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Farmland Features in the European Union

A Description and Pilot Inventory of their Distribution

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ABSTRACT

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This report contains a first inventory towards occurrence of farmland features in the farmland landscapes of Europe. As smaller and linear features can only be determined accurately from field survey, there are up to now few good datasets, nor is there insight in the changes that take place. The abundance data will be much less accurate and only indicative than those for areal land cover features. However, farmland features are crucial in the detecting change in agrobiodiversity, being important element of all biodiversity in Europe. The report gives the first European picture of the likely range of farmland features based on databases that were available to the authors as well as additional field work in several regions in Europe. Trend data are available in just a few datasets but these show that the only way to improve the accuracy is to collect further data or at least examine available data at the national and regional level.

Keywords: Farmland features, Habitat, National databases, Biodiversity, European Environmental Stratification

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Preface

This report has been made as part of a larger study lead by IEEP for DG Environment and DG Agriculture on the Environmental Benefits of unfarmed features in the landscape. The report can be accessed through IEEP (http://www.ieep.eu/publications/pdfs/2008/ieep_2008_unfarmeddg.pdf). Separate volumes have been produced on case studies in various countries. This report has been the basis of chapter 4 of the report to DG Environment (Farmer et al 2008). We would also like to acknowledge the advice Martin Farmer (IEEP), and Anna Barnett (DG Environment).

This project could never be accomplished without the willingness of many people in Europe to provide their data and without the regional experts to share their information and support the project. We thank therefore Ramón Elena Rosselló (UPM, Madrid, Spain), Thomas Wrbka and Martin Prinz (UNIVIE, Vienna, Austria), Anna Allard, Sture Sundquist (SLU-Umea, Sweden), Jesper Brandt (RUC, Denmark), Arjan Koomen (Alterra, The Netherlands).

The report shows clearly that data availability on farmland features in Europe is restricted. As biodiversity in the European landscapes is strongly based on the landscape features in agricultural landscapes this is an important omission especially because the changes for better or for worse are taking place here. Landscape monitoring programmes such as the Countryside Survey in Great Britain have shown that the small habitat fragments are susceptible to quantitative and qualitative change. This is confirmed by the data being collected in this project and in literature covering changes in landscape features. The results reported here are now the basis for further work to be carried out in the BIO BIO project that focuses on biodiversity indicators in organic farming and low input farming systems (http://www.biobio-indicator.org).

R.H.G. Jongman and R.G.H. Bunce
Wageningen 29-10-2009

Summary

Unfarmed features are not well monitored. They do not have the attention of policy as they are small and seem less important. Alterra has developed a typology for farmland feature suitable for use with available data as well as for field monitoring. This typology proposes eight main classes of farmed and unfarmed features. Among these classes two (class 5 and 6) fulfil the definition of a 'farmland feature on EU farmland'.

During the analysis of available datasets we have harmonised and refined the typology as far as possible given the structure, design and differing underlying methodologies of the various datasets. However, examining the entire landscape matrix is essential to obtain insight in the relative proportion of farmland features across the whole land surface. As national datasets do not make the difference between farmland and forest, it is important in this project to make that distinction. This distinction sets the baseline between (currently) farmed land and land out of farming such as land abandoned in the past and now under forest management. In the field visits it was important to decide which part of a square was under farming and which part was not.

The overall objective of the work carried out is to understand the distribution and abundance of farmland features and quantify trends and changes if possible based on existing data. The project has been based on available databases and a number of field visits covering different environmental zones in Europe.

For insight in the distribution of farmland features in Europe use has been made of a division in Environmental zones, rather than in biogeographical zones. The reason is that the environmental zones also include smaller differences between mountains and lowlands that are not included in the biogeographical zones. In countries such as Spain and Greece landscape and land use differences between mountains and lowland are crucial.

The first approach in this study has been to analyse existing datasets. Alterra identified data sets relevant to this study. These datasets stem from habitat surveys of varying levels of detail and geographic resolution. The data is based on in-field habitat surveys of randomly selected 'squares' (normally 1km x 1km). This means that the data have a certain statistical rigidness that allows generalisations and general conclusions.

The reasons for using field visits are that these can be a check on the data in the available databases as the databases are not all meant for farmland feature inventories and that more details might be seen in the kind of features in European farmland. Field checks have been carried out in Great Britain, Northern Ireland, The Netherlands, France, Spain and Sweden. Following discussions in the field only regularly grazed areas were included in the farmed category.

It appears that abandonment is locally important in the mountains, the Mediterranean as well as in Sweden, but in Britain and the Netherlands it is very rare or even absent. Much land at high altitude has no farming at all. The most diverse range of features is found in Alpine South and Lusitanian, because of the wide range of altitudes, topographic conditions as well as contrasting agricultural patterns. Linear and point features are the dominant type of unfarmed features. They make up the largest part of the farmland landscapes and in this way determine the landscape character. The structure of linear elements can be specific for an Environmental Zones, partly it can be general. Hedgerows and tree lines can be found in all zones. The species composition and its management can be different for different parts of Europe. However, further analysis is required to determine this.

Walls do occur in all mountainous regions of Europe, from Ireland to Greece and from Spain to Sweden. They are absent in alluvial areas such as the Netherlands. On the other hand, terraces are specific for Mediterranean Mountain and Mediterranean North.

Point features can have the same characteristics as linear features. Pollarded trees have been seen everywhere, but there are specific ways for pollarding and there are also different tree species used. All mountains or former mountains have occasionally rocks and boulders that are also absent in alluvial areas. Also some features are rare in the Mediterranean such as ponds and water troughs; they have not been recorded in the limited number of squares covered and are more widespread in other zones. Linear and point elements are also important reservoirs for biodiversity. This report shows the quantities of such features are partly in decline, partly recovering. Experience suggests that in countries such as Romania and Slovakia the resource remains high. An important feature in the agricultural boundaries in the Nemoral Zone was the margin with the forest.

The inventory of farmland features has shown that there is a wealth of landscape diversity and cultural values present in the landscapes of Europe that have not yet been well explored. As these landscape elements, especially the small linear and point features are making the richness of the European landscape; it is worth to know their extent, trends and threats. Only fragmented knowledge is available on stock and change of these elements. Future touristic developments, outdoor recreation and the economy of the rural areas might be dependent on the attractiveness of these landscapes.

National inventory programmes are available for some countries. A European overview based on a sample collected in a comparable way as in Sweden, Austria or Great Britain would help to clarify this. Most projects analysed here have used the same basic approach. The work done in the Netherlands on the comparison of farmland features in three European regions also could help to develop additional methods for management and land dynamics.

1 Introduction

National and regional datasets on landscape features can be used to analyse the stock and change of farmland features. However, these landscape datasets are not categorised according to farmland features, farmed features or unfarmed features. The available national level datasets are used to obtain information on the extent and distribution of unfarmed features within the major Member States of the European Union. Data of farmland features are extracted from national projects and datasets. National projects have been carried out for governments to analyse stock and change in the country for policy purposes. These projects have been carried out in Great Britain, Sweden and Spain. There are more dataset that explain stock and change in a country but do not have a national policy objective. These have been carried out in the Netherlands and in Austria. The comparability between country datasets is not very good as an interpretation has of the meaning of the different features has to be done, because not all features have the same definition. Especially lengths of linear features and point features (unfarmed) are restrictedly available as there is a restriction in what is recorded and what is not. Presence of solitary trees and small patches of natural grasslands are not always collected.

Alterra has developed a typology suitable for use with the available data. This typology proposes eight main classes of farmed and unfarmed features. Among these classes two (class 5 and 6) fulfil the definition of a 'farmland feature on EU farmland', as defined for this study, as follows:

- Linear or point features on, or adjacent to, farmland that are managed directly e.g. hedges on farmland or terrace walls in managed vineyards.
- Linear or point features on, or adjacent to, farmland that are indirectly influenced by agriculture but are not managed actively e.g. field corners and small woodlands surrounded by agricultural land.

During the analysis of the datasets we have harmonised and refined the typology as far as possible given the structure, design and differing underlying methodologies of the various datasets. However, examining the entire landscape matrix is essential to obtain insight in the relative proportion of farmland features across the whole land surface. As national datasets do not make the difference between farmland and forest, it is important in this project to make that distinction. This distinction sets the baseline between (currently) farmed land and land out of farming such as land abandoned in the past and now under forest management. In the field visits it was important to decide which part of a square was under farming and which part was not.

National databases allow estimates to be made of the abundances of features by environmental zone within the different Member States. However, not all databases allow this analysis yet. There will be differences between zones depending upon the sample number either in the original sample or in the subset examined for a certain environmental zone in the present project. Large semi-natural features such as

forests can be accurately determined because they are available on the CORINE Land Cover map, although also in the CORINE land cover map different member states use different interpretations. However, for this project these larger features have been excluded as they are considered to be situated outside of farmed land (Class 8).

As smaller and linear features can only be determined accurately from field survey, their abundance data will be much less accurate and only indicative. The report however at least gives the first European picture of the likely range of farmland features. It should be stated that the only way to improve the accuracy is to collect further data or at least examine available data at the national and regional level. Most of these data will be field data, but there is a potential for colour and infrared (IR) photographs as used systematically in SISPARES, Steekproef Landschap and in NILS. The use of satellite images for farmland features has to be explored further as this requires costly high resolution scanners.

It is also important to note that landscape monitoring programmes such as the Countryside Survey in Great Britain have shown that the small habitat fragments are susceptible to quantitative and qualitative change. This is confirmed by the data being collected in this project and in international projects such as the landscape change project covering the Netherlands, Denmark and Great Britain (Chapter 4). This is also emphasised by literature (e.g. Jongman, 2002) and previous field visits to Romania and Slovakia where many small patches still remain in the less intensively managed landscapes. However, statistical data for these observations are lacking at present.

2 Methodology

2.1 Rationale

The overall objective of the work carried out is to understand the distribution and abundance of farmland features and quantify trends and changes if possible based on existing data. The project has been based on available databases and a number of field visits covering different environmental zones in Europe.

For insight in the distribution of farmland features in Europe use has been made of a division in Environmental zones, rather than in biogeographical zones. The reason is that the environmental zones also include smaller differences between mountains and lowlands that are not included in the biogeographical zones. In countries such as Spain and Greece landscape and land use differences between mountains and lowland are crucial.

The first approach in this study has been to analyse existing datasets. Alterra identified data sets relevant to this study. These datasets stem from habitat surveys of varying levels of detail and geographic resolution. The data is based on in-field habitat surveys of randomly selected 'squares' (normally 1km x 1km). This means that the data have a certain statistical rigidness that allows generalisations and general conclusions.

The reasons for using field visits are these can be a check on the data in the available databases as the databases are not all meant for farmland feature inventories and that more details might be seen in the kind of features in European farmland.

Before going into the field in Spain discussions were held regarding the SISPARES project, which has followed the changes in habitats in Spain from 1956 to 1984 and 1998 using interpretation of air photos. The mapping was made according to the structure and composition of the vegetation and the separation of different types of grassland are not possible. Whilst some information is available on linear features the results are robust in the separation of farmed and unfarmed land and summary tables are included in the document giving figures for the ten habitats covered. Air photos of examples of the sites were first examined before field visits were made. Different landscapes have contrasting potential for identifying the unfarmed features. For example individual trees were well defining but grass strips between fields were not.

The visit to Sweden showed the major advantage of infra-red photographs and that even with stereo pairs black and white photos are limited but are excellent for determining the major categories. Whilst it was not possible to determine local grazing patterns evidence of grazing could be derived from tracks of animals especially leading to water troughs. Many Spanish forests are grazed and there are problems of separating those areas that have occasionally animals present as opposed to those that are regularly grazed. The height of ground vegetation is the most

reliable indicator together with grazed leaf tips. Following discussions in the field only regularly grazed areas were included in the farmed category.

2.2 Farming Landscapes and farmland features

Land is defined as the physical environment including the results of past and present human activity influencing the potential for land use. Purely economic and social characteristics, however, are not included in the concept of land. Land and landscape both can be expressed by the same definition as something formed by mutual working of living and non-living nature and culture (Zonneveld, 1995). Land use is defined as human activities on the land, which are directly related to the land (van Gils et al; 1991) Land cover describes the vegetation and artificial constructions covering the land surface (Anderson et al, 1976). Land cover is not only related to how the land is used but also related to the physical characteristics of the area. Land use and therefore land cover can change over time, both within seasons and over the years.

Human land use has created landscapes that are characteristic for natural circumstances as well as for cultural and economic differences (Jongman 1995). Landscapes are characterised by abiotic or physical factors, such as biogeographic zone, location, topography, soil, biotic features such as vegetation and fauna and human factors such as history of land use (Figure 1). Together these factors define the present landscapes. Many landscapes in Europe can be characterised as cultural landscapes since they reflect human activities in a scale of time.

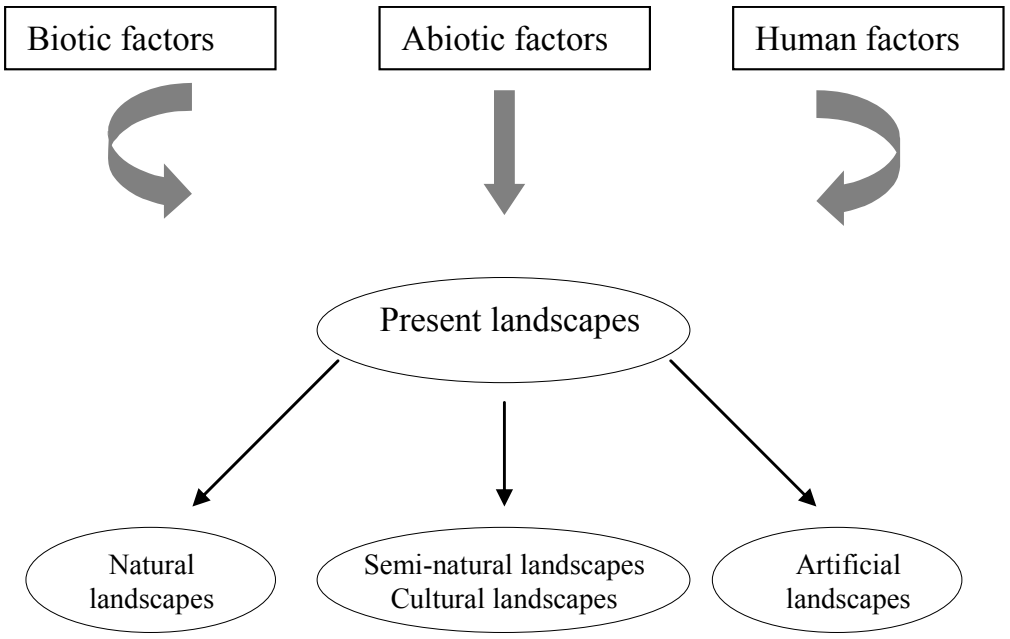

Figure 1: Landscape typology and its originating driving forces.

Box 1: Categories of landscape elements classified on their structural characteristics

I. Woody elements

a. Woods/woodlots: Woods are elements characterised by the presence of plants from wood communities, woody species and a non linear appearance. Elements consist out of a tree layer, scrub layer and an herb layer. Fringe vegetation will be present on the transition to agricultural land, ditch or road.

b. Hedgerows: Hedgerows are linear elements that consist out of several rows of trees with a good developed scrub layer. The herb vegetation is associated to wood communities. Fringe vegetation with ruderals is present and the whole has a more or less closed appearance.

c. Tree rows: Tree rows consist of one row of trees. with often an undergrowth of herbs and grasses. A scrub layer is absent. The trees are on a fixed space from each other. The row can have an open to a more closed linear appearance.

d. Alleys: roads with double rows of trees. with often an undergrowth of herbs and grasses. A scrub layer is absent. The trees are on a fixed space from each other.

e. Hedges: Hedges are linear elements that consist of mainly wood and scrub species not higher than 2 meters with an obvious unnatural maximum height. Management, mainly cutting, mowing or flailing is clearly present to keep the hedge it's characteristically shape. Next to woody species there can be herbs and grasses. Species in a hedge are mostly densely placed together which gives a closed appearance.

f. Solitary trees stand alone or in a cluster up to three specimens.

II. Grassy elements

a. Verge: A verge is a linear element characterised by a grassy appearance with herbs. A tree row is not present but incidental trees may be there. The verge is situated next to a road.

b. Grass strip: A grass strip is a linear element characterised by a grassy appearance with herbs. A tree row is not present but incidental trees may be there. A grass strip is mainly used as a boundary between parcels.

c. Stone wall: A stone wall is a linear element used as a parcel boundary and characterised by stones often covered with grasses and herbs and sometimes with scrub and woody species.

d. Rough grassland: Rough grassland is characterised by a rough grassy vegetation with a certain amount of ruderal and other herbs. Sometimes small scrubs are present. The grassland is extensively grassed which is characterised by species composition and often fencing.

e. Abandoned grassland: Abandoned grassland is grassland that is not used any more but still has got a grassy appearance and can be recognised as former grassland by derelict fencing or left fencing poles. Woody species start to appear in the element.

f. Heathland: A Heathland is characterised by a dominance of ericaceous scrub vegetation with heather (Erica, Calluna), grasses like Molinea caerulea and Descampsia flexuosa and/or sedges and sometimes Ulex species. Vegetation is characteristic on poor acid soils. A heathland is mostly grazed.

g. Bog: A bog is characterised by a low, water logged, vegetation with mainly herbs characteristic for nutrient low communities and bog mosses. Vegetation is characteristic on acid mineral deficient soils.

III. Wet elements

a. Water courses/Ditches: Water courses are linear elements characterised by a strip of grasses and herbs alongside a waterbody. The watercourse has got a water guiding function during (a part of) the year and can also be used as parcel boundary and drinking place for livestock. Incidental trees can be present at the sides.

b. Ponds: Ponds are patches of water with grasses and herbs alongside the borders. Trees can be present at the sides. Ponds are often used as drinking place for livestock.

c. Quacking mire / Fens: Quacking mire or fens are characterised by a wet herb, sedge and rushes vegetation. Grasses are much less in evidence. Vegetation is mainly developed in depressions above a water layer. If the water table is above the peat layer reeds swamp communities become characteristic.

IV Artificial elements

a. Stone wall: stone walls are made by man as a permanent partition between fields they often are found in combination with grassy strips

b. Cairns, stone heaps: stone heaps or cairns can have a religious or cultural meaning, but they also can be just heaps where the farmer collected his remnant stones when there was no need or tradition for building stone

Landscapes can be classified (Figure 1) from totally natural landscapes without any human intervention, to totally human-impacted landscapes known as artificial landscapes such as the urban landscapes (Forman and Godron, 1986). In between there are semi-natural or cultural landscapes which are defined by a certain level of human influence. The differences in the types of landscapes are defined by the intensity of the human influence in space and time. Boundaries between different types of landscapes are difficult to recognise and are dependent on regional, physical and cultural circumstances.

Cultural landscapes are recognisable by the history that is still present in the patterns and processes. They are composed by a mosaic of patches (Urban et al, 1987), a pattern of components (Zonneveld, 1995) and landscape elements. Landscape elements can be divided by form characteristics or structure characteristics. In most cases landscape elements are divided by form characteristics and classified into linear elements and patch elements. In this research a division by structural characteristics is used. Landscape elements can be divided into (I) woody features, (II) grassy features and (III) wet features and artificial features. These three groups of landscape elements are defined by structural characteristics (box 1).

An agricultural landscape is characterised by a dominance of agricultural land use and management with a strong human influence, introduced elements and remnants of the original natural landscape. The presence of historic elements and the presence of man made features in general determine the character of cultural and the artificial landscapes (Figure 2). For instance, a region with a dominance of glasshouses may be classified as an artificial landscape, whereas areas with a dominance of terraces or stone walls may be classified as a cultural or semi-natural landscape. The artificial landscape will be poor in small semi-natural landscape features.

An agricultural landscape is composed by a mosaic of landscape elements or patches. Of these patches, the matrix is the most extensive and most connected landscape element type and therefore plays an important role in the function of the landscape. In general a matrix is defined by the most common element in the landscape. In an agricultural landscape the matrix is formed by the land in agricultural use, the small patches, linear and point features can be of all other type of landscape elements (Box 1, Table 1).

Most farmland features are linear or point elements as will become clear from this study. However, some elements can be of such a size that there could be defined as areal elements. Different countries in Europe have different approaches towards this. In this report we have defined a common approach for international comparison.

Table 1. Types of landscape elements (Forman 1995)

Element	*Type*
Matrix	*Background ecosystem or land use type: agricultural land, forest*
Patch	*Relatively homogeneous non-linear area different from the matrix: Wood, lake, marsh, bog, moorland, heathland*
Linear	*Feature with dominant linear structure: Road, fence, dyke, stonewall, verge, line of trees, wooded bank, hedgerow, hedge, river, ditch*
Point	*Structure below a mappable area for patch or linear feature: Solitary tree, pond*

Categories landscape elements used in this research are combinations of different elements: a verge with a hedgerow, a verge with a tree row, a verge with a hedge, a verge with a stone wall, a verge with a ditch, a grass strip with a tree row, a ditch with a hedgerow, a ditch with a tree row, a ditch with a hedge, a ditch with a stone wall. The basic classification is based on management.

Landscape elements do not exist just for scenery but have, often historically, a function within the agricultural production system. Many landscape elements are integrated parts of agricultural land use and thus have an agricultural function such as (1) hedgerows that act as cattle fence, as wind shelter, as a border, against erosion and supply of fodder and fuel and farm wood, (2) ditches used as cattle fence, for irrigation or drainage, (3) terraces to prevent erosion, (4) woodlots to supply fodder and fuel and farm wood, (5) bogs to supply fodder and fuel and so on. Landscape elements in an agricultural landscape can be influenced by agricultural practices or require separate management. Depending on the agricultural function of the landscape element there are different ways of management, among others: pollarding, cutting or sawing, burning, grazing, mowing, flailing or dredging. Next to maintenance of the agricultural function purpose of the management can also be to prevent dispersion of species from the surrounding elements into the agricultural land. Together with the agricultural function and physical conditions these different ways of management define the type, structure, configuration or size of the landscape element and composition and abundance of species present in the element together constituting the landscape.

Names of farmland features can differ throughout Europe. Often regional names are used having a meaning within the country involved or have different connotations elsewhere. For example, in northern Portugal the common heathlands are called baldios and they are used for extensive grazing. From the settlements, tracks to the baldios are made in irregular shaped granite stones, a form of calçada Portuguesa. These paths made for the movements of people and animals through and from the fields (Figure 2).

Figure 2. Field path with calçada Portuguesa (Minho, Northern Portugal) as the path between fields to the grazing land with the gate closed (left) and the gate open (right).

In the analysis and the field visits elements which may have been formerly on farmland but which are now in units which have been long abandoned e.g. walls, and terraces in scrub, have been excluded as far as possible, as have other habitats on unfarmed land e.g. streams in forests and grass rides in woodlands. In the field visits fences and telegraph poles have not been included if they do not have different vegetation beside them. The presence of agricultural land and non-agricultural land is important to know as this determines if landscape features are unfarmed or outside farmland. Class 1 and 3 are farmed (intensively or extensively); the classes 5 and 6 are unfarmed features on agricultural land and are the focus of this study (Figure 3). Class 2, 4, 7 and 8 are not within farmed land. Abandoned land is considered to be Class 8 (Figure 3). All features within Class 8 are excluded from the analysis in this study (Table 2).

A typology of unfarmed features has been developed for the project using previous experience and preliminary field visits to the Picos de Europa, north-west Spain and the southern Lake District UK (Table 2). Experience with classifying almost 200 vegetation plots from the GB Countryside Survey showed that the categories are reasonably robust. In some cases the separation of categories 5 and 6 was arbitrary. The patterns of such categories in the landscape may vary over distances of a few metres in some regions but hundreds of metres elsewhere. Small fragments are often below the scale of units mapped in habitat surveys and will be categorised here as point features. Class 2, 7 and 8 are unfarmed and outside the farmland. Classes 5 and 6 are unambiguously unfarmed within farmland, while Class 4 is differently between countries. Class 1 and 3 are farmed land.

Grazed grassland with linear features (Table 2: Class 1 and Class 6)

Abandoned grasslands with fern (*Pteridium aquilinum*) and some remnant solitary trees (Table 2: Class 8)

Figure 3. Mountain grasslands in the Picos de Europa in different stages of use

Fields that are no longer part of the farm system, but in the process of colonization by scrub because of difficult accessibility do occur through all Europe. Such polarization of farm systems means that formerly diverse patches of grassland are becoming dominated by a few competitive species and subsequently by a limited number of scrub species. For example chalk downlands in southern England, steep banks in northern France and vias pecuarias (cañadas) in Spain are now isolated and

are colonized by two or three grass species and then by hawthorn or cistus. These features, when clearly out of farming are not considered as farmed features (Table 2).

Table 2. Classes for defining farmland features as farmed and unfarmed land. Classes 1, 3, 5 and 6 are unequivocally part of farmed land; class 4 has different interpretations in member states e.g. it is included in GB but excluded in Greece; class 2, 7 and 8 are unfarmed.

Class 1. Land categories managed only for agricultural objectives. Such fields are usually intensively used but may also involve extensive systems. Usually there is a division between cultivated land whether for herbaceous or woody crops e.g. vineyards and those used by stock, including horses for meat. The fields of part time farmers managed for produce fall in this category. Horticulture, tree nurseries, commercial orchards, perennial crops, vineyards and olive groves. It also includes dehesas, montados and wood pastures.
Class 2. Fields managed regularly for non-agricultural objectives, usually horses or donkeys for recreational purposes. Fields and mesotrophic grasslands managed often by domestic animals for nature conservation and landscape objectives would also fall into this category. Hobby farming fields fall in this category
Class 3. Open land used regularly by stock, usually sheep and goats but also cattle and horses for meat. This category has a wide range of intensity of use and varies in character both regionally and locally. It also includes many upland grasslands and heathlands.
Class 4. Open land rarely or not used by sheep or goats but not in regular agricultural use and minimally affected by grazing e.g. gorse heaths in the Picos de Europa and some blanket bogs and mountain summits in Britain.
Class 5. Linear or point features on, or adjacent to, farmland that are managed directly e.g. hedges on farmland in the Great Britain or the Netherlands, terrace and dry stone walls in managed vineyards, individual olive trees, cork oak trees and pruned evergreen oak, candelabra ash trees (Cantabria mountains) rascasse (oak trees pruned for firewood in Brittany) or willow pollards in lowland areas are included in this category. Also solitary Castanea, Hazelnut and Walnut trees come in this category as do lines of fruit trees.
Class 6. Linear or point features on, or adjacent to, farmland that are indirectly influenced by current agriculture but are not managed actively e.g. field corners and small woodlands surrounded by agricultural land, trees in hedgerows, isolated trees in arable fields and grasslands, ponds and forest patches under 400m^2, banks between fields and streams running through farmland, ruined walls come within this category,
Class 7. Land not used by agriculture (usually urban herbaceous using the BioHab definition) and managed usually by mowing, e.g. roadside verges, recreation areas and sport fields.
Class 8. Land not used by agriculture but maybe managed for forestry, nature conservation water or urban objectives: (a) Abandoned fields and unenclosed land no longer used by agriculture. Long term set-a-side could be included here. This category would also include habitats under nature conservation management e.g. wetlands, some salt marshes and heathlands. (b) Land which has never been used by agriculture or managed e.g. steep roadside banks, cliffs and scree. (c) Forests. These could be divided into three categories if a relationship was required with intensity of management (i) Forests managed regularly often for nature conservation objectives using active management e.g. coppice woods for vernal flowers and for firewood (ii) Commercial forests of planted species e.g. Sitka spruce in the GREAT BRITAIN and Norway spruce in northern and central Europe. Small recent amenity plantations are not included here as they are still indirectly affected by agricultural practices (iii) Forests that have not been managed in recent times, say about 50 years, but usually between 100 and 150 years. (d) Urban land within the definition provided by the BioHab project (e) Steep river banks and unmanaged steep roadsides

Low heathlands in Great Britain are mostly grazed, but low brambles are a sign of abandonment. In the Boreal and Nemoral zone abandonment is indicated by scattered young spruce trees in the grasslands. In the Mediterranean low scrub is grazed (garigue) while tall scrub (maquis, mattoral) is mostly not in agricultural use.

Gradients of abandonment were seen in several squares in Sweden covering various proportions of the sites. It is quite likely that the degree of abandonment is linked to soil types maybe in the following sequence:

- Rocky un-ploughable soils: over 50 years
- Poor soils, either wet or low fertility-currently being left
- Fertile soils-still in cultivation

If agricultural prices continue to rise, the poor soils could come back into cultivation but not the rocky ones.

2.3 The European Environmental Stratification as basis for Comparison

When travelling from southern Spain to northern Sweden the landscape changes from an open nearly semi-desert through intensive large corn field into small scale mountain landscapes, back to large arable fields, extensive grasslands with dairy farming and in the north into bogs and extensive Boreal heathlands. The Environmental gradient in Europe is not only characterised by natural vegetation, but also by different forms of farming (Figure 4). Mountain areas in the Mediterranean are characterised by terraces, while they are in the north part of Europe rough grazing land. Lowland areas vary from open marginal arable, to intensive pastures and extensive grazing land. Therefore it is needed to make a distinction between the different European environments when exploring the distribution of landscape features in general and farmland features especially.

Farmland near Almeria (Spain) with solitary olive trees and a water collecting system in the hills

Hedgerow and stonewalls in the Lake district

Grassland in northern Estonia on the edge of abandonment. The trees in the grassland are young spruce

Figure 4 European farmland examples

The official biogeographical zones of Europe as decided upon by the European Commission are a proper tool to divide countries in groups on their main

environmental characteristics, but it is not sufficient to divide the European landscapes into more or less comparable units. Mountains do occur in Spain, Austria, Germany and Scandinavia. They have comparable features as they all have mountain farming, but they also have differences due to the differences in climate. These differences have to be covered in the inventories. Terraces do occur in Mediterranean mountains, but not in Scandinavia. However, hedges and stonewalls do occur in all Europe, from Greece to Ireland, but with a preference for pasture landscapes. Some landscapes, such as the semi-desert of Almeria and the Mani in Greece have very specific features (Figure 4).

The Environmental Stratification of Europe (Metzger et al 2005) is covering the environmental variation in the European continent the best. It has proven its value in several European studies. For the different databases that are being used in this study national stratifications have been made. Most of these can be transformed into the European stratification without big problems. Therefore this stratification has been used as a unifying approach for a European overview.

The Environmental Stratification of Europe (Figure 5) has been constructed using tried and tested statistical procedures to link European Environments as well as field data. It shows significant correlations with principal European ecological data sets. As shown in comparative studies, such stratification can be used for strategic random sampling for resource assessment and for measurement of change (Metzger et al 2005, Jongman et al 2006). The hierarchy of the Environmental Stratification (EnS) allows regional applications to be aggregated into continent-wide assessments, thus facilitating the growing demand for coherent European ecological data to assist EU policy and global state of the environment assessments such as the EU State of the Environment Report and the Millennium Ecosystem Assessment. The EnS does not replace existing classifications, but has proven to provide a framework for integration between them and subsequent estimates of habitat and vegetation when field data become available.

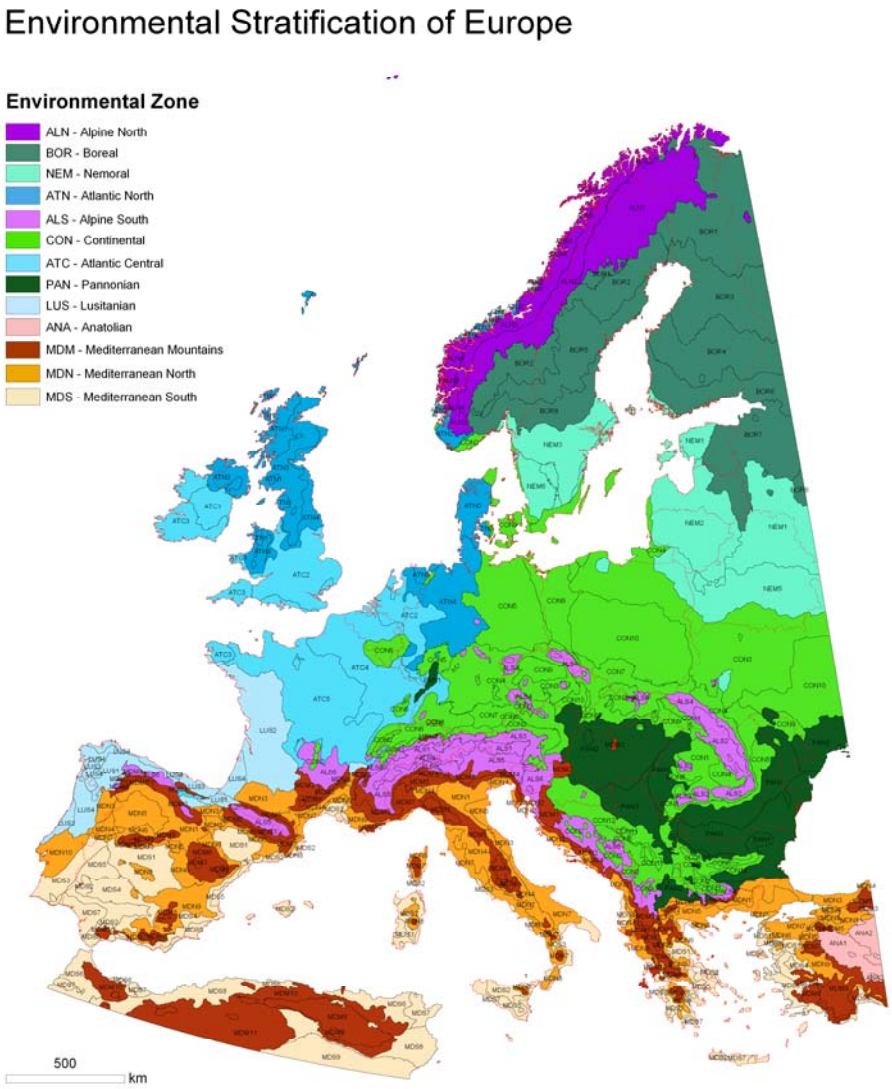

Figure 5. The Environmental Stratification of Europe in 13 zones and 84 strata. Where the size of the stratum permits, the individual strata are labelled within the main Environmental Zones. The stratification extends from 11° W to 32° E and from 34° N to 72° N. It is projected in a Lambert Azimuthal equal area projection. Certain strata do not necessarily fit traditional experience as in this stratification strict statistical rules have been maintained, leading to these apparent inconsistencies, e.g. Pannonian zone in the in Germany as a dry rain shadow area (Metzger et al 2005).

The Environmental strata provide a convenient set for monitoring and assessing change for a continent as diverse as Europe and are appropriate for stratified sampling and analysis of environmental data. However, there are too many strata for summary reporting and presentation of the principal characteristics of Europe. An aggregation of the strata into a limited number of Environmental Zones (EnZs) was created to facilitate communication based on the experience of a similar situation in Great Britain, where 32 land classes were reduced to six zones for reporting purposes. The main environmental regions mentioned above (Alpine, Boreal,

Continental, Atlantic, Mediterranean and Anatolian) were subdivided on the basis of the mean first principal component score of the strata in the regions. All Mediterranean strata with altitudes above 1000 m were assigned to Mediterranean Mountains.

The Environmental Zones have been used as a guideline for analysing and comparing farmland features in Europe in stock and change.

2.4 Database analysis

Alterra identified data sets relevant to this study. These datasets stem from habitat surveys of varying levels of detail and geographic resolution (Table 3). The data is based on in-field habitat surveys of randomly selected 'squares' (normally 1km x 1km). Much of the necessary detail that is required to determine farmland features is not available from the existing data, for a number of reasons. First, these surveys were not designed to collect this information. Second, much of the management information, which may be necessary to maintain a feature, can only be obtained through field visits. Third, many farmland features are below the resolution thresholds of most studies, especially those using aerial photography. However, the survey results can be manipulated in such a way as to be useful for the present study.

The datasets that have been used are selected from the potential databases that have preliminary been scanned on its usefulness to ensure coverage of representative areas in Europe (Table 1). The finally selected databases are:

- NILS (Sweden) - to cover Alpine North, Boreal and Nemoral.
- SINUS (Austria) - to cover Alpine South, Continental and Pannonian.
- SISPARES (Spain) – to cover Mediterranean North, Mediterranean South, Mediterranean Mountains and Alpine South
- Steekproef Landschap, Dutch Landscapes Survey (Netherlands) – to cover Atlantic Central.
- Countryside Survey (Great Britain) - to cover Atlantic North and Atlantic Central.

The selection of the databases used has been partly their coverage (selective or random data) and partly on their practical availability. For instance, the Small Biotopes Survey (Denmark) was assessed for its coverage of the Atlantic Central/Continental environmental zone. However, the version of this dataset available for the project was corrupt and could not be used for this study. The database available from the Picos de Europa was based on short student projects that were not based on representativeness. A number of sites in the Picos de Europa has been revisited in 2008 and included in the overview of recent field data, although it was not possible to perform detailed analysis as the data work did not offer complete and consistent coverage.

Table 3. Databases identified as potentially useful for the analysis of farmland features.

Existing data source	**Description data base (Coverage, contents)**	**Dataholder expert/institute**
Countryside Survey (CSS-GB)	UK; the database has been checked, but it needs to be approached with care as there does not seem real consistency.	CEH-UK
CAREN (Rennes)	Pleine Fougère, Britanny; they have worked on land use changes period 1966-1995	CAREN, Rennes, France www.caren.univ-rennes1.fr/pleine-fougere
NILS database	A countrywide inventory of Sweden;	SLU-Umea, Sweden
Small biotope inventory, KVL study	Denmark, See Landscape and Urban planning 2002 (32*4 km2)	NERI/RUC Denmark
Picos de Europa inventory (CSS methodology)	Picos de Europa; data available, through diverse groups of students	Alterra, the Netherlands
SINUS, COSINUS	Stratified random sample in Austria; data are available through the data owner.	University of Vienna/ Umweltbundesamt, Austria
Alterra project database linked with KVL	Various sites in northern European Atlantic landscapes 5*1km² in three moments of time in Søndr Omme (DK), Groningen (NL) and Lake District (GB). Detailed geographical information, vegetation squares and management information (1999-2001).	Alterra the Netherlands; and KVL Denmark
SISPARES	Monitoring Project of forest and land cover change in Spain based on stratified random sample of 215 squares of 4*4 km².	UPM Madrid, INIA, Spain
Steekproef Landschap	Monitoring project on changes in a number of landscape features in the Netherlands based on a stratified random sample of 72 squares.	Alterra, the Netherlands

The experts responsible for each database have been consulted in order to relate the available data to the present study, allocating the identified features to the typology developed. Given that small habitat fragments are often below the mappable scale of general habitat surveys, the experts involved were consulted in order to identify those features that are likely to be present in the different environmental zones.

Land use categories and farmland features had to be analysed and defined according their use in farming. This is not difficult for an arable field, but in many parts of Europe there are gradual categories that require clear decisions.

In SISPARES a strict definition of dehesa is used including only regularly spaced Quercus ilex and Q. suber but in the literature open forests of other species are also included in this term. In the present project however all regularly grazed forests are included under Class 1 (farmed, see Table 3) as they are integral to the management of the farm enterprise and cover the same conditions regardless of the biogeographic

region involved. Thus grazed forests in the Picos de Europa, the English Lake District and Sweden are all grouped under this heading.

2.5 Field inventory

The Environmental Stratification has been used as a guideline for setting up the field inventory of unfarmed features. It has been recognised, that full mapping of landscape features from stereo or IR photographs as in the NILS project would take about two days for each 1 km square or less if a simple area is involved but even then field visits would be required to ensure complete coverage of small units. Direct field mapping is in this stage efficient as lists of relative abundance can be drawn up for about three km squares a day providing they are not too far apart and no long procedures are required to acquire photographs from different national agencies. Any future extension of this kind of work, however, would need to consider combinations of air photo interpretation (including the most recent Google Earth images when available of consistent high quality such as large parts of Spain and field visits.

In the field inventory names of the categories used are based on the General Habitat Categories as described by Bunce et al (2005) with the aggregations described below. All General Habitat Categories can be patch (areal), linear or point shaped. Standard categories have been used to make comparison possible between different environmental zones in Europe. It has been recognised, that features can have different structure and management. This has been included in the different classes (see Table 2). Land categories used in the field survey can be:

- Urban: all urban categories have been included under this heading; including land associated with buildings, playing fields, golf courses, roads hard core tracks and other features not used by agriculture.
- Crops: bare ground, ploughed land, fallow and herbaceous crops.
- Woody crops : orchards, vineyards and olive groves and fruit trees
- Sea and tidal
- Aquatic: Lakes, ponds, rivers streams and ditches with standing water: aquatic
- Terrestrial sparsely vegetated: dry river beds, boulders, inland and sea cliffs:
- Wetland; marshland plants
- Annuals: annual herbaceous plants
- Grassland: includes all other herbaceous categories
- Dwarf scrub: below 30 cm
- Low scrub: 30-60cm
- Mid scrub: 60cm-2 m
- Tall scrub: 2-5m
- Forest and trees: over 5m

The differences in the density and height of scrub are important fore the determination of abandonment and the time that have passed since abandonment. In some parts of farmland in Europe (low) scrub is part of the farming system, in other parts it is a sign of abandonment.

The first field visit highlighted the difficulty of drawing the boundary between land and linear features. It was concluded that only land within the farm context or farming system should be included. For example a road would be urban and the verge next to the road whilst it might be affected by farming would not be in the farm unit. The strip of grass which is often present between the verge and the field would however be considered to be a farmland feature as the famer could plough or cultivate it if he wished. The initial list of farmland categories has been elaborated during the field work and harmonised into a common master list that is discussed in chapter 5.

Squares have been selected at random in the different zones that could be visited. These were Nemoral, Atlantic North, Atlantic Central, Lusitanean, Alpine South, Mediterranean Mountains, Mediterranean North and Mediterranean South. For practical reasons all squares are situated in the western part of Europe as they had to be combined with other ongoing projects. No squares have been selected for reasons of convenience or special elements.

In Spain sites were either drawn from SISPARES database or were random sites from other studies such as the Picos de Europa studies. Use has been made of the regular visits to the Picos de Europa with students from the University of Cumbria. It was originally intended to extract results from the various projects which have been carried out over the yeas but in practice this proved to be too time consuming because of the different scales and sampling intensity of the work. However, figures by Bunce et al (1998) give an overview of the composition of the region. About 33% of the region is high mountain with virtually no agriculture; 31% is scrub and grazed grasslands of which under a quarter being farmed; 36% is a mixture of forest and meadows of which almost half is managed grasslands.

In the Picos de Europa three squares were drawn at random from the local environmental stratification and field visits were made to these squares. These squares were in the valley in the lowest category of the Alpine South stratum and are typically mountain grassland areas. The high level land over 1800m i.e. 33% is not used by agriculture or have been abandoned (Figure 5). The upper slopes are dominated by scrub and heathland although some grazed pastures and meadows are present. However they mainly contain mountain features such as scree, cliffs and low scrub and fall within open land without boundaries.

For the Lusitanean Zone time was not available to visit random samples. Instead arbitrary visits to sites were made whilst driving from France to Spain. Whilst these sites are not strictly representative they do convey the main unfarmed features present.

In Sweden sites were selected to cover a range of variation for two days adjacent to Stockholm and Uppsala. Visits were made to these stratified random squares, which were within the NILS sample and the infra-red photos were taken into the field for consultation. Although all the sites were in the Nemoral Environmental Zone but discussions indicated that similar combinations of features were likely to be found in farmland in the Boreal zone in Sweden some photographs of squares in the mountains in Sweden were also examined, which fall within the Alpine North Environmental Zone.

The squares selected in the Great Britain are all within the Countryside Survey stratified random sample except the one on the Shap Fells which was included as a site with no fields. All the sites visited in Northern Ireland are within the Northern Ireland Countryside Survey series of stratified random samples. They were visited in 2007 as part of the quality assurance exercise for the survey.

Atlantic Central is represented by two arbitrary selected squares in central France and three squares in the Netherlands. As such the French sites are typical of the open landscapes which are present from Northern France to the boundaries of the Massif Central in the south. The Dutch sites represent partly intensive and partly open extensive grazing land.

3 National Databases with landscape elements

3.1 NILS (Sweden)

3.1.1 Introduction

The NILS project covers Sweden. In Sweden the Alpine North environmental Zone, the Boreal and Nemoral Environmental Zone are represented. The NILS project is a combined inventory of IR photograph interpretation and field data collection. In the years 2003-2007 the NILS project has collected information from 631 squares, each of which is 5*5 km^2 in size, of which the central 1 km^2 has been analysed intensively (Figure 6). The project has used a stratified random sampling system for the field and air photograph research (Esseen et al 2003). The squares have been selected through a stratified random procedure.

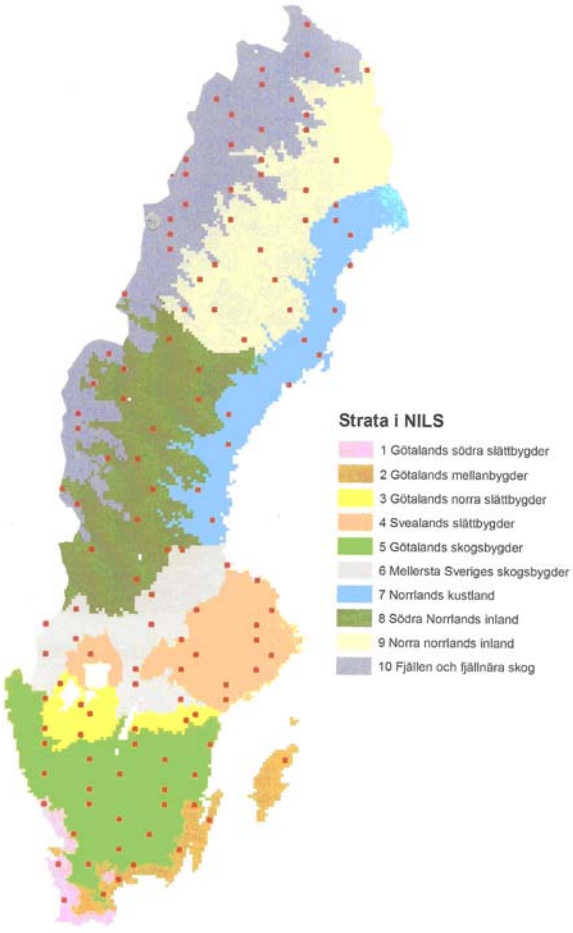

Figure 6. NILS stratification (Esseen et al 2003).

Strata 1 and 2 of the Swedish stratification are situated along the southern coast and can be identified as part of the Continental zone of the European stratification (Metzger et al 2005). Strata 3 and 5 of the Swedish stratification form Scania and are more or less synonymous with the Nemoral zone in the European Classification. Strata 6, 7, 8 and 9 form the Boreal Zone. Stratum 4 of the Swedish stratification is and intermediate zone between Boreal and Nemoral. In the Swedish stratification it is mostly included in the group with Strata 6, 7 and 8 and considered as Boreal. Stratum 10 is equivalent with the alpine north zone of the European Stratification.

The first stage of the visit to Sweden was to discuss the approach used in the NILS project. It was clear that experienced interpreters could extract a great deal of information on unfarmed features from infrared photographs much easier in comparison with monochrome. However, each 1 km square takes one to three days to interpret and these data are further supported by several working days in the field for validation and collection of vegetation data.

At high elevations the mountains in Sweden consist of mosaics of rock, grassland, bog and scrub assemblages; the majority of which are grazed by semi-domesticated reindeer and therefore fall into class 3 of the typology (Table 2). At lower altitudes there are complexes of tall scrub, bogs and forest usually only occasionally grazes by reindeer. Therefore in terms of the present project Alpine North in Sweden does not fall within the study remit. I

3.1.2 Stock in Swedish farmland features

Agricultural land in Sweden is predominantly located in the Continental and Nemoral zone (Table 4). The much larger Boreal zone only has one third of the agricultural land and in the alpine north zone there is no agricultural land cover at all. There is very little agricultural land in the Boreal zone and no agriculture in the mountains of the alpine north zone as well as in the northern Boreal zone. This means that most farmland is located in the southern part of the country.

When looking at the dominant land use type it can be concluded that most farmland is found in the Continental-Nemoral Zone (Table 4). About 22% of the land in the Continental-Nemoral zone is farmland and 70% of al Swedish farmland is found here. There is some farmland in the Boreal zone (3% of the area and 30% of the total Swedish farmland).

Table 4. Land cover in the Swedish strata and their interpretation towards a European stratification. The Swedish strata can be identified in Figure 6 and the European Zones in Figure 4. In Sweden the Boreal stratum is dominant. Only agricultural land cover can contain farmland features. All figures are in km² (Glimskär 2007a)

	manmade urban (km²)	Farmland (km²)	forest (km²)	other terrestrial (km²)	wetland, not alpine (km²)	Alpine (km²)	Total(km²)
1 Götalands södra slättbygder	2600	2230	180	590	70	0	5670
2 Götalands mellanbygder	240	2950	6750	300	340	0	10580
3 Götalands norra slättbygder	410	4660	5340	760	110	0	11280
4 Svealands slättbygder	1010	3920	20540	3840	570	0	29880
5 Göttalands skogsbygder	1090	7960	38420	1900	4860		54230
6 Mellersta Sver. Skogsbygder	1140	1620	26160	1930	2120		32970
7 Norrlands kustland	910	2240	31990	1570	2020		38730
8 Södra Norrlands inland	950	0	54320	1540	16990	0	73800
9 Norra Norrlands inland	3380	90	49130	2200	14060	3540	72400
Fjällen och fjälnära skog	320	0	15790	2620	5020	56890	80640
Continental and Nemoral	**4340**	**17800**	**50690**	**3550**	**5380**	**0**	**81760**
Boreal	**7390**	**7870**	**182140**	**11080**	**35760**	**3540**	**247780**
Alpine North	**320**	**0**	**15790**	**2620**	**5020**	**56890**	**80640**
Total	**12050**	**25670**	**248620**	**17250**	**46160**	**60430**	**410180**

Table 5. Farmland features in all Swedish farmland according to the NILS inventory. Mean Variance is the average variation on both sides of the average length (Glimskär et al 2007b)

	Total length (km)	**Average length (m)/ha agricultural land**	**Mean var (%)**
farm roads	36849	14.0	19.2
stonewalls	7094	2.7	77.3
Stone cairns	83	0.1	107.7
vegetation strips	12724	4.8	29.2
earth walls	2448	0.9	78.0
Ditches	92839	35.3	10.2
streams	6857	2.6	44.8
tree lines	20780	7.9	28.0
hedges	8289	3.2	23.5
alleys	4710	1.8	34.0

The Swedish NILS inventory makes a differentiation between point elements, linear features and edges (border between different matrix elements). There has been no differentiation made between these elements within agricultural land, forests and natural land. Most of the features of interest to this study are along farmland edges. Dominant features are ditches, farm roads and to a lesser extent tree lines (Table 5). This means that the land in Swedish farmland is characterised by openness. From a regional differentiating study on linear landscape features it is concluded that that farmland features such as ditches, farm roads and roadside verges are more apparent in the Continental-Nemoral zone than in the Scandinavian mountains (Alpine North zone, Table 6). The Boreal zone holds an intermediate position. Here, however, land

cover is dominated by forest (75%) and not by agricultural land. The absence of agriculture in the Boreal zone and alpine north zone can be clearly seen in the low length of fences, ditches and field borders compared to the Continental-Nemoral zone (Table 6). Paths and roads are common in both Boreal and Continental-Nemoral zone. It must be noticed that the categories are slightly different from the general report on Sweden and that no distinction is made between farmland and non-farmland (Glimskär et al 2007a).

Table 6. Farmland features in Sweden divided for the three zones of the European Stratification occurring in Sweden: Continental-Nemoral, Boreal and alpine north (Figure 1). The alpine north zone does not have agricultural land, but is dominated by alpine vegetation. The Boreal zone has only a restricted area of agricultural land (3%). From Glimskär et al 2007a.

	Continental-Nemoral m/km²	**Boreal m/km²**	**Alpine North m/km²**
Path	1835.2	1679.3	897.0
farm road	921.1	335.8	34.0
roadside verges	964.2	898.8	85.0
ditch verge	305.5	139.8	6.0
field border	287.0	50.0	0.0
protected water course	152.3	44.3	0.0
fences	959.3	138.3	0.0
ditches	3664.3	793.8	17.0
canals < 6 m	75.1	45.3	17.0
natural streams < 6 m	617.4	830.3	2596.0

3.2 SINUS (Austria)

3.2.1 Introduction

In Austria three projects include coverage of farmland features, the SINUS project (1996), the Sustainability Indicator Project (2002) and Orchard Project (2005). The objective of SINUS was to develop reliable indicators for the long term development of the Austrian cultural landscape. The scientific objective was to analyse spatial relationships in landscape structure and the processes behind these. The project delivered a contribution to the development of environmental indicators for the EEA and OECD.

To carry out the SINUS project a stratified random sampling design has been developed to reflect the spatial diversity with Austria and to produce a systematic and reproducible sample of landscape feature data. The requirements were that the sampling was cost effective and it should allow conclusions on the spatial distribution of environmental resources, drivers, pressures and responses.

Within the 12 main groups and 41 subgroups of Austrian landscapes a sample of 131 km squares spread over Austria have been analysed with help of air photographs and field data (Figure 7). This has later been expanded to about 200 sample units. In the analysis for this project use has been made of 167 squares that could be analysed because of the presence of farmland.

The stratification is based on altitudinal data, exposition data, geomorphology, topography and landscape typology as basis for land use (Wrbka 2003). The classification has been made by using TWINSPAN (Hill, 1979) and ISO-cluster in Arc-Info. Within this project data have been collected on spatial heterogeneity, including linear features. The data on features in agricultural landscapes have been used for the analysis of farmland features.

Based on the sample that was available from SINUS two follow up projects have been carried out, the BINK/IN2 project (2002) and the OM project (2005). The BINKL/IN5 is a project focussing at the sustainable development of Austrian cultural landscapes and bioindicators for the sustainable use of Austrian cultural landscapes. The data basis was drawn from field survey in 40 test sites in Austria. In this project environmental quality targets for Austrian cultural landscapes were defined and a system of long-term monitoring of the targeted organisms in selected test sites was designed. The Orchard meadows (OM) project had the objective to describe key-elements for the maintenance and advancement of the biodiversity in Austrian agricultural landscapes. Analysis was performed by comparison of ten year old project-data with actual data derived by interpretation of 25 test sites. The same landscape features have been collected as in the SINUS project.

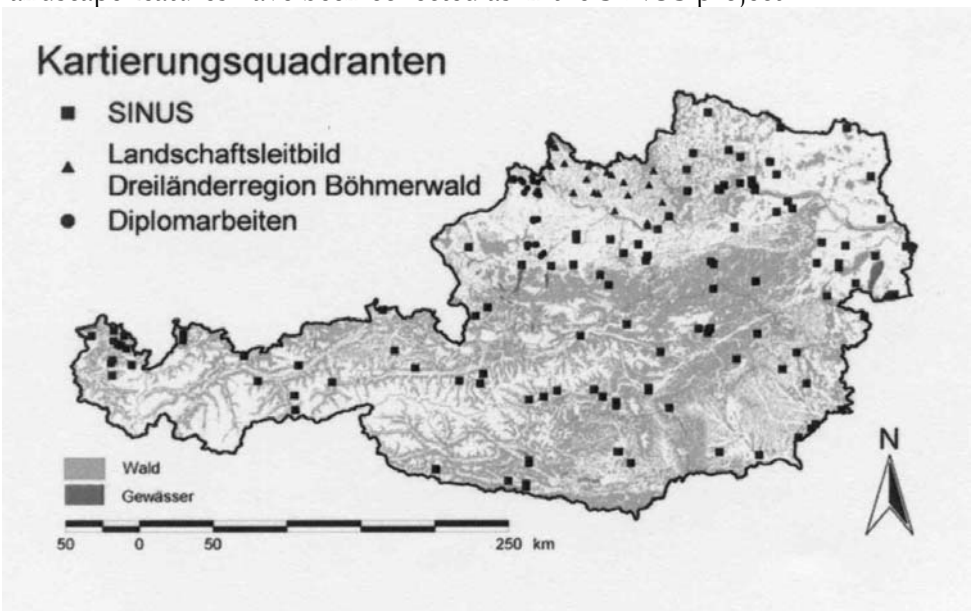

Figure 7. The 131 squares in Austria that formed the basis of the SINUS project. Originally the sample consisted of 120 squares; these have been expanded to 131 by work in student projects and later to 200.

3.2.2 Types of farmland features and data used

In Austria the European Environmental zones are Alpine South, Continental and Pannonian (Figure 4). The available data have been analysed for these zones. The Pannonian zone (Neusiedler See and surroundings) is the smallest one and therefore the results for this regions show the largest variation.

The types of features in the SINUS, IN and OM database were:

- Avenue old/young
- solitary tree old/young (Figure 8)
- field scrub
- field bank (Figure 8)
- semi natural rivers
- ditches
- tree hedge
- scrub hedge (Figure 8)
- small structures
- periodical rivers
- periodically standing water natural
- natural standing water
- leafy traffic route

These categories have been used in the analysis of features. All are considered to be part of agricultural land. The SINUS database provides data presented as the percentage cover of a km square. All data are given in that way and are therefore not comparable with other data such as the NILS data that gives linear features in meter per km^2. Data have been analysed for this project to show the percentage of land that is in agricultural use, in non agricultural use and the percentage of farmland features.

Field bank and steep roadside verge | Vegetation strip and scrub hedge along arable field | Solitary tree

Figure 8. Winter view of farmland features in the Austrian square Freundorf (Continental zone).

3.2.3 Stock and changes in Austrian farmland features

General data for Austria and for the three zones can only be compared with 1996 as they have used parts of the 1996 squares, but these projects do not cover the same squares (Table 7). For the Pannonian zone the squares for 2005 are not representative as there are only a restricted number of squares with a low percentage of agricultural use. However, the trends seem consistent.

Table 7. Data on abundance and trends in agricultural land, non-agricultural land and farmland features in Austria and the three environmental zones based on SINUS data, IN 2002 project and the OM2005 project. The units are in ha/km².

	Agri-cultural use	Unfarmed features	Non agri-cultural use	Agri-cultural use	Total area unfarmed features	Non agri-cultural use	Agri-cultural use	Total area unfarmed features	Non-agri-cultural use
1996	61.53	**3.20**	35.31						
1996-2002	66.75	**3.71**	29.69	66.92	**3.74**	29.49			
1996-2005	62.60	**3.70**	34.50				65.02	**2.64**	32.60
Alpine-south									
1996	54.27	**3.14**	42.73						
1996-2002	60.53	**3.37**	36.09	60.30	**3.44**	36.26			
1996-2005	59.36	**2.74**	37.89				59.97	**2.26**	37.77
Continental									
1996	62.65	**3.20**	34.20						
1996-2002	66.73	**3.81**	29.45	67.20	**3.91**	28.92			
1996-2005	67.34	**3.22**	29.45				69.73	**2.66**	27.61
Pannonian									
1996	69.27	**3.35**	27.38						
1996-2002	73.44	**3.76**	22.81	73.71	**3.67**	22.63			
1996-2005	32.26	**2.82**	64.93				39.52	**2.45**	58.04

For this project the Austrian data have been separated in the three European environmental zones that occur in Austria: alpine south, Continental and Pannonian. The analysis of the alpine zone is based on 42 squares from the SINUS project (1996). The relative cover of features per square is relatively low and does not reach 4% in average. Compared to the SINUS project the Sustainability Indicator project (IN) shows a relative increase in features in the Alpine region by 2002. This is based on 13 squares. The change is mainly for the account of a few squares where scrub vegetation and young solitary trees increase. This might be an indicator for land abandonment, but this is difficult to confirm as no data on farming are present to confirm this. In the orchard project (2005) the area of features clearly decreased for the squares that have been sampled. However as this sample is small (only 5 squares) no firm conclusions might be drawn from this.

For the Continental region 100 squares are available from the SINUS project and 15 squares from the Sustainability indicator project. Here also a small increase in features can be observed between 1996 and 2002. In the orchard project (16 squares) the features have declined considerably (17.5%). Field banks are relatively untouched, but trees and water courses are declining.

The biggest changes take place in the Pannonian region. The subsample here is the smallest. The SINUS project had 25 squares here, while the Sustainability Indicator project had 12 that to be compared. For the Orchard Project there were only 5 squares that could be used for comparison. This is a flat region that is easily accessible and can be changed relatively easily. Changes take place between 1996 and 2002 and continue to become even stronger in 2005. All elements, hedges, ditches and vegetation strips decline.

3.3 SISPARES (Spain)

3.3.1 Introduction

Spain covers the European Mediterranean zones (Mediterranean North, Mediterranean Mountains, Mediterranean South, the Lusitanean Zone in the North-West and the Alpine South Zone in the Pyrenees and the Cantabrian mountains (Figure 4). The Spanish Environmental zones consist of 7 Ecoregions and below that at the second level there are 12 strata (Figure 9). The 12 strata can be translated into European Zones. As reporting has been carried out at this level a comparison at the level of the European Zones can be made. The relationship is not complete, but there is a reasonable relationship to use the Spanish Strata for the European Environmental Zones in this study. The SISPARES project has selected its sample squares in a stratified random procedure within the 12 strata. In total 215 sample squares of 2x2 km^2 are part of the stratified sample (Figure 10). Data on linear features are restrictedly available as the focus of SISPARES was not these elements, but on land cover. Figure 11 shows some examples of Farmland in the different zones in Spain.

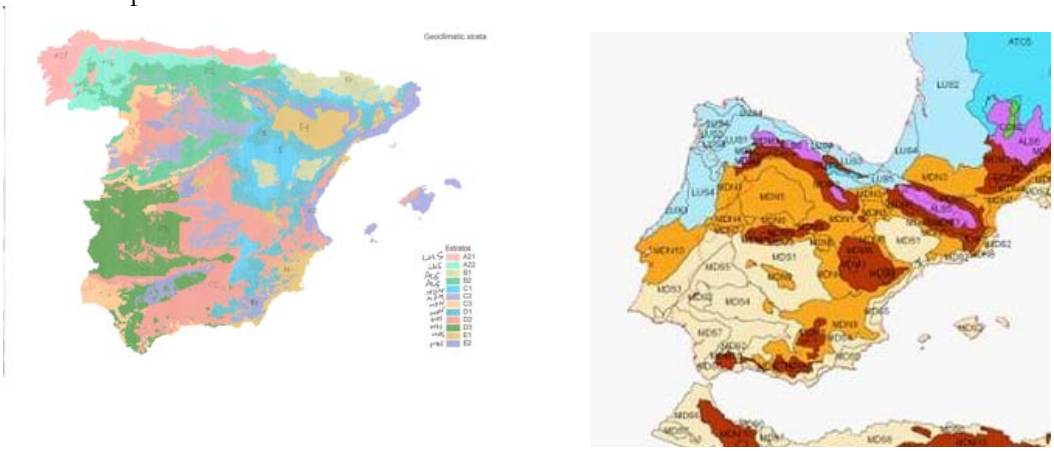

Figure 9. The 8 Spanish Ecoregions as used in the SISPARES project and the basis for reporting and their relationship with the European zoning. The relationship is as follows: Strata A (A21 and A22): Lusitanean Zone; Strata B (B1 and B2): Alpine South; C3 and D1: Mediterranean North; D2, D3, E1, E2: Mediterranean South; C1, C2, Mediterranean Mountains

Figure 10. Stratified Sample of the SISPARES project consisting of 215 2X2 km squares, of which 204 from the Spanish mainland, 2 from the Baleares and 9 from the Canary Islands. The data from the Canary Islands have not been included in this analysis. The squares used are therefore 206.

Mediterranean North, Navalcarnero

Mediterranean Mountains, Camaleño valley, Picos de Europa

Mediterranean South, Aljete

Figure 11. Examples of Spanish Farmland

3.3.2 Stock and change in Spanish farmland features

The dominant land cover in Spain is agricultural land (30%), forest (25%) and matorral (scrubland, 21%). Dehesa is also agricultural land and covers nearly 10% (Table 8). Grazing pressure on pastures and mattoral has not been further analysed as these are part of the Class 1, class 2 or 8 and fall beyond the feature categories used for this project. The analyses are based on Spanish data available through the SISPARES project (Elena-Rossello 2003).

Table 8. Average land cover of the ten main land use classes in Spain (%) in 1998 and the confidence interval with a probability of 95%.

Land cover type	Estimated average cover (%)	Confidence interval (%)
Forest	25.58	2.07
Crops	29.85	2.57
Dehesa	9.33	1.73
Riparian	0.38	0.07
Water	0.59	0.18
Bare land	0.72	0.18
Matorral	21.13	1.71
Pastures	5.66	0.65
Reforestation	6.21	1.06
Urban	0.54	0.21

There is regional differentiation between the Environmental Zones as can be concluded from the squares data collected in the SISPARES project. As can be seen from Table 9 most agricultural cropland and dehesa are situated in Mediterranean South. The second in cropland is Mediterranean Mountains that however, is dominated by forest and matorral. In the Lusitanean zone the pastureland is dominating together with forest and matorral. Here much of reforestation takes place, often on former heathlands. Mediterranean North has an even share of forest, cropland and matorral. Much of the matorral might still be land that is grazed by cattle, sheep and goats. However, no information is yet available to confirm this.

Within the SISPARES project data have been collected on solitary trees, buildings in the countryside and linear vegetation (tree lines and hedges). A comparison has been made between the years 1956, 1984 and 1998 (Table 10). The first two years have been done by photo interpretation only. In 1998 field research has been carried out as well.

The dates that have been used reflect the period 1956 that Spain was then a rather autarchic country (1956), the period after Franco when the country starting to develop (1984) and the period after the accession to the European Union.

Table 9. Land cover distribution over the Environmental zones in Spain according to SISPARES in 1998 in percentage. N indicates the number of km squares from the sample that are situated in that zone (data after Elena Rosselló, 2003)

	N	**forest (%)**	**crops (%)**	**Matorral (%)**	**Dehesa (%)**	**Reforestation (%)**	**Pasture (%)**	**Urban (%)**
Lusitanean	75	20.4	9.6	27.1	0.0	23.7	15.9	0.4
Alpine South	93	44.1	17.8	22.8	1.6	3.5	8.6	0.2
Mediterranean mountains	63	37.1	26.1	17.0	6.9	5.7	4.2	1.0
Mediterranean North	99	32.7	22.8	24.3	9.6	5.7	3.3	0.3
Mediterranean South	288	15.9	42.3	18.8	14.7	2.8	3.2	0.7

What can be concluded from these data is that there is divergence between the regions. Especially in the Alpine region the number of solitary trees is declining, but the buildings in this region are increasing considerably. Apparently the mountains have been rediscovered as touristic area. Also the linear features increase here. Especially in the Mediterranean Mountains there is slight decrease in linear vegetation, probably due to farming intensity, abandonment of inaccessible pastures and tourism development (houses). This however, can not be confirmed as specific data are lacking. In both Alpine South and Mediterranean Mountains linear vegetation plays a more prominent role in the landscape. The length of vegetation strips for Mediterranean North and South (the non mountain areas) is comparable with the Swedish situation.

Table 10. Landscape features for the Environmental zones in Spain. N indicates the number of km squares from the sample that are situated in that zone; n is the number of trees or buildings. Data from the Lusitanean Zone are lacking. (from Elena Rosselló, 2003).

	N	trees n/ha			rural buildings n/ha			linear vegetation m/ha		
Year		**1956**	**1984**	**1998**	**1956**	**1984**	**1998**	**1956**	**1984**	**1998**
Alpine South	66	0.59	0.15	0.10	0.01	0.02	0.21	7.04	5.86	8.95
Mediterranean mountains	36	0.20	0.30	0.40	0.01	0.01	0.02	18.54	17.01	16.62
Mediterranean North	51	0.80	2.00	2.10	0.02	0.08	0.07	4.37	6.99	3.10
Mediterranean South	288	0.57	0.33	0.58	0.02	0.03	0.04	5.50	4.02	4.60

3.4 Steekproef Landschap, Dutch Landscapes Survey (The Netherlands)

3.4.1 Introduction

Steekproef Landschap (Sample Landscape) has been a project with the objective to collect precise data on landscape changes in the Netherlands between 1990 and 2003. The project has made use of a stratified sampling procedure by dividing the Netherlands into 15 Dutch landscape types (Figure 12). Results have been analysed for the 15 types, for the four major classes and for two main strata that are of importance for the Netherlands, "low" and "high". A sixteenth landscape type is urban that covers rather large areas. Different from the other classifications climate has not been a driving force for making the classification as climate differences are small in the Netherlands. There are indeed differences within climate in the Netherlands (Jongman, 1990), but these are considered minor compared to the differences in hydrology and soil and topography. The stratification is built on these elements (Table 11). In the European Classification there are two zones in the Netherlands, Atlantic North, covering the north-eastern part and Atlantic Central, which covers the rest of the country. Within these landscapes 72 1-km squares have been taken in a stratified random way. Data have been collected from the years 1990, 1996 and 2003. In 2003 field research was carried out, while the two other years have been analysed through topographic maps (1: 10,000).

The measured variables differ from the other samples as they are complex and country specific. The variables measured were:

- linear vegetation: tree rows and double tree lines. The definitions are based on the definitions of the UK Countryside Survey.
- Buildings in the rural areas
- Relief as measure of change in geomorphology (important in artificial and lowland landscape
- Cultural historical elements: relicts, (points, lines and areas) that were already mapped as such in 1900 on the "Bonne"-map. The Bonne map is the Chromo-topographic map of the Kingdom of the Netherlands scale 1:25000 originally produced in the second half of the 19th century.

Table 11. Stratification of the Netherlands in three levels. For the further analysis the important categories are Pleistocene Sand, Lowland peat, Marine Clay, Polder and Rivers.

Level 1	**Level 2**	**Level 3**
Urban	Urban	Urban
The Netherlands low	Polders	Polders
	Coastal zone	Coastal zone
	Lowland peat	Lowland peat east
		Lowland peat west
	Marine clay	Marine clay northeast
		Marine clay northwest
		Marine Clay southwest
The Netherlands high	Southern hills	Southern hills
	Former peat bogs	Former peat bogs north
		Former peat bogs south
	Pleistocene sand	Pleistocene sand north
		Pleistocene sand central
		Pleistocene sand east
		Pleistocene sand south
	Rivers	Rivers

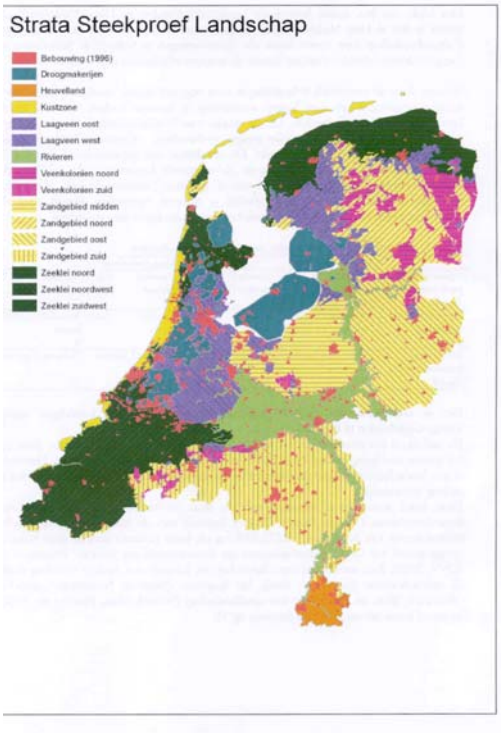

Figure 12. The stratification of the Netherlands for Steekproef Landschap into 16 regional landscapes (including urban). The regional landscapes are: 1: urban, 2: polders; 3: southern hills; 4: coastal zone; 5: lowland peat east; 6: lowland peat west; 7 rivers; 8: former raised bogs north; 9 farmer raised bogs south; 10: pleistocene sand central; 11: pleistocene sand north, 12: pleistocene sand east; 13: pleistocene sand south; 14: marine clay north; 15: marine clay northwest; 16: marine clay southwest.

The Dutch data are not well comparable with the data from the other surveys, but are an indication of changes in urbanised lowland and river delta landscapes. These landscapes are common in Europe and have the highest level of urbanisation and intensive farming. However the linear features and the cultural historical remnants are mostly related with agricultural land use. These will be further discussed.

3.4.2 Stock and change in Dutch farmland features

The agricultural land use in the Netherlands is about 60% of the total land area. The dominant land use type is dairy farming (38%). Linear plantings are important in the plans for agricultural improvement and reallotment. In the Netherlands statistics have been made of planting and removal as land dynamics is rather high. Due to agricultural improvement and urbanisation many changes can be observed. Large scale agricultural improvement led in the 1990s to a net increase in linear features after decades of decrease (Jongman, 2002). In the second part of the 1990s (1996-2003) removal and plantings more or less levelled out. The planting in the period 1990-1996 is nearly 12% of the total stock in 1996 (Figure 13). This confirms the dynamic character of land use in the Netherlands. Compared for the major regions it is clear that the small continuation of increase in the Pleistocene sand area is in strong contrast with the decline in the polder and rivers. The strong change here is expected to be related to urbanisation processes, but no data are available to confirm this.

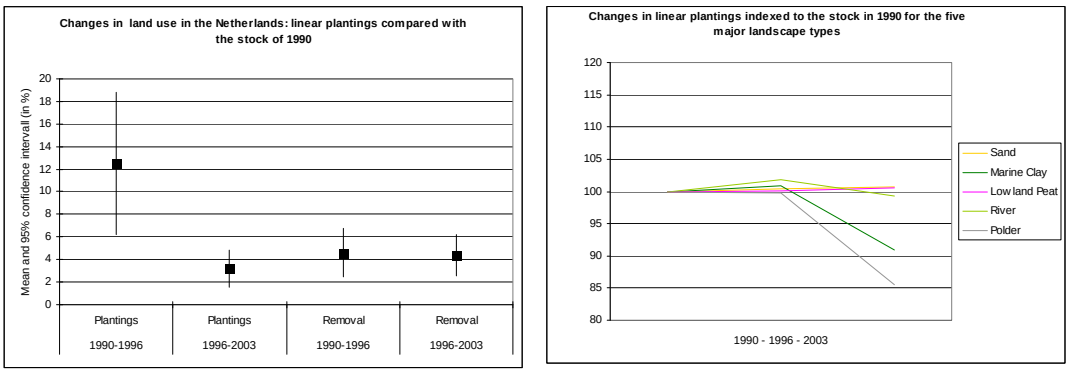

Figure 13 Changes in linear vegetation in the Netherlands in two periods, 1990-1996 and 1996-2003. In the left figure data are given for all of the Netherlands; the right graph present a regionalisation. The period 1990-1996 shows an increase, while the period 1996-2003 shows a net decrease mainly caused by changes in the river and polder landscapes.

Most changes in historical features in the Netherlands take place in the period 1996-2003, both for the total of features and for the parcel boundaries as a specific group (Figure 14). Parcel boundaries are often removed in agricultural improvement works (Figure 15). These types of works have been carried out from 1920 on and have changed a major part of the Dutch landscapes. The scope and content of this kind of projects have changed at present with the decentralisation of tasks and the introduction of Regional Development Plans. Compared for the main regions the decrease is a general trend for parcel boundaries. Other relict features re not further analysed as they are not dominantly in agricultural landscape.

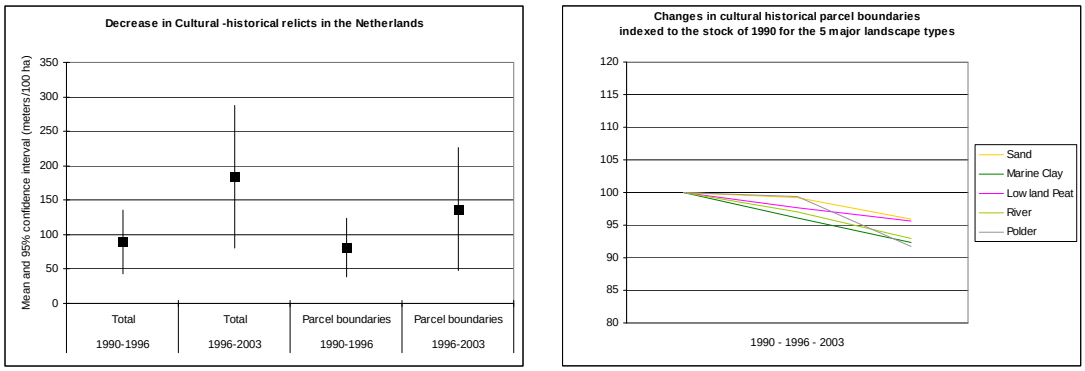

Figure 14. Decrease in cultural-historical relict in the Netherlands for the period 1990-1996 and 1996-2003. In the right figure the data for parcel boundaries are shown for the major landscape types. All results are significant.

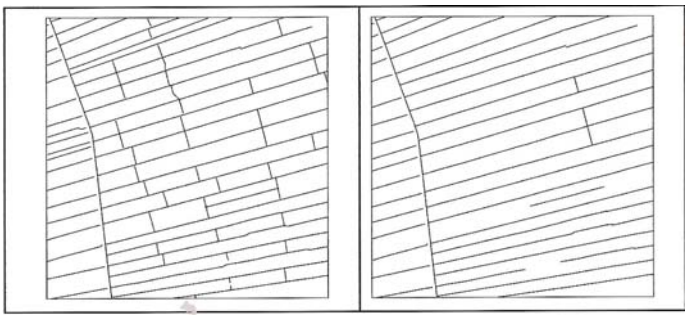

Figure 15. Historical parcel boundaries (ditches) in one of the sample squares near Oosterwolde in 1990 (left) and 1996 (right). Changes have been caused by reallotment and agricultural improvement works.

In the Netherlands as a strongly urbanised country changes in landscape features in general are caused by urbanisation processes, internal dynamics in agriculture such as the development of tree nurseries, agricultural improvements and since 1996 also redevelopment of nature due to the nature policy decided upon in 1991. Geomorphologic changes (relief, land height) are important; in farmland land is drained and at the same time levelled as this improves production. This means a decrease in landscape heterogeneity.

3.5 Countryside Survey (Great Britain)

3.5.1 Introduction

The British countryside survey covers Atlantic North and Atlantic Central Zones of the European stratification. The British countryside Survey stratification has 40 strata. For reporting these have been summarised into 6 zones (Figure 16). The environmental zones all have agricultural land. Zone 5 (Northern coast and isles) has the lowest cover of land in agricultural use (42%).

In 1977 the Institute for Terrestrial Ecology (ITE) carried out it first ecological survey on Great Britain based on a sample with 256 stratified random units using the stratification in 40 strata. In 1984 the sample was expanded to 384 units. The survey was designed to answer questions on land use issues. Data collection has been

focussed on land cover and land feature mapping rather than on data collection at the detailed vegetation plot level as this is time consuming and not suited to monitoring. This work has repeated in 1990, 1998 and 2007. In this overview a comparison will be made between 1990 and 1998.

The overall objective of the British Countryside Survey was to record stock and change of countryside features including information on land cover, habitats and species. Farming and management information was not a direct goal, so the distinction between farmed and unfarmed features has not been made directly. However several features have been collected that fall into class 5 and class 6 of this project and these will be analysed and presented here.

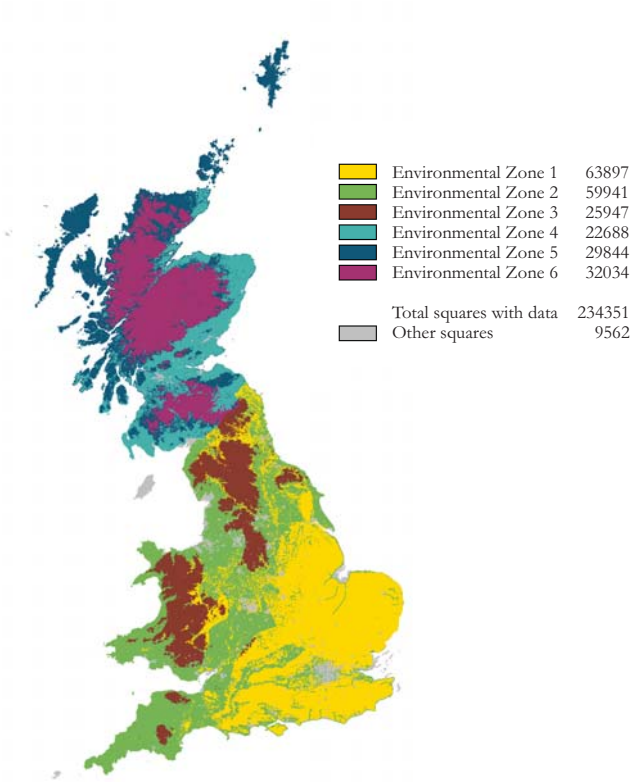

Figure 16. Environmental zones of the GB countryside survey. Zone 1-3 are part of the European Atlantic Central Zone; zone 4-6 are part of the Atlantic North Zone.

The linear features in the Countryside Survey are:

- Wall: a built structure of natural stone or manufactured blocks, mostly of traditional dry stone wall construction but including mortared walls. Includes walls with fences and lines of trees or shrubs.
- Hedge: a more or less continuous line of woody vegetation that has been subject to a regime of cutting in order to maintain a regular shape. This category includes both recently-managed and other hedges, including hedges with walls or fences.
- Bank/grass: An earth or stone-faced bank with or without a fence or a grass strip without a fence.

3.5.2 Stock and change in farmland features in Great Britain

The features analysed from the Countryside Survey Information system are total boundaries, banks/grass strips, hedge and walls. In Great Britain these features all are part of the agricultural landscape. However, part of these features (total boundaries) might occur in non-farmed land as well. In Great Britain rough grazing land is still used in the highlands of Scotland and the difference between non-grazed (Class 8) and occasionally grazed is difficult to make.

The main zone containing linear features is zone 6 (upland zone in Atlantic North). However, in Atlantic North there is a big contrast between the three zones. The lowland and the northern Islas do not have many linear features, while the uplands are rich in linear features. The abundance of features is rather low in zone 3 in Atlantic Central, being the zone with the highest percentage of agricultural land (65% arable, 16% improved grassland).

There are differences between the three categories of features. Hedges are the most important category. They are declining in Atlantic north and slightly increasing in Atlantic Central caused by an increase in the pastoral zone in western Britain. In the whole GB hedgerows have been declining until 1990 (Figure 17 and Table 12). In quantitative respect the decline has been stopped; however, that is not yet the case in qualitative aspect.

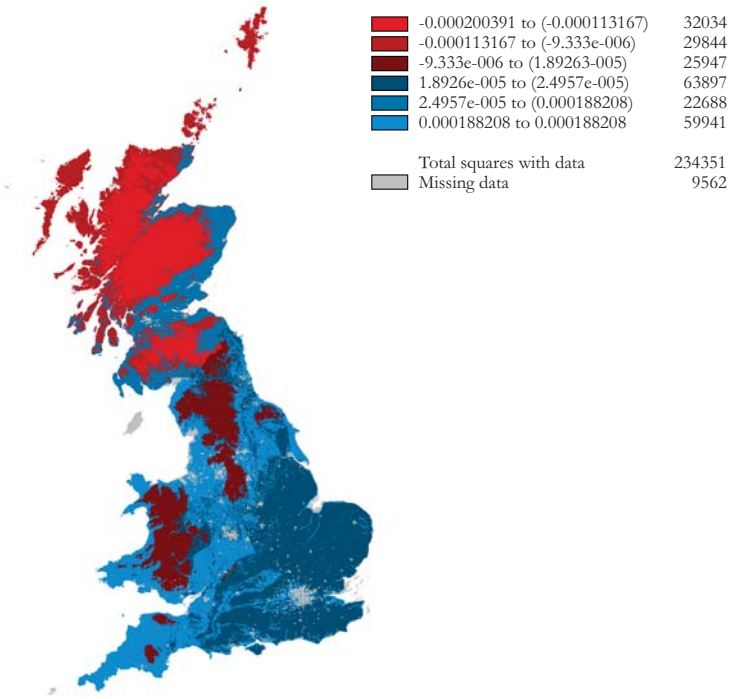

Figure 17. Change in hedgerows in Great Britain in the period 1990-1996. In general of the previous period has been stopped, but continues in the mountain areas. The red areas show a decrease the blue zone an increase. The figures indicate the range of increase or decrease in '000 km/km². The last column represents the area of that class. In the tables below this has been transformed into m/km².

Table 12. Length (m/km²) of linear features according to the data of the British Countryside Survey for 1990 and 1998. The second column denotes the area of the zone in km².

Zone	Area (km²)	walls 1990	Walls 1998	hedges 1990	hedges 1998	bank/grass 1990	bank/grass 1998	total 1990	total 1998
zone 1	63897	61	67	4892	4964	390	358	10377	11022
zone 2	59941	121	119	2655	2843	338	321	7941	8047
zone 3	25947	17	17	3337	3328	181	172	6867	7059
Atlantic Central	**149785**	**78**	**79**	**3728**	**3832**	**333**	**311**	**8794**	**9145**
zone 4	22688	9	7	2359	2132	329	310	5832	5157
zone 5	29844	40	62	3265	3152	283	290	8719	8628
zone 6	32034	543	579	5511	5191	2609	2442	12415	12868
Atlantic North	**84566**	**222**	**243**	**3873**	**3651**	**1176**	**1110**	**9344**	**9303**

3.6 Conclusions

The databases that have been analysed had all a comparable approach for data collection. However, the way the data have been analysed and how they are available is different. It still allows for comparisons.

The trends that can be concluded from the databases and the literature are that there is in general a decline in farmland features that are unfarmed. Not all figures are unambiguous pointing at decline. In Austria the trend seems variable as in 1996-2002 there seems to be stabilisation or increase in most regions, while the period after that points at a decline. Especially in the lowland areas around Neusiedler See (Pannonian Zone) there is a strong decline. However, conclusions must be made carefully as the three studies used the same method, but rather small samples. The trends in Spain indicate a rather decline for the squares analysed in SISPARES especially for linear vegetation except for the Alpine South. However, here also the number of buildings is increasing considerably, which indicates a process of further exploration. Solitary trees are increasing in Mediterranean North.

In the Netherlands the impact of intensive agriculture and land improvement project that are centrally organised have a strong impact on the presence of linear features in the landscape. It is obvious that a strongly urbanised area as the Netherlands will be rather dynamic. However, this also would imply that a careful planning of the landscape is needed.

In Great Britain the data from the Countryside Survey allow to analyse trends in changes from 1978 on. In this study this is only been done for the period 1990-1998 as the older data are not available in digital format. It can however be concluded that the decline that has been reported in the 1980s. The trend from the 1980s has been turned into a stabilisation in the 1990s due to policies directed at maintaining landscape features (hedgerows and stonewalls).

Sweden has led the way in the use of infrared photographs but other countries such as Norway are now following (Ihse 2007). Whilst the tables produced so far can be used to indicate the likely extent of unfarmed features, further interpretation could undoubtedly be carried out in order to reveal more detail. This exercise would be practical in Sweden because of the major investment but elsewhere the cost of obtaining the coverage of photos and the interpretation would be very large in comparison with direct field visits, particularly as precise estimates of extent or spatial arrangement of elements is required.

The Countryside Survey in Great Britain has done much pioneer work in how to collect data and how to store and analyse them (Bunce et al 1996). It can be seen that the other approaches have been based on the ideas that have been developed in Great Britain in the period 1970-1980. It is valuable to use that knowledge also when specifying research questions to farmland features and their management.

4 Stock and change in farmland features in Atlantic North

4.1 Introduction

There are only few projects that compare international stock and change in landscape features. Most studies are done within national boundaries and therefore have national objectives, indicators and measurements of change. Only a few projects really compare changes with field data in a consistent way. The conclusions drawn in the previous chapter can only be validated when confirmed by cross border comparisons. The report on stock and change in Atlantic North is one of these projects. It has been carried out in the period 1996-2001 and has not been reported yet. In this chapter only the changes in linear features are highlighted. However, also information on farm management and land mobility are available.

The analysis in Atlantic North has been based on topographical maps of three different years: the 1960's, 1980's and 1990's and field control in 1998-1999. The areas compared are three times five blocks of 1 km squares in Great Britain (Greystoke), Denmark (Søndr Omme) and the Netherlands (Vlagtwedde). An impression of the three regions is given in Figure 18. For Great Britain only two years are used due to availability of maps from the 1960's and bad conditions of existing maps. The database content of both the paper and the digital maps is based on fieldwork and aerial photo interpretation and refers mainly to land cover classes.

Vlagtwedde, Groningen, The Netherlands

Greystoke, Lake district, Great Britain

Søndr Omme, Jutland, Denmark

Figure 18. Impression of the Farmland in the three regions compared

In all study areas five squares of a 1 km² have been selected. A total of 28 different land cover categories were identified and assigned on the topographical maps in the three different study areas. The resulting legend structure should be considered as the best compromise between the three country legends based on the insights available in 1997, rather than a perfect fit. The categories can be merged in more general classes.

The land cover category *arable and grasslands* contains the matrix of the squares for the three case study areas. In the Netherlands the amount of *grassland* might change every year as farmers can be very dynamic in their grassland management. Forest types and

scrub types have been included in the features as they are small in area and are integrated in the agricultural landscape in all three regions. This is not done for heath and bracken as this is extensively grazed or abandoned.

The database is filled with the land cover class category, line and point element information. Most data concerned line and point information. In the spatial analysis the merged set of 18 area based land cover categories is used to interpret the results.

The categories of land classes, linear features and point elements have been transformed into the farmland feature classes (Table 2). The class to which the category belongs is always indicated in the tables and used in the analysis to make interpretation possible. Emphasis is given to the classes 5 and 6 as they are the categories unfarmed features in farmland (see Table 13).

Table 13. Features classification based on a comparative study in Denmark, Great Britain and the Netherlands. Country codes: All = land cover category in all three countries present, DK = land cover category present in Denmark, NL = land cover category present in the Netherlands, GB = land cover category present in Great Britain. The Class 5 and 6 features are indicated in bold.

Country code	Original class	Farmland feature	Class Farmland feature
All	Arable and grassland	Arable	1
GB	rough grassland	Grassland	1
All	**dirt road**	**Track,**	**5**
GB	**Partition**	**Fence + grassland**	**5**
GB	**Coppice**	**Point**	**5**
GB	**Scrub**	**Scrub**	**6**
DK	**wet pasture**	**wet pasture,**	**6**
GB	**Marsh**	**Marsh**	**6**
All	**ditch/channel**	**ditch**	**6**
NL/GB	**Walking path**	**footpath**	**6**
All	**Deciduous woodland**	**Woodland**	**6**
NL/GB	**mixed woodland**	**Woodland**	**6**
All	**coniferous woodland**	**Woodland**	**6**
NL	**Wicker**	**Tall shrub**	**6**
All	**water-area**	**Water**	**6**
All	Building	Urban	8
DK	Premises	Urban	8
All	main road	Urban	8
All	local road	Road	8
All	partly paved road	Road	8
NL/GB	Bicycle path	Urban	8
GB	Partition in decay	Abandoned	8
GB	bracken and rough grazing	Abandoned	8
GB	Bracken	Abandoned	8
GB	Outcrop	Outcrop	8
DK	Sand	Sand	8
DK/GB	Heath	Heath,	8

A *partition* in this project was a boundary between parcels and can be a fence, hedge or stone wall. A partition in decay means that the boundary is not managed and not

stock proof. In the landscape it is visible as some stones in a line with scattered hawthorns as a leftover of a stone wall. This means that mostly this is in an area that is not farmed anymore. Abandonment or at least marginalisation takes place.

4.2 Stock and change in North Atlantic farmland

Different overlay techniques made it possible to calculate for all sample squares separately the land cover composition. This analysis established:

- Total area of land for 17 categories of land cover at three moments in time.
- Percentage area of land cover at three moments in time.
- The totals for each land cover change between two moments in time.

The squares selected are predominantly in farmland use (*arable and grassland*), in the Netherlands for over 90% of the area, for Great Britain 53% without and 78% with rough grassland; in Denmark it increased from 71% to 78%. This means that except for Denmark in the period 1970-1985 the agricultural matrix stayed relatively stable over the years (Table 14). However in the Netherlands the dynamics within the farmland are rather high due to crop rotation. The study area in Denmark the matrix is predominantly in agricultural use (*arable and grassland, heath, marsh and wet pasture*), for about 90% of the area. The change here has mainly been from wet grassland, Marsh and heathland into arable, a sign of intensification.

The total woodland area shows an increase in the Netherlands (from 1.57% to 3.13%) and a slight decrease in the Great Britain (-0.3%). This increase in the Netherlands is the result of an increase in *deciduous woodland*. In Great Britain a larger part of the area consists of woodland, almost 18%. The total area of woodlands in Denmark shows an increase from 1 to 5.96 %. The increase can mainly be accounted for by *coniferous woodlands* which are used as plantations (Christmas trees). Most of the woodlands in Denmark and the Netherlands are small and part of the farmland.

Roads, especially dirt roads, are declining in length and area in The Netherlands and Denmark and stable in GB, a sign of intensification. In the Dutch study area a decline in *water* area is caused by a decrease in length of ditches. This mainly originates from the reallotment project that also caused the decrease in *dirt roads*. This means that edge length decreases and shape complexity and isolation of dirt roads increase. In Great Britain there is a decrease in partition in decay with one sixth of the original amount present. All other land cover categories stay stable.

Table 14 Percentage of total area (500 ha) for each land cover category in Vlagtwedde, Groningen (NL), Greystoke Cumbria (GB) and Søndr Omme, Jutland (DK).

Land cover category	Class	NL Area % 1968	NL Area % 1982	NL Area % 1997	GB Area % 1989	GB Area % 1998	DK Area % 1971	DK Area % 1985	DK Area % 1993
Rough grassland	1				24,33	25,12			
Wet pasture	1						14,49	9,08	7,27
Arable and grassland	1	90,88	93,13	92,68	52,98	52,95	70,88	77,79	78,18
dirt road	**6**	**4,14**	**1,43**	**1,20**			**1,48**	**-**	**-**
Path	**6**	**0,00**	**0,01**	**0,17**	**0,39**	**0,39**			
Partition	**6**				**0,46**	**0,46**			
Deciduous woodland	**6**	**1,19**	**2,43**	**3,01**	**11,20**	**10,94**	**0,25**	**0,48**	**0,48**
other woodland	**6**	**0,38**	**0,19**	**0,12**	**6,72**	**6,24**	**0,76**	**4,58**	**5,48**
Water	**6**	**0,83**	**0,72**	**0,71**	**0,33**	**0,33**	**1,02**	**1,48**	**1,51**
buildings & yards	8	0,42	0,30	0,40	0,19	0,19	0,81	1,30	1,29
paved road	8	2,16	1,78	1,70	2,52	2,51	3,12	3,01	2,81
Partition in Decay	8				0,06	0,05			
Scrub	8				0,81	0,81			
Heath	8						7,10	2,28	2,96
Marsh	8						0,09	-	-

In the Netherlands and Great Britain the area of *buildings & yards* (Table 14) is rather constant with small fluctuations and a tendency to decrease. Only in Denmark the buildings increase with the increase of agriculturally used land in the period 1971-1985. In the NL the buildings are concentrated near the *paved roads* closest situated near the village Vlagtwedde. In general the stability of buildings indicate that these areas are remaining in agricultural use. No signs of suburbanisation (increase) or land abandonment (decrease) are seen yet.

In the English study area the number of solitary trees does not change over the years. Even in the different sample squares the number and location of solitary trees stays the same. In this area solitary trees is not restricted to one single tree but to an open woodlot consisting of several big trees with grazed grassland underneath. These are very distinct features in the landscape.

In the Dutch study area there is an overall decrease of length and number of tree rows and solitary trees (table 15). In this area tree rows are mainly restricted to a line of trees on a regular distance along roads. The decrease of these tree rows is therefore related to the decrease of roads. A very strong decrease in solitary trees is observed. A reason can be found in the problems that solitary trees cause in using modern machinery. In Denmark the number of tree rows remained stable after a decrease in the period 1971-1985 and its length increased. Tree rows in this area are mainly restricted to shelterbelts originally a one row of Picea glauca which is nowadays often replaced by 3 to 5-rows of deciduous trees and scrubs. These tree rows are for a large part related to the scale of the agricultural land. Although the number of solitary trees in Denmark fluctuates, there is a net increase due to plantings after 1985. These plantings are partly based on joined planning, partly private initiatives of mainly hobby farmers (Primdahl 1999)

Table 15 Changes in tree rows and solitary trees in the Netherlands and Denmark (Class 6).

Linear and point elements	NL 1968	NL 1982	NL 1997	DK 1971	DK 1985	DK 1993
Tree rows (meters)	14011	11394	9796	22953	22469	22974
Number	108	87	78	126	116	118
Average length (meters)	565	632	567	929	1050	1031
Solitary trees (number)	221	104	10	50	66	58

4.3 Conclusions

When looking at the changes in the five sample squares in the Netherlands (table 6) three major changes can be distinguished namely:

1. An increase in *deciduous woodland* is replacing mainly a decrease in *other woodland* or from agricultural land (mainly *grassland*) and roads;
2. A decrease of *dirt roads*, which almost disappear, going to agricultural land (*arable & grassland*) and woodland or the *dirt roads* get paved or become a *path*. However *paved roads* show a general decline towards agricultural land and *deciduous woodland*;
3. A decrease of *water* going towards *arable and grassland*.

Most other categories are fluctuating having a net decrease mainly going into *arable and grassland* and *deciduous woodland*. *Arable and grassland* show a small net increase coming from all categories but mainly *dirt road* and *water*.

In the Netherlands there is an increase in agricultural land between 1968 and 1982 (3%). In 1997 the area is more or less the same as in 1982. Most changes are within or going to agricultural land. Of all categories only *arable and grassland* and *deciduous woodland* show a net increase. The increase in *deciduous woodland* comes from all categories. In 1997 almost a quarter of the remaining *dirt roads* have been paved. In general the changes within the squares in The Netherlands are small. There is a strong fluctuation in crops, but only relatively small changes in the non-farmed features. However, only small areas of farmland are changed into non-farmland.

The causes behind the changes can be explained by two events. Firstly there has been a reallotment and farm improvement project in the past. This is the cause of the decrease in ditches, roads and probably also solitary trees. It has also caused parcels (patches) to become larger.

Secondly part of the study area is designated as part of the National Ecological Network (NEN). The increase in *deciduous woodland* is caused by the fact that those squares belong to a core area of the National Ecological Network (NEN) namely the river valley of the Ruiten A. The two main trends for areas within the NEN are increase in *deciduous woodland*.

When looking at the changes in the sample squares in Great Britain it is clear that there are very little changes, most squares do not change at all. In one square there is *partition in decay*, due to the fact that most land is owned by the two old farmers of

Murray Hall who have hired a family member to manage the farm activities. Most changes are between *rough grassland* and *deciduous woodland* showing a small increase in *rough grassland.* The changes in Great Britain are similar in magnitude. Arable and grassland swap some area with rough grassland and paved road resulting in a net decrease.

When analysing the changes in the Danish sample squares, most appear to take place between 1971 and 1985, whereas most land cover categories are very stable between 1985 and 1993. The main change is the decrease in wet pasture, which takes mainly place between 1971 and 1985, going mainly to arable and grassland. At the same time dirt roads are changing into to arable and grassland and paved roads; a small increase in other woodland, a decrease in heath which takes place between 1971 and 1985 going to arable and grassland and some to other woodland and wet pasture. Together with the wet pastures also the area of open water declines mainly place between 1971 and 1985.

The conclusion is that farmland features are different in the three countries and the dynamics are also different. The farming system in GB is in the period under investigation very stable, while in both Denmark and the Netherlands rather strong changes take place. Despite the high percentage of agricultural land the agricultural land cover increases in the squares in the Netherlands. However, this is not in accordance with the general trend in the Netherlands where urbanisation and nature redevelopment is developing on the cost of agricultural land. The sites are situated in areas with stable agricultural development. The developments here are therefore considered representing rural developments and not rural-urban fringe developments. In Denmark land still is being developed for agricultural use. There is an obvious difference between the Netherlands and Denmark in the development of linear features, a decrease in the Netherlands and a stable situation in Denmark. However, also in Denmark there seems to be a great internal dynamics; trees are removed on one place and more are planted elsewhere (Primdahl 1999).

5 Results of field visits to analyse the distribution, density and diversity of farmland features

5.1 Introduction

In order to provide additional information on the distribution, density and diversity of farmland features in Europe field visits were made to several parts of Europe for this study. An inventory was made of all farmland features in km squares in different agricultural landscapes (& environmental zones). The field data could not be collected as intensively as in the NILS project or the SINUS project due to the restricted resources available for this project and the need for developing a consistent approach. However as the field visits were explicitly focused on farmland features they better reflect the diversity that can be found in agricultural landscapes.

In all the field visits elements which were formerly on farmland but which are now in units which have been long abandoned e.g. walls, and terraces in scrub, have been excluded, as have other larger scale habitats on unfarmed land e.g. streams in forests and grass rides in woodlands. Fences and telegraph poles have not been included if they do not have different vegetation beside them because they are otherwise not considered to have implications for biodiversity.

The rules that have been used in the field are as follows. Patches are considered if over 400m^2, linear elements over 30m length and points less than either of these measurements (table 14). Over 30% cover of woody or scrub species is needed to be included as scrub and forest. Mixtures of categories, as described by Bunce et al (2005), have been excluded for simplicity and the name used in the present document is included first with equivalents afterwards. Short comments have also been added to indicate landscape context. Table 16 shows the coding system (per km^2). This coding system is used as complete quantification was impossible in the time available for the project. It gives a logarithmic ordinal scale that allows semi-quantitative conclusions. The field visits can be done in reasonable time to allow collecting a sufficiently big sample.

Table 16. Codes and related measures of features to be included in the inventory of unfarmed features.

Code:	Patch features	Linear features	Point features
1:	400-100 m^2	30-700 m	1-3
2:	100- 1ha	700-3000 m	4-20
3:	>1 ha	>3000 m	>20

The Environmental Zones that have been sampled are Nemoral, Atlantic North, Atlantic Central, Lusitanean, Alpine South, Mediterranean Mountains, Mediterranean North and Mediterranean South. The countries involved have been Sweden, United Kingdom, the Netherlands, France and Spain.

5.2 Stock in farmland features based on field visits

The Nemoral Zone (Table 17) has been visited in six squares in Sweden and is represented by six squares. The visits have been made with the researchers working in the NILS project. For a description of the squares see Annex 1.

It can be concluded that the frequency and abundance of farmland features are linked to certain landscapes and that some environmental zones are richer than others. The inventory done here has only covered a restricted number of squares that are not considered to represent the whole zone. However, they give an impression of the richness and the diversity of the agricultural landscapes in the European Union and the importance of farmland features, especially linear features. The results of the field visits are given in Table 17 - 24

In Sweden, Spain and in Great Britain it was clear that many landscape units contained several individual unfarmed features e.g. grass, scrub and trees. Attention therefore needs to be paid in due course as to how these units can be managed to maintain the different features-the comments in the tables next to the categories are a first attempt to provide such context.

The matrix in the Nemoral Zone is made by arable crops and grassland and the land is rather open. There is little abandonment, although it is visible in the field. Patches are mainly field corners, small woods and occasionally grass strips between fields. More dominant are the linear features, grassland strips and tree lines. Point features are important here; mainly small field corners (comparable with the patches but small), scattered trees and boulders.

The Atlantic North Zone has been visited in five squares in England (Lake district) and five squares in Northern Ireland (Table 18). For a description of the squares see Annex 1. Crops are found in these squares but less common than in Nemoral and other zones. Most squares are dominated by grassland. There are not many unfarmed patches. Dominant are however linear features such as walls, hedges and tree lines adjacent to fields. Point features are not very abundant and are mainly small wetlands and trees.

Atlantic Central is situated in north-western France, southern England, Belgium and the southern part of the Netherlands. Only the Netherlands and France have been visited and the urbanised heart of Atlantic Central is not included. Two squares in France and four squares in the Netherlands have been included (Table 19). For a description of the squares see Annex 1. The matrix is made up by either crops or grasslands. In many places the land is dominated by one type of farming. Only in traditional small scale landscapes there is a strong mix (Oud Ootmarsum). These landscapes are rich in linear and point features. The uniform landscapes also have little variation in non-farmed features (grass strips or ditches and streams). This zone shows that man-made variation is still huge within the zones and requires further attention.

Table 17 Farmland features in the Nemoral Zone

Nemoral 2008		**Strasatter**	**Near Strangas**	**Malmslo**	**Nyongo**	**Enebi**	**Vasby**
Areal	**Category**	**Area**	**area**	**area**	**area**	**Area**	**Area**
Class 1	Crops *(ploughed, wheat, barley)*	0	3	3	0	0	0
	Grassland *(grazed/hay/silage)*	3	0	0	3	0	0
	grassland *(mown/set aside)*	3	0	0	0	0	0
Class 2	grassland *(horses)*	0	0	3	0	0	0
Class 6	Wetland/marshland	2	0	0	0	0	3
	Grassland *(recently abandoned)*	2	0	0	0	3	3
	Grassland (*bank below fields)*	0	2	1	1	2	0
	Grassland *(between fields/corners)*	2	2	1	2	2	0
	Mid scrub *(in grassland patches/islets)*	0	1	1	2	2	3
	small woods *(islets and strips)*	2	2	1	2	2	2
Class 8	Urban	1	3	1	2	2	2
	Forest	3	3	3	3	3	3
Linear	**Category**	**length**	**length**	**length**	**length**	**length**	**Length**
Class 6	stream *(+ grass bank)*	2	0	1	1	0	0
	wet ditch	2	0	0	2	2	0
	grassland *(between vineyards/fields/dry ditches)*	3	3	3	3	0	0
	grassland (*strips/banks between fields)*	1	0	0	0	0	0
	tall scrub	0	0	1	2	0	0
	trees *(adjacent to vineyard/fields)*	0	2	2	0	0	2
Class 7	grassland *(roadside verge)*	3	3	2	2	2	2
	grassland (*roadside dry ditch)*	2	2	3	2	2	2
:	grassland *(roadside banks)*	3	0	0	0	0	0
Points	**Category**	**number**	**number**	**number**	**number**	**number**	**Number**
Class 5	Woody crop (*Olive trees/almonds, fruit trees)*	0	1	0	0	0	0
	grassland *(Field corner)*	2	3	2	3	3	0
Class 6	rock outcrops/boulders	1	1	1	1	1	1
	Marshland	0	1	0	0	1	0
	low scrub *(in grassland patches/fields)*	2	1	2	2	1	0
	mid scrub *(in grassland patches/fields)*	0	1	2	2	2	0
	tall scrub (in grassland patches/fields)	0	2	2	1	1	0
	trees (in field)	3	3	3	2	2	0

Table 18 Farmland features in Atlantic North

		Meathop	Witherslack	New Hutton	Arkholme	Borrowbeck	Shap Fell	Rope bridge	Ballycastle	Ballymoney	Loch Earn	Fermannagh	Derrygonally
Atlantic north 20008		**area**	**area**	**area**	**area**	**area**	**area**	**area**	**area**	**area**	**area**	**area**	**area**
Areal	**Category**												
Class 1	Crop	3	0	0	0	0	0	0	0	0	0	0	0
	grassland *(grazed/silage)*	3	3	3	3	2	0	3	3	3	3	0	3
	grassland (saltmarsh)	2	0	0	0	0	0	0	0	0	0	0	0
	mid scrub (grazed)	0	0	0	0	0	0	2	2	0	0	0	0
	tall scrub (grazed)	0	0	0	0	0	0	0	2	0	0	0	1
	forest (grazed)	1	2	0	1	2	0	0	0	0	0	0	0
.	grassland horses	3	2	3	0	0	0	2	2	0	0	0	0
Class 3	grassland (open mountainside)	0	0	0	0	3	3	0	0	0	0	0	3
	low scrub (grazed heather)	0	0	0	0	0	3	0	0	0	0	0	0
Class 6	small lake	1	1	2	0	0	0	0	0	0	0	0	0
	grassland (bank below fields)	1	1	0	0	0	0	0	0	0	0	0	0
	dwarf scrub (lightly grazed)	0	0	0	1	2	0	0	0	0	0	0	0
	small woods	1	2	1	2	2	0	0	0	0	0	0	0
Class 8	Urban	3	2	2	2	1	1	2	2	2	1	1	2
	Rock	1	1	0	0	2	3	3	0	0	0	0	2
	River	2	0	0	0	2	2	0	0	0	0	0	0
	large lake	0	0	0	0	0	0	0	0	0	3	0	0
	Mid scrub	0	0	0	0	0	0	2	0	0	1	0	2
	Tall scrub	0	0	0	0	0	0	2	0	0	1	1	2
	Forest	3	3	2	3	3	3	0	2	0	3	3	3
Linear	**Category**	**length**	**length**	**length**	**length**	**length**	**length**	**length**	**length**	**length**	**length**	**length**	**length**
Class 5	woody cops (line of fruit trees)	0	1	0	0	0	0	0	0	0	0	0	0
	walls (fields and vineyards)	1	3	3	1	3	2	2	0	0	0	0	1
	grass track	0	0	0	0	0	0	0	1	2	1	0	0
	tall scrub (hedge)	3	3	1	3	0	0	2	3	3	1	0	2
Class 6	sparsely vegetated *(dry river bed)*	0	0	0	0	0	0	0	0	0	1	2	2
	stream *(+ grass bank)*	2	2	0	1	2	2						
	wet ditch	2	0	0	0	0	0	0	0	0	0	0	2
	grassland *(strips/banks between fields)*	2	0	0	0	0	0	0	2	2	1	0	0
	Grass track *(incl. cañadas)*	0	1	2	1	0	0	0	0	0	0	0	0
	low scrub-*(between fields/vineyards)*	0	0	0	0	0	0	0	0	0	2	0	2
	tall scrub (next to vineyards/fields)	1	0	0	1	1	0	0	0	2	2	1	1
	trees *(adjacent to vineyard/fields)*	3	3	2	1	0	0	0	0	2	0	1	2
Class 7	grassland *(roadside verge)*	2	2	3	2	2	0	0	0	0	0	0	0
:	grassland *(roadside banks)*	0	2	0	0	0	0	0	0	0	0	0	0
points	**Category**	**number**	**number**	**number**	**number**	**number**	**number**	**number**	**number**	**number**	**number**	**number**	**number**
Class 5	grassland *(Field corner)*	1	1	0	0	0	0						
Class 6	Marshland	0	2	1	1	2	1						
	mid scrub *(in grassland patches/fields)*	0	0	1	1	1	0						
	tall scrub (in grassland patches/fields)	0	3	0	0	1	0	0	1	0	1	0	0
	trees (in field)	1	3	1	1	3	0						
	trees (in hedges and edges)	1	3	2	0	0	0	0	1	2	2	0	2
Class 8	Boulders	0	0	0	0	2	2						
	tall scrub	1	1	2	0	0	0						
	Trees	2	2	2	2	0	0						

Table 19 Farmland features in Atlantic Central

Atlantic Central 2008		Levroux	south of Levroux	Binnenveld	Oud Ootmarsum	Lower Rhine	Arkemheen
Areal	**Category**	**Area**	**area**	**area**	**area**	**area**	**area**
Class 1	Crop	3	3	3	2	0	0
	Woody crop - *Vineyards/orchards*	0	0	0		3	0
	Grassland *(grazed/silage)*	0	0	3	3	3	3
	Grassland *(mown-set aside)*	3	2	0		0	0
Class 2	Grassland horses	3	0	3	1	3	0
Class 6	small lake	0	0	0		3	0
	Wetland	0	0	2		2	3
	small woods	1	1	1	3	2	1
Class 8	Urban	3	2	2	1	3	0
	River	0	0	0		3	0
	Forest	3	3	0	2	0	0
Linear	**Category**	**Length**	**length**	**length**	**Length**	**length**	**length**
Class 5	grass (mown wood edge)	2	0	0	2	0	0
	grass track	2	2	1	2	3	0
	tall scrub (hedge)	2	2	0	3	0	0
	line of pollards	0	0	2	1	2	0
Class 6	stream *(+ grass bank)*	0	0	3	2	1	3
	wet ditch	0	0	3	3	3	3
	grassland *(between vineyards/fields/dry ditches)*	2	2	2	0	0	0
	Grassland (*strips/banks between fields)*	2	2	2		0	0
	Grass track *(incl. cañadas)*	0	0	1	2	0	2
	low scrub-*(between fields/vineyards)*	1	0	0		0	0
	mid scrub*(brambles between fields/vineyards)*	0	0	1	1	0	0
	trees *(adjacent to vineyard/fields)*	1	2	0	0	3	0
Class 7	grassland *(roadside verge)*	2	2	3	2	3	0
	grassland (*roadside dry ditch)*	2	2	2	2	0	0
:	grassland *(roadside banks)*	0	0	0	0	0	0
points	**Category**	**number**	**number**	**number**	**Number**	**number**	**number**
Class 5	Pond	1	0	0	1	0	0
	grassland *(Field corner)*	1	1	0	2	0	0
	Trees *(Pollarded, Candelabra)*	0	0	0	1	2	0
Class 6	low scrub *(in grassland patches/fields)*	0	1	0	0	0	0
	mid scrub *(in grassland patches/fields)*	1	1	0	2	0	0
	tall scrub (in grassland patches/fields)	0	1	0	0	0	0
	trees (in field)	1	0	0	3	0	0
	trees (in hedges and edges)	0	1	2	3	3	0

The Alpine South Zone covers the mountain ranges in Europe south of Scandinavia. It includes the high peaks of the German mountains as well as the highest peaks of the Cantabrian Mountains. Four squares have been visited in the Cantabrian Mountains (Table 20). For a description of the squares see Annex 1. As in most mountain ranges grassland dominates here. This is in accordance with the data from SINUS and SISPARES. Abandonment takes place in mountains; therefore patches with recently abandoned or at least grassland not used in the last years can be found scattered on the steeper slopes. Also grazed scrub (heathlands) is found here as well.
Linear features differ from the northern zones by more abundant presence of walls, hedges and scrub and tree lines. In the Cantabrian Mountains terrace walls can be found as an indication that it is close to the Mediterranean mountain. In some squares lines of trees are prominent as candelabras, a regional way of harvesting leaves of ash (Fraxinus angustifolia) as fodder. This habit is going extinct at present. Streams occur, but ditches are less prominent. Solitary trees (fruit trees and field trees and trees in hedges) are common.

Table 20. Farmland features in Alpine South

Alpine South 2008		**Espinama**	**Bodia**	**Besoy**	**Posada de Valdeon**
Areal	**Category**	**area**	**area**	**area**	**area**
Class 1	Crop	0	0	3	0
	grassland *(grazed/silage)*	3	3	3	3
	low scrub (grazed)	1	1	1	0
	tall scrub (grazed)	1	0	0	1
	forest (grazed)	0	1	2	1
Class 6	grassland (recently abandoned <5years)	2	2	0	2
	grassland (between fields)	1	1	0	1
	mid scrub (lightly grazed)	2	2	1	1
	small woods	1	2	2	2
Class 8	Urban	1	2	2	2
	River	0	0	0	2
	Mid scrub	1	0	0	2
	Tall scrub	2	0	0	2
	Forest	3	3	3	3
Linear	**Category**	**length**	**length**	**length**	**length**
Class 5	woody cops (line of fruit trees)	0	2	1	0
	terrace walls	3	2	2	2
	walls (fields and vineyards)	0	0	1	2
	tall scrub (hedge)	0	2	1	0
Class 6	stream *(+ grass bank)*	2	2	0	1
	wet ditch	0	1	0	0
	grassland (*strips/banks between fields)*	0	1	0	0
	Grass track *(incl. cañadas)*	0	2	2	0
	low scrub-*(between fields/vineyards)*	0	1	0	0
	mid scrub*(brambles between fields/vineyards)*	1	1	1	1
	tall scrub (next to vineyards/fields)	3	0	2	2
	Trees (*adjacent to fields)*	2	1	2	2
Class 7	grassland *(roadside verge)*	0	2	1	2
:	grassland *(roadside banks)*	0	2	1	2
	tall scrub *(river bank, roadside)*	3	0	0	0
	trees *(river bank roadside)*	2	2	0	2
Points	**Category**	**number**	**number**	**number**	**number**
Class 5	Woody crop (*Olive trees/almonds, fruit trees)*	0	2	2	1
	Pond	0	1	0	0
	grassland *(Field corner)*	0	1	1	0
	Trees *(Pollarded, Candelabra)*	0	2	2	1
Class 6	low scrub *(in grassland patches/fields)*	1	2	1	1
	mid scrub *(in grassland patches/fields)*	2	1	1	2
	tall scrub (in grassland patches/fields)	1	2	1	1
	trees (in field)	1	1	2	0
	trees (in hedges and edges)	2	3	2	3

In the Lusitanean zone two squares have been visited in south-western France and three in north-western Spain (Table 21). For a description of the squares see Annex 1. Grasslands dominate the matrix in this zone as it is the southern continuation of the Atlantic Zones. There is grazed scrub in different heights as the southern heathlands get much taller than the northern heathlands. Abandonment indicators (not recently grazed grassland) are rare. Linear features are many of which tree lines are the most obvious. Other important linear features are walls and grass strips.
Point features are not very abundant but especially trees (fruit trees, field trees and trees in hedges) do occur.

Table 21 Farmland features in Lusitanean Zone

Lusitanean 2008		**near Perigeux**	**near Orthes**	**near Elizando**	**near Cabazon**	**near Santander**
Areal	**Category**	**area**	**area**	**area**	**area**	**area**
Class 1	Crop	3	0	0	0	0
	Woody crop –*Vineyards*	2	0	0	0	2
	grassland *(grazed/silage)*	3	3	3	2	3
	mid scrub (grazed)	0	0	2	0	0
	tall scrub (grazed)	0	2	1	0	0
	grazed forest	0	2	0	0	1
Class 6	Wetland	0	1	0	0	0
	grassland (recently abandoned <5years)	0	2	0	0	2
	dwarf scrub (lightly grazed)	0	0	2	0	1
	small woods	1	1	2	0	1
Class 8	Urban	2	2	2	1	2
	River	0	2	0	2	0
	Forest	3	3	3	3	3
Linear	**Category**	**length**	**length**	**length**	**length**	**length**
Class 5	walls (fields and vineyards)	0	0	3	2	2
	line of pollards	0	2	0	0	0
Class 6	stream *(+ grass bank)*	0	1	2	2	2
	wet ditch	0	1	0	0	0
	grassland *(between vineyards/fields/dry ditches)*	2	0	0	0	0
	grassland (*strips/banks between fields)*	2	2	2	0	1
	Grass track *(incl. cañadas)*	0	0	2	0	0
	low scrub-*(between vineyards)*	0	2	0	0	0
	mid scrub*(brambles between fields/vineyards)*	0	2	2	0	1
	tall scrub (next to vineyards/fields)	1	1	2	0	1
	trees *(adjacent to vineyard/fields)*	2	3	3	3	2
Class 7	grassland *(roadside verge)*	2	3	2	2	2
	grassland (*roadside dry ditch)*	1	2	0	0	0
:	grassland *(roadside banks)*	1	2	2	2	2
Class 8	mid scrub (*river bank, roadside*	0	0	0	3	0
	tall scrub (*river bank, roadside)*	0	0	0	3	0
	trees *(river bank roadside)*	1	2	2	3	2
points	**Category**	**number**	**number**	**number**	**number**	**number**
Class 5	Woody crop (*Olive trees/almonds, fruit trees)*	3	0	0	0	1
	grassland *(Field corner)*	1	0	0	0	0
	Trees *(Pollarded, Candelabra)*	0	0	0	0	1
Class 6	rock outcrops/boulders	0	1	0	0	0
	mid scrub *(in grassland patches/fields)*	0	1	2	0	2
	tall scrub (in grassland patches/fields)	1	0	2	0	1
	trees (in field)	1	2	1	1	1
	trees (in hedges and edges)	0	2	3	0	2
Class 8	tall scrub	0	0	0	3	0
	Trees	0	0	0	0	2

The Mediterranean Mountain zone has been visited in three squares Spain (Table 22). For a description of the squares see Annex 1. As in Alpine South the matrix is dominated by grassland, but also vineyards do occur regularly. The linear features are prominent by walls, both between fields and terrace walls. Streams are present as well.

Point features do occur regularly, mainly as solitary trees, both fruit trees and solitary trees in the field.

Table 22 Farmland features in Mediterranean Mountains

Mediterranean Mountains		**Navaluenga**	**Valsordo**	**Torreledonas**
Areal	**Category**	**Area**	**Area**	**Area**
Class 1	Woody crop (*vineyard*)	0	3	0
	Grassland (*grazed*)	3	3	3
	Forest (*grazed*)	0	0	3
Class 2	Tall scrub (*grazed*)	0	0	3
	Low scrub (*grazed*)	3	0	2
Class 6	Lake	0	2	0
	Wetland	1	0	0
	Grassland (*recently abandoned*)	0	2	0
	Dwarf scrub (*occasionally grazed*)	3	0	2
Class 8	Urban	2	1	1
	Freshwater (*river)*	0	2	0
	Aquatic vegetation	0	2	0
	Low scrub	2	2	3
	Mid scrub	3	3	3
	Tall scrub	3	3	3
	Forest	3	3	3
Linear	**Category**	**Length**	**Length**	**Length**
Class 5	terrace walls	0	2	0
	walls (*fields & vineyards*)	2	1	0
	grass track	0	0	2
Class 6	trees *(adjacent to vineyard/fields)*	3	2	1
	grassland *(between vineyards)*	0	2	0
	stream	2	1	0
Class 7	grass- roadside verge,	2	0	0
Points	**Category**	**number**	**number**	**number**
Class 5	Woody crop (*Olive trees/almonds*)	0	2	0
	Trees (pollard)	2	0	0
	Pond	0	1	0
Class 6	low scrub	2	0	2
	mid scrub	0	1	3
	tall scrub	2	2	2
	trees	0	2	0
Class 8	boulders	2	3	3

In Mediterranean North three squares have been visited in Spain (Table 23). For a description of the squares see Annex 1. The matrix is a mixture of arable crops, vineyards and some grassland. Dehesa is a special part of the Mediterranean North matrix as a combination of woody crops (cork and acorns) and grassland. The main unfarmed features are small parts of recently abandoned or fallow land. There are

many linear features such as tree lines, grass tracks and hedges of different sizes from low to tall.

There are several solitary olive trees and oak trees partly in use, partly not influenced by agriculture. There are also many small patches of unused grasslands on those places that are not well accessible with agricultural tools. Some of these small patches have changed into small scrubby bushes.

Table 23. Farmland features in Mediterranean North

Mediterranean North		**Almorox**	**Cadalso**	**Navalcarnero**
Areal	**Category**	**Area**	**Area**	**Area**
Class 1	Crop	3	0	3
	Woody crop -*Vineyards*	0	3	3
	Annual *fallow*	3	0	3
	grassland (grazed)	3	3	3
	Dehesa/grazed forest	3	3	0
Class 2	grassland (game management)	0	3	0
Class 4.	grassland	3	0	3
Class 6	grassland (recently abandoned 5 years)	3	0	3
	fresh water (river)	2	0	0
Class 8	Urban	3	3	3
	rock	0	3	0
	Dwarf scrub-*abandoned vineyard*	0	3	0
	Low scrub- *abandoned vineyard*	0	3	0
	Grass-annuals-*abandoned vineyards*	0	2	0
	Mid scrub	0	3	3
	Tall scrub	0	3	3
	forest	3	3	3
linear	**Category**	**length**	**length**	**Length**
Class 1	grassland, between vines	0	0	2
Class 5	terrace walls	0	2	0
	walls	1	1	0
Class 6	trees *(adjacent to vineyard/fields)*	2	2	0
	grassland *(between vineyards)*	0	3	0
	mid scrub*(brambles between vineyards)*	0	3	0
	low scrub-*(between vineyards)*	0	3	0
	grass (strips/banks between fields)	3	0	3
	Grass track	2	2	2
	rock-dry river bed,	1	1	0
	urban constructed-ruined wall	2	0	0
Class 7	grass- roadside verge,	3	3	0
	grass -dry ditch	3	3	0
:	grass-roadside banks,	1	0	0
Class 8	tall scrub – river bank,	2	0	0
	mid scrub - river bank	2	0	0
points	**Category**	**number**	**number**	**Number**
Class 5	Woody crop (Olive trees)	3	0	0
	Trees (Oak)	3	0	0
	grass	1	2	2
Class 6	Dwarf scrub	1	2	1
	low scrub	1	2	3
	mid scrub	1	1	3
	tall scrub	1	1	3
	trees	3	3	3
Class 8	boulders	2	3	0
	tall scrub	3	3	0
	Trees	0	3	0

In Mediterranean South four squares have been visited (Table 24). For a description of the squares see Annex 1. There is not much grassland here. The matrix is mainly made up of crops (inland) and scrub that is partly grazed (Class 2) and partly ungrazed (class 8).

Linear features do occur and are mainly boundaries between fields in the form of grassland strips or scrub strips of different heights. River beds are mostly dry as rivers are intermittent. They are characterised by rocks and boulders. Point features are rare.

Table 24. Farmland features in Mediterranean South

Mediterranean South		**Aljete**	**Coast las Negras**	**Inland las Negras**	**Hills Cabo da Gata**
Areal	**Category**	**Area**	**Area**	**Area**	**Area**
Class 1	Crops	3	2	0	0
	Woody crop (vineyard/olives)	3	0	0	0
	Grassland (grazed)	1	0	2	0
Class 2	Low scrub (grazed)	0	3	3	3
Class 6	Grassland (recently abandoned)	2	0	0	0
	Grassland (bank below fields)	2	0	0	0
	Grassland (between fields)	2	0	0	0
	Mid scrub (in grassland patches)	1	0	0	0
	Tall scrub (in grassland patches)	3	0	0	2
Class 8	Low scrub	0	3	0	3
	Mid scrub	0	3	3	3
	Tall scrub	0	2	3	3
	Forest	2	0	0	0
	Bare rock *(sea & inland cliff)*	0	3	0	2
Linear	**Category**	**length**	**length**	**length**	**length**
Class 6	trees *(adjacent to vineyard/fields)*	0	0	2	0
	grassland *(between vineyards/fields)*	3	0	2	0
	Grass (*strips/banks between fields)*	1	0	1	0
	Grass track *(incl. cañadas)*	2	0	0	0
	stream *(+ grass bank)*	2	0	0	0
	rock-dry river bed,	2	2	1	0
Class 8	tall scrub – river bank,	2	0	0	0
	Trees	1	0	1	0
Points	**Category**	**number**	**number**	**number**	**number**
Class 5	Pond	1	0	0	0
Class 6	mid scrub (in grassland patches)	3	0	0	0
	tall scrub	3	0	0	0
Class 8	Boulders	0	3	3	3

5.3 Conclusions

In the early tables all individual records were included. However, this resulted in very large tables that were difficult to assimilate and link to the features being identified in the rest of the project. An overview of the frequency features and number of squares visited is given in Table 25. Table 25 summarises the habitats that were recorded in

the field in the eight environmental zones. Linear features have by far the highest representation with patch features being the lowest. This result shows the high importance of linear and point features in cultural landscapes.

The absence of patch features Class 5 (managed directly, but not for production) and the relatively low frequency of linear point features Class 5 indicates that in the landscapes visited the majority of land other than forest and urban is still farmed for producing crops and that garden like production systems and the use of fruit trees along fields is not common practice any more.

Abandonment is locally important in the mountains, the Mediterranean as well as in Sweden, but in Britain and the Netherlands it is very rare or even absent. In hill and mountain regions with open land the only large areas indirectly affected by farming are class 4 where occasional grazing animals occur.

Much land at high altitude has no farming at all. The most diverse range of features is found in Alpine South and Lusitanian, because of the wide range of altitudes, topographic conditions as well as contrasting agricultural patterns. The low figures for Mediterranean North and South probably do not reflect the actual diversity present, because there is a wide range of contrasts between regions within the Mediterranean (Blondel 2004). For example, in the context of the field visits conducted for this survey, terraces were not recorded in Mediterranean South, whereas in the Peloponnese in southern Greece and Tuscany (Central Italy) whole areas are dominated by such features. By contrast, from discussion with the NILS team, the Nemoral Zone does not have such high degree of intrazonal variation.

Table 25 Summary table of sample size and inventoried features in the different Environmental Zones depicted in Figure 4. The class 5 and class 6 refer to the classes defined in Table 2.

	Nemoral	**Atlantic North**	**Atlantic Central**	**Alpine South**	**Lusitanian**	**Mediterranean Mountains**	**Mediterranean North**	**Mediterranean South**	**Total**
Sample size	6	12	6	3	5	3	3	4	42
Patch class 5	0	0	0	0	0	0	0	0	0
Patch class 6	6	4	3	4	4	4	2	5	32
Linear class 5	0	4	4	4	2	3	2	0	19
Linear class 6	6	8	8	7	9	3	8	6	55
Point class 5	2	1	3	4	3	3	3	1	20
Point class 6	6	5	5	5	5	4	5	2	37
Total:	20	22	22	24	23	18	20	14	

Linear and point features are the dominant type of unfarmed features (Class 6). They make up the largest part of the farmland landscapes and in this way determine the landscape character. The structure of linear elements can be specific for an Environmental Zones, partly it can be general. Hedgerows and tree lines can be

found in all zones. The species composition and its management can be different for different parts of Europe. However, further analysis is required to determine this.

Walls do occur in all mountainous regions of Europe, from Ireland to Greece and from Spain to Sweden. They are absent in alluvial areas such as the Netherlands. On the other hand, terraces are specific for Mediterranean Mountain and Mediterranean North.

Point features can have the same characteristics as linear features. Pollarded trees have been seen everywhere, but there are specific ways for pollarding and there are also different tree species used. All mountains or former mountains have occasionally rocks and boulders that are also absent in alluvial areas. Also some features are rare in the Mediterranean such as ponds and water troughs; they have not been recorded in the limited number of squares covered and are more widespread in other zones.

Linear and point elements are also important reservoirs for biodiversity as shown for Great Britain by Bunce and Hallam (1996) and Haines Young et al (2000). As this report shows, the quantities of such features are partly in decline, partly recovering. Experience suggests that in countries such as Romania and Slovakia the resource remains high. Elsewhere in Europe Baudry (1993) for western France, Hermy and de Blust for Flanders (1998) and Fjellstadt et al (2001) for Norway. Haines Young et al (2000) also show that the quality such features is in decline indicating that policies are required to maintain the current biodiversity e.g. by encouraging farmers to manage them positively or to be more careful with indirect impacts such as spray drift. This is emphasised by the majority of both linear and point elements being indirectly affected by farming as opposed to being managed directly.

An important feature in the agricultural boundaries in the Nemoral Zone was the margin with the forest, which can consist of the following sequence: (1) managed field, (2) grass strip of 1m, occasionally mown, (3) dry ditch also occasionally mown, (4) forest 1-2m also occasionally mown and (5) forest. Categories 2, 3 and 4 were managed by the farmer to restrict expansion of shade into the field and are therefore class 5 (directly managed). The majority of forest margins adjacent to agricultural land in Sweden have this pattern and represent an important gradient between farmland and forest. Butterfly are utilising this strip as also seen on the day of the visit. These edges are detectable directly from the infrared photographs.

6 Recommendation

The inventory of farmland features has shown that there is a wealth of landscape diversity and cultural values present in the landscapes of Europe that have not yet been well explored. As these landscape elements, especially the small linear and point features are making the richness of the European landscape; it is worth to know their extent, trends and threats. Only fragmented knowledge is available on stock and change of these elements. Future touristic developments, outdoor recreation and the economy of the rural areas might be dependent on the attractiveness of these landscapes.

Linear and point features also are of great importance for agrobiodiversity as they are nesting, hiding and overwintering place for many species. They therefore could be contributing to the reaching the 2010 goals.

National inventory programmes are available for some countries. A European overview based on a sample collected in a comparable way as in Sweden, Austria or Great Britain would help to clarify this. Most projects analysed here have used the same basic approach. The work done in the Netherlands on the comparison of farmland features in three European regions also could help to develop additional methods for management and land dynamics.

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Appendix 1 Field Survey sites description

Nemoral Zone, Sweden

Starsatter (2008)
This square consisted of intensively managed short term grassland surrounded by forest. However there was also a gradient of varying sized patches mainly around the edge of the forest, from land which had been abandoned about six years, to areas that had scattered scrubs kept in check by mowing to patches where formerly individual trees were coalescing into forest, to islets (in the term used in the Swedish case study) that had been abandoned over 50 years ago. Whilst strictly speaking such islets should be surrounded by agricultural land several had now become joined to the forest because of the difficulty of ploughing the narrow separating strip.
An important feature was the margin of the forest which consisted of the following sequence: (1) managed field, (2) grass strip of 1m, occasionally mown, (3) dry ditch also occasionally mown, (4) forest 1-2m also occasionally mown and (5) forest. Categories 2, 3 and 4 were managed by the farmer to restrict expansion of shade into the field and are therefore class 5 (directly managed).

Near Strangas (2008)
The main part of this square consisted of arable land recently cultivated. There was also however, two large areas of forest as well as the edge of a township with some vacant land adjacent to the farmed area. The forest edge was sharp in comparison with the previous square but did have a dry ditch adjacent to the field. The edges of the fields were complex mixtures of linear and point features some of which were adjacent to the road which ran through the square. There were also several former islets which had now become promontories emerging into the fields. These contained mosaics of trees, various scrub categories and grassland. There was also an abandoned building with units adjacent to farmland which was included in class 5 as they were affected by farming. In comparison with the other sites visited in Sweden this landscape is likely to remain stable because of the high quality soils under arable with the forest likely to be from land abandoned probably in the 19th Century.

Malmsjo (2008)
This square seemed to be in a state of transition with non-agricultural parcels such as a golf course and riding school having arrived relatively recently. There was also a significant area still remaining under crops as well as some grassland and patches of forest. The ditches had strips of unmanaged grass beside them, including patches of scrub, and there were strips of grass between the arable fields, as well as in field corners.

Nyongo (2008)
The centre of the square was occupied by a traditional series of farm buildings with an elderly occupant. There was therefore the classic situation as to what will happen when a farmer retires. Throughout the square there was evidence of declining management intensity, although apart from the forest the land was still farmed. As with several of the squares features such as individual trees and small woodland patches formerly on agricultural land had merged with the large forest units and were no longer distinct. One field had not been used for about a year and there was an abandoned field. The second homes present had minimal influence.

Eneby (2008)
Throughout this square there were signs of declining use and abandonment. Unless there is an upturn in agriculture this site will no longer be used at all by agriculture in a few years. Several fields were abandoned grassland and the ditches were overgrown although some patches still had limited grazing. The various houses had minimal impact on the overall picture. There was also a large area of mature forest.

Vasby (2008)
This site was adjacent to a large lake and had an area of new housing as well as much forest. Throughout the square there was evidence of former agricultural use but now this had virtually ceased. About 30 years ago there would have been many unfarmed features but now these had merged into

forest patches or were no longer in managed fields. The site is therefore a good example of the decline in landscape level diversity following abandonment and in 20 years if the process is not reversed it will become forest.

Atlantic North

North-west England

Meathop (2008)
This square is on the edge of Morecambe bay and mainly consists of reclaimed salt marshes but also with an outcrop of carboniferous limestone in the centre. There is a small area of salt marsh and sand flats in the corner of the square. Most of the grassland is intensively managed and there is also a limited area of crops. There are some scattered residential houses and farm buildings.

Witherslack (2008)
This square is classical bocage with small fields and many hedgerows. The extensive woodlands were formerly managed for coppice produce and charcoal. The soils are generally shallow with rock outcropping in several places with declining grazing leading to small patches of scrub colonizing. There is also a stable with horses covering several hectares and the general impression is that agriculture here is under pressure. As such the many unfarmed features would be susceptible for change depending on the profitability of agriculture.

New Hutton (2008)
This square is on gently rolling moraines on an expose position at about 150m. Apart from a few small patches of woodland the square consists of intensively managed grasslands and apart from the two horse fields is likely to stay in agricultural use. There was a section of green lane and most of the boundaries were walls.

Arkholme (2008)
This square comprises rich farmland in the lower Lune valley although there are some less intensively used patches. The fields are fertile grassland but there are several small woodland patches and strips. Hedges are a prominent feature in the square which is on the edge of a village but this is not likely to expand on current planning guidelines. As with the previous square farming is likely to continue to be profitable here.

Barrow beck (2008)
This square is situated in a steep sided valley on the boundaries between the Lake District and Yorkshire Dales National Park at an altitude of about 250m. As such it is an excellent example of land which is traditionally marginal in agricultural terms as there is a small area of fields in the valley floor with the sides of the valley being open grazing used by sheep. The open grazings are on shallow soils and are often poorly drained so the forage quality is low. Such land is the most likely to be affected by falls in agricultural profitability but the recent upturn in prices could maintain the current level of grazing. The unfarmed features are probably quite stable as they are generally in small steep rocky areas by streams are on low cliffs

Shap Fell (2008)
This square is included to show the contrast between the sites with fields and many unfarmed features as compared with those that have completely open grasslands and heathlands. Such sites do not have comparable features to the filed systems because although they have many habitats such as streams and screes these are not part of the faming system. The exception is the walls which are an important feature of such landscapes.

Northern Ireland

Rope Bridge (2007)
A precipitous basalt slope dropping to the sea with a relatively level area at the upper limit of the square where the farm house and road are situated. The grass fields are relatively extensively grazed and there are sections of banks and walls showing previously more intensive use. The patches of scrub are still grazed but are probably expanding. The lower part of the square is a sea cliff with herb rich vegetation unused by agriculture and has the intensively used coastal footpath passing immediately above it.

Ballycastle (2007)
A gently sloping square but with some steeper banks and a few shallower soils where relatively low grazing pressure has led to scrub formation. In general however the site consists of highly fertile intensively used grassland mainly surrounded by hedges and walls.

Ballymoney (2007)
This square is almost flat and consists of intensively managed lowland grass surrounded by hedges although one of the fields is being invaded by rushes. The small fields and dense hedge network make the square effectively a bocage landscape although the biodiversity in the fields is low.

Lough Earn (2007)
This square is flat and adjacent to Lough Earn, one of the largest water bodies in Northern Ireland. A large part of the square is actually in the lake or occupied by wet woodlands along the shore. Only two of the fields are still managed relatively intensively whereas the others are virtually ungrazed and are returning to woodland.

Fermanagh (2007)
This square is on poor wet soils which have mainly been planted with Sitka spruce. The remaining land is used for extensive cattle grazing but could well be abandoned in the immediate future. The site is thus representative of marginal land on poor soils in the province-during the field work local abandonment was seen in several locations as well as evidence of declining intensity of use but only on the poorer soils

Derrygonely (2007)
The upper part of this square is a steep carboniferous limestone scarp that has largely been abandoned and is now covered in various stages of scrub. The lower part of the square is a mixture of intensively famed land and other fields which are probably changing from agricultural grass back to species-rich wet grasslands. The linear features are still generally well managed but some are overgrown. The square is likely to polarize between the intensively managed grasslands and areas which are undergoing extensification.

Atlantic Central

France

Levroux (2008)
This square was on the boundary between almost level lands dominated by crops with heavier, wetter soils where grassland predominated. Scattered farm house were present as well as a large medieval woodland surrounded by a bank and ditch as in Britain. Whilst most of the arable was intensively managed there was also some set-a-side and stabling for horses. This square is likely to be stable under almost any scenario.

South of Levroux (2008)
This square is a classic example of the cereal prairies of almost level land in central France, although there were some woodland patches. Some unfarmed features were however present and the site is very unlikely to change.

The Netherlands

Lower Rhine forelands (2008)
This square occupies level land beside the river and is regularly flooded in winter. The grazing pressure is not high and the many wet patches have various categories of trees and scrub. There are also managed elements from the cultural landscape which are still managed traditionally. There is also some hobby farming and horses. The structure of the landscape would change quite rapidly if abandonment took place or if there was a more pronounced shift to nature management as is the case in many river forelands. Alternatively increase in farm prices could lead to destruction of a currently rather varied landscape.

Binnenveld (2008)
This square is a typical gradient landscape between the Pleistocene moraines of the Veluwe and low peatlands. It is characterised by intensively managed grasslands intersected by ditches. The area is comparable to many such sites in East Anglia, Denmark and northern Germany. There is a tendency of changing from dairy farming into tree nurseries and suburban activities such as renting land for horse keeping. Farm and land prices are here the highest in Europe. As this part of Europe is highly urbanised and agricultural production is among the highest of Europe. Agricultural profits have to compete here with urban use.

Oud Ootmarsum (2007)
This square represents the lower Saxony landscape in the east part of the Netherlands. It is situated on the edges of the tertiary hills and consists of relatively intensively managed grassland (mainly dairy farming) with maize as a fodder crop on the traditionally higher situated arable fields. The landscape is dissected by small natural streams and rich in hedgerows. It is situated near the small town of Ootmarsum as shown by the presence of some horse grasslands.

Polder Arkemheen (2008)
This is a lowland peat on clay area along the former Zuiderzee. In the vegetation along the dike still brackish influences can be noticed. Large parts of this polder are now own by the State forestry and managed extensively. It is one of the main wintering sites of Bewicks' Swan in the Netherlands.

Lusitanean Zone

France

Near Perigeux (2008).
This square is on the edge of the Dordogne with its traditional small scale landscapes and fruit trees. The site is almost level and mainly occupied by intensively managed species poor grasslands. Fruit trees present included vines, walnuts and apples. A number of different trees were present but in comparison with the main part of the region there were relatively few features.

Near Orthez (2008)
This square is in the foothills of the Pyrenees and is in a river valley with steeper slopes leading to the higher ground. There are many linear features and the landscape which has the appearance of having a higher tree cover than the figures suggest. The steepest slopes in the square are in various stages of abandonment but otherwise the grasslands are intensively managed and species poor. The core area in the square is likely to remain in agricultural use but the steeper areas are likely to be further abandoned.

Spain

Near Elizondo (2008)
This square is just within Spain below a mountain pass of about 800m. The higher ground above the pass is no longer used by agriculture and all the steep slopes are forested. Most of the square however is intensively managed grassland but with isolated patches of scrub. There are many tree lines along

linear features such as the stream which runs through the centre of the square. The square thus looks to be stable with the unfarmed features under little threat.

Near Cabazon (2008)
This site was formerly visited as part of a sampling programme. It is representative of the sandstone mountains and hills of the coastal plain of north-west Spain in which agriculture is now only present in the valleys. The site consists of a narrow valley with a river, above which are steeper slopes now almost entirely forest. The few fields are intensive grassland but otherwise the formerly grazed forests with many ancient pollards are now no longer used. The higher slopes are occupied by complexes of heathlands, scrub and forest with many bracken covered slopes. As in many other sites therefore formerly managed features have now merged with the forest.

Near Santander (2008)
This square is on the coastal plain and is almost flat. In comparison with many other landscapes nearby this site was relatively poor in features. Intensively managed grasslands covered most of the square with small groups of farm buildings and some orchards.

Mediterranean Mountains

Navaluenga (2008)
This square is in a valley in the centre of the Gredos mountains north west of Madrid. The soils are shallow and acidic being derived from granite but there is a small stream running through the lower part of the square with some better soils. The small fields by the river are cut for hay in good years but otherwise are only grazed. The fields are surrounded by walls and have ancient Fraxinus pollards also present. The upper slopes in the square are now largely abandoned and covered by Cistus scrub or forest. The square is therefore in a state of flux and agriculture could disappear because of the low fertility-indeed much of the land at higher levels is now no longer used.

Valsordo (2008)
This square has a river running through it with some aquatic features but is mostly dry with a mixture of poor grazing and vineyards. Some of these have been abandoned but most are still in regular use. The rockiest areas are also not used by agriculture, so as in many of the sites visited polarization is occurring with the poorest soils being left unmanaged and the better conditions still being used quite intensively. A wide range of unfarmed features were present some of which were still being actively managed as in many traditional Mediterranean landscapes.

Torreledones
This square is gently sloping but the main feature are large outcrops of granite between which are very shallow acidic soils. Part of the square is intensively grazed by cattle that have controlled the expansion of Cistus. Adjacent to this area, which is fenced is a less intensively grazed area but still in regular use which has encroaching Cistus. Apart from a small recreation area the rest of the square is dense Cistus and virtually unused. If grazing disappears the whole area will revert rapidly to dense Cistus scrub but will be in a halted succession as the canopy is too dense for trees to colonise.

Mediterranean North, Spain

Almorox (2008)
This site is about 75 km from Madrid and was selected as a series of samples for testing survey methods and is not part of the SISPARES series. Most of the square slopes gently down to the river but in the north there is steeper land with shallow soils. During regular visits since 1998 the site has been seen to change with the extent of fallow land declining and abandoned land increasing. As in many areas of Europe it is the poorer soils which are being left first. Many of the parcels are however still grazed but the level of grazing is difficult to assess during one visit as much is seasonal in nature. The complex ownership would make measures to maintain the unfarmed features difficult to implement.

Cadalso los Vidrios (2008)
The site is about 85 kilometres north-west of Madrid. The topography is almost flat. Most of the square is covered by forest with large granite quarries present within them. There is also a large residence with extensive grounds. The rest of the square is divided between land which seems to be managed for game and small vineyards in various degrees of abandonment. Each small unit is in separate ownerships. These vineyards are too small to be included in agricultural statistics and from other work carried out previously the majority are managed by hobby farmers. There is a high level of biodiversity which is threatened by the decline in diversity of management and whilst domestic stock has used the verada (a small type of Canada now difficult to find) it seems likely that the whole area will become abandoned in the near future-a pattern which is widespread locally.

Navalcarnero (2008)
This site is now falls within the expanding urban area of Madrid and has some local developments which are probably illegal. Several fields were in various stages of colonization by scrub and the process is likely to accelerate. Many of the fields did however have signs of grazing and a herd of sheep was seen moving through the landscape. In common with the Aljete square in Mediterranean south there were a series of grassland patches between fields that also had trees and scrubs invading. There were also several different strips of grassland between vineyards and olive groves. Such strips are a common feature in many Mediterranean landscapes and are important reservoirs of biodiversity both for plants and insects.

Alpine South, Spain

Espinama (2008)
This square is in the valley bottom adjacent to the main road up the valley. As with many other parts of the Picos de Europa the fields with vehicular access are still intensively managed but the steeper slopes are in various stages of abandonment and are often difficult to asses as to whether they are still farmed on a single visit. The presence of scrubs provides a good indicator and there is little doubt that in a few years the situation will be similar to that in Sweden, where features previously on farmed land will become joined with the forest.
Bodia (2008)
The centre of this square is formed by the hamlet of Bodia which consist entirely of traditional houses in various states of disrepair and dereliction suggesting that the population is declining. The hamlet is about four kilometres from the main road along a narrow track so has not seen the improvement in the buildings as in villages with more ready access. The main fields are, however, still well managed but marginal areas are in varying stages of abandonment. There are some steep slopes but most the fields have vehicular access with forest on the steeper slopes. The forests also contain many trees that have been utilised by farmers in the past but which have now become incorporated into the forest. These forests would also have been grazed so there is increased polarization of farmed and unfarmed land that is likely to become more pronounced in future. The many fruit trees are hardly managed any more but were previously important.
Besoy (2008)
This square is about half a kilometre from the main road and is generally gently sloping although one corner is rather steep and there are also steep wooded slopes. There is a small group of well maintained houses and most of the fields are still in intensive use, favoured by ready access. Some of the steeper patches have grazed scrub and there is also some grazed forest but this is now much more restricted than in the past. Further pressure on the farming industry would lead to these areas being completely abandoned. A common feature of the valley is that most of the farmers are quite old and a principal question is what will happen when these men retire.
Posada de Valdeon (2008)
This square is in a steep high valley in the centre of the Picos de Europa. Whilst the valley bottom land is still quite intensively used the steeper slopes are becoming abandoned. An indicator of the pressure on farmers is the increasing number of horses being grown for meat because of the lower veterinary costs and need for supervision. As with many of the sites visited many formerly unfarmed features have now merged with the adjacent woodland parcels and the process is continuing. Further decline in grasslands is however unlikely as use is now restricted to the best fields.

Mediterranean South, Spain

Aljete near Madrid (2008)
This site is representative of the arable landscapes of the meseta both north and south of Madrid covering thousands of square kilometres. The Spanish landscapes in general do not have farms scattered through the countryside but rather the farmers are based in small villages although in the present case there was new urbanization on the edge of the square. The fields are generally large but often have steep banks between them as well as by watercourses which are often dry in summer. The site was gently sloping and at the highest point but outside the square is a large area of scrub. The old air photo showed this area to be formerly more open and almost certainly it was no longer grazed-a pattern repeated throughout Spain as showed by the expansion of scrub (matorral) in the SISPARES project. Originally the stock would have grazed the scrub in winter and spring and then moved through the stubble in summer and autumn but also would have grazed the patches of grassland on the steep banks. Also of interest in this site was a Via Pecuarias (a type of cañada). However as in many such cases it had been much degraded and generally only the access road was left apart from a strip of grassland about 100m by one of the fields.

Coast Las Negras (2007)
This site was a shallow bay backed by steep headlands. There was no sign of agriculture at all, with the village expanding into the countryside although there are some controls in the park. The site is therefore representative of Spanish coastal areas that were formerly grazed but are now largely abandoned.

Inland from Las Negras (2007)
The upper edge of the square consists of steep rocky hillsides that are no longer used by agriculture. The lower part of the site is formed by grazed fields and fallow with shallow poor stony soils. The farm buildings are partly derelict and the former gardens are abandoned suggesting that it will not be long before agriculture ceases. Plastic greenhouses are expanding rapidly on more level sites nearby and the lower edge of the square could change into such use. Such greenhouse areas have virtually no fragments of semi-natural vegetation left and are effectively urban. They cover probably several hundred square kilometres in Almeria. The site is therefore representative of many areas in southern Spain where traditional agriculture using grazing animals is in decline for various socio-economic reasons.

Low hills near Cabo da Gata village (2007)
These hills are covered by pre-desert scrub of various types with low productivity and which have probably been abandoned by agriculture for some considerable time.