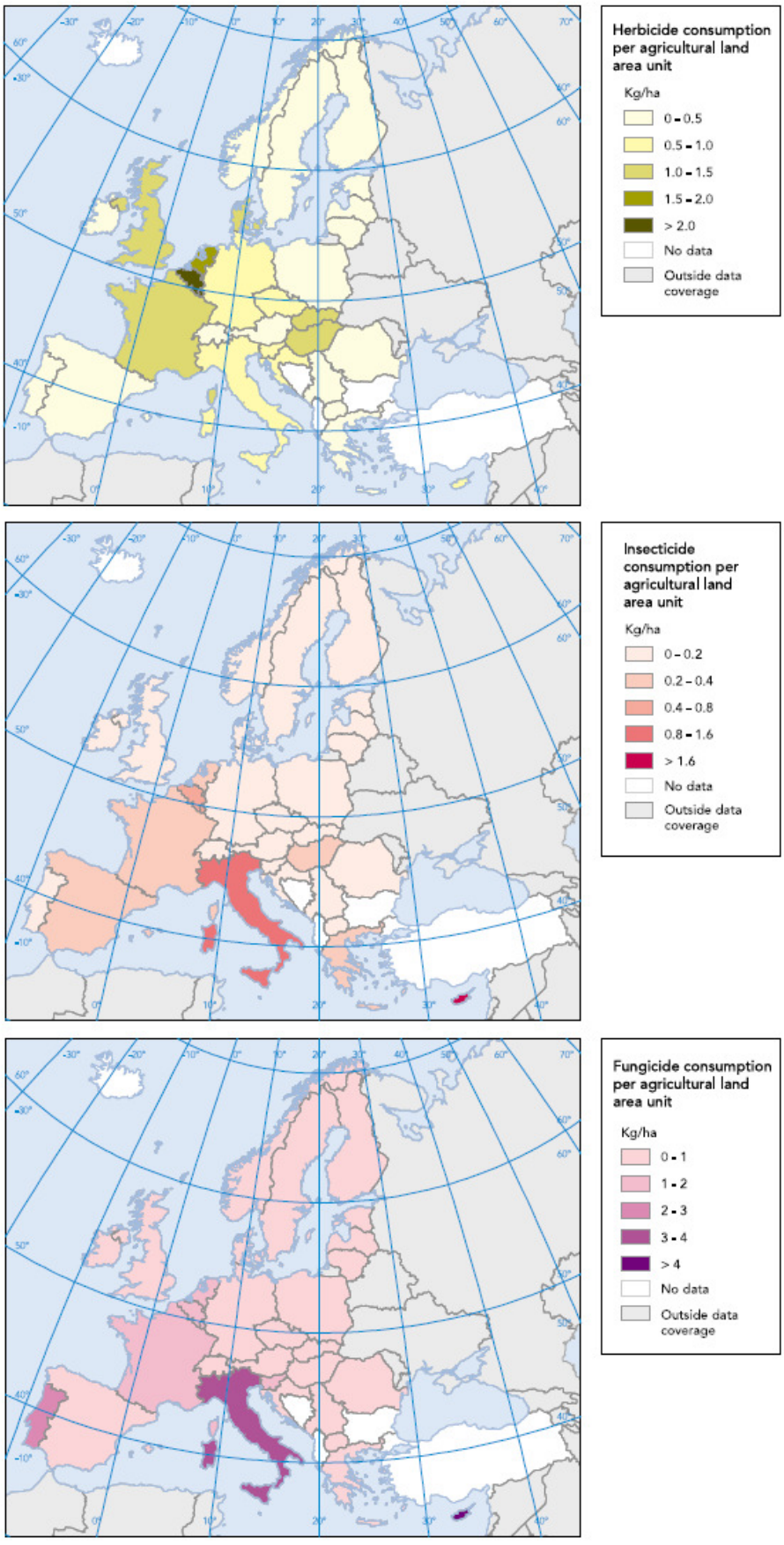
Tab. 4 - Consumption of pesticides (OECD Environmental Data 2008)

tonnes (active ingredients/éléments actifs)

		Year/ Année	Total pesticides	Insecticides	Fungicides/ Fongicides	Herbicides	Other pesticides/ Autres pesticides
Canada	*	2006	36573	1288	3723	28712	2851
Mexico/ Mexique	*	2006	44765	14641	..	30124	..
USA/ Etats-Unis	*	2001	306175	33112	19051	196405	57606
Japan/ Japon	*	2006	59565	22554	24559	12016	436
Korea/ Corée	*	2004	23910	8367	7220	5655	2668
Australia/e	*	2006	35901	8036	2572	24789	503
N.Zealand/ N.Zélande	*	2007	4939	299	1359	3077	204
Austria/ Autriche	*	2005	3405	274	1650	1466	15
Belgium/ Belgique	*	2006	6943	812	2351	3009	771
Czech Rep./ Rép. tchèque	*	2006	4589	182	927	2639	841
Denmark/ Danemark	*	2006	3212	57	536	2479	140
Finland/ Finlande	*	2006	1645	40	261	1274	70
France	*	2006	71700	2100	36000	23100	10500
Germany/ Allemagne	*	2007	32683	1092	10942	17147	3502
Greece/ Grèce	*	2006	10320	2540	4600	2250	930
Hungary/ Hongrie	*	2004	9941	1728	2517	4758	939
Iceland/ Islande	*	2003	4	-	-	3	-
Ireland/ Irlande	*	2003	2913	42	627	1854	390
Italy/ Italie	*	2006	81450	10947	50749	8924	10831
Luxembourg		..	..	..	..	..	..
Netherlands/ Pays-Bas	*	2007	10740	1499	4709	2736	1796
Norway/ Norvège	*	2007	751	10	103	572	66
Poland/ Pologne	*	2006	7781	495	3720	2556	1010
Portugal	*	2005	16346	425	12366	1751	1804
Slovak Rep./ Rép. slovaque		2006	2985	222	432	1413	917
Spain/ Espagne	*	2006	40595	13695	13090	11002	2808
Sweden/ Suède	*	2007	2136	54	220	1809	53
Switzerland/ Suisse	*	2006	1359	105	638	595	21
Turkey/ Turquie	*	2006	16470	6668	5228	4023	551
UK/ Royaume-Uni	*	2006	24305	1075	5308	12284	5637

Use of herbicides, insecticides and fungicides across Europe

Source: FAO.



Notes: Years: 1996 EU and 1998 accession countries

8. Biodiversity

Agriculture as human activity occupying the largest share of the total land area for all European countries plays a key role with regard to biodiversity which is highly dependent on land use. The expansion of farm production and intensification of input use are considered the best cause of the loss of biodiversity, whilst at the same time some agro-ecosystem can be useful to maintain biodiversity. Farming is also dependent on biological services, such as the provision of genes to develop improved crop varieties and livestock breeds, crop pollination and soil fertility provided by microorganisms. In some cases, non-native species cause damage to crops from alien pests and competition for livestock forage.

The main focus of policy actions on biodiversity has been to protect and conserve endangered species and habitats, but some countries have also begun to develop more holistic national biodiversity strategy plans. These plans usually incorporate the agricultural sector in biodiversity conservation, as the International Convention on Biological Diversity.

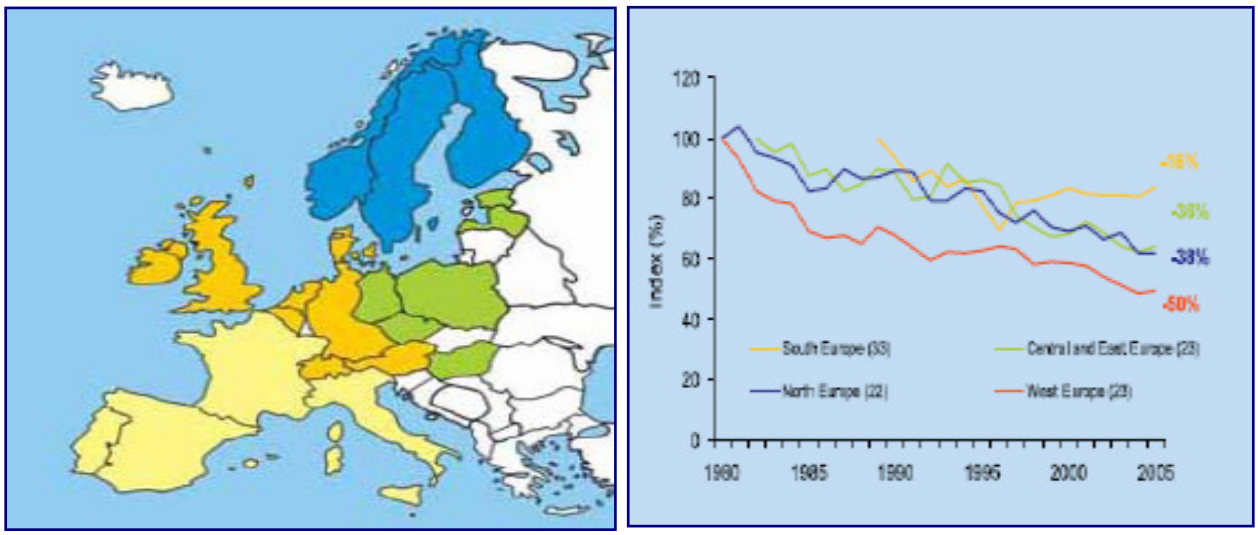


Fig. 12 - Biodiversity and agriculture – the role of long-term studies University of Reading 25-26th September 2008 Ken Norris, University of Reading (UK)

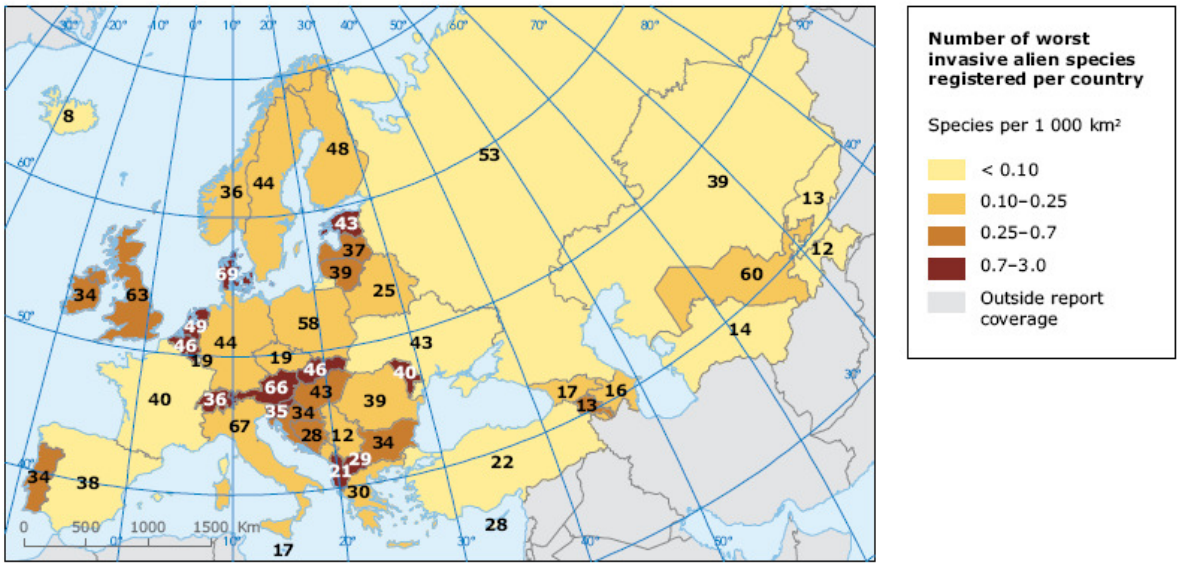
8.1. Alien species in Europe increasing risk for biodiversity

An increase in the number of established alien species implies a growing potential risk of species turning invasive and causing damage to native biodiversity (EEA, 2009).

Based on opinion in the SEBI 2010 expert group on invasive alien species, 163 species out of a total of 10000 established alien species, are classified as 'worst invasive', because they are highly invasive and damaging native biodiversity (Map 3.2). Whilst the number of invasive species is relatively low, their impacts can be severe through competition with other species, health effects on human populations or damage to economic activities.

Invasive alien species are recognised as the great cause of biodiversity loss, but the issue of 'alien species' may in the future need to be considered in the context of climate change and particularly adaptation. For example, as agricultural food production adapts to a changing climate, farmers may welcome the arrival of pollinator species that match the new plant varieties that are used. Indeed, the movement of plant and animal species together may be necessary to facilitate adaptation. EU Strategy on Invasive Species will be adopted by 2010

Map 3.2 **Number of the listed 'worst' terrestrial and freshwater invasive alien species threatening biodiversity in Europe**

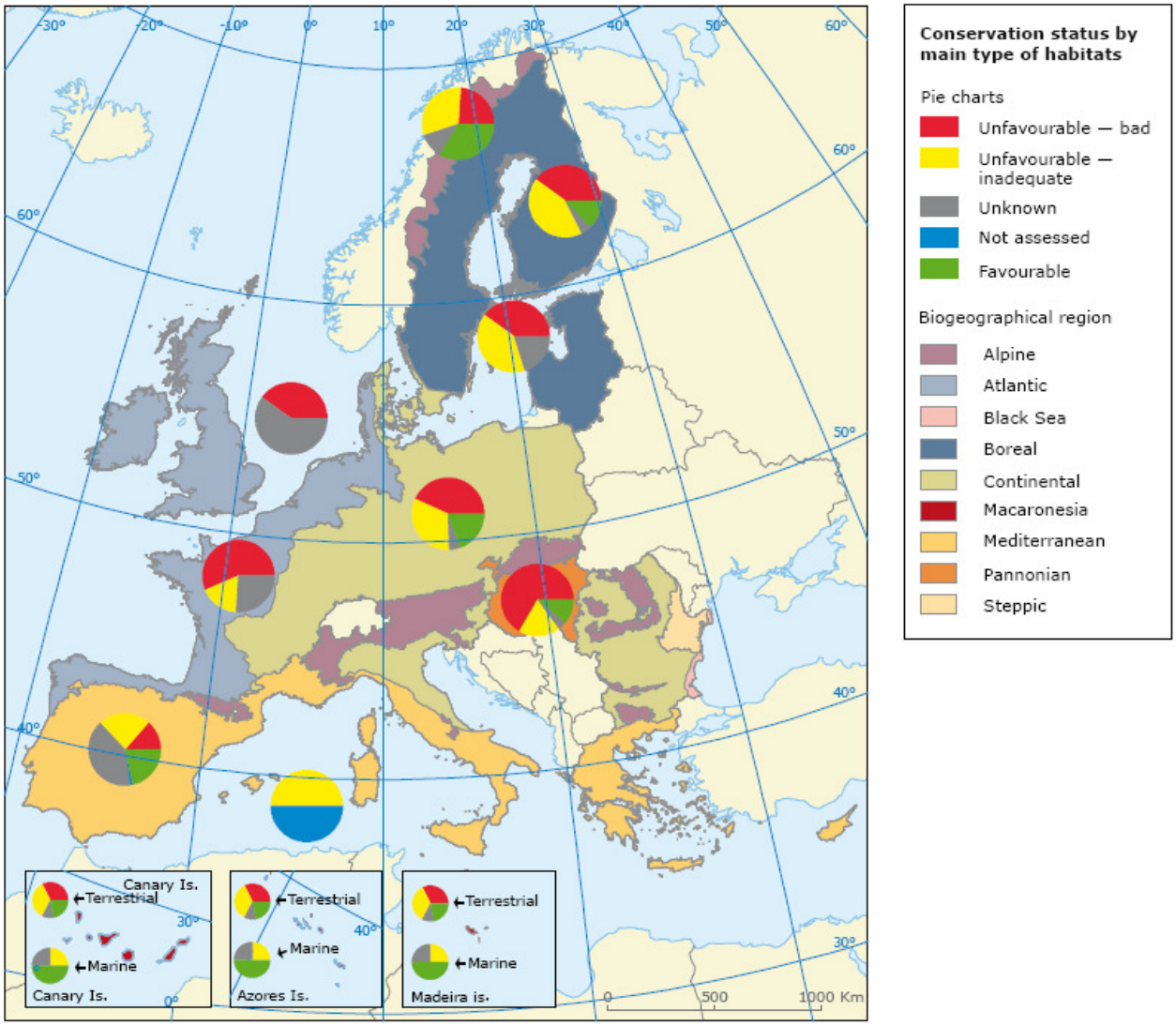


Note: How to read the map: of the list of 163 'worst invasive alien species', 34 are present in Portugal.

Source: EEA/SEBI2010, Expert Group on trends in invasive alien species, 2006.

These results, which vary across biogeographic regions, generally show biodiversity is at risk of being lost widely across Europe and much effort will be needed to establish a more favourable conservation status in all regions (Map 2.2). It must be noted that this is the first assessment of conservation status under the Habitats Directive. These species and habitats were listed in the annexes of the Directive. More detailed findings can be found in the European Commission's report on the status of protected species and habitats (Article 17 of the Habitats Directive).

Map 2.2 Habitats of European interest — conservation status by biogeographical region



Note: How to read the map: in the Mediterranean biogeographical region, about 21 % of habitats are in favourable conservation status, but 37 % are in unfavourable (bad plus inadequate) status.

Source: DG Environment and ETC/BD, based on data provided by 25 EU Member States (Bulgaria and Romania will be included in the next reporting phase in 2013) through their reports under Article 17 of the Habitats Directive (2008).

9. Mediterranean soil erosion

In the Mediterranean countries soil erosion is a serious problem, which could be solved through the rotation of crops suitable.

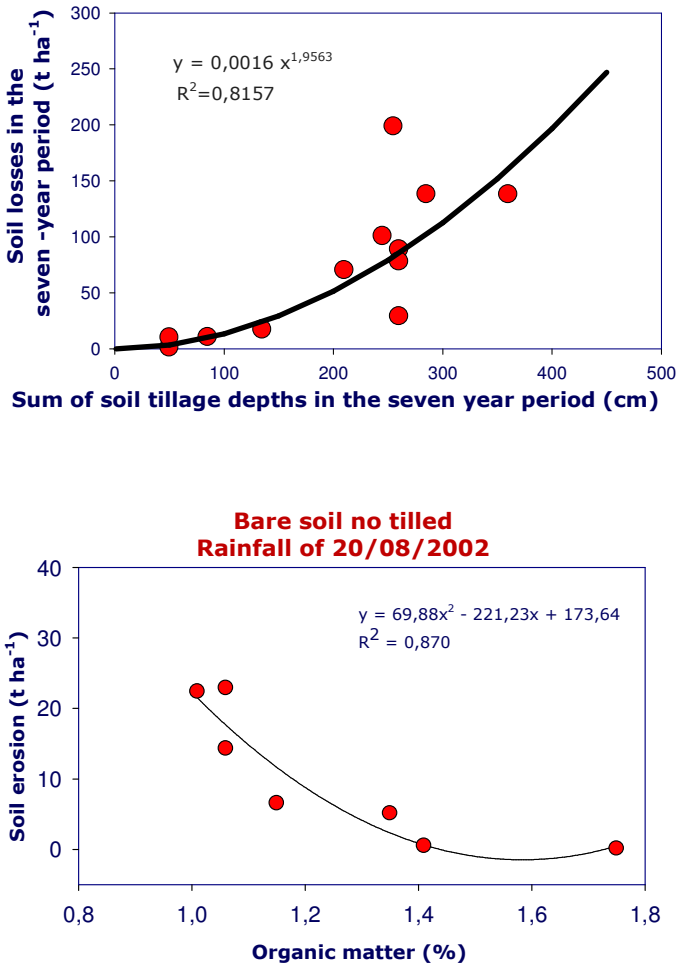


Fig. 13 - Relation between soil losses recorded in plot without crops and rainfall erosion index (from Cosentino et al., 2007)

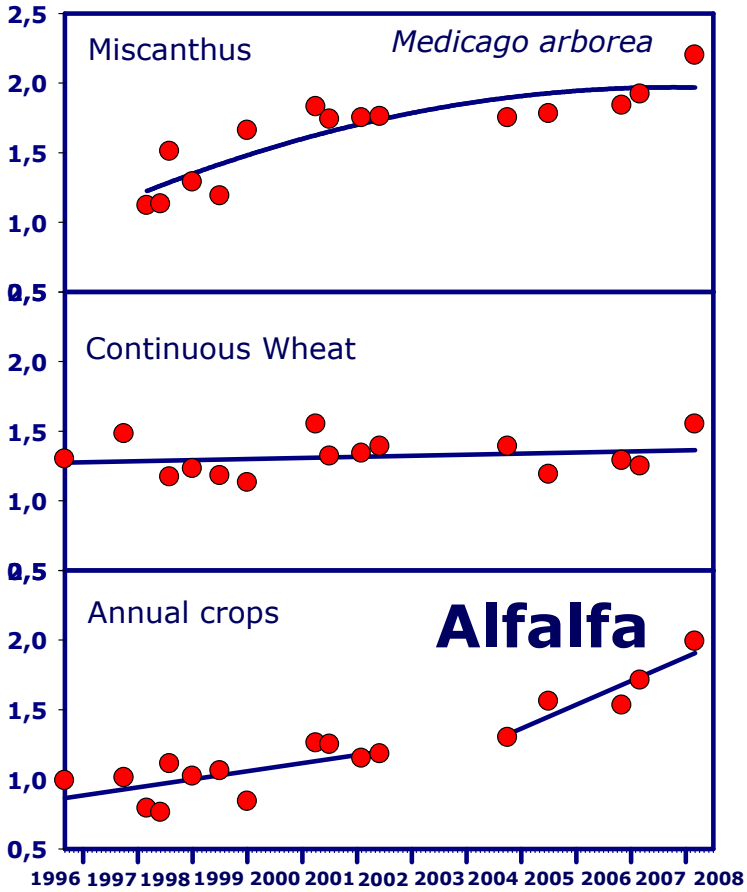
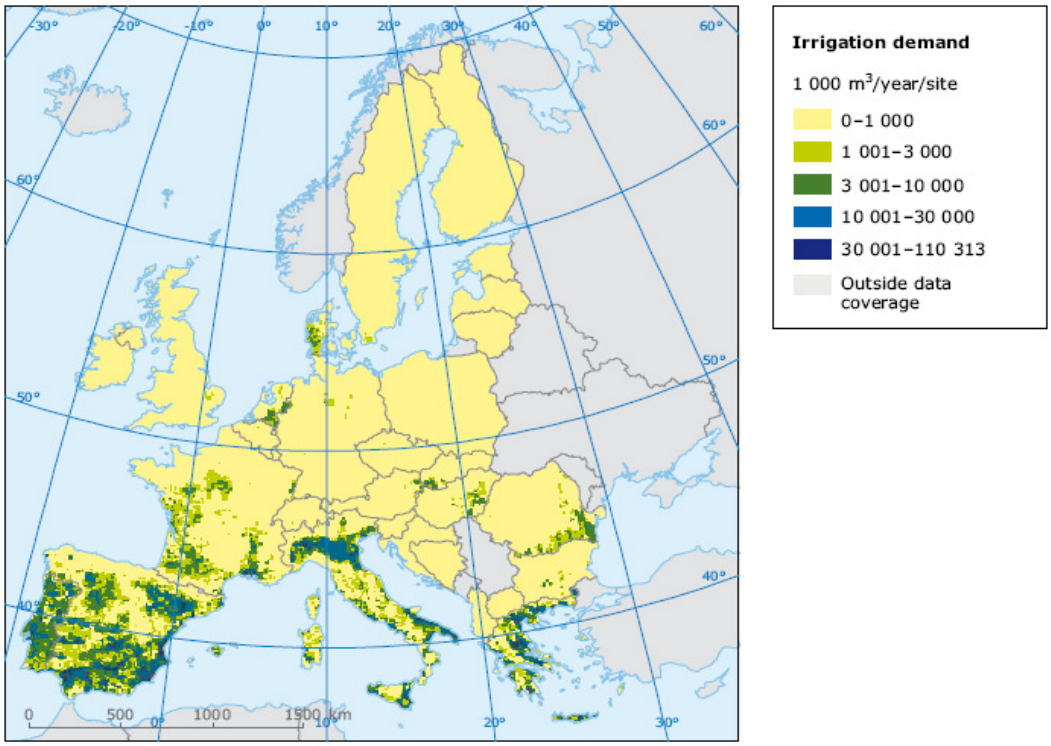

Miscanthus
Medicago arborea
Continuous Wheat
Annual crops
Alfalfa
2,5
2,0
1,5
1,0
0,5
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
Year

Fig. 14 -

10. Irrigation demand and WUE (Water Use efficiency)

Average irrigation demand per site (10 x 10 km cell) in the EU and Switzerland (1 000 m^3/year per site over a simulation period 1995–2002)



Source: Wriedt *et al.*, 2008.

Tab. 5 - Water use efficiency (WUE) and other crops characteristics

			Growing period		Total water requirement growing period		Growing season	Yield crop		Yield biomass DM		WUE gr. product/kg water		WUE gr. biomass DM/ kg water	
			Short	Long	Short	Long	Europe	Temperate	Mediter-ranean	Temperate	Mediter-ranean	Low	High	Low	High
Crop	Crop type	Use	Days	Days	Mm	Mm	Mm	Ton/ha	Ton/ha	Ton/ha	Ton/ha	gr./ kg water	gr./ kg water	gr./ kg water	gr./ kg water
Alfalfa	C_3	Biomass	100	365	800	1 600	summer	10.0	21.8	10.2	25.6	1.5	2.0	1.5	2.0
Maize	C_4	Starch	100	140	500	800	summer	6.0	8.8	13.2	22.0	0.8	1.6	1.8	3.5
Olive	C_3	Oil	210	300	600	800	winter/ spring		7.0		22.6	1.5	2.0	3.4	4.5
Pea, fresh	C_3	Protein	65	100	350	500	summer	3.0	0.5	1.3	1.3	0.5	0.7	0.2	0.3
Pea dry	C_3	Protein	85	120	350	500	summer	0.8	0.7	2.0	2.0	0.2	0.2	0.4	0.5
Potato	C_3	Starch	100	150	500	700	summer	40.0	9.5	18.0	15.8	4.0	7.0	1.8	3.2
Rice	C_3	Starch	90	150	350	700	summer	6.0	5.7	10.9	12.8	0.7	1.1	1.3	2.0
Safflower	C_3	Oil	120	160	600	1 200	summer		3.6		11.7	0.2	0.5	0.6	1.5
Sorghum	C_4	Starch	100	140	450	650	summer	3.0	4.4	7.5	12.4	0.6	1.0	1.5	2.5
Soybean	C_3	Protein	100	130	450	700	summer		3.2		9.2	0.4	0.7	1.1	1.8
Sugarbeet	C_3	Starch	160	200	550	750	summer	55.0	10.2	23.4	25.5	6.0	9.0	2.6	3.8
Sugarcane	C_4	Starch	270	365	1 500	2 500	summer		28.0			5.0	8.0	4.0	6.4
Sunflower	C_3	Oil	90	130	600	1 000	summer	2.5	3.2	9.2	12.9	0.3	0.5	1.1	1.8
Tobacco	C_3	Biomass	90	120	400	600	summer	2.0	2.3	3.3	4.2	0.4	0.6	0.7	1.0
Wheat	C_3	Starch	100	130	450	650	summer/ winter	6.0	5.2	12.9	12.9	0.8	1.0	1.7	2.2

Source: Own adaptation by K. van Diepen ([23]) based on Doorenbos and Kassam (1986) and Berndes (2002).

Tab. 6 - WUE values (kg m^{-3}) for species cultivated in the Mediterranean region

Grain crops	**WUE (kg m^{-3})**	**source**
wheat	1.08-1.59	Katerji et al., 2005
maize	0.82-1.17	Katerji et al., 1996
barley	1.46-2.78	Katerji et al., 2006
sugar beet	6.6-7	Katerji et al., 2003
sunflower	0.39-0.72	Katerji et al., 1996
soybean	1.47-0.77	Katerji et al., 2003
grain sorghum	0.86-1.37	Katerji et al., 2003
chickpea	0.46-0.98	Katerji et al., 2005
lentil	0.36-2.09	Katerji et al., 2003
potato	16.2-18.5	Katerji et al., 2003
tomato	4.4-8.3	Katerji et al., 2003
sweet sorghum	3.69-4.20 (stalk)	Mastrorilli et al., 1995

11. Environmental zone characteristics

Tab- 7- Environmental zone characteristics

Characteristics	Alpine North	Boreal	Nemoral	Atlantic North	Alpine South	Conti-nental	Atlantic Central	Pannonian	Lusitanian	Mediter-ranean Mountains	Mediterra-nean North	Mediterra-nean South
Soil compaction	Low	Medium	Medium	Medium	Low	Medium	High	Low	Medium	Low	Low	Low
Eutrophication	Low	Medium	Medium	Medium/ High	Medium	Medium	High	Low	Medium	Low	Low	Low
Pesticide pollution	Low	Low	Medium	Medium	Low	Medium	High	Low	Medium	Low	Medium	Medium
Water abstraction	Low	Low	Low	Low	Low	Low	Low	Medium	Medium	High	High	High
Fire risk	Low	Low	Low	Low	Medium	Low	Low	Medium	Medium	High	High	High
Land abandonment	High	High	Medium	Medium	High	Medium	Low	High	Medium	High	High	High
Habitat fragmentation	Low	Low	Low	Low	Medium	Medium	High	Low	Medium	Low	Medium	Medium

(1) Corine land cover 2000.
(2) Corine land cover 2000. HNV map is selection of HNV land cover classes (selection from Erling. *et al.,* 2003, and further adjustments from JRC).
(3) IRENA typology of Farming systems (indicator 13: Cropping and livestock patterns. Ind. 15 Intensification/Extensification; source data: FADN 2000. The farming types are only available for the EU-15. This means that for the zones that are partly or fully located in the new Member States the farming system information is only applicable to the farming systems in the EU-15 (e.g. Continental. Nemoral. Mediterranean Mountains and Alpine South) or is missing completely (e.g. Pannonian).
(4) Pressures from MIRABEL I project and additional expert knowledge.

Sources: FAO: FAOSTAT average national yield 2000–2005.

Annexes

Database FAOSTAT: Area harvest (hectares) and Production (tonnes) in EU countries

Wheat

EU Countries	Area Harvest (ha)	Production (t)	(t ha^{-1})	Average nitrogen value (kg ha^{-1})	Nitrogen use (kg t^{-1})	Sources
Austria	292976	1399341	4.8	106	22.2	EarthTrend Austria 2003; Institute for Hydraulics and Rural Water-Management University of Agricultural Sciences Vienna; Gemeinsamer Sortenversuch AGES - LAKO 2005
Belgium	199598	1480710	7.4	155	20.9	D'Haene et al. 2008; FAOSTAT 2001
Bulgaria	1088000	2390610	2.2	120	54.6	Tosheva and Alexandrova. (2004)
Cyprus	40500	89100	2.2	90	40.9	
Czech Republic	810987	3955437	4.9	150	30.8	Papastylianou, DW Puckridge and ED Carter Milada et al POROVNÁNÍ PRODUKČNÍHO POTENCIÁLU PŠENICE OZIMÉ PRO 1XCO2 A 2XCO2 KLIMA; Petr et al 2008; Svoboda andHaberle 2006
Denmark	688800	4519200	6.6	160	24.4	Jørgensen et al. 2007
Estonia	94000	322000	3.4	140	40.9	Lank. 2006; Malle Järvan 2006
Finland	202600	796800	3.9	157	39.9	Ministry Agriculture and Foresty 2001; Muurinen et. al. 2007; Stacey et al.2006
France	5315000	33219000	6.3	158	25.2	Makowski et al.(2001); AGRESTE - Enquête pratiques culturales 1994; EarthTrends 2003
Germany	3005300	21366800	7.1	198	27.8	Kucke and Kleeberg. (1996); Kuesters et al. 1999
Greece	632000	1403200	2.2	100	45.0	Lithourgidis et al. (2006); Dordas et al. 2009
Hungary	1109699	3988177	3.6	130	36.2	Loch and Vágó, University of Debrecen, Faculty of Agriculture; Mineral fertilizer Hungary 1997; Doctoral Dissertation Kalocsai 2003
Ireland	84400	684900	8.1	180	22.2	Stacey et al. 2006; DIETERICH et al. 2008
Italy	2034793	7260309	3.6	125	35.0	Borghi et al. (1997); OECD calculated 7.66 kg/hectare for Italian agricultural land
Latvia	224000	807300	3.6	145	40.2	Ilze Skudra and Andris Skudra. Latvia Agriculture Advisory and Training Centre; Environment Statistics Country Snapshot: Latvia
Lithuania	354600	1390700	3.9	90	22.9	Ilze Skudra and Andris Skudra. Latvia Agriculture Advisory and Training Centre
Luxembourg	12700	70400	5.5	155	28.0	FAOSTAT
Malta	2000	9200	4.6	70	15.2	FAOSTAT
Netherlands	140000	990000	7.1	120	17.0	Ellen 1993; Oenema 2004; FAOSTAT 2001
Poland	2125500	8378600	3.9	140	35.5	Makowska et. al. 2008
Portugal	62300	135800	2.2	95	43.6	ABREU et al. 1993
Romania	1904633	2866234	1.5	120	79.7	Imbrea et al.(2008); Cioubanu et al. Agricultural Research Station Oradea-Romania
Slovakia	360786	1440637	4.0	125	31.3	AIMANOVÁ 2007; Babulicová 2008
Slovenia	32040	133339	4.2	145	34.8	Mihelic et al. 2006;
Spain	1840500	6376900	3.5	120	34.6	Abad et al. (2004); Bellido et al. 2001; Martinez 2004; FAOSTAT 2000 (pesticide use)
Sweden	360400	2254700	6.3	175	28.0	Hoffmann and Johnson. (2000) Royal Swedish Academy of Sciences;Delin et al. 2005; FAOSTAT 2001
United Kingdom	1820000	13362000	7.3	158	21.5	Department for Environment, Food and Rural Affairs (Defra); FAOSTAT 2001
Nemoral	***965300***	***3880475***	***4.0***	***141***	***35***	
Continental	***9293804***	***35729345***	***3.8***	***139***	***36***	
Atlantic Central	***5394979***	***35625420***	***6.6***	***161***	***24***	
Atlantic North	***2517270***	***17747220***	***7.1***	***174***	***25***	
Lusitanian	***1980637***	***11765010***	***5.9***	***124***	***21***	
Med. North	***3015404***	***10033257***	***3.3***	***110***	***33***	
Med. South	***1387719***	***4549242***	***3.3***	***100***	***31***	
UE	**23467112**	**116939359**	**4.9**	**136**	**28**	

Barley

EU Countries	Area Harvest (ha)	Production (t)	(t ha^{-1})	Average nitrogen value (kg ha^{-1})	Nitrogen use (kg t^{-1})	Sources
Austria	193331	810980	4.2	117	27.9	Graneitz and Bauer 2000
Belgium	48484	365049	7.5	100	13.3	D'Haene et al. 2008; Survey on agricultural pratices 2001
Bulgaria	186849	419762	2.2	103	45.8	PAN Germany & AGROLINK
Cyprus	49500	108900	2.2	60	27.3	Papastylianou 1985
Czech Republic	498691	1919712	3.8	75	19.5	Kulhánek et al 2007; Prochazkova et al. 2002
Denmark	631500	3104200	4.9	90	18.3	The National Commitee on Crop Hunsbandry Denmark 1992; Nielse et al.2001
Estonia	140800	372800	2.6	90	34.0	Kõlli et al. 2008
Finland	533300	1984400	3.7	120	32.2	Ministry Agriculture and Foresty 2001; Muurinen et. al. 2007; Stacey et al. 2006
France	1691000	9472000	5.6	120	21.4	BOURGUIGNON 2001
Germany	1933500	11034200	5.7	125	21.9	Maidl et al. 1996; Chloupek et al. 2004
Greece	115000	264500	2.3	80	34.8	BLADENOPOULOS K. B. ; KOUTROUBAS S. D
Hungary	324347	1041434	3.2	110	34.3	PAKURÁR et al.
Ireland	167700	1130200	6.7	138	20.4	Holden and Brereton 2005; Stacey et al. 2006
Italy	337776	1205638	3.6	80	22.4	Delogu et al. 1998; Rizza et al. 2004
Latvia	144000	363200	2.5	90	35.7	Ruza et a., 2001. Department of Crop Production, Latvia University of Agriculture Latvia
Lithuania	381400	1013700	2.7	90	33.9	Leistrumaite and Razbadauskienė 2008
Luxembourg	9300	44600	4.8	100	20.9	
Malta	400	1600	4.0	80	20.0	Malta: Food, Agriculture, Fisheries and the Environment 1993
Netherlands	45000	260000	5.8	85	14.7	Ellen 1993
Poland	1234300	4065800	3.3	60	18.2	Pecio et al. 2001
Portugal	39800	73900	1.9	75	40.4	Martinez et al. 1995
Romania	364614	503689	1.4	140	101.3	Organizatia Interprofesionala „Cereale si Produse Derivate din România"-O.I.C.P.D.R.
Slovakia	210697	695042	3.3	130	39.4	Klimeková and Z. Lehocká 2007
Slovenia	18532	67904	3.7	138	37.5	Brezinik et al.
Spain	3209300	11684000	3.6	75	20.6	MARTINEZ et al. 1995.
Sweden	321000	1439000	4.5	100	22.3	Delin et al. 2005;
United Kingdom	885000	5149000	5.8	113	19.3	Department for Environment, Food and Rural Affairs (Defra) England
Nemoral	***1279750***	***4093850***	***3.2***	***98***	***31***	
Continental	***4014272***	***15163106***	***3.8***	***110***	***29***	
Atlantic Central	***2168016***	***12503533***	***5.8***	***113***	***20***	
Atlantic North	***1687590***	***9215000***	***5.5***	***116***	***21***	
Lusitanian	***900517***	***4355293***	***4.8***	***90***	***19***	
Med. North	***1971291***	***7021220***	***3.6***	***78***	***22***	
Med. South	***1443635***	***5119358***	***3.5***	***75***	***21***	
UE	**13278222**	**57051598**	**4.3**	**97**	**23**	

Maize

EU Countries	Area Harvest (ha)	Production (t)	(t ha^{-1})	Average nitrogen value (kg ha^{-1})	Nitrogen use (kg t^{-1})	Sources
Austria	170884	1555891	9.1	300	32.9	www.mueller-umwelttechnik.at
Belgium						
Bulgaria	214400	312900	1.5	143	98.0	PAN Germany & AGROLINK; Nikolova and Popp 2006
Cyprus						
Czech Republic	93065	608179	6.5	120	18.4	Balík et al 2003
Denmark						
Estonia						
Finland						
France	1481000	13107000	8.9	170	19.2	Colomb et al. 2007
Germany	383100	3480600	9.1	190	20.9	Graeff and Calupein 2003
Greece	198600	1767500	8.9	225	25.3	Dordas et al. 2009
Hungary	1250800	8400000	6.7	175	26.1	Sarvari and Boros 2008
Ireland						
Italy	1081680	9891362	9.1	225	24.6	Di Paolo and Rinaldi 2008; Baldoni e Giardini 1989
Latvia						
Lithuania	5400	26000	4.8	190	39.5	Klimeková and Z. Lehocká 2007
Luxembourg	300	1900	6.3	110	17.4	Survay on agricultural preatices 2001
Malta						
Netherlands	24000	217000	9.0	110	12.2	Survay on agricultural preatices 2001
Poland	261500	1639700	6.3	160	25.5	University of Natural Sciences in Pozna□, Department of Soil and Plant Cultivation
Portugal	116700	646500	5.5	200	36.1	Maria Isabel Ferreira Maghalaes-Martins 1996
Romania	2118274	3686502	1.7	150	86.2	Popescu et al. 2000
Slovakia	157948	675226	4.3	180	42.1	Klimeková and Z. Lehocká 2007
Slovenia	40906	308259	7.5	200	26.5	Lesnik 2003
Spain	364600	3647900	10.0	270	27.0	Martinez 2004; Villar-Mir et al. 2002; Valero et al. 2005
Sweden						
United Kingdom						
Nemoral	*5400*	*26000*	*4.8*	*190*	*39*	
Continental	*4499327*	*18926957*	*4.2*	*180*	*43*	
Atlantic Central	*1087953*	*9651120*	*8.9*	*157*	*18*	
Atlantic North	*114930*	*1044180*	*9.1*	*190*	*21*	
Lusitanian	*576807*	*4992390*	*8.7*	*213*	*25*	
Med. North	*1233344*	*11232890*	*9.1*	*230*	*25*	
Med. South	*445096*	*4096982*	*9.2*	*230*	*25*	
UE	**7748457**	**49657619**	**7.7**	**199**	**28**	

Triticale

EU Countries	Area Harvest (ha)	Production (t)	(t ha^{-1})	Average nitrogen value (kg ha^{-1})	Nitrogen use (kg t^{-1})	Sources
Austria	38852	209021	5.4	99	18.4	Gemeinsamer Sortenversuch AGES - LAKO 2005
Belgium	6546	40716	6.2	120	19.3	Gyssels et al.
Bulgaria	6499	12699	2.0	120	61.4	PAN Germany & AGROLINK; Nikolova and Popp 2006
Cyprus						
Czech Republic	50050	214597	4.3	130	30.3	http://apps.fao.org.
Denmark	32200	149900	4.7	140	30.1	Jørgensen et al. 2007
Estonia	3800	13600	3.6	120	33.5	Alaru et al. 2004
Finland				180		Stacey et al. 2006
France	330000	1539000	4.7	200	42.9	Faostat
Germany	380600	2167700	5.7	200	35.1	Ewert et al. 1999
Greece						
Hungary	129000	373000	2.9	125	43.2	KÁDÁR et al.Proceedings. 43rd Croatian and 3rd International Symposium on Agriculture. Opatija. Croatia (578- 582)
Ireland						
Italy	4500	18900	4.2	80	19.0	Giunta et al.2001; Baldoni e Giardini Patron Editore 1989
Latvia	10500	26300	2.5	135	53.9	Crops Research Centre Oak Park Research Report 2007
Lithuania	80500	227600	2.8	100	35.4	Danusevicius J, 2001
Luxembourg	4100	20600	5.0	120	23.9	Gyssels et al.
Malta						
Netherlands	4000	20000	5.0	120	24.0	Ellen 1993
Poland	1263700	4201600	3.3	88	26.3	Kozak et al. 2007; Kwiatkowska et al. 2007
Portugal	12500	20000	1.6	120	75.0	Estação Nacional de Melhoramento de Plantas (ENMP) Portugal
Romania	30842	108317	3.5	120	34.2	Ittu et al. 2007
Slovakia	12609	38509	3.1	120	39.3	Ducsay and Ložek 2004
Slovenia	3091	12032	3.9			
Spain	47832	140600	2.9	120	40.8	Ramos et al. 1994
Sweden	53600	276300	5.2	160	31.0	Agriculture and Food-- Sweden
United Kingdom	17000	65000	3.8	100	26.2	CALU TECHNICAL NOTES Ref: 030101 2005
Nemoral	*108200*	*336575*	*3.1*	*139*	*45*	
Continental	*1727125*	*6267197*	*3.6*	*125*	*34*	
Atlantic Central	*312984*	*1539184*	*4.9*	*148*	*30*	
Atlantic North	*154880*	*832710*	*5.4*	*147*	*27*	
Lusitanian	*119783*	*535060*	*4.5*	*147*	*33*	
Med. North	*32516*	*93420*	*2.9*	*107*	*37*	
Med. South	*22533*	*64020*	*2.8*	*107*	*38*	
UE	**2471522**	**9655467**	**3.9**	**131**	**35**	

Rapeseed

EU Countries	Area Harvest (ha)	Production (t)	(t ha^{-1})	Average nitrogen value (kg ha^{-1})	Nitrogen use (kg t^{-1})	Sources
Austria	48509	142131	2.9	140	47.8	www.nationmaster.com
Belgium	10776	38470	3.6	90	25.2	D'Haene et al. 2008
Bulgaria	53999	93018	1.7		0.0	PAN Germany & AGROLINK; Nikolova and Popp 2006
Cyprus						
Czech Republic	337571	1038400	3.1	160	52.0	Kuchtová, J. Vašák 2004; Matula and Pechova 2002
Denmark	179200	596300	3.3	125	37.6	Kõlli et al.2004
Estonia	73000	132400	1.8	120	66.2	SIDLAUSKAS & BERNOTAS Estonian Agricultural University, Tartu, ESTONIE (2003)
Finland	90200	114000	1.3	120	94.9	REPORT OF THE STATE OF FINLAND: IENICA is a project funded under the FAIR programme by DG XII of the European Commission
France	1577000	4554000	2.9	135	46.7	FORMING PART OF THE IENICA PROJECT
Germany	1546400	5320000	3.4	183	53.2	Sieling et al. 1997; Sieling et al. 2006
Greece	4000	6000	1.5	135	90.0	Crowley 1998
Hungary	223000	498200	2.2	100	44.8	Kastori et al.2003
Ireland	6000	20000	3.3	180	54.0	DIETERICH et al. 2008
Italy	7200	14962	2.1	135	65.0	Baldoni e Giardini 1989
Latvia	99300	211700	2.1	100	46.9	Latvian Agrochemical Research Centre
Lithuania	174400	311900	1.8	150	83.9	Šidlauskas and Tarakanovas (2004) - Lithuanian Institute of Agriculture
Luxembourg	5400	18400	3.4	150	44.0	D'Haene et al. 2008
Malta						
Netherlands	4000	14000	3.5	180	51.4	Diepenbroc 2000
Poland	795200	2112600	2.7	200	75.3	Department of Agricultural Chemistr, Poland
Portugal						
Romania	348758	348169	1.0	150	150.3	IENICA REPORT FROM THE STATE OF ROMANIA-BUCHAREST, 2002
Slovakia	155220	336368	2.2	120	55.4	Slovak Agricultural Research Centre
Slovenia	5358	14740	2.8	130	47.3	Breznik and Tajnsek 2005
Spain	18700	37800	2.0	135	66.8	Instituto Técnico y de Gestión Agrícola de Navarra 2009
Sweden	88000	223000	2.5	125	49.3	Wivstad & Nätterlund 2008
United Kingdom	681000	2108000	3.1	174	56.1	Christen et al. ; Department for Environment, Food and Rural Affairs (Defra) England
Nemoral	*458900*	*825750*	*1.8*	*122*	*68*	
Continental	*2744407*	*7256449*	*2.6*	*146*	*55*	
Atlantic Central	*1717097*	*5209647*	*3.0*	*157*	*52*	
Atlantic North	*984820*	*3250300*	*3.3*	*165*	*50*	
Lusitanian	*527537*	*1521780*	*2.9*	*135*	*47*	
Med. North	*17910*	*35070*	*2.0*	*135*	*69*	
Med. South	*10120*	*19912*	*2.0*	*135*	*69*	
UE	**6406792**	**18025890**	**2.5**	**142**	**58**	

Sugar beet

EU Countries	Area Harvest (ha)	Production (t)	(t ha^{-1})	Average nitrogen value (kg ha^{-1})	Nitrogen use (kg t^{-1})	Sources
Austria	42012	2651210	63.1	140	2.2	www.nationmaster.com
Belgium	82701	5746892	69.5	160	2.3	D'Haene et al. 2008
Bulgaria	1284	16281	12.7	100	7.9	PAN Germany & AGROLINK; Nikolova and Popp 2006; ALBAYRAK and ÇAMAŞ 2006
Cyprus	54271	2598676	47.9	120	2.5	Metochis et al. 1988
Czech Republic						-
Denmark	39400	2255300	57.2	112	1.9	Sillebak Kristensen. Danish Institute of Agricultural Science
Estonia						-
Finland	16000	673100	42.1	115	2.7	REPORT OF THE STATE OF FINLAND: IENICA is a project funded under the FAIR programme by DG XII of the European Commission
France	393000	32338000	82.3	130	1.6	Draycott 2007
Germany	406000	26114000	64.3	200	3.1	Kuesters et al. 1999
Greece	13700	862300	62.9	250	4.0	Tsialtas and N. Maslaris 2005
Hungary	40000	2000000	50.0	180	3.6	D'Haenea et al. 2007
Ireland	1000	45000	45.0	100	2.2	DIETERICH et al. 2008
Italy	85600	4629900	54.1	115	2.1	Baldoni e Giardini 1989
Latvia	300	10800	36.0	250	6.9	OGA, T. S Agrokhimiya .
Lithuania	16900	799900	47.3	150	3.2	Brazien. 2009. Lithuanian Institute of Agriculture
Luxembourg						-
Malta						-
Netherlands	84000	5400000	64.3	110	1.7	Institute of Sugar Beet Research - IRS
Poland	248800	11057800	44.4	135	3.0	Kozicka 2005
Portugal	4300	320000	74.4	200	2.7	see Mediterranean countries
Romania	26855	698575	26.0	60	2.3	Report from the state of Romania. Fifth Framework Programme by DG XII of the European
Slovakia	18869	855343	45.3	228	5.0	MILAN et al. 2007
Slovenia	6800	260000	38.2	145	3.8	MIHELIÈ et al. 2006
Spain	73500	5141000	69.9	200	2.9	Monreal et al. 2007
Sweden	40786	2000000	49.0	100	2.0	Steen and Lindén 2008
United Kingdom	122000	6500000	53.3	89	1.7	Department for Environment, Food and Rural Affairs (Defra) England
Nemoral	*43397*	*1983800*	*45.7*	*154*	*3*	
Continental	*615187*	*32511840*	*52.8*	*150*	*3*	
Atlantic Central	*544134*	*39298728*	*72.2*	*132*	*2*	
Atlantic North	*222400*	*13348500*	*60.0*	*125*	*2*	
Lusitanian	*140070*	*11421433*	*81.5*	*177*	*2*	
Med. North	*116540*	*7006030*	*60.1*	*191*	*3*	
Med. South	*105761*	*5903746*	*55.8*	*177*	*3*	
UE	**1786205**	**111457796**	**61.2**	**159**	**3**	

Pea

EU Countries	Area Harvest (ha)	Production (t)	(t ha^{-1})	Average nitrogen value (kg ha^{-1})	Nitrogen use (kg t^{-1})	Sources
Austria	28111	56676	2.0	0	0.0	
Belgium	1200	4000	3.3	20	6.0	D'Haene et al. 2008
Bulgaria	700	4200	6.0	0	0.0	PAN Germany & AGROLINK; Nikolova and Popp 2006
Cyprus						
Czech Republic	22886	57623	2.5	0	0.0	
Denmark	5800	19400	3.3	50	14.9	Nielse et al. 2001
Estonia	4850	9400	1.9	9	4.6	Verloop et al. 2006
Finland	4400	10700	2.4	40	16.4	Department of Ecology and Environmental Science, University of Kuopio, Finland
France	173000	643000	3.7	25	6.7	Lecoeur and Sinclairb 2001
Germany	68200	200000	2.9	25	8.5	Institute of Agronomy and Plant Breeding, University of Goettingen, Germany
Greece	400	600	1.5	30	20.0	ref. Italy
Hungary	18900	48800	2.6	0	0.0	
Ireland	900	3800	4.2	0	0.0	
Italy	12551	38078	3.0	30	9.9	Baldoni e Giardini 1989
Latvia	900	1800	2.0	0	0.0	
Lithuania	15600	24200	1.6	0	0.0	
Luxembourg	300	600	2.0	0	0.0	
Malta						
Netherlands	1500	6000	4.0	0	0.0	
Poland	13500	32400	2.4	5	2.1	Helios and Kotecki 2005
Portugal						
Romania	18734	16588	0.9	0	0.0	
Slovakia	9207	16380	1.8	20	11.2	Klimeková and Z. Lehocká 2007
Slovenia	1901	4064	2.1	0	0.0	
Spain	147000	163900	1.1	0	0.0	
Sweden	13400	38100	2.8	0	0.0	
United Kingdom	37000	130000	3.5	4	1.1	Department for Environment, Food and Rural Affairs (Defra) England
Nemoral	*29100*	*55625*	*1.9*	*16*	*9*	
Continental	*148439*	*338064*	*2.3*	*14*	*6*	
Atlantic Central	*150493*	*545373*	*3.6*	*15*	*4*	
Atlantic North	*44940*	*145160*	*3.2*	*26*	*8*	
Lusitanian	*72367*	*230723*	*3.2*	*25*	*8*	
Med. North	*83821*	*112832*	*1.3*	*30*	*22*	
Med. South	*61430*	*73356*	*1.2*	*30*	*25*	
UE	**590590**	**1501134**	**2.4**	**22**	**12**	