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Investing in Opportunities

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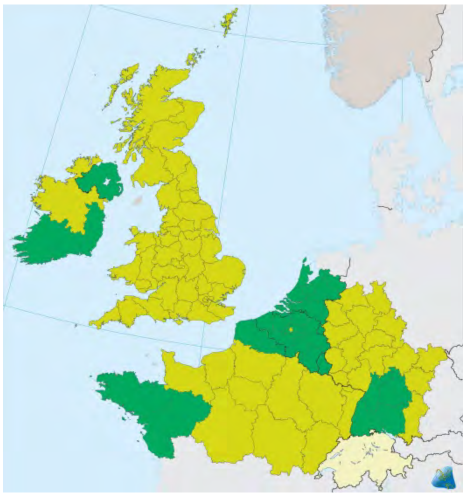
DAIRYMAN aims to strengthen rural communities in the regions of North-West Europe where dairy farming is a main economic activity and a vital form of land use. Dairyman is the acronym of Dairy Management. Through better resource utilization on dairy farms and stakeholder cooperation DAIRYMAN will lead to a more competitive dairy sector, stronger regional economies and an improved ecological performance with the rural area.

DAIRYMAN is a project in the INTERREG IVB program for North-West Europe (NWE) co-funded by the European Regional Development Fund. Under chairmanship of Wageningen University & Research Centre 14 partners in 10 NWE regions (dark green) covering 7 countries are cooperating.



INTERREG IVB North-West Europe
The INTERREG IVB North-West Europe (NWE) programme is a financial instrument of the European Union's Cohesion Policy. It aims to find innovative ways to make the most of territorial assets and tackle shared problems of Member States, regions and other authorities. Over seven years, from 2007 to 2014, the programme will invest € 355 million from the European Regional Development Fund (ERDF) into the economic, environmental, social and territorial future of NWE. The fund will be used to co-finance projects that maximize the diversity of NWE's territorial assets by tackling common challenges through transnational cooperation.

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Introduction

Climatic and soil conditions in North-Western Europe are excellently suited for dairy farming and an extensive market for dairy products is close at hand. As a result, dairying is an important economic sector in this region. The downside is that nutrient and greenhouse gas emissions from the dairy sector tend to be high owing to too low efficiencies in the use of fertilizers, feed, energy and water. These inefficiencies are hampering the delivery of key public services such as clean water, clean air and recreation facilities, all of which are being demanded by policy makers and by society. In addition to these environmental pressures, dairy farmers are also facing the financial crisis in the Euro zone, milk price volatility, high investment costs, and narrow profit margins. All this puts the sustainability of dairy farming in NW Europe under threat, both environmentally and economically.

The INTERREG IVB project DAIRYMAN aims to strengthen rural communities and regional economies by improving dairy farm resource management in a profitable way and by stimulating collaboration between dairy farmers and other rural stakeholders. New ways of working and innovations are jointly demonstrated within networks of commercial pilot farms and Knowledge Transfer Centers. Cooperation exists in the development of education programs and interregional exchange of farmers and farm advisors. DAIRYMAN highlights examples of profitable cooperation between dairy farmers and other rural stakeholders. The implementation of EU regulations is compared in the different participating regions to demonstrate the importance of taking into account region-specific factors in a transparent way that can be easily verified by the EU, leading to a higher degree of acceptance by local farmers. DAIRYMAN brings together partners from the regions Brittany (FB), Pays de la Loire (FL), Nord Pas de Calais (FN), Ireland (IR), Northern Ireland (IN), Flanders (BF), Wallonia (BW), Baden-Württemberg (GE), Luxembourg (LU) and the Netherlands (NL). Annual milk production in the DAIRYMAN regions amounts to 35 billion tonnes and accounts for about a quarter of the EU27 production.

Cooperating partners from these regions are:

- Wageningen University (lead partner) - NL (the Netherlands)
- Plant Research International, part of Wageningen UR - NL (the Netherlands)
- Wageningen UR Livestock Research - NL (the Netherlands)
- Teagasc - IR (Republic of Ireland)
- Agri-Food and Biosciences Institute (AFBI) – IN (Northern Ireland, United Kingdom)
- Institut de l'Elevage - FR
- Chambre Régionale d'Agriculture de Bretagne - FB (Brittany, France)
- Chambre Régionale des Pays de la Loire – FL (Pays de la Loire, France)
- Chambre Régionale d'Agriculture du Nord-Pas de Calais – FN (Nord–Pas de Calais, France)
- Institute for Agriculture and Fisheries Research (ILVO) – BF (Flanders, Belgium)
- Hooibeekhoeve, Province Antwerpen - BF (Flanders, Belgium)
- Centre wallon de Recherches agronomiques (cra-w) – BW (Wallonia, Belgium)
- Landwirtschaftliches Zentrum Baden-Württemberg (LAZBW)- GE (Baden-Württemberg, Germany)
- Lycée Technique Agricole – LU (Luxembourg)

As an output of DAIRYMAN a stakeholder conference was organized for information provision and as a platform for discussion. The conference was held in Ghent, on 24 and 25 October 2012 and consisted of three sessions. Session 1 dealt with the assessment of regional sustainability and

Session 2 concerned the assessment of regional implementation of EU environmental Directives. The third session involved the creation of a network of dairy pilot farms and an analysis of the information generated by this network. For each session, facts and figures of the involved regions were presented as a basis for discussion. This report presents the facts and figures for Sessions 1 and 2.

1. Assessment of regional sustainability

A similar methodology was followed for assessment of regional sustainability in all regions to obtain the required results. Firstly, an indicator framework was constructed, consisting of structural, economic, ecological and social sustainability indicators. The objective of this uniform indicator framework was to obtain an evaluation of regional sustainability for each of the participating regions in a similar and consequently comparable way. This framework served as a guideline for each region to construct a regional report on sustainability of (1) the region, (2) agriculture in the region, and (3) dairy farming in the region. A draft version of the regional report was used as input for regional workshops across the DAIRYMAN regions. During the individual workshops, results were presented and discussed, and main challenges for dairy farming in the (near) future were identified. Input obtained during the workshop was incorporated in the final version of each regional report.

This 'sustainability chapter' consists of four sections. Section 1.1 gives a short description of each region in which general characteristics are presented. Section 1.2 describes the importance of dairy farming in the region, using both objective indicators and more subjective evaluations. Subsequently, Section 1.3 characterizes an average dairy farm in the region, together with a classification of potential difficulties encountered by local dairy farmers. Section 1.4 presents objective information regarding the state of environmental issues in each region. This is followed by a ranking for each region based on the priority given to each of the issues and the contribution of dairy farming as seen by the regional stakeholders. Finally, common challenges for sustainability are described in Section 5.1

1.1 Short description of participating regions

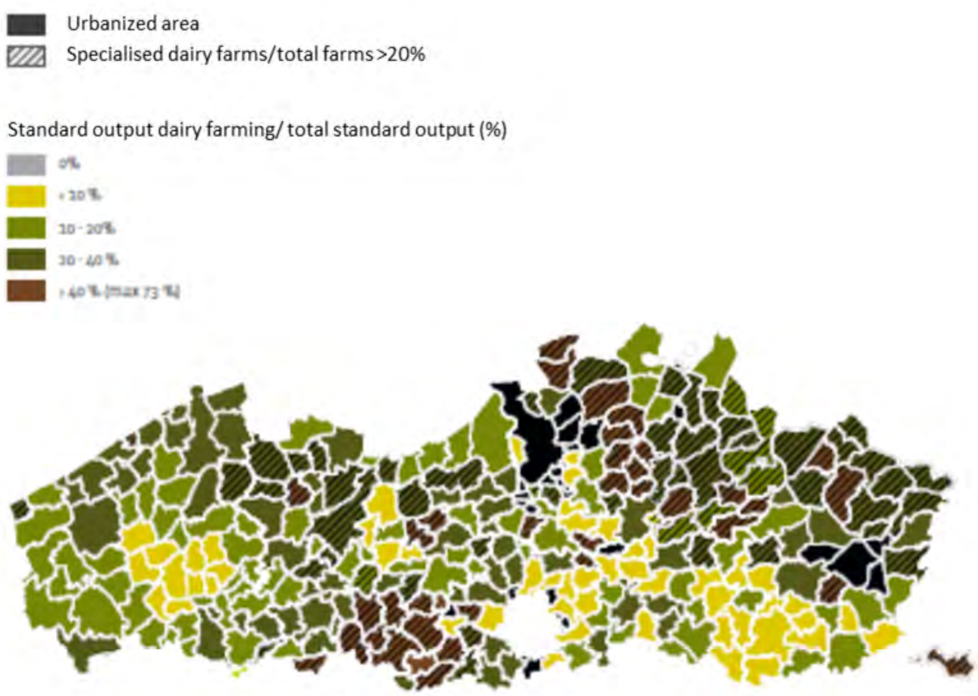
This section presents some important characteristics of each participating region, together with a map of the region and a short explanation. The ten regions differ greatly in size, with Ireland (IR) as the largest, followed by the Netherlands (NL), Baden-Württemberg (GE), Pays de la Loire (FL), Brittany (FB), Wallonia (BW), Northern Ireland (IN), Flanders (BF), Nord Pas de Calais (FN) and Luxembourg (LU) as the smallest. However, the ranking in population density differs from that of the regional size. The highest population density is found in Flanders (462 inhabitants per km^2), followed by the Netherlands, Nord Pas de Calais, Baden-Württemberg, Wallonia, Luxembourg, Northern Ireland, Brittany, Pays de la Loire, ending with Ireland with the lowest population density of only 68 inhabitants per km^2. All regions share a similar temperate, maritime climate with cool summers and mild winters, differing slightly in precipitation. More inland regions have a more heterogeneous climate, with characteristics of both maritime and continental climates. Finally, agriculture occupies 45% or more of the land area in all regions.

The economic indicators again show large differences between the regions. Gross domestic product (GDP: the market value of all officially recognized final goods and services produced *within* a country in a given period) divided by the country's population gives the GDP per capita. This indicator is by far the highest for Luxembourg (appr. €75,000 per capita), with Flanders, Ireland, the Netherlands and Baden-Württemberg as next highest with GDPs per capita between €31,000 and €36,000, whereas the remaining regions have GDPs per capita less than or equal to €28,000, with the lowest for Northern Ireland (€19,000). As mentioned in the regional description for Luxembourg, its high GDP per capita can be partially explained by the high number of foreign laborers in the country. When the profits made by companies and state are disregarded, the average income (the sum of all salaries divided by the country's population, including active as well as non-active inhabitants) is again highest for Luxembourg, followed by Flanders and Wallonia with average incomes well above €30,000 per inhabitant per year. This contrasts with the other regions, where average incomes vary between €17,000 and €23,000 per inhabitant per year. In Brittany the significance of the primary sector and the food industry for regional employment, with the predominance of relatively low paid (lowly qualified) jobs in these sectors, and the seasonality of employment associated with tourism etc., result in a rather low average income for the region. Unemployment is highest in Ireland, Wallonia and Nord Pas de Calais (above 10%) and lowest in Flanders at 4.3%.

Flanders - Belgium

Area (km^2)	13,522 (ADSEI)
Population (#)	6,251,983 (ADSEI, 2010)
Population density (#/ km^2)	462 (ADSEI 2010)
Population change (% per year)	109 (2010)
Climate	Oceanic climate (mild winters, cool summers and rain throughout the year) Average temperature: 11°C in 2009 Average precipitation: between 750 and 850 mm
Area utilization % Agriculture Forestry Other	 45.6 (2010, Eurostat) 10.8 (2010, Eurostat) 43.6
GDP per capita €	41,400 (2009, Eurostat)
Average income €	36,648
Unemployment rate %	4.3 (2011)

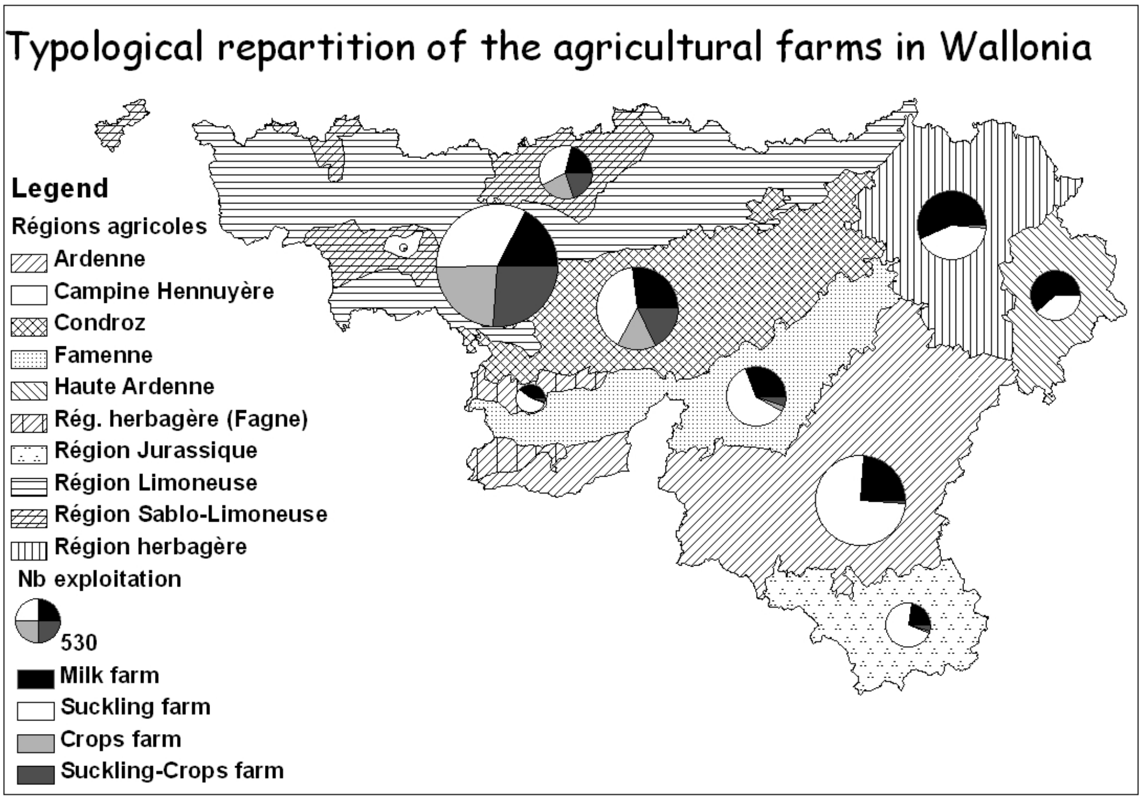
The region of Flanders is situated in the north of Belgium and counts 5 provinces. With a total area of 13,522 km² it covers slightly less than half of the total Belgian area (30,528 km²) but as a region Flanders is more densely populated than the Belgian average of 365 inhabitants/km². Flanders counts about 6,500 milk-producing farms, with slightly less than 4,000 specialized dairy farms and 2,500 mixed farms, often combining dairy farming and arable crops. The dairy sector is the third most important sector in Flanders after pig farming and vegetable production. The sector occupies about 50-55% of the total Flemish agricultural area to grow grass and forage maize. Most of the specialized dairy farms are located in the province of Antwerp (Noorderkempen) but the Flemish Ardennes (southern part of the province East-Flanders) and Pajottenland (province of Flemish Brabant) also count a considerable number of such farms.



Wallonia - Belgium

Area (km^2)	16,844
Population (#)	3,456,775 (EUROSTAT 2010: 3,512,000)
Population density (#/ km^2)	205.1
Population change (% per year)	100.53 (2009)
Climate	Moist temperate
Area utilization %	
Agriculture	52.1
Forestry	29.5
Other	18.4
GDP per capita €	22,662
Average income €	33,624 (2009)
Unemployment rate %	11.5

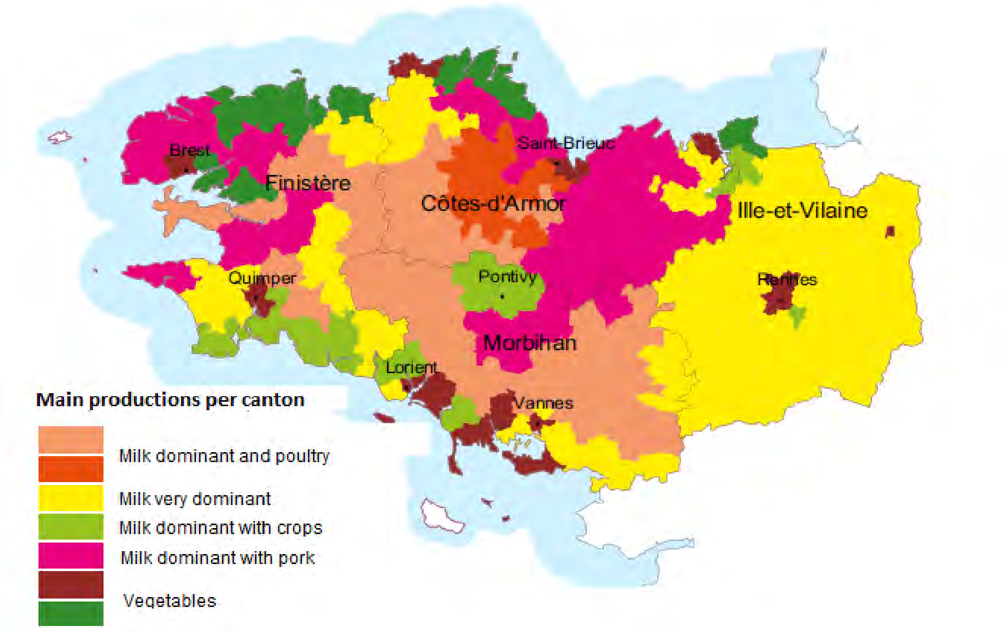
Wallonia is divided into 10 agricultural areas, each characterized by its own pedoclimatic conditions. The varying characteristics regarding soil quality, temperature and precipitation have led to the development of several farming strategies. The north-east of Wallonia is mainly characterized by dairy production with grassland-based systems whereas in the fertile north of Wallonia dairy herds are more often included in mixed farming systems together with arable crop production. The south of Wallonia is also characterized by grassland-based livestock farming systems but the focus in this area is on beef production (suckling systems). Dairy production accounts for 25 % of the farming systems in this area.



Brittany – France

Area (km^2)	27,506
Population (#)	3,163,000
Population density (#/ km^2)	116.3
Population change (% per year)	109 (107 % linked to regional immigration)
Climate	Oceanic: frequent rainfall, good repartition over the year (Brest: 1200 mm/year ; Rennes: 700 mm/year); small temperature amplitude (coldest month: 5-7 °C, warmest month: 17-20 °C)
Area utilization (%)	
Agriculture	65
Forestry	12
Other	23
GDP per capita €	25,739 (2009)
Average income €	18,557 (Revenu Disponible Brut/ habitant 2009)
Unemployment rate (%)	8.3 (1st trimester 2012) – France : 9.6

Once, Brittany was a poor region, with shallow and acidic soils in a peninsular situation with bad transport networks. From the 1950's onwards, an active policy of development was pursued with the objective to prevent emigration. Agriculture was at the heart of this policy; this included intensification, development of industrial husbandry, and the development of an agro-food industry. Nowadays, Brittany is an attractive region, with the second lowest unemployment rate in France. The primary sector still represents more than 5% of the employment and the food industry another 5%. Brittany is the leading agricultural region in France, particularly as regards milk, pork and poultry production. The climate is oceanic with frequent rainfall and small temperature variations. There is, however, a strong intra-regional variability with more than 1200 mm precipitation in the West and less than 700 mm in the South-East. The region is characterized by a dense water system with 30,000 km of rivers.



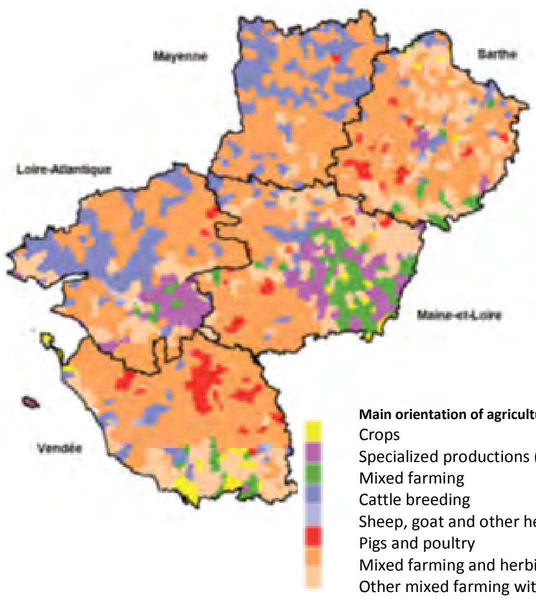
Farm specialization in Brittany
Source : Agreste – DRAAF Bretagne – recensement agricole 2010 – typologie SRISE

Pays de la Loire - France (data 2010)

Area (km^2)	32,082
Population (#)	3,500,000 (2009)
Population density (#/ km^2)	110
Population change (% per year)	109
Climate	Moderate oceanic climate with relatively mild temperatures in winter. Average rainfall : 750 mm (heterogeneous, depending on areas and years)
Area utilization (%)	
Agriculture	71
Forestry	11
Other	18
GDP per capita €	27,533
Average income €	17,518 (2007)
Unemployment rate (%)	8.2 (1st trimester 2012)

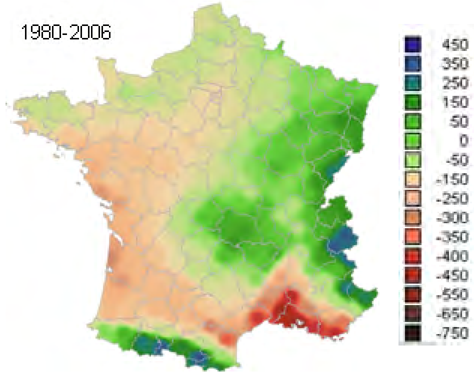
Pays de la Loire is the second most important agricultural region in France. With 10% of national sales, farming and food in the region is a major economic force (8.3% of regional GDP and low unemployment) and an essential factor as regards the occupation and balance of the regional territory (72.9% of the area used for farming). Pays de la Loire is the leading region in France for the production of beef, rabbits, ducks, guinea fowls and poultry labels. It is also the second most important region for the production of milk, pork and poultry. In terms of horticultural crop production, Pays de la Loire is distinguished as being the primary region for the specialized production of bedding plants, tree nursery stock, lamb's lettuce, lily of the valley, and leeks. This region, with a population density of 110 inhabitants/km², benefits from an economic dynamism. Consequently, there has been an erosion of the agricultural land area, with an average loss of 9,500 ha per year. The region is highly dependent on water, and access to water is critically important for agricultural production.

Orientation of the main productions in farms



Main orientation of agricultural production per municipality
Crops
Specialized productions (wine, vegetables, fruits and flowers)
Mixed farming
Cattle breeding
Sheep, goat and other herbivores
Pigs and poultry
Mixed farming and herbivores
Other mixed farming with breeding
Source : Agreste – Recensement agricole 2010

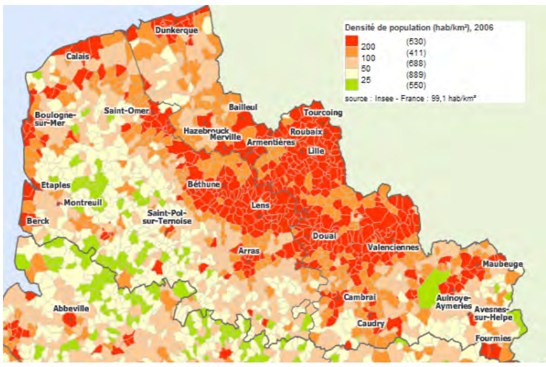
Deficit between precipitation and evapotranspiration of plants



Nord Pas de Calais - France (data 2009)

Area (km^2)	12,414
Population (#)	4,022,000
Population density (#/ km^2)	329
Population change (% per year)	106
Climate	heterogeneous climate: mixed oceanic and continental
Area utilization (%)	
Agriculture	78
Forestry	9
Other	13 (urban)
GDP per capita €	24,129
Average income €	17,758
Unemployment rate (%)	13.2

Nord Pas de Calais is one of the most densely populated French regions and is an important center of industrial and economic activities. This results in a strong competition for land between urbanization (13% of the regional land is urban) and farming. But this also offers the advantage of having consumers close to production centers, which enables direct selling, on-farm processing, etc. Farming, however, plays a major role in the region, with systems of cereal crop production and cattle (simple or mixed) predominating. Lots of different crops are cultivated in the region. Vegetable production is mainly situated around the cities of Bethune, Lille, St Omer, and Dunkerque. Wheat, rapeseed, sugar beet, potatoes, and flax are grown on arable farms.
The population density of the region shows a wide variation with a really high density in the center (Lille-Béthune-Douai) and a low density in the perimenter of the region (Avesnois and Boulonnais). Farming types show a wide variation due to different soil conditions (from extensive grassland-based dairy/beef farming to intensive crop farming) but also due to environmental constraints (urban pressure, erosion, climate). Several areas are classified as “natural park” with specific constraints/incentives concerning farming (grassland, hedges, etc.). Food processing industries are well developed in the region, providing a good market for local production as well as by-products from sugar beet and barley processing which are used in cattle feed.



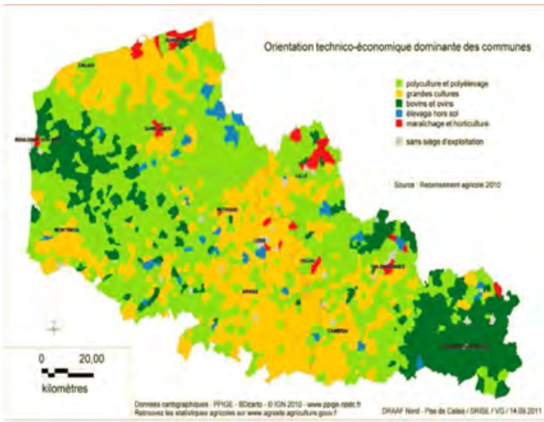


Fig 1: Population density (INSEE, 2006)

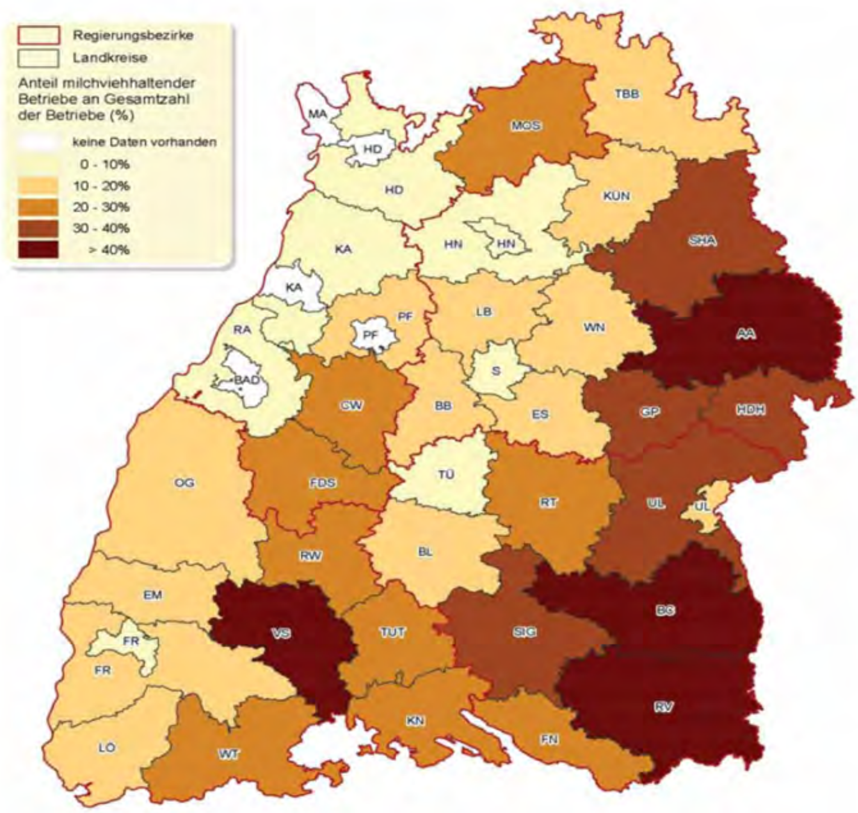
Fig 2: Occupation of agricultural area

Baden-Württemberg

Area (km^2)	35,751
Population (#)	10,749,000 (EUROSTAT 2010)
Population density (#/ km^2)	301
Population change (% per year)	108 (2009-2010)
Climate	8.1 °C, 980 mm, 170 frost-free days
Area utilization %	
Agriculture	45.9 (of which 38% grassland and 58% arable land)
Forestry	38.3
Other	15.8
GDP per capita €	31,982 in 2009
Average income €	20,504 in 2009
Unemployment rate %	4.9 in 2010

Baden-Württemberg is one of the 16 states in Germany. It is located in the south-western part of Germany and shares its borders with France, Switzerland, Rhineland-Palatinate, Hessen and Bavaria. Stuttgart is the capital of Baden-Württemberg, which is the third largest state in Germany, both in area and population. The state is divided into 35 districts and 9 independent cities that have been further grouped into four administrative districts by the government. Intensive animal production occurs in the eastern part of Baden-Württemberg. Whereas cattle production is predominant in the South-East linked to the main grassland areas, pig and poultry production are mainly found in cropping areas in the North-East.

Percentage of dairy farms out of total number of farms in counties of Baden-Württemberg, 2010



Source: Statistisches Landesamt Baden-Württemberg 2010

Northern Ireland

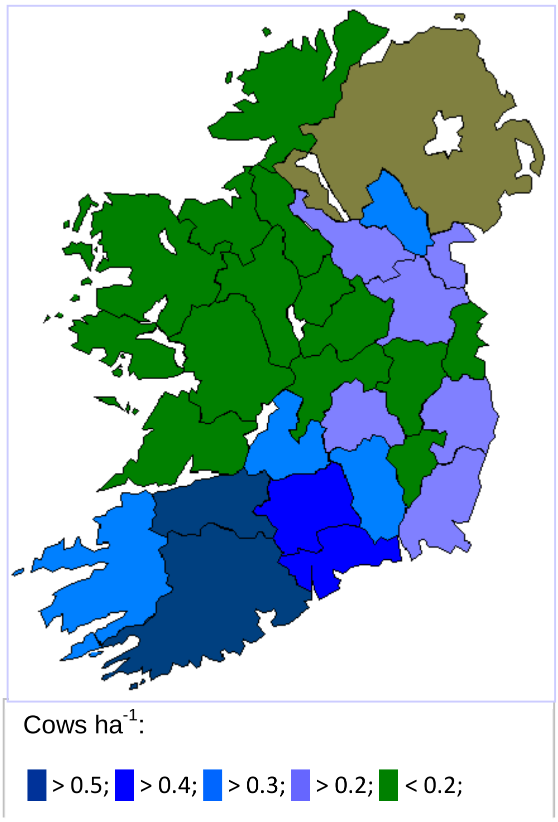
Area (km^2)	14,146 (2012)
Population (#)	1,799,000 (2010) (EUROSTAT 2009 1,788,000)
Population density (#/ km^2)	132 (2012)
Population change (% per year)	100.6 (2010)
Climate	Cool temperate (2012)
Area utilization (%)	(2011)
Agriculture	70
Forestry	6.2
Other	23.7
GDP per capita €	19,086 (2010)
Average income €	22,829 (2010)
Unemployment rate %	6.7 (1st Quarter 2012)

Northern Ireland (NI) is the smallest region of the United Kingdom (UK), with an area of just over 14,000 km². The rural population accounts for 24% of the total population, has a density of approximately 30 person per km², and is for the most part made up of family units living in single dwellings scattered across the countryside. Northern Ireland experiences a cool but temperate climate that is dominated by maritime influences. The mean annual daily air temperature is 8.9 °C. Rainfall exceeds 2000 mm year^{-1} in the uplands, but annual lowland rainfalls range from just under 800 mm year in central and eastern parts, to 1250 mm per year in the North and West. A low percentage of the landscape is devoted to forestry – primarily conifer forests on upland peaty soils. A high area is devoted to freshwaters, Lough Neagh and Erne. These two lakes are lowland water bodies and drain large catchments. Their current eutrophic status governs much of the concerns with respect to nutrient use by agriculture. About 70% of the total land area is devoted to agriculture, and is dominated by managed grassland with less than 5% devoted to arable agriculture. The agricultural sector contributes 4% of civil employment. Although only 14% of farms are involved in dairy production, the dairy sector is responsible for 47% of the total gross margin from agriculture, and thus economically is the most important sector of the Northern Ireland farming industry.

Ireland

Area (km^2)	69,000
Population (#)	4,722,028 (EUROSTAT 2010: 4,474,000)
Population density (#/ km^2)	68.4
Population change (% per year)	111
Climate	Maritime temperate
Area utilization %	
Agriculture	63
Forestry	11
Other	26
GDP per capita €	35,445
Average income €	22,168
Unemployment rate %	14.8

Ireland has a total land area of just over 7 million ha and is predominantly rural with only 1.8% urban area. Agriculture utilizes approximately 4.4 million ha (63% of total land area) while forestry uses 0.7 million hectares (8%). Ninety per cent of agricultural land is under grassland and this is mostly permanent grassland. Ireland's climate is largely determined by the prevailing south-westerly winds and the warm surface water Gulf Stream current, receiving a third of its heat by latent heat transfer. Ireland has a cool temperate maritime climate characterized by mild moist winters and cool cloudy summers and rainfall that is distributed relatively evenly throughout the year. The dairy sector is the most important sector of Irish agriculture, accounting for 28% of the value of agricultural output. Approximately 10% of the Irish milk output is consumed domestically in liquid form; the balance is used in the manufacture of dairy products of which 80% is exported.



Density of dairy cows per utilizable agricultural area (cows ha^{-1}) by county in Ireland.

Luxembourg

Area (km^2)	2,586
Population (#)	512,000
Population density (#/ km^2)	200
Population change (% per year)	200
Climate	Temperate and humid climate Average temperature: 9°C Average precipitation: 862 mm
Area utilization (%)	
Agriculture	50
Forestry	36
Other	14
GDP per capita €	75,000
Average income €	52,000 gross salary
Unemployment rate %	6.1 (June 2012)

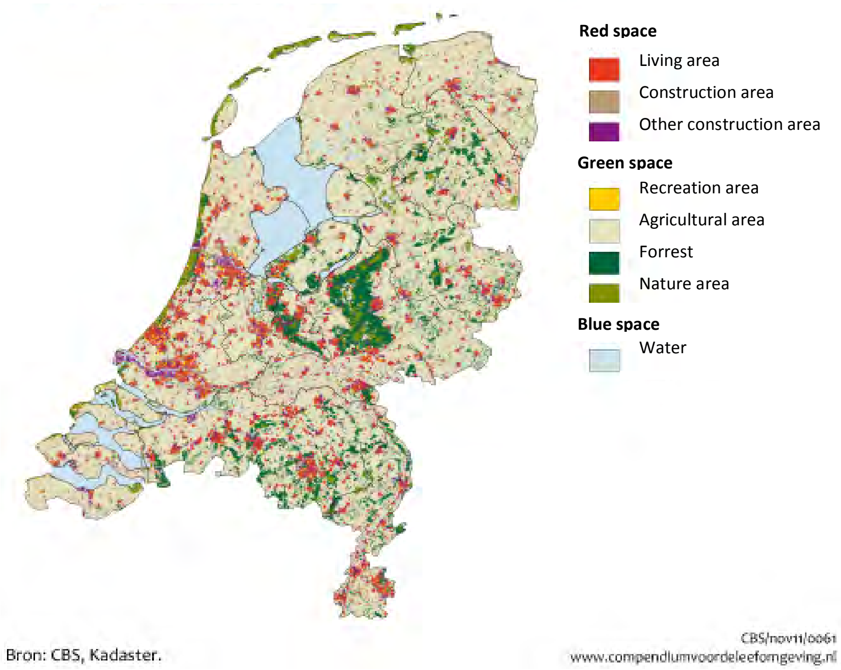
Luxembourg is one of the smallest countries of the European Union. The economy is mainly based on the tertiary sector which is well developed. The Gross Domestic Product is one of the highest in the European Union and - consequently - incomes are also high. Forty three percent of the working population comes from the border countries to work in Luxembourg every day. Forty four percent of the resident population is not of Luxembourgish nationality. The economic situation attracts more and more people to Luxembourg. The population is increasing every year and more and more land is needed for houses, buildings and streets. For agriculture this situation is threatening as infrastructure is consuming more than 1 ha of land per day.

The Netherlands

Area (km^2)	41,543 (2011)
Population (#)	16,743,643 (2011)
Population density (#/ km^2)	403
Population change (% per year)	100 (2010-2011)
Climate	Oceanic climate (mild winters, cool summers and rain throughout the year)
Area utilization (%)	(2011)
Agriculture	55
Forestry	12
Other	33 (of which 56% is water)
GDP per capita €	34,903 (2010)
Average income €	22,100 (2010)
Unemployment rate (%)	6.3 (2012)

Population density is highest in the West and lowest in the South-West and North-East. Seven of the twelve provinces are predominantly urban and according to OECD typology there are no rural provinces. Within the Netherlands, agriculture and the agri-food sector have historically occupied a significant economic and cultural position. They have been important drivers of growth and development, particularly through the export of commodities and processed products, as well as expertise and innovation. Around 75% of agricultural produce is exported, which makes the Netherlands the world's second largest agricultural exporter and for several products such as flowers, eggs and pigs it dominates the world market. The major soil types in the Netherlands are sand, marine clay, riverine clay, and peat. Sand, clay and peat soils cover about 50, 40 and 10% of the land area, respectively. Designated nature reserves are embedded in the so-called 'Ecologische Hoofdstructuur' (Ecological Main Structure; EMS). All Natura 2000 areas are inside the EMS area, while 45% of the EMS area on land is also Natura 2000 area.

Area utilization in the Netherlands, 2008



1.2 Dairy farming in the region

Dairy farming is an important agricultural and economic activity in all ten DAIRYMAN regions. This importance appears from a range of structural and socio-economic indicators. Table 1.2.1 provides a limited selection of indicators, giving some insight in farming and, more in particular, dairy farming in the regions.

Table 1.2.1. Farming in the regions: facts and figures

	BF	BW	FB	FL	FN	GE[3]	IN	IR	LU	NL
Total number of farms (x 1,000)	29.4	16.0	37.7	34.3	13.8	43.4	24.4	99.5	2.2	72.3
Number of dairy farms (x 1,000)	6.2	4.6	15.6	10.4	4	10.2	3.5	23	0.8	17.5
% specialized (> 65% of gross margin)	62	48	72	58	33	70[2]	88	87	77	83
Annual milk production (x 10^6 kg)	1,934	1,444	4,700	3,400	1,280	2,286	1,964	5,175	290	11,627
Contribution of agriculture, forestry and fisheries (NACE A) to employment (%)[4]	1.2	1.8	5.9	3.9	1.5	1.2	3.2	4.6	1.2	2.5
Land price (€/ha)	28,300	13,797	4,050[3]	3,000	10,000	20,831	11,228	25,000	30,000[1]	47,000

[1] estimation

[2] data from 2010

[3] data from 2011. Since 2010 methodology changed – only registration of farms with more than 5 ha agricultural area or minimum production units; therefore not directly comparable with previous years.

[3] price of arable land, € 1980 for permanent grassland

[4] data from 2011. Source: Employment NACE A/all NACE activities, Eurostat

In all ten regions, agriculture, including the dairy sector, has seen a similar type of evolution, i.e., a steady decline in the number of farms and a steady increase in farm size (quota, animal numbers and area) and productivity (milk/cow). In Northern Ireland, for instance, many small dairy farms have ceased milk production while other farms have expanded their herd sizes through short-term rental and land purchase, resulting in a relatively small number (3,500) of much larger dairy enterprises. Most regions also show a trend towards increased specialization. The increased degree of specialization usually leads to lower costs per unit milk produced (economies of scale) but could potentially also affect the vulnerability of individual farms and their capacity to handle sudden price fluctuations, which are expected to become more frequent in the future.
Diversification of farm activities, on the other hand, can mean a diversification in sources of farm income which would potentially make farms less vulnerable. In France the quota system, where quota cannot be bought but can only be acquired by purchasing extra land, has led to a lower quota per hectare, and in turn to more diversified farms (crops, beef cattle, …), rather than specialization.

Dairy herds have decreased in number throughout almost all regions since the year 2000, the exception being Ireland, where numbers remained fairly constant. Regional (or national) milk production levels, however, have been increasing steadily due to higher production levels per cow.

In all but one region, dairy farms represent over 20% of all farms, with Brittany taking the lead with over 40% of all farms classified as dairy farms. Northern Ireland has the lowest percentage of dairy farms in the region (14%), but at the same time it has the highest level of specialized dairy farms (88%)[1]. The Netherlands is in the lead as regards national milk production, with over 11 billion kg milk produced annually, on 17,500 farms, and thus an average milk production of approximately 650,000 liters milk per farm.

Land use for dairy farming

The proportion of the land area used for agriculture in each region is considerable and ranges from 45% in Flanders to 78% in Nord Pas de Calais (see Chapter 1). The contribution of dairy farming to land use between regions is not easily compared as the information is not available from European data sources. From the regional reports, however, data are available on the numbers and average sizes of dairy farms in each region, thus enabling the areas used for dairy farming in each region to be calculated. For example, Brittany counts 15,600 dairy farms with an average farm size of 77 ha (see Table 1.3.1). However, a large proportion (28%) of dairy farms in this region is not specialized. On average, a dairy farmer in Brittany uses 1/3 of the land area for crop production and land may also be used for other types of animal production. So, instead of 67% of the regional area being used for dairy farming, 55-60% is a more likely estimate. Depending on the degree of specialization on dairy farms, the actual proportion of the agricultural area used for dairy farming may deviate to some extent from the calculated percentages in Table 1.2.2; this discrepancy is expected to be higher in regions with a higher percentage of mixed farms. Regardless of this expected margin of error, significant differences exist between regions as regards the percentage of the agricultural area used for dairy farming, ranging from about one quarter of the agricultural area of Ireland and Northern Ireland to well over half the agricultural areas of Brittany and Luxembourg.

*Table 1.2.2. Land use for dairy farming (area farmed by dairy farmers = total number of dairy farms (mixed and specialized, Table 1.2.1) * average dairy farm size (Table 1.3.1). The agricultural area = total area * percentage for agriculture (Chapter 1))*

	BF	BW	FB	FL	FN	GE	IN	IR	LU	NL
Number of dairy farms (*1000)	6.2	4.6	15.6	10.4	4	10.2	3.5	23	0.8	17.5
Average size of dairy farms (ha)	45	66	77	96	90	60	68.5	50	95	49
Area farmed by dairy farmers (ha *1000)	278.4	303.6	1,201.2	996.3	360	614	239.7	1,159.2	76	850.5
Proportion of **agricultural area** farmed by dairy farmers (%)	45.1	34.6	67.2	43.7	37.2	37.3	24.2	26.7	58.8	37.3
Proportion of **regional area** farmed by dairy farmers (%)	20.6	18	43.7	31.1	29	17.2	16.9	16.8	29.4	20.5

The impact of dairy farming on land use and the pressure on land availability for dairy farming in a region, however, is not solely determined by the area used for dairy production but it is also affected by the pressure on available land in a region, linked to population density and degree of urbanization. Higher land prices (Table 1.2.1) are generally an indication of strong competition between the land requirements of industry, infrastructure, housing, agriculture and nature; this is particularly the case in the Netherlands and Flanders. In Baden-Württemberg, scarcity of land is also considered to be an important issue, especially in areas with many biogas plants. In 2011, Baden-Württemberg counted 796 biogas plants which were mainly located in the counties with

[1] FADN Definition of specialized dairy production: farms with >65% of gross margin obtained by dairy production

most dairy cows. In regions with good quality arable land available, dairy farming is potentially under pressure from crop production, especially when crop prices are good, which is the case in Pays de la Loire and Nord Pas de Calais. In Northern Ireland, however, 70% of the agricultural land area is designated 'Less Favored Area', and, being less productive, this tends to be used more for beef and sheep farming than for dairying.

Price evolution and situation on the world market (from 2007 onwards)

World milk production is estimated to have increased by 1.6% in 2009 (FAO) with the EU accounting for approximately one fifth of this total. Milk produced in the ten DAIRYMAN regions amounts to 35 billion tons and accounts for about a quarter of the EU27 production. The main feature of the four-year period 2007-2010 has been the high level of volatility in agricultural markets in general, including the milk sector across Europe. While in the past dairy farming guaranteed a steady income, the situation has changed quite drastically since the CAP mid-term review of 2003, when the reform of the dairy sector was introduced. At that time a gradual reduction of intervention prices for butter and SMP (skimmed milk powder) was introduced, together with a gradual quota increase. At the same time, a direct farm payment scheme was implemented. The main change occurred in 2007, when milk supply was low due to drought in certain important milk-producing regions, which led to an imbalance between supply and demand, and rising milk prices on a global scale. Input prices followed suit, albeit with a certain time lag. During 2008 and early 2009, milk prices again dropped dramatically, leading to significant decreases in the value of the milk sector and in farm income. Milk prices started to increase again by the second half of 2009. However, higher milk prices did not always compensate for the higher input costs; in Northern Ireland, e.g., in 2009 the price index fell below the input index value for the first time since 1985. During 2011 milk prices where on the up, but the EU average turned downwards in early 2012, following the seasonal trend and pressure from increased milk supply inside and outside the EU. The latest EU average farm gate milk price is estimated at 31.6 c/kg for May 2012 (which is 5% below the average price of May 2011). This volatility has led to more uncertainty, and even though price changes were less extreme during 2010 and 2011, it is expected that in the future both milk and input prices will be subject to even sharper increases and decreases (Dairy report, 2011; EC-report on the situation of the dairy market, July 2012; data from regional reports).

Importance of dairy production in relation to total agricultural production value

The proportion of gross value added to the regional total by agriculture, forestry and fisheries (NACE A) is below 5% in all regions and below 1% in Flanders, Wallonia and Baden-Württemberg. In several of the DAIRYMAN regions, the dairy sector is the most important economic agricultural sector. In Ireland, dairy accounts for 28% of the value of agricultural output, in Northern Ireland 47% of the total gross margin in agriculture can be attributed to dairy production (with only 14% of the farms being dairy farms). And also in other regions milk is the main agricultural product. In Luxembourg, Baden-Württemberg, Brittany and Pays de la Loire it represents 26%, 21%, 22% and 21%, respectively, of the total value of agricultural production and is worth between 700 million and 1000 million euro. In other regions, where dairy production may not be the primary economic output from agriculture, it still contributes significantly to the agricultural economy. For instance, in Nord Pas de Calais, dairy production represents 20% of the value of agricultural output and is worth 463 million euro and in Flanders it represents 9.8% of agricultural output and is worth 658 million euro.

At European level regional statistics are not always complete. However, in Table 1.2.3 common macro- and micro-economic indicators have been compiled for all regions, with some data gaps, which have been completed using alternative data sources. When comparing data between 2007 (regional reports, Eurostat) and 2009 (Table 1.2.3) we observe, as expected from the price evolutions during that period, a significant decrease in the value of the milk sector in Northern Ireland (-36%), Ireland (-33%), Flanders (-32%) and Baden-Württemberg (-24%). In other regions there has been a less pronounced decline, e.g. in Brittany (-8%), Pays de la Loire (-1%) and Nord Pas de Calais (-6%).

Table 1.2.1. Macro- and microeconomic indicators. Gross Value Added (GVA) all activities, GVA NACE A (agriculture, forestry and fisheries), production value at basic prices agricultural output, production value at basic prices milk (data source: Eurostat, 2009); GVA specialist dairying (TF14), Farm Net Income (FNI), Farm Net Value Added (FNVA), FNI specialist dairying (TF14), FNVA specialist dairying (TF14) (data source: FADN, 2009).

	BF	BW	FB	FL	FN	GE	IN	IR	LU	NL
GVA all activities (10^6 euro)	174,623	71,935.6	70,261.5	83,491.2	86,737.5	304,720	30,618.2	143,971	33,806	509,148
Production value at basic prices agricultural output (10^6 euro)	*4,500*[1]	*1,935*[2]	7,244	6,250	2,229	3,734	1,479	5,593	*269*[1]	22,883
GVA NACE A (10^6 euro)	1,402	635	1,758	2,001	848	*2,298*[1]	357	1,726	*95.9*	7,985
GVA NACE A/all activities (%)	0.8	0.9	2.5	2.4	1.0	0.7	1.2	1.2	*0.3*	1.6
FNI (€/FWU)	30,462	31,494	17,806	20,413	22,828	20,235	24,110	17,758	27,307	20,213
FNVA (€/AWU)	34,196	43,101	24,960	26,912	31,326	25,377	25,356	19,438	32,668	40,339
Production value at basic prices milk (10^6 euro)	*441*[1]	387[2]	1,330.5	964	345	558	397	1,090	70[1]	3,888
GVA specialist dairying (10^6 euro)[3]	190.6	123.3	411.7	300.1	48.5	210.9	124.0	450.1	23.7	1,346.2
GVA specialist dairying/NACE A (%)	13.6	19.4	23.4	15	5,7	*9*	34.7	26.1	25	16.8
FNI specialist dairying (€/FWU)[4]	32,959	32,620	20,083	22,171	18,791	21,573	31,079	31,240	32,326	27,590
FNVA specialist dairying (€/AWU)[4]	42,311	42,799	26,747	28,507	26,016	28,252	31,420	32,570	38,360	53,338

1 Data not available from Eurostat, data from alternative data source (2009)

2 Data from 2011

3 The gross value added was calculated by taking average total output minus intermediate costs for farms in the TF14-typology 'specialist milk'. The difference is multiplied by the total number of farms classified in that group for each region (FADN).

4 FNI: farm net income, FNVA farm net value added. Data for these indicators are based on a three-year calculated average (2007-2009), for specialized dairy farms (TF14 – specialist milk, FADN). FNI: remuneration to fixed factors of production of the farm (work, land and capital) and remuneration to the entrepreneurs risks (loss/profit) in the accounting year, expressed per family labor unit. Expression per FWU takes differences in the family labor force to be remunerated per holding into account. FNVA: Remuneration to the fixed factors of production (work, land and capital), whether they be external or family factors. As a result, holdings can be compared irrespective of their family/non-family nature of the factors of production employed. This indicator is sensitive, however, to the production methods employed: the ratio (intermediate consumption + depreciation)/fixed factors may vary and therefore influence the FNVA level. For example, in the livestock sector, if production is mostly without the use of land (purchased feed) or extensive (purchase and renting of forage land)

The economic performance at farm level can be rated by the net farm income expressed per family labor unit, to allow for differences in the family labor force on different farms (Fig. 1.2.1). Interestingly, in all regions specialized dairy farms earn a higher net income than the average income for agriculture, with the largest difference seen in Ireland. The only exception is Nord Pas de Calais, where net income from specialized dairying is less than the average income from agriculture; this may possibly pose a threat to dairying in the region, particularly with the availability of good quality arable land for crop production.

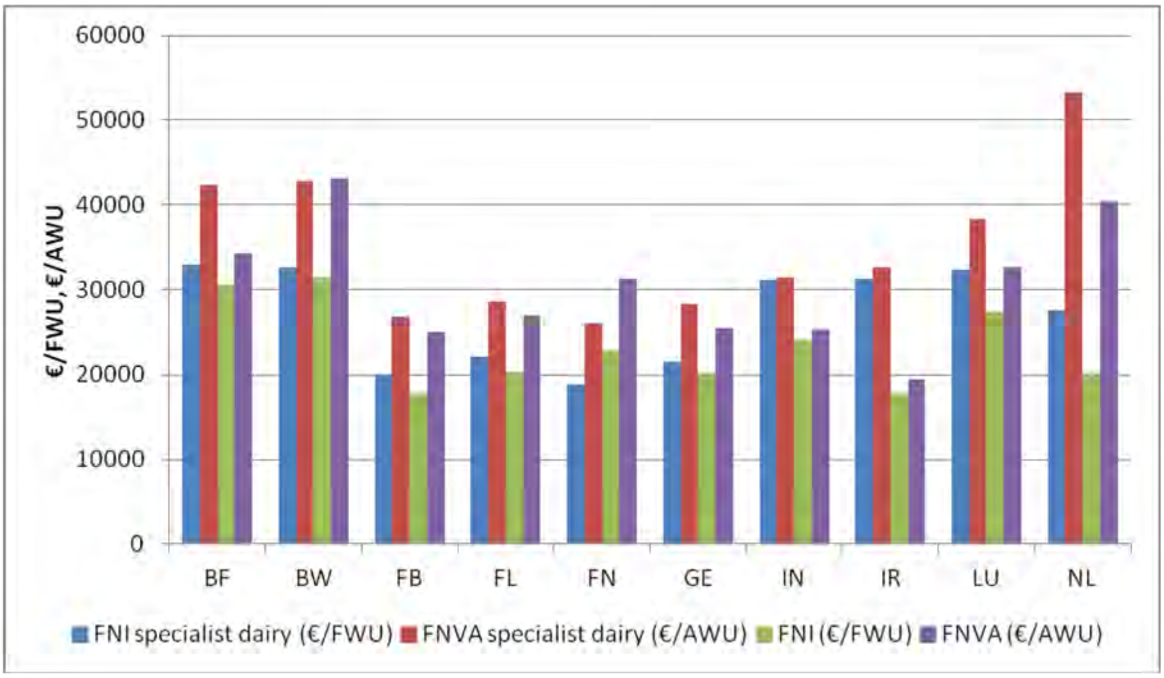


Figure 1.2.1. Comparison of farm net income/family work unit and farm net value added/annual work unit for specialized dairy farms (TF14) and total agriculture (FADN, average 2007-2009).

Influence of dairy farming on regional employment

The influence of dairy farming on employment is more difficult to quantify in a meaningful and comparable manner across regions. Overall, the contribution of primary production (agriculture, forestry and fisheries) to employment is less than 5% in all regions, and even less than 2% in Flanders (Table 1.2.1). As dairy farming is only a part of this, this sector is not expected to have a significant impact on employment in a region. The percentage of the active population employed on (specialized) dairy farms is presented in Table 1.2.3 as an objective indicator. However, as these data only take into account employment on specialized dairy farms and not that on mixed farms, the significance of dairy farming for regional employment may be underestimated. The proportion of regional employment on dairy farms provides rather limited insight into the actual impact and importance of dairy farming and the dairy sector for regional employment. A point worth noting in this respect is the high contribution of family or unpaid labor to the workforce on dairy farms in all regions. Not only do the numbers in Table 1.2.4 fail to account for employment on mixed farms with dairy production, they also fail to account for employment in food processing, advice, teaching and research institutes, and in agricultural equipment and animal feed industries, all of which are linked with dairy production. When employment in the agro-industry (total agriculture) is included, employment in agriculture rises to 6.8% in Pays de la Loire, 10.3% in Brittany, and 11% in Nord Pas de Calais (compared to 3.9%, 5.9% and 1.5%, respectively – see Table 1.2.1). Brittany, for example, counts43,360 direct jobs in the dairy sector: 28,440 in dairy production, 310 in the feed industry, 11,350 in the dairy industry, and 3,260 in services. In

Northern Ireland, 0.7 persons are employed in the dairy processing industry per dairy farm (2,318 employees). However, data on this aspect are not readily available across the different regions and are therefore difficult to compare. To further demonstrate and discuss the relative significance of dairy farming for regional employment, DAIRYMAN researchers and stakeholders across the different regions were asked to provide a subjective interpretation of this aspect (Table 1.2.4). The impact of dairy farming on regional employment and income was only considered as more important in Brittany and Pays de la Loire; this can be seen in the context of the fact that these two regions are the first and second dairy producing regions in France, respectively, having strong auxiliary industries and services, and associated employment related to the dairy sector. Regional employment in primary production is also the highest in these regions as well as in Ireland.

Table 1.2.2. Impact of dairy farming on regional employment.
*Number of specialized dairy farms = total number of farms * % specialized (Table B1), active population (Eurostat, 2009); AWU per farm - specialization milk (TF14) (FADN, 2009).*

	BF	**BW**	**FB**	**FL**	**FN**	**GE**	**IN**	**IR**	**LU**	**NL**
Active population (15-64 yrs)(*1000)	2,836.8	1,456.9	1,387.9	1,589.3	1,692.5	5,547.6	790.2	2,127.8	226.5	8,742.2
N° specialized dairy farms	3,844	2,208	9,204	6,032	1,320	7,140	3,080	20,010	616	14,525
AWU per farm	1.65	1.64	1.71	1.84	1.75	1.57	1.79	1.59	1.66	1.66
Unpaid – family (%)	99.4	96.3	95.3	95.7	84.6	91.7	89.4	88.1	91.6	91.6
Proportion of regional employment on specialized dairy farms (%)	0.22	0.25	1.13	0.70	0.14	0.20	0.70	1.50	0.45	0.28
Impact of dairy sector on employment in the region (subjective)	L	L	M	M	L	L	L	L	L	L

1.3 Average dairy farm

Table 1.3.1 gives an overview of the average dairy farm in each region. Although the table does not provide insight into the diversity of dairy production systems on individual farms, it does indicate the intensity of dairy production in each region and the importance of other types of agricultural production in mixed farming systems with dairying. Table 1.3.2 provides a more subjective interpretation of the main problems or issues faced by dairy farmers in each region.

As discussed earlier, milk production in Ireland is based mainly on a grass-based system, in contrast to the grain/maize silage systems mainly seen in continental Europe. This is largely due to the fact that the Irish climate is characterized by mild winters and high amounts of precipitation, which gives a long growing season. Almost 90 per cent of the diet of dairy cattle is grass-based, either from grazed grass or grass-silage and it is estimated that up to 85 per cent of milk produced in Ireland comes from grazed grass. The Irish system is based on compact spring-calving between February and April. Grass silage is fed in the winter period between October and March, of which a considerable part falls within the dry (non-lactation) period. Concentrate supplements are used only during early lactation (February-May). Milk production is thus highly seasonal with most of the milk produced between March and November. The most commercial and economically viable dairy farming enterprises are located in the South-West of Ireland. These farms also have the highest input of organic N to agricultural soils. On most Irish dairy farms beef production is a second major enterprise. The Irish low-cost system, aiming at minimum winter feeding, concentrate supplementation and replacement, depends strongly on seasonal calving in spring. This, in turn, requires a calving interval of around 365 days, which can be achieved only with milking cows of high fertility and body condition. As a consequence, the genetic merit of the Irish dairy herd (mostly Holstein Friesian) is relatively low for milk production.

Similar to the situation in Ireland, the dairy system in Northern Ireland is also grass-based, with almost 300,000 hectares of silage being produced, most on dairy farms. But there are notable differences between the two regions. For instance, spring calving is not an inherent part of the Northern Ireland dairy system, and there is a tendency towards a more intensive system, aiming to maximize the utilization of high genetic merit Holstein cows by means of increased concentrate input. Dairy farms may have an intensive enterprise such as pigs or poultry on the same premises but this is often owned and operated by a different family member and is classified as a separate business. Also, on average, Northern Irish dairy farms are considerably larger (both in hectares and herd size) than their Irish counterparts.

Average milk production per farm in Northern Ireland is exceeded only by that in the Netherlands, where 673 tonnes of milk are produced per farm (both specialized and mixed farms). In the Netherlands, this higher level of milk production is achieved with a lower number of dairy cows, which is a direct result of the higher milk yield per cow compared to that in Northern Ireland (8,200 vs 7,100 kg/cow). Due to the high population density and the high pressure on available land, dairy farming in the Netherlands is characterized by an intensive milk production system, with a high stocking rate and an average production of nearly 14 tonnes milk per ha from grassland + forage crops. To support this high level of production, the system relies on high inputs from concentrates. The high degree of specialization is also reflected in the low acreage of arable land (see also Ireland and Northern Ireland), which is in sharp contrast with the average dairy farms in France, Wallonia, Flanders, Luxemburg and Baden-Württemberg. However, the average farm offers only a limited picture in relation to specialization. In Wallonia, for instance, about half of all farms with dairy production are specialized farms. Dairy farms in the North-Eastern part of

Wallonia are more specialized in grassland alone, while in areas with good crop production potential more mixed farming systems are found.

Table 1.3.1. Characteristics of the average dairy farm. (In comparison: average EU-27 farm: 33 dairy cows, with a yield of 6,700 kg/cow).

	BF	BW	FB	FL	FN	GE	IN	IR	LU	NL
Farm land (ha)	45	66	77	96	90	60	68.5	50	95	49
grassland (%)	47	68	42	46	28	53	94	95	54	80
forage crops (%)	34	11	25	22	19	18	2	0	22	17
arable land (%)	19	21	34	32	53	29	4	5	24	2
Cattle (no)										
dairy cows	56	48	50	50	47	46	80	57	51	83
young stock	44	65	41	46	15	60	63	29	50	68
Milk (tonnes)										
milk/farm	392	318.7	298	343	344	304	568	278	344	673
milk/cow	6.9	6.9	7.7	6.8	7.4	6.6	7.1	4.9	6.9	8.2
milk/ha grassland + forage crops	10.8	6.1	5.8	5.3	8.1	7.1	8.6	5.9	4.8	14.2
milk/ha farm land	8.7	4.8	3.9	3.6	3.8	5.1	8.3	5.6	3.6	13.9
Grazing of lactating cows										
Number of days	180	180	260	245	120-180	160	196	305	160	168
Hours per day	9	20	15	15	8	10	20	18.4	8	9

NL data from 2011.

IN data from 2011, figures in this table are the average (mean) of farms classified as dairy farms according to the EU classification system. The figure for forage crops excludes silage, the predominant fodder crop in Northern Ireland. Figures from 2011 suggest that almost 300,000 hectares of silage were produced, most on dairy farms. Grass silage is harvested from approximately 50% of the grassland area on an IN dairy farm with either 2 or 3 cuts taken.

BF data from 2009, data for grazing from 2007.

GE farm accounting data of financial year 2010/11 – average of 398 specialized dairy farms.

FL data from 2010. Grazing data are an estimated average, which doesn't demonstrate variation depending on system, weather and soil conditions. On average, 6 hours/day during 3 months (early spring and autumn), 20 hours/day during 5 months.

FB Data from 2009-2010, members of the advisory service Bretagne Conseil Elevage, 10,426 farms (about 70% of the total number of dairy farms); milk/farm: from the regional statistics service. Grazing: 6-8 hours/day during 80 days (early spring and autumn), 18–20 hours/day for 180 days.

FN Grazing patterns show extensive diversity across farms. In grazing-based management systems, cows do not receive any forage (and sometimes concentrate) during 2 months, and supplementation is limited throughout the year. In contrast, zero-grazing is also being applied on some dairy farms.

BW data from 2011 (CBL).

LU Forage crops and grassland also used to feed suckling cows (2010).

Similar to the situation in Wallonia, the information given for the average dairy farm in Flanders also masks the high degree of regional diversity as regards dairy farm types. In the north of Flanders (region Noorderkempen and Limburg) the dairy farming system is similar to that in the Netherlands, i.e. very intensive and highly specialized, with zero - or very limited - grazing predominating in these parts. Mixed farms are more predominant in the south and west of Flanders where dairy farming is usually combined with arable cropping or pig production. When comparing average farms in both Belgian regions, the farming systems in Flanders are more intensive, with higher levels of milk production per ha from grassland + forage. Average milk yield per cow, however, in both regions is similar, indicating that the Walloon production system has a higher autonomy to reach the same production level per cow.

Dairy production in Nord Pas de Calais is also heterogeneous and is linked to urban densities and the potential for arable cropping. Most farms are mixed farms with crops and dairy cattle. Agricultural land in areas with a low potential for crop production is mainly used for grass and forage crops (Avesnois, Boulonnais) to support beef and dairy cattle production (in Avesnois). Most dairy producers are situated in these two areas. Feeding is based on grazing during spring and summer, and maize and grass silage during winter time. These farms are more dependent on weather conditions because their systems are grass-based. After several bad years for grass and maize growth, farmers have sought to diversify their forage sources by including, e.g., cereal-protein mixed silage. Grassland in the region is mainly permanent with very little reseeding. In the northern part (Flanders) dairy farming is not only mixed with cropping but also with pigs and poultry. On mixed farms with a good cropping potential very little grass is included in cattle diets and there is little or no grazing. Rations are constant throughout the year and these are based on maize silage, by-products, and concentrates. By-products such as sugar beet pulp and potato waste are readily available, thanks to nearby food industries. This offers major opportunities for mixed farmers since they can decrease the amount of land needed for forage production and increase the amount used for cereals, which is particularly worthwhile in years with high cereal prices. However, this dairy production system is vulnerable to a reduction in forage production capacity (forage platform), for instance low yields due to poor weather conditions.

Across France, farms tend to have low quota/ha, i.e. from 3,500 in Nord Pas de Calais to 3,900 in Brittany. As a result, it is possible for these farms to become more self-sufficient in feed and even to develop other forms of production, such as in particular crops in Nord Pas de Calais, industrial animal husbandry in Brittany, and poultry and beef cattle in Pays de la Loire. In Brittany and Pays de la Loire, the forage system is mainly based on maize forage during winter and interim periods and on grazed grass in spring and summer if the weather is not too dry. Temporary grassland containing perennial ryegrass and white clover is predominant and is integrated into the rotation which, with relatively low fertilization, provides good maize or wheat yields. With these two good quality fodder crops (maize silage and grazed grass), the quantities of concentrate can be limited to less than one tonne per cow per year for a milk output around 7,500-8,000 kg per year in Brittany.

On most dairy farms in Baden-Württemberg cows are fed with grass silage and maize. The intensity of grassland use is very high in the South (Allgaeu and Oberschwaben) with 5–6 cuts per year but it is less intensive in the hilly regions of Schwarzwald and Swabian Jura. Most cattle herds are fed indoors. Grazing is not very common due to the fact that most land parcels are small and not close to the farm buildings.

In Luxembourg the average dairy farm is mixed and produces milk, meat and crops. Since the introduction of the quota system dairy farms have often expanded the production of suckling cows. However, milk production is the main economic activity on most dairy farms (see Table 1.2.1). As 50% of the agricultural land area in Luxembourg is permanent grassland, the diet of dairy cows is mainly based on grass but maize silage also plays an important role. Due to the structural change in the dairy sector, milk production on the farm has often increased faster than the acreages available for grazing close to the farm. This resulted in a reduction in dairy cattle grazing over the last 30 years. Today most dairy cows are fed with a mixed ration during the year, with grazed grass representing only a small fraction of the diet. Due to pedoclimatic reasons, Luxembourg is classified as a “less favored area”. This aspect largely explains the lower milk production per ha shown in Table 1.3.1.

Table 1.3.2 provides an overview of the challenges that dairy farmers are facing now, and in the near future. Several challenges that are considered important are related to the economics of the farm, such as high land prices, low income and price fluctuations. In Ireland, the incomes of dairy farmers are higher than those in other agricultural sectors but incomes are still considered problematic. Other challenges are linked to social issues, such as an increased workload and the lack of free time, partly caused by an increased administrative load. High workload and lack of free time, e.g., score medium to high in all regions. These issues could be considered as possible threats to the future of dairy farming. Overall, dairy farmers are considered to have had a good level of education and the necessary skills to pick up and adopt innovations. This will only improve in the future as the education level of farmers increases in all regions and a diverse array of training possibilities are offered to dairy farmers.

Some issues are regarded very differently across the different regions. The high rating attributed to the costs of manure surplus in the Netherlands and certain parts of Flanders is easily explained by the intensity of dairy production in these regions. In other regions this aspect was given lower ratings since there is ample space to place the manure on the farm. However, this issue is also closely related to farm income, i.e. when farm income is high enough, costs associated with manure surplus are not considered problematic. However, with incomes under pressure, costs of manure surplus represent another additional cost and added pressure. Finally, there is the issue of farm succession, with a high score in Nord Pas de Calais but low in Flanders, Wallonia and Luxembourg (Table 1.3.2). The reason for this differing impression seems contradictory since farm numbers are decreasing equally in all regions and farm succession requires a large investment by young farmers. It may, however, be that in regions where some of the other more pressing challenges are being addressed in a positive manner, farming is becoming more appealing to the younger generation. The lack of a successor also influences management of the farm, and the possibility of certain investments. In Northern Ireland and Flanders, succession is more of a problem in other sectors than in dairy farming. Also, in Pays de la Loire and Brittany the settlement of new farmers mainly occurs on dairy farms, often as participants in an existing farm, which does offer new challenges in the form of human resource management. Nord Pas de Calais shows the opposite phenomenon. Forty per cent of the farmers are over 50 years old and dairy farming is considered less attractive for succession than other sectors. Especially the availability of enough good quality arable land tends to reduce the attractiveness of succession in dairying. An issue not included in Table 1.3.2 is the milk quota system, which is considered as a major problem in certain regions, such as Ireland. However, as the system will be abolished in 2015 there is a clear end to this problem. But a high degree of uncertainty exists about the future after 2015, especially concerning milk price, input prices, regulations, etc.

Table 1.3.2. Impression of main challenges faced by dairy farmers, at present and in the near future. Arbitrary scores given by DAIRYMAN researchers, based on individual experience, frequent contacts with dairy farmers and discussions during regional workshops. H = high, M = medium and L = low.

	BF	**BW**	**FB**	**FL**	**FN**	**GE**	**IN**	**IR**	**LU**	**NL**
High land prices	H	M	M	M	M	H	M	H	H	H
Low income	M	H	H	M	H	H	H	H	M	M
Costs manure surplus	H	M	L	L	L	L	L	L	L	H
Lack of farm successors	L	L	M	M	H	M	M	M	L	M
High workload/lack of free time	H	M	H	M	H	H	H	M	H	M
Administrative burdening related to regulations	H	M	H	H	H	H	M	H	H	M
Low awareness of environmental issues	L	L	M	M	L	L	L	M	L	L
Lack of education/skills to use innovations	L	M	L	L	L	L	M	M	M	M
Price fluctuations (input/output)	H	H	H	H	H	M	H	H	M	M

1.4 Environment

Environmental sustainability in the participating regions will be considered and compared in this section. Table 1.4.1a and 1.4.1b present some objective indicators of air, water and soil quality to provide an overview of the environmental state of each region. Comparisons between regions, however, are not appropriate as the indicators are not measured or expressed in the same way in each region. Subsequently, Table 1.4.2 provides an indication of how environmental issues are prioritized in each region. Finally, Table 1.4.3 gives an impression of the contribution of dairy farming to the different environmental issues. It is important to note that the rankings in Tables 1.4.2 and 1.4.3 are subjective and that these have been scored by researchers and policy makers who are familiar only with the environmental state of their own regions, and hence interregional comparisons are not really appropriate. The reason for presenting the information in this manner is that each country monitors environmental indicators (e.g. nitrate values of groundwater) in a different way, even though all countries have the same common goals under European environmental Directives.

Nitrate (NO_3) is naturally present in all ecosystems. At excessive concentrations, however, it causes problems for drinking water (the threshold value in the European Union is 50 mg NO_3/ l) and can give rise to eutrophication in some coastal waters. Nitrate concentrations above 25 mg/l indicate an anthropogenic influence. Agriculture is a major contributor to nitrate leaching. When applying the Water Framework Directive, nitrate concentrations have to be expressed in centile 90 (Q90). The objective of this indicator is to furnish a result representing critical but not exceptional situations. The Q90 value is determined by the highest value of at least 90% of the analysed samples. It is always higher than the average concentration. This means that, on average, the percentage of stations with Q90 above 50 mg/l is always higher than the percentage of stations above 50 mg/l; this means that both values cannot be compared.

Phosphorus is an essential constituent of animals and plants. Concentrations generally observed in waters are not directly harmful for humans but phosphorus is a major cause of eutrophication and can induce the proliferation of *Cyanobacteria,* which produce very dangerous toxins. Phosphorus is found in surface waters, either soluble (< 0.45 µm) or insoluble. The soluble form mainly consists of phosphate ions (PO_4^{3-}), which can be assimilated by plants and are directly responsible for eutrophication. Its origin is agricultural, industrial or urban. Phosphorus concentrations (mg PO_4/l or mg P total/l) have to be expressed in centile 90 or Q90.

Most *pesticides* are synthetic molecules with toxic properties for organisms considered as pests or weeds. Once dispersed in the environment, pesticides can affect other organisms than those aimed at and can accumulate in water causing a deterioration of water quality, making the production of potable water more difficult and more expensive. Pesticide contamination is caused by agricultural activities but also by public and private use. European Directives (98/83/CE and 75/440/CEE) set official thresholds: a maximum of 2 µg/l per substance and 5 µg/l for the sum of substances in natural water; a maximum of 0.1 µg/l per substance and 0.5 µg/l for the sum of substances in distributed water. Moreover, the Water Framework Directive defines thresholds for different molecules according to their own noxiousness (yearly average concentration between 0.005 µg/l to 1 µg/l).

Table 1.4.1a. State of environmental issues in the regions: water quality

	Indicators	**BF**	**BW**	**FB**	**FL**	**FN**	**GE**	**IN**	**IR**	**LU**	**NL**
Nitrogen	Organic N pressure (kg N org produced / ha agricultural area)	203[1]	115	125[1]	76[1]	85.5	56	165[1]	115	98	188[1]
	Total N pressure (kg N tot / ha agricultural area)	254[1]	190	185[1]	150	168	135	201[2]	185	200	320[1]
Nitrate in surface water	% of stations with 10% of the measurements > 50 mg/l (Q90 > 50 mg/l)	28		7[2]	10	0	0	0	0[1]	0[1]	
	% of stations with 10% of the measurements between 25 and 50 mg/l (Q90 between 25 and 50 mg/l)	26		74[2]	39	58	15	1		81[1]	
	% of measurements > 5 mg N total/l										30[2]
	% of measurements > 2.2 mg N total/l										66[2]
Nitrate in deep water	% of stations with 10% of the measurements > 50 mg/l (Q90 > 50 mg/l)	35	9	32		3		0	<1		
	% of stations with 10% of the measurements between 25 and 50 mg/l (Q90 between 25 and 50 mg/l)	12	32	35	21	66		2	12		
	% of stations > 50 mg/l						6				
	% of stations > 25 mg/l						43				
	% of water abstraction points > 50 mg/l									11	13[3]
	% of water abstraction points > 25 mg/l									36	15[3]
Phosphate in surface water	% of stations with 10% of the measurements > 0.2 mg P total/l (Q90 > 0.2 mg P total/l)	49		14[2]	2		43	7	0[2]	88[1]	
	% of stations with 10% of the measurements > 0.5 mg PO_4/l (Q90 > 0.5 mg PO_4/l)			8[2]	32		28	1	0	6	
	% of stations with 10% of the measurements > 0.4 mg PO_4/l	29		10[2]							
	% of stations classified "mediocre" (stations with 10% of the measurements (Q90) > 1 mg PO_4/l or < 0.5 mg PO_4/l)			5[2]		19					
	% of measurements > 0,15 mg P total/l										44[2]
	% of measures > 0.5 mg P total/l										21[2]
Pesticides in surface water	% of stations > 0.5 µg/l			14[2]				0	0	0	
	% of water bodies exceeding UQN						13[1]				
	% of stations classified "bad"					35					
	% of stations > MTR norm										26[4]
	% of stations > 0.1 µg/l			89[2]							36
Pesticides in deep water	% of stations > 0.5 µg/l	56						0	0		3[5]
	% of stations with atrazine						4				

	over 0.5 µg/l			
	% of stations with desethylatrazine > 0.5 µg/l		9	
	% of stations with bentazone > 0.5 µg/l		2	
	% of stations > 0.1 µg/l	21		11[5]

IN: [1] Total N in organic manure (kg) in 2010 produced by cattle (44,330,000), pigs (3,500,000), and poultry (36,160,000) during the housing period and also by cattle (38,190,000) during the grazing period, divided by the total agricultural land area (991,400 ha). [2] Total N in organic manure plus fertilizer N (77,400,000 kg) divided by agricultural land area.

FB: [1] After treatment and export from the territory: 103 kg N_{org}/ha, 163 kg N_{tot}/ha (source DRAAF Bretagne, enquête pratiques culturales). [2] www.observatoire-eau-bretagne.fr.

GE: [1] UQN = Umweltqualitätsnorm (environmental quality standard) according to EU Directive 2008/105/EU.

NL: [1] www.compendiumvoordeleefomgeving.nl. [2] Tables 4.3 (nitrate deep water) and 5.6 (rest). RIVM, Milieukwaliteit en nutriëntenbelasting, 2007 (Figures are from 2004 (nitrate deep water) and 2005 (rest) and come from measurements on farms (LMM)). [3] RIVM, De kwaliteit van ondiep en middeldiep grondwater in Nederland, 2010 (figures from the year 2008 from fixed measuring points in the Netherlands (LMG)). [4] www.bestrijgingsmiddelenatlas.nl, according to MTR norm = maximum acceptable risk, which is different per substance. [5] RIVM, Residuen van gewasbeschermingsmiddelen in het grondwater. Een analyse voor de KRW, 2007.

IR: [1] Average nitrate in surface water in Ireland is 8 mg/l. [2] The river water Environmental Quality Standard (EQS) of 0.035 mg/l P for phosphate (as an annual mean concentration) is taken as the threshold value for groundwater. Between 2007 and 2009, a total of 2,732 individual samples were analyzed for phosphate at 211 monitoring locations. Concentrations greater than 0.035 mg P /l were recorded in 251 (9%) of the samples. In the period 2007-2009, the average phosphate concentration in groundwater exceeded this threshold value of 0.035 mg/l P at 16 monitoring locations, eight of which exceeded 0.05 mg/l P. Between 1995 and 2006, there had been a gradual increase in the percentage of monitoring locations with mean phosphate concentrations less than 0.015 mg/l P. This increase was more pronounced during the period 2007-2009. There has also been a noticeable increase in monitoring locations with mean concentrations in the range 0.015 to 0.025 mg/l P. Overall, there has been an increase of approximately 27% of monitoring locations with mean concentrations less than 0.035 mg/l P when compared with the previous period.

BF: [1] Not all produced organic manure is being used, in fact only 122.6 kg Norg/ha is used + 51 kg Nmin/ha. On dairy farms total N/ha is on average 309 kg N/ha (study of 128 Flemish dairy farms, 2005). In 2010 about 26.9 million kg animal manure was processed and/or exported, mainly from poultry and pig production.

LU: [1] monitoring network of Directive 91/676/CEE (Nitrates).

FL: [1] organic pressure is relatively low with values between 46 kgN org/ha and 190 kg Norg/ha (only in 1 canton) and most cantons under 120 kg Norg/ha.

Table 1.4.1a compares the state of the regional water quality by giving a number of indicators. The value of the indicator for organic nitrogen pressure is highest in the Netherlands and Flanders, with levels well in excess of 170 kg organic N/ha, followed by Northern Ireland with a value just below the 170 limit. Baden-Württemberg, Nord Pas de Calais and Pays de la Loire, however, have a low organic nitrogen pressure (below 80 kg organic N/ha). Luxembourg, Ireland, Wallonia and Brittany are in between, with around 100-120 kg organic N/ha. Three regions have to treat and/or export nitrogen beyond their borders: the Netherlands, Flanders and Brittany (with 33, 80 and 22 kg organic N/ha, respectively, treated and/or exported). Brittany needs to export nitrogen because the average figure masks strong regional differences. Furthermore, until 2011 French legislation calculated the organic N pressure over 70% of the total agricultural area (available area for spreading), which decreased the 170 kg N threshold to 120 kg N/ha for the whole agricultural area. Total N pressure is, again, particularly strong in the Netherlands: 320 kg N/ha. The other regions follow with a total N pressure between 150 and 250 kg N total/ha. Interestingly, N pressures are not directly related to nitrate concentrations in surface water and deep waters. Lowest concentrations are found in Ireland (Ireland and Northern Ireland), where grasslands represent about 90% of the agricultural area. Several indictors of the state of regional air quality, soil quality and biodiversity are given in Table 1.4.1b.

Table 1.4.1b. State of the environmental issues in the regions: air quality, soil quality, biodiversity.

	Indicators	BF	BW	FB	FL	FN	GE	IN	IR	LU	NL
Air quality											
NH_3	Contribution of agriculture to regional NH_3 emissions (%)	93	93	99.7	98	95[1]	94[1]	96	97	93[1]	86[1]
GHG (greenhouse gas)	Contribution of agriculture to regional GHG emissions (%)	11	10	34[1]	21	16[2]	6	26	26	4	13[1]
Soil quality											
	% of agriculture area with slope > 10%	small	2	14	small	small[3]	8	17			0
	Average % organic matter in agricultural area	1.7	1.1 - 4.9	3.7[2]	3	49 t/ha	2-10	18	11	1.5 - 3.5	2.3[2]
Biodiversity											
Natura 2000	Part of the regional area included in Natura 2000 (%)	12	13	4	20	3	18	13[1]	10	18	14[3]
	Part of the agricultural area included in Natura 2000 (%)	32	7	49	15	4	31[2]	4	9	26	0.5[4]
Agro-ecological structures	permanent grassland as % of the agricultural area	37	49	13 (+27)[3]	22	21	38	65[2]	90	52	41[5]
	Length of hedges (m/ha agricultural area)		18	103		149[4]	50[3]	115[3]	80		
	Length of talus, banks, walls (m/ha agricultural area)			7		?[4]		42[4]	20		

IN: [1] Total area of land (181,981 ha) included in Natura 2000 divided by total land area of region (1,414,000 ha) x 100. [2] Area of permanent grass (647,353 ha) divided by total agric. area (991,400 ha) x 100. [3] Total length of hedgerows (113,648,000 m) divided by total agric. area (991,400 ha). [4] Total length of earth banks (32,387,000 m) plus stone walls (9,057,000 m) divided by total agric. area (991,400 ha).

FB: [1] source: Climagri CRA Bretagne; 11 t eq CO2 / inhabitant, 6.8 t eq CO2 / ha. [2] Official data: 15 % of the territorial divisions are above 5% ; 2% of the territorial divisions are below 2%. [3] 13% of the agricultural area are permanent grasslands, i.e., grasslands that are never ploughed; in addition, 27 % of the agricultural area are temporary grasslands, i.e., grasslands that can be part of a rotation (short-term or long-term grasslands). In total, the % of grasslands then is 40%.

GE: [1] In 2011 the Fertilizer Ordinance was concretized – since July 2011 farmers have to incorporate slurry, liquid manure, biogas digestate, poultry manure and liquid sewage sludge within 4 hours after distribution. [2] 27% grassland, 4% arable land. [3] average of our pilot farms.

FN: [1] Plan particules. [2] Agriculture contributes 10% of CO2 regional emissions, 53% of CH4 regional emissions and 60% of N2O regional emissions. [3] 15% classified into high risk of erosion. [4] Agro-ecological structures are heterogeneous in the region. In crop area (Flandres, Cambraisis), hedges hardlyt exist. However, in grassland areas (Boulonnais, Avesnois), landscape is mainly hedged farmland. Total hedges: 14,400 ha in the whole regional area.

NL: [1] www.emissieregistratie.nl. [2] RIVM rapport 680718001/2009. [3] http://www.natura2000.nl/pages/ barometer.aspx; August 2011. [4] ELI, Landbouw Economisch Bericht, 2011 (figures from 2009).[5] www.cbs.nl.

LU: [1] Luxembourg NH3 emissions are below the limit of the EU Emission Directive (2001/81/CE). So no efforts for reduction are needed.

Regional priority of environmental issues

The priority of environmental issues in each region is ranked in Table 1.4.2. The relative rankings given for the same indicators in different regions, however, should be interpreted carefully. A high ranking in one region doesn't necessarily mean that the particular indicator is at a level posing a serious threat to the environment within that region; it may have been awarded highest priority for other policy reasons.

Table 1.4.2 shows that nitrate in water is most frequently ranked as an issue of high priority, followed by the amount of greenhouse gases (GHG) in air, biodiversity, and the amount of phosphate in water. Summed across all regions, ammonia emissions are given the same priority ranking as pesticide pollution of water. Although in most regions soil erosion and soil fertility are ranked as having a low priority, both are in at least one region ranked as having a high priority (Nord Pas de Calais: erosion; Wallonia: fertility), indicating the importance of each issue in certain parts of North-Western Europe.

In Flanders virtually all environmental issues are considered important, are high on the agenda, and are being monitored. During the last 10 years progress has been made to reduce the emissions of ammonia and GHG (below threshold levels). However, a recent rise in livestock numbers and the future abolishment of the milk quota suggest that ammonia and GHG levels may increase again. On the other hand, the requirements on housing systems are now much stricter than they were ten years ago; this should restrict the expected rise in ammonia and GHG emissions. Although water quality has improved significantly over the last decade, target values are still not being reached for nitrate and phosphate. Erosion is mainly a problem in the south of Flanders. A set of measures has therefore been implemented to address these problems and farmers can participate in 'management covenants' to help tackle the issues.

In Wallonia, highest priority is given to tackling GHG emissions and nitrate emissions to water. Pesticide pollution of waters and soil fertility are also given high priority. In fact, Wallonia is the only region to rank soil fertility as a high-priority issue. Phosphate leaching is not considered a pressing issue, and soil erosion, ammonia emissions and biodiversity are given moderate priority.

In Brittany, nitrate leaching remains the main problem, with an average nitrate concentration in surface water of 36 mg/l (Q90 in 2011), with a few stations close to the 50 mg/l threshold, and proliferation of green algae in some sensitive bays along the coast. However, both nitrate concentrations and nitrogen fluxes have continuously decreased over the two last decades thanks to better manure management, reduced use of fertilizers, increased use of cover crops, treatment of surplus nitrogen, as well as urban waste water treatment plants. As for all French regions, there is an objective to halve the use of pesticides before 2018. Aware of the risk to human health, farmers have readily engaged in this program. Awareness of the impact of farming on air quality, and in particular ammonia emissions, however, is just commencing. Biodiversity is a priority but not an issue: hedges are part of the traditional landscapes and humid areas are being restored because of their role in denitrification and biodiversity. Soil quality is not a high priority in Brittany or in Pays de la Loire.

In Pays de la Loire, organic N pressure is relatively low with values between 46 kg N-org/ha and 190 kg N-org/ha (only in 1 canton) and most cantons below 120 kg N-org/ha). Furthermore, 15% of the regional area is Natura 2000 area and 22.4% of the agricultural area is permanent grassland. Water quality shows an improvement as regards phosphorus concentrations (in 2008, only 2% of the monitoring stations had 10% or more measurements ≥ 0.2 mg P/L in surface water) but water quality as regards nitrate concentrations remains problematic despite the committed efforts to improve the situation (in 2008, 10% of the monitoring stations had 10% or more measurements of ≥50 mg nitrate/L in surface water). Only 60% of the streams have a good ecological state and herbicides are still often detected. Water quantity can also be a problem, especially during summer.

In Nord Pas de Calais, air pollution from agriculture is not a big problem when compared with industrial and urban air pollution. Also, deep groundwater (to produce drinking water) is of good quality. Surface waters on the other hand generally have a low quality, particularly as regards nitrate levels. Phosphorus pollution is generally attributable to urbanization and not so much to agriculture since only 21% of the farming area is used for manure spreading and is therefore not considered as a high priority. A lot of work has already been done on pesticides and much improvement is observed; this issue is therefore considered less pressing than in the past. Soil erosion, however, is a major problem in alluvium and sloping soils and is being enhanced by land consolidation, the cutting of hedges, intensification, and a lack of cover crops during heavy rain. This phenomenon is specific for open land. Drainage of the soil also occurs, which is positive for agriculture, but which has some drawbacks such as the disappearance of humid areas, uniformization of the landscape, and loss of biodiversity (aquatic organisms).

Table 1.4.2. Priority of environmental issues in each region, ranked by the individual regions. 1 = lowest priority and 5 = highest priority.

	BF	BW	FB	FL	FN	GE	IN	IR	LU	NL	Total
Air quality											
Ammonia	4	3	3	3	2	3	2	2	1	5	26
GHG	4	5	3	3	1	2	5	5	2	3	33
Water quality											
Nitrate	5	5	5	4	4	3	2	1	4	3	36
Phosphate	4	2	3	2	1	2	5	3	3	5	30
Pesticides	3	4	4	4	3	1	1	1	2	3	26
Soil quality											
Erosion	3	3	2	1	5	2	1	1	3	1	22
Fertility	3	4	1	1	1	1	2	1	2	2	18
Biodiversity	2	3	3	4	3	4	3	1	4	2	29

In Baden-Württemberg the reduction of ammonia emissions only recently became a political issue because Germany did not succeed in reaching its goal to reduce these emissions to 510 ktonnes in 2010, when in fact some 581 ktonnes of ammonia were emitted. Measures have been taken by the Ministry of Agriculture to decrease these emissions, such as the obligation for farmers to incorporate manure within 4 hours after spreading (resulting in an expected reduction of 31 ktonnes). Especially biodiversity is given high priority in Baden-Württemberg with its various landscapes, to the extent that the government of Baden-Württemberg compiled an action program in 2008 aimed at saving biodiversity. Environmental organizations consider the increased cultivation of monocultures for energy production to be a major problem because this may have negative effects on habitats for plants and animals. When comparing the different environmental issues, phosphate leaching and GHG emissions do not have high priority, and lowest priority is given to soil quality and pesticide pollution.

In Northern Ireland (data 2012) nitrate in water is not a real problem, but rather phosphorus enrichment which is driving eutrophication of fresh water bodies. However, while tackling P enrichment remains the highest priority in Northern Ireland, an equally high priority is being given to controlling GHG emissions, which are linked to high animal stocking rates (CH_4) and high N surpluses on some more specialized dairy farms (N_2O). Finally, loss of biodiversity is becoming more of an issue, particularly with the coming reform to ‘Single Farm Payments’ and the ‘greening’ of the CAP.

Phosphorus loss to water is Ireland’s most serious pollution problem. Agriculture is reported to account for 70% of P entering Irish inland surface waters. Phosphorus loss from agricultural soils to water occurs primarily in overland flow. It is associated with high soil P concentrations and the inappropriate timing of fertilizer and slurry applications. However, it is not as high on the agenda as GHG emissions, for which it is predicted that the annual obligations under the EU2020-target from 2017 onwards will not be met even in the best-case scenario. In Ireland biodiversity is not a problem, but is nevertheless considered a priority when it comes to maintaining the green image of dairy farming.

In Luxembourg, water quality issues are high on the agenda of most stakeholders. The problem tends to be very localized with problematic regions showing high concentrations of nitrogen in deep and surface water and high concentrations of phosphorus in surface water (see Table 1.4.1a). GHG and ammonia emissions are no longer problematic because the levels of ammonia and GHG are well below the target levels (ammonia emissions 2010: 5,507 tonnes, with a target level of 7,000 tons; GHG emissions: only 4% of the GHG emissions originates from agriculture). Reductions in total livestock numbers (because of higher productivity) and in mineral fertilizer use, coupled with improvements in organic nitrogen efficiency via better application techniques, have resulted in reaching target emissions. Biodiversity is an important issue in Luxembourg: a lot of payments are linked to biodiversity maintenance and the pressure from environmental organizations on agriculture is high in this regard. Soil erosion and fertility have a high priority at a local level, i.e., in regions with annual crops on slopes and unfavorable soil types and farm management, such as growing maize on sandy soils on slopes without catch crops or under-sowing.

In the Netherlands, ammonia volatilization is close to the NEC threshold. Goals for nitrate levels in groundwater are being achieved in most areas, and are almost being achieved in the remaining ones. In many Dutch surface waters, however, nitrogen and phosphorus concentrations are too high; this is primarily due to the buffering effects of soils. Regulations will have to be tightened to achieve a good ecological status of surface waters. Pesticides are not considered a pressing problem since levels in groundwater are well below critical levels. In surface waters, however, they often exceed critical levels. Soil quality and biodiversity are not considered to be problems.

Contribution of dairy farming

Table 1.4.3 shows for each region to which extent dairy farming contributes to the regional environmental issues. Similarities in ranking between regions can reflect similarities between the structures of dairy farming in the regions. For example, similar feeding patterns and housing and spreading conditions for similar numbers of cows and heifers should result in similar ammonia emissions from dairy farming. However, the contribution of dairy farming to the environmental issue may nevertheless be ranked differently between regions, because in some regions the contribution of dairy farming may be relatively low compared to that from other sectors. Therefore, differences in ranking can reflect differences in farming structures between regions but also differences in the relative intensity of dairy farming compared to other sectors within the region. The ranking in the table can also be based on the results (opinions) from stakeholder surveys.

In most cases it is not likely that dairy farming will have a positive influence (i.e. improvement) on the environment. This is true for air and water quality, although it may be disputed for soil quality and biodiversity. Whether or not dairy farming has a positive or a negative effect on soil quality depends on regional history. Increasing the variety of the surroundings with grassland and hedges will increase the regional biodiversity. With the same reasoning, dairy farming can have a positive effect on soil fertility if it is considered that natural heath and dune soils in their pristine state are less fertile than grassland soils.

Only four of the regions consider dairy farming a relatively high contributor to ammonia emissions to the air: the Netherlands, Flanders, Ireland and Luxembourg. In every region, a large proportion of the ammonia emissions originates from agriculture (ca. 97%, see Table 1.4.1b), to which dairy farming contributes. In Ireland, 25% can be attributed to dairy farming; in Flanders 30% it to be attributed to the bovine sector (60-65% from dairying), and 50% to pigs and 10% to poultry. In Baden-Württemberg, however, dairy farming is not considered to have such a big influence on ammonia emissions as might be expected for the whole of Germany. Likewise, in Northern Ireland the contribution of dairy farming to ammonia emission is ranked as medium since pig and poultry production are responsible for a significant proportion of the emissions and not dairying alone. The Netherlands and Flanders have indicated that ammonia concentrations in air are high in these regions, whereas Ireland and Luxembourg gave no such indication although they did indicate that dairy farming was a major contributor to overall ammonia emissions. The reason for the differences in relative contribution may be caused by the proportion of dairy cows of the total number of livestock units.

Table 1.4.3. Relative influence of dairy farming on the regional environmental issues. This influence can be H = high, M = medium or L = low and is either relative to non-human influences or to other sectors within the region. For air and water quality the influence can only be negative (red). For soil quality and biodiversity the influence can be either positive (green) or negative (red).

	BF	BW	FB	FL	FN	GE	IN	IR	LU	NL
Air quality										
Ammonia	H	L	M	L	L	M	M	H	H	H
GHG	H	L	H	H	M	M	M	H	M	H
Water quality										
Nitrate	M	M	M	M	M	M	M	H	H	H
Phosphate	M	M	L	L	M	L	M	H	M	H
Pesticides*	L	M	L	M	L	L	L	L	M	L
Soil quality										
Erosion	L	M	M	L	M	L	L	L	L	L
Fertility	L	H	H	L	H	L	M	L	M	L
Biodiversity	L	M	M	H	H	M	M	M	H	M

* the impact of dairy farming on pesticide pollution takes into account the pesticides used for purchased forage.

Half of the regions indicate that dairy farming is a high contributor to GHG emissions resulting from enteric methane emissions and the use of fertilizers. In Ireland, 27% of national GHG emissions emerges from agriculture, of which a quarter can be attributed to dairying; in Flanders, 37% of the GHG emissions from agriculture originate from bovines (60% from dairying) and 24% from pigs. Wallonia, Nord Pas de Calais, Baden-Württemberg, Northern Ireland and Luxembourg do not rank dairy farming as a high contributor to GHG emissions. In Nord Pas de Calais farming has a relatively low impact on air quality compared to road traffic, industries and urban centers.

Farming contributes to the recycling of city (75%) and food industry wastes. The situation is similar in Wallonia, where the agricultural sector produces only 10% of total GHG, leaving 90% to come from other sectors. Reduction in agricultural emissions will be difficult to achieve, as dairy farming is based on grassland and pastures where emissions of GHG and ammonia will always occur. Dairy farmers have already made good efforts to decrease emissions, even though they are not the biggest contributors as a result of the high carbon sequestration potential of grassland. In Baden-Württemberg and Luxembourg agriculture only accounts for 6% and 4%, respectively, of the regional GHG emissions (see Table 1.4.1b). Dairy farming contributes to these emissions but targets are easily met, for example by the reduction of cattle numbers (higher milk production per cow) in Luxembourg. Although the Netherlands and Flanders are ranking dairy farming as a high contributor to GHG emissions, agriculture itself is not a major contributor to such emissions in these regions (see Table 1.4.1b).

In Baden-Württemberg, Pays de la Loire and Brittany, dairy farming is not considered to contribute much to high phosphate levels in water. In the two French regions this is because dairy farms have a low phosphorus surplus at farm scale compared to other production systems, thanks to an N/P ratio of bovine manure which is adapted to crop needs. Besides, dairy farms reduce the environmental impact of the other production types by receiving pig or poultry manure, thereby mitigating nutrient pressure. In Pays de la Loire, the impact of dairy farming on nitrate levels is also lower than the impact of other production systems, especially linked to the grassland share of total farm area, which is around 40 % on an average dairy farm. Furthermore, dairy farmers in Pays de la Loire have been very much involved in improving water quality through high participation in voluntary programs (livestock housing upgrading to prevent direct discharges and better use of livestock manure, programs set up to support farms in areas of water catchments to tackle environmental issues, etc.). This has resulted in a positive evolution of farming practices with reduced mineral fertilizer use and improved plant health. In Flanders dairy farming contributes to nitrate and phosphate problems in water, but not as much as horticulture and other intensive farming sectors. Dairy farmers do not use a lot of mineral phosphate (problems with phosphate-rich soils are mainly due to historically added cinders or pig slurry). In Wallonia, a soil analysis is carried out in autumn to assess the risk of nitrate leaching, and in comparison with arable crops the risk of nitrate leaching from dairy farms is very low (30-35 kg N- NO_3 against more than 100kg of N- NO_3 in potatoes for example).

In contrast to the other regions, Wallonia, Pays de la Loire and Luxembourg consider that dairy farming contributes to the pesticide pollution of waters (Table 1.4.1a). In Luxembourg this is due to the use of a highly water-soluble pesticides in forage production (maize, cereals). In Pays de la Loire, dairy farms occupy a considerable area, 95 ha for an average dairy farm (see Table 1.3.1). Their practices, especially the use of herbicides, have an important impact on water quality and often dairy farmers are less well trained than crop managers. This lack of training and experience is currently being addressed especially with the French Ecophyto plan. In Pays de la Loire more than 7000 farmers are being trained over a 2-year period. In Nord Pas de Calais, dairy farming is not considered to contribute a lot to pesticide pollution because even if pesticides are used on forage crops, its usage is low compared to the amounts used in others crops (potatoes, cereals, sugar beet).

In all regions dairy farming is considered to have a very low negative or even, in some cases, a positive impact on soil erosion. In Pays de la Loire and Brittany, dairy farms are thought to limit erosion because of the preponderance of hedges around grassland fields (see Table 1.41b). In Wallonia, grassland is an important part of the agriculture area and this soil is protected against erosion because it is always covered. In other regions like the Netherlands and Flanders, erosion is not a big problem. Only in Nord Pas de Calais and Luxembourg is dairy farming thought to have an impact on soil erosion. In Luxembourg there are always local erosion problems due to steep slopes, easily eroded soil types and cultivation of maize on these slopes, but the high amount of permanent grassland on dairy farms has a positive impact on soil erosion. In Nord Pas de Calais, a lot of sensitive areas have erosion problems. Crop farms have more problems than dairy farms, but because dairy farms are often mixed with crops, and because they also grow forages, they also have an impact on erosion. Over the past 15 years, considerable work has been carried out together by farmers, communities and agricultural institutions to implement improvement measures such as increasing the amount of hedges and retention ponds.

In Wallonia, Northern Ireland, Luxembourg and the French regions, dairy farming is not thought to negatively affect soil fertility; instead it is considered to improve soil fertility, partly because of the presence of grassland and the link between crop and livestock production. In Northern Ireland for example, dairy farming has a tendency to increase soil P status and hence soil fertility. In Wallonia the organic matter content of grassland soil is high in comparison with the soil used for arable farming. Although dairy farming in Baden-Württemberg is not as detrimental to the environment as other farming activities, it is not considered to have a positive effect on soil fertility.

In general, dairy farming is considered to have a moderate to high negative influence on biodiversity. Biodiversity experts would be of the opinion that in Ireland dairy farming practices have a negative impact on biodiversity. In Flanders and the three French regions, however, dairy farming is seen as a minor contributor to the decline in biodiversity, and may even be considered as a factor contributing to the increase in biodiversity. Although French regions have the lowest share of permanent grassland (Table 1.4.1b), they have considerably higher amounts of hedges than other regions and their dairy farms apply more biodiversity-friendly practices. The amount of hedges in Northern Ireland is similar to that in the French regions but in Northern Ireland the influence of dairy farming on biodiversity is graded negative. In Nord Pas de Calais agriculture generally does have a negative impact on biodiversity, but compared to other systems (crop farms for pesticide use, open fields), dairy farming is an activity improving environmental issues thanks to grassland and hedges. This is also the case in Pays de la Loire, where the utilization of pasture is valued highly in terms of biodiversity, water protection and carbon storage (pasture = 46% of UAA on dairy farms). Extensive farming is generally considered to be positive for biodiversity in view of the amount of permanent grassland and the species- richness associated with these types of meadows. In addition, the positive impact considered by the French regions and Flanders may be due to the homogeneity of the surrounding nature. In Luxembourg dairy farming has a negative impact on biodiversity due to the intensity of forage grassland, in contrast to the meat production sector where suckling cows graze on more extensive grassland. In Wallonia, dairy farming is considered to have a medium negative influence on biodiversity, as often the same grass variety is used.

1.5 Common challenges for sustainability

It can be concluded that there is considerable diversity between farming systems across the different regions. There are some commonalities, like a temperate cool climate well suited to dairy farming and a good local market for dairy products, but the farm characteristics and structures in the different regions are quite diverse and reflect regional differences, including differences in history, culture, and politics. This diversity is also reflected in the environmental legislation in the different regions. Although this legislation may be based, in part, on common European Directives, the interpretation of these Directives and the resulting implementation is widely differing across the regions; this is discussed in greater detail in Chapter 2. The main question is what and how can we learn from each other to improve farming strategies, taking into account the regional characteristics and differences? The results in this report should hopefully provide the basis for mutual understanding, discussion, and learning across regions, keeping in mind that sustainable dairy farming implies coherence between people, planet and profit.

Agriculture and dairy farming represent an important form of land use in all regions. In some of the DAIRYMAN regions, land availability for dairy farming is under pressure because land may be used for other purposes, both agricultural and non-agricultural. To make more efficient use of the available land, therefore, intensification has taken place in some regions, resulting in high input levels on farms, and associated problems and challenges from economic (e.g. high variable costs) and environmental (e.g. import of soy) perspectives. Dairy farmers are also operating in a more volatile market environment, which presents a major challenge across the regions, and which is linked to past and future changes in European agricultural policy (CAP), including the abolishment of the quota system by 2015, increased market power of the suppliers and processors through consolidation, and speculation on commodities. Past changes in the CAP led to a gradual decrease in intervention mechanisms for the dairy sector, making the European dairy sector more vulnerable to volatility in the world market. This has presented major problems to dairy farmers, who in the past had been used to steady and predictable milk prices but who are now being confronted with major price fluctuations. This has led to an increased risk at farm level, and since this volatility in milk and resource prices is not expected to decrease in the future, dairy farmers will simply have to learn to deal with these circumstances. Excellent management skills will be critical in such times of uncertainty, and risk management planning will need to be built into the farm's management system. Dairy farmers will have to strengthen their position on the (world) market with alternative strategies, for example by forming cooperatives to obtain a stronger position in the market, or by increasing product value by shortening supply chains (on-farm sales, farmers' markets, etc.).

Farm size and structure are changing across all regions, total farm numbers are declining, while the average farm size is increasing, and larger farms are being managed by fewer people, which presents a challenge in relation to labor. Traditionally, dairy farming has been very much family-oriented, and in some regions hiring full-time or part-time external labor has not been straightforward. In addition to, or as an alternative to, external labor, farmers may also seek to increase automation or form cooperations with other farmers to share workloads. Again, such changes will make greater demands on farmer management skills, be it either in the form of human resource management (external labor, cooperations) or increased technical knowledge (automation). Also note in this respect that the increased pressure on income and labor may have a negative effect on the wellbeing of the farmer and his/her family (increased stress, less family time). The challenge therefore is to secure an adequate income in a socially acceptable way.

Efficient use of nutrients is an important aspect of ecologically sustainable agriculture. Minimizing losses by closing nutrient cycles is an important priority. Increasingly strict legislation on fertilizer management has led to improvements in water quality and reductions in ammonia and GHG emissions from agriculture in many regions. However, to reach legislatively imposed targets additional efforts are needed. The most pressing environmental problems are GHG emissions to the air and high nitrate concentrations in water. In most regions, these are heavily influenced by dairy farming. With the expected increases in farm size and specialization in several regions, more manure will have to be managed and spread, making it even more challenging to mandatory environmental targets. It is necessary, therefore, that measures are implemented to reduce this pressure on the environment and on farmers.

Improvements in nutrient use efficiency will require a broad range of interventions, including those related to diet (e.g. on-farm production of crops with high protein content), animals (e.g. lower replacement), housing (e.g. low-emission stables) and fertilizer management (e.g. valorization of waste). However, such interventions should not interfere with other sustainability issues, such as acceptance by society (e.g. reductions in grazing time), economy (e.g. exceptional costs for housing changes) or animal health. In addition, there is a need to emphasize the positive contribution that dairy farming can make as regards biodiversity or landscape management. Current regional legislation resulting from the implementation of EU Environmental Directives (Chapter 2) leaves scope for further improvement in nutrient efficiency, especially in relation to cattle management and storage regulations.

The dairy sector is also characterized by distinct strengths across all regions, which may help to turning present challenges into opportunities instead of threats. In all regions, the education level of dairy farmers is increasing and ample training opportunities and facilities are being improved, supported by high quality research and innovations in KTCs and research institutes, to help dairy farmers improve their management skills. There is a good local market for dairy products, offering opportunities in the form of short-chain initiatives. Despite the concerns about farm income, dairy farming is more profitable than other agricultural sectors in nearly all regions and although farm numbers are declining, young farmers are still entering the dairying profession, making succession less of an issue than in other agricultural sectors.

2. Regional implementation of EU Environmental Directives

Assessment of regional implementation of the EU Environmental Directives consists of a description of regulations for dairy farmers covering the following topics:
1. Nutrient application limits (2.1);
2. Manure production norms (2.2);
3. Cattle management regulations (2.3);
4. Fertilizer application regulations (2.4);
5. Storage regulations (2.5);
6. Crop management regulations (2.6);
7. Administrative requirements (2.7).

These regulations have been implemented in regional legislation to comply with European Environmental Directives, mainly the Nitrates Directive (ND) but also the Water Framework Directive (WFD), the National Emission Ceilings (NEC), and the international agreements made to limit GHG emissions. Within the framework of Dairyman, each region has written a report in which the process of implementation, regulation specifications (namely national Action Program), and monitoring of the effectiveness of these regulations are described. The tables in this report are a summary of the regulations specified in the individual regional reports. Remarks have been provided by the Dairyman team in each region. Nevertheless, there is always a possibility of mistakes due to the complexity and diversity of regional regulations which make comparison difficult.

2.1 Nutrient application limits

Before describing and comparing the nutrient application limits (Table 2.1) it should be noted that these limits and all other regulations mentioned in the other tables only apply in nitrate vulnerable zones (NVZ). Outside NVZs farmers are stimulated to perform according to good agricultural practice (GAP). All ten regions participating in this project are classified completely as NVZ, except Wallonia and Pays de la Loire with 41.8% and 83%, respectively, of their area classified as NVZ.

The ND requires establishment of nitrogen fertilization limits and these must include a limit of 170 kg nitrogen (N) from organic manure per hectare per year. In Flanders and Luxembourg the limits for N from organic manure for crops with a low N requirement (Flanders) or for protein crops (Luxembourg) are even stricter. The European Commission can be asked to allow applications in excess of the limit of 170 kg of organic N per hectare per year. This is only permitted under certain circumstances, e.g. for a crop with a long growing season or a high nitrogen uptake. Farms with a minimum of 70% grassland of the total farm area can apply for derogation in the Netherlands. In Ireland the minimum share of grassland has to be 80%. In Northern Ireland, grazing livestock (cattle and sheep) manure can be applied on derogation farms up to a limit of 250 kg organic N/ha, but pig and poultry manure may only be applied up to a limit of 170 kg organic N/ha. In Flanders only cattle manure or pig slurry may be applied on derogation farms. Whereas derogation is quite common in the Netherlands, where it applies on 95% of the dairy farms, it is less common in the other regions. It shows a strong decline from 51% of the dairy farms in Flanders to 20%, 4% and less than 0.1% in Ireland, Northern Ireland and Baden-Württemberg (only 48 farms applied for derogation in Baden-Württemberg), respectively. The reason for this is that farmers don't need derogation (production less than 170 kg organic N/ha) and if manure production is above 170 kg organic N/ha farmers can relatively easily export excess manure from their farms to less intensive neighbors, thereby avoiding the extra paperwork and regulations associated with derogation. Farmers in France, Wallonia and Luxembourg cannot apply for derogation. In Luxembourg farmers cannot apply because the average organic nitrogen pressure is only 100 kg per ha; this means that most farmers do not need a derogation. And if an individual farmer would have a manure surplus, this can easily be exported to a neighboring farm.

Each region has defined nitrogen application limits for different crop types. The N limits can be *fixed* by law in the national Action Plan but they can also be *calculated* with variables that can change each year (like soil nutrient status). In the Netherlands the application limits are fixed by law, differentiating between grassland, grazing time and different types of arable crops but also between soil types (sandy, clay, peat and loess soils). Other regions do not have fixed limits but calculate the allowed amount of nitrogen dependent on soil analysis results, cropping history, mineralization, stocking rate, etc. (see footnotes 7, 10, 14, 16 and 19 in Table 2.1). In Table 2.1 the *fixed* legal nitrogen application limits are printed **bold** to differentiate them from limits that are *calculated* with variables that can change each year (normal font).

The parameter 'total N allowed' takes into account both the N in organic manures and in mineral fertilizers that are plant-available (mineral N) and the amount of N not being plant-available in the first year. The percentage 'available' in organic manure differs per type of manure but some regions use one standard. This percentage is referred to as the "working coefficient" (Wc) of the total amount of nitrogen in animal manure and is used by every region except Wallonia. An example for the Netherlands: a maximum application amount of effective N of300 kg/ha and a maximum application amount of manure N of250 kg/ha (derogation) with a working coefficient of 0.5 (i.e., 250 x 0.5 = 125 kg/ha available N) results in an allowed amount of available N from chemical fertilizer of: 300 - (250 x 0.5) = 175 kg/ha. This results in a total amount of N (available and non-available) that may be spread of: 250 + (300 - (250 x 0.5)) = 250 + 175 = 425 kg/ha. Ireland uses almost the same calculation method for total N, but also takes into account the period that organic manure is deposited during grazing, when the Wc is considered 0.

Baden-Württemberg, France and Luxembourg have set a maximum surplus of N allowable on dairy farms in one year or over a couple of years. Other regions have defined a maximum amount of nitrate in the soil after harvesting in autumn (Flanders and Wallonia). This regulation functions as a control measure, whereas the maximum surplus functions as a preventive measure to limit N losses to groundwater.

Total P_2O_5 application limits have not been defined in Wallonia, Baden-Württemberg and Northern Ireland. In Northern Ireland, however, the usage of mineral or chemical P_2O_5 is restricted; application is not permitted unless the soil test indicates a crop requirement in accordance with guidance provided in the 2010 DEFRA Fertilizer Manual. A similar restriction is in place in Flanders and Luxembourg. In fact, all regions, except Wallonia and France, take into account soil analysis results to regulate the application of phosphorus (P). In the French regions other factors, such as location and size of the farm, are taken into account. Other regions take account of factors such as cropping history, stocking rate, crop yield, and crop requirement (see footnotes 8, 10, 14 and 17 of Table 2.1). A general maximum P-surplus is defined in Baden-Württemberg (an average of 20 kg P_2O_5 per ha over 6 years) and Luxembourg (0 kg P_2O_5 per ha over 5 years), whereas in Northern Ireland and Brittany a maximum P-surplus applies under certain conditions: in Northern Ireland only on derogation farms (22.9 kg P_2O_5 per ha per year) and in Brittany only for farms producing more than 25,000 kg N (0 at farm scale).

Table 2.1. Nutrient application limits in Nutrient Vulnerable Zones (NVZs) for 2012. Given ranges refer to different limits according to crop types. Fixed legal limits are printed bold, whereas variable limits calculated with yearly changing variables are shown in normal font. Total (= non-available + available N) N or P_2O_5 is given in kg/ha/year. NA = not applicable, ND = not defined.

		BF[2]	**BW**	**FR**	**GE**	**IN**	**IR[1]**	**LU**	**NL[1]**
% area NVZ		100	42	FB, FN:100 FL: 83	100	100	100	100	100
% dairy farms with derogation		51	0	0	<0.1	4	20	0	95
	Derogation								
	No	Yes							
Total N /ha farm area	ND	ND	ND	**140, 210** or ND[6]	ND[16]	ND	ND	0-410[10]	ND
Total N /ha grassland	**323-380**	**230-410**	350	50-300[7]	ND[16]	392-442[18]	378-493[14]	410[10]	**375-475**
Total N /ha maize	**203-220**[5]	**270-330**[5]	250	0-160[7]	ND[16]	0-150[19]	177-282[14]	285[10]	**265-310**
Total N /ha other crops	**120- 330**[11]	NA	250	80-245[7]	ND[16]	0-280[19]	0-327[14]	0-380[10]	**0-465**
Total N from manure/ha farm area, no derogation	**100-170**	NA	**170**[15]	**170**	**170**	**170**	**170**	**85-170**	**170**
Total N from manure/ha farm area, derogation	NA	**250/200**	NA[15]	NA	**230**	**250**	**250**	NA	**250**
N working coefficient (Wc) defined?		yes[12]	no	yes	yes	yes	yes	yes	yes
Maximum N-surplus (kg/ha) defined?		no	no	yes[3]	yes[3]	no	no	yes	no
Maximum nitrate residue in soil (in autumn) defined?[17]		yes	yes	no	no	no	no	no	no
Total P_2O_5 /ha farm area		**75-95**	ND	**75-95**[8]	ND[16]	ND	0-173[14]	0-180[10]	**55-100**
Total P_2O_5 /ha grassland		**90-95**	ND	ND	ND[16]	ND[19]	59.5-173[14]	0-170[10]	**85-100**
Total P_2O_5 /ha other crops		**75-95**	ND	ND	ND[16]	ND[19]	0-268[14]	0-180[10]	**55-85**
Total P_2O_5 /ha dependent on soil P-status?		yes	no	no	yes	NA[19]	yes	yes	yes
Mineral P_2O_5 permitted?		yes[13]	yes	yes	yes	yes[4]	yes	yes[10]	yes
Maximum P_2O_5-surplus (kg/ha) defined?		no	no	no[9]	yes[9]	no[9]	no	yes[9]	no

1 NL: Figures assume an organic manure N application of 250 kg/ha/year (derogation) with a working coefficient of 50%. IR: Figures assume organic manure N application of 170 kg/ha/year (no derogation) with a working coefficient of 40%.

2 Presented figures assume the area is not situated in areas delineated as nature vulnerable areas. The total N figures are the maximum values accounting for two systems to calculate application limits (see remark 12).

3 FR: maximum surplus = 50, GE: maximum surplus = 60. Calculation based on field-stable balance, not farm gate balance; surpluses are averaged over 3 years of fertilization.

4 But only if soil analysis shows a P requirement as determined by the latest (2010) edition of DEFRA Fertilizer Manual RB209.

5 Derogation requires that maize is preceded by at least one cut of grass or rye. For fields without derogation the maximum total N/ha application dose on the grass (or rye) and maize combination is 268-300.

6 Limit of 140: for 7 watersheds in Brittany with Q90 over the 50 mg/l limit; limit of 210: for ZAC (complementary actions area with Q90 over 40 mg /l = 1/3 of Brittany) and green algae watersheds in Brittany; crop requirement for other regions.

7 Allowed organic and mineral N quantity for grassland = (Pf –P0) /CAU, allowed mineral N quantity for other crops = Pf - Pi - Ri - Mh - Mhp - Mr - MrCi - Nirr + L + Rf (Pf = N required by crop, P0 and Ri = soil N status at the moment of fertilization, CAU = 0.7, a

coefficient of expected N utilization, Pi = N already taken up by the crop at the moment of fertilization, Mh/Mhp/Mr/MrCi = mineralization of respectively: soil humus/incorporated grass/crop residue after harvest/residue of intermediary crops, Nirr = N supplied with irrigation, L = N lost to environment, Rf = N in soil after the harvest (immobilization)). Most farmers do not calculate themselves, they are advised. [*Calculated limits: Grassland: maximum effective N possible (grazing not included) between 50 kg/ha (more than 30 % of legumes) and 300 kg/ha (no legume, high yield (10 t DM/ha), no organic fertilization in previous years). Maize: maximum effective N possible between 0 kg/ha (after grassland) and 154 kg/ha (high yield (18 t DM / ha), rotation without grassland, no organic fertilization in previous years). Wheat : maximum effective N possible between 80 kg/ha (low yield (6 t/ha), bovine manure every 2 years) and 245 kg N/ha (high yield (10 t/ha), no organic fertilization in previous years)*.]

[8] According to farm location and size.

[9] IN: only for farms with derogation, maximum surplus = 22.9, GE: maximum surplus = 20. Calculation based on field-stable balance, not farm gate balance; surpluses are averaged over 6 years for P_2O_5. LU: maximum surplus over 5 years = 0. FR-FB: only for farms producing more than 25,000 kg N, maximum surplus = 0 at farm scale.

[10] Maximum application limits depend on crop requirement (based on estimated yields) but also on soil status. For P_2O_5 maximum soil concentrations are defined. Above these concentrations, no mineral or organic P_2O_5 can be applied. For example in sandy soils: P_2O_5 > 31 mg/100 g soil, no mineral P_2O_5 permitted (no sludge spreading permitted); IfP_2O_5 > 41 mg/100 g soil, no organic P_2O_5 permitted (pasture allowed). If P_2O_5 < 5 mg/100 g soil, 60 kg P_2O_5 can be applied above crop requirement.

[11] For non-vegetable crops.

[12] Farmers are free to choose between the system based on total N or effective N (using Wc's). Total N allowed differs only slightly if the allowed slurry dose is supplemented with mineral fertilizers. If litter or other fertilizers are used the differences between total N allowed under the total or effective N systems become larger. Working coefficient of liquid animal manure is 60%.

[13] With some exceptions, depending on crop requirements, technical reasons, or (extra) allowances based on soil requirements.

[14] For maize and other crops, total N allowed is dependent on cropping history, total P allowed is dependent on soil P status based on analysis. On grassland, total N and P allowed is also dependent on grazing period (only N) and stocking rate: the amount of N in animal manure produced/excreted on a farm divided by the total grassland area (grazed or silage) in kg/ha/year.

[15] The amount of organic nitrogen may not exceed 170kg/ha at farm level. On grassland 230 kg/ha organic nitrogen may be spread but only if the grassland share of total farm area is not exceeding the proportion 1 (grassland) : 1.5 (arable area) → (arable area*115 + Grassland*230)<170kg/ha.

[16] The allowed amount for both N and P is dependent on crop requirement (based on estimated yield), previous cropping and/or soil requirement after analysis. Soil analysis for N requires N values according to recommendations of federally accepted advisory centers, for arable land at least once a year. For P_2O_5 soil analyses are obligatory at least every 6 years. For grassland the maximum amount of nitrogen fertilizer depends on yield of grassland. Soil analysis for P_2O_5 on grassland is not necessary if the grassland parcel is only used for grazing or is fertilized with a maximum of 100 kg N/ha from organic manure.

[17] BF: maximum values depend on crop and soil, GE and LU: only in water protection areas.

[18] The maximum value applies for dairy farms. For other livestock farms the value is 392 kg N/ha.

[19] Maximum amount of total N as fertilizer plus organic manures that can be applied is in accordance with advice given in the 2010 edition of DEFRA Fertilizer Manual RB209 and is dependent on cropping history, crop management, soil type and rainfall. The maximum amount of total P (mineral fertilizer + organic manure) is not defined. Instead, limits are placed only on the amount of chemical or mineral P that may be applied to grassland or arable crops, which is dependent on the soil test showing a crop requirement in accordance with advice given in the 2010 edition of DEFRA Fertilizer Manual RB209, and may vary from 0-250 kg P_2O_5/ha.

2.2 **Manure production norms**

Norms are formulated for the production of manure from dairy cows and young stock (kg N or P per animal per year) in order to calculate the quantities of nitrogen and phosphorus produced on the farm. These norms are also necessary to calculate the capacity of manure storage for the periods in which fertilizer application is not allowed (Table 2.4). In each region the norms are calculated in a different way. All regions, except Wallonia, Northern Ireland and Ireland, take into account milk production of the cow, which influences feed intake. Besides milk production, the protein content of feed can be used to calculate the excretion norms, as this influences the nitrogen content of the manure. In France, the N excretion norms take into account the time spent outside buildings, assuming that whilst outside the diet is mainly based on grazed grass (with high protein content) and volatilization is nonexistent. It is also assumed in France that whilst inside, the diet is mainly based on maize and grass silage or hay (with lower protein content), the protein content of concentrates is balanced, and ammonia emission losses represent 25% of the excreted nitrogen. The urea content of the milk is thought to be an indicator of the protein content of the feed and is therefore taken into account for the excretion standards in the Netherlands. In Baden-Württemberg it is possible for farmers to use the urea content of milk (Dutch method) as proof of differing values but generally the standard reference values for manure production are used that only take into account the level of milk production and the feeding system, i.e. whether it is based on grassland or on arable land. Furthermore, a certain amount of nitrogen is lost after excretion by volatilization during storage. In Ireland current ammonia emission losses are set at 10% but these may be changed to 18%, which is the percentage used in the national GHG inventory. Non-inclusion of all factors above (milk production, urea content of milk, protein content of feed, volatilization losses) in the calculation of the excretion norms may result in an incorrect prediction of the nitrogen and phosphate production by farms. This does not stimulate farmers to decrease the nutrient excretion by improved management or feeding. Farmers in the Netherlands, Northern Ireland and Baden-Württemberg are allowed to calculate the nitrogen and phosphate excretion of their cattle with very farm-specific feed consumption data. However, only farmers in the Netherlands are actively using this possibility.

In Baden-Württemberg, Flanders and the Netherlands, P-excretion norms also depend on the total amount of milk produced per cow. In Ireland and France there is only one value for P-excretion per cow, whereas in Wallonia, Northern Ireland and Luxembourg no P-excretion standards have been set (except on derogation farms in Northern Ireland). The P-excretion norms appear to be lowest in Ireland, Flanders and Baden-Württemberg. The amount of manure produced by the cows in a region should equal the amount allowed for spreading in the region plus the amount that is exported or treated. In the Netherlands and Flanders the manure surplus is putting a strain on the farmers as they have to find ways to dispose of this surplus without considerable costs. In other regions this does not pose such a problem. A solution for manure surplus is manure treatment, converting manure into other useful products, like chemical fertilizer-equivalent. Manure treatment, however, is only obligatory in Flanders and in Brittany in zones with a high organic pressure.

Table 2.2. Manure production norms (excretion standards) for cattle (in NVZ). ND = not defined.

	BF	BW	FR	GE	IN	IR	LU	NL
N standards depend on milk production (kg/cow)?	yes	no	yes	yes	No	no	yes	yes
N standards depend on milk urea content?	no	no	no	no[4]	No	no	no	yes
N standards depend on protein content of feed, e.g. as a result of grazing intensity?	no	no	yes	yes	No	no	no	no
N losses during housing and storage (% of annual excretion)	10-20	15	25	15-30	ND	10	ND	11
Norms N (kg/ milking cow) (after correction for losses during housing and storage)	81-151	90	75-126	76-120	91	85	85-102	68-163
Norms P_2O_5 (kg/dairy cow)	26-43[2]	ND	38	27-39[2]	ND[3]	30	ND	34-49[2]
Obligation to treat manure surplus?	yes	no	no[1]	no	No	no	no	no
Permission for farm-specific excretion calculation instead of standard values?	no	no	no	yes	yes	no	no	yes

1 Only in certain areas with high organic pressure (FR: ZES).

2 P-excretion norms are dependent on milk production (kg/cow).

3 On farms with derogation the norms are 38 kg/milking cow.

4 Farmers are allowed to use the urea content as proof of different excretion, but this is not generally done.

2.3 Cattle management regulations

In Flanders and in France (only in high risk zones) limits are set on the amount of nutrients produced on a farm, i.e. manure production or, effectively, the amount of animals on a farm (Table 2.3). In Wallonia, farmers are obliged to export any surplus manure but there is no restriction on the amount of manure they produce. In Europe the milk quota system still controls the number of dairy cows in many regions but abolishment of the quota system in 2015 is expected to result in an increase in the number.

Table 2.3. Cattle management regulations (in NVZ).

	BF	BW	FR	GE	IN	IR	LU	NL
Nutrient emission rights (maximum number of animals allowed) defined?	yes	no	no[1]	no	no	no	no	no
Low-emission housing obliged?	no	no	no	no	no	no	no	no
Low-nitrogen feeding obliged?	no	no	no	no	no	no	no	no
Low-phosphorus feeding obliged?	no	no	no	no	no	no	no	no[2]
Grazing-restricted period defined? [3]	no	no	no	no	no	no	no	no
Grazing-restricted area defined? [4]	no	no	no	no	no	no	no	no

[1] Only in certain high-risk areas.

[2] Expected to be introduced soon.

[3] IR: a constraint on the grazing period is that the soil may not get excessively muddy or wet, LU: only restricted or prohibited in water protection zone 1.

[4] GE: only prohibited in water protection zone 1; in water protection zone 2 grazing is only allowed if stocking rate and grazing period are adapted to amount of feed. FR: only restricted in certain water catchment areas; IR: grazing close to waters only restricted under special circumstances; IN: instead, animals must at all times have free access to the land area.

Ammonia emissions can be reduced by demanding low-emission housing systems. In addition, lower nutrient concentrations in the feed result in lower nutrient concentrations in the manure, and thus reduce the risks of ammonia emissions and nitrate and phosphate leaching. Feed with a low P concentration is expected to be introduced soon in the Netherlands as a result of agreements between farmers' unions and feed companies. However, currently no region has put these measures into practice. Furthermore, almost no regulations are set to restrict grazing *periods*, except for water protection zones in Luxembourg and some exceptions in Ireland. Restrictions are neither set for the *area* of grazing. Grazing restrictions mainly concern areas close to (protected) surface waters. In Baden-Württemberg grazing is completely restricted in some water protection zones and in the French regions restrictions only in place in certain areas close to water catchment sites. In Ireland grazing restrictions close to waters are exceptional. In contrast, in Northern Ireland it is even required to give animals free access to the land area at all times.

2.4 Fertilizer application regulations

Table 2.4 summarizes the application periods that are valid in each region and specifications on whether or not low-emission application methods or risk-avoidance measures are obliged.

Table 2.4 presents the most general application periods but it should be noted that many regions have exceptions in specific situations. In Luxembourg, for example, there are different application periods in water protection zones. These periods are mentioned in footnotes in Table 2.4. Regulations in France are complex, with different application periods for spring crops and autumn crops, different application periods in case a catch crop is grown after the spring crop, and exceptions are made for specific crops and areas. To be able to make a comparable summary in the table, only the application periods for spring crops have been entered, with a reference to the application periods for autumn crops below the table. Overviews of the application periods for solid manure, slurry and chemical fertilizer are given in Figures 2.4 A, B and C, respectively. These figures show the application periods for grassland in green (fertilizer application allowed) and red (not allowed). If the application period for grassland differs from that for other crops, such a different period for other crops is marked by an arrow. The periods specific for water protection areas are not included in these tables.

Table 2.4. Fertilizer application regulations (in NVZ). NA = not applicable.

	BF	BW	FB	FL	FN	GE	IN	IR	LU	NL
Allowed application period for:										
Solid manure (grassland)	16 Jan -14 Nov[3]	All year round		15 Jan -15 Dec		All year round[3]	1 Feb - 31 Oct	13/31 Jan -31 Oct	All year round [3, 8]	1 Feb - 1/15 Sept
Solid manure (other crops)	16 Jan -14 Nov[3]	All year round / not 1 July -15 Oct [7]		15 Jan - 30 June + 1 Sept - 15 Nov[5]		All year round[3]	1 Feb - 31 Oct	13/31 Jan -31 Oct	All year round [8]	1 Feb - 1 Sept or all year [3]
Slurry (grassland)	16 Feb - 31 Aug/ 14 Oct	15/31 Jan -15 Sept [7]	15 Jan - 15 Sept	15 Jan - 15 Dec	15 Jan - 15 Dec	1 Feb - 15 Nov[4]	1 Feb - 15 Oct	13/31 Jan -14 Oct	16 Feb - 14 Nov [8]	16 Feb - 31 Aug
Slurry (other crops)	16 Feb - 31 Aug/ 14 Oct	15 Feb -1 July/15 Oct [7]		1 Feb - 30 June [5]		1 Feb - 31 Oct[4]	1 Feb - 15 Oct	13/31 Jan -14 Oct	16 Feb - 14 Oct [8]	1 Feb - 31 July
Chem. fert. (grassland)	16 Feb - 31 Aug	1 Feb - 15 Sept	1 Feb - 31 Aug	1 Feb - 30 Sept	1 Feb - 31 Aug	1 Feb - 15 Nov[4]	1 Feb - 15 Sept	13/31 Jan -14 Sept	16 Feb - 14 Oct	1 Feb - 15 Sept
Chem. fert. (other crops)	16 Feb - 31 Aug	15 Feb - 15 Oct	16 Feb - 30 June [5]	1 Feb - 31 Aug [5]	16 Feb -30 June	1 Feb - 31 Oct[4]	1 Feb - 15 Sept	13/31 Jan -14 Sept	16 Feb - 14 Oct	1 Feb - 15 Sept
Application methods										
Emission-low application obliged? [2]	yes	no		no		yes	no	no	yes[6]	yes
Risk-avoidance regulations[1]										
Buffer zones to surface water needed? [9]										
- With grass (m.)	NA	NA		5-10		NA	2-250	1.5-200	3	NA
- For spreading fertilizer (m.)	5	6		5-500		1-3	2- 250	1.5-200	10	0.25-5
Maximum on one application of manure defined? [7]	no	no		no		no	yes	no	no [8]	no

[1] It is not allowed in any region to apply fertilizer on frozen or water-logged soils or when heavy rain is forecasted in the next 48 hours. In addition, most regions have a restriction for manure application on slopes: BF: on slopes >8%, BW: on slopes of >15%. IN: on steep slopes ≥ 20% (grassland) or ≥ 15% (other land). FR: on slopes of >7%. FL condition with buffer zone on slope >7%. In IN a risk assessment is required when there is a significant risk of water pollution because of soil conditions, proximity to a water course, the rate of fertilizer application, or the type of crop.

[2] This includes: direct or fast (within couple of hours) manure injection/incorporation in soil.

[3] GE and LU: exception for poultry manure. LU: no application from 16 Nov to 15 Feb for manure with low DM content DM. NL: application allowed whole year on clay and peat soils (for solid manure on other crops). BF: under derogation the application of solid manure is restricted between 16 Feb to 31 Aug.

[4] Outside this period application of fertilizers with a considerable amount of available nitrogen is forbidden (organic manure and chemical fertilizer).

[5] Given periods apply for spring crops. However, different application periods are allowed for autumn crops. When using *solid manure (other crops)* these periods are: 15 Jan - 15 Nov (in FL, sometimes only allowed until 1st of Nov). Extra rules for spring crops: application is only allowed if a catch crop is grown and in FL not allowed in sensitive area. When using *slurry (other crops)*: 1 Feb - 30 June (in FN until 1 Sept). Furthermore it is allowed in FB to fertilize until 30 Sept for rapeseed and in FL until 1 Oct or 1 Sept if it is

15 days before planting and with soil incorporation within 24h. For spring crops there are some extra rules for fertilization: this is not allowed on maize before 15 Feb (FB), it is allowed during the growing season of a catch crop (FB) or 15 days before planting of a catch crop until 1 Oct (FL) or 15 days before planting till 20 days before destruction of a catch crop (FN). When using *chemical fertilizers* no differentiation is made between spring and autumn crops for the application periods. In FB, an exception is made for rapeseed (may be fertilized until 31 Aug) and in FL in sensitive areas, where the allowed application period runs only until 30 June.

6 Low-emission application in LU: incorporation within 24 h on arable land, on grassland no incorporation needed, but other low-emission techniques.

7 Maximum amount in one application, taking into account the application norms. BW: for other crops than grassland, 80 kg organic N (solid manure or slurry) per ha is allowed between the 1st of July and the 15th of October, only if incorporated into the soil or before a catch crop. In grassland and in good climate conditions, 80 kg organic N per ha is allowed between the 16th and the 31st of January. IR: only for soiled water. IN: 50 m^3 per ha in 3 wks. GE: only in water protection areas 50-100 kg per ha in 3 wks. See footnote 8 for LU.

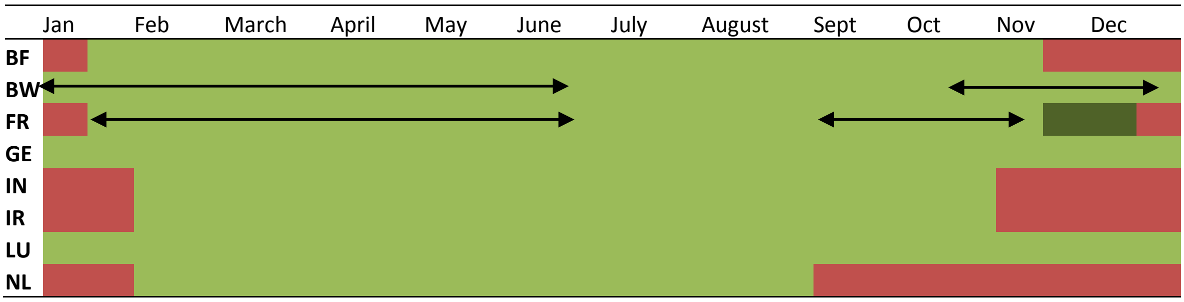
8 In Luxembourg different restriction periods are valid in WPAs. For solid manure on grassland: 1 Feb - 30 Sept, on other crops: 1 Feb - 30 Sept, for slurry on grassland: 1 March - 30 Sept, on other crops: 2 March - 31 July. In addition, maximum application rates are set in WPAs: 80 kg in total between 1 Aug - 1 Oct.

9 Ranges of buffer zones refer to different zones applicable for different cultures (e.g. grassland or maize).

As regards application methods, immediate or fast (within a couple of hours) manure injection/incorporation into the soil is not obligatory in any region except in the Netherlands, Flanders, Luxembourg and Baden-Württemberg. In the French regions, it is only required to extend the non-spreadable area near houses (in a perimeter of 100 m for slurry and 50 m for solid manure). In Luxembourg, incorporation within 24 h is required on arable land, whereas on grassland no incorporation is needed but other low emission techniques are required.

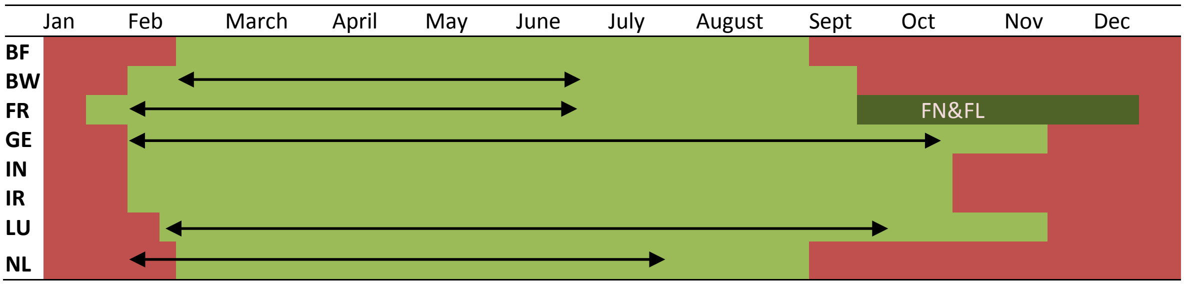
In addition to application periods and methods, other methods to avoid the risk of nutrient losses are regulated and include buffer strips near water courses where no crop should be grown or no fertilizer should be applied. Regions have different buffer zones for different crops (e.g. grassland or maize) resulting in a range (Table 2.4). Buffer zones with grass are required in each region except in the Netherlands, Baden-Württemberg and the Belgian regions. Buffer zones for manure spreading, however, are required in every region, with strips of 0.25 m in the Netherlands to 500 m in France. For all regions application of fertilizer is not permitted on frozen or water-logged soils or when heavy rain is forecasted in the next 48 hours. In addition, most regions have a restriction for manure application on slopes; in Flanders on slopes >8%, in Wallonia on slopes >15%, in Northern Ireland on steep slopes ≥ 20% (grassland) or ≥ 15% (other land), in France on slopes > 7% (in Pays de la Loire conditional with extra buffer zones on slopes >7%). In Northern Ireland a risk assessment is required when a significant risk of water pollution exists because of soil conditions, proximity to a water course, the rate of fertilizer application, or the type of crop. Finally, a maximum amount of fertilizer per time of application (taking into account the application norms) is set only in Northern Ireland (50 m^3 of manure per ha in 3 weeks). In Wallonia there is a limit only in specific periods: for arable crops: 80 kg organic N per ha, between the 1st of July and the 15th of October, with incorporation into the soil or before a catch crop, on grassland and under good climatic conditions: 80 kg organic N per ha between the 16th and the 31st of January. In Ireland maximum application rates are set only for soiled water, not for manure. In Baden-Württemberg, maximum manure application rates are set only for water protection areas: 50-100 kg per ha in 3 weeks.

Figure 2.4 A. Solid manure application periods on grassland and other crops (if different shown with: ⟷) (rules for WPAs are not included). Green period = spreading allowed, red period = not allowed.



Other crops: NL: for other crops on clay and peat soils spreading is allowed throughout the year FR: Given application periods are valid for spring crops only. It is compulsory to grow a catch crop. For autumn crops the application period is 15 Jan -15 Nov, see darker green period which is then excluded (FL until 1 Nov). BF: On derogation farms only allowed from 16 Feb until 31 Aug. BW: between 1 July and 15 October only allowed with a maximum of 80 kg N with incorporation into the soil or before a catch crop.

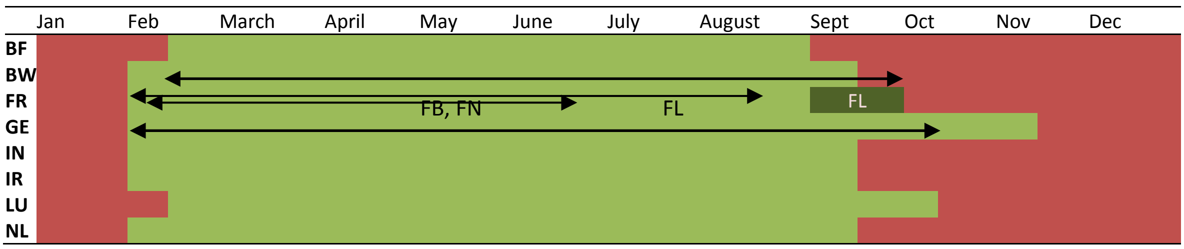
Figure 2.4 B. Slurry application periods on grassland and other crops (if different shown with: ⟷) (rules for WPAs are not included). Green period = spreading allowed, red period = not allowed.



Grassland. BF: longer period in Polders (until mid Oct). BW: Start period can be 15 January as well. IR: Start period can be 13 January as well.

Other crops. BF: longer period in Polders (until mid Oct). BW: between 1 July and 15 October it is allowed only with a maximum of 80 kg N with incorporation into the soil or before a catch crop. IR: Start of period can be 13 January as well. FR: Given periods apply for spring crops, and longer periods are possible if a catch crop is grown. For autumn crops the application period runs until 1 September in FN.

Figure 2.4 C. Mineral fertilizer application periods on grassland and other crops (shown with: ⟷ if different) (rules for WPAs are not included). Green period = spreading allowed, red period = not allowed.



IR: application period starts 13/31 January

Other crops. FR: Arrows indicate periods for spring crops and autumn crops. In FL application periods in sensitive areas only until 30 June.

2.5 Storage regulations

Using the manure production norms (Table 2.2) and the allowed application periods (Table 2.4) a farmer can calculate the required storage capacity. Nevertheless, a minimum is set to the storage capacity to make sure a farmer always has sufficient capacity (Table 2.5). The lowest storage capacity in terms of months of manure production is set at four months in France, Luxembourg and in some regions in Ireland. In France, however, farmers that are restricted from manure application for periods *longer* than four months, should adjust their storage capacity accordingly. The highest storage capacity of nine months is required in Flanders and, notably, also in some places in France and Luxembourg. In Ireland, the storage capacity depends on the location of the farm in the country and on rainfall; higher rainfall increases the risk of liquefaction of the soil when cattle graze, resulting in a longer time of cattle housing (see footnote 4 in Table 2.3) and a higher manure production.

Table 2.5. Storage regulations (in NVZ).

	BF	BW	FR	GE	IN	IR	LU	NL
Minimum storage capacity slurry (months)	6-9	6	4-9 [1]	6	5	4-5,5	4,6,9[2]	7
Roofed manure storage obliged?	yes[5]	no	no[4]	no	no[4]	no[4]	no	yes
Silage effluent collection obliged?	no[6]	yes	yes	yes	yes	yes	yes	yes
Field storage of solid manure allowed? [7]	yes	yes	yes	yes[3]	yes	yes	yes	yes
Field storage of silage camp allowed? [8]	yes	yes	yes	yes[3]	no	no	yes	yes
Soiled water (from manure storage, cleaning milking equipment, farm yard) storage obliged?	no	yes	yes	yes	yes[9]	yes	yes	yes

1 Storage periods depend on application periods (see table 2.4).

2 Depending on the respective legislation (especially the date of the investment in buildings is taken into account). In pig production 9 months are required. A farmer can get special payments for nine months storage.

3 Field storage of manure and silage only allowed if additional requirements, such as storage time, are fulfilled. Generally forbidden in water protection zone 1&2.

4 The uncovered storage capacity should, however, be able to accommodate rainfall.

5 Only required for liquid manure.

6 Only required for built silos, not required for silos put directly on the soil surface.

7 For a maximum of 1 month (BF), or 8 months and only for straw manure (BW), or 6-9 months (GE), or 120 days (IN), or 14 days (NL), or 2 years on the same place (LU). IR: no storage is allowed during application-restricted periods. FR: other conditions for field storage of manure, e.g. only allowed with a minimum distance to surface water, only if compact manure is used (at least 2 months after excretion by animals and with a high C/N ratio).

8 NL: except if no (percolation) fluids will be lost to the environment. IR: silage camps are not allowed, except with a concrete base and fluid collection tank. Silage bales are allowed, but only with a minimum of 25 meters distance to water surfaces. IN: Only silage bales may be stored in fields and these must be stored at least 10 m from a water course.

9 Storage required for the period when conditions for land application are unsuitable.

To prevent ammonia emissions and to capture rainfall, manure storages have to be covered in the Netherlands and Flanders but not in the other regions. In Ireland, Northern Ireland and France no cover is required, but it is obliged to keep a slurry store with a capacity for rainwater also. Silage effluent leaching has to be prevented in all regions, except in Flanders where silage silos on the soil surface do not need effluent collection. Field storage of solid manure is generally allowed in all regions, but there are always restrictions on storage duration (see footnote 7 in Table 2.5) except in France. In France field storage of solid manure is, however, restricted to the location in the field; no storage is permitted close to surface waters. Field storage of silage camps is allowed in all regions except in Northern Ireland and Ireland, where a silage camp is only allowed as long as it has a concrete base and a fluid collection tank. In these two regions, silage bales are allowed, but must be stored at least 25 m (Ireland) or 10 m (Northern Ireland) from surface waters. This is probably because in Ireland and Northern Ireland *wet* grass is cut and collected for silage, whereas in the other regions the silage is less moist which reduces the potential of effluent leaking. In the Netherlands field storage of silage is allowed as long as no percolation fluids are lost to the environment. Soiled water, e.g., originating from manure storage, cleaning milking equipment and farmyard has to be stored in all regions except in Flanders. In Northern Ireland soiled water has to be stored when conditions for land application are unsuitable.

2.6 Crop management regulations

Besides regulations for fertilization, manure storage and cattle management, each region has defined regulations for crop management (Table 2.6) to avoid unnecessary nutrient leaching risks due to poor management. These regulations mainly concern the permission to destruct grassland or catch crops, to fertilize destructed grassland and the obligation to grow a certain percentage of catch crops, growing in the winter period before sowing spring crops. For all regions, except Flanders and Northern Ireland, periods have been defined during which the destruction of grassland and catch crops is not allowed. Some details of the restrictions for Ireland, Luxembourg and Baden-Württemberg are mentioned in footnote 1 of Table 2.6. In Flanders and Northern Ireland restrictions only exist for farms with *derogation*: in Flanders grassland destruction is only allowed between the 15th of February and the 31st of May and in Northern Ireland grassland may only be ploughed in spring and must be followed by a crop with high nitrogen demand.

Table 2.6. Crop management regulations (in NVZ). ND = not defined.

	BF	BW	FR	GE	IN	IR	LU	NL
Restricted periods of grassland or catch crop destruction defined?[1]	no	yes	yes	yes	no	yes	No[4]	yes
Fertilization of destructed grassland permitted?[2]	yes	no	no	yes	yes	yes	yes	no
Obliged % of catch crops before spring crops[3]	0	75	100	0	0	0	0	100

[1] BF: grassland destruction only prohibited on derogated farms, except between 15th Feb and 31st May. IN: only restrictions for farms with derogation: temporary grassland can only be ploughed in spring and must be followed by a crop with a high N demand. LU: grassland fertilized with organic N between 15th Oct and 15th Feb cannot be ploughed before the 15th February; in WPAs: grassland fertilized with organic N between 1st Aug and 1st Oct can only be ploughed before the 1st Dec. GE: since 1.7.2011 it is generally forbidden to destruct permanent grassland. IR: not allowed to plough grassland between 16th of October and 30th of November, grassland ploughed between 1st July and 16th October must have a green cover from a *sown* crop by the 1st of Nov.

[2] BF: only prohibited on derogated farms, FR: only after calculating soil need, taking into account mineralization from the grassland. IR: only prohibited for derogated farms during restricted organic manure application periods, LU: in WPAs not allowed to fertilize with organic N, NL: only if soil analysis shows need.

[3] NL: not obligatory on clay and peat soils; BF: 100% for derogation fields with maize; IR: obliged to sow a catch crop if ploughed (see footnote 1), otherwise natural regeneration; GE: only obligatory in water protection areas; LU: farmers get a special payment for growing a catch crop, FR: except for clay soils under certain conditions and in FN and FL on flooded soils.

[4] LU: Farmers in special Agri-environmental programs have restricted periods for catch crop destruction

After destruction of grassland no fertilization is allowed in the Netherlands, Wallonia and Brittany. In the Netherlands destructed grassland may only be fertilized if soil analysis shows a need for fertilization. No restrictions on the fertilization of destructed grassland are in place in other regions, except in water protection areas in Luxembourg, in ZAC areas in Pays de la Loire and Nord Pas de Calais, and on derogation farms in Ireland during a certain period (see footnote 2 of Table 2.6). In France, fertilization is only permitted on the basis of a calculated soil requirement, in which mineralization from the destructed grassland has to be taken into account; this means that fertilization is generally not required.

Catch crops are only obligatory in the Netherlands (100% of land area, but not on clay or peat soils), Wallonia (75% of land area) and France (100% of land area, except on flooded soils (FN and FL) and clay soils under certain conditions). However, there is a requirement to have 100% of the land area covered with catch crops in Flanders on derogation fields with maize and in Baden-Württemberg in water protection areas. In Luxembourg farmers are encouraged by a financial compensation to grow a catch crop. In Northern Ireland and Ireland there are no obligations to grow a catch crop before spring crops, except in Ireland when the land has been ploughed. Arable crops are hardly grown on dairy farms in Northern Ireland and Ireland, which explains the lower priority set on this regulation.

2.7 Administrative regulations

Restrictions require monitoring systems. These systems often result in a lot of administrative work, part of which has to be done by the farmers themselves. A limited overview of the administrative obligations of farmers in NVZ is given in Table 2.7. Differences between farmers with derogation and farmers without derogation are pointed out for the regions in which derogation is allowed. Large differences exist between regions.

Soil sampling for N and P concentrations is only required in Flanders and Baden-Württemberg. In Flanders, however, only organic matter and pH need to be sampled but on farms with derogation more analyses are required. In France, sampling is only required for certain ‘classified’ farms. In the Netherlands and Ireland farmers may sample for P content to avoid being classified into the highest soil index which considerably restricts P fertilization. Similarly, farmers in Northern Ireland have to sample their soils for P status if they want to apply chemical P fertilizers. In Luxembourg farmers only have to sample their soil if they get a payment for good land maintenance. In fact 95% of the farmers are putting this into practice! In Wallonia farmers do not have to determine the soil nutrient status themselves, as the state checks a random 3% of the farms each year before the leaching period in autumn. If farmers exceed the allowed amount of residual nitrate in the soil, they remain under surveillance and risk a fine if no improvement is seen in subsequent years. In addition, in all regions with derogation, farms with derogation are required to regularly sample their soils for N and/or P concentrations.

A fertilization plan is only required in France, Ireland, the Netherlands, and Luxembourg. In Flanders such a plan is only necessary for farms with a high soil nitrate residue in autumn. In Luxembourg it is required only for farms with more than 8,500 kg organic N or for farms that import more than 500 kg organic N per year. In Wallonia a fertilization plan is only necessary in cases of bad management (high residual nitrate levels). A fertilization plan is always required in regions where farmers can apply for derogation.

Records of fertilization or cropping sequences or N & P balance sheets are necessary in all regions, except in Flanders, Wallonia and Northern Ireland. But in Flanders such records are obligatory for farms with a high soil nitrate residue in autumn. In Baden-Württemberg this requirement applies for farms with a certain level of fertilization/production; a nutrient balance sheet is, e.g., not needed if all parcels are fertilized in an extensive way (less than 50 kg N/ha or 30 kg P_2O_5/ha). In regions where farmers can apply for derogation, fertilization, cropping sequences or N&P balance sheets must always be recorded.

In half of the regions (Baden-Württemberg, Northern Ireland, Ireland and Luxembourg) farmers are required to make a risk assessment for steep slopes. In the regions where this is not required, it is neither required for derogation farms. Import or export of manure must always be recorded, except in Luxembourg where this is only necessary on farms with an excretion of more than 8500 kg organic N or on farms that import more than 500 kg organic N per year. With some exceptions, none of the regions require farmers to submit their fertilization plans or records to the government for inspection (see Table 2.7). In a small part of Pays de la Loire, however, farmers can do this, and 99% of them actually do. For derogation farmers this is required in Baden-Württemberg, Northern Ireland and Ireland.

Table 2.7. Administrative and other obligations (in NVZ). NA = not applicable.

	BF	BW	FR	GE	IN	IR	LU	NL
Regular soil sampling obliged? [1]	yes	no	no	yes	no	no	no	no
Derogation [2]	*yes*	*NA*	*NA*	*yes*	*yes*	*yes*	*NA*	*yes*
Fertilization plan obliged? [3]	no	no	yes	no[10]	no	yes	yes	yes
Derogation	*yes*	*NA*	*NA*	*yes*	*yes*	*yes*	*NA*	*yes*
Records of fertilization/cropping or N & P balance sheet obliged?	no[4]	no	yes	yes[4]	no	yes	yes	yes
Derogation	*yes*	*NA*	*NA*	*yes*	*yes*	*yes*	*NA*	*yes*
Risk assessment for steep slopes obliged?	no	no	no[9]	yes[5]	yes	yes	yes	no
Derogation	*no*	*NA*	*NA*	*yes*	*yes*	*yes*	*NA*	*no*
Records of import or export of manure obliged?	yes	yes	yes	yes	yes	yes	yes[3]	yes
Derogation	*yes*	*NA*	*NA*	*yes*	*yes*	*yes*	*NA*	*yes*
Requirement to submit plans and/or records to government?	no[4]	no	no[8]	no	no	no[7]	no	no
Derogation	*no*	*NA*	*NA*	*yes*	*yes*[6]	*yes*[7]	*NA*	*no*

1 NL and IR: optional for P (if no test the highest index is assumed, which restricts P use), BF: only organic matter and pH. BW: a random 3% of the farmers is checked each year before autumn by the state, IN: only necessary if farmer wants to apply mineral phosphorus fertilizer. LU: obligatory for farms that receive payment for good maintenance of the land (95% of farms applied for this extra payment). FR: only for “classified farms”.

2 NL: soil sampling obliged for N and P. IR: soil sampling only obliged for P, not for N. IN: every 4 years for Pstatus only, and at least 3 months after the application of P-containing fertilizers. BF: for farm with derogation more analyses are required than organic matter and pH only.

3 only obligatory BF: for farms with a high soil nitrate residue in autumn, LU: on farms with more than 8500 kg organic N or on farms that import more than 500 kg organic N per year, BW: in case of bad management (high results).

4 BF: only obligatory for farms with a high soil nitrate residue in autumn, GE: applies to farms of certain criteria of fertilization/production level.

5 GE: establishment of a soil erosion register required since 1.7.2010 (in the framework of cross compliance). Depending on classification of the plot, farmers have to observe regulations concerning restricted ploughing.

6 Fertilization accounts on derogated farms should be prepared and submitted to Government Regulators (NIEA) each year before the 2nd of March for the previous calendar year.

7 For derogation farms: must be completed and submitted before March each year. Non-derogation farms: submission not required but must be available for inspection at any time.

8 In a small part of Pays de la Loire the farmers can voluntarily submit the plans; 99% is actually doing this.

9 Under the 5th Action Program (September 2013), however, obligatory for certain farms for phosphorous application.

10 Assessment of fertilization requirements required: “Düngebedarfsermittlung”.

2.8 Discussion

The above comparison of regulations shows that regulations are implemented in very region-specific ways. The resulting regulations are difficult to compare due to the high diversity and complexity. The reasons for the diversity are not always clear. Diversity can inspire, which can lead to improvement of the next Action Program of an EU Member State. The question is whether or not more standardization of the regulations, norms and limits between and within regions is required? Standardization means easier comparison and control but it also assumes (especially for manure production norms and fertilizer application limits) comparable farm circumstances and performances, and this is not the actual situation. More standardization would lead to norms or limits that are either too high or too low for a specific farm. The target should be to make regulations as farm-specific as possible (within boundaries: administrative costs, controllability, etc.).

Appendix 1

Attractive options to strenghen rural sustainability and to improve environmental regulations: the opinions of stakeholders

During a conference in Ghent, on 24 and 25 October 2012, about 140 stakeholders from the DAIRYMAN regions were informed - through plenary presentations - about 1) facts and figures regarding rural sustainability of the regions, and 2) implementation of EU Environmental Directives.
Next, ten discussion groups were formed to exchange ideas about attractive options for improvement. Each group discussed one statement/question provided by the DAIRYMAN staff and was asked to formulate no more than three opinions/answers. Two parallel groups were dealing with the same statement/question. Each group representative presented the results during the following plenary session (50 minutes). The opinions/answers of the two groups dealing with the same statement/question were combined to a maximum of five. Finally, each of the 140 participants of the conference ranked her or his preferences by voting.

The results are presented below. The statement/questions that were discussed by both parallel groups is presented first. This is followed by a listing of the opinions/answers ranked by importance, where the answer considered to be most important by the voting audience (highest percentage) is given first.

The names of the stakeholders who participated in the conference are given in Appendix 2.

Attractive strategies to strengthen rural sustainability in dairy regions

1.	**How to face milk price volatility and the increase of costs (land, feeds, fertilisers and labour) and how to get income stability?**	
a.	Reducing costs of purchased feed and fertilisers by training farmers in resource management	38%
b.	Encouraging the cooperation of dairy farming with other rural stakeholders, like arable farmers	28%
c.	Developing new income (biomethanization, solar energy, recreation)	18%
d.	Encouraging the communication between producer and society	16%

2.	**On the mid-long term (next 25 years) the main problem of dairy farming in Northwest Europe is:**	
a.	Profitability of dairying	29%
b.	Combining high productivity with environmental standards	22%
c.	Access to land	20%
d.	Quality of legislation quality (instability, conflicts)	16%
e.	Attractiveness of dairy farming for young people (successors)	13%

3.	**The intensification (high input-high output) of the dairy production systems in Europe is questionable:**	
a.	Yes, because related high energy costs will increase costs of feeds and fuels	26%
b.	Yes, because we should focus on increasing efficiency (more output with equal input)	22%
c.	No adequate answer possible	20%
d.	No, but farm specific constraints (like vulnerability for nitrate leaching) should be taken into account and can limit intensification	19%
e.	Yes, because intensive farming is hard to sell to the customer	14%

4.	**Improvements most needed to improve resource utilisation of dairy farms, are:**	
a.	Improvement of the management skills of the farmer	28%
b.	Farming stronger grass based	28%
c.	Improvement of manure quality and manure management, inducing the effectiveness as fertilizer	17%
d.	Genetic improvements of animals and plants	16%
e.	Improvement of stables and manure/feed storage facilities, to reduce losses	10%

5.	**Should direct payments (subsidies) be made dependent on the environmental performances of individual farms (efficient resource use, reduction of nutrient losses, C-storage, biodiversity, etc.)?**	
a.	Yes, to improve the efficiency of resource utilization with good management and new technology	28%
b.	Yes, but with a simplified system	21%
c.	No, because farmers will not be able to maintain sufficient income	19%
d.	Yes, it is better to subsidy good results than to put penalties on bad results	19%
e.	Yes, because it stimulates the quality of environment	14%

Attractive options to improve the cost-effectiveness or robustness of regulations in dairy regions

1.	**In the near future, environmental legislation should put more emphasis on:**	
a.	Measurable environmental results and less on means (dictated measures)	27%
b.	Farm-specific elements, like mineral balances with soil-specific limits of surpluses	24%
c.	Stable and less restrictive legislation	18%
d.	Payments for excellent environmental performances	16%
e.	Risk-assessment on farm level (manure storage capacity)	14%

2.	**A standard limit of 170 kg/ha of organic N doesn't make sense if we look at the diversity between and within regions. Is it possible to develop a common method that details the limit for a region or farm, taking into account yields, application method, crops, soils etc.?**	
a.	Yes, based on a farm-gate balance, taking into account yield and soil-productivity of farm or region	37%
b.	Yes, by splitting in a simple way, for instance into grassland and arable land	23%
c.	Yes, because different countries have different situations	14%
d.	Yes, between a and b	14%
e.	No, one common limit is easy to control	12%

3.	**Fertilizer application standards for grassland and fodder crops can be improved by:**	
a.	Using a farm nutrient plan (soil analysis P, crop history, manure application and timing and predicted crop yield)	24%
b.	Taking into account variety in soil types and climates	24%
c.	Making them better understandable for farmers	22%
d.	Harmonization of principles of nutrient planning across the member states but with regional flexibility	18%
e.	Taking into account crop needs and the possibility to grow a catch crop (late harvesting does not always allow)	13%

4.	**Most important regulations to improve (re)cycling of nutrients on a dairy farm are:**	
a.	Education is always more important than regulations	29%
b.	Nutrient balance on farm-gate level will lead to good management	26%
c.	The timing of manure applications (more important than techniques)	21%
d.	Increased storage capacity for manure	18%
e.	Restricted grazing periods	7%

5.	**How to support farmers to implement new environmental rules?**	
a.	By research, advice and education	24%
b.	By payments/ subsidies	21%
c.	Increase awareness of environmental issues and take enough time for communication	8%
d.	Consult dairy farmers before defining rules	18%
e.	By stimulating exchange of knowledge and experiences between farmers	18%

Appendix 2

List of participants for the stakeholder meeting of 24 and 25 October 2012

Name	Profession/position	Organisation
Belgium Flanders		
Dirk Van Oevelen	Sustainability Manager/milk supply officer	Belgian Confederation of the Dairy Industry (BCZ-CBL)
Guy Van de Poel	Research service Boerenbond	Farmers Union (Boerenbond)
Diane Schoonhoven	Advisor	Farmers Union (Boerenbond)
Karoline D'Haene	Coordinator	Research and Extension Advisory Board on Sustainable Fertilisation
Isabelle Magnus	Policy maker	Ministry of Agriculture and Fisheries – Flemish Government
Eddy Decaesteker	Dairy farm advisor, subpartner Dairyman	Inagro – Farm Advisory service Dairy (BAM)
Els Stevens	Dairyman	Hooibeekhoeve – Dairyman KTC Flanders
Geert Buysse	Dairyman pilot farmer	
Jo Bijttebier	Assistant coordinator Dairyman Flanders	Institute for Agriculture and Fisheries Research
Lies Debruyne	Coordinator Dairyman Flanders	Institute for Agriculture and Fisheries Research
Belgium Wallonia		
Charles Hendrickx	involved in the implementation of the Nitrate Directive	SPW
Joseph Flaba	involved in communication around agriculture	DGARNE Direction Générale Agriculture, Ressources naturelles et Environnement
Benoit Georges	involved in communication around agriculture	DGARNE Direction Générale Agriculture, Ressources naturelles et Environnement
Frédérique Huppin	advicer for farmers about nitrogen management	Nitrawal
Aurélie Grignard	assistent coordinator DAIRYMAN	CRA-W (Walloon Agricultural Research Centre)
Sylvain Hennart	assistent coordinator DAIRYMAN	CRA-W (Walloon Agricultural Research Centre)
Daniel Jacquet	adviser for farmers	AWE (Association Wallone de l'Elevage)
Didier Stilmant	Coordinator DAIRYMAN	CRA-W (Walloon Agricultural Research Centre)
Patrick Mayeres	adviser for farmers	AWE (Association Wallone de l'Elevage)
Christophe Vandenberghe	involved in the implementation of the Nitrate Directive	University of Liege/Luik
Emilien Vincent	involved in communication around agriculture	CRA-W (Walloon Agricultural Research Centre)
France Brittany		
Pauline Defrance	Staff member DAIRYMAN	Chamber of Agriculture - Brittany
Rémi Espinasse	Staff member DAIRYMAN	Chamber of Agriculture - Brittany
Elisabeth Congy	Staff member DAIRYMAN	Chamber of Agriculture - Brittany
Alain Hindré	elected dairy farmer for CRAB	Farmer / Chamber of Agriculture - Brittany
Jean-Pierre Le Bihan	elected farmer for CRAB specialized on environment	Farmer / Chamber of Agriculture - Brittany
André Sergent	Elected farmer for CRAB	Farmer / Chamber of Agriculture - Brittany
France, Pays de la Loire		
Fernand PINEAU	Regional Administration of agriculture and forest	Direction régionale de l'agriculture, de l'agroalimentaire et de la forêt des Pays de la Loire
Denis GERE	Dairy industry	Fromageries Perreault
Pascal GALLARD	Dairy farmer - Regional Farmer Union	Chambre d'agriculture du Maine-et-loire
Christophe SABLE	Elected dairy farmer for region	Chambre d'agriculture de Loire-Atlantique

Name	Profession/position	Organisation
Estelle PELLETIER	CRAPdL	Chambre régionale d'agriculture des Pays de la Loire
Sarah PETIARD-COLOMBIE	CRAPdL	Chambre régionale d'agriculture des Pays de la Loire
France, Nord – Pas de Calais		
Dominique Dericbourg	Farmer representative in CA	Chambre d'Agriculture de région du Nord-Pas de Calais
Julien Dugué	DRAAF (government administration)	DRAAF
Adeline Screve	Conseil régional	Conseil Régional Nord Pas de Calais
Philippe Carteaux	Farmer representative	Chambre d'Agriculture de région du Nord-Pas de Calais
Fabrice Riquier	Manager of dairy department in CA	Chambre d'Agriculture de région du Nord-Pas de Calais
Pierrick Boulan		Chambre d'Agriculture de région du Nord-Pas de Calais
Elisabeth Castellan	Coordinator Dairyman	Chambre d'Agriculture de région du Nord-Pas de Calais
Philippe Duez	Producer representative	CRIEL (interprofessional regional committee for dairy economics)
France		
Emmanuel Beguin	Project manager at French livestock Institute	French livestock Institute (Idele)
Marie Thérèse Bonneau	Administrator at FNPL (national federation of dairy farmers - Farmers union)	French dairy farmers federation (FNPL)
Philippe Jannot	In charge of the natural resources and agriculture	Minister of sustainable development and environment (France)
Luc Delaby	Researcher at INRA (French National Institute for Agricultural Research)	French National Institute for Agricultural Research (INRA)
Sylvain Foray	Project manager at French livestock Institute	French livestock Institute (Idele)
Claire Le Grand	Advisor at FNPL (national federation of dairy farmers - Farmers union)	French dairy farmers federation – Farmers union (FNPL)
Elise Lorinquer	Project manager at French livestock Institute	French livestock Institute (Idele)
André Le Gall	Manager at French livestock Institute	French livestock Institute (Idele)
Germany		
Helga Pfleiderer	Ministry of rural development and consumer protection	MLR Stuttgart (Ministerium für Ländlichen Raum und Verbraucherschutz Baden-Württemberg)
Alfred Weidele	Breeding organisation	RBW (Rinderunion Baden-Württemberg)
Karl Baisch	Dairy industry	Milchwerke Schaben e.G.
Franz Käppeler	Farmers' union	BLHV (Badischer Landwirtschaftlicher Hauptverband e. V.)
Gerhard Bronner	Nature conservation	LNV (Landesnaturschutzverband Baden-Württemberg)
Thomas Eib	Advisor	Landwirtschaftlicher Beratungsdienst Milchviehhaltung Ravensburg e.V.
Alexander Fuchs	Pilot farmer	
Klaus Fischerkeller	Pilot farmer	
Franz Schweizer	Director of LAZBW	Landwirtschaftlichen Zentrums für Rinderhaltung, Grünlandwirtschaft, Milchwirtschaft, Wild und Fischerei Baden-Württemberg (LAZBW)
Martin Elsäßer	Dairyman project leader in Baden-Württemberg	LAZBW
Thomas Jilg	Scientific manager of Dairyman in Baden-Württemberg	LAZBW
North Ireland		
Brian Ervine	Head of Environmental Policy, Department of Agriculture and Rural Development (DARD); involved in implementation of the Nitrates Directive	Department of Agriculture and Rural Development (DARD)
Sinclair Mayne	Departmental Scientific Advisor to DARD	Department of Agriculture and Rural Development (DARD)
Andrew Addison	Chairman of Dairy Committee	Ulster Farmers Union (UFU)

Name	Profession/position	Organisation
Jonathan Moore	Vice Chairman of Dairy Committee, and a practicing dairy farmer	Ulster Farmers Union (UFU)
Ian McCluggage	Head of Dairy and Pig Development Branch	College of Agriculture, Food and Rural Enterprise (CAFRE)
Martin Mulholland	Senior Dairying Technologist CAFRE – involved with technology transfer to farmers and students aimed at improving the economics and sustainability of dairy enterprises	College of Agriculture, Food and Rural Enterprise (CAFRE)
Thomas Steele	Pilot dairy farmer in DAIRYMAN – 400 cow herd	Rowreagh Farm
John Bailey	UK coordinator for DAIRYMAN – Soil scientist working on nutrient management and researching ways of addressing N and P overuse problems on farms	Agri-Food and Biosciences Institute (AFBI)
Ireland		
James Humphreys	Dairyman research	Teagasc
Andy Boland	Dairyman extension	Teagasc
Cathal Moran	Dairyman farmer	
Harold Kingston	Farmer, chairman of the Environment & Rural Affairs Committee	Irish Farmers Association (IFA)
Pat Duggan	Policy maker	Department of Environment, Community and Local Government
Ger Shortle	Works on Catchments Programme	Teagasc
Eimear Ruane	Works on Cantogether	Teagasc
Jack Nolan	Policy maker	Department of Agriculture, Food and the Marine
Patrick Rohan	Farmer, chairperson of Farm Services & Environment Committee	Irish Creamery Milk Suppliers Association (ICMSA).
Paddy Barrett	Carbery Group, sustainability program	Carbery Group
Luxemburg		
Pascal Pelt	Policy Maker	Ministery of Agriculture, Viticulture, and Rural Development *-Department Agriculture and Environnment*
Simone Marx	Policy Maker	Ministery of Agriculture, Viticulture, and Rural Development *-Department Soil and Mapping*
Claude Hermes	Advisor	Ministery of Agriculture, Viticulture, and Rural Development *-Department Economics*
Simone Adam	Advisor	Ministery of Agriculture, Viticulture, and Rural Development *-Department Economics*
Claude Neuberg	Policy Maker	National Water Administration- Luxembourg Ministry of Internal Affairs)
Steve Turmes	Advisor	CONVIS- Breeding and advisor Organisation
Nico Kass	Dairy Farmer	Agricultural Chamber of Luxembourg
Marco Koeune	Dairy Farmer	
Henri Kohnen	Teacher	Lycée Technique Agricole
Jeff Boonen	Dairyman -Research	Lycée Technique Agricole
Claude Felten	Teacher	Lycée Technique Agricole
Louis Boonen	Farmer	CONVIS- Breeding and advisor Organisation

The Netherlands		
Machtelt Meijer	Senior policy advisor environmental legislation agriculture	Ministry of Economy, Agriculture and Innovation
Douwe Jonkers	Senior policy advisor watermanagement	Ministry of Infrastructure and Environment
Wiebren van Stralen	Senior advisor environment/livestock	Farmers union LTO-Nederland
Jaap Petraeus	Manager Corporate Environment & Sustainability	Friesland Campina
Geert Wilms	Secretary LIB	LIB= farmers union ZLTO/province Brabant
Peter Hoeks	Dairy farmer	Farmers union ZLTO
Jos de Kleijne	Pilot dairy farmer	Farmers union LTO Nederland
Paul Witlox	Coordinator reseach	PZ =Dutch dairy board
Paul van Enckevort	Senior policy advisor agriculture	Province of Noord-Brabant
Jeanet Brandsma	Chairman board NL-pilot farm network /dairy farmer	Farmers union LTO Nederland
Michel de Haan	Manager NL-pilot farm network	Wageningen UR Livestock Research
Maria de Vries	Assistent coördinator DAIRYMAN	Wageningen UR Plant Research International
Frans Aarts	Coördinator DAIRYMAN	Wageningen UR Plant Research International
Jouke Oenema	Researcher DAIRYMAN	Wageningen UR Plant Research International
Irene Gosselink	Secretary DAIRYMAN	Wageningen UR Plant Research International
Eddy Teenstra	Communication manager DAIRYMAN	Wageningen UR, Communication Services

Within DAIRYMAN 14 partners cooperate:

Wageningen University (lead partner), Netherlands
Plant Research International , Netherlands
Wageningen UR Livestock Research, Netherlands
Teagasc, Ireland
Agri-Food and Bioscience Institute (AFBI), United Kingdom (Northern Ireland)
Institut de l'Elevage, France
Chambre Régional d'Agriculture de Bretagne, France
Chambre Régional des Pays de la Loire, France
Chambre Régional d'Agriculture du Nord -Pas de Calais, France
ILVO, Belgium (Flanders)
Hooibeekhoeve (Province of Antwerp), Belgium (Flanders)
CRA-W, Belgium (Wallonia)
LAZBW Aulendorf, Germany
Lycée Technique Agricole, Luxembourg