Final report for

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THE ENVIRONMENTAL IMPACT OF DAIRY PRODUCTION IN THE EU: PRACTICAL OPTIONS FOR THE IMPROVEMENT OF THE ENVIRONMENTAL IMPACT

FINAL REPORT

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S1. Executive summary

S1.1. Objectives and methodology

This report explores the environmental impact of dairy farming in the EU and aims to provide technical advice (to DG Environment) on practical suggestions which could be easily monitored on how to reduce or eliminate any identified negative environmental effects of dairy farming. It also aims to contribute to the public debate about the environmental impact of dairy production.

The study was undertaken primarily as a desk research exercise. However, some additional interviews and discussions were held with some farm advisers, farmers, farmers' representative organisations, government officials and researchers.

S1.2. Typology for examining the environmental impact

A typology was developed to provide a framework for examining the environmental impact of dairy farming and for setting priorities for environmental enhancement. This essentially differentiates systems according to the way in which farmland is managed combining economic/technical classification criteria (see section 2), bio-geographical region and forage and fodder resources (see section 3). Using these three dimensions, all dairy farm in the EU have been allocated to one of ten broad dairy systems by reference to threshold values of some key indicators such as fertiliser use, concentrate use, farm size, herd size, milk yield, livestock density and main winter fodder used (see section 4).

Overall, the typology groups together dairy farms into systems according to environmental impact and their relative importance to dairy production (section 5). This identifies three main groupings of systems:

- those for which the biggest environmental issues are negative impacts on the environment. This includes four systems which account for most of the EU's dairy farms and where approximately 80% of dairy cows and 84% of milk production occur;
- four systems which have either a largely neutral effect on the environment or for which information is lacking. These represent dairy farms where 12% of EU milk is produced and 13% of dairy cows are kept;
- two ecologically valuable systems for which the continuation of dairy farming is the principal issue but which account for only 6% and 8% respectively of EU milk production and dairy cows.

EU dairy farming is restricted to a relatively few, rather limited geographical areas (see sections 2 & 3). Within these, the systems tend to focus on output maximisation and are more influenced by market constraints than physical constraints. As a result, farms of different dairy systems frequently occur contiguous with each other. For instance, conventional mixed systems can occur next to organic mixed systems, intensive grassland systems or maize silage systems.

S1.3. Trends in EU dairy systems and the environmental implications

a) Trends (see section 2)

In general, dairying in the EU is becoming more intensive and more specialised (see section 2, notably sub-section 2.4 which illustrates general declines in cow numbers, increases in average herd size and average yield per cow). This means that production is concentrating on fewer, larger farms (eg, 40% of EU dairy cows are in herds of at least 50 head) resulting in a corresponding decrease of dairy farming on many holdings and in some cases abandonment of holdings. This is true for virtually all dairy farms irrespective of system or bio-geographical region; noting that 85% of EU milk production is derived from one high input/output (see section 2) economic/technical class of dairy farming, except where national authorities actively seek to help maintain small producers or promote organic production (eg, Austria), such as some in mountain areas (P1 and G3 systems). The primary driving force behind these trends is economic. However, the economic framework is itself heavily influenced by the nature of the support regime (largely price support), technology development and structural change in the production sector (plus structural change in the up and downstream supply chain). The complex interaction of these factors makes disaggregating their respective (separate) impact virtually impossible.

b) Environmental implications (see section 5)

For all dairy systems described, largely negative environmental issues increase with increasing intensity of production (which is itself an underlying and major feature of EU dairy production: see section 2). Associated with the intensive dairy systems are high stocking rates, high use of chemical fertilisers and pesticides and mechanised methods (see section 2). These result in problems of direct point source pollution, diffuse pollution and pressure on marginal habitats and landscape features (see section 5 for further detail). More specifically:

- landscape and habitat: since some of Europe's dairy landscapes are grazing mediated systems whose structure and function are determined by the free-ranging movement of locally adapted stock, the effect of this process has been colonisation of meadows by scrub and woodland, loss of open grassland and field boundaries and degradation of hydro geological systems (see sub-section 5.3.2);
- biodiversity (see sub-section 5.3.3): the effect of dairying on biodiversity is far from straightforward, and includes the development of invasive herbs and loss of grassland diversity due to the increased use of fertiliser (particularly N&K), silage production, reduced grazing and scrub encroachment. While some intensively managed grassland, is of strategic importance to migrating and wintering wildfowl, large-scale changes in the intensity of use in traditional farmed areas seem to be associated with a loss of both complexity and stability. This effect is particularly significant in river-based and mixed Mediterranean systems;
- soil (see sub-section 5.3.4): the main impact is on soil integrity which is affected by increased use of fertilisers, feed additives and the more concentrated use of waste products like manure. As intensification increases, the level of application of fertilisers and manures usually rises to levels that are greater than crop requirements or the ability of the soil to retain them. Where these nutrients are relatively immobile or have limited water solubility this may result in the soil changing its essential character. Intensive production systems also make fairly widespread use of feed additives, medicines and growth promoters. Little is known about the impact of these on the environment, however: feed concentrates contain phytotoxic heavy metals such as copper (Cu), zinc (Zn) and cadmium (Cd) which accumulate in the soil and vet medicines persist in dung, affecting its fauna and potentially the

dependant bird populations. Also, high stocking rates may result in increased incidence of trampling and subsequent erosion;

- water (see sub-section 5.3.5): the primary impact is via the pollution of groundwater with nitrates and pesticides and surface water eutrophicated (eg, the guide level of nitrate concentration (25 mg/l) is exceeded in the groundwater under 85% of the EU's farmland). The full extent of surface and groundwater pollution due to farming (both in general and more specifically to dairying) is however largely unquantified;
- air (see sub-section 5.3.6): the impact of dairying on the atmosphere arises from de-nitrification, the production of, methane, ammonia volatilisation and carbon dioxide. Whilst methane generation per animal tends to be higher in low input systems than in the more intensively managed systems that use feed supplements, ammonia emissions are highest for intensively managed systems (these occur during manure storage and application to arable and grassland). In terms of carbon dioxide and nitrous oxide emissions, dairy production has only an indirect impact (mainly the use of energy to manufacture feed concentrates and to assist forage production as well as housing systems).

Overall, it is important to recognise that many of the complex relationships between intensive dairy systems and the environmental impact are not fully understood. In low input/output, transhumant and mountain grassland systems, the main issue is one of abandonment of dairying leading to scrub development or commercial forestry, loss of biodiversity and changes in landscape character. In the more intensive systems that dominate dairy production, the main issues are nutrient contamination of soil, groundwater pollution, surface water eutrophication and ammonia emissions.

S1.4. Future policy perspective and implications (see section 6)

The underlying policy perspective for dairy farming over the next few years is derived from the existing dairy regime coupled with some aspects of reform initiated by Agenda 2000. The main possible impacts of the (Agenda 2000) reforms on dairy production systems (section 6) are, however, likely to be limited and will largely not be implemented until 2005. This means that in the medium term the ways in which the dairy regime impacts on dairy production systems and on the environment is unlikely to be subject to significant change.

Where change can reasonably be expected to occur (post 2005) it mainly relates to the impact of lower milk prices, lower levels of gross farm revenue and ultimately lower income from dairy farming. In the main milk producing regions of the Community (northern countries and the Atlantic bio-geographical region), lower returns coupled with improved competitiveness of cereals as a feed ration is likely to make silage feeding relatively less attractive as a feeding alternative. To the extent that this may result in a shift away from silage feeding to cereal feeding, this is likely to result in higher levels of phosphorus and nitrogen output, increased eutrophication of water courses, possible increases in erosion and greater emissions of ammonia.

The recent policy changes do, however, introduce some scope for introducing positive environmental aspects into dairy husbandry systems via the implementation of the national envelope component of the direct payment, use of the horizontal and rural development regulations and continued adaptation of '2078' measures.

S1.5. Success to date of 'neutrality and enhancement' measures

Assessing the impact of measures targeting environmental neutrality or positive environmental benefits on dairy production has proved very difficult although it is probable that the impact has been limited (see section 7). In many cases this reflects the voluntary nature of measures offering environmental neutrality (eg, Codes of Good Agricultural Practice) or encouraging environmental enhancement ('2078' measures) although the targeting of almost all measures at environmental media rather than specific farming sectors also makes assessment of impact on dairying very difficult. The measures under 2078/92 do, however, provide a range of examples whereby livestock production in general (and therefore, by implication, dairy production in particular) may be made more environmentally friendly.

In general the two approaches, neutrality or enhancement, tend to be linked to two different types of location or region. The main features of each are:

- Neutrality measures, although universal to all areas, these tend to have the greatest impact in regions where particular environmental problems exist. For example, in the more northerly Member States, the Nitrates Directive largely replaced and incorporated existing national legislation. In contrast, in Greece, legislation to combat nitrate loss was only adopted to meet EU requirements. The most 'forward' examples of measures being taken to address the pollution problems can be perhaps drawn from in the Netherlands and Denmark. In both, pollution problems from intensive agriculture (mostly dairy farming and pig farming) have been an important target for many years and measures adopted to address the problem are widely perceived to have been reasonably successful. It should, however be noted that the problems remaining to-date in the Netherlands are considerable and the degree of compulsion in delivering reduced nutrient surpluses at the farm level only apply to about half of all Dutch farms. This contrasts with Denmark where mandatory controls apply to almost all farms. An important additional conclusion that can be drawn is that the success of measures to reduce environmental impact through voluntary codes and legislation depends as much on the awareness of the issues by farmers as on the design of the actions.

- Enhancement (2078/92) measures tend to be focused on more marginal areas which are characterised by relatively lower levels of intensity and include remote and/or mountainous areas. Here dairy farming is usually widespread, but comprises smaller scale producers in bio-geographical regions such as Alpine and parts of the Mediterranean, Continental, Boreal and Atlantic regions where mixed farming systems dominate. Overall, the current '2078' measures most likely to offer environmental benefits through the dairy regime are the grassland management measures. At a general level, restrictions on the use of inputs have led to environmental benefits in terms of reductions in phosphorus levels in surface water and reductions in nitrate levels in surface and groundwater. Reductions in fertiliser use have also resulted in a potential for increased biodiversity (section 7). However, whilst these positive environmental attributes have been delivered it is difficult to attribute specifics to changes in dairy production.

S1.6. The main environmental issues and practical options for addressing them (see section 8)

The limited impact of environmental policies and agri-environmental (2078) on EU dairy farming mainly reflects the technical and economic relationships that dominate in most of the dairy systems. For most systems the nature of markets and the dairy support regime provides a fairly strong incentive to produce milk within a high input/output system in which reasonably high levels of fertiliser (eg, 300kg+ N/ha) are applied. As a result, most dairy farms have a relatively low level of biological diversity associated with marginal habitats and are linked to environmental problems relating to excess nutrient losses and significant diffuse pollution to air and water.

Any measures that might be used through Agenda 2000 policy changes (for example, by reducing nitrogen use on a large scale) would, most probably, impose a substantial cost to farmers (and in turn to the taxpayer if compensation or incentive payments were made). It would also, in most systems, probably have limited success in improving biological diversity due to the inherent high fertility and stored nutrients in most dairy pastures. It would, however, be more appropriate to use such measures in systems where the fertility of pastures is relatively low and there remains floristic diversity.

The most important and widespread environmental issues that affect all systems relate to the polluting effects of nutrient and chemical losses into soil, water and air. The second major issue, although affecting a relatively small proportion of dairy farms and only a few geographical areas, relates to the decline of dairy systems that are associated with farmland of high biodiversity. A secondary, but widespread, issue to these two environmental issues is the preservation of marginal habitats and landscape features which are characteristic of the dairy farming landscape.

S1.6.1. Common Market Organisations: dairy and beef

There are very limited possibilities within the milk and dairy products and beef and veal sectors to directly address these issues. The main measure, that could provide a small disincentive to further intensification of dairy farming, is the way that additional payments are paid by Member States through their national envelope allocation. However, in most cases this is likely to simply be paid as a top-up to the Dairy Cow Premium.

S1.6.2. The Horizontal Regulation

This regulation potentially offers the greatest opportunities for directly addressing any negative environmental impacts of EU dairying (and other agricultural) systems by attaching ‘appropriate environmental measures’ to agricultural land and agricultural production which are subject to direct payments.

In order to suggest options which are practical and have a reasonable chance of successful delivery, we have focused on generic actions which can be applied widely and fairly to all dairy farms. The primary aim of the environmental controls proposed is to contribute to ‘sustainable’ farming and for most of the dairy systems this has as its starting point a better understanding of sustainable nutrient management. Both the Dutch and the Danish ministries recognised this need several years ago because of the high intensity of their dairy farms and the excessive nitrate losses to water and to air and approached the problem through the Farm Nutrient Balance (FNB). Accordingly, we suggest that the first step in the introduction of conditionality on direct payments to dairy farmers should be measures to bring about the better management of nutrients, waste and water.

The adoption of these nutrient, waste and water requirements offers the following attractions:

- contributes to providing information about environmental impact: helping to define better the issues and identify appropriate actions;

- provides potential economic benefits to the farmer through scope for achieving more efficient use of inputs. It also offers flexibility and leaves choice of actions to the farmer's discretion;
- can offer practical benefits to farmers and contribute to improving understanding and perceptions about the environmental impact of dairy farming systems;
- national authorities may be more receptive to the imposition of conditions that can be seen to affect all EU farmers;
- they offer scope for being cost effective ways of encouraging changes in farming practices;
- provides for a basic practical measure, which could be monitored, to show that direct payments to dairy farmers are linked to one of the fundamental requirements for moving towards a more sustainable European agriculture. This could also provide a foundation on which to build further tiers of conditionality (if required) in the future;
- could help in the development of guidelines for good farming practice that incorporates good environmental practice and environmental enhancement.

S1.6.3. Rural Development Regulation

a) Less Favoured Areas

If the use of nutrient and water budgets and waste management plans became a minimum environmental condition in the dairy sector it could be included as a condition in LFAs for receiving supplementary payments.

b) Agri-environment (2078 type measures)

Actions under this measure to delivery environmental enhancement could include a range of actions (best practice) which protect and improve the environment. As there are budgetary constraints on the scope for using such measures, our suggestions are limited to (generic) schemes for the biologically most diverse systems and to areas where dairy farming is associated with interest of high nature value. Best practice is most effectively introduced through a combination of raised awareness (the FNB and training) and the provision of structural support required to introduce more sustainable techniques (see below). One exception is conversion to organic production. In the dairy sector, virtually all of the systems would benefit from organic conversion because of the limits on fertiliser use and stocking density that would be required. It would bring a degree of extensification into most systems and meet one of the explicit objectives of agri-environment requirements (Article 22). In the same vein we have only suggested specific management incentives for the low input/output systems where the conservation of a 'high nature-value farmed environment is under threat' (of abandonment).

c) Farm structures

The provisions for support for investment in agricultural holdings provides an important link between the nutrient and water budgets, the identification of better environmental practice and the ability to take actions to achieve improvement. For some systems (eg, transhumant) where facilities are often out dated and below modern hygiene standards there are possibilities for structural support which could help to keep these dairy farms in business.

d) Training

Training and advice will have an important role to play in delivering environmental improvements. This starts with providing farmers with an improved appreciation of the benefits of sustainable production systems and about the adverse environmental impact of some commonly used practices.

As such, the Rural Development Regulation could be used to provide training (and advice) which would enable dairy farmers to maximise the information they obtain on their nutrient balances. With a better understanding of the issues affecting their farm, they would be in a better position to choose the most appropriate elements of good environmental practice and environmental enhancement to adopt. Training could also be used to increase awareness of the possibilities for structural support and other options relating to marketing, diversification and organic conversion.

S1.7. Potential for greater benefits in future from new (or better targeted) options (see sections 8 & 9)

A summary of targeted, practical actions that are recommended for delivering environmental improvements in the dairy sector are as follows:

- introduce some element of cross-compliance via the introduction of the Farm Nutrient Balance (FNB) across all dairy farms together with requirements to do water budgets and waste management plans;
- use the nutrient balances as a starting point for targeting appropriate actions to move management practices beyond "usual good-farming practice" and towards what is considered to be good environmental practices. Using farm waste management plans some elements of better environmental practice can be introduced into dairy systems across Europe, especially the more intensive systems. Precedents in this area have already been set for example in Denmark. Specific requirements (cross compliance) for including as part of GAP are also suggested in Section 8 for reducing nutrient leakage from soils, ammonia emissions and pesticide use/emissions. Cost implications: these are extremely difficult to estimate as they will vary by farm. In the Netherlands the average cost per farm (in a region experiencing severe nitrate pollution problems) of complying with targets was estimated to be about 25,000 (equal to about 15-20% of income[1]) including the introduction of some capital changes such as increased manure storage capacity. This probably contributed to the limited imposition of mandatory controls to-date in the Netherlands where until 2002, only farms with stocking densities in excess of 2.5 LU/ha are subject to mandatory controls (ie, about half the national herd). In contrast, in Denmark, mandatory controls apply to all farms, although here average stocking densities are only about 0.9 LU/ha and the global nature of pollution problems are less intense (and hence less costly to address) than in the Netherlands. This highlights the importance of initiating FNBs before drawing up prescriptions for improving the environment and implementing parallel measures via, for example, the rural development and horizontal regulations (eg, provision of capital grants, subsidised finance/loans) to assist farmers in addressing the environmental problems rather than simply imposing controls and expecting the associated costs to be covered from existing economic activity;
- use the FNB to introduce greater flexibility in agri-environmental schemes and for providing flexibility to farmers in how they achieve better environmental practices (eg, timing and methods of application of manure, slurry and fertiliser). The cost implications here are also variable at the farm level (see above) and difficult to forecast. However, by providing flexibility it offers scope for delivering good value for money from an EU budget perspective if dairy farmers are encouraged to and can choose options that suit them (contributes to overcoming perceptions of compulsion and offers possible practical benefits);

[1] Source: Charter (1998) Farmers and custodians of water resources. Nuffield Farm Scholarship Trust, Maresfield.

- use agri-environment measures to target dairy systems of high biodiversity, especially those in danger of abandonment. The cost implications are also very difficult to assess. However, as high biodiversity dairy systems represent a very small minority of total EU dairy farms and are confined to fairly small bio-geographical regions, the cost implications are unlikely to be significant and can probably be reasonably easily incorporated within existing '2078' measures and budgets;
- support the above measures with specific training and use of advisory services to raise the level of awareness of the agriculture/environment interactions on dairy farms. Cost implications here are also difficult to assess. The provision of training and advisory services is an area in which a wide range of levels of expenditure probably occur across different member states. In some, the public sector (ie, national or regional authorities) dominate provision and funding is from a central source whilst in some other countries, there is greater degree of private sector involvement and hence fee charging. Either way it is likely that the provision of additional environmental awareness training could be reasonably easily be incorporated within existing extension service provisions that are mainly funded centrally. More in depth analysis of the ways in which the Dutch and Danish system operates might usefully be undertaken;
- provide financial support to dairy farmers required to make one off/capital style investments to comply with requirements (eg, increased manure storage capacity). This is particularly important in the more remote regions (LFAs) where marginal producers are increasingly leaving the sector. The cost implications are similar to those discussed above relating to measures required to fulfil FNB targets. Further examination of the Dutch system might usefully be undertaken;
- encourage the establishment of system-specific priorities to highlight where controls rather than enhancement type actions are more important. These could be undertaken at a regional or national level as part of the process of drawing up frameworks or plans for specific regions and associated rural development measures.

1. Introduction

The integration of environmental concerns into Community policies, including agriculture is now of increasing importance especially with the reinforcing of the Treaty of Rome by the new Treaty of Amsterdam and the adoption of the Agenda 2000 reforms. Within this context, Directorate-General Environment of the European Commission requested a study to provide technical advice on the environmental impact of dairy farming in the EU.

This document presents the findings of this study. The views set out and analysis presented are those of the authors and do not necessarily represent the views of the Commission in general or of the Environment Directorate General.

1.1. Objectives

The main aim of the study is to improve DG Environment's technical knowledge of EU dairy farming and its impact on the environment. The study also has the aim of contributing to the public debate about the environmental impact of dairy production and how to address resulting 'problems' where adverse impact may arise. It was to cover the following key elements:

- Provide a short but concise description of dairy production systems throughout the EU (including herd sizes, yields, farm numbers, geographical location, types of production systems). This was also to include consideration of likely future trends taking into account Agenda 2000.
- Provide a comprehensive and detailed description of the environmental impact (problems and benefits) of dairy farming in the EU. This was to entail an examination of several different systems and intensities of production with particular reference to land use and feed inputs and include impacts on soil, air, water, bio-diversity and landscape.
- Produce a series of detailed, practical suggestions which could be easily monitored of how to reduce or eliminate any identified negative environmental effects of dairy farming. These were to be relevant to the sector and costed, where possible. Particular emphasis was to be placed on low cost and easy to monitor options and on measures that go beyond usual good-farming practice.

1.2. Methodology

The study was undertaken primarily as a desk research (literature review and analysis) exercise. However, some additional interviews and discussions were held with some farm advisers, farmers, farmers representative organisations, government officials and researcher. In the latter case these were mainly with some of the authors of literature reviewed in the course of the study. More specifically:

- discussions were held with relevant officials within departments of DG Environment and DG Agriculture;
- reviewing a wide range of documents, including reports and information held by the Commission, Member State governments, independent research institutes, academics, consultants, independent associations and agri-environment interest groups. These include analyses and evaluations of different agri-environmental schemes;
- drawing on the existing specific knowledge, research experience and analysis undertaken by the contractors;

- a selection of telephone, e-mail and some personal interviews with a selected number of key organisations involved in implementing agri-environmental schemes in some key Member States, representatives of farmer organisations and environmental groups (farmers unions, conservation advisory groups/NGOs), some farmers, advisory services and research bodies/academic institutes.

1.3. Report structure

The report comprises nine main sections, the structure of which was agreed in advance with DG Environment. It comprises the following:

Part one

- Section two briefly reviews dairy production in Europe and covers baseline production data, the main production regions and provides an outline economic and technical classification;
- Section three gives a description of dairying in the main agro-environmental zones in the EU;
- Section four provides an environmental classification of dairy systems;
- Section five presents information identified to date (or where available) on the main trends and environmental issues;
- Section six briefly considers the potential impact of the Agenda 2000 policy changes agreed;

Part two

- Section seven examines existing measures and provisions for neutrality and enhancement across EU agriculture and its applicability to dairy farming;
- Section 8 explores practical options for delivering improved neutrality and enhancement, specifically in relation to dairying and the Agenda 2000 policy changes
- Lastly, Section 9 provides the study conclusions.

PART1: DAIRY SYSTEM CLASSIFICATIONS AND ENVIRONMENTAL IMPACT

2. A review of dairy production in Europe

This section covers the following aspects:

- base production data;
- an overview of the main production regions;
- a brief classification of dairy systems from a technical and economic perspective.

2.1. Production base data

a) Cattle and cow numbers

Table 2.1 shows the evolution of suckler, dairy and total cow numbers for the EU between 1985 and 1997[2].

Table 2.1: Suckler, dairy and total cow numbers (1984, 1992 and 1997)

'000 head									
	Suckler cows			**Dairy cows**			**Total cows**		
	1984	**1992**	**1997**	**1984**	**1992**	**1997**	**1984**	**1992**	**1997**
Belgium	175[1]	460	502	1,065[1]	751	642	1,240[1]	1,211	1,144
Denmark	59	119	117	951	708	695	1,010	827	812
Germany	152	482	703	5,684	5,382	5,026	5,836	5,864	5,729
Greece	145	102	96	222	205	182	367	307	278
Spain	761	1,275	1,657	1,889	1,490	1,279	2,650	2,765	2,936
France	3,062	3,912	4,098	6,926	4,685	4,476	9,988	8,597	8,574
Ireland	435	911	1,137	1,642	1,262	1,268	2,077	2,173	2,406
Italy	764	700	691	2,925	2,443	2,088	3,689	3,143	2,779
Luxembourg	With Be	26	30	With Be	51	47	With Be	77	77
Netherlands	0	94	80	2,584	1,821	1,674	2,584	1,915	1,754
Austria	n/a	n/a	213	n/a	842[2]	678	n/a	n/a	891
Portugal	195	236	289	355	381	362	550	617	651
Finland	n/a	n/a	32	n/a	426[2]	383	n/a	n/a	415
Sweden	n/a	n/a	162	n/a	506[2]	462	n/a	n/a	624
UK	1,351	1,731	1,873	3,281	2,747	2,498	4,632	4,478	4,372
EU-12	6,721	10,049	11,274	27,524	21,686	20,237	34,623	31,974	31,512
EU-15			11,681		23,460	21,760			33,442

Notes:
1. Includes Luxembourg
2. EU Commission estimates
Source: Eurostat

Key points relating to cow numbers are:

- France had the greatest number of cows in the EU in 1997 (26% of the EU total), followed by Germany (17%) and the UK (13%). However, Germany had the largest number of dairy cows in 1997 (23% of the EU total), followed by France (21%) and the UK (12%). France had by far the greatest proportion of suckler cows in 1997 (35% of the EU total), followed by the UK (16%) and Spain (14%);
- Luxembourg had the smallest number of cows in 1997 (0.2%), followed by Greece (0.8%). Luxembourg and Greece also accounted for the smallest proportion of dairy cows (0.2% and 0.8%

[2] 1997 is the latest available data covering all EU member states (source: Eurostat).

respectively) whilst Luxembourg and Finland had the smallest proportion of suckler cows (0.2% each);

- total cow numbers decreased by 3.4% between 1984 and 1997, despite the accession of Austria, Finland and Sweden. Total cow numbers declined from 34.623 million head to 31.512 million head (9.0%) if these Member States are discounted;
- numbers of total cows declined in most Member States between 1984 and 1997, most notably in the Netherlands (32%), Italy (25%) and Greece (24%). Increases occurred in Portugal (18%) and Ireland (16%);
- numbers of dairy cows also declined between 1984 and 1997. The largest decreases occurred in Belgium (40%), France (35%), the Netherlands (35%), Spain (32%) and Italy (29%). Dairy cow numbers in the EU as a whole declined by 26% for the EU-12 between 1984 and 1997 from 27.524 million head to 21.760 million head and by 7% between 1992 and 1997 for the EU-15;
- the number of suckler cows in the EU-12 increased by 68% between 1984 and 1997, however, there were significant variations between Member States. The largest increases took place in the Netherlands (0 to 80,000 head) and Germany (363%), although this includes reunification, Belgium (187%) and Ireland (161%). The largest decreases occurred in Greece (34%) and Italy (10%).

b) Herd size and structure

In relation to the average size of dairy herds across Europe (Table 2.2) the most noticeable features and trends are:

- the average herd size in the EU increased by 74% between 1984 and 1997;
- the UK has the largest average herd size, nearly 1.6 times that of the Netherlands (the Member State with the next largest average herd size) and nearly three times greater than the 1997 EU average;
- the smallest average herd sizes are found in Portugal, Greece and Austria;
- all Member States recorded an increase in average herd size between 1984 and 1997. The largest increases took place in Germany, Italy and Greece, and the smallest increases occurred in the Netherlands, Luxembourg and the UK.

Table 2.2: Average dairy herd size (1984, 1991, 1995 and 1997)

	1984	1991	1995	1997	% increase 84-97
Belgium	21.1	27.8	31.5	32.3	53%
Denmark	28.4	39.8[2]	42.8	50.8	79%
Germany	15.1[4]	17.3	26.7	27.9	85%
Greece	3.1[6]	4.6	6.4	7.7	148%
Spain	6.1[7]	8.2	10.8	11.9	95%
France	18.4	27.3[1]	29.5	30.7	67%
Ireland	17.8[5]	24.6	30.2	32.4	82%
Italy	7.2[5]	12.9	18.7	20.5	185%
Luxembourg	29.3	31.3[1]	34.1	36.5	24%
Netherlands	42.3	41.2[1]	44.0	44.0	4%
Austria	N/A	N/A	7.8	8.4	-
Portugal	3.2[7]	3.9	4.2	5.2	62%
Finland	N/A	N/A	12.4	13.3	-
Sweden	N/A	N/A	27.2	29.6	-
UK	58.2	63.1	71.6	68.8	18%
EU-15 (weighted average)	**13.8[3]**	**18.5[3]**	**22.6**	**24.0**	**74%**

Notes:
1. 1992 2. 1993 3. EU-12 4. Former West Germany
5. 1983 6. 1983 estimate for all cows 7. 1985
Source: Eurostat

Table 2.3 and Table 2.4 summarise important cross sectional data relating to the distribution and structure of the EU dairy herd drawn from the latest available structural survey of the sector. The main features are as follows:

- more than 40% of the EU dairy cow population is kept in herds of at least 50 head. Nearly 50% of UK dairy cows are kept in herds of at least 100 head, double the number of dairy cows in Italy, its nearest rival, and three times the EU average;
- Denmark, Italy, the Netherlands and the UK all have at least half of their dairy cows in herds of 50 head or more;
- more than half the dairy cows in Greece, Austria, Portugal and Finland are kept in herds with less than 20 head;
- more than half the dairy cows in France, Luxembourg and Sweden are kept in herds of between 20 and 49 head;
- the majority of EU dairy herds are relatively small with more than 60% comprising 19 or less dairy cows;
- there are large differences in the distribution of dairy herd size according to Member States. More than a third of all herds in Denmark, the Netherlands and the UK comprise more than 50 dairy cows. The UK has the greatest number of herds in the largest size category, more than three times as many as its nearest rival Denmark;
- more than a third of all herds in Greece, Spain, Italy, Austria, Portugal and Finland have less than 10 dairy cows;
- more than half of all Portuguese dairy holdings and just under half of all Greek holdings have less than 3 cows. Nearly 70% of Austrian dairy farms have less than 10 dairy cows.

Table 2.3: Percentage distribution of dairy cows by herd size (1995)

	Size group (number of dairy cows)						
	1-2	**3-9**	**10-19**	**20-29**	**30-49**	**50-99**	**100+**
Belgium	0.1	1.9	9.3	16.0	33.6	34.6	4.5
Denmark	0.1	0.6	2.9	7.9	28.0	47.0	13.4
Germany[1]	0.5	4.9	15.1	18.8	24.5	16.9	19.3
Greece	10.4	28.0	20.8	11.7	13.1	10.7	5.4
Spain	4.0	17.8	27.4	11.5	18.1	11.1	10.2
France	0.2	1.7	9.8	18.8	40.2	26.2	3.1
Ireland	0.3	2.3	10.5	15.5	30.3	30.6	10.5
Italy	1.6	10.4	12.9	10.8	14.3	25.3	24.7
Luxembourg	0.1	0.5	4.5	14.8	54.8	23.1	2.2
Netherlands	0.2	0.9	3.2	6.7	25.5	50.4	13.1
Austria	3.4	37.5	43.9	11.5	3.2	0.5	..
Portugal	17.7	28.8	19.4	9.5	8.2	10.6	5.8
Finland[2]	0.4	19.3	59.1	17.7	2.9	0.4	0.2
Sweden	2.7		14.8	23.3	32.2	20.0	7.1
UK	0.1	0.3	1.3	3.1	11.1	35.7	48.3
EU-15	**7.1**		**12.9**	**13.9**	**24.5**	**25.5**	**16.1**

Notes:
1. 1994
2. 1990
Source: Eurostat

Table 2.4: Structure of dairy cow holdings (1995)

	Structure of dairy farms							Total number of farms ('000)
	1-2	**3-9**	**10-19**	**20-29**	**30-49**	**50-99**	**100+**	
	Percentage of holders per size class							
Belgium	3.2	9.5	20.5	20.9	27.7	17.3	1.4	22.0
Denmark	4.3	5.5	8.5	14.0	30.5	30.5	6.7	16.4
Germany	7.9	20.7	26.6	19.8	16.7	6.8	1.6	209.4
Greece	45.7	37.1	10.4	3.2	2.5	1.1	0.4	28.0
Spain	31.4	34.9	20.9	5.2	5.2	1.7	0.5	114.6
France	4.2	8.4	20.0	22.5	31.8	12.3	0.8	158.6
Ireland	5.5	11.2	22.6	19.5	24.3	14.5	2.4	42.0
Italy	19.3	37.5	17.8	8.7	7.2	6.7	2.8	113.2
Luxembourg	3.6	3.6	7.1	21.4	50.0	14.3	0.0	1.4
Netherlands	5.0	7.0	9.7	12.0	28.4	33.4	4.5	40.1
Austria	17.1	52.3	26.0	4.0	0.8	0.1	0.0	90.7
Portugal	58.7	31.2	5.7	1.2	2.3	0.8	0.1	85.7
Finland[1]	3.4	34.0	52.2	9.3	0.9	0.0	0.0	32.4
Sweden	13.0		27.1	26.6	23.7	8.5	1.1	17.7
UK	3.0	3.8	6.0	9.3	20.2	35.7	22.1	36.7
EU-15	**41.3**		**20.5**	**12.8**	**14.7**	**8.7**	**2.1**	**1,008.9**

Notes:
1. 1990
Source: Eurostat

c) Milk yields, quotas and production

Table 2.5 shows the average annual milk yield in kg/head between 1992 and 1997 across the EU and highlights the following features:

- milk yields per cow have increased steadily in every Member State between 1985 (or 1992 where 1985 information is not available) and 1997;
- the highest average annual milk yields are recorded in Sweden (7.2 tonnes/head), Denmark (6.6 tonnes/head), the Netherlands (6.5 tonnes/head) and Finland (6.4 tonnes/head);

- the lowest milk yields per cow are in Greece (4.0 tonnes/head), Ireland (4.2 tonnes/head) and Austria (4.6 tonnes/head);
- the largest increases in yield occurred in Italy (48%), Spain (41%) and Greece (33%) and the smallest increases between 1985 and 1997 took place in Ireland (13%), Denmark (22%) and the UK (23%).

Table 2.5: Average milk yield (kg/head)

	Average yield (kg/head)					
	1985	1992	1995	1996	1997	% increase 1985-1997
Belgium	3,850	4,409	4,688	4,994	5,005	30.0
Denmark	5,379	6,173	6,517	6,576	6,573	22.2
Germany	4,599	4,970	5,428	5,504	5,711	24.2
Greece	2,946	3,416	4,366	4,081	4,066[1]	38.0
Spain	3,322	4,052	4,579	4,714	4,668[1]	40.5
France	3,967	5,096	5,343	5,369	5,411	36.4
Ireland	3,751	4,159	4,217	4,319	4,232[1]	12.8
Italy	3,365	4,067	4,844	5,139	4,988	48.2
Luxembourg	4,239	5,000	5,482	5,542	5,660[1]	33.5
Netherlands	5,151	5,795	6,429	6,198	6,524[1]	26.7
Austria	N/A	3,750[1]	3,886	4,291	4,558	21.5[3]
Portugal	N/A	4,355	4,783	4,904	5,011	15.1[3]
Finland	N/A	5,667[1]	5,975	6,047	6,431	13.5[3]
Sweden	N/A	6,301[1]	6,569	6,894	7,216	14.5[3]
UK	4,855	5,137	5,345	5,611	5,958	22.7
EU-15	**4,291[2]**	**4,877**	**5,279**	**5,396**	**5,513[1]**	**13.0[3]**

Note:
1. 1992 figures for Austria, Finland and Sweden are EU Commission estimates
2. EU-10
3. Percentage increase 1992-1997
Source: Eurostat

Table 2.6 shows milk quota and production across the EU between 1985/86 and 1998/99 and highlights the following key features:

- quota has been adjusted since its introduction, but has remained unchanged from 1995/1996. Milk production in the EU-12 has fallen by 7% since quotas were introduced;
- Germany is currently the largest holder of quota (and therefore also producer of milk) with 24% of the EU-15 total. France and the UK hold the next largest proportions of quota with 21% and 12% respectively;
- Luxembourg is the smallest holder of quota with 0.2% of the total, followed by Greece and Portugal with 0.5% and 1.6% respectively;
- it is not possible to comment on the change in milk quota since its inception at the EU-15 level due to data unavailability. However, quota has increased by 1.5% for the EU-10 between 1985/86 and 1998/99. The largest increase in quota occurred in Germany as a result of reunification (18%). Increases also took place in Greece (8%) and Spain (10% between 1990/91 and 1998/99). The largest decreases in quota occurred in Denmark and France (both 9%), Belgium, Luxembourg, the Netherlands and the UK (all 8%);
- although milk production has decreased at the EU-12 level, this masks considerable differences at the Member State level. The greatest decreases in production took place in Belgium (15%), France

(14%) and the Netherlands and Denmark (13% each). Milk production increased by 56% in Portugal and 6% in Germany, although this has been influenced by reunification.

Table 2.6: Milk quotas and total production ('000 tonnes) by Member State (1985/86-1998/99)

	1985/86		1990/91		1995/96[3]		1998/99[4]	
	Quota	Production[2]	Quota	Production[2]	Quota	Production[2]	Quota	Production
Austria	n/a	n/a	n/a	n/a	2,749	3,034	2,749	2,749
Belgium	3,611	3,918	3,364	3,543	3,310	3,416	3,310	3,311
Denmark	4,883	5,111	4,525	4,640	4,455	4,695	4,455	4,456
Finland	n/a	n/a	n/a	n/a	2,394	2,431	2,394	2,394
France	26,508	28,074	24,613	25,759	24,236	25,084	24,236	24,156
Germany	23,553[1]	26,350	21,927[1]	29,063	27,865	28,779	27,865	27,865
Greece	583	648	581	711	631	755	631	631
Ireland	5,599	5,614	5,301	5,338	5,246	5,472	5,246	5,246
Italy	9,914	10,660	9,220	10,982	9,930	10,690	9,930	9,930
Luxembourg	291	299	272	265	269	266	269	269
Netherlands	12,074	12,695	11,213	11,047	11,074	11,013	11,074	11,075
Portugal	n/a	1,201	n/a	1,737	1,872	1,785	1,872	1,872
Spain	n/a	6,115	5,079	7,100	5,567	6,038	5,567	5,567
Sweden	n/a	n/a	n/a	n/a	3,303	3,316	3,303	3,303
UK	15,790	16,235	14,789	14,770	14,590	14,763	14,590	14,591
EU-15	**102,806[5]**	**116,920[6]**	**100,884[7]**	**114,955[6]**	**117,491**	**121,537**	**117,491**	**117,415**

Notes:

1 Excluding former East Germany.

2 Production figures are recorded in calendar years. We have presented 1986, 1991 and 1996.

3 Production figures are Commission estimates with the exception of Luxembourg.

4 Production figures are as at July 1998, the most recent available figures.

5 EU-10.

6 EU-12.

7 EU-10 plus Spain.

Source: CAP Monitor, EUROSTAT

In sum, the tables above show the following key points:

- there has been a clear intensification of dairy production in the EU since 1985. The number of dairy cows has decreased across the EU (declining in all Member States) whilst the average herd size in all countries has increased;
- average yield per cow has increased markedly in all Member States while total production across the EU has only decreased marginally (the nature of the quota system has effectively constrained global EU production levels since the mid 1980s);
- forty per cent of EU dairy cows are in herds of at least 50 head. This suggests that EU dairying is a fairly intensive activity (has become and continues to be more intensive) carried out on fairly specialised (dairy) farms;
- overall EU dairy production has become and continues to follow a trend towards increased intensification on a smaller number of larger, more specialised production units. The primary factors of influence driving these trends are probably the nature of the support regime (largely price support) and the associated economic and technical implications for production systems. For all producers this effectively focuses attention on producing a clearly defined maximum output level (quota determined) at the lowest possible cost. For the producers that account for the majority of EU production this has resulted in maximising production output per cow via intensification and the use of high input: high output systems. These issues are discussed further in the sub-sections below;

- there are nevertheless a large number of registered dairy cow holdings with relatively low levels of cow numbers. For example, 40% of dairy cow holdings have 9 or less cows. This highlights a 'long tail' in the structure of production whereby a majority of total dairy holdings are relatively small in terms of cow numbers and contribution to total EU production. These farms are probably less specialised than those accounting for the majority of production with dairying being one of a number of enterprises (mainly other livestock enterprises) undertaken. However, to these farms dairying as an activity remains an important part of total economic activity. This issue is explored in more detail in the sub-sections below.

2.2. Main production regions

In sub-section 2.1 above base production data for the EU dairy sector was presented at the EU Member State level. It highlighted some significant differences between some Member States and regions which account for the majority of the EU's dairy cows and herds and where production is concentrated. Of particular note is that about 60% of the total dairy herd and cow numbers occur in four countries - Germany, France, Italy and Spain[3].

However, moving the consideration of the EU dairy sector on from a Member State level to a regional basis, it should be noted that about half of the EU's milk production comes from just 10 regions (van Eck et al, 1996), of which the most important are the 8 regions of Asturias, Lower Normandy, Brittany, the Netherlands, Lower Saxony, Denmark, Ireland and west England. These can be found in the agri-environmental or bio-geographical region known as Atlantic (Table 2.7).

Table 2.7: Distribution of dairy cows and milk production by agri-environmental or bio-geographical region

Bio-geographical region	Total dairy cows ('000 head)	Percentage of total	Total milk production ('000 tonnes)	Percentage of total
Atlantic lowlands	12,205	54%	63,634	56%
Continental	6,890	31%	32,881	29%
Alpine	1,014	5%	4,630	4%
Mediterranean	1,462	7%	5,958	5%
Boreal	799	4%	5,587	5%
Macronesian	95	0%	382	0%
Total	**22,464**		**113,021**	

Notes:
1. Milk production = milk delivered to dairies
2. 1995 data used as base: latest available to Nuts 2 level held by Eurostat on dairy cows.
Source: Eurostat base, CEAS Consultants estimates

Table 2.7 highlights the dominance of the Atlantic region in terms of dairy production; with the Continental region it accounts for 85% of both dairy cows and production of milk.

2.3. Economic and technical classification of dairy farming

Whilst the above sub-section introduces a classification of dairy production in the EU according to reasonably distinct bio-geographical and agri-environmental perspectives, it is also possible to classify dairy production systems from an economic and technical perspective. Inevitably this produces some overlap

[3] Also highlighted in Entec (1997).

with the bio-geographical and agri-environmental classification (this issue is examined further in subsequent sub-sections). However, a technical and economic classification provides some insights into dairy systems that are not necessarily apparent from a bio-geographical region basis alone. Accordingly this study provides both (this sub-section and section 3), before combining them in section 4.

In general, EU dairy production can be broadly broken down into four main economic/technical systems, although there still remains significant variation within each system. These are outlined below. Their contribution and importance to dairy production are summarised in Table 2.8. This highlights the dominance of high input/output systems which account for 83% of dairy cows and 85% of milk production. The reader should note that features only are outlined in this sub-section, with supporting data relating to the key indicators presented in Section 4[4].

Table 2.8: Distribution of dairy cows and milk production by economic and technical systems

Economic and technical system	Total dairy cows ('000 head)	Percentage of total	Total milk production ('000 tonnes)	Percentage of total
High input/output	18,549	83%	96,235	85%
Low input/output	1,439	6%	6,198	5%
Mountain	1,014	5%	4,630	4%
Mediterranean	1,462	7%	5,958	5%
Total	**22,464**		**113,021**	

Notes:
1. Milk production = milk delivered to dairies
2. 1995 data used as base: latest available to Nuts 2 level held by Eurostat on dairy cows.
Source: Eurostat base, CEAS estimates

2.3.1. High input/output system s

a) Locations. The Netherlands, England, SW Scotland, La Mayenne region of France, Western and SW France, Northern Italy, Sweden, Finland, Northern Spain, Denmark, Germany.
b) Production. These systems account for 83% of total EU dairy cow numbers (about 18.5 million head) and approximately 85% of total EU milk production (about 96 million tonnes).
c) Structure. They are characterised by having relatively large average herd sizes (eg, over 70 cows in the UK, but within a range that falls to about 44 cows (the Netherlands). These systems are also where most specialist dairy farms are found (data deficiencies preclude the provision of supporting data).
d) Intensity. Stocking rates tend to be high (eg, over 2.0 LU/ha/year but can be as low as 1.4 LU/ha/year), supported by relatively intense fertilisation (150kg N/ha to 300kg N/ha), use of buffer feeds (zero grazed grass (eg, former East Germany), maize silage and brewers grains are commonly used: eg, maize silage accounting for over 25% of the main fodder area) and use of concentrates which are usually fed to yield in the milking parlour (especially in the 'industrial' production systems of East Germany). Winter feed tends to consist predominantly of maize silage, although grass silage is used in regions such as Finland and Sweden where the climate is not suited to growing maize. Winter feed is supplemented with products such as cereals, brewers grain and wet beet pulp fed as straights or via concentrates.
e) Calving. Tends be all year round with a slight bias towards spring in certain countries, such as the Netherlands, in order to maximise the use of peak grass growth in spring and to match peak milk

[4] To avoid undue repetition.

production to the perception that prices are usually higher in the summer and have traditionally been so. More northerly Member States such as Finland and Sweden have a slight bias towards autumn calving (August to October). Variability in calving by location is significant even within zones, regions or countries.

f) Housing. Cows are housed in the winter months (up to 8 months of the year in the more northerly parts of the EU) and in certain cases may be housed overnight in autumn and spring. The harsher the conditions, the longer the winter housing period becomes. In Finland and Sweden the period spent housed is even higher (between eight and ten months (depending on latitude)), but is constrained beyond this by animal welfare legislation which stipulates a minimum outdoor grazing period. The extreme form of housing can be found in the 'industrial' units in parts of the former East Germany (the new Länder) where cows are sometimes permanently housed.

g) Replacement/age of herd. Average herd age tends to be young which implies a relatively high replacement rate.

h) Breed. Specialist dairy breeds of which Friesian/Holstein dominates (ie, variants of which eg, British Friesian, Holstein (Prim'Holstein in France), Dutch Holstein). These account for almost all of herds (over 95%).

Table 2.9: Typical high input/output system

Production parameters	Typical option
Calving season	All year round with a bias toward spring or autumn depending on the climate
Feed strategy	High use of concentrates
	High use of fertiliser on grazing
	Buffer feeding used to allow higher stocking densities
	High use of silage for winter feed (usually maize, but grass in Sweden and Finland)
Milking frequency	Twice daily
Size	Medium to large herds, often specialised
Indoor/outdoor	Indoor over winter, longer periods of housing in the north
Replacement strategy	Generally closed herds, some use of 'flying herds'
Breed	Specialist dairy, usually bred for high milk yield

2.3.2. Low input/output systems

a) Locations. This type of system is essentially associated with the main form of dairy production in Ireland, although variations to this exist in some other regions such as the northern and western extremities of the UK, parts of northern and eastern France, some of the Azores and throughout the Atlantic and Continental zones (see section 3) where producers have taken up 'organic' production systems.

b) Production. These systems probably account for 6-8% of total EU dairy cow numbers (about 1.3-1.75 million head) and about 4-5% of total EU milk production (about 4.8-6 million tonnes).

c) Structure. Farm sizes can fall within a broad range of 20 to 80 ha. Accordingly average herd size also falls within a fairly broad range (25-70 cows, with an average of about 30 in Ireland (the main location)). These systems include some specialist dairy farms and organic producers but mainly comprise mixed farms in which other livestock enterprises are practised (data deficiencies preclude the provision of supporting data).

d) Intensity. Stocking rates tend to be in the range of 1.0-1.4 LU/ha (1.9 LU/ha in Ireland). Where organic systems are practised stocking rates fall to about 0.8 LU/ha. Less than 30% of farmed land tends to be used for forage (mix of cereals and brassicas), with the rest being permanent grassland. Forage areas are supported by fertilisation levels of about 50-100kg N/ha (zero use in organic systems). Grazing is an important part of the feeding regime with use of concentrates not usually higher than 500kgs/cow. Winter diets tend to comprise a mix of grass and maize silage and hay and the summer diet is dominated by grazing. In organic systems areas of fodder beet and arable crop silage may be only half the corresponding area under conventional systems with greater use of clover and lucerne based silage.

e) Calving. Features do not differ significantly from high input/.output systems. The increased reliance on grazing means that calving takes place to take maximum advantage of the peak grass production period. As such, spring calving dominates in Ireland, but autumn calving is preferred in Normandy/Brittany regions of France.

f) Housing. Housing patterns are similar to the more intensive systems whereby cows are housed in the winter months (which tend to be longer in the more northerly regions practising these systems). Average winter housing periods are mid-October to mid-March.

g) Replacement/age of herd. Average herd age and replacement rates are similar to more intensive systems, although on mixed livestock farms cows tend to be kept longer (eg, an extra year or two). This usually reflects non economic/technical factors of influence on producers.

h) Breed. Similar to high input systems where specialist dairy breeds like Friesian/Holstein dominate. Additional use of Jerseys/Guernseys may occur in organic systems.

Table 2.10: Typical low input/output system

Production parameters	Typical option
Calving season	Spring to maximise use of peak grass growth in mountains, autumn in uplands/foothills
Feed strategy	Low use of concentrates and silage
	Low use of fertiliser on grazing
	Self help silage over winter
Milking frequency	Twice daily
Size	Medium-large herds, mix of specialised dairy and mixed livestock farms
Indoor/outdoor	Indoor for around five months over winter
Replacement strategy	Generally closed herds, some use of 'flying herds'
Breed	Specialist dairy

2.3.3. Mountain systems

a) Locations. The mountain and foothill areas of the Alps, Pyrenees and Cantabria. Also upland and plateaux areas such as the Massif Central, Auvergne and the Black Forest.

b) Production. These systems probably account for less than 5% of total EU dairy cow numbers (under 1 million head) and less than 4% of total EU milk production (up to about 4.5 million tonnes).

c) Structure. In the mountain regions farms comprise two units (valley and mountain pastures) with typical sizes being 10-30ha of valley and 200ha mountain pasture. For the upland and foothill farms average size is 30-50ha within a range of 40-80ha in Franche-Comte, 50-70ha in the Black Forest and 25-40ha in the French Alpine foothills. Herd sizes range from 10 to 200 cows (average of 50) in mountain areas. In the upland and foothill regions average herd size is 25-45 cows (20-30 in the Black Forest).

d) Intensity. Summer stocking rates in the mountain regions are within a range of 1.0-2.0 LU/ha. In the foothill and upland regions the range is 0.4-1.4 LU/ha. Pasture grazing dominates with limited use of forage in mountain farms (hay taken from valley pastures for winter feeding). Grassland also dominates in upland/foothill farms (80-100%) of the farm area. Mountain systems fertilise adjacent (closest to summer 'farm' site) fields in mountain pastures and valley pastures with natural manures. Upland/foothill farms may also use relatively low levels of mineral fertilisation of pastures (about 40-

80kg N/ha). Grazing is the most important part of the feeding regime. In mountain farms, winter feeding is largely based on hay with concentrates limited to cows producing milk for cheese making. In upland/foothill farms some limited supplementary feeding at grass occurs (100-300kgs DM hay or silage but up to 500kgs in some hay based systems). Winter feeding is similar to mountain farms but with additional use of silage and hay.

e) Calving Spring calving dominates in mountain farms whilst autumn calving (September-December) dominates in uplands/foothills to benefit from availability of winter fodder and seasonally higher liquid milk prices at this time of year.

f) Housing. Mountain systems are based on winter housing (October-May) and summer grazing. Similar patterns occur in the uplands/foothills, but with slightly shorter winter housing and longer summer grazing (6 months).

g) Replacement/age of herd. Average herd age and replacement rates are probably longer than more intensive systems (eg, an extra year or two).

h) Breed. Local/regional mountain breeds adapted to harsh and cold conditions (eg, Grey Alpine) are mainly used in mountain farms. In the foothill/upland farms, Friesian/Holsteins are common on the more intensive farms although red and white breeds and some local breeds remain widely used on farms in regions like Tarin, Hintervald and Eringer.

Table 2.11: Typical Alpine system

Production parameters	Typical option
Calving season	Winter whilst in valleys
Feed strategy	Low use of concentrates
	Low use of inorganic fertiliser on grazing
	Zero grazing often used where plots of land are fragmented
	Hay used for winter feed
Milking frequency	Twice daily
Size	Small herd size
Indoor/outdoor	Indoor over winter in valleys
Replacement strategy	Closed herds
Breed	Dual purpose

2.3.4. Mediterranean systems

a) Locations. Mediterranean countries and regions excluding Northern Spain, upland/mountain foothills, mountains (Pyrenees).

b) Production. These systems probably account for 7%[5] of total EU dairy cow numbers (about 1.5 million head) and about 5% of total EU milk production (about 6 million tonnes).

c) Structure. Herd sizes fall within a broad range because of two contrasting types of production system: the commercial specialist system and the mixed system. In the former 50-60 head herds are common whilst in the latter numbers can be as low as 10.

d) Intensity. The commercial systems tend to keep cows indoors all year round with zero grazing. On mixed farms stocking rates tend to be low (under 1.0 LU/ha). Feed in the commercial farms comprises a mix of farm grown roughage (a mix of maize and ryegrasssilage and alfalfa hay). On the mixed farms grazing is used for 3-4 months per year in the spring with feed for the non grazing seasons derived from traditional polyculture systems (mix of tree crops, vegetables and cereals). The latter system makes very little use of mineral fertilisers (slurry and manure are however widely used in

[5] Authors qualitative estimates.

the forage cultivation system). On the commercial dairy farms there is widespread use of irrigated maize silage and dry-land ryegrass growing which is cut 2-3 times per year.

e) Calving. Features do not differ significantly from high input/output systems on the commercial farms (ie, a broad mix of spring or autumn calving depending on local circumstance and preference). All year round calving also occurs in the mixed systems.
f) Housing. All year housing on the more commercial specialist farms. On the mixed farms, housing occurs for 7-8 months per year (spring grazing) but facilities tend to be much more basic than in the more commercial systems (including widespread use of hand milking).
g) Replacement/age of herd. Average herd age and replacement rates are similar to more intensive systems in northern regions. On mixed livestock farms cows tend to be kept longer (eg, an extra year or two). This usually reflects non economic/technical factors of influence on producers.
h) Breed. Similar to high input systems where specialist dairy breeds like Friesian/Holstein dominate. On the mixed farms both Holsteins and multipurpose (local) breeds are used plus some cross breeding with Limousains and Charolais.

Table 2.12: Typical Mediterranean system

Production parameters	Typical option
Calving season	All year round
Feed strategy	Increasing use of concentrates and other supplementary feed Rough grazing predominates Use of silage or hay uncommon
Milking frequency	Twice daily
Size	Small to medium average herd size
Indoor/outdoor	Indoor over summer when grazing options are limited. Indoor all year round on specialist dairy farms
Replacement strategy	Generally closed herds
Breed	Friesian/Holstein and some mix of hardy local breeds

2.3.5. Organic systems

Lastly an additional economic and technical system classification is that of organic systems.

a) Locations. Can be found in all regions.
b) Production. No data on EU level organic milk production are available. However, 70 million litres of organic milk are currently produced in Sweden, 250-325 million litres in Germany (60% of which are sold direct from the farm), 50 million litres in the Netherlands (1998), 65 million litres in France (1998), 45 million litres in the UK and 340 million litres in Denmark[6]. Data from 1995 suggests that 12.3% of dairy cows in Austria, 3.1% of Danish dairy cows and 2.5% of dairy cows in Sweden are certified as organic[7]. However, the organic market is expanding rapidly and significant increases in organic dairy cow numbers and milk production are expected to have occurred in the last few years.
c) Structure. Because organic systems can be variations on any type of regional system they have a wide range of herd sizes. However, commercial organic farms are thought to have an average herd size of 50-60 cows.

[6] Ane Mette Arve of the Danish Dairy Board Speaking at the 4th Annual UK Dairy Conference (14-15 June, 1999).
[7] Source: Agriculture, environment, rural development facts and figures: a challenge for agriculture. DGVI, DGXI and Eurostat July 1999.

d) Intensity. Feed is sourced on-farm as much as possible to ensure organic status (although off-farm feed is permitted if organic or 'in conversion' (30% of feed may be 'in conversion' if off-farm, 60% if sourced on-farm)) and is likely to be derived from the same fodder crops that are grown conventionally in the region. At least 60% of daily dry matter intake must consist of roughage, fresh or dried fodder, or silage. Stocking densities are relatively low at between 0.8 and 1.4 LU/ha reflecting the more extensive nature of production. Mineral fertilisation is not permitted and the total amount of manure applied on holdings must not exceed 170kg N/ha/year (Member States may impose stricter requirements if they wish).
e) Calving. Unlikely to be any different to conventional practice in the region concerned.
f) Housing. Housing requirements will be determined by the conditions in the region concerned and are therefore likely to be variable. However, due to the more extensive nature of organic dairy farming, housing is likely to be kept to a minimum.
g) Replacement/age of herd. Average herd age and replacement rates are likely to be similar (although perhaps slightly higher and lower respectively) to conventional systems in the region concerned. Where cows are kept for an extra lactation or two this may reflect a different farming philosophy.
h) Breed. Similar to conventional systems where specialist dairy breeds like Friesian/Holstein dominate. However, there may be a greater use of traditional breeds, again reflecting a different approach to farming and the greater influence of non-technical factors.

Table 2.13: Typical Organic system

Production parameters	Typical option
Calving season	All year round
Feed strategy	At least 60% of daily dry matter intake must be roughage, fresh or dried fodder, or silage Off-farm feed may be bought, but it must be organic or 'in conversion' Grazing predominates
Milking frequency	Twice daily
Size	Small to medium average herd size, although this will incorporate larger scale more commercial farms and non-commercial operations
Indoor/outdoor	Outdoor whenever possible. Indoor as dictated by climate
Replacement strategy	Generally closed herds to ensure organic status
Breed	Friesian/Holstein and a wide range of specialist breeds such as Jersey and Guernsey

2.4. Overview and trends

In drawing together the data presented in the previous two sub-sections on bio-geographical regions and economic/technical classifications, the following key features can be highlighted:

- there are very limited data available which classify dairy production by either category. Consequently the analysis presented is estimated by the contractors based on latest available data. Our brief consideration on trends (see below) is also based entirely on qualitative views;
- EU dairy cows and milk production are dominated by one economic/technical classification (high input/output) which accounts for 83% of dairy cows and 85% of milk production. This type of production can be found mainly in the Atlantic region and (to a lesser extent) the Continental region. 'Pockets' can also be found in the Mediterranean, Boreal and Macronesian regions;
- the economic/technical classification of Mountain and Mediterranean are broadly the same as the bio-geographical classifications of Alpine and Mediterranean;

- the economic/technical classifications of low input/output and high input/output can be found across the bio-geographical regions of Atlantic, Continental, Boreal and Macronesian, although the latter bio-geographical region may also exhibit some Mediterranean type features;
- trends. These are summarised in Table 2.14.

Table 2.14: Trends in milk production by bio-geographical region and economic/technical classification

Region	Trend and comments
Atlantic	Stable. Main reason: presence of dairy quotas since mid 1980s and very little quota transferability (none across borders)
Continental	Stable. Main reason: presence of dairy quotas since mid 1980s and very little quota transferability (none across borders)
Alpine	Stable. Main reason: presence of dairy quotas since mid 1980s and very little quota transferability (none across borders)
Mediterranean	Stable. Main reason: presence of dairy quotas since mid 1980s and very little quota transferability (none across borders)
Boreal	Stable. Main reason: presence of dairy quotas since mid 1980s and very little quota transferability (none across borders)
Macronesian	Stable. Main reason: presence of dairy quotas since mid 1980s and very little quota transferability (none across borders)
Economic/technical	
High input/output	Fairly stable but slow expansion
Low input/output	Fairly stable. Some decline as increasing move to above but counterbalanced by growth in organic
Mountain	Stable. Organic development contributing to arresting past decline
Mediterranean	Stable with some slow decline

Source: CEAS Consultants qualitative estimates.

Trends in dairy cow numbers by bio-geographical regions are discussed further in Section 3. By economic/technical classification there is a general (organic exception) trend towards lower cow numbers and higher yields per cow.

3. Description of dairying in the bio-geographical regions

In sub-section 2.2, EU dairy production was briefly classified into a number of bio-geographical regions. Some of these can be relatively simply associated with specific and entire Member States whilst others overlap national borders. Of particular note are:

- the Atlantic region (which includes the Netherlands, Belgium, the UK, Ireland and parts of Denmark, France, Germany and Spain): the most important region for dairy production;
- the southern European states where three main regions can be identified: the Mediterranean region (Greece, Spain, Portugal and Italy), Atlantic region (part of Spain) and the Macronesian region (Azores, Canaries, Madeira);
- between the above two relatively clear groupings of regions are a group of countries (Finland, Sweden, Austria, Germany and France) where dairy production systems occur within up to four main bio-geographical regions (the Boreal, Alpine, Continental and (in France) Mediterranean regions.

At the Member State level, France is the most diverse country for dairy production systems. All of the regions referred to above, occur with the exception of the Boreal and Macronesian regions (see Figure 3.1).

In the sub-sections below each region is presented, although it should be recognised that this classification represents a simplification of EU dairying as there is inevitably a wide variety of systems within each bio-geographical region (hence a major reason for also considering dairying by economic and technical criteria in Section 2). To this end, after the bio-geographical classification is discussed further in this section, the two classifications of bio-geographical regions and economic/technical criteria are amalgamated in Section 4 to produce our 'definitive' classification for environmental purposes.

The reader should also note that data availability about dairying by bio-geographical region is limited. A note detailing the availability and sources used can be found in Appendix 1.

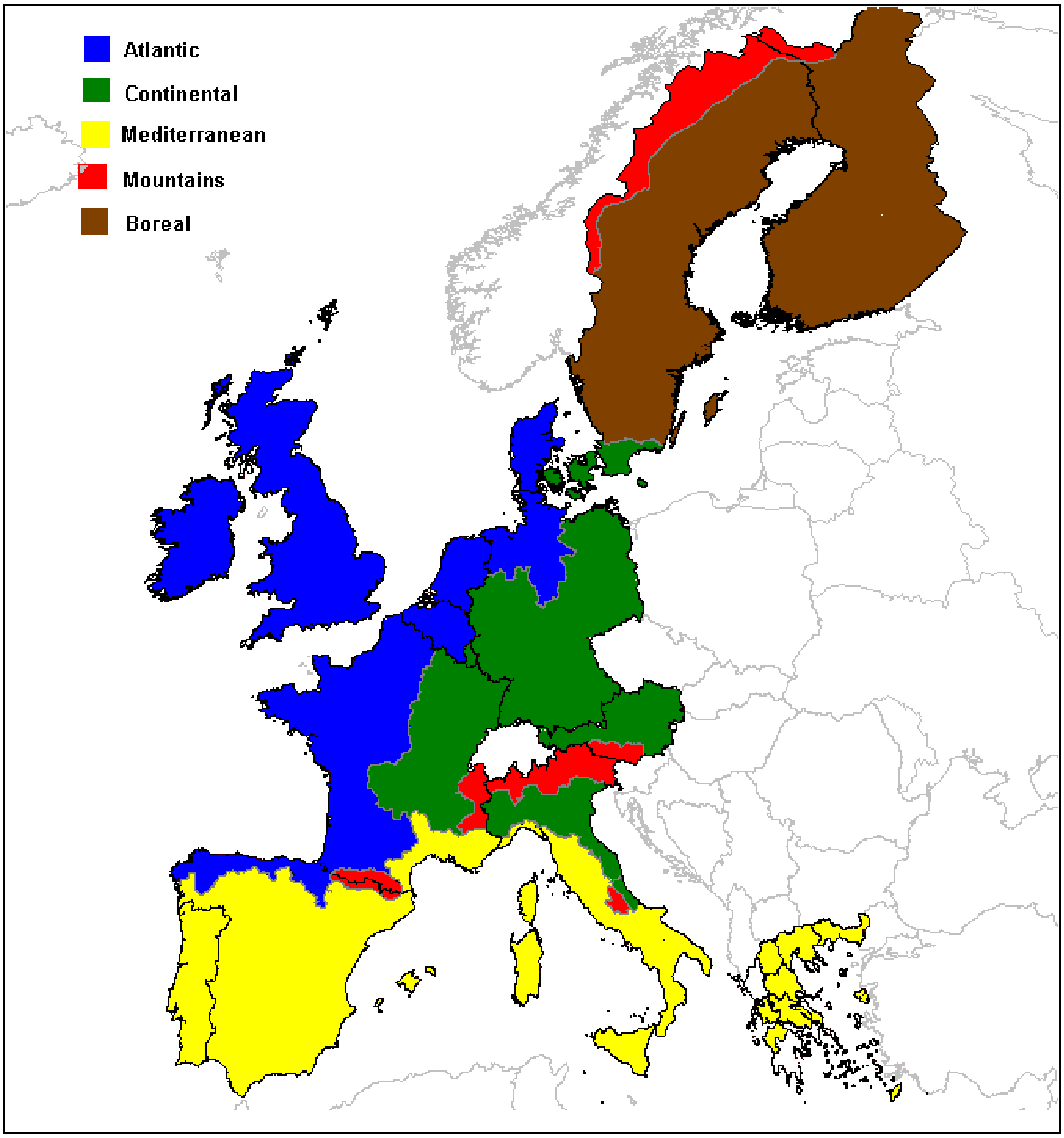
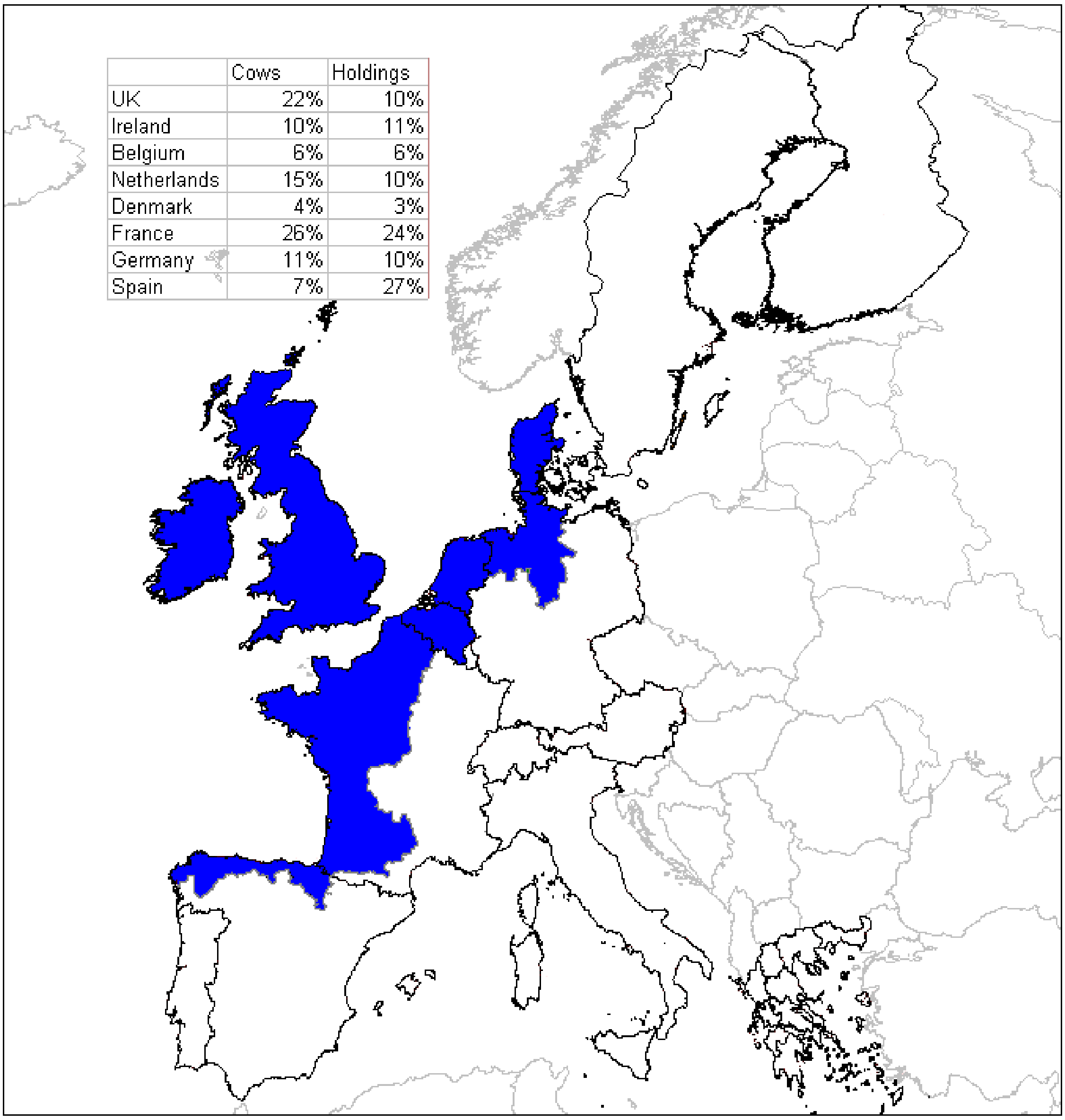


Figure 3.1: EU bio-geographical regions

3.1. Atlantic region

The Atlantic region comprises all of the UK, Ireland, Belgium and the Netherlands, and parts of France, Germany, Denmark and Spain. Data from these Member States (or the relevant part of them) were aggregated to provide statistics for the region as a whole. Where bio-geographical regions split NUTS data regions (around the Pyrenees in both France and Spain) the data was divided proportionally. This is slightly artificial as there is no reason to suppose that dairy production is homogenous across these areas, however, it was the only way in which data at the bio-geographical level could be constructed.

a) Regions



	Cows	Holdings
UK	22%	10%
Ireland	10%	11%
Belgium	6%	6%
Netherlands	15%	10%
Denmark	4%	3%
France	26%	24%
Germany	11%	10%
Spain	7%	27%

Figure 3.2: Atlantic region

The UK and Atlantic region of France are the two most important regions with respect to the proportion of dairy cows, accounting for just over a fifth and a quarter of the dairy cows in this bio-geographical region respectively. The Netherlands also has a significant proportion of dairy cows, especially given its small size relative to other components of this region.

The proportion of dairy holdings in the French Atlantic region is approximately the same as the proportion of dairy cows, although the UK has twice the proportion of dairy cows than it has holdings, suggesting a greater concentration of the dairy industry relative to Atlantic France. In contrast, the proportion of dairy holdings in Atlantic Spain is more than three times the proportion of dairy cows in this region which suggests that there are a lot of relatively small scale producers. The Netherlands also has a lower proportion of holdings than dairy cows suggesting that dairying is fairly intensive and/or specialised. In the other components of this region the proportions of holdings and dairy cows are approximately balanced.

Eight of the EU's most productive dairy farming regions occur in the Atlantic bio-geographical region (Ireland, south-west England, Lower Normandy, Brittany, the Netherlands, Denmark, Lower Saxony and Asturias) and these include the most intensive dairy production systems in Europe and the largest dairy farms. With the exception of the northern Spanish region of Asturias and Ireland, these are the places where dairy farming tends to be most intense. Key features are larger farms, higher levels of milk produced per cow, less use of grazing and more use of supplementary feeding with concentrates and off-farm fodder than in any other regions within the EU. There are, of course, considerable differences between dairy farming regions and between areas within the regions.

Table 3.1 shows the number of dairy cows in the Atlantic region by Member State (or part thereof). Key features are:

- the number of cows in the Atlantic region declined by nearly a quarter between 1985 and 1995;
- although the percentage decrease differs in different Member States, the proportions of dairy cows in each remained approximately the same over this period with the exception of the UK, Ireland and Atlantic Germany (slight increase) and Atlantic France (slight decrease);
- with the exception of Ireland (where there was a slight increase in the number of dairy cows between 1995 and 1996) the decline in numbers has been smooth.

Table 3.1: Atlantic region dairy cow numbers ('000 head)

	1985	1990	1995	1996	1997	% decrease 1985-1995
United Kingdom	3,256.5	2,890.0	2,631.0	2,510.0	2,497.6	19%
Ireland	1,495.2	1,322.2	1,267.1	1,272.4	n/a	15%
Belgium	973.0	830.6	683.8	n/a	n/a	30%
Netherlands	2,412.4	1,997.2	1,854.1	n/a	n/a	23%
Atlantic Denmark	608.7	512.7	476.0	n/a	446.9	22%
Atlantic France	4,495.8	3,727.4[1]	3,188.4	n/a	n/a	29%
Atlantic Germany	1,651.0	1,423.6	1,295.2	1,284.5	1,230.6	22%
Atlantic Spain	1,122.9	860.0	809.6	n/a	n/a	28%
ATLANTIC REGION	**16,015.4**	**13,563.7**	**12,205.2**	**n/a**	**n/a**	**24%**

Note:
1. 1989 figure
Source: Eurostat

In relation to dairy holdings (Table 3.2):

- the number of dairy holdings in the Atlantic zone declined by 27% over the period 1985 to 1995, a slightly greater rate of decline than seen in dairy cow numbers over the same period suggesting a concentration of more cows onto fewer holdings;
- this trend was particularly noticeable in Denmark, Atlantic France and Atlantic Germany.

Table 3.2: Atlantic region dairy holdings

	1990	1993	1995	1990-1995 percentage decrease
United Kingdom	44800	41350	38390	14%
Ireland	49,070	46,750	42,440	14%
Belgium	31,270	24,650	21,880	30%
Netherlands	47,080	40,530	37,470	20%
Atlantic Denmark	15,447	11,953	10,640	31%
Atlantic France	147,746	116,378	93,857	34%
Atlantic Germany	54,023	45,317	105,116	29%
Atlantic Spain	141,342	108,314	39,597	27%
ATLANTIC REGION	**530,778**	**435,242**	**389,390**	**27%**

Source: Eurostat

b) Breeds

The predominant breed in the Atlantic region is the Holstein-Friesian. However, other breeds are also significant in certain areas, for example, the Normande in Normandy and the Simmental in Germany.

c) Management systems

The main systems found in the Atlantic region are intensive grassland, conventional mixed and intensive maize silage systems. Further details are given in section 4.4.

d) Intensity

Table 3.3 summarises some measures of intensity for the Atlantic region.

Table 3.3: Atlantic region measures of intensity

	1985	1990	1995	% increase (earliest to latest figure)
Average herd size (head)	n/a	26	31	23%
Average size of dairy holdings (ha)	n/a	35	43	23%
Average milk yield (kg/cow/year)	4,263	4,617	5,214	22%

Source: Eurostat

The main feature is that all indicators suggest an increase in intensity. Average herd and average size of dairy holding increased by 23%, whilst average yield per cow increased by 22%.

Table 3.4 and Table 3.5 show the change in structure of dairying in the Atlantic region in terms of the distribution of holdings and dairy cows respectively. The main points are:

- dairy holdings are fairly evenly distributed in terms of size class, although more than a quarter fall into the 30 to 49 head category;
- dairy cow distribution is skewed towards larger holdings with more than three quarter of Atlantic region dairy cows on holdings with at least 30 head;
- there has been an increase in the proportion of dairy holdings with more than 20 head, with the largest increase being in the proportion of holdings with more than 100 head, at the expense of the smaller size categories;
- the proportion of dairy cows kept in herds of at least 50 head has also increased at the expense of the proportions in all other size classes.

Table 3.4: Size distribution of Atlantic region dairy holdings (1990-1995)

Size category (head)	1-2	3-9	10-19	20-29	30-49	50-99	100+
1990	14.21%	21.59%	22.74%	17.18%	21.10%	12.10%	2.43%
1993	12.95%	18.26%	21.18%	17.53%	23.65%	15.04%	3.01%
1995	11.88%	15.75%	20.02%	17.27%	25.21%	17.64%	3.56%
% change 1990-1995	-16.4%	-27.1%	-12.0%	0.5%	19.5%	45.8%	46.9%

Source: Eurostat

Table 3.5: Size distribution of Atlantic region dairy cows (1990-1995)

	1-2	3-9	10-19	20-29	30-49	50-99	100+
1990	0.75%	4.30%	11.42%	14.73%	28.35%	28.14%	12.31%
1993	0.59%	3.30%	9.54%	13.37%	28.35%	31.29%	13.57%
1995	0.49%	2.61%	8.32%	12.13%	27.88%	33.89%	14.68%
% change 1990-1995	-34.87%	-39.17%	-27.20%	-17.67%	-1.65%	20.43%	19.30%

Source: Eurostat

Table 3.6 shows the differences in intensity at the Member State level.

Table 3.6: Member State differences in intensity

	Average milk yield, 1995 (kg/cow/year)	Average herd size, 1995 (head)	Average farm size, 1995 (ha)
United Kingdom	5,350	69	83
Ireland	4,173	30	37
Belgium	4,349	31	30
Netherlands	5,838	49	28
Atlantic Denmark	6,265	45	54
Atlantic France	5,232	34	58
Atlantic Germany	5,861	33	50
Atlantic Spain	3,974	8	22
ATLANTIC REGION	**5,214**	**31**	**43**

Source: Eurostat

This shows:

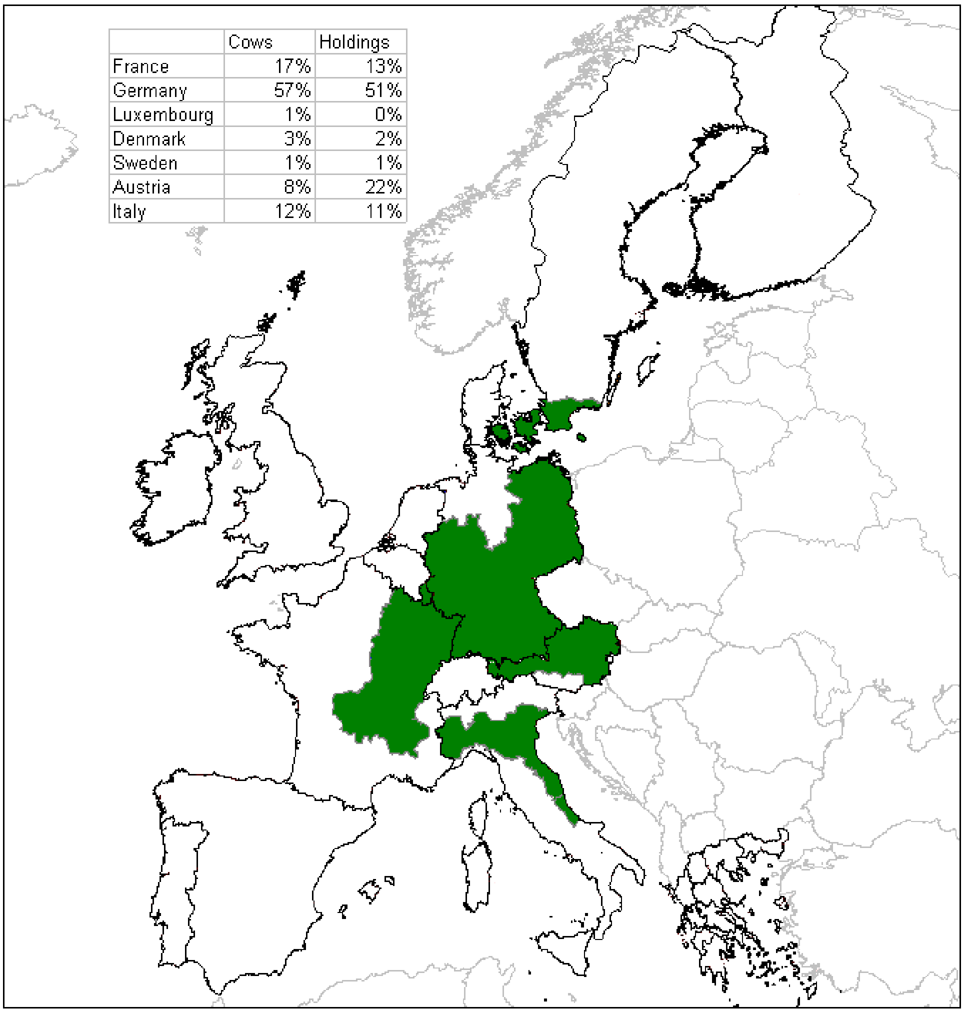
- average milk yields vary widely from Atlantic Spain (lowest) to Atlantic Denmark (highest). Member States with above average milk yields for the Atlantic region are: Denmark, Atlantic Germany, the Netherlands, the UK and Atlantic France. Those Member States with below average yields are (lowest first): Atlantic Spain, Ireland and Belgium;
- average herd size also varies widely from 69 in the UK to only 8 in Atlantic Spain;
- average dairy holding size is also largest in the UK and smallest in Atlantic Spain, although other Member States are not ranked in the same order. For example, the Netherlands has the second highest average herd size, but the second smallest average dairy holding size. This suggests that dairying in the Netherlands is high intensity (with presumably a high level of non-grazed feed) and/or highly specialised. Average farm size in Atlantic France is second only to the UK, yet average herd size is only slightly above the Atlantic region average. This suggests that dairying in this region is

relatively more extensive (more reliant on grazing/fodder crops) and/or less specialised than that in the Netherlands.

3.2. Continental region

The continental region is made up of Luxembourg and parts of France, Germany, Denmark, Sweden, Austria and Italy. Data from the relevant regions of these countries were aggregated to provide statistics for the bio-geographical region as a whole. Where country regions were split between bio-geographical regions (around the Alps in Italy, France and Austria) the data were divided proportionally. Although this is unlikely to reflect the reality on the ground, this is the only way in which data at the bio-geographical level could be compiled.

a) Regions



	Cows	Holdings
France	17%	13%
Germany	57%	51%
Luxembourg	1%	0%
Denmark	3%	2%
Sweden	1%	1%
Austria	8%	22%
Italy	12%	11%

Figure 3.3: Continental regions

Within the region key features are:

- more than half the dairy cows can be found in Germany; France and Italy are also important areas;

- Germany accounts for around half of the dairy holdings, although a smaller proportion than dairy cows (implying that production is fairly large scale);
- Austria has the second largest proportion of dairy holdings, which, together with its relatively smaller proportion of dairy cows, suggests that dairying is a widespread activity in Austria, but usually on a small scale;
- France, Denmark, Luxembourg and Italy all have a greater proportion of dairy cows than holdings, implying a relatively higher than average (for the region) level of intensity.

The number of dairy cows in the Continental region declined by 21% between 1990 and 1995 with the greatest decline in numbers in percentage terms seen in Italy (1985 to 1995), the smallest in Sweden (1990-1995: Table 3.7).

Table 3.7: Continental region dairy cow numbers ('000 head)

	1985	1990	1993	1995	1996	1997	% decrease 1985-1995
Continental France	1,633.3	1,424.2[2]	n/a	1,183.5	n/a	n/a	28%
Continental Germany	3,795[1]	4,927	n/a	3,930	3,907	3,792	20%[3]
Luxembourg	70.3	58.8	50.9	47.7	n/a	n/a	32%
Continental Denmark	304.3	256.3	237.0	238.0	n/a	223.45	22%
Continental Sweden	n/a	78.9	72.1	64.6	63.3	n/a	18%[3]
Continental Austria	n/a	722.6	n/a	565.5	558.6	n/a	22%[3]
Continental Italy	1,412.3	1,210.5	982.6	860.1	n/a	n/a	39%
CONTINENTAL REGION	**7,215.7**	**8,678.0**	**n/a**	**6,889.7**	**n/a**	**n/a**	**21%[3]**

Notes:
1. West Germany only
2. 1989
3. 1990-1995 decrease

Source: Eurostat

The number of dairy holdings in the region declined by 30% between 1990 and 1995 with the largest decrease occurring in Italy and the smallest in Germany. The percentage decrease in holdings is larger than that in dairy cow numbers suggesting a significant increase in the concentration of dairy cows onto fewer farms (Table 3.8).

Table 3.8: Continental region dairy holdings

	1990	1993	1995	1997	1990-1995 percentage decrease
Continental France	59,007	45,893	41,883	n/a	29%
Continental Germany	215,083	183,877	163,447	n/a	24%
Luxembourg	1,890	1,550	1,400	1,280	26%
Continental Denmark	7,723	5,977	5,320	4,397	31%
Continental Sweden	n/a	n/a	2,180		n/a
Continental Austria	n/a	n/a	71,170	68,029	n/a
Continental Italy	68,510	45,184	35,239	n/a	49%
CONTINENTAL REGION	**352,214**[1]	**282,481**[1]	**247,289**	**n/a**	**30%**[1]

Notes:

1. Excludes Sweden and Austria

Source: Eurostat

b) Breeds

The predominant breed in the Continental region is the Holstein-Friesian. However, other breeds are also significant in certain areas, for example, the Simmental in Germany.

c) Management systems

The main systems found in the Continental region are intensive maize silage and conventional mixed systems. Further details are given in section 4.4.

d) Intensity

Table 3.9, Table 3.10, Table 3.11 and Table 3.12 show the main changes relating to structure and intensity of dairy production in the Continental bio-geographical region. Its main features are:

- average herd size and milk yield have increased, although the average size of holding decreased (however this may be because the 1990 figure does not include Austria and Sweden, whereas the 1995 figure does);
- half of the dairy holdings in the Continental region have between 3 and 19 dairy cows;
- more than half of dairy cows in this region are kept on holdings with at least 30 head;
- the proportion of holdings with more than 100 dairy cows has increased dramatically, albeit from a low base, whilst the proportion of dairy cows kept on holdings of more than 100 head has increased by an even greater amount;
- these figures suggest that dairy production in this region is becoming increasingly large scale;
- average milk yields vary significantly within the Continental region. The highest is in Denmark and the lowest in Austria;
- the largest average herd size is in Denmark and the lowest in Austria;
- the largest average farm size is in France and the smallest farms are found in Austria.

Table 3.9: Continental region measures of intensity

	1985	1990	1995	% change (earliest to latest figure)
Average herd size (head)	n/a	22[1]	28	25%
Average size of dairy holdings (ha)	n/a	54[1]	51	-6%
Average milk yield (kg/cow/year)	3,892[1]	4,328[1]	4,765[2]	22%

Notes:
1. Excludes Sweden and Austria
2. Excludes Sweden

Source: Eurostat

Table 3.10: Size distribution of Continental region dairy holdings (1990-1995)

Size category (head)	1-2	3-9	10-19	20-29	30-49	50-99	100+
1990	9.52%	26.42%	26.99%	17.67%	14.17%	4.75%	0.47%
1993	8.89%	22.05%	25.43%	18.68%	16.90%	6.67%	1.42%
1995	9.31%	25.80%	24.93%	16.49%	15.18%	6.83%	1.48%
% change 1990-1995	-2.3%	-2.4%	-7.6%	-6.7%	7.1%	43.8%	213.5%

Source: Eurostat

Table 3.11: Size distribution of Continental region dairy holdings (1990-1995)

	1-2	3-9	10-19	20-29	30-49	50-99	100+
1990	0.91%	9.47%	21.84%	23.55%	26.85%	13.53%	3.86%
1993	0.56%	5.95%	15.76%	19.15%	25.01%	14.84%	18.72%
1995	0.72%	7.53%	16.36%	17.82%	23.59%	15.74%	18.25%
% change 1990-1995	-20.62%	-20.45%	-25.10%	-24.34%	-12.13%	16.28%	373.29%

Source: Eurostat

Table 3.12: Elements of intensity 1995

	Average milk yield, 1995 (kg/cow/year)	Average herd size, 1995 (head)	Average farm size, 1995 (ha)
Continental France	4,551	28	70
Continental Germany	4,930	24	46
Luxembourg	3,983	34	69
Continental Denmark	6,265	45	54
Continental Sweden	n/a	30	57
Continental Austria	3,265	8	16
Continental Italy	5,282	24	17
CONTINENTAL REGION	**4,765[1]**	**28**	**51**

Note:
1. Excluding Sweden

Source: Eurostat

3.3. Mediterranean region

The Mediterranean region comprises Greece, mainland Portugal and parts of Italy, France and Spain. Data from the appropriate parts of these Member States were aggregated to provide statistics for the Mediterranean region. Where one region is split between bio-geographical regions (for example, in France and Spain on either side of the Pyrenees), data were divided proportionally. This approach may not accurately reflect differences in dairy production, but in the absence of more detailed regional data this was the only way to compile data at the bio-geographical region level.

a) Regions

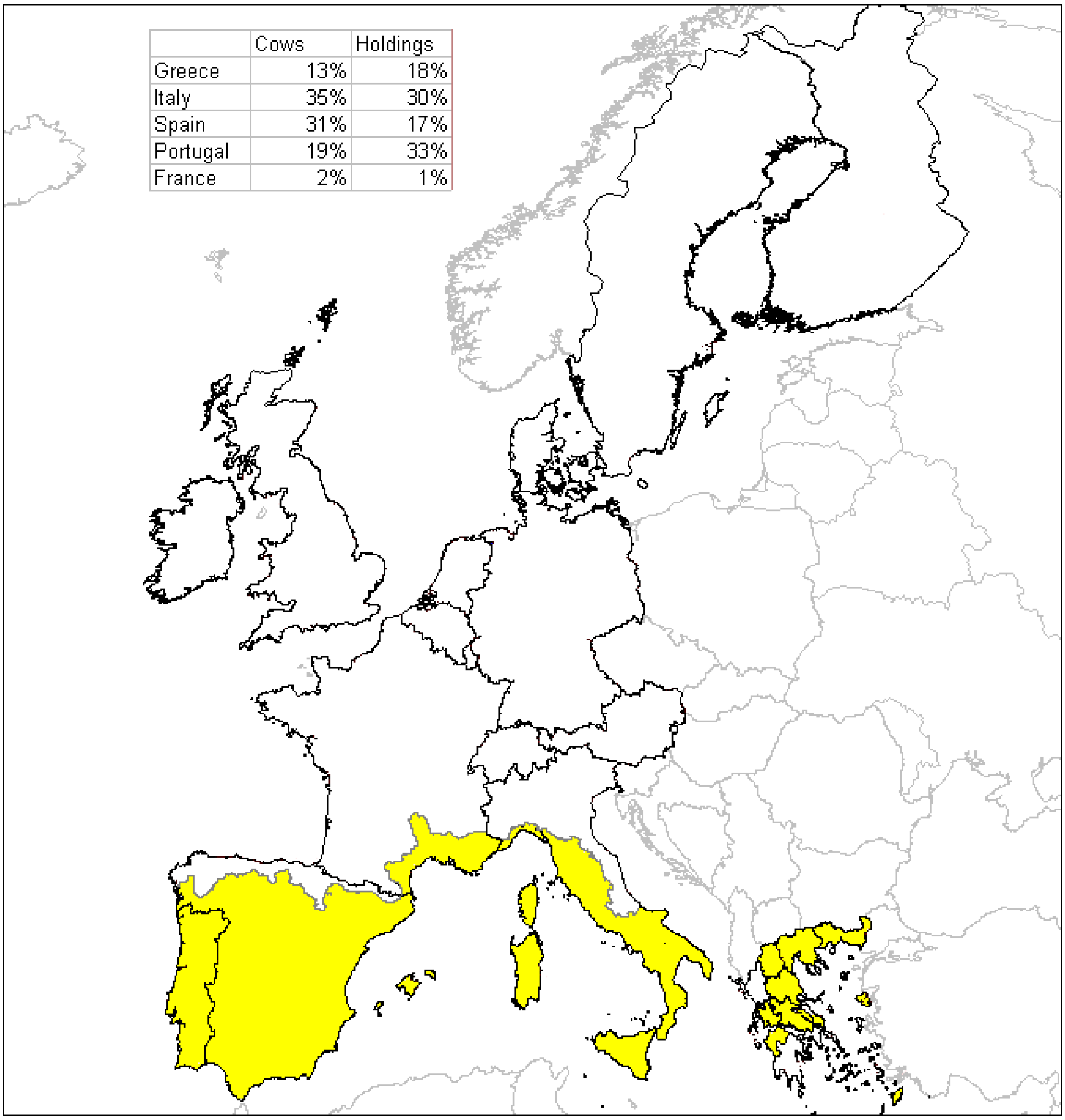


Figure 3.4: Mediterranean regions

Italy and Spain account for 35% and 31% of the dairy cows in the Mediterranean region respectively. In terms of holdings, Portugal has a third of the total holdings and Italy accounts for another 30%. There is a greater proportion of holdings than of dairy cows in Portugal and Greece, which suggests that dairy production in these two countries is smaller scale and/or possibly less specialised than in Spain, France and Italy where the proportion of cows is greater than that of holdings.

Table 3.13 shows the number of dairy cows in the Mediterranean region at the Member State (or part thereof) level. It highlights a decline in cow numbers, but a lack of data makes it difficult to comment further.

Table 3.13: Mediterranean zone dairy cow numbers ('000 head)

	1985	1987	1988	1989	1990	1995	1996	% decrease earliest to latest
Greece	n/a	n/a	233.0	n/a	241.5	191.5	183.7	21%
Italy	686.2	n/a	n/a	n/a	792.3	509.6	n/a	26%
Spain	723.1	n/a	n/a	n/a	685.7	446.6	452.9	37%
Portugal	n/a	314.0	n/a	n/a	328.0	283.0	278.0	11%
France	40.6	n/a	n/a	36.7	n/a	31.2[2]	n/a	10%
MEDITERRANEAN REGION	**n/a**	**n/a**	**n/a**	**n/a**	**2,084.2**[1]	**1,461.9**	**n/a**	**30%**

Notes:
1. Total includes 1989 French figure
2. CEAS Consultants estimation

Source: Eurostat

Examining the number of dairy holdings in the region (Table 3.14) shows

- the number of dairy holdings in the Mediterranean region decreased by 43% between 1990 and 1995;
- the percentage decrease was highest in Spain and lowest in France;
- the decline in the number of holdings is greater than that of dairy cows and this suggests that there has been a significant concentration of cattle onto a smaller number of farms.

Table 3.14: Mediterranean region dairy holdings

	1990	1993	1995	1990-1995 percentage decrease
Greece	37,620	30,630	27,970	26%
Italy	82,820	57,090	47,160	43%
Spain	60,343	32,708	26,109	57%
Portugal	88,930	59,780	51,620	42%
France	2,345	1,875	1,797	23%
MEDITERRANEAN REGION	**272,058**	**182,083**	**154,655**	**43%**

Source: Eurostat

b) Breed

The predominant breed in the Mediterranean region is Holstein-Friesian, although other breeds are also popular in certain countries, for example, Simmental and Brown Swiss in Greece.

c) Management systems

The main systems found in the Mediterranean region are Mediterranean commercial and Mediterranean mixed systems. Further details are given in section 4.4.

d) Intensity

Table 3.15 provides measures of intensity for the Mediterranean region. The main feature is that all measures of intensity suggest that dairy farming in the Mediterranean region has been intensifying.

Table 3.15: Mediterranean region measures of intensity

	1985	1990	1995	% increase (earliest to latest figure)
Average herd size (head)	n/a	8	9	23%
Average size of dairy holdings (ha)	n/a	16	19	15%
Average milk yield (kg/cow/year)	n/a	2,770[1]	4,915[2]	77%

Note:

1. French figure in the total is from 1989
2. French figure in the total is a CEAS Consultants estimate

Source: Eurostat

For structure in the region Table 3.16 and Table 3.17 show the following:

- the vast majority of Mediterranean region holdings are small, nearly three quarters of the total have less than 10 head;
- dairy cows are fairly evenly spread across size category with the exception of the smallest class (1-2 heads) which is under represented;
- the period 1990 to 1995 has seen a general movement towards larger holdings with the consequential increase in the proportions of dairy cows kept on larger holdings.

Table 3.16: Size distribution of Mediterranean region dairy holdings (1990-1995)

Size category (head)	1-2	3-9	10-19	20-29	30-49	50-99	100+
1990	43.70%	36.67%	11.80%	3.86%	2.53%	1.08%	0.41%
1993	42.67%	34.22%	11.52%	4.97%	3.92%	2.00%	0.73%
1995	38.46%	35.00%	12.51%	5.44%	4.46%	3.13%	0.98%
% change 1990-1995	-12.0%	-4.5%	6.0%	41.1%	76.1%	190.4%	140.7%

Source: Eurostat

Table 3.17: Size distribution of Mediterranean region dairy cows (1990-1995)

Size category (head)	1-2	3-9	10-19	20-29	30-49	50-99	100+
1990	9.14%	25.02%	21.25%	12.17%	12.65%	9.57%	10.20%
1993	7.19%	19.05%	17.12%	12.75%	15.91%	14.36%	13.61%
1995	5.53%	16.45%	16.04%	12.06%	15.43%	18.70%	15.78%
% change 1990-1995	-39.49%	-34.26%	-24.49%	-0.91%	22.01%	95.42%	54.71%

Source: Eurostat

At a regional level (Table 3.18) highlights:

- there is a high degree of variation in average milk yield across the Mediterranean region. The lowest yields are in Mediterranean France and the highest in Mediterranean Spain;
- average herd size is also variable, ranging from 5 in Mediterranean Portugal to 17 in Mediterranean Spain and France;
- average farm size is largest in France and smallest in Greece.

Table 3.18: Regional differences in intensity

	Average milk yield, 1995 (kg/cow/year)	Average herd size, 1995 (head)	Average farm size, 1995 (ha)
Greece	3,361	7	7
Italy	3,213	11	23
Spain	5,326	17	40
Portugal	4,337	5	9
France	2,269	17	64
MEDITERRANEAN REGION	**4,915**	**9**	**19**

Source: Eurostat

3.4. Boreal region

The Boreal region is made up of Finland and most of Sweden. Data from the relevant regions of Sweden and from Finland were aggregated to provide statistics for the bio-geographical region.

a) Regions

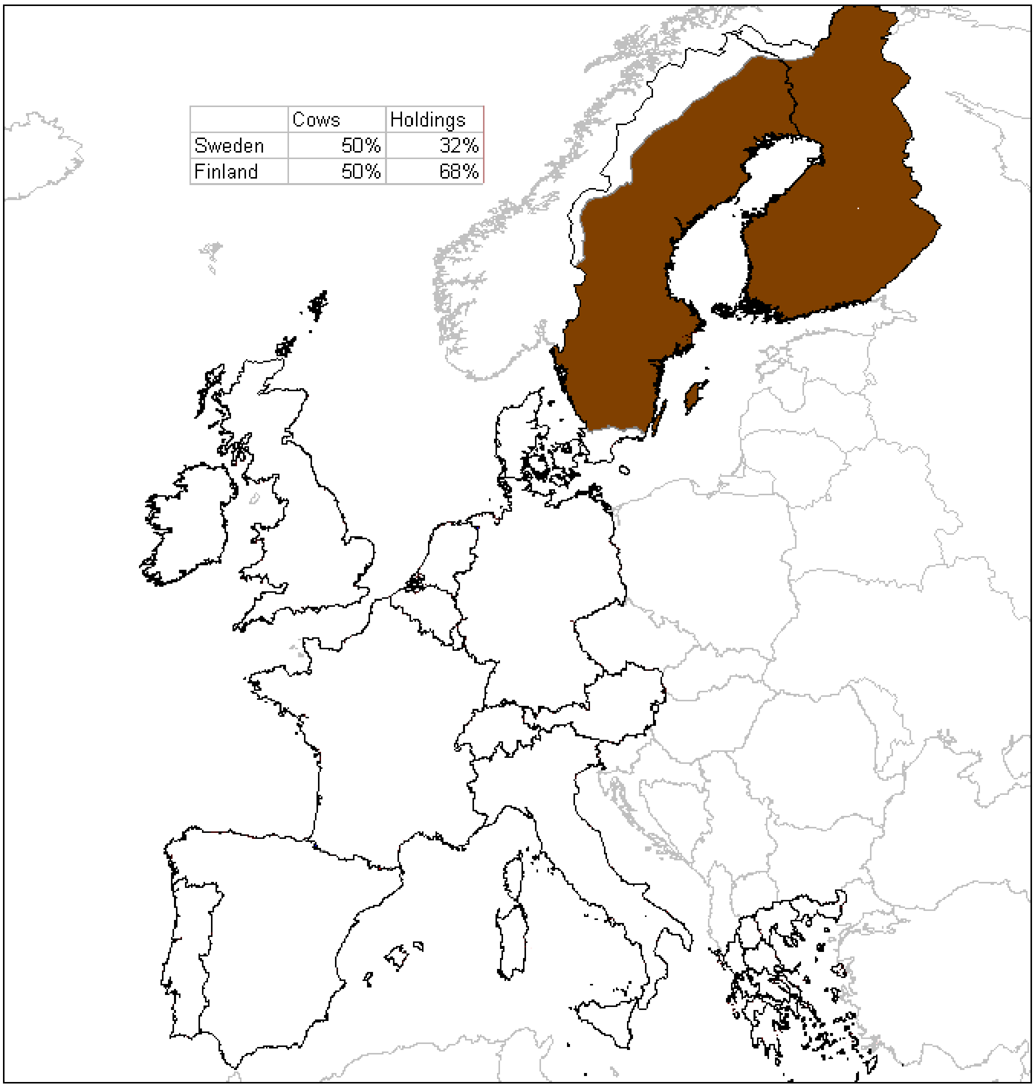


Figure 3.5: Boreal region

Dairy cows are evenly distributed between Sweden and Finland, however, two thirds of the Boreal region dairy holdings are located in Finland and only one third in Sweden. This implies that dairy production in Sweden is larger scale and suggests that it may be more intensive and/or specialised than dairy farming in Finland.

Table 3.19 shows the number of dairy cows in the Boreal region. It shows that the number of dairy cows is decreasing with the decrease being broadly the same between 1995 and 1996 for both Sweden and Finland.

Table 3.19: Boreal region dairy cow numbers ('000 head)

	1988	1990	1993	1995	1996	% decrease earliest to latest figure
Boreal Sweden	489.0	497.4	452.3	417.5	403.0	18%
Finland	n/a	n/a	n/a	402.3	395.5	2%
BOREAL REGION	**n/a**	**n/a**	**n/a**	**819.8**	**798.5**	**3%**

Source: Eurostat

In terms of dairy holdings (Table 3.20) data deficiencies do not allow examination of trends in the Boreal region. Nevertheless, the number of dairy holdings fell between 1995 and 1997 in Finland, and are likely to have done the same in Sweden.

Table 3.20: Boreal region dairy holdings

	1995	1997	1990-1995 percentage decrease
Boreal Sweden	15,450	n/a	n/a
Finland	32,740	30,820	6%
BOREAL REGION	**48,190**	**n/a**	**n/a**

Source: Eurostat

b) Breeds

The Boreal region contains predominantly more hardy cattle such as the Ayrshire breed, but also a significant amount of Holstein-Friesian.

c) Management systems

The predominant systems found in the Boreal region are: intensive grasslands and permanent grasslands. Further details are presented in section 4.4.

d) Intensity

Table 3.21 provides measures of intensity in Boreal dairy production.

Table 3.21: Boreal region measures of intensity

	1985	1990	1995
Average herd size (head)	n/a	n/a	17
Average size of dairy holdings (ha)	n/a	n/a	36
Average milk yield (kg/cow/year)	n/a	n/a	n/a

Source: Eurostat

This again highlights the limited availability of data.

In relation to structure, Table 3.22 and Table 3.23 show the following:

- the majority of Boreal dairy holdings have between 3 and 29 head (three quarters of the total in 1995);
- dairy farming in the Boreal region appears to be becoming smaller scale as the proportion of small holdings (1 to 19 head) and the proportion of dairy cows kept on small holdings are increasing at the expense of larger size classes (although this may be because (larger) Swedish holdings are not included in the 1997 data).

Table 3.22: Size distribution of Boreal region dairy holdings (1995-1997)

Size category (head)	1-2	3-9	10-19	20-29	30-49	50-99	100+
1995	3.11%	26.96%	43.27%	15.34%	8.32%	2.76%	0.35%
1997[1]	5.84%	29.10%	50.36%	12.46%	2.08%	0.16%	0.00%
% change 1990-1995	87.6%	8.0%	16.4%	-18.8%	-75.0%	-94.1%	-100.0%

Note:

1. Finland only

Source: Eurostat

Table 3.23: Size distribution of Boreal region dairy cows (1995-1997)

Size category (head)	1-2	3-9	10-19	20-29	30-49	50-99	100+
1995	0.46%	10.94%	35.78%	21.29%	18.27%	10.26%	3.00%
1997	0.79%	15.30%	55.27%	22.30%	5.64%	0.71%	0.00%
% change 1990-1995	71.71%	39.88%	54.48%	4.73%	-69.14%	-93.12%	-100.00%

Source: Eurostat

At a regional level, (Table 3.24) the average herd size in Sweden is more than twice that in Finland, as is average dairy farm size.

Table 3.24: Regional differences in intensity

	Average milk yield, 1996 (kg/cow/year)	Average herd size, 1995 (head)	Average farm size, 1995 (ha)
Boreal Sweden	n/a	27	59
Finland	5,888	12	25
BOREAL REGION	**n/a**	**17**	**36**

Source: Eurostat

3.5. Alpine region

The Alpine region comprises the Alps, the Pyrenees and the Apennines. It is therefore made up of parts of France, Italy, Austria and Spain. Data from the relevant regions of these countries were aggregated to provide statistics for the bio-geographical region as a whole. Where country regions were split between bio-geographical regions the data were divided proportionally. Although this artificial division is unlikely to reflect the position on the ground, in the absence of more regionally specific data, this was the only methodology available.

a) Regions

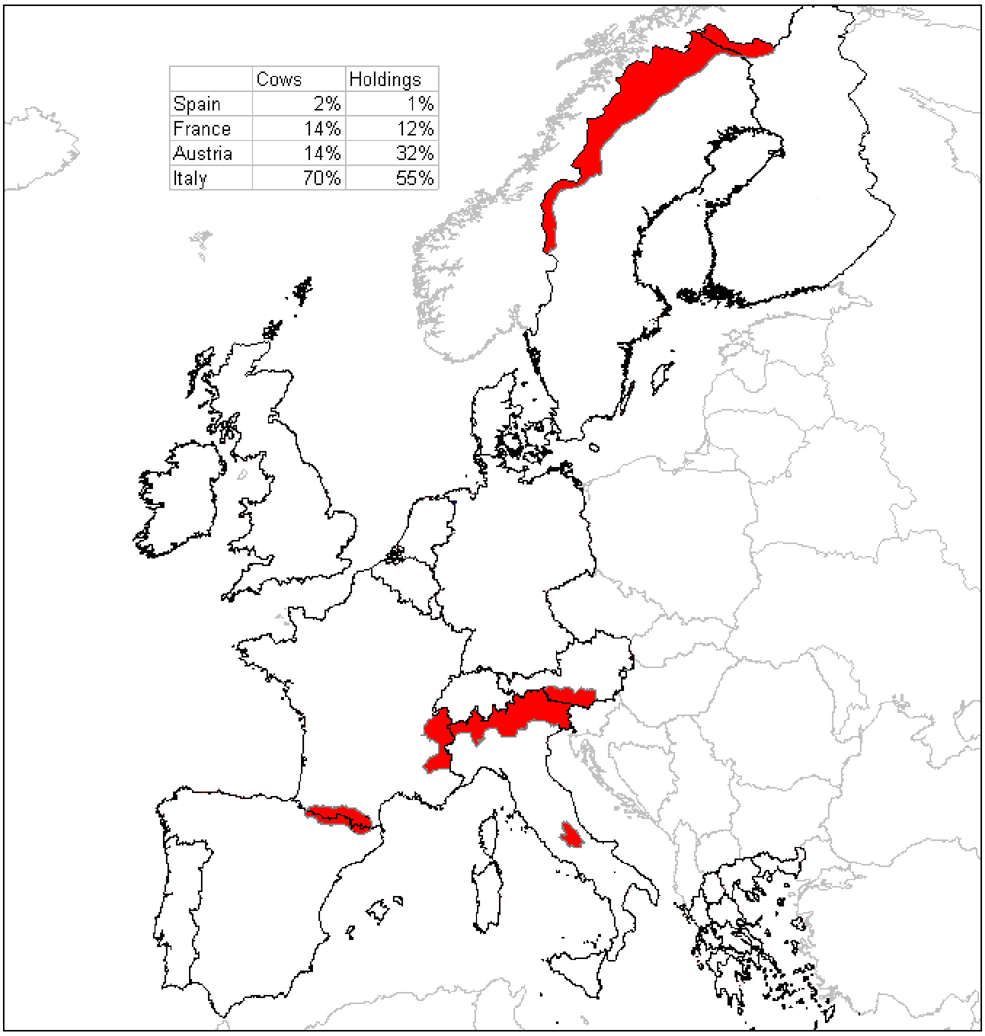


Figure 3.6: Alpine regions

The main regional features are:

- 70% of the dairy cows in the Alpine region are located in Italy (predominantly in the Italian Alps, 2% of Italian Alpine region dairy cows are found in the Apennines);
- 14% of Alpine region dairy cows are found in France (predominantly the Alps, also the Pyrenees) and 14% in the Austrian Alps. 2% are located in the Spanish Pyrenees;
- the proportion of dairy cow holdings broadly matches the distribution of dairy cows in the case of France and Spain, but 32% of Alpine region dairy holdings are found in Austria (cf. only 14% of the dairy cows) and 55% in Italy. This suggests that the intensity of production is above average for the region in Italy and below average for Austria. There are thus likely to be fewer and larger dairy farms in Italy, more frequent, but smaller dairy holdings in Austria.

In terms of dairy cow numbers, Table 3.25 shows a decline in the Alpine region by 28% between 1985 and 1995. The largest declines were seen in Spain and Austria, the smallest in France and Italy. From a dairy holding perspective, Table 3.26 shows that these have also been declining with the decrease being largest in Spain and smallest in France.

Table 3.25: Alpine region dairy cow numbers ('000 head)

	1985	1990	1994	1995	1996	% decrease 1985-1995
Spanish mountains	34.2	29.8	n/a	23.9	23.4	30%
French mountains	192.2	172.9[2]	n/a	139.9[1]	n/a	27%
Austrian mountains	201.9[1]	181.4	n/a	140.5	138.4	30%
Italian mountains	976.9	877.8	735.0	710.1	n/a	27%
ALPINE REGION	**1,405.2**	**1,261.9**	**n/a**	**1,014.4**	**n/a**	**28%**

Notes:

1. CEAS Consultants estimate
2. 1989 figure

Source: Eurostat

Table 3.26: Alpine region dairy holdings

	1990	1993	1995	1990-1995 percentage decrease
Spanish mountains	1,565	918	864	45%
French mountains	9,746	7,640	6,951	29%
Austrian mountains	n/a	n/a	18,920	n/a
Italian mountains	55,060	40,796	32,561	41%
ALPINE REGION	**n/a**	**n/a**	**59,296**	**n/a**

Source: Eurostat

b) Breeds

Recent data on breeds is largely unavailable, and where data have been found they are at the Member State level. For this reason it is difficult to list the breeds used in the Alpine region with any degree of accuracy. However, there are specific mountain breeds and dairying in mountain areas is more likely to be mixed and/or small scale and therefore a higher proportion of multi-purpose cattle can be expected. This is examined further in Section 4.

c) Management systems

The predominant systems found in the Alpine region are: permanent grasslands (mountains) and transhumant systems. Further details are given in section 4.4.

d) Intensity

Table 3.27 provides information (where it exists) on some of the main intensity variables. The limited availability of data makes it difficult to comment on trends.

Table 3.27: Alpine region measures of intensity

	1985	1990	1995	% increase (earliest to latest figure)
Average herd size (head)	n/a	n/a	17	n/a
Average size of dairy holdings (ha)	n/a	n/a	10	n/a
Average milk yield (kg/cow/year)	n/a	n/a	4,564[1]	n/a

Note:

1. Italian figure is from 1994

Source: Eurostat

Features and trends relating to structure (Table 3.28 and Table 3.29) are:

- dairy farming in the Alpine region is generally small scale with three quarters of dairy holdings having less than 20 head;
- more than half the dairy cows in the Alpine region are kept on holdings with more than 30 head. This discrepancy highlights the significant regional differences apparent within this region;
- the proportion of small (3 to 19 head) and large (at least 50 head) dairy holdings are increasing at the expense of very small and medium holdings. The largest size category shows the largest increase in the proportion of dairy cows.

Table 3.28: Size distribution of Alpine region dairy holdings (1990-1995)

Size category (head)	1-2	3-9	10-19	20-29	30-49	50-99	100+
1990	20.75%	37.42%	19.04%	8.94%	7.56%	4.54%	1.77%
1993	19.17%	34.57%	17.15%	10.41%	9.94%	6.33%	2.48%
1995	15.77%	38.40%	22.72%	8.71%	6.82%	4.97%	2.60%
% change 1990-1995	-24.00%	2.60%	19.40%	-2.70%	-9.90%	9.50%	46.60%

Source: Eurostat

Table 3.29: Size distribution of Alpine region dairy cows (1990-1995)

	1-2	3-9	10-19	20-29	30-49	50-99	100+
1990	2.17%	12.79%	16.62%	13.51%	17.97%	19.12%	17.83%
1993	1.53%	9.57%	12.45%	13.18%	19.59%	22.19%	21.48%
1995	1.46%	11.85%	17.60%	11.80%	14.54%	18.71%	24.05%
% change 1990-1995	-32.83%	-7.37%	5.92%	-12.68%	-19.11%	-2.14%	34.93%

Source: Eurostat

Regionally, the main features are (Table 3.30):

- average milk yield is highest in Spain and lowest in Austria;
- the largest average herd size is found in France, the lowest in Austria, and the largest average dairy holding is in Spain, the smallest in Austria.

Table 3.30: Regional differences in intensity

	Average milk yield, 1995 (kg/cow/year)	Average herd size, 1995 (head)	Average farm size, 1995 (ha)
Spanish mountains	5,610	25	28
French mountains	4,953	44	20
Austrian mountains	3,160	15	7
Italian mountains	4,570[1]	18	22
ALPINE REGION	**4,564**	**10**	**17**

Note:

1. 1994

Source: Eurostat

3.6. Macronesian region

The Macronesian region contains the Spanish and Portuguese island groups of the Canaries, Madeira and the Azores, situated off the Iberian and north-west African coasts.

a) Regions

Table 3.31: Distribution in Macronesian region

	Cows	Holdings
Canaries	11%	22%
Azores	87%	64%
Madeira	2%	15%

Eighty seven per cent of the dairy cows in the Macronesian zone are located in the Azores, 11% in the Canaries and 2% on Madeira. There is a greater proportion of dairy holdings than dairy cows in the Canaries and Madeira, suggesting that keeping a small number of cows is common. The reverse is true for the Azores suggesting that dairying here is more intensive and larger scale.

Dairy cow numbers in the Macronesian region increased between 1985 and 1996 (Table 3.32). This reflects an increase in cow numbers in the Azores whilst numbers fell in Madeira. Dairy cow numbers fluctuated over this period in the Canaries, but appear to have now begun a downward trend.

Table 3.32: Macronesian region dairy cow numbers ('000 head)

	1985	1990	1995	1996	% change 1985-1996
Canarias	10.5	12.4	10.7	10.5	0%
Azores	69.1	72	79	82	19%
Madeira	4.0[1]	3	2	2	-50%
MACRONESIAN REGION	**83.6**	**87.4**	**91.7**	**94.5**	**13%**

Note:
1. 1986 figure.
Source: Eurostat

A summary of changes in dairy holding numbers is shown in Table 3.33. It shows that unlike dairy cow numbers, the number of dairy holdings decreased. The decline was greatest in Madeira and the Canaries, and not so significant in percentage terms in the Azores. The increase in dairy cow numbers in the Azores (Table 3.32) was more than compensated for by the decline in the number of holdings (Table 3.33) with the result that the average number of dairy cows per holding rose from 9.5 in 1990 to 14.2 in 1995. Concentration also increased on the other islands.

Table 3.33: Macronesian region dairy holdings

	1990	1993	1995	1990-1995 percentage decrease
Canarias	3,530	2,060	1,880	47%
Azores	7,580	6,340	5,560	27%
Madeira	2,530	1,380	1,290	49%
MACRONESIAN REGION	**13,640**	**9,780**	**8,730**	**36%**

Source: Eurostat

b) Breeds

No quantitative data is available, although it is believed that most of the dairy cows are Holstein-Friesians.

c) Management systems

The main systems found in the Macronesian region are intensive grasslands and permanent grasslands. Further details of management practice are given in section 4.4.

d) Intensity

Table 3.34 provides measures of intensity for the Macronesian region.

Table 3.34: Macronesian region measures of intensity

	1985	1990	1995
Average herd size (head)	n/a	6	11
Average size of dairy holdings (ha)	n/a	7	10
Average milk yield (kg/cow/year)	n/a	4,251[1]	4,712

Note:

All average milk yields exclude the Canaries

1. 1993 figure

Source: Eurostat

The main feature appears to be one of intensification (in terms of all the indicators presented). Structural features and trends (Table 3.35 and Table 3.36) are:

- dairy farming in the Macronesian region is small scale: nearly two thirds of dairy holdings have less than 10 cows;
- however, dairy cows are spread fairly evenly across the size categories with the exceptions of the 50-99 head, more than 100 and 1-2 categories (under represented);
- the trend is for larger farms, most notably in all size categories which exceed 20 head. Dairy cows are becoming concentrated onto holdings with more than 20 head.

Table 3.35: Size distribution of dairy holdings in the Macronesian region

Size category (head)	1-2	3-9	10-19	20-29	30-49	50-99	100+
1990	49.71%	29.62%	12.32%	4.25%	2.71%	1.03%	0.22%
1993	40.90%	29.14%	16.05%	7.46%	4.50%	1.53%	0.41%
1995	34.59%	31.50%	16.27%	8.59%	6.19%	2.18%	0.57%
% change 1990-1995	-30.40%	6.40%	32.10%	102.00%	128.00%	112.00%	160.40%

Source: Eurostat

Table 3.36: Size distribution of dairy cows in the Macronesian region

	1-2	3-9	10-19	20-29	30-49	50-99	100+
1990	11.15%	22.09%	23.55%	14.35%	14.22%	9.80%	4.84%
1993	6.17%	16.10%	23.27%	18.58%	17.66%	10.44%	7.78%
1995	4.41%	15.11%	20.38%	18.51%	20.51%	12.58%	8.50%
% change 1990-1995	-60.48%	-31.63%	-13.46%	29.04%	44.26%	28.42%	75.63%

Source: Eurostat

At a regional level (Table 3.37) average milk yield in the Azores is more than twice that in Madeira. However, average herd size and farm size in the Azores is much greater than those found in either Madeira or the Canaries.

Table 3.37: Regional differences in intensity

	Average milk yield, 1990 (kg/cow/year)	Average herd size, 1995 (head)	Average farm size, 1995 (ha)
Canarias	n/a	6	3
Azores	4,784	14	14
Madeira	1,900	2	1
MACRONESIAN ZONE	**n/a**	**11**	**10**

Source: Eurostat

4. Classification of dairy farming for environmental purposes

4.1. The environmental perspective

From an environmental or nature conservation perspective, dairy farming systems present a rather more straightforward set of interactions with the landscape, biotopes and the broader aspects of environmental quality (pollution, eutrophication) than many other agricultural sectors. Also, the main dairy producing areas are geographically rather discrete (Sections 2 and 3); although in fact, the volume of milk production alone can give a misleading picture of the distribution of farms which include a dairy enterprise.

The information presented in Sections 2 and 3 shows clearly that the majority of EU milk production comes from intensive production systems in the lowlands of the Atlantic Region. Key trends on dairy farms in this Region have been: moves to larger average herd size; higher yields per cow; increased use of fertilisers; and, at the same time, fewer dairy farms. Whilst this trend for intensification of production is rather a broad generalisation and there are some notable regional differences (particularly between northern and southern Member States), it is a picture which reflects the dominant trend across most of the major dairy farming areas of Europe.

There are two very important measures of intensity of production; at farm level, increased production per unit essentially means increasing the output per hectare for crops and increasing the number of livestock units per hectare for livestock.

At the industry level it is reflected in a continuing shift away from the grazing of natural pastures (or the provision of rough fodder from pastures and crops) and the seasonal production of milk (the common historical European method of producing milk), towards production using less grazing and less farm produced fodder. The end point in this trend is the use of industrial production units with a zero-grazing regime, and producing no on-farm fodder. Between these extremes (which also clearly have extremes of associated environmental value or impact) there are a range of dairy enterprises, in a continuum within which there are three rather distinct groupings. Firstly, those that utilise managed grasslands to provide both grazing and winter fodder; secondly, those that produce a high proportion of grain and cereals as fodder for indoor and winter feeding; finally, those where the feeding system is based almost exclusively on fodder with little or no grazing.

4.2. Land use categories (fodder and forage resources)

Ideally we would propose a categorisation of dairy farms which would be initially based on the division of each of the bio-geographical regions presented in Section 3 into a number of farmland categories or types of dairy farms. However, a drawback of using the bio-geographical regions, which were first put forward in the Habitats Directive, is that they are based primarily on climate, topography and latitude and they do not reflect soil-type, which is so important in determining the distribution of agricultural practices. In addition, they can take no account of technological and economic factors which are often critical in determining the location of agricultural practices.

For the purposes of the Habitats Directive this was not a problem because the focus was a European stratification to describe the distribution of naturally occurring plants and animals, with the habitat classification itself providing the further sub-division needed. Attempts to generate very detailed classifications, for example the digitised map of European ecological regions DMEER (ETC/NC,1977), often run into the problem that in the quest for detail the general picture becomes obscured. Although simplification is always a source of impoverishment (Rouquette et al, 1997) it is unquestionably better to have a clear, global vision, albeit somewhat simplified.

In practice there are a variety of regional descriptions of dairy farms in Europe which can be used to form the basis for a classification structure and which meet the criteria of ensuring that groups are:

- relatively stable (that there is greater variation between groups than within);
- broad enough to apply to a large number of farms over large areas;
- easily differentiated by a small numbers of indicators;
- clearly related to the bio-geographical regions and to environmental impact.

From a biological and a landscape viewpoint probably the best <u>initial</u> discriminator between different types of dairy farms is in the balance of management between the grazing land (the pastures and meadows) and the cropped land to produce forage and fodder. This is because virtually all dairy farms combine the use of pastures for grazing with the production of fodder for the period outside of the growing season (winter in the north but also summer in the south). So, the proportion of the farm under broad types of pasture and crops (natural pasture, permanent grassland, ley (sown) grassland or types of cereals and grains) can be used to produce broad land use classes that characterise the way the farms use the land. In essence, this means that the primary way in which we classify EU dairy systems from an environmental perspective is using a combination of the economic/technical classifications presented in Section 2, the bio-geographical regions of Section 3 and categories of land use (fodder and forage resources). These are brought together in Table 4.1 and the forage and fodder resources discussed in more detail below.

a) Semi-natural pastures (P1)

Natural vegetation pastures form over 80% of the forage area and the pasture includes a variety of vegetation – grassland, heathland, scrub and woodland. Winter fodder is predominantly on-farm produced hay, silage and some grains. Traditional, locally adapted regional breeds are used, often involving short or long distance transhumance to the summer pastures. Crops are grown in different locations to the pastures.

b) Grasslands (G1 to G3)

i) Ley (sown) grassland dairy farms (G1)

Maximum use is made of rotational and permanent grasslands to provide both winter fodder and summer forage. Crops (barley, maize, fodder beets, lucerne depending on locality) represent less than 40% of the UAA. Maize is increasingly being grown (for silage) but over 60% of the UAA is forage composed of rotational (ley) grassland.

ii) Permanent grassland dairy farms (G2 and G3)

Permanent grassland accounts for 80-100% of the MFA (main fodder area). Little if any cereal is grown and only for on-farm consumption.

c) Cereals and grain 1: maize (M1)

At least between 25% and 60% of the MFA is used to grow maize in association with grass. Over 80% of the UAA is suitable for ploughing and the cultivated land not growing maize or cereals is under grass with swards based on ryegrass. In some areas maize cultivation exceeds 60% of the MFA.

d) Cereals and grain 2: mixed cropping (CG1 to CG3)

Many of the northern European dairy farms (the UK, the Netherlands, Denmark, Sweden) combine grasslands with a variety of arable crops to provide grain and arable silage. There are strong regional differences in crops (reflecting soils and climate). For instance, in Denmark a typical combination on a conventional dairy farm would be 12% permanent pasture, 26% rotational grass/lucerne, 10% fodder beets, 16% whole crop silage, 32% grain for harvest and 3% cash crops (Halberg et al 1997).

On an organic mixed farm in the UK a typical combination of crops that would be grown in rotation would be: spring barley, winter barley, oats, peas (for silage) and permenent and short term grass/white clover grazing leys with red clover/lucerne and perennial ryegrass leys for silage.

In southern Europe (Greece, Spain, Portugal and Italy) small family enterprises with low yielding cows (grazed for only three months in spring and early summer) cultivate a wide variety of fodder crops which are cut and fed to the cows by hand.

e) Limited grazing dairy farms (L1 and L2)

These include two types of dairy enterprise at different ends of the spectrum. However, in both, the cows spend most of their time housed. In the north and east it involves large dairy herds (up to 500 milking cows) which may be permanently housed. They are high yielding cows fed concentrated rations and bought-in maize or lucerne silage. There is virtually no on-farm production of fodder. In the south it includes many of the commercial Mediterranean dairy farms (Italy and more recently in Greece and southern Portugal) in which cows are permanently housed and fed concentrates and purchased fodder (eg, maize silage, alfalfa hay and straw). Some of the more intensive L2 systems verge of being the Mediterranean equivalent of L1 (in Portugal dairy farmers regard commercial systems as those which have enough land to produce their own fodder to support the herd and industrial systems as those which do not[8]). However, this is complicated by irrigation which effectively reduces the area needed per cow.

The broad categories or classes are not rigid and there is overlap between farm types and the regions where they occur. However, the classes do reflect the key differences in the impact on the character of the land made by dairy farming. Considering dairy farms in this way is helpful from an environmental perspective because there is a tendency for some environmental issues and farm types to be associated more with particular bio-geographical regions than others, with rather discrete geographical areas, and

[8] P Eden pers.comm.

importantly, with particular production systems. Accordingly, by linking them with the technical and economic production classification it is possible to produce a typology of EU dairy systems.

Since this typology reflects both the physical characteristics of the land and the intensity of its management, it should be possible to make assessments and generalisations about the main environmental impacts associated with dairy farms in a relatively small number of EU dairy systems.

4.3. A Typology of EU Dairy Systems

In Table 4.1 the five main economic and technical production classes (described in section 2.3) are cross-tabulated with the land-use categories described in section 4.2 above. It should be noted however, that not all of the intersecting boxes produce combinations that can be regarded as a system. For example, high input/output cannot combine with semi-natural pastures, nor can maize cultivation with Alpine or Boreal dairy farms. However, there are 10 combinations which do describe systems into which most of the EU's dairy farms can be allocated. For two of these, L1 and CG2, there is only limited (specific) information but they are included for completeness (and may assume greater importance in the future[9]).

It is possible to differentiate the systems by reference to threshold values of some key indicators (where data exists - Table 4.2). These are expanded upon in Section 4.4 (a-j) to provide a profile of systems. Although these systems are not derived in a strictly objective way, using the information in the profiles, they can be characterised quantitatively as well as by description, as shown in Figure 4.1. This dendrogram can also be used to allocate any EU dairy farm to one of the systems. The three rows at the bottom of Figure 4.1 show in which biogeographical regions the systems occur and provide an estimate of the proportion of dairy cows and milk production.

[9] It is possible to technically identify two more classes but the number of farms within them is too low to merit detailed description.

Table 4.1: EU dairy systems

See Table 4.2 for typical threshold values for indicators of each system

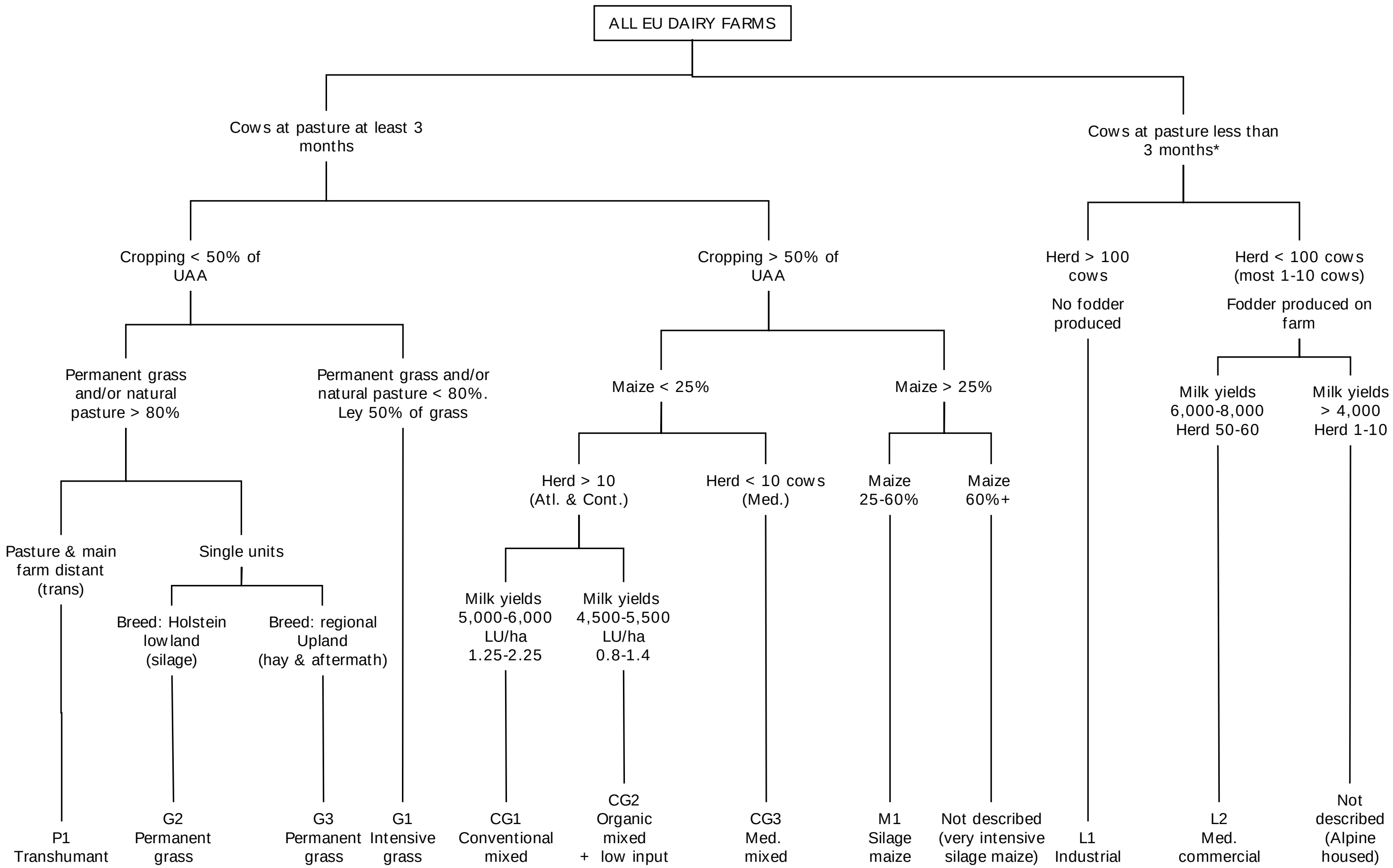
		FODDER AND FORAGE RESOURCES (LAND USE CATEGORIES)				
CATEGORIES OF PRODUCTION AND REGIONS		***SEMI-NATURAL PASTURES***	***GRASSLANDS***	***CROPS & GRAIN MIXED***	***CROPS & GRAIN MAIZE***	***LIMITED GRAZING***
CONTINENTAL ATLANTIC BOREAL MACARONESIAN	***HIGH INPUT/OUTPUT***		**G1** INTENSIVE GRASSLAND SYSTEMS (LEYS) GRASS 60% + CROPS	**CG1** CONVENTIONAL MIXED SYSTEMS CROPS 50%+	**M1** INTENSIVE MAIZE SILAGE SYSTEMS MFA = Maize 25%-60% CROPS 50%+	**L1** INDUSTRIAL
	LOW INPUT/OUTPUT		**G2** PERMANENT GRASSLAND SYSTEMS (Lowland) GRASS 80%-100%	**CG2** LOW-INPUT AND ORGANIC MIXED SYSTEMS		
ALPINE AND BOREAL	***LOW INPUT/OUTPUT***	**P1** TRANSHUMANT SYSTEMS	**G3** PERMANENT GRASSLAND SYSTEMS (Mountain) GRASS 80-100%			
MEDITERRANEAN	***HIGH INPUT/OUTPUT***					**L2** MEDITERRANEAN COMMERCIAL SYSTEMS
	LOW INPUT/OUTPUT			**CG3** MEDITERRANEAN MIXED SYSTEMS (SMALL SCALE)		

Table 4.2: EU Dairy systems: Typical threshold values for indicators of each system

		PRINCIPAL EU DAIRY SYSTEMS				
		P1	***G1***	***G2***	***G3***	***CG1***
INDICATOR	***NAME OF SYSTEM***	**TRANSHUMANT**	**INTENSIVE GRASSLAND (Leys)**	**PERMANENT GRASSLAND (Lowland)**	**PERMANENT GRASSLAND (Mountain)**	**CONVENTIONAL MIXED**
	FERTILIZER USE KgN/ha/year	Very low mineral + manure	100-150 (Fr) 150-350 (UK+NL)	50–100 (up to 200 in the UK)	40-80	150–230
	MAIN WINTER FODDER (IN ORDER)	Hay	Grass silage/cereals	Grass silage/hay/cereals	Hay/grass silage	Grass and arable silage/cereals/beet
	CONCENTRATES FED kg/cow/year	500-1,000	1,000–1,200 (Fr) 1,600–3,000 (UK)	100–2,000	800-1,500	1,000-2,000 (including grain)
	FARM SIZE UAA (ha)	10–30 in valley 100–500 in mountain	70–140 (UK) Others 20-60	20–80 more in the UK 100-140 on collectives in FR	30–50	50–70 (Dk) 60-90 (D), more in UK
	AVERAGE HERD SIZE	5-150 (av. 20)	30-60 (Fr), 30 (Sw/Fin) 55-200 (UK)	30–100	25–45	40–60 (Dk) 80-200 (UK)
	BREED (most common)	Regional	Holstein-Friesian	Holstein-Friesian	Red & White, Regional And Dual Purpose	Holstein-Friesian
	MILK YIELD Litres/cow/year	3,000-4,000	6,000–8,000 (UK/Sw)	4,000-6,000 7,500 (UK)	4,000–5,500	5,000–8,000
	LIVESTOCK DENSITY LU/ha	Traditionally <1.0 but increasing	1.4–2.0	0.6–1.4 (1.9 Ire)	0.4–1.4 most <1.2	1.25–2.25
	MAIN LOCATIONS	Alps, Pyrenees, Cantabrian	UK, Brittany, NL, Sweden & Finland	Normandy & Ireland	Mt. Foothills & plateaux France & Germany (Bavaria) Boreal	Denmark UK, German Old Länder
	BIO-GEOGRAPHICAL REGIONS	Alpine	Atlantic, Boreal, Continental, Macaronesian	Atlantic, Macaronesian	Alpine, Boreal, Continental, Atlantic	Atlantic, Continental
	NUMBER/SHARE OF DAIRY COWS (‘000s)	150 (1%)	13,863 (62%)	1,239 (6%)	1,112 (5%)	2,063 (9%)
	NUMBER/SHARE MILK PRODUCTION (‘000 tonnes)	695 (1%)	71,791 (64%)	5,392 (5%)	4,537 (4%)	11,097 (10%)

Table 4.2 (continued)

		PRINCIPAL EU DAIRY SYSTEMS				
		CG2	***CG3***	***M1***	***L1***	***L2***
INDICATOR	***NAME OF SYSTEM***	**LOW-INPUT & ORGANIC MIXED**	**MEDITERRANEAN MIXED (SMALL-SCALE)**	**INTENSIVE MAIZE SILAGE**	**INDUSTRIAL**	**MEDITERRANEAN COMMERCIAL**
	FERTILIZER USE KgN/ha/year	<170 (no mineral)	None	120–150 (Fr)	-	No data
	MAIN WINTER FODDER (in order)	Grass silage & arable/hay/cereals/beet	Cereals/dryland rye grass silage and hay	Maize silage	Maize silage and bi-products	Maize silage/rye grass silage
	CONCENTRATES FED kg/cow/year	500 and cereals (1,000)	300-600	1,300-1,800	c.2,000+	2,000+ 3,000 (Italy)
	FARM SIZE UAA (ha)	50 (Dk)	No data (very small)	30-35	Detached from land	20
	AV. HERD SIZE	50-60	1–10	25-35	100-500	50-60
	BREED (Most common)	Jersey, Guernsey Red & Whites	Wide variety	Holstein-Friesian 80%	Holstein-Friesian	Holstein-Friesian
	MILK YIELD Kg/cow/year	4,500-5,500 (7,000) organic	2,000-3,000	7,000–8,000	Est. c. 9,000+	6,000-8,000 6,000 (Gr)
	LIVESTOCK UNITS LU/ha	0.8–1.4	1-0	1.7–2.2 (Fr)	Zero grazing	Zero grazing
	MAIN LOCATIONS	Denmark UK	Portugal Greece S. Italy S. Spain	Brittany & Basse-Normandie, N.Italy, Germany(Rhine valley)	New Länder N. European lowlands (NL and UK)	Spain, Portugal, Italy
	BIO-GEOGRAPHICAL REGIONS	Atlantic, Continental	Mediterranean	Atlantic, Continental	Atlantic, Continental	Mediterranean
	NUMBER/SHARE OF DAIRY COWS (‘000s)	674 (3%)	365 (2%)	1,405 (6%)	729 (3%)	864 (4%)
	NUMBER/SHARE MILK PRODUCTION (‘000 tonnes)	2,826 (3%)	1,489 (1%)	7,350 (7%)	3,375 (3%)	4,469 (4%)



* may be longer in irrigated systems

Figure 4.1: EU dairy farms

4.4. Dairy system profiles

a) P1 Transhumant systems

i) Management objectives

The seasonal exploitation of natural high altitude pastures to graze dairy cows producing milk for specialist (high value) products. To exploit the (consumer and producer) perception that the taste and quality of alpine cheeses is attributable to the oils and aromatic substances in the grasses and herbs grazed by the cows.

ii) Location

Restricted to mountain areas such as the Alps, Pyrenees and Cantabrian mountains. These are long established systems which reduced significantly in recent years.

iii) Farm structures and forage

Farms are composed of two main sub-units. The valley farm, usually close to or in a village, where the cows are milked and housed from October to May, and the facilities on the mountain pastures used to milk the cows from June to September. In the mountains the cows are hand milked and units consist of a main building for milking (and producing and storing cheese), accommodation for the farmer and a cow shed. Typical Transhumant dairy farms in the Italian Alps have between 10 and 30ha in the valley and around 200ha in the mountains. Summer stocking rates vary between 1.0–2.0 LU/ha in the most active areas but are lower where abandonment is happening. Slurry is spread in the mountains on pasture close to the cow sheds or more widely using elaborate systems of ditches and distribution channels.

iv) Animal system

Local regional mountain breeds adapted to the rough and cold conditions (eg, Grey Alpine, Dappled Red, Rendena) are used depending on the area. Herd size ranges from 5 to 150 cows (average around 50) with milk yield averaging 3,400kg/cow/year. Approximately 100kg of milk makes 10kg of cheese (ie, usually 10% of milk). In the French Alps yields are raised to 4,000kg using 800kg of concentrate for making Beaufort Roblechon cheese. Calving is in the Spring to maximise summer milk production. During the winter cows are housed in cow sheds.

v) Feeding system

In Spring the cows graze valley and mid altitude meadows and again in Autumn when they are aftermath. During the summer they graze sections of pasture in rotation to allow regeneration. In winter they are fed on hay from the natural valley meadows. Concentrate feeds and silage are generally restricted to cows not producing milk used to make cheese as it is perceived by some that these feeds may taint the milk.

b) G1 Intensive grassland (leys) systems

i) Management objectives

The primary objective is to meet the industrial demand for constant all year round milk supply using intensive animal production. A secondary objective is to produce milk of suitable composition for specialist uses (chocolate, milk products, cheese) by meeting the herds nutritional requirements with high-quality grass forage. In northern latitudes maximising the production per hectare of high quality grass silage for the long indoor feeding period whilst minimising the high concentrate costs is important. In the UK and Holland soils and climate make intensive grassland management the most economic option for maximising output per cow and per hectare.

ii) Location

The wetter and cooler parts of the Continental and Atlantic regions where conditions are unsuitable or marginal for maize cultivation, and in the Boreal zone. Also on potentially more intensive farms (eg, in areas with potential for maize silage) where extensification is an objective (eg, biodynamic farms). The main regions are Holland, SW England and SW Scotland, Western France (eg, La Mayenne), Sweden and Finland, North Spain, parts of the Azores.

The Atlantic and Continental regions account for 69% of all temporary grass and nearly 80% of all dairy cows, the majority of which are reared in either this system or M1 (see below).

iii) Farm structures and forage

This system is found on large specialist modern dairy farms (from between 70-140 ha) and although there is wide variation in farm size (largest in the UK, smallest in Brittany and Holland) the intensity of production is always high (two or three cuts of silage). Fertiliser application ranges from 150kg to 300kg N/ha. Clover-safe herbicides are often used on the grasslands. Stocking rates are high (eg, 1.0-1.4 LU/ha in France, 2.00-2.5 LU/ha in UK). Grass silage is complemented with the cultivation of fodder crops including small grains (barley), fodder beets and silage maize, however, the cropped ground rarely exceeds 25% of the UAA (but it can be as high as 40%).

iv) Animal system

Average herd size is between 30 and 60 cows (higher in the UK, lower in Sweden and Finland) and the commonest breed is the Holstein-Friesian. Milk yield is between 6,000 and 8,000kg/cow (typical for southern Sweden and the UK). Calving may be spring or autumn depending on location and whether there are seasonal changes to the price of milk (ie, whether a spring or autumn peak). Cattle are housed for a large part of the year (8 months in the north).

v) Feeding system

More than 60% of the farmland is grass and crops, and summer grazing consists of intensively managed grass pasture and silage and arable aftermaths. Supplementary feed is fed throughout the year in the highest yielding herds. Concentrate quantities can exceed 1,500kg/cow/year (eg, 1,600-1,800kg in the UK) representing as much as 40% of the feed consumption. An increasing proportion of farms (10%) give a complete mixed ration and on the more technologically advanced units concentrates are fed on an individual basis. Some cows are fed purely to entice them into the milking parlour, depending on the relative costs of labour or concentrates.

c) G2 Permanent grassland systems (lowlands)

i) Management objectives

To take advantage of summer grass production by feeding cows primarily at grass pasture in the summer in regions where tillage is difficult, soils shallow or temperatures low, making conditions unsuitable for cereal and maize cultivation. High rainfall favours maximum use of grass. Also organic and biodynamic dairy farms.

ii) Location

Northern and eastern France, Ireland, north and west of UK, parts of the Azores.

iii) Farm structures and forage

These systems are found on modernised specialist dairy farms. Farm size varies considerably (20-80ha), but in general these are large holdings, especially where farms are run collectively (eg, through a Groupement agricole d'exploitation en commun in France) and in the UK.

Most of the UAA is not under forage crops, cereals occupy less than 30% of UAA often in rotation with maize, wheat and brassicas. The rest of the land is under grass, mainly in the form of permanent grassland. Many farms are purely grass with no tillage at all (eg, mainly in Ireland). Forage growing areas are managed on a fairly extensive basis, with mineral nitrogen applications between 50-100kgs/ha/year although this can be more on small farms that abandon cropping (tillage) and maximise returns from grass with more than one cut of silage (eg, in Wales up to 240kg/ha plus slurry). Stocking rates are on average 1.0-1.4 LU/ha (1.9 LU/ha in Ireland and locally at higher levels in parts of France and the UK).

iv) Animal system

Average herd size is 30-60 cows in France (higher in the UK) and usually Holstein-Friesian. The average herd size is increasing as more small farms stop dairying (eg, Wales). Farms often produce beef as well, with a fattening unit for dairy and cross-beef bull calves born on the farm. Many farms also have suckler cows but because of the 120,000kg[10] limit on dairy farms receiving SCP these are either as split businesses or only on small farms. In the UK, sheep may also be reared. Average milk yield is around 6,000 litres/cow. If grazing is well managed concentrate input can be as low as 500kg per cow. Calving is mainly in the spring in Ireland, but in the autumn in places like Brittany and Normandy. The objective is always to maximise the economic return from quota using grassland management. Farms are often family concerns with simple feed systems; technical performance is sometimes not the prime concern or objective of the system.

v) Feeding system

The feeding system involves a mixed winter diet of grass silage, hay and maize silage and a summer diet based on grazing. The most widespread feeding system is individual troughs or with self-help silage feeders with concentrate feed in the milking parlour.

d) G3 Permanent grassland systems (mountains)

i) Management objectives

These specialist dairy systems are based on hill grasslands with the intensity of management reflecting the milk production possibility (quota) per hectare. At the intensive end of the scale, where quota is not limiting, production is derived from grass silage plus concentrate feeding to

[10] 120,000kg is about the production from 20 cows at around 5,500kg/cow/year, so the EU regulations tend to encourage specialisation rather than mixed farms.

obtain higher yields per cow. The more traditional hay plus aftermath system occurs where limiting production costs is the prime concern or where there are requirements for cheese making. The smaller, less intensive holdings are often managed part-time.

ii) Location

In uplands, high plateaux and mountain foothills in the Atlantic, Continental and Alpine regions, for example, the Massif Central, Auvernge, the Black Forest and the foothills of the Alps, Pyrenees and Cantabrian mountains.

iii) Farm structures and forage

Holdings generally have a UAA of 30-50ha with the smallest in the Alps and the largest on the plateaux (eg, 40-80ha in Franche-Comte, 50-70ha in Black Forest, 25-40ha in the French Alps). Farms have virtually all their land under grass with just a few hectares of cereal for on-farm consumption. Natural grassland accounts for 80-100% of the MFA. Stocking rates range on average from 0.4 to 1.4 LU/ha depending on farm size and quota. Mineral fertiliser use is low (40-80kg N/ha) but this intensification enables earlier first cut hay or silage and the possibility of silage or barn-dried hay followed by high-quality aftermath.

iv) Animal System

Holstein-Friesians are common on the more intensive farms, but red and white breeds are common elsewhere, and in many areas, small regional breeds are still common (Montbeliard, Tarin, Abondance, Hinterwald, Vorderwalder, Hinterwalder and Eringer). Herds are generally composed of between 25 and 45 cows (20-30 in the Black Forest). Average yields are very variable from 4,000-5,500kg/cow/year (ranging from 3,800kg/ cow/year in southern Germany to 6,000kg/cow/year in Franche-Comte). Calving is generally from September to December to take advantage of winter fodder and higher milk prices. On the less intensive farms calving is later and more protracted to take advantage of the spring flush of grass and reduce winter feed distribution.

v) Feeding System

Virtually all the farmland is under grass. Grazing lasts at least six months, generally in rotation with hay, silage and aftermath. Supplementary feeding at grass is limited (100-300kg DM hay or silage) but can be as much as 300-500kg in hay systems. Winter rations consist of hay or grass silage plus concentrates. The later strongly determining the output of milk per cow (eg, 1,000kg/cow for a yield of 5,000 litres and 1,500kg for 6,000 litres yield). At the same level of output, systems using the most direct-cut silage use more concentrate than the less intensive systems; use of barn dried hay economises even more on concentrates. Farm buildings vary widely but are generally closed and functional – with loose housing (free stalls or slatted) or tethered housing with or without a dunging mechanism, feeding alley and milk pipeline. Hay is usually stored in the same building, silage outside. The latter is fed mechanically, but hay is often fed by hand.

e) CG1 Conventional mixed systems

i) Management objectives

To meet the industrial demand for year round fresh milk using intensive cultivation of farm produced fodder crops, adjusted to soil type and climatic conditions to maximise yields. Dairy production is often combined with grain production.

ii) Location

Found throughout the lowlands of the Atlantic and Continental regions where soils make crop cultivation viable but where temperature restricts the possibility of intensive maize cultivation. Denmark, UK, Western Germany.

iii) Farm structures and forage

These farms employ a system of rotational arable cropping with cereals, fodder beets and cash crops in combination with temporary grassland, usually with only a small area of permanent pasture. Proportions vary between areas, on the relative price of bought-in feed to home grown fodder and on the proportion of concentrates fed. Typically 50% of the UAA is under crops. Average farm size is between 60 and 90ha, smaller in Denmark and larger in the UK. Stocking rates range from 1.25 to 2.25 LU/ha. Mineral fertiliser use is in the region of 150-230kg N/ha.

iv) Animal System

The commonest cows are large heavy breeds mostly Holstein-Friesian, but also regional breeds (Ayrshire, Danish Friesian, Danish Red and Jersey and Guernsey in the UK). Average herd size is 40-60 cows (up to 100+ in the UK) with milk yield averaging 5,000-6,000kg/cow/year, but higher on intensive farms using a high proportion of concentrates.

v) Feeding System

These are intensively managed dairy farms with cows at grass in the summer (temporary grass and aftermath) and in open shed or yards in winter where they are fed a ration of grass and arable silage, small grains and harvested fodder beets. Concentrate supplements are fed in the milking parlour or at individual feeders and vary a lot between farms depending on target milk production. For example, up to 2,000kg/cow/year (including grain) on conventional Danish mixed dairy farms with a milk production of 7,800kg milk/cow/year.

f) CG2 Low input & organic mixed systems

i) Management objectives

To meet the rapidly increasing demand for organic milk and milk products. Also where environmental schemes seek to reduce the damaging effects of intensive mixed dairy farming. This is a developing, relatively recent dairy system, within which there is a very wide range of farms. They are probably most common in Denmark and France but are increasing.

ii) Location

Throughout the lowlands of the Atlantic and Continental regions wherever conventional mixed cropping systems occur (see above).

iii) Farm structures and forage

Although essentially based on a rotational arable cropping system there are some important differences from the intensive system. The hectarage of permanent pasture and temporary grass tend to be similar, but the area of fodder beets and arable (whole crop) silage can be only half that of conventional systems, the balance generally being met by a larger area of rotational clover-grass and lucerne for silage. The average yields per hectare of grain crops, beets or grass fodder can be expected to be 15-30% lower than using conventional methods. Stocking rates are around 40% less ranging from 0.8-1.4 LU/ha. On organic farms the use of mineral fertiliser is prohibited and the use of animal manure is restricted to that produced from 1.4 LU/ha/year. The latter would lead to greater N losses to the atmosphere, for example, 102kg N/ha/year compared with 33kg N/ha/year in conventional systems in Denmark (Halberg et al 1995). There is no pesticide use on organic farms and more stringent standards of animal welfare than in conventional farms.

iv) Animal systems
Breeds such as Jersey and Guernsey are used in addition to the Holstein-Friesian. Average herd size is 50-60 cows (larger in the UK) with milk yields between 4,500 and 5,500kg/cow/year.

v) Feeding systems
Cows are at grass in the summer (temporary grass and aftermath) and in open shed or yards in winter where they are fed a ration of grass and arable silage. Organic systems are restricted as to the amount of purchased non-organic fodder that can be included in the diet (usually 15%). A typical organic mixed farm in Denmark might use on average 10% rapeseed cake and 20% grain in the total ration. For a target production of around 7,200kg of milk/cow this would equate with 500kg of rapeseed cake and 1,000kg of grain.

g) CG3 Mediterranean mixed systems

i) Management objectives
Small scale production of milk using family labour to provide local milk factories.

ii) Location
Widespread throughout the Mediterranean region in the wetter parts of northern Portugal, in the less fertile and arid areas of Spain, Italy and Greece (where irrigated maize cultivation is not possible).

iii) Farm structures and forage
Farms are small, generally less that 20hawith cows kept intensively or semi-intensively with grazing restricted to three to four months in the spring depending on the area. Traditional polyculture systems include a mixture of tree crops, vegetables and cereals (rye, maize, oats, triticale, lucerne) grown in small unfenced plots to produce roughage for harvesting. Slurry and manure is used in the cultivation system but there is virtually no use of mineral fertilisers.

iv) Animal system
Both Holsteins and multipurpose breeds (some of local origins) are used. Holsteins and regional breeds are crossed with beef bulls such as Charolais or Limousain. Housing facilities are often antiquated and most cows are milked by hand for seven to eight months. Average milk yield is about 2,000-3,000kg/cow/year. Calving is mainly in the spring and calves are either sold to a fattening unit or kept for a suckling period of 2-3 months and fattened and sold for slaughter at a live-weight of 450-500kg aged 15-18 months.

v) Feeding system

Cattle are often grazed in the day on poor pastures and stubbles and housed at night. Feed is a combination of home produced fodder and a small amount of purchased concentrates (300-600kgs/cow/year). Supplementary green fodder fed in the summer is often hand cut or using hand held petrol-driven reapers.

h) M1 Intensive maize silage systems

i) Management objectives

To use intensive animal production to meet the industrial demand for a year round milk supply for processing into cheese and fresh milk products. To meet the herd's nutritional requirements from high quality forage (maize) while keeping production costs as low as possible.

ii) Location

Those lowland parts of the Atlantic and Continental regions where climate and soils favour the growing of early to semi-early maize, for example, parts of western France, south-west France, northern Italy, the Rhine valley and some areas of southern England. These are farms where over 80% of the UAA is normally suitable for cultivation. These are highly productive farms; more than 45% of French milk is produced in this system (mostly in western France).

iii) Farm structure and forage

Holdings have 30-35ha UAA on average (less in Italy, more in Germany) but everywhere farm size is increasing annually (eg, by 1ha/year in France). These are low lying regions (below 400m) with good conditions for cultivation. Stocking rates are 1.7-2.2 LU/ha with mineral fertiliser applied at the rate of at least 120-150kg N/ha.

iv) Animal system

The commonest breed is the Holstein-Friesian (over 80%). Average herd size is 30–35 cows and milk yield is between 7,000 and 8,000kg/cow/year. Calving is concentrated in the autumn between September and December to take advantage of higher milk prices. Over half of the herds are housed loose, the others being kept mostly in free stalls.

v) Feeding system

The balance of arable land not under maize is usually under rotational grass based on rye grass (most frequently maize represents 25-60%, but can sometimes be over 60%). Maize silage usually provides two-thirds (or more) of stored feed because of its uniform nutritional value and high forage yield. Concentrates are fed in quantities varying from 1,300-1,800kg/cow/year consisting of 60-70% N-enriched concentrate and 30-40% pulp or cereals. At 60% of farms silage is fed at the trough, at the rest at self-feed clamps.

i) L1 Industrial systems

i) Management objectives

Specialist industrial-like enterprises which can produce cheap milk using economies of scale for the industrial market.

ii) Location

These systems occur in the German 'New Länder(former East Germany).

iii) Farm structures and forage

Milk production is essentially ‘detached from the land’ making effluent and slurry disposal difficult.

iv) Animal system

Cows are all Holstein-Friesians with very large herds (up to 500 cows in Germany) kept in specially designed buildings. Milk yields are high (no average figures but estimated at 9,000) with individual cows likely to yield up to 14,000kg/cow/year – a figure not dissimilar to intensive systems in the UK.

v) Feeding system

Cows are zero grazed and fed concentrate and roughage in a complete ration and minerals to maximise output per cow.

j) L2 Mediterranean commercial systems

i) Management objectives

To produce milk for cheese making and dairy products using modernised facilities and taking advantage of the availability of fodder produced from irrigated cultivation and concentrate feeds.

ii) Location

Occurs throughout the Mediterranean region: central and northern Greece, northern Italy, Spain and Portugal.

iii) Farm structures and forage

This system is composed of medium to large commercial dairy units with fully modernised facilities for milking high yielding cows. Irrigated maize silage and dry-land ryegrass gives two to three cuts per year.

A typical commercial dairy farm in the Alentejo Region of Portugal grows an irrigated rotation eg, ryegrass sown in autumn and cut in March using 150kg N followed immediately with maize cut in August or September and receiving 170kg/N. All manure is used on the holding.

iv) Animal system

Herd size is large in the southern European context (eg, 50-60 cows in Greece and Portugal). The cows tend to be almost all Holsteins and are milked mechanically for 10 months; average milk yields are about 6,000kg/cow/year (calves are usually born in the spring and sold 5 to 10 days after calving to specialist fattening units). There are some very large L2 farms in Portugal (eg, 450 wet and dry cows) with yields of 7,000-7,500kg/year.

v) Feeding system

Cows are kept at pasture for less than 3 months, many are indoors all year round and fed a supplementary diet of farm produced and purchased roughage together with large amounts of concentrates (over 2,000kg/cow/year) often at least 50% of total. Around 70% of the cow’s energy requirements are met by these concentrates (cereal grains, wheat middlings, soyabean meal, cotton seed cake, sugar beet pulp and minerals and vitamins) and roughage is mostly maize silage or ryegrass silage, alfalfa hay and straw.

5. Main trends and environmental issues in EU dairy systems

5.1. The European perspective

Like virtually every other sector of agriculture, the environmental impact of dairy farming produces contradictory responses from different environmental interests. To some, intensification is seen as the major villain because it is associated with pollution, eutrophication, low biodiversity and landscape simplification (Willeke-Wetstein (1997)); but to others the neglect and abandonment of dairy farming is linked with the decline of valued habitats, reduced biodiversity and changes in landscape character (Petretti (1996), Luick (1997), Milne & Osoro (1997)). Given this situation, it is perhaps not surprising that the environmental message about dairy farming seems confused, and that well-intentioned environmental policies or initiatives often fail to achieve real environmental benefits (de Haan et al (1997) ch2).

Problems in perceiving how farming impacts on the environment relate to two main areas. First there is a lack of quantitative information about types of livestock production and their associated ecosystems (de Haan et al (1996) ch.1). Second, the effect of land management on the environment is not straightforward: species differ in their response to a management gradient (Burel et al (1998)), and both too much and too little disturbance can reduce landscape complexity and biodiversity. These difficulties make it hard to determine the environmental effects of either increasing or decreasing the level of economic exploitation and pose considerable problem problems for policy makers.

Notwithstanding the complex relationships between intensive dairy systems and their environmental impact (Willeke-Wetstein (1997), de Haan et al (1997)), it is becoming increasingly recognised that many traditionally managed landscapes have stabilised with respect to local levels of exploitation (various references, see Bibliography), and are, for all practical purposes, self contained and sustainable (de Haan et al (1997)). The harmony between the environment and human economic exploitation was probably common throughout Europe until modern attempts to increase production in the form of intensification were applied on a large scale. The main effect of this process of intensification was the creation of a pattern of overuse and neglect across most of Europe, with overuse generally occurring in the more fertile areas, and neglect, where conditions were more limiting. This spatial relationship between overuse and neglect is not a simple one, however, because even in the least fertile areas there may be localised overuse and vice versa.

5.2. Approach to the assessment

The study attempts to assess the impact of dairying on the environment as a basis for projecting trends and developing policy options. The complexity of agri-ecological interactions, however, and lack of even basic information on the typology of many European farming systems, presents a constant danger of oversimplifying the arguments and making inferences that are unsupported by the facts. The study attempts to minimise these problems by looking at a combination of general and specific impacts of dairying on a range of environmental variables. The specific impacts are looked at in terms how these variables have been affected by each of the ten principal EU dairy systems. This data is presented in a tabular form (Table 5.5 to Table 5.14) in order to aid comparison and revision and where appropriate, this data is referred to in the general text and used to prioritise issues according to current understanding

(Table 5.1). This approach reflects the uncertainty of current knowledge and provides a reliable and pragmatic basis for developing the kind of practical policy options examined later in this study. These will look at how and whether environmentally desirable dairy systems are likely to continue and in what areas. They will also consider where dairy systems might be replaced with other livestock systems, possible environmental effects and the kind of controls that may be needed to reduce negative impacts.

5.3. Environmental issues and EU dairy systems

5.3.1. Overview

Overuse is associated with high stocking rates and the increasing use of chemical fertilisers, pesticides and mechanisation and business specialisation. Its main impacts are on soil, water, air, biodiversity (including the diversity of farm stock) and non-renewable resources, often imported. Soil is affected by nutrient contamination, trampling and subsequent erosion. Drainage is simplified, reducing hydrological inertia and contributing to flooding. Ground water is polluted with nitrates and pesticides, surface water is eutrophicated and emissions of ammonia methane increase the burden of greenhouse gases. Neglect is associated with the abandonment of dairying, leading to scrub encroachment, and the extension of commercial forestry, both of which simplify the structure of the landscape by displacing the open habitat mosaics associated with traditional farmland. Not surprisingly, these processes can reduce biodiversity throughout the ecological hierarchy, not least because of the loss of locally adapted breeds of crop and stock. Given the comprehensive influence of the intensification process on the environment, it is understandable why something as simple as changing in the level of exploitation may have long-term and complex implications for the environment, and in particular for those processes that affect food security, human health, and climatic stability.

5.3.2. Landscape and habitats

As dairying becomes more intensive, it becomes more uniform and less dispersed. Hardy, locally adapted stock is displaced by highly selected productive animals that are more demanding in terms of food supplements and veterinary support, and need specialised housing, often with a standard design using imported (to the farm) materials. There is also a tendency to simplify farm structure, which may involve a reduction of non-dairy stock, and fodder production; and, in situations where this is not viable, it may involve farm abandonment. Since many of Europe's dairy landscapes are grazing mediated systems whose structure and function are determined by the free-ranging movement of locally adapted stock, the effect of this process may be dramatic.

> Many traditional dairy landscapes are integral parts of regional landscapes and are characterised by landscape features such as polyculture, bocage, hedgerows and hay meadows. These landscapes have a cultural and aesthetic value (Williams (1989); Bignal (1988); Luick (1996); van Eck et al (1996)) as do large tracts of open countryside which have been shaped by the more intensive dairy farming systems, for instance in Brittany, Ireland, southern Sweden and Finland, the UK and a large proportion of Holland and Denmark.

For example, meadows become colonised by scrub and woodland (Table 5. 2) there may be a loss of large open areas of grassland and their characteristic field boundaries (Table 5.3) traditional arable components of dairying systems may decline (Table 5.5) and sometimes fragile hydro geological systems may be degraded by neglect (5.2) or simplified by modern drainage systems. In the case of transhumance (both large-scale and small-scale) a change in the intensity of dairying may have significant cross-landscape effects that simplify both landscapes and habitats (Table 5.2). Cumulatively these changes to field patterns, drainage systems and the distribution of woodland, scrub and grassland may affect the landscape character of whole regions (Table 5.3).

5.3.3. Biodiversity

Bearing in mind the landscape scale influences of dairying on the landscape, it should not be surprising that shift in the level of intensification may affect biodiversity at a number ecological levels. In the case of intensification, locally adapted 'native' breeds are displaced by productive types adapted to fertile conditions (Table 5.1). Neglect, however, causes native breeds to decline and to become locally extinct (Table 5.2). Both intensification and neglect, therefore, decrease variation both within and between breeds, increase epidemiological risk, and pose a threat to food security (FAO 1998).

Table 5.1: Selection of most productive types - breeds of dairy cow that account for the bulk (60%) of lactations (cows and heifers) in England and Wales, 1995/96

		Total lactations (Cows and Heifers)	
Breed	Average milk yield (kg)	Number	Percentage
Holstein Friesian	6638	963,559	94.5
Guernsey	4703	10,304	1.0
Ayrshire	5822	13,105	1.3
Jersey	4491	18,719	1.8
Shorthorn	5587	4,378	0.4
Island Jersey	4324	3,985	0.4
Island Guernsey	5125	1,674	0.2
Meuse-Rhine-Issel	5217	1,003	0.1
Brown Swiss	6010	946	0.1
Simental	5205	368	0.04
Red Poll/Red Dane	4931	214	0.02
Montbeliarde	5824	309	0.03
Devon/South Devon	4726	44	0.004
Total lactations qualifying for production report		1,019,187	100

Source: National Milk Register

Table 5.2: Displacement of locally adapted types (European Union - 15 countries, 1996) - breeds of domestic animals at risk

	cattle	pigs	sheep	goat	horses
Critical	36	14	19	7	12
Endangered	35	7	38	17	33

Notes: Critical - breeding (females <100) (males <5)
Endangered - breeding (females 100-1000)(males >5 but < 20)
Source: FAO/UNEP Environmental Statistics (pub 1997) (ISBN 92-82807142).

The type and number of stock used in dairying also has a number of knock on effects. For instance, the spatial and temporal patchiness (forms of biodiversity) created by the grazing patterns of locally adapted stock used in traditional production systems is replaced by the simpler disturbance patterns associated with silage cutting and the grazing regimes of intensive systems. Moreover, since highly productive breeds only perform well on an ample supply of high-value food (Figure 5.1), most intensive systems use fertilisers to boost the productivity and palatability of farm grassland. This encourages the dominance of competitive plants, thereby reducing species diversity. Competitive dominance and the loss of species diversity, however, may also occur when grazing declines or ceases (Table 5.2) and may ultimately lead to scrub and tree encroachment (Tables 5.5; 5.8). Although these trends generally hold true it should be noted that in nutrient-poor systems reduced grazing can increase diversity whereas increased grazing can often increase diversity in nutrient rich situations (Proulx and Mazamder (1998)).

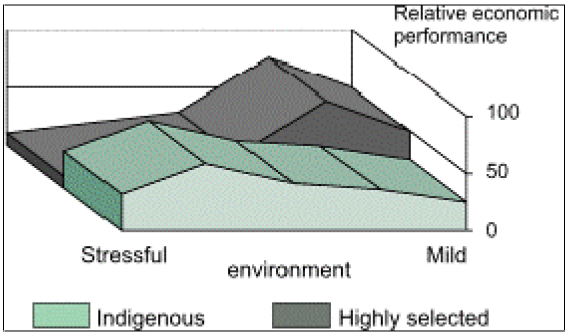


Figure 5.1: Source (de Haan, 1997) http://www.fao.org/ag/aga/lxehtml/tech/ch5b.htm

Unimproved species-rich grasslands are associated with environments that restrict the total annual forage production to around 6 tonnes dry matter per hectare (Jansenns et al (1998)). At lowland sites in Northwest Europe this represents less that half of the output that can be achieved from intensively managed grassland. The quality of fodder cut from unimproved grasslands (at the traditional time) make them inappropriate as a feed for highly productive livestock (Tallowin pers comm and EGRO Project, 1998). Cutting in mid-July in northern Europe appears to constitute a good compromise between obtaining acceptable forage quality and the maintenance of plant diversity. In the Pyrenees, this compromise is reached in mid-June (Tallowin pers comm).

Since little opportunity exists for compromise between the maintenance of high grassland biodiversity and the use of inorganic fertilisers, of which P and K are most important, species richness declines markedly when grassland is intensified. Again, the relationship between fertility and species diversity is not a simple one, because although species diversity of grass swards fall when extractable P values rise above 5mg/100kg dry soil (c.50kg/ha) and extractable K values above 35 mg/100kg dry soil (c.100kg/ha), a similar decrease may occur when nutrient values fall too low.

The effect of dairying on biodiversity is far from straightforward, and includes the development of invasive herbs and loss of grassland diversity due to the increased use of fertiliser (particularly N&K), silage production (Table 5.3 and Table 5.4) and to reduced grazing and scrub encroachment (Table 5.2 and Table 5.5). While some intensively managed grassland, is of strategic importance to migrating wildfowl (Table 5.6), large-scale changes in the intensity of use in traditional farmed areas (either overuse or neglect) seem to be associated with a loss of both complexity and stability. This effect is particularly significant in river-based (Table 5.7) and mixed Mediterranean systems (polyculture, Table 5.11).

5.3.4. Soil

The impact of dairying on soil involves structural, chemical and ecological changes, all of which interrelate and influence the soils essential integrity, that is its ability to remain a stable productive medium for plant growth that can recycle nutrients. Generally speaking, traditional locally adapted land management practices are at some level of equilibrium in terms of soil-based processes (de Haan et al (1997)) and are usually associated with an increase in the ecological and structural complexity of the soil as well as an improvement in its inherent stability. Changes along the overuse-neglect continuum can destabilise this balance causing a variety of problems. While both heavy grazing and no grazing for instance are known to be associated with low infiltration rates and soil erosion (G. M. S (1996)), problems such as organic matter loss, reduced fertility, nutrient leakage and erosion usually occur when soil is subjected to intensive land management practices. These involve a reduction in the recycling of organic matter in the form of animal waste, or overloading the soil in terms of mechanical disturbance (see sub-section 5.4), the use of fertilisers or animal waste, or even by introducing contaminants in the form of feed residues, vet medicines and pesticides. Irrigation may also concentrate salt in the surface layers of the soil in dry climates, and on the more fragile soils induce a progressive loss of soil structure, leading to loss of fertility and erosion.

Nutrient cycles are influenced by the inputs used on the farm: feeding regime, feed and forage production, manure storage and application. The principal nutrients concerned are nitrogen, phosphorus and potassium. They are released at different locations on the farm into the air and the soil - for example: from the animal (NH_3 volatilisation), from storage (P, K, NH_4 leaching and runoff), slurry and manure spreading (NH_3 volatilisation and N, P, K and Cu, Zn in surface runoff), and from the soil (N_2O de-nitrification and NO_3 and P leaching): see Bos and de Wit (1996) for a review.

Intensification involves the increased use of inorganic fertilisers, feed additives, and the more concentrated use of waste products like manure (Table 5.2 and Table 5.7). With fertilisers and manures, the level of application is usually greater than the needs of the crop or the ability of the soil to retain them. If nutrients are water soluble or mobile like nitrogen, potassium or some forms of phosphate, they leach out into the wider environment as pollutants (Tables 5.3; 5.6; 5.7; 5.8; 5.10; 5.12). If they are relatively immobile like the insoluble phosphate they remain in the soil changing its essential nature.

Nitrogen is a key plant nutrient a component of animal feed and features in most farm waste; because of this and the fact that in many forms it is highly mobile in the environment and a good indicator of the status of other mobile elements and the rate of farming induced environmental change.

Nitrogen turnover and the environmental consequences of Nitrogen (N) in agriculture have been intensively studied in both Europe and North America (eg, Aarts et al (1992), Bacon S.C. et al (1990), Barraclough and Jarvis S.C (1989), Gaarn Hansen (1991)). Halberg et al (1995) investigated nitrogen turnover on conventional and organic mixed dairy farms in Denmark and found that N surplus can only be reduced by reducing the production level and, importantly, that no production is possible without loss. Losses can only be reduced by reducing the output per hectare of crops or the density of the livestock. Korevaar (1999) also found that the intensity of Dutch dairy farms (in terms of kilogrammes of milk produced per hectare) had a great impact on the surplus of N in kg/ha. Increasing milk yield from 8,700kg to 20,500kg per hectare raised the N surplus from 376kg N to 650kg N per hectare. This was a result of increased fertiliser application per hectare and a greater input of roughage and feed concentrates. Of particular relevance to low-input and organic systems is the variation in manure N content. The amount and concentration of N/LU in slurry is influenced by animal feeding levels, the type of N in the feed and animal utilisation for meat and milk production, N loss in the cow shed and during storage and the amount of water in the slurry storage tank. Halberg et al (1995) found this to be between 136 and 166kg N/LU/year.

As well as using higher levels of fertilisers, intensive systems of production also use more feed additives, medicines and growth promoters. Little is known about the impact of these on the environment, however: feed concentrates contain phytotoxic heavy metals such as copper (Cu), zinc (Zn) and cadmium (Cd) that accumulate in the soil, particularly where fertiliser use is high (Bos and de Wit (1996), Brandjes et al (1996)); and vet medicines persist in dung, affecting its fauna and potentially the dependant bird populations. There is also widespread use of herbicides in some intensive systems and this can pose problems for watercourses (Table 5.7) and groundwater supplies, particularly if residual chemicals are applied to surfaces with runoff problems.

5.3.5. Water

Dairying may affect the aqueous environment in a number of ways. Increased inputs, or changes in the manner and timing of their application, or in the way they are distributed the farm (ie, dispersed or concentrated) may overload the soil's capacity to retain agri-chemicals. The result may be the leakage of these materials into the wider environment, either as surface or ground water pollutants. This leakage may be aggravated by reductions in the permeability of the soil or its storage capacity due to loss of organic matter and porosity, or because of a reduce hydrological inertia due to farm drainage.

The full extent of surface and ground water pollution due to farming is unknown because Europe's monitoring programme is only just being put in place; however, nitrate pollution has been a concern for some time (Council Directive 91/676) and is a useful guide to the likely impact of agricultural pollution generally. It may be significant, therefore, that the guide level for nitrate concentration (25mg/l) is exceeded in groundwater below 85% of Europe's farmland (Dobris), particularly since the problem seems to be getting worse, especially where animals and vegetables are farmed intensively. Surface water pollution is also a problem in many areas, causing localised eutrophication and algal blooms.

While there is no quantitative data on the extent of dairying's contribution to the problem, its effects may be at least as comprehensive as any other sector and include such things as: the effects of slurry and washings (Tables 5.2, 5.3, 5.6) surface and ground water leaching of fertilisers (Table 5.12), particularly nitrogen, potassium and phosphorus (Tables 5.3; 5.7), and in some situations, herbicides such as Atrazine (Tables 5.12, 5.14)

5.3.6. Air

The impact of dairying on the atmosphere arises from de-nitrification (Table 5.3), the production of, methane (Tables 5.3, 5.4, 5.7, 5.12), ammonia volatilisation (Tables 5.3, 5.7, 5.12), and carbon dioxide (see Energy Consumption) all of which are to some extent capable of being controlled at source.

Atmospheric methane is estimated to have doubled since the early 1900s. It has 4-6 times the thermogenic effect of carbon dioxide and is responsible for 19% of global warming. Slowing down emissions by15-20% (80-85% for other gasses) would allow atmospheric concentrations to stabilise. Ruminants account for up to 20% of global methane production and more than 80 % of this (86.6 million tonnes) (de Haan (1996)) is enteric (a source that can be manipulated through diet). Manures only produce methane under anaerobic conditions when temperatures exceed 15^0C, conditions associated with intensive systems using bulk storage (Table 5.3).

Dairy cows produce 20% of the enteric methane, making them an attractive target for methane reduction. Methane generation per animal is higher in low input systems than in the more intensively managed systems that use feed supplements. Supplements (by-pass protein and nutrients) improve the efficiency of food conversion and live weight gain. It appears the best responses to these treatments are from animals on fibrous diets (for a comprehensive review see: Leng (1993)).

Ammonia emissions occur during manure storage and application to arable and grassland. Ammonia emissions from cowsheds and storage represent between 50% and 35% of total N excreted, with a potential for reduction of about 50% for dairy cattle sheds (Brandjes et al (1996)). A higher risk of volatilisation occurs after manure application. Marschiner et al (1995) measured ammonia emissions after application to arable land and grassland, and found that the emissions from grassland were 1.5 times higher than from arable land. Injection of manure led to a reduction in NH_3 emissions of up to 90% compared to conventional distribution techniques. The dry matter content of the manure has the greatest influence on the amount of NH_3 lost.

5.3.7. Greenhouse gases

Greenhouse gases are produced directly by livestock populations as well as forage and feed production processes. Emissions of carbon dioxide, methane and nitrous oxide are all influenced in an indirect way by intensive production systems (but not just dairy farming). Globally the main source of CO_2 emissions is the burning of biomass for livestock production (de Haan et al (1997)). In Europe energy input for feed concentrate and forage production as well as housing systems all contribute to increasing the level of carbon dioxide emissions produced through burning fossil fuel. Since feed concentrates constitute the greatest energy input into intensive systems (Willeke-Wetstein (1999)) they should be proportionate to CO_2 emission; although quantifying this is difficult and would be better achieved by breaking down into by-products and food grains.

Methane emissions are a result of human activities (eg, from rice cultivation, production and distribution of oil and gas). Bouwman (1995) quantifies global methane emissions from livestock at 18%. The main source of methane is ruminants fed on low quality, fibrous diets (ie, not applicable to most of Europe's dairy cows). The characteristic diet in intensive production systems is high quality feed and therefore methane emissions from dairy cows is not of major concern. However, Safely et al. (1992) estimates that 20% of livestock related global methane emissions is caused by the anaerobic processes taking place in liquid manure. These processes take place in intensive housing systems with slatted floors. To summarise, methane emissions should be seen in a global context and therefore are not an important issue for dairy systems which are overwhelmingly intensive systems. It is, however, possible to make estimates at a farm level using equations developed by Kirchgessner et al (1991b) for individual animals. It is an interesting question whether today extensively reared domestic livestock contribute more or less methane to the atmosphere than natural wild herbivores would.

5.3.8. Energy consumption use of non renewable resources

The energy consumption of dairy systems is relevant because of carbon dioxide emissions and the consumption energy and non-renewable resources (Table 5.3). Dairy systems, characterised by high feed input and poor nutrient conversion efficiency, are less efficient in energy terms than plant production (Schumacher (1996), Hulsbergen et al (1997), Eckert et al (1997)). Although CO_2 emissions from agriculture do not in general contribute greatly to greenhouse gases, for example, in Germany only 2.4% of carbon dioxide emissions is the result of agricultural production (Trunk (1995)). High intensity systems have a higher energy input than extensive systems.

Table 5.3: Fertilisers in the European Union (15 countries) and the UK: changes in consumption, imports, and cost of imports between 1963 and 1994. The UK figures are shown in (brackets)

Total fertilisers	1963	1994	change (%)
Consumption (metric tonnes)	12,736,720 (1,495,200)	17,459,160 (2,219,800)	+37 +49
Imports (metric tonnes)	3,219,376 (615,600)	12,025,410 (1,461,500)	+274 +137
Imports as a % of consumption	25 (41)	68 (66)	
Cost of imports ($1000) Note: % change adjusted for inflation.	346,168 (56,330)	4,481,722 (489,622)	+ +

Source: U N FAOSTAT WWW. Inflation rate: US CPI. All urban sample: all items - annual inflation rate, from 30/6/63 to 30/6/94

The process in livestock production requiring the most energy is by far the production of concentrate feed and its processing (whereas in plant production it is the use of mineral fertiliser). Willeke-Wetstein (1997) recommended that for policy evaluations the level of CO_2 emissions should be estimated by taking the concentrate feed and mineral fertiliser inputs into feed and forage production as the main sources of CO_2. Reducing the relatively high energy input in dairy systems would contribute to the global goal of reducing the concentration of CO_2 in the atmosphere. There are three possible strategies: decrease energy input; increase energy efficiency; and, recycle energy through biogas production (see de Haan et al (1997)).

Table 5.4: Environmental issues

***	Issue is of major importance	*	Present, but not an important issue
**	Issue is of importance	+	Not relevant to the system

		P1	*G1*	*G2*	*G3*	*CG1*	*CG2*	*CG3*	*M1*	*L1*	*L2*
ISSUE	SOIL: mineral enrichment & heavy metals	*	***	*	*	***	**		***	***	**
	WATER: pollution by Nitrates and pesticides	*	***	*	*	***	**	*	***	***	**
	AIR: high Methane emissions.	+	***	*	*	***	**	*	***	***	*
	FAUNA & FLORA: biodiversity high.	***	*	*	**	*	*	**	+	+	*
	HABITATS: natural habitats present.	***	*	*	**	*	*	**	*	+	*
	LANDSCAPE: system of high landscape quality	***	**	**	***	*	*	**	*	+	*
	Energy and non renewable resources										

5.4. Trends and issues in each system

These are summarised in Table 5.4 and presented in more detail in Table 5.5 to Table 5.14.

Table 5.5: P1 Transhumant systems

Area of interest	Effects and Issues	References
Soil	According to research in Italy decline in use of mountain pastures will result in the degradation of the fragile hydrogeological system of the uplands previously protected by sound pasture management and maintenance of paths, ditches and stone walls.	Regione Autonoma della Valle d'Aosta (1994)
Water	Concentration of herds in fewer areas increases the potential for pollution from slurry and washings.	Petretti
Air	No specific information. See sub-section 5.3.6	
Biodiversity	Transhumant dairy farming areas in the Alpine region are considered to be some of the most important areas for nature conservation and biodiversity in Europe. They are composed of a mix of forest and open habitats, mostly grasslands and heaths. Habitats listed in the EC Directive are Alpine rivers and riverbank vegetation, Alpine and sub-Alpine heath, Scrub of Pinus mugo and Rhododendron hirsutum, Mountain hay meadows and various mountain and mid-altitude grasslands. Cattle grazing restricts the spread of invasive herbs and grasses that reduce grassland biodiversity.	Petretti Farino Directive refs: 24.221/24.222 31.4 31.5 36.32/36/41/45 36.3
Landscape and habitats	Not only are there biological implications if this system continues to decline, but also landscape issues. Open pastures and meadows quickly become colonised by scrub and woodland. This may have implications for tourism.	Luick Hindalang
Energy and non-renewable resources	See sub-section 5.3.8	
Current Trends and Future Environmental Options	A small decline in cattle numbers is linked with a much greater decline in the number of dairy farms. This has led to a concentration of dairy herds on the most productive land and abandonment of other pastures particularly on steeper slopes. Gradual shift from dairy farming to calf breeding and steers (suckler cows) because less labour is needed. This will not continue the type of periodic grazing pressure of dairy herds. Sheep farming has also replaced cattle in many mountain areas.	Luick Petretti, 1995 Farino, 1998 De Sanctis, 1997.

Table 5.6: G1 Intensive grassland (ley) systems

Area of interest	**Effects and Issues**	**References**
Soil	Frequent ploughing for rotational grassland, slurry spreading and the use of high inputs of fertiliser for multiple cut silage leads to an imbalance in the nitrogen turnover resulting in surplus N, P and K in the soil. The more intensive the production (LU/ha) the higher the losses. Typical N loss values are 400kg/ha for N and 26kg/ha P. Heavy machinery damages soil structure in humid areas and can lead to erosion in arid areas.	Halberg Welten 1994 Halberg(ELPEN)
Water	Surface water runoff and ground water leaching of N from fertiliser and slurry (little evidence of P and K) is a major issue as this is a system of the higher rainfall areas of the Atlantic region. Especially critical on sandy soils.	See 5.3.
Air	High releases of nitrous oxide and ammonia associated with high fertiliser use especially on saturated soils (eg, Holland). Methane emissions from stored manure and slurry. No regional data available.	Ryden, 1983 Jarvis et al, 1989 Scholefield et al, 1988
Biodiversity	Any fertiliser application, and in particular inorganic K and P, cause loss of species richness in grasslands. No compromise between the maintenance of high biodiversity and high agricultural output has been found. This system includes intensive, multiple cut silage management and is intrinsically poor in fauna and flora. Marginal features and habitats can be of local value and the subject of special measures. Some intensively managed grasslands are often used by large numbers of migratory wildfowl and geese, eg, in the UK and Holland, and can be of national importance.	Jansenns et al 1998
Landscape and Habitats	Although biologically impoverished landscapes, dairy farming and the existence of large open areas of grassland with cattle grazing and characteristic field boundaries (hedges, ditches, woodland) contribute to valued regional landscapes, eg, in Sweden and Finland.	van Eck et al, 1996
Energy and non-renewable resources	See sub-section 5.3.8	
Current Trends and Future Environmental Options	The trend is for continuation of high intensity production of grass and livestock unless mitigated by specific environmental schemes (eg, in Holland for waterbirds) or legislation (nitrate sensitive areas).	

Table 5.7: G2 Permanent grassland systems (lowlands)

Area of interest	Effects and Issues	References
Soil	Average fertiliser use on both grassland and crops is low (40-80kg/ha) and with minimal ploughing of grassland, losses are correspondingly less. Localised N enrichment around cow pats and urine pools can reach the equivalent of 950kg/ha. Implications are proportional to stocking density. Localised soil compaction through trampling a potential issue.	Halberg refs Steele K W, 1982 No references available.
Water	Can be direct effects from grazing pressure – direct pollution from faeces and urine, river bank and waterside erosion can lead to local sedimentation.	
Air	Methane emissions from livestock at pasture and from slurry and manure stored and used on arable land. Emissions are higher at the low intensity farms where cows are fed low quality fibrous diets. More a global issue than one specific to livestock systems. 18% of global methane emissions are from livestock but 20% of this is caused by anaerobic processes taking place in liquid manure.	Bouwman, 1995 Safely et al, 1992 Kirchgessner et al, 1991
Biodiversity	Fertiliser and manure applications on grass pastures generally too high for species rich grasslands together with change to silage over hay (associated with more intensive grassland management). Often in remote or upland areas with relatively steep slopes or difficult terrain. Marginal habitats associated with these areas such as marshes, natural grassland, woodland, heath provide potential for local high biodiversity, rather than on the farmland itself.	Meister E, 1994
Landscape and Habitats	Farms operating these systems are often integral parts of regional landscapes of high aesthetic value, eg, central and southern Ireland, Isle of Man, western parts of the UK.	Williams G, 1991 Bignal et al, 1988
Energy and non-renewable resources	See sub-section 5.3.8.	
Current Trends and Future Environmental Options	Labour availability is often an issue for expansion or even continuation, especially for the systems using traditional practices. In Ireland and the marginal areas of the UK the system depends heavily on family labour.	

Table 5.8: G3 Permanent Grassland Systems (Mountains)

Area of interest	Effects and Issues	References
Soil	Fertiliser and herbicide use is traditionally very low. Autumn calving herds (the more intensive farms) may have slurry and waste disposal problems.	No data available.
Water	Increased use of 'big bale' silage in place of hay could lead to local water pollution incidents. Hay systems have greater use of concentrates (up to 500kg/cow) and correspondingly greater potential for N surplus.	No data available.
Air	Stocking levels are low and potential methane emissions low at pasture and from housing.	
Biodiversity	At the lowest intensity end of the scale, traditionally managed hay meadows can be of very high floristic value. Dereliction of farmland leads to scrub encroachment and reduced biodiversity in the mountains. In northern latitudes the cessation of grazing in wood pastures leads to reduced biodiversity. Studies in the Spanish Pyrenees showed that without the contribution of forages from relatively intensively managed irrigated meadows into the whole farm livestock system the sustainable livestock production in these valleys would become untenable. This means that survival of the unfertilised and botanically most rich meadows is interdependent with the management of the fertilised and irrigated meadows.	EGRO project
Landscape and Habitats	This is typically a 'mountain' hay plus aftermath system of great cultural and landscape value.	Luick, 1996
Energy and non-renewable resources	See sub-section 5.3.8.	
Current Trends and Future Environmental Options	Farms are expanding and becoming fewer leading to dereliction of farmland and scrub encroachment in some places and more intensive pasture management in others. Traditional practices survive in some areas only because of the requirements associated with the production of specialist cheeses (and the associated higher price of the milk), but in many areas EU hygiene and health standards for producing and marketing milk and dairy products, and the structural requirements for dairies, are causing problems for both producers and the competent authorities. There is a risk that these enterprises will be regarded as illegal leading to further abandonment of mountain pastures with associated loss of biodiversity and the increase in scrub/forest. In Sweden and Finland there is abandonment of grazing in wood pastures and permanent grasslands as dairy farms become larger, more specialised and more intensive.	EC Directive 92/46/EC

Table 5.9: CG1 Conventional mixed systems

Area of interest	Effects and Issues	References
Soil	These farms make high use of pesticides, mineral fertilisers and manure. Typical N surplus can be 250kg N/ha. Higher yields and higher stocking densities produce greater surplus; loss is proportional to use. N turnover depends on the proportion of crop to livestock area and growth of different crops or varied levels of N fixation. No crops on conventional farms remove more N than is supplied.	Aarts et al, 1992 Bacon et al, 1990 Huggins and Pan, 1993. Halberg et al, 1995
Water	Pollution of surface water (runoff) and groundwater by nitrates, phosphates and potassium compounds.	Wolfsen et al, 1987 Charter E, 1995
Air	Methane and ammonia emissions during manure transfer in cow sheds, storage, field application and grazing. There is uncertainty about the proportion lost to the atmosphere. Estimates are 20-40% of total N in shed manure, 10-20% of excretion on pasture.	Hansen et al, 1990 Jarvis and Pain, 1994 Sommer, 1992
Biodiversity	The intensity of the system and the high proportion of cultivated land results in low biodiversity. Marginal features may provide ‘corridors’ for plants and animals but this is an anthropogenic concept with little empirical support at the farm scale. Marginal habitats may be of value, but high usage of pesticides and herbicides reduces potential value. Winter sown cereals remove the potential value of winter stubble of spring grown cereals to farmland birds. Spring cereals undersown with grass (for temporary pasture) can enhance insect and bird numbers. See below.	Plachter, 1999 Aebischer et al, 1997
Landscape and Habitats	An intensive agricultural landscape of the northern European lowlands. Often close to towns and cities.	No literature found
Energy and non-renewable resources	See sub-section 5.3.8.	
Current Trends and Future Environmental Options	There are probably two simultaneous trends – separation and intensification on some farms and integration and extensification on others; both in an attempt to balance inputs with profitability. Advantages of the move to low-input (organic) systems are discussed below.	Weinschenk, 1986 De Wit et al, 1987

Table 5.10: CG2 Low-input and organic mixed systems

Area of interest	Effects and Issues	References
Soil	No mineral fertiliser or pesticide use. Nitrogen surplus still an issue because of release of Nitrates from ploughing and from manure applications. On whole farm units the organic farms are 25% more efficient in their use of N. On organic farms crops tend to remove more N than is supplied by manure, eg, beets and spring sown cereals for whole crop silage. Also fodder beets which can utilise large amounts of N mineralised during summer. Differences in N use reflect differences in crop production (lower output) which lead to lower stock density and lower output (compensated for by higher prices).	Halberg, 1996
Water	Leaching is thought to be significantly lower from organic farms than conventional ones and less of an issue over clay soils than on sandy soils.	Halberg, 1996
Air	No evidence available to suggest losses of Methane and ammonia are different to conventional farms (despite composting)	
Biodiversity	Whilst the physical features of the system (crops and pastures) are similar to conventional systems their potential for supporting farmland plants and animals should be greater because of the lack of chemical use and better N utilisation.	
Landscape and Habitats	See sub-section 5.3.2 above.	
Energy and non-renewable resources	See sub-section 5.3.8.	
Current Trends and Future Environmental Options	Mixed systems with low inputs or meeting organic criteria are increasing, but it has not been possible to quantify this increase. For organic farms this increase partly reflects economic incentives for organic conversion, but also the higher market price (and increasing demand) for organic milk products. Some predictions are for 10% of the total world food market to be organic by 2005.	No data available. Elm Farm Research Centre unpublished report.

Table 5.11: CG3 Mediterranean mixed systems

Area of interest	Effects and Issues	References
Soil	No negative effects reported. In these small farms the manure available for use in cultivation would be utilised by crops. No information about potential nutrient enrichment from stored manure or wastes from fattening units or dairy cow sheds. Proportion of concentrates fed will affect potential nutrient surplus. Terrace cultivation prevents soil erosion.	Eden pers. Comm.
Water	No data available.	
Air	No specific data. See sub-section 5.3.6 above.	
Biodiversity	The mosaics of vegetation and crops associated with Mediterranean mixed (polyculture) systems with a mixture of tree crops, vegetables, fodder crops and grazing livestock can be extremely rich in plants and animals and compliment other cultivation systems (eg, olives, cork and holm oak).	No data available.
Landscape and Habitats	Because cows are housed for most of the year the cultivation systems are not obviously associated with dairy farming. May include traditional terraced cultivation which is characteristic of Mediterranean landscapes and which is in decline.	
Energy and non-renewable resources	See sub-section 5.3.8.	
Current Trends and Future Environmental Options	The trend is for these very small family farms to decline.	No data available.

Table 5.12: M1 Intensive silage maize systems

Area of interest	Effects and Issues	References
Soil	Associated with these intensive farms are major problems of large nitrogen and phosphorus surpluses in the soil. Maize is grown on a large proportion of the holding leaving land bare in the winter. Pastures are generally intensively grazed which result in further nitrogen leaks (the cows are fed a high concentrate ration).	Brunschwig See Maize study
Water	Major problems with leakages of nutrients into water courses. Major problem with pollution of water courses with the red list substance Atrazine. Generally pre-emergence Atrazine at 2L/ha is combined with a post emergence application of Atrazine at 1L/ha. Atrazine is highly toxic to aquatic life.	SAC/FMH Charter E, 1995
Air	With high stocking rates emissions of methane and ammonia from cows at pasture, slurry and dung in storage and during spreading is high (see sub-section 5.3.6).	
Biodiversity	These are intensively farmed areas and biodiversity is low with the environmental issue of highest priority being methods of reducing the damaging effects of such high concentration of cattle on soil and water and peripheral habitats (see below).	
Landscape and Habitats	Intensive farmland of low landscape quality.	
Energy and non-renewable resources	See sub-section 5.3.8.	
Current Trends and Future Environmental Options	Milk quotas encourage the increase in yield per cow (+100kg/cow/year) maximising genetic potential. This has entailed an increase in the proportion of maize silage to grazed herbage in the feeding system. To optimise nutrition of these high yielding cows farmers increasingly use complete or semi-complete rations, home grown cereals and protected amino acids incorporated into the rations. Maintaining the same milk quota with smaller herds has enabled farmers to grow cereals and produce beef alongside dairying. Future pressures on these systems to control input costs could be addressed with [1] maximum use of pasture and less maize silage; [2] cutting forage production costs through better utilisation of farm manure and introducing white clover into grass swards; [3] reducing the use of concentrates. Future improvements in water quality require reduction of surplus nitrogen, better balance between herbage and maize (less bare ground), better utilisation of dung and controlling pesticide applications.	

Table 5.13: L1 Industrial

Area of interest	Effects and Issues	References
Soil	Slurry and wastes are disposed away from the production units.	
Water	No data.	
Air	No data.	
Biodiversity	None.	
Landscape and Habitats	None.	
Energy and non-renewable resources	See sub-section 5.3.8.	
Current Trends and Future Environmental Options	This system is currently not common enough to warrant description. It is included because the prediction of the UK dairy industry and of Dutch researchers is that it will become more common as milk prices fall as the EU is committed to pursuing a more free-market trade policy.	van Eck et al, 1996

Table 5.14: L2 Mediterranean commercial systems

Area of interest	Effects and Issues	References
Soil	Irrigated maize cultivation and multiple cut dryland ryegrass receive high applications of fertiliser, manure and pesticides (see 5.3.8 above). In Portugal, legislation controls water pollution from buildings, but not slurry spreading.	See Irrigation study
Water	Where irrigation is used to produce fodder there can be problems with lowering the ground water table and with salination. Use of Atrazine on maize cultivation can result in water pollution.	See Maize study
Air	No data.	
Biodiversity	No specific information available, but these systems are the southern European equivalent of the very intensive dairy farms of the Atlantic and Continental regions. Many of the issues (nitrates and pesticides) are similar. In southern Europe there is also the major subject of introduction of irrigation into areas where formerly there was dryland cultivation. Intensive dairy production could be associated with these schemes.	Refer also to DG XI Irrigation study
Landscape and Habitats	No information.	
Energy and non-renewable resources	See sub-section 5.3.8.	
Current Trends and Future Environmental Options	These are modern, mechanised farms with high yielding cows with over half the cows energy requirements met by concentrates. The trend is likely to be that this form of dairy production will replace the small scale mixed systems run as family enterprises. This polarisation and intensification of production will have environmental implications as environmentally beneficial farming systems will be replaced by potentially harmful ones.	P.Eden pers comm

6. Agenda 2000 and the dairy sector: comments and analysis

In this Section the possible impact of the implementation of the Agenda 2000 reforms on dairy production systems is briefly considered.

6.1. Summary of reforms[11]

a) To the CMOs (dairy, cereals and beef)
The key features of relevance in the reforms are:

- a reduction in the level of (intervention) price support (for butter and skimmed milk powder) of 15%[12], phased in over the period 2005-2008 (ie, in 3 annual reductions);
- specific quota increases to a few Member States. These are 70,000, 550,000, 150,000, 600,000 and 19,700 tonnes respectively for Greece, Spain, Ireland, Italy and the UK (Northern Ireland). These quota additions will be phased in over 2 years commencing with 64% of the additional quota applicable in 2000 and the balance in 2001;
- a 1.5% linear increase in milk quotas for all other member states including the UK, phased in over the three years from 2005;
- milk quotas are to be retained until at least 2006 although a review of the mechanism will begin in 2003;
- there is scope for introducing greater flexibility in the operation of quotas. This stems from breaking the link between the land and quota, scope for ring fencing quota in defined areas, possible use of a siphon or claw-back on transactions to create a reserve pool, and confiscation of unused quota;
- as compensation for the cut in the intervention price support, a direct payment (dairy cow premium (DCP), payable per tonne of quota is to be introduced). The level of payments per tonne of quota will be 5.75, 11.49 and 17.24 respectively for 2005/6, 2006/7 and 2007/8. This payment is based on the quota held by a producer in 1999/2000;
- the above DCP may also be supplemented at the Member State level (under what is referred to as the national envelope). Such supplements can be paid either per head (13.9 in 2005 rising to 41.7 in 2007) or per hectare (210 in 2005 rising to 350 in 2007). In total, if the national envelopes are fully paid, the direct payments would be roughly equal to a level of compensation of about 50% of the price cut (ie, the price cut is equal to about 53/tonne in intervention milk price equivalent with the direct payment compensation comprising 17.24 plus about 7.5/tonne from the national envelope (based on EU average production levels);
- cereal support prices will fall by 15% over the 3 year period 2000/1 to 2002/3. This may potentially improve the competitive position of cereals as a dairy feed ingredient relative to non-cereal sources (eg, grass, silage). This in turn may encourage greater use of cereal-based feeding systems than is currently the case;
- the beef intervention price will fall by 30% to 1,950/tonne over the period to 2002/3 (in 3 tranches) and safety net intervention (the effective support price) from 2002 will be set at 1,560/tonne (25% below current levels). As compensation for the price support cuts, beef special premia will increase from 2002 to 210/head payable once per life for bulls and to 150/head

[11] It is assumed that the reader is familiar with the background to, rationale and detail of, the proposals and ultimate changes agreed. Accordingly this overview is provided to assist the reader in following the subsequent discussion.
[12] There is also a 17% cut in the target price.

payable twice per life for steers. Suckler cow premia will also increase to 200/head per year. The age brackets for beef special premium are to be reduced from 10 to 9 months and from 23 to 21 months;

- a ceiling on the availability of suckler cow premium is to be fixed for each Member State as the highest number of animals on which payments were made in the years 1995-97 plus 3%;
- a new beef slaughter premium applies from 2000. For adult cattle (over 8 months of age) the premium is 80/head and for calves, it is 50/head. National ceilings for receipt of this new premium are fixed on the basis of slaughterings and exports to third countries in 1995;
- member state can nationally top up the suckler cow premia by 50/head, can raise the 90-head limit on claims under the beef special premium scheme (eg, Ireland has proposed to use 180-head) and choose to exempt smaller producers (ie, those with claims below a specified number of cattle) should the national or regional ceiling be exceeded;
- two options exist for use of the extensification premium. Firstly there is a two tier mechanism with payments of 33/head and 66/head for producers with stocking rates of less than 2LU/ha and 1.6LU/ha respectively in 2000 and 2001, rising to 40/head and 80/head in 2002 (stocking densities to also fall to 1.8LU/ha and 1.4LU/ha respectively). Secondly a single tier system could operate with a payment of 100/head for producers with a stocking density of less than 1.4LU/ha;
- the limit of 120,000 kgs milk quota which currently limits eligibility of dairy producers for suckler cow premium is to become optional;
- member states can make additional payments on male cattle, suckler cows, dairy cows and heifers within the terms of the basic premium schemes or as supplements to the slaughter premium for adult cattle. They can also make area payments in respect of permanent pasture land which is not used to support claims for additional payments on cattle.

b) Horizontal Regulation

The Horizontal Regulation within Agenda 2000 introduces two measures: environmental protection and modulation, which can be attached to the direct payments outlined above:

- Environmental protection is introduced (by 1 January 2000) as a general obligation on Member States to take 'the environmental measures they consider to be appropriate in view of the situation of the agricultural land used or the production concerned and which reflect the potential environmental effects'. Three kinds of measure are possible:
    - support for agri-environmental actions;
    - general mandatory environmental requirements;
    - specific environmental requirements (cross compliance) on CAP direct payments.

  This measure introduces for the first time a need for Member States to define minimum environmental standards below which penalties would be introduced, involving the reduction of direct subsidies. It places much greater significance on the definition of good agricultural practice, although this may not necessarily equate with good environmental practice.

- Modulation is introduced giving Member States the option of modulating (reducing) by up to 20% the total CAP direct payments to individual farmers. The criteria that can be used for justifying these reductions are employment on the farm or overall prosperity of the holding.

The savings made through either of these measures can be used (within time limits to be fixed by the Commission) as additional support for four measures in the Rural Development Regulation: less favoured areas; agri-environment; afforestation; and early retirement.

c) The Rural Development Regulation

This Regulation aims to produce a more coherent policy for rural development based on the premise that farming plays a number of roles including the preservation of the rural heritage, but at the same time recognising that alternative sources of income must be an integral part of rural development policy.

The Regulation brings together a number of existing policies. It include optional measures for the modernisation of agricultural holdings, processing and marketing of quality agricultural products, support for young farmers, early retirement incentives and support for less favoured areas (LFAs) (paid per hectare rather than per head), ecological forestry and farm diversification. LFA payments will be extended to areas where farming is restricted by the existence of specific environmental constraints arising from Community environmental legislation. Compensatory payments for farmers in the LFA will in future be conditional on the use of sustainable farming practices. Additionally, the Rural Development Regulation introduces an environmental element not only to the conditions attached to LFA support payments, but also to all support given to rural development projects.

Agri-environment measures will be the only compulsory element that Member States must include in their rural development plans.

The main elements of each of the three components are summarised in Table 6.1 below.

Table 6.1: Elements of Agenda 2000 with possibilities for integrating environmental conditions or incentives with dairy systems.

CMOs – dairy, beef sectors	Horizontal Regulation (HR)	Rural Development Regulation (RDR)
• Dairy Cow Premium and national envelope supplement	• Optional Payments for environmental actions	• Less Favoured Areas Payments
• Beef slaughter premium	• Mandatory environmental requirements.	• Agri-environment measures
• Suckler cow premium		
	• Specific environmental requirements on CAP direct payments	
• Beef national envelope	• Optional Modulation (providing for funds for RDR measures)	• Investment in agricultural holdings
• Beef Special Premium		• Training
		• Farm diversification
		• Early retirement
		• Processing and marketing
• Extensification payment		

6.2. General implications of reforms

The main possible impacts of the Agenda 2000 reforms on dairy production systems are likely to include the following:

a) The reforms do not represent fundamental reform or change in the nature or base of the dairy support regime. Whilst the introduction of a direct payment form of support (dairy cow premium) is new to the regime, the underlying level of support provided to dairy farmers is not being significantly altered – price cuts are partly compensated via the provision of direct payments. This means that in the long run the ways in which the dairy regime impacts on dairy production systems, husbandry methods, intensity, etc, and on the environment is unlikely to be subject to significant change.
b) Given that the reforms are also not to be initiated until 2005, there is unlikely to be any noticeable impact on production systems for several years.
c) As support prices will remain unaltered until 2005, and even after that date are likely to continue to be at levels that are significantly higher than long run world market prices for dairy products (eg, the current EU average whole milk powder price is about 65-75% higher than third country price equivalents)[13], the economic incentive to produce milk to a level of output that is equal to quota levels across the EU is likely to continue. The degree of economic incentive inherent in the current system can be illustrated in the UK where lease values for traded milk quota[14] were equal to 48% of the support price in 1997/98 (9.6 pence/litre relative to the average milk price of about 20 pence/litre); this highlights the high level of demand for milk quota relative to supply. Although the support price cut will probably contribute to decreasing quota rental values (the direct payments will tend to offset this), these are unlikely to fall to a level where there is little or no demand (ie, quota values would be very low). Hence, total EU milk production is likely to be closely aligned to quota levels. As a result, total EU production is likely to increase by an amount equal to the level of increase in quota size agreed in the reforms (1.5% across the EU plus the additional volumes in specific regions).
d) It should be noted that the implication referred to above relates to the general level and is indicative of the average dairy farm. Whilst it therefore reflects the underlying position for the majority of dairy farms, the decrease in the level of price support (and not providing full compensation via direct payments) may have a more significant impact on the more marginal producer.

   For such marginal producers any decrease in the returns derived from milk production may result in additional producers leaving the sector (ie, not using quota or selling/leasing it where allowed). In such instances, the level of quota does not constrain the level of milk production and it might result in production levels falling below quota limits. Ultimately the net effect of such an impact will depend upon how many marginal producers might seek to lease production and the scope for trading quota. Where quota trade is prohibited or made difficult, the net effect will be production at levels below quota. Where it is tradable it could result in a significant net outflow of quota from these more marginal regions to the main production areas (also the regions where intensity levels tend to be highest (evidence from the UK supports this hypothesis in that there has been in recent years a net transfer of quota to Northern Ireland, the West and North of England from the South and East of England), unless 'ring fencing' of quota is initiated in these marginal regions. It should however, be noted that the possible impact of 'ring fencing' is heavily dependent on local factors. For example, in the Southern Isles of Scotland ring fenced area, the net effect of ring fencing between 1994/95 and 1996/97 is considered to have contributed to keeping prices at levels below those prevailing outside

[13] For example, in March 1999 the EU average market price was about 2.5/kg compared to prices in Central Europe (Slovakia) of about 1.4- 1.5/kg.

[14] The UK being the Member State in which the market for and trade in quota is probably the greatest – also bearing in mind that many Member States do not currently permit open market trade in quota.

the ring fenced area. This has been to the economic advantage of producers wishing to acquire quota, but to the disadvantage of those wishing to leave the sector[15].

e) The precise implications of the cereal support price cuts on the relative competitive position of cereal-based feed (concentrates, straight and silage maize) is difficult to predict because impact will vary at the farm level. Accordingly, to fully assess this would require detailed examination of farm level accounts and dairy gross margins for a number of representative farms. Whilst this is beyond the terms of reference for this project, the scope for undertaking such analysis would be constrained by the limited availability of data. Therefore, at a general level, it should, on a priori grounds, contribute to an increase in cereal ingredient use in the dairy feed ration, which would represent a re-enforcement of existing trends in dairy feeding. Also, the introduction of area payments for grass silage in some regions where maize silage is not a traditional crop could result in an overall increase in use of grass silage in these regions (mirroring part of the upward trend in maize silage usage after the 1992 reforms).

f) The implications of the beef regime changes are also difficult to predict. Again impact will vary at the farm level and to fully assess this would require detailed examination of farm level accounts and comparisons of different enterprise margins. This is beyond the terms of reference of the project and would probably be constrained by limited data availability. At a general level, the reductions in beef support should, on a priori grounds, contribute to reduced levels of production as some of the more marginal producers leave the sector. However, it is the margin derived from beef (coupled with dairy margins) relative to other enterprises that will ultimately determine changes to production practices. Clearly the intention of the policy changes (notably setting the beef premium for dairy cows at a level that is influenced by milk yield) is to deliver as 'neutral' a policy change as possible, that neither encourages or discourages beef relative to dairy, post-Agenda 2000.

g) As the beef slaughter premium to be introduced in 2000 also applies to cows over 8 months old and the beef national envelope can be used to top up payments on male or female bovines, including dairy cows, this may contribute to partially offsetting the underlying greater disincentive to stay in beef or dairy production for the more marginal producer.

6.3. Implications by farm types

- **Intensive specialist dairy farms**. On a priori grounds the most likely response of such farms will be to attempt to offset the small net decrease in income by further intensification (increasing production by taking advantage of lower cereal based feed costs to increase yield per cow, and buying or leasing-in additional quota[16]). In northern regions of the EU (eg, Finland) the change in the relative price of grain and grass (the lowering of cereal prices) is likely to make the production of grass feed less competitive. This may potentially lead to some silage based feeding being replaced by cereal diets. However, the inclusion of grass silage as eligible for arable payments for regions which do not grow silage maize because of climatic limitations, such as Finland, may offset this effect.
- **Semi-intensive mixed dairy-beef farms**. Where a beef enterprise makes a significant contribution to total farm income the priority will be to qualify for the Extensification Premium, which now takes account of all grazing livestock, including dairy cows. The new higher stocking thresholds that Agenda 2000 is introducing will probably mean there is less likelihood of some producers needing to

[15] Source: MAFF 1998 'Economic evaluation of milk quotas'. The contractors are not aware of any similar study having been undertaken in countries such as the Netherlands or Germany (the other member states where quota transfer occurs to a reasonable level).

[16] Assuming all Member States facilitate quota transfer.

de-stock, either through selling or renting out milk quota or Suckler Cow Premium quota (if the farm has suckler cows). The resulting higher stocking rate thresholds, and availability of cheaper cereal feed, could therefore result in increased fertiliser use.

- **Extensive mountain dairy farms**. These farms tend to be less intensive producers than the mainstream core of production found in the Atlantic bio-geographical region. Hence, it is reasonable to assume that this category of farm is where the most marginal dairy farms can be found and where the greatest concentration of those who might leave the sector might also be found, post-Agenda 2000. As indicated earlier, the precise nature of the impact of the cut in support derived revenue is difficult to assess without access to farm level income and gross margin data. Additionally, long established cultural traditions and practices further complicate the economic factors that affect abandonment. Farm level behaviour is therefore significantly affected by both economic and non-economic factors (see van Eck et al, 1996 and the report 'Possible options for the better integration of environmental concerns into the various systems of support for animal products' produced by CEASC and EFNC for DGXI in 1997). Key points to take into consideration include the following:
  - in regions where quotas are being largely fulfilled (ie, quota are constraining production levels) the provision of additional quota may contribute to keeping some dairy producers in the sector that may have otherwise left;
  - where quota transfer has been allowed some have sold or leased their quota to farmers in non-mountainous areas. The scope for greater flexibility in quota transferability included in the Agenda 2000 reforms may accelerate this process. However, this may be counter balanced by the opportunities for ring fencing;
- in some of these regions quota is going unfilled because production for the most marginal producers is simply unprofitable. In this case, the extra quota allocation under Agenda 2000 is unlikely to improve profitability. In fact, the less than full compensation provided via direct payments for the price cuts will probably result in more marginal producers leaving the sector;
- in Member States where more than 50% of milk production comes from mountain areas, dairy cows kept on mountain farms may be eligible for beef extensification payments. Where applicable ,this may partially offset some of the possible trend of more marginal producers leaving the sector.

6.4. Scope for affecting the environmental impact of dairy farming

As indicated above, the net effect of the Agenda 2000 policy changes on dairy farming economics and methods of production is likely to be very limited. Also, any impact that may occur will not manifest itself for several years.

Where change can reasonably be expected to occur mainly relates to the impact of lower milk prices, lower levels of gross farm revenue and ultimately lower income from dairy farming. In the main milk producing regions of the Community (Northern countries and the Atlantic bio-geographical region), lower returns coupled with improved competitiveness of cereals as a feed ration is likely to make silage feeding relatively less attractive as a feeding alternative. To the extent that this may result in a shift away from silage feeding to cereal feeding, this is likely to result in higher levels of phosphorus and nitrogen output, increased eutrophication of water courses, possible increases in erosion and greater emissions of ammonia.

The reforms do, however, introduce some scope for introducing positive environmental aspects[17] into dairy husbandry systems via the implementation of the national envelope component of the direct payment. These payments offer the potential to implement a number of positive environmental practices, making their adoption conditional for receipt of the direct payment. From a positive environmental perspective, the scope for using area payments rather than headage opens a way for well targeted actions which can adequately reflect regional environmental interest or sensitivity. They also offer the opportunity for harmonisation with measures in other sectors and for favouring more extensive producers.

One clear way to use these national envelopes would be to give further support to certain categories of producers whose management practices are regarded as environmentally beneficial (positive environmental objectives might also be built in as objectives for ring fencing. In the past the main objective for ring fencing, for example in the Scottish Islands, has been to ensure adequate supply volumes to a local processing plant). For example, those with high proportions of natural pasture, mountain dairy farms and organic producers. However, focusing the provision of the national direct payment top ups on such categories of producer is likely to be resisted by other producers in more intensive areas, especially if there is considerable difference in the way top ups are made available across different Member States.

This aspect of how best to utilise the national envelopes for deriving maximum positive impact on the environment together with the potential for use of measures from the horizontal and rural development regulations are examined in more detail in Section 7 of Part 2. The reader should, however note that, as indicated in sub-section 6.2, the impact of measures agreed in Agenda 2000 are unlikely to have any significant impact on how the majority of EU dairy farming impacts on the environment.

6.5. The potential use of the ty pology of EU Dairy Systems

Within the context of examining ways in which positive environmental practices might be encouraged as part of the Agenda 2000 package, the typology of EU dairy systems presented in section 4 provides a structure for grouping dairy farms which respond to economic and policy pressures in discrete ways (summarised in Figure 4.1). From an agricultural policy perspective this could help in predicting and interpreting the wider environmental impact of centralised policies. We would expect that within the systems, the dairy farmer’s reaction to policy incentives (if he remains in dairying) would ultimately tend to manifest itself on the ground through a shift in management emphasis that would change the character of the system (with some predictable results for the environment). For example, if it changed the proportion of rotational grassland to maize cultivated in the Intensive Maize Silage Systems (M1). It could also shift the balance of dairy farms within the systems. For example, if large numbers converted from conventional to organic mixed dairy systems; again with some predictable environmental consequences.

From a more specific environmental perspective the typology could also form a more robust method of assessing good dairy farming practice and good environmental practice and targeting incentives within agri-environmental schemes. These issues are discussed further in the following sections.

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[17] In addition to the possibilities inherent in the agri-environmental schemes initiated via the accompanying measures part of the 1992 reforms.

PART 2: PRACTICAL OPTIONS FOR IMPROVING THE ENVIRONMENTAL IMPACT OF EU DAIRY SYSTEMS

In the sections below, practical options for improving the environmental impact of EU dairy systems are examined. This is considered from two main perspectives:

- environmental neutrality and the scope for incorporation within standards of good agricultural practice (GAP);
- environmental enhancement.

This part of the report is structured as follows:

Section 7: covers existing measures and provisions for good agricultural practice, neutrality and enhancement across EU agriculture and considers their applicability to dairy farming.

Section 8: examines practical options for delivering good agricultural practice with ‘improved’ neutrality and enhancement, specifically in relation to dairying and the Agenda 2000 policy changes.

Section 9: conclusions.

7. Existing measures for improving the environmental impact of EU dairy systems

7.1. Introduction

EU level environmental policy has its legal origins in the Single European Act of 1987 where specific articles were included 'authorising' an EU environmental policy. Subsequent ratification of the Maastricht Treaty placed a legal obligation on the Union to take account of environmental protection requirements when drawing up and implementing policy. This obligation was further reinforced by the Treaty of Amsterdam in May 1999.

There are two broad types of EU-wide environmental policy:

- those that attempt to achieve environmental neutrality (generally designed with the objective of mitigating existing negative environmental impacts);
- those that attempt to provide environmental enhancements under Regulation 2078/92.

In addition to EU level measures there are also national level policies and initiatives.

The discussion in the sub-sections below considers environmental neutrality and environmental enhancements at both the EU and national level.

7.2. Overview of present meas ures to minimise the environmental impact

a) EU level measures

There are a range of measures in operation that focus on environmental neutrality. These operate to a common set of principles, but differ in substance and detail across Member States because of the degree of flexibility allowed in implementation at the national level. The most important point to recognise about these measures is that they tend to be targeted at environmental media and/or specific problems (eg, water protection or fertiliser use). Targeting does not tend to be specific to agricultural sectors such as dairying, and as a consequence, this makes it difficult to assess impact on the dairy sector.

The main areas of legislation are related to the nitrates' directive, the water framework directive, environmental assessment directive, integrated pollution prevention and control (IPPC), habitats directive, wild birds' directive and the financial instrument for the environment (LIFE). Within these, the legislation concerning water quality (the key problem of nitrate pollution) is probably the most relevant for dairy production.

Early European water policy began with the First Environmental Action Programme in 1973. This was followed by a first wave of legislation, starting with the 1975 Surface Water Directive and culminating in the 1980 Drinking Water Directive. This first wave of water legislation included water quality standard legislation on fish waters (1978), shellfish waters (1979), bathing waters (1976) and groundwaters (1980). Emissions were also considered under the Dangerous Substances Directive (1976) and its daughter Directives on various individual substances.

A second wave of water legislation followed a review of existing legislation and an identification of necessary improvements and gaps to be filled. This phase of water legislation included the Urban Waste Water Treatment Directive (1991) and the Nitrates Directive (1991). Other elements identified were revisions of the Drinking Water and Bathing Water Directives to bring them up to date (proposals for revisions being adopted in 1994 and 1995 respectively), the development of a Groundwater Action Programme and a 1994 proposal for an Ecological Quality of Water Directive. The IPPC Directive also covers water pollution.

Whilst some existing legislation aims at protecting water resources, some others try to secure better water quality for consumers by defining a number of quality parameters to be complied with. As indicated above, from the agricultural (and hence dairy) perspective, the most relevant water directive is the Nitrate Directive, which focuses on farming practices.

The following tables (Table 7.1 to Table 7.7) consider the objectives, mechanisms, success and impact on dairy production of the EU level legislation.

Table 7.1: Nitrates Directive

Legislation:	Nitrate Directive 91/676
Objective:	• reduce nitrate-causing activities in designated zones vulnerable to nitrate leaching.
Mechanisms:	• control of application of nitrogenous fertiliser; • reduce the over-stocking of livestock and spreading of animal effluent in vulnerable zones; • impose restrictions on the application of nitrogen compounds; • establish codes of good agricultural practice; • establish National Plans of Action (for four years to 1999); • obligation to have a maximum level of nitrogen application per ha to 210kg/ha by the end of 1998; • obligation to have a maximum level of nitrogen application per ha to 170kg/ha by the end of 2002; • setting land management practices for certain soil types; • establishment of non-mandatory codes of good agricultural practice.
Success:	• as certain Member States were late (end 1995 was the requirement) in designating nitrate vulnerable zones within the time frame and/or sought derogations this suggests that success (when measured by adoption) is limited. However, the lack of take up may be prompted by a realisation that complying with the legislation may require significant changes in practice. For example, in the Netherlands the original action plan was withdrawn until after the scale of the problems was identified. The intense nature of the problems in the country has resulted in the application of higher "allowable" limits in the short to medium term. Also, many Member States have been subject to critique for inadequate development of monitoring and surveillance systems (DG Environment 1998 - evaluation of the costs of groundwater inspection in the Member States); • the voluntary nature of the codes of good agricultural practice possibly weakens their impact.
Impact on dairy:	**Potential:** • widespread impact on use of nitrogenous fertiliser if requirements made mandatory, applicable to most farms and penalties applied; • general extensification; • possible changes to manure storage and handling.
	Actual: • there are currently no studies that have formally assessed impact on the dairy sector.

Table 7.2: Proposals for a water framework directive

Legislation:	Water framework Directive (1997)
Objective:	• to achieve 'good status' for all groundwaters and surface waters by 2010. This includes the four sub-objectives of a sustainable water policy: - sufficient provision of drinking water; - sufficient provision of water for other economic requirements; - protection of the environment; - alleviation of the adverse impact of floods and droughts.
Mechanisms:	• the establishment of river basin management based on an assessment of river basin characteristics; • monitoring of surface and groundwater status; • setting a definition of quality objectives; • establishment of programmes and measures to achieve the objective.
Success:	• the programme of measures are based on all relevant water-related legislation, whether Community, national or regional legislation and have to be legally binding. This indicates that this Directive is likely to be successful as long as the mechanisms are sufficient to meet the objective.
Impact on dairy:	**Potential:** • this Directive brings together the range of water regulations and is not limited to agriculture, let alone the dairy sector. However, the impact on dairy will be the sum of the impacts of other water measures which affect dairy production. The most important measure with regard to dairy is the Nitrates Directive (See Table 7.1) and the potential impact will be consistent with that given above.
	Actual: • the direction still has 'proposal' status and has not yet been approved for implementation.

Table 7.3: Environmental Impact Assessment Directive

Legislation:	Environmental Impact Assessment (EIA) Directive (85/337)
Objective:	• to ensure pollution prevention and fair competition on the internal market.
Mechanisms:	• an environmental impact assessment must be conducted before consent for a development likely to have a significant environmental impact is given; • the promoter must supply the competent authority with detailed relevant information about the project in the impact statement; • environmental authorities must be given an opportunity to comment before a decision on the project is taken; • the public must be informed of the request for development and the impact statement and allowed to express its opinion.
Success:	• this Directive was amended (with effect from 14 March, 1999) in an attempt to overcome widely accepted weaknesses in the original Directive. Insufficient time has passed to assess whether the revisions to the Directive are proving successful or not.
Impact on dairy:	**Potential:** • this Directive makes EIA compulsory for certain intensive livestock farms, although dairy is not listed as one of these. Its inclusion is therefore at the discretion of Member States; • where EIA is a requirement, dairy farmers will incur costs in the EIA process for new developments (eg, milking parlours, winter accommodation). In some cases plans may be rejected.
	Actual: • there are currently no studies that have formally assessed impact on the dairy sector.

Table 7.4: Integrated Pollution Prevention and Control (IPPC)

Legislation:	Integrated Pollution Prevention and Control Directive (96/61)
Objective:	• to prevent emissions from industrial facilities into air, water or land, including measures concerning waste, wherever practicable and, where it is not, to minimise them in order to achieve a high level of protection for the environment as a whole.
Mechanisms:	• Best Available Techniques which take into account technical characteristics of the installation, geographic location and local environmental conditions are used to minimise pollution across environmental media; • a framework is provided which will allow common EU emission limits to be set at a later date.
Success:	• Member States have until the end of October 1999 to apply IPPC to new installations and until October 2007 for existing installations. Insufficient time has passed to assess whether the controls will prove successful or not.
Impact on dairy:	**Potential:** • the provisions apply to intensive livestock production located in vulnerable zones of more than 100 livestock units and producing more than 170kg of Nitrogen per hectare of spreading surface available. There are likely to be impacts for intensive dairy farming enterprises.
	Actual: • there are currently no studies that have formally assessed impact on the dairy sector.

Table 7.5: Habitats Directive

Legislation:	Habitats Directive (92/43)
Objective:	• to contribute to the maintenance of biodiversity within the EU through the conservation of natural habitats and of wild fauna and flora.
Mechanisms:	• extends many protection mechanisms provided for under the Birds Directive (see Table 7.6) to other species and habitats; • implements the Biological Diversity Convention and imposes obligations on Member States similar to those laid down by the Bern Convention; • establishes a 'favourable conservation status' for habitat types and species selected as being of EU interest; • the measures fall into two categories: the conservation of habitats; and, the strict protection of certain species of plants and animals.
Success:	• Member States have until June 2004 to designate sites as Special Areas of Conservation (SACs). In the meantime, a single list of sites of EU importance has been adopted; these sites are now subject to protection obligations.
Impact on dairy:	**Potential:** • the impact on dairy farming is likely to be considerably less than for arable enterprises. However, it is conceivable that the presence of certain plant species may prevent the improvement of pasture. The designation of SACs in dairy farming areas may also have implications.
	Actual: • there are currently no studies that have formally assessed impact on the dairy sector.

Table 7.6: Wild Birds Directive

Legislation:	Wild Birds Directive (79/409)
Objective:	• to protect migratory wild birds and their habitats.
Mechanisms:	• Member States must preserve, maintain or re-establish a sufficient diversity and area of habitats by creating protected areas, managing habitats inside and outside protected areas, re-establishing destroyed biotopes and creating new ones; • the prohibition of deliberate killing or capture; the deliberate destruction of/or damage to nests and eggs; the taking of eggs in the wild; the sale of wild birds, including any parts or derivatives of live or dead birds; deliberate disturbance during breeding and rearing; and the keeping of birds whose hunting and capture is prohibited; • Member States are required to take special measures to conserve the habitats of listed vulnerable species as well as migratory species by designating as Special Protection Areas, (SPAs), the most suitable territories for these species.
Success:	• the overall surface of the SPAs has increased five times from 1986 to 1994, from 1.4 million to 6.8 million hectares. However, there is still a gap between the number and area of SPAs and what is estimated as necessary to establish a sufficient and coherent network; • the designation of a site as a SPA is not always followed by the implementation of the necessary measures.
Impact on dairy:	**Potential:** • the impact on dairy farming is likely to be considerably less than for arable enterprises. However, it is conceivable that some improvement to pasture may be prevented. The designation of SPAs in dairy farming areas may also have implications, although special attention is paid to wetlands, which is unlikely to impinge on dairy farming.
	Actual: • there are currently no studies that have formally assessed impact on the dairy sector.

Table 7.7: Financial Instrument for the Environment (LIFE)

Legislation:	Financial Instrument for the Environment Regulation 1973/92
Objective:	• to contribute to the development and, if appropriate, the implementation of Community environmental policy and legislation.
Mechanisms:	• this financial instrument supports the 'polluter pays' and subsidiarity principles of the EU. Grants fund a proportion of project costs.
Success:	• the second phase covers the period 1996-1999 and has a budget allocation of 450 million.
Impact on dairy:	**Potential:** • as one of the main fields of action for this Regulation is to provide funds for nature conservation actions such as the Habitat and Wild Bird Directive, the impact on dairy is likely to be minimal (although see Table 7.5 and Table 7.6); • more impact is likely from the other main field of action which is to fund actions designed to implement legislation concerning the protection of water resources (see Table 7.1 and Table 7.2) as nitrate pollution can be caused by dairy production.
	Actual: • there are currently no studies that have formally assessed impact on the dairy sector.

The key points to note from Table 7.1 to Table 7.7 are:

- in all cases impact is dependent on enforcement;
- the Nitrates Directive (Table 7.1) is likely to exert the greatest influence over dairy production;
- there is a universal lack of data, studies and assessments of the impact of dairy farming on any of these environmental issues;
- the focus of the legislation on environmental media and pollutants is widely perceived to be the most efficient way of addressing the environmental problems rather than implementing a plethora of measures at the level of several sectors in agriculture. However, this makes assessment of the environmental

impact of dairy production techniques (if any) on problems such as nitrate pollution and the impact of legislation to mitigate the environmental problems on dairy farming very difficult to assess. As indicated above there is also a universal lack of data and studies examining the impact at the dairy sector level.

b) Member state level

i) General

Environmental priorities in agriculture vary substantially from one Member State to another according to the nature of the problem, the natural environment, the relative importance of agriculture to an economy and the nature of agricultural practices. However, as at the EU level, all approaches are based on either the pollutant or the environmental media that are affected, rather than the sector of agriculture that may contribute to the problem.

Environmental priorities by topic can be broadly summarised as follows:

Water pollution: France, Germany, Denmark and the UK are Member States which have relatively high environmental standards relating to water pollution in general (although France has so far (November 1999) failed to identify nitrate polluted or eutrophic waters under the Nitrates Directive), and for agriculture related pollution in particular (ie, their standards are perceived to be more strict that EU level standards). Limiting water pollution by nitrates is a priority in regions with high livestock densities. Also, Italian standards relating to nitrate emissions are now considered to be generally higher than EU requirements (ie, under the Nitrates Directive). Overall, the standards relating to water pollution (especially with regard to nitrates) are likely to have the greatest impact on dairy production systems.

Soil erosion: this is a major problem in Italy. Regional programmes to counter soil erosion in Italy focus on long term set-aside. This is also an important issue in the UK where a specific Code of Good Agricultural Practice has been developed. It is unlikely measures to counteract soil erosion exert much influence over dairy farming techniques.

Landscape conservation: landscape conservation has a relatively high priority in Italy and the UK. In contrast, it is given very limited prominence in France, although some actions are taken mainly for economic reasons (eg, agri-tourism). Where such measures apply, they are usually to more marginal agricultural production regions. The main implications for dairy farming are restrictions on practices that may contribute to intensification of production such as improvement of pasture. Most measures taken are associated with agri-environment measures (see sub-section 7.3).

Biodiversity and habitat protection: actions to maintain biodiversity and habitat are widely perceived to be limited, with the notable exceptions of Italy and the UK. Loss of biodiversity is also perceived to be a major public issue in Germany, however limited action has been taken to address this. Biodiversity probably has a fairly low priority in France where the implementation of the Habitats Directive has been delayed. The impact on dairy farming of such measures are most likely to occur in more marginal areas (subject to the proper implementation of appropriate measures). Most measures taken are associated with agri-environment measures (see sub-section 7.3).

Rural depopulation: this is major concern in France. The French government has developed various schemes to try to retain farmers on the land in some parts of the country (Massif Central and North East border) for socio-economic reasons, and to minimise abandonment and to provide fire protection. These type of measures (often contained within broader structural funds type measures) may contribute to maintaining dairy farming in marginal areas.

Other issues: forest fires are considered to be an important 'target' issue in France and Italy. Air pollution from intensive livestock production is considered an important issue in the Netherlands. Measures targeting these environmental issues may impact on dairy farming, for example, by minimising abandonment (fires) and limiting housed stocking density (air pollution).

Overall, in terms of dairy farming, water pollution is likely to be the biggest environmental issue in Atlantic regions where dairy production is heavily concentrated and most intensive. Landscape conservation, biodiversity and habitat protection measures may also impact on dairy production, particularly in more marginal areas (eg, in Alpine systems). Rural depopulation issues could potentially impact on dairy farming (eg, in Alpine areas) if they serve to discourage abandonment. This may however, have a positive impact on the environment because active land management (as distinct from abandonment) in mountain areas usually promotes biodiversity. Measures to control air pollution from intensive livestock production may also impact on dairy farming. This is likely to be most notable in Atlantic regions where dairy farming is highly commercial and intensive.

The most widespread mechanism for offering environmental neutrality at the Member State level is the use of Codes of Good Agricultural Practice. These are discussed further in the sub-section below.

ii) Codes of Good Agricultural Practice

Most countries have formulated Codes of Good Agricultural Practice (mandated for water under the Nitrates Directive, but different environmental media are also covered in certain Member States). However, the importance of these codes varies by country:

- the French approach is based on a legislative framework where standards are defined to be included in the Codes;
- the UK has adopted a more voluntary approach to the Codes of Good Agricultural Practice;
- the German authorities at Federal and Länder level take a more regulatory approach than their counterparts in the UK. However, Germany is similar to France in that it tends to use the principle of compensation for the provision of environmental services. As advice schemes are perceived to be unpopular with farmers, the only advice given by the Ministry of Agriculture relates to the use of pesticides and fertilisers. The impact of the former on dairy farming is likely to be minimal, although the later may have implications for stocking densities in that it is likely to reduce yields from grasslands;

- Italy formulated its first Code of Good Agricultural Practice in 1991 and this essentially deals with the protection of waters from nitrate emissions. The Code is very general and flexible and can be considered as a basis for the development of regional Codes of Good Agricultural Practice as it allows regional differences in priorities and problems to be addressed. Italy has a preference for mechanisms such as advice and information which are considered to yield more positive results, require limited financing, and do not require burdensome control measures. Compulsory standards were much more prevalent in the past. However, these proved to be difficult to enforce and require a significant administrative capacity.

More detailed examples of Codes of Good Agricultural Practice are provided for Belgium and the UK respectively in Table 7.8 and Table 7.9.

Table 7.8: Code of Good Agricultural Practice (water), Walloon, Belgium

Objective:	• to help optimise the use of nitrates in order to avoid the pollution of water courses, specifically groundwater supplies.
Mechanisms:	• the code brings together existing and forthcoming legislation in this area and provides advice on best practice; • obligatory measures include: - an upper limit on the amount of nitrogen per hectare (400kg/ha/year); - restrictions on the spreading of manure and slurry; • measures obligatory in NVZs (voluntary elsewhere) include: - prescriptions concerning storage facilities; - further spreading restrictions; - the setting of maximum levels of application according to the crop; • advice on best practice includes: - best planting dates and sowing practices (to minimise nitrogen loss); - the importance of establishing existing soil levels of nitrogen before applying more; - the necessity of only applying nitrogen in the autumn as a last resort.
Success:	• there are currently no studies that have formally assessed impact and/or success of this code.
Impact on dairy:	**Potential:** • dairy farming is likely to be affected as much as any other enterprise, although as stated above, the impact is likely to be marginal.
	Actual: • There are currently no studies that have formally assessed impact and/or success of this code on dairy farming.

Table 7.9: Codes of Good Agricultural Practice (water, soil, air), UK

Objective:	• to help farmers and growers avoid pollution of water, soil and air.	
Mechanisms:	• the codes contain a wealth of advice which producers are encouraged to follow to minimise pollution. The water code includes advice on: - farm waste management planning; - storage and treatment of slurry; - managing dirty water; - silage effluent; - fertilisers/pesticides storage and usage; • the air code includes inter alia advice on: - minimising odours from land spreading of livestock wastes; - minimising odours from housed livestock systems; - reducing ammonia losses from manure and slurries.	
Success:	• a report prepared for MAFF by Taylor Nelson AGB in 1996 evaluated some aspects of the success of all the codes in existence at that time and found that although 46% of farmers were aware of one or more of the codes, only 18% owned a copy of the water code (compared to 7% and 5% for the air and soil codes, respectively); • two thirds of farmers claimed to be farming in compliance with the codes and the highest rates of compliance were noted in matters relating to rivers and watercourses. This is thought to result from a combination of greater level of awareness (as manifested in the water code being the code with highest levels of readership and awareness), being the focus of pollution visits and being perceived to have been well policed by the then National Rivers Authority (now the Environment Agency); • the evaluation indicated that the codes were generally referred to only after a problem, rather than providing a basis for operations. Their success was therefore thought of as limited in terms of impact on farming practice. The evaluation did however make recommendations for improving the use of the codes, and these have been largely implemented. The voluntary nature of the codes is however likely to mitigate against effectiveness.	
Impact on dairy:	**Potential:** • dairy is as likely to be affected as any other enterprise.	
	Actual: • there are currently no studies that have formally assessed impact on the dairy sector.	

As with the EU level 'environmental' policies referred to earlier and Member State initiatives, there is an almost universal lack of data, studies and assessments of impact of codes of practice both in general and on dairy farming.

iii) Other national environmental neutrality measures

As indicated in the above sub-sections environmental standards as applicable to agriculture vary significantly among Member States and are often based on codes of practice. Table 7.10 summarises the nature of the main types of measures applicable at the national level. Key features are:

- Environmental standards in French agriculture tend to focus on pollution caused by livestock production. Standards are set by regulations, and a Code of Good Agricultural Practice which have implications mainly for livestock farming. There are relatively high standards for particularly sensitive regions where nitrate emissions are perceived to be high (such as Brittany, a major dairy farming region). Some standards are also set at a regional level depending on the nature of the problem and its intensity. By contrast, France has relatively low standards relating to pesticide use. Other environmental concerns are mainly related to rural depopulation and soil erosion. However, specific standards have not yet been developed. Instead, the French government has relied on advice given to farmers and local authorities. It has also tried to develop specific contracts with individual farmers (Sustainable Production Contracts).

- Denmark has adopted relatively high standards relating to livestock production including specific standards for livestock stocking density and the storage capacity of manure. For crop production there are standards relating to crop rotation and fertiliser use for which annual plans must be drawn up and submitted. These are perceived to have significant impacts for dairy production although there are no studies available that have formally examined impact.

- The Netherlands (along with Denmark and Sweden) has introduced the concept of a Farm Nutrient Balance (FNB). Called MINAS, the mineral accounting system, this form of FNB was introduced in 1998 when it replaced the previous regulations covering manure. Livestock farmers with a stocking density of more than 2.5 LU/ha (falling to 2.0 LU/ha and also applying to arable farmers from 2002) are required to submit a record of their nutrient surplus. Farmers with a nitrogen surplus are charged a levy of 0.68/kg/ha and those with a surplus of phosphate 1.13/kg/ha for the first 10kg of surplus per hectare and 4.53/kg/ha for each successive kg. These levies are designed to act as a stimulus to change rather than as a means of raising revenue and are likely to have been successful given the fact that the (less stringent) legislation that MINAS replaced led to a reduction in nitrogen surplus of 16% between 1985 and 1994 (nitrogen surpluses were widely expected to have risen by 40% over this period). MINAS offers economic benefits to the farmer in that excess applications of inputs are avoided, and it also promotes the use of ecologically sound systems (Charter, 1998).

- Standards relating to pollution from nitrate emissions were introduced in Germany in 1996 and aim at complying with EU standards. However, the earlier Waste Act, Fertiliser Act and the Pollution Prevention Act had already contained provisions concerning nitrate and ammonia emissions. Detailed standards are set by regional authorities which results in substantial variability by region. The perceived impact on dairy farming is also thought to vary - again there are no studies available which have examined or assessed impact.

- Environmental standards in Italian agriculture were introduced in the 1980s through several laws and regulations. Most regulations applied EU Directives and, in general, standards (eg, nitrate emissions) were brought in line with EU recommended levels. Most environmental standards are reported to have proved difficult to enforce through laws and regulations, which has led to Italy implementing regional programmes based on advice and information services. There are no empirical or evaluation studies available on the subject.

- Water related measures (particularly those with reference to Nitrates) have been in operation in some of the Member States of the EU where Nitrates have been considered to be a problem area before the EU Nitrates Directive was implemented (eg, Sweden and Denmark both have water protection policies dating back to 1985 according to Charter (1998)). However, most national legislation now works under the general guidelines of the EU Directive, although standards in various Member States (or regions of Member States) sometime exceed the EU minimum standards. There is however, a universal lack of data and assessment on the impact of dairy farming on nitrate pollution and on the impact of measures taken to alleviate the problems on dairy farming.

Table 7.10: The main national neutrality measures: as applicable to dairying

Member State	Legislation/schemes
Germany	• the Fertiliser Act (1996) and Fertiliser Application Ordinance adopted in 1995 aim at limiting nitrate emissions from agricultural sources and implement the EU Nitrate Directive. The Fertiliser Application Ordinance includes standards on: - the application of animal manure: the maximum amount of manure to be applied should not exceed 170kg N/ha on arable land and 200kg N/ha on grassland; - restrictions on the spreading of animal manure: spreading of manure is prohibited between 15 November and 15 January; - the compulsory preparation of nitrogen balance sheets. • the Waste Act (1990) is concerned with the safe deposit of waste. It includes standards on: - the application of slurry; and, - the heavy metal content in sewage sludge. • the Pollution Protection Act (1990) mainly addresses air pollution and aims at the prevention of environmental pollution by controlling ammonia emissions during production. The act prescribes that preventative measures be incorporated into the production process in order to prevent pollution.
Impact on dairy	• it is quite likely that dairy production will have been affected by the above measures if dairy farming was responsible for nitrate pollution before their introduction. The magnitude of effect will be determined by the scale of any changes that took place. No information exists to evaluate any change or causality.
UK	• under the Water Act of 1989 it is an offence to knowingly discharge any poisonous, noxious or polluting matter, or solid waste matter, into groundwater, coastal or inland waters without proper authority. The Environment Agency (EA) is responsible for the prosecution of farmers who pollute and Magistrates can impose a maximum fine of £20,000 for each offence. The Crown Court can impose unlimited fines. A person found guilty of causing pollution may also have to pay for any damage caused and meet EA costs. • the Environmental Protection Act of 1990 updated the UK's pollution control systems. In particular a system of integrated pollution control for the disposal of waste to land, water and air was instigated. From April 1992, this Act requires anyone responsible for 'controlled' waste to: - prevent the illegal management of waste; - prevent the escape of waste; - transfer waste to an authorised person; and, - record waste types and movements. • the Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) Regulation of 1991 aims to prevent silage effluent, slurry, dirty water and fuel oil pollution by setting minimum standards for the construction of new or improved farm waste stores. Facilities constructed prior to March 1, 1991, are exempt from these rules, but the EA can ask for improvements if there is a significant risk of causing pollution. This regulation also requires that farmers take all steps necessary to ensure that their farming practices do not pollute inland or coastal waters. Silage seepage, slurry storage systems and agricultural fuel oil stores are specifically covered.
Impact on dairy	• the Water Act may well impact on dairy farmers who cause particular pollution incidents, but it is perceived to do little to improve nitrate emissions generally and across the sector. The Environment Protection Act does provide for more general improvements and its effects are likely to be felt across agriculture. It may be the case that dairy is disproportionately affected as a result of the greater need to use water to clean housing facilities (ie, milk parlours). However, there are no studies or data available that have assessed impact of these measures on dairy farming.
Italy	• the Water Pollution Law of 1976 permits farmers to either discharge manure into surface water after treatment, or into a public sewage treatment plant. Otherwise manure must be applied to fields according to hygiene rules set down by Local Health Authorities. Waste water discharges from commercial farms are subject to a charge related to water consumption and the costs of the sewerage and treatment services rendered; • animal manure storage capacity, application levels of manure and periods of spreading are regulated at a regional level. However, specific programmes have been formulated in the regions which have major problems with nitrates in water such as the Po Valley Area. An action programme was formulated in 1989 to stimulate environmentally sound farming practice and was based on voluntary measures. These measures included a reduction in the amount of rinse water used in housing and prescriptions on the processing and storage of animal manure.

Member State	Legislation/schemes
Impact on dairy	• the above measures will have impacts on all livestock production, although it is possible that the impact is greater on dairy production as a result of waste water produced through cleaning milking parlours. The actual impact of the regional measures on dairy farming will depend on the importance of dairy farming in the regions affected.
France	• the 1976 law on environmental requirements for livestock installations (concerning the pollution of water by livestock) was amended in 1993 to specifically include dairy cows and suckler cows in the nomenclature of classified livestock; • an Action Programme was initiated in 1996 with the objective of reducing water pollution from nitrate emissions in sensitive areas. This programme further curtails the amount of nitrogen that can be applied (from a previous limit of 350kg N/ha/year on grassland to 210kg N/ha/year by 2000 and to 170kg N/ha/year by 2003). Certain regions of France with particular nitrate problems have gone further than this. For example, Finistère (a major dairy region) introduced an application limit of 170kg N/ha/year in 1995 and also banned the expansion of livestock farms with a manure surplus.
Impact on dairy	• these two national laws (and the regional 'spin-offs') are likely to have an impact on dairy farming, although the nitrogen limits are probably more significant and may have implications for stocking density on pasture. There are however, no studies or data available that quantify impact.
Denmark	• the framework of policies relating to nitrate emissions dates back to the Aquatic Environment Action Programme of 1987. There are five main statutory orders covering: - animal manure and silage; - green fields, crop rotation and fertiliser planning; - crop demands for nitrogen and the nitrogen content of animal manure; - livestock holdings; and, - the burning of straw.
Impact on dairy	• the first four of the above measures are likely to have an impact on dairy farming. Inter alia these measures impose standards on livestock installations, the application of manure, stocking densities and amount of land required for manure application. Danish environmental measures are generally believed to be reasonably effective and the implication is therefore that some negative environmental impacts of dairy farming have been mitigated. However, no studies or data assessing impact on dairy farming are available.

Finally, other measures that may impact on dairy farming include legislation relating to planning, the provision of advice and extension and measures concerning the treatment of waste. However, none of these initiatives tend to be targeted at specific agricultural sectors and they are therefore widely perceived to offer limited and indirect contribution to environmental neutrality in dairy farming. There are no data or studies available that have examined impact on dairy farming.

7.3. Overview of present environmental enhancement measures (Regulation 2078/92 measures)

The differences in environmental problems and priorities in agriculture between Member States can be seen more clearly in the implementation of CAP accompanying measures. Agri-environmental programmes developed by national governments, regions or local authorities are adapted to the local environment, the type of agriculture, the natural landscape and also to existing environmental standards. France, for example, has placed an emphasis on the maintenance of extensive grassland, the reduction of livestock density and long term set-aside. In Italy, most programmes aim at reducing the use of fertilisers and converting to organic farming. Denmark’s agri-environment programme focuses on the reduction of fertiliser use, conversion to organic farming, conversion of arable land to extensive grassland and long term set-aside. These are discussed in the sub-sections below.

7.3.1. Overview of measures

The Agri-environmental measures began in 1992 as accompanying measures to the MacSharry CAP reforms. Agri-environment agreements now cover one farmer in seven within the EU and cover about 20% of European farmland[18]. The objectives and key elements of agri-environmental programmes as laid down in the DGVI/DGXI/Eurostat report Agriculture and Environment of July 1999 are summarised in Table 7.11. The areas devoted to 2078 measures are summarised in Table 7.12.

Table 7.11: Objectives and key elements of agri-environmental programmes

Member States are required to apply agri-environment measures throughout their territories, according to the environmental needs and potential. Two broad types of environmental objective are evident:

- to reduce the negative pressures of farming on the environment, in particular on water quality, soil and biodiversity;
- to promote farm practices necessary for the maintenance of biodiversity and landscape, including avoiding degradation and fire risk from under use.

The main elements which characterise agri-environmental agreements are the following:

- farmers deliver an environmental service;
- agreements are voluntary for the farmers;
- measures apply only on farmland;
- payments cover the income forgone, costs incurred and necessary incentive;
- undertakings go beyond the application of good environmental practice.

Source: DGVI/DGXI/Eurostat report Agriculture and Environment of July 1999

Table 7.12: Area and percentage of farmed area covered by 2078/92 by Member State in 1998

	Hectares covered ('000)	UAA ('000 ha)	% of UAA covered
Austria	2,429	3,585	67.8%
Belgium	23	1,375	1.7%
Denmark	107	2,722	3.9%
Finland	1,878	2,160	86.9%
France	6,901	30,170	22.9%
Germany	6,741	17,335	38.9%
Greece	35	5,741	0.6%
Ireland	1,090	4,530	24.1%
Italy	2,291	16,792	13.6%
the Netherlands	34	1,848	1.9%
Portugal	664	3,960	16.8%
Spain	871	29,650	2.9%
Sweden	1,642	3,180	51.6%
UK	2,323	15,870	14.6%
EU-15	**27,126**	**139,046**	**19.5%**

Source: DGVI Commission working document: Evaluation of environmental programmes

Although the area covered by agri-environmental agreements does not provide a measure of 'quality of application' or delivery of positive environmental attributes, it is likely that the impact of 2078/92 measures may be greater in those countries with a greater proportion of UAA covered by agreements. Therefore the agricultural sectors in Belgium, Denmark, Greece, the Netherlands and Spain are likely to have been less influenced by this regulation than the sectors in other Member States.

[18] The target set by the fifth Environmental Action Programme was 15% by 2000

Table 7.13 summarises the basic themes of agri-environmental schemes and Member State emphasis in recent years. The reader should note that Table 7.13 does not aim to provide an overview of current agri-environmental policies but to highlight the nature and subjects/themes prevailing in recent years. In this way it seeks to provide the reader with an appreciation of the nature and emphasis of schemes across the EU.

Table 7.13: Agri-environment themes

Continuation of relatively low input farming systems associated with environmentally sensitive practices.	• in **Germany**, **France**, **Ireland**, the **UK** and **Sweden** the emphasis is on extensively managed grassland. The prime à l'herbe scheme in **France** is a good example. Accounting for about 90% of total expenditure between 1993 and 1997, 5.4 million hectares of land are eligible for entry. A livestock density of less than 1.4 LU/ha is a condition of entry; • in **Austria** and **Finland** national scheme coverage is wider and significant areas of arable land are also included. However, pasture still accounts for a large proportion of enrolled land; • Spain provides an exception where one of the main schemes is designed to encourage the maintenance of dryland arable systems.
The reduction or control of pollution from agricultural land.	• reductions in nutrient water pollution are a major concern in several schemes; • reductions in water pollution are central to schemes in **Italy** and **Greece**; • although agricultural pollution is considered less of an issue in northern Europe, schemes such as the **UK's** Nitrate Sensitive Areas do exist.
The conservation of valued habitats and landscapes.	• this may often be a subsidiary aim of schemes designed to promote the continuation of low input farming systems, however, there are also schemes targeted on particular types of landscape and habitats; • these schemes are often small in scale and well targeted. They form important parts of national programmes in the **UK** and **Sweden**.
The promotion of organic farming.	• payments during conversion to organic farming are available in every Member State with the exception of Luxembourg, and payments for maintaining organic production techniques are widespread; • **Finland**, **Austria** and **Germany** provide examples of significant organic schemes.
Other themes.	• Training and development schemes are widespread, in fact, in **the Netherlands** this measure is the single largest element; • there are schemes for the management of abandoned land, long term set-aside and the preservation of endangered breeds of farm animals, however, these schemes tend to be small scale; • measures designed specifically to reduce livestock numbers are rare, examples include the Moorlands scheme in the **UK** and several zonal programmes in **Spain**; • public access to farmland is a minor scheme component in some Member States, although other countries have not adopted this option.

Source: Assessment of the Environmental Impact of Certain Agricultural Measures. Institute for European Environmental Policy, December, 1997

The agri-environment measures cover various agricultural and environmental interactions. There are several which may be of relevance to dairy production. These are detailed below in Table 7.14 along with the mechanisms used.

Table 7.14: Agri-environmental measures of relevance to dairy production

Agricultural/environmental interactions	Agri-environmental mechanisms
Use of grassland and rough land:	- stocking limits; - grazing management specifications; - removing stocking (for either seasons or a period of time); - specification of breed to be used; - rearing farm breeds under threat; - restrictions on supplementary feed; - specification of method of feeding; - prohibition of surface disturbance; - seeding restrictions; - seeding requirements; - mechanical control of invasive plants; - clearance of shrubs and trees; - hay production requirement; - other vegetation production; - grass cutting requirement; - requirement for number of cuts; - limitations on grass cutting dates; - specification of grass cutting method.
Input use- fertiliser:	- zero use; - reduced use; - restriction on type of input; - restriction on method/timing of use; - restriction on zone of application; - manure use requirements; - manure disposal restrictions; - use of seaweed and other fertilisers.
Input use- pesticides:	- zero use; - reduced use; - restriction on type of input; - restriction on method/timing of use; - restriction on zone of application; - use of infective thresholds; - use of insect traps; - requirement to use pesticide.
Landscape cultivation:	- prevent new drainage; - reduce drainage efficiency.
Organic farming	- conversion to, and maintenance of, organic farming.

Source: DGVI/DGXI/Eurostat report Agriculture and Environment of July 1999

The importance of each category to dairy farming differs according to situation, but broadly the mechanisms relating to the use of grasslands are likely to be of greatest importance (because they are the most direct). Mechanisms relating to pesticides are likely to be the least important, but have been included because they may apply in certain cases. The importance of organic farming varies according to Member State, although in all countries it accounts for a small minority of production systems and output.

At a general level, restrictions on the use of inputs have led to environmental benefits in terms of reductions in phosphorus levels in surface water and reductions in nitrate levels in surface and groundwater. Reductions in fertiliser use have also resulted in increased biodiversity (Source: DGVI/DGXI/Eurostat report Agriculture and Environment, July 1999). However, whilst these positive environmental attributes have been delivered it is difficult to attribute specifics to changes in dairy production. Also, there are no studies that have examined impact on dairy production systems. How much of these reductions are attributable to agri-environment programmes relating to dairy is therefore not determinable from this general information.

In the sub-sections below examples of agri-environmental agreements throughout the EU are considered. The discussion is not intended to be comprehensive, but rather to provide an overview of the types of measures currently used and to provide an indication, where possible, of their relative success. When considering the examples the authors have concentrated on those regions where dairy is an important activity (and therefore where any environmental enhancements resulting from changes to dairy production are likely to be of greatest significance). It is also important to note that the provision of data and examples across different Member States that are presented are limited to those countries where information was provided to the authors. In some cases whilst data exists, it was not provided to the authors during the timeframe for the study. For example, the contacts listed in relation to national evaluation reports in Annex 1 of the DGVI Commission Working Document State of Application of Regulation (EEC) No. 2078/92: Evaluation of Agri-Environment Programmes were all contacted several times over the period June to October, 1999. 2078/92 evaluation documents were only forthcoming from the UK, Italy, Finland, Austria, Belgium and the Netherlands. The Ministries in Spain and Greece informed the authors that their national evaluation reports would not be of use due to late implementation of 2078/92[19].

7.3.2. Grassland management measures

As discussed above, measures that focus on this issue are likely to be of major significance to dairy production. Nevertheless, it is important to recognise that grassland management measures are indirect and not targeted specifically on any one agricultural sector such as dairying. Assessing levels of take up in terms of dairy is virtually impossible because data does not exist on the proportions of species grazing grassland that is entered into schemes. Attributing environmental impact to dairy production has therefore not been possible. It is however reasonable to assume that measures offering environmental enhancements will impact across all livestock enterprises and at least some environmental enhancements can be attributable to changes in dairy production as a result of the grassland management measures taken.

Grassland management measures are widespread across the bio-geographical regions of the EU, although they often only relate to particular (and generally more marginal) areas. Examples are provided below from Bolzano, Italy; Austria (Alpine bio-geographical region); and South West Peak ESA, UK (Atlantic bio-geographical region).

a) Bolzano, Italy
Sixty four per cent of the Bolzano region of Italy is located above 1,500 metres and the region is described as being typically alpine in character. Dairy farming is a major agricultural activity in this area.

Table 7.15: Bolzano, Italy- grassland management

Objectives:	- Maintain existing grassland management practices. - Maintain extensive forage culture.

[19] Contradicting this position, Caraveli (1998) in Brouwer and Lowe (eds) (1998) CAP and the Rural Environment in Transition states that no environmental assessment of the 1992 CAP reform has been attempted in Greece.

	- Maintain biodiversity and landscape character. - Avoid abandonment.
Prescriptions:	- No general use of mineral fertiliser or pesticide (applications to use inputs can be made in certain circumstances). - Restrictions on the storage of slurry. - No improvements to land (ie, drainage, re-seeding). - Stocking density must be at least 0.4 LU/ha and no more than 1.5 or 2.3 LU/ha depending on altitude and accessibility. - Eligibility is only above 700 metres and on farms with no more than 15 hectares and more than 35 livestock units. A premium of 200 is paid per hectare.
Total cost:	- 9 million (71.6% of total 2078 cost in this region).
Take up/success:	- Take up is described as being good. 44,700 hectares were enrolled by 1997, which accounts for 59% of total grassland in Bolzano (approximately 65% of eligible farmers have enrolled). - The high take up rate may suggest that the prescriptions are not too restrictive, in which case the measure may serve to maintain the status quo and environmental enhancements may not be significant.
Impact on dairy:	**Potential** - The high take up rate suggests that the impact on livestock in general is likely to be high. - Depending on the original stocking density, the measure may exert pressure for extensification.
	Actual - The impact on dairy will be dependent on the proportion of dairy cattle that are grazed on grassland that is enrolled in the scheme under this measure. Approximately 90% of cattle in the north east of Italy are dairy cows, although it does not follow that 90% of the grazed area is grazed by dairy cattle as some will be grazed by other species. On the basis of the above, the impact on dairy production is likely to be reasonable. - However, the measure only applies to farms with less than 15 hectares and will not therefore impact on larger farms (although farm sizes are small in this region (an average size of dairy holdings in the Italian Alpine zone is 18 hectares).

Source: Le misure agroambientali in Italia: analisie e valutazione del reg. CEE 2078/92 nel quadriennio 1994-97. Repporti regionali. INEA

Applicazione del regolamento 2078/92 nella Provincia Autonoma di Bolzano: valutazione socioeconomica e strutturale 1999. INEA

b) ÖPUL, Austria

The Austrian Programme for an environmentally sound and sustainable agriculture which protects the natural habitat (ÖPUL) has a broad focus and offers horizontally operating environmental protection. There are two elements to this scheme; the first tends towards more basic prescriptions and minimal environmental benefit, whereas the second element is not available everywhere and offers a greater degree of environmental enhancement through more stringent prescriptions.

ÖPUL covers approximately 76% of the utilisable agricultural area in Austria with 64% of holdings making claims under the scheme in 1995. Total payments in 1997 amount to 0.5 billion, with an average payment per farmer of 3,700.

Table 7.16: ÖPUL, extensive grassland cultivation in traditional areas, Austria

Objectives:	- To prevent the intensification of grassland cultivation.
Prescriptions:	- maximum stocking density 2.0 LU/ha; - at least 0.5 roughage consuming LU/ha forage crop area; - refrain from silage preparation and feeding; - a payment of 189 per eligible fodder crop hectare is payable.
Total cost:	- 21.2 million, just under 4% of the total ÖPUL budget.
Take up/success:	- There are approximately 114,000 hectares of land under agreement with respect to this measure, about 4% of Austria's UAA. Just over 6% of Austrian holdings have land entered under this measure.

	- No definition of 'traditional area' was given, but it is likely that these agreements are centred on more marginal land. These areas are often species and landscape rich and the preservation of them is therefore considered important.
Impact on dairy:	**Potential** - Dairy farming as an activity is fairly widespread in Austria, which increases the likelihood that grasslands in 'traditional areas' are utilised for dairy production. The inability to use silage is likely to result in the substitution of hay as feed which can be seen as a landscape enhancement. This may also have biodiversity implications. The stocking density limit will reduce the likelihood of over-grazing.
	Actual - The actual impact is dependent on the number of dairy cattle affected by the measure, which depends on the distribution of dairy farming in 'traditional areas'. However, given the distribution of dairy farming in Austria, this measure is likely to impact on a reasonable number of dairy cows and may therefore provide significant environmental benefits through the dairy regime.

Source: Case study on the Austrian programme on an environmentally sound and sustainable agriculture, based on EU Regulation 2078/92: experiences and consequences on sustainable use of biodiversity in Austrian agriculture, a document drawn up for the OECD in November 1998 by the Working Party on Economic and Environmental Policy Integration and the Working Group on Economic Aspects of Biodiversity

c) South West Peak ESA, UK

The UK's Environmentally Sensitive Areas (ESA) programme covers various parts of the UK that are designated worthy of conservation for reasons of biodiversity and landscape type (469,121ha were under some 9,201 agreements in 1997 according to MAFF). The designation criteria means that most ESAs tend to be on marginal land where biodiversity and landscape value are often highest. Dairy production (if not dairy farming), on the other hand, tends to be concentrated on more productive land with less biodiversity or notable landscape value. For this reason, ESAs do not tend to include major dairy regions. The South West Peak ESA is probably the one with greatest concentration of dairying.

The South West Peak is an upland area at the southern end of the Pennines, covering 33,810 hectares of north Staffordshire, Cheshire and Derbyshire. Farming in this region is characterised by dairy farming on suitable grassland and the grazing of sheep in more upland areas. A summary of the ESA grassland measures and impact on dairying is shown in Table 7.17.

Table 7.17: South West Peak ESA, UK- grassland management

Objectives:	- To maintain and enhance the wildlife conservation value and landscape quality of semi-natural upland vegetation and grassland. - To enhance the wildlife conservation value and landscape value of semi-natural moorland vegetation. - To enhance the wildlife conservation value and landscape quality of species-rich meadows and pastures. - To maintain and enhance landscape quality through management of characteristic landscape elements.
Prescriptions:	- There are two tiers of entry. Tier one has four parts relating to basic requirements applying to all land, enclosed permanent grassland, enclosed permanent rough grazing, and moorland. Tier two has two options relating to enhancing the landscape and wildlife interest of pastures and meadows (option one), and moorlands (option two).
Total cost:	- n/a
Take up/success:	- The area eligible for tier one (part one) is not specified, so the proportion of available land under agreement is not known (although the area under this part is 2,301 hectares. - Take up rate for the other five elements ranges from 24% under tier two (option two) to 78% under tier two (option one). - The results of the environmental monitoring are considered interim, but do not seem particularly encouraging. There have been very few changes in the species composition of various grasslands, and declines in breeding bird populations have continued (although both these effects are thought to result from a drying out resulting from drainage installed prior to ESA status- since new drainage is now prohibited, it may be the case that more negative impacts have been averted). In general, the ESA has been successful in meeting environmental objectives in part only.
Impact on dairy:	**Potential** - The reasonable take up rates suggest that impacts will be in evidence on dairy farming. The fact that there have been few changes in grassland species composition suggests that stocking densities are not altering (either up or down). The prohibition on the installation of new drainage implies that grassland is not being improved.
	Actual - The impact on dairy is dependent on the proportion of grazing animals made up by dairy cattle. Although there is some beef production and some lowland sheep production in this ESA, dairy farming is the predominant lowland activity. The actual impact on the environment resulting from dairy farming is therefore likely to be at worst a maintenance of the status quo in terms of intensity of production, and is likely to have been positive for some indicators. There are however, no empirical data or studies that have examined impact on dairying or on environmental enhancement that may have resulted from grassland measures adopted on dairy farms.

Source: ADAS report to MAFF entitled: South West Peak Report of Environmental Monitoring 1993-1996

7.3.3. Rare breeds measures

Rare breeds measures could be classified as grassland management measures, although they are distinct enough to merit separate treatment. Rare breeds measures usually involve several species and several breeds within species. They are therefore not targeted specifically at particular livestock enterprises and the impact resulting from changes to dairy breeds is virtually impossible to draw out. However, where rare breed agreements are entered into, there are likely to be unquantifiable or intangible impacts on dairy production.

There are several agri-environmental measures relating to the maintenance of rare breeds. The examples below are drawn from Finland's Supplementary Protection Scheme (Boreal bio-geographical region) and Bolzano, Italy (Alpine bio-geographical region).

a) Supplementary Protection Scheme, Finland- conservation of rare breeds

The Finnish Supplementary Protection Scheme (SPS) offers a greater degree of protection than the basic General Agricultural Environment Protection Scheme (GAEPS), which is intended to be available to all farmers. The SPS is designed for use where more efficient environmental protection and management measures are required and it offers environmental benefits above and beyond those under GAEPS (Table 7.18).

Table 7.18: Supplementary Protection Scheme, Finland- conservation of rare breeds

Objectives:	- To maintain the diminishing populations of local breeds.
Prescriptions:	- Farmers sign 5 year agreements to raise indigenous breeds in exchange for 85 per livestock unit.
Total cost:	- 599,745 in 1997.
Take up/success:	- 7,100 livestock units are covered in around 2,000 agreements. The objective was to account for 21,600 livestock units under this measure, so take up is reasonable at a third of objective. - Local breeds are best suited to the management of traditional biotypes and therefore are likely to exert more positive effects on the environment than non-indigenous breeds.
Impact on dairy:	**Potential** - The milk yields of indigenous Finnish cattle relative to non-indigenous breeds is not known, however, local breeds are likely to be lower yielding than Holstein-Friesians (purely because the Holstein-Friesian is bred for high yield). The use of local breeds may therefore exert upward pressure on dairy cow numbers to compensate.
	Actual - The 7,100 livestock units will be spread across several species and the impact on dairy is likely to be proportional to dairy cow numbers in this total.

Source: Agri-Environmental Programme in Finland 1995-1999 (1998) Ministry of Agriculture and Forestry

b) Bolzano, Italy- conservation of rare breeds

Table 7.19 summarises application of this measure in Bolzano.

Table 7.19: Bolzano, Italy- conservation of rare breeds

Objectives:	- To maintain numbers of indigenous local breeds.
Prescriptions:	- Certain breeds must be kept (for cattle: Pusterer Sprintzen and Pinzgauer). A premium of 123 is paid per head.
Total cost:	- 157,000 (1.2% of total 2078 cost in this region).
Take up/success:	- 60 Pusterer Sprintzen (no information on total numbers of this breed) and 1,300 Pinzgauer (approximately 100% of eligible cattle) are registered for the scheme. - Although the take up with regard to the Pinzgauer seems impressive, it is difficult to disentangle the impact of the scheme from other economic factors. - Because the objective of this measure is related to the maintenance of indigenous species rather than the provision of environmental benefits, any environmental enhancements will be largely incidental, although it may be the case that indigenous breeds are better matched with local flora and fauna which may provide biodiversity enhancements over grazing with non-indigenous cattle.
Impact on dairy:	**Potential** - The high take up rate is suggestive of significant impact on dairy.
	Actual - Average milk yields from the two indigenous cattle are higher than nationally at 5,310kg/cow/year (compared with 4,988kg/cow/year for Italy as a whole and 4,564kg/cow/year for the Alpine region (1995 figure)), despite being multi-purpose breeds. - The high take up rate suggests that the compensation is more than sufficient and it may be the case that these types of cattle (particularly the Pinzgauer) would be used anyway.

Source: Le misure agroambientali in Italia: analisie e valutazione del reg. CEE 2078/92 nel quadriennio 1994-97. Repporti regionali. INEA

Applicazione del regolamento 2078/92 nella Provincia Autonoma di Bolzano: valutazione socioeconomica e strutturale 1999. INEA

7.3.3.1. Input restriction measures

Input restriction measures mainly relate to the use of fertiliser and pesticides, and as applied to livestock, are essentially grassland management measures. Generally, the impact of fertiliser restrictions greatly exceeds the impact of pesticide measures, which are more pertinent to arable farming. However, pesticides are used on grassland and pesticide restrictions may therefore have some impact on the environment as a result of changes induced via dairy production systems. However, this influence is widely perceived to be insignificant and pesticide restriction measures are not examined further in this part of the study.

The restriction of fertiliser use has two main impacts. Firstly on the disposal of livestock manure, and secondly on the fertility of grassland, which may in turn have implications for stocking density. Some schemes separate these two issues out, others combine them within the same measure.

A range of agri-environment schemes have measures relating to the restriction of inputs (and therefore also on the storage and spreading of manure). The examples below are drawn from the Finnish General Agricultural Environmental Protection Scheme (GAEPS) and the more restrictive Supplementary Protection Scheme (SPS) (Boreal bio-geographical region).

a) The General Agricultural Environment Protection Scheme (GAEPS), Finland- fertiliser restriction
As Table 7.20 shows, the highest proportion of land in agri-environmental agreements in any Member State is in Finland (87% of UAA). Finnish environmental aid for agriculture is based on the General Agricultural Environmental Protection Scheme (GAEPS) which is available to all farmers and the Supplementary Protection Scheme (SPS) which provides a greater degree of protection and is more stringent.

Table 7.20: GAEPS, Finland- fertilisation and storage of manure (GAEPS)

Objectives:	- Prevent the use of manure exceeding requirements. - Lower peak fertilisation levels.
Prescriptions:	- Quantities of artificial fertiliser and manure must not exceed the maximum quantities set by the Ministry of Agriculture and Forestry. - Manure must be stored in an approved manner. - Manure must not be spread on frozen land or snow. - In certain regions there is a minimum requirement for arable land in relation to livestock units (1 hectare per 1.5 livestock units).
Total cost:	- The total cost of GAEPS was 234 million in 1997. The proportion of money spent on individual measures was not available to the researchers.
Take up/success:	- The targets for livestock density have been met in all areas with little difficulty. - 8% decline in nitrogen use and 33% decline in phosphorus use on silage grass (average figures for different regions). - 11% decline in nitrogen use and 27% decline in phosphorus use on fodder barley. - 2% decline in nitrogen use and 36% reduction in phosphorus use on turnip rape (average figure for different regions).
Impact on dairy:	**Potential** - Pressure to reduce stocking rates to reduce levels of manure to meet application targets. This pressure appears to have resulted in lower levels of nitrogen and phosphorus.
	Actual - The high take up rate suggests that either farmers can meet the prescriptions without making major changes to their management strategies, or that the payment is sufficient compensation. In the former case the impact is likely to be insignificant. In the latter case the impact may be greater, but no information is available to explain how the recorded reductions in nitrogen and phosphorus on fodder crops was achieved.

Source: Agri-environmental programme in Finland 1995-1999. Ministry of Agriculture and Forestry

b) The Supplementary Protection Scheme (SPS), Finland- fertiliser restriction

Table 7.21: SPS, Finland- increasing efficiency in the use of manure (SPS)

Objectives:	- Increase the utilisation of animal manure. - Spread manure over a larger area.
Prescriptions:	- Accept, handle and utilise animal manure in an approved manner. - Take animal manure or organic waste from a farm that cannot utilise these and deal with it in an approved manner. - A premium of 34/hectare was available in 1997 for farmers signing 5 year contracts.
Total cost:	- 211,605 in 1997.
Take up/success:	- 700 contracts evenly distributed throughout Finland cover approximately 6,000 hectares of land. The objective was to account for 69,000 hectares under this measure, so take up is low at 9% of objective. This is believed to be the result of insufficient payments. - This scheme contributes to achieving more balance between livestock numbers and arable land. - It has proved difficult to find enough land area to spread the manure on in certain regions, especially where the grassland area is significant.
Impact on dairy:	**Potential** - Pressure to reduce stocking rates and hence manure levels to better match land availability.
	Actual - Likely to be very small. Firstly, the low take up rate means that not many farms are affected. Secondly, dairy is only one of several livestock enterprises to be affected. - It is likely that farmers with a manure surplus would seek to pass it on to a farmer with a land area surplus. If this is not possible, the payment rate is perceived to be insufficient to induce any stocking density reductions. No studies or data exist which have attempted to assess impact on actual fertiliser use in the dairy sector.

Source: Agri-environmental programme in Finland 1995-1999. Ministry of Agriculture and Forestry

c) ÖPUL, Austria- non-use of specified yield raising substances

Table 7.22: ÖPUL, Austria, non-use of specified yield raising substances

Objectives:	- To support agricultural methods which help to reduce environmentally harmful effects of agriculture. - To contribute to improved market equilibrium by lowering production levels. - To promote the management of the land in a manner compatible with the protection and improvement of the environment and the preservation of the natural habitat, the landscape, natural resources, the soil and genetic diversity.
Prescriptions:	- Maximum stocking density of 2.0 LU/ha. - Refrain from the use of easily soluble commercial fertilisers and synthetic plant protection products (treatment of individual plants is allowed). - Farm units with more than 90% permanent grassland (with the exception of Alpine pasture areas) must have at least 0.2 roughage consuming LU per forage hectare. - A premium of 151/ha of eligible grassland is available (226.5/ha for eligible arable land).
Total cost:	- 42.2 in 1997 for arable and grassland (7.8% of the total budget under ÖPUL).
Take up/success:	- 20% of Austrian farmers (11% of UAA) draw funds from the scheme. - The fact that premiums are available for both arable and grassland under the same scheme makes it impossible to ascertain the take up for the individual components.
Impact on dairy:	Potential - The ability to use pesticides on individual plants is likely to mitigate any negative impacts on grass production that might otherwise result from a ban on plant protection products. This more targeted approach is likely to combine the needs of the farmer to maintain good quality grassland with the environmental desire to maintain species diversity.
	Actual - In the absence of more details on the distribution between grassland and arable take-up and without knowing the numbers of dairy cows affected by this measure the actual impact through dairy production is not possible to ascertain. There have also not been any studies that have assessed input in the dairy sector.

Source: Case study on the Austrian programme on an environmentally sound and sustainable agriculture, based on EU Regulation 2078/92: experiences and consequences on sustainable use of biodiversity in Austrian agriculture, a document drawn up for the OECD in November 1998 by the Working Party on Economic and Environmental Policy Integration and the Working Group on Economic Aspects of Biodiversity

7.3.3.2. Prevention of abandonmen t measures

Measures of this nature tend to be more socio-economic than environmental, however, they are also likely to have some positive environmental benefits in that maintaining cultivation of the land may help prevent degeneration into scrub land. This has positive implications for biodiversity and landscape. This duality of purpose is reflected in the objectives and prescriptions which can be essentially environmental.

Where used, agri-environmental schemes which reduce or prevent abandonment are targeted at more marginal areas where farming is not always considered economically viable. In the context of the EU, these areas are usually mountainous. The example below is drawn from the Austrian ÖPUL scheme (Alpine bio-geographical region).

a) ÖPUL, Austria

Table 7.23: ÖPUL, Austria- Alpine pasturing

Objectives:	- To promote the cultivation of Alpine pasture areas for livestock grazing and the use of herding personnel to tend livestock.
Prescriptions:	- Conserve Alpine pasture areas. - No use of easily soluble commercial fertiliser. - No prophylactic use of pesticide. - Alpine pasturing must last at least 60 days. - A labour force must be continually present to qualify for the herding supplement. - A minimum stocking density is envisaged (although not specified). - The herding supplement is granted for a maximum of 26 LUs of dairy cows per herdsmen (70 LU of other animals). - 90.6/ha is available for dairy cows (52.9/ha for other animals). - 60.4/ha is available as a herding supplement for dairy cows (22.7 for other animals).
Total cost:	- 20.9 million in 1997. This equates to 3.9% of the total expenditure under ÖPUL.
Take up/success:	- Around 10% of the UAA in Austria (265,000 hectares) is enrolled under this measure. This involves some 7,000 farmers (4.2% of the total). - It is not clear how successful this measure has been because there is no baseline against which to compare. For example, it is not possible to determine whether some Alpine pastures would be abandoned in the absence of this measure. In the light of this, it is only possible to say that some abandonment (with its consequential environmental impacts) may have been prevented.
Impact on dairy:	Potential - The prohibitions on the prophylactic and general use of pesticides is likely to have contributed to a maintenance (if not necessarily an increase) in biodiversity. - The requirement for a minimum stocking level is likely to provide a more accurate balance between the optimal carrying capacity of pastures and livestock numbers.
	Actual - Not possible to ascertain for reasons given above. Also, no studies have been undertaken that aim to measure impact.

Source: Case study on the Austrian programme on an environmentally sound and sustainable agriculture, based on EU Regulation 2078/92: experiences and consequences on sustainable use of biodiversity in Austrian agriculture, a document drawn up for the OECD in November 1998 by the Working Party on Economic and Environmental Policy Integration and the Working Group on Economic Aspects of Biodiversity

7.3.3.3. Organic farming

Although the number of organic farms has increased significantly in recent years (from just over 6,000 in 1985 to over 100,000 in 1998[20], only 1% of all EU holdings are certified organic. However, this accounts for 2% of the total agricultural area. Organic farming may offer environmental protection and benefits through the less intensive use of land and by providing a changed balance in the use of inputs. Although horticulture is an important organic focus in southern Member States, the most prevalent use of organic land is for grass production[21]. Some impact on livestock can therefore be expected. Despite this, EU-wide rules setting organic standards for livestock were only agreed in late August 1999. Prior to this, national legislation was used to define organic livestock production.

Detailed information concerning organic livestock production is sparse and Table 7.24 reflects this.

[20] Agriculture, environment, rural development facts and figures: a challenge for agriculture. DGVI, DGXI and Eurostat July 1999.

[21] The regional differences are highlighted by the example of Bolzano, Italy, where more than 90% of certified organic land is used for viticulture and the production of fruit. Organic grassland is not eligible for payments under 2078/92 in this region.

Table 7.24: Share of certified dairy cows in total dairy cows for selected Member States (1995)

	Certified organic dairy cows as percentage of total
Austria	12.3%
Denmark	3.1%
France	Some
Finland	Some
Luxembourg	Some
the Netherlands	Some
Sweden	2.5%
UK	Some

Source: Agriculture, environment, rural development facts and figures: a challenge for agriculture. DGVI, DGXI and Eurostat July 1999

The examples below are drawn from the Finnish Supplementary Protection Scheme (SPS) (Boreal bio-geographical region) and Austria (Alpine bio-geographical region).

a) Finland- organic production and conversion to it (SPS)

Table 7.25: Organic production and conversion to it (SPS)

Objectives:	- To increase the area of organic arable land.
Prescriptions:	- A commitment to convert the majority of land to organic production over a three year period. - A commitment to continue using organic production techniques. - Commitments for organic conversion/maintenance and extensification (of land, not livestock) may not be made for the same land.
Total cost:	- 21,000,000 for conversion to organic production. - 2,500,000 for continued use of organic techniques.
Take up/success:	- The objective of 120,000 hectares should have been achieved by 1998. - Calculated according to area and funds, this measure is the most significant of the Supplementary Protection Scheme. - 5% of Finnish arable area was certified organic in 1997.
Impact on dairy:	Potential - It is possible that organic farming may lead to reduced stocking densities as a result of the prohibition of non-organic fertiliser and the inability to use non-organic fodder.
	Actual - It is not possible to quantify due to a lack of data and studies.

Source: Agri-environmental programme in Finland 1995-1999. Ministry of Agriculture and Forestry

b) Organic production under ÖPUL, Austria

Table 7.26: ÖPUL, Austria- Organic measure

Objectives:	- To support financial agricultural production methods which help to reduce environmentally harmful effects of agriculture, which also contribute to an improved market equilibrium by lowering production levels.
Prescriptions:	- no use of artificial fertilisers or pesticides; - maximum stocking density of 2.0 LU/ha; - farms with more than 90% grassland must have at least 0.2 roughage LU/ha feeding areas, but at least 1.5 fodder LU/farm; - hay must be offered as roughage compensation when silage feeding.
Total cost:	- 65.7 million in 1997. This equates to 12.1% of the total expenditure under ÖPUL.
Take up/success:	- About 257,000 hectares are registered as organic (just under 10% of the total UAA). - There are about 18,000 contractors registered as organic (11% of the total). - Organic farming is believed to offer significant environmental benefits, particularly with respect to biodiversity.
Impact on dairy:	Potential - The potential benefits to the environment through organic dairy production are high. However, this does not mean that significant changes to dairy production have been made. The high proportion of organic production implies that few changes to conventional practice are required and organic farming under 2078/92 may be preventing farmers from becoming more intensive rather than encouraging greater extensification.
	Actual - The actual impact on dairy production is not possible to ascertain (lack of data and studies). However, it is likely that this measure is offering environmental benefits where taken up in the dairy sector.

Source: Case study on the Austrian programme on an environmentally sound and sustainable agriculture, based on EU Regulation 2078/92: experiences and consequences on sustainable use of biodiversity in Austrian agriculture, a document drawn up for the OECD in November 1998 by the Working Party on Economic and Environmental Policy Integration and the Working Group on Economic Aspects of Biodiversity

7.4. Existing enhancement measures and environmental impact: conclusions

The sub-sections above have provided examples of measures which may offer environmental neutrality or contribute to positive environmental benefits. However, the impact of both types of measure on dairy production is very difficult to assess and is probably limited. In many cases this reflects the voluntary natures of measures offering environmental neutrality (eg, Codes of Good Agricultural Practice).

However, it is also important to recognise that almost all measures are targeted at environmental media rather than specific farming sectors. This reasonable and understandable approach provides one set of rules or advice covering the entire agricultural sector and hence avoids duplication that would otherwise occur if virtually the same measures had to be applied through separate legal provisions to each sector. However, taking a sector by sector approach might have a greater impact on production strategies for various enterprises and the environment and would also facilitate easier evaluation.

The environmental enhancement measures under 2078/92 offer potential for delivering environmental improvement. However, where used to date, the approaches taken are often not enterprise specific. The current measures most likely to offer environmental benefits through the dairy regime are the grassland management measures. These measures tend to affect all grazing livestock, but by not being enterprise specific they make assessment of impact on a sector such as dairy difficult.

The measures under 2078/92 do, however, provide a range of examples whereby livestock production in general (and therefore, by implication, dairy production in particular) may be made more environmentally friendly.

In general the two approaches, neutrality or enhancement, tend to be linked to two different types of location or region. Key features of each are summarised in Table 7.27 and Table 7.28.

a) Neutrality measures, although universal to all areas, tend to have the greatest impact in regions where particular environmental problems exist. For example, in the more northerly Member States, the Nitrates Directive largely replaced and incorporated existing national legislation. In contrast, in Greece, legislation to combat nitrate loss was only adopted to meet EU requirements. Other legislation such as the Habitats Directive is also likely to have greater significance in the intensive agricultural areas of the Atlantic bio-geographical region.

b) Enhancement (2078/92) measures tend to be focused on more marginal areas which are characterised by relatively lower levels of intensity and include remote and/or mountainous areas. Here dairy farming is usually widespread, but comprises smaller scale producers in bio-geographical regions such as Alpine and parts of the Mediterranean, Continental, Boreal and Atlantic regions where mixed farming systems dominate (see Sections 4 and 5).

Table 7.27: Summary of environmental standards and measures in agriculture for selected Member States

Type of standard/policy measure	UK	France	Germany	Denmark	Italy
Legal measures	- Water Act 1989 - Pesticides: Code of Practice 1990 - Environmental Protection Act 1991 - The Pesticide (Maximum Residue Levels in Crops, Food and Feeding Stuffs) Regulations - Control of Pesticides Regulation 1997	- Law on water 1992 - Nitrates Implementation 1996 - Act on Classified Installations	- Fertiliser Act - Waste Act - Plant Protection Act - Ordinance on Pesticides - Water Resources Management Act	Statutory Orders on: - Animal Manure and Silage - Crop Demands for Nitrogen - Livestock Holdings - Banning of Straw Burning	- Water Pollution Act - National Integrated Control and Protection Plan - Law on the Protection of Sites - Framework Law on Protected Areas - Hunting Law
Legal measures with financial compensation	- Set-aside measures	- Set-aside measures - Sustainable development plans - Agreements with farmers	- Set-aside measures	- Set-aside measures - Danish Pesticide Action Plan	- Set-aside measure
Financial incentives	Agri-environment measures - Nitrate Sensitive Areas - Environmentally Sensitive Areas - Organic Aid Schemes - Moorland Scheme - Habitat Scheme - Countryside Access Scheme - Countryside Stewardship Scheme - Tir Cymen - Countryside Premium Scheme	Agri-environment measures - Reduction in use of inputs - Organic farming - Extensive grassland - Reduction of livestock density - Rearing of endangered species - Long-term set-aside - Training	Agri-environment measures - Regional programmes with priorities: - Preservation of wetlands - Extensive pastures	Agri-environment measures - 'Environmentally Friendly Agriculture Programme' - Reduction of fertiliser use - Extensive grassland - Organic Farming - Long-term set-aside	Agri-environment measures - Regional programmes with priorities: - Reduction of fertiliser use - Conversion to organic farming
Environmental taxes				- Tax on pesticide use	
Voluntary actions without financial aid	- Codes of Good Agricultural Practice	- Code of Good Agricultural Practice - FERTI-MIEUX Programme	- Code of Good Agricultural Practice		Code of Good Agricultural Practice
Advisory measures	- Free pollution advisory scheme				

Table 7.28: Comparison of approaches to environmental standards in agriculture

	UK	France	Germany	Denmark	Italy
Regulatory vs voluntary approach	regulatory, voluntary and advisory schemes	regulatory	regulatory	regulatory	regulatory and advisory schemes
Financing	in some areas	financing provided	financing above minimum standards	limited to certain environmental services	limited financing
Levels of standards	wide coverage	high standards limited to certain areas	high, but depends on region	high	generally low
National vs regional standards	national and regional	national	regional	national	regional
Attitude towards farmers	competitive	protectionist	protectionist	competitive	depends on the region
Attitude towards agri-environment	high interest	growing interest limited to certain areas	high priority	high priority	low priority
Intensity of environmental problems	high	high	high	medium-high	limited to certain areas (Po Valley)
Priorities	water protection, landscape, nature and conservation	nitrate pollution	nitrate pollution, water protection, landscape conservation	nitrate pollution, pesticide use	biodiversity, landscape conservation, pesticide use

8. Potential new options for improving the environmental impact of EU dairy systems

8.1. Introduction

Our brief in this research has not been to develop new ideas for future reforms of the dairy sector, but to confine our attention to practical options within the limits of Agenda 2000, namely the CMO for dairying, the Horizontal Regulation, and the Rural Development Regulation. These were briefly discussed in Section 6. In the sub-sections below, options for delivering improved environmental impact within the framework of this legislation are considered.

With unlimited support, or draconian controls all agricultural production systems could move closer to being environmentally neutral. However, in practice we can only aim to minimise or improve the impacts to a level which we broadly regard as acceptable within the constraints of reasonable production objectives, economics and practicalities. Thus, any farming practice has some environmental impact and environmental neutrality (if taken to mean no impact on the environment) for dairy systems, which includes some of the most intensive agricultural production systems in Europe, is probably not a realistic objective.

In the dairy sector, the most important environmental impact issues (which affect to some degree all of the systems described in section 4) are the polluting effects of nutrient and pesticide losses into water and the air (see sub-sections 5.3.5 and 5.3.6). However, there is an interaction between negative impact and positive enhancement, and it can be common to have both effects simultaneously. For example, even in the relatively low input/output Transhumant systems (P1) there could be localised water pollution around milking parlours, or nutrient losses from silage fields in the valley, whilst at the same time positive maintenance of floristically rich seasonally grazed pastures on the mountain. Similarly, in the CG2 organic mixed systems there is no pesticide or 'artificial' fertiliser use, yet at the same time composting of manure may release more ammonia than conventional slurry. There may also potentially be more nitrate leaching from leguminous crops (often grown on organic farms). This means that drawing up practical options for going beyond good agricultural practice and ultimately delivering environmental enhancements are far from straightforward.

Therefore, the objective must be to bring all dairy farms up to some minimum standard upon which receipt of direct payments is dependent. This raises the questions of what these standards are, and whether they are the same for all farms. The Agenda 2000 provisions allow Member States to specify the standards, but they are unlikely to be able to make direct measures relating to 'environmental quality' or to the degree of 'environmental degradation'. Accordingly, the standards will have to relate to some form of control or limitation of the practices that take place. The codes of good agricultural practice outlined in sub-section 7.2 (for a full review see Stopes[22] et al, 1999) are in reality likely to be the starting points for any standard set by Member States.

[22] In the evaluation, for DG XI, of codes of good agricultural practice submitted under the Nitrate Directive (Stopes September 1998) suggestions are made for developing an 'ideal code' in terms of content and delivery (see report for full appraisal). One very practical option would be to use the recommendation of the report to produce a code for the dairy sector.

Within the wider context of the dairy sector, the most practical option for minimising adverse impact would be to improve the efficiency of fertiliser and pesticide use and the efficiency of waste management. If the losses of nutrients and chemicals (to air, water and soil) can be minimised (and quantified) it would be a major environmental improvement. The question here is how best to begin to address this, in a practical way, within the framework of the current policy Regulations.

Environmental groups have expressed disappointment with the reforms in that the ‘cross-compliance’ measures in the Horizontal Regulation are optional and give discretion to Member States to take the environmental measures that they regard as appropriate. However, in reality the range of farm types (and, as described above, even the range of systems within the dairy sector) actually determine the scope, and hence giving Member States this flexibility is probably the most practical option to take. This flexibility already exists to some extent via 2078 measures.

In many existing 2078 schemes, for example in the UK and Ireland, basic conditions (to tackle negative environmental impact) are only imposed on farmers who are prepared to go the ‘next step’ (to environmental enhancement), but are not imposed on those who remain outside of schemes. In these cases it tends to be the smaller farms (of the more environmentally benign systems), that have a greater need for financial support to survive, that are attracted to these schemes whilst the bigger, more industrialised production units tend to remain outside of the schemes. However, this is not the case in all Member States; for example, in Sweden, the Netherlands and Denmark there are tighter basic controls on all farms. These conditions are much tighter than existing legislative controls in other countries (eg, UK and Ireland or Spain and Portugal). For example, Danish farmers are required to provide annual plans on crop rotation and fertiliser use and to show that 65% of total farm area in the winter has green cover. This does nevertheless highlight a problem that there are already strong national differences in the application of controls on agriculture (although to-date not linked to CAP direct payments). Nevertheless, the Danish authorities have already announced that compliance with existing environmental law will be used as a condition for farmers to receive EU direct payments.

In sum (see also Section 7), to-date current basic standards of environmental protection have usually related either to national or Community legislation (and codes of good agricultural practice associated with these) with variable implementation across Member States (in some cases only enforced on farms that have entered enhancement schemes through Regulation 2078/92). An important aspect of most national legislation and codes of practice is that they focus on point source pollution rather than diffuse pollution. A major step would be for environmental conditions to tackle both aspects – ideally at the scale of the whole farm.

The Agenda 2000 reforms offer some limited scope for a solution to this dilemma (of placing tighter controls on the least polluting farmers) because they provide a mechanism for making a better link between good agricultural practice and good environmental practice. This could be approached through the following tiered approach:

a) Member States could introduce, as a basic cross compliance requirement of CMO direct payments and LFA support payments, conditions that require all farmers (not just dairy farmers) to at least meet national legislation and existing codes of usual good agricultural practice. This would be done with the recognition that in the latter, environment might only be one element along with safety, animal welfare and food hygiene regulations. For the dairy sector there is already a considerable weight of controls in place with respect to this, although often targeted at point rather than diffuse pollution – but they could now be linked to direct payments, with the sanction of reduction or cancellation. Sanctions are most likely to be an issue for the more intensive systems (eg, G1, M1, CG1) that could potentially breach environmental and other legislation (for example, where, as a direct result of farming, levels of pesticides and nitrogen in drinking water exceed those specified in EU legislation). It would therefore introduce a formal element of the 'polluter pays principal' to the vast majority of dairy farms.

The provisions of the Horizontal Regulation could then be used to introduce additional elements of what might be referred to as good environmental practice into what has more commonly been referred to as good agricultural practice (GAP) on dairy farms. These would have to be carefully selected on a regional basis to address the most important issues in the most cost effective way.

b) Finally, payments should continue to be available for dairy farmers who take a further step to environmental enhancement (see also sub-section 8.2 below) through the agri-environment measures of the Rural Development Regulation.

Table 8.1 below shows how environmental practices could be related to the measures in Agenda 2000 to produce the 'tiered' approach outlined above.

Table 8.1: Links between levels of environmental actions and the Agenda 2000 measures

	Rural Development Regulation		
	Basic requirement of CMO payments	Agri-environmental programmes	Environmental conditions on LFA payments
Legislation and Codes of usual Good Agricultural Practice (GAP) and incorporating 'improvements' that embody elements of good or better environmental practice	Yes	Yes	Yes
Environmental enhancement	No	Yes	No

Taking this a step further to practical recommendations the sub-sections below make a number of practical suggestions.

8.2. Practical options for delivering good agricultural (and environmental) practice: cross compliance across dairy production systems

a) Definition of good agricultural practice to include provision of farm waste management plan plus nutrient and water budgets.

Applicability: all dairy farms

Nature: all dairy farms in receipt of direct payments should be required to annually produce the following:

- a Farm Waste Management Plan;
- a Whole Farm Nutrient Budget;
- a Farm Water Budget.

Examples of the above are shown in Box 8.2, Box 8.3 and Box 8.4 below. Box 8.2 summaries existing requirements for farm waste and nutrient budgeting in the Netherlands (as applicable to systems G1 and L1), Box 8.3 summaries similar existing requirements in Denmark (as mainly applicable to system CG1). Box 8.4 summarises suggestions for a 'generic' farm water budget that could be applied to all systems. The reader should note that these examples also go beyond the strict level of budgeting to laying down compliance conditions (see also b) below.

Rationale and benefits

The reasoning behind this is to introduce cross-compliance in a way that presents to the farmer (and farmer's organisations) a tangible benefit, and in a way that can be seen to be treating all farmers equally. If appropriate, assistance to certain categories of dairy farmer (LFA producers, amount of production, number of cows, certain dairy systems) could be provided through the Rural Development Regulation provisions for example for one off capital investments. It has the advantage that, although obligatory, it offers the farmer the potential to become more efficient in the use of inputs and thus encourages improvement of the environmental impact in conjunction with potential economic savings. When Member States and ministries have the information on individual farm nutrient balances they can take the next step of penalising, for example the worst 5% or 10%. However, until the scale of the problem is known, introducing cross-compliance at the farm level is not straightforward. Particularly with respect to phosphates and nitrates it is not what you USE, but what you LOSE (and where it goes) that is important. This would be a very practical way of taking the first steps towards minimising any negative environmental impact of dairy farms. Even if in itself it did not result in reduced fertiliser and pesticide use, or the better management of waste-water, it would at least indicate the scale of the problem in a consistent way across Member States. As it is already in place in some countries it would not affect the 'level playing field' that farmers and their organisations so often refer to in relation to cross-compliance, but would bring all dairy farmers up to a minimum standard of recording. The advantages are summarised in Box 8.1 in respect of the example of whole farm nutrient balances.

Box 8.1: The whole farm nutrient balance: advantages

The advantages of this farm scale measure of N, P and K inputs, outputs and surpluses are:

- it deals with potential problems at the source;
- there is a direct relationship between the farm's nutrient surpluses and losses to the environment;
- it conforms to the 'polluter pays principal' and if surpluses are penalised then the polluter acts on the problem;
- it is cheaper than prescriptive, inhibiting and mandatory regulations which often can not be adequately monitored;
- farmers are free to choose how they reduce surpluses – different reactions might be more appropriate for different systems;
- it helps in the promotion of both economically efficient and ecologically sensitive systems;
- experience shows that it is liked by farmers (it is practical) – tens of thousands of farmers in the Netherlands, Denmark and Sweden have made nutrient balances;
- results are encouraging – eg, in the Netherlands the N losses to soil decreased by 16% between 1985-94 when the prediction was for them to increase by 40% over the same period. Also in Denmark model computations show nitrogen leaching from the root zone at the nationwide monitoring catchment sites were reduced 17% between 1989/90 and 1995/96

In many countries this type of approach has already been introduced with what is widely perceived to be reasonable success. Probably the best examples are in the Netherlands, Sweden and Denmark (Charter, 1998). Box 8.2 and Box 8.3 below provide further details.

An important aspect for consideration is the extent to which such requirements should apply (as GAP) to all systems as a condition for receipt of direct payments. Since livestock density (LU/ha) is the best indication of production intensity it could be introduced (in the first instance) to focus on dairy farms with high stocking rates or zero grazing (ie, systems G1, CG1, L1, M1). If the threshold was set initially only for farms with over 2.0 LU/ha it would include all the potentially most problematic systems. The Dutch system currently adopts this approach although not (yet) the 2.0 LU/ha threshold (>2.5 LU/ha in 1998, >2.0 LU/ha 2002) although it is of note that the Danish system applies to all farms regardless of stocking density.

Overall, it would facilitate the use of penalties (or witholding of some/all of direct payment entitlement) related to certain levels of nutrient surplus or to give farms with high surpluses a period over which to reduce their surplus (eg, three years). If penalties were eventually applied to farms with continually high surpluses these savings could be redistributed (as per the modulation principles), through measures in the Rural Development Regulation (such as training or support for producing farm nutrient balances) to certain categories of dairy farms to promote better agricultural practices or environmental enhancement.

Cost implications: the drawing up of the initial balances have limited cost implications as they could effectively be undertaken by the farmer in consultation with an extension adviser and involve a maximum initial input of between half and 2 days input from advisers (costs will vary but possibly between 300 and 1,000 euros/farm[23]). In many cases the advisory service input may have little or no cost to the farmer if costs are covered by publicly funded advisory services. Once initial balances have been undertaken farmers would probably undertake them on their own in subsequent years and require a time input of 1-3 hours only.

Box 8.2: Example nutrient management and farm waste plans: systems G1 and L1 (Netherlands)

[23] Qualitative estimate – Danish costs for advisory service input into drawing up FNBs are reported to be about 400 for 10 hours input.

The Dutch minerals accounting system (MINAS)

Requirements

a) Farm level annual registration of mineral inputs (nitrogen and phosphate) used in fertilisers and animal feeds and mineral output in the form of products and manure. The difference between inputs and outputs is the mineral loss to the environment;

b) Acceptable mineral loss standards are set which farmers are subject to financial penalties or levies. These are:
- phosphate (kg/ha): 1998 40kg/ha falling to 20 kg/ha by 2008 (current losses estimated at 65kg/ha);
- nitrogen (kg/ha): 1998 300 kg/ha for grassland falling to 180 kg/ha in 2008 (current losses estimated at 370kg/ha);
- penalties or levies: to 2005 for first 10kgs exceeding the standard 5dfls/kg fine and 20dfls/kg thereafter per kg excess.

Applicability

a) To 2002 only to apply as a compulsory element to farms with a livestock density of 2.5 LU/ha or over. This is to be lowered to 2LU/ha in 2002. Estimated to cover 50% of livestock farms up to 2002.

b) For farms with LU/ha of 1.5 to 2, there is encouragement to reduce mineral losses – subject to review in 2005 when mineral accounting for this group may be considered on a mandatory basis. They are also to control use of manure from other farms (eg, that are subject to mandatory controls). The supply standard for manure and inorganic fertilisers is set at 120kg/ha to 2000 and falling to 85kg/ha for grassland from 2000

Environmental benefit:

Planned use of nutrient inputs and outputs, can have environmental benefits as well as economic benefits for the farmer (eg, Poulton et al., 1997). Reduction in fertiliser lost to water and other non-target habitats, with consequent reduction in eutrophication of watercourses, and in loss of botanical diversity in non-cropped habitats (Boatman et al., 1994; Tsiouris & Marshall, 1998; Kleijn, 1996). Finally farmers' attitudes will be changed, by reflection on their own management.

Box 8.3: Example nutrient management and farm waste plans: system CG1 (Denmark)

Requirements
- Fertiliser or nitrogen input standards set for each farm, piece of land and divided according to crop, soil type and microclimate (quotas set per farm)
- Use of penalties for exceeding standards
- Standard for nitrogen (kg/ha): max set at 210 kg/ha for cattle at a LU/ha of 1.7 falling to 170kg/ha by 2003 (some exemption for farms set at 230kg/ha for about 3.7% of the cattle herd if 70% of the farm area is put to fodder crops with a high nitrogen requirement);
- Minimum demands for utilisation efficiency of nitrogen in animal manures set at 55% for cattle slurry (to 65% by 2003)
- Each farm has to set a crop rotation (specifications of green fields (65% of the farm area must be green cropped and a further 6% must be grass catch crops) and fertilisation plan that takes into account use of nitrogen and lower yields – this involves estimated need for nitrogen and phosphorus application according to economic optimal dosages as well as specifications as to how the fertiliser demand is met. Plans must include a map showing location and size of individual fields. The fertiliser application total must not exceed the crop demand (set by the authorities for example on nitrogen demand for each crop according to nominal yield levels and hence nominal crop nitrogen demand – these are set out for three distinct climatic zones in the country set by the authorities in a variety of crop rotations set as a function of soil type and access to irrigation and the minimum utilisation efficiency of nitrogen in animal manure and other organic fertilisers must be observed. Examples of the nitrogen demand values are shown in Appendix 2
- all surpluses must be disposed of within a 10km radius on a contract basis
- manure spreading is only permitted if crops 'need it', must be only in the growing season, and a minimum of 6 months manure storage capacity is required
- if quotas are exceeded fines are 10dkrs for first 30kgs of excess nitrogen and dkrs 20 for each kg over 30kgs

Applicability
- all livestock farms

Environmental benefit:

Planned use of nutrient inputs and outputs, can have environmental benefits as well as economic benefits for the farmer (eg, Poulton et al., 1997). Reduction in fertiliser lost to water and other non-target habitats, with consequent reduction in eutrophication of watercourses, and in loss of botanical diversity in non-cropped habitats (Boatman et al., 1994; Tsiouris & Marshall, 1998; Kleijn, 1996). Finally farmers' attitudes will be changed, by reflection on their own management.

Box 8.4: Example of a water management plan: applicable to all systems

Requirements
Assessment of hydrological changes for whole farm due to increased drainage, lowering ground water level etc. and development and implementation of appropriate water management.

Measurement of ground water level and water level in the ditches, and nett. water balance etc. (cf. Bleumink & Buys, 1996). Water book-keeping system for all cultivated parts of the farm. Attention should be given to the water management on the farm, such as the amount and period of irrigation etc. After the assessment, prevention measures could be taken in terms of decreasing water extraction, decreasing crop evaporation measures etc. As with waste and nutrient budgeting/balances, farmers' attitudes may be changed, by reflection on their own water management.

Environmental benefit
Higher ground water level benefits biodiversity, especially in nature reserves, woodland etc. due, not only changes in water level, but also to changes in soil aeration, mineralization, eutrophication etc. (Runhaar, 1999). Also, the runoff of surface water into rivers and extraction of ground water could be reduced.

Cost: Low, water measurements of ground water and ditches.

b) Cross compliance conditions: definition of GAP to include the following measures for reducing nutrient leakage from soils (impacting mainly on adverse environmental impacts on water, soil and biodiversity)

Applicability: all dairy systems except L1/L2

Requirements

- Better use of manure by planned fertilisation, nitrate analysis in soil and in the manure.
- Sufficient slurry storage capacity so that it can be spread at optimum times.
- Reduction in the use of nitrogen during autumn, especially slurry.
- Avoid slurry spreading where drains are newly installed.
- A maximum of 50 m^3/ha/year slurry application.
- No use of slurry straight after maize harvest - spread only in the spring.
- Adjust ploughing times for old grassland leys so that mineralisation coincides with crop uptake (up to 90kg N/ha mineralised from ploughed grassland),
- No ploughing out of old permanent pasture.
- Grow beet rather than maize after grassland to use mineralised nitrogen.
- Split applications of fertilisers in spring.
- Optimum irrigation techniques (too much irrigation can lead to higher nitrate leaching).
- Refine animal nutrition to optimise nitrate and phosphate utilisation, use animal feeds with low mineral contents (phosphate levels in manure can fall 10% or more).
- Improve animal feed quality.
- Restrict grazing after autumn date (eg, 1st September in Netherlands) when there is less uptake of nitrate from urine patches. In the Netherlands, ending summer grazing a month early (October) reduces the amount of N in the soil at the end of the growing season, and gives an average reduction in leaching of 20kg N/ha.
- Use of nutrient balance/minerals accounting to minimise waste.
- Sell less profitable stock and increase milk yield per cow.
- Dairy washings can be stored with manure and spread, or put in a lagoon (retention time 2-3 months).
- Use the ‘Ecowash’ method of cleaning a milking system which saves water and reduces effluent requiring treatment.
  a) the first rinse with milk residues goes to animal drinking water;
  b) sterilant is used at least twice before going into the sewage treatment system;
  c) the last rinses are used for cleaning cow sheds.

Cost: Relatively low as a number would derive from improved management. Where capital investment required, facilitate via grants/loans (as per Dutch/Danish existing systems) channeled via the Rural Development Regulation and part funding from penalties/direct payment abatement.

c) Cross compliance conditions: definition of GAP to include the following measures for reducing nutrient leakage from soils (impacting mainly on adverse environmental impacts on water, soil and biodiversity)

Applicability: mixed systems CG1, CG2, CG3, M1

Requirements

- Spread nitrate fertiliser and manure on growing crops; this is the most important way to reduce N leaching.
- Avoid nitrogen fertiliser during autumn, especially the use of slurry.
- Integrated arable farming results in lower nitrate leaching than a conventional system.
- Catch crops greatly reduce nitrate leaching, taking up about 40kg nitrogen/ha in winter
- Ending summer grazing earlier, (1st October instead of 1st November), reduces the amount of nitrate in soil at the end of the growing season, and gives an average leaching reduction of 20kg N/ha.
- Planned fertilisation, based on individual field and crop requirement, regular soil tests, (unfertilised crops may leach more, healthy crops use nutrients more efficiently).
- Increase acreage of green land especially in winter, using pasture and undersowing spring cereals with ryegrass, sown at 5-10kg/ha.
- Grow triticale (rye/wheat hybrid) instead of wheat as animal feed, (it grows more in autumn so reduces leaching).
- Minimise area of winter-grown cereals, on which there is high leaching and erosion risk and more nitrate and pesticide use than spring cereals (note that views on this differ).
- Winter barley and winter oilseed rape are better cover crops than winter wheat because they establish soil cover earlier.
- Map high risk areas for surface run-off and erosion, and maintain these areas as grass if possible.
- Establish wetlands and grassed buffer zones along watercourses, (strips of >9 m may reduce sub-surface flow of nitrate by 80%, phosphate reduced too by sediment deposition).
- Adjust ploughing times for turning in stubble so that mineralisation coincides with crop requirement in spring.
- Split applications of fertilisers in spring, including manure into growing crop.
- Winter wheat removes 10-15kg/ha nitrate, winter rape is also good for reducing leaching.

Cost: Relatively low as a number would derive from improved management. Where capital investment required, facilitate via grants/loans (as per Dutch/Danish existing systems) channeled via the Rural Development Regulation and part funding from penalties/direct payment abatement.

d) Cross compliance conditions: definition of GAP to include the following measures for reducing ammonia emissions (impacting on adverse environmental impacts on air)

Applicability: all systems

Requirements

- Evaluate all manure handling to minimise exposure of manure/slurry to air.
- Introduce low emission housing for cattle (still in infancy and expensive).
- Avoid slatted floor and cellar management systems as they can lead to high ammonia emission. Instead use cubicle houses with solid sloping floor, a central channel and a dung scraper (rapid removal of dung to covered store minimises ammonia emissions).
- Renew manure storage system; change from solid manure to slurry (but extremely costly).
- Cover manure stores with a roof.
- Cover open slurry silos with crust of chopped straw or cover with Leca balls (fired clay) although latter are expensive in UK.
- Use large concrete slurry containers with a life of >30 years (as in Denmark).
- Plough-in slurry as soon as possible after spreading, within 2 hours if possible.
- Change application techniques to reduce percentage methane emission compared with surface spreading – slurry boom (50%), spreading harrows (60%), tine or disc injection (85%-95%).
- Acidification of slurry to reduce ammonia loss is better on peat and clay and although difficult to handle can give close to 100% reduction compared with surface spreading (reference Luten and Den Boer, 1993 after Charter, 1998).

Cost: Relatively low as a number would derive from improved management. Where capital investment required, facilitate via grants/loans (as per Dutch/Danish existing systems) channeled via the Rural Development Regulation and part funding from penalties/direct payment abatement.

e) Cross compliance conditions: definition of GAP to include the following measures for reducing pesticide use and emissions (impacting mainly on adverse environmental impacts on water, soil and biodiversity)

Applicability: all systems except organic

Requirements
For pests and diseases:

- Introduce carefully planned crop rotations to specifically avoid the build up of pests.
- Introduce the use of resistant cultivars.
- Using mixes of varieties of cereal crops can lead to lower fungicide use.
- Healthy crop from correct fertiliser application, is less vulnerable to disease.
- Enhance the populations of beneficial organisms through the use of organic manure, minimum tillage and the use of only selective chemical control.
- Monitor harmful species to identify control thresholds.
- Careful selection of pesticide on criteria which include environmental impact.

For weeds:

- Use crop species with rapid soil covering habit and early leaf development.
- The use of mechanical weeding techniques to replace chemicals.
- The use of flame weeders in preference to chemicals, pre-emergence and post-harvest.
- The careful selection of herbicide based on criteria which include environmental impact.
- Use row application against annual weeds.
- Use spot treatment of perennial weeds where possible.
- Reduce the amount of winter cereals (pre-emergence herbicides used in autumn causes most herbicide pollution of water, as rainfall, sediment run-off and leaching are higher).
- Use the 'Pesticides Yardstick' to reduce the environmental impact of pesticide use.
- Spray pesticides at night when conditions are more likely to be still and humidity higher.

Cost: Relatively low as a number would derive from improved management. Where capital investment required, facilitate via grants/loans (as per Dutch/Danish existing systems) channeled via the Rural Development Regulation and part funding from penalties/direct payment abatement.

8.3. Practical options for deliv ering good agricultural (and environmental) practice: cross compliance for specific dairy production systems

As indicated in sub-section 8.2 above if all dairy farmers were producing nutrient and water balances and waste management plans these would provide information on the scale of environmental problems, would identify the most polluting systems and provide a quantitative basis for setting standards that may be considered as GAP. These are already forming the basis of mechanisms applied in countries such as the Netherlands (systems G1 and L1) and Denmark (system CG1) and could become a basis for implementation across the EU dairy sector. It should however be recognised that the considerable scope for variability in the precise nature of environmental problems between farms even at a local level means that it would be prudent to first initiate the requirements to do nutrient and water balances so as to better appreciate the extent to which environmental problems exist (even within regions and systems). Given this, the limit of the extent to which this study can propose practical options is at a general level (see sub-section 8.2 above) and to also make some at the dairy production system level. Even here it is important to recognise the options proposed are of a general nature and may ultimately require subsequent and more detailed, disaggregated development, if and when nutrient and water balances and waste management plans have been undertaken. Accordingly, in this sub-section, practical measures to minimise the negative environmental aspects of dairy farming are examined with specific reference to dairy production systems identified in Section 4 and the environmental problems discussed in Section 5 (summarised in Tables 5.5 to 5.14). In particular, the focus in placed on those dairy systems for which the issues are much more about minimising adverse environmental impact (as part of GAP) than taking opportunities for environmental enhancement – in other words focusing on measures that might become part of GAP compliance conditions for receiving direct payments. The most polluting are the intensive dairy farms, they occur mostly in the G1 and M1 (intensive grassland and maize silage) systems.

8.3.1. P1 Transhumant dairy sys tems

Table 8.2: Options for delivering good agricultural/environmental practice: System P1

MAIN ISSUES[1]	OPTIONS	BENEFIT	MONITOR / COST	MECHANISMS
Water and waste management in the mountains.	Produce water/waste management plan as condition of LFA area payment, receipt of DCP /SCP and extensification.	Identification of scale of problem.	Monitor production of plan through DCP claim. Cost: Low.	Use the Horizontal Regulation attached to CMO's DCP, BSP, Slaughter Premium as appropriate.
Nutrient surplus; use of fewer pastures leads to concentration.	Produce whole farm nutrient balance (conditional as above).	Identification of scale of problem. Incentive for reductions on economic grounds.	Monitor production of balance through DCP claim. Cost: Low.	Use Rural Development Regulation Or Horizontal Regulation to pay for plans.
Outdated dairy facilities, especially in mountains.	Provide financial assistance to improve the efficiency of milking parlours and cattle sheds.	Better management of waste water, slurry and manures will reduce impacts on soil, water and air.	Monitor actions as part of assistance. Cost: High.	Rural Development Regulation.
No recognition of an environmental problem.	Provide free advice to farmers on measures to reduce nutrient losses.	Promotes action on reducing the nutrient loss.	Monitor attendance at training. Cost: Low.	Rural Development Regulation – training for farmers.
Abandonment of farming in the mountain areas.	Remove the 120,000kg limit on dairy producer for receipt of SCP.	Will encourage continuation of livestock farming by improving financial viability of taking cattle into the mountains without the need to increase stocking levels (currently below 1.0 LU/ha)[2].	Monitoring through agricultural census returns and BSP claims Cost: Low	CMO – Beef Suckler Cow Premium.
	Pay higher LFA area payments on semi-natural and natural vegetation.		Monitor throughIACS. Cost: Low	Rural Development Regulation (LFA).

Notes:

1. See Table 5.5

2. Extensification premium (to the BSP) will be paid on dairy cows kept on holdings in mountain areas (in Member States where more than 50% of milk is produced in these areas). This will also help improve financial viability.

8.3.2. Intensive grassland (ley) s ystems: G1

Table 8.3: Options for delivering good agricultural/environmental practice:

MAIN ISSUES[1]	OPTIONS	BENEFIT	MONITOR / COST	MECHANISMS
Nutrient leakage into soil and water and ammonia; nitrous oxide and methane emissions from high fertiliser use, slurry and manure storage and spreading.	Produce water/waste management plan; whole farm nutrient balance as condition of CMO payments.	Identification of scale of problem. Incentive to reduce surplus on economic grounds.	Monitor production of plan. Cost: None regard as cross-compliance.	Use the Horizontal Regulation attached to CMO's DCP, BSP, Slaughter Premium as appropriate.
	Provide assistance for advisory service report on the nutrient budget to adopt most appropriate GEP options to reduce surplus, set targets and identify actions, eg, avoid ploughing old pastures, split fertiliser application, adjust ploughing time to reduce mineralisation, cover manure stores with roof (see sub-section 8.2.2 for list).	The polluter pays principal is no good unless the polluter knows how to address the problem. Farmers are more likely to accept advice from agricultural organisations.	Monitor through condition of grant aid. Cost: Low.	Horizontal Regulation – support for actions; or Rural Development Regulation – 'to promote sustainable farming and educate farmers and inform them of agricultural methods compatible with the environment'.
	Introduce, as a condition of receiving direct payments, submission of details of the annual farm nutrient surplus for farmers over certain stocking density, eg,1.8 LU/ha.	Data available to take action, eg, penalise the worst 10% or to set thresholds for proportion of the subsidy to be withheld.	Monitor / collect through direct payment claim forms. Cost: Low.	Is dependent on the introduction of the Farm Nutrient Balance. Horizontal Regulation – cross-compliance.
This system includes intensive multiple cut silage management and grassland are intrinsically poor. Silage effluent is a potential environmental problem especially in the Atlantic region (wetter).	Provide training and information on the environmental impacts of silage and the possibilities of making haylage (already very common in NL and DK) which produces virtually no effluent.	Potential for a big reduction in silage effluent pollution. Also for an increase in silage dry matter and enhanced feed value for dairy cows. Production costs would increase (more use of tedders) but storage costs could reduce.	Training participation could be monitored. Long term changes in production techniques could be monitored through census returns. Costs: Low.	Rural Development Regulation: Article 9, Training: 'the application of production practices compatible with the protection of the environment'.
Although grass production for pasture and silage is at least 60% of the UAA, these farms also include arable crops including maize silage and grains.	Provide training on integrated crop management to maximise utilisation of surplus nitrogen and reduce losses and the potential/feasibility of organic conversion.	Exposure to information about management practices which have economic as well as environmental implications, so more likely to be attractive to farmers.	Monitor through take up of training opportunities. Cost: Low.	Rural Development Regulation: Article 9, training.

Notes:

1. See Table 5.6

8.3.3. Permanent grassland (low land) systems: G2

Table 8.4: Options for delivering good agricultural/environmental practice:

MAIN ISSUES[1]	OPTIONS	BENEFIT	MONITOR / COST	MECHANISMS
Fertiliser use is low, ploughing infrequent and corresponding nutrient losses potentially low. Local nitrogen enrichment is proportional to stocking density. Slurry and manure storage and spreading method affect Ammonia and Methane emissions.	Produce whole farm nutrient balance as condition of CMO payments.	Identification of scale of problem. Incentive to reduce surplus on economic grounds.	Monitor production of plan. Cost: None regard as cross-compliance.	Use the Horizontal Regulation attached to CMO's DCP, BSP, Slaughter Premium as appropriate.
	Provide assistance for advisory service report on the nutrient budget to adopt most appropriate GEP options to reduce surplus, set targets and identify actions, eg, better use of manure and fertiliser, reduction of N and slurry in autumn, cover manure stores with roof (see 8.2.2 for list).	The polluter pays principal is no good unless the polluter knows how to address the problem. Farmers are more likely to accept advice from agricultural organisations.	Monitor through condition of grant aid. Cost: Low.	Horizontal Regulation – support for actions; or Rural Development Regulation – 'to promote sustainable farming and educate farmers and inform them of agricultural methods compatible with the environment'
	Introduce submission of details of the annual farm nutrient surplus as a condition of receiving direct payments.	Data available to take action, eg, penalise the worst 10%, or to set thresholds for proportion of the subsidy to be withheld.	Monitor / collect through direct payment claim forms. Cost: Low.	Is dependant on the introduction of the Farm Nutrient Balance. Horizontal Regulation – cross-compliance.
The system often depends heavily on family labour and/or part-time working (pluriactivity).	Allow LFA payments to part-time farmers.	To avoid disadvantaging farms which use labour intensive good agricultural practices.	Monitor through agricultural census returns. Number of producers is small and cost would be low.	Rural Development Regulation: 'whereas a rural development policy should contribute to the maintenance and creation of employment in those areas (rural areas)'.

Notes:

1. See Table 5.7

8.3.4. Permanent grassland (mountain) systems: G3

Table 8.5: Options for delivering good agricultural/environmental practice:

MAIN ISSUES[1]	OPTIONS	BENEFIT	MONITOR / COST	MECHANISMS
Slurry and waste disposal and potential for water pollution from silage effluent are main issues. In relation to other systems this is one of the least polluting.	Produce whole farm nutrient balance and waste water management plan as condition of CMO payments.	Identification of scale of problem. Incentive to reduce surplus on economic grounds.	Monitor production of plan. Cost: None regard as cross-compliance.	Use the Horizontal Regulation attached to CMO's DCP, BSP, Slaughter Premium as appropriate.
	Provide financial assistance for advisory service report above. Use plan to adopt most appropriate GEP options to minimise waste water and silage effluent pollution. Set targets and identify actions, eg, production of wrapped big bale haylage to maximise dry matter, make handling easier (lighter) and eradicate potential effluent issues.	The polluter pays principal is no good unless the polluter knows how to address the problem. Farmers are more likely to accept advice from agricultural organisations.	Monitor through condition of grant aid. Cost: Low.	Horizontal Regulation – support for actions; or Rural Development Regulation – 'to promote sustainable farming and educate farmers and inform them of agricultural methods compatible with the environment'.
The system often depends heavily on family labour and/or part-time working (pluriactivity).	Allow LFA payments to part-time farmers.	To avoid disadvantaging farms which use labour intensive good agricultural practices.	Monitor through agricultural census returns. Number of producers is small and cost would be low.	Rural Development Regulation.
EU hygiene and health standards and structural requirements for dairies can make milk and cheese production in mountain areas uneconomic (despite quality product premia).	Provide structural support (for capital works) to assist in the upgrading of facilities in the mountains.	Prevent further abandonment and biological impoverishment.	Monitor through conditions attached to support payments. Cost: Moderate.	Rural Development Regulation – measures to support agricultural structures.
Traditional extensive practices being replaced by more mechanised and less labour intensive ones with negative environmental effects. Gradual process of abandonment of mountain areas.	Pay higher LFA area payments on semi-natural and natural vegetation to give a financial incentive to maintaining, for example, traditional hay meadows or unfertilised pastures.	Direct payments reflect ecological value and agricultural/pastoral constraints.	Monitor through LFA administration. Cost: potentially none because adjustments are made at the intensive end of the scale making the change budget neutral.	Rural Development Regulation: LFA payments should be made on an area basis.
	Pay National Envelope supplement to DCP as an area payment. Remove the 120,000kg limit on dairy producers in receipt of SCP	Favours / rewards extensive production methods and mixed dairy / beef farms which have better survival chances.	Monitor through scheme rules. Cost: neutral	CMO: Dairy Cow Premium and Suckler Cow Premium.

Notes:
1. See Table 5.8

8.3.5. Conventional mixed dairy systems: CG1

Table 8.6: Options for delivering good agricultural/environmental practice:

MAIN ISSUES[1]	OPTIONS	BENEFIT	MONITOR / COST	MECHANISMS

High use of pesticides, mineral fertilisers and manure resulting in high nutrient surplus and high actual and potential pollution from pesticides. High outputs of Methane and ammonia to the air.	Produce whole farm nutrient balance and waste water management plan as condition of CMO payments.	Identification of scale of problem. Incentive to reduce surplus on economic grounds.	Monitor production of plan. Cost: None regard as cross-compliance.	Use the Horizontal Regulation attached to CMO's DCP, BSP, Slaughter Premium as appropriate.
	Introduce, as a condition of receiving direct payments, submission of details of the annual farm nutrient surplus for farmers over certain stocking density, eg,1.8 LU/ha.	Data available to take action, eg, penalise the worst 10% or to set thresholds for proportion of the subsidy to be withheld.	Monitor / collect through direct payment claim forms. Cost: Low.	Is dependent on the introduction of the Farm Nutrient Balance. Horizontal Regulation – cross-compliance.
	Provide assistance for advisory service report on the nutrient budget results, to adopt most appropriate GEP options to reduce surplus, set targets and identify actions, eg, spread N and manure on growing crops, avoid slurry applications in autumn, undersow spring cereals with rye grass. See 1.5.1.2 for full list.	The polluter pays principal is no good unless the polluter knows how to address the problem. Farmers are more likely to accept advice from agricultural organisations.	Monitor through condition of grant aid. Cost: Low.	Horizontal Regulation – support for actions; or Rural Development Regulation – 'to promote sustainable farming and educate farmers and inform them of agricultural methods compatible with the environment'.
Silage maize is increasing at the expense of tradition crops and grass silage with associated problems of high N losses, bare ground in winter and use of chemicals.	In areas where maize is not a traditional crop, pay arable area payments on grass silage.	Including more grass would help to reduce N surplus and reduce the amount of land left bare in winter (without significantly reducing the dry matter yield of silage) and would reduce the use of herbicides.	Monitor through IACS and scheme rules. Cost: Not known and difficult to quantify.	CMO arable sector, arable area payment scheme. (Prior to this, only crops involved in price cuts from 1992 onwards were eligible for direct payments; this appears to set a precedent).

Notes:
1. See Table 5.9

8.3.6. Low input and organic mixed dairy systems: CG2

Table 8.7: Options for delivering good agricultural/environmental practice:

MAIN ISSUES	OPTIONS	BENEFIT	MONITOR / COST	MECHANISMS
International organic standards and no use of pesticides or mineral fertiliser effectively replace the need for basic cross-compliance. Manure storage and handling could be an issue (although organic farms are restricted to production from 1.4 LU/ha).	Produce whole farm nutrient balance and waste water management plan as condition of CMO payments.	Identification of scale of problem. Incentive to reduce surplus on economic grounds.	Monitor production of plan. Cost: None regard as CC.	Use the Horizontal Regulation attached to CMO's DCP, BSP, Slaughter Premium as appropriate.
	Pay the national envelope supplement as an area payment rather than a premium supplement.	This would reduce the incentives to stock as close to the 1.4 LU/ha maximum, and, since stocking density is correlated with N surplus and ammonia emissions, there would be potential benefits.	Effects on N surplus would be monitored in the farm nutrient balance. Cost: No extra cost involved.	CMO (dairy): Dairy Cow Premium and national envelope supplement (paid on quota held).
Manure and slurry storage and handling facilities necessary on organic farms involve high capital input to make structural improvements.	Provide financial assistance to improve the efficiency of manure and slurry storage and manure handling systems in cattle sheds.	Better management of slurry and manure will reduce impacts on soil, water and air.	Monitor actions as part of assistance. Cost: High.	Rural Development Regulation: investment in agricultural holdings.

Notes:

1. See Table 5.10

8.3.7. Mediterranean mixed dair y systems: CG3

Table 8.8: Options for delivering good agricultural/environmental practice:

MAIN ISSUES[1]	OPTIONS	BENEFIT	MONITOR / COST	MECHANISMS
Although data is not readily available the main issue is likely to be point source pollution and emissions from stored manure and wastes from fattening units and dairy cow sheds.	Produce whole farm nutrient balance and waste water management plan as condition of CMO payments.	Identification of scale of problem. Incentive to reduce surplus on economic grounds.	Monitor production of plan. Cost: None regard as cross-compliance.	Use the Horizontal Regulation attached to CMO's DCP, BSP, Slaughter Premium as appropriate.
	Provide assistance for advisory service report on the nutrient budget to adopt most appropriate GEP options to manage surplus, set targets and identify actions especially on manure and slurry handling and use.	The polluter pays principal is no good unless the polluter knows how to address the problem. Farmers are more likely to accept advice from agricultural organisations.	Monitor through condition of grant aid. Cost: Low.	Horizontal Regulation – support for actions; or Rural Development Regulation – 'to promote sustainable farming and educate farmers and inform them of agricultural methods compatible with the environment'.
The system often depends heavily on family labour and/or part-time working (pluriactivity).	Allow LFA payments to part-time farmers.	To avoid disadvantaging farms which use labour intensive mixed systems with environmental benefit.	Monitor through agricultural census returns. Cost: Low.	Rural Development Regulation. 'whereas a rural development policy should contribute to the maintenance and creation of employment in those areas (rural areas)'.
Dairy facilities often very basic, and farms are small lacking capital to make structural improvements.	Provide financial assistance to improve the efficiency of milking parlours and cattle sheds.	Better management of waste water, slurry and manures will reduce impacts on soil, water and air.	Monitor actions as part of assistance. Cost: High.	Rural Development Regulation.

Notes:
1. See Table 5.11

8.3.8. Intensive silage maize dairy systems: M1

Table 8.9: Options for delivering good agricultural/environmental practice:

MAIN ISSUES[1]	OPTIONS	BENEFIT	MONITOR / COST	MECHANISMS
A potentially highly polluting system: large phosphorus and nitrogen surplus in soils, major problems with leakages of N to water courses. Major problem with pollution of red list chemical Atrazine in water courses. High stocking rates lead to ammonia emissions from faeces, slurry and dung in storage and during spreading. High use of concentrates adds to Nutrient surplus.	Produce whole farm nutrient balance, waste water management plan and farm pesticide plan as a condition of CMO payments.	Identification of scale of problem. Incentive to reduce surplus on economic grounds.	Monitor production of plan. Cost: None regard as cross-compliance.	Use the Horizontal Regulation attached to CMO's DCP, BSP, Slaughter Premium as appropriate.
	Provide assistance for advisory service report on the nutrient balance, water, pesticide use results, to adopt most appropriate GEP options to reduce surplus, set targets and identify actions, eg, increase green cover on land in winter, increase % grass pasture to maize, no use of slurry straight after maize harvest, establish buffers and wetlands along watercourses, etc. See sub-section 8.2.2 for full list.	The polluter pays principal is no good unless the polluter knows how to address the problem. Farmers are more likely to accept advice from agricultural organisations.	Monitor through condition of grant aid. Cost: Low.	Horizontal Regulation – support for actions; or Rural Development Regulation – 'to promote sustainable farming and educate farmers and inform them of agricultural methods compatible with the environment'
	Introduce, as a condition of receiving direct payments, submission of details of the annual farm nutrient surplus.	Data available to take action eg, penalise the worst 10% or to set thresholds for proportion of the subsidy to be withheld.	Monitor / collect through direct payment claim forms. Cost: Low.	Is dependant on the introduction of the Farm Nutrient Balance. Horizontal Regulation – cross-compliance.

Notes:
1. See Table 5.12

8.3.9. Industrial dairy systems: L 1

Table 8.10: Options for delivering good agricultural/environmental practice:

MAIN ISSUES[1]	OPTIONS	BENEFIT	MONITOR / COST	MECHANISMS
No data on scale of problem.	Produce whole farm nutrient balance and waste water management plan as condition of CMO payments.	Identification of scale of problem. Incentive to reduce surplus on economic grounds.	Monitor production of plan. Cost: None regard as cross-compliance.	Use the Horizontal Regulation attached to CMO's DCP, BSP, Slaughter Premium as appropriate.

Notes:
1. See Table 5.13

8.3.10. Mediterranean commercial dairy systems: L2

Table 8.11: Options for delivering good agricultural/environmental practice:

MAIN ISSUES[1]	OPTIONS	BENEFIT	MONITOR / COST	MECHANISMS
High applications of fertiliser, manure and pesticides (Atrazine) on irrigated maize and multiple-cut dryland ryegrass. Slurry and manure storage and spreading potentially have negative impacts on air. High use of concentrates adds to farm nutrient surplus. Irrigation can lower ground water table and cause salination.	Produce whole farm nutrient balance and waste water management plan as condition of CMO payments.	Identification of scale of problem Incentive to reduce surplus on economic grounds.	Monitor production of plan. Cost: None regard as cross-compliance.	Use the Horizontal Regulation attached to CMO's DCP, BSP, Slaughter Premium as appropriate.
	Provide assistance for advisory service report on the nutrient balance, water, pesticide use results, to adopt most appropriate GEP options to reduce surplus, set targets and identify actions, eg, adopt ecowash system of cleaning dairy parlours, no use of slurry straight after maize harvest, etc. See 1.5.1.2 for full list.	The polluter pays principal is no good unless the polluter knows how to address the problem. Farmers are more likely to accept advice from agricultural organisations.	Monitor through condition of grant aid. Cost: Low.	Horizontal Regulation – support for actions; or Rural Development Regulation – 'to promote sustainable farming and educate farmers and inform them of agricultural methods compatible with the environment'
	Introduce, as a condition of receiving direct payments, submission of details of the annual farm nutrient surplus.	Data available to take action, eg, penalise the worst 10%, or to set thresholds for proportion of the subsidy to be withheld.	Monitor / collect through direct payment claim forms. Cost: Low.	Is dependant on the introduction of the Farm Nutrient Balance. Horizontal Regulation – cross-compliance.

Notes:
1. See Table 5.14

8.4. Options for going beyond GAP and delivering environmental enhancement

Most of the EU dairy cattle are in, and milk production comes from, intensive production systems (see Section 4). As a consequence environmental enhancement measures (fauna and flora, habitats and landscape) in the dairy sector tend to be secondary to the need for greater integration of good environmental practice, as GAP. Indeed, for some of the systems (eg, G1, M1 and CG1) even with the integration of practical measures to minimise environmental impact there will always be nutrient surpluses and emissions. With more open markets in the future and lower milk prices the prognosis is likely to be for more intensive milk production from fewer specialist production units in these systems. Associated with this is the likelihood that economic pressures will result in the more environmentally benign systems (eg, P1, G2, CG2 and G3) will become less viable and less likely to survive. This is already being seen in some of the marginal production areas of the EU. For example, in the marginal areas of the UK, it is a trend (which is accelerating) that has been present for the last 20 years. For example, in Islay (Hebrides, Scottish LFA) in 1977 there were 23 dairy farms and all had beef cows as well, by 1998 there were 8 dairy farms of which only one had beef cows as well (and with 214,000kg/year from 40 cows not eligible for SCP). Currently there are 5 dairy farms, three having converted to suckler beef in the last six months. One of the remaining dairy farms plans to increase herd size to 200 milking cows.

As a result it is appropriate to consider the applicability of general environmental enhancement measures from the perspectives of these two groups of dairy systems.

- For the intensive systems (mostly G1, G2, M1, CG1, L1, L2) the issues are mostly about introducing or increasing good environmental practice (as GAP) and seeking environmental enhancement via management 'at the margin', of peripheral, marginal features. These management actions could be considered as "best practice" (eg, creating waterside margins) or targeted at features which deserve special management in their own right (eg, boundary features such as hedges and woodlands).
- For the lower intensity systems (mostly P1, G3, CG2, CG3) the main issue is much more about how to encourage the continuation of this form of dairy production because the functional elements of the farms also have an ecological function or nature conservation value. This presents challenges both at the general level (how to keep them as dairy farms) and at the specific level (how to maintain certain practices). Although only a small proportion of EU dairy farms fall into this category it can be argued that they should be the highest priority with respect to enhancement measures, especially whilst funding for the enabling Regulations is limited.

As well as providing direct opportunities for enhancement measures (through agri-environment), the Rural Development Regulation also provides indirect possibilities linked with other measures. For example, through promoting the adaptation and development of rural areas, through improving the processing of agricultural products and through investment in agricultural holdings. All of the latter can have actions linked to them that improve the natural environment; imaginative schemes could prioritise structural activities that include an environmental objective. In addition, the provision of training can be used to help farmers become better informed about the environmental impact of their activities and ways to minimise the negative, and maximise the positive, effects. Several national authorities, especially in the more intensive production areas such as the Netherlands, Denmark and the UK, have already identified this as an important first step to reducing environmental impact – especially if environmental improvements can be linked with economic benefits. These include measures discussed in sub-sections 8.2 and 8.3 above but in some cases extend to 'enhancement' measures as often initiated through the agri-environment measures.

Because enhancement measures have to be tailored to both the systems and to the regional variation in these, it is not appropriate to list general measures (see Section 7 above for a review of some of the existing Regulation 2078/92 programmes and measures affecting dairy farms). The suggestions for each of the systems given in the tables in sub-section 8.4.1 below are “generic” ones which would need to be developed in an appropriate way for specific areas, within the locations where a specific system prevails. For example, even within the mountain dairy systems (Transhumant P1, and Mountain Grassland G3) which might appear to be fairly homogenous, there is local variation in management practices, production goals and local ecology.

The degree to which general recommendations are relevant at a national level will also depend on whether national governments apply agri-environment schemes across the whole territory (as in Ireland) or targeted at specific areas (as in the UK).

8.4.1. Issues and options for env i ronmental enhancement by dairy production system

8.4.1.1. Transhumant dairy system s : P1

Table 8.12: Options for environmental enhancement

MAIN ISSUES[1]	OPTIONS	BENEFIT	MONITOR / COST	MECHANISMS
Transhumant dairy farming areas are some of the most important areas for nature conservation and biodiversity in Europe. However the number of dairy farms is falling, land is being abandoned and management practices intensified.	Introduce (or continue in the cases where programmes are already in place, continue) agri-environment schemes which target the biological components of the farms eg the alpine pastures, the mid-altitude pastures and meadows and the valley meadows. The aim should be to continue the traditional production systems that were integrated with the natural environment.	Many of the components of these dairy farms will not survive either under abandonment or under alternative farming systems (eg, suckler cows or sheep). Small changes in management (eg from hay to silage can have big effects).	Whole farm plans for the 5-year period would provide the information to monitor the actions. Extra survey would be needed to monitor success. Cost : Moderate.	RDR: agri-environment:- “management of low-intensity pasture systems” “conservation of high nature value farmed environments which are under threat”.
	Introduce incentives to encourage the continuation of transhumance by giving financial assistance for infrastructure both in the mountains and in the valleys. Examples could be assistance to build better living quarters in the mountains, better communications, support for temporary employees (none of these things would increase production).	A major factor in the demise of farms in this system is the lifestyle which is unattractive to young farmers because of the conditions and because of unsociable hours. More attractive living and working conditions and the opportunity for days away from the farm would help sustain the system.	Any financial packages could have conditions attached which would enable monitoring of the impacts. The cost (for structural works) would be moderate.	Rural development Regulation “ to promote farm practices necessary for the maintenance of biodiversity including under use” Article 4: investment in agricultural holdings and improvement of living, working and production conditions. Article 33: setting up of farm relief / management services.
	Provide training for transhumant dairy farmers on potential for organic conversion and for reflecting the “quality environment” in which their milk is produced.	This would help to in the longer term to make production more sustainable by emphasising the economic potential rather than just stressing the environmental importance. It would help to overcome the problem of appearing to want to "fossilise" the systems.	The number of farmers taking up training would be straightforward to monitor. Costs would be low.	RDR: Training, article 9.

Notes:
1. See Table 5.5

8.4.1.2. Intensive grassland (ley) systems: G1

Table 8.13: Options for environmental enhancement

MAIN ISSUES[1]	OPTIONS	BENEFIT	MONITOR / COST	MECHANISMS
Marginal features and habitats can be of local value from both a biological and landscape point of view.	Introduce (or continue) agri-environment schemes in selected areas to maintain these features, especially where they complement good environmental practice, eg water margin protection and de-nitrification buffer zones next to watercourses..	Maintains the landscape value and the biological fabric of the countryside. The benefit is low compared with other systems and would be given a lower priority than measures to reduce the negative impacts of the system.	Monitor through conditions of the schemes and the whole farm plan. Cost: potentially moderate but the priority should be low compared with actions in other systems.	Rural Development Regulation: agri-environment measures.
Intensively managed grassland is intrinsically poor in fauna and flora because of high inputs of inorganic N and P.	Encourage organic conversion	Big reduction in fertiliser use and no use of pesticides.	Monitoring would be straightforward. Costs: Moderate to High	
Some areas which are internationally important for migratory wildfowl (geese) include G1 dairy farms eg, in the NL and the UK .	Provide management agreements which recognise this nature value (even though overall biodiversity is not high) by compensating farmers for the "environmental restriction". Compensation could be paid on an area basis proportional to wildfowl use.	This would:- (a) Help to maintain the wintering (and in some cases breeding) areas of these species (mostly arctic breeding geese); (b) Give protection to the species whilst on farmland.	Management agreements can include provisions for monitoring the schemes. Costs: potentially moderate.	LFA may include areas with specific environmental handicaps relating to Community legislation eg, areas designated under the Wild Birds Directive). Articles 16 and 20.

Notes:
1. See Table 5.6

8.4.1.3. Permanent grassland systems (lowland): G2

Table 8.14: Options for environmental enhancement

MAIN ISSUES[1]	OPTIONS	BENEFIT	MONITOR / COST	MECHANISMS
These are mostly grass-based dairy farms in the wetter areas of the Atlantic Region with up to 30% in arable rotation in Continental Europe. In the last 20 years intensification (hay to multiple cut silage) and farm amalgamation have reduced biodiversity of fields, permanent pastures and natural features. But many areas remain with, in some areas, a high proportion of marginal features and habitats.	Introduce (or continue) agri-environment schemes that maintain these features, especially where they contribute to the farming systems (eg, permanent rough meadows for dry cows and heifers). As most farms have (or will) move from hay to silage provide incentives to make a proportion of hay or haylage.	Maintaining a variety of habitats in the farmed countryside (bocage, woodlands, meadows, marshes etc.) Reduction in potential for silage effluent pollution both during storage and feeding. Use of hay reduces % of concentrates used and potential for nutrient surplus.	Monitor through conditions of the schemes and the whole farm plan. Cost: potentially moderate but the priority would be lower than compared with actions in other systems.	Rural Development Regulation: agri-environment measures.
	Use agri-environment schemes to encourage more tillage where it has declined (in the west there has been a marked reduction in the last 15 years) and to maintain it where it survives.	Home grown cereals and fodder can be used to replace concentrates reducing nutrient surplus. Growing the crops will utilise manure and slurry. Cropped ground will increase local diversity in these grass dominated systems.		

Notes:
1. See Table 5.7

8.4.1.4. Permanent grassland systems (mountains): G3

Table 8.15: Options for environmental enhancement

MAIN ISSUES[1]	OPTIONS	BENEFIT	MONITOR / COST	MECHANISMS
The lowest intensity farms can include areas of very high biological value associated with pastures and meadows (including wood pastures in Boreal Region) but cessation of dairying and abandonment are important issues. Many mountain farms are linked with valley farms for the production of fodder.	Introduce (or continue) agri-environment schemes that specifically target the maintenance of these features, especially where they contribute to the farming system eg wood pastures, hay meadows, summer pastures. Also target peripheral habitats to provide management payments which would contribute to the viability of the farm, not lead to any increase in production and have important ecological value eg, heathlands, steep mountain pastures, woodlands, marshes and riverside areas.	The aim should be to conserve the biological value in the context of a living landscape in which the components still have a functional importance to agriculture. These anthropogenic habitats have been created by farming and are most effectively maintained by appropriate farming.	Whole farm plans for the 5-year period would provide the information to monitor the actions. Extra survey would be needed to monitor success. Cost : Moderate.	Rural Development Regulation: agri-environment measures. Specifically the objective "of promoting the management of low-intensity pasture systems". RDR: article 5 " support shall be granted to agricultural holdings which comply with minimum standards regarding the environment, hygiene and animal welfare".
Specialist products (cheeses) help these systems to survive but continued production is perceived to be threatened in many areas by EU hygiene regulations and structural requirements for dairies.	Provide financial assistance for the improvement of living working and production conditions.	This would help to slow or prevent abandonment by assisting farms which would otherwise not have the capital to meet new regulations.	Monitoring through the conditions of aid. Cost: potentially High.	
There is a general problem of intensification (and amalgamation of holdings) in some areas and abandonment in others.	Provide training in marketing and in the potential economic benefits of organic conversion.	Provide farmers with information which widens their choices beyond simple intensification.	Monitor attendance at courses. Cost Low.	RDR: Training.(article 9)

Notes:

1. See Table 5.8

8.4.1.5. Conventional mixed systems: CG1

Table 8.16: Options for environmental enhancement

MAIN ISSUES[1]	OPTIONS	BENEFIT	MONITOR / COST	MECHANISMS
The intensity of the system and the high proportion of cultivated land result in low biological diversity. Main enhancement issue is protecting peripheral biological features such as hedges, waterside habitats and woods.	Introduce (or continue) agri-environment schemes in selected areas to maintain these features, especially where they complement good environmental practice, eg water margin protection and de-nitrification buffer zones next to watercourses. Specific regional actions could benefit wildlife eg, the under sowing of cereal crops with grass and winter stubble for insects and birds.	Mostly landscape and aesthetic benefit as biological value of marginal habitats often reduced because of high use of pesticides and herbicides. Waterside margins assist in buffering water bodies against N leakage.		Rural Development Regulation: agri-environment measures.
Intensively managed crops and rotational grass is intrinsically poor in fauna and flora because of high inputs of inorganic N and P.	Provide training to encourage organic conversion.	Organic mixed systems involve a big reduction in fertiliser use and no use of pesticides. However for intensive producers to contemplate conversion to organic systems they must be exposed to the relevant information.	Monitoring would be straightforward. Costs: Moderate to High	RDR: agri-environment: extensification of farming.

Notes:
1. See Table 5.9

8.4.1.6. Low-input and organic mixed systems: CG2

Table 8.17: Options for environmental enhancement

MAIN ISSUES[1]	OPTIONS	BENEFIT	MONITOR / COST	MECHANISMS
Although low input in terms of chemicals and mineral fertilisers these systems can occur in very intensively farmed landscapes with few peripheral features. The range is wide and not geographically discrete – an organic farm can occur next to a conventional mixed farm or a intensive grassland farm (dairy or otherwise).	Introduce an organic payment within agri-environment schemes to maintain organic practices and marginal farmland features, especially where they complement good environmental practice, eg water margin protection and de-nitrification buffer zones next to watercourses. As with conventional systems specific regional actions could benefit wildlife eg, the under sowing of cereal crops with grass and winter stubble for insects and birds.	Because of better use of N and lack of chemicals the potential for peripheral features to support insects, plants and birds should be greater than on conventional mixed farms.	Monitor through the scheme conditions and through independent biological monitoring. More information is needed on the apparent benefits of organic farming.	Rural Development Regulation: agri-environment measures.
Although organic systems potentially have less environmental impact than conventional systems, their environmental contribution is not reflected in any direct payments – reducing attractiveness to farmers.	Within the LFA member states could include organically managed land as a category for higher area payments. Member States are currently devising methods to convert headage payments to area (hectarage) payments.	This would provide encouragement for organic production in the LFA which would have environmental benefits through the reduced use of fertiliser and chemicals.	The proportion of LFA farmers claiming for organic land could be monitored through the scheme. Cost: budget neutral because more intensively managed land would be receive less per hectare.	Rural Development Regulation – LFA article 13(a) “to maintain and promote sustainable farming systems which in particular take account of environmental protection requirements”.

Notes:
1. See Table 5.10

8.4.1.7. Mediterranean mixed systems: CG3

Table 8.18: Options for environmental enhancement

MAIN ISSUES[1]	OPTIONS	BENEFIT	MONITOR / COST	MECHANISMS

Mosaics of natural vegetation in association with polyculture which includes fodder crops, vegetables and tree crops can be very rich in wildlife. In combination with other cultivation systems (olives, cork and holm oak) creates a Mediterranean farmed landscape of high aesthetic value.	Introduce (or continue) agri-environment schemes in selected areas to maintain areas of natural vegetation (eg, extensive pastures) and small scale, non irrigated mixed crop production. Maintain structural landscape features especially dry stone walls, traditional buildings and livestock holding areas.	In the Mediterranean region biological productivity is high and invertebrate populations are some of the richest and most diverse in Europe. Livestock rearing and cultivation add to this diversity eg there is rapid remove of animal dung by coprophilous insects. The latter are important food items for mammals and birds.	Monitoring incorporated as a condition of the schemes. Cost: Medium.	Rural Development Regulation: agri-environment measures.

Notes:
1. See Table 5.11

8.4.1.8. Intensive silage maize syst e ms: M1

Table 8.19: Options for environmental enhancement

MAIN ISSUES[1]	OPTIONS	BENEFIT	MONITOR / COST	MECHANISMS
These are some of the most intensive farms in Europe. Biological diversity is intrinsically low and the main issues are of reducing pollution and eutrophication control.	Subject to meeting certain standards, which could be linked a farm nutrient balance threshold, introduce (or continue) agri-environment schemes in selected areas to maintain regionally important peripheral features and aesthetically or culturally important landscapes.	Peripheral features and fragmented natural habitats would be protected subject to certain pollution controls on the whole farm.	Monitor through conditions attached to the scheme. Cost: potentially moderate (many large farms) but priority low in relation to actions in other more biologically important systems.	Rural Development Regulation: agri-environment measures.

Notes:
1. See Table 5.12

8.4.1.9. Industrial systems: L1

Table 8.20: Options for environmental enhancement

MAIN ISSUES[1]	OPTIONS	BENEFIT	MONITOR / COST	MECHANISMS
Industrial systems are outside the scope of environmental enhancement.				.

Notes:
1. See Table 5.13

8.4.1.10. Mediterranean commercial systems: L2

Table 8.21: Options for environmental enhancement

MAIN ISSUES*	OPTIONS	BENEFIT	MONITOR / COST	MECHANISMS
These are very intensive systems which are essentially "mixed" with point source pollution issues associated with housed cattle and fertiliser, manure and pesticide use on cultivated land.	There is potential for agri-environment schemes to address peripheral features but no information has been obtained on this. As with other intensive systems entry to any "enhancement" measures should be conditional on meeting certain standards as outlined above.	Peripheral features and fragmented natural habitats would be protected subject to certain pollution controls on the whole farm.	Monitor through conditions attached to the scheme. Cost: potentially moderate (many large farms) but priority low in relation to actions in other more biologically important systems.	Rural Development Regulation: agri-environment measures.

Notes:
1. See Table 5.14

9. Conclusions

9.1. The value of the typology of EU dairy systems

The aim of the typology developed in this report is to provide a framework for a more targeted approach to actions to address the environmental impact of dairy farming and for setting priorities on potential inducements (or rewards) for environmental enhancement. An objective was to describe each system using typical values (indicators) of a combination of commonly used descriptive parameters of dairy farms. This essentially differentiates systems according to the way in which grazing land is managed and hence combines both economic/technical classification criteria (see section 2) and classification by bio-geographical region and land use (see section 3). Using these, any dairy farm in the EU can be allocated to one of ten broad dairy systems by reference to threshold values of some key indicators such as location, fertiliser use, concentrate use, farm size, herd size, milk yield, livestock density and main winter fodder used (see section 4). Some types are more variable than others, but in all of the systems variation within the systems is less than the variation between the systems.

In drawing up the typology, an in-depth literature review and analysis was undertaken and views from farmers, consultants and agricultural advisors from France, Greece, Germany, Denmark, Sweden, Finland, Portugal, the UK and Ireland were taken into consideration (asking each to either allocate their individual farm to one of the systems or to assess whether, in their view the systems covered the range of variation in their areas).

The value of the typology is that:

a) It provides a framework to assist logical and structured consideration of any environmental measures that might be proposed or instigated (eg, relating to opportunities for cross-compliance). In this way it should contribute to ensuring that the most important environmental issues associated with variations in dairy management strategies and decisions are incorporated. For example, management strategies determine whether winter fodder is hay or silage, whether tillage is carried out or to what degree grazing at pasture is used. Management decisions include, for example, the amount of fertiliser and slurry used, spreading techniques, waste water management, manure and slurry storage facilities. The typology simply provides a mechanism for providing systematic and consistent assessment of the possible impact of measures.

b) It takes into account the dairy production system and the ‘environment’, the latter in the form of the main forage and fodder resources, giving a logical qualitative basis for differentiating between dairy farms on both management practices and intensity of production. From an environmental perspective, this is required in all livestock sectors (eg, also beef and sheep).

c) It enables systems with different production characteristics to be grouped together according to environmental impact and their relative importance to dairy production. This has been summarised in Table 5.1 (Section 5) in relation to the main environmental issues; three groupings of systems can be identified as follows:

- those for which the biggest environmental issues are negative impacts on the environment. This includes systems G1, CG1, M1 and L1 systems which account for most of the EU's dairy farms and where approximately 80% of dairy cows and 84% of milk production occur;
- a group of systems which have either a largely neutral effect on the environment or for which information is lacking (G2, CG2 and L2). These represent dairy farms where 12% of EU milk is produced and 13% of dairy cows are kept;
- ecologically valuable systems for which the continuation of dairy farming is the principal issue (P1, G3 and CG3), but which account for only 6% and 8% respectively of EU milk production and dairy cows.

d) It differentiates between dairy systems of the first two groups (see c) above) in which farm business decisions shape management practice (and their environmental value or concerns) and the third group in which the natural characteristics of land are still a major influence (constraint). In this respect, geographical location in the first two groups has become largely secondary to what is the most appropriate management strategy to maximise profit. For example, G1 occurs from the Azores to Scandinavia and G2 from western Ireland to Normandy (in fact dairy, production in G2 has greater similarities with dairy production in New Zealand than with the European M1 system).

e) It shows that most of the ten systems (and the dairy farms where over 90% of EU milk is produced) occupy a rather limited geographical area on agricultural land with the highest production potential. Here production systems tend to maximise output through management strategies which are more strongly influenced by market constraints (eg, national interpretation of milk quota policy) and individual management decisions than by physical constraints. A result of this is that within the bio-geographical regions, farms of different systems frequently occur contiguous with each other. For instance, conventional mixed systems (CG1) can occur next to organic mixed systems (CG2), intensive grassland systems (G1) or maize silage systems (M1). Also, in the Mediterranean region, small scale mixed systems (CG3) can sometimes be found close to intensive commercial systems (L2).

   An implication of this is that most of these farms have potential for changing management system in response to market forces in order to either maintain profitability in dairy farming or to change to alternative enterprises. However, as broad market or policy changes affect different systems in different ways, the typology can assist in both identifying the most appropriate measures for different systems (see sub-section 8.3) and predicting likely implications of 'broad brush' measures. For example, cross compliance measures to combat pollution may have a disproportionate financial impact on the currently non-polluting systems that we value.

9.2. Further developing the typ ology

The typology focuses specifically on dairy farms and uses the characteristics of the dairy enterprise to differentiate between dairy systems. However, on many farms, found both in LFAs and non-LFAs, the dairy enterprise only represents one part of a business. In the LFAs, dairy farms are mostly of the low input/output systems and dairy is often combined with suckler beef and sheep, whilst in non-LFAs, dairying (often high input/output) is often combined with intensive beef, pig or cereals production . Hence, realities are often more complicated than the typology indicates and there could be additional value derived from developing typologies for other sectors and exploring to what extent some of these occur in combination as mixed systems.

9.3. Trends in EU dairy system s and the environmental implications

a) Trends

The evidence presented in this report (notably sections 2 to 5) shows that in general, dairying in the EU is becoming more intensive and more specialised (see Section 2, notably sub-section 2.4 which illustrates general declines in cow numbers, increases in average herd size and average yield per cow). This means that production is concentrating on fewer, larger farms (eg, 40% of EU dairy cows are in herds of at least 50 head) resulting in a corresponding decrease of dairy farming on many holdings and increasing abandonment of holdings. This is true for virtually all dairy farms irrespective of system or bio-geographical region (noting that 85% of EU milk production is derived from one high input/output (see section 2) economic/technical classification of dairy farming), except where national authorities actively seek to help maintain small producers, such as some mountain areas (P1 and G3 systems) and where there are significant incentives to promote organic production systems (eg, Austria)[24]. The primary driving force behind these trends is economic. However, the economic framework is itself heavily influenced by the nature of the support regime (largely price support), technology development and structural change in the production sector (plus structural change in the up and downstream supply chain). The complex interaction of these factors makes disaggregating them virtually impossible (it is also beyond the terms of reference for the study to attempt such an exercise). The only way to remove the policy framework from the equation would be to compare trends in two (similar) agricultural sectors, one where the CAP applies, and one where no agricultural policy exists. All other factors influencing production would have to be the same - no such country or region exists[25].

In some of the more remote regions (remote from major areas of population and hence demand for milk) within member states, the distance from markets and processing facilities is adding to costs of supply and re-inforcing the concentration process. Thus, in G2 systems in south Wales, an important factor influencing farmers leaving dairying (mostly with herds of between 40 and 100 cows) has been recent changes to the pricing regime for milk collection. Daily milk collections are expensive, and if milk is collected less frequently more on-farm storage capacity is required which in turn requires additional capital investment in new equipment. A similar pressure exists on Scottish island milk producers where a charge of 5p per litre to take milk to the mainland effectively makes island production (without a local creamery) largely uneconomic. In the Mediterranean Region, the traditional small scale mixed dairy system (CG3) is gradually being replaced by Commercial systems (L2). For instance, in the Alentejo region of Portugal there are now large herds (with 450 wet and dry cows not uncommon) on dairy farms using irrigated cultivation to provide fodder. These farms produce ryegrass sown in the autumn and harvested in March using 150kg N/ha followed immediately with a crop of maize with 170kg N/ha and harvested in August or September. Up to 50% of the cows requirements are met by providing feed in the form of concentrates (approximately 2,500kg/cow/year). Lastly, in the remote and mountainous areas of LFAs, dairy farming (in G2, G3 and CG3) is likely to be gradually replaced by suckler beef or sheep farming; although since both of these are limited by quota on premium rights these sectors could

[24] Although organic farming can be on a large scale and does not necessarily equate with small and medium sized farms.

[25] The nearest relevant country might be New Zealand although even here, there has historically been some policy support. Also to make comparisons with New Zealand is beyond the terms of reference for this study.

also become more concentrated. In several mountain areas this cessation of dairy farming then leads to possible replacement by forestry (eg, in the Black Forest), or by a livestock system which utilised pastures differently to the seasonal and periodic grazing by closely managed dairy cows.

b) Environmental implications

In terms of environmental implications, the review of the available information presented in the report (see section 5) suggests that for all of the dairy systems described, largely negative environmental issues increase with increasing intensity of production (which is itself an underlying and major feature of EU dairy production: see section 2). Associated with the intensive dairy systems are high stocking rates, high use of chemical fertilisers and pesticides and mechanised methods (see section 2). These result in problems of direct point source pollution, diffuse pollution and pressure on marginal habitats and landscape features. More specifically:

- landscape and habitat: as dairying becomes more intensive, it becomes more uniform and less dispersed. Hardy, locally adapted stock is displaced by highly selected productive animals that are more demanding in terms of food supplements and veterinary support, and need specialised housing, often with a standard design using imported (to the farm) materials. There is also a tendency to simplify farm structure, which may involve a reduction of non-dairy stock, and fodder production; and, in situations where this is not viable, it may involve farm abandonment. Since many of Europe's dairy landscapes are grazing mediated systems whose structure and function are determined by the free-ranging movement of locally adapted stock, the effect of this process has been colonisation of meadows by scrub and woodland, loss of open grassland and field boundaries and degradation of hydro geological systems (see sub-section 5.3.2);
- biodiversity (see sub-section 5.3.3): the effect of dairying on biodiversity is far from straightforward, and includes the development of invasive herbs and loss of grassland diversity due to the increased use of fertiliser (particularly N&K), silage production, reduced grazing and scrub encroachment. While some intensively managed grassland, is of strategic importance to migrating wildfowl, large-scale changes in the intensity of use in traditional farmed areas seem to be associated with a loss of both complexity and stability. This effect is particularly significant in river-based and mixed Mediterranean systems;
- soil (see sub-section 5.3.4): the main impact is on soil integrity (its ability to remain a stable medium for plant growth that can recycle nutrients) which is affected by increased use of fertilisers, feed additives and the more concentrated use of waste products like manure. As intensification increases, the level of application of fertilisers and manures usually rises to levels that are greater than crop requirements or the ability of the soil to retain them. Where these nutrients are relatively immobile or have limited water solubility this may result in the soil changing its essential character. Intensive production systems also make fairly widespread use of feed additives, medicines and growth promoters. Little is known about the impact of these on the environment, however: feed concentrates contain phytotoxic heavy metals such as copper (Cu), zinc (Zn) and cadmium (Cd) which accumulate in the soil and vet medicines persist in dung, affecting its fauna and potentially the dependant bird populations. Also, high stocking rates may result in increased incidence of trampling and subsequent erosion;
- water (see sub-section 5.3.5): the primary impact is via the pollution of groundwater with nitrates and pesticides (eg, Atrazine) and surface water eutrophicated (eg, the guide level of nitrate concentration (25 mg/l) is exceeded in the groundwater under 85% of the EU's farmland). The full

extent of surface and groundwater pollution due to farming (both in general and more specifically to dairying) is however largely unquantified;

- air (see sub-section 5.3.6): the impact of dairying on the atmosphere arises from de-nitrification, the production of, methane, ammonia volatilisation and carbon dioxide. Whilst methane generation per animal tends to be higher in low input systems than in the more intensively managed systems that use feed supplements, ammonia emissions are highest for intensively managed systems (these occur during manure storage and application to arable and grassland). In terms of carbon dioxide and nitrous oxide emissions, dairy production has only an indirect impact (mainly the use of energy to manufacture feed concentrates and to assist forage production as well as housing systems).

Overall, it is however important to recognise that many of the complex relationships between intensive dairy systems and the environmental impact are not fully understood. In low input/output, transhumant and mountain grassland systems, the main issue is one of abandonment of dairying leading to scrub development or commercial forestry, loss of biodiversity and changes in landscape character. In the more intensive systems that dominate dairy production, the main issues are nutrient contamination of soil, groundwater pollution, surface water eutrophication and ammonia emissions.

9.4. Future policy perspective and implications

The underlying policy perspective for dairy farming over the next few years is derived from the existing dairy regime coupled with some aspects of reform initiated by Agenda 2000. The main possible impacts of the (Agenda 2000) reforms on dairy production systems (see section 6) are, however, likely to be limited. The reforms do not represent fundamental reform or change and whilst the introduction of a direct payment form of support is new, the underlying level of support provided to dairy farmers is not being significantly altered – price cuts are partly compensated via the provision of direct payments and will not be implemented until 2005. This means that in the medium term the ways in which the dairy regime impacts on dairy production systems, husbandry methods, intensity, etc, and on the environment, is unlikely to be subject to significant change.

Where change can reasonably be expected to occur (post 2005) it mainly relates to the impact of lower milk prices, lower levels of gross farm revenue and ultimately lower income from dairy farming. In the main milk producing regions of the Community (northern countries and the Atlantic bio-geographical region where G1 and G2 systems dominate), lower returns coupled with improved competitiveness of cereals as a feed ration is likely to make silage feeding relatively less attractive as a feeding alternative. To the extent that this may result in a shift away from silage feeding to cereal feeding, this is likely to result in higher levels of phosphorus and nitrogen output, increased eutrophication of water courses, possible increases in erosion and greater emissions of ammonia.

The recent policy changes do, however, introduce some scope for introducing positive environmental aspects into dairy husbandry systems via the implementation of the national envelope component of the direct payment, use of the horizontal and rural development regulations and continued adaptation of '2078' measures (see below).

9.5. Success to date of 'neutral i ty and enhancement' measures

In section 7 of the report, examples of existing measures which aim to contribute to environmental neutrality or to positive environmental benefits were examined. Assessing the impact of both types of measure on dairy production has proved very difficult although it is probable that the impact has been limited. In many cases this reflects the voluntary natures of measures offering environmental neutrality (eg, Codes of Good Agricultural Practice) or encouraging environmental enhancement ('2078' measures), although the targeting of almost all measures at environmental media rather than specific farming sectors also makes assessment of impact on dairying very difficult. The measures under 2078/92 do, however, provide a range of examples whereby livestock production in general (and therefore, by implication, dairy production in particular) may be made more environmentally friendly.

In general the two approaches, neutrality or enhancement, tend to be linked to two different types of location or region. The main features of each are:

- Neutrality measures, although universal to all areas, these tend to have the greatest impact in regions where particular environmental problems exist. For example, in the more northerly Member States, the Nitrates Directive largely replaced and incorporated existing national legislation. In contrast, in Greece, legislation to combat nitrate loss was only adopted to meet EU requirements. The most 'forward' examples of measures being taken to address the pollution problems can be perhaps drawn from in the Netherlands and Denmark. In both, pollution problems from intensive agriculture (mostly dairy farming and pig farming) have been an important target for many years and measures adopted to address the problem are widely perceived to have been reasonably successful. In the Netherlands, between 1985 and 1994, N surplus losses to soil has decreased by 16% compared to the widely held view that they would otherwise have increased by 40% without the implementation of specific environmental policies coupled with the introduction of milk quotas. In Denmark it is estimated that nitrogen leaching was reduced 17% between 1898/90 and 1995/96. Use of nitrate fertiliser has been reduced by almost 30% since 1985, and since 1980 there has been a 26% reduction in ammonia emissions from manure. In addition, in the Dutch Province Noord-Brabant, a project to stimulate good agricultural practice to protect ground water since 1991 has resulted in (to 1995) the average nitrate surpluses on dairy farms falling from 428 to 367kg/ha (-14%) and average phosphate surplus falling 39% to 66kg/ha. It should however be noted that the problems remaining to-date in the Netherlands are considerable and the degree of compulsion in delivering reduced nutrient surpluses at the farm level only apply to about half of all Dutch farms. This contrasts with Denmark where mandatory controls apply to almost all farms. An important additional conclusion that can be drawn from the Dutch, and in particular the Danish examples, is that the success of measures to reduce environmental impact through voluntary codes and legislation depends as much on the awareness of the issues by farmers as on the design of the actions. Training and advice must therefore be an element in any measures, especially if these are introduced with some degree of compulsion (goal orientated solutions tend to be more attractive to farmers than regulations).

- Enhancement (2078/92) measures tend to be focused on more marginal areas which are characterised by relatively lower levels of intensity and include remote and/or mountainous areas. Here dairy farming is usually widespread, but comprises smaller scale producers in bio-geographical regions such as Alpine and parts of the Mediterranean, Continental, Boreal and Atlantic regions where mixed farming systems dominate (CG2, CG3, P1, G3 and CG1). Overall, the current '2078' measures most likely to offer environmental benefits through the dairy regime are the grassland management measures. At a general level, restrictions on the use of inputs have led to environmental benefits in terms of reductions in phosphorus levels in surface water and reductions in nitrate levels in surface and groundwater. Reductions in fertiliser use have also resulted in a potential for increased biodiversity (see section 7). However, whilst these positive environmental attributes have been delivered it is difficult to attribute specifics to changes in dairy production.

9.6. The main environmental issues and practical options for addressing them

As indicated in sections 6 and 7, the role and impact of environmental policies and agri-environmental (2078) measures have probably had very limited impact on EU dairy farming simply because they are not the target of most schemes. This mainly reflects the technical and economic relationships that dominate in most of the dairy systems described (except P1, G3 and CG2). Here for most systems the nature of markets and the dairy support regime (primarily price support) provides a fairly strong incentive to produce milk within a high input/output system in which reasonably high levels of fertiliser (eg, 300kg+ N/ha) are applied. As a result, most dairy farms have a relatively low level of biological diversity associated with marginal habitats and peripheral features and are mainly linked with environmental problems relating to excess nutrient losses and significant diffuse pollution to air and water. For example, dairy farms are the largest contributor to ammonia pollution in the UK (DOE London 1994)[26].

Any measures that might be used through the Agenda 2000 policy changes which attempt to reverse the adverse environmental effects referred to above (by reducing nitrogen use on a large scale) would probably impose a substantial cost to farmers (and in turn to the taxpayer if compensation or incentive payments were made). It would also, in most systems, probably have limited success in improving biological diversity due to the inherent high fertility and stored nutrients in most dairy pastures (Goss, et al, 1997). It would, however be more appropriate to use such measures in systems where the fertility of pastures is relatively low and there remains floristic diversity (P1, G3 and some G2).

The same general comment applies to measures that might be initiated to reduce stocking rates to the threshold levels specified in the Regulations for extensification payment (two payment levels at 1.4 LU/ha and 1.8 LU/ha by 2002) or the specific stocking density requirements to be established by Member States for their national envelope payments. For most of the more intensive dairy systems a reduction in stocking rates to 1.4 LU/ha would most probably incur a significant cost, which would be accentuated by CAP price support and direct payments. Any attempt to promote such extensification in most of the dairy systems will therefore need to be preceded by more in depth consideration of the potential environmental benefits and costs. However, for the P1, G2, G3 and CG3 systems the use of extensification payments will probably reward dairy farmers for currently stocking below the threshold and help the economic viability of the systems.

[26] UK Review Group on the impacts of Nitrogen Deposition on Terrestrial Ecosystems (1994) Impacts of Nitrogen Deposition on Terrestrial Ecosystems. Department of the Environment, London.

The most important and widespread environmental issues (that affect all of the systems to some extent) relate to the polluting effects of nutrient and chemical losses into soil, water and air. The second major issue, although affecting a relatively small proportion of dairy farms and only a few geographical areas, relates to the decline of dairy systems that are associated with farmland of high biodiversity. A secondary, but widespread, issue to these two environmental issues is the preservation of marginal habitats and landscape features which are characteristic of the dairy farming landscape.

Against this background of environmental issues and concerns facing dairy production systems, possibilities[27] within Agenda 2000 for addressing these issues (see section 6 and section 8 for more detail) are broadly summarised as follows.

9.6.1. Common Market Organisations: dairy and beef

There are very limited possibilities within the milk and dairy products and beef and veal sectors to directly address these issues. The main measure, that could provide a small disincentive to further intensification of dairy farming, is the way that additional payments are paid by Member States through their national envelope allocation. It is likely that, in most cases, this will simply be paid as a top-up to the Dairy Cow Premium. Paying it as an area payment would tend to favour dairy farms with low stocking densities, because only land that is not used to comply with the specific stocking density requirements for other direct payments (eg, SCP, DCP and AAA) will be eligible.

The scope for attaching stocking density requirements which take into account 'the environmental impact of the production with a view to improving the environmental situation of the land' (article 14), which are part of the BSP additional payments, is not mentioned in the DCP additional payments and is therefore difficult to assess. Dairy farmers who also claim SCP would be affected by this condition, as would dairy farmers receiving additional payments for dairy cows through the beef envelope (this is not obligatory so it would only apply if Member States paid this on dairy cows).

The scope for introducing extensification premiums in Member States where more than 50% of the milk is produced in mountainous areas could provide additional support for the (important) P1 and G3 systems in countries such as Austria, mainly because stocking densities in these areas tends to be below this threshold (see sub-sections 8.3.1 and 8.3.4).

Overall, the direct effect of the new Agenda 2000 'CMO' payments like the DCP on the main issues causing negative environmental impacts is likely to be small (see section 8).

[27] The reader should note that the objective of the practical options for adoption presented is to suggest measures that have least cost implications. However, placing detailed and precise costs on these is very difficult. This reflects the following:

- a lack of empirical data to draw on within a desk based study such as this;
- the non dairy-specific nature of almost all neutrality or enhancement measures makes estimating any cost of a measure to the dairy sector very difficult;
- the variability of environmental issues/problems across regions and within regions;
- the lack of quantitative information about the extent to which environmental problems exist by region – very few for example have initiated requirements such as farm nutrient balances (FNBs).

9.6.2. The Horizontal Regulation

This regulation potentially offers the greatest opportunities for directly addressing any negative environmental impacts of EU dairying (and other agricultural) systems by attaching 'appropriate environmental measures' to agricultural land and agricultural production which are subject to direct payments.

However, although Member States will be required to link direct payments to certain environmental conditions, such conditions are to be determined according to national circumstances. This may represent a potential weakness in delivering consistent environmental improvements because it offers scope for variability in the levels of environmental conditionality between countries, even though many of the dairy systems occur in several Member States (notably the high input/output systems). Indeed, there is already disparity between the national legislative pollution controls that apply to (dairy) farms in the EU (see section 7). To some degree these reflect the scale of the problem; for instance, where intensive systems (G1 and CG1) occur on light sandy soils such as in the Netherlands and Denmark, although they also reflect levels of national awareness and priorities.

In order to address the conditionality aspect of the reforms, and to suggest options which are practical and have a reasonable chance of successful delivery, we have focused on generic actions which can be applied widely and fairly to all dairy farms (see sub-section 8.2). In some cases we have suggested that there should be linkages with other measures to minimise the economic effects of this conditionality on certain systems.

The primary aim of the environmental controls proposed on dairy farming is to contribute to 'sustainable' farming and for most of the dairy systems described in this report this must have as its starting point a better understanding of sustainable nutrient management. Both the Dutch and the Danish ministries recognised this need several years ago because of the high intensity of their dairy farms and the excessive nitrate losses to water and to air and approached the problem through the farm nutrient balance. Accordingly, we suggest that the first steps in the introduction of conditionality on direct payments to dairy farmers should be measures to bring about the better management of nutrients, waste and water (see sub-section 8.2). In other words, requirements to establish a Farm Nutrient Balance (FNB - Farm Waste Management Plan and Water Budget).

The adoption of these steps has the following attractions:

- environmental organisations and lobby groups are pushing hard for cross-compliance on all direct payments, but often with little regard to either the realities of the economics of farming or the practicalities and effectiveness of the measures. Very often it is difficult to pin down exactly what is required and this is often because good quality information about environmental impact is not available (Bignal and McCracken, 1996). The initiation of 'balance' calculations would contribute to providing this information, helping to define better the issues and identify appropriate actions;
- farmers are concerned about the impact of environmental conditions attached to direct payments on profitability. Further economic pressures could lead to more farmers leaving dairy farming. This could be counter productive for the environment if it results in an acceleration in the rate of increase in farm size and intensity of production, and hence further concentration of production in the G1,

CG1 and M1 systems. The production of balances and waste management plans should have attractions to farmers because although they have an environmental objective, they also can provide potential economic benefits to the farmer through scope for achieving more efficient use of inputs. It also offers flexibility, which farmers like, as acting on the results of the balances to reduce surpluses can be left to the farmer's discretion. Importantly, in the countries where for example, nutrient balances are already being produced they meet with approval from farmers;

- farmers' organisations often view negatively the imposition of further controls on agriculture. Although this is probably, in part, a negotiating position, it does reflect their view that more conditions on agriculture, all of which have financial implications, simply serve to make farming less economically viable. There is also a fear that environmental conditions will be applied differently by Member States, leading to market distortions within the EU. The measures proposed do however represent the type of measures that these organisations could view positively because they offer practical benefits for farmers. In addition, the adoption of such a requirement will contribute to improving understanding and perceptions about the environmental impact of dairy farming systems. For example, it would be better if farmers perceived manure and slurry, not as farm waste, but more as a fertiliser resource with a financial value. Also, there is a widespread perception that slurry spreading only causes odour nuisance, whereas it actually causes nitrogen loss (as ammonia) and contributes to acid deposition. The use of nutrient/water budgets and waste management plans in combination with the typology of dairy systems could therefore be used to show that minimum standards of good agricultural practice can mean different things on different farms, and that current normal husbandry practices can sometimes be polluting;
- national authorities may be more receptive to the imposition of conditions that can be seen to affect all EU farmers equitably and for some Member States the use of such measures are familiar. They also offer scope for being cost effective ways of encouraging changes in farming practices. The Danish and Dutch authorities have most experience of this (see sub-section 8.2). From an administrative perspective details of for example, nutrient surpluses of a farm can be used in either a positive or negative way. Farms with low surpluses could be rewarded whilst those with excessive surpluses penalised if they are not reduced over a given period;
- the European Commission would have a basic practical measure, which could be monitored, to show that its direct payments to dairy farmers are linked to one of the fundamental requirements for moving towards a more sustainable European agriculture. It would provide a foundation on which to build further tiers of conditionality (if required) in the future. The use of nutrient/water budgets and waste management plans could be regarded as requirements of introducing better environmental practice into dairy farms as part of GAP. Only with knowledge of where losses are occurring is it possible to rectify them through the most appropriate best practices. It could also help in the development of guidelines for good farming practice and environmental enhancement;
- consumer interest groups and supermarkets are increasingly seeking to influence agricultural production methods and EUREP, an umbrella organisation of large European supermarkets, has recently produced internal guidelines for good agricultural practice to which all suppliers of these supermarkets must comply. In most cases their proposals already apply in the usual codes of good agricultural practice of the respective countries; although on fertiliser application they stipulate that quantities of nitrogen to be applied should be calculated from a nitrogen management plan. The recommendations to adopt measures requiring the submission of nutrient balances is consistent with these market oriented developments.

9.6.3. Rural Development Regula tion

a) Less Favoured Areas

If the use of nutrient/water budgets and Farm Waste Management Plans became a minimum environmental condition in the dairy sector it could be included as a condition for LFA dairy farmers (mostly in P1, G2, G3 and CG3 systems) receiving supplementary payments, which in future could be paid as an area payment. In the report by Goss, et al, (1997) such a system of areas payments based on adjusted forage area was suggested. The marginally viable mountain dairy systems (P1 and G3) would benefit from such an area payment that was weighted to give higher payments to forage areas of semi-natural and natural vegetation, in recognition of the more sustainable form of dairy farming.

b) Agri-environment (2078 type measures)

Actions under this measure are potentially very diverse, but should go beyond the application of good farming practices to require the delivery of environmental enhancement. Measures could include a range of actions (best practice) which protect and improve the environment (see wsub-section 8.3). As there are budgetary constraints on the scope for using such measures, we have restricted our suggestions for (generic) schemes to the biologically most diverse systems and to areas where dairy farming is associated with interest of high nature value (eg, parts of the Netherlands and the UK where wildfowl concentrations exist). Provision of support for best practice is complicated by the way Member States can choose to implement schemes which could apply to whole territories (as in the REPS scheme in Ireland), to specific areas (as in the UK) or to specific activities such as organic farming. An additional problem has been the lack of dairy-specific schemes. Consequently, we have been selective in suggesting options where we believe there will be greatest potential benefit in a most cost-effective way. Best practice is most effectively introduced through a combination of raised awareness (the FNB and training) and the provision of structural support required to introduce more sustainable techniques (see below). One exception is conversion to organic production. In some sectors it is not always clear whether organic conversion produces any significant environmental benefits. For instance, some sheep and suckler beef systems are already more extensive than organic standards would require. However, in the dairy sector, virtually all of the systems except P1 and G3 would benefit from organic conversion because of the limits on fertiliser use and stocking density that would be required. It would bring a degree of extensification into most systems and meet one of the explicit objectives of agri-environment requirements (Article 22). In the same vein we have only suggested specific management incentives for the low input/output systems (mostly P1 and G3) where the conservation of a 'high nature-value farmed environment is under threat' (of abandonment). The constraints outlined above mean that our proposals are 'generic' although they do indicate the most appropriate options for each system (see sub-section 8.3).

e) Farm structures

The provisions for support for investment in agricultural holdings provides an important link between the nutrient and water budgets, the identification of better environmental practice and the ability to take actions to achieve improvement. It specifically identifies as an objective to preserve and improve the natural environment, hygiene conditions and animal welfare standards. Accordingly, in sub-section 8.3 we have tried to identify for each of the systems where (and how) this measure could be effectively used to reduce any negative environmental impact of systems. In other cases (eg, P1 and CG3) where facilities are often out dated and below modern hygiene standards we have identified possibilities for structural support which could help to keep these dairy farms in business.

f) Training

As the main environmental issues associated with most dairy farms (high input/output types that dominate production systems) are largely negative ones, maximising benefits in the future will be heavily influenced by the effectiveness of measures taken to reduce these impacts. Part of this effectiveness will relate to how receptive farmers are to proposed changes. Even with the threat of the possible imposition of sanctions on direct payments (cross compliance) it is still not practical or realistic to perceive that environmental best practice can be imposed entirely by compulsion. A better appreciation of the issues is required and hence training and advice will have an important role to play.

Dairy farmers have traditionally been advised on how to maximise production. However, over the last 10 years there has been greater awareness about the environmental impact of agriculture amongst both agricultural extension advisors and farmers/farmers organisations. Although farmers' groups have now accepted that agriculture can have positive interactions with the environment there has been a much slower acceptance that agriculture is also a polluter. Consequently it is important not to underestimate the huge step that cross-compliance measures may introduce for farmers at a time when the economics of dairy farming are widely perceived to be very difficult.

Environmental lobby groups have pushed hard for adoption of the 'polluter pays principal (PPP)' into CAP supported sectors, but implementation of this is more complicated than at first appears. The PPP is of limited value unless the polluter recognises what is happening and knows how to address the problem.

Given this, it will be important to inform farmers about the benefits to them of more sustainable production systems. Farmers run businesses that only continue as long as they make a reasonable profit; so if they see economic benefits in using good environmental practice there is a better chance of farmers wanting to introduce/adopt them. In the longer-term, if no direct support existed there would be very limited opportunities for cross-compliance, therefore there is a requirement to increase awareness now if farmers are to become accustomed to operating cost-effective good environmental practices.

To contribute towards these goals, the report aims to indicate where the Rural Development Regulation could be used to provide training (and advice) which would enable dairy farmers to maximise the information they obtain on their nutrient balances. With a better understanding of the issues affecting their farm, they would be in a better position to choose the most appropriate elements of good environmental practice and environmental enhancement to adopt. Training could also be used to increase awareness of the possibilities for structural support and other options relating to marketing, diversification, organic conversion, etc. All of these would contribute towards the development of more sustainable management practices on dairy farms.

9.7. Concluding comments: potential for greater benefits in future from new (or better targeted) options

The Agenda 2000 measures offer some scope for improved integration of agricultural policy with the environment and rural development objectives[28]. It essentially continues and simplifies the role of agri-environmental schemes and offers national authorities the scope to introduce some degree of cross-

[28] But is regarded by some (eg, World Wildlife Fund (1999)) as not going far enough.

compliance. Unfortunately, the dairy sector will largely be affected by the Agenda 2000 reforms that become effective in 2000, only in an indirect way and even post 2005 the effect is likely to be limited.

Against this background, a summary of targeted, practical actions that are recommended for delivering environmental improvements in the dairy sector are as follows:

- introduce some element of cross-compliance via the introduction of the Farm Nutrient Balance (FNB) across all dairy farms together with requirements to do water budgets and waste management plans;
- use the nutrient balances as a starting point for targeting appropriate actions to move management practices towards what is considered to be good environmental practices. Using farm waste management plans some elements of better environmental practice can be introduced into dairy systems across Europe, especially the more intensive systems. Precedents in this area have already been set for example in Denmark. Specific requirements (cross compliance) for including as part of GAP are also suggested in Section 8 for reducing nutrient leakage from soils, ammonia emissions and pesticide use/emissions. Cost implications: these are extremely difficult to estimate as they will vary by farm. In the Netherlands the average cost per farm (in a region experiencing severe nitrate pollution problems) of complying with targets was estimated to be about 25,000 (equal to about 15-20% of income[29]) including the introduction of some capital changes such as increased manure storage capacity. This probably contributed to the limited imposition of mandatory controls to-date in the Netherlands where until 2002, only farms with stocking densities in excess of 2.5 LU/ha are subject to mandatory controls (ie, about half the national herd). In contrast, in Denmark, mandatory controls apply to all farms, although here average stocking densities are only about 0.9 LU/ha and the global nature of pollution problems are less intense (and hence less costly to address) than in the Netherlands. This highlights the importance of initiating FNBs before drawing up prescriptions for improving the environment and implementing parallel measures via, for example, the rural development and horizontal regulations (eg, provision of capital grants, subsidised finance/loans) to assist farmers in addressing the environmental problems rather than simply imposing controls and expecting the associated costs to be covered from existing economic activity;
- use the FNB to introduce greater flexibility in agri-environmental schemes and for providing flexibility to farmers in how they achieve better environmental practices (eg, timing and methods of application of manure, slurry and fertiliser). The cost implications here are also variable at the farm level (see above) and difficult to forecast. However, by providing flexibility it offers scope for delivering good value for money from an EU budget perspective if dairy farmers are encouraged to and can choose options that suit them (contributes to overcoming perceptions of compulsion and offers possible practical benefits);
- use agri-environment measures to target dairy systems of high biodiversity, especially those in danger of abandonment. The cost implications are also very difficult to assess. However, as high biodiversity dairy systems represent a very small minority of total EU dairy farms and are confined to fairly small bio-geographical regions, the cost implications are unlikely to be significant and can probably be reasonably easily incorporated within existing '2078' measures and budgets;
- support the above measures with specific training and use of advisory services to raise the level of awareness of the agriculture/environment interactions on dairy farms. Cost implications here are also difficult to assess. The provision of training and advisory services is an area in which a wide range of

[29] Source: Charter (1998) Farmers and custodians of water resources. Nuffield Farm Scholarship Trust, Maresfield.

levels of expenditure probably occur across different member states. In some, the public sector (ie, national or regional authorities) dominate provision and funding is from a central source whilst in some other countries, there is greater degree of private sector involvement and hence fee charging. Either way it is likely that the provision of additional environmental awareness training could be reasonably easily be incorporated within existing extension service provisions that are mainly funded centrally. More in depth analysis of the ways in which the Dutch and Danish system operates might usefully be undertaken;

- provide financial support to dairy farmers required to make one off/capital style investments to comply with requirements (eg, increased manure storage capacity). This is particularly important in the more remote regions (LFAs) where marginal producers are increasingly leaving the sector. The cost implications are similar to those discussed above relating to measures required to fufill FNB targets. Further examination of the Dutch system might usefully be undertaken;
- encourage the establishment of system-specific priorities to highlight where controls rather than enhancement type actions are more important. These could be undertaken at a regional or national level as part of the process of drawing up frameworks or plans for specific regions and associated rural development measures.

Appendix 1: Note about data

A significant volume of data used in this section to present dairy production by agri-environment zone is drawn from Eurostat's New Cronos database and is at the NUTS1 or NUTS2 level, depending on the Member State (the authors have attempted to provide a reasonable regional breakdown, therefore NUTS2 data has been used most of the time). However, in some cases data at the NUTS2 level was not available (for example, Austria), in other cases NUTS1 provided a sufficient picture of regional differences (for example, the UK)). Although NUTS3 level data is available for some key economic indicators, it is incomplete and does not cover the topics required here, ie, it does not cover agriculture but focuses on key economic data. In addition, for some Member States such as Denmark, Ireland and Luxembourg, the national boundary coincides with the NUTS1, and NUTS2 levels.

Although Eurostat recently updated their NUTS classification, data from the NUTS 1995 regions has been used in this report. This is because data from the NUTS 1998 classification is yet to be put in the public domain (NUTS 1998 made alterations to the internal boundaries in Finland, Sweden, the UK and Germany).

The Eurostat data is also inconsistent in many places. For example, there are several ways of calculating total dairy cow numbers for a given year, and these different ways often provide different totals. In some places therefore, tables presented in the sub-sections below have inconsistencies. These reflect the data inconsistencies and are not due to errors by the authors.

Statistical information from other sources is also used occasionally, and this does not always match the information calculated from Eurostat. Of particular note are average milk yields provided in Changes in Annual Milk Yield from Eurostat's Statistics in Focus series. Average milk yields in this publication are consistently higher than those calculated from Eurostat data from the New Cronos database. The lower, calculated data was used because of the need to consider parts of Member States.

The data are also sparse and in many cases certain years do not have data available. Throughout the sub-sections below we have tried to use data from 1985, 1990, 1995, 1996 and 1997 (other years are also sometimes used to provide more details in some tables), where we do not use these years it is because the data are not available. In these cases we have used the nearest available years and the most recent years. This point should be borne in mind when attempting comparisons between agri-environmental zones and/or Member States.

It should also be noted that the authors had hoped to calculate stocking density to show changes in intensity from this data source (Cronos). However, this was not possible. To calculate stocking density we would need to know the number of dairy cows and the number of hectares of land that they are associated with. There are two possible approaches:

1. Divide the total number of dairy cows in a region by the total hectares of dairy farms in that region. However, there is no way of knowing how many of the dairy farms are solely dairy and how many have other enterprises (either other livestock or cropping). Calculating stocking density in this manner would produce under estimates because we would not be counting other grazing livestock or arable production.

2. Divide the total number of dairy cows in a region by the total hectares of forage area on farms with a dairy enterprise in that region. Again, there is no way of knowing the number of other livestock on the dairy farms and under estimates would be produced.

Neither of these approaches would pose a problem in relative terms (ie, in order to compare stocking densities over time or across regions) if it was a reasonable assumption that the proportion of mixed farms and the proportion of other livestock on dairy farms is the same for each region. However, this is clearly not the case and other proxies of intensity (average herd size, average milk yield per cow) have been used instead.

In addition the authors had hoped to use this EU-wide data source to show changes in forage maize areas. However, forage maize is recorded within 'forage plants', a categorisation that is defined as 'temporary grass' and 'other' which means that it is not possible to attribute changes in the area of forage plants only. For example, is an increase in 'forage plants' an increase in maize and a smaller decrease in the area of temporary grass, or an increase in maize area and an increase in temporary grass? For this reason the area of forage maize is not examined.

Data on the breeds of dairy cows used in each Member State are generally not available. Several institutions have been contacted in each Member State, as have international organisations (the European Dairy Association, the International Committee for Animal Recording Breeds, the International Dairy Federation and the European Confederation for Black and White Breeds). All contacts have been followed up several times by telephone, fax and e-mail, but in most cases no recent information has been forthcoming. The National Dairy Council of the UK used to publish a handbook entitled 'EC Dairy Facts and Figures' which included a table of breeds used in each Member State. The most recent version of this publication dates from 1994 and contains information on breeds from 1973 (Italy) to 1993 (Luxembourg). The National Dairy Council informed the authors that the provision of this information was discontinued due to the unavailability of data. Although likely to be out of date, this information has been drawn on in the absence of anything more recent.

Appendix 2: Nitrogen content in animal manure

Table A2.1: The content of total nitrogen in animal manure

Animal category and animal housing system	Type of fertiliser	Content (ex storage) Kg total-N
1 annual cow (large stock)		
Box-housing, mechanical mucking	solid manure	50.6
	+ urine	55.3
Box-housing, slatted floor	slurry	116.6
Free-range housing, slatted floor	slurry	108.7
Free-range housing, deep litter + slats	deep litter	65.3
	+ slurry	55.3
1 annual calve		
Box + Box-housing	deep litter + solid manure	3.8
	+ urine	11.4
Box + slatted floor	deep litter	13.7
	+ slurry	3.8
Box + deep litter	deep litter	25.8
	+ slurry	3.8
		30.3
Cattle for fattening, 250kg slaughter weight		
Box + slats	deep litter	7.4
	+ slurry	6.3
Cattle for fattening 350kg slaughter weight		
Box + slats	deep litter	7.4
	+ slurry	23.2
Cattle for fattening 450kg slaughter weight		
Box + slats	deep litter	9.9
	+ slurry	26.4

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