HNV Indicators for Evaluation: Final report for DG Agriculture

FINAL REPORT FOR THE STUDY ON HNV INDICATORS FOR EVALUATION

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EXECUTIVE SUMMARY

The High Nature Value Concept

The High Nature Value (HNV) concept first emerged in 1993 and recognises the causality between certain types of farming activity and 'natural values' (Baldock *et al*., 1993). Typically, HNV farming systems are low intensity, low input systems, frequently with high structural diversity. In addition, the utilisation of semi natural vegetation by livestock, often in combination with the presence of other semi natural features, is a key characteristic of these systems. These systems and their associated features are beneficial to biodiversity, and support the presence of species and habitats of European, and/or national, and/or regional conservation concern.

Recently, the high nature value concept has been applied to forestry. On account of a combination of structural, compositional and functional characteristics, all natural, and a majority of semi-natural forests, when coupled with an ecologically sympathetic management regime (historical and present), can support high levels of biodiversity and thus can be considered HNV forests.

HNV Indicators in the CMEF

Under the EAFRD (Council Regulation 1698/2005), Member States receive Community support for agreed rural development programmes which should meet the Community's strategic objectives. The objective relating to High Nature Value Farming and Forestry is:

> "To protect and enhance the EU's natural resources and landscapes in rural areas, the resources devoted to axis 2 should contribute to three EU-level priority areas: biodiversity and the preservation and development of high nature value farming and forestry systems and traditional agricultural landscapes; water; and climate change." (Council Decision 2006/144/EC, OJ L 55/20, emphasis added).

Rural development programmes will be subject to a mid term and ex post evaluation in 2010 and 2015, respectively, to assess both the efficiency and effectiveness of rural development measures and the extent to which the objectives of the programme have been achieved. The Common Monitoring and Evaluation Framework (CMEF) provides a single framework for the monitoring and evaluation of all rural development interventions through the application of five sets of indicators.

There is a suite of indicators designed to measure whether the High Nature Value resource of a Member State is being preserved and maintained which are also enshrined in the Implementing Regulation (Commission Regulation 1974/2006).

> **Baseline Indicator 18**: Biodiversity: High nature value farmland and forestry, measured as UAA of HNV Farmland, in hectares.
>
> **Result Indicator 6**: Area under successful management contributing to biodiversity and HNV farming / forestry, measured as the total area of HNV Farmland and Forestry under successful land management, in hectares.
>
> **Impact Indicator 5**: Maintenance of HNV Farming and Forestry, measured as changes in High Nature Value areas and defined in terms of quantitative and qualitative changes.

Implicit Obligations on Member States

In order to meet the objective to preserve and enhance HNV Farming and Forestry systems and to conduct effective monitoring, there are a number of implicit obligations on Member States, including:

- Have measures in place to maintain their HNV Farming and Forests and Traditional Agricultural Landscapes;
- Apply Baseline Indicator 18 at the start of the rural development programme;
- Introduce indicators to measure the extent and quality of their HNV Farmland and Forests annually, from 2010, to the end of the rural development programme. These indicators will be a modified version of the Baseline Indicator, and relate to Impact Indicator 5 so that changes may be detected over time;
- Apply indicators to monitor the extent and quality of their HNV Farmland and Forests at the end of the rural development programme (Impact Indicator 5);
- Where appropriate, measure the extent (in hectares) of their Traditional Agricultural Landscapes over the period of the current rural programme;
- Appoint programme evaluators to evaluate the extent to which the programme objectives have been achieved.

Definitions of Key Terms

Within the study, a range of associated terms relating to the overarching HNV farming concept is used, reflecting the diversity of terms in the literature. HNV farming is presented as the umbrella concept and can refer both to HNV farmland areas and HNV farming systems. HNV farmland areas and HNV farming systems are not interchangeable concepts. The distinction broadly reflects differences in approach to their characterisation, and the indicators and data used in their identification. HNV farmland areas are defined with reference to the HNV state, as such, delimiting fairly static areas of farmland, whereas HNV farming systems are characterised, in part, in terms of the driving forces for the HNV state, which are dynamic and change over time. This study sets out an approach to identifying HNV farming systems. Whilst the indicators presented relate to the characteristics that typify an HNV farming system, they refer to land use, and as such, are termed HNV farmland indicators.

HNV Farmland Areas and Farming

A definition of HNV farmland at the European scale has been developed under the IRENA operation (EEA Report No. 6/2005, drawing on the work of Andersen *et al*., 2003). For the purpose of developing the CMEF Impact Indicator, the definition first developed by Andersen *et al*., (2003) has been modified within this study to take account of the national and/or regional scale.

> "High Nature Value farmland comprises those areas in Europe where agriculture is a major (usually the dominant) land use and where that agriculture supports or is associated with either a high species and habitat diversity, or the presence of species of European, and/or national, and/or regional conservation concern, or both."

It must be noted, however, that not all HNV farmland makes the same contribution in conservation terms. The highest grade of HNV farmland is that which supports the presence of species of European conservation concern, and the lowest grade is that which supports species of regional conservation concern.

HNV Farmland Features

> "An HNV farmland feature supports the presence of habitats and species of European, and/or national, and/or regional conservation concern whose survival depends on the maintenance or continued existence of the feature."

HNV Forests

> "High Nature Value forests are all natural forests and those semi-natural forests in Europe where the management (historical or present) supports a high diversity of native species and habitats, and/or those forests which support the presence of species of European, and/or national, and/or regional conservation concern."

Traditional Agricultural Landscapes

> "Traditional Agricultural Landscapes in Europe are typically derived from historic - frequently family and/or subsistence-style - farming methods where the dominant cultural landscape characteristics are the result of a traditional or locally adapted approach to management. In general, these farming systems are characterised by the presence of farmland features, whose distribution will be regionally and/or locally specific, which contribute to the landscape's aesthetic qualities as well as to supporting its ecological integrity."

Monitoring Changes in the Extent and Quality of HNV Farmland and Forests

Data exist on the approximate extent of potential HNV farmland areas in 26 Member States of the EU at the present time (excluding Malta)[1]. The JRC/EEA have mapped the distribution of HNV farmland areas drawing on CORINE land cover data, trends in bird and butterfly populations, Natura 2000 data and some national data, including grassland surveys. These maps are useful in providing a preliminary indication of the location of HNV farmland areas, however, this measure of the extent of HNV farmland areas is not sensitive enough to inform the monitoring of the impact of policy over the reasonably short time frame of a rural development programme.

As a result, a complementary approach has been developed for the purposes of monitoring and evaluating rural development programmes and is described below. This approach involves 1) characterising potential HNV farming systems and forests and identifying the nature values - including the species and habitats of European and/or national, and/or regional conservation concern - associated with them; and 2) selecting indicators to identify and measure the extent and quality of HNV farmland and forests, within the period of the current rural development programmes.

Member States also have the option of measuring the extent of their Traditional Agricultural Landscapes. This would involve characterising these landscapes on the basis of three criteria defined in chapter one of the report and the development of nationally specific indicators to measure the extent of TAL.

[1] For further information on the work of the EEA and the JRC see http//eea.eionet.europa.eu/Public/irc/envirowindows/hnv/library).

Characterising HNV Farming and Forests, and Traditional Agricultural Landscapes

Characterising and Identifying HNV Farming Systems

A typology of livestock, arable and permanent crop systems in the EU-27 is presented in chapter three of the report. It identifies generic characteristics which distinguish systems which are most likely to be HNV from non-HNV systems. The broad potential HNV farming systems identified through the European typology can be observed in national and regional sub-types and under the approach presented here, Member States would be encouraged to identify their sub-types.

Once likely HNV farming systems are identified, their key characteristics would be described, drawing on expert knowledge and relevant literature. Characterisations would be structured around three criteria derived from the definition of HNV farming systems:

1) Intensity of land use;

2) The presence of semi-natural features; and

3) The presence of a land use mosaic.

The characterisation of the system would include providing information on the physical characteristics of the region; the production characteristics of the system; management practices; semi-natural features; the scale and diversity of land cover; the biodiversity supported by the system, including the species and habitats of European, national and/or regional conservation concern, and Natura 2000 habitats and species. It is critical that the relationship between the intensity of use, the presence of semi-natural features, the presence of a land use mosaic and the nature values - the conservation needs of habitats and species - are specified.

Characterising and Identifying HNV Farmland Features

Semi-natural features are an integral part of HNV farming systems. In addition, HNV features can be found in more intensive agricultural landscapes. Although these HNV features would contribute an HNV presence to the intensive agricultural land, they are not part of an HNV farming system.

To identify likely HNV farmland features, Member States would need to identify which features are of a high enough habitat quality to support the presence or likely reintroduction of species of conservation concern. This would be ascertained through the identification of selected species of European, and/or national, and/or regional conservation concern, which depend on the maintenance or continued existence of farmland features for their survival. For the species selected, a description would be provided of their relationship with, and dependence upon features in the agricultural landscape, with attention paid to the size, density and condition of the feature, and its spatial pattern in the landscape.

Characterising and Identifying HNV Forests

To identify potential HNV forests at either the national or regional scale involves first classifying forests as 'naturally dynamic', 'semi natural' or 'plantation'. This schema is based on the three categories used to assess the degree of forest naturalness under the MCPFE Indicator 4.3 (EEA, 2006). All naturally dynamic forests are HNV; all semi natural forests have the potential to be HNV, although some will not be; and plantation forests are not HNV forests in their current state (see chapter five for a European typology of potential HNV forests).

The HNV status of a semi-natural forest is a function of its state and the present day and/or historical management regime. Management may mimic natural processes, or comprise cultural practises that were typical in pre-industrial woodland and which are known to promote biodiversity. Member States with more widespread natural forest may be more selective about which semi-natural forests may qualify.

To determine whether a semi-natural forest is HNV or not, one, or a combination of the criteria listed below may be applied at the scale most appropriate to national conditions. The first is the core criterion and will eliminate most semi-natural forests that are not HNV. One, or a combination of criteria two to four need only be applied where there is some uncertainty over whether a forest is HNV or not. For each criterion, a threshold is set at which a forest is classified as HNV, providing a justification based on the ecology of the forest. The four criteria are:

1. Proportion of native tree species (measured as the percentage of native species per given area).

2. Volume of standing and lying deadwood in the forest (measured in $metres^3$ / hectare).

3. Density of large trees in the forest (measured as the number of trees per given area).

4. The proportion of the area of a forest which is made up of stands older than the age of economic maturity (measured as the percentage of old trees per given area).

Characterising and Identifying Traditional Agricultural Landscapes

If appropriate, Member States could identify and characterise TAL on the basis of the following three criteria:

1. The existence of high aesthetic and cultural values;

2. The pursuit of a broadly traditional or locally adapted approach to management;

3. The presence of features, whose distribution is regionally and/or locally specific, which contribute to its aesthetic qualities and to its ecological integrity.

Indicators to Measure the Extent and Quality of HNV Farmland and Forests

Indicators to Measure Changes to the Extent of HNV Farmland and Forestry

Having identified and characterised their HNV farming and forestry, and TAL, a selection of indicators may be applied with the aim of determining what is HNV farmland and forestry in order to measure:

- Changes in the extent of HNV farmland and forests.

- Changes in the nature values associated with HNV farmland and forests to provide an indication of changes in the quality of the HNV resource.

In the case of HNV farming, it is not feasible to use indicators common to all agricultural land uses and so indicators have been developed which are specific to different categories of land use, including semi-natural forage land, arable and improved grassland, and permanent cropland. In order to determine whether a specific area of farmland is HNV or not, indicators would be applied which capture the three criteria characterising HNV farming: intensity of land use; presence of semi-natural features; and the presence of a land use mosaic.

The minimum number of indicators applied would need to be one indicator relating to the intensity of land use, and one indicator relating to the presence of semi-natural features. Indicators relating to the presence of a land use mosaic will be applied in addition to the other two under appropriate conditions. The full list of indicators is provided in chapter six of the report which discusses the way in which they may be applied along with potential data sources.

Indicators to Measure Changes in the Quality of HNV Farmland and Forestry

Changes in the ecological condition or quality of HNV farmland and HNV forestry can be assessed using a combination of biodiversity indicators to provide broad contextual trends at the regional or national scales. Changes in ecological quality can either be captured in terms of trends in the abundance of selected species of conservation concern.

Species of conservation concern associated with HNV farming systems and forests would need to be identified, including plant species; vertebrates, including birds; invertebrates, including butterflies; and fungi, depending on data availability. The species selected may be of European, national and regional conservation concern, although the choice should not be limited to the most threatened or emblematic species, but rather to suites of plant and animal species that are considered to be indicators of habitat quality. Changes in the abundance of these species over time provide a measure of the nature value of HNV farmland and forests within a Member State. Existing systems for measuring the abundance of populations at the national level, or through regional case studies, could be utilised or new systems established.

Assessing the Impact of Rural Development Programmes

Over the period of the 2007 – 2013 rural development programme, indicators measuring the extent and quality of the HNV resource could reveal various changes in state. The area of HNV farmland and forests could increase, remain stable, or decline which would be coupled with changes to the quality of the resource. In some cases, this change in state would indicate an improvement, in others a deterioration, and in still others, conflicting trends may emerge. The aggregation and weighting of trends at the national level must, however, be conducted with sensitivity as trends may vary significantly between regions, farming systems and forests, for example. Judgements on the part of programme evaluators will need to be made in this regard.

The indicators reflect changes in the environment arising from a variety of driving forces and decisions by different actors. The extent to which the changes observed can be attributable to rural development programmes will need to be inferred by programme evaluators on the basis of evidence available to them.

1 CONCEPTS AND DEFINITIONS

1.1 Introduction

The chapter seeks to provide definitions and conceptual tools in order to better understand the High Nature Value (HNV) concept[2]. Its intent is not to characterise or illustrate, which is the role of other chapters of this report, rather to provide the reader with an analytical frame. With regards to agriculture, there is a body of thought and literature on HNV which has a clear bearing on the use of the concept in contemporary European policy. In contrast, the HNV forestry concept is less well developed and this chapter attempts to apply the ecological underpinnings of the HNV concept to a forestry context.

1.2 The Decline in Farmland Biodiversity

Since the end of the last ice age, nature in Europe has been under the continuous influence of humans which has caused a considerable loss of mega-fauna and forest, whilst at the same time creating a varied landscape with extensive tracts of open habitat. Human communities have modified the landscape into a wide variety of farming systems but not without over exploitation. The loss of the dominant natural vegetation cover of forest did not initially result in a decrease in biodiversity, however. For instance, Tubbs (1977) suggests that the period of maximum biodiversity in southern England occurred around the middle of the eighteenth Century. This coincides with the occurrence of 'parliamentary' enclosures whereby strips in open fields were consolidated into more compact units surrounded by hedges. Thus, the loss of "naturalness" caused by the rise of agriculture was more than compensated for in biodiversity terms by the new open, semi-natural habitats and increases in habitat diversity within specific areas. In other words, Europe's natural environment has been greatly shaped by farming practices over the centuries, and the mosaic of habitats that traditional farm management has created has been important for the diversity of plant and animal species across Europe (Tubbs 1977; Plachter 1996; Plachter, 1998). It is estimated that 50 per cent of all species in Europe depend

[2] 'HNV' is used in conjuction with a variety of different concepts: HNV farmland areas; HNV farmland; HNV farming; HNV farming systems; HNV farmland features; HNV forestry and HNV forests.

on agricultural habitats including a number of endemic and threatened species (Kristensen, 2003).

In recent decades, however, there has been a marked decline in biodiversity across European farmland. This has arisen primarily through the industrialisation of agriculture, resulting in intensification, farm specialisation, increase in farm size and mechanisation. Simplification of the landscape has occurred, replacing the systems of multiple use that dominated in the past. These changes happened first and most intensely in the lowlands of northwest Europe on the most productive land, such as in southern England, northern France, Belgium, the Netherlands and Germany. However, the wider availability of technologies, and more recently the influence of market forces and public policy, has meant that the trend in intensification has spread to all but the least accessible areas and the poorest land. Concurrently, the progressive marginalisation and abandonment of agricultural land caused by physical or climatic handicaps and wider socio-economic changes has been another cause of agricultural biodiversity decline in recent years. Agricultural land abandonment can have a detrimental affect on biodiversity as many of the farmland habitats of high nature value need to be actively managed to maintain them, especially semi-natural grasslands (DLG *et al.,* 2004).

Intensification and abandonment exert negative effects on many populations of species across Europe, with the most vulnerable being those at the top of food chains, such as large carnivores, endemic local species with a very limited distribution, species with chronically small populations, migratory species and specialists (EEA 2006). Farmland birds are one of the few groups for which trend information is available across a number of European countries and monitoring has shown that on average, common farmland birds have declined sharply in number over the past 25 years (BirdLife International, 2004). This is a concern, since changes in farmland bird populations can be used as an indicator of the general state of farmland biodiversity.

1.3 The HNV Farming Concept

The concept of 'High Nature Value farming' originated in light of a growing recognition that throughout Europe, many of the habitats and species upon which we place high nature conservation value, and which are declining, have been created, and need to be maintained by, farmers and their farming practices. Such high nature values tended to be found in the more marginal areas and on poorer land that still maintain less intensive farming practices (for example, Baldock *et al.,*1993; Beaufoy *et al.*, 1994; Bignal *et al.*, 1994; Bignal and McCracken, 1996; 2000). Hence, in order to conserve nature in Europe and prevent further decline, it is necessary to maintain these farming systems.

The HNV concept is fundamentally a conservation concept, whose purpose is to make a link between three distinct domains: (i) ecology (ii) farming and/or forestry and (iii) public policies. The concept brings an approach to nature conservation that differs from, and complements, the more established approach based on site protection. It recognises that biodiversity is not solely a selection of rare or endangered species that can be maintained on certain sites. Biodiversity in Europe also depends on the continued existence of large areas of HNV farmland and the practices that maintain it, not only for those species and habitats identified as of European importance, but also to maintain high biological diversity across significant tracts of the countryside. The management of biodiversity through HNV systems must be understood in relation to their core functioning: biodiversity is not coincidental and should be explained through the characteristics of the system.

High Nature Value farming proved a popular and attractive concept on account of its capacity to communicate the biodiversity and landscape goods provided by certain types of farming. However, whilst the concept served to focus attention on the biodiversity, landscape and environmental goods that low intensity agricultural systems provide, it proved difficult to operationalise in policy terms, in part, on account of its vagueness and the lack of any quantified criteria to distinguish high nature values from common nature values. Indeed, because of its normative and relative character, the identification of HNV will always be subjective to some extent.

HNV farming systems were first described and defined in Baldock *et al.* (1993):

> "High Nature Value (HNV) farming systems are predominantly low-intensity systems which often involve a relatively complex interrelationship with the natural environment. They maintain important habitats both on the cultivated or grazed area (for example, cereals steppes and semi-natural grasslands) and in features such as hedgerows, ponds and trees, which historically were integrated with the farming systems. […] The semi-natural habitats currently maintained by HNV farming are particularly important for nature conservation in the EC because of the almost total disappearance of large scale natural habitats."

This description is probably the most comprehensive as it encompasses the causal relationship between (i) farming systems, (ii) farmed habitats, which are synonymous with farmland, and (iii) nature conservation issues. Bearing in mind the classical definition of a farming system as a combination of labour (quantity and quality, including local knowledge) and capital (including biological capital, such as breeds) in order to take profit from the farmed land, the HNV concept as a whole - HNV farming systems and HNV farmland and their contribution to nature conservation - can be represented as in Figure 1.1.

Figure 1.1 illustrates that the different components of HNV and the extent to which they overlap. The overall HNV concept attempts to bridge these different components and establish the relationships between farming systems, farmland areas and the presence of species of conservation concern. These different components are unified through the farmland.

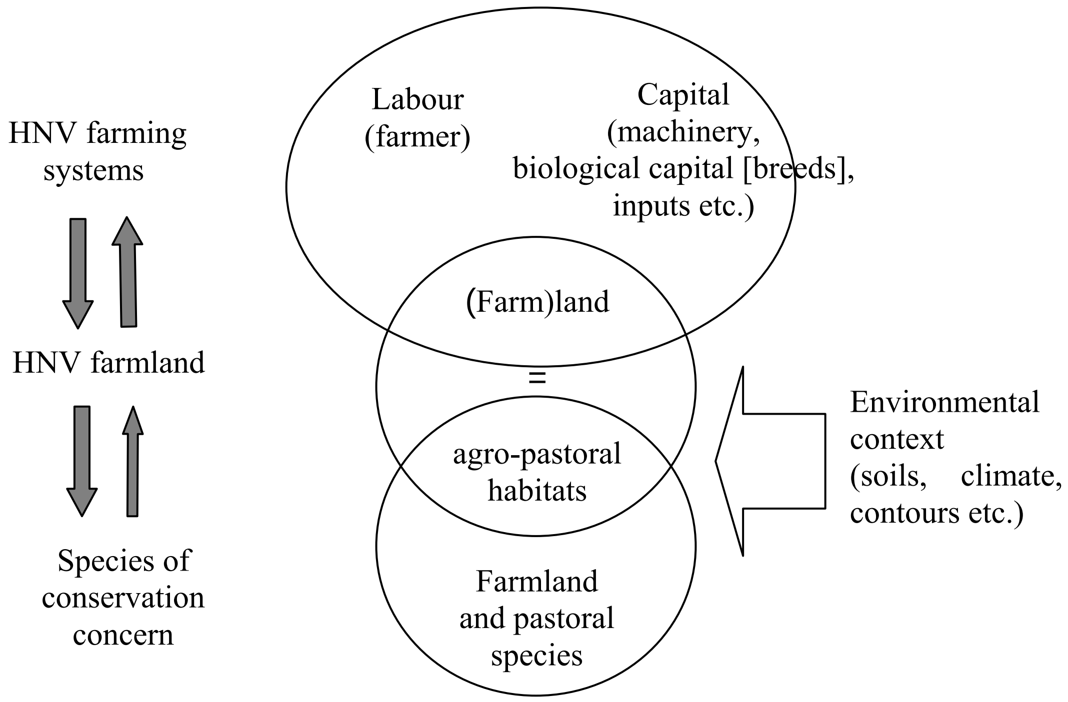

Figure 1.1 Conceptual relationship between HNV farming systems, HNV farmland and the conservation of species

The arrows in the figure can be explained as follows:

- The farmland is part of the farming system and both its nature, for example, semi-natural vegetation, and management, low intensity, are the cause and consequence of the functioning of the farming system, as suggested by the double arrows.

- The farmland is a particular type of habitat, agro-pastoral, whose characteristics explain the presence, or absence, of specialised species of flora and fauna. The thinner arrow in an upwards direction suggests that, except in some rare cases, species of European/national/regional conservation concern do not influence the functioning of the farming systems. A rare orchid, for example, in grazed dry pastures might disappear without affecting the economy of the system.

In the Nature of Farming (Beaufoy *et al*., 1994), a study conducted the following year, characteristics of HNV farming systems were extensively analysed and their characterisation elaborated:

> "The alpine pastures of northern Italy, grazing marshes of the French Atlantic coast, hay meadows of the Yorkshire Dales and the open expanses of dryland wood pasture in western Spain have at least one feature in common. Each is the product of a system of farming quite distinct from intensive modern agriculture. Often, but not invariably, traditional in character, these systems

> can be described as "low intensity" because they tend to be low yielding and modest in their use of agricultural inputs, such as fertilisers." (Beaufoy *et al*., 1994).

HNV systems are thus defined by the following three parameters (as represented in Figure 1.4).

1) Intensity of land use (livestock density, nitrogen and biocide use);
2) The presence of semi-natural features (unimproved grassland, scrub, field margins, ponds);
3) The presence of a land use mosaic (scale and diversity of land cover).

The following section describes these key characteristics in more detail and their link to nature values.

1.3.1 Intensity of Land Use

Stocking densities are generally low. Extensive grazing is very important for maintaining the biodiversity value of permanent semi-natural grasslands (for example, Bignal and McCracken, 1996; Miguel and Miguel, 1999; Anger *et al*., 2002; Nagy, 2002). Grazing, as long as it engenders low to medium disturbance levels, determines the relative abundance of plant species in a habitat, thus influencing the competitive abilities of plant species relative to each other, preventing one species from becoming dominant over the rest. The range of species present and structures in the vegetation is therefore maintained at a higher level (see, for example, Stevenson and Thompson, 1993; Harris and Jones, 1998; Palmer and Hester, 2000; Mitchell and Hartley, 2001; Alonso *et al*., 2001). For farmland birds, diversity at the landscape scale is very important too, and this is strongly influenced by grassland management practices. Appropriate grassland management provides more open types of vegetation without letting these develop fully to their climax stage which results in suitable habitats for birds to winter and roost (Angelstamm, 1992; Söderström and Pärt, 2000). In addition, low stocking rates in the breeding season decrease the chance of egg and chick trampling for ground breeding birds. A low stocking rate in winter leaves more food available for birds, for example, geese.

External inputs such as agro-chemicals, artificial fertilisers, concentrate feedstuffs and water (irrigation) are generally low in HNV farming systems, which favours the survival of semi-natural vegetation and its associated fauna. The low artificial fertiliser and agrochemical input in extensive livestock systems results in a diverse invertebrate fauna (for example, Siepel, 1990), in contrast to high input farming systems. Adverse effects of insecticide and herbicide inputs are numerous because they often affect non target species. Studies have also shown that a few individual, usually common, species could become more abundant over less common species. Herbicide and insecticide use also result in lower weed-seed and prey-insect availabilities and these again affect seed and insect eating birds, and also raptors and owls indirectly through the decline in insectivorous prey species (for example, RSPB, 1995; Tucker and Evans, 1997). In livestock systems, the use of anti-parasite drugs for cattle may also have some adverse effect on the number of invertebrates in manure and dung in fields. These invertebrates are an important food source for different types of birds, for example, chough, especially in winter. High nutrient inputs from artificial fertilisers are designed to favour crop growth and hence cause dense crops which may suppress growth of other weeds and plants, leading to a loss of plant species diversity which may in turn affect invertebrate abundance and diversity (Wilson and Tilman, 1993; Kleijn and van der Voort, 1997). Dense growth of crops can also impede access to the crop and ground by foraging birds and young chicks (Shrubb and Lack, 1991). In farmland, higher fertiliser inputs lead to higher productivity levels in grasslands which may be harmful for certain groups of species, but could favour other species. The other well known effect of fertiliser input is that it contributes to eutrophication of freshwater, estuarine and shallow coastal habitats.

Agriculture practices on marginal land leads to greater synchronisation of farming practices with natural features and processes and the utilisation of a high proportion of semi-natural vegetation due to fewer opportunities for mechanisation. These areas are generally more constrained by location, climate and topographic factors. Such natural constraints limit the proportion of land available for intensive utilisation and limit any fundamental alteration of the land. An example of a fundamental alteration to the land is drainage, which is often followed by conversion from wetland or wet grassland to arable or dry grassland. Drainage leads to the destruction of floristically rich grasslands and the breeding and foraging habitats of certain bird species birds (Green, 1991). In HNV farming systems, relatively small parts of the land have been drained and often only superficially. Climatic constraints also mean that the timing of management is typically synchronised with the annual natural growth cycle of the vegetation if detrimental effects on soil, for example, erosion, are to be avoided. For example, the number of cuts for hay or silage is limited to the drier months in summer due to wet weather conditions and/or lack of drainage. In arable agriculture in northern Europe, this implies that spring sowing and stubble fields in winter are maintained. This first practice provides better breeding opportunities to birds (Donald and Vickery, 2001); the latter provides winter food supplies for a large number of farmland bird species (Moorcroft *et al.*, 2002; Whittingham and Markland, 2002). A lack of irrigation is particularly important for farmland biodiversity in drier areas of Europe. In HNV farming systems, the lack of irrigation often implies that areas need to be left fallow for part of the year which is of great importance for many bird species. On the other hand, high water abstraction by agriculture through irrigation has adverse effects on biodiversity causing salinisation and contamination of water, loss of wetlands and even the complete disappearance of habitats through the creation of dams and reservoirs.

1.3.2 Semi-Natural Vegetation and Semi-Natural Features

The presence of semi-natural habitats is a defining feature of HNV farmland. In many HNV farmland areas, the majority of the farmed area is semi-natural, comprising various types of grazed vegetation. In addition, the presence of semi-natural elements such as field margins, hedges, grass strips, patches of uncultivated land and other semi-natural vegetation, such as grassland, is an essential ecological complement to the low intensity agricultural fields.

It is therefore important to define semi-natural vegetation and features, when characterising HNV farming systems. A precise definition of what constitutes a semi-natural habitat is most appropriately developed at the local level, on the basis of characteristics of the vegetation and species composition, and the practices that are known to maintain the required conditions.

The concept of semi-natural is difficult to define in concrete terms, but it is central to an understanding of HNV farming. Semi-natural vegetation is vegetation that is subject to human intervention, or has been in the past, but that maintains ecological functions and a composition of habitats and species that can also be found in natural vegetation.

In other words, human intervention has not transformed the vegetation to a totally artificial state, for example, to a single species sward, but rather has mimicked natural interventions such as grazing by wild herbivores, occasional natural fires, or storm damage in forests. Semi-natural habitats are especially important for nature conservation in Europe because of the almost total disappearance of wilderness and natural habitats.

In the case of grazing land, the most relevant practices are fertilisation and re-seeding. The combination of these two practices (pasture improvement in agronomic terms), transforms natural or semi-natural vegetation into an artificial state. If these actions are not repeated, then over time the vegetation will revert gradually towards a semi-natural state. How long this takes will depend on several factors, including:

- Intensity of the fertiliser application and reseeding;
- Surrounding vegetation and potential for recolonisation;
- Soil and climate conditions affecting the persistence of nutrients;
- Management, for example, whether biomass is removed or left on site.

Changes in vegetation can also result from excessive grazing pressure and from the input of nutrients through livestock manure, when the animals are fed significant quantities of feed from off the holding. Vegetation may lose its semi-natural status as a result of this build up of nutrients, without the application of chemical fertilisers or reseeding.

A basic definition of semi-natural vegetation could be:

> "Vegetation that has not been fertilised or sown in recent years, and where the grazing pressure and nutrient input through animal manure are not causing a decline in species diversity."

Clearly the number of years after which vegetation is considered to recover its semi-natural status, and the appropriate grazing pressure and acceptable threshold of nutrient input, must be defined at local or regional level.

Vegetation that is subjected to occasional tillage, but not reseeding, may be considered semi-natural in some circumstances. For example, the herbaceous layer of olive groves may be tilled once per year under traditional, low intensity management.

If this takes place later in the spring, allowing plants to set seed, and the land is not fertilised, then the vegetation may be considered as semi-natural.

Part of the importance of semi-natural vegetation for providing high nature values is that the management that creates and maintains it produces moderate levels of disturbance that support species and habitat diversity. This can be demonstrated by Figure 1.2 which shows the classic hump-backed model of species richness versus disturbance relationship postulated by Grime (1973). The top figure shows that the species richness occurring in any given situation will vary in accordance with the severity and regularity of disturbance to which that situation is exposed. Depending on the situation under consideration, the disturbance events can refer to natural factors, for example, exposure, flooding, grazing by wild herbivores or storms; or be linked to human influenced management factors such as harvesting of the vegetation, grazing by livestock, ploughing, nutrient input and tree felling.

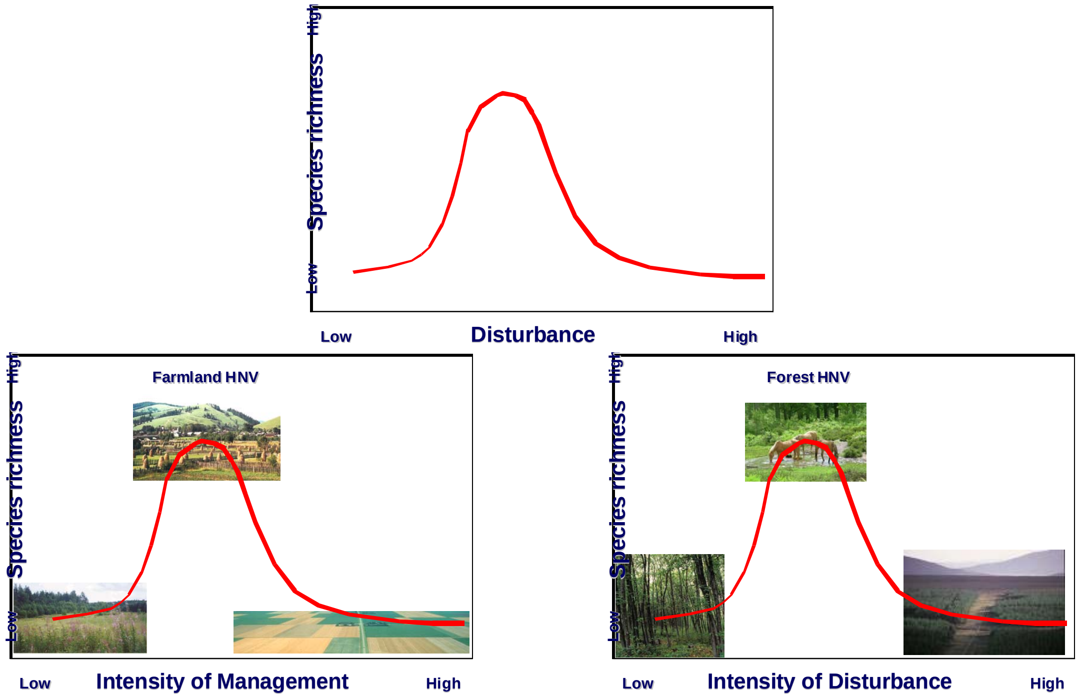

Figure 1.2 Classic hump-backed model of species richness versus disturbance relationship

Source: Grime, 1973

Taking plant species richness as a core example, the model indicates that situations subject to high disturbance, either in terms of severity or regularity of the disturbance events, will produce conditions which only a limited number of species are adapted to, and hence the overall species richness in such situations will be relatively low. At the other end of the scale, situations subject to little or no disturbance will similarly result in the domination by a relatively limited number of plant species which can outcompete others. Both extremes result in relatively homogeneous vegetation types and structures which limit the possibility of colonisation and growth by other species.

However, medium disturbance, such as that generated in traditional agricultural management, introduces a greater amount of variety by providing greater opportunities for more plant species to colonise and become established. Such medium level disturbance therefore provides a greater variety of niches and hence potentially more species, and is a characteristic of HNV farming systems.

1.3.3 Land Use Mosaic

At the landscape scale, HNV farming systems provide a wider mosaic of different arable, grass and semi-natural habitats and landscape elements, such as field margins, hedges and tree lines, used at different levels of intensity. A varied habitat mosaic generally offers the greatest biodiversity benefit (Angelstamm, 1992). In the case of farmland birds, it is important because it offers a combination of breeding, foraging, and roosting habitats (Vickery et al., 2004). The benefits to birds of mixed farming are well described (for example, Hurford, 1997; Burel et al., 1998; Robinson et al., 2001).

Figure 1.3 summarises the way in which diversity at the landscape level will influence the level of biodiversity, as measured in terms of number and abundance of species. The figure illustrates that more complex landscapes contain a greater range of different 'biodiversity groups' (as illustrated by the different characters in each box), and within each 'biodiversity group' there is a greater number of individuals using that landscape (as illustrated by the numbers within each box). As the landscape simplifies, the range of biodiversity groups declines (boxes become empty), and for those that remain, the number of individuals that can live in that landscape reduces. In intensive arable situations there can be a larger number of individuals of some of the generalist crop pest species (as illustrated by the three insect boxes added to the bottom diagram).

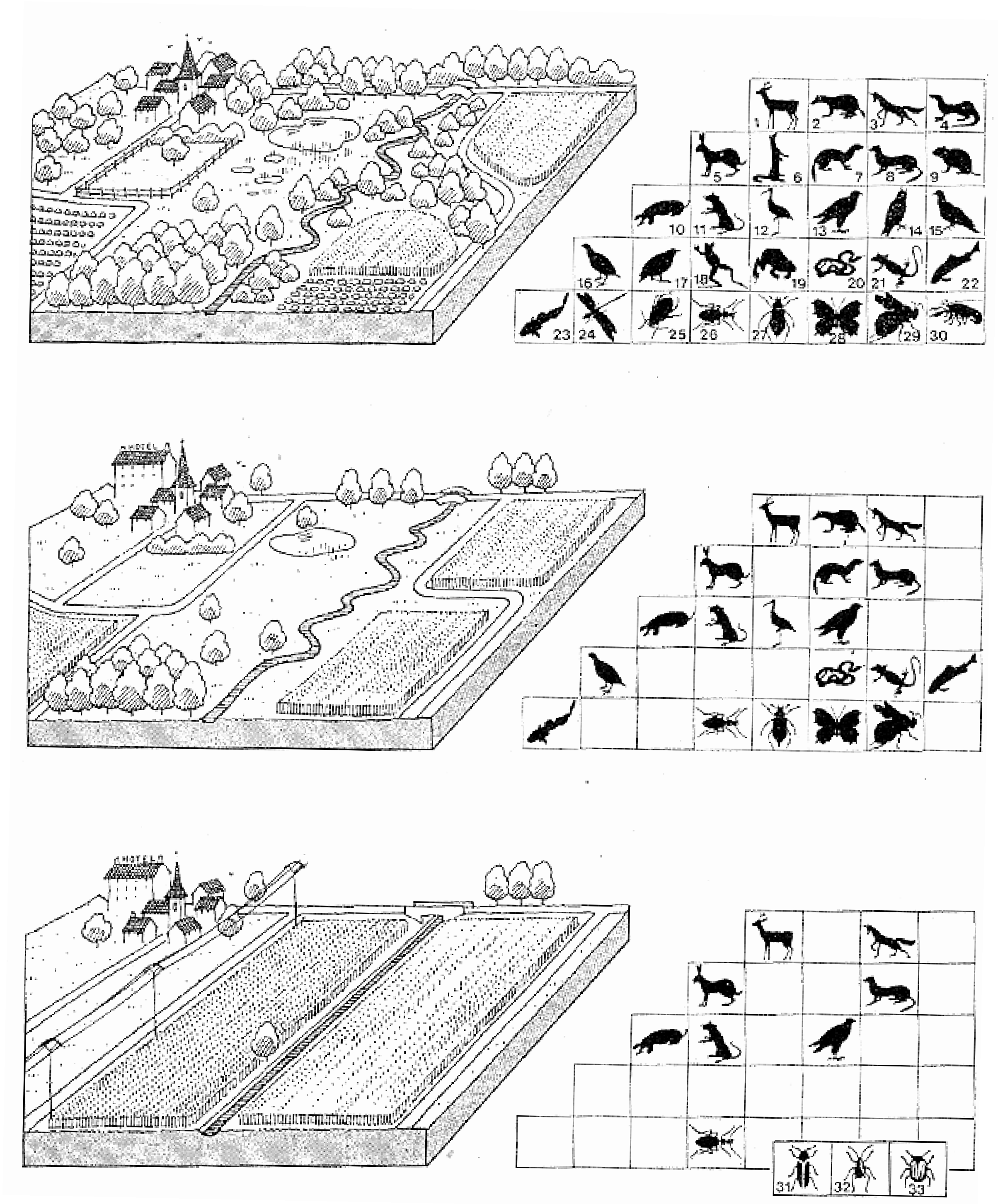

Figure 1.3 Influence of landscape diversity and structure on species diversity

Source: Peeters, 2006.

1.3.4 Nature Values of HNV Farming Systems

As a precursor to linking the biodiversity dimension of HNV - the presence of species and/or habitats of conservation concern - with an examination of farming systems, Maljean and Peeters (2002) propose a helpful typology of biodiversity classes, distinguishing 'domestic biodiversity', 'auxiliary biodiversity' and 'wild biodiversity'.

'Domestic biodiversity' is composed of breeds and species intentionally selected by farmers for production purposes. It is clearly out of the scope of HNV farmland criteria[3] despite the fact that breeds/species are a key factor at the farming system level and that domestic biodiversity forms a field of conservation in itself.

Auxiliary biodiversity is composed of natural species, such as insects, birds, worms and plants including weeds, which play a functional role in pest control and/or nutrient cycles in agro-ecosystems. Farmers have been selecting these auxiliary species for centuries by adopting management practices that favour these species and by removing other species which compete with them. As stated above, certain agricultural practices mimic natural disturbances such as grazing by wild animals, opening of spaces by fires caused by storms etc. Hence, whilst these species are natural, they also have also been selected by humans (Tubbs 1997). With regards to the definition of farming systems given above, the set of domestic and auxiliary biodiversity can be interpreted as part of the biological capital of the farming system.

The third category, 'wild biodiversity', is composed of species which benefit from the functioning of the agro-ecosystems without being crucial from a productive point of view. Some of these species may be considered as agricultural pests, and will be eradicated, but may have a positive influence on natural value. However, in general terms, wild species will be associated with auxiliary species without causing any harm to them.

It is important to note that the boundaries between auxiliary and wild biodiversity are not always clear and depend on the context. For example, under a certain density, wild predators, such as mammals and birds of prey, will not be considered to play a significant role in agro-ecosystem functioning, but above a certain density, they can help to control rodent pest populations. In this context they can be considered as 'auxiliary' (see, for example, Bretagnole, 2006).

From a conservation point of view, one can argue that the HNV depends on the interrelation between auxiliary and wild species. As all HNV ecosystems are semi-natural as explained above, a set of core criteria can be proposed, composed of both compositional aspects (presence of both auxiliary and wild species), structural aspects (the structure reflecting the relationship between species) and functional aspects (as already outlined). This distinction between auxiliary and wild biodiversity helps to clarify debates about which components should be retained. While some ecologists

[3] Farmland will not be characterised as HNV based on the presence of rare domestic agricultural breeds/species alone.

will focus on wild species, agro-ecologists will tend to retain the auxiliary species. In the context of HNV farming systems, the extent to which and processes through which wild species are, or are not, functionally associated with auxiliary species needs to be specified.

Defining the relationship between farming systems and the presence of species of conservation concern can sometimes be complicated by historical processes. A full understanding of HNV should be situated in a historical context which describes the development of European agricultural systems over time. This is because some scarce landscape elements or features, inherited from ancient farming systems, may exist on farmland, with no clear relationship with the characteristics of present day farming systems. In such cases, the existence of species of conservation concern does not mean that this is an HNV farming system, since the system is not necessary to maintain the presence of the species. For example, in the French Causses (Southern Massif Central), it has been shown that the present open grazed landscape hosting a flora of conservation interest, including *Arenaria provencialis, Narcissus juncifolius*, and several orchids, is mainly due to the presence of mixed crops/livestock systems in the nineteenth Century, while the present day grazing sheep system only slows down encroachment and colonisation by pine trees (Lepart *et al*., 2006).

1.3.5 The HNV Farming State

The HNV 'state' is defined in terms of the nature values present, such as the assemblage of species and habitats, and is represented by those areas in which significant nature values can currently be found. For farming, characteristics such as the area and type of crops, the presence and proportion of semi-natural vegetation and of linear, point and patch features will determine whether a farmland area is HNV or not. The state of a HNV farmland area can change over time, depending, to a certain extent, on the way in which land uses and management practices are maintained, evolve or are abandoned. This means that the characteristics and boundaries of a HNV farmland area are also subject to change.

Figure 1.4 represents the main criteria that lead to HNV on farmland. The 'state' characteristics are represented by the bottom two corners of the triangle: a) a high *proportion* of semi-natural land cover, such as semi-natural vegetation of features, such as water bodies, or field margins; and b) a *diversity* of land cover. Often some combination of a) and b) will be found.

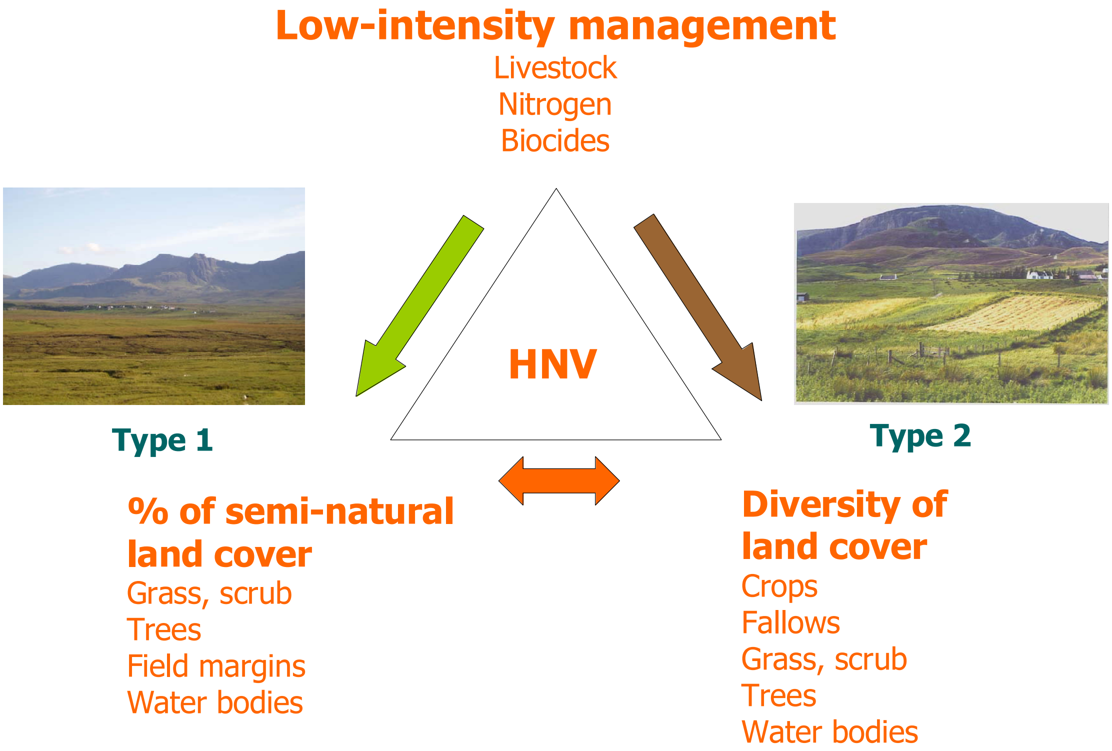

Figure 1.4 Three core criteria that combine to favour nature on farmland

Photographs show HNV farmland in the Western Isles of Scotland.

Andersen *et al*. (2003) recognise three types of HNV farmland which are discussed further in section 1.6. HNV farming whose nature value results primarily from a high proportion of semi-natural vegetation is labelled 'Type 1' HNV by Andersen *et al*. (2003) and corresponds to the left side of the triangle (see section 1.6 for definitions of the three types of HNV farmland). HNV farming whose nature value results primarily from a diversity of land cover combined with semi-natural elements is labelled as 'Type 2' by Andersen *et al*. (2003) and corresponds to the right side of the triangle. The difference between Type 1 and Type 2 is not black and white and many HNV farmland areas are a mix of the two situations. An individual farm, for example, often includes both situations, using Type 1 land for extensive grazing and Type 2 for producing fodder crops. The distinction between the two Types is intended to clarify the factors that contribute to HNV, rather than as a strict classification of different systems.

Farmland areas can also be Type 3, where the farmland provides a habitat that is used by rare species, or by a large proportion of the total European or global population of a species. In this Type, the farming system is more intensive and does not exhibit the HNV characteristics, such as presence of semi-natural vegetation at large scale and diversity of land cover, to the same extent as Types 1 and 2.

In many cases, Type 3 will mostly overlap with the distribution of Type 1 or Type 2 farmland, however this is not always the case. Hence Type 3 farmland does not always display the characteristics of being associated with semi-natural vegetation or a mosaic of land covers. Indeed, the Type 3 farmland definition was developed particularly to deal with the fact that there is a number of bird species of high conservation value that can be associated with farmland which is quite intensively managed and hence contains low vegetation diversity.

In southern Europe, a typical example is provided by the Great Bustard populations in Spain and Portugal. Although they are generally associated with HNV fallow systems in pseudo-steppic landscapes (HNV Type 2), some populations co-exist with more intensified forms of arable cropping, especially where alfalfa is present and can be used as a feeding area by the birds. Similarly rice fields in the Mediterranean countries can support valuable bird populations even where management is relatively intensive in terms of input use.

In northern Europe, Type 3 HNV Farmland is generally more closely associated with the geographical location and ecological requirements of the rare bird species involved, rather than the wider characteristics of the farms per se. A typical example is the large populations of wintering geese which feed on highly nutritious crops such as winter wheat and winter barley and intensively managed and fertilised rye-grass swards in Denmark, the Netherlands and northern Germany. Similarly, in south east England, steppic birds, such as the stone curlew, utilise the intensively managed arable land.

Type 3 HNV Farmland does not always have to be associated with bird species. For example, in arable situations, individual field conditions in an otherwise intensively managed landscape may allow a greater diversity of other plants to occur in association with the main crop. Such conditions may arise from differences in soil type and growing conditions across the field, greater spacing between plants or limited use of crop protection strategies. Many arable associated plants or weeds are now rare and hence their occurrence in fields or farms has important nature conservation value in their own right.

In Type 3 situations, the current state of farmland is not considered optimal for nature conservation. In most cases, a move to less intensive farming and a greater presence of semi-natural vegetation (i.e. towards HNV farming) would benefit the particular species concerned, as well as increasing the overall biodiversity of the farmland.

1.3.6 The Driving Forces of HNV Farming

In addition to the presence of semi-natural vegetation, management practices that are currently being carried out, or which have been carried out in the past, can influence the HNV state of farmland, and are therefore the driving forces of HNV. As
Figure 1.4 shows, for HNV farmland, such management will be low intensity in agronomic terms, with regards to its grazing regimes, use of inputs and tillage[4], for example. Farming systems that are characterised by practices that inherently favour

[4] Labour is often the exception, as some HNV practices are labour intensive, for example, shepherding.

biodiversity can be considered as a positive driving force for nature value, whereas the decline of these practices and characteristics would be a negative driving force.

Crucially, it is the combination of suitable land cover and features, the 'state', with appropriate management, the 'driving force', that creates the conditions for a farming system to be HNV. Thus low intensity, seasonal grazing is potentially an HNV driving force, but if applied to recently abandoned, intensively fertilised arable land the result will not be HNV, at least for many years. Conversely, a patchwork of semi-natural vegetation is potentially HNV, but is unlikely to retain its high nature values if it is heavily and continuously overgrazed.

1.3.7 HNV Farming Terms

Within the study, a range of associated terms relating to the overarching HNV farming concept is used, reflecting the diversity of terms in the literature. HNV farming is presented as the umbrella term, and can refer both to HNV farmland areas and HNV farming systems. HNV farmland areas and HNV farming systems are not interchangeable concepts. The distinction broadly reflects differences in approach to their characterisation, and the indicators and data used in their identification. HNV farmland areas are defined with reference to the HNV state, as such, delimiting rather static areas of farmland, whereas HNV farming systems are characterised in part in terms of the driving forces for the HNV state, which are dynamic over time. This study sets out an approach to identifying HNV farming systems. Whilst the indicators presented relate to the characteristics that typify an HNV farming system, they refer to land use, and as such are termed HNV farmland indicators.

1.4 Traditional Agricultural Landscapes

The TAL concept has emerged more recently and in many ways, parallels and overlaps with the HNV farmland concept. However, rather than focusing on nature value, the TAL concept takes a broader view of farmed landscapes that retain certain 'traditional' aspects. These may be elements of the farming system itself, for example, diversity of production, the fact that it is small scale, or historical features that remain in the landscape but that are largely divorced from the farming system. With its emphasis on diversity and landscape elements, the closest HNV parallel is with Type 2. The difference is that in TALs the farming system may have been intensified, thus eliminating much of the nature value, while maintaining the landscape features. These observations have led to the following definition of TAL being proposed:

> "Traditional Agricultural Landscapes in Europe are typically derived from historic - frequently family and/or subsistence-style - farming methods where the dominant cultural landscape characteristics are the result of a traditional or locally adapted approach to management. These farming systems are characterised by the presence of features, whose distribution will be regionally and/or locally specific, which contribute to the landscape's aesthetic qualities as well as to supporting its ecological integrity."

TAL can be characterised and identified according to three criteria:

1. The existence of high aesthetic and cultural values;

2. The pursuit of a broadly traditional or locally adapted approach to management;

3. The presence of features, whose distribution is regionally and/or locally specific, which contribute to the landscape's aesthetic qualities and to its ecological integrity.

Traditional agricultural landscapes will sometimes overlap with HNV farmland areas and be managed by HNV farming systems. However, not all TALs will be HNV. The functional relationship between TAL and HNV areas can be summarised as follows:

- Extensive forms of TAL where traditional land use allows, or supports, HNV with clear similarities in terms of the principle ecological, structural and management characteristics;
- Highly or moderately intensive forms of TAL where the traditional land use is not compatible with HNV;
- Some HNV farmland, typically of Type 3, is independent of TALs and can be found in more modern agricultural landscapes.

1.5 HNV Forestry and Forests

Although no formal definition of HNV forestry has existed to date, the HNV concept is applied to forestry systems within the Community Strategic Guidelines for Rural Development[5]. It is underpinned by the same primary rationale and refers to forests and their associated characteristics and management systems which contain and maintain habitats and species of high nature value[6]. As such, HNV forests can be defined as:

> "High Nature Value forests are all natural forests and those semi-natural forests in Europe where the management (historical or present) supports a high diversity of native species and habitats, and/or those forests which support the presence of species of European, and/or national, and/or regional conservation concern."

This definition implies that not all HNV forests make the same contribution in conservation terms and distinguishes between HNV forests of European importance from those of national or regional importance, depending on the conservation status of the species and habitats that it supports.

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[5] Council Decision of 20 February 2006 on Community Strategic Guidelines for Rural Development (programming period 2007 to 2013), 2006/144/EC, OJ L 55/20, 25.2.2006.

[6] In the forestry domain, a parallel concept has been developed over the last decade: High Conservation Value Forests (HCVF). This originated in the certification criteria of the Forest Stewardship Council (FSC) and is defined as 'forests of outstanding and critical importance due to their high environmental, socio-economic, biodiversity or landscape values' (FSC 2000).

1.5.1 The State and Driving Forces of HNV Forests

In terms of forests, the 'state' is defined through its *composition* and *structure* (see Table 1.1) along with its geographical and climatic location. The state will determine where a forest is situated along a continuum of naturalness at any given point in time, and a distinction can be made between three categories: plantation, semi-natural and naturally dynamic[7]. All Naturally dynamic forests are HNV; all semi natural forests have the potential to be HNV, although some will not be; plantation forests are not HNV Forests.

Plantation Forests: Forest stands are established by planting and/or seeding in the process of afforestation or reforestation. They are either composed of introduced species (all planted stands), or intensively managed stands of indigenous species which meet all of the following criteria: one or two species in the plantation, even age class, and regular spacing. This excludes stands which were established as plantations but which have been without intensive management for a significant period of time. These should be considered semi natural (EEA, 2006).

Semi-Natural Forests: These are non-plantation forests whose natural structure, composition and function are, or have been, modified through anthropogenic activities. Most European forests with a long management history belong to this category.

Naturally Dynamic Forests: These are forests whose composition and function have been shaped by natural disturbance regimes without substantial anthropogenic influence over a long time period.

[7] This schema is a modification of the three categories (undisturbed, semi-natural forest and plantation) used to assess the degree of forest naturalness under the MCPFE Indicator 4.3 (European Forest Types. EEA Technical Report No. 9/2006).

Table 1.1 Key factors which influence forest biodiversity in Europe

Scale	Structural key factors	Compositional key factors	Functional key factors
National/ regional	Total area of forest with respect to: – Legal status/utilisation or protection – Forest ownership – Tree species and age – Old growth/Forest left for free development – Afforestation/deforestation	Native species Non-native or not "site original" tree species	FOR ALL SCALES: NATURAL DISTURBANCE: Fire Wind and snow Biological disturbance
Landscape	Number and type of habitats (incl. water courses) Continuity and connectivity of important habitats Fragmentation History of landscape use	Species with specific landscape-scale requirements Non-native or not "site original" tree species	HUMAN INFLUENCE: Forestry Agriculture and grazing Other land-use Pollution
Stand	Tree species Stand size Stand edge/shape Forest history Habitat type(s) Tree stand structural complexity Dead wood Litter	Species with specific stand type and scale requirements Biological soil condition	

Source: Larsson *et al.*, 2001.

Similar to farming, in forests, the type of management carried out, both current and historic, is the driving force for HNV. However, management is not a requirement for HNV, as naturally dynamic forests, which have had little disturbance, are HNV forests. Nevertheless, the majority of Europe's forests are managed in some way and the type of management will determine where the forest lies in relation to the HNV threshold. The effect that different management practices have on the HNV of a forest will depend on their effects on the structure and composition of the forest which will determine whether the forest is semi-natural or not. For example, more commercial management will drive a forest towards a more artificial state and away from the HNV threshold.

Where a forest is currently not HNV, changes to management practices have the potential to drive a forest towards the HNV threshold. There is a temporal element involved since it would take a lot longer for an artificial forest to be converted to a more natural state via management, compared to a forest that is close to its HNV threshold. In contrast, a natural or semi-natural forest can be made artificial almost instantaneously through practices such as clearcutting and the planting of exotic tree species.

1.6 Operationalising the HNV Concept

Concurrent with the evolution of the HNV concept, it has, over the past decade, been inculcated in European policy, as discussed in Chapter 2. This formalisation into public policy presents a pressing need for an operational definition with quantified geographically sensitive criteria, and an indication of the general location and distribution of the HNV farmland areas for the targeting of resources.

This led to a study conducted by Andersen *et al* (2003) 'Developing a high nature value farming area indicator' for the European Environment Agency. Complementary to the Nature of Farming approach, this work focused on farmland areas, rather than farming systems. An overarching definition of HNV farmland areas was proposed, and they were categorised into three main types. This has become a widely accepted and the most commonly used definition of HNV farmland.

> "High Nature Value farmland comprises those areas in Europe where agriculture is a major (usually the dominant) land use and where that agriculture supports or is associated with either a high species and habitat diversity, or the presence of species of European conservation concern, or both" (Andersen *et al*., 2003; p11).

This definition highlights that HNV farmland is distinguished by the biodiversity value of its habitats. Those species maintained by HNV farmland are those associated with open farmland habitats. More specifically, while species of European conservation concern are part of the definition, it also includes those areas where a high number of species and habitats can be found.

According to this definition, Andersen *et al.* (2003) proposed a typology of HNV farmland whose attributes are associated with the presence of habitats/species:

Type 1: Farmland with a high proportion of semi-natural vegetation.

Type 2: Farmland dominated by low intensity agriculture or a mosaic of semi-natural and cultivated land and small scale features.

> Farmland with a mosaic of low intensity agriculture and natural and structural elements, such as field margins, hedgerows, stone walls, patches of woodland or scrub, small rivers etc. (modified Paracchini *et al*., 2006).

Type 3: Farmland supporting rare species or a high proportion of European or World populations.

The definition of three types of HNV farmland is a useful aid to understanding the concept and to identifying HNV farmland on the ground in different situations. However, there is no concrete line dividing the three types. Rather, there are significant overlaps between them, and many areas of HNV farmland will combine elements of 2 or 3 HNV types (see Paracchini *et al*., 2006).

1.6.1 The EEA Approach

This definition was operationalised in an approach to identify the distribution of HNV farmland areas in the EU-27, building on work under the IRENA operation (EEA, 2005). The JRC/EEA (see Paracchini *et al*., 2006) have identified potential HNV farmland areas on the basis of assumptions about the relationship between certain types of land cover and the intensity of farming and the presence of high nature values. These were mapped drawing on CORINE land cover data, bird and butterfly population abundance data, Natura 2000 selected sites containing habitats dependent on extensive agricultural practices (see Annex 3), and ancillary data. Under certain natural or geographical conditions, the relationship between land cover and nature value is weak or locally imprecise and therefore other data sources such as national data (for example, grassland surveys, information on soils, altitude, landscape type and IACS/LPIS data) have been included when available.

This approach is effective in mapping the broad extent and distribution of HNV farmland at the European scale and to provide a picture of the location of HNV farmland of European importance. However, it is not particularly sensitive to the micro scale, as CORINE land cover polygons have a minimum size of 25 hectares and are assigned the land cover class that dominates each polygon. In some Member States, including Sweden, the Czech Republic, England, Estonia and Lithuania, the mapping is more accurate and the mapping unit is significantly smaller than 25 hectares, aided by the availability of national data (Paracchini, 2007, *pers. comm.*). For the most part, however, the scale of resolution of the mapping unit does not capture the presence of semi-natural features or a land use mosaic at the micro scale, which is typical of certain types of HNV farmland.

The timing and frequency of data collection also renders this approach less suitable for an evaluation of the impact of rural development programmes on HNV farming. CORINE land cover data were collected in 1990, 2000 and 2006 so that changes in area and condition, in the short term, are not detected, with the effect of implying the presence of fairly static and homogeneous blocks of HNV farmland.

Although national datasets can be used to improve the scale of resolution, this mapping approach serves to provide a picture of the location of HNV farmland of European importance. It is therefore not sensitive enough to assess changes to the extent and quality of HNV farmland attributable to rural development programmes which operate at the national or regional scales.

To inform the monitoring of the impact of policy over the period of a seven year rural development programme, a complementary approach has been tailored to the obligations and requirements of the Strategic Guidelines[8] and the CMEF, respectively. This approach is discussed and elaborated in the remainder of this report and the accompanying Guidance Document (Cooper *et al*., 2007). For the purposes of developing the CMEF Impact Indicator, the Anderson *et al*. (2003) definition has been modified to take account of the national and/or regional scale:

[8] Council Decision of 20 February 2006 on Community Strategic Guidelines for Rural Development (programming period 2007-2013), 2006/144/EC, OJ L 55, 25.2.2006.

> "High Nature Value farmland comprises those areas in Europe where agriculture is a major (usually the dominant) land use and where that agriculture supports or is associated with either a high species and habitat diversity[9], or the presence of species of European, and/or national, and/or regional conservation concern[10], or both."

This modified definition is used in this study and presented in the Guidance Document. Whilst this definition recognises HNV Farmland of importance at the European, national and regional scales, it must be noted that not all HNV Farmland makes the same contribution in conservation terms. The highest grade of HNV Farmland is that which supports the presence of species of European conservation concern, and the lowest grade is that which supports species of regional conservation concern.

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[9] In the definitions of HNV Farmland and Forests, reference is made to high species and habitat diversity. In each case, this is defined at the Member State level to accommodate the differences in conditions across the European Union.

[10] Species of conservation concern are defined according to the IUCN Red List criteria of threatened species. Three categories of threatened species are recognised. 'Critically Endangered' – a taxon is critically endangered when it is considered to be facing an extremely high risk of extinction in the wild; 'Endangered' – a taxon is endangered when it is considered to be facing a very high risk of extinction in the wild; and 'Vulnerable' – a taxon is vulnerable when it is considered to be facing a high risk of extinction in the wild (IUCN Red List Categories and Criteria, Version 3.1, 2001).

2 HIGH NATURE VALUE FARMING AND FORESTRY: THE EU POLICY CONTEXT

2.1 Introduction

This chapter provides an overview of the development of the high nature value (HNV) term in EU policy. The analysis focuses primarily on EU agricultural and rural development policy and Member State obligations in respect to both high nature value farming and forestry. The indicators for high nature value that the Member States are required to use as part of the formal evaluation and monitoring of national rural development programmes are examined.

It is shown that the term 'high nature value', and its variations, have featured in official EU documentation[11] in recent years. However, the term has not been used in a consistent way to date and these documents offer little guidance on a common definition at either the EU or Member State level.

The term has a precedent in EU agricultural policy. The term 'high nature value' was used in the former Rural Development Regulation (Council Regulation 1257/1999), and the application of the term has evolved with the publication of the official documents relating to EAFRD to refer to both forestry and agricultural land uses. These documents recognise three applications of the term: 'high nature value areas', 'high nature value farming and forestry systems', and to a lesser extent, 'high nature value features'. This chapter shows that the indicators for HNV as defined by Commission Regulation 1974/2006 and elaborated upon in the current version of the Common Monitoring and Evaluation Framework (CMEF) focus exclusively on HNV areas, and not on HNV systems or HNV features. In part this reflects the fact that there is an established methodology (Andersen *et al*, 2003; Paracchini *et al*, 2006) for mapping the distribution of potential HNV farmland areas in 26 Member States of the EU (excluding Malta) that does not exist, at present, from either a farming systems or farmland features perspective. The conclusions suggest that the way the existing

[11] Such as legislation or Communications published in the Official Journal, including the EAFRD, the Community Strategic Guidelines for Rural Development, and the Common Monitoring and Evaluation Framework (CMEF).

group of HNV indicators in the CMEF (Baseline Indicator 18; Result Indicator 6; Impact Indicator 5) are defined and measured could be revised to offer a more comprehensive and consistent articulation of what they need to measure to assess whether programme objectives are being met with regard to the preservation and enhancement of HNV farming and forestry.

This chapter does not consider 'Traditional Agricultural Landscapes' (TAL), which require consideration in this study. This term does not have a precedent in EU policy in the same way as HNV, although the characteristics and values associated with TAL are addressed in some of the more recent initiatives of the European Commission.

2.2 Application of the Term 'High Nature Value' (HNV) in the EU Policy Arena

This section provides an overview of how the term 'high nature value' has been used in official Community documentation, including legislation, Communications and Action Plans. The term has risen in prominence over a period of approximately fifteen years and been defined, conceptualised and applied in a variety of ways. Despite this, it is common for certain terms, such as HNV, not to be defined in EU legislation in order to avoid being overly prescriptive.

2.2.1 Usage of the High Nature Value Term in EU Policy Documents

The term 'high nature value' first emerged in expert circles in the early 1990s (see for example, Baldock *et al.*, 1993) and first appeared in a piece of Community legislation in 1999 in the context of agriculture. Article 2 of the rural development Regulation (Council Regulation 1257/1999) states that support for rural development may concern 'the preservation and promotion of <u>a high nature value</u> and a sustainable agriculture respecting environmental requirements' (our emphasis – all emphasised text hereafter is underlined). Article 22 of the same Regulation states that support for agri-environment shall 'promote the conservation of <u>high nature value farmed environments</u> which are under threat', thus presenting the term in an agricultural light. There is no reference to high nature value forestry at this stage.

In 2001, the Commission put forward an indicator for high nature value as part of an overall drive to integrate environmental concerns into the CAP through the use of appropriate indicators in monitoring and evaluation exercises (see COM (2000) 20). A total of 35 indicators were proposed, one of which was 'area of high nature value, grassland etc' (COM (2001) 144). Whilst no further elaboration was provided at this point, the subsequent IRENA (Indicator Reporting on the Integration of Environmental Concerns into Agricultural Policy) operation expanded on and analysed the usefulness of this and all of the proposed indicators (EEA, 2005). Whilst not a formal policy exercise, the IRENA operation was co-ordinated jointly between several Commission Directorate-Generals and the European Environment Agency, and carries some policy significance. The indicator was presented here as 'high nature value (farmland) areas' and followed up on earlier work by the EEA (2004) and Andersen *et al* (2003). More recently, EEA (2007) have led a process to determine the most appropriate set of indicators through which to monitor the achievement of the goal to halt the loss of biodiversity by 2010.

The Kyiv resolution on biodiversity, agreed by European Ministers of the environment in 2003, maintains the focus on agricultural land and states that:

> 'By 2006, the identification, using agreed common criteria, of all high nature value areas in agricultural ecosystems in the pan European region will be complete. By 2008, a substantial proportion of these areas will be under biodiversity-sensitive management by using appropriate mechanisms such as rural development instruments, agri-environment programmes and organic agriculture, to *inter alia* support their economic and ecological viability …' (UNEP, 2003).

The next reference to high nature value in a prominent EU document, although not formal policy, came in 2004 with the 'Message from Malahide' (Duke, 2005) at a conference jointly organised by the incumbent Irish Presidency and the European Commission. The Message from Malahide provides a number of objectives and targets to meet the EU's commitment to halt the decline of biodiversity by 2010. Objective 5 refers to the integration of biodiversity issues into the CAP and sub-objective 5.2 stipulates the need to identify and provide measures to address the threats to high nature value areas, including the Natura 2000 network, threatened with loss of biodiversity and abandonment. Sub-objective 5.2 states the need to provide continued support for high nature value areas and traditional farming systems included in Less Favoured Areas. This document emphasises the importance of targeting support at farming systems in order to support high nature value areas.

The term is next used in EU documentation in the context of EU rural development policy. Both the European Agricultural Fund for Rural Development (EAFRD) and the accompanying Community Strategic Guidelines for Rural Development refer to the term. The Strategic Guidelines set out the priorities for rural development policy intervention. The introductory text of the Strategic Guidelines state that 'Axis 2 provides measures to protect and enhance natural resources, as well as preserving high nature value farming and forestry systems and cultural landscapes in Europe's rural areas'. The introductory text states further that 'High nature value farming systems play an important role in preserving biodiversity and habitats, as well as in landscape protection and soil quality'. One of the six strategic guidelines refers directly to the term. As this is a strategic priority for Member States to address in their programmes, this is perhaps the most important statement regarding the high nature value term in current EU policy.

> 'To protect and enhance the EU's natural resources and landscapes in rural areas, the resources devoted to axis 2 should contribute to three EU-level priority areas: biodiversity and the preservation and development of high nature value farming and forestry systems and traditional agricultural landscapes; water; and climate change.'

This statement sets the orientation of policy intervention towards HNV farming and forestry systems and suggests that appropriately managed farming and forestry systems can act as drivers of high nature value. These systems can then either preserve the current state of high nature value or develop it further in some way. This development could take the form of expanding the total area of HNV farming and forestry systems, or by enhancing the current state of management so that the conservation status of the area improves.

The term 'high nature value' is used just once in the EAFRD Regulation (Regulation 1698/2005). Article 41 defines a measure for Non-productive Investments under which aid can be granted for 'on-farm investments which enhance the public amenity value of a Natura 2000 area or other high nature value areas to be defined in the programme.' There is a higher incidence of other terms which have a similar meaning, including: 'areas of high natural value' (Paragraph 37 of the recitals), 'high ecological and social value' (Paragraph 39 of the recitals), 'high value forest ecosystems' (Paragraph 41 of the recitals), 'places of high natural value' and 'high natural value sites' (both within Article 57). The usage of such interchangeable terms suggests that there is a need to develop a common understanding.

The most recent references to the term are found in the May 2006 Communication on Halting the Loss of Biodiversity by 2010 and the corresponding Action Plan. The Communication refers to 'optimising the use of available measures under the reformed CAP, notably to prevent intensification or abandonment of high–nature–value farmland, woodland and forest and supporting their restoration'. The Communication requests the Community and Member States to ensure adequate financing for high nature value farmland and forests. The accompanying Action Plan makes reference to 'high nature value' in four separate actions, as shown in Box 1. The Action Plan also includes an indicator of 'HNV Area' as one of the specific indicators to determine the 'Area of forest, agricultural, fishery and aquaculture ecosystems under sustainable management' (*sic*). Notably, these actions are not binding on Member States.

Box 1 Application of the HNV term in the EU Action Plan for Halting the Loss of Biodiversity.

- Apply Rural Development (RD) measures in the next programming period [2007-2013] to optimise long-term benefits for biodiversity – in particular for Natura 2000 areas and for other ‘high nature value’ farm and forest areas. (A.2.1.2)
- Define criteria and identify [2006-07] high-nature-value farmland and forest areas (including the Natura 2000 network) threatened with loss of biodiversity (with particular attention to extensive farming and forest/woodland systems at risk of intensification or abandonment, or already abandoned), and design and implement measures to maintain and/or restore conservation status [2007 onwards]. (A.2.1.3)
- Ensure future ‘less favoured area’ (LFA) regime [from 2010] under Axis 2 enhances its contribution to biodiversity and to ‘high nature value’ farm and forest areas. (A.2.1.7)
- Ensure that implementation of EU Biomass Action Plan takes due account in assessments, where relevant, of impacts on biodiversity, in particularly on high-nature-value farmland and forests, in order to achieve ecological sustainability of biomass production [2006 onwards] (A.9.3.2) *(sic).*

Source: EU Action Plan for Halting the Loss of Biodiversity, 22.5.2006.

Neither the Sixth Community Environment Action Programme nor the EU Sustainable Development Strategy refers to high nature value. The EU Forestry Strategy (1998) and the Forest Action Plan (2006) make no reference to high nature value forests.

2.2.2 Conclusion

The overview presented above shows that there is no consistent definition of the term ‘high nature value’ in official documentation to date. Its usage in relation to farming systems or forestry, management practices and high nature value areas has been relatively fluid. The different characterisations of high nature value in current circulation potentially affect how the term is understood and operationalised at the Member State level. This affords the Member States a certain degree of flexibility, allowing individual countries or regions to interpret the term as they choose in order to meet a range of objectives. As is shown in the next section, the treatment of the HNV term also varies in the context of the CMEF. The CMEF introduces the term high nature value features, and also states that Member States are free to define additional indicators to those prescribed in the CMEF, thus providing scope for the application of rather different interpretations of the term.

The varied references to and discourse on high nature value suggest the need for conceptual clarity, in which relationships between measurable parameters are clarified. In addition, a common operational definition is required which is sufficiently broad to encapsulate co-existing applications of the term and yet has a robust and unifying rationale and accompanying set of criteria to afford identification and measurement of high nature values.

The need to offer some coherence is necessary, not least, because the HNV term is one of the priorities specified in the Community's Strategic Guidelines for Rural Development and features in three indicators that the Member States should have included in their national strategy plans, rural development programmes and in their monitoring and evaluation programmes. If the term is not properly understood at either the Member State or supranational level, there is a risk that the Community's strategic priorities for improving the environment and the countryside may not be met.

2.3 Monitoring and Evaluation of High Nature Value Areas

In addition to the legislation, action plans and communications cited above, the high nature value term also features in the Common Monitoring and Evaluation Framework (CMEF). This framework is binding on Member States and is part of a Commission effort to improve the quality and consistency of monitoring and evaluation. This framework links to the preparation of national strategy plans and rural development programmes that are written by the Member States and approved by the Commission. According to the Implementing Regulation (Council Regulation 1974/2006) the rural development programme must contain a description of biodiversity as it links to agriculture and forestry, including high nature value farming and forestry systems, and be supported by quantified data. An ex-ante evaluation needs to be included as an annex to the rural development programme. It should define expected results and quantified targets and give consideration to high nature value. These targets are largely set in relation to the indicators specified in the Implementing Regulation, which are elaborated in the CMEF. The achievement of the Strategic Objective is therefore not only dependent on the implementation of appropriate and effective measures, but also on the establishment of adequate targets and monitoring activity that make use of clearly defined, meaningful and operational indicators.

This section explores the content of the CMEF for both those indicators that exclusively concern HNV and those that do not explicitly refer to HNV but may be useful to support the HNV indicators.

2.3.1 Overview of the Common Monitoring and Evaluation Framework

The CMEF describes the monitoring and evaluation commitments relating to Member States' rural development programmes. The first of these commitments is the ex-ante evaluation which is submitted as part of each rural development programme and identifies objectives, target levels and baselines for the programme. After the first year of implementation, the Managing Authority of each Member State has to submit an annual progress report to the Commission which must include financial data and quantitative information derived from the common output and result indicators. From 2008, this progress report should also evaluate the progress of the programme through the use of the impact indicators, where these are appropriate. In 2010, this report shall take the form of a mid-term evaluation and in 2015 the form of an ex-post evaluation. Member States must also submit a strategic monitoring summary report every two years, commencing in 2010. This report should summarise the progress made towards meeting the objectives established by the national strategy plan, and therefore allow an assessment to be made of the contribution of the programme to the Community's strategic priorities. The CMEF places a focus on the quantification of impact and only permits qualitative assessment where statistically significant data are not available.

The CMEF consists of a set of guidance notes about the choice and use of common indicators by Member States and a large number of fiches that describe in some detail the objectives of each common indicator, how the indicator is defined and measured and what the appropriate data sources might be. The CMEF contains a total of 120 common indicators, of which there are five different types: baseline, input, output, result and impact indicators (see Box 2 below). Whilst baseline indicators are designed to form the basis of a Member State's national strategy and provide information to allow an assessment of what might be called the reference point, the output, result and impact indicators help to assess the progress made towards achieving the Community strategic priorities.

Box 2 The Different Types of Indicator Used in the CMEF.

Baseline Indicators are used in the SWOT analysis and the definition of the programme strategy. They fall into two categories:

- *Objective related baseline indicators*. These are directly linked to the wider objectives of the programme. They are used to develop the SWOT analysis in relation to objectives identified in the Regulation. They are also used as a baseline (or reference) against which the programme's impact will be assessed. Baseline indicators reflect the situation at the beginning of the programming period and a trend over time. The estimation of impact should reflect that part of the change over time that can be attributed to the programme once the baseline trend and other intervening factors have been taken into account. There are 36 objective related baseline indicators; 10 of which are for Axis 2.
- *Context related baseline indicators*. These provide information on relevant aspects of the general contextual trends that are likely to have an influence on the performance of the programme. The context baseline indicators therefore serve two purposes: (i) contributing to identification of strengths and weaknesses within the region and (ii) helping to interpret impacts achieved within the programme in light of the general economic, social, structural or environmental trends. There are 23 context related baseline indicators; 10 of these are for Axis 2.

Input Indicators. These refer to the budget or other resources allocated at each level of the Assistance (*sic*). These indicators do not feature in the common indicator list.
Example: expenditure per measure declared to the Commission.

Output Indicators. These measure activities directly realised within programmes. These activities are the first step towards realising the operational objectives of the intervention and are measured in physical or monetary units. There are 42 output indicators; 13 of these are for Axis 2.
Example: number of training sessions organised, number of farms receiving investment support, total volume of investment.

Result Indicators. These measure the direct and immediate effects of the intervention. They provide information on changes in, for example, the behaviour, capacity, or performance of direct beneficiaries and are measured in physical or monetary terms. There are 12 result indicators; one of these is for Axis 2 (and is split into five sub-indicators).
Example: gross number of jobs created, successful training outcomes.

Impact Indicators. These refer to the benefits of the programme beyond the immediate effects on its direct beneficiaries both at the level of the intervention but also more generally in the programme area. They are linked to the wider objectives of the programme. They are normally expressed in "net" terms, which means subtracting effects that cannot be attributed to the intervention (e.g. double counting, deadweight), and taking into account indirect effects (displacement and multipliers). There are seven impact indicators; four of these are for Axis 2.
Example: increase in employment in rural areas, increased productivity of agricultural sector, increased production of renewable energy.

Source: CMEF, September 2006.

According to the CMEF, each Member State should consider all baseline indicators in drawing up a national programme. This is because the baseline indicators are the basis for setting national objectives that directly relate to those in the EAFRD Regulation and the Community Strategic Guidelines. Member States can also use the baseline indicators to justify why the national programme does not respond to one of the EU priorities. The use of baseline indicators is especially important. They help to define the starting point and therefore allow the impact of the programme to be assessed at a later stage through the impact indicators, if the two sets of indicators are congruent (i.e. they measure the same thing). There are seven common impact indicators, against which the programme as a whole, and not individual instruments should be assessed.

Member States can also define 'additional indicators' where the common indicators do not fully capture all the effects of programme activity. The CMEF suggests that the use of additional indicators is most pertinent where the common impact indicators do not capture the wider benefits of a measure, particularly where impact is highly site specific, as might be the case with agri-environment schemes.

2.3.2 The CMEF Indicators for HNV Areas

Three of the common indicators refer to high nature value. One of these is an objective related baseline indicator, one is a result indicator and one is an impact indicator. These are described in a set of fiches in the CMEF and summarised in Box 3 below. The full text of each indicator is available from the guidance notes available from the European Commission website[12]. Whilst the titles of these indicators are enshrined in the Implementing Regulation (Regulation 1974/2006) and therefore cannot be changed, it is anticipated that their definition and measurement may be revised as a result of this study.

Each of these three indicators relates to HNV farming and forestry areas, and the baseline indicator introduces the idea of high nature value features. This contrasts with the emphasis in the Community's Strategic Guidelines on farming and forestry systems. However, these indicators do show a path through which to assess the influence of rural development policy intervention both over time and within a spatial area.

[12] http://ec.europa.eu/agriculture/rurdev/eval/index_en.htm

Box 3 Summary of CMEF Indicators for HNV

Objective Related Baseline Indicator 18
Title of indicator: Biodiversity: High Nature Value farmland and forestry.
This indicator is to be measured as: 'UAA of High Nature Value Farmland' (in hectares of UAA).
*The indicator is defined a*s: 'High Nature Value farmland and forestry is associated with high biodiversity. The concept on high nature value does not only cover defined areas but also high nature value features (e.g. buffer strips etc) introduced into areas that as such would not fall under the definition of high nature value. In addition it refers to agricultural and forestry management systems being a driver of high nature value' (*sic*). The description refers to the work of Andersen *et al* (2003) in using CORINE land cover data and the subsequent work of the EEA and the JRC in using additional layers of biodiversity data to map potential areas of high nature value farmland. The description states that the indicator only covers part of the concept and does not at present include small scale features and forestry. This definition also states that 'for New Member States, HNV farmland areas consist in semi-natural grassland, being defined according to their dependence upon continuing agricultural management in order to persist. Alpines pastures above 1900m that can be maintained without any human intervention are not included' (*sic*). The fiche also states that 'Given the current state of development of the EEA/JRC indicator Member States may wish to make use of a national definition for this indicator.'
Common Result Indicator 6
Title of indicator: Area under successful land management contributing to biodiversity and high nature value farming/forestry (and water quality, climate change, soil quality and the avoidance of marginalisation and land abandonment).
This indicator is to be measured as: 'total amount of hectares under successful land management'.
The indicator is defined as: 'Successful land management is defined as the successful completion of land management actions contributing to improvement of biodiversity (defined as protection of wildlife species or groups of species, maintain or reintroduce crop-combinations and safeguarding endangered animal breeds and plant varieties), improvement of water quality (defined as decrease in concentration of nutrients, phosphorous and/or pesticides, the reduced use of chemical fertilisers, reduced life stock density (*sic*), improved nitrogen balance and reducing the transport of pollutants to aquifers), mitigating climate change, improvement of soil quality (defined as reduction of erosion (water/wind/tillage), less water logging, reduction or prevention of chemical contamination (less use of plant nutrient/manure, plant protection substances, …), stabilising and enhancing the level of soil organic matter through the use of appropriate sources of stable organic matter and, where appropriate, through reduced tillage) and the avoidance of marginalisation and land abandonment.
Common Impact Indicator 5
Title of indicator: Maintenance of high nature value farming and forestry.
This indicator is to be measured as: 'Changes in high nature value areas'.

The indicator is defined as: 'Change in area targeted by the intervention is the quantitative and qualitative change in high nature value areas that can be attributed to the intervention once double counting, deadweight, and displacement effects have been taken into account.' It is stated that the indicator remains relatively underdeveloped at the EU level and that Member States should make use of national approaches to identify 'farmland biodiversity rich areas (with EU support)' and other national or regional indicators to further interpret changes in high nature value areas. Sub-indicators for agricultural and forestry areas are noted, but not specified. It is stated that the unit of measurement is 'quantitative change and qualitative judgement' at the programme level. Estimations need to be provided of the general trend at programme area level compared to the baseline trend where this is feasible or statistically significant. The number of direct and indirect beneficiaries should also be estimated on the basis of output and result data, survey data and benchmark data and coefficients from similar projects and past evaluations (for the calculation of double counting, deadweight and displacement). Cross-checking against the counter-factual situation and contextual trends should also take place.

Source: CMEF, September 2006 (NB Common Impact Indicator title adjusted following consultation with DG Agriculture).

The baseline indicator identifies the area of potential HNV farmland, but not the area of HNV forests. A key concern is that it is measured as a proportion of utilised agricultural area (UAA), as opposed to total agricultural area. A measure of the UAA will exclude significant areas of land, for example, common grazings which are often HNV. As a result, this measure of the area of HNV farmland will often provide an underestimate of the actual extent.

The baseline indicator is spatially explicit and theoretically measurable, given the existence of relevant data. The nature value of the agricultural land may be a function of its historic management, although its current management may no longer be conducive for maintaining or improving that value and this would not be captured in measures of extent. This indicator also adds another layer to our interpretation of what is meant by HNV by referring to high nature value features. The definition adds another dimension by putting forward one definition of HNV for the EU-15 - as developed by Andersen *et al.* (2003) - and an alternative interpretation for the new Member States, which shares some ground with the former. The focus on HNV farmland area is perhaps largely a result of the availability of data and the existence of a methodology to map HNV areas (Andersen *et al.,* 2003; Paracchini *et al.*, 2006). This body of work sets the tone for the formulation of the evaluation indicators, but does not correspond to the policy objectives set out in the Strategic Guidelines which relate to farming and forestry systems. HNV systems and HNV features have not yet been systematically explored in the same way as HNV areas and the existing baseline indicator lacks the potential to capture these aspects of HNV.

The common result indicator links HNV to biodiversity protection. This is a logical coupling and implies that present day management practices can contribute to high nature value farming or forestry. The use of the phrase 'successful land management', despite the definition provided in the CMEF, is somewhat qualitative and open to mixed interpretations. This focus may mean that the area measured by this indicator differs somewhat from that measured by the baseline indicator as the two may capture different subsets of agricultural land that may or may not overlap, with only the result indicator capturing forestry. The definition, in its reference to 'improvements to biodiversity', also presumes that land management may not be considered successful if policy measures act to avoid any further decline in biodiversity. Such an outcome may be considered successful given other contextual drivers that may affect the biodiversity interest of a particular site, region or Member State.

The common impact indicator seeks to measure quantitative and qualitative changes in high nature value areas. As an impact indicator it aims to examine the impact of the rural development programme as a whole, rather than individual measures. It implies changes in area of HNV farmland and forests and changes in their conservation status or environmental quality. The indicator implies that data is available concerning the baseline area of HNV forests, yet this information is not collected by baseline indicator 18. Programme evaluators may therefore need to access retrospective data in order to determine the change in HNV areas. An alternative solution could be to change the measurement of baseline indicator 18 to include 'area of HNV forests (hectares)' in addition to 'UAA of High Nature Value farmland (in hectares of UAA)'.

The impact indicator also requires a consideration of double counting, deadweight, and displacement in order to calculate the net impact of intervention. Deadweight considers the changes that would have occurred even without the intervention. Displacement effects are those intended and unintended effects obtained in one area at the expense of another. These aspects of the analysis may be difficult to quantify and may, at best, be addressed in a qualitative and contextual manner. A consideration of the counterfactual, or 'policy-off' situation, for example, could involve an examination of the historical precedent to identify cases in which a lack of intervention has led to the abandonment of the active management of either agricultural or forest land.

2.3.3 Other Relevant CMEF Indicators

The CMEF also contains a number of other baseline indicators that may be useful in considerations of HNV farmland areas, systems and features and HNV forests. These indicators do not specifically relate to HNV but rather complement the information provided by the specific HNV indicators or generate data to feed the HNV indicators. The additional relevant indicators are listed below according to where they might be most useful (features, farmland biodiversity, forestry biodiversity and traditional agricultural landscapes).

Features

Output indicator 35: Total area under agri-environment support.
This is defined as 'Supported UAA of farmers and other land managers who make on a voluntary basis agri-environmental commitments, going beyond the relevant mandatory EU/national standards'. Data must be broken down under a number of headings, some of which are relevant to HNV features: Creation, upkeep of ecological features (e.g. field margins, buffer areas, green cover, hedgerows, trees); Upkeep of the landscape and maintenance of high nature-value farmland areas, including the conservation of historical features (for example, stonewalls, terraces, small wood);

Management of pastures (including limits on livestock stocking rates, low-intensity measures, mowing) and creation of pastures (including conversion of arable crops); Management of other high nature-value farmland areas (e.g. traditional orchards).

Biodiversity (farmland)

Context related baseline indicator 9: Areas of extensive agriculture
Defined as per cent of UAA used for extensive arable crops and per cent of UAA used for extensive grazing, which may overlap with potential HNV farmland areas. Indeed, grazed, semi-natural vegetation is one of the key characteristics of HNV farmland.

Context related baseline indicator 8: Less favoured areas
Defined in terms of the UAA classified as LFA. Natural handicaps typically are characterised by more extensive forms of production.

Output indicators 29 and 31: Supported agricultural land in mountain areas and areas with handicaps
Collected as hectares of UAA and potentially of use in relation to context related baseline indicator 8.

Objective related baseline indicator 17: Biodiversity - Population of farmland birds
Trend data can indicate the broader biodiversity health of agricultural landscapes.

Context related baseline indicator 10: Natura 2000 areas
Defined as the per cent of UAA and forest areas under Natura 2000 designation, and hence provides an indication of habitats that are of conservation interest.

Output indicator 33: Supported agricultural land area under Natura 2000
Collected as hectares of UAA, this indicator focuses on agricultural land which needs to be managed appropriately in order to maintain the conservation status of the Natura 2000 site. It could be used in relation to context related baseline indicator 10.

Output indicator 35: Total area under agri-environment support.
This is defined as 'Supported UAA of farmers and other land managers who make on a voluntary basis agri-environmental commitments, going beyond the relevant mandatory EU/national standards'. Data must be broken down under a number of headings including: Extensification of livestock; Creation, upkeep of ecological features (e.g., field margins, buffer areas, green cover, hedgerows, trees); Upkeep of the landscape and maintenance of high nature-value farmland areas, including the conservation of historical features (e.g., stonewalls, terraces, small wood); Management of pastures (including limits on livestock stocking rates, low-intensity measures, mowing) and creation of pastures (including conversion of arable crops); Management of other high nature-value farmland areas (e.g. traditional orchards); Actions to maintain habitats favourable for biodiversity (e.g. leaving of winter stubbles in arable areas, adaptation of mowing dates).

Output indicator 36: Physical area under agri-environment support
This is defined as 'Supported UAA of farmers and other land managers who make on a voluntary basis agri-environmental commitments, going beyond the relevant

mandatory EU/national standards without double counting of the area in which more than one agri-environmental scheme is applied.'

Biodiversity (Forestry)

Objective related baseline indicator 19: Biodiversity - Tree species composition
Where data on the relative area of mixed species forests compared to the area of coniferous and broadleaved forests helps determine the biodiversity richness of forests and other wooded land.

Context related baseline indicator 10: Natura 2000 areas
Defined as the per cent of UAA and forest areas under Natura 2000 designation, and hence provides an indication of habitats that are of conservation interest.

Output indicator 50: Supported forest land in Natura 2000 area
Collected as hectares; this could be used in relation to context related baseline indicator 10.

Output indicator 52a: Forest area under forest-environment support
Based on those supported by the forest environment measure and muse be broken down according to those commitments that enhance biodiversity and preserve a high value ecosystem.

Context related baseline indicator 11: Biodiversity - Protected forest
Based on Ministerial Conference on the Protection of Forests in Europe (MCPFE) criteria and defined as the proportion of forest and other wooded land that are protected according to national nature conservation laws and classified according to the level of management intervention.

Context related baseline indicator 12: Forest ecosystem health
Also based on an MCPFE indicator and measures defoliation caused by air pollution as an indicator of wider ecosystem health.

Traditional Agricultural Landscapes

Objective related baseline indicator 16: Importance of semi-subsistence farming in New Member States
These are defined as being smaller than one Economic Size Unit (ESUs) and expressed in relation to the number of farms greater than one ESU. This indicator could be useful in considerations of traditional agricultural landscapes.

The output indicators for Axis 2 (29, 31, 33 35, 36, 50, 52a) are relevant as they measure the area in receipt of support. The result indicator for the area under successful management contributing to the avoidance of marginalisation and land abandonment (6e) may also contribute to an understanding of the preservation and development of HNV if HNV is regarded as being dependent on a particular type of farming activity and therefore human intervention (although this is not necessarily so with forestry). Impact indicator 4, 'reversing biodiversity decline', is also likely to relate to HNV.

2.3.4 Developing the CMEF HNV Indicators Further

It is the task of this study to provide Member States with guidance on the way in which changes in HNV farming and forestry can be defined and measured for the purpose of monitoring the impact of rural development programmes.

In order for the indicator to be operationalised, Member States require guidance on how to determine the location and extent of HNV farmland, farmland features and forests in order to set a benchmark figure from which to calculate the eventual digression from this figure by the impact indicator. This means Member States must be provided with a coherent description as to what is meant by HNV and how national authorities should seek to measure the extent, distribution and quality of the national HNV resource. Guidance to Member States is provided in a Guidance Document which accompanies this report (Cooper *et al.*, 2007).

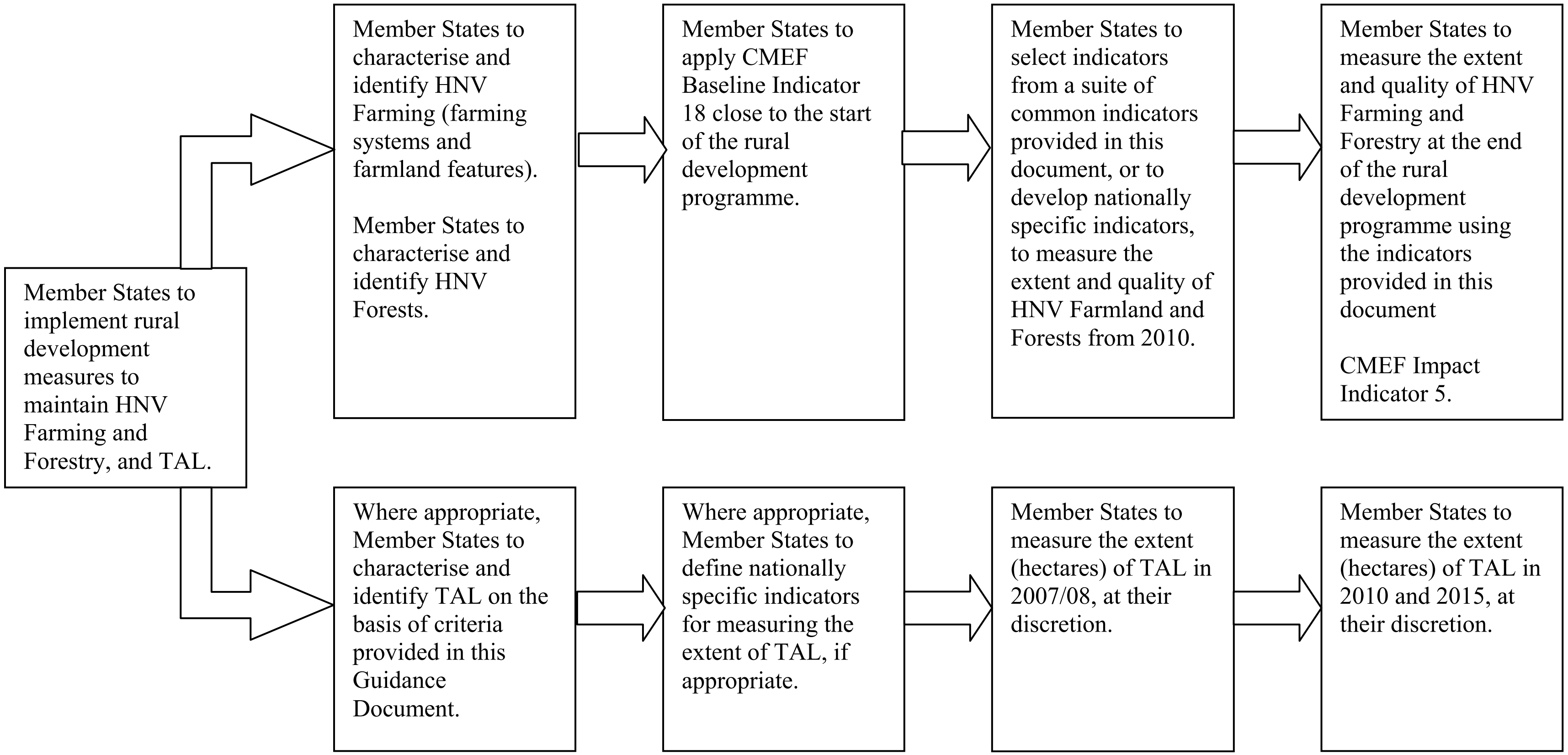
2.4 Implicit Obligations on Member States

In order to meet the objective to preserve and enhance HNV Farming and Forestry systems, and to conduct an effective monitoring programme, there are a number of implicit obligations on Member States. These are depicted in Figure 2.1. They should:

- Have measures in place to maintain their HNV Farming and Forests and Traditional Agricultural Landscapes;
- Apply Baseline Indicator 18 at the start of the rural development programme;
- Introduce indicators to measure the extent and quality of their HNV Farmland and Forests annually, from 2010, to the end of the rural development programme. These indicators will relate to Impact Indicator 5 so that changes may be detected over time;
- Apply indicators to monitor the extent and quality of their HNV Farmland and Forests at the end of the rural development programme (Impact Indicator 5);
- Where appropriate, measure the extent (in hectares) of their Traditional Agricultural Landscapes over the period of the current rural programme;
- Appoint programme evaluators to evaluate the extent to which the programme objectives have been achieved.

The accompanying Guidance Document to this report demonstrates how Member States can meet these obligations (Cooper *et al*., 2007). Important background material to support this is provided in the remaining chapters of this report.

Figure 2.1 A systematic approach to operationalising the HNV indicators in the monitoring of the 2007 -2013 rural development programmes



3 A TYPOLOGY OF POTENTIAL HNV FARMING SYSTEMS

3.1 Introduction

The term 'farming system' has been defined and applied in a number of ways. Generally it refers to the way in which natural resources and other factors are managed for farm production. Christofini (1985) proposes that the regional level is appropriate for characterising farming systems[13].

In the context of HNV Farming, the important point about a farming systems approach is that it situates farm production within a particular natural environment. The HNV farming systems approach considers the way in which farming activities exploit and manage this natural environment, in other words, how farmers use the land. It recognises that a certain type of natural environment, managed for farm production in certain ways, gives rise to high nature values as defined through high biodiversity and the presence of species and habitats of conservation concern.

In the following sections, the farming systems approach is presented at the European and regional levels. The characteristics that are considered to contribute towards making a farming system HNV are explained and the criteria to identify them are defined. Drawing on four regional examples[14], the study attempts to suggest a quantification of the criteria that could be used to determine whether a farming system is HNV or not.

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[13] References for the micro-economic, farm-level approach include Mazoyer (1987) and Sébillotte (1989). At the regional level, Christofini (1985) proposes that 'there are only a limited number of possible farming systems. There are probably not so many patterns, in a given period and in a given region, to manage and combine livestock, farmland, money, information, labour in a meta-stable and sustainable way'.

[14] IEEP *et al.*, 2007 (unpublished). Four Regional HNV Farming Systems. Case studies to the final report for the study on HNV Indicators for Evaluation, for DG Agriculture, Contract Notice 2006-G4-04.

It is recognised that there is no crisp dividing line between HNV and non-HNV farming systems, but rather a gradient along which thresholds can be defined, on the basis of expert knowledge. These thresholds will vary depending on geographical circumstances. A set of indicators with appropriate thresholds can serve to distinguish farming systems that are more likely to be HNV, from those that are not HNV.

3.2 A Typology of Potential Farming Systems in the EU-27

The following typology and associated descriptions aim to identify and characterise broad farming systems that are likely to be HNV ('potential HNV farming systems'), at the level of the EU-27.

The potential HNV farming systems are presented according to the following broad categories:

- Livestock systems
    - Cattle (bovines)
    - Sheep and Goats
    - Pigs and Poultry
- Arable crop systems
- Permanent crop systems

In each case, a discussion is presented of the main characteristics that contribute to nature value, followed by a table summarising the broad farming systems that are potentially HNV. The approximate geographic distribution of systems within the EU is indicated very broadly at this stage (by biogeographic region, or north Europe, south Europe, etc.), with some examples of more specific locations where information is readily available. Information on nature values is given by way of examples in some cases, but generally the geographic level of the EU-27 is not an appropriate level for identifying the nature values associated with these systems very precisely. This should be done at the regional level.

In the typology, farming systems are distinguished primarily by the way in which they use the land. For example, livestock systems based on semi-natural grazings are distinguished from systems using grassland and arable crops. This differs from the way in which farm types are classified in FADN, for example. In the FADN classification, a farm type is a group of farm businesses which have similar combinations of economic outputs. These groupings are not considered appropriate for this typology because they do not reflect the land cover characteristics that are critical to HNV.

3.3 Livestock Systems Likely to be HNV

Three core characteristics have been identified in the literature and case studies as defining potential HNV livestock systems.

1. Presence of Grazing Livestock

Livestock provide an efficient way of moving nutrients around the farm and controlling unwanted vegetation, so that in the most intensive farming areas the very presence of grazing livestock is seen as increasing the nature value of a farm. This effect is a result of increased landscape complexity, along with the possibility of reduced biocide use and of a more natural form of nutrient cycling. However, clearly the mere existence of grazing livestock does not in itself indicate an HNV system.

2. Stocking Densities

Nutrient flux in livestock systems is a key indicator of the intensity of a livestock system. Unlike in cropped areas, nutrient inputs are not only in the form of imported fertilisers. Feedstuffs themselves are high in nutrients; indeed some of the most intensive, high-nitrogen flux systems involve dairy cows where most of the fertiliser applied is in the form of slurry from the cows themselves. Livestock density is therefore probably a better determinant of intensity than fertiliser input, in most cases.

The effect of grazing on biodiversity depends strongly on the nutrient availability and the related biomass production. To be considered HNV farming systems, the maximum stocking densities should not adversely affect nature values. The threshold level of stocking densities, however, is complex to determine and will vary between locations. The hump back model of Grime (1973) illustrates the relationship between animal diversity, nutrient availability and stocking density (see Figure 3.1).

In principle, the density of cattle on an HNV system should be related to annual biomass production, leaving enough vegetation for species to function. On soils with a low annual biomass production, the removal of the above soil biomass by grazers will endanger the survival of many field layer inhabiting animals sooner than on soils with high biomass production. Many animal species, from arthropods, reptiles, amphibians and mammals, need vegetation for food, for shelter and for deposition of eggs or pupae. If above soil vegetation is removed by cattle or sheep, food resources become limited, and shelter disappears. While at high annual biomass production, it takes much longer before grazers destroy the natural conditions of field layer inhabiting animals. Cessation of grazing in areas with a high annual biomass will even lead to reduction in species diversity in the field layer. In the short term, this will first lead to abundant flowering which favours survival and reproduction of nectar and pollen feeding animals. In the longer term, the field layer vegetation will become higher and denser, which is accompanied in most cases by a loss of plant diversity and the dominance of a few grass species.

3. Biocide Use[15]

The destruction of biota by the use of pesticides is not as great a concern in most livestock systems as arable and permanent crop systems, as they are used less. While some concerns have been expressed over the use of avermectins[16], we are not aware of any studies which cite veterinary medicines as a key factor in a significant loss of nature value. Herbicides are used in some livestock systems, but occasional targeted use of weedkiller on, for example, *Rumex spp, Cirsium spp, Sencio jacobea, Juncus effuses* or *Pteridium aquilinum* is accepted even within nature reserves in the UK and Ireland. Again their use does not seem to be a critical determinant of HNV.

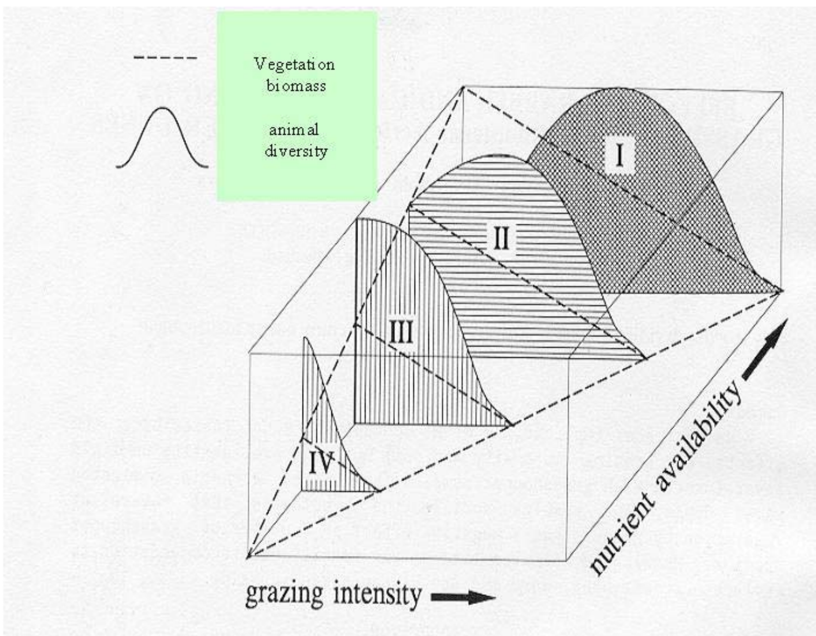


Figure 3.1 Relationship between animal diversity, nutrient availability and stocking density

Source: After Grime, 1973

[15] A biocide is a chemical substance capable of killing living organisms. It is either a pesticide which includes fungicides, herbicides, insecticides, algicides, miticides and rodenticides, or an antimicrobial which includes germicides, antibiotics, antivirals, antifungals and antiprotozoals.

[16] This drug severely reduces the number of invertebrates in cow's dung as many that are attracted to dung after defecation are killed. These invertebrates are an important food source for some birds (for example chough), especially in winter.

3.3.1 Cattle (Bovine) Systems

Cattle require a lot of feed intake for their maintenance. During pregnancy this needs to be of a certain quality and the result is that cattle tend to occupy slightly more productive niches than sheep. This is especially true when high milk production is required, so that in general, dairy systems are found on more productive land than suckler beef systems. Almost the whole of Europe has a seasonal pattern of vegetation growth and therefore cattle systems can be discussed in terms of the source of feed in the productive and in the unproductive seasons. This approach is taken by CEAS and EFNCP (2000) in their environmental typology of dairy systems.

Extensive Systems using Semi-Natural Pastures

In the main growing season, it is possible in most regions for cattle to be pastured outside. Where this is predominantly on semi-natural vegetation, the system is likely to be HNV, whatever the source of fodder in the season of low productivity. Only in the Alpine zone is the seasonal productivity and quality of semi-natural vegetation such that yields acceptable to modern dairy farmers are possible (CEAS and EFNCP, *ibid*.). Outside this zone, otherwise similar environments are used by suckler cattle, often in combination with sheep, notably in the Atlantic zone, and more localised in other areas, such as the Pyrenees. However, the functional relationship between grazing animal and the environment is similar. Patterns of use vary by zone, with Alpine systems being primarily transhumant at a local scale, while in the milder Atlantic, sedentary grazing/housing or even set-stocking systems (outwintered on the semi-natural pastures) are found.

In all other cattle-rearing and finishing areas the feed for the animals, when home produced, comes from more intensively managed grasslands and/or arable crops. A range of dairy systems is described in CEAS and EFNCP (*ibid.*), but very few are of the low input/low output types likely to be HNV. One such low input class comprises organic and similar systems, but while these may be low input compared to their conventional equivalents, they are not necessarily HNV. The same applies to organic beef systems.

Extensive Grass Based Systems

A second class is the low input systems based on more intensively managed grassland and found predominantly in the Atlantic and Alpine zones where grass systems have the advantage over arable. In the case of dairying, these systems are by virtue of their location vulnerable to intensification or the abandonment of dairying in favour of other systems and HNV dairy systems therefore are extremely rare. In general, these systems overlap in intensity with grass based suckler and beef finishing systems. HNV types are more common in the latter, but in both cases, livestock density must be relatively low in order to be potential HNV systems.

Extensive Mixed Systems with Crops and Grass

The third class identified by CEAS & EFNCP (*ibid.*) only existed in dairy systems in the Mediterranean zone of the EU of the time (EU-15) – low intensity mixed systems with crops and grass. These were mostly small scale and are replicated in key ways in many parts of the new Member States of Central and Eastern Europe (CEEC), where they are similarly threatened with imminent abandonment. Similar systems occur more widely in the beef sector, where they are present outside of the semi subsistence and semi commercial sectors. Out summering is common, but HNV stall fed systems are possible and do exist locally in CEEC.

Table 3.1 Potential HNV Cattle Systems (Beef and Dairy)

Farming Systems	Geographic Areas	Nature Values	Possible Indicators
Extensive systems using semi-natural pastures. Stock on semi-natural vegetation for the growing season; rest of the year variable. Semi-natural vegetation dominates the forage area used by the farm. Transhumant systems are present locally.	Still a common type of system in large areas of Europe. Dairying - Alpine zone, e.g. France, Italy, Austria, Spain, Romania. Beef – widespread in LFAs e.g. in Alpine, Atlantic, Continental, Mediterranean and Pannonic zones.	[Not appropriate to identify at this geographic level]	Presence of large semi-natural areas; stocking density; breed of cattle.
Extensive grass based system. During grazing season stock usually use mostly improved or semi-improved grassland, although semi-natural vegetation may be used for heifers, dry cows, etc. Zero grazing systems possible but unusual. In non productive season, livestock may be housed. This system usually is *not* HNV, except under low intensity management.	Alpine and Atlantic zones. Dairy examples increasingly unusual; Beef systems common. In case of dairying, mostly semi subsistence, in case of beef, mostly small scale and increasingly non commercial in extensive (HNV) type.	Ditto	Stocking density
Extensive grass/arable systems. Equivalent of extensive grass based system, but in other biogeographical zones. When stall fed, cattle eat mixture of fodder and arable crops, e.g. grass, lucerne, arable silage, grains. All year housing more common than in grass based systems. Only HNV when under low intensity management. Very vulnerable to intensification pressures.	All other zones. All HNV dairying and most HNV beef systems small-scale or semi-subsistence. Especially common in CEEC. Declining rapidly in other zones, including Mediterranean where still present.	Ditto	Stocking density; non-use of herbicides; make up of rotation.

3.3.2 Sheep and Goat Systems

Sheep and goat production is often associated with extensive grazing systems. These cover large areas of the more marginal regions of the EU-27 and in many cases are potential HNV systems. However, intensive systems are also quite common (for example indoor systems and intensive grassland systems), though covering a much smaller land area. These systems are not HNV.

To be considered potentially HNV, sheep and goat systems must use mainly semi-natural grazing/browsing or be associated with HNV arable land (grazing stubbles and fallows – see Arable Systems below).

The semi-natural land must be unfertilised and used at low stocking densities to allow for high nature value. Smaller parts of the farm may be used more intensively, for example, for hay, cereals or other fodder crops. These parts may add habitat diversity in a predominantly semi-natural land cover.

The principal semi-natural element is provided by the grazing/browsing land. This may be grassland, scrubland or forest, or some combination thereof. Additional elements in the form of hedges, scrub, woodland, etc., generally add to the habitat value.

In potential HNV sheep systems grazing on arable stubbles and fallows, the semi-natural element is provided by field margins, headlands, long fallows and other semi-natural patches. The management practices to which they are subjected are crucial. Herbicide treatment of semi-natural grass field margins and headlands, or repeated burning of patches of scrub or woodland, are extremely damaging to their nature value.

Many traditional orchards and some olive groves have a permanent understorey that is grazed by sheep. If grazing is at a suitably low intensity, and fertiliser and biocide is minimal, such orchards and olive groves are likely to be HNV.

When semi-natural vegetation covers the majority of the farmland area and is managed at an appropriate low intensity, sheep and goat systems generally should be HNV even in the absence of land cover diversity. Patches of hay production, crops, wetlands, etc., will increase the habitat diversity and, all else being equal, nature value.

Table 3.2 Potential HNV Sheep and Goat Systems

Farming Systems	Geographic Areas	Nature Values	Possible Indicators
Sedentary low-intensity systems on semi-natural grassland. Stock are normally on fenced, semi-natural grassland on the farm holding, although some local shepherding of other pastures may occur. Stocking densities typically vary from as low as 0.15 LU / ha to 0.6 LU / ha, and higher in areas that would be regarded as overgrazed.	Present in most countries, especially in Less Favoured Areas and other marginal land. Main areas in north west UK, west Ireland, Iberia.	[Not appropriate to identify at this geographic level]	% of semi-natural grazing; stocking density; N/ha
Pastoral on semi-natural vegetation. The most typical system in Southern Europe, based primarily on poor, semi-natural forage resources (grassland, scrub and woodland, often mixed), especially common in uplands and mountains. In more traditional systems, shepherds accompany the stock all day and most days of the year (no fencing, predators); in modernised systems stock are taken to different types of pasture and then visited daily or weekly, but not accompanied (fencing, no predators). Seasonal/altitude movements are common.	South Europe (including southern France) and east Europe.	Ditto	% of semi-natural grazing; stocking density; number of days shepherding per year; seasonal movements
Pastoral on stubble and fallows. Only HNV when arable system is HNV; daily shepherding as the land is mostly unfenced. Stocking density <0.3LU/ha (Spain).	South and east Europe.	ditto	% of semi-natural grazing; stocking density; number of days shepherding per year

3.3.3 Pig and Poultry Systems

The fact that pigs and poultry are traditionally grouped together by analysts of agricultural systems illustrates the general pattern of development in these two sectors. The vast majority of both species are now kept very intensively indoors and fed mostly on arable products. Indeed, their distribution in Europe to a large extent mirrors that of specialist arable areas.

Free range systems do occur, but the only systems likely to be HNV are those where free ranging pigs use woodlands or wood pastures in an extensive manner. Once common throughout Europe, these systems are now increasingly rare and are common only in certain parts of the Mediterranean, especially western Iberia.

Table 3.3 Potential HNV Pig Systems

Farming System	Geographic Areas	Nature Values	Possible Indicators
Low-intensity pannage pig systems. For at least some of the year pigs forage freely and at low densities in woodland.	Present but infrequent in most countries, e.g. in UK in New Forest. Common in certain Mediterranean areas, e.g. Iberia.	[Not appropriate to identify at this geographic level]	Use of woodland or wooded pasture as forage; Stocking density; breeds

3.4 Arable Crop Systems

Much of European arable farming is intensive in the use of nitrogen fertilisers and biocides, and consequently is not associated with significant nature values. However, in parts of southern Europe the climatic conditions, and especially the low precipitation, restrict the ability of crops to respond to nitrogen fertilisers. In areas with a more continental climate (interior regions), extremes of temperature (cold winters) and lack of humidity also reduce the incidence of pests and fungal problems in crops, and thus the need for a heavy use of biocides. Irrigation overcomes many of these natural handicaps, but the consequent increase in inputs means that Mediterranean irrigated crop areas do not fall in the High Nature Value category.

In central and eastern Europe, intensity of input use is also low, for a combination of historic and economic reasons. On better land this is in large measure due to the collapse of Communist era state and collective farms and the lack of capital thus far to reintensify them. In more marginal areas, and in much of Poland, for example, a traditional smallholding based land use was allowed to survive and in these areas low intensity is a response both to poor growing conditions as well as resulting from a lack of capital.

In summary, low intensity dryland arable cropping exists in some parts of south and east Europe, and can be of significant nature value when they are in conjunction with the presence of semi-natural features and/or a diversity of land cover. In north Europe, extensively managed cereals are very unusual and where they occur they are likely to be associated with livestock systems.

In the context of rice cultivation, low inputs of biocides and fertiliser lead to a higher 'naturalness', wet grassland and wetland type habitats, which is less typical that the dry grasslands with which rice is generally associated.

In some areas of relatively intensive cereals cultivation, populations of species of conservation importance, usually birds, have survived. Because of their presence, such areas are considered of significant nature value and are identified as Type 3 HNV Farmland areas. An example are those areas with populations of Great Bustard *(Otis tarda)* and/or Little Bustard *(Tetrax tetrax)*, where the farming intensity is not optimal for the survival of these species, but they continue to use the areas because of preference for established breeding sites.

Similar examples are Cattle Egret and Common Crane *(Grus grus)* in intensive rice fields in western Iberia. The farming systems in these areas generally need to introduce changes in order to ensure a favourable conservation status for the species present, particularly in terms of the intensity of land use, the maintenance of semi-natural features, and/or a land use mosaic.

Exceptions to this general pattern are of course possible. In the UK, the NGO Plantlife has carried out a survey of important sites for arable weeds (Byfield and Wilson, 2005), identifying 105 sites, mainly on calcareous substrates. However, these examples are notable not so much as an exception to the principles outlined, but more as an exception to the generalisations of where such systems are to be found.

Semi-natural vegetation in arable systems is found principally in the form of elements such as field margins, headlands, patches of scrub and woodland. In some cases, arable land exists in a mosaic with semi-natural farmland in the form of grassland or long fallows. In addition, arable/set-aside mosaics exist on all farms with significant areas of cereals.

These elements are essential for nature value, due to their habitat function, and because they provide a refuge for species using the cultivated area as part of their life cycle. The management practices to which they are and have recently been subjected are crucial. Herbicide treatment of semi-natural grass field margins and headlands, for example, is extremely damaging to their nature value.

The density of such elements varies greatly. In the major cereal-producing regions of central and north western Europe, the density of field margins and headlands has been reduced greatly due to intensification and rationalisation of fields and farms. Recently, set aside land and the growth in agri environment funded field margin management have increased the diversity of these elements, however for the most part, the system with which they are associated is not low intensity or HNV.

The density of semi-natural elements is far higher in areas that have not been intensified, for a combination of economic and climatic/edaphic reasons, and this often coincides with areas of low intensity practices, such as parts of south and east Europe. Diversity in land cover in arable sytems may come in the form of the different elements in a rotation, for example, crops, grass and fallows. Depending on farm size, mosaic patterns may be small, medium or large scale.

Table 3.4 Potential HNV Arable Crop Systems

Farming Systems	Geographic Areas	Nature Values	Possible Indicators
Low intensity arable systems. With a significant density of semi-natural elements and mosaic land cover mosaic.	Generally: interior regions of Portugal, Spain, Italy and Greece. Parts of eastern Poland, Romania, Bulgaria. Exceptionally: can be found locally in all areas.	[Not appropriate to identify at this geographic level]	Nitrogen input / ha, yield / ha, use of biocide types (pesticides, fungicides, herbicides) / ha. Density / ha of semi-natural elements, e.g. field margins. Proportion of UAA under fallow. Diversity of land cover, e.g. number of parcels with different cover.
Semi intensive arable systems. Supporting species of conservation concern.	Specific Bustard populations in Portugal, Spain, France, Austria, Germany. Wetland birds, amphibians, on ricefields e.g. in Italy (Po valley), Iberia.	Birds of conservation concern.	Presence of specific species.

3.4.1 Permanent Crop Systems

Much of European permanent crop farming is intensive in the use of nitrogen fertilisers and biocides, and consequently is not associated with significant nature values. Modern, intensive cultivation of tree crops involves small varieties (half standard and dwarf varieties) planted at high densities, often with irrigation in southern Europe. In these intensive conditions, problems with pests and fungal infections tend to increase, along with the need for biocides.

However, traditional fruit and nut orchards (for example apples, pears, plums, cherries, walnuts, chestnuts) survive in some areas of most countries, and often involve no use of nitrogen fertilisers or biocides. In south Europe, the largest areas of low intensity permanent crops are olive, and to a far lesser extent almonds, and locally figs, hazelnuts, walnuts, carrobs, etc. However, in recent years, a more intensive use of nitrogen fertilisers and biocides has become widespread in some crops (such as olives), especially in areas with a high concentration of more commercially orientated producers.

Vines are sometimes cultivated with low inputs, but very rarely include significant semi-natural elements as the plant itself is small and the herbaceous layer is usually absent for all or most of the year.

The trees themselves are an important semi-natural element when they are large, old and not treated with broad spectrum insecticides. They constitute a significant habitat for a range of species (insects, reptiles, birds, small mammals). Vines are not comparable to tree crops in this aspect due to their small size.

The herbaceous understorey of tree crops is a potential semi-natural element. Many traditional orchards and some olive groves have a permanent understorey that is grazed by livestock, especially sheep. If grazing is at a suitably low intensity, and fertiliser and biocide application is minimal, such orchards probably will be HNV. In south Europe, the understorey usually is eliminated for part of the year to avoid competition with the tree crop for the limited moisture that is available. If this is done through occasional tillage (for example, once or twice a year) and the timing allows the development of flora and associated insects in spring, this temporary herbaceous layer is of significant nature value, when combined with the trees.

Other significant elements are field margins, headlands, patches of scrub and woodland, and dry stone walls (used by reptiles). These elements are essential for nature value, due to their habitat function, and because they provide a refuge for species using the cultivated area as part of their life cycle. The management practices to which they are subjected are crucial. Herbicide treatment of semi-natural grass field margins and headlands, or repeated burning of patches of scrub, are extremely damaging to their nature value.

Traditional permanent crops often exist alongside other land uses on the farm, including arable crops and grassland.

Table 3.5 Potential HNV Permanent Crop Systems

Farming Systems	Geographic Areas	Nature Values	Possible Indicators
Traditional orchards with permanent semi-natural or low intensity crop understorey.	Locally in all countries.	[Not appropriate to identify at this geographic level]	Tree size. Nitrogen input / ha, yield / ha, use of biocide types (pesticides, fungicides, herbicides) / ha. Presence of semi-natural understorey. Density / ha of semi-natural elements, e.g. field margins. Diversity of land cover, e.g. number of parcels with different cover.
Mediterranean dryland tree crops with permanent or temporary semi-natural or low intensity crop understorey.	Locally in Spain, more widespread in Portugal, Italy, Greece.	ditto	Tree size. Nitrogen input / ha, yield / ha, use of biocide types (pesticides, fungicides, herbicides) / ha. Presence and timing of semi-natural understorey. Density / ha of semi-natural elements, e.g. field margins. Diversity of land cover, e.g. number of parcels with different cover.

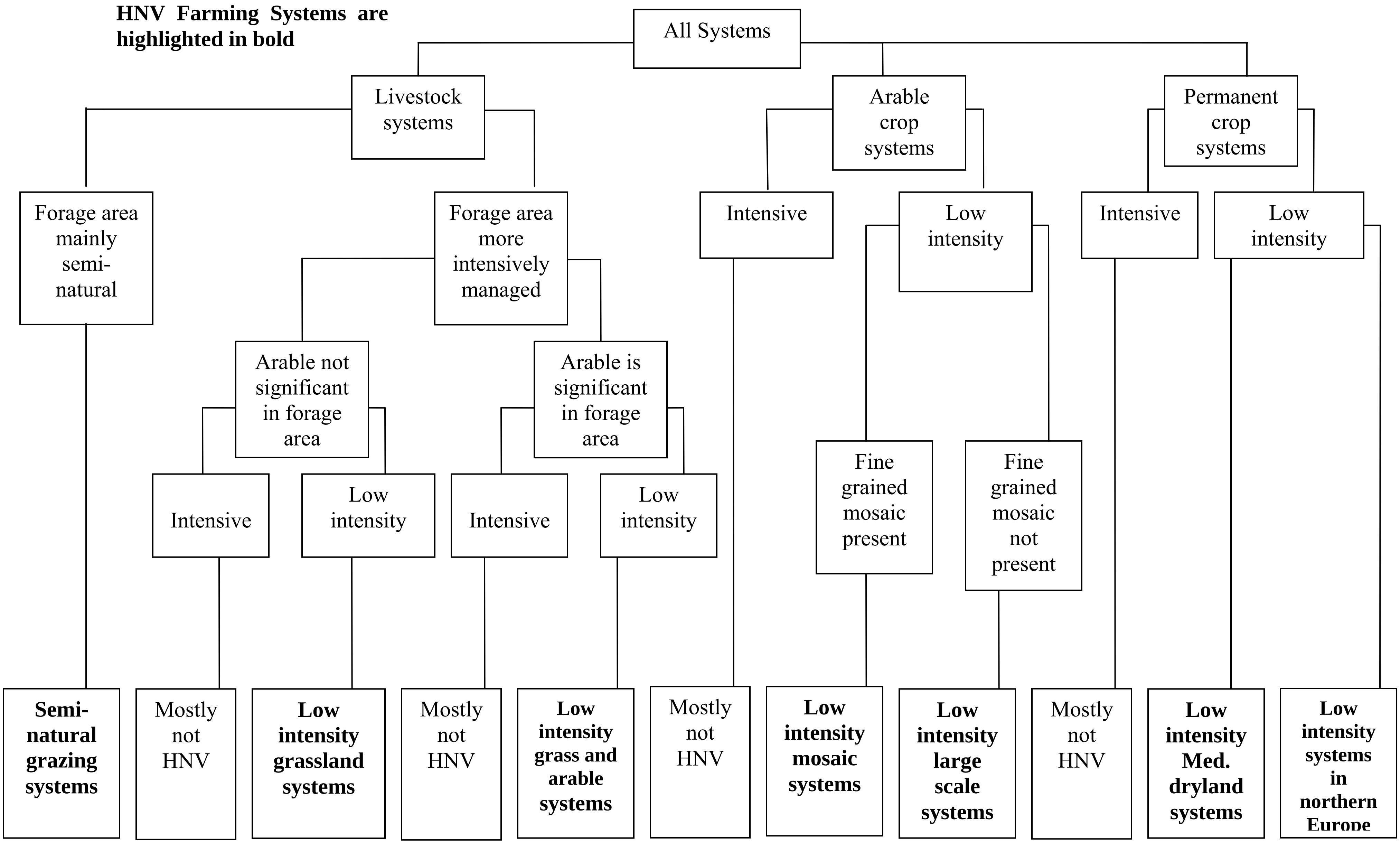
3.5 A Simple Typology of Potential HNV Farming Systems in the EU-27

The typologies above can be combined into the simplified Figure 3.2 below which separates the major groupings of potential HNV systems (shown in bold at the end of the diagram) from predominantly non-HNV systems.

If the result is compared to the analysis of Andersen *et al.* (2003) it can be seen that:

- The principal class corresponding to HNV Farmland Type 1 is semi-natural grazing systems. Low-intensity permanent crops with a semi-natural understorey can also be considered Type 1.
- HNV Farmland Type 2 is the most complex group of systems (low intensity grassland and arable and grass systems, and low intensity arable crop mosaics and large scale cultivations).
- HNV Farmland Type 3 is possible in all of the ‘mostly non-HNV’ classes, for example, grasslands important for black-tailed godwit *Limosa limosa* fall into the intensive grassland livestock systems category, more intensive arable systems with Great bustard (*Otis tarda*) population would fall into Type 2 when less intensive.

Figure 3.2 Typology of potential HNV farming systems in EU-27



3.6 Identification of Regional Sub Types

3.6.1 Introduction

The broad potential HNV farming systems identified through the European typology are observed in national and / or regional sub types. The number of sub types present in a given region will vary between Member States and some regions will not have any HNV farming systems. This will depend on the structural characteristics of the agricultural sector in different Member States, geographical conditions, and the concentration and distribution of the HNV resource. Regional HNV farming systems have been characterised in four regions for the purposes of this study: Basse Normandie in northern France, Extremadura in Spain, the western Carpathians in the Slovak Republic, and the Highlands and Islands in Scotland[17]. The aim of these regional examples is to explore the typology of EU farming systems and its application in a regional context; to establish a process for characterising regional farming systems which are likely to be HNV and describe their associated nature values; to define the threshold levels of the three core criteria which characterise HNV farming – intensity of land use, presence of semi-natural features, and the presence of a land use mosaic – above which the farming system can be classed as HNV in specific regional contexts. See Box 1 for a summary of the characterisation of HNV livestock systems in Basse-Normandie.

Finally, the regional examples provide a model for Member States to follow in the characterisation of their regional HNV farming systems, as a precursor to selecting indicators to measure the extent and quality of HNV farmland. They indicate what sort of material is required in order to characterise farming systems, including a brief introduction to the area; an overview of the land uses in the area; describes the potential HNV farming systems present in the region as a sub type of the broad European systems identified, setting out their production characteristics, CORINE categories, Natura 2000 habitats, nature values, semi-natural elements, farming practices and their significance for nature; those practices which impact negatively on nature values, and possible indicators for defining whether a system is HNV or not.

Three of these regions were selected because of their importance for nature and because, with the exception of Basse – Normandie, they are dominated by significant swathes of HNV farmland according to previous mapping exercises (Andersen *et al.*, 2003). Normandy was selected because it is more typical of a lowland, more intensively farmed area with some known conservation interest (Pointereau, 2006). Three of the regions – Extremadura, the Highlands and Islands, and the western Carpathians – are dominated by Type 1 HNV farmland; there is some Type 3 HNV

[17] IEEP, 2007 (unpublished). Four Regional HNV Farming Systems. Case Studies to the Final report for the study on HNV Indicators for Evaluation, for DG Agriculture, Contract Notice 2006-G4-04.

farmland in the western Carpathians, and the Basse-Normandie case includes large areas of Type 2 HNV farmland.

A summary of the key findings and broad messages from the regional examples is presented in the following section.

Box 1 Characterisation of a Regional HNV Livestock System in Basse-Normandie

Basse-Normandie is situated in the north west of France, in the Atlantic biogeographical zone. The European HNV sub-type can be described as a low intensity cattle grassland system for the production of milk and meat. The thresholds cited are specific to this regional system. It is characterised by:

Semi-Natural Features

- A high proportion of permanent grasslands, in excess of 70 per cent of the UAA of the farm holding.
- Semi-natural features, including hedges, wood edges and traditional orchards comprise at least 20 per cent of the UAA of the agricultural region.

Intensity of Land Use and Management of Semi Natural Features

- Low inputs of mineral Nitrogen fertiliser, less than 50kg/hectare/annum, the grassland is generally not fertilised, and no pesticide use.
- The permanent grasslands have a high natural productivity, allowing a stocking density of between 0.8 and 1.2 LU/ha. Below 0.8 LU/ha, encroachment of scrub presents a risk to nature values.
- A wide range of mowing dates between June and July.
- Hedges are cut by hand, leading to a diversified age structure and the presence of old trees.

Nature Values

- Stocking densities of around 1LU/ha on non fertilised permanent grassland allow a high number of plant species per field (up to 50 – 60).
- The presence of hedges and their management, combined with a large proportion of unimproved, semi-natural grassland, is a key factor in explaining the high nature value of the farming system. Hedges significantly increase the number of insects and birds.
- The nature value of traditional orchards is high because they are always associated with hedges and permanent grasslands. This nature value is also linked to the small size of the parcels and the presence of a minimum number of old trees. For example, 74 breeding bird species have been observed in traditional orchards with an average of 24 to 44 species per orchard.
- The following species of farmland birds of European and/or regional concern are present (*Phoenicurus phoenicurus, Passer ontanus, Pyrrhula pyrrhula, Lanius collurio, Jynx torquilla, Upupa epops, Athene noctua*, associated with extensive grazing systems with traditional orchards, and *Emberiza citronella, Milvus milvus, Lanius collurio, Hippolais polyglotta, Sitta europea, Athene noctua, Strix aluco*, associated with extensive grazing systems with hedges).

3.6.2 Identification of HNV Farming Systems at the Regional Scale

In all four case study regions, the identified HNV farming systems are livestock systems, or mixed systems in which the livestock production is the critical element for nature value. Although there are cases of HNV permanent crops (orchards, olive groves), these are also grazed by livestock, and the grazed vegetation contributes a key part of the nature value. Livestock systems may include arable land, but the parts of the farm most significant for nature value are within the livestock system. In other words, they are forage land of some sort, and the proximity of this land is also critical to maintaining the nature value of the arable land (see Chapter 4 for a more detailed explanation of the habitat function of these different land uses).

Following the EU-level Typology in Figure 3.2 the systems identified in the study regions are presented in Table 3. below. The EU level Typology was found to cover practically all the identified systems in a coherent manner, with the exception of horse breeding, which could be added if considered appropriate.

In particular, it makes more sense in some circumstances to combine livestock types (for example, sheep and beef cattle), reflecting the reality of many HNV farming systems, for example, in the dehesas of Extremadura. Indeed, this exemplifies the HNV farming systems approach, and its focus on a distinct natural context, in this case dehesa, in which production takes place.

HNV arable systems were identified only in Extremadura. However, the findings suggest that, in order to support high nature values, in the region, arable land must be in a mosaic with a sufficient proportion of semi-natural grazing land (dry grassland, fallow) and additional semi-natural features, such as field margins and patches of scrub. Thus an area of farmland that is entirely arable would not be HNV, but low intensity arable cropping could add additional nature value to a farm that has a large proportion of land under semi-natural grazing. From the point of view of identifying HNV farming areas through indicators, the grazing land must be present, and thus exclusively arable farmland is unlikely to be HNV.

Table 3.6 Potential HNV Farming Systems in the Four Case Study Regions

Potential HNV Cattle, Sheep and Goat Systems

EU Level Types	Basse-Normandie Sub Type	Carpathian Sub Type	Extremadura Sub Type	Highlands and Islands Sub Type
Extensive systems using semi-natural pastures		Beef and dairy systems in high mountain areas	Suckler beef on mountain vegetation	Suckler beef systems
		Beef and dairy systems in other mountain areas	Suckler beef in *dehesas*	Mixed sheep and suckler beef systems
			Suckler beef on steppe grasslands	Sheep only systems
			Sheep and goats in *dehesas*	
			Sheep (meat and milk) on steppe grasslands Goat (meat and milk) on mountain vegetation	
Low intensity grassland systems	Low intensity cattle grassland systems	Beef and dairy systems in other mountain areas		Suckler beef systems
		Beef and dairy systems at lower altitudes		Mixed sheep and suckler beef systems
		Sheep and goat systems in high mountain areas		Livestock systems with beef finishing (rare at low intensity)
		Sheep and goat systems in upland areas		Sheep only (rarely)
		Sheep and goat systems at lower altitudes		
Low intensity grass and arable systems			Sheep and goats on grassland, stubbles and fallows	Suckler beef systems
				Mixed sheep and suckler beef systems
				Livestock systems with suckler beef systems (but rare and low intensity

Potential HNV Pig Systems

EU level Types	Basse-Normandie Sub Type	Carpathian Sub Type	Extremadura Sub Type	Highlands & Islands Sub Type
Low-intensity pannage pig systems			Pannage pig system in *dehesas*	

Potential HNV Horse Systems

EU level Types	Basse-Normandie Sub Type	Carpathian Sub Type	Extremadura Sub Type	Highlands & Islands Sub Type
Not covered		Pastoral horse system Small farms mostly oriented on horse breeding		

Potential HNV Arable Crop Systems

EU level Types	Basse-Normandie Sub Type	Carpathian Sub Type	Extremadura Sub Type	Highlands & Islands Sub Type
Low-intensity arable systems with a significant density of semi-natural features, and small or large scale mosaic land cover.			Same as EU Level Type	

Potential HNV Permanent Crop Systems

EU level Types	Basse-Normandie Sub Type	Carpathian Sub Type	Extremadura Sub Type	Highlands & Islands Sub Type
Traditional orchards		Traditional orchards		
Mediterranean dryland tree crops			Dryland olives with semi-natural grass layer	

3.7 Criteria Defining HNV Farming Systems

3.7.1 Semi-Natural Forage Land

All four cases conclude that the type and proportion of forage land are the fundamental criteria determining HNV in the study regions. This forage land can be on the holding, but also off the holding in the case of common grazings. These are extremely important and must be taken into account when defining, applying and measuring relevant HNV indicators.

In most cases, the HNV farming systems use more than one type of forage land, which may range from the least altered semi-natural vegetation which is never tilled, sown or fertilised, through to grasslands that may be occasionally tilled and/or lightly fertilised, to more intensive grassland and arable forage crops.

Grazed semi-natural vegetation is the basis for the nature value of the HNV farming systems described in the case studies. This vegetation may be grassland, scrub or woodland, or a combination of different types. However, the other types of forage land may contribute nature value, when combined with a large proportion of semi-natural vegetation, by providing additional habitat and feeding opportunities for wildlife. This point also applies to arable land within a predominantly grazing system.

The fact that the vegetation is grazed by livestock, or mown for hay, is relevant, as this confirms that it is part of a farming system. Thus semi-natural woodland that is not grazed is considered as a separate non farming landuse. It may be considered as a semi-natural feature that contributes nature value. Land that is grazed primarily by wild herbivores, such as deer, for example, on shooting estates in Scotland and Spanish dehesas, should be excluded.

The four studies conclude that farmland under an HNV system of the two types explored will include a minimum proportion of grazed or mown semi-natural vegetation, and that the other forage types if not strictly semi-natural, should be under low intensity management, for example, low intensity grazing or cropping, low fertilisation, untilled fallow.

It is recognised that there is no clear dividing line between what is semi-natural vegetation and what is not. For the purposes of the present study, the most useful approach may be to consider as semi-natural vegetation that which has not been sown or fertilised, although it may be tilled occasionally. This is especially relevant in the Spanish case, where dehesa and other grasslands may be tilled occasionally for scrub control, without significantly reducing their nature value. Spontaneous vegetation in olive groves and on low intensity fallow land may also be counted in the same category.

3.7.2 Livestock Densities

Livestock densities are relevant for two reasons:

- As an indication of the predominant forage type used by the farm. A low stocking density per hectare of forage indicates that the forage is of low productivity. If it is very low, it is probably semi-natural, or close to semi-natural.
- Stocking density affects the nature value of the forage vegetation. Overstocking will reduce the value of semi-natural vegetation, while understocking will allow the vegetation to evolve through natural succession, so that the original habitat will be lost.

The natural productivity of land is determined primarily by soil and climate. For a given area with common soil and climate conditions, this natural productivity determines approximately the stocking density that can be supported without improvements such as fertilisation, reseeding and irrigation. The use of fodder, such as hay, cereals or purchased feeds, at times of forage deficit (winter in northern Europe, summer in the south) also allows for a higher livestock density over the year.

The nature value of forage vegetation is affected by the intensity of use, including the grazing regime, type and number of livestock, periods of the year, shepherded or not, fertilisation, including dunging by livestock which may be significant where purchased feeds are used, burning, ploughing, etc. In simplified terms, the more intensive the use, the lower the nature value of the habitat, so long as grazing or mowing is sufficient to prevent natural succession and a consequent loss of the habitat.

The stocking density over the year, measured in LU/ha, gives a good indication of the productivity of the forage land and of the intensity of use. For a given area, it seems possible to define a stocking density that gives a strong indication of a high proportion of semi-natural (or close to semi-natural) vegetation.

However, it is clear from the four studies that, because the natural productivity of vegetation varies between areas, this stocking density threshold will also vary. Examples from the case studies include:

	Range of stocking densities associated with HNV systems	Possible stocking density indicator for HNV systems
Basse Normandie		0.8-1.2 LU/ha
Highlands and Islands	0.2-1.0 LU/ha	0.2 LU/ha (semi-natural) 0.8LU/ha (other grassland)
Carpathians	0.3-1.0 LU/ha	
Extremadura	0.1-0.5 LU/ha	0.3LU/ha

3.7.3 Farmland Features

These were considered as features that are present on the farmed area and that add nature value, in addition to the forage area. In other words, semi-natural features such as field margins, streams and ponds. Other land uses, such as non grazed forest, were not considered as a farmland feature in the case studies.

In Basse Normandie, hedgerows are a common feature and add significant nature value. In Extremadura, spontaneous grass field margins, dry stone walls, streams and ponds, are all common features that add nature value on dehesa and steppe farmland.

In the Highlands and Islands, features are scarce on the extensive semi-natural grazing land, but density increases on land that has been improved for farming, for example, mosaics of grassland, hay meadows.

3.8 Conclusions

All the potential HNV farming systems identified in these four regions depend on the presence of livestock grazing for their nature value:

- Livestock systems based mainly on the grazing of semi-natural vegetation, often in combination with some other forage land managed at low intensity.
- Livestock systems based on the low intensity grassland, for example, permanent pasture, with smaller semi-natural features (may be some grazing, field boundaries).
- Mosaics of low intensity arable and low intensity grassland with semi-natural features (grazing land, field boundaries).
- Orchards (including olives) in which the understorey is grazed at low intensity.

Of these broad groups, the first two are by far the most widespread in the four regions. From the evidence, it is expected that throughout the EU as a whole, this will also be the case: that HNV farming systems are predominantly livestock systems using semi-natural and/or low intensity forage land. This does not detract from the importance of those HNV systems outside this category.

HNV systems with a significant arable component are extremely rare in the Scottish and Slovak cases and do not exist in the French case. In the Spanish case, it is less clear. It is proposed that arable systems that do not include a considerable proportion of semi-natural grassland or other vegetation are not considered HNV. Low intensity arable land with a high presence of semi-natural field boundaries and fallow might be considered HNV. However, even in the latter case, sheep grazing on stubbles and fallows is normally a significant part of the system.

HNV permanent crops are identified in the case studies (Basse Normandie, Carpathians, Extremadura), but only in certain localities and much less extensive than grazing land. To be identified as HNV, permanent crops (orchards) should be under low intensity grazing.

For the study regions, it is clear that the key considerations for identifying HNV farming systems through indicators measured at the farm scale would be:

- The presence of livestock on the farm;
- The type of vegetation used for feeding livestock (forage land) both on the holding and off the holding (e.g. common grazings);
- The intensity of use of the forage land.

In particular, it is important to have an indication of the proportion of the farmed area that is under semi-natural forage (unseeded and unfertilised grassland, grazed woodland and scrub). A high proportion, such as 60 - 70%, is a strong indicator of an HNV farming system.

In the Basse Normandie case, it is proposed that a livestock density indicator can be used to identify those systems that have at least part of their forage area in a semi-natural condition (unfertilised). A similar approach is proposed in the Scottish case for systems that are not predominantly under semi-natural vegetation.

This approach is based on the hypothesis that if a farm has very low stocking densities per forage hectare, it can be assumed that at least a part of that forage area must be of very low productivity, and therefore must be under low intensity management (i.e. unimproved grassland that is close to a semi-natural state).

For this most widespread type of HNV system (livestock on low intensity and/or semi-natural forage), a pragmatic approach involves developing indicators that are adapted to the regional context, and that use a combination of criteria:

- Livestock density on the forage area used by the farm;
- Low intensity and/or semi-natural forage as a proportion of the farmed area (including common grazings).

Permanent crops that are grazed and have a permanent herbaceous layer, including certain traditional orchards and olive groves, for example, would be counted as low intensity or semi-natural forage land, as part of the livestock system.

Arable land presents greater complications. In the three cases that identify potential HNV systems with a significant proportion of arable land (Carpathians, Highlands and Extremadura), there seem to be some doubts about how to consider them. While a small proportion of low intensity arable land is considered to potentially increase natural value (Highlands and Islands, Extremadura), as the proportion increases, the nature value of the farm depends to an even greater extent on a combination of features such as field margins, and the presence of low intensity grassland, fallows and/or semi-natural vegetation.

One approach to these arable and arable grassland systems would be to consider them from the point of view of the livestock system and the forage area, as above, rather than the cropped area itself. Thus, if the proportion of land under low intensity or semi-natural forage falls below a certain threshold, and arable is thus above a certain threshold, the system is not considered HNV. In areas with very low intensity arable systems, generally with a significant fallow element and with semi-natural field margins, the threshold for semi-natural forage could be set lower (for example, 50 per cent) than in areas where arable land is more intensive and of lower nature value. Fallow land with spontaneous vegetation could be allowed to count towards this threshold (see Extremadura case).

The common indicators proposed to identify HNV Farming and to assist in its measurement are introduced in Chapter 6.

4 A DESCRIPTION AND TYPOLOGY OF HNV FARMLAND FEATURES

4.1 Farmland Features and their Classification at a European Level

Farmland features are considered to be spatially identifiable natural or man-made landscape elements which collectively form the farmland landscape. Farmland features can be both farmed and unfarmed features and are classified in a number of ways, depending on the level of detail at which they are studied and identified. This study draws on a classification based on the BioHab field handbook (Bunce *et al.*, 2005)[18] which has been field tested by a large number of experts in all the major environmental zones in Europe. It is both practical and exhaustive in covering all habitats in Europe in a consistent manner and was developed to be used for field recording in order to monitor changes in habitats and biodiversity.

Following the classical description of a landscape, the BioHab system of classification clusters features in a farmed landscape into three categories:

[18] This Handbook is the principal output from the BioHab Concerted Action project of the Fifth Framework (EUK2-C1-2002-20018) – A framework for the Coordination of Biodiversity and Habitats (Bunce *et al.,* 2005). The Handbook was developed from the Countryside Survey 2000 Field Handbook (Barr, 1998). It was modified for European use in 1999 and 2000 by the ECOLAND forum (an International Association for Landscape Ecology (IALE) working group for monitoring European vegetation and landscapes. The BioHab handbook can be accessed at the following link: http://www.alterraresearch.nl/pls/portal30/docs/FOLDER/BIOHAB/BIOHAB/DISCUSSIONDOC/BIOHABFIELDHANDBOOK_1STEDITION_1.PDF

1. **Patch Features**: landscape components covering large areas, for example, fields, woodlands, waterbodies, etc. According to the BioHab definition, features should be mapped as patches if they have a minimum surface area of $400m^2$, with minimum dimensions of 5 x 80 metres.

2. **Linear Features**: landscape components that are linear in nature, for example, hedges, banks, streams, grassland strips, riparian strips, tracks, roads, walls, irrigation networks, etc. According to the BioHab definition, a linear feature is less than five metres wide and has a minimum mappable length of 30 metres.

3. **Point Features**: individual objects which only cover a small part of the overall landscape, for example, isolated trees, ponds, monuments, windmills, isolated buildings, cairns, tumuli, etc. According to the BioHab definition, these features do not correspond to the definition of the patch and linear features which means they have surface areas of less than 400 m^2.

A classification of HNV farmland features is given in Table 4.1. It identifies 18 broad habitat categories with additional qualifying information, and provides examples of features associated with each habitat category.

4.2 The Spatial Context of HNV Features

In order to characterise HNV features, it is necessary to provide a broad geographical context. Previous studies (for example, Baldock *et al.,* 1993; Beaufoy *et al.,* 1994; Bignal and McCracken, 1996; Andersen *et al.,* 2003) have shown that many HNV features are geographically sensitive. Annex 1 describes the characteristics of potential HNV farmland areas typical of different Environmental Zones in Europe along with the features associated with these areas (see Annex 2 for a map of European environmental zones) (Jongman *et al.* in press; Metzger *et al*. 2005). It is based on published material and expert information on HNV farmland areas, farming systems and features in the EU-27.

Although there is a large overlap in the type of features associated with HNV areas in different environmental zones, there are also features which are typical of specific zones. For example, mires and bogs are much more common in the northern environmental zones than in the Mediterranean. While woodland meadows occur in all environmental zones, they are much more extensive and common in Mediterranean HNV areas compared to other zones. Garrigue, maquis and traditional olive groves are also typical of Mediterranean zones. Grazed salt meadows occur more in northern and central European zones than in southern ones. Stonewalls in HNV farmland areas are typical in most zones, but hedgerows, ditches and watercourses are much more typical of the Atlantic.

A more precise classification of HNV features is provided in Annex 3 which, identifies features typical of different altitudes within each environmental zone. This division reflects the fact that within each zone, altitude will determine what habitat types and features are present. The altitude and climatic characteristics will also influence which farming systems can occur and the constraints that will be imposed on these systems. These constraints will in turn determine which features occur. The altitude thresholds differ between environmental zones because the influence of climate and altitude on features varies depending on the latitudinal location of the environmental zone.

Table 4.1 A classification of patch, linear and point features occurring in agricultural land.

Source: Bunce *et al.,* 2005

Biohab General Habitat Categories	Qualifiers	Patch Feature	Linear Feature	Point Feature	Examples of Features associated within each Habitat Category
1. Urban-constructed	Agricultural	X	X	X	Farm buildings, sheds, stables, walls, terrace walls, etc.
2. Cultivated herbaceous crops	Intensive arable (<10 weed species per 10 m²)	X	X		Potatoes, maize, sugar beet, common wheat, tomatoes, stubble field etc.
	Extensive arable (>10 weed species per 10 m²)	X	X		Barley, spring wheat, oats, linseed, triticale, etc.
3. Cultivated woody crops		X	X		Oranges, fruit trees (apple, pear), vineyards, intensive olive groves, extensive olive groves
4. Sparsely vegetated aquatic	Ponds (below 400 m² surface)			X	Natural pond, artificial pond,
	Spring			X	Permanent spring, temporary dry spring
	Water coarse standing water		X		
	Ditch (full of water or dry) >0.5m deep		X		
	Stream		X		
	Free standing water			X	
5. Herbaceous wetlands		X	X		Grazed or ungrazed inland marsh, reed bed, fen, mire
6. Pure grasslands (>70% grass cover)	Acid soils	X	X		Intensive permanent grassland, extensive permanent grassland, grasslands on dykes
	Neutral soils + set-aside or neglected	X	X		Temporary grassland, set aside grassland, recently abandoned grassland, intensive permanent grassland, grasslands on dykes
	Calcareous soils	X	X		Extensive permanent grassland, grasslands on dykes
7. Mixed grassland-herbs (both coverage <70%)	Acid soils	X	X		Extensive permanent grassland, hay meadow, semi-natural grassland

	Neutral soils + set-aside or neglected	X	X		Extensive permanent grassland, abandoned grassland, set aside grassland, grazed permanent grassland, semi-natural grassland, grasslands on dykes
	Calcareous soils	X	X		Extensive permanent grassland, hay meadow, semi-natural grassland
8. Annuals	Set-aside (<5 years)	X			Set-aside land
9. Low scrub (0-60 cm)		X			Grazed or ungrazed heathlands, Mediterranean scrub (e.g. Garrigue or areal), grazed or ungrazed moorland, abandoned (>5 years)
10. Tall scrub (61 cm - 5 m)		X	X		Transitional woodland + tall Mediterranean scrub (e.g. maquis, matteral), hedgerow
11. Forest over 30% tree cover			X	X	Line of trees, hedgerows, woodland patch
12. Forest over 30% tree cover	Arable	X			Dehesa, Montado
	Grazing by domestic stock or cutting	X			Dehesa, Montado, wooded pasture, wooded hay meadow
13. Complexes of grassland/herbs or arable	10-30% trees or scattered trees (minimum 5-20 individual per ha)	X			Dehesas, Montados, wooded pasture, wooded hay meadow
14. Complexes of grassland/mixed grasslands/herbs	Saline	X		X	Grazed inland or coastal saltmarsh, salt meadow
15. Complexes of several herbaceous categories mixed with tall and dwarf shrub	Peatbog	X		X	Peatbogs
	Sand dunes and machair	X			Grazed Machair
16. Additional complexes	Terraces (excavated level areas of land with retaining walls)	X	X		Terraces
	Group on non-mapable terraces (parcels with terraces that are less than 5 m apart	X			Small scale terraces
17. Sparsely vegetated terrestrial	Rock (limestone and other pavements maintained as open habitats by grazing)	X	X		Grazed limestone rocks
18. Other life forms (e.g. Succulents, bulbs and cushion plants and mosses)		X	X	X	Peatbogs, high alpine or Scandinavian mountain mosses grazed by sheep and reindeer

4.2.1 The Characteristics of Features and their Contribution to Nature Value

Determining the nature value of landscape features is difficult as it depends, to a large extent, on the condition of the feature and its size and spatial location in the farmed landscape. However, it is possible to construct a broad hierarchy of nature value based on the degree of naturalness and the likelihood that different groupings of features (natural, semi-natural, human-influenced, infrastructure) contain a greater diversity of vegetation types and structures (illustrated in Figure 4.1). In terms of their nature value, natural features are potentially greater than or equal to semi-natural features, which are potentially greater than or equal to features dominated by only a small number of plant species, which are potentially greater than or equal to infrastructure features. The actual nature value of a feature will depend on the condition and size of the feature, its distribution and its position in the farmed landscape relative to other features.

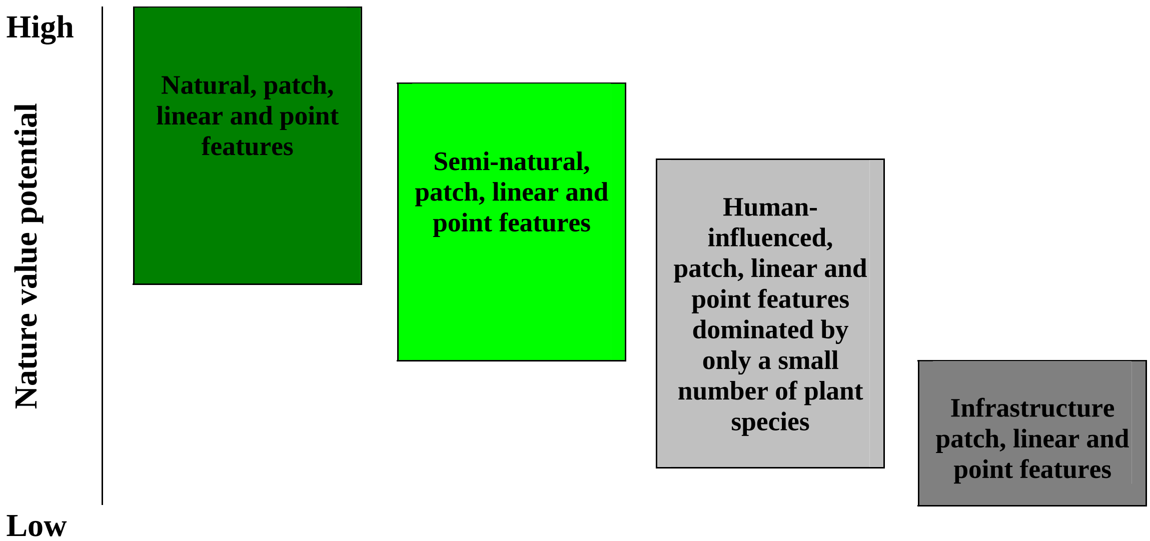


Figure 4.1 Theoretical hierarchy of the Nature Value potential.

Landscape ecology and the metapopulation theory may help to explain variations in the nature values of different types of feature. According to the metapopulation theory, population viability depends on four important landscape measures:

- amount and quality of habitat;
- spatial configuration of the habitat within the landscape;
- and landscape permeability.

The combination of these landscape measures influences the capacity of populations to disperse in the landscape, to have sufficient opportunities to feed, roost, find shelter and to encounter other individuals in order to reproduce, and to maintain a large and healthy population (see, for example, Foppen *et al.,* 2000; Vos *et al*, 2001; Opdam *et al.,* 2003). Farming activities exert a significant influence on these four landscape measures and so contribute to the capacity of a landscape to sustain a high biodiversity of species and viable populations.

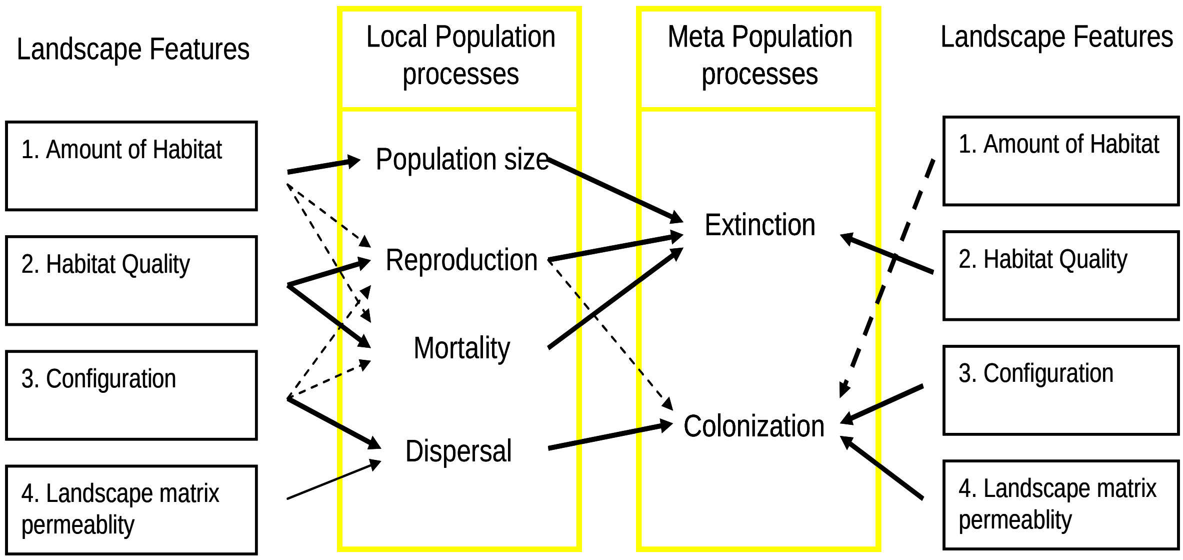


Figure 4.2 Population survival depends on four landscape measures

Source: Opdam *et al.*, 2003. Modified by authors

In summary, the potential NV of an individual feature is influenced by the combination of:

- The current, and potential future size of the feature itself;
- The immediate surroundings of the feature;
- The habitat quality of the feature and how this is likely to change over time;
- The location of the feature in the landscape, especially with regard to:

  - The proximity to other features in the landscape;
  - Potential barriers to movement and/or spread of species across the landscape to and from the feature;
  - The connectivity between features and the degree of fragmentation;
  - The topography of the landscape and the extent to which this impacts on the potential to maintain or enhance existing features or make provision for new features.

The size of a feature is often very significant. In general, the larger the size a feature, the higher its nature value (De Blust and Hermy, 1997). This is well illustrated by results from bird inventories in hedges and tree lines where numbers of different bird species increase with increasing length of the feature. De Blust and Hermy (1997) provide a number of explanations for this. Firstly, it is likely that larger habitats have better environmental conditions than smaller ones, at least in the centre, where negative influences from outside the borders are reduced or absent. In larger habitats, there is also a lower chance of generalist species entering the habitat and out-competing rarer species. Secondly, in larger habitats, the environmental conditions show a larger variation (more gradients) leading to more niches for a wider variety of species that require different environmental conditions. The same applies for variation in vegetation structure. The larger the variation in structure, more ecological niches occur to satisfy a larger range of species. Finally, there is a strong relationship between the size of a habitat and the size of a population. The larger the population, the larger the chance of survival as the threshold for a *minimum viable population* is more easily reached.

Since the size of a habitat has an important influence on the NV of a feature it is also more likely that the larger patch and linear features have a more important function in sustaining NV in a landscape than the smaller point features.

Another important principle is that a feature in a landscape cannot be divorced from its surroundings; the type and number/density/frequency of other features occurring in those surroundings will impact on and influence the NV potential of the feature under consideration. Small isolated fragments of semi-natural habitat within agricultural areas are insufficient on their own to achieve biodiversity conservation.

Since the nature values of features are highly context specific, determining whether a feature is HNV is best done by taking into account their immediate surroundings. However, the scale at which the potential value of the feature needs to be considered will depend on the characteristics of the species potentially utilising the feature. For example, if the conservation interest is driven primarily by the vegetation, then the characteristics of the feature itself and its immediate surroundings will provide a good indication of that feature's NV. If more mobile species, such as insects or birds, are the focus of interest, then the potential NV of the feature may need to be considered in a wider context than the feature itself.

Billeter *et al*. (in press) conducted a large scale study of 25 agricultural landscapes in seven European countries, and investigated relationships between species richness in several taxa (vascular plants, birds, wild bees (*Apoidea*), true bugs (*Heteroptera*), carabid beetles (*Carabidae*), hoverflies (*Syrphidae*) and spiders (*Araneae*) and the links between biodiversity, and landscape structure and management. The species richness of all groups increased with the area of semi-natural habitats present in the landscape. The consistent importance of this species-area relationship suggested to Billeter *et al*. (in press) that in most agricultural landscapes, the largest contribution to total biodiversity comes from the natural and semi-natural habitats and is directly influenced by their area. As those authors point out, many other studies have shown similar positive relations between numbers of species and area of semi-natural habitat (for example, Steffan-Dewenter *et al*. 2002). Not only are many species confined to these habitats, but some species closely associated with agro-ecosystems may require the presence of semi-natural habitats (Duelli and Obrist, 2003). The only other landscape parameter that contributed significantly to species richness was habitat diversity.

Of the five variables used to characterise agricultural land use in the 25 landscapes, Billeter *et al*. (in press) found that none was consistently important in explaining species richness, but three were significant for particular taxonomic groups. The number of vascular plant species was negatively related to the percentage of intensively fertilised land. Indeed, fertiliser application is known to reduce plant species richness both in arable fields and agricultural grasslands. The numbers of birds were also negatively correlated with the mean input of nitrogen. In this case, the effect is likely to be indirect: high levels of agrochemicals have been associated with both a lower availability of weed seeds - which are an important component of the diet of many farmland birds (Marshall *et al.,* 2003) - and with a lower biomass of many insect species (Di Giulio and Edwards, 2003). The third significant land use variable was crop diversity, which was positively associated with the species richness of arthropods, and particularly of bees, carabids and bugs indicating that species richness in an agricultural landscape is dependent not solely upon the semi-natural habitats but is also affected by the diversity of forms of agricultural production (Tscharntke *et al.,* 2005).

In general, higher NV will be linked directly to naturalness and the heterogeneity of plant types and structures that occur within a particular feature. These are not just influenced by the condition of the feature itself, which can be affected by management, but also by more natural processes, such as exposure or flooding. The age of the feature is also important. So, for example, a young newly planted hedge will, by its very nature, have less NV than an older, mature hedge.

The size of the unit area and the number of particular features that need to occur within that unit area to support biodiversity conservation will vary markedly depending on the type of biota under consideration. For example, viable populations of a wide range of invertebrates could potentially be accommodated within an area covering only tens of hectares, while larger species such as birds and mammals often require hundreds of hectares. For many arthropods, for example, survival in agricultural landscapes depends on the suitability of the habitats, which is largely influenced by field management, but also on the characteristics of the surrounding landscape (for example, Jeanneret *et al.,* 2003). Weibull and Ostman (2003) found that the effect of landscape features is largest for the most mobile species, such as butterflies. Plant species richness is also frequently explained by habitat quality and distance. Neighbouring habitats can affect plant species richness by providing a source of rhizomes and diaspores over a short distance (Zonneveld, 1995). Distance to nature rich landscape elements is particularly important for plant re-colonisation in a patch after disturbance (Kotanen, 1997) and thus contributes to maintaining the overall NV at the landscape level.

The NV of a feature may be dependent on some form of disturbance in order to periodically create conditions favouring a return to a more varied mixture of structures and habitats and/or retain parts of a particular feature in a specific growth form. Such disturbance events may be linked to management, for example, cutting, grazing, burning, or more ‘natural’ factors, for example, exposure and flooding. If maintaining the HNV status of a heathland is dependent on periodic burning, then this relies upon appropriate management, and if a meadow or woodland is dependent on periodic flooding then alterations to the upstream hydrology will have an adverse effect on this.

In addition to connectivity between habitats, habitat loss and fragmentation will influence the potential NV of landscape features. Arable features are generally very dynamic, and thus fragmentation of these habitats may have less impact on their NV potential, since the species associated with them are likely to be adapted to the unpredictable availability of the feature, across space and over time. In contrast, those features, such as woodland, marshland, wetlands and unimproved grasslands, which are less dynamic, are likely to lose NV if they become fragmented, since their associated species will not be able to cope with the changes, and hence are vulnerable to fragmentation. The wider landscape context in which these different types of habitat sit, however, will also be important in influencing the scale of the impact of fragmentation upon their potential NV.

Finally, the nature value of a feature will depend on the needs of the associated species. Assessing the potential NV of different features is not straightforward since different species will react to them in different ways and at different scales. This is particularly true for the fauna, since their relationship with the landscape and its constituent features can be particularly complex. For example:

- Individual species may require different features at various stages in their lifecycle. For example, dragonfly larvae develop within freshwater, whereas adults require suitable riparian vegetation on which to rest and use as hunting bases. Lapwings nest in short, bare vegetation in cereal fields but as soon as the chicks hatch, the adults take them to neighbouring grassland fields to forage.

- Individual species may require a range of features simultaneously. For example, brown hares utilise a mosaic of farmland features throughout the year. Many farmland birds nest in cover, such as hedgerows and woodlands, but need open features, such as arable or grassland fields, or field margins, in close proximity for feeding.

- Individual species may only be present at particular times of the year. Many breeding birds are only present in the spring and summer, many overwintering birds, for example, geese, only occur in the winter while other species may only pass through on migration in the spring and winter.

- Species associated with particularly dynamic features, such as arable crops, will need places of refuge to retreat to at the times of year when the feature becomes unsuitable for them, for example, at harvest or during ploughing. In Mediterranean arable systems, naturally regenerating fallows can serve to maintain plant, invertebrate and bird life which would otherwise be unable to survive in the cropped lands themselves.

- Even within the same feature, many species have exacting requirements. Many bees, for example, require bare soil to gain access to burrows in close proximity to flowering plants.

- Although for many species we understand their broad associations and needs with respect to particular features, other factors which are less well known also need to be taken into account, such as their mobility and dispersal ability in the landscape. For example, many insects are strong fliers or drift with the wind and hence may not need physical connections in the landscape. However, on cereal farmland, some butterfly species have been shown to move along hedgerows and the edges of patches of scrub and wood rather than crossing open ground. In addition, many invertebrates have precise microclimate requirements and those which are slow moving, in particular, may not be able to traverse large areas where temperature and humidity are inappropriate owing to extensive shading or exposure.

4.2.2 Principal Features and their Nature Value Potential

In addition to indicating the key characteristics which can influence the NV of a feature, such as its degree of naturalness and the diversity of vegetation types and structures, a score of the NV potential of typical examples of patch, linear and point features has been allocated on a five-point scale of Very Low, Low, Medium, High, Very High on the basis of the judgement of an experienced agricultural ecologist. It is possible that a feature will be of no value for nature (a zero nature value potential score). Such a feature will be classed as 'non-HNV' unless its condition can be improved in such a way as to increase its nature value potential.

Patch Features

Artificial: On farms throughout Europe, the main features in this category are farm buildings, storage facilities and livestock handling facilities. They can potentially provide roosting and nesting sites for some farmland birds, such as swallows, house sparrows, barn owls, lesser kestrel, chough, and overwintering sites for some invertebrates and small mammals. The overall NV score of artificial features throughout Europe is Very Low to Low, but can be Medium to High in specific localised situations where alternatives are limited and where the presence and access to that feature is essential to the maintenance of a viable population, such as the lesser kestrels in the Monegros steppes in Spain. The condition of the feature is critical in such cases, for example, roofs must be of traditional loose-tile construction to provide nesting sites.

Arable Land: This category encompasses the wide variety of non-permanent arable and horticultural crop types which can occur on non-irrigated and irrigated cultivated land throughout Europe (for example, fallow land, stubbles, wheat, barley, rye, oats, maize, other cereals, potatoes, sugar beet, other root crops, sunflower, rape seeds, soya, cotton, tobacco, other fibre and oil crops, pulses, fresh vegetables, tomatoes, flower and ornamental plant production). Typically, these crop types involve the main crop plant being the dominant plant species which, together with the spacing of the plants and the intensity of any crop protection strategy employed, generally limits the range of wildlife which is able to utilise such features. Therefore, the majority of well-managed (from an agricultural production perspective) crops across Europe provide only limited opportunities for utilisation by wildlife and hence have an overall NV score of Very Low to Low.

In some parts of Europe, however, such as north east Scotland and northern Germany, some crops may prove attractive to foraging birds, especially wintering geese, because of their close proximity to wetland wintering grounds and hence their NV score may be higher. Similarly, patches of arable in a predominantly grassland landscape can add habitat value. Vickery *et al.* (2004) showed that continuing declines in farmland bird populations in the UK are related to gaps in resource provision in intensive agricultural landscapes. The authors demonstrate that the creation of non-cropped habitats and field margins, ‘arable pockets’ in grassland regions, and ‘grassland pockets’ in arable regions could be effective in supporting a greater range of farmland bird species. Indeed, the NV of any crop as a whole can generally be enhanced to some extent by the occurrence of strips of vegetation, either placed through or around the crop. However, in general, the NV benefit is more associated with the strip itself and the immediate neighbouring area of crop. As such, it is more linked to the linear feature than the crop as a whole.

The NV of all these individual crop cover types has the potential to be much higher, from <u>Medium</u> to <u>Very High</u>, where conditions in the field allow a greater diversity of other plants to occur in association with the main crop. Such conditions may arise from differences in soil type and growing conditions across the field, greater spacing between plants, or limited use of crop protection strategies. The BioHab classification makes a distinction between extensive and intensive arable crops whereby the threshold is determined by ten species of weed per 10 m^2. The presence of arable associated plants or weeds increases the diversity of plant types and structures within the crop, which not only increases the range of other wildlife, such as invertebrates and birds, but also increases the volume and variety of the seed resource available for exploitation by wildlife. An example of a typical bird species that has its main habitat in the cereal plains of the Iberian Peninsula and in eastern Europe is the threatened steppe bird species, the Great Bustard (*Otis Tarda*) (Moreira, F. *et al.,* 2004). Even so, the presence of semi-natural features (field margins, grassland) in the arable landscape is regarded as essential to the survival of these populations.

Permanent Crops: This category encompasses vineyards, olive groves and the wide variety of fruit, berry and nut orchards that occur throughout Europe. As with arable crops, the majority of these features are relatively homogeneous in structure and are managed in such a way to offer a relatively small resource for wildlife. As such, they have an overall NV score of <u>Very Low</u> to <u>Low</u>. However, where there is greater heterogeneity in the crops (for example, in terms of the age and structure of the trees and vines, the spacing between these trees or vines, the type and structure of the understorey vegetation, and where surface vegetation beneath the vines is not cleared) this can enhance the NV and lead to NV scores of <u>Medium</u> to <u>Very High</u>. Examples of HNV permanent crop features include traditional olive groves in the Mediterranean and orchards in central Europe.

Agro Forestry: This category encompasses agricultural systems where trees and crops/grassland are cultivated on the same area of land. Traditionally, these systems are widespread in Europe. One of the most important and well known agro forestry systems is the Dehesa (Spain) and Montado (Portugal). These are open forests of evergreen oak species (typically *Quercus suber* and/or *Q. rotundifolia*) in combination with cereal growing and/or pasture (Pinto-Correia, 1993). Because of the alternating tree densities, due to natural regeneration, in combination with an extensive use of the understorey, the system is highly diversified and therefore supports high levels of species and habitat diversity (Ojeda, *et al.,* 1995). Moreover, this type of agro forestry system provides habitats for rare species, such as the Iberian Lynx (*Lynx pardinus*), the Imperial Eagle (*Aquila adalberti)* and Woodchat Shrike (*Lanius senator*). The

Dehesas and Montado are listed in the EU Habitats Directive as a habitat type of community wide interest (Council Directive 92/43/EEC, Annex 1). Hence, such features qualify for an overall NV score of High to Very High.

Woodland: This category encompasses broad-leaved, coniferous, mixed forest and smaller areas of woodland, together with tree crops such as poplars, eucalyptus and, increasingly, willow and other more regularly harvested bioenergy feedstock crops. Individual tree and shrub species can have a different NV in their own right, but in general, the greater the diversity of trees, shrubs and under-storey vegetation in an area of woodland, the higher its NV score is. Woodlands and woodland edges can not only support wildlife communities but can also act as habitat and shelter for other wildlife utilising the neighbouring farmland features. While plantation woodland generally has a dense structure and hence a correspondingly Low NV score, the presence of woodland and wooded areas in a farmed landscape is generally of Medium to High NV.

Shrubland: This category encompasses the range of heathland, grass moorland and the wide variety of scrub in transition to woodland habitats which occur across Europe, for example, heather moorland of the northern mountains of Europe, garigue and maquis in the Mediterranean. Many of these are semi-natural habitats (in that management by humans preserves them at this stage and prevents further succession to shrub/woodland) and can be relatively species poor in terms of the overall number of plant species occurring in the vegetation assemblage. However, many of these habitats are relatively restricted in their overall range and occurrence across Europe and as such they have a High NV in their own right. In addition, a range of other rare wildlife, from invertebrates such as butterflies through to predatory birds such as eagles, has also become adapted and closely associated with such features and this further increases their NV score to Very High.

Permanent Grass: This category encompasses the relatively wide range of pastures and meadow grasslands which occur across Europe. Many permanent grasslands under agricultural management (and temporary grasslands forming part of an arable rotation) are almost homogeneous in terms of their dominance by a small number of agriculturally preferred grass species, and their management is such that there is little opportunity for other plant species to colonise and become established. Consequently, such grasslands are utilised by a relatively limited range of other wildlife species, most of which are generalists and relatively common, for example, birds such as crows and woodpigeons. Hence, these grasslands generally score Very Low to Low in terms of NV. As with arable land, some of these agriculturally productive grasslands occur in close proximity to wildfowl wintering sites and hence their use by wintering geese and waders, such as in south west Scotland and the Netherlands, can increase their NV score.

However, some grassland pastures and meadows have High to Very High NV scores because they are more varied in terms of species composition and vegetation structure. This is largely driven by the varied nutrient and moisture status of the soils in which they are growing which encourages colonisation and establishment by other grasses, annual and perennial broad-leaved plants, thereby preventing over-dominance by any one grass or plant species. Examples of HNV permanent grassland features include species rich *Nardus* grassland, chalk grassland, lowland hay meadows and upland hay meadows.

Bareland: As its name suggests, this category encompasses the range of unvegetated or sparsely vegetated features which can occur within grassland and heathland habitats. Large areas of such unvegetated features provide a very extreme habitat for wildlife and hence are generally of Low NV. However, small areas of bare soil and rock occurring within other grassland, heathland or woodland features can add to the variety of habitat conditions present and hence make a greater contribution to NV. For example, the presence of unvegetated soil or bare rock within grassland or heathland features can provide basking or hunting habitats for invertebrates such as butterflies.

Water and Wetland: This category encompasses a range of inland marshes, peatbogs and salt marshes, as well as the range of large and small water bodies which can occur in many farmed landscapes throughout Europe. As with permanent grass features, many of these wetland features are relatively restricted in their occurrence throughout Europe and have developed characteristic vegetation, invertebrate and bird assemblages which are adapted to their underlying soil and moisture conditions. As these wetland associated species are generally different from the species occurring elsewhere in the farmed landscape, their presence adds to the overall NV. Hence the presence of a wetland or water feature in any farmed landscape generally contributes to NV and so these score Medium to Very High.

Linear Features

Boundaries: This category encompasses a range of man made and more natural boundary and marginal features, such as stone walls, dykes, banks, hedges, lines of tree, and vegetated field margins and roadside verges. Like buildings, the occurrence of stone walls, terraces and banks in the landscape can provide shelter, hunting grounds and overwintering places for some species, such as stoats and insects, as well as habitat for specialised plant species such as lichens. However, the NV of these features is generally closely associated with their age and condition, which again helps introduce a greater diversity of conditions for wildlife to exploit. The more natural and semi natural features, such as hedges, lines of trees, field margins, beetle banks and roadside and watercourse verges, are, in themselves, generally higher NV, since they provide a contrasting condition to that in the neighbouring features and hence can serve as refuges and breeding areas for a variety of plant species which are unable to exist in the surrounding area. The same principle applies to these linear features as to many of the patch features mentioned above, in that although their overall NV score can range from Medium - Very High, the latter is very closely related to the diversity of plant types and structures occurring in the feature.

Water: This category encompasses the wide range of river, stream, ditch and irrigation channels which occur in farmed landscapes. The NV scores assigned to these are closely related both to the bordering vegetation conditions and to the vegetation occurring within the water feature. The latter is closely related to the structure of the feature itself, with rivers, streams and ditches of varying depths and with different shapes of banks, housing a greater diversity of plant and associated wildlife species. Hence while heavily modified and canalised watercourses are generally of Very Low to Low NV, more natural rivers, streams and ditches are of Medium to High NV.

Infrastructure: This category encompasses the man made tracks, roads, railways, powerlines and communication cables which occur in farmed landscapes. Although some of these features, such as telegraph poles, can serve as useful perches for certain bird species, many others are not well adapted to, or do not make use of these largely artificial features. As such their overall NV score is generally Very Low to Low.

Point Features

According to the Biohab definition, these features have a surface area of less than 400 m^2, covering only a small part of the landscape. On account of this, their potential to contribute to the NV of a landscape is generally lower than that of patch and linear features.

Artificial: The main features in this category include smaller, more solitary constructions, such as shelters in remote fields, smaller sheds, storage facilities and other farm buildings. Like artificial patch features they can also potentially provide roosting and nesting sites for some farmland birds and overwintering sites for some invertebrates and small mammals. The overall score of NV contribution given to artificial features throughout Europe is Very Low to Low, but can be Medium if their density is high and alternatives are limited.

Ponds and Pools: These features include drinking places for animals and fishing ponds of natural or artificial nature, but could also be springs and small inland marshes. Because of their size they do not have a NV that is similar to that of a wetland which can potentially maintain populations of regionality important bird species. However, pools do provide an important habitat for species that need to live in or near to water bodies such as many plant species, amphibians, insects and snails. In a landscape where water bodies are scarce, pools and springs can create extra species diversity. Many birds and small mammals also need water bodies in their direct living environment for drinking and foraging and a small pool can be the reason for their presence in that particular place. The nature value of small water bodies is usually threatened as they are very sensitive to external influences and have little or no buffer capacity, for example, against pollution by pesticides and fertilisers and water balance changes caused by agriculture. The NV of these small water bodies can vary strongly from Low to High or even Very High nature value. This NV depends strongly on the environmental state of the surrounding area, but also on the age of the water body and its maintenance (Van Damme, 2001). The type and condition of the pond is critical. Thus ponds which are built with plastic or concrete liners will develop a far less rich wildlife community than natural ponds. Over-stocking of livestock around ponds will reduce the nature value of waterside vegetation.

Solitary Trees: Solitary trees occur anywhere in the landscape and by definition only occupy a small place in, or bordering, a field. Their landscape value is usually very high since they occur in the middle of an open landscape and increase the landscape diversity. Their NV is, however, Low since their capacity to provide shelter or nesting facilities can only be limited to a small number of species. However, if the density of solitary trees in the wider landscape is high, their NV increases as their joint capacity to support species increases. The type of solitary trees also influences the NV. The English Oak (*Quercus Robur*), for example, supports a greater variety of wildlife than any other species of tree in Europe. A single tree can contain up to 284 different species of insect plus birds, mammals and even plants.

4.3 Identifying HNV Features in Member States

All of the features described above have the potential to be HNV, however, a feature will only be classified as HNV if it meets the criteria set out in the definition of an HNV feature.

HNV farmland features are defined as:

> "Those features which support the presence of habitats and species of European, and/or national, and/or regional conservation concern whose survival depends on the maintenance or continued existence of the feature"

Semi-natural features are an integral part of an HNV farming system. In addition, semi-natural features can be found in more intensive agricultural landscapes. Although these features contribute an HNV presence to the intensive agricultural landscape, they do not render the farming system an HNV farming system.

To identify likely HNV farmland features, Member States are encouraged to refer to the table presented in Annex 1 of typical features associated with each of Europe's broad Environmental Zones (Annex 2). If they are of a high enough habitat quality to support the presence or likely reintroduction of species of conservation concern they can be regarded as HNV Features occurring within a non-HNV Farmland Area (see decision tree in Figure 4.3). To identify HNV features, Member States will need to:

1. Identify selected species of European, and/or national, and/or regional conservation concern, which depend on the maintenance or continued existence of farmland features for their survival.

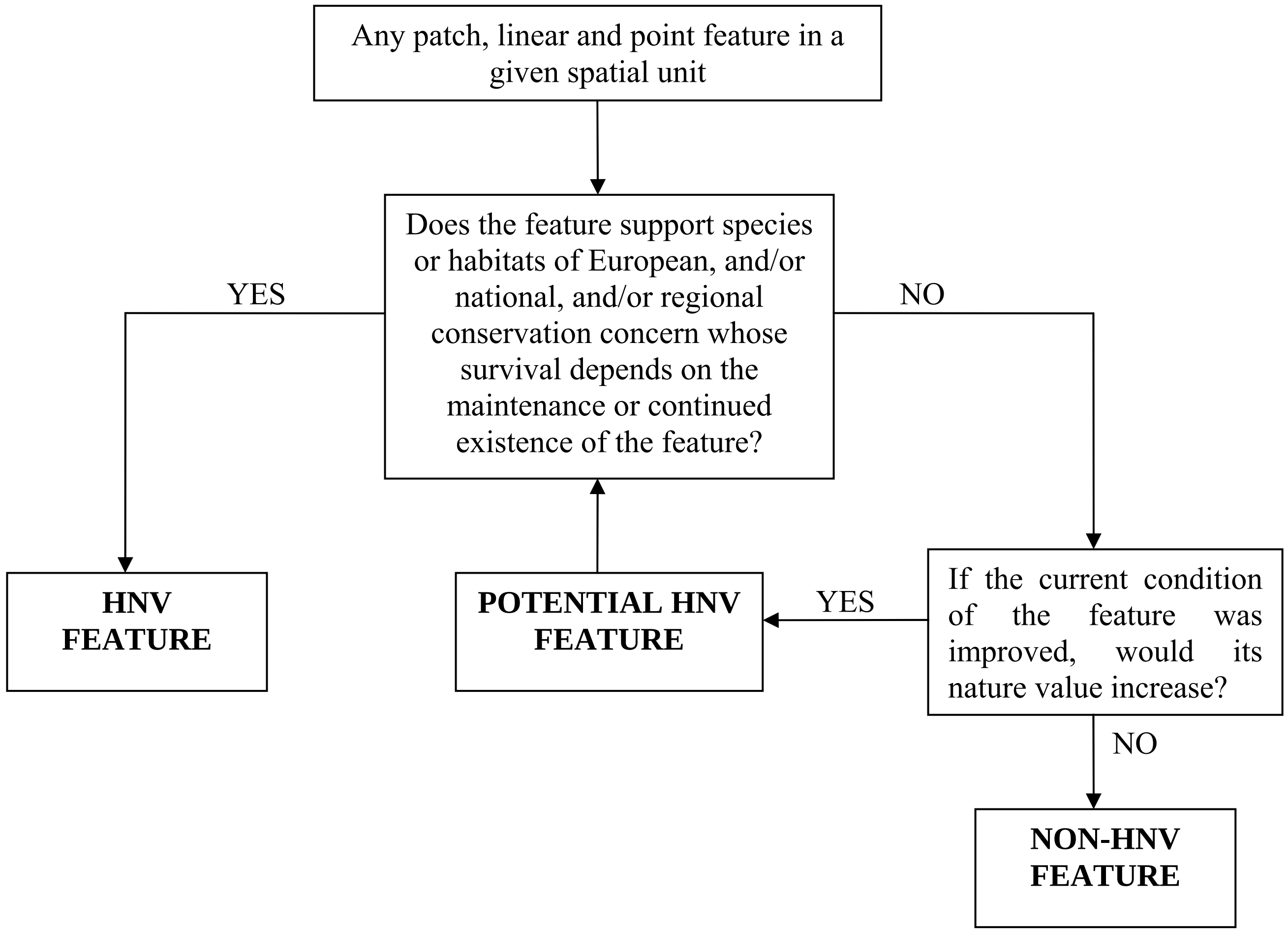
2. For the species selected, provide a description of their relationship with, and dependence upon, patch, linear and point features in the agricultural landscape[19].

3. Include those features which support selected species of conservation concern in a national inventory of HNV Features.

It is unlikely that data will be available for all features. Member States are advised to draw on national data sources and the data collected under Output Indicator 35 of the CMEF[20].

[19] Attention should be paid to the size, density and condition of the feature, and its spatial pattern in the landscape.

Figure 4.3 Decision tree to identify HNV features.



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4.4 Data Requirements and Possible Data Sources

It is possible to obtain information on the diversity of certain features, at least for particular areas through a combination of farmer's surveys, field surveys, aerial photographic data interpretation, and remotely sensed data interpretation.

4.4.1 EU Wide Data Sources

Currently there are several EU wide data sources providing aggregated information on the overall regional distribution of a selection of patch features, such as arable fields, permanent grasslands and semi-natural grazing land. However, none of these sources provide the information at the field level (the patch), rather they present it at an aggregated level (the land use or the land cover class). Although these data sources will not tell us anything about the detailed spatial distribution of patch features, they do provide information on where there are spatial concentrations of interesting patch features from an HNV perspective, such as permanent grassland or semi-natural patch features. This is also why CORINE Land Cover data was used as a main source for mapping HNV farmland areas in the JRC-EEA approach (Anderson *et al*., 2003; Paracchini *et al.*, 2006), especially to identify the main concentrations of HNV Types 1 and 2 which are dominated by permanent grassland and semi-natural patch features. For further information on the main European data sources containing information on land use see Box 1.

Box 1 Main European Data Sources Containing Information on Land Use Categories

Statistical data sources

The statistical information on regional distribution of patch features is included in the Eurostat Farm Structural Survey (FSS) database, and the DG Agriculture Farm Accountancy Data Network (FADN). The first data source gives information on the main agricultural land use categories at a NUTS 2 level. The FADN data base contains this land use information at the level of a selection of individual farms, but this information can only be displayed at the regional (NUTS 1 or 2) level for disclosure reasons, and also because no geographic reference is contained in the database except for the FADN region (NUTS1/2) a farm is situated in.

Spatial data sources derived from aerial and remote sensing information

The Corine Land Cover (CLC) system also provides spatially referenced data on some agricultural land use categories. Information on the exact location and extent of patch features can not, however, be derived from CLC because the minimal mapping unit is 25 hectares and therefore the CORINE classes are either determined by the most dominant land use or they have been classified as a mixed class. Especially with mixed CORINE classes, such as complex cultivation patterns, it is difficult to determine where different land uses occur, even at an aggregated scale. Finally, the LUCAS database also provides some estimates of patch features in relation to agricultural land uses. Data in LUCAS come from field survey observations in central points of the plot on the basis of a sampling scheme. In these points, observations are made of the real land use occurring in a circle of 3 metres diameter (in terms of detailed crops). The spatial resolution at which data in LUCAS are collected is high, but still not fine enough to present the distribution of the detailed field observed results at a level lower than NUTS 1 and 2 (for larger countries).

Spatial disaggregation approaches to predict land use locations
Another interesting database in relation to land use information is the Dynaspat-Capri land use data. The DYNASPAT project developed a statistical approach combining a binary choice model with a Bayesian highest posterior density estimator to break down land use choices from European administrative regions (NUTS 2) to 150,000 Homogeneous Spatial Mapping Units (HSMUs). A HSMU is a cluster of 1 x 1 km cells which hold identical information on soil topological unit, slope class, CORINE land cover class and FSS district and are assumed to be similar both in terms of agronomic practices and the natural environment.

A two step approach is followed to predict the crop shares in every HSMU. The first step regresses cropping decisions in each HSMU on bio-physical factors (soil characteristics, climate, slope class and land cover), using results of the LUCAS survey point information. This is done through the application of a spatial statistical technique, a *Locally Weighted Logit model,* which results in normally distributed predictions of crop shares per HSMU. This approach results in the expression of expected shares of agricultural crops.

The second step creates an optimal distribution of the agricultural crops over the HSMUs according to total crop areas at NUTS 2 level provided by FSS. This optimalisation is based on a *Bayesian Highest Posterior Density* method and maximises the posterior density of crop shares within the totals for the NUTS regions. It aims at creating an optimal consistency between scales, i.e. between the totals at NUTS 2 and HSMU levels.

4.4.2 National Data Sources

It is clear that there are no EU wide data on the spatial distribution of patch, linear or point features. In IRENA (Indicator 35), for example, changes in linear elements could only be illustrated through the use of a number of national field survey based sources. However, some data on features are collected in certain Member States (see Table 4.2). It should be noted that this overview is not exhaustive as there are certainly more regions in Europe where databases have been developed containing survey based information on location and distribution of a selection of features.

What is interesting in the overview in Table 4.2 is that all the countries that have set up spatial data bases have worked with a random stratified sampling methodology as it is impossible to cover the whole surface with field collection sites. The stratification methodology enables the data to be integrated at the stratum level which means that mean figures from the stratum can be extrapolated to produce estimates in features at regional and national levels.

Table 4.2 Overview of national spatial databases with detailed landscape features information

Existing Data Source	Geographic Coverage	Dataholder Expert/Institute	Sampling Methodology	Data Collection Methodology	Type of Features Info Collected	Time Series
Countryside Survey (CSS)	Wider countryside UK	CEH-UK	Stratified random sampling within environmental stratification	Remote Sensing (RS), aerial photographs and field surveys	Location, distribution and status of patch, linear and point features	1974-2007
CAREN (Rennes)	Pleine Fougère wider countryside , Britanny	CAREN www.caren.univ-rennes1.fr/pleine-fougere	Stratified random sampling within environmental stratification		*Location*, distribution and status of patch, linear and point features	1985-2007
National Inventory of LandScapes (NILS)	Wider countryside Sweden	SLU Umea	Stratified random sampling within environmental stratification	Aerial photographs and field visits	*Location*, distribution and status of patch, linear and point features	Yes
Small biotope inventory	Wider countryside Denmark	KVL	Stratified random sampling within environmental stratification	Aerial photographs and field visits	*Location*, distribution and status of patch, linear and point features	Yes
Picos d'Europe inventory (CSS methodology)	Wider countryside Picos d'Europa	Alterra	Stratified random sampling within environmental stratification	Aerial photographs and field visits	*Location*, distribution and status of patch, linear and point features	1980-2007
CISPARES	Wider countryside Spain	Escuela Forestal, Madrid	Stratified random sampling within environmental stratification	Remote Sensing, aerial photographs and field visits	*Location*, distribution and status of patch, linear and point features	?
SINUS	Wider countryside Austria	University of Vienna/ Umweltbundesamt	Stratified random sampling within environmental stratification	RS, aerial photographs and field visits	*Location*, distribution and status of patch, linear and point features	1990-2000

handboek voor geïntegreerde monitoring van de terrestrische biodiversiteit in het Vlaamse buitengebied'	Belgium, only Flanders wider countryside	Instituut voor Natuur en Bosonderzoek	Stratified random sampling within environmental stratification	Aerial photographs and field visits	*Location*, distribution and status of patch, linear and point features	No, only 2000
Database on area features	Wider countryside in selection of regions in Pleistocene part of the Netherlands	Alterra/	Stratified sampling	Aerial photographs and field visits	*Location*, distribution and status of patch, linear and point features	1950-2001

The databases detailed in Table 4.2 use similar approaches to collect features information, but the type of data collected differs per system. No system will completely cover all features present in a landscape. In spite of this, they provide a good basis for estimating where farmland features occur as the data contained in the database provide spatially explicit information on the location of features.

All of these databases are based on a sampling framework. They only provide real estimates for the sampled squares and also average estimates for the environmental strata used in the sampling. When using these data sources to provide an overview of HNV features, additional field samples may be needed to complement the data and to increase the sampling density, especially in those strata that seem to contain high shares of HNV features. Ideally, all farms need to be covered in order to map all the features of HNV interest/importance. This would highlight features of special importance and form a baseline against which to check the situation in future years.

IACS (Integrated Administration and Control System for the management of CAP payments) and the associated LPIS (Land Parcel Identification System) would potentially be one way to capture information at the farm level. Once the information has been gathered at the farm level, aerial photography could be used to sample a range of farms each year to check that the features claimed actually exist. A larger selection of farms could be tackled by aerial photography, with a smaller proportion of these having additional on-the-ground spot checks to ground truth the aerial interpretation. Member States would need to consider what features they are especially interested in and what mechanism would be best to obtain information on these at the farm level.

Overall it is clear that many EU countries have limited data on features. The status, distribution and extent of features that could potentially be of NV are therefore generally unknown in most places in Europe. This implies that if a Member State want to measure the extent and condition of HNV features they would first need to make an inventory of what information on features is already being collected and then establish a data collection system to systematically collect data on HNV features. The BioHab handbook guidelines would be a useful starting place. If these were used in more Member States it would help to build up a consistent and comparable monitoring database on the state of HNV features for all HNV farmland areas along with those HNV features that occur in more intensive agricultural areas in Europe. Once this state is mapped, a further monitoring framework could be set up, based primarily on aerial interpretation, with some random field checks, to assess whether the features actually exist and whether they are well maintained.

5 A TYPOLOGY OF HIGH NATURE VALUE FORESTS

5.1 Introduction

In most of Europe, the natural climax vegetation of terrestrial ecosystems is forest or woodland. Most of the forests of the European continent, especially in the Atlantic and lowland, broad-leaved deciduous forest regions have been severely altered throughout history (Mayer, 1984). The clearing and cultivation of forested land has caused a dramatic reduction and fragmentation of the once naturally dynamic primeval forest. In Europe, it is estimated that intact forest only remains in three vegetation zones: in the boreal, hemiboreal and nemoral regions, where it constitutes 20 per cent, 2 per cent and 0.2 per cent of the total forest area respectively (Hannah *et al.*, 1995). The introduction of intensive forest management and agriculture has dramatically altered naturally dynamic forests, affecting their compositional characteristics, such as the abundance and richness of native species; structural characteristics, such as deadwood and old forests; and functional characteristics, such as the connectivity of habitat networks and the functioning of ecosystem processes.

The HNV status of naturally dynamic forests is a function of their state, whereas that of semi-natural forests is a function of their state and the present day and/or historical management regime.

Natural disturbances in forests range from small to large scale and from abiotic to biotic, with the mix varying considerably among regions. Forest disturbance and successional features may differ substantially according to: the characteristics of the dominant tree species, for example, shade tolerant or intolerant; local site conditions such as wet/dry, poor/rich; landscape features such as slope, aspect, altitude and latitude; and climate. Since natural disturbances have been occurring within forests for thousands of years, forest dwelling species have become adapted to these processes. Thus, those forests that have had little or no human intervention will be of high nature value as they support a high diversity of native species and habitats. However, such naturally dynamic forests are now very rare in Europe, and almost all forests having been subject to at least some form of management. In such forests, management which mimics the natural disturbance regimes will promote biodiversity and is likely to maintain or re-create the HNV status of the forest.

High nature values have also been maintained in some semi-natural forests through cultural management methods that do not necessarily mimic natural disturbance regimes, but act in such way as to promote biodiversity (Mantel, 1990; Tucker and Evans, 1997). For example, to maintain summer and winter fodder for cows, sheep and other domestic animals, traditionally grazed forests were managed using fire, mowing, grazing, clearing, and tree and water management. This range of cultural disturbances often resulted in forest biodiversity being maintained because of the presence of large trees in landscapes dominated by grazing or agriculture. Today, such traditionally managed forest habitats usually remain as small isolated patches. Traditional practices such as pollarding, shredding and lopping, whereby branches of wild trees are cut, maintain large trees that grow slowly. As a consequence of such practices, suitable substrates are maintained on the outside and inside (if hollow) of trees which provide habitat for many specialised forest species, ranging from shade intolerant vascular plants, to lichens, insects and large birds (Mikusinski and Angelstam, 1998; Nilsson *et al*., 2002).

Since naturally dynamic forests and those semi-natural forests whose management mimics natural disturbance regimes, or utilises pre-industrial cultural management practices, are likely to be characterised by high biodiversity, HNV forests can be defined as:

> 'All natural forests and those semi-natural forests in Europe where the management (past or present) supports a high diversity of native species and habitats, and/or those forests which support the presence of species of European, and/or national, and/or regional conservation concern'.

It must be noted, however, that not all HNV Forests make the same contribution in conservation terms. The highest grade of HNV Forests are those which support the presence of species of European conservation concern, and the lowest grade are those forests which supports species of regional conservation concern.

5.2 Typology of HNV Forests

Figure 5.1 outlines a typology to identify forests that are likely to be HNV. These are referred to as 'potential HNV forests'. The first step in this process is to determine where a forest is situated along a continuum of naturalness at any given point in time, since this will influence the HNV state of the forest. A distinction can be made between three widely recognised categories of forest: plantation, semi-natural and naturally dynamic forests, which are defined below[21]:

Plantation Forests: Forest stands are established by planting and/or seeding in the process of afforestation or reforestation. They are either composed of introduced species (all planted stands), or intensively managed stands of indigenous species which meet all of the following criteria: one or two species in the plantation, even age class, regular spacing. This excludes stands which were established as plantations but

[21] See the EEA's categorisation of three overarching Forest Types and accompanying definitions (European Forest Types. EEA Technical Report No. 9/2006).

which have been without intensive management for a significant period of time. These are considered as semi natural.

Semi-Natural Forests: These are non-plantation forests whose natural structure, composition and function are, or have been, modified through anthropogenic activities. Most European forests with a long management history are found in this category.

Naturally Dynamic Forests: These are forests whose composition and function have been shaped by natural disturbance regimes without substantial anthropogenic influence over a long time period.

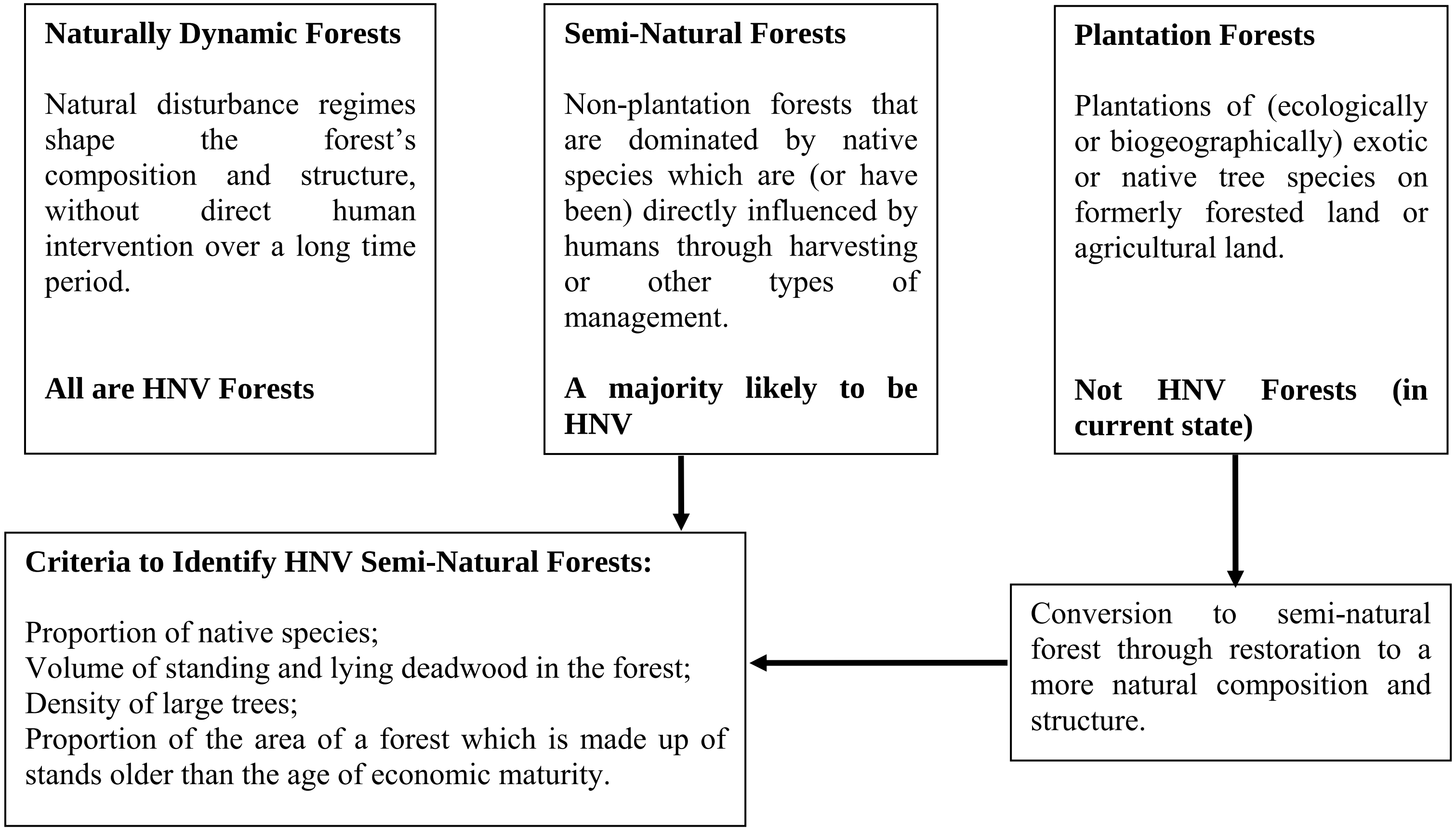
The first step in determining whether a forest has the potential to be HNV or not is to classify it according to one of the three categories listed above.

Plantation forests cannot be considered HNV since the intensive management practices carried out in these forests, such as planting one or two species at regular spacings, intensive silvicultural treatments, and input of chemicals, do not promote a high diversity of native species or habitats, and are unlikely to support forest species of conservation concern. However, stands which were established as plantations but have been without intensive management for a signficiant period of time could be considered semi-natural or have the potential to be converted to semi-natural forests via changes to their management. This can, for example, happen in plantations of native tree species or plantations on ancient woodland sites (PAWS) which have a soil seed bank of the tree species naturally found at that site.

All naturally dynamic forests are HNV since a high diversity of native species and habitats, as well as species of conservation concern, are supported in these forests. This high nature value is maintained through natural disturbance processes such as fire, flooding, windthrow, insect outbreaks and fungal diseases which have maintained habitats for a wide variety of forest species over many years.

The nature value of semi-natural forests varies widely, with the consequence that many of them will be considered HNV if their management is such that the forest's compositional, structural and functional characteristics support a high diversity of native species or habitats, and/or the presence of species of European and/or regional and/or national conservation concern. In such forests, management promoting HNV may mimic natural processes, or comprise cultural practices that were typical in pre-industrial woodland and which are known to promote biodiversity, for example, pollarding of old trees and coppicing. However, some forms of management systems applied in semi-natural forests tend to move them away from a state of near naturalness, for example, through the manipulation of tree species composition and stand age, as well as reductions in the volume of deadwood. In recent years, however, many forest management systems have been modified to better mimic the forest's natural disturbance regime. For example, quantities of deadwood and large trees are left at harvesting sites; natural regeneration is favoured over reforestation; and there is an ongoing phasing out of introduced species and a clear preference for native tree species.

Figure 5.1 Typology of potential HNV forests in the EU-27



In order to determine whether a semi-natural forest is HNV, Member States could apply one or a combination of the criteria listed below. The first, the proportion of native tree species, is the core criterion and should be applied to all semi-natural forests. This will eliminate most semi-natural forests that are not HNV. One or a combination of criteria two to four could then be applied where there is some uncertainty over whether a forest is HNV or not. For the purposes of operationalising these criteria, Member States would need to set the threshold at which a forest is classified as HNV, providing a justification based on the ecology of the forest, and drawing on expert knowledge. Member States with more widespread natural forest may be more selective about what semi-natural forest may qualify.

The four criteria are:

1. Proportion of native tree species, measured as a percentage of native tree species per given area.

This criterion describes the proportion of the forest comprising native tree species. Above a certain proportion, the forest will be HNV. Member States would need to set the actual proportion, depending on their national circumstances.

A native or near native tree species composition is a basic prerequisite for a forest to be HNV since many forest species depend on specific habitat features which are provided exclusively by one or a few native tree species (Jonsell *et al*., 1998).

2. Volume of standing and lying deadwood in the forest (measured in metres^3/hectare).

This criterion describes the mean volume of standing and lying deadwood in the forest, measured in metres^3/hectare. Above a certain proportion, the forest will be HNV. Member States would need to set the actual volume based on the ecology of their forests.

Intensive forest management typically reduces the number of trees allowed to die and decay in the forest. This has resulted in marked decreases in the volume of deadwood present in European forests. Deadwood is important for nature value since a large proportion of forest species of conservation concern at the European, national and regional scales are dependent on deadwood at some stage of their life cycles (Berg *et al*., 1994; Peterken, 1996; Siitonen, 2001). Ideally, deadwood should be present in a diversity of forms with respect to its position (standing or lying), stage of decay, size and tree species. In cultural woodland, much of the deadwood may be found as dead limbs on large trees.

3. Density of large trees in the forest (measured as the number of trees per given area).

This criterion describes the density of large trees exceeding a pre-selected diameter at breast height, measured as the number of such trees per unit area of forest. Above a certain density of such trees, the forest will be HNV. Member States would need to set the threshold density based on the ecology of their forests.

Large trees, often veteran or ancient trees, are a common feature of naturally dynamic forests across Europe. Trees allowed to live long enough to attain very large diameters often develop features, such as tree hollows, large crowns and dead limbs, which are important to several forest species (Peterken, 1996). The population dynamics of specialised species dependent on large trees require that they are common enough in the landscape to allow colonisation of new sites. For example, the beetle *Osmoderma eremita* is dependent on a high density of large trees with hollows at the landscape scale for long term survival, due to its low dispersal rate and small range (Ranius and Hedin, 2001).

4. The proportion of the area of a forest which is made up of stands older than the age of economic maturity (measured as the percentage of old trees per given area).

This criterion describes the proportion of the area of a forest which is made up of stands older than the age of economic maturity for the dominant tree species in the region. Above a certain proportion, the forest will be HNV. Member States would need to define the threshold proportion depending on the ecology of their forests and national circumstances.

Old forest stands typically cover large proportions of the forest area in naturally dynamic forest landscapes. By contrast, the majority of present day forest management aims to achieve a normal age distribution whereby each age class covers approximately the same area, with all stands harvested when they reach economic maturity. Forest stands allowed to develop beyond the age of economic maturity are important for nature value as they may provide habitat features, such as a diverse vertical and/or horizontal structure, old trees and deadwood, which are important for a large number of forest species of conservation concern (Berg *et al*., 1994; Peterken, 1996).

5.3 Data Availability

The proposed classification of HNV forests requires data to determine the 'state' of the forest, so that the three categories of forest can be distinguished.

Distinguishing between plantation, semi-natural and naturally dynamic forests requires first, determining whether the forest is a plantation or not. According to the definition of plantations given in 5.2, the key criteria are tree species composition, the presence of an even age class, and regular tree spacing. Information on tree species composition could be obtained from forest management plans or through remote sensing. Data on tree age could also be obtained from forest management plans or through on-ground assessments. Regular tree spacing may be detected using high resolution remote sensing techniques such as aerial photography or on-the-ground assessments.

Distinguishing semi-natural forests from plantation forests requires data on tree species composition and on the natural range of the different planted species. Data on the natural distribution of tree species in Europe at large scale geographic ranges are available in the ecological literature (for example, Mayer, 1984), while information on the local ecological site affinities of the tree species may require more in depth ecological knowledge (for example, Ellenberg, 1996). Surveys of biodiversity elements, in combination with knowledge about the history of management (or absence thereof) will also be needed. Some proxies including, for example, the distance to the nearest road, or site accessibility, may be used in order to do a preliminary screening of forests which are likely to be naturally dynamic. Most European countries have developed databases and maps describing the occurrence of such forests, many of which are formally protected.

As regards the criteria listed above for distinguishing HNV from non-HNV semi-natural forests, data are generally available, but not always at a fine spatial scale. National forest inventories typically consider tree species composition, deadwood, large trees and stand age (see Annex 5 for examples of national forest inventories in the EU-27). However, many forest stands remain unsurveyed by these inventories, meaning that additional data sources may be required. The proportion of native tree species and stand age may be obtained from forest management plans, from remote sensing data, or from on-the-ground assessments. Densities of large trees may be obtained from forest management plans, remote sensing data, natural heritage databases and on-the-ground surveys. By contrast, data on deadwood generally can only be obtained from on-the-ground measurements.

6 A SUITE OF HNV FARMING AND FOREST INDICATORS

6.1 Operationalising the Concept for Monitoring Rural Development Programmes

Under the EAFRD (Council Regulation 1698/2005), Member States receive Community support for agreed rural development programmes which should meet the Community's strategic objectives within the sphere of rural development. The objective relating to High Nature Value Farming and Forestry is as follows:

> "To protect and enhance the EU's natural resources and landscapes in rural areas, the resources devoted to axis 2 should contribute to three EU-level priority areas: biodiversity and the preservation and development of high nature value farming and forestry systems and traditional agricultural landscapes; water; and climate change."[22] (Emphasis added).

Rural development programmes will be subject to a mid term and ex post evaluation in 2010 and 2015, respectively, to assess the extent to which the objectives of the programme have been achieved. The Common Monitoring and Evaluation Framework (CMEF) provides a single framework for the monitoring and evaluation of all rural development interventions through the application of five sets of indicators.

The CMEF establishes five types of indicators. Baseline indicators are used to define strategy objectives and impact indicators correspond to these objectives. For each measure, input, output and result indicators are established to assess the extent to which the expected objectives have been achieved.

[22] Council Decision of 20 February 2006 on Community Strategic Guidelines for Rural Development (programming period 2007 to 2013), 2006/144/EC, OJ L 55/20, 25.2.2006, Annex 3.2.

There is a suite of indicators designed to measure whether the High Nature Value resource of a Member State is being preserved and maintained. These indicators are enshrined in the Implementing Regulation Commission Regulation 1974/2006) and reproduced in the CMEF indicator fiches.

Baseline Indicator 18: Biodiversity: High nature value Farmland and Forestry, measured as UAA of HNV Farmland, in hectares.

Result Indicator 6: Area under successful management contributing to biodiversity and HNV Farming / Forestry, measured as the total area of HNV Farmland and Forestry under successful land management, in hectares.

Impact Indicator 5: Maintenance of HNV Farming and Forestry, measured as changes in High Nature Value areas.

This chapter develops Impact Indicator 5[23] and guides Member States in its definition and measurement[24].

6.2 Implicit Obligations on Member States

In order to meet the objective to preserve and enhance HNV Farming and Forestry systems, and to conduct an effective monitoring programme, there are a number of implicit obligations on Member States (see Figure 2.1, Chapter 2). They should:

23 Available from http://ec.europa.eu/agriculture/rurdev/eval/index_en.htm.

24 Impact Indicator 5 measures quantitative and qualitative changes in HNV areas (farming and forestry) and it is recommended that these changes are captured in terms of the extent and the quality or condition of HNV areas. It should be noted that Baseline Inidcator 18 does not provide a measure for the condition of these areas and one will need to be established. Under Impact Indicator 18, Member States should measure the extent of HNV Farmland in hectares of the total agricultural area and the extent of HNV Forests in hectares of the total forest area. The measure of the extent of HNV Farmland (hectares of total agricultural area) is a different unit of measurement from that proposed in the Baseline Indicator 18 (hectares of UAA). Programme evaluators should note and account for this difference when assessing changes in the extent of HNV Farmland.

- Have measures in place to maintain their HNV Farming and Forests and Traditional Agricultural Landscapes;
- Apply Baseline Indicator 18 at the start of the rural development programme;
- Introduce indicators to measure the extent and quality of their HNV Farmland and Forests annually, from 2010, to the end of the rural development programme. These indicators will relate to Impact Indicator 5 so that changes may be detected over time;
- Apply indicators to monitor the extent and quality of their HNV Farmland and Forests at the end of the rural development programme (Impact Indicator 5);
- Where appropriate, measure the extent (in hectares) of their Traditional Agricultural Landscapes over the period of the current rural programme;
- Appoint programme evaluators to evaluate the extent to which the programme objectives have been achieved.

6.3 Monitoring Changes in the Extent and Quality of HNV Farmland and Forests

Data exist on the approximate extent of potential HNV Farmland Areas in 26 Member States of the EU (excluding Malta) at the present time[25]. The JRC/EEA have mapped the distribution of HNV Farmland Areas drawing on CORINE land cover data, trends in bird and butterfly populations, Natura 2000 data, and some national data, including grassland surveys (see Paracchini *et al*., 2006).

While these maps are useful in providing a preliminary indication of the location of HNV Farmland Areas, there are several characteristics of the approach used which mean that this measure of the extent of HNV Farmland Areas is not sensitive enough to inform the monitoring of the impact of policy over the reasonably short time frame of a rural development programme.

A complementary approach has been developed for the purposes of monitoring and evaluating rural development programmes comprising two sequential steps:

1. To characterise potential HNV Farming and Forests and identify the nature values - including the species and habitats of European and/or national, and/or regional conservation concern - associated with them drawing on the three typologies presented in chapters 3, 4 and 5 of this report.

2. To select indicators to identify and measure the extent and quality of HNV Farmland and Forests over the period of the rural development programme, and define the threshold at which farmland and forests can be classed as HNV, justified through an *a priori* characterisation of the HNV resource.

Member States will apply Baseline Indicator 18 at the start of the rural development programme. However, this only measures the area of HNV Farmland. The area of HNV Forestry is not included. In subsequent years, the indicators used in monitoring will need to be adapted to measure both the extent and the quality of HNV Farming and Forestry Areas, so that Impact Indicator 5 can detect changes over time (see footnote 24).

Member States are also encouraged to measure the extent of Traditional Agricultural Landscapes, if appropriate (see Annex 6). In addition, this would require Member States:

1. To characterise TAL on the basis of three criteria defined in Annex 6 page 170.

2. To develop nationally specific indicators to measure the extent of TAL.

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[25] The work of the EEA and JRC is documented under: http//eea.eionet.europa.eu/Public/irc/envirowindows/hnv/library.

6.3.1 Indicators to Measure Changes in the Extent of HNV Farmland

It is not feasible to use single indicators for all agricultural land uses. Therefore, Member States should define quantified indicators, specific to the following land uses: semi-natural forage land; arable and improved grassland; and permanent cropland.

For each land use, indicators should be applied which relate to the three core criteria which characterise HNV Farming, discussed in chapter 1 of this report:

1. Intensity of land use;
2. Presence of semi-natural features;
3. Presence of a land use mosaic.

The *minimum number* of indicators that should be applied to identify and measure the extent of HNV Farmland is one indicator relating to the first criterion (intensity of land use), and one indicator relating to the second criterion (the presence of semi-natural features).

Indicators relating to the third criterion (the presence of a land use mosaic) will be applied *in addition* to the other two in situations considered appropriate.

For each indicator, Member States will need to define indicator thresholds which will be informed by the regional characterisations of HNV Farming systems.

Table 6.1 provides an overview of the different indicators for each of the three land uses. Member States should define indicator thresholds that are appropriate for the conservation of nature value (habitats and species), informed by the regional characterisations of HNV farming systems.

Table 6.1 Indicators to Measure the Extent of HNV Farming

	Intensity of Land Use Indicators	Presence of Semi-Natural Features Indicators	Presence of a Land Use Mosaic Indicators
Semi-Natural Forage Land	Livestock density for all forage land (LU/ha/year).	Livestock density for all forage land (LU/ha/year) *Or* Extent of semi-natural vegetation (if grassland survey data are available)	Modal parcel size in hectares *And/or* Proportion of total agricultural area under semi-natural field margins *And/or* Number of land uses on the holding
Arable and Improved Grassland	N input / biocide use (kg/ha/year) *And/or* Average yield (t/ha/year) *And/or* Fallow as a proportion of total arable area and the number of years the land is in fallow For improved grassland, Livestock density for all forage (LU/ha/year)	Proportion of total agricultural area under semi-natural features	Modal parcel size in hectares *And/or* Proportion of total agricultural area under semi-natural field margins *And/or* Number of land uses on the holding
Permanent Cropland	N input / biocide use (kg/ha/year) *And/or* Average yield (t/ha/year)	Presence of standard or semi-standard productive trees A*nd* Presence of a semi-natural understorey	Modal parcel size in hectares *And/or* Proportion of total agricultural area under semi-natural field margins *And/or* Number of land uses on the holding

Intensity of Land Use

For **semi-natural forage land**, the indicator is **livestock density** (LU/ha/year), calculated at the holding level and including grazing land off the holding (for example, common land). This is a widely used measurement of intensity of use, and is directly relevant to nature value. Data should be collected on the total Livestock Units (LU), including non ruminants, per forage hectare. In certain cases, the spreading of manures from any animals on fields will have the same effect as high stocking densities. In those areas where this is a significant issue, Member States should take account of farm level nutrient balances in combination with a measure of stocking density.

Livestock density will be set at a level appropriate for semi-natural grazing land and / or unfertilised hay meadows in the region or Member State. It should consist of a range, giving a minimum and maximum livestock density. This range will be established on the basis of the regional characterisations of HNV farming systems, and may vary considerably according to the region and according to the predominant types of semi-natural forage.

The data may be available from national sources. In some Member States, it can be extracted from the IACS declaration of each holding, and aggregated to the regional level. Data may also be found in national Animal Health Registries, and from other sources.

For **arable land**, the indicator is the **volume of Nitrogen or biocide applied**, per annum per hectare, or **average crop yields**, per hectare per annum. Average crop yields can be measured at the holding level, and should be set against a regional reference level. For **improved grassland,** the indicator is **livestock density** (LU/ha/year). Set at an appropriate level, this indicator will distinguish grassland under less intensive management from the more intensively used improved grassland.

In some regions, more specific indicators may be applicable given the characteristics of the HNV system. Particularly in Iberia and in some other Mediterranean regions, low intensity arable land includes a proportion of rotating fallow and it is this fallow land which is important for nature value. In this case, **the proportion of land under fallow, and the number of years the land is in fallow**, are relevant indicators of intensity. More than one indicator may be chosen.

Once an indicator has been chosen, the data collected depends on availability. Data on nitrogen inputs may not be available at the level required. Data on the proportion of arable fallow can be determined from IACS declarations in some Member States. To measure average crop yields at the holding level, the forthcoming Survey of Agricultural Production Methods will provide this data although it is not likely to be available before 2013.

For **permanent crops,** the **volume of Nitrogen or biocides applied,** per hectare per annum, and **average yields**, per hectare per annum, are reliable indicators of intensity of use. In HNV orchards and olive groves, there is usually no use of synthetic fertilisers, or only occasional use in small quantities. Biocide use is a critical factor for nature value in permanent crop systems. Again, HNV orchards and groves normally involve no or minimal use of biocides. Yields are at the bottom end of yield ranges for these crops. Average crop yields can be measured at the holding level, and should be set against a regional reference level.

Once an indicator has been chosen, the data collected depends on availability. Data on nitrogen inputs may not be available at the level required. Data on the proportion of arable fallow can be determined from IACS declarations.

For **permanent crops,** the **volume of Nitrogen or biocides applied** per hectare per annum and **average yields**, per hectare per annum are reliable indicators of intensity of use. In HNV orchards and olive groves, there is usually no use of synthetic fertilisers, or only occasional use in small quantities. Biocide use is a critical factor for nature value in permanent crops. Again, HNV orchards and groves normally involve no or minimal use of biocides. Yields are at the bottom end of yield ranges for these crops. Average crop yields can be measured at the holding level, and should be set against a regional reference level.

Presence of Semi-Natural Features

Again, it is recommended that Member States use different indicators according to three land use categories.

The most significant semi-natural feature found in HNV farming systems is various types of **semi-natural forage land,** namely unimproved grazed grass, scrub and woodland, and unfertilised hay meadows.

In order to determine if semi-natural forage land is HNV, an intensity of use indicator should be applied. In this case, **livestock density** (LU/ha/year), calculated at the holding level, and excluding grazing land off the holding, is the most appropriate indicator, and is described above.

Data on the **area covered by semi-natural grazed and mown vegetation** can be collected in various ways:

- IACS forms in some Member States include categories of forage land that can be assumed to be semi-natural, if livestock densities are below a certain level. These assumptions, however, should be corroborated by ecologists.
- Vegetation inventories (comprehensive grassland surveys) are available in some Member States and it is recommended that these are used.

If forage land is predominantly semi-natural vegetation and the overall livestock density on this land is within the thresholds that favour nature value for the area in question, these two criteria are considered to provide a sufficient indication of HNV Farmland.

For **arable and improved grassland**, a significant presence of semi-natural vegetation on or adjacent to this land is critical to nature value. To constitute a significant presence, this should be in the form of adjacent semi-natural grazing land or hay meadows, and / or a high coverage of smaller semi-natural features on the land in question.

For **arable land and improved grassland**, the indicator is the **proportion of total agricultural area under semi-natural land or features.** This proportion should be quantified by the Member State, based on their regional characterisations of HNV farming systems. Member States should specify the features that will be included in the calculation, in accordance with their importance for nature value. These will be features that are known to support species of conservation concern at the European, national or regional levels.

Data on the presence of semi-natural features other than forage land are not generally available at a European level and national authorities will need to utilise the best data available. In some cases, IACS forms may contain useful information. New forms of data collection may be required to complete this task effectively.

In the case of **permanent cropland**, conditions vary considerably and much will depend on the relevant crops, growing conditions, the management of understorey vegetation, and the type of field margins present. The **productive trees** themselves are an important **semi-natural feature**. To be considered semi-natural, they must be large (standards or semi-standards) and not treated with biocides. The indicators are the **density of standard or semi-standard productive trees** per given area and the **presence of a semi-natural understorey**. Data generally are not available for both indicators. Data for these two indicators can be collected at the farm level only. In some regions, inventories of traditional orchards exist.

Presence of a Land Use Mosaic

Indicators of land use diversity are particularly relevant for arable and improved grassland, and for permanent crops, in situations where a small scale diversity of land uses is known to be a key factor supporting species of conservation concern.

These indicators should be used in combination with indicators on the intensity of use and the presence of semi-natural features, but only in situations where this diversity is known to be significant for nature value. However, an indicator of the presence of a land use mosaic is not sufficient by itself to identify a farming system as an HNV system.

The indicator can be one or a combination of the following, applied at the holding level:

- **Modal parcel size below a given maximum, in hectares;**
- **Proportion of total agricultural area under semi-natural field margins;**
- **A minimum number of different land uses (for example, types of crop) on a single holding.**

Member States should define the threshold level for each indicator, informed by the characterisations of regional HNV farming systems.

HNV Features in non-HNV Farmland Areas

If the indicators listed relating to intensity of land use, the presence of semi-natural features and the presence of a land use mosaic do not apply or reach the appropriate threshold, but there are point, linear or patch features which support species of European, and/or national and/or regional conservation concern, the following indicator should be applied:

Total area under HNV Features.

As such:

The total extent of HNV Farmland in a given Member State will be a measure of the combined area of HNV semi-natural forage land, arable/improved grassland and permanent cropland and the area under HNV features, in hectares.

6.3.2 Indicators to Measure the Quality of HNV Farmland

Changes in the ecological condition or quality of HNV Farmland will be assessed using a combination of biodiversity indicators. These will be applied at the national level and will provide broad contextual trends and measurement will be taken over the course of the rural development programme.

Through their characterisations of regional HNV farming systems, Member States will have identified species of conservation concern that are associated with these systems. These may be plant species; vertebrates, including birds; invertebrates, including butterflies; and fungi, depending on data availability. They may be species of European, national and regional conservation concern. Farmland bird and butterfly species of European conservation concern are listed in Annex 4.

Member States should select suites of species on the basis of available data. The selection of species should not be limited to the most threatened or emblematic species associated with an area or a type of farmland. Rather, suites of species that are considered to be indicators of habitat quality for a range of taxa should be selected.

The state of the populations of these species, measured as the **abundance of individuals at the national level**, provides a measure of the nature value of HNV Farmland for a Member State.

Systems should be established for measuring the abundance of their populations at the national level, or through regional case studies, with observed trends extrapolated to the national level.

Trends in the abundance of these species will indicate whether the quality of the HNV Farmland is improving, remaining stable, or deteriorating.

6.3.3 Indicators to Measure the Extent and Quality of HNV Forests

As such:

> **The extent of natural and semi-natural HNV Forests will be measured over the period of the rural development programme.**

A figure will be provided at the national or regional scale from an aggregation of the area of each HNV forest.

Changes in the ecological condition or quality of HNV Forests will be assessed using a combination of biodiversity indicators, one of which has to be species abundance. These will be applied at the national level and will provide broad contextual trends and measurement will be taken ocer the course of the rural development programme.

Member States should identify species of conservation concern associated with their HNV Forests. These may be plant species; vertebrates, including birds; invertebrates, including butterflies; and fungi, depending on data availability. They may be species of European, national and regional conservation concern.

Member States should select suites of species on the basis of available data. The selection of species should not be limited to the most threatened or emblematic species associated with a particular area or type of forest. Rather, suites of species that are considered to be indicators of habitat quality for a range of taxa should be selected.

Systems should be established for measuring the abundance of their populations at the national level, or through case studies, with observed trends extrapolated to the national level.

The state of the populations of these species, measured as the **abundance of individuals at the national level**, provides a measure of the nature value of HNV Forests for the Member State.

Trends in the abundance of these species will indicate whether the quality of the HNV Forest is improving, remaining stable, or deteriorating.

Additional indicators could include:

1. **Volume of standing and lying deadwood in the forest, measured in metres^3/hectare.**

2. **The degree of forest fragmentation over time, measured in terms of the mean forest patch size.**

6.4 Impact of Rural Development Programmes

Over the period of the 2007 – 2013 rural development programme, indicators measuring the extent and quality of the HNV resource could reveal various changes in state. The area of HNV farmland and forests could increase, remain stable, or decline which would be coupled with changes to the quality of the resource. In some cases, this change in state would indicate an improvement (+), in others a deterioration (-), and in still others, conflicting trends may emerge (?). The aggregation and weighting of trends at the national level must, however, be conducted with sensitivity as trends may vary significantly between regions, farming systems and forests, for example. Judgements on the part of programme evaluators will need to be made in this regard.

		QUALITY OF HNV RESOURCE		
		Increase	Stable	Decline
EXTENT OF HNV RESOURCE	Increase	+	+	?
	Stable	+	0	-
	Decline	?	-	-

The indicators reflect changes in the environment arising from a variety of driving forces and decisions by different actors. The extent to which the changes observed can be attributable to rural development programmes will need to be inferred by programme evaluators on the basis of evidence available to them.

6.5 Conclusions and Recommendations for the Monitoring of HNV Farming and Forests

6.5.1 HNV Farmland and Forest Indicators

Incorporating the preservation and development of HNV farming and forestry systems as a strategic objective of the EAFRD is a welcome development, but its operationalisation cannot be achieved overnight.

Chapter two revealed considerable diversity in the terms used, both in the official documents of the Commission and more broadly in the literature. This diversity in part reflects differences in conceptual understanding, but also in the approach to the characterisation, identification and spatial delimitation of HNV areas and / or systems. This, in turn, has implications for the data needed to identify and measure them. To efficiently operationalise this strategic objective, there needs to be a common level of understanding and definition of the key terms and this study has attempted to offer some clarity and consistency in the terms used in relation in the High Nature Value concept, and to explain the relationships between them.

The approach developed has been designed with the evaluation of rural development programmes in mind, and specifically to detect those quantitative and qualitative changes in a Member State's HNV resource over the seven year time period of rural development programmes which can be attributed to the application of rural development measures. It does, however, have wider application and offers a means of monitoring changes in the area and condition of HNV farming and forestry more broadly.

The approach has been informed by a requirement on Member States to measure changes in HNV farming and forestry at a national and/or level. This has resulted in the modification of the commonly used Andersen *et al*. (2003) definition. Andersen's definition draws attention to farmland of exceptional nature value at the European scale, and provides a common measure of value which is comparable across Member States. This has been modified in order to recognise and identify HNV farmland which is important at the European, national and/or regional scales, in part, to correspond with the scale at which a rural development programme operates[26].

It is also probable that many types of farmland identified as HNV, even that identified as being of European conservation importance, could be improved from a nature conservation perspective. In particular, this may be the case for Type 3 HNV: the presence of an individual species that is adapted to quite intensive farming does not mean that the farmland is optimal for wider nature conservation.

6.5.2 Monitoring and Evaluation

There is clear room for improvement in the data needed for the identification and measurement of HNV farmland and forests, and in the systems for monitoring changes in their area and condition. For the current rural development programmes a baseline has already been established, relating to a measurement of the total area of HNV Farmland in hectares, as stipulated through the application of Baseline Indicator 18. This is a different unit of measurement from that proposed for Impact Indicator 5, which also attempts to measure the area of HNV farmland and HNV forests as well as the quality or condition of these areas. An assessment of changes in quality is important in order to assess whether they are improving or degrading over time, and whether additional measures need to be targeted at them. Whilst these differences in measurement are unavoidable, given the discrepancy in the timing of the development of the Impact Indicator and the start of the 2007 – 2013 Rural Development

[26] Whilst the definition has been modified, it does not negate the importance of distinguishing between HNV farmland of European importance, and farmland with significant nature values at the national and/or regional level, as this will give rise to very different types of farmland being defined as HNV. In terms of the allocation of EU resources, HNV farmland of European importance should be the priority.

programmes, in future, these measurements would need to be harmonised for a more accurate picture of changes over time to emerge.

In addition, it requires a long term commitment to the development and/or modification of existing data bases, in order to provide consistent data for the indicators. Currently available data could be improved for the purpose. Either the most relevant existing data bases need to be adapted explicitly to the identification of HNV farming systems, forests and farmland features or new systems should be established which account for nature value both in farmland and forest/woodland. In order to implement the approach proposed in the report, Member States will need to gather together existing sources of data or invest in the collection of new data, both in relation to the indicators of extent, and of quality.

To apply the indicators of the extent of HNV farmland, data should be collected at the farm level. The basic data that need to be collected at farm level are:

- Parcels under semi-natural vegetation;
- Livestock densities per forage hectare;
- The presence of semi-natural features such as hedges and ponds.

The only existing systems common to all Member States are the Farm Structure Survey (FSS) and IACS/LPIS. Of the two, IACS/LPIS provides more relevant information, and the data are collected every year, although they will not be adequate in all Member States, and additional data sources may need to be sought.

To apply indicators of the extent of HNV forests requires the collection of data to distinguish plantations, semi-natural, and naturally dynamic forests. Moreover, data are required on the indicators used to distinguish HNV from non-HNV semi-natural forests. These include indicators of forest biodiversity such as the composition of native tree species, the volume of standing and lying dead wood, the density of large trees, and the age structure of the forest. To allow effective assessment, such data should be collected at the most appropriate scale. Due to a diversity of ownership structures, tenures, and traditions, data at the scale of forest management units or forest properties, for example, are not currently available in all 27 Member States. Most national forest inventories provide reliable information at larger spatial scales (for example, municipalities, counties and regions), but survey intensity is often too low to allow assessment in individual management units. In forests managed by private companies or state enterprises, however, data on tree species composition and age structure, for example, may be readily available from the forest management plans. That said, there does not appear to be any current EU-wide scheme which allows the collection of the data necessary to identify HNV forests at the local scale. Hence, a first step could be to develop such a scheme and to apply it specifically to those forests which are subject to rural development measures.

To apply the quality indicators for farmland and forest, many Member States will need to draw on existing data. For example, they are already obliged to monitor those species that are listed under the Habitats Directive (Council Directive 92/43/EEC) and the Birds Directive (Council Directive 79/409/EEC). Many Member States have, or are developing, Biodiversity Action Plans, listing species of conservation concern, and therefore will have systems to monitor their abundance. For those Member States that have not yet developed their BAPs, they will have other monitoring programmes in operation for specific species. In addition, new programmes of species monitoring may be required and the establishment of regional case studies for the collection of data could provide one solution, with observed trends extrapolated to the national level. Importantly, common bird indices used at present should be complemented by the monitoring of more demanding and specialised species which are not captured in the common bird scheme, for it is often these species which are most threatened by declines in the nature value of farmland and forest. Collectively, this data will be extremely valuable for biodiversity monitoring, not only in relation to HNV farming and forestry, but also for other CMEF and SEBI 2010 indicators (EEA, 2007).

6.5.3 Monitoring of HNV Farming and Forestry Systems

In addition to the approach using indicators, it is recommended that Member States establish a system for surveying the evolution of key practices in HNV farming systems. This is the only way to gather information on the crucial changes in the driving forces which render a system HNV or not. The indicators proposed do not capture this sufficiently.

Member States will have identified, in their regional characterisation of HNV farming systems, the particular practices and features that are most significant for nature value. Many of the more specific practices cannot be identified through basic indicators. These include practices such as the timing and method of hay cutting, shepherding and grazing regimes, and the management of features such as field margins.

In order to monitor qualitative changes in HNV farming, it is important to know how such practices are evolving, as they are often critical to the maintenance of nature values. They may also be influenced by rural development measures. Establishing comprehensive data bases of such practices would require an excessive amount of resources. Therefore Member States could monitor changes in farming practices by undertaking surveys of a percentage of farms in a given area that are shown to be predominantly HNV by the indicators measuring the extent of HNV farmland.

Surveys should be undertaken by means of farm interviews using a common format focusing on changes in:

- Practices identified as important for the nature value of the farming system;
- Features identified as important for the nature value of the farming system.

The results of these surveys would feed back into the evaluation of rural development programmes by providing an indication of the extent to which key HNV farming practices have increased or declined during the programme period.

As regards forestry systems, monitoring at the Member State level would be a challenging task. It would require knowledge of the forest management practices which are being applied locally, and an assessment of the extent to which they imitate natural dynamics for the forest type under consideration. National standards for ecologically sustainable forest practices have been established in the context of forest certification, mainly those of the Forest Stewardship Council (FSC) and Programme for the Endorsement of Forest Certification Schemes (PEFC). Monitoring the proportion of forests which is certified could thus provide an estimate of trends in HNV forestry systems. Thus, in the meantime, monitoring the extent and changes in quality of HNV forests appears to be a more realistic objective than monitoring forestry systems through an evaluation of management practices.

Through data collection and monitoring, Member States will be in a position to detect changes in the extent and quality of their HNV farming and forestry. This information will mean that they are able to introduce appropriate rural development measures to ensure that they are effectively maintained.

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Annex 1 Inventory of Potential HNV Features

Environmental Zone	Characteristics of Typical HNV Farmland Areas	Typical Features		
		Patch	Linear	Point
Alpine North and Boreal	HNV areas are found in upland, mountain and lowland areas with open semi-natural grasslands. These areas are strongly constrained by climate (long, cold winters with long snow cover and short growing season), topography (steep slopes), and isolation (low population density). Agricultural activities have declined strongly in the last century in both zones resulting in wide-spread abandonment of land. Main extensive agricultural activities include summer-grazing with cows, sheep and goats, reindeer pastoral systems and mixed farming systems similar to that in Northern-Scotland (in-by and out-by systems).	Extensive arable fields, hay meadows, semi-natural grasslands (e.g. mountain and alpine pastures), extensive grasslands, grazed mires, moors and heathlands, grazed coastal meadows, wooded hay meadows, wooded pastures, grazed salt meadows, grazed orchards, traditional orchards	Stonewalls, rows of trees, vegetated margins	Woodland patches, springs
Nemoral	This zone only consists of lowland areas dominated by open semi-natural grasslands. These areas are also constrained by climate (long, dark and cold winters). Agricultural activities have also declined strongly in the last century resulting in wide-spread abandonment. Main extensive agricultural activities include summer grazing with cows and sheep.	Extensive arable fields, hay meadows, semi-natural grasslands, extensive permanent grasslands, grazed mires, moors and heathlands, grazed coastal meadows, wooded hay meadows, wooded pastures, grazed salt meadows, grazed orchards, traditional orchards	Stonewalls, rows of trees/shrubs, vegetated margins	Ponds, pools, woodland patches, springs, solitary trees

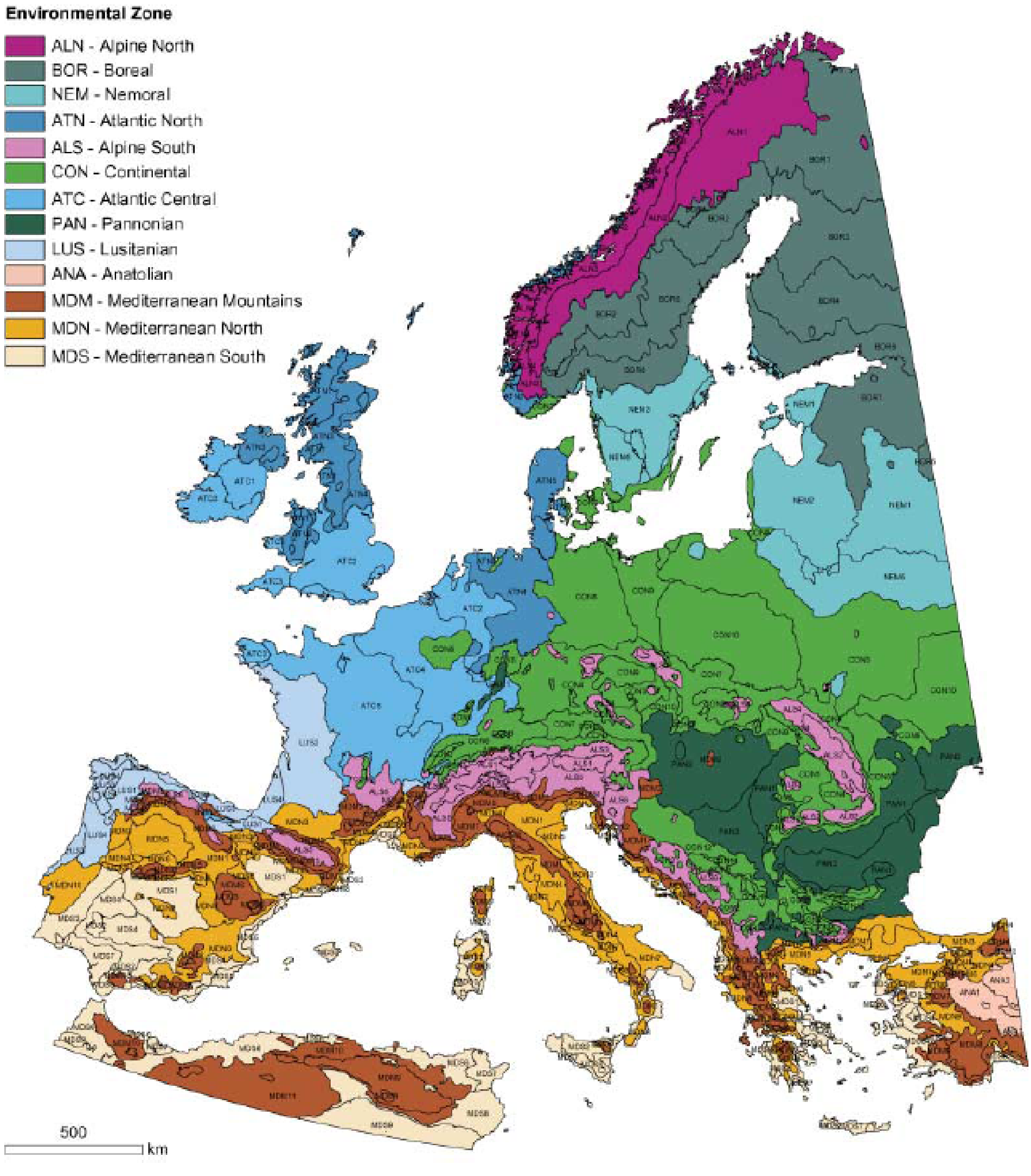
Environmental Zone	Characteristics of Typical HNV Farmland Areas	Typical Features		
		Patch	Linear	Point
Atlantic North	HNV areas are found in lowland but more often in upland areas dominated by open semi-natural and/or wet grasslands, moors and heathlands. These HNV areas are most often constrained by soil (wet, unfertile and shallow and /or salty) and/or topography (steep slopes) and remote *location* (island or inland l*ocation* in low populated and isolated regions). Agriculture is the most important land use in this zone, but has generally intensified strongly although abandonment is also a problem in the more isolated regions. Main extensive agricultural activities include extensive grazing with cows and sheep and mixed farming.	Hay meadows, semi-natural grasslands, extensive permanent grasslands, grazed mires, moors and heathlands, grazed salt meadows	Stonewalls, hedges, rows of trees/shrubs, vegetated margins	Ponds, pools, woodland patches, springs, solitary trees
Atlantic central	Very limited HNV areas are found in this zone which consists of flat or undulating lowland. HNV is mainly found in areas dominated by semi-natural and/or wet permanent grasslands, moors and heathlands and (salt) marshes. These HNV areas are most often constrained by soil (wet, unfertile and shallow and /or salty). Agriculture is the most important land use in this zone, but has generally intensified significantly. Main extensive agricultural activities include extensive grazing with cows and sheep.	Semi-natural grasslands, extensive permanent grasslands, grazed moors and heathlands, grazed salt meadows	Stonewalls, hedges, rows of trees/shrubs, vegetated margins, ditches, dykes	Ponds, pools, woodland patches, solitary trees
Alpine	HNV areas are found in both upland and mountain areas dominated by semi-natural, unimproved grasslands, hay meadows and/or a mosaic of small arable fields and grasslands. These areas are strongly constrained by topography (steep slopes and altitude) and climate (cold and long snow cover above 1000 metres). Only a small part of the zone is still used for agricultural activities. Both intensification in the valleys and land abandonment in the mountains is a problem in these areas. Main extensive agricultural activities include extensive grazing with cows and sheep with some transhumance practices and mixed farming.	Hay meadows, semi-natural grasslands (e.g. mountain and alpine pastures), extensive permanent grassland, grazed mires, moors and heathlands, grazed orchards, traditional orchards	Stonewalls, rows of trees/shrubs, vegetated margins	Woodland patches, springs, solitary trees

Environmental Zone	Characteristics of Typical HNV Farmland Areas	Typical Features		
		Patch	Linear	Point
Continental	HNV areas are found in lowland but more often in upland areas dominated by extensive semi-natural, unimproved grasslands, hay meadows and/or a mosaic of small arable fields and grasslands. Agricultural land use is very important in this zone, in terms of share of land use, and there may be a significant variation in intensity. HNV areas in this zone still mostly coincide with areas where natural constraints are most severe in relation to topography (steep slopes and higher altitudes), soil quality (e.g. shallow, wet, peaty, alkaline soils) and/or climate (very arid zones e.g. semi-steppes or mountain ranges with long cold winters) and in regions where farm structures are dominated by small family holdings. Both intensification and land abandonment is a problem in this region. Main extensive agricultural activities include grazing with cows, sheep and goats, with or without transhumance practices, mixed farming and low intensity arable cropping.	Extensive arable fields, hay meadows, semi-natural grasslands (e.g. mountain pastures), extensive permanent grasslands, grazed mires, moors and heathlands, wooded hay meadows, wooded pastures, grazed salt meadows, grazed orchards, traditional orchards	Hedges, rows of trees/shrubs, vegetated margins	Ponds, pools, woodland patches, springs, solitary trees
Pannonian	HNV areas are dominated by extensive semi-natural, unimproved grasslands and/or a mosaic of small arable fields and grasslands. The whole zone can be categorised as lowland and agricultural land use is very important in this zone, in terms of share of land use, there may be a significant variation in intensity. HNV areas in this zone still mostly coincide with areas where natural constraints are most severe in relation to soil quality (e.g. shallow and alkaline soils) and/or climate (very arid zones e.g. semi-steppes) and in regions where farm structures are dominated by small family holdings. Both intensification and land abandonment is a problem in this region. Main extensive agricultural activities include extensive grazing with cows, sheep, goats and pigs and mixed farming.	Extensive arable fields, hay meadows, semi-natural grasslands, extensive permanent grasslands, grazed salt meadows, grazed orchards, traditional orchards	Rows of trees/shrubs, vegetated margins	Ponds, pools, woodland patches

Environmental Zone	Characteristics of Typical HNV Farmland Areas	Typical Features		
		Patch	Linear	Point
Lusitanian	HNV areas are still found in lowland areas but more often in upland areas dominated by extensive semi-natural, unimproved grasslands, hay meadows and/or a mosaic of small arable fields and grasslands. Agricultural land use may vary significantly in intensity but there is still extensive farming present. HNV areas in this zone mostly coincide with areas where natural constraints are most severe in relation to topography (steep slopes and higher altitudes) and/or soil quality (e.g. shallow soils) and some agricultural areas with very small family holdings. Both intensification and land abandonment is a problem in this region. Main extensive agricultural activities include extensive grazing with cows, sheep and goats, with or without transhumance practices, mixed farming and low intensity permanent cropping.	Extensive arable fields, hay meadows, semi-natural grasslands (e.g. mountain pastures), extensive permanent grasslands, grazed mires, moors and heathlands, wooded hay meadows, wooded pastures, grazed orchards, traditional orchards	Stonewalls, rows of trees, vegetated margins, terrace boundaries	Ponds, pools, woodland patches, springs, solitary trees
Mediterranean North	HNV areas are found in both lowland and upland areas dominated by extensive semi-natural, unimproved grasslands, dehesas/montados and/or a mosaic of small fields of arable, permanent crops and grasslands. Agricultural land use may vary very significantly in intensity. HNV areas in this zone mostly coincide with areas where natural constraints are most severe in relation to topography (steep slopes) and/or soil quality (e.g. shallow and alkaline soils). Both intensification and land abandonment is a problem in this region. Main extensive agricultural activities include extensive grazing with cows, sheep and goats, with or without transhumance practices, mixed farming, low intensity permanent cropping and agro-forestry.	Semi-natural grasslands (e.g. Mountain pastures), extensive permanent grasslands, garrigue, maquis, grazed salt meadows, dehesa, montado, traditional olive groves	Stonewalls, rows of trees, vegetated margins, terrace boundaries	Woodland patches, springs, solitary trees

Environmental Zone	Characteristics of Typical HNV Farmland Areas	Typical Features		
		Patch	Linear	Point
Mediterranean Mountains	In these upland areas, HNV areas are dominated by extensive semi-natural, unimproved grasslands. Natural constraints are severe in this zone in relation to topography (steep slopes and higher altitudes) and/or soil quality (e.g. shallow, wet and alkaline soils) and/or climate (short growing season in higher mountains but generally low precipitation). Mostly land abandonment is a problem in this region. Main extensive agricultural activities include extensive grazing with cows, sheep and goats, with or without transhumance practices, mixed farming and low intensity permanent cropping.	Semi-natural grasslands (e.g. mountain pastures), extensive permanent grasslands, garrigue, maquis, wooded hay meadows, wooded pastures, dehesas	Stonewalls, rows of trees, vegetated margins, terrace boundaries	Woodland patches, springs, solitary trees
Mediterranean South	In these upland areas, HNV areas are dominated by extensive semi-natural, unimproved grasslands. In these lowland areas HNV areas are dominated by extensive semi-natural, unimproved grasslands, dehesas/montados and/or a mosaic of small fields of arable, permanent crops and grasslands. Agricultural land use may vary significantly in intensity. HNV areas in this zone mostly coincide with areas where natural constraints are most severe in relation to topography (steep slopes and higher altitudes) and/or soil quality (e.g. shallow, wet and alkaline soils) and/or climate (very dry long summers). Both intensification and land abandonment is a problem in this region. Main extensive agricultural activities include extensive grazing with cows, sheep and goats, with or without transhumance practices, mixed farming, low intensity permanent cropping and agro-forestry.	Semi-natural grasslands (e.g. mountain pastures), extensive permanent grasslands, garrigue, maquis, dehesa, montado, traditional olive groves	Stonewalls, rows of trees, vegetated margins, terrace boundaries	Woodland patches, springs, solitary trees

Annex 2 Map of European Environmental Zones



Source: Metzger, M.J., Bunce, R.G.H., Jongman, R.H.G, Mucher, C.A., Watkins, J.W., 2005 A climatic stratification of the environment of Europe. Global Ecology and Biogeography, **14**, 549–563.

Annex 3 A Classification of HNV Features by Altitudinal Zone within each Environmental Zone

Note: Annex I habitats from the Habitats Directive[27] are drawn from Paracchini, *et al.* (2006)[28] who have provided an overview of all these habitats which depend on extensive agricultural practices. The list builds on a review by the EEA Topic Centre for Nature Protection and Biodiversity and revises a previous proposal by Ostermann, 1998. It includes feeback from Member States, EEA internal discussions and expert advice.

The Annex I habitats marked as * were not included in the list of Paracchini, *et al.* (2006), but are dependent on agricultural practices in some local circumstances. They have been added following consultation with experts and are grazed in certain locales.

Environmental zone	Altitude	Features	Annex I Habitats that depend on extensive agricultural practices
Alpine North and Boreal	Lowland (0-400)	Hay meadows, semi-natural grasslands, extensive permanent grasslands, wooded hay meadows, wooded pastures, grazed salt meadows, grazed orchards, traditional orchards interspersed with stonewalls, rows of trees/shrubs and vegetated margins	<u>Coastal, riverside and saline habitats</u> 1630 Boreal Baltic coastal meadows; 2130 Fixed coastal dunes with herbaceous vegetation; *2180 Wooded Dunes of Boreal region; *Juniperus communis* formations on calcareous grasslands; 2320 Dry sand heaths with *Calluna* and *Empetrum nigrum.* <u>Heath and scrub</u> *4060 Alpine and Boreal heaths <u>Grasslands</u> 6110 Ripiculous calcareous or basophilic grasslands of the *Alisso-Sodium albi;* 6120 Xeric sand calcareous grassland; 6150 Selicious alpine and boreal grasslands; 6170 Alpine calcareous grasslands; 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*); 6270 Fennoscandian lowland species-rich dry to mesic grasslands; 6280 Nordic alvar and precambriam calcareous flatrocks; 6410 Molinia meadows on calcareous or

[27] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild flora and fauna. OJ L206, 22/07/1992 P, 0007-0050.

[28] Paracchini, M.L., Terres, J.M., Petersen, J.E. and Hoogeveen, Y., 2006. Background document on the methodology for mapping High Nature Value farmland in EU27, European Commission Directorate General Joint Research Centre and the European Environment Agency.

Environmental zone	Altitude	Features	Annex I Habitats that depend on extensive agricultural practices
			peaty soils; 6430 Eutrophic tall herbs; 6440 Alluvial meadows of the *cnidion dubii*; 6450 Northern Boreal alluvial meadows; 6510 Lowland hay meadows; 6520 Mountain hay meadows; 6530 Fennoscandian wooded meadows. <u>Bogs, mires and fens</u> *7120 Degraded raised bogs still capable of natural regeneration; *7130 Blanket bogs. <u>Forests</u> 9070 Fennoscandian wooded pastures;
	Upland (400-700)	Semi-natural grasslands, extensive permanent grasslands, grazed mires, moors and heathlands, wooded hay meadows, wooded pastures, rows of trees/shrubs and vegetated margins	<u>Coastal, riverside and saline habitats</u> *3220 Alpine rivers and the herbaceous vegetation along their Banks. <u>Heath and scrub</u> *4060 Alpine and Boreal heaths <u>Grasslands</u> 5130 *Juniperus communis* formations on calcareous grasslands; 6150 Selicious alpine and boreal grasslands; 6410 Molinia meadows on calcareous or peaty soils; 6170 Alpine calcareous grasslands; 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco Brometalia); 6230 Species rich *Nardus* grasslands on silicious substrates in mountain areas; 6440 Alluvial meadows of the cnidion dubii; 6450 Northern Boreal alluvial meadows; 6520 Mountain hay meadows; 6530 Fennoscandian wooded meadows. <u>Bogs, mires and fens</u> *7120 Degraded raised bogs still capable of natural regeneration *7130 Blanket bogs *7240 Alpine pioneer formations of *Caricion bicoloris-atrofuscae* <u>Forests</u> 9070 Fennoscandian wooded pastures;
	Mountains (700+)	Semi-natural grasslands, grazed mires, moors and heathlands	<u>Coastal, riverside and saline habitats</u> *3220 Alpine rivers and the herbaceous vegetation along their Banks

Environmental zone	Altitude	Features	Annex I Habitats that depend on extensive agricultural practices
			Heath and scrub *4060 Alpine and Boreal heaths Grasslands 5130 *Juniperus communis* formations on calcareous grasslands; 6150 Selicious alpine and boreal grasslands; 6170 Alpine calcareous grasslands; 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco Brometalia); 6230 Species rich nardus grasslands on silicious substrates in mountain areas; 6450 Northern Boreal alluvial meadows. Bogs, mires and fens *7120 Degraded raised bogs still capable of natural regeneration; *7130 Blanket bogs; 7140 Transition mires and quaking bogs; *7240 Alpine pioneer formations of *Caricion bicoloris-atrofuscae.*
Nemoral	Lowland (0-200)	Arable fields, hay meadows, semi-natural grasslands, extensive permanent grasslands, grazed mires, grazed coast meadows, moors and heathlands, wooded hay meadows, wooded pastures, grazed salt meadows, grazed orchards, traditional orchards, stonewalls, rows of trees/shrubs and vegetated margins, ponds and pools	Coastal, riverside and saline habitats 1630 Boreal Baltic coastal meadows; 2130 Fixed coastal dunes with herbaceous vegetation; 2140 Decalcified fixed dunes with *Epetrum nigrum*; 2160 Dunes with *Hipophea rhamnoides*; 2170 Dunes with *Salix repens* ssp. *Argantea*; *2180 Wooded Dunes of Boreal region; *Juniperus communis* formations on calcareous grasslands; 2310 Dry sand heaths with *Calluna* and *Genista;* 2320 Dry sand heaths with *Calluna* and *Empetrum nigrum.* Heath and scrub 2330 Inland dunes with open *Corynephorus* and *Agrostis* grasslands; 4030 European dry heath; 5130 *Juniperus communis* formations on calcareous grasslands. Grasslands 2330 Inland dunes with open Corynephorus and Agrostis grasslands; 6120 Xeric sand calcareous grassland; 6280 Nordic alvar and precambriam calcareous flatrocks; 6410 Molinia meadows on calcareous or peaty soils; 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates

Environmental zone	Altitude	Features	Annex I Habitats that depend on extensive agricultural practices
			(Festuco Brometalia); 6230 Species rich nardus grasslands on silicious substrates in mountain areas; 6270 Fennoscandian lowland species-rich dry to mesic grasslands; 6430 Eutrophic tall herbs; 6440 Alluvial meadows of the cnidion dubii; 6510 Lowland hay meadows; 6530 Fennoscandian wooded meadows. Bogs, mires and fens *7120 Degraded raised bogs still capable of natural regeneration; *7130 Blanket bogs. 7140 Transition mires and quaking bogs. Forests 9070 Fennoscandian wooded pastures
Atlantic North	Lowland (0-300)	Hay meadows, semi-natural grasslands, extensive permanent grasslands, grazed mires, moors and heathlands, wooded pastures, grazed salt meadows, hedges, rows of trees/shrubs, vegetated margins, stone walls, ponds and pools	Coastal, riverside and saline habitats 1330 Atlantic salt meadows; 2130 Fixed coastal dunes with herbaceous vegetation; 2140 Decalcified fixed dunes with *Epetrum nigrum*; 2150 Atlantic decalcified fixed dunes; 2160 Dunes with *Hipophea rhamnoides*; 2170 Dunes with *Salix repens* ssp. *Argantea;* *2180 Wooded Dunes of the Atlantic region; *Juniperus communis* formations on calcareous grasslands; 21A0 Machairs; 2310 Dry sand heaths with *Calluna* and *Genista.* Heath and scrub 4010 Northern Atlantic wet heath with Erica tetralix; 4030 European dry heath; 4040 Dry Atlantic coastal heath with Erica vagans. Grasslands 2330 Inland dunes with open *Corynephorus* and *Agrostis* grasslands; 5130 *Juniperus communis* formations on calcareous grasslands; 6120 Xeric sand calcareous grassland; *6130 Calaminarian grasslands of the *Violetalia calaminariae;* 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates; 6410 Molinia meadows on calcareous or peaty soils; 6430 Eutrophic tall herbs; 6440 Alluvial meadows of river valleys;

Environmental zone	**Altitude**	**Features**	**Annex I Habitats that depend on extensive agricultural practices**
			6510 Lowland hay meadows; 6440 Alluvial meadows of river valleys. <u>Bogs, mires and fens</u> *7120 Degraded raised bogs still capable of natural regeneration; *7130 Blanket bogs. <u>Forests</u> *91CO Caledonian forest
	Upland (300+)	Hay meadows, semi-natural grasslands, extensive permanent grasslands, grazed mires, moors and heathlands, stone walls	<u>Heath and scrub</u> 4010 Northern Atlantic wet heath with *Erica tetralix*; 4030 European dry heath; *4060 Alpine and Boreal heaths. <u>Grasslands</u> 5130 *Juniperus communis* formations on calcareous grasslands.
			*6130 Calaminarian grasslands of the *Violetalia calaminariae;* 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates; 6230 Species rich *Nardus* grasslands on silicious substrates in mountain areas; 6430 Eutrophic tall herbs; 6440 Alluvial meadows of river valleys. <u>Bogs, mires and fens</u> *7120 Degraded raised bogs still capable of natural regeneration; *7130 Blanket bogs; 7140 Transition mires and quaking bogs; *7240 Alpine pioneer formations of *Caricion bicoloris-atrofuscae.* <u>Forests</u> *9140 Medio-European subalpine beech woods with *Acer* and *Rumex arifolius.*

Environmental zone	Altitude	Features	Annex I Habitats that depend on extensive agricultural practices
Atlantic Central	Lowland (0-300)	Semi-natural grasslands, extensive permanent grasslands, grazed moors and heathlands, grazed salt meadows interspersed with Stonewalls, hedges, rows of trees/shrubs, vegetated margins, ditches, dykes, ponds and pools	Coastal, riverside and saline habitats 1330 Atlantic salt meadows; 2130 Fixed coastal dunes with herbaceous vegetation; 2150 Atlantic decalcified fixed dunes; 2160 Dunes with *Hipophea rhamnoides*; 2170 Dunes with *Salix repens* ssp. *argantea*; *2180 Wooded Dunes of the Atlantic region; *Juniperus communis* formations on calcareous grasslands. 21AO Machairs. 2310 Dry sand heaths with *Calluna* and *Genista.* 2330 Inland dunes with open *Corynephorus* and *Agrostis* grasslands. Heath and scrub 4020 Temperate Atlantic wet heath with Erica caliaris and Erica tetralix; 4030 European dry heath; 4040 Dry Atlantic coastal heath with *Erica vagans*. Grasslands
			5130 *Juniperus communis* formations on calcareous grasslands; 6110 Ripiculous calcareous or basophilic grasslands of the *Alisso-Sodium albi;* 6120 Xeric sand calcareous grassland; 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates; 6410 *Molinia* meadows on calcareous or peaty soils; 6440 Alluvial meadows of river valleys; 6510 Lowland hay meadows. Bogs, mires and fens *7120 Degraded raised bogs still capable of natural regeneration; *7130 Blanket bogs; 7140 Transition mires and quaking bogs. Forests *9130 *Asperulo-Fagetum* beech forests; *9140 Medio-European subalpine beech woods with *Acer* and *Rumex arifolius*; *9150 Medio-European limestone beech forests of the *Cephalanthero-Fagion*.
Continental	Lowland (0-700)	Extensive arable fields, hay meadows, semi-natural grasslands, extensive permanent grasslands, grazed mires, moors and heathlands,	Coastal, riverside and saline habitats 1340 Inland salt meadows; 2180 Wooded Dunes of the Continental region; *Juniperus communis* formations on calcareous grasslands; 2310 Dry sand heaths with *Calluna* and *Genista*;

Environmental zone	Altitude	Features	Annex I Habitats that depend on extensive agricultural practices
		wooded hay meadows, wooded pastures, grazed salt meadows, grazed orchards, traditional orchards, hedges, rows of trees/shrubs, stone walls, vegetated margins, ponds and pools	2330 Inland dunes with open *Corynephorus* and *Agrostis* grasslands. Heath and scrub 4030 European dry heath; *4070 Bushes with *Pinus mugo* and *Rhododendron hirsutum*; *40AO Subcontinental peri-Pannonic scrub. Grasslands 5130 *Juniperus communis* formations on calcareous grasslands; 6110 *Ripiculous* calcareous or basophilic grasslands of the *Alisso-Sodium albi;* 6120 Xeric sand calcareous grassland; 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates; 6220 Pseudo-steppes with grasses and annuals of the Thero-Brachipodietea; 6240 Sub-Pannonic steppic grasslands; 6410 Molinia meadows on calcareous or peaty soils; 6430 Eutrophic tall herbs; 6510 Lowland hay meadows; 6440 Alluvial meadows of river valleys; 6240 Sub-Pannonic steppic grasslands; 6430 Hydrophilous tall herb fringe communities of plains and montane levels. Forests *9130 *Asperulo-Fagetum* beech forests; *9150 Medio-European limestone beech forests of the *Cephalanthero-Fagion.*
	Upland (700+)	Extensive arable fields, hay meadows, semi-natural grasslands, extensive permanent grasslands, grazed mires, moors and heathlands, wooded pastures, rows of trees/shrubs, stone walls, vegetated margins	Heath and scrub 4030 European dry heath; Grasslands 5130 *Juniperus communis* formations on calcareous grasslands; 6110 Ripiculous calcareous or basophilic grasslands of the *Alisso-Sodium albi;* 6120 Xeric sand calcareous grassland; 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates; 6170 Alpine calcareous grasslands; 6150 Selicious alpine and boreal grasslands; 6230 Species rich *Nardus* grasslands on silicious substrates in mountain areas; 6240 Sub-Pannonic steppic grasslands; 6410 Molinia meadows on calcareous or peaty soils; 6430 Eutrophic tall herbs; 6440 Alluvial meadows of river valleys; 6430 Hydrophilous tall herb fringe communities of plains and montane levels.

Environmental zone	Altitude	Features	Annex I Habitats that depend on extensive agricultural practices
			<u>Bogs, mires and fens</u> *7120 Degraded raised bogs still capable of natural regeneration; *7240 Alpine pioneer formations of *Caricion bicoloris-atrofuscae*; 7140 Transition mires and quaking bogs. <u>Forests</u> *9130 *Asperulo-Fagetum* beech forests; *9140 Medio-European subalpine beech woods with *Acer* and *Rumex arifolius*; *9150 Medio-European limestone beech forests of the *Cephalanthero-Fagion*; *9410 Acidophilous *Picea* forests of the montane to alpine levels; *9420 Alpine *Larix decidua* and/or *Pinus cembra* forests.
Pannonic	Lowland	Extensive arable fields, hay meadows, semi-natural grasslands, extensive permanent grasslands, grazed mires, moors and heathlands, wooded hay meadows, wooded pastures, grazed salt meadows, grazed orchards, traditional orchards interspersed with stonewalls, rows of trees/shrubs, vegetated margins	<u>Coastal, riverside and saline habitats</u> 1340 Inland salt meadows; 1530 Pannonic salt steppes and salt marshes; <u>Heath and scrub</u> *40AO Subcontinental peri-Pannonic scrub <u>Grasslands</u> 2340 Pannonic inland dunes; 6120 Xeric sand calcareous grassland; 6190 *Rupicolous* pannonic grasslands; 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates; 6220 Pseudo-steppes with grasses and annuals of the *Thero-Brachipodietea;* 6250 Pannonic leoss steppic grassland; 6260 Pannonic sand steppes; 6410 Molinia meadows on calcareous or peaty soils; 6430 Eutrophic tall herbs; 6510 Lowland hay meadows; 6440 Alluvial meadows of river valleys; 6430 Hydrophilous tall herb fringe communities of plains and montane levels. <u>Forests</u> *9130 *Asperulo-Fagetum* beech forests; *9140 Medio-European subalpine beech woods with *Acer* and *Rumex arifolius*; *9150 Medio-European limestone beech forests of the *Cephalanthero-Fagion;* *91KO Illyrian *Fagus sylvatica* forests (*Aremonio-Fagion*).

Environmental zone	Altitude	Features	Annex I Habitats that depend on extensive agricultural practices
Alpine South	Lowland (0-700)	Hay meadows, semi-natural grasslands (e.g. Mountain and Alpine pastures), extensive permanent grassland, grazed mires, moors and heathlands, wooded hay meadows, wooded pastures, grazed orchards, traditional orchards, hedges, rows of trees/shrubs, vegetated margins, woodland patches, springs	Coastal, riverside and saline habitats Heath and scrub 4060 Alpine heath; *4070 Bushes with *Pinus mugo* and *Rhododendron hirsutum*. Grasslands 5130 Juniperus communis formations on calcareous grasslands; 6110 Ripiculous calcareous or basophilic grasslands of the Alisso-Sodium albi; 6120 Xeric sand calcareous grassland; *6130 Calaminarian grasslands of the *Violetalia calaminariae*; 6150 Selicious alpine and boreal grasslands; 6170 Alpine calcareous grasslands; 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates; 6230 Species rich nardus grasslands on silicious substrates in mountain areas; 6520 Mountain hay meadows. Bogs, mires and fens *7120 Degraded raised bogs still capable of natural regeneration; 7140 Transition mires and quaking bogs. Forests *9130 *Asperulo-Fagetum* beech forests; *9140 Medio-European subalpine beech woods with *Acer* and *Rumex arifolius*; *9150 Medio-European limestone beech forests of the *Cephalanthero-Fagion*; *9410 Acidophilous *Picea* forests of the montane to alpine levels; *9420 Alpine *Larix decidua* and/or *Pinus cembra* forests; *9430 Subalpine and montane *Pinus uncinata* forests; *9560 Endemic forests with *Juniperus* spp.
	Upland (700-2000)	Hay meadows, semi-natural grasslands (e.g mountain and alpine pastures), extensive permanent grassland, grazed mires, moors and heathlands, wooded pastures, stonewalls, rows of trees/shrubs, ponds, woodland patches, springs, streams	Coastal, riverside and saline habitats *3220 Alpine rivers and the herbaceous vegetation along their banks. Heath and scrub 4060 Alpine heath Grasslands 5130 Juniperus communis formations on calcareous grasslands; 6110 Ripiculous calcareous or basophilic

Environmental zone	Altitude	Features	Annex I Habitats that depend on extensive agricultural practices
			grasslands of the Alisso-Sodium albi; 6120 Xeric sand calcareous grassland; *6130 *Calaminarian* grasslands of the *Violetalia calaminariae*; 6150 Selicious alpine and boreal grasslands; 6170 Alpine calcareous grasslands; 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates; 6230 Species rich *Nardus* grasslands on silicious substrates in mountain areas; 6520 Mountain hay meadows; 6430 *Hydrophilous* tall herb fringe communities of montane to alpine levels. <u>Bogs, mires and fens</u> *7120 Degraded raised bogs still capable of natural regeneration; 7140 Transition mires and quaking bogs; *7240 Alpine pioneer formations of *Caricion bicoloris-atrofuscae.* <u>Forests</u> *9130 *Asperulo-Fagetum* beech forests; *9140 Medio-European subalpine beech woods with *Acer* and *Rumex arifolius*; *9150 Medio-European limestone beech forests of the *Cephalanthero-Fagion*; *91KO Illyrian *Fagus sylvatica* forests (*Aremonio-Fagion*); *9560 Endemic forests with *Juniperus* spp.
Lusitanian	Lowland (0-600)	Hay meadows, semi-natural grasslands, extensive permanent grasslands, garrigue, maquis, wooded hay meadows, wooded pastures, grazed salt meadows, rows of trees, vegetated margins, terrace boundaries, hedges, ponds, pools individual trees	<u>Coastal, riverside and saline habitats</u> 2130 Fixed coastal dunes with herbaceous vegetation; 2150 Atlantic decalcified fixed dunes; 2330 Inland dunes with open C*orynephorus* and *Agrostis* grasslands. <u>Heath and scrub</u> 4020 Temperate Atlantic wet heath with *Erica caliaris* and *Erica tetralix;* 4030 European dry heath; 4040 Dry Atlantic coastal heath with *Erica vagans*; 4090 Endemic oro-mediterranean heath with gorse; 5120 Mountain *Cystus purgans* formations. <u>Grasslands</u> 5130 *Juniperus communis* formations on calcareous grasslands; 6110 *Ripiculous* calcareous or basophilic grasslands of the *Alisso-Sodium albi;*

Environmental zone	Altitude	Features	Annex I Habitats that depend on extensive agricultural practices
			6120 Xeric sand calcareous grassland; 6140 Selicious Pyrenean *Festuka eskia* grasslands; 6160 Oro-Iberian *Festuca indigesta* grasslands; 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates; 6410 Molinia meadows on calcareous or peaty soils; 6420 Mediterranean tall humid grasslands of the *Molinio Holoschoenion;* 6430 Eutrophic tall herbs; 6440 Alluvial meadows of river valleys; 6510 Lowland hay meadows; 6440 Alluvial meadows of river valleys. <u>Bogs, mires and fens</u> *7120 Degraded raised bogs still capable of natural regeneration; *7130 Blanket bogs. <u>Forests</u> *9130 *Asperulo-Fagetum* beech forests; *9140 Medio-European subalpine beech woods with *Acer* and *Rumex arifolius*; *9150 Medio-European limestone beech forests of the *Cephalanthero-Fagion*; **9230 Galicio-Portuguese* oak woods with *Quercus robur* and *Quercus pyrenaica*; *9560 Endemic forests with *Juniperus* spp.
	Upland (600+)	Semi-natural grasslands (e.g. mountain pastures), extensive permanent grasslands, rows of trees, vegetated margins, individual trees	<u>Coastal, riverside and saline habitats</u> *3220 Alpine rivers and the herbaceous vegetation along their banks <u>Heath and scrub</u> 4020 Temperate Atlantic wet heath with *Erica caliaris* and Erica tetralix; 4030 European dry heath; 4060 Alpine heath 4090 Endemic oro-mediterranean heath with gorse; 5120 Mountain *Cystus purgans* formations. <u>Grasslands</u> 5130 *Juniperus communis* formations on heath or calcareous grasslands; 6110 *Ripiculous* calcareous or basophilic grasslands of the *Alisso-Sodium albi;* 6120 Xeric sand calcareous grassland; 6140 Selicious Pyrenean *Festuka eskia*

Environmental zone	Altitude	Features	Annex I Habitats that depend on extensive agricultural practices
			grasslands; 6160 Oro-Iberian *Festuca indigesta* grasslands; 6170 Alpine calcareous grasslands; 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates; 6230 Species rich *Nardus* grasslands on silicious substrates in mountain areas; 6430 Eutrophic tall herbs; 6440 Alluvial meadows of river valleys. <u>Bogs, mires and fens</u> *7120 Degraded raised bogs still capable of natural regeneration; *7130 Blanket bogs. <u>Forests</u> *9130 *Asperulo-Fagetum* beech forests 89140 Medio-European subalpine beech woods with *Acer* and *Rumex arifolius*; *9150 Medio-European limestone beech forests of the *Cephalanthero-Fagion*; **9230 Galicio-Portuguese* oak woods with *Quercus robur* and *Quercus pyrenaica*; *9560 Endemic forests with *Juniperus* spp.
Mediterranean North	Lowland (0-600)	Hay meadows, semi-natural grasslands, extensive permanent grasslands, garrigue, maquis, deheas, montados, traditional olive groves, stonewalls, rows of trees, vegetated margins, terrace boundaries	<u>Coastal, riverside and saline habitats</u> *1520 Iberian gypsum steppes <u>Heath and scrub</u> 4090 Endemic oro-mediterranean heath with gorse; *5210 Arborescent matorral with *Juniperus* spp. <u>Grasslands</u> 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates; 6220 Pseudo-steppes with grasses and annuals of the *Thero-Brachipodietea;* 5420 *Sarcopoterium spinosum phraganas*; 5430 Endemic *Phryganas* of the *Euphorbio-Verbascion*; 6120 Xeric sand calcareous grassland; 6160 Oro-Iberian *Festuca indigesta* grasslands; 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates; 6220 Pseudo-steppes with grasses and annuals of the *Thero-Brachipodietea;* 62A0 Eastern sub-Mediterranean dry grasslands 6420 Mediterranean tall humid grasslands

Environmental zone	Altitude	Features	Annex I Habitats that depend on extensive agricultural practices
			of the *Molinio Holoschoenion;* 6430 Eutrophic tall herbs; 6440 Alluvial meadows of river valleys; 6510 Lowland hay meadows; 6310 *Sclerophellous* grazed forests (Dehesas) with evergreen *Quercus suber* and/or *Quercus ilex*; <u>Forests</u> 9540 Mediterranean pine forests with endemic *Mesogean* Pines; **9230 Galicio-Portuguese* oak woods with *Quercus robur* and *Quercus pyrenaica* **9330 Quercus suber* forests *9340 *Quercus ilex* and *Quercus rotundifolia* forests *9560 Endemic forests with *Juniperus* spp.
	Upland (600+)	Semi-natural grasslands (e.g. mountain pastures), extensive permanent grasslands, stonewalls, rows of trees, vegetated margins, terrace boundaries, individual trees	<u>Heath and scrub</u> 4090 Endemic oro-mediterranean heath with gorse; 5120 Mountain *Cystus purgans* formations; 5130 *Juniperus communis* formations on heath or calcareous grasslands; *5210 *Arborescent* matorral with *Juniperus* spp. 5420 *Sarcopoterium spinosum phraganas*; 5430 Endemic *phryganas* of the *Euphorbio-Verbascion;* <u>Grasslands</u> 6120 Xeric sand calcareous grassland; 6140 Selicious Pyrenean *Festuka eskia* grasslands; 6160 Oro-Iberian *Festuca indigesta* grasslands; 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates; 62A0 Eastern sub-Mediterranean dry grasslands 6420 Mediterranean tall humid grasslands of the *Molinio Holoschoenion;* 6430 Hydrophilous tall herb fringe communities of montane to alpine levels; 6440 Alluvial meadows of river valleys; 6520 Mountain hay meadows; <u>Bogs, mires and fens</u> 8240 Limestone pavements; <u>Forests</u> 9540 Mediterranean pine forests with endemic Mesogean Pines; **9230 Galicio-Portuguese* oak woods with *Quercus robur* and

Environmental zone	Altitude	Features	Annex I Habitats that depend on extensive agricultural practices
			Quercus pyrenaica *9560 Endemic forests with *Juniperus* spp.
Mediterranean Mountains	Lowland (0-600)	Hay meadows, semi-natural grasslands, extensive permanent grasslands, garrigue, maquis, deheas, montados, traditional olive groves, stonewalls, rows of trees, vegetated margins, terrace boundaries	<u>Coastal, riverside and saline habitats</u> 1340 Inland salt meadows; *1520 Iberian gypsum steppes <u>Heath and scrub</u> 4090 Endemic oro-mediterranean heath with gorse; *5210 Arborescent matorral with *Juniperus* spp. <u>Grasslands</u> 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates; 6220 Pseudo-steppes with grasses and annuals of the Thero-Brachipodietea; 5130 Juniperus communis formations on heath or calcareous grasslands; 5420 *Sarcopoterium spinosum phraganas;* 5430 Endemic *Phryganas* of the *Euphorbio-Verbascion*; 6120 Xeric sand calcareous grassland; 6160 Oro-Iberian Festuca indigesta grasslands; 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates; 6220 Pseudo-steppes with grasses and annuals of the *Thero-Brachipodietea;* 62A0 Eastern sub-Mediterranean dry grasslands 6430 Eutrophic tall herbs; 6440 Alluvial meadows of river valleys; 6310 Sclerophellous grazed forests (Dehesas) with evergreen *Quercus suber* and/or *Quercus ilex*; 6420 Mediterranean tall humid grasslands of the *Molinio Holoschoenion.* <u>Forests</u> 9540 Mediterranean pine forests with endemic *Mesogean* Pines; **9230 Galicio-Portuguese* oak woods with *Quercus robur* and *Quercus pyrenaica* **9330 Quercus suber* forests *9340 *Quercus ilex* and *Quercus rotundifolia* forests *9560 Endemic forests with *Juniperus* spp.
	Upland (600+)	Semi-natural grasslands (e.g. mountain pastures), extensive permanent grasslands,	<u>Heath and scrub</u> 4090 Endemic oro-mediterranean heath with gorse; 5120 Mountain *Cystus purgans* formations.

Environmental zone	Altitude	Features	Annex I Habitats that depend on extensive agricultural practices
		stonewalls, rows of trees, vegetated margins, terrace boundaries, individual trees	<u>Grasslands</u> 6120 Xeric sand calcareous grassland; 6140 Selicious Pyrenean *Festuka eskia* grasslands; 6160 Oro-Iberian *Festuca indigesta* grasslands; 6170 Alpine calcareous grasslands; 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates; 62A0 Eastern sub-Mediterranean dry grasslands; 6430 Eutrophic tall herbs; 6440 Alluvial meadows of river valleys; 6520 Mountain hay meadows; 6420 Mediterranean tall humid grasslands of the *Molinio Holoschoenion.* <u>Forests</u> 9540 Mediterranean pine forests with endemic Mesogean Pines; **9230 Galicio-Portuguese* oak woods with *Quercus robur* and *Quercus pyrenaica* *9560 Endemic forests with *Juniperus* spp.
Mediterranean South	Lowland (0-700)	Semi-natural grasslands, extensive permanent grasslands, garrigue, maquis, dehesa, montado, traditional olive groves, stonewalls, rows of trees, vegetated margins, terrace boundaries	<u>Coastal, riverside and saline habitats</u> 1340 Inland salt meadows; *1520 Iberian gypsum steppes. <u>Heath and scrub</u> 4090 Endemic oro-mediterranean heath with gorse; 5210 Arborescent matorral with *Juniperus* spp; 5420 *Sarcopoterium spinosum phraganas*; 5430 Endemic *phryganas* of the *Euphorbio-Verbascion*. <u>Grasslands</u> 6120 Xeric sand calcareous grassland; 6160 Oro-Iberian *Festuca indigesta* grasslands; 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates; 6220 Pseudo-steppes with grasses and annuals of the *Thero-Brachipodietea;* 62A0 Eastern sub-Mediterranean dry grasslands 6310 Sclerophellous grazed forests (Dehesas) with evergreen *Quercus suber* and/or *Quercus ilex*; 6420 Mediterranean tall humid grasslands of the *Molinio Holoschoenion;* 6430 Eutrophic tall herbs; 6440 Alluvial meadows of river valleys.

Environmental zone	Altitude	Features	Annex I Habitats that depend on extensive agricultural practices
			<u>Forests</u> 9540 Mediterranean pine forests with endemic *Mesogean* Pines; **9330 Quercus suber* forests; *9340 *Quercus ilex* and *Quercus rotundifolia* forests; *9560 Endemic forests with *Juniperus* spp.
	Upland (700+)	Semi-natural grasslands (e.g. mountain pastures), extensive permanent grasslands, stonewalls, rows of trees, vegetated margins, terrace boundaries, individual trees	<u>Heath and scrub</u> 4090 Endemic oro-mediterranean heath with gorse; 5120 Mountain *Cystus purgans* formations; *5210 Arborescent matorral with *Juniperus* spp. <u>Grasslands</u> 6120 Xeric sand calcareous grassland; 6160 Oro-Iberian *Festuca indigesta* grasslands; 6170 Alpine calcareous grasslands; 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates; 62A0 Eastern sub-Mediterranean dry grasslands; 6420 Mediterranean tall humid grasslands of the Molinio Holoschoenion; 6430 Eutrophic tall herbs; 6440 Alluvial meadows of river valleys; <u>Bogs, mires and fens</u> 8240 Limestone pavements; <u>Forests</u> *9520 *Abies pinsapo* forests; *9540 Mediterranean pine forests with endemic *Mesogean* Pines; *9560 Endemic forests with *Juniperus* spp.

Annex 4 Farmland Species of European Conservation Concern.

European Farmland Bird Species

Bird species indicators of the quality of HNV Farmland can be drawn from the following list of 119 European farmland bird species. They are either species of conservation concern or those species that occur in large abundances[29].

Scientific Name	Common Name
Accipiter brevipes	Levant Sparrowhawk
Acrocephalus paludicola	Aquatic Warbler
Aegypius monachus	Cinereous Vulture
Alauda arvensis	Eurasian Skylark
Alectoris chukar	Chukar
Alectoris rufa	Red-legged Partridge
Anas querquedula	Garganey
Anser albifrons	Greater White-fronted Goose
Anser anser	Greylag Goose
Anser brachyrhynchus	Pink-footed Goose
Anser erythropus	Lesser White-fronted Goose
Anser fabalis	Bean Goose
Anthus campestris	Tawny Pipit
Aquila adalberti	Spanish Imperial Eagle
Aquila clanga	Greater Spotted Eagle
Aquila heliaca	Imperial Eagle
Aquila pomarina	Lesser Spotted Eagle
Asio flammeus	Short-eared Owl
Athene noctua	Little Owl
Branta bernicla	Brent Goose
Branta leucopsis	Barnacle Goose
Branta ruficollis	Red-breasted Goose
Bucanetes githagineus	Trumpeter Finch
Burhinus oedicnemus	Eurasian Thick-knee
Buteo rufinus	Long-legged Buzzard
Calandrella brachydactyla	Greater Short-toed Lark
Calandrella rufescens	Lesser Short-toed Lark
Carduelis cannabina	Eurasian Linnet
Carduelis flavirostris	Twite
Chersophilus duponti	Dupont's Lark
Chlamydotis undulata	Houbara Bustard
Ciconia ciconia	White Stork

[29] This list was drawn up by the JRC/EEA for use in their mapping approach of HNV Farmland areas (Paracchini *et al*., 2006). The contributions of Birdlife International are acknowledged. An initial list of 75 farmland bird species was derived from Birdlife International's 'Birds in Europe' (2004). Following a consultation exercise with the Member States carried out by the EEA in the second half of 2006, this list was revised. The final list was produced in April 2007.

Circaetus gallicus	Short-toed Snake-eagle
Circus cyaneus	Northern Harrier
Circus pygargus	Montagu's Harrier
Columba oenas	Stock Pigeon
Coracias garrulus	European Roller
Corvus frugilegus	Rook
Corvus monedula	Eurasian Jackdaw
Coturnix coturnix	Common Quail
Crex crex	Corncrake
Cursorius cursor	Cream-coloured Courser
Cygnus columbianus	Tundra Swan
Cygnus cygnus	Whooper Swan
Cygnus olor	Mute Swan
Dendrocopos syriacus	Syrian Woodpecker
Elanus caeruleus	Black-winged Kite
Emberiza cirlus	Cirl Bunting
Emberiza citrinella	Yellowhammer
Emberiza hortulana	Ortolan Bunting
Emberiza melanocephala	Black-headed Bunting
Emberiza schoeniclus	Reed Bunting
Erythropygia galactotes	Rufous-tailed Scrub-robin
Falco biarmicus	Lanner Falcon
Falco cherrug	Saker Falcon
Falco naumanni	Lesser Kestrel
Falco tinnunculus	Common Kestrel
Falco vespertinus	Red-footed Falcon
Francolinus francolinus	Black Francolin
Galerida cristata	Crested Lark
Galerida theklae	Thekla Lark
Gallinago gallinago	Common Snipe
Gallinago media	Great Snipe
Glareola pratincola	Collared Pratincole
Grus grus	Common Crane
Gyps fulvus	Eurasian Griffon
Haematopus ostralegus	Eurasian Oystercatcher
Hieraaetus fasciatus	Bonelli's Eagle
Hieraaetus pennatus	Booted Eagle
Hippolais olivetorum	Olive-tree Warbler
Hippolais pallida	Olivaceous Warbler
Hirundo rustica	Barn Swallow
Jynx torquilla	Eurasian Wryneck
Lanius collurio	Red-backed Shrike
Lanius excubitor	Great Grey Shrike
Lanius minor	Lesser Grey Shrike
Lanius nubicus	Masked Shrike
Lanius senator	Woodchat Shrike
Limosa limosa	Black-tailed Godwit
Locustella fluviatilis	Eurasian River Warbler
Locustella naevia	Common Grasshopper-warbler

Lullula arborea	Wood Lark
Melanocorypha calandra	Calandra Lark
Merops apiaster	European Bee-eater
Miliaria calandra	Corn Bunting
Milvus migrans	Black Kite
Milvus milvus	Red Kite
Motacilla flava	Yellow Wagtail
Neophron percnopterus	Egyptian Vulture
Numenius arquata	Eurasian Curlew
Nycticorax nycticorax	Black-crowned Night-heron
Oenanthe hispanica	Black-eared Wheatear
Oenanthe oenanthe	Northern Wheatear
Otis tarda	Great Bustard
Otus scops	Common Scops-owl
Passer montanus	Eurasian Tree Sparrow
Perdix perdix	Grey Partridge
Philomachus pugnax	Ruff
Picus viridis	Eurasian Green Woodpecker
Pluvialis apricaria	Eurasian Golden-plover
Porzana porzana	Spotted Crake
Pterocles alchata	Pin-tailed Sandgrouse
Pterocles orientalis	Black-bellied Sandgrouse
Pyrrhocorax pyrrhocorax	Red-billed Chough
Saxicola rubetra	Whinchat
Saxicola torquata	Common Stonechat
Serinus canaria	Island Canary
Streptopelia turtur	European Turtle-dove
Sylvia communis	Common Whitethroat
Sylvia hortensis	Orphean Warbler
Sylvia nisoria	Barred Warbler
Tetrao tetrix	Black Grouse
Tetrax tetrax	Little Bustard
Tringa totanus	Common Redshank
Turdus iliacus	Redwing
Turdus pilaris	Fieldfare
Tyto alba	Barn Owl
Upupa epops	Eurasian Hoopoe
Vanellus vanellus	Northern Lapwing

European Farmland Butterfly Species

The following butterfly species are considered indicators of HNV Farmland habitats and are either species of conservation concern or are present in high abundance in these habitats[30].

Alpine Grassland
Erebia calcaria
Erebia Christi
Erebia sudetica
Parnassius apollo
Polyommatus golgus

Dry Grassland
Argynnis elisa
Erebia epistygne
Hipparchia azorina
Hipparchia miguelensis
Hipparchia occidentalis
Lycaena ottomanus
Maculinea arion
Maculinea rebeli
Melanargia arge
Papilio hospiton
Plebeius hespericus
Plebeius trappi
Polyommatus dama
Polyommatus galloi
Polyommatus humedasae
Pseudochazara euxina
Pyrgus cirsii

Humid Grassland
Coenonympha hero
Coenonympha oedippus
Euphydryas aurinia
Maculinea nausithous
Maculinea teleius

Note: Woodland species were not included in the list.

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[30] This list was drawn up the EEA/JRC in their mapping approach of HNV Farmland areas (Paracchini *et al.,* 2006) using Van Swaay, C. and Warren, M. (2003), 'Prime Butterfly Areas in Europe: Priority Sites for Conservation', Wageningen, The Netherlands. The contributions of De Vlinderstichting (Wageningen) are also acknowledged. The final list has been revised following consultation with the Member States.

Annex 5 Examples of National Forest Inventories in the EU-27

The table was compiled using data from the COST Action E27 Protected Forest Areas in Europe-Analysis and Harmonisation (PROFOR) project country report supported by the EU RTD Framework Programme.[31]

Country	Name of Inventory	Recorded Data	Reference Area	Spatial Data (linked to GIS?)	Date of First Survey	Frequency of Repeat Survey
Austria	Austrian Forest Inventory	Forest area, management methods, growing stock (volume), age, damages, forest grazing, altitude, slope gradient, soil categories, ground vegetation types, woody species, deadwood, regeneration, natural woodland community.	Countrywide	Sample grid pattern with 5500 systematically distributed tracts across Austria. Each tract contains four clustered sampling plots of $300m^2$, each invisibly fixed by an iron tube. Standing trees are assessed by a Bitterlich plot with the same centre as the sampling plots.	1961-70	1961-1980 10 years 1981-1996 5 years 2000+ not known exactly
Belgium	Regional Inventories of woody resources	Dendrometric data on living and dead trees and herbaceous vegetation survey	Countrywide	Systematic inventory along a fixed grid of 1000m x 500 m (14,000 survey plots for whole country). Database MS Access	1994 (Wallonia) 1997-1999 (Flanders)	10 years
Bulgaria	Management Plans		National Parks Nature Parks	GIS methods	1997 1980	10 years 10 years

[31] Frank, G., Parviainen, J., Vandekerhove, K., Latham, J., Schuck, A., Little D., (Editors), 2007: COST Action E27 Protected Forest Areas in Europe – Analysis and Harmonisation (PROFOR): Results, Conclusions and Recommendations. Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW). Vienna, Austria

Country	Name of Inventory	Recorded Data	Reference Area	Spatial Data (linked to GIS?)	Date of First Survey	Frequency of Repeat Survey
Cyprus	Continuous Forest Inventory	Annual increment, growing stocks, yield, regeneration, main plant species	Productive State Forests	Not linked to GIS	1981-1982	10 years
	Continuous Forest Inventory	Number of cedar and pine trees. Existing shrubs and their abundance	Tripylos Nature Reserve	Not linked to GIS	1998-1999	10 years
Czech Republic	Forest management plans	Tree composition, timber volume, stocking etc.	All forests	GIS	1947	10
	Regional plans of forest development	Forest typology, health condition, production capacity etc.	All forests	GIS	1998-2002	20
	Forest Inventory of Czech Republic	Soils, herb layer, shrub layer, tree layer etc.	All forests	GIS	2001-2004	?
Denmark	National Forest Resources Assessment	Areas, species, ages	Countrywide	Partly, municipality level	1881-2000	Approx. 10 years
	National Forest Inventory	Area, growing stock, biodiversity etc.	Countrywide	GIS	2002-2006	Continuous after 5 years
	Forest Health Monitoring	Growing stock, health, soil and climate, biodiversity	Countrywide	GIS	1986	Annual
	Key-habitat	Small habitats, species	Restricted biotopes	GIS	2000	Not planned
	Oak-habitat	Area, condition	Restricted biotopes	GIS	2000	Not planned
Finland	National Forest Inventory	Stand level data: land use, soil, tree storeys, treatments, important habitats On the plots measured: living trees, dead trees	Countrywide	GIS	1921-1924	8-10 years, since 2004 every year.
	Network of 3000 permanent sample plots	Stand level data: land use, soil, tree storeys, and treatments.	Countrywide	GIS	1985-1986	5-10 years, remeasured 1990-1995

Country	Name of Inventory	Recorded Data	Reference Area	Spatial Data (linked to GIS?)	Date of First Survey	Frequency of Repeat Survey
		Sample plots: tree measurements, deadwood, vegetation survey. Other: samples of soil and humus layer, samples for heavy metal research.				
	Landscape Ecological Planning	Land use, important habitats, threatened species, data on biodiversity indicator species, deadwood, data on living trees.	State owned lands managed by Metsahallitus	GIS	1996-2000	Continual updating
	Forest Management Planning	Stand level inventory assessment of: Soil, tree storey structure, growing stock, important habitats, deadwood	Private land	GIS		10-15 years
France	Terruti annual survey	Land cover and uses	Countrywide	Annual observation of 556,000 points from aerial photographs.	-	Annual
	National Forest Inventory	Vegetation types, dendrometric data, floristic and ecological features	Countrywide	GIS	-	10 years
Germany	Federal forest inventories	Ownership, tree species, silvicultural systems, standing volume. Second inventory (2000-2004) contains ecological parameters e.g.		Sample plots 4 x 4 km, 2.83 x 2.83 km or 2 x 2 km.	1986-1990	

Country	Name of Inventory	Recorded Data	Reference Area	Spatial Data (linked to GIS?)	Date of First Survey	Frequency of Repeat Survey
		potential natural forest vegetation, deadwood, degree of naturalness.				
	Nationwide forest damage survey	Degree to which tree crowns are defoliated and discoloured (crown condition assessment)		Sample plot density 16 x 16 km.	1984	
	Nationwide forest soil inventory	Investigate current condition of forest soils, changes in soil chemical properties, conservation status of soil.			1987-1993	
Greece	National Forest Inventory	Forest area, forest species, forest structure, volume increment, regeneration, wood production	Countrywide	-	1963-1989	-
	Hydrological atlas of Greece	Hydrological basins	Countrywide	-	1972	-
	Forest soil survey	Soil types, depth, aspect, inclination, erosion, ecological area.	Countrywide	-	1977-2000	-
Ireland	National inventory	State owned and private forests	Countrywide	-	1986-1973	Repeated 2004 (see National Forest Inventory)
	Coillte inventory	State owned forests	Coillte property (state owned land)	Yes	1970s	Ongoing
	Old Woodland Survey	Old woodlands, based on 1830 OS maps	Countrywide	Yes – all Coillte foresters	-	Once off desk top survey
	Forest Service Inventory System	20 broad species & maturity categories for all forests ≥ 0.2ha area. Information on location and extent	Countrywide	To forest inspectors	On and before 1997	Repeat inventory of forest estate in 2004
	National Forest	Forest resource criteria – timber	Countrywide	-	2004	Every 5 -10 years

Country	Name of Inventory	Recorded Data	Reference Area	Spatial Data (linked to GIS?)	Date of First Survey	Frequency of Repeat Survey
	Inventory	measurements, biodiversity, forest health				
	National survey of Native Woodland in Ireland	Native woodlands – location, size, ownership, protection etc.	Countrywide	-	Ongoing	Ongoing
Italy	National Forest Inventory		Countrywide	-	1985	-
	Regional Forest Inventories		Carried out in each region	-	Varies across regions	-
Lithuania	National Forest Inventory	Condition of forests, harvesting, regeneration, volume of growing stock, mortality increment, balance and structure.	All forests	No separate plans, sample plots are related with GIS. Use satellite maps and aerial photos.	1996	5 years
	Stand wise forest inventory	Stands are singled out, their quantitative and qualitative characteristics are provided, forest health is assessed and silvicultural measures foreseen	All forests	Based on ortho-photographic plans related with GIS	1816	10-15 years
Netherlands	Sample 4th National Forest inventory 1985	Standing (dead or living) wood volume, growth, vegetation and site	Countrywide	Digital (ORACLE database)	1983-1985	Followed up by MFV
	Meetnet FunctieVervulling Bos 2000 (MFV)	Standing/lying volume, dead or living, vegetation type, soil type, site description	Countrywide, all forested land	Digital (ORACLE database)	2000-2004	Rounds of 10 years, next period probably 2008-2012
	Staatsbosbeheer spoor12	Vegetation map, number of animals/birds/species	Countrywide; applied to management regimes of areas under State Forest Service management	Digital	2000	Annual

Country	Name of Inventory	Recorded Data	Reference Area	Spatial Data (linked to GIS?)	Date of First Survey	Frequency of Repeat Survey
Poland	National Forest Inventory	Standwise taxation of forest resources including non timber forest products	Countrywide, all non-agricultural land	GIS linked	1921	10 years
	Monitoring of Forests	Defoliation, discolouration of crowns, forest floor vegetation, forest regeneration, soil chemistry, leaf/needle chemistry, health of pine seeds, pollutant deposition, entomological and phytopathological monitoring	State forests	Spatial data linked to GIS	1989	1-5 years
	Monitoring of Nature	Habitat types, protection status, Natura 2000 sites and indicators, wetland areas, herbaceous vegetation, lichens, fungi, Red List species, forest regeneration, soil chemistry, leaf/needle chemistry	National Parks	Spatial data linked to GIS	2000	5 years
Portugal	National Forest Inventory	Area, distribution, volumes, wood production, stand structure, forest condition	All forests	Aerial photography used with GIS	1965-66	
Romania	Forest management planning studies	Owner, area, functional zoning classification, site conditions, composition, species, species mixture, density, degree of naturalness, ground	National forest fund	Field observations and measurements	1950-1956	10 years

Country	Name of Inventory	Recorded Data	Reference Area	Spatial Data (linked to GIS?)	Date of First Survey	Frequency of Repeat Survey
		vegetation type, shrub species, state of regeneration, erosion, protection state				
Slovenia	Forest Inventory	Forest stand parameters, site parameters, forest function.	All Forest Management Units	Different GIS layers (stands, functions, compartment s etc.)	Late 1940s	10 years
Spain	National Forest Inventory	Description of wooded land	Countrywide	There are maps linked to GIS	1966	10 years
	Spain's Forest Map	Description of forest vegetation	Countrywide	There are maps linked to GIS	1990	10 years
	Protected Natural Sites Database	Description of PNAs legal status	Countrywide	-	1993	Yearly
Sweden	National Forest Inventory	Plotwise taxation of forest resources including non-timber forest products	Countrywide all land classes and all owner categories.	Linked to GIS	1923	5 years
	Swamp Forest Inventory	Land class hydrology, forest measures, vegetation data, tree storey data, forest continuity, deadwood.	Countrywide, swamp forests.	Linked to GIS	1982	Continuously updated
	The Swedish Woodland Key Habitat Survey	Stand history, current stand structure, occurrence of signal species and red listed species	Countrywide, privately owned land.	Linked to GIS	1993-1998	Sample of design at key biotopes were resurveyed starting in 2000.
	Old growth forest inventory	Forest age, continuity	Countrywide	Not linked to GIS	1978-1982	None
United Kingdom	National Inventory of Woodland and Trees	Area of forest greater than 2 ha categorised in to 'conifer', 'broadleaved', 'mixed' and minor types. 1% ground sample for structural and management	Great Britain	Linked to GIS	2000	5 years, yet to be agreed.

Country	Name of Inventory	Recorded Data	Reference Area	Spatial Data (linked to GIS?)	Date of First Survey	Frequency of Repeat Survey
		information				
	Ancient Woodland Habitats	Areas of woodland >2ha suspected to have been in existence since AD 1600 and coded as semi-natural, replanted (with non-native species) and cleared.	Great Britain	Held on GIS, but background information on paper maps only.	-	-
	Scottish Semi-natural Woodland Inventory	Semi-natural woodland type, condition and structure	Scotland	Linked to GIS	1990s	None set
	Phase 1 habitats survey	All semi natural habitats >0.2 ha including forests (distinguished as conifer, broadleaved, plantation etc.)	Wales	Linked to GIS	1985-1995	None set

Annex 6 Traditional Agricultural Landscapes and their Relationship with HNV Farming

Introduction

This chapter defines traditional agricultural landscapes in Europe in their broadest sense and considers, more specifically, those TALs which incorporate HNV farmland. Criteria to identify the entirety of traditional agricultural landscapes are presented.

Landscapes as an over arching concept

The term 'Landschaft/Landschap' originated in Germany and Holland, and gradually became used in Britain, to indicate the horizontal and oblique views of the countryside, synonymous with the English 'scenery'. In Germany and Holland 'Landschaft' had a wider meaning than the English version, namely the 'total character of an Earth district'. This is also reflected in more recent holistic approaches addressing the interaction between cultural and natural processes (Messerli, 1978; Grossmann, 1983).

The following definition of landscapes has been proposed:

> "Landscapes are spatial entities where characteristics, processes and functions are determined by a complex and often region-specific interaction between natural and cultural factors that are driven by socio-economic and environmental forces" (Wascher, 2004).

Agricultural landscapes are not homogeneous across regions or countries. This is because agricultural production relies upon location specific natural conditions including climate, soils, water, and different forms of land management. Agricultural production and activities hence create heterogeneous agricultural landscapes. This heterogeneity includes varieties of agricultural landscapes where land is being managed both in traditional and non-traditional, or 'modern', ways.

In order to define traditional agricultural landscapes, it is important to understand them in relation to which landscapes are excluded by this term, in other words, to examine what constitutes a 'modern agricultural landscape'. Henle *et al.* (2003) define modern agriculture as:

> "The modern form of agriculture is particularly characterised by its striving to achieve the largest possible short term profit on the available area and is typified by a minimisation of labour input through the use of a wide range of machines on cleared, agricultural areas with resulting negative ecological effects."

However, not all forms of modern agriculture have detrimental effects on the environment. Similarly, the landscapes produced by modern agriculture are not necessarily more environmentally degraded than other agricultural landscapes. One example of the potentially beneficial effects of modern agriculture can be seen in the emerging new technology of 'precision farming' which combines remote sensing information retrieved from satellites with robot operated farm management devices. This new technology, though not completely compatible with small scale mosaic landscape patterns, is considered to support the integration of environmental quality goals into technology driven forms of land use (Werner *et al*., 2005).

In order to strengthen the link between agricultural and cultural heritage, the FAO launched the Globally Important Agriculture Heritage Systems (GIAHS) initiative in 2002, a global programme for conservation and adaptive management of indigenous farming systems, with the support of the Global Environment Fund (GEF), UNDP and UNESCO.

Definition of Traditional Agricultural Landscapes

Forms of traditional agriculture can exhibit rather small local or regional variations and undergo developments that reflect both technological as well as political changes. Such developments are often considered as linear processes leading from extensive to intensive forms of farming, whereas in reality, different forms of farm management often co exist, sometimes on the same holding.

Analysing the Common Agricultural Policy, Bruckmeier (2001) points out that: "Traditional forms of agricultural production, although technically and economically less efficient, become positively valued for their environmentally beneficial and animal welfare promoting production methods." However, the author also admits that traditional agriculture is "only vaguely defined in terms of its ecological adaptation to local conditions of production" and cautions against a too one dimensional interpretation of the situation:

> "Traditional forms of agriculture, which are particularly important in the implementation of agri environmental measures in southern Europe, cannot be seen simply as forms of production or ecologically sound technologies, as they are just part of larger systems which require specific economic and socio cultural structures and institutions in order to remain viable."

The view that traditional agriculture is not synonymous with environmentally beneficial forms of land management has also been confirmed by a recently compiled typology of traditional farming systems in Spain which included a number of intensive agricultural systems (Viladomiu, 2005). This study illustrated that traditional farming can be intensive; that the notion of what is 'traditional' is culturally and geographically sensitive; and that even extensive agricultural systems that are managed in traditional ways are not necessarily of high nature value.

It is also important to realise that traditional farming has passed through different phases and forms over time with dynamic changes occurring to the landscape. As such, traditional landscapes are not static entities, they evolve over time. This defies the idea that a certain point in time could be used as the division between traditional and modern agriculture which is common to the different geographical conditions across Europe. As such, any definition of what constitutes traditional farming will require the identification of the most appropriate phase for a given region.

In essence, identifying forms of traditional farming needs to take into account: the historical origins of traditional farming; the spatial dimension in terms of where different types of farming traditionally belong; and the particular attributes of traditional farming. These attributes and characteristics are identified in the definition proposed below which has been developed within the frame of this study.

> "Traditional Agricultural Landscapes in Europe are typically derived from historic - frequently family and/or subsistence-style - farming methods where the dominant cultural landscape characteristics are the result of a traditional or locally adapted approach to management. These farming systems are characterised by the presence of features, whose distribution will be regionally and/or locally specific, which contribute to the landscape's aesthetic qualities as well as to supporting its ecological integrity."

The GIAHS initiative of the FAO has identified a number of TALs in Europe:

- **Lemon Gardens (Southern Italy)**

  The "lemon gardens ("giardini di limoni"), in the Italian southern peninsula sorrentina-amalfitana, are an outstanding example of how an agricultural landscape characterises a complete geographical area. Lemon pergolas, chestnut windbreaks, "pagliarelle" (terraces incorporated in containment walls) and narrow footpaths have been built, and preserved, over centuries to guarantee the conservation of local lemon varieties (*Citrus limonum* spp.). By occupying even the steepest slopes, their presence has protected the territory and contributed to preserving the soil from hydrogeological instability. In addition, it has created a beautiful coastal landscape.

- **Traditional Agro-Ecosystems in the Carpathians (Slovakia)**

  The Carpathian region is a refuge for original agro-ecosystems, traditional knowledge and customs of the people of central and eastern Europe. Over centuries, the interaction of nature and humanity in the Carpathian region have resulted in a landscape both rich in domesticated and wild species and habitats. The traditional agro-ecosystems of this region are high in genetic biodiversity and offer an opportunity to revive and use more than ten thousand landraces derived over generations from at least three hundred domesticated and introduced plant species. The mosaic like landscape that has evolved as a result is very beautiful and rich in different micro-ecological sub-systems on which highly integrated and complementary agricultural activities take place.

- **Mobile Pastoral Systems (Romania)**

  Extensive livestock production in Romania has created and maintained semi-natural grassland habitats of exceptional biodiversity. The management practices of transhumance and pendulation are adapted to, and integrated with the environment. Production is linked to seasonal cycles and the availability of forage and fodder resources. At present, few if any agro chemicals are applied to the land. Landscapes created and maintained by pastoralism are considered to be exceptionally beautiful; they generate income for the region by attracting national and international tourists.

- **The *dehesa* system of southern Spain and Portugal**

  A unique agroforestry system, named *dehesa* in Spain and *montado* in Portugal, dominates the landscape of the south western Iberian Peninsula (Joffre *et al*., 1988; San Miguel 1994; Gomez Guttierez and Perez Fernandez 1996). These systems are characterised by the presence of a savannah like open tree layer, mainly dominated by Mediterranean evergreen oaks – holm oak (*Quercus ilex*) and cork oak (*Q. suber*) – and to a lesser extent by the deciduous *Q. pyrenaica* and *Q. faginea*. These systems occupy more than 5,800,000 hectares in the western and south western provinces of Spain, representing 52 per cent of total utilised agricultural area within these provinces, and more than 50,000 hectares in southern Portugal.

- **The agro forests of the vinho verde region of Portugal**

  The agricultural landscape of north western Portugal is characterised by a pattern of small, fragmented farms that produce mainly for family consumption, interspersed with somewhat larger and more mechanised farms specialising in commercial crops. Since at least the ninth century, Portuguese peasants have developed complex farming systems, the sustainability of which has stood the test of time. These traditional agroecosystems, which consist of crop polycultures surrounded by vines (*Vitis vinifera*) upon tree hosts, reflect the priorities of peasant farmers, meeting the needs of a simple, largely self sufficient peasant society. These vineyard based agroforestry systems are found mainly in the designated regions of 'Vinho verde' including Minho and a portion of northern Beira Litoral (Stanislawski, 1970).

The interesting aspect of this list of examples is the extent to which they reflect existing overviews of cultural and traditional agricultural landscapes as well as HNV farmland areas. These examples are useful, but to consider them as exclusive or applicable throughout all European regions is unrealistic. The challenging question is whether it is possible to establish a rationale according to which traditional agricultural landscapes, such as the ones listed above, can be considered HNV or not.

Relationship between TAL and HNV Farmland and Features

Given its emphasis on 'landscapes', TAL concept is more likely to share similarities with concepts such as 'cultural landscapes', 'historic agricultural landscapes' or 'industrial landscapes' than with HNV farmland. This is mainly because they have 'landscape' as their central basis, while the concept of HNV is not concerned with landscape as such, and has a strong focus on specific types of farmland and the practices that generate them. That said, there is clearly significant overlap between TALs and HNV Farmland.

Introducing the notion of TAL in the context of HNV raises a number of conceptual considerations and specifically an exploration of the functional relationship between TAL and HNV farmland areas with regard to their characteristics, origins and spatial overlay. The three types of HNV farmland defined by Andersen *et al*. (2003) provide a useful starting point for understanding the relationship between TAL and the three types of HNV farmland.

> Type 1: Farmland with a high proportion of semi-natural vegetation.
> Type 2: Farmland with a mosaic of low intensity agriculture and natural and structural elements, such as field margins, hedgerows, stone walls, patches of woodland or scrub, small rivers etc.
> Type 3: Farmland supporting rare species or a high proportion of European or World populations.

The similarities and differences between TAL and HNV farmland can be summarised as follows:

- Extensive forms of TAL where traditional land use allows, or supports, HNV with clear similarities in terms of the principle ecological, structural and management characteristics;
- Highly or moderately intensive forms of TAL where the traditional land use is not compatible with HNV;
- Some HNV farmland, typically of Type 3, is independent of TALs and can be found in more modern agricultural landscapes.

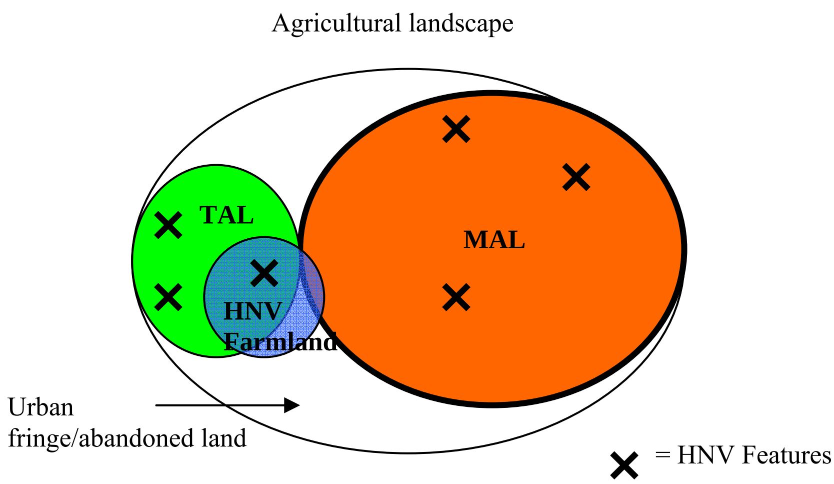

Figure VI.1 Relationship between HNV Farmland, HNV Features, TAL and MAL

Not to scale
Soucre: Wascher, 2006, after Jones, 2006

As Figure VI.1 illustrates, TAL and Modern Agricultural Landscapes (MALs) co-exist as part of the overall agricultural landscape. HNV farmland is part of each, though with much larger representation in TAL. The relationships between the three

HNV categories and modern agriculture and TAL are clearly complex. The principal relationships between the main types of agriculture can be described as follows:

- Modern Agricultural Landscapes (MALs) appear in many different forms covering various levels of land use intensity, which is mainly high, but differences can be substantial and clearly defined thresholds do not exist. The majority of MALs are low in nature value and only rarely contain HNV areas, and, to a greater extent, HNV features of non-HNV farmland, such as in the case of intensive grassland farming hosting migrating bird populations. MAL is considered to be mutually exclusive to TAL.

- There is a much greater overlap between HNV farmland and TAL, compared to HNV farmland and MAL. TALs are considered to be more closely associated with Type 2 HNV farmland than with Type 1 or Type 3.

- HNV farmland areas can be found in both MAL and TAL.

Criteria for Identifying TALs

Drawing on the definition provided of TALs, the following criteria could be used to identify and characterise them:

1. **The existence of high aesthetic and cultural values;**

2. **The pursuit of a broadly traditional or locally adapted approach to management;**

3. **The presence of features, whose distribution is regionally and/or locally specific, which contribute to the landscape's aesthetic qualities and to its ecological integrity.**

The following attributes of TALs are similar to those of HNV farmland which are analysed in the following section:

1. High proportion of on-farm semi-natural habitat types;
2. High land use and farm production complexity;
3. High farm species diversity.

In the following section, these key attributes will be further analysed.

High proportion of on farm semi-natural habitat types

The presence of semi-natural habitat types is certainly a criterion for assessing which traditional agricultural landscapes support biodiversity and are therefore likely to overlap with HNV farmland areas. The bigger the unit, the more likely it is that the habitat is present, but at the same time the habitats may be more diffusely distributed.

High land use and farm production complexity

One of the key determinants of high biological diversity in agricultural landscapes is a high level of structural complexity. Since land use patterns are closely linked to biophysical, for example, geo-morphology, and to socio-economic or production method factors, structural complexity changes with these factors over time. These changes not only address the spatial distribution, dimension and type of farm structural components, but also include the complexity of the spatial resource and energy flow systems. In the past, a high richness of agro morphological forms and patterns was characteristic of many rural landscapes. Such agricultural landscapes exhibited diverse habitat mosaics with a high proportion of edges or ecotones between different habitat types, for example, between forest to crop, crop to grassland, or pasture to meadow.

This variation offers a wide range of possible species and habitat functions, for example, for feeding, nesting, and shelter. Though structural complexity is also high in areas that have undergone major disturbances such as mining and urban or tourist development, landscape ecologists have developed techniques to identify the type of structural complexity in rural landscapes that is considered to be beneficial for biodiversity.

Though structural complexity alone is not a guarantee of favourable ecological conditions, it is commonly accepted that it is a good indicator of high biodiversity values.

Perhaps one of the simplest indicators of the state of biodiversity is the size, frequency and distribution of habitats. Such indicators can be readily linked to biodiversity conservation targets, with particularly important habitats monitored regularly, for example, by satellite based remote sensing, or by sample surveys.

The example of the land use changes observed in a farmstead in the Loisach-Kochelsee Fen area in southern Germany illustrates the shift from diverse and extensive land use patterns towards simplified, intensively managed, large field units. The land use change resulted in the disappearance of extensively managed meadows. Such habitat types are of high conservation importance because they are known to host a high level of biological diversity, often host rare or endangered species, and are threatened by human activities. These habitats include extensively managed tall herb grassland communities, riparian corridors, seasonally flooded lowlands, dry calcareous grass and heathlands, and many others. More than 20 of these habitat types are listed in the Annexes of the EC Habitats Directive (CEC, 1992), and many more are acknowledged in scientific literature.

Furthermore, and perhaps more importantly, data on the extent of a habitat does not give any information on its quality. For example, although the extent of a habitat such as wood pasture may be stable within an area, it may nevertheless be degraded by factors such as excessive grazing by livestock that results in little regeneration of trees. Information on the extent of a habitat does not offer any indication of the presence or absence of important species dependent on that habitat. In the UK, for example, many farmland birds have shown substantial declines despite relatively small changes in the extent of their arable and grassland habitats over recent decades.

To solve these limitations, biodiversity indicators must also take habitat quality and the presence of important species into account.

High Farm Species Diversity

The wide mosaic of different arable, grass and semi-natural habitats and landscape elements, such as field margins, hedges and tree lines provide a wide range of niches for different farm species to exist. Thus these landscapes are characterised by high diversity of farmland speices. For example, such landscapes offer a combination of breeding- foraging- and roosting-habitats (Vickery *et al*., 2004).

Potential Tools for Mapping TALs

Land Character Assessment (LCA) can be used for sampling environmental data, for example species, as well as re-sampling economic and social statistics in a coherent way. It also has the potential to identify TALs. The advantages of using LCA are: to establish a European wide, harmonised assessment scheme to allow comparisons between countries and regions; to improve the interpretation of indicators of spatial interactions and landscape based modelling; and to enter into an informed dialogue with a range of users, by combining environmental change with landscape characters, to more meaningful effect.

On the basis of the European wide CORINE Land Cover (CLC) programme carried out in 1990 and 2000 for more than 25 countries, the EEA is developing land use and ecosystem accounts (Weber, 2005). Changes are accounted for in terms of the land use functions of landscapes and ecosystem state, including ecosystem health or distress, ecosystem wealth (the natural capital) and ecosystem services. Results of land use accounts from the CLC programme could be used to identify areas of low land use change dynamics. Combined with information on landscape structure, for example, land cover diversity, maximum size of coherent parcel units, mosaic structures, this information could provide a first generic indication of the likely location of TALs within Europe.

Projects such as ELCAI (Wascher 2005) have documented a number of countries that have developed typologies for characterising landscapes, which vary in terms of their methodologies and objectives. While none of the current approaches make explicit use of the TAL concept, the existing international and national initiatives can be considered as potentially instrumental for future assessments of TALs in Europe. With LANMAP (Mucher *et al*. 2006), a European landscape classification exists that is adequate in terms of scale, the number and size of units, covers all relevant landscape types in the range from natural to rural to peri-urban and urban; and in methodology. It is transparent, GIS-compatible and links up with a wide span of environmental data at the European level.

The result of the identification and classification process is a European landscape typology map, the so-called LANMAP2. The map gives an overview of the spatial distribution of each criterion within Europe and is an ArcView shape file with about 14000 landscape mapping units of which more than 12000 are larger than 2500 hectares.

One of the priority tasks for the coming years will be to integrate region-specific data on cultural heritage and to populate the LANMAP database with existing European environmental information, for example, soil types, potential natural vegetation, species information, as well as policy data such as on protected area schemes and landscape legislation. If TAL with HNV farming characteristics are going to be a focus of EU policy, it can be envisaged that landscape characteristics corresponding to these characteristics will become part of the LANMAP database.

Conclusions

Reviewing the different types of agricultural landscapes and examining concepts such as indigenous and modern agricultural landscapes, the following overall definition of TAL is proposed:

> "Traditional Agricultural Landscapes in Europe are typically derived from historic - frequently family and/or subsistence-style - farming methods where the dominant cultural landscape characteristics are the result of a traditional or locally adapted approach to management. These farming systems are characterised by the presence of features, whose distribution will be regionally and/or locally specific, which contribute to the landscape's aesthetic qualities as well as to supporting its ecological integrity."

When examining the relationship between TALs and HNV, it must be concluded that: traditional farming can be intensive; the notion of what is 'traditional' is culturally and geographically-sensitive; and that even extensive agricultural systems that are managed in traditional ways are not necessarily of high nature value. Nevertheless, there are reasons to assume that relatively high proportions of HNV farmland can be associated with farming systems that are frequently related to TALs. However, a reliable scientific account of what this proportion is and its geographic location does not exist at present. Achieving this will require overall agreement on measurable characteristics of TALs, and data to support assessments and European-wide identification.

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Annex 7 Potential Data Sources for HNV Farmland indicators

The following tables detail the data available at the farm level in a sample of Member States.

Table 1 Data for HNV indicators from national Farm Structure Survey (FSS) data for selected Member States

Member State	Livestock Categories Recorded	Semi-Natural Vegetation (SNV) or Permanent Grassland (PG) Categories Recorded	FSS information
Denmark	All: pigs, poultry, dairy cattle, beef, sheep, goats and horses	Permanent grassland not in rotation	Census every 10 years and an annual sample
Finland	-	-	-
France	All: pigs, poultry, dairy cattle, beef, sheep, goats and horses		Census, every 10 years and no integration with IACS or LPIS
The Netherlands	All: pigs, poultry, dairy cattle, beef, sheep, goats and horses	3 categories of natural grassland (per parcel) are recorded: natural grassland (max 5 ton dry matter production) with 1) >75% grassland coverage; 2) 75-50% grassland coverage; 3) <50% grassland coverage.	Yearly recording because FSS is matched with IACS

Table 2 Relevant data from IACS Declarations for selected Member States

Member State	Livestock Categories Recorded	Semi-Natural Vegetation/Permanent Grassland Categories	Other Landscape Elements Recorded
Denmark	Not registered in IACS but in separate animal registry	Since 2005 the following categories: Permanent grassland, very low yield Permanent grassland, low yield Permanent grassland, normal yield Permanent grassland <50% clover, re-sown <5 years Permanent grassland >50% clover, re-sown <5 years Permanent grassland without clover, re-sown <5 years Permanent grassland and clover-grass, re-sown <5 years Permanent grassland for drying industry min. yield 6 t/ha Permanent grassland for grass layers Permanent grassland under AEP scheme pre-2003, max. 80 kg N/ha Permanent grassland under AEP scheme pre-2003, 0 kg N/ha	

Member State	Livestock Categories Recorded	Semi-Natural Vegetation/Permanent Grassland Categories	Other Landscape Elements Recorded
France	Animal categories are only registered if subject to decoupled payments or second pillar payments (e.g. LFA and/or special AE grassland payment (PHAE) and/or the "extensification premium"). This implies that a proportion of cows and pigs are not registered. However, these are usually the share of the animals which are not generally part of HNV system.	At farm level following the categories are collected: Permanent grassland: >5 years, Temporary grassland: 1-5 years old, Estive (summer pasture) (on farm only, no mention of collective estive), Moorland and individual grazing land (on farm).	Non-productive surfaces ("non agricultural surfaces" such as ponds, woods, and other features) are registered if subject to cross compliance and/or AE payments.
The Netherlands	All: pigs, poultry, dairy cattle, beef, sheep, goats and horses	3 categories of natural grassland (per parcel) are recorded: natural grassland (max 5 ton dry matter production) with: 1) >75% grassland coverage; 2) 75-50% grassland coverage; 3) <50% grassland coverage.	

Table 3 Relevant data from the Land Parcel Information System (LPIS) for selected Member States

Member State	Title of LPIS System, Status, Scale, Methodology	Semi-Natural Vegetation or Permanent Grassland Categories Recorded	Other Landscape Elements Recorded	Link to IACS
Denmark		Same land use categories are registered as in IACS, but at the level of a block of fields (this is an amalgamation of parcels/fields (max 10 fields)		Yes, link at the level of block of fields, but not individual fields
France	Registre Parcellaire Graphique	At parcel level all productive land uses receiving payments are registered. A link is established with IACS, so all IACS land uses are registered per parcel: Permanent grassland: >5 years: Temporary grassland: 1-5 years old, Estive (summer pasture) (on farm only, no mention of collective estive), Moorland and individual grazing land (on farm).	Mon-productive surfaces ("non agricultural surfaces" such as ponds, woods, and other features) are registered if subject to cross compliance and/or AE payments.	
The Netherlands	Dutch LPIS system called GIAP collects information through BRP (Parcel registration information) and FSS survey (Landbouw meitelling). In the GIAP system all collected information is integrated at farm level (both BRP and Landbouw meiteling). In addition a link at farm level is also established with the animal health registry in which all livestock is registered.	3 categories of natural grassland (per parcel) are recorded: - natural grassland (max 5 ton dry matter production) with: 1) >75% grassland coverage; 2) 75-50% grassland coverage; 3) <50% grassland coverage.		Yes, complete integration at farm level.

Member State	Title of LPIS System, Status, Scale, Methodology	Semi-Natural Vegetation or Permanent Grassland Categories Recorded	Other Landscape Elements Recorded	Link to IACS
Romania				The Romanian government is implementing a Land Parcel Information System/Integrated Administration and Control System (LPIS/IACS). Farmers often own or work a number of small, noncontiguous parcels of land. There are approximately 2.5 million agricultural plots farmed by more than 1.5 million people in the country. It is estimated that the LPIS system will handle about 1.5 million subsidy claims per year and will manage about 755,000 claimants. An agricultural information and decision support system will be installed in the country's agency of payments and interventions in agriculture (APIA). In the first phase, only authorised employees from the 210 local offices will have access to the LPIS system. A dedicated geoportal for use by the general public will be integrated into the system at a later date, providing access for farmers to register online for subsidies.

Table 4 Relevant data from the Animal Health Registry for selected Member States

Member State	Livestock Categories Recorded	Link to IACS	Other Relevant Data Sources (Scale, Quality, Methodology)	Semi-Natural Vegetation or Permanent Grassland Categories Recorded	Other Landscape Elements Recorded
Denmark	All: pigs, poultry, dairy cattle, beef, sheep, goats (except horses)	Not clear			
The Netherlands	All: pigs, poultry, dairy cattle, beef, sheep, goats and horses	Yes, at farm level	Topographic information (Top-10 vector) at 1:10000 m resolution; SynBioSys (Syntaxonomic Biological System). This is an information system for the evaluation and management of biodiversity among plant species, vegetation types and landscapes. It incorporates a GIS platform for the visualisation of layers of plant species, vegetation and landscape data. The section 'Vegetation' holds a distribution database of relevé data (plot data). Because each relevé in the database is – through an automated process using the program ASSOCIA - assigned to a plant community we have a database with distribution of plant communities. SynBioSys can be used to predict the distribution of HNV Farmland. The different HNV farmland areas have first been described in terms of plant communities as described in Symbioses. Subsequently these plant communities have been mapped using Synbioses. For example the type 'Saltmarsh'	Semi-natural types that can be mapped are: Dry calcareous and non-calcareous dune grasslands; Salt meadows in or behind dunes; Dry heather and moorland (including on dunes); Peatlands; Dry and wet infertile grasslands; Calcareous grasslands; Wet (semi) - infertile grasslands; Marsh Marigold grasslands in peat, clay and brook valleys.	Top-10 vector provides coordinates of wet (ditches of less and more than 3 metres wide) and green (hedges, tree lines and field boundaries) landscape elements.

Member State	Livestock Categorie s Recorded	Link to IACS	Other Relevant Data Sources (Scale, Quality, Methodology)	Semi-Natural Vegetation or Permanent Grassland Categories Recorded	Other Landscape Elements Recorded
			belonging to HNV type 1 can be associated with 8		
			plant communities.		
Czech Republic			Grassland inventory Czech Republic		
Estonia			Grassland inventory project; Estonian Fund for Nature and Estonian Seminatural Community Conservation Association: period 1998-2001: http://www.veenecology.nl/data/Estonia.PDF	Wooded, floodplain, coastal and alvar meadows	

Member State	Livestock Categories Recorded	Link to IACS	Other Relevant Data Sources (Scale, Quality, Methodology)	Semi-Natural Vegetation or Permanent Grassland Categories Recorded	Other Landscape Elements Recorded
Hungary			Grassland inventory project: http://www.veenecology.nl/data/Hungary.PDF	Grassland type total area in Hungary (x1.000 ha) Alkali grasslands 250-270 Sand grasslands 35-40 Steppes 100-230 Rock grasslands 1.7-3 Flood-plain and hay meadows 200-250 Fen meadows and sedge-beds 20-60 Mountain grasslands 1.4-2	
Latvia			Grassland inventory project: http://www.veenecology.nl	Area of grassland habitat type (ha) and % (of all grasslands) 1. Dry grasslands 1851 ha (11%) 1.1. Dune grasslands Corynephorion 124 ha (0.72%) 1.2. Dry siliceous grasslands Plantagini-Festucion 473 ha (2.73%) 1.3. Dry grasslands on cliffs Alysso-Sedion albi 4 ha (0.02%) 1.4. Dry calcareous grasslands Bromion erecti 1116 ha (6.44%) 1.5. Xero-thermophile fringes Geranion sanguinei 12 ha (0.07%) 1.6. Mesophile fringes Trifolion medii 121ha (0.7%) 2. Fresh grasslands 6386 ha (36.86%) 2.1. Nardus grasslands Violion caninae 221 ha (1.28%) 2.2. Mesophile pastures Cynosurion 4236 ha (24.45%) 2.3. Hay meadows Arrhenatherion 1908 ha (11.01%) 2.4. Potentillion anserinae 10 ha (0.06%) 3. Moist grasslands 5876 ha (33.92%) 3.1. Humid riverine grasslands Alopecurion 1088 ha (6.28%) 3.2. Humid eutrophic grasslands Calthion 3889 ha (22.45%) 3.3. Humid oligotrophic grasslands Molinion 46 ha (4.88%) 3.4. Coastal brackish grasslands Armerion maritima 47 ha (0.27%) 4. Wet grasslands 2937 ha (16.96%) 4.1. Acidic dwarf sedge communities Caricion fuscae 258 ha (1.49%) 4.2. Calcareous dwarf sedge communities Caricion davallianae 47 ha (0.27%) 4.3. Tall sedge communities Magnocaricion 2632 ha (15.19%)	

Member State	Livestock Categories Recorded	Link to IACS	Other Relevant Data Sources (Scale, Quality, Methodology)	Semi-Natural Vegetation or Permanent Grassland Categories Recorded	Other Landscape Elements Recorded
				5. Semi-ruderal grasslands 273 ha (1.57%)	
Lithuania			Grassland inventory project: http://www.veenecology.nl (See below)		
Slovenia			Grassland inventory project: http://www.veenecology.nl	Area of grassland habitat type (ha) and % (of all grasslands) 1. Submediterranean-Illyrian- meadows (Scorzonerion villosae) 9534 ha (3%) 2. Submediterranean-Illyrian karst pastures (Satureion subspicatae) 10095 ha (4%) 3. Suboceanic/submediterranean dry grasslands predominately on basic (calcareous) substrate (Mesobromion) 8875 ha (3%) 4. Matgrass (Nardus stricta dominated grasslands on acid substrate	

Member State	Livestock Categories Recorded	Link to IACS	Other Relevant Data Sources (Scale, Quality, Methodology)	Semi-Natural Vegetation or Permanent Grassland Categories Recorded	Other Landscape Elements Recorded
				(Nardo-Callunetea) 221 ha (1%) 5. Oligotrophic moist meadows with Molinia caerulea (Molinion) 2875 ha (1%) 6. Mesotrophic wet meadows (Calthion) 354 ha (0.1%) 7. Meadowsweet dominated wet meadows and lowland tall herb communities (Filipendulion) 120ha (0.04%) 8. Manured mesotrophic and eutrophic slightly moist (Arrhenatheretalia) 84809 ha (27%). 8.1. Oatgrass dominated manured meadows (Arrhenatherion) 3884ha (1.4%) 8.2. Ryegrass-Crested Dogstail grasslands (Cynosurion) 2719ha (0.01%). 9. Small Sedge intermediate mire and swamp swards (Scheuchzerio-Caricetea fuscae) 32ha (0.01%). 10. Water fringe vegetation and swamps (Phragmition communis) 1137ha (0.4%). 11. Vegetation dominated by bulky sedges (Magnocaricion elatae) 1090ha (0.4%). 12. Vegetation dominated by grasses and herbs along the water banks (Glycerio-Sparganion) 8ha 13. Pioneer annual flooded mudflats grasslands (Thero-Salicornietea) 271 ha (0.1%) 14. Perennial halophytic grasslands of mudy semi-dry soils (Arthrocnemetea fruticosi) 16 ha (0.01%). 15. Marine swamps (Juncetea maritimi) (not mapped). 16. Submarine grasslands (Posidonia, Cymodocea, Zostera in Ruppia beds) (not mapped)/ 17. Village mosaic 7935 ha (2.8%). 18. Extensive grasslands (based on Land use map 2002) 100905 ha (35.2%). 19. Unclassified (mosaic of types) 58303 ha (20.3%).	

Member State	Livestock Categorie s Recorded	Link to IACS	Other Relevant Data Sources (Scale, Quality, Methodology)	Semi-Natural Vegetation or Permanent Grassland Categories Recorded	Other Landscape Elements Recorded
				Total Area 286581ha	
Slovak Republic			Grassland inventory project: http://www.veenecology.nl		
Bulgaria			Grassland inventory project: http://www.veenecology.nl		
Romania			Grassland inventory project: http://www.veenecology.nl/data/Hungary.PDF		

Grassland Inventories

Source: Veen Ecology (http://www.veenecology.nl/)

During the period 1997-2006, mapping projects of semi-natural and natural grasslands were initiated by the Royal Dutch Society for Nature Conservation (KNNV) in close collaboration with colleagues in Central and Eastern Europe.

These were conducted in the following countries:

- Estonia: Estonian Fund for Nature and Estonian Seminatural Community Conservation Association: period 1998-2001: http://www.veenecology.nl/data/Estonia.PDF

- Latvia: Latvian Fund for Nature: period 1999-2003: http://www.veenecology.nl/data/Latvia.PDF

- Lithuania: Lithuanian Fund for Nature and Institute of Botany: period 2002-2005: http://www.veenecology.nl/data/Lithuania.PDF

- Slovakia: Daphne, Institute of applied ecology: period 1998-2002: http://www.veenecology.nl/data/Slovakia.PDF

- Hungary: Ministry of Environment, National Authority for Nature Conservation, Institute of Botany: period 1997-2001: http://www.veenecology.nl/data/Hungary.PDF

- Romania: University of Bucharest, Association of Botanical Gardens, Danube Delta Institute: period 2000-2004: http://www.veenecology.nl/data/Romania.PDF

- Bulgaria: Institute of Botany, Wilderness Fund, Bulgarian Society for the Protection of Birds: period 2001-2004; http://www.veenecology.nl/data/BG_grasslands_text.pdf

- Slovenia: Slovenian Natural History Society, Institute of Botany, University of Maribor and of Ljubljana: period 1998-2003: http://www.veenecology.nl/data/Slovenia.PDF

The Grassland inventories are highly standardised following the recommendations of the European Workshop on National Grassland Inventory, held in 1999 in Bratislava by KNNV in cooperation with Daphne, Institute for Applied Ecology, Slovakia.

A six step approach was followed:

1. By means of satellite image and/or aerial photo processing the permanent grassland complexes will be identified as well as the boundaries of the complexes. In the screening phase all the potential sites are globally screened by grassland specialists on actual agricultural use and other relevant issues like land abandonment. The field research areas are defined in this phase taking into account the position of the grasslands in the national bio-geographical zones and variation in abiotic conditions like climatic factors and soil types.

2. In preparation for the mapping phase, a list of national grassland vegetation mapping units is compiled in order to achieve comparative outputs across the project. The vegetation units are described by means of a set of indicator species which provide an indication of the development of the vegetation at a local site. The selection of the indicator species is based on existing knowledge concerning threatened and endangered species, endemic species and species which reflect the environmental conditions of the grasslands, for instance for nutrient input, continuity in management, water management and others.

3. In the mapping phase, the semi-natural grassland units are mapped in the field in selected areas by mapping the different vegetation units, listing the species, and drawing the boundaries of homogeneous vegetation or vegetation mosaics. For this purpose, the national project coordinators develop a manual for field mapping activities in which the system of identification of vegetation units to be mapped is included along with the indicator species and other requirements like information regarding management of the sites and soil type.

4. On the base of all the outputs of the previous phases, the GIS database is built up, including information on land management, land use, history of land use, specific threats like land abandonment. The boundaries of the mapped vegetation units are digitised and stored in a GIS database. To achieve compatibility which other geographical information systems at the national level, national digital maps/satellite images are used as a background layer in the database.

5. Based on this information a flexible database is produced which is available for policy makers and other specialists. The results of the project are interpreted and recommendations for protection and management are described.

For the evaluation report see:
http://www.veenecology.nl/data/EVALUATIONNATIONALGRASSLANDINVENTORYfinal4.pdf

In Poland, a separate project was organised in the early 1990s by Dorschkamp Institute in the Netherlands. In the Czech Republic, a habitat mapping project was organised by the government and institutions.