

ASPECTS OF DATA ON DIVERSE RELATIONSHIPS BETWEEN AGRICULTURE AND THE ENVIRONMENT

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Final report

Final Report:

Aspects of data on diverse relationships between
agriculture and the environment

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LIST OF ABBREVIATIONS

AEI	Agri-Environmental Indicator
ANC	Areas of Natural Constraint
CAP	Common Agricultural Policy
CC	Cross Compliance
CEC	Commission of European Community
CMEF	Common Monitoring and Evaluation Framework
DG	Directorate-General (e.g. DG-Agri, DG-ENV, DG-ESTAT)
EAFRD	European Fund for Rural Development
EC	European Commission
EEA	European Environmental Agency
EENRD	European Evaluation Network for Rural Development
EU	European Union
EVG	Ecologically valuable grasslands
FADN	Farm Accountancy Data Network
FAO	Food and Agricultural organisation of the United Nations
FSS	Farm Structural Survey
GAEC	Good Agricultural and Environmental Condition
GHG	Greenhouse gases
GMES	Global Monitoring for Environment and Security
HNV	High Nature Value farmland
IACS	Integrated Administration and Control System
IRENA	Integration of Environment into EU agricultural policy
JRC	Joint Research Centre
LC	Land Cover
LFA	Less Favoured Area
LPIS	Land Parcel Information System
LSU	Livestock Unit
LUCAS	Land use/cover area frame survey of Eurostat
M&E	Monitoring and Evaluation
MS	Member State
NGO	Non-Governmental Organisation
NRF	National Regional Forum
OECD	Organization for Economic Cooperation and Development
RBS	Riparian Buffer Strips
RDP	Rural Development Program
SAPS	Single Area Payment Scheme
SAPM	Survey on Agricultural Production Methods
SEBI	Streamlining European Biodiversity Indicators
SMR	Statutory and Mandatory Requirements
SPB	Scientific and Policy Board
TEEB	The Economics of ecosystems and biodiversity
UAA	Utilised Agricultural Area
WFD	Water Framework Directive

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EXECUTIVE SUMMARY

Data and information systems are critical to effective policy development for two reasons. On the one hand, development of effective policies is only possible if good indicators and data are in place for measuring changes taking place on the ground, and for evaluating and understanding the effects of CAP policies. On the other hand, effective targeting of policy instruments is highly dependent on data and administration systems that capture the full range of farmland types, and that enable the differentiation of farmland types according to key environmental values and threats.

Agri-environmental indicators (AEIs) are also important in the assessment of trends over time and are increasingly seen as means to report on agri-environmental interactions and on the implementation of agri-environmental policies. The member states (MS) are responsible for ongoing evaluation of each rural development programme and are therefore also for the data collection. Finally, there is also a separate set of 26 biodiversity indicators which was agreed under the Streamlining European 2010 Biodiversity Indicators process (SEBI 2010). In spite of this there are still large data gaps particularly on issues increasingly influenced and affected by the CAP proposals for 2014-2020. The purpose of this study is therefore to provide a synthesis of data available, and consider the need for improved data, so as to underpin the policy process in these areas. One of the guiding developments in this respect are new policies currently under discussion in the new CAP.

More specifically the main objectives presented in the report are:

- 1) To examine data gaps in the field of ecologically valuable grasslands and land at risk of abandonment by gathering existing data and making recommendations on how the gaps might best be filled to underpin the present and future policy process in these fields
- 2) To gather existing data and providing best/less good practice examples in relation to the environmental impacts of afforestation in agricultural lands in order to underpin the present and future policy process and environmental policy objectives
- 3) To find and present best/less good practice examples in relation to optimal design and management of riparian buffer strips in the context of environmental policy objectives.

Data and data gaps on Ecologically Valuable Grassland.

For the purpose of this study, we assume that the intention of the policy is to include all agricultural land. EVG are therefore understood to mean grasslands *that are notable, within the overall context of agricultural grasslands, for their ecological value. EVG have a spectrum of values depending on management but focus on biodiversity value and there is often a strong relation between high biodiversity value and other services. The EVG are semi-natural and natural grasslands that are not agriculturally-improved (e.g. through cultivation, reseeded, fertilisation, irrigation and drainage) of long standing and species-rich (taking account of all taxa not only higher plants).*

Based on this definition an inventory of data sources EU wide and at National level for all EU-27 countries was done. From the inventory it has become clear that data gaps in relation to location and distribution of EVG are large. Overall there is no EU wide data systems that enables to directly identify EVG. The sources evaluated do provide information on the

extent of grassland per class but the classification is not sufficiently based on parameters of agricultural improvement and species richness. For all data sources identified it is difficult to verify how complete their coverage is in relation to all grassland classes. Many statistical data bases only cover the agricultural areas that are eligible for payments, and or fall in the definition of agricultural land according to CAP (Commission Regulation EU No 796/2004) and therefore often exclude classes of land used for grazing which have a coverage with trees and/or shrubs above the threshold for agricultural land.

The inventory of national sources has shown that there are sufficient data sources available that provide information on one of the three main aspects according to which EVG are characterised but none of the sources cover the 3 aspects at the same time. These 3 aspects are management (level of improvement) semi-natural status and species richness. High resolution data for all these 3 types of information are usually absent and or scarce. Management, species and habitat information is required at the level of a field plot or at least at landscape scale. The combination of detailed and historic management information at the level of a semi-natural habitat is usually absent. Both types of data are collected in a separate way and it usually remains a challenge to match the two. Reliable species data is scarce and what is there is usually limited to vegetation, birds and possibly butterflies. Other species strata are not covered which makes the establishment of whether a grassland is species rich and thus EVG more difficult, particularly if it's species rich for strata for which no data coverage exist (e.g. soil biodiversity). Finally, as a key step in defining the management parameters of ecologically valuable grasslands at the EU level, it will be important to consider an appropriate EU-level definition of uncultivated grasslands including grasslands in which herbaceous forage coverage is not predominant.

Data and data gaps on land at risk of abandonment

At EU level the LUCAS data source has the largest potential to add information to better identify farmland at risk of abandonment using the methodology in the JRC study (Terres et al., 2013). LUCAS data provide valuable additional information on land cover classes 'fallow and abandoned land' and on land management.

Following the results from the national expert questionnaire, data on indicators for agricultural land prices and farmers qualifications seem to have the most added value. These national data are mostly useful for more profound analysis at a national level, but could also help to improve the already collected EU-wide data sources to assess the risk for abandonment.

It is also worthwhile to investigate further whether the available FADN data at a national level are more detailed or include a bigger sample than the FADN data used at EU level.

It also became clear that current national data do not seem to provide a basis for overall EU analysis of land abandonment. Generally they are too diverse in terms of methodology used. Given the wide availability of national data on the indicators of agricultural land prices and farmers' qualifications one could consider to strive for a more harmonized method of data collection and harmonization from existing sources. This will require an additional investment but seems feasible as it can build on existing methodologies and collection processes already in place.

Key environmental risk of farmland afforestation and key safeguards for achieving positive environmental effects

Farmland afforestation became a very significant, pan-EU measure when Regulation 2080/92 was introduced alongside the set-aside mechanism, partly to help address agricultural production surpluses, which was a key issue of the 1992 CAP reform. However, mechanisms were not put in place to pursue effectively the goal of reducing agricultural production through afforestation. Afforestation was not targeted on more productive land, and in fact took place predominantly on marginal grazing land of low productivity.

A key conclusion of the present study is that, as with the production-control objective of the 1990s, the environmental objectives of farmland afforestation have not been pursued effectively. Again this is due to a failure to target afforestation onto the land where environmental benefits can be expected, with the exception of a very small number of MS.

From the review of MS expert questionnaires, it appears that reasonably effective mechanisms are in place to prevent afforestation in situations that are indicated as negative by designations of protected areas (e.g. Natura 2000) for non-forest habitats. However, outside such areas there is a continuing process of afforestation on EVG in some MS.

It therefore should be considered whether afforestation of all types of farmland is a rational environmental objective in itself. On some types of land covering very large areas, such as EVG, there may be greater synergies to be achieved through measures that favour climate and biodiversity aims under other types of land management, for example extensive farming systems, whereas farmland afforestation often presents a dilemma of choosing one or other of these aims.

Overall, the key environmental risks of farmland afforestation emerging from this study can be summarised as:

- The loss of semi-natural farmland and other farmland of high nature value, especially outside protected areas. Some of this farmland corresponds with Habitats Directive Annex 1 habitats and/or supports Annex 2 species.
- Increased fire risk in situations where dry matter accumulates due to exclusion of livestock grazing and where there is a reduced human presence in the landscape due to the withdrawal of farming.
- Longer-term land abandonment in the case of economically unviable forests at the end of the period when forest maintenance payments are available.
- Limited environmental benefits in situations where afforestation has not been targeted on to land most suitable for achieving these benefits, and/or where the forest type/management is not most appropriate to deliver these benefits.

The key safeguards for achieving positive environmental effects emerging from this study can be summarised as:

- Clear and specific environmental objectives at EU and RDP levels, with each objective quantified as far as possible and cross-referencing to environmental policy objectives.
- Targeting mechanisms that build on objectives and steer the most suitable forest types onto the most suitable land for achieving environmental objectives. This

probably means less afforestation but better targeted so that environmental benefits will be greatest.

- Exclusion from afforestation of types of land that are most likely to entail significant environmental losses, such as EVG and Habitats Directive Annex 1 habitats. The new CAP rules on non-ploughing of environmentally sensitive grasslands are potentially relevant.
- Prioritisation of support for the creation of forest types that are scarce, fragmented and/or deliver a particularly high environmental benefit compared with the previous land use.
- Improvement of data bases on land use, land cover and land condition (including soil, habitats and species) in order to enable better targeting and screening of afforestation. Integrating such information on LPIS would greatly facilitate targeting.
- Improvement of data recording in relation to afforestation projects in order to enable monitoring and evaluation of land use change, habitats change, environmental issues addressed (e.g. eroded land). Integrating such information on LPIS would greatly facilitate monitoring.
- Adequate human resources on the ground in the form of trained and pro-active forestry-environmental agents
- Better coherence of policy mechanisms and removal of perverse effects, such as CAP eligibility rules that can drive High Nature Value grazing land out of farming and towards afforestation to facilitate receipt of Pillar 1 payments; and rules that exclude afforested land from grazing even though this can provide benefits for fire prevention and biodiversity.
- The broader use of the improved agroforestry measure which could help to combine benefits from forestry elements and at the same time maintain agricultural production including extensive grazing. This measure could also help to improve environmental services on intensive agricultural (arable) systems.

Best ways to achieve positive multifunctional effects for environment from riparian buffer strip management

In the new CAP 2014-2020 riparian buffer strips have also been identified as elements that can become part of 'Ecological Focus Areas'. The creation of new, and the maintenance of existing RBS may well be further enhanced by the obligation to create an EFA on arable land. Creation and/or maintenance of RBS is also a measure taken by Member States under the Nitrogen Directive and through National Action Plans (NAP) for Sustainable Pesticide Use. Although RBS are primarily motivated for their contribution to the protection of surface waters, they also contribute to biodiversity. Their function can therefore be multifunctional. To which extent they are multi-functional and how they need to be designed to make them as multi-functional as possible has been investigated.

For this an evaluation framework for the effectiveness of multi-functional buffer strips was designed. The framework was then tested in four best practice examples in the EU. It became clear that there are several factors in both design and management that determine the effectiveness of BS for reaching specific goals. These include factors like width, profile, type of vegetation, harvesting of biomass, fencing, soil, slope and hydrology, land use, stream density, discharge continuity and integration with the existing ecological network.

It is also concluded that one can strive for multiple goals, but in many cases required conditions, design and management requirements for reaching one goal can be contra productive for reaching another goal. Therefore multiple or even three zone buffer strips are best for reaching multiple goals with RBS management.

Because of the wider width and the large structural diversity in vegetation the ecological functions of the 2- and especially to of the 3-zone BS is larger then that of the 1 zone grassland buffer strip.

Overall we conclude that buffer strips derived or developed from natural riparian buffer strips provide better opportunities for multi-functionality, for a number of reasons related to their conditions: they combine wet and dry zones, and tall and short vegetation, in other words they provide gradients, which is advantageous for both biodiversity and water quality.

Combined conclusions

There are some significant areas of overlap between farmland afforestation and other areas, particularly ecologically valuable grasslands (EVG) and farmland abandonment, specifically:

- From the afforestation analysis it became clear that in some countries there was a strong overlap between land afforested with RDP support and EVG. This is a logical result of the fact that, although not the initial objective when the measure came into force, it is more attractive to use low productive land for this measure. In fact results show that it took place predominantly on marginal grazing land of low productivity.
- Aids for afforestation play a role in encouraging the abandonment of farming activity. This again may lead to ceasing of important low intensity management of semi-natural habitats which may lead to loss of EVG.
- The chances that EVG therefore get abandoned and their management and thus conservation lost are larger.
- Afforestation on EVG is by no means guaranteed to deliver an overall environmental benefit.
- The effect of afforestation on rural development will be limited, at least on the short run, as the 'newly grown' vegetation or forests require, once established, very extensive management, so limited labour input.
- Since 2007 also non-agricultural lands have become eligible for afforestation aids. This implies the EVG have become at higher risk of being lost through afforestation activities as these are also falling regularly outside the eligible farmland.
- RBS can be used as extra protection for maintenance of EVG is they are surrounded by areas of intensive agriculture and clearly form a minor land use.

Overall one can therefore conclude that a good spatial identification of EVG in combination with the places that are at highest risk of abandonment will have many advantages for better targeting 1st and 2nd pillar payments for reaching the greening target of the CAP.

1 INTRODUCTION, SCOPE AND PURPOSE OF THE STUDY

Aim and contents of this chapter:

In this chapter the scope and objectives of the study are presented and the overall structure of the report is explained. Furthermore the wider context of the study is presented. This context includes agri-environmental concerns and the recent reform of the CAP which needs to address many of these concerns by better targeting of Pillar 1 and 2 payments and by setting up an effective monitoring and evaluation framework including improved identification and elaboration of data to underpin this process.

1.1 Scope and objectives of the study

While agriculture has historically shaped the rich biodiversity heritage of EU countries, over the last 60 years this synergistic relationship has been undermined. A ‘polarisation’ process has been operating, involving intensification and specialisation of agricultural production on land with more production potential, and marginalisation, abandonment and afforestation of land with less agricultural production potential. This has resulted in substantial losses of species and habitats associated with farmland, such as, for example, indicator bird species (Vickery, *et al.*, 2004, EEA, 2006, Heath, *et al.*, 2000, SEBI, 2012), grassland butterflies (BCE papers) and declines in the extent and condition of Annex I farmland habitats. The Common Agricultural Policy (CAP) has been a central influence in the development of European agriculture, along with technological and market developments, and broader socio-economic processes in rural areas, all of which have driven structural change and changes to management practice. Sustainable management of natural resources has therefore been added to the objectives of the CAP as from 2014 which beside integration of measures to protect biodiversity and the wider environment within agriculture also requires increased attention for climate action in agriculture. The Biodiversity Strategy targets 1, 2 and 3 are dependent to a considerable extent on addressing these challenges given the wide land use share of agriculture.

Data and information systems are critical to effective policy development for two reasons. On the one hand, development of effective policies is only possible if good indicators and data are in place for measuring changes taking place on the ground, and for evaluating and understanding the effects of CAP policies. On the other hand, effective targeting of policy instruments is highly dependent on data and administration systems that capture the full range of farmland types, and that enable the differentiation of farmland types according to key environmental values and threats.

Agri-environmental indicators (AEIs) are important in the assessment of trends over time of (i) the effects of agriculture on the environment, and (ii) the effectiveness of agricultural and environmental policy measures. The Diredate project results have shown that for the reporting on the 28 agri-environmental indicators (AEIs) 97 different types of data are needed. These come from 45 different data sources of which the most important are the Farm Structure Survey (FSS), the Survey on Agricultural Production Methods (SAPM) and the Farm Accountancy Data Network (FADN), Land Use/Cover Area frame Statistical Survey (LUCAS), OECD agri-environmental indicators and Corine Land Cover (Corine) (Vinther *et al.*, 2011).

The AElS are increasingly seen as means to report on agri-environmental interactions and on the implementation of agri-environmental policies. Evidently, AElS need good quality data and information at the appropriate spatial and temporal scales and at the appropriate level of detail, to be able to convey meaningful information to policy makers, public and the research community.

Eurostat coordinates the work within the European Commission and with the EEA on the 28 Agri-environmental indicators (AElS) that were identified in the Commission (Communication COM(2006) 508) and subsequently approved by the Agricultural Council. There is also the Common Monitoring and Evaluation Framework (CMEF) which consists of a list of baseline, output, result and impact indicators for monitoring and evaluation of the CAP (Pillar I and II). The member states (MS) are responsible for ongoing evaluation of each rural development programme and are therefore also responsible for the data collection for the specification of the CMEF indicators on which basis mid-term and ex-post evaluation is done both for the current and the new reformed CAP. Member states are also obliged under Article 17¹ to report regularly on the status and extent of semi natural habitats, both inside and outside Natura 2000 areas. Information on such habitats requires Member States to systematically monitor the status of all habitats (as listed in Annex 1 of the Habitat Directive) including the types of ecologically valuable grassland covered by Annex 1 of the habitats Directive.

Finally, there is also a separate set of 26 biodiversity indicators which was agreed under the Streamlining European 2010 Biodiversity Indicators process (SEBI 2010) co-ordinated by the European Environment Agency to monitor the European state of Biodiversity (EEA, 2009). These indicators provide a baseline for Europe, but have limitations for assessing impacts of regional or local CAP measures on biodiversity and environment, certainly in the light of the reform of the CAP. Also, they are largely dependent on the same primary sources as referred to above, particularly Article 17 reporting and bird data.

In spite of the large data collection activities and different indicator frameworks already in place, there are still large data gaps particularly on issues increasingly influenced and affected by the CAP proposals for 2014-2020 which are:

- 1) Ecologically valuable grasslands maintained by extensive farming systems
- 2) Farm lands at risk of abandonment
- 3) Environmental impacts of afforestation of agricultural land
- 4) Environmental impacts of different approaches to riparian buffer strips

The purpose of this study is therefore to provide a synthesis of data available, and consider the need for improved data, on certain specific environmental issues linked to agriculture, so as to underpin the policy process in these areas. One of the guiding developments in this respect are new policies currently under discussion in the new CAP. These new policy developments are an important context for this study and will be discussed in the next chapter of this report.

¹ Article 17 of the Habitat Directive (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora)

More specifically the main objectives presented in this report are therefore:

- 1) To examine data gaps in the field of **ecologically valuable grasslands** and **land at risk of abandonment** by gathering existing data and making recommendations on how the gaps might best be filled to underpin the present and future policy process in these fields
- 2) To gather existing data and providing best/less good practice examples in relation to the **environmental impacts of afforestation in agricultural lands** in order to underpin the present and future policy process and environmental policy objectives
- 3) To find and present best/less good practice examples in relation to **optimal design and management of riparian buffer strips** in the context of environmental policy objectives.

1.2 Background of the study

The loss of biodiversity remains one of the most pressing environmental concerns in the EU, potentially leading to substantial economic and welfare losses (COM (2010) 4). European agriculture is also facing many other challenges, including the increasing pressure on farm incomes, abandonment of farmland and even whole rural regions, ageing and declining farming populations and a negative public image. The latter is especially related to the perceived negative environmental externalities associated with agriculture, public spending on farm support, world food-crises and agricultural market protection and associated distortions of world agricultural markets and trade.

The recent reform of the CAP needs to address these challenges. The CAP proposals for 2014-2020 provide some opportunities to better target Pillar 1 payments to HNV farmland which may be favourable to ecologically valuable grasslands and the prevention of farmland abandonment. Relevant in this respect are support measures for farms within Areas of Natural Constraints, as well as the greening measure for the protection of permanent grassland. Also within the Pillar 2 there are relevant measures that may be beneficial to the protection of Ecologically Valuable Grasslands and the prevention of abandonment. These involve special support to Areas of Natural Constraint (ANC), and the already existing measures that will be continued and that include the agri-environment-climate measures, the organic farming measure and the Natura 2000 measures.

The creation of new and maintenance of existing riparian buffer strips may well be enhanced by the obligation to maintaining an “ecological focus area” (EFA) of at least 5% of the arable area of the holding for farms with an area larger than 15 hectares (excluding permanent grassland). Good-practice examples of such multifunctional buffer strips are needed as inspiration to actors that are likely to be involved in development of new buffer strips in order to meet the greening obligations of the CAP.

A further evaluation of the environmental impacts of farmland afforestation is also part of this report as afforestation support to farmers is to be continued from 2014 as part of the Pillar II payments. Afforested land will also be eligible for Pillar 1 payments. There are some significant areas of overlap with the issues concerning Ecologically Valuable Grasslands and

farmland abandonment: a large proportion of the land afforested with RDP support in some MS has been permanent pasture under extensive use, and aids for afforestation of such land may be seen as playing a role in encouraging the abandonment of farming activity and by extension of farmland. Since 2007, abandoned farmland has been explicitly eligible for afforestation aids. Non-agricultural land has also been eligible for RDP afforestation aids; in some MS, land classified as non-agricultural may in fact be extensive grazing land that is not eligible for CAP Pillar 1 support, but following afforestation it can become eligible.

The reform of the CAP is now in the process of being agreed and then worked out in detail at national and regional level over the next year. It is therefore of utmost importance to identify which data is there and which data is additionally required to enable better targeting of CAP to biodiversity priorities. This requires better management of data to properly design and monitor policies that are targeted to those areas where biodiversity values are most threatened.

The current study has been specifically implemented to identify the necessary data to assess the effects of current and future policies on EVG, farmland abandonment, afforestation and to enhance good practices in the design of riparian buffer strips. Good data are necessary for monitoring and evaluation of policies, but are also a pre-requisite to target certain environmental issues with policy measures.

1.3 Outline

The report consists of 8 chapters including this first introductory chapter. Chapter 2 deals with the policies, particularly the CAP, and how they effect on the four issues, particularly in relation to related requirements for data for monitoring and evaluation. Chapter 3 reports on the way ecologically valuable grasslands can be defined. Chapter 4 gives an overview of the data availability and data gaps identified for EVG at EU-wide and national level. Chapter 5 provides the same type of information as in 4 but then for land at risk of abandonment. Chapter 6 focusses on the issue of afforestation of agricultural land. Chapter 7 presents a conceptual framework for the multifunctional evaluation of different types of Riparian Buffer strips (RBS) in the EU and good practice examples of these in 4 different EU regions. Chapter 8 presents the conclusions and recommendations of the study.

Key messages and conclusions of this chapter:

In spite of the large data collection activities and different indicator frameworks already in place, there are still large data gaps particularly on issues increasingly influenced and affected by the CAP proposals for 2014-2020 which are:

- 1) Ecologically valuable grasslands maintained by extensive farming systems
- 2) Farm lands at risk of abandonment
- 3) Environmental impacts of afforestation of agricultural land
- 4) Environmental impacts of different approaches to riparian buffer strips

The purpose of this study is therefore to provide a synthesis of data available, and consider the need for improved data, on certain specific environmental issues linked to agriculture, so as to underpin the policy process in these areas.

More specifically the main objectives presented in this report are therefore:

- 1) To examine data gaps in the field of **ecologically valuable grasslands** and **land at risk of abandonment** by gathering existing data and making recommendations on how the gaps might best be filled to underpin the present and future policy process in these fields
- 2) To gather existing data and providing best/less good practice examples in relation to the **environmental impacts of afforestation in agricultural lands** in order to underpin the present and future policy process and environmental policy objectives
- 3) To find and present best/less good practice examples in relation to **optimal design and management of riparian buffer strips** in the context of environmental policy objectives.

2 EU POLICIES AFFECTING THE RELATIONSHIP BETWEEN AGRICULTURE AND THE ENVIRONMENT

Aim and contents of this chapter:

In this chapter the current and future policies, particularly the CAP policies, are discussed as to how they effect on EVG, land at risk of abandonment, farmland afforestation and Riparian buffer strip design and management. The policies are particularly discussed in relation to data collection requirements for policy monitoring and evaluation. After all, development of effective policies is only possible if good indicators and data are in place. The same applies for effective targeting of policy instruments. This is highly dependent on data and administration systems that capture the full range of farmland types, and that enable the differentiation of farmland types according to key environmental values and threats.

2.1 EU policies affecting the relationship between agriculture and the environment

Agriculture affects the environment in many different ways. Both in positive ways, farming systems generating semi-natural habitats with high levels of biodiversity and negative ways, e.g. farming systems that cause pollution, eutrophication and deterioration of habitats. In addition afforestation of agricultural lands can generate opportunities to create additional farm income and increase the sequestration of carbon, the regulation of water and protection of soils, but if not implemented carefully it may not deliver these benefits and in some circumstances it may also have very adverse effects on both environment and biodiversity.

EU agriculture is highly diverse and dynamic, responding to changes in markets, social and technological development, and policies. EU policies strongly influence agriculture, especially the EU Common Agricultural Policy (CAP).

Pillar I of the CAP focuses on direct farm payments and limited market intervention and influences farm practices by means of Cross-Compliance. Pillar 2, providing funding for rural development programmes, contains a range of policy instruments which substantially influence the socio-economic environment for farms and their choices of farming practices.

Pillar 1

Until now, the instruments/measures most relevant to environment, biodiversity and habitats protection in Pillar 1 include:

- Cross compliance² (CC) with the Good Agricultural and Environmental Condition (GAEC standards)³ and Statutory Management Requirements (SMR)⁴ which are

² Cross compliance, which became mandatory for all Member States with the 2003 reform of CAP (Council Regulation 1782/2003 and Commission Regulation 796/2004), links the CAP subsidies to environmental policies.

³ Good agricultural and environmental condition (“Annex IV”): All farmers claiming direct payments must abide by standards to be established by the Member States, which constitute minimum requirements for the maintenance of land and soil conditions and must cover the aspects set out in Annex IV of Regulation 1782/2003, updated in Annex III under Regulation (EC) No 73/2009. GAEC standards are specified by the Member States. By contrast to SMRs, they offer the possibility to Member States to introduce new

linked to the Single Payment Scheme (SPS). The introduction of compulsory cross compliance has introduced a baseline of environmental management that is considered to be good farming practice.

- Specific support under Article 68 of Council Regulation 73/2009 which covers special support for specific types of farming which are important for the protection of the environment and for specific agricultural activities entailing additional agri-environmental benefits.

When looking back on the CAP-Pillar 1 policies it can be concluded that there is no consensus view yet on the environmental impacts of cross compliance and decoupling of support payments from production decisions.⁵ There is evidence that these CAP mechanisms can be beneficial for the maintenance of biodiversity in valuable farming habitats, but that it may also lead to both land abandonment and intensification (Oñate 2007, Brady et al. 2009, Poláková et al. ,2011). In the study by Poláková et al. (2011) this is discussed extensively in relation to biodiversity and habitat preservation and a distinction should be made between the effect of decoupling and, that of SMRs and GAEC standards as part of CC.

Overall it is clear that direct payments can be an important source of income helping to prevent land abandonment. However, because of decoupling of payments from production there is a risk that management of certain categories of land, especially extensively managed semi-natural grasslands, will be reduced to occasional mechanical clearance of vegetation to comply with GAEC rather than being maintained by grazing regimes under an active farming system. Such a change leads to a reduction in biodiversity on the land in question, as well as a loss of the farming system and its inherent multifunctionality. Meanwhile in some member states there are large areas of semi-natural grasslands that are not eligible for payments because of the way rules are applied, which increases the chance of them being abandoned. Although partial 'coupling' of Pillar 1 payments to specific types of production can prevent abandonment and thus provide benefits for biodiversity, there are also several examples where coupled payments have led to intensification with negative effects on biodiversity. One well discussed case is that headage payment for suckler beef are higher than for sheep and goat encouraging the grazing with beef cattle where in some situations from an habitat management perspective it would only be beneficial to graze with sheep and goats. Another disadvantage linked to headage payments has been that it encourages grazing with stocking densities above the carrying capacity of specific grazing habitats.

requirements. GAEC standards differ significantly regarding the type and the level of implementation among Member States.

⁴ Statutory Management Requirements ("Annex III"): Farmers must respect standards called statutory management requirements (SMRs) which correspond to 19 EU Directives and Regulations (listed in Annex III of Regulation 1782/2003) including the Wild Birds and Habitats Directive. SMR standards are mandatory in legal terms; cross compliance adds a sanctioning element through the link to the direct payments under the CAP.

⁵ An effectiveness analysis undertaken by the European Court of Auditors highlights that "the objectives and the scope of cross compliance are not well defined, making it unclear what cross compliance is designed to achieve" (ECA 2008). Thus it's difficult to measure the environmental impact of cross compliance.

As to the contribution of SMR to conservation of habitats and biodiversity the study by Poláková et al. (2011) concludes that several effects of legislative measures which are included in the SMRs can be beneficial for biodiversity and habitat quality. There is no doubt for example on the positive contribution of the Nitrate Directive that sets limits to fertiliser application and requires manure management although incomplete or insufficient implementation at MS level does hamper its positive contribution in some situations. The situation in the Netherlands is an example where derogation agreements have maintained the Nitrate input levels above the Nitrate Directive limits of 170 kg Nitrogen for many more years adversely affecting habitat quality and especially meadow birds depending on these (MNP, 2011; Kleijn, 2013; Sovon, 2012). The same applies to the Framework Directive on Sustainable use of Pesticides and the Water Framework Directive which all set limits to application of plant protection products, use of riparian buffer strips and field margins.

The effect of the Birds and Habitats Directive, can also be assessed as positive to biodiversity and habitat conservation, where it concerns requirements on upkeep and management of biotopes and habitats, landscape elements which are necessary for maintaining the ecological coherence of a landscape and require special conservation measures for protection of listed species, migratory species, breeding and nesting birds, rare plants, avoidance of deterioration of habitats and landscape features where these occur in farmland. However, the effectiveness of the implementation of the Habitat Directive depends very much on the continuation of farmland management by the farmers. The viability of a farming activity is not directly supported through this Directive. There are therefore other support measures and market developments necessary to keep the management activity viable and to prevent abandonment.

Another Directive which should not be forgotten is the Environmental Impact Assessment (EIA) Directive which requires a screening (an environmental impact assessment) in case of restructuring of agricultural land and the conversion of uncultivated and semi-natural habitats to intensive farming or afforestation (see also next). However, this Directive is not included in the SMRs. For further details on the effects on biodiversity and habitats we refer to Poláková et al. (2011) (Chapter 3).

The GAEC obligation effects on biodiversity and habitat quality are generally positive, but depend very much on the type of GAEC standards applied in every region and the way they are implemented. There are several GAECs that potentially contribute positively to biodiversity conservation particularly in semi-natural habitats and permanent grassland areas (Elbersen et al., 2010 and in Poláková, 2011). GAECs directly targeting biodiversity are discussed extensively in both studies and the most important for the EVGs assessed in these studies are the compulsory GAECs on the protection of permanent pastures, avoiding the encroachment of unwanted vegetation on agricultural land and also optional standards such as Minimum stocking rates or appropriate regimes and establishment or retention of habitats. The effectiveness of these GAEC standards depends however strongly on the way they are implemented and are of course only effective in land eligible for payments and where the farming activity is economically viable under the current policy framework. Therefore GAECs have certainly not proved to be sufficient to avoid all the negative environmental consequences of decoupling. Beside eligibility and viability, the reason is also that GAEC only represents a minimum management requirement that does not go beyond

basic farming standards. In some MS the minimum management requirement is merely to clear vegetation by mechanical means, so that grazing is no longer required on semi-natural farmland, resulting in a loss of positive management for biodiversity.

Pillar 2 of CAP

Rural development programmes financed under the 2nd CAP pillar represent a key policy instrument currently available to protect and enhance natural resources, including farmland biodiversity, as well as preserving forestry systems and HNV farmland.

Most important are the agri-environment schemes (AES) (Axis 2: Improving the environment and supporting land management), which are the only compulsory rural development measures in the EU and represent until 2013 the most important tool for delivering farming practices supporting biodiversity objectives (Oñate et al. 2007, BirdLife 2009, Keenleyside et al. 2006, Poláková, 2011). An extensive inventory of the coverage, examples of successful and beneficial AES is given in Poláková (2011). Overall there are many positive examples, however it does not necessarily mean that the way AES is implemented is always as effective. Several studies have shown that the targeting of AES is biased towards agriculturally improved habitats (e.g. Hart et al., 2012; Poláková, 2011 and EEA, 2010, 2013). In terms of actual budget allocation, relatively little money is spent on areas with a high proportion of HNV farmland and support measures aimed at maintaining HNV farming are inconsistently applied across Member States. Spending on agri-environment schemes, as a percentage of total CAP spending is also low (currently only up to 4% and 23% of the Pillar 2 budget in over 2007-2013 period) and intuitively, this would seem insufficient to provide substantial support to HNV farming (EEA 2009: 7 and EEA, 2013).

The compulsory transfer of funding from Pillar 1 to Pillar 2 of the CAP has also served to increase funding available for rural development, although the degree to which this drives environmental management varies. Other policy changes have also had an impact on the environment, although this has not been their core rationale, for example the removal of the link between payments and production through the introduction of decoupled payments, the phasing out of coupled payments and the removal of measures such as quota and set-aside. However, the degree to which the changes brought about by CAP reforms have led to an improvement in the environmental performance of agriculture is a matter of continued debate.

In addition, measures supporting farming in Areas of Natural Constraint (previously the Less Favoured Areas), as well as measures targeting farming in Natura 2000 and WFD sites, plus selected non-productive investment measures, can all help to support management practices beneficial for biodiversity and habitat quality if designed and targeted with these objectives in mind.

The subsidiarity principle allows Member States significant autonomy and flexibility in the design of their national RDP programmes. This results in great diversity of approaches and the subsequent potential for positive or negative impact on biodiversity and overall habitat quality. Broadly speaking, the impact of rural development programmes on biodiversity depends on the priority given to specific objectives, the funding allocation among the axes and individual measures, the specific design and implementation of the measures and their

uptake by farmers. How policies affect upon the 4 issues that are the main focus of this report is further elaborated in next sections.

CAP 2014-2020

The CAP 2014-2020 promises a stronger focus on environmental concerns with special emphasis on sustainable management of natural resources and climate action, with a focus on greenhouse gas emissions, biodiversity, soil and water. Several existing and new CAP measures, particularly those elements that make part of the new 'greening' of the CAP are relevant for the four issues addressed in this study. According to the CAP reform adopted in June 2013:

- *'Greening' of 30% of direct payments will be linked to three environmentally-friendly farming practices: crop diversification, maintaining permanent grassland, including the protection of environmentally valuable permanent grasslands inside and outside Natura 2000 areas, and conserving 5%, and later 7%, of areas of ecological interest as from 2018 or measures considered to have at least equivalent environmental benefits.*
- *At least 30% of the rural development programmes' budget will have to be allocated to agri-environmental measures, support for organic farming or projects associated with environmentally friendly investment or innovation measures.*
- *Agri-environmental measures will be stepped up to complement greening practices. These programmes will have to set and meet higher environmental protection targets (guarantee against double funding).*

Source: European Commission, MEMO, Brussels, 26 June 2013, http://europa.eu/rapid/press-release_MEMO-13-631_en.htm (last accessed 6 September, 2013)

Overall this implies that with the greening measures of the CAP the environmental and biodiversity targeting in Pillar I is extended, as compared to the CAP until 2013. Details of the new policy proposals are discussed in more detail in the following section in relation to the four issues addressed in this study.

2.2 EU policies targeting ecologically valuable grasslands

Since agri-environmental payments have existed as part of the Pillar 2 of the CAP, support has been available for the maintenance of the ecological values in agricultural lands, including permanent grasslands. This support was never meant to target grasslands specifically. It is therefore only recently that the CAP has given increasing prominence to permanent pastures and mechanisms for their protection as part of the Cross Compliance package (since 2005) and more recently in the Pillar 1 "greening" proposals. But also for Pillar 2 the CAP 2014-2020 proposals seems to give more room to target ecologically valuable grasslands through AES, new measures for Areas of Natural Constraint (ANC), the agri-environment-climate measure, the organic farming measure and the Natura 2000 measures.

For a summary overview of the main policies affecting ecologically valuable grasslands at present, and also under the new CAP 2014-2020 see Table 1 in Annex 2.

An overview of the different management practices enhanced by the policies listed in Table 1 (Annex 2) is provided in Table 2 (Annex 2). This Table was directly copied from Poláková (2011) and provides a detailed summary of the specific management practices linked to the detailed CAP measures relevant for the maintenance of grasslands, including the ecologically valuable grasslands. The most important direct impacts until 2013 are from the Pillar 2 agri-environment, Natura 2000, LFA measures and non-productive investment and from the obligatory GAEC measures.

More recently in the new CAP 2014-2020 increasing prominence to the environmental values of permanent pastures and mechanisms for their protection as part of the Pillar 1 “greening” proposals is given. The recitals to the current Regulation (COM(2011) 625), specifying the environmental goals of the CAP justify the intention to protect permanent grasslands as part of the measures that have been proposed within the Pillar 1 Direct Payments system as ‘payments for agricultural practices beneficial for the climate and the environment’. This phrase is likely to be rooted in 2 of the 6 new priorities of the CAP that provide the environmental goals: Restoring, preserving and enhancing ecosystems dependent of agriculture and forestry (Objective 4); and promoting resource efficiency and supporting the shift towards a low-carbon and climate resilient economy in the agriculture, food and forestry sector (Objective 5). In relation to the latter Objective it has been assumed that amongst the driving force behind this provision is the perceived need to prevent carbon release by the conversion of permanent grasslands into arable. As to the Objective 4 it has also been assumed that there are indeed many grassland ecosystems that depend on agriculture for their existence and their related ability to provide certain ecosystem services. It is clear that many (if not most) grasslands have a role in some aspect of maintaining stable environmental conditions, from carbon sequestration to erosion prevention to preservation of biodiversity.

Consequently, the CAP proposals for 2014-2020 provide an increase in the opportunities to better target Pillar 1 payments to HNV farmland which may be favourable to the maintenance of environmentally valuable permanent grasslands and also the prevention of their abandonment. There is now a possibility for Member States to use up to 5 % of their Pillar 1 budgets to support farms within Areas of Natural Constraints, as well as the greening measure for the protection of permanent grassland. The latter is an obligatory measure to prevent permanent grasslands as part of Natura 2000 areas from being ploughed. Member States are free however to also target this protection measure to permanent grasslands outside Natura 2000 which is particularly relevant to HNV farmland areas as not all of these are necessarily situated within Natura 2000. In this respect it is particularly relevant to identify the permanent grasslands of high biodiversity value in the different member states to also enable the targeting by policy. The widening of the support to ANC is particularly relevant in the context of prevention of farmland abandonment and also maintenance of ecologically valuable grasslands that are likely to often coincide. The outcomes for EVG will depend on several factors, including the level of payments, the extent to which these are targeted at EVG and the minimum management requirements applied under GAEC.

For Pillar 2, the agri-environment-climate measure, the organic farming and the Natura 2000 measures will continue to play an essential role in helping to support the continuation of farming systems in areas where EVG is most concentrated. The new measures for Areas of

Natural Constraint (ANC) have the potential to contribute to this objective, but in some MS this potential is not realised because of the way the measures are implemented.

An interesting new elements in the reform proposals is that tools are provided to allow for greater flexibility in relation to how measures can be combined and used in integrated packages. There is an increased emphasis on cooperation and providing higher payment rates for agri-environment agreements that involve more than one farmer. This flexibility enables a more targeted support to regions where there is a large concentration of EVG making it likely that the support measure will yield a higher positive effect on biodiversity. However, much depends on how these measures are designed and implemented by Member States eventually.

The widening in the possibilities to support farms managing EVG also becomes clear from a recent report by the EC 'Farming for Natura 2000' (EC, 2013). In this report an overview is given of the main CAP support instruments for Natura 2000 and/or HNV farming systems, including instruments in the new CAP 2014-2020 proposals and non-CAP instruments. Since farming systems in Natura 2000 and HNV farmland areas are the main systems managing EVG the listed instruments are also relevant here. All the support instruments listed are categorized as: CAP support that ensures the economic viability of extensive farming systems, CAP support for building capacity of farm systems, CAP support for adding value to the produce of extensive farming systems, CAP support for the management of Natura 2000 farmland habitats and species, CAP instruments for co-operation projects and local partnerships and other non-CAP instruments. The latter include the LIFE+ funding instruments, the European Structural Funds and the European Social Fund. For further details see EC, 2013).

Although all the key measures identified as important for achieving biodiversity objectives in EVG under both Pillars the challenge is now that they are also targeted to where the EVG are located. Eligibility of EVG together with their proper identification remains therefore an important point of concern. A main reason for this is that agricultural land to be targeted by CAP must fall into one of only three categories named by the policy, i.e. permanent crops; arable and permanent pasture. The definition of permanent pasture is officially as follows: *land used to grow grasses or other herbaceous forage naturally (self-seeded) or through cultivation (sown) and that is not included in the crop rotation of the holding for five years or longer* (Commission Regulation EU No 796/2004).

This definition has been very much debated during the process of the CAP-reform. The EC has now proposed an amendment in the original definition in COM(2011) 625 and to define permanent pasture as: *land used to grow grasses or other herbaceous forage naturally (self-seeded) or through cultivation (sown) and that has not been included in the crop rotation of the holding for five years or **more**; it may include other species **such as shrubs and/or trees which can be grazed** provided that the grasses and other herbaceous forage remain predominant **as well as, subject to a decision by Member States to include land which can be grazed and which forms part of established local practices where grasses and other herbaceous forage are traditionally not predominant in grazing areas.***

It is interesting to see that the definition is now proposed to be widened in the new CAP 2014-2020 as until now in practice there are known to be significant exclusions of permanent grasslands purely resulting from the permanent pasture definitions and (related) eligibility rules and EC guidance under the CAP (See Poláková, 2011) . It is clear that currently the CAP does not recognise the difference between cultivated and uncultivated grasslands and this remains to be a problem even with the adapted definition proposed by the EP in 2013. The uncultivated grasslands, which include the ecologically valuable and semi-natural grasslands are generally of quite low agricultural productivity, but they are of exceptional environmental value compared with cultivated farmland. For example, they harbour the majority of EU farmland biodiversity (e.g. Sala, et al., 1996; Picó, F.X., Van Groenendael, J., 2007; Matzdorf et al., 2010;). It is therefore not surprising that maintaining ecologically valuable grasslands goes hand in hand with reaching target 2 of the Biodiversity Strategy which is concerned with maintaining ecosystems and their services, especially in the form of “green infrastructure” and to ensure that it is appropriately protected and targeted for support under the CAP. Beside the ecological value it is also clear the majority of EU farmland carbon is contained in permanent grasslands and they provide the majority of water catchment services on farmland (e.g. Jones and Donnelly, A. 2004; Abberton, et al., 2010; Butler, et al., 2008; Conant, et al., 2001; De Deyn, et al., 2011). In spite of the widely acknowledged diverse ecosystem functions of permanent grasslands, there is no acknowledgement in CAP policy of intensive or extensive grasslands or semi-natural grasslands or ecologically valuable grasslands. The reasons for this is gaps in knowledge and data to properly identify different categories of permanent grasslands.

The role of permanent grasslands in carbon sequestration seems to have most clearly been anchored in EU policy. Clear further evidence for this is that in the new proposal for a decision on accounting rules and action plans on greenhouse gas emissions and removals resulting from activities related to land use, land use change and forestry (LULUCF) (COM 2012/0042 COD) specific mention is made of reducing the conversion of grassland and application of agroforestry, as agricultural practices that can contribute to the reduction of emissions and enhancement of carbon sinks. In spite of this it is surprising however that agroforestry areas are largely excluded from Pillar I support for reasons of eligibility. This oversight does not seem fully solved however with the adapted definition of permanent grasslands as proposed by the EC as member states can still decide themselves which non-herbaceous dominated grasslands can be targeted by CAP support. The Working Document on eligibility available at the time of writing (DS/EGDP/2013/9 – rev.1) suggests rules on tree density that would exclude or penalise large areas of wood pasture. It is also surprising in this context that pastures afforested with aid from Pillar 2 automatically become eligible for Pillar 1 payments.

On the concept of ‘permanent grassland’ it is clear that there are several definitions and that the political decision on an adapted definition is still in process. As to the term ‘ecologically valuable grasslands’ we conclude that it is not even a clearly established concept, let alone a policy targeting. There are however various concepts and terms within EU policy that can be considered to encapsulate or overlap with this concept. In the next chapter we will therefore first elaborate on the concept of EVG, how it can be defined and also consider the definitions of types of grasslands in policy documents (partly) overlapping with the EVG concept. The

proposed definition of EVG will then be used as the basis for a further inventory of data availability on the concept in the rest of the study.

2.3 EU policies targeting farmland at risk of abandonment

From an environmental policy point of view, the process of farmland abandonment threatens biodiversity in the so-called High Nature Values farmlands, including ecologically valuable grasslands. These farmlands have been extensively managed for decades and over the years the agro-ecosystem resulted in valuable semi natural habitats. Because of this they harbour high levels of biodiversity but are often also at high risk of abandonment. Abandonment of HNV farming causes a steep decline in level of biodiversity (EEA, 1999; Baldock, et al. 1996; Preiss et al., 1997; MacDonald et al., 2000; Suárez-Seoane et al., 2002; Sirami et al., 2008, Stoate et al., 2009). Once the process of abandonment sets in rotational arable cropping and permanent grasslands will soon be overgrown by weed-species, and later on by shrubs and trees. Without the grazing pressure of domesticated ruminants on the rough grazing its vegetation will radically change. The loss of farmland habitats will inevitably lead to a loss of species depending on them and will certainly include many bird, butterfly and plant species of European nature conservation concern that depend upon (extensively) farmed land.

With the accumulation of biomass the vulnerability for wildfires increases. After such wildfires risks for soil erosion is extremely large. In terms of rural development, abandonment of farming might cause rural depopulation threatening quality of life in rural areas. As globalisation of agricultural markets is an on-going process, it is expected that the economic driving forces of abandonment continue to exist and even might become stronger in the near future.

Environmental considerations are a main reason for preventing farmland abandonment and underpin to address this issue in the CAP and other policies. The main policies impacting on changes in land at risk of abandonment are listed in Table 3 of Annex 2.

Direct payments can be an important source of income helping to prevent land abandonment. In the study by Poláková et al. (2011) several examples are given of specific land use categories of higher risk of being abandoned because they are not eligible for direct payments such as common and grazing lands which have high coverage of trees and shrubs which makes them fall outside the official CAP grassland definition (see also next subsection). As long as part of the payments remain coupled to production through the suckler beef and sheep and goat premia there is still some payments flowing to these extensively managed grazing areas increasing the chance of keeping them under management (although such payments do not necessarily require extensive grazing to be continued). So partial 'coupling' of Pillar 1 payments to specific types of production can help to prevent abandonment and this is still the case in countries like Spain, France, Austria, Portugal, Finland, Slovenia and Greece. However as de-coupling of direct payments from production continues coupled payments might not be maintained in the future. For the new CAP period it is still possible to maintain coupled payments for certain sectors or regions specific agricultural sectors that are *particularly important for economic, environmental and/or social reasons*. So prevention of land abandonment could be a reason for maintaining part of the

coupled payments also after this year's CAP reform. For increasing the effectiveness of coupled payments as an instrument to prevent abandonment it is important to provide up-to-date information on which type of agricultural lands are in largest danger of being abandoned and where are these situated.

Next to the coupled payments also the payment for young farmers, and the payment for natural constraints are important measures in the new CAP to prevent land abandonment. The payment for young farmers will encourage young farmers to start and continue their farm, and this may occur in areas more susceptible for abandonment if these areas are specifically targeted with sufficiently high payments.

Farmers in areas with natural constraints might receive already a 2nd pillar LFA-payment, but in the new CAP there is a possibility to pay these farmers an extra payment from the 1st pillar: payment for areas with natural constraints. It is also possible to declare new areas as eligible for these payments. Extra support to farmers in the less favoured areas may encourage continuation of farming and contribute to the prevention of farm land abandonment, although the outcome will depend on how the measures are designed and targeted (LFA measures in some MS have been found to have no significant effects in preventing abandonment).

The recent publication by the EC 'Farming for Natura 2000' (EC, 2013) further confirms that there is an increase in the instruments to support extensive farming in regions more likely to be affected by farmland abandonment. An overview of the type of instruments which also include new CAP 2014-2020 measures and non-CAP instruments see the report 'Farming for Natura 2000' (EC, 2013).

2.4 EU policies targeting afforestation of agricultural land

Part of the study focuses on first afforestation of agricultural land (for simplicity we will use the term "farmland afforestation" hereafter) supported from the CAP budget. Farmland afforestation as an explicit EU policy was introduced by the 1989 Community Forestry Action Programme. Aids for this purpose from the CAP budget became available under Regulation 1610/89. They were reinforced from 1992 under Regulation 2080/92, integrated with rural development programming from 2000, and are proposed to continue from 2014.

There was also considerable afforestation funded under the Structural Funds in Objective 1 regions prior to 1989, but this is not the subject of the present study.

The aim of this study is to gather existing data and provide best/less good practice examples in relation to the environmental impacts of farmland afforestation in order to underpin the present and future policy process and environmental policy objectives. The main focus is on legislative and administrative mechanisms for promoting positive environmental effects and for preventing negative environmental effects. These mechanisms will be considered in the context of the environmental objectives of the regulations establishing the measures for supporting farmland afforestation.

Although farmland afforestation funded by the CAP is intended to ensure sustainable use of land, the environmental impact, particularly in relation to biodiversity, is known to vary.

Concerns have been raised by environmental NGOs about the negative environmental impacts of farmland afforestation. These concerns have focused especially on the loss of semi-natural habitats, particularly grassland habitats (ecologically valuable grasslands - EVG).

Additional concerns have been expressed about impacts on soil and carbon as a result of some plantation techniques (e.g. sub-soiling, which is used against soil-compaction⁶, mechanical clearance of pre-existing vegetation), and the increased risk of wild fires when a grazed landscape is replaced by closed forest.

There are also questions about biodiversity and ecosystem priorities, and whether the new forests that are being established are in fact the types of habitat and ecosystem that are under most pressure in the EU and that therefore need to be expanded with public subsidy.

2.4.1 Overview of afforestation measures and how they have evolved

Farmland afforestation became a very significant, pan-EU measure in 1992, when Regulation 2080/92 was introduced as obligatory for MS to implement. Part of the argumentation was that afforestation would, alongside the set-aside mechanism, help to address agricultural production surpluses, which was a key issue of the 1992 CAP reform.

Although this objective is not a focus of the present study, it is clear that mechanisms were not put in place to pursue effectively the goal of reducing agricultural production through afforestation. Afforestation supported by the CAP has taken place predominantly on marginal land of low productivity.

Thus the evaluation of Regulation 2080/92 concluded that *as regards the reduction of agricultural surpluses, the impact of Regulation 2080 is negligible. It is very clear that the regulation has proved to be ineffective in encouraging the afforestation of the most productive agricultural land* (Institut Pour le Développement Forestier, 2001). The Court of Auditors concluded in 2004 that *these effects had been quite limited*.

However, the production-control justification of the CAP afforestation measures was abandoned without explanation after 1999 and the objectives thereafter were shifted towards simply expanding the forest area, with a mix of quite general socio-economic and environmental objectives.

This study will consider the period from 1992 to the present day. Policy has evolved in this period and can be summarised in four broad phases as presented in Annex 2 in Table 4.

Over the period of 20 years from 1992 to the present, a key change was from compulsory (for Member States) to optional measure after 1999. In addition, the large financial

⁶ <http://www.fs.fed.us/t-d/pubs/pdfpubs/pdf08342828/pdf08342828dpi72.pdf>

commitments from the 2080/92 measure for compensation payments over 20 years meant that there was less funding available for new applicants after 1999, and rates of afforestation in many MS were reduced. From 2007, the period that compensation payments are available to beneficiaries has been reduced from 20 to 12 years.

There have been various changes to the wording of the objectives, and to the environmental requirements, but in practice the Regulations providing for aid for farmland afforestation have not set out in clear and concrete terms either the environmental objectives or the mechanisms that should or could be implemented in order to pursue these objectives. Regulation 2080/92 provided an optional mechanism for afforestation planning (see section 6.5). From 1257/99 the approach was to refer to forest planning commitments resulting from forestry policy, and to mechanisms required for the elaboration of RDPs. However, there were no references to the EIA Directive, even though this Directive has explicit requirements concerning afforestation of semi-natural land.

From 2007 there was also an EAFRD measure explicitly for afforestation of non-agricultural land, and abandoned agricultural land was also explicitly eligible (they had been eligible before but less explicitly), both of which had possible implications for EVG (see below). Payments for afforestation of agricultural and non-agricultural land are to continue from 2014-15.

In a very significant development, from 2009 land afforested under measures existing since 1999 became eligible for the Pillar 1 Single Payment Scheme (SPS) (such land was eligible for set-aside entitlements from 2005). From 2014-15, land afforested since 1999 will be eligible for the new Pillar 1 direct payments. This constitutes a significant incentive to farmers with low-income or negative-income farming systems to abandon the activity in favour of afforestation. For example, many farming systems based on EVG grasslands have been shown to be uneconomic in the absence of Pillar 1 support payments. If the farmer can claim these same payments while avoiding the costs of farming, afforestation becomes a more attractive option.

There is some policy incoherence in the fact that land in active grazing use but with more than a certain density of trees can be excluded from Pillar 1 payments under current eligibility rules because of the presence of trees, while land that is newly planted with the same tree density but NOT under grazing is eligible for afforestation payments AND Pillar 1 direct payments.

Also from 2014-15 an important new policy element is introduced with “greening” and the requirement for holdings to have a percentage of Ecological Focus Area (EFA) in order to receive the green payment. Afforested land is on the list of features that can be counted as EFA, according to the consolidated draft on Direct Payments of 21st June 2013 (Interinstitutional File 2011/0280 (COD)).

However, grassland including EVG is not included on the list of potential EFA elements. This situation creates an incentive to farmers to afforest remaining patches of EVG grassland, especially given the availability of the EAFRD afforestation measure to cover the costs of this action.

Under current CAP rules for permanent pastures, any decline in the permanent pasture area of a region resulting from afforestation that is “compatible with the environment” will not trigger the control mechanism on permanent pastures. Under the proposals for the new CAP, there are requirements for MS to protect environmentally sensitive grasslands against ploughing in areas designated under Natura 2000, with the option to extend this protection to sensitive grasslands beyond Natura 2000. It is not clear whether “ploughing” in this context would include soil disturbance for afforestation purposes.

2.5 EU policies targeting riparian buffer strip development

Riparian buffer strips (RBS) are included in many nitrate action plans (EU nitrates directive, ND), and river basin management plans (RBMPs, Water Framework Directive, WFD) to mitigate emissions from fields to water courses and to protect surface water quality and aquatic ecology. Although they are primarily motivated for their contribution to the protection of surface waters, they also contribute to biodiversity. RBS are therefore accepted for cross compliance in the common agricultural policy (CCAP) as an asset to natural resource management. These policies may either refer to the maintenance of existing RBS next to natural streams or to the introduction of newly installed RBS next to manmade water courses or highly modified streams.

In 2005 buffer strips were mentioned in two Agri Environmental Measures related to productive land management (European Commission 2005):

e) Undersowing and cover crops, strips (e.g. farmed buffer strips) and preventing erosion and fire: Undersowing and cover crops can have positive impacts on water quality, soil quality and biodiversity. Field strips can be positive for biodiversity, and water quality; they can also help prevent soil erosion. Various other measures can be used to prevent erosion and help prevent forest fires.

f) Actions in areas of special biodiversity/nature interest: Measures to promote biodiversity in such areas are many and diverse and include e.g. postponing mowing dates to protect nests, the establishment of buffer strips, and input reduction. There may be secondary positive effects on water quality and quantity.

According to (Dworak, Berglund et al., 2009), a new water-related GAEC buffer strips standard would be implemented by 2012, comprising mandatory establishment of dry buffer strips along water, both within and outside nitrate vulnerable zones [Nitrates Directive 91/676], and with requirements relating to the conditions for land application of fertiliser near water courses. Farmers who do not comply with the new GAEC standard could lose or receive less direct payment compensation. Dworak, Berglund et al. (2009) also provide an inventory of buffer strips regulations, mainly on a voluntary basis, in a considerable number of European countries.

In the CAP 2014-2020 riparian buffer strips have also been identified as elements that can become part of ‘Ecological Focus Areas’ (Piechnik, Goslee et al., 2012). The creation of new, and the maintenance of existing RBS may well be enhanced by the obligation to maintain an

EFA of at least 5% of the arable area of the holding for farms with an area larger than 15 hectares (excluding permanent grassland).

Key messages and conclusions on policies

Key policies affecting EVG:

- Cross compliance requires farmers to comply with SMRs and GAECs. Compulsory GAEC standards ensure a minimum level of maintenance on their farmland, including the maintenance of the permanent grassland area. However minimum management in some MS as simple mechanical clearance, meaning that beneficial grazing can be lost. In the new CAP 2014-2020 stricter requirements are set to ploughing of valuable grasslands inside (obligatory) and outside (voluntarily for MS) Natura 2000 sites; but the option to require minimum grazing regimes and retention of farmland habitats have been removed. Several SMRs put limits on manure and plant protection inputs and require sustainable management practices.
- Through Pillar 1 Article 68 Support can be given to farmers that are important for the management of ecologically valuable grasslands. This may help to prevent the abandonment and enhance the continuation of management entailing additional agri-environmental benefits.
- In the Birds and Habitats Directive several protected habitats are included that represent valuable grasslands. These provide a legal protection basis for EVG within and also outside Natura 2000 sites.
- Pillar 1 (CAP 2014-2020) provides an obligatory measure to prevent permanent grasslands in Natura 2000 sites from being ploughed. MS are also free to identify environmentally valuable permanent grasslands outside Natura 2000 sites for which this obligation applies. The proper identification of these EVG becomes more important to make this measure effective.
- In the new CAP additional payments can be made to farmers with specific production systems which could be HNV farmers or ecological farming systems which are likely to manage EVG
- In the new CAP a new delimitation of Areas of Natural Constraint can be elaborated which can receive a top-up. This provides an opportunity to reconsider the LFA delimitation including more ecologically valuable grassland and creating an additional opportunity to give top-up premia to EVG.
- Farmers can receive special support for the maintenance of ecologically valuable grasslands. Several MS have AES targeted specifically at EVG.
- According to priority 4 in the RDP agri-environment schemes are to give specific attention to the additional needs of farming systems that are of high nature value which is interesting as most EVG are located in HNV farmland areas.
- Projects involving intensification or conversion (including afforestation) of semi-natural farmland are explicitly cited for Environmental Impact Assessments in the EIA Directive. However, policy implementation at national level remains limited.
- The LIFE Nature Programme actions benefit EVG, specifically where they are relevant for populations of species listed in Annex I, of the Wild Birds Directive or in II and IV of the Habitats Directive.

Key policies affecting land at risk of abandonment:

- The GAEC standards linked to Cross Compliance require that farmers must ensure a minimum level of maintenance on their farmland. But if the burden of CC is too great and payments too low, this can drive abandonment.
- Coupled payments are important to support extensive grazing systems. Mostly the land itself is not eligible for CAP-payments but through payments per cow / sheep / goat farmers are encouraged to continue the extensive grazing practices. In the new CAP for certain regions / sectors payments coupled to production might be maintained / reintroduced.
- The young farmers support offers an extra financial top-up for farmers younger than 35 years which may encourage more young farmers to start and continue the farm management and thus prevent farm abandonment.
- In the new CAP a payment for farmers in areas with natural constraints is encouraged and further facilitated. This also applies for investments to improve the farm infrastructure. This encourages supporting farming particularly in areas where abandonment is a problem abandonment, if the payments are high enough. For good targeting this requires a good identification of areas at risk of abandonment.
- Continuation of the afforestation support in the new CAP Can provide an alternative to help to prevent land abandonment. Afforestation is a pause in the abandonment process while farmers are paid to plant trees and maintain them, but these payments are for a limited number of years of course. If the plantations are not economically viable they may still be abandoned when the payments finish.

Key policies affecting farmland afforestation:

- In the new CAP the afforestation measure is to be maintained with a similar combination of payments for establishment, maintenance, and compensation for loss of agricultural income. Both agricultural and non-agricultural land will be eligible for afforestation aids
- There will be an integrated forestry measure that covers “the extension and improvement of forest resources through afforestation of land and creation of agroforestry systems combining extensive agriculture with forestry systems”
- The draft regulation does not set out specific objectives for afforestation.
- The regulation establishes over-arching priorities for rural development policy that include elements of relevance for farmland afforestation, such as restoring, and preserving and enhancing biodiversity, preventing soil erosion and improving soil management and fostering carbon conservation and sequestration in agriculture and forestry
- In order to ensure that afforestation of agricultural land is in line with the aims of environmental policy, the Commission produced a proposed texts (published on 11th March 2014) providing minimum environmental requirements (Article 6) which all relate to species use but not to the type of land cover that can be afforested as is recommended in this study.
- In the new CAP through “greening” the requirement for holdings to have a percentage of Ecological Focus Area (EFA) is introduced in order to receive the green payment. Afforested land is on the list of features that can be counted as EFA. However, grassland including EVG is not included on the list of potential EFA elements. This situation creates an incentive to farmers to afforest remaining patches of EVG grassland

Key policies affecting riparian buffer strips:

- Riparian buffer strips (RBS) are included in many nitrate action plans (EU nitrates directive, ND), and river basin management plans (RBMPs, Water Framework Directive, WFD) to mitigate emissions from fields to water courses and to protect surface water quality and aquatic ecology. Although they are primarily motivated for their contribution to the protection of surface waters, they also contribute to biodiversity. RBS are therefore accepted for cross compliance in the common agricultural policy (CCAP) as an asset to natural resource management.
- In the CAP 2014-2020 riparian buffer strips have also been identified as elements that can become part of EFAs. The creation of new, and the maintenance of existing RBS may well be enhanced by this obligation.

3 DEFINING ECOLOGICALLY VALUABLE GRASSLANDS

Aim and contents of this chapter:

In this chapter the need for providing a definition of Ecologically Valuable Grassland (EVG) is explained and a definition is presented. It is also described how different grassland types are already defined and characterised in existing policies. This is done for the Annex 1 grassland habitats in the Habitat Directive, the ‘highly biodiverse grasslands’ in Article 17.3 of the Renewable Energy Directive, the “uncultivated land or semi-natural farmland” in the Environmental Impact Assessment Directive (EIA) and the grasslands that are part of High Nature Value (HNV) farmlands. The aim is to understand whether and how already existing definitions of grassland categories encapsulate and or partly overlap with EVG. The finally proposed definition is the crucial starting point for the analysis of the data availability for identifying EVGs as described in Chapter 4.

3.1 The need for defining Ecologically Valuable Grasslands

The CAP aims to address (regulate, support) the totality of EU agricultural activity and agricultural land. Agricultural land must fall into one of only three categories named by the policy, i.e. permanent crops; arable and permanent pasture (permanent grassland in the definition proposed in the reformed CAP Regulations, see Section 2.2). Although the current definition of permanent grasslands has been widened, it may still be argued that the CAP Regulations themselves currently contain a contradiction in that all land used for agriculture is not necessarily included in a strict interpretation of the permanent pasture definition as individual Member states can still decide to not include grasslands that are not dominated by herbaceous vegetation even though used for grazing.

For the purpose of this study, we therefore assume that the intention of the policy is to include all agricultural land; ‘grasslands’ is therefore understood to mean all land which is in agricultural use and is not permanent crops or arable and thus:

- 1) Excludes grasslands in which there is no evidence of human intervention (e.g. through grazing, mowing) and cannot therefore be categorized as agricultural land.
- 2) Includes all uncultivated land with vegetation that is grazed and/or cut for fodder or biomass, including herbaceous and non-herbaceous species

The definition above is in line with the definition of grassland as proposed by the EGF working group (2013): *Land devoted to the production of forage for harvest by grazing/browsing, cutting, or both, or used for other agricultural purposes such as renewable energy production. The vegetation can include grasses, grass-like plants, legumes and other forbs. Woody species may also be present. Grasslands can be temporary or permanent.*

By proposing the term Ecologically Valuable Grasslands (EVG), the clear implication is that some grasslands are of greater ecological value than others. This fact is recognised already in several policy instruments at EU level and within countries, as discussed below.

In practice there is a spectrum from grasslands of low ecological value to grasslands of high ecological value; distinguishing EVG from non-EVG grasslands is a value judgement, there is no precise dividing line dictated by science. The challenge is to tease out the over-arching

criteria for making this distinction at the macro level of the EU. At the local level the parameters will vary, although within the same over-arching criteria.

The term “ecological” is linguistically equivalent to “environmental”, ecology being from the Greek οἶκος "house"; and λογία "study of". In practice, ecology is normally taken to focus on relationships that living organisms have with each other and with their abiotic environment. We therefore take “ecologically valuable” to refer to value for living organisms, i.e. for wildlife, or biodiversity.

In this report we propose to take two broad approaches to determining the ecological value of an agricultural grassland:

- On the basis of the biodiversity that is present, typically focused on higher plants but that should also take account of other taxa including soil organisms. Criteria for ecological value can be e.g. presence of a minimum number of species, a certain composition of species (community), or the presence of certain indicator species.
- On the basis of the agricultural use. Critical management practices including grazing and cutting regimes; fertilisation and use of biocides; tillage and reseeded; irrigation and artificial lowering of water tables.

As an over-arching rule, ecological value is higher in the case of grasslands that are not tilled or reseeded, that are not artificially fertilised and where there is no human interference in the water regime. These are the basic determinants of semi-natural and natural grasslands, as distinct from agronomically improved grasslands. Furthermore, (semi-) natural grasslands have often a greater value for carbon storage and soil protection than grasslands that are tilled, reseeded and fertilised.

In practice, a combined approach can be used to identify EVG. Thus semi-natural grasslands in the UK are defined on the basis of plant species composition, and history of use (see Annex 3).

Thus if we are looking for EVG in data sets (a central objective of the present study) we will be looking at data sets that classify grasslands in terms of their biodiversity (e.g. habitats inventories) and in terms of their agricultural use (e.g. agricultural and landuse statistics that include categories such as permanent grasslands, rough grazings, etc.).

The term ‘ecologically valuable grasslands’ is not an established concept. However, there are various concepts and terms within EU policy that can be considered to coincide to a greater or lesser extent with this concept, including: Annex I grassland habitats (Habitat Directive), high nature value grasslands (CMEF HNV farmland indicators), highly biodiverse and species-rich grasslands (Renewable Energy Directive), semi-natural and uncultivated land (EIA Directive) (See Annex 1 for their definition and description) and environmentally valuable permanent grasslands (a term introduced in the new CAP Directive (EC, 2013) Article 31 on Permanent grassland). Also highly relevant are the concepts of “green infrastructure” and “ecosystems” (Target 2 of the EU Biodiversity Strategy 2020), both of which can be understood to include ecologically valuable grasslands as a significant component.

At the same time, the CAP has given increasing prominence recently to the environmental values of permanent pastures in the Pillar 1 “greening” proposals as discussed already above. Also the role of permanent grasslands in carbon sequestration seems to have most clearly been anchored in EU policy, although the biodiversity conservation importance of grasslands is also increasingly acknowledged.

The need for management to maintain the biodiversity value has been underpinned by a large list of scientific literature (e.g. Anger et al., 2002; Bignal and McCracken, 1996; de Miguel & de Miguel, 1999; Nagy, 2002; EC-LIFE, 2008; Poláková, et al., 2011). For grassland this is especially applicable to practices such as grazing and cutting. As long as these practices only cause low to medium disturbance levels, they determine the relative abundance of plant and other species (including fauna) in a habitat, and thus influence 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 e.g. Peco et al., 2006; Palmer and Hester, 2000; Harris and Jones, 1998; Mitchell & Hartley, 2001; Alonso et al., 2001; Stevenson and Thompson, 1993; López-Mariño et al., 2004; Reiné et al., 2000). For example, 92% of all target butterfly species in Europe depend on extensively managed grasslands. For farmland birds, the diversity at landscape level is very important. 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 & Pärt, 2000). Another factor is that low stocking rates in the breeding season reduce the chance of egg- and chick trampling for ground breeding birds (Vickery et al., 1992). A low livestock stocking rate in winter leaves more food available for geese. Undergrazing of pastures e.g. in the dehesas in Spain that had been grazed for centuries also leads to a decline in biodiversity (e.g. MacDonald et al., 2000).

Overall it is generally acknowledged that many grasslands may perform the environmental values mentioned above to a greater or lesser extent than other land covers/uses. What is however not clear is to which extent certain types of grasslands are acknowledged to contribute to these values more strongly than others and how these should be distinguished. Overall however it can be claimed that non-improved semi-natural grasslands that have higher biodiversity values are also performing very well in other services such as carbon sequestration, improving the water holding capacity of the soil and erosion prevention (e.g. Cooper et al., 2009; MA, 2005; Maes et al., 2011).

Grasslands in farming use vary enormously in the way that they are managed and in their physical environment (soil, climate, topography etc.). Their environmental values are equally varied. For the purpose of this report we assume as a starting position that EVG are a category of grasslands that is notable, within the overall context of agricultural grasslands, for its ecological value, although acknowledging that it also delivers services such as carbon sequestration, erosion control, and water management and, fire-control.

The central question now is:

How do we define EVG in order to be able to also identify and potentially target them through CAP and other environmental policies?

3.2 Current approaches to defining and identifying different types of permanent grasslands of ecological value

In the following we will discuss how different grassland types already mentioned in policy documents discussed above are defined and characterised. We start with the Annex 1 grassland habitats in the Habitat Directive and end with the grasslands that are part of High Nature Value farmlands. The aim is to understand whether and how already existing definitions of grassland categories encapsulate and or partly overlap with EVG.

3.2.1 Annex 1 grassland habitats

In 1998 Ostermann published a first list of Annex 1 habitats that depend for their survival on agricultural management practices such as grazing and mowing. This selection of 'semi-natural' habitats was further elaborated by Sipkova et al. (2010), Halada et al. (2011) Luick et al. (2012) adding qualifiers on the level of dependence on agricultural practices.

Table 3.1: Annex 1 habitats that are fully dependent of farming practices for their survival (based on "Farming Natura 2000"⁷).

Habitat name	Code	Agricultural dependence
Coastal sand dunes, inland dunes and halophytic habitats:		
Atlantic salt meadows	1330	1
Pannonic salt steppes and salt marshes	1530	1
Fixed coastal dunes with herbaceous vegetation (grey dunes)	2130	1
Machiars	21AO	3
Dry sand heaths with <i>Calluna</i> and <i>Genista spec.</i>	2310	1
Dry sand heaths with <i>Calluna</i> and <i>Empetrum nigrum</i>	2320	1
Inland dunes with open <i>Corynephorus</i> and <i>Agrostis</i> grasslands	2330	1
Pannonic Inland Dunes	2340	3
Temperate and boreal heath and scrub:		
Temperate Atlantic wet heaths with <i>Erica ciliaris</i> and <i>Erica tetralix</i>	4020	3
European dry heaths	4030	3
Dry Atlantic coastal heaths with <i>Erica vagans</i>	4040	3
Alpine and Boreal heath	4060	1
Endemic oro-Mediterranean heath with gorse	4090	2
Sclerophyllous scrub (matorral)		
Arborescent matorral with <i>Juniperus</i> spp.	5210	1
Thermo-Mediterranean and pre-desert scrub	5330	1
Natural and semi-natural grassland formations		
Rupicolous calcareous or basophilic grasslands of the <i>Alyso-Sedion albi</i>	6110	1
Xeric and calcareous grasslands	6120	2
Alpine and subalpine calcareous grasslands	6170	2
Rupicolous pannonic grasslands (<i>Stipo-Festucetalia pallentis</i>)	6190	3
Eastern sub-Mediterranean dry grasslands (<i>Scorzoneratalia villosae</i>)	62AO	3
Pseudo-steppe with grasses and annuals of the <i>Thero-Brachypodietea</i>	6220	3
Species-rich <i>Nardus</i> grasslands, on silicious substrates in mountain areas (and sub-	6230	3

⁷ see details in the study on farming Natura 2000 : Annex A "Key habitat types of Community interest that are dependent on agricultural management" and Annex C "Main habitats of Community interest dependent on agriculture in each Member State". See also -See also (in the above document/annexes) the references for the relevant scientific papers (Halada et al 2011, Sipkova et al 2010 and the Commission Interpretation Manual of European Union Habitats http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf

mountain areas in Continental Europe)		
Sub-pannonic steppic grasslands	6240	2
Pannonic sand steppes	6260	3
Fennoscandian lowland species rich dry to mesic grasslands	6270	3
Nordic alvar and precambian calcareous flatrocks	6280	3
Dehesas with evergreen <i>Quercus spec.</i>	6310	3
Molinia meadows on calcareous, peaty or clayey-silt-laden soils (<i>Molinion caruleae</i>)	6410	3
Hydrophellus tall herb fringe communities of plane and of the montane to alpine levels	6430	1
Alluvial meadows of river valleys of the <i>Cnidion dubii</i>	6440	3
Northern boreal alluvial meadows	6450	3
Lowland hay meadows (<i>Alopecurus pratensis</i> , <i>Sanguisorba officinalis</i>)	6510	3
Mountain hay meadows	6520	3
Fennoscandian wooded meadows	6530	3
Bogs and fens		
Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davellianae</i>	7210	1
Alkaline fens	7230	2
Rocky habitats		
Siliceous rock with pioneer vegetation of the Sedo-Scleranthion of the Sedo albi-Veronicion dillenii	8230	1
Limestone pavements	8240	2
Forests		
Fennoscandian wooded pastures	9070	3

For a full overview of Annex 1 habitats that can be included in the semi-natural grassland category we refer to the study “Farming Natura 2000”⁸ that identifies the key grasslands/pastures habitat types of Community interest that are dependent on agricultural management: coastal and halophytic habitats. In Table 3.1 we provide an overview of a selection of the habitats that are most/fully dependent on extensive farming practices.

Regarding identification is that there are already systems in place that well define the Annex 1 habitats and provide a clear and consistent approach for identification and monitoring of Annex I habitats⁹ (see Bunce et al., 2012), although not applied to the whole EU territory yet. As specified in Article 17 of the Habitat Directive Member States have to report every six years about the progress made with the implementation of the Habitats Directive. The article 17 reporting gives information on the area and on the distribution of these habitats characterized by the definition of semi natural habitats, which are also outside designated Natura 2000 areas, which means that the Ministries of Environment in Member States should have the information on localization and quantification of grasslands/pastures area.

At EU level, the EEA has produced distribution gridded maps (10x10km) for all habitat types in Annex I of the Habitats Directive. This was made from the national maps, used for the Article 17 reporting. It is expected that the complete release of the Article 17 reported data by the EEA will take place at the end of 2014. Until now it becomes clear however that the

⁸ see details in the study on farming Natura 2000 : Annex A "Key habitat types of Community interest that are dependent on agricultural management" and Annex C "Main habitats of Community interest dependent on agriculture in each Member State". See also - See also (in the above document/annexes) the references for the relevant scientific papers (Halada et al 2011, Sipkova et al 2010 and the Commission Interpretation Manual of European Union Habitats
http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf

⁹ EBONE project: <http://www.wageningenur.nl/en/Expertise-Services/Research-Institutes/alterra/Projects/EBONE-2/Products/Annex-I-Habitats-key.htm>

national approaches are inconsistent and although they should cover the whole national territory still focus on Natura 2000 sites. Therefore the location, extent of these Annex 1 habitats still requires a lot of effort to obtain a spatially explicit up-to-date overview but in some countries there are already useful identification and monitoring frameworks in place as will be discussed later.

Overall, these Annex 1 semi-natural grasslands can be considered a selection of ecologically most important grasslands at the EU level, and therefore they are a sub-set of EVG. Some ecologically valuable grassland types are not included in Annex 1 (e.g. acid grasslands in the Atlantic).

3.2.2 Highly biodiverse and species-rich grasslands in the Renewable Energy Directive sustainability criteria

The land use category that is aimed to be conserved against land use changes for production of biofuels includes both natural and semi-natural (referred to as 'non-natural' in the RED). The focus here should be on the 'non-natural' and the natural grassland categories provided the 'natural' ones can be considered agricultural as there is some evidence of use through grazing. In several often mountainous regions in Europe there are naturally occurring grasslands (climax vegetation) that are used by grazing livestock.

Box 3.1: Legal text for grasslands in of the Renewable Energy Directive

Article 17.3 of the RED specifies that:

Biofuels and bioliquids shall not be made from raw material obtained from land with high biodiversity value, including land that has the following status in or after January 2008, whether or not the land continues to have that status:

(c) highly biodiverse grassland that is:

(i) natural, namely grassland that would remain grassland in the absence of human intervention and which maintains the natural species composition and ecological characteristics and processes; or

(ii) non-natural, namely grassland that would cease to be grassland in the absence of human intervention and which is species-rich and not degraded, unless evidence is provided that the harvesting of the raw material is necessary to preserve its grassland status.

The Commission shall establish the criteria and geographic ranges to determine which grassland shall be covered by point (c) of the first subparagraph.

Further explanations on the definition of the term 'grassland' relevant for its interpretation is given under the "explanation" 69:

[...] Having regard, furthermore, to the highly biodiverse nature of certain grasslands, both temperate and tropical, including highly biodiverse savannahs, steppes, scrublands and prairies, biofuels made from raw materials originating in such lands should not qualify for the incentives provided for by this Directive. The Commission should establish appropriate criteria and geographical ranges to define such highly biodiverse grasslands in accordance with the best available scientific evidence and relevant international standards.

So for the non-natural grasslands the key characteristics are that these would cease to continue to be grasslands if management stops and that they are species rich (See Box 3.1 definition in point (ii) in RED). The latter qualifier can be interpreted very widely or very narrowly.

To understand how highly biodiverse non-natural grasslands are defined and operationalized in the implementation of the sustainability criteria of the RED we discuss two issues in the

following. First we make a summary of how different organisation responded to the public consultation organised by DG-ENER to seek views on how to define grasslands in general and 'highly biodiverse grasslands' more specifically. Secondly we discuss how the concept of these grasslands has been operationalized in sustainability schemes until now.

Response to public consultation

In 2010 the EC organised a public consultation to seek views on possible approaches to define the criteria and ranges of highly biodiverse grasslands¹⁰. In the responses to this consultation very valuable recommendations were made on how to further define and identify these type of grasslands. The consultation asked response to several questions of which the key-questions in relation to the definition of the grasslands in general, of non-natural grasslands and recommendations on their assessment are summarized in Annex 4 and main observations are discussed here. The responses summarized in the Annex 4 come from organisations which have paid particular attention to the EU-wide grassland situation. In the consultation comments were asked to the following operational definitions proposed in the RED:

- Grassland: An area where a continuum of grasses or grass-like plants with few woody plants grows.
- Non-natural grassland: an area whose condition as grassland is maintained [for at least [5] years] as a result of human intervention such as ploughing, sowing, mowing or livestock grazing.

The explanation 69 in the RED (see Box 3.1, second part) underpins the grassland definition. However, the explanation text seems to present a much broader interpretation of what is grassland than the proposed operational definition above which focuses strongly on the grasslands with herbaceous ("grass-like" species) and leaves little space for presence of other woody species, while no mention is even made of scrub-like species. This aspect is therefore criticised by all respondents to the consultation of this paper.

From the responses summarized in Annex 4 to the proposed definition of grasslands in the RED it becomes clear that there is a general agreement that a broad definition should be applied which allows enough space for other than herbaceous vegetation, particular shrub and woody (tree) species. All propose to build on the scientifically based definition of White et al. (2000), but broaden this as follows: "Terrestrial ecosystems dominated by herbaceous and shrub vegetation". The question then arises of where to put the threshold for maximal shrub and tree coverage. WWF proposes to leave grassland types with a shrub/tree coverage of up to 60%. Whether such a threshold is an acceptable one most probably depends on the location and type of habitat involved. Dehesas and other grazed woodland of high biodiversity can for example have tree cover of 60% and sometimes quite a lot more and still have a dense and continuous herbaceous understorey suitable for grazing.

¹⁰ http://ec.europa.eu/energy/renewables/consultations/2010_02_08_biodiverse_grassland_en.htm.

As to the definition of the high biodiversity non-natural grassland several new views were added which were generally overlapping and/or complementary. WWF and IEEP emphasised that the separation between natural and non-natural is not practical when linked to human intervention/management only. What counts most is species richness and level of degradation. The JRC comments that the level of diversity is not higher in natural grasslands as compared to non-natural grasslands, this all depends on types and biogeographical context as is also emphasised by all other responses. Furthermore, the definition of “non-degraded” should take into consideration temporarily and recoverable which is further elaborated in the IEEP response who show that there are 4 types of grasslands in the non-natural category which may not have high biodiversity value in the current state, e.g. intensively managed or abandoned lands but this value can be sometimes (easily) be restored in biodiverse grasslands if right management is put in place.

In all responses the incorporation of the concept of semi-natural grasslands in the definition is recommended. This class of biodiverse grassland is estimated to make up a large part of the highly biodiverse non-natural grasslands in Europe. These are characterised in the responses in a similar way as grasslands which are usually used for extensive livestock grazing and/or hay production. They often need such grazing or other forms of disturbance to maintain their diversity of flora and dominance of the grass sward. They tend to hold a high proportion of native species of open habitats and are often species rich, and are therefore classed as highly biodiverse. They are mostly linked to the Annex 1 habitats of the Habitat Directive as already discussed in the former section of this paper. The overlap of these semi-natural habitats is also underpinning the strong link between the non-natural grasslands in the RED and HNV farmland areas which also show a very strong overlap with the semi-natural grasslands as is specifically stated in the JRC response.

For the assessment of the non-natural grasslands all respondents agree that this should be based on presence of species of both floristic and faunistic indicator species, both above ground and in the soil as emphasised by EFNCP, and management intensity in relation to input levels and also stocking densities of grazing animals. The species richness is an important assessment instrument as not all non-natural grasslands are of equal biodiversity value. The EFNCP also emphasise this, but propose to place larger emphasis for the separation of the species rich from the species poor grassland types through the level of improvement measures applied to the grasslands. At least they assume a high level of correlation between improved grasslands and species poor grasslands and vice versa. So management in their rational provides a practical approach to make a first selection of the real species-poor grasslands (i.e. the GO-areas for biofuel production) after the 5 year threshold level for maintenance of the grassland as grassland. The largest challenge is however to determine the threshold between species rich and species poor. This is for example complicated when it involves grasslands that have some level of improvement in terms of inputs, but certainly do not belong to the intensively managed. The same applies to grassland types in the ‘degraded’ class because of recent abandonment or intensification. For these it becomes quite a challenge to determine whether these can still be ‘recoverable’ provided right management is put in place to bring back the original species diversity.

Sustainability schemes

In May 2009, the European Commission (EC) also requested CEN/TC 383 (European Committee for Standardization) to initiate work on standards. The issue on the highly biodiverse and species rich grasslands was to be further elaborated in a separate report which was agreed to be published by 2012 but still not available¹¹. Therefore clues on how the concept of 'Highly biodiverse and species rich grasslands' is now addressed in the RED can therefore only be derived from the implementation of the concept in sustainability schemes for biofuels already developed and approved. These sustainability schemes need to be developed for biofuels (whether locally produced or imported) used in the EU in order to receive government support or count towards mandatory national renewable energy targets to prove that they comply with sustainability criteria. These sustainability schemes need to be developed by member states or economic operators and need to be approved by the European Commission (EC). One of the criteria to be covered is the prevention of the conversion of areas of high biodiversity and high carbon stock for the production of raw materials for biofuels. As made clear these areas include the highly biodiverse and species rich grasslands as defined in the RED.

Table 3.2: Overview of how 'Highly biodiverse and species rich grasslands' are defined in officially approved Biofuel sustainability schemes and their conservation is verified

Sustainability scheme	Reference/Definition of highly biodiverse and species rich grasslands in the scheme	Means of verification
International Sustainability and Carbon Certification (ISCC)	Highly biodiverse grassland, as stated in the RED, has not yet been fully defined by the EC. Until definitions, criteria and geographic areas featuring grassland with high biodiversity are determined by the Commission, <u>any conversion of grassland in or after January 2008 is prohibited within the ISCC system.</u>	Land use/land cover: Checking of field use before 2008 by means of Satellite pictures, plans of land utilisation or comparable official documents.
Roundtable of Sustainable Biofuels EU RED	This scheme specifies 'no-go' areas and these include the highly biodiverse grasslands as defined in the RED. These are then included in the "no-conversion" areas and these are further defined as "Areas that contain identified conservation values of global, regional or local importance or that serve to maintain or enhance such conservation values".	Conservation values check is done through maps, databases, local experts of presence of 'conservation values of global, regional or local importance'.
Biomass Biofuels voluntary scheme	The 'highly biodiverse and species rich grasslands' are in the category of land with a 'High Biodiversity Status' in or after January 2008'. This status should be designated by law, or by other competent national authority, for nature protection purposes or for the protection of rare, threatened or endangered ecosystems or species recognised by international agreements or included in lists drawn up by intergovernmental organisations or the IUCN.	A check is required on land designations by law, or by other competent national authority, for nature protection purposes or for the protection of rare, threatened or endangered ecosystems or species recognised by international agreements or included in lists drawn up by intergovernmental organisations or the IUCN. In addition is should be verified whether the country of biomass origin has ratified whether the country of origin of the sustainable biomass has ratified the following international biodiversity agreements & conventions: Cartagena Protocol on Biosafety & Convention on International Trade in Endangered Species of Wild Fauna and Flora
Red Tractor Farm Assurance Combinable Crops & Sugar Beet Scheme (UK-based scheme)	All <u>permanent grasslands</u> cannot be converted	Producers are not permitted to convert to arable production areas from (amongst others) areas of permanent grassland (grassland that has been established for more than five years). Producers should therefore retain information of the conversion including area, previous land type and cultivation method for 5 years.

¹¹ It concerns EN 16214-3, Sustainably produced biomass for energy applications — Principles, criteria, indicators and verifiers for biofuels and bioliquids — Part 3: Biodiversity and environmental aspects, which is was expected to be published in 2012, but has not appeared until now.

The EC publishes which sustainability schemes have been approved until now¹² and in Table 3.2 an overview is given of how the concept of the highly biodiverse and species grassland is implemented in a selection of the already approved schemes that are particularly relevant for biomass produced within the EU territory.

From the inventory it becomes clear that because definitions, criteria and geographic areas featuring grassland with high biodiversity have not been further determined by the EC until now the further definition and criteria for their identification remains rather general. In the sustainability schemes there are basically two ways of approaching the identification and preventing the use of the highly biodiverse grasslands.

The first is that these grasslands are assumed to be equal to all permanent grasslands. This is the case for the ISCC and the Red Tractor Assurance Combinable Crops & Sugarbeet Scheme. In the first no further definition is given of grasslands and in the second it is referred to the definition of permanent grasslands in the CAP which implies that it is has remained grassland for at least 5 years or longer, although in several countries (including UK, Netherlands) this grassland can be reseeded every year.

The second approach of ‘highly biodiverse grasslands’ is that it is assumed to be part of land with some ‘official conservation status’ referring to ‘conservation values of global, regional or local importance either acknowledged by law or other national authorities and/or nature conservation organisations. This approach follows the more formal route and optimistically assumes that all grasslands of high biodiversity will already be acknowledged and identified officially.

In conclusion it means that from the sustainability schemes we cannot find direct solutions yet on the definition and identification of highly biodiverse non-natural grassland until now. Either all permanent grasslands are identified as no-go areas or it concerns areas that have some official protection status. Clues on types of management and/or species richness cannot be derived from these schemes until now. However, the basic premise established in the RED remains that highly biodiverse agriculturally used grasslands must be “species rich and not degraded”. These grasslands therefore could be considered as a sub-set of EVG, as species richness is not the only criterion for determining EVG (in some cases EVG may not be “highly biodiverse”, but include species communities of high conservation concern).

3.2.3 Semi-natural and uncultivated lands in the EIA Directive

Through the Environmental Impact Assessment Directive it is required in all EU countries to perform an environmental impact assessment in case of “projects likely to have significant effects on the environment”. The projects include “projects for the use of uncultivated land or semi-natural areas for intensive agricultural purposes” and also first afforestation of such land. However “uncultivated land or semi-natural farmland” is not defined as such in the Directive, nor are “intensive agricultural purposes”. And the implementation in practice is to be done at the member state level. This is also made clear in the Document on

¹² http://ec.europa.eu/energy/renewables/biofuels/sustainability_schemes_en.htm

interpretation of definitions accompanying the EIA Directive as is quoted in Box 2. From this quote a clear definition of semi-natural land cannot be extracted and the freedom of interpretation is very large. This also becomes clear from the translation of the uncultivated and semi-natural land categories in different EU languages (see Annex 4). In some languages such as German and Swedish the term “semi-natural” cannot be translated as such. In fact semi-natural might be considered more scientifically precise than “highly biodiverse” or “ecologically valuable” and is less open to wide interpretations than these terms.

Box 3.2: Definition of “semi-natural farmland” in the EIA Directive

“The definition of what constitutes semi-natural areas will vary from one Member State to the next, given that it relates to the adjudged value of different areas which occur throughout the EU. In this context, the term ‘value’ will certainly include the nature conservation value of an area, but will also include, where relevant, other valued environmental factors. For example, the concept of semi-natural areas may be associated with their landscape and/or archaeological value.

The term ‘semi-natural’ indicates that even areas where there has been some degree of human intervention, which prevents an area from being ‘natural’, will fall within this category, regardless of the moment in time when the human intervention took place. In many Member States, the term ‘semi-natural’ is likely to be applicable to large parts of the country area, although the extent of management will vary.

The definition of which areas should be considered ‘semi-natural’ may, in practice, depend upon a wider evaluation of the role of habitats and areas or features of high biodiversity interest in the wider countryside (such as ponds, small wetlands, ancient hedgerows, patterns of tree cover) by the competent authority or authorities responsible for nature conservation designations or biodiversity in the Member States. Other potentially relevant environmental factors may have to be considered by other authorities — those responsible, for example, for landscape designations or protection of archaeology. There is therefore some margin for discretion, but the main emphasis should be on identifying those areas which reflect natural conditions and have some intrinsic nature conservation or other environmental value which would be lost by agricultural management proposals employed to permit intensification of agricultural practices.”

Source: (Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment (EIA Directive). Interpretation of definitions of certain project categories of annex I and II of the EIA Directive. Document 2008-022)

In our opinion semi-natural land can be defined in a simple way as follows:

Land cover (vegetation) that has characteristics similar to natural habitats (in terms of species composition) but that depends on human intervention (grazing, cutting) for its maintenance in this state

This simple description is also in line with the way semi-natural grasslands are defined by King et al. (2010) as:

“those grasslands which consist of unsown vegetation and are maintained by some form of human intervention, for example grazing by livestock or mowing for hay, but have not been substantially modified by intensive agriculture; fertiliser, where it is applied, is usually provided by organic manure; drainage is avoided or consists of shallow surface drains; herbicides are not routinely used. Semi-natural grasslands are typified by extensive grazing systems using traditional breeds of livestock, and have a relatively low productivity compared with intensively managed grasslands. Where mowing occurs it takes place sufficiently late for flowers to have set some seed. Semi-natural grasslands are rich in biodiversity, as well as contributing to high quality landscape character.” (King et al., 2010, p.6).

The EGF working group also proposes a definition in line with King's definition and not contradicting the simple definition of semi-natural proposed here: *Low-yielding permanent grasslands, dominated by indigenous, naturally occurring grass communities, other herbaceous species and, in some cases, shrubs and/or trees. These mown and/or grazed ecosystems are not substantially modified by fertilisation, liming, drainage, soil cultivation, herbicide use, introduction of exotic species and (over-)sowing (EGF, 2013).*

King et al. (2010) investigated through an expert consultation how the EIA Directive was implemented in 8 Member States in relation to the protection of semi-natural grasslands. The screening by King et al. (2010) on the implementation of the EIA Directive on semi-natural grasslands confirmed that this Directive is being implemented in some regions (e.g. Ireland, Northern Ireland, England, Wales, Estonia, Sweden, Spain, Bulgaria) while in other MS the consulted experts could not find any evidence of it being implemented. In the countries where it was implemented in most cases there were quite high thresholds put as regard to the minimal area size above which an EIA was required. It also seemed that in protected sites (Natura 2000 sites) the thresholds were not applied or lower. From this inventory it has not become clear how different MS have defined the "uncultivated and semi-natural land". The difference in definitions is further illustrated by a comparison of definitions of grassland categories in different languages as specified in different national policy implementations in Annex 5.

3.2.4 High Nature Value (HNV) farmland

A concept that has been receiving much policy attention in the last years within the wider CAP context is that of High Nature Value (HNV) farmland (see Box 3.3 for background and definition). This is a highly relevant concept as semi-natural vegetation that mostly consists of pastures and meadows managed by livestock systems is by far the dominant land use in most HNV farmland areas (Luick et al., 2012 and Paracchini et al., 2008).

Box 3.3: HNV farmland

In the 1990s a common definition of High Nature Value (HNV) farmland emerged: 'farmland that comprises those areas in Europe where agriculture is a major (usually the dominant) land use and where 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 and EEA/UNEP, 2004).

The dominant characteristic of HNV farming is its low-intensity with a significant presence of semi natural vegetation (e.g. Baldock et al. 1993 and Bignal and McCracken, 2000). In certain situations more intensive farmlands in low land western Europe with a high density of green and wet (linear) landscape elements and/or areas that harbour important populations of species of European conservation interest can be considered HNV.

Since 2003 the concept of HNV farmland was increasingly taken up by EU policy and a first official definition of the concept was published by the EEA based on a study done by Andersen et al. (2003) building on this the study by Paracchini et al. (2007) defined HNV farmland as¹³: "Those areas in Europe where agriculture is a

¹³ As identified by Andersen et al. (2003) and subsequently modified by Paracchini et al., (2007)

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.”

There are three HNV types:

- 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 Common Monitoring and Evaluation Framework (CMEF) contains three HNV indicators (see table underneath): a baseline indicator, a result indicator and an impact indicator. They are designed to assess whether the HNV resource is being maintained over the programming period (2007-2013).

Overview of HNV indicators integrated in the CMEF

Indicator	Indicator Title	Measurement
Baseline Indicator 18	Biodiversity: High nature value farmland and forestry	UAA of HNV Farmland (hectares)
Result Indicator 6	Area under successful land management contributing to biodiversity and HNV farming / forestry	Total area of HNV farming and forestry under successful land management, (hectares) i.e. the completion of land management actions aimed at conservation of agro-biodiversity.
Impact Indicator 5	Maintenance of HNV farmland and forestry	Changes in HNV farmland and forestry defined in terms of quantitative and qualitative changes.

The Baseline indicator describes the situation at the beginning of the RDP programming period. As such it functions as a baseline against which the impact of RDP support, in this case support to HNV farming, can be assessed. The Impact indicator measures the changes in HNV farmland both in extent and condition. It assists in determining what has *really* been achieved, in terms of HNV protection, with the resources used.

The three types of HNV farmland that are defined seem to encapsulate all of the grassland categories addressed in the policies discussed above. The HNV farmland type 1 includes semi-natural habitats listed in the Annex 1 of the Habitat Directive and are managed through grazing with domestic livestock and/or mowing. The HNV farmland type 2 with a mosaic of low intensity agriculture and natural and structural elements provides because of this combination important habitats for both faunistic and floristic species which are less likely to occur in intensive farmland areas. This category of HNV is likely to cover all remaining Annex 1 habitats, not covered by HNV type 1, and all grasslands with above average species diversity. Finally there is type 3 HNV farmland which combines presence of rare species of European or national nature conservation value with some form of agricultural management which is not necessarily the most extensive. All HNV farmland types together are likely to cover the whole range of grasslands that are managed by agriculture and where there is either presence of Annex 1 semi-natural habitats and/or a more than average species diversity or presence of rare species of conservation concern. In that respect the HNV grassland types can all be characterised as ‘non-natural’ grassland and species rich grasslands as included in the ‘no-go’ areas of the RED. Provided however that ‘species richness’ is also allowed to be interpreted as presence of species of nature conservation value. The latter has not been made clear in any official document until now however.

Work on identifying (mapping) HNV farmland is also already in place as it is already a concept incorporated in the rural development programme. Therefore Member States have to explore the possibilities of implementing the concept of HNV into their own rural development (including agri-environmental) programmes. The European Commission provides guidelines and supports this process through the European Evaluation Network for Rural Development (EENRD). For the programming of the Rural Development Programme (RDP) period 2007-2013 a new tool for the assessment of the rural development policy was introduced: the Common Monitoring and Evaluation Framework (CMEF). This framework provides a common basis to assess progress, results and impacts (see Box 2 on HNV indicators in the CMEF). The obligation to carry out monitoring within the framework of the CMEF puts pressure on member states to take the identification and monitoring of HNV farmland seriously. To apply this indicator, HNV should be identified and subsequently monitored to measure changes in both the extent and condition (see Box 2). In 2008 a *Guidance Document on the Application of the HNV impact indicator* was published (European Evaluation Network for Rural development, 2008) to provide support to the Member States on how to identify HNV farming in order to direct support to it under the RDP. However MS are free to choose data sources, methodology and whether indicators are also being used to target RDP resources to HNV. Therefore a great variety of approaches exist (Peppiette 2011). Some approaches identify the HNV farmlands by floristic indicator species and presence of Annex 1 habitats (e.g. Germany, Estonia), others put more emphasis on the characteristics of the farming systems in terms of inputs and traditional management practices (e.g. Austria), while other countries apply a mix of indicators covering species and management (e.g. Netherlands). In these specific MS approaches valuable information is brought together however this does not necessarily deliver data with a full area coverage as is for example the case in Germany where the assessment of HNV is done in sample squares only.

On European level the JRC / EEA has also already published a map that gives an impression of the spatial distribution of HNV over Europe (Paracchini et al., 2008). An up-dated version on the European HNV farmland map is due to be published this year by the EEA. Both maps are based on Corine land cover data (CLC 2000 in the Paracchini et al., 2008 and CLC 2006 in the new up-date by EEA) combined with and other auxiliary data sources on areas designated for their floristic and/or faunistic species and or habitats. While the use of the CLC is aimed to ensure some EU wide consistency in the base information the incorporation of the auxiliary data are from national sources and aim to improve the selection of CLC classes to be incorporated in the final HNV farmland map. The national data sources identified in Paracchini et al. (2008) include very interesting national approaches to identifying ecologically valuable grasslands. An overview of these national sources which are already identifying Annex 1 habitats is provided in the JRC response to the public consultation within the RED to seek views on possible approaches to define the criteria and ranges of highly biodiverse grasslands.

3.3 Final definition of and main indicators for ecologically valuable grasslands

In this section we summarize the main observations from the inventory of grassland definitions and propose how to identify from the wider definition of grasslands those grasslands which we can consider EVG and to which extent such grassland are already overlapping with types of grasslands already identified and/or targeted in policy.

The wider definition of grasslands used as the starting point of this study is that ‘grasslands’ are to include all land which is in agricultural use and is not dominated by the cultivation of permanent or arable crops and thus:

- 1) Excludes grasslands in which there is no evidence of human intervention and cannot therefore be categorized as agricultural land.
- 2) Includes all uncultivated land with vegetation that is grazed and/or cut for fodder, including herbaceous and non-herbaceous species and including in certain cases natural grasslands that are grazed.

Furthermore we take as the next starting point that **EVG has a spectrum of values depending on management but focuses on biodiversity value and there is often a strong relation between high biodiversity value and other services.**

Therefore EVG are only a subset of this overall population of grassland types – those which are of high value for biodiversity.

The next step is now to determine which part of the grasslands as defined above can be considered EVG in terms of biodiversity value. From the description of grassland types already defined in existing policies in Chapter 3 and specifically from the responses to the public consultation of highly biodiverse grasslands in the RED Directive it becomes clear that there is a complete or partial overlap with EVG, however we claim that there is not an exact match to one of the categories discussed in chapter 3.

1. Firstly we propose that the EVG subset is predominantly composed of semi-natural grasslands, as long as these are non-improved.
2. Therefore all Annex 1 semi-natural habitats managed by livestock and mowing activities can be considered EVG. For these it does not matter whether they are located inside or outside Natura 2000 sites. The selection of which of these Annex 1 habitats are considered semi-natural grasslands depends on their dependence on extensive agricultural management.
3. All grasslands that are unimproved which are of long-standing, can be considered EVG. Some of these grasslands are impoverished in higher plant species but are still species rich as the diversity in species is found in the soil and in other strata such as in fungi and invertebrates. This implies that EVG can also be more than only Annex 1 habitats, which focusses on the floristic and faunistic biodiversity.
4. EVG are not the same as HNV farmland, although they overlap in the HNV type 1. The mis-match occurs in the HNV type 3 category where there is presence of improved grasslands which are species poor.
5. The EVG are also not fully overlapping with the semi-natural grasslands as defined by the EGF who specify in their definition that *all mown and grazed ecosystems that are not substantially modified by fertilisation, liming, drainage, soil cultivation, herbicide use, introduction of exotic species and (over-)sowing (EGF, 2013).* In this definition

there is still room for some improved grasslands to be included, while for EVG need to be unimproved.

6. Finally it is clear the EVG need to be long-standing which raises the question of how this should be defined. To make this more concrete we propose to link to the EGF definition of permanent pastures which stipulates that these grasslands *'have not been completely renewed after destruction by spraying or ploughing for ten years or longer'*. For the EVG we propose to copy this period indication and exchange 'long standing' for 'ten years or longer' and that this applies to the status of being unimproved. A complete renewal of a grassland after ploughing or spraying is likely to hardly ever result in an EVG in the current definition, even if this has taken place more than ten years ago. This is because the high species richness situation is hard to be restored at all and most certainly not within a period of 10 years.

The following final definition of EVG is therefore proposed:

*EVG are a category of grasslands (including those with non-herbaceous species) that are notable, within the overall context of agricultural grasslands, for their ecological value. EVG have a spectrum of values depending on management but focus on biodiversity value and there is often a strong relation between high biodiversity value and other services. **The EVG are semi-natural and natural grasslands that are not agriculturally-improved (e.g. through cultivation, reseeding, fertilisation, irrigation and drainage) for at least 10 years but mostly longer and species-rich (taking account of all taxa not only higher plants).***

Key messages and conclusions on defining EVG:

Permanent grasslands include **all land which is in agricultural use and is not dominated by the cultivation of permanent or arable crops** and thus:

- 1) **Excludes grasslands in which there is no evidence of human intervention** and cannot therefore be categorized as agricultural land.
- 2) **Includes all uncultivated land with vegetation that is grazed and/or cut for fodder, including herbaceous and non-herbaceous species** and including in certain cases **natural grasslands that are grazed.**

EVG are only a subset of this overall population of grassland types – those which are of high value for biodiversity.

EVG are defined as: semi-natural and natural grasslands that are NOT agriculturally-improved for at least 10 years but mostly longer and species-rich (taking account of all taxa not only higher plants).

4 DATA AVAILABILITY FOR ECOLOGICALLY VALUABLE GRASSLANDS

Aim and contents of this chapter:

In this chapter an inventory is presented of EU wide and national statistical and spatial data sources, that contain data on permanent grassland in terms of area and management. It is assessed per data source which permanent grassland classes are registered, how these are defined and to which extent they fit or can be fitted to the definition of EVG as presented in Chapter 3.

At the end of this chapter the main data gaps are identified, recommendations are made on how to improve the data to identify EVG and a first estimate of the EVG area share is presented using existing data sources.

4.1 Introduction

When focussing on indicators used in different agri-environmental indicator frameworks (Table 4.1) we can conclude that there is no EU wide indicator for ecologically valuable grassland available. However, there are several indicators that do have a strong link as they include (among others) EVG areas or are based on species monitoring data that are partly or fully indicative for EVG.

Table 4.1 Overview of existing indicators and relations with ecologically valuable grasslands

Indicator	Measurement	Data source used	Relevance to ecologically valuable grasslands	Limitations
CMEF C7: Land cover	% area in grassland and semi-natural grassland	Corine Land Cover (CLC)	The natural grassland category is a proxy for EVG. The pastures category is not differentiated between improved and unimproved grasslands	Rough observation which does not provide information on the species present and the type of management.
CMEF C9: Areas of extensive agriculture	% UAA for extensive grazing	FSS	The extensively grazed grasslands should coincide to a large extent with the ecologically valuable grasslands.	Data are available at aggregated regional level. Results cannot be linked to species richness nor to exact grassland management as they are aggregate regional average figures. Some large areas of grassland are excluded, e.g. common lands. It is also not clear how and whether it is exactly established that the grassland is extensive and whether this implies unimproved in the definition of EVG.
CMEF C10: Natura 2000 area	% UAA under Natura 2000	Natura 2000 dataset combined with CLC	Gives a proxy indicator of the location and rough extent of a proportion of EVG, but not the majority.	Since this indicator is a composite indicator with Corine LC has the same limitations as the CMEF C7 indicator above. Furthermore it only covers Natura 2000 sites while EVG also occurs outside these areas.
CMEF O17: Population of farmland birds	Trends of index of population of farmland birds	Birdlife bird count information	Gives an indication of the status of ecologically valuable grasslands as the indicator consists for a certain part of meadow and wintering birds on grasslands	The indicator is a composite indicator which also includes farm land birds living in arable and other fields. The indicator is not available for new MS yet. The indicator only provides results at national level. For the identification of EVG there is a need to make a sub-set of birds indicative for grasslands. JRC is working on this.

Indicator	Measurement	Data source used	Relevance to ecologically valuable grasslands	Limitations
CMEF baseline indicator 18 and AEI: High Nature Value farmland	UAA of High Nature Value Farmland areas	Different national sources are used as MS are required to report on this baseline indicator. At EU level the only source is the EEA-JRC HNV farmland likeliness score (Paracchini et al., 2007)	This indicator can be seen as a proxy indicator for the likely concentration of ecologically valuable grasslands	The indicator refers to HNV farmland in general and not only to HNV grassland areas. The estimates are based on different data sources of varying quality and spatial and temporal resolution. This applies to both the National estimates as the EEA/JRC HNV farmland indicator. Every MS has or is still developing its own approach to reporting on this indicator. Most data only provide a regional or national estimate which does not need to be spatially specific. The exact location of the HNV farmland, let alone the EVG which is part of it is not known.
CMEF impact indicator 5: Maintenance of HNV farming and forestry areas	Changes in HNV areas (in terms of quality and extent)	Not clear yet. Every country needs to develop and collect own data to report on this indicator if RDP support targets HNV farmers/farmland	This indicator could provide proxy information on the changes in EVG as the largest part of HNV farmland is in grassland areas.	Not measured yet by the different MS. Data for measuring it are generally not available in most MS, but efforts are made in some countries may report on the indicator in the future.
SEBI 04: Habitat coverage	Trends in extent of selected biomes, ecosystems and habitats including grassland	Based on Corine land cover and LEAC (Land and Ecosystems Accounts)	This indicator provides an indication in the change in permanent grassland area in the EU	Since this indicator is mostly based on CLC it has the same limitations as for the CMEF C10 indicator.
SEBI 05: conservation status of habitats of Community interest	Provides estimates of the conservation status of permanent grassland habitats per MS	Based on Member State's assessments of Annex I habitats in favourable and unfavourable condition	This indicator provides an indication of the conservation status of permanent grasslands	No all MS report on this. The data are only available at MS level and not more spatially specific
SEBI 20; area under management practices potentially supporting biodiversity	Distribution of HNV farmland	Based on EU wide assessment of HNV farmland following the Paracchini (2007) approach	This indicator can be seen as a proxy indicator for the likely concentration of ecologically valuable grasslands	The indicator refers to HNV farmland in general and not only to HNV grassland areas. The estimates are based on different data sources of varying quality and spatial and temporal resolution. This applies to both the National estimates as the EEA/JRC HNV farmland indicator. Every MS has or is still developing its own approach to reporting on this indicator. Most data only provide a regional or national estimate which does not need to be spatially specific. The exact location of the HNV farmland, let alone the EVG which is part of it is not known.

Most of the indicators in Table 4.1 have been reported on using the data sources to be discussed in the next and also national data sources to be identified and further described in Section 4.2.

4.2 Ecologically valuable grasslands: Data availability in EU-wide data sources

4.2.1 Statistical data sources

There are several EU wide statistical data sources in which one or more permanent grassland categories are defined. An overview of the data sources, categories and definitions is extensively described in Lesschen et al. (2013)¹⁴. A summary of this, specifically concentrating on the categories that are mostly overlapping with the EVG is given here.

An overview of the data sources identified is given in Table 4.2 in which it is specified which type of grassland classes are identified from the broad definition of grasslands taken as a starting point in this study. Meta information on the data sources is provided in Annex 6. A further descriptions of the data sources is provided in Annex 7 for the statistical sources and in Annex 8 for the spatial data sources based on remote sensing and aerial photographic information.

Since the definition of EVG as proposed in the former requires permanent grasslands to be unimproved and species rich it is assessed for all the data bases whether this type of information was used in making the classification.

The statistical data sources such as FADN, FSS and the Crop statistics all distinguish between 'pastures and meadows' and 'rough grazing' (see Figure 4.1). The distinction between the two is based on yielding capacity and whether the grass is improved. The rough grazing category is always unimproved and in that respect fits with the EVG, although the species richness is not known and therefore a complete match cannot be fully expected. From the FSS data in Figure 4.1 it becomes clear that countries that have a large share of rough grazing and therefore likely to be important in terms of Ecologically Valuable grasslands are Austria, Greece, Latvia, Croatia, Portugal, Spain and UK. However, whether this is completely a correct selection depends on what EVG are also included in the 'Permanent grassland and meadows' class. This latter category seems to include both the very intensively managed grasslands, but could also the extensive grasslands with practically no agronomic improvement or high biodiversity value. More qualifiers on both management and species richness are needed to separate the part of meadows and pastures that could fall in the EVG category. Surprisingly in countries like Belgium, Czech Republic, Estonia, Lithuania, Luxembourg, Malta and Poland no rough grazing land is reported at all. This can surely not be true and is likely to be related to the differences in definitions of permanent grassland and Utilised Agricultural Area applied in every country and every type of statistical data source. In next section on national data availability this will be further discussed.

¹⁴ Lesschen, J.P.; Elbersen, B.S.; Hazeu, G.; Doorn, van A.; Mucher, S.; Velthof, G. (2013). Task 1 - Defining and classifying grasslands in Europe. Report for *Grassdate* Project (2012/S 87-142068) Methodological studies in the field of Agro-Environmental Indicators. Lot 2. Grassland areas, production and use

Table 4.2 Overview of data sources, definitions and classes of grasslands used

Name of data source	Permanent grassland classes distinguished+definitions	Classification method	Information on level of improvement?	Classification based on species richness?
Current CAP	Permanent grassland is defined as: <i>land used to grow grasses or other herbaceous forage naturally (self-seeded) or through cultivation (sown) and that is not included in the crop rotation of the holding for five years or longer</i> (Commission Regulation EU No 796/2004).	From a farming practice and land cover perspective	No	No
CAP post 2013	The EC has now proposed an amendment in the original definition in COM(2011) 625 to define permanent pasture as: <i>land used to grow grasses or other herbaceous forage naturally (self-seeded) or through cultivation (sown) and that has not been included in the crop rotation of the holding for five years or more; it may include other species such as shrubs and/or trees which can be grazed provided that the grasses and other herbaceous forage remain predominant as well as, subject to a decision by Member States to include land which can be grazed and which forms part of established local practices where grasses and other herbaceous forage are traditionally not predominant in grazing areas.</i>	From a farming practice perspective	No	No
FADN	<p>1) Meadows and permanent pastures (var.150): <i>Grassland grown for 5 years or more on cultivated land.</i></p> <p>2) Rough grazing (var. 151) <i>Generally uncultivated and not-fertilised land, including scrub, used as poor quality pasture.</i> <i>Generally uncultivated and not-fertilised land, including scrub, used as poor quality pasture.</i></p> <p>3) Permanent grassland no longer used for production purposes and eligible for direct payments (var.314): <i>Areas of permanent grassland and meadows no longer used for production purposes which, in line with Regulation (EC) No 73/2009 are maintained in good agricultural and environmental condition and are eligible for financial support.</i></p>	From an economic perspective in order to allocate both costs and returns to the classes	Yes, rough grazing is uncultivated, no-fertilisers inputs. For other classes not clear.	No

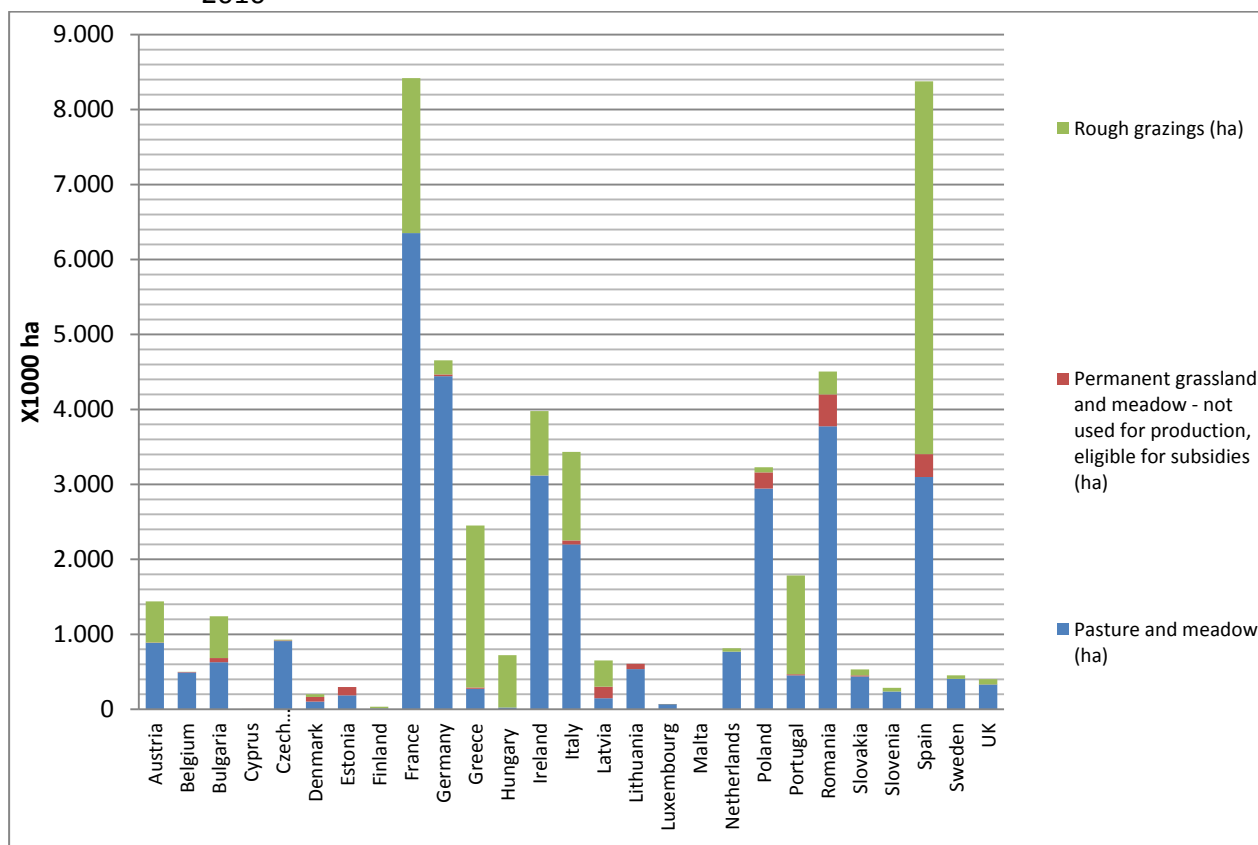
Name of data source	Permanent grassland classes distinguished+definitions	Classification method	Information on level of improvement?	Classification based on species richness?
FSS	<p>F. Permanent grassland and meadows:</p> <p><i>I. Land used permanently (for five years or more) to grow herbaceous forage crops, through cultivation (sown) or naturally (self-seeded) and that is not included in the crop rotation on the holding.</i></p> <p><i>II. The land can be used for grazing or mowed for silage or hay.</i></p> <p>F/1 Pasture and meadow, excluding rough grazing</p> <p><i>I. Permanent pasture on good or medium quality soils. These areas can normally be used for intensive grazing.</i></p> <p><i>II. The following are excluded:</i></p> <ul style="list-style-type: none"> — rough grazing, whether used intermittently or permanently (F/2), — pasture and meadow not in use (H/1). <p>F/2 Rough grazing</p> <p><i>I. Low yielding permanent pasture, usually on low quality soil, for example on hilly land and in high altitudes, usually unimproved by fertiliser, cultivation, reseeding or drainage. These areas can normally be used only for extensive grazing and cannot support a large density of animals and are normally not mowed.</i></p> <p><i>II. This can include stony ground, heath, moorland and ‘deer forests’ in Scotland. Rough grazing not in use is excluded (H/1)</i></p> <p>F/3 Permanent grassland and meadows no longer used for production purposes and eligible for the payment of subsidies</p> <p><i>Areas of permanent grassland and meadows no longer used for production purposes, which, in line with Regulation (EC) No 1782/2003 (or, where applicable, the most recent legislation), are maintained in good agricultural and environmental condition and are eligible for the single payment.</i></p>	Following the definitions in the EC regulation (1999) and updated Regulation 1200/2009	Yes, rough grazing is unimproved by fertiliser, cultivation, reseeding or drainage. For other classes not clear.	No
Eurostat annual crop statistics	The same as for FSS (see above)	Following EC regulation 543/2009	The same as for FSS	No
FAOSTAT	In FAOSTAT under the land statistics (part of the Resource statistics), grassland categories are distinguished. The main distinction is between temporal and permanent grassland and also irrigated versus non-irrigated is distinguished and also the area under organic agriculture is indicated. There is no mention of semi-natural grassland however.	Following FAOSTAT definitions	No, except for irrigation input	No
LPIS	In most LPIS systems a distinction is made between: Temporary grassland: grassland <5yrs without ploughing (categorized under ‘arable land’) Permanent pasture: grassland 5 yrs or > without ploughing. The different types of permanent pasture distinguished in LPIS varies per Member State. For details see Section 4.3 on national data sources.	Farmers judgement on temporal / permanent grassland	In some LPIS systems ‘rough grazing’ and other extensive grasslands specified	No

Aspects of data on diverse relationships between agriculture and the environment

Name of data source	Permanent grassland classes distinguished+definitions	Classification method	Information on level of improvement?	Classification based on species richness?
UNFCCC	<p><i>“Grassland includes rangelands and pasture land that is not considered as cropland. It also includes systems with vegetation that fall below the threshold used in the forest land category and are not expected to exceed, without human intervention, the threshold used in the forest land category. The category also includes all grassland from wild lands to recreational areas as well as agricultural and silvi-pastoral systems, subdivided into managed and unmanaged consistent with national definitions”.</i></p> <p>(source: IPCC Good Practice Guidance for LULUCF, 2003)</p>	Country specific, combination of statistics and RS	Possibly, depending on how unmanaged is defined in the national definitions followed.	No
OECD	The same as FAOSTAT definitions	Following FAOSTAT	No	No
EW-MFA	The same as for FSS	Following Eurostat Crop Statistics	The same as for FSS	No

Information on management could be derived from the survey on agricultural production methods (SAPM). It was carried out for the first time in 2010 to collect data at farm level on agri-environmental measures and it is not clear whether and when this survey will be repeated. Through this survey data were collected on tillage methods, soil conservation, landscape features, animal grazing, animal housing, manure application, manure storage and treatment facilities and irrigation (volume of water used for irrigation on the agricultural holding). The interesting thing is that results of the SAPM are linked at the level of individual agricultural holdings to the data obtained from the Farm structure survey (FSS) in 2010. It should be further investigated whether the combined SAPM-FSS survey data could provide some basis for separating the intensively managed meadows and pastures from the extensively managed (unimproved) grasslands in the FSS survey. Whether this will help to make a first estimate of likelihood of EVG depends on whether links were made on the level of the land use categories at a farm holding and whether these individual FSS and SAPM data are accessible. It is already clear that such an assessment can only be performed at MS level as they collected the FSS and SAPM data from individual agricultural holdings and, observing rules of confidentiality, (aggregated) data were transmitted to Eurostat.

Figure 4.1 Overview of permanent grassland category totals and shares reported in FSS 2010



Source: FSS 2010 (for detailed figures see Annex 13)

In FADN individual farm data are also collected combining land use and production information and land management. The grassland classes for which data is collected are similar to those in FSS and the crop survey of Eurostat. Therefore the same limitations are connected to it, which is that it is difficult to separate the intensively managed meadows and pastures from the unimproved extensively managed ones, except for the rough grazing

category which is also included. However, in FADN more information is available on management of the land than in FSS and the EU data source is centrally available for analysis (at DG-AGRI) at the level of individual farms. Real input factors, such as kg N per hectare per type of grassland are however not available as the management information is collected from the perspective of producing economic accounts. This implies that input levels are specified in economic terms (costs and values in €) rather than in real amounts (e.g. KG N, litres of irrigation water, etc.) and it is not possible to link the management data available to the exact land use class, let alone the parcel. Another limitation of FADN is the representation of small farms as inclusion in the FADN sample needs to be above an economic size threshold (see Annex 8 (Table 1) for details on this threshold, which is different per MS) excluding large parts of the farming population. From the perspective of EVG this is even more of a limitation as we know, also from the experience with HNV farmland identification, that these type of habitats are often more concentrated on farms with limited economic size and part-time farmers, particularly in the CEEC and Mediterranean countries (See Opperman et al., 2012). The representation of farms in FSS and SAPM is clearly much better as they cover all agricultural holdings with a utilised agricultural area (UAA) of at least one hectare (ha) and also those holdings with a UAA of less than 1 ha where their market production exceeds certain natural thresholds.

However, beside representation of farms it also important that not only statistical data are recorded on all farms but that the data also include all land that is in agricultural use. Although the narrow definition of grasslands in the CAP excludes grassed lands with high non-herbaceous coverage (e.g. trees and shrubs), with the inclusion of the 'rough grazing' class in FSS, Crop statistics and FADN there seems to be a coverage of at least part of the EVG that goes beyond the narrow CAP (Commission Regulation EU No 796/2004) definition. To which extent all grasslands are covered fitting with the wider definition of grasslands taken as the starting point for this study (see Section 3.1) requires further investigation into the data sources, especially those at national level. A particular challenge will be to identify the EVG that are on common land, an issue extensively discussed already in the studies on HNV farmland (Paracchini et al., 2006 and 2012).

In LPIS the permanent grassland definition is similar to that applied in the Eurostat and FADN sources, however the subdivision of this class is very different. A distinction is made between sown and self-seed permanent pastures and also between pastures with shrubs and or trees. Both the self-seed and presence of trees and shrubs are proxy indicators for level of improvement, which seems to be limited in both cases. However they are not sufficient indicators for classification as EVG as high input levels can still be applicable in both cases going together with low species richness. Data on the types of pastures from LPIS are therefore an initial indication of the presence of EVG, but need further investigation in terms of level of improvement and intensity of management and presence of species. The latter data are not part of the LPIS but additional management information is likely to be available in LPIS or in other data sources often linked to the LPIS parcel information. This however requires further investigation of data at MS level.

Other statistical data sources in which land use information is collected are from FAO and OECD. These data sources provide data aggregated at country level. They register grassland starting from the wider definition of grassland applied in this study assuming that it includes

all land that is not considered as crop land. Since data to FAO and OECD are the responsibility of the MS it is likely that they are based on similar national data sources used for the reporting of the data to Eurostat for the FSS and/or the crops statistics.

All statistical data sources have been discussed now. Next is now the spatial data sources which have been collected using aerial photographs and remotely sensed information sometimes combined with field based survey information. See for further details on the different sources Annex 8 and Annex 9.

4.2.2 Spatial data sources

Lucas

The first source is LUCAS which provides data on land use and land cover and sometimes also management gathered through a combination of direct observations by surveyors on the ground and by photo interpreting satellite images or orthophotos as done in Corine Land Cover and other sources in the Table 4.3 (for further details See Annex 8).

Based on the LUCAS survey EUROSTAT report on the permanent grassland land cover class. This permanent grassland complies with the definition in Table 4.2. For grassland classes it sets a maximum density of tree-crown of less than 10% and of tree+shrub-crown of less than 20%. In addition in LUCAS points information is registered on dominant land cover (LC1 most dominant and LC2 second most dominant) and land use and for these additional information is registered on % area coverage. For the grassland land cover a distinction is made between Grassland with sparse trees (E10); Grassland without trees (E20) and Spontaneous vegetation (E30). Overall, it is clear that not all grazed grasslands are included in the LUCAS permanent grassland class. A threshold of 20% coverage set with trees and shrub is not sufficient to cover all grazed grasslands. As discussed in chapter 3 much higher tree and shrub coverage is possible while still providing enough understorey for grazing. In Spain (see Annex 12) grazed grassland of 60% or more tree coverage are grazed (good pasture can be found even with 100% crown cover).

In addition per LC also additional information is registered on land use (e.g. type of crops, forests, abandoned etc.) and also information on management, tree coverage and tree height. Management indicators which are helpful (but not sufficient) for identifying EVG (and also land at risk of abandonment) are:

- 1) Visible signs of grazing. This is registered for land covers permanent grasslands, forest and shrubland (see Annex 8, Table 1).
- 2) Presence and type of water management (irrigation, drainage, sprinkler irrigation, gravity irrigation etc.)
- 3) Trees/shrub presence
- 4) Height of the trees present

All this information is relevant for establishing whether grasslands is managed, e.g. in agricultural use and whether it is extensively used are helpful to identify areas that are potentially EVG.

The limitation of the LUCAS information is however that it is point information and that the land cover area can be up-scaled to a total area share per region (Nuts 1,2 3 level) because an area coverage per point is registered. However, for the combination of LC class with additional land management information no area coverage information is gathered. Therefore it cannot directly be established which area it is covering nor representing. Therefore LUCAS cannot be used for making a good estimate of the EVG area nor share as it is the combination of information of LUCAS land cover, land use and management indicator combination that enables to identify permanent grasslands with low input management which are likely to strongly overlap with EVG.

In Table 1 in Annex 8 an overview is given of LUCAS points with specific permanent grassland Land cover and grazing management. The interpretation of the table is complex as it seems that many countries have grazed forest that are known to not having this practice (e.g. Netherlands 52% grazed forests). How this should be interpreted is not entirely clear as the share of forest and shrubs with grazing are very high in countries where this is known to be an almost absent practice. For the point information in Table 1 in Annex 8 it is not known which share of the land use is represented. The shares are therefore not representative for the share of land use, but only for the Lucas points. This implies that in e.g. Spain in 33% of the LUCAS points with main land cover class 'forest' signs of grazing were identified. For which share of the real forest land cover this applies cannot be known directly. If all point information is available it is acknowledged that one can elaborate from all LUCAS points what the real land area is represented by the 2 dominant land cover-land use combinations per LUCAS point. By adding the management indicators to the land cover-land use combinations some area estimate for the management can be elaborated although it remains an estimate. Such an assessment is very time consuming and requires complete access to all LUCAS point information.

Corine LC and other Land Cover information layers

The Corine Land Cover Mapping maps different types of grasslands already since 1990. However the limitations of CLC regarding the identification of intensively, extensively and abandoned grasslands are well known from the HNV farmland mapping exercise (Paracchini et al., 2006). Additional (national and regional) data sources on habitats and species richness were required to separate the intensive from the extensive grassland categories. Furthermore, the CLC data are often based on too coarse data sources and aggregating average observations to large mapping units. Therefore many grasslands of high ecological value of small size become part of the many mosaic classes in CLC. Because of this their identification from the CLC becomes impossible.

For the Global land Cover data the spatial resolution of interpretation sources and mapping units is also a main comment making useful identification of EVG problematic. However the classifications used are different and allowing for a better understanding of the distribution of grasslands in relation to coverage by other than herbaceous species. This is particularly the case with GlobCover and FAOLCC which identify grasslands with a long list of cover classes by shrubs and trees (see Table 4.3 and also further details in Annex 8 per data source).

Table 4.3 Overview of data sources, definitions and classes of grasslands used

Name of data source	Permanent grassland classes distinguished+definitions	Classification method	Information on level of improvement?	Classification based on species richness?
LUCAS	<p>Grassland (E00): Land predominantly covered by communities of grassland, grass like plants and shrubs. The density of tree-crown is less than 10% and the density of tree+shrub-crown is less than 20%.</p> <p>Three subclasses are distinguished:</p> <p>E10 Grassland with sparse trees: Land predominantly covered by communities of grassland, grass-like plants and forbs including sparsely occurring trees (the density of the tree crown is between 5 and 10% and the total density of the tree+shrub crown is between 5 and 20% of the area). Fruit trees in small groups or along an avenue on grassland are classified here as well.</p> <p>E20 Grassland without trees: Land predominantly covered by communities of grassland, grass like plants and forbs without trees and shrubland (density of tree+shrub crown is less than 5%).</p> <p>E30 Spontaneous vegetation: Mostly agricultural land which has not been cultivated this year or the years before. It has not been prepared for sowing any crop this year. This class can also be found on unused land, storage land etc.</p>	LUCAS land cover and land use nomenclatures (see Annex 7)	No	No
Article 17 Semi-natural habitats	<p>The article 17 reporting which needs to be done every 6 years by every MS (last in 2007, next in 2013) gives information on the area, distribution and status of semi natural habitats both inside and outside <u>Natura 2000 areas</u>. Semi-natural habitats are key grasslands/pastures habitat types of Community interest that are dependent on agricultural management: e.g. coastal and halophytic habitats (eg 1330 atlantic salt meadows) ; coastal sand dunes and inland dunes (eg 2190 Humid dune slacks) ; temperate heath and scrub (eg 4010 Northern Atlantic wet heaths with Erica tetralix) ; natural and semi-natural grassland formations (eg 6420 Mediterranean tall humid herb grasslands of the Molinio-Holoschoenion); raised bogs and mires and fens (eg 7230 Alkaline fens). At EU level, the EEA has produced distribution gridded maps (10x10km) for all habitat using the MS reports for article 17. The quality of these maps is heterogenous. For the future, maps will be delivered for the 2007-2012 reporting... which are expected to be of better quality. The new maps from individual MS will start to be available in CDR on the 4th quarter of 2013. The consolidated 10x10 European data set towards the end of the 1st quarter 2014.</p>	Selection of the Annex 1 habitats that are semi-natural	Yes/No MS need to report threats to habitats, so this can also include information on intensification	Yes, indicator species are used to identify the habitats in general, although certain habitats are only identified using aerial and remote sensing information
UNFCCC	<p>"Grassland includes rangelands and pasture land that is not considered as cropland. It also includes systems with vegetation that fall below the threshold used in the forest land category and are not expected to exceed, without human intervention, the threshold used in the forest land category. The category also includes all grassland from wild lands to recreational areas as well as agricultural and silvi-pastoral systems, subdivided into managed and unmanaged consistent with national definitions". (source: IPCC Good Practice Guidance for LULUCF, 2003)</p>	Country specific, combination of statistics and RS	Possibly, depending on how unmanaged is defined in the national definitions followed.	No
OECD	The same as FAOSTAT definitions	Following FAOSTAT	No	No

Name of data source	Permanent grassland classes distinguished+definitions	Classification method	Information on level of improvement?	Classification based on species richness?
EW-MFA	The same as for FSS	Following Eurostat Crop Statistics	The same as for FSS	No
GlobCover	<p>The following classes are distinguished that coincide with grassland in the broad definition of this study:</p> <ul style="list-style-type: none"> - (20) Mosaic cropland (50-70%) /vegetation (grassland/shrubland/forest) (20-50%) - (30) Mosaic vegetation (grassland/shrubland/forest) (50-70%) / cropland (20-50%) - (60) Open (15-40%) broadleaved deciduous forest/woodland (>5m) - (90) Open (15-40%) needle-leaved deciduous or evergreen forest (>5m) - (110) Mosaic forest or shrubland (50-70%) and grassland (20-50%) - (120) Mosaic grassland (50-70%) and forest or shrubland (20-50%) - (130) Closed to open (>15%) shrubland (<5m) - (140) Closed to open (>15%) grassland - (180) Closed to open (>15%) grassland or shrubland or woody vgt on regularly flooded or waterlogged soil, fresh, brakish or saline water 	Semi-automatic	No	No
Global land Cover 2000	<p>Relevant classes distinguished are:</p> <ul style="list-style-type: none"> 3. Tree Cover, broadleaved, deciduous, open (open 15-40% tree cover) 11. Shrub Cover, closed-open, evergreen 12. Shrub Cover, closed-open, deciduous (i) sparse tree layer 13. Herbaceous Cover, closed-open ((i) natural, (ii) pasture, (iii) sparse trees or shrubs) 	Semi-automatic	No	No
CLC1990/2000/2006/2012	<p>Class 2.3 Pastures: Lands, which are permanently used (at least 5 years) for fodder production. Includes natural or sown herbaceous species, unimproved or lightly improved meadows and grazed or mechanically harvested meadows. Regular agriculture impact influences the natural development of natural herbaceous species composition.</p> <p>231: Pastures on abandoned land: Grassland developed by not using arable land for more than three years (Identification of the grassland requires application of data obtained by field checking).</p> <p>231: Wooded meadows: Meadows where dispersed trees and shrubs occupy up to 50% of surface of the area. These meadows are characterised by rich floristic composition.</p> <p>321 Natural grassland: Natural grasslands are areas with herbaceous vegetation (maximum height is 150 cm and gramineous species are prevailing) which cover at least 50 % of the surface covered by vegetation which developed under a minimum human interference (not mowed, fertilized or stimulated by chemicals which might influence production of biomass); here belong for instance grass formations of protected areas, karstic areas, military training fields, etc. (even though the human interference cannot be altogether discarded in quoted areas, it does not suppress the natural development or species composition of the meadows), areas of shrub formations of scattered trees.</p>	Visual/semi-automatic following CLC nomenclatures (see Annex 8)	Yes, indirectly through biomass development and other features	No
FAO-LCC	Grasslands occur under “Cultivated and managed Terrestrial Areas” and “Natural and Semi-Natural Terrestrial vegetation”. A set of classifiers are tailored to the major land cover types. Classifiers	Visual/semi-automatic	Yes, through biomass	No

Name of data source	Permanent grassland classes distinguished+definitions	Classification method	Information on level of improvement?	Classification based on species richness?
	describing grassland are Life forms (Herbaceous – Forbs or Graminoids), Cover and Height.	following methodology (see Annex 8)	development	
GIO HR grassland	Grassland includes the following landscape types: - Pastures, grassland used for grazing or hay production (CLC classes 2.3.111, but also appears in classes 2.1.1 to 2.4.4). - Cultivated or semi-natural grassland within forests, and grass covered surfaces with-in transitional woodland (appears in CLC classes 3.1.1-3.1.3, 3.2.4). - Natural grassland in any surrounding (CLC class 3.2.1). - Grassy areas with low (10%) fraction of scattered trees and shrubs. - Alpine meadows with low fraction of bare rock or gravel.	Semi-automatic following CLC nomenclatures but based on higher resolution information layers (see Annex 8)	Yes, through biomass development	No
Volet grasslands of Geoland2 project	The continental component of the Land Monitoring Core Service (LMCS) as addressed by the EU FP7 project geoland2 has presented a set of high-resolution (HR) pan-European thematic land cover layers (Imperviousness, Forest, Grassland, Wetland and Water). These layers are to supplement the European wide harmonized CORINE Land Cover assessments by important complementary information and by regular updates. The high-resolution (HR) Grassland Layer products aim to serve European-level users (such as EEA and EC DG's) and various national applications with harmonised and validated basic grassland information to fulfil several reporting obligations in the context of sustainable agriculture and Biodiversity 2020 targets (regarding for example connectivity of NATURA-2000 sites and landscape ecological potential).	It is aimed at differentiating grassland types according to wetness, intensity of use (cutting indicator), mixture with high vegetation elements (trees, shrubs) and cover density.	Yes indirectly the level of improvement can be determined based on the wetness, cutting indicator, mixture with high vegetation and the cover density.	Yes, to some extent

For the identification of EVG using the CLC similar problems will be encountered as with the identification of HNV farmland. However, in the last couple of years much progress is being made with identifying different grasslands through RS and aerial photographic interpretation also in relation to CLC. This relates mainly to using higher resolution images for interpretation of grassland classes. Higher temporal and spatial resolution images in combination with better interpretation methods enable better identification of improved and unimproved grasslands. This is also the reason why in CLC 2012 more effort has been invested in distinguishing semi-natural grassland classes such as class 231: Pastures on abandoned land and 321 Natural grassland. This distinction is done by assessing grassland productivity (to establish level of intensity in management) and management in relation to grazing and cutting through indirect features identified on in-situ information or field surveys.

Examples of projects and actions within which such improvements are made are discussed in Annex 9 and particularly refer to GIO HR grassland action and the GEOLAND2 HR project. Both focus strongly on improving the interpretation of the grassland classes summarized in Table 4.3 for GIO HR and Volet grasslands of Geoland2.

EAGLE is a EIONET Action Group on Land monitoring in Europe was set up to discuss solutions for a better integration of national mapping activities with European land monitoring initiatives (i.e. CORINE Land Cover) The objective of the working group is to elaborate a future-oriented conceptual solution that will allow the “feeding” of a European land monitoring database from existing national sources. Special attention in this group is also paid to identifying different grassland classes.

Other interesting activities are performed in the European Grassland Federation in which a working group has recently been set up on semi-natural grasslands to further define and identify national data availability of these grasslands at national level.

Finally it is interesting to know that within the EBONE project a rule based system for Annex I and EUNIS habitats identification in the field has been designed. It enables their consistent identification between EU MS. The full information for the identification of the Annex I habitats is given in the Interpretation Manual of EU27, together with additional information from Evans (2010). The key has been field tested in several EU countries already and links to national mapping activities. Results of this project need further investigation in relation to the grassland habitats identified and mapped until now.

4.2.3 Short term possibilities for identifying EVG for the whole EU territory with Remote Sensing

The mapping and monitoring of ecological valuable grasslands is becoming increasingly important in the context of new EU CAP policy and other environmental policies. At the moment no better input data for the EU wide mapping of EVGs is available than the various CORINE Land cover updates. Between the versions 1990, 2000, 2006 and in the near future 2012 monitoring of grasslands, natural grasslands, moors and heathland etc. is possible.

However, the thematic, spatial and temporal detail is limited. For example, no EU wide information is available on the properties that characterize EVGs. The limitations of CLC regarding the identification of intensively, extensively and abandoned grasslands are well known from the HNV farmland mapping exercise (Paracchini et al., 2006). Additional (national and regional) data sources on habitats and species richness were required to separate the intensive from the extensive grassland categories. Furthermore, the CORINE Land Cover (CLC) is based on satellite imagery with a spatial resolution of 25*25m and the CLC databases have a minimum mapping unit of 25ha which means that detailed spatial information is lost. Therefore many grasslands of high ecological value of small size become part of the mosaic classes in CLC. Because of this their identification from the CLC becomes impossible if not additional data are collected or used in combination.

However, in the last couple of years much progress is being made with identifying different grasslands through RS and aerial photographic interpretation also in relation to CLC. This relates mainly to using higher resolution images for interpretation of grassland classes. Higher temporal and spatial resolution images in combination with better interpretation methods enable better identification of improved and unimproved grasslands.

The classification and mapping of Ecological Valuable Grasslands (EVGs) at European level with remote sensing has potential in the case that the properties of EVGs can be translated into features (remote sensing indicators) that can be classified by the interpretation of satellite imagery.

The translation of EVG's properties into remote sensing indicators will need to be site specific, i.e. the relation will depend in many cases on the bio-geographical region.

In the following EU projects attempts are/were made to monitor grasslands on basis of remote sensing (RS) at higher temporal, spatial or thematic detail:

1. EU wall to wall ecosystem mapping
2. Geoland2
3. HR grassland
4. Extensive managed grasslands – time series analysis

Ad 1. The typology that is used for mapping ecosystems was developed within the MAES working group (MAES Working paper v 9.7.5). This typology groups the main EUNIS-classes into three distinct groups (terrestrial, freshwater and marine ecosystems). The EU wall to wall map is focussed on level 3 of the MAES WG which corresponds with EUNIS level 2 habitats. It is produced on basis of different input datasets. The CLC classes 231 (pastures) and 321 (natural grasslands) are refined into the EUNIS classes E1-E4 on basis of thematic rules (subtract wet (E3) and alpine grasslands (E4)) and phenological characteristics (subdivision in dry and mesic grasslands (E1 and E2)). Correlation with EVG is not 1:1 as for the different grassland types identified it is not known to which extent they are agriculturally managed nor abandoned. In addition since the identification is building on CLC data the result has the same limitations as discussed above: ecological valuable grasslands of small sizes disappear in the large (mosaic) CLC mapping units.

Ad 2/3. In Geoland2¹⁵ a methodology was developed for High Resolution (HR) mapping of permanent grasslands. In the Copernicus Land component on basis of these experiences a permanent HR grassland layer (20m*20m pixel) will be produced for EU. The analysis will use the three reference years (2006, 2009, 2012) to detect the permanent presence of grassland. The discrimination of permanent grassland from other agricultural land areas such as arable land and bare soil needs to take into account seasonal variations. A minimum of 3 (worst case), an average of 4-5 and up to maximum 8 seasonal images of AWiFS data (reference year 2012) will be used as additional information for the classification process. The discrimination of permanent grassland with agriculture use from permanent grassland with non-agriculture use (urban, sport and recreation, airport) will be provided through an Additional Support layer. The grassland will be classified in more spatial detail (higher spatial resolution) as the grasslands in CORINE Land Cover. However, a further distinction in improved and unimproved grasslands is not made. So in that respect it does not support the identification of EVG.

Ad 4. MODIS time series of 2001-2013 prepared for the EEA is a possible valuable source for the detection of extensively managed grasslands. On the basis of various phenological layers (mean, low and peak NDVI (Normalized Difference Vegetation Index), start, end, peak and low season) the development of vegetation within a year and between years can be characterised. Threshold values for grasslands vary between biographical region. The method shows great potential for mapping EVG in Europe. In the Netherlands as case study an extensive managed grassland map was made on basis of phenological characteristics based on multi-temporal DMC imagery. The advantage of DMC over MODIS is the finer spatial resolution of 25m*25m that corresponds with field parcel sizes in the Netherlands. A mask of Dutch-LPIS grassland is subdivided into agricultural grasslands (permanent grasslands and temporary grasslands, intensively managed) and (semi)-natural grasslands (extensive management of grasslands (no mowing in specific periods) and/or restrictions to fertilisation). For both groups a mean growth/NDVI curve is established through the year showing a (significant) lower NDVI in the beginning of the growing season for natural grasslands. This makes it possible to establish an indicator for extensively managed grasslands. However, the threshold value for extensively managed grasslands is still arbitrary and needs to be put in the environmental context. The resulting map shows the deviation in NDVI for a specific area from the mean NDVI of all grasslands in that period March –May (see Figure 4.2).

¹⁵ <http://www.gmes-geoland.info/>

Characteristics EVG mapped with RS:

EVGs properties	RS-indicators	feasibility	projects
grassland mask	Biophysical parameters	++	2/3.HR grassland ¹⁶
extensive agricultural use	NDVI	+	4.Extensively managed grasslands
high species richness ¹⁷	-	-	-
low productivity	Phenology indicators (Low off Season in summer time, low NDVI +/- NDVI of bare soil) ¹⁸	+ / ++	1.Ecosystem mapping

Feasibility:

The mapping of grasslands in more spatial detail (HR Grassland) is under way and will probably be ready in 2014. However, the quality of this map is not yet known. One additional remark: the grazed moors and heathland belonging to the EVGs definition are not taken into account, and thus this exercise is focussed on the herbaceous dominated permanent grassland types.

A broad scale map of EUNIS habitats is produced in 2013. The map shows the spatial distribution of 4 EUNIS grassland habitats over Europe. The accuracy of this map and the link of one or more of these habitats with EVGs still has to be verified, but since the grassland mask used for the spatial allocation of the different EUNIS grassland habitats is based on CLC the result is likely to have similar limitations. At least it will not enable the separation of the LPIS permanent grassland plots into EVG and non-EVGs as the resolution of CLC is too coarse.

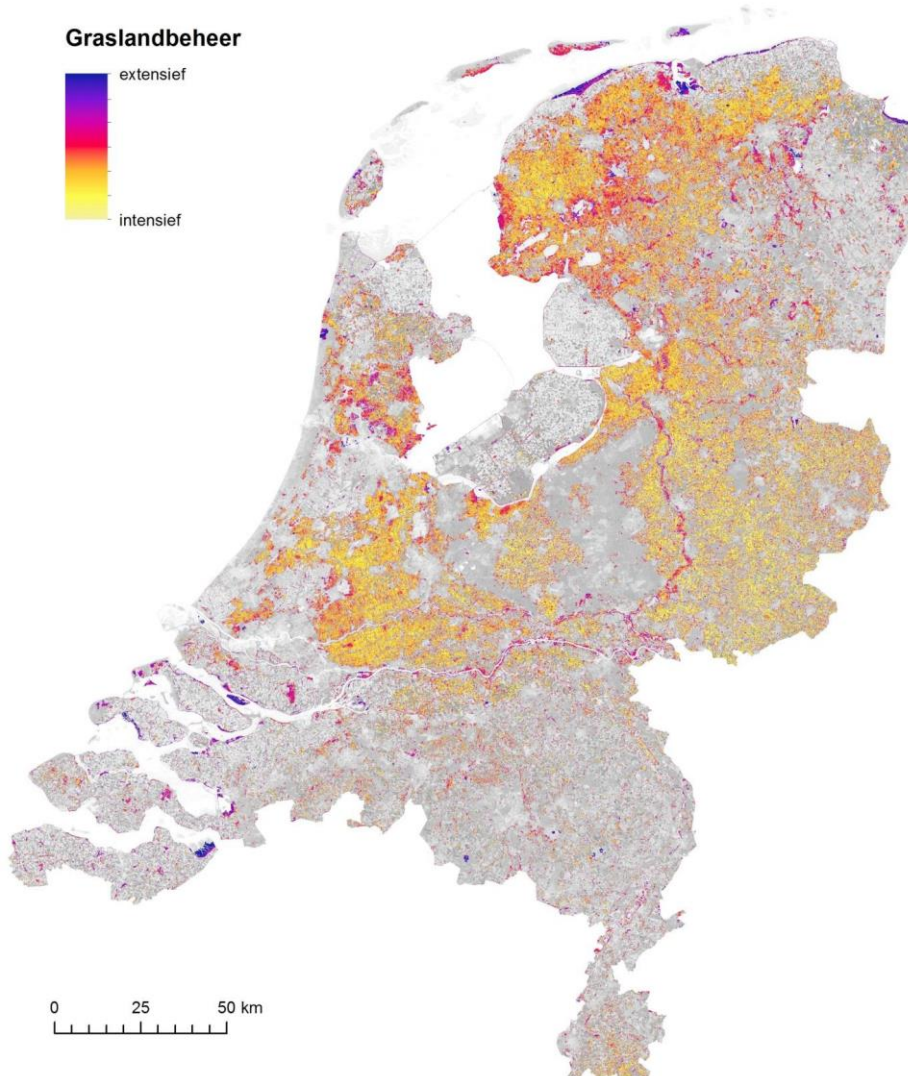
The MODIS phenological dataset shows great potential. In the Netherlands on basis of seasonal DMC data for one year an indicator could be established to map (extensive managed) natural grasslands. However, more testing is required, incorporation of other years and applicability for other biogeographical regions needs to be investigated.

¹⁶ In the methodology description for the production of the HR grasslands the biophysical parameters used are not specified. A subdivision is made between agricultural and non-agricultural permanent grasslands.

¹⁷ The use of remote sensing to detect species richness in grasslands is not operational at EU level. Species richness detection by Remote Sensing is just started at the case study level. Information on structure (phenology) and biochemistry (species) could be obtained by RS having sufficient temporal respectively spectral/spatial detail. Hyperspectral information at high spatial resolution is needed to have information on diversity/number of species. At the moment this RS information for entire EU is not available (expensive, small swath).

¹⁸ The EUNIS definition of dry grassland is: "Well-drained or dry lands dominated by grass or herbs, mostly not fertilized and with low productivity. Included are [Artemisia] steppes. Excluded are dry Mediterranean lands with shrubs of other genera where the shrub cover exceeds 10%; these are listed as garrigue (F6)." In plant phenological terms it could be rewritten as: dry grassland is facing severe water deficits in the hot summer times and will die almost completely in that period; the grass becomes yellow/brown and has almost no photosynthetic activity left at that time. In HANTS phenological terms it could be translated as: dry grassland has a LOS in summer time and the Low NDVI should have a value close to bare soil NDVI values in that period.

Figure 4.2 The deviation in NDVI for all permanent grassland areas from the mean NDVI of all grasslands in that period March –May for the Netherlands. Purple implies low NDVI as compared to average (=extensive) and light yellow implies high NDVI (=intensive) as compared to average



Source: Gerbert Roerink (2013). Extensief graslandbeheer in Nederland.

The feasibility of a species richness map on basis of direct RS measurements at EU level is not possible in the near future. Indications of species richness will be indirect, based on combination of different datasets and/or extrapolation of field sampling information. The combination of RS-indicators to define EVGs needs to be explored.

Another activity that have potential for the detection of EVGs is the EAGLE (EIONET Action Group activities on Land monitoring in Europe) initiative. The objective of the working group is to elaborate a future-oriented conceptual solution that will allow the “feeding” of a European land monitoring database from existing national sources. Special attention in this group is also paid to identifying different grassland classes on basis of national data.

4.3 Ecologically valuable grasslands: National data availability

To identify which data are already collected at national level for grassland categories that come close to the idea of EVG as we are defining it in Chapter 2 a survey was held among country experts. The list of experts is included in Annex 10 and the questionnaire presented in Annex 11. Results of this survey have been used to present the country based overview in Annex 12. These survey results have also been supplemented with results of another questionnaire on agricultural statistical data held as part of a simultaneous project Commissioned by DG-Eurostat to Alterra¹⁹. It involved wider expert consultations in different EU MS working in national statistical offices and responsible for reporting data to Eurostat on FSS, nitrogen balances for AEI, LPIS and IACS data collection. The country summaries in Annex 12 are basically representing the views of the experts consulted through the EVG survey of this study combined with views derived by the authors of this report when studying supporting material on national data availability provided by the national experts.

From the national inventories that have been done it has become clear that there are several countries, but certainly not all, that have suitable data sources with which after integration at field level a reasonable spatially explicit identification of the EVG as defined in this study could be made. The suitable sources at national level are based on field surveys, aerial and remote sensing data interpretations which enable integration of land cover, land use, land management and habitats and species information. These data types together are needed for identification of EVG. The picture at national level is however very diverse. Access to individual data that provide information at farm and field level is very difficult to get. In the scope of this study, such data access could hardly be derived.

Two groups of data have been evaluated as part of this study in most EU member states:

- 1) Data on permanent grasslands and management in national agricultural statistics and land use and management registered in IACS/LPIS at parcel or physical block level
- 2) Ecological data on presence extent and quality of semi-natural habitats/Annex 1 habitats used for article 17 reporting under the Habitat Directive but also used in some countries for identifying HNV farmland areas

For these data sources it has been evaluated to which extent they are helpful in identifying where and how much of EVG are available in every country. This implies that it was necessary to be verify whether the data enable to:

- 1) Identify all permanent grasslands that are truly unimproved and of long standing
- 2) Identify grasslands that are in agricultural use i.e. used for extensive grazing
- 3) Identify grasslands that are species rich

4.3.1 National agricultural statistical service for identifying EVG

The statistical data sources covered in this category are usually the agricultural census data or the agricultural sample and survey based statistical data collected regularly. These also

¹⁹ Methodological studies in the field of Agro-Environmental Indicators. Lot 2. Grassland areas, production and use'.

include the IACS-LPIS systems that every MS is obliged to operate as part of the CAP payment system. Most of the sources collected at national level are input to the national reporting to Eurostat for the two types of databases produced by Eurostat:

- 1) The FSS database
- 2) Annual crop statistics
- 3) Other irregularly published data (e.g. SAPM)

Beside the IACS-LPIS data, which require reporting of land use on all parcels/physical blocks for all farmland receiving Pillar I and/or II payments, census data can be a valuable source of information. Usually the census data, which cover the whole farming population and which are obligatory every 10 years, provide the highest spatial and thematic detail. Most countries held this 10 yearly census around 2010. Some countries do not have a 10 yearly census, but feed the Eurostat FSS database from their IACS data which are collected at a yearly basis. The IACS database covers the whole farming population, or at least the farmland eligible for payments and is updated yearly. Examples of countries who use IACS for reporting to Eurostat are Austria, The Netherlands, Finland, Hungary, Ireland, Poland, Portugal, Romania and Slovakia. This also explains why these countries are able to report to FSS on a yearly basis at Nuts 2 level (see Annex 6).

The question now is: To which extent do national data sources provide added value as compared to the already reported variables by Eurostat for identifying EVG? To answer this question several aspects need to be discussed:

- 1) Categories of permanent grassland types identified in national sources
- 2) Distinction between improved and unimproved grasslands
- 3) Inclusion of all grazed permanent grasslands in relation to national definitions
- 4) Spatial resolution of available data

Categories of grassland vegetation classes registered

There are some countries that register many more categories of permanent grasslands than is required for Eurostat reporting. Some of the categories distinguished are extensive grasslands that are likely to overlap strongly with HNV farmland grasslands and even with EVG as defined in this report as they are truly unimproved.

Good examples of suitable national statistical data sources providing data on classes of permanent grasslands that are likely to strongly overlap with (some part of the) EVG come from several Mediterranean countries. They illustrate that there are a wide range of vegetation types used for grazing and that they include many lands with high shrub and tree cover (see Box 4.1 and 4.2 for an overview). Usually more statistical data sources are required to identify the whole range of grazed habitats in these countries. In the agricultural census of Portugal there are 3 types of permanent grassland separately registered which are characterised by absence of improvement in combination with type of vegetation coverage. Spain also registers some specific separate classes of extensive grasslands that directly coincide with EVG. However, because of the diversity there is no single data source that covers the whole range of grazed permanent grasslands. In France and Greece there is less attention paid to wood-pastures or grazed agro-forestry areas in statistical sources than in the Spanish, Portuguese and Italian sources. In other countries, e.g. the Nordic, CEEC and western countries, the types of grasslands separately registered in different statistical

sources is more limited to the sub categories of permanent grasslands and meadows as specified in FSS e.g. permanent grassland and meadow, rough grazing and permanent grassland and meadows no longer used for production purposes and eligible for the payment of subsidies. An exception is Belgium that does register pastures with trees in LPIS, Scotland also includes a category of 'Open woodland (grazed).

There are also some countries that register alpine pastures separately (e.g. France, Bulgaria) or common land, depending on the importance of these types of grassland categories in the specific countries. The registration of land that is receiving agri-environmental payments is of course also obligatory for the LPIS system. However, there are countries that go further than what is obligatory and include more qualifiers to the LPIS parcels/blocks such as whether it is organically farmed, HNV farmland, part of a protected site/Natura 2000 area or whether it overlaps with Annex 1 habitat areas which makes it suitable to receive AEP for. This will be discussed further later in this section.

Box 4.1: Categories of permanent grasslands reported in Spanish national statistical sources (for details see also Annex 12 'Spain')

In Spain there is a very wide range of vegetation types used and categorised as pasture. This includes many types of land with woody vegetation, even quite dense forest; and also arable stubbles, arable fallow and abandoned arable land. The SEEP²⁰ categorisation makes clear that, compared with some regions of the EU where pasture is generally synonymous with grassland, in Spain there are many types of grazing lands with very high coverage of trees and shrubs that are used for grazing. This diversity is also a reason why there are so many data sources that try to identify the different types of pasture lands.

The types of grassland in the SEEP categorization relevant in relation to EVG in Spain are as follows:

- 1) *Prados* – grasslands in more humid areas (e.g. Atlantic Spain) that are productive enough to be mown (although they may be not mown in practice). *Prados naturales* are unsown but may have been improved through manuring and artificial fertilisation, and may be irrigated; so may be EVG or may not. *Prados* can have some trees and shrubs. *Praderas* generally refers to more productive grasslands that have been sown and agronomically improved, so not EVG, but this interpretation varies according to the data base (also, after several years without cultivation a *pradera* will revert to a more natural *prado*).
- 2) *Pastizal* – permanent grasslands in dry areas (i.e. most of Spain) that generally are not productive enough to be mown and that dry out in the summer months. In principle they have not been sown and climate/soil conditions do not allow for significant agronomic improvement, so generally they are EVG (although may be locally over-grazed). Sub-types include *pastizal* with trees and with shrubs.
- 3) *Erial a pastos* – spontaneous vegetation on low-productivity land that is no longer cultivated. Generally semi-natural, but the land may be previous arable land or occasionally cultivated so not always EVG.

²⁰ The Spanish Society for the Study of Pastures (SOCIEDAD ESPAÑOLA PARA EL ESTUDIO DE LOS PASTOS - SEEP) agreed a terminology/typology of pastures in 2001. The original proposals and justifications are explained in the publication *Pastos* (1997).

- 4) *Dehesa* – farmland with scattered (sometimes quite dense) tree cover, mostly permanent pasture but can be arable. A large proportion of the grassland Dehesas are likely to be EVG, but not all.
- 5) *Matorral* – shrub vegetation, may be under grazing use and then a candidate for EVG if rich in species
- 6) *Monte* – general term for forest vegetation, of which some types are under grazing use e.g. *monte arbolado ralo* is open grazed woodland. All of these overlap with EVG, but many of these are not registered as agricultural.
- 7) *Pastos herbaceos* - herbaceous pastures. These all meet the CAP definition of herbaceous permanent Pasture, although they may have a high proportion of trees and shrubs. High mountain pastures could face eligibility issues post-2014 if land is required to be available for use throughout the year.
- 8) *Pasto arbustivo* - shrub pasture – pasture of woody species (trees or shrubs) of less than 5 metres in height. Used mainly by goats, sometimes by sheep. This type of pasture may include a significant herbaceous element but shrubs may be predominant or even 100%. Technically this does not meet the current herbaceous Permanent Pasture definition, but nevertheless is CAP-eligible under the flexible rules and guidance referred to above. On LPIS these pastures are defined as having >40% shrub/tree coverage.
- 9) *Pasto con arbolado ralo/disperse* - Pasture with sparse tree cover – Forest with open, gappy tree cover (natural or thinned) used for extensive grazing but not always the main production – such land had other uses historically e.g. charcoal making, firewood, but at present there may be no economic use other than grazing and perhaps shooting/hunting.

How these different types are identified in different data sources is as follows:

- The agricultural statistics published annually by the Ministry of Agriculture (MAGRAMA) give a total extent of pastures (*prados* and *pastizales*) in 2011 of 6,494,036 ha. This is the figure reported to Eurostat for pastures in Spain. However the same tables show a column for “land principally used as pasture” that includes *eriales* (abandoned cropland used for grazing), giving a total for 2011 of 10,021,637 ha. This figure does not include grazing land with trees, that is counted in the Agricultural Statistics under “forests”, although the section of the statistics introducing forests explains that this includes land where scattered trees share the space with other uses, that may include grazing under Spanish law. Note that *dehesas* alone cover around 4 million ha but apparently are not counted in the permanent pasture area under these statistics.
- In the agricultural census data on some of these EVG categories are indeed collected and encompass *prados*, *pastizales*, *eriales a pastos*, *monte arbolado ralo* (open Woodland). But *Prados* distinguished as a separate category may in some cases be under intensive use and therefore not EVG. The census gives the total extent of permanent pasture (*prados*, *pastizales*, *eriales a pastos*) in 2009 as 8,377,389 ha. In this case permanent pasture includes all types of pasture of >5 years, including pastures with trees and shrub (quantitative criteria on % coverage are not given) and *eriales*, when these are under some form of farming use.
- In the *Mapa de Cultivos y Aprovechamientos* the categories relevant to EVG are *Prados y praderas naturales* – these are described as having “natural” vegetation, but

as already mentioned some may still be under intensive management, making it problematic to assume this is all EVG. There are two separate categories for those with occasional irrigation and those with more permanent irrigation. There are four separate categories for *Prados* with trees, with shrubs, with both and with fruit trees (orchards with permanent pasture) – probably all EVG. *Prados de alta montaña* are mountain herbaceous grasslands used for grazing - EVG. *Pastizales* are permanent grasslands in dry areas that are not productive enough to be mown, and that generally are not ploughed (except in some cases for occasional clearance of shrubs), so these can be included in EVG. There are separate categories for *pastizales* with trees, with shrubs, and with both – which can also be expected to be EVG. *Pastizal* in this data base includes *erial a pastos*.

- Permanent pastures according to ESYRCE covered 8,360,026 ha in 2012. This figure includes pastures with trees up to 20% cover and pastures with shrubs that may reach 100% cover if still used for grazing. It does not include land with >20% tree cover.
- SIGPAC²¹ is the Spanish LPIS - Categories that encompass EVG are *pastizales*, *pastos arbustivos*, *pastos arbolados*. The *pastos arbustivos* and *pastos arbolados* are assumed to be EVG, although management may not be perfect for conserving ecological values (e.g. possibility of localised over-grazing). In this data base the category *pastizal* includes *prados* and also *praderas*, some of which are under intensive management (especially *praderas*), so whereas the majority of this category can be assumed to be EVG, it is not 100%. According to LPIS there was a total area of permanent pasture of 18,622,983 ha in 2013 (see Table X in Annex 11 ‘Spain’). This figure is the sum of the categories PA (*pasto arbolado* or pasture with trees >40% cover), PR (*pasto arbustivo* or pasture with shrubs >40% cover) and PS (*pastizal* or pasture with <40% tree/shrub cover). Approximately 86% of the total area of pastures on LPIS are in the categories of pastures with trees (PA) and pastures with shrubs (PR). They amount to 16 m ha in total. By contrast “herbaceous” pastures (PS) cover only 2.5 m ha, but note that this category of pasture can include up to 40% tree/shrub cover, so even this type is far from being purely herbaceous.

Box 4.2 Categories of permanent grasslands reported in Portuguese national statistical sources (for details see also Annex 12 ‘Portugal’)

In terms of types of grazing lands the diversity in Portugal is likely to be as large as in Spain with similar problems in relation to identification and eligibility.

As to the statistical sources in Portugal there is the agricultural census RGA (*Recenseamento geral Agricola*)²² in which data are collected for different types of permanent grassland categories.

These include categories that could entirely or almost entirely be part of the total EVG area

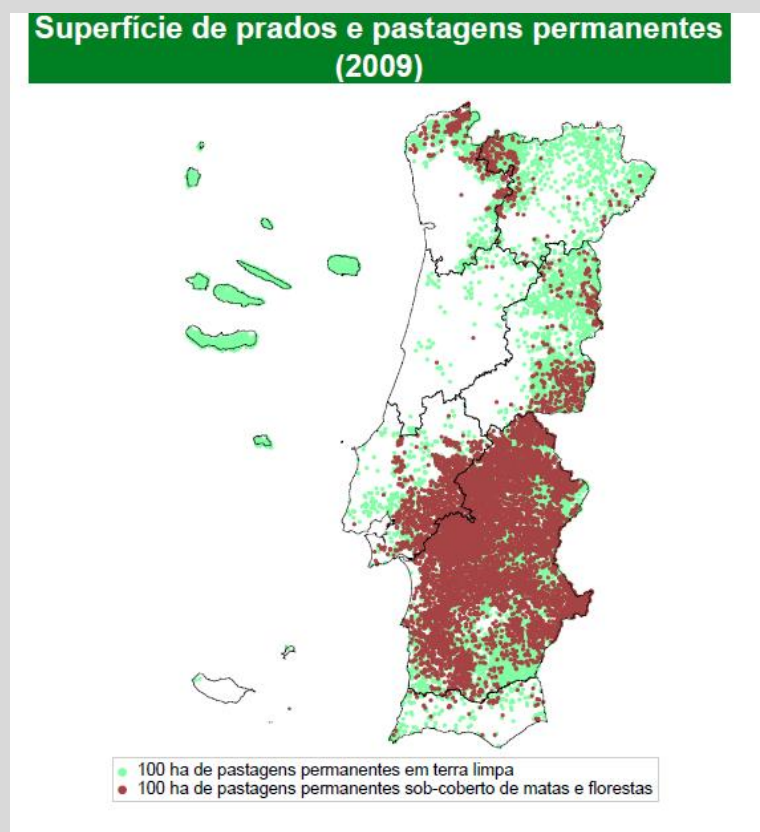
²¹ <http://sigpac.magrama.es/fega/visor/>

²² http://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_publicacoes&PUBLICACOESpub_boui=119564579&PUBLICACOESmodo=2 in the page 48 of the report RA_2009_part1 there is a map containing the areas per type.

in Portugal as they are unimproved and could also be non-herbaceous. The state of unimprovement is determined by the absence inputs of fertilisers, irrigation, drainage and are located on poor soils. These categories are:

- 1) Permanent grasslands unimproved with dominant herbaceous cover (*prados e pastagens permanentes pobres em terra limpa*)
- 2) Permanent grasslands unimproved with bushes/shrubs/matorral/montes (*prados e pastagens permanentes pobres sob-coberto de matas e florestas*)
- 3) Permanent grasslands unimproved with permanent cultures/trees/montado (*prados e pastagens permanentes pobres sob-coberto de culturas permanentes*)

The results of this survey show that there are 1.83 mln ha of permanent pastures in Portugal of which almost 75% are unimproved and that more than 50% have some kind of herbaceous and/or forest cover either by natural vegetation or from permanent tree cultures (e.g. oaks in Montados, or olive trees, almonds etc.).



Turquoise coloured patches are predominantly herbaceous permanent grasslands. Brown patches represent the permanent grasslands with some shrub and/or tree cover. (Source: *Recenseamento geral Agrícola, 2009*)

The RGA is a quite complete database covering all 4.7 mln ha of land occupied by agricultural holding in Portugal. Of this land 78% is defined as agricultural (either arable, permanent crops or permanent grasslands), 18% is forest and shrub land with no economically exploited understory (no grazing) and the remainder 4% consists of buildings, infrastructure and other non-productive land uses.

Box 4.3: Examples of categories of permanent grassland registered in IACS-LPIS

In the **Italian** IACS-LPIS system several classes of permanent grasslands are registered including those in AEP (see Annex 12 'Italy' Table 1). The types of permanent grasslands registered provide 4 different types of rough grazing classes (so unimproved) with different levels of coverage with trees and shrubs, one permanent grassland class, one permanent pasture class and 3 different types of agro-forestry classes with different levels of shrub and/or tree cover levels.

In the **French** LPIS there are the following types of permanent grasslands registered:

- Permanent grasslands devoted to hay sold off farm
- Permanent grassland
- Alpine and summer mountain pastures
- Heather and rangelands (*landes et parcours*)
- Ligneous rangeland (for Corsica only)

For the first 2 categories it is clear that no distinction is further made between intensive and or improved and extensive/unimproved grasslands and species richness. For the later 3 categories it is clear that these are unimproved grasslands and that they are likely to cover a large area share of the EVG in France.

In the **Dutch** LPIS the following permanent grassland sub-categories are distinguished:

- 1) Permanent grasslands
- 2) Natural grasslands with main function agriculture
- 3) Natural grasslands with limited agricultural activity
- 4) Moors and heathlands

The 'natural' grasslands refer to rough grasslands not seeded. Whether these can be fully included in the EVG category is further discussed in Box 4.6.

The **Austrian** LPIS system includes many parameters at field level on different types of permanent grassland, including all very specific traditional grasslands and meadows targeted in AEP.

In **Belgium** LPIS the type of permanent grassland types included are:

- 1) Permanent grasslands
- 2) Permanent grasslands with grass-clover mix (>5 years)
- 3) Grassland with trees (>50 trees/ha)
- 4) Grasslands with AEP

The registration of Grassland in AEP is not an exception as all countries need to register this, but the registration of trees in grasslands is different from practice in most other EU countries, except for most Mediterranean countries.

In **Spain** the LPIS registers three types of permanent grasslands but it also registers the forest area used by farms, although not eligible for payments. The figures (see Table 1) illustrate that only a very small proportion of the permanent grassland area is predominantly herbaceous. The LPIS data from 2013, shown in Table 1 below show that approximately 86% of the total area of pastures are in the categories of pastures with trees (PA) and pastures with shrubs (PR). These LPIS categories have 40-100% shrub cover and 40-80% tree cover. They amount to 16 m ha in total. By contrast "herbaceous" pastures (PS) cover only 2.5 m

ha, but note that this category of pasture can include up to 40% tree/shrub cover, so even this type is far from being purely herbaceous. However, there are variations to the pattern. Regions where herbaceous pastures make up a more significant proportion of all pastures (though still only 30% at most) include Atlantic regions such as Asturias, Basque Country, Cantabria and Galicia, as well as Andalucía.

Table 1: LPIS categories PA (pasto arbolado), PR (pasto arbustivo) and PS (pastizal) – all are CAP eligible. FO is forest, not CAP eligible

	2013					
	PA	PR	PS	Total pasture	FO	TOTAL
	(ha)	(ha)	(ha)		(ha)	(ha)
ANDALUCIA	10,065,097	881,027	965,679		1,153,160	4,006,376
ARAGÓN	373,461	1,379,050	43,030		889,390	2,684,931
ASTURIAS	11,820	308,188	109,519		385,660	815,187
BALEARES	40,092	81,008	3,145		101,403	225,649
CANARIAS	1,670	376,507	4,422		102,828	485,426
CANTABRIA	24,930	179,900	119,722		141,813	466,365
CASTILLA-LA MANCHA	816,849	1,669,866	92,892		983,493	3,563,099
CASTILLA Y LEÓN	772,475	2,277,398	371,841		1,312,797	4,734,510
CATALUÑA	397,730	672,859	40,284		895,324	2,006,197
EXTREMADURA	1,059,218	789,970	223,956		297,643	2,370,787
GALICIA	63,235	825,041	344,193		1,051,578	2,284,047
MADRID	94,360	186,775	37,669		70,524	389,329
MURCIA	93,631	295,202	6,828		121,418	517,079
NAVARRA	28,302	145,821	77,047		362,426	613,596
PAIS VASCO	22,789	77,123	73,389		359,448	532,750
LA RIOJA	34,083	182,669	5,455		84,383	306,590
VALENCIA	153,896	767,102	13,357		357,500	1,291,855
TOTAL	4,995,051	11,095,505	2,532,426	18,622,983	8,670,789	27,293,771

Source: LPIS Spain 2013

Permanent grasslands and intensity of management

EVG are not improved and of long standing. Generally this is difficult to establish for all different categories of permanent grasslands reported in different statistical sources. Management of a grassland needs to be established at parcel level, but most information on management and land use is not jointly reported nor collected at this level. There are however several examples of data collection in which distinctions are made in improved and unimproved and in intensive and extensive permanent grasslands (see Box 4.4). For all the wide diversity in grassland vegetation types registered it still remains very difficult to establish whether these are truly unimproved and/or whether the reported unimprovement status is correct. For grasslands registered as rough grazing one can expect that in most cases they are correctly reported by the users as inputs are completely absent. However

they can still be heavily fertilised by high grazing intensity, whether this is taken into account when classifying them into the rough grazing class is not known.

Some of the categories distinguished are likely to be largely unimproved, such as the ones classified in the rough grazing class, but for the rest of the permanent grasslands it cannot be established how intensively/extensively they are managed and to which extent they have been improved. Even in countries that do distinguish between intensive and extensive grasslands it remains a challenge to establish whether they are truly unimproved in terms of absence of artificial input and low manuring through grazing (see Box 4.4).

Box 4.4: Examples of farm management data available in agricultural statistical sources

In the **French** census and TERUTI data in which a distinction is made between improved and unimproved grasslands and also common grazing lands, however, the definition of intensive and extensive has limitations as it is debatable whether one threshold value of <5Y Ton DM/ha can be applied countrywide to separate the intensive from the extensive grasslands. Furthermore the threshold chosen does not coincide with complete un-improvement status required for EVG. An alternative and more useful source of information in France would then be the latest survey on agricultural practices on grassland²³ (2006) which indicates that one third of the permanent grasslands are not fertilised with artificial fertilisers (*Enquête pratiques prairies permanentes* 2006). This is interesting to know, but a major disadvantage of this source is however that it only covers the pure grasslands with dominant herbaceous cover. So to include all grazing habitats it is better to combine this data source with the TERUTI data, which is another interesting source of information on land use which is a stratified sample based approach using aerial photographic interpretation and field survey data collection. It is comparable to LUCAS but applied at much denser grids covering the whole of France and up-dated regularly. Relevant grassland types coming near to the definition of EVG are grassland with traditional orchards, and summer or communal grasslands and extensive permanent grasslands registered in TERUTI. The definition of low productive follows the same logic as in the agricultural census and is therefore also limiting, but if combined with the data on artificial fertilisers may still yield an almost complete picture of unimproved permanent grasslands in France at regional level.

The **Austrian** LPIS system includes many parameters at field level on management such as stocking density per field and a long list of management requirements in the Austrian AEP (ÖPUL). This programme covers a large part of the agricultural territory which is characterised by a small farm structure a very high share of organic and extensive farming which depend heavily on CAP funding. For a detailed overview see Annex 11 'Austria'. The mapping on HNV farmland (Type 1 and 2) was done by using the LPIS data only and confirms that the data contained in this database is a very good basis for identifying the unimproved farmed grassland habitats representing EVG.

²³ This survey is based on a sample of representative grassland types. While it gives indication on the % of grassland under different management regimes, it does not give the actual size of the sample. Such survey is undertaken at regional (NUTS 2) level. The last one dates 2011 but has not been released yet.

The **Danish** LPIS and the registry system for farms (GLR)²⁴ also collect information on permanent grasslands. For this category additional valuable information that helps to identify EVG grassland categories is collected. The additional information that is also registered per permanent grassland plot is:

- 1) Permanent grassland under the Single Payment Scheme (SPS) with the land-use code 250 which is grassland with very low yield (and low input: Nitrogen <25 kg/N/ha). It comprises approx. 11.000 hectares.
- 2) Additional information is also registered about nature area status and also organic farming status. Such status can be taken as an proxy indicator for low intensive management and is therefore used to identify the farmlands with likely low intensity management in the HNV farmland indicator approach.

In the **Bulgarian** IACS/LPIS and the agricultural census data the deviation in low and high productive grasslands is made by determining on which type of soil the grassland is. Poor soils and thus low productive grasslands are registered in soil class 8-10 in the Bulgarian soil map. High productive grasslands and meadows are in soil class 1-7. Whether in the case of

For inclusion in the EVG group it needs to be established whether they are really unimproved and this is usually not the same as 'extensive', as low input levels for these grasslands may still be allowed. Generally one can expect that if permanent grasslands are categorized into the rough grazing class there will not be more substantial improvement such as irrigation, drainage and ploughing. However whether there will be no input of artificial fertilisers is likely to be more difficult to assume. Furthermore, even if no artificial inputs are there they may still be a very high input of fertilisers through organic manuring through intensive grazing (see also Box 4.5 on Dutch validation results). So ideally additional information on the level of (nitrogen) inputs and grazing density over several years would be required to separate the EVG from the rest of the permanent grasslands both for the permanent grassland and meadow classes as for rough grazing and other possible classes of permanent grasslands registered.

However, It can be concluded that the most detailed information on type of management and use of permanent grasslands is available in the IACS/LPIS database. Some of the categories distinguished are clearly unimproved, but for the rest of the permanent grasslands in most countries it cannot be established how intensively/extensively they are managed and to which extent they have been improved. The only exception to this is the Austrian LPIS information in which stocking density can be obtained per plot in combination with a whole range of information on different types of traditional permanent grassland categories and AEP management practices applicable. Austria is however the only country with this level of information included in LPIS. This country is also exceptional as the number of farmers included in AEP schemes is very high covering a large part of the permanent grasslands.

²⁴ AgriFish Agency, The Ministry of Food, Agriculture and Fisheries

Overall it can be concluded from the former that the most crucial information on farm management to identify EVG from LPIS is stocking density and absence of irrigation, drainage and ploughing for at least 10 years or longer. A distinction between irrigated and dry grasslands is made in most LPIS systems in Mediterranean countries. Information on the other factors is not collected in any LPIS system.

Box 4.5 Reliability of farm management information in Dutch LPIS

With remote sensing information the vegetation development of different types of LPIS grasslands were assessed in order to establish to which extent permanent grasslands, rough grazing lands and natural grassland classes were correctly declared. The method to measure the productivity of grasslands and especially the development in the biomass through the year refers to the NDVI (Normalized Difference Vegetation Index). On the basis of various phenological layers (mean, low and peak NDVI (Normalized Difference Vegetation Index), start, end, peak and low season) the development of vegetation within a year and between years can be characterised. Threshold values for grasslands vary between biographical region. In the Netherlands as case study an extensive managed grassland map was made on basis of phenological characteristics based on multi-temporal DMC imagery. The advantage of DMC over MODIS is the finer spatial resolution of 25m*25m that corresponds with field parcel sizes in the Netherlands. A mask of Dutch-LPIS grassland is subdivided into agricultural grasslands (permanent grasslands, temporary grasslands) and (semi)-natural grasslands (extensive management of grasslands (no mowing in specific periods) and/or restrictions to fertilisation). For both groups a mean growth/NDVI curve is established through the year showing a (significant) lower NDVI in the beginning of the growing season for natural grasslands. This makes it possible to establish an indicator for extensively managed grasslands. However, the threshold value for extensively managed grasslands is still arbitrary and needs to be put in the environmental context. The resulting map shows (see Map 1 and Map 2) the deviation in NDVI for a specific area from the mean NDVI of all grasslands in that period March –May (see Figure 4.2).

Next an overlay was made of the mapped semi-natural habitats included in the Dutch Symbioses system. This system includes all vegetation mapping results of botanists in The Netherlands and is regularly up-dated. A selection was made of the locations where semi-natural habitats occur (according to species composition and presence) that fall in the definition of EVG. Also this information was spatially matched with the LPIS plots for different permanent grassland categories.

Results:

It confirms that the very large majority of permanent grasslands (91%) declared in LPIS are of intensive nature, but that there are also extensive grasslands within this group (see Table 1). However it turns out that a large majority of the LPIS grasslands categorised as rough grazing are actually quite intensive with a very high biomass production measured through the NDVI.

The overlay between the Symbioses selection of semi-natural grassland with the LPIS grasslands shows that only 40% is agricultural, or at least overlaps with a declared LPIS plot. The other 60% is likely to be part of a protected natural area and not managed agriculturally. In total the symbioses semi-natural grasslands only match with 2.3% of the permanent grasslands or rough grazing classes declared in LPIS. There is no clear over representation of

the symbioses type in the rough grazing class. 16% of the semi-natural grasslands from symbioses do not match with a grassland class, which is surprising. An overlay between the Synbioses plots and the NDVI was not very meaningful however as the semi-natural plots were too small in size to reliable link the NDVI measure to the semi-natural grassland.

Map 1: LPIS grasslands in The Netherlands

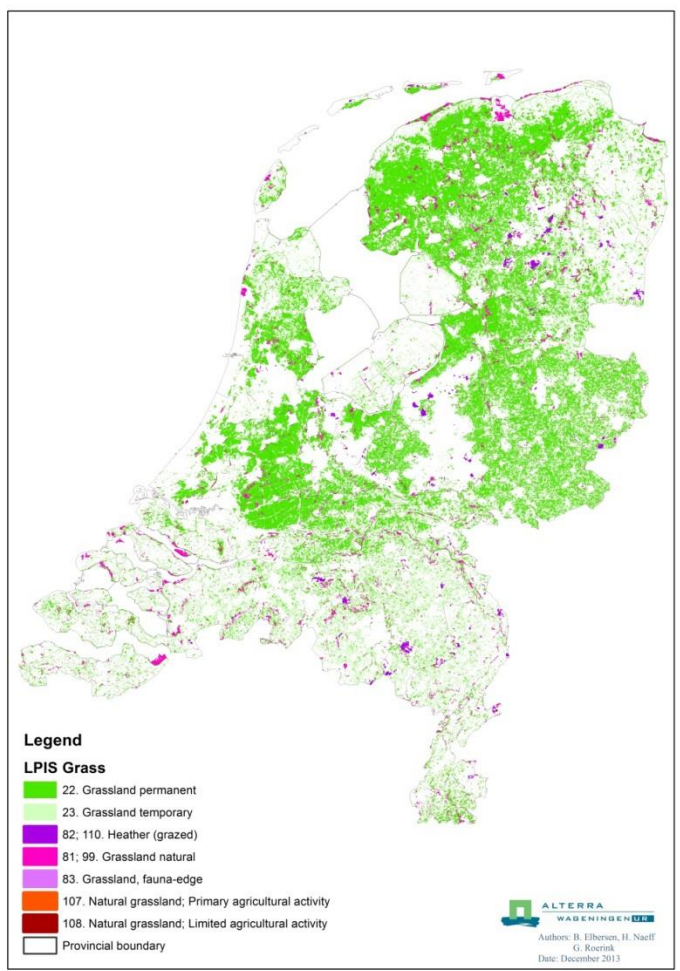


Table 1: Match NDVI class different types of permanent grasslands registered in LPIS

LPIS class:	Ha	NDVI=1 (very intensive)	NDVI=2 (intensive)	NDVI=3 (intensive)	NDVI=4 (medium intensive)	NDVI=5 (less intensive)	NDVI=6 (extensive)	NDVI=7 (very extensive)
Permanent grassland	724,173	24.6%	45.4%	20.9%	6.4%	2.0%	0.6%	0.1%
Rough grazing	45,426	2.1%	21.0%	36.8%	28.7%	19.7%	9.4%	2.0%
Rough grazing with limited agricultural activity	167	0.2%	1.3%	12.6%	31.0%	42.2%	11.8%	0.9%

Map 2: Overview for all LPIS locations the mean NDVI for of all grasslands in the period March –May for the Netherlands. Purple implies low NDVI as compared to average (=extensive) and light yellow implies high NDVI (= intensive) as compared to average

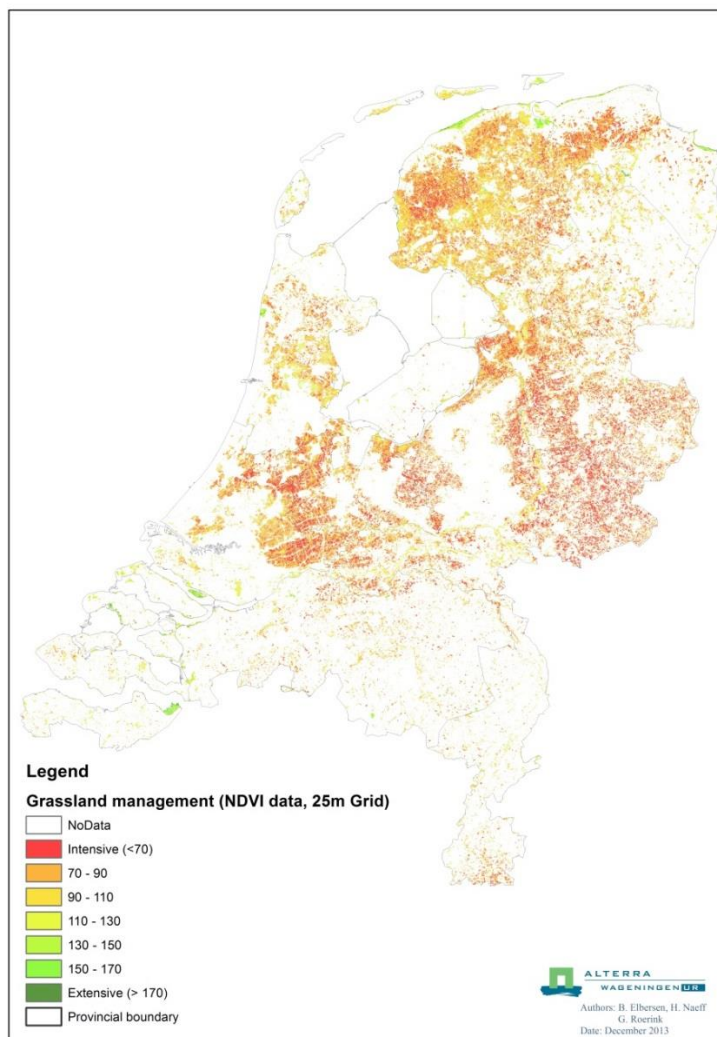


Table 2: Match Symbioses semi-natural grasslands with LPIS permanent grasslands

	Ha	%
Semi-natural class symbioses	79,260	
<i>Not agricultural</i>	48,067	60.6%
<i>Agricultural</i>	31,193	39.4%
<i>Grassland</i>	18,255	23.0%
<i>Other</i>	12,938	16.3%

Map 3 Locations of semi-natural grasslands derived from vegetation mapping from Symbioses



Inclusion of all permanent grassland area in statistical sources

Before discussing the information that is gathered through LPIS the issue regarding eligibility needs to be further clarified. This LPIS system which is the spatial register within the Integrated Administration and Control System (IACS), registers the land use for all beneficiaries of CAP payments. This implies that land of farmers not receiving CAP payments are not necessarily included, but it also implies that only the agricultural land which is 'eligible' needs to be registered. Since the CAP defines that only agricultural area is eligible it implies that land that is taken up by 'arable land, permanent pasture or permanent crops' can be included. For pastures the narrow definition of Commission Regulation EU No 796/2004 is often applied. In certain countries LPIS is therefore excluding large parts of important EVG areas in which the coverage with non-herbaceous species is dominant (e.g. grazed moors and heathlands, agroforestry (dehesas, montados), grazed forests, shrubs (matorales) etc.). In other countries these areas are registered in LPIS but they are shown as ineligible. However, in several countries where agro-forestry and grazed woodland pastures are taking up large parts of the grazing area, e.g. Spain, Italy, Portugal, use is made of the Art 34 in Regulation 1122/2009 that states *an agricultural parcel that contains trees shall be considered as eligible area for the purposes of the area-related aid schemes provided that agricultural activities or, where applicable, the production envisaged can be carried out in a similar way as on parcels without trees in the same area*. Spain and Italy therefore aim to register all land in LPIS that is used for grazing which implies that categories are included as eligible in Spanish LPIS that have 40-100% shrub cover and 40-75% tree cover. If the tree

cover is >75% it is registered in LPIS as forest and as non-eligible in the Spanish case (see Box 4.5).

The freedom countries have of registering grasslands in LPIS as eligible is large. This follows also from the guidance to MS on what to register in LPIS on the MARS website (marswiki.jrc.ec.europa.eu):

- With regards to shrubs, rocks etc., the conditions under which these elements can be considered as part of the agricultural parcel should be defined on the basis of the customary standards of the Member State or region concerned (e.g. land cover type, maximum area percentage).
- To assess the eligibility of / eligible area within an agricultural parcel of (permanent) pasture, Member States can use a reduction coefficient, which can take the following forms:
- a *pro rata* system whereby the eligible area taken into account is determined according to different thresholds applied at the level of each parcel. For instance, if the crown cover determined on the ortho-imagery and recorded as such in the LPIS-GIS ranges between 25% and 75%, the parcel is considered as 50% eligible.

How countries handle the registration of eligible grasslands differs strongly and is of course most complicated for countries having high shares of grasslands with high shrub and tree cover. This is particularly relevant in the Mediterranean, Nordic and some CEEC countries (see also Box 4.6). Member states set different thresholds and rules for inclusion of land in the permanent grassland category and therefore show large differences in what they include in the eligible area. Therefore the coverage of land in LPIS will also be different as some countries choose to only include land that is eligible in LPIS, others register all land that is used by a farmer that receives payments in first and second Pillar. Overall it is clear that the first categories of land to be excluded from payments and also therefore often not included in LPIS are the semi-natural habitats. The cases in Box 4.6 illustrate that this often leads to semi-natural habitats that have a high ecological value. Abandonment of management of these grasslands is therefore a large threat. This leads to exclusion of grasslands with more tree and shrub vegetation. In countries where this is known to be a problem are Sweden, Slovakia, France, Estonia and Spain this is a problem. In Box 4.6 an overview is given of limited registration of grasslands because of differences in definitions applied between countries.

Box 4.6 Examples of exclusions of large permanent grassland areas in LPIS because of strict applications of definitions

For **Bulgaria** a comparison was made in 2011 by EFNCP between the permanent grassland area registered in the agricultural statistics and the ones from LPIS and it turned out that in the later in 2009 only 25% (0.44 mln ha) of this grassland was registered. The main reason for this is related to strict eligibility criteria from grasslands: For permanent grassland in general the criteria apply that there cannot be more than 50 trees and/or shrubs per hectare with a height of 50 cm. For the low productive grasslands the criteria are less strict and specify that they may have up to 75 trees and/or shrubs per hectare (with height of 50 cm or more) and that dispersed buildings, equipment, rocks, rocky areas, eroded or bare areas cannot cover more than 20% of the area.

Table 1 Comparison permanent pasture representation in agricultural statistics and LPIS for Bulgaria

LAND USE (000 ha)	Agrostatistics (2009)	SAPS eligible area (2007)	SAPS eligible area (2009)	Difference Agrostatistics/ SAPS 2009 (000 ha)	Difference SAPS/ Agrostatistics 2009 (%)
Arable land	3126	2941	2930	196	93%
Permanent crops	165	129	124	41	75%
Permanent pastures (pastures, meadows and other)	1719	715	436	1283	25%
Family gardens	21	20	3	18	14%
UAA (total)	5030	3806	3492	1538	69%

Source: http://www.efnecp.org/download/brussel2011/Bulgaria_example.pdf

In **Denmark** the definition of grassland is taken very strictly as it cannot be grassland if more than 10% (crown cover) is covered by woody plants (trees and shrubs). In other words grazed heathlands and other habitats are excluded as agricultural and included in the forest land use category.

In **Spain** the authorities have only recently reviewed LPIS and reclassified as forest all parcels with a tree cover >75%. This has caused many complaints. Which is not surprising as the situation is complicated and depends on the type of grassland category. Dehesas may have very few trees per hectare, or a large number. The upper limit generally is considered to be 60% tree cover. However in practice there are dehesas and also large areas of grazed forest with a tree cover considerably more than 60%. Even with 100% tree cover there can be significant forage and active grazing, especially by goats. While it is true that at high tree densities the availability of herbaceous pasture diminishes, this is not to say that >75% crown cover the pasture availability is negligible. Other factors play a critical role, e.g. tree species, soil, slope. In wood pastures of *Quercus faginea* and *Quercus humilis* in Navarra with crown cover >75%, the production of herbaceous pasture has been measured at between 250 kg DM/ha/year and 1,467 kg DM/ha/year. By comparison in herbaceous pastures of Sierra de Andía the production ranges from 900 kg DM/ha/year and 1,850 kg DM/ha/year.

In total the forage value of *Quercus faginea* woodland taking into account grass and shrubs is estimated at 350 Forage Units per ha/year, similar to shrub pastures in the same area that are eligible for CAP support. In addition, there is a forage value in the fruits and foliage of the trees, estimated at 150 Forage Units per ha/year.

The LPIS criteria in Spain consider forest with >75% crown cover to be primarily for forest production, but the reality is “forest” production in many cases is limited to firewood and environmental goods. Livestock grazing cannot realistically be considered a lesser production than these two, they are all complementary. So basically the forest cover alone is not the only difficult issue to address to decide which vegetation type meets CAP definitions and rules as Permanent Pasture, but whether a particular parcel is actually *in use as livestock*

forage.

In **Estonia** the inclusion of land as permanent pasture needs to comply to a maximum tree density of 50 trees/ha at least this was the situation before 2007. Many farmers complaint as it was shown that because of this was that the majority of semi-natural permanent pastures were excluded from receiving CAP payments. After a court case the 50 trees/ha rule was dropped in some of the regions of Estonia, but not in all. In spite of this eligibility of semi-natural areas and therefore inclusion into LPIS still remains a problem and is a threat for their existence as without CAP support they are likely to be abandoned more quickly. The main issue at present is that quite a significant part of valuable semi-natural habitats is or has been ineligible for direct payments and a range of other area-based support (e.g. rough estimations state that only ~40% of semi-natural habitats in Natura 2000 network overlap with CAP eligible field parcels). Furthermore, no concrete information is available how much of that overlapping area actually has applied for CAP support but some estimations refer to only 10% of the eligible area received Single Payments (SAPS). For the situation outside Natura 2000 there is even less information available about eligibility. In other words this also means that the area of farm land registered both in EELIS and by the National Paying Agency is incomplete in terms of full semi-natural grassland (and EVG) coverage. How incomplete is difficult to tell.

Some examples in relation to eligibility of land from Beaufooy et al. (2010):

In **Scotland** the rule is that parcels with less then 50 trees per hectares are included in the eligible area as perment grasslands. An exceptionis also applied in that parcels which have more then 50 tree/ha can still be included if it can be demonstrated that there is a history of acceptable grazing practices in the plot and grazing is not damaging the ecological value of the site.

In **Sweden** there is a tradition of grazing semi-natural areas with a relatively high amount of trees and shrubs (like is the case in many regions of the Mediterranean). The most critical semi-natural areas in this respect are the fennoscandian forest pastures and the Alvars and pre-cambian calcareous flatrocks typically of the boreal environmental zone. In 2007 Sweden was obliged to change it's eligibility rules after EU audits which resulted in a decline of eligible area from 531,000 ha to 454,000 ha. The main reasons were that on certain plots to high tree/shrub density occurred and/or insufficient forage production. Eligibility rules for Sweden are as follows:

- 1) Land that is not suitable for ploughing is used for grazing. If not it is excluded from agriculture
- 2) Land that is covered with grass and herbs that are suitable as fodder. If the fodder herbs and grasses are overgrown by non-fodder species the area is considered abandoned. This criterium leads often to exclusion of Alvars, while these are dependent on grazing for remaining in good ecological state.
- 3) Woods and areas where measures are taken essentially to encourage tree growth cannot be considered pasture,even if the land remains covered by trees and herbs suitable as fodder.
- 4) In the case of presence of bushes or scrubs or impediments the total area of patches of these may not exceed 5% of the area of a parcel.
- 5) As to tree presence the upper limit is set at 60 trees/ha (tree has a diameter of 10 cm

at breast height) with an upper limit of 100 trees/ha for certain cases of pastures with high biodiversity value. Areas with more than 100 trees but grazed cannot be applied for direct payments, but are still eligible for payments under rural development.

In **France** the situation of inclusion of grazed lands into the permanent grassland category as eligible land differs strongly per French region (Departement) as they apply their own thresholds and rules which can be very different. So there are departments that stick to the strict rule the grassland need to have a dominant herbaceous vegetation while others allow for varying coverage of trees and shrubs.

The inconsistencies between countries with regard to inclusion of grazed lands into eligible area, particularly in relation to the semi-natural areas, makes clear that there are limitation to using LPIS as a source for identifying EVG. In spite of this LPIS is still the best sources to use as a basis as it provide land use and land management information at the parcel/physical block level. This is the only level at which it can be established whether a grassland is an EVG or not.

Common land inclusion in data sources

Another reason that statistical sources are not well covering all semi-natural grassland areas is related to the way common lands are registered. Common lands are largely lands used for grazing and therefore need to be included in the permanent grassland class, in many cases also falling in the sub-category of rough grazing land. Many countries however do not register or only partly register common lands in their statistics, particularly in LPIS. For these 2 reasons several countries exclude large parts of permanent grasslands that are grazed and that fall in the wide definition of permanent grasslands taken as a starting point for this study (see Chapter 3).

This problem has now recently been addressed by Eurostat and it is now (as from 2010) obligatory for all countries to include common land in their reporting of data to Eurostat (see Table 1 and 2 in Annex 13). This has improved the coverage of permanent grasslands in FSS and in the Annual Crop Statistics. Common lands are likely to strongly coincide with EVG as these lands have been used for grazing animals for long periods of time.

What the status of common land registration is in national data sources becomes clear from an overview elaborated by Eurostat regarding common land inclusion: Up until 2009/2010, in some countries, the FSS did not cover particular types of land not belonging directly to agricultural holdings on which common rights apply - designated as common land. However as from 2010 common land is part of the UAA and MS are obliged to register common land for FSS (Regulation 1166/2008). They can choose 3 models of registration as becomes clear from the Table 1 (Annex 13).

The registration of common land although using different systems is an improvements as it leads to a better registration of permanent grasslands, especially those likely to be of very extensive nature and strongly overlapping with EVG. However to understand fully the role of common land in EVG information on livestock presence should be collected for these lands. This however is not happening in any country until now as is the case with permanent

grasslands in general (see Annex 13). In addition to this, also for common land the problem still remains that although it is grassed it is not registered as agricultural area if it does not comply with the narrow definition of permanent grassland area.

Overall it is clear that common lands make up a considerable part of the total UAA especially in Bulgaria, Greece, Romania, Ireland, Spain, Portugal, Slovenia, Bulgaria, Hungary and also some regions in the UK. Most of these lands fall in the rough grazing category and are likely to largely overlap with EVG. Registration of common lands in FSS now seems to be addressed relatively well as from 2010. Registration in LPIS of these lands still remains a large limitation for the correct coverage of all permanent grasslands. The best option in LPIS would be that all common land used by holdings for grazing is registered proportionally to the use of the land as part of the total land used on that holding. With the registration it would be most useful if specifications on the use of that common land are registered at the same time in relation to frequency of use and type of grazing and stocking density used.

4.3.2 Habitat mapping and species data

Finally an assessment was done of the suitability of the semi-natural habitat mapping data available for identifying EVG. In principle all EU countries will have some form of semi-natural habitat mapping as they are obliged to report on the extent and status of their semi-natural habitats under article 17 of the Habitat directive on a 6 yearly basis. The last reporting was in 2008 and the next is due by 2014. Some examples of ecological data collection for mapping the location, extent and ecological status of semi-natural areas is given in Box 4.7. An extensive description for practically all EU countries is given in Annex 12. It becomes clear that some countries have more efforts invested and better up to date data than others. The potential of these data to identify EVG are very large especially when combined with farm land use and management information. This can only be done if data on location and status of the habitats are up-to date, available at high resolution, preferably the field level, where it can be combined with information on land use and management.

In practice however the ecological information is not always that up-to-date and in many countries the coverage of the whole agricultural land use territory is limited often most strongly developed for the protected sites part of the Natura 2000 network. This is not surprising, but the article 17 reporting requires that the monitoring is done both for sites within and outside the Natura 2000 network.

Box 4.7 Examples of good data sources on for mapping the location, extent and ecological status of semi-natural areas

In **Estonia** there is the Estonian Environmental Register (Estonian Nature Information System, EELIS) information is included on Estonian Nature including information about Annex 1 habitats. Most of the data included in EELIS was derived through on-site data collection by surveyors/ botanists (full area coverage). A main inventory and mapping of semi-natural habitats in Estonia (including Annex 1 habitats) was done in 1999-2001 together with preparations for Natura 2000 designation process. Then there were several up-dates and separate inventories with different purposes. Overall it means that for Estonia the most reliable and comprehensive information about EVG location and extent is available

in the EELIS (Layer “b”) which is equivalent to the SPS layer of Natura 2000 network (reference year 2004). However for EVG outside Natura 2000 there is less reliable information available as for these areas the habitat inventory data are not updated regularly or information is out of date.

In **Germany** article 17 reporting is done based on the FFH-data (habitat Directive). The data is collected separately in every federal state in Germany using a similar methodology and sampling framework. The most recent FFH-mappings or biotope mappings are from 2007, partly rely on more or less “old” (from the 1980ies and 1990ies). Partly they derive from current on-site-mappings (mainly 2004 - 2007). The current mappings are designed different in the federal states and partly even within the federal states, e.g. partly only grasslands within the Natura 2000 boundaries have been mapped, partly also all other grasslands have been mapped in respect of the meeting of FFH-criteria. Overall it can therefore be concluded that the dataset has limitations, both in terms of age of the data recording and in terms of consistency in coverage of grasslands in different federal states.

However for the identification of HNV farmland a new system of ecological semi-natural habitat mapping needed to be implemented. The data are gathered through field surveys of some 900 sample plots nationwide, which were selected at random, and consist of 100 ha in size each and a minimum of 5% of open land. Since the occurrence of HNV features depends heavily on land use and local ecological conditions, the random sample is based on a two-fold stratification; actual land use (6 landcover categories) and 21 ecoregions. In a second step the field mapping methods were developed. The HNV quality of the land use types (3 quality categories of HNV exist) is evaluated by using specific sets of indicator taxa, which can indicate floristic diversity of the land use type accordingly. While most land use types lists are valid for all Germany, the grassland regionalised lists are also provided, due to the differences of grassland communities within Germany. As a last step the extrapolation of the indicator value is carried out. Due to harmonised surveying methods, extrapolation at the national level as well as at the level of the countries is possible. Information of farm management is not used for the identification of the HNV farmland types. This has limitations but if both would be combined the potential of this data to identify EVG will improve significantly.

In **Ireland** much work has been done and is done on identifying and monitoring Annex I habitats. There is the National Vegetation Database. This database includes a record of all relevés gathered both recently and historically and is based on national surveys. It is more used as a tool for developing a plant database than an inventory of semi-natural grasslands, but provides a very useful source for determining the species richness of semi-natural habitats mapped further in other surveys.

The other specific focused surveys in Natura 2000 sites are based on on-site collection by surveyors. This includes results from the Irish Semi-natural Grassland Survey (ISGS). It is an on-going exercise which is not a complete inventory of semi-natural grasslands as not all regions have been covered by the survey. For the targeted surveys in Natura 2000 sites there is a full coverage of the area and the survey is repeated regularly as it is used for the six-yearly Article 17 reporting. It is interesting to know that the Irish Semi-natural Grassland Survey identifies threats such as under grazing and other signs of abandonment as these

need to be reported as part of the threats to semi-natural habitats in the Article 17.

In addition there are also several separate surveys done in Natura 2000 site on specific habitats these include: Orchid rich calcareous grasslands (6210), Species-rich Nardus Upland grasslands (6230), Molinia meadows (6410), Lowland hay meadows(6510), Limestone pavement (8240) and Machair (21A0) are the main recorded Annex 1 habitats found in Natura 2000 sites²⁵.

Overall, one can therefore conclude for Ireland that existing data sets (Semi-natural grassland Survey, Natura 2000 sites) give sufficient data on type, condition and threats, only lack information on the overall extent of the EVG in Ireland. On the other hand when all survey data both from the different habitat inventories and the IACS/LPIS were combined one could establish a first relatively complete overview of EVG extent in Ireland.

In **Latvia** there is an official concept of 'Biologically Valuable Grasslands' (BVG). These include both semi-natural grasslands floristically diverse and cultivated grasslands (permanent grasslands) valuable for birds as feeding or nesting habitats. No other ecological values of these grasslands have been evaluated and described until now. There is therefore a database of Biologically valuable grassland database of the Latvian Fund for Nature developed and maintained by Latvian Fund for Nature. This database contains several data on botanically valuable grasslands classified according to national grassland habitat classifier, based on phytosociological approach. Grasslands were mapped by on-site data collection by surveyors/botanists and resulted in a full area coverage. The database was further developed in the frame of RDP the agro-environmental measure Management of Biodiversity in Grasslands was established. To find new grassland areas eligible for this measure the Ministry of Agriculture invited farmers (owners) of grasslands to apply for inventory (it was done in 2005, 2006, 2007, and 2009). All grasslands applied for this inventory were surveyed by botanists. There are shortcomings for this database but still it contains a lot of valuable information which is further improved.

In addition for Annex 1 habitats in Natura 2000 there are two main sources of information which is the Database of EU importance grassland, scrub and heathland habitats in Latvia developed in the frame of LIFE+ project. It combines all existing spatial data on EU importance grassland habitats in Latvia (inside and outside Natura 2000 sites) which are the

²⁵ Details of each Natura 2000 site are available at the websites:

<http://www.npws.ie/protectedsites/>

http://www.npws.ie/publications/archive/6210_Orchid-Rich_Calcareous_Grassland_Assessment.pdf

http://www.npws.ie/publications/archive/6230_Species-Rich_Nardus_Upland_Grassland_Assessment.pdf

http://www.npws.ie/publications/archive/6410_Molinia_Meadows_Assessment.pdf

http://www.npws.ie/publications/article17consultation/habitatsassessments/individualhabitatreports/6510_Lowland_Hay_Meadows_Assessment.pdf

http://www.npws.ie/publications/article17consultation/habitatsassessments/individualhabitatreports/8240_Limestone_Pavement_Assessment.pdf

data from all Natura 2000 sites in Latvia. The other is the common data base for Natura 2000 sites in Latvia named « Ozols». Information on grassland habitats is gathered in this database from nature management plans for Natura 2000 sites and mapping data of habitats in 2011 and 2012 in the frame of the project “Monitoring of plants and habitats in Natura 2000 sites in Latvia” by Latvian Fund for Nature.

Overall one can conclude that with the existing data one can reveal a near extent of the EVG in Latvia. However there are shortcomings as inventories have been done about 10 years ago, many sites are now overgrown or destroyed by urbanisation. To come to a better database for identification of exact extent and location of EVG in Latvia updates are needed in existing data sets and more inventories need to be done outside Natura 2000 sites.

In **Slovakia** a national Grassland Inventory organized by DAPHNE-Institute of Applied Ecology in the years 1998-2006. It was on-site data collection by botanists with full-area coverage. Nearly the whole country (more than 96%) was covered by the inventory. It was more or less one-off exercise, dataset is renewed only by case on very small areas and the renewal is not systematic. Overall one can conclude that with the current data available on habitat mapping there is a good basis for identifying EVG in Slovakia. However given the dramatic changes in agricultural land use in the last 10-15 years (including large scale abandonment) there is a need for improvement in existing data sources. This would require new up-dates in field data collection at large scale, preferable for the full area, at least in terms of aerial photographic interpretation.

In the **UK** there are different data sets available that can be used to identify at least part of the EVG in the UK. For designated sites the Common Standards Monitoring CSM is carried out by regular site visits. The monitoring results in a detailed breakdown of habitat and land use types (including Annex 1 habitats of Community Interest), which allows for the calculation of totals for EVG. This may on a case by case basis also be available for UK-designated Sites of Special Scientific Interest. In the UK Land Cover information system ‘improved grassland’ are separated from other, semi-natural, grasslands along the same dividing line as has been found to be significant in studies of grassland fungi, for example (in UK National Vegetation Classification terms, in the middle of the MG6 mesotrophic grassland community). Assuming that the classification is accurate for this distinction, the UK Countryside Survey and Northern Ireland Countryside Survey should therefore provide a value for EVG in the UK. Some grasslands in the UK are BAP priority habitats and these should certainly be part of EVG. Their extent is reported as part of the Countryside Survey (CS). The CS is based on a combination of remote sensing and aerial photography of the whole UK complemented with with sample based ground-truth information on species and management.

Overall it can be concluded that the closest identification of EVG in UK data sets is coinciding to the semi-natural habitats from the Countryside Survey, but with the caveat that some are not farmed; an LPIS mask is therefore always necessary. The sum of Countryside Survey non-woodland, non-rocky, semi-natural terrestrial habitats gives an estimate of semi-natural grasslands; agricultural land use data summarised in the annual Economic Report on Scottish Agriculture can be used to correct the data for England, Wales and Northern Ireland; for Scotland, the total land used to claim SPS must also be used to exclude non-farmed rough

grazings. For an improved identification of EVG in the UK there is no need to improve the existing data sets or create new data sets. The current data sources discussed above cover well the EVG extent.

Integration of statistical and ecological data sources

Integration of these data with LPIS data is the best way forward to identifying EVG as they are characterised by high species richness which can be verified using ecological habitat and species richness information. On the other hand EVG also need to be managed by grazing or mowing and are unimproved and of long standing. These aspects can only be assessed using data on land management. In different countries there have already been good examples of integration of ecological data with LPIS data on agricultural land use to identify which areas should be targeted in AEP schemes and to identify HNV farmland areas. Different examples of such data integration approaches are presented in Box 4.8, but further information can be obtained from the country description in Annex 12.

Box 4.8 Examples of integration of statistical and ecological information using LPIS

In **Ireland** there is also a registration in IACS/LPIS of species rich grasslands under agri-environment payments and traditional hay meadows under agri-environment schemes. These registration are based on a farm plan drawn up through an agricultural/environmental consultant. The field must contain at least 5 positive indicator species from a list of grassland species to be classed as species rich. However, these form part of agri-environment scheme and involve an one off exercise, although could be continued into the next scheme. The approach is interesting a would be very suitable for identifying the whole of EVG when extended to all sites already identified in the other semi-natural habitat mapping results.

HNV farmland is recorded in LPIS in **Bulgaria**. This is done by adding the HNV qualifier to the physical blocks²⁶ in LPIS using information derived through remote sensing and integrating GIS layers of different biodiversity datasets, including Corine Land Cover.

In **Latvia** there is the Geospatial database of biologically valuable grasslands developed and maintained by Rural Support Service and includes geospatial data on location of biologically valuable grasslands (no other information is stored in the database - no information on habitat type or quality etc.) together with the LPIS data per plot. The database is used to manage agro-environmental measures in grassland habitats. The data on the biologically valuable grassland database from the Latvian Fund for Nature is included and based on field based botanical data collection. Additionally, data were included of those biologically valuable grasslands, which were inventoried in 2009.

In **Luxembourg** the project “*cadaster des biotopes protégés*” was implemented between 2007 and 2011. It was a full area coverage mapping and evaluation of all Annex 1 habitats in and outside protected areas excluding forests. Mapping and assessment was done according to a standard methodology and implemented by experts. The data collection is based on aerial photographic interpretation and field surveys identifying the plant communities

²⁶ A physical block in LPIS is a continuous area bounded by permanent topographic features which has an identical dominating land use and may comprise one or more parcels of farmers.

indicative for the Annex 1 habitats. Per site there is also information included on species composition, structure, area and main threats. This detailed information allows for multivariable queries in relation to the definition provided of EVG. The farmed habitats in the Cadastre are also combined with the LPIS information and therefore land use and management data are available for the EVG.

In the **Netherlands** the identification of HNV farmland was done. Input data used are BKN database which has mapped all habitats targeted by AEP. In this spatially explicit database which is up-dated every 2 to 3 years there are 18 general 'nature types' (e.g. grasslands, semi-natural grasslands, forests, moorlands etc.) and 58 'nature management types' (e.g. meadow bird grasslands) mapped. Identification of area that can be targeted by AEP is based on several studies that identified the potential species per habitat to be realised under ideal management. However, since agricultural management is intensive in most of the Netherlands the likeliness that a semi-natural habitat state is reached again is very low. Therefore the AEP often are allocated to grassland areas that are substantially improved and do not opt for categorization in any of the Annex 1 habitats, let alone EVG. Other important spatially explicit sources were therefore used for the final identification of HNV farmland which were LPIS (=BRP), IACS (linked to LPIS parcels), Landscape elements data (VIRIS) and species distribution data on farmland birds (Sovon), Butterflies (Vlinderstichting), vegetation (Symbioses). These were all integrated at the level of LPIS plots and then up-scaled for final presentation.

In **Slovakia** in order to establish a GIS-layer of LPIS blocks under agri-environmental payments the Institute of Soil Science and Soil Protection (which is responsible for LPIS maintenance) asked the State Nature Conservancy to certify grassland for AEP. For this purpose DAPHNE-IAE did an additional farm mapping exercise in the years 2003-2006. The methodology of farm mapping was compatible with the methodology of national grassland inventory. The eventual certification is based on results from the additional farm mapping, the national grassland inventory and own data from the State Nature Conservation, but there is no common standard for farm mapping of AEP.

4.4 Ecologically valuable grasslands: data gaps and data needs

For identification of EVG. The picture at national level is however very diverse. A summary table has therefore been produced that rates the suitability of different national data sources available for identifying EVG location and extent in 3 classes from 'good' (with minor limitation) to 'not good' (with many limitations) (see Table 4.4).

Three types of data have been assessed in the EU member states:

- 1) Data on permanent grasslands and management in national agricultural statistics
- 2) Data on land use and management registered in LPIS at parcel or physical block level
- 3) Data on presence extent and quality of semi-natural habitats/Annex 1 habitats used for article 17 reporting under the Habitat Directive but also used in some countries for identifying HNV farmland areas

Two extra columns have been added to Table 4.4; the first specifies the most relevant national data sources for (partial) identification of EVG. The second column specifies whether HNV farmlands and thus grasslands have been identified already nationally as this category of land is partly overlapping with EVG. However, the level of overlap will be very different per country as the EVG are clearly a subgroup of the HNV farmland grasslands as was already discussed already in Chapter 3.

Table 4.4 Evaluation of national data sources in terms of their suitability to reflect the true extent of EVG

Country	Agricultural statistics (e.g. national agricultural survey and census data)	FSS and	LPIS	Sources used for semi-natural habitat reporting art. 17	Most suitable source(s) so far reflecting extent of grassland categories closest to EVG	HNV grasslands identified nationally?
Austria					INVEKOS (LPIS) SINUS, BINKL and LANDEBEN	Yes
Belgium					Biological Valuation Map (BVM) for Flanders and SGIB (Sites de Grand Intérêt Biologique')	No
Bulgaria					LPIS-HNVF, PINMATRA grasslands inventory and Natura 2000 Habitats inventory.	Yes
Cyprus					LIFE third countries mapping data	No
Czech Rep.						
Denmark					Naturbeskyttelse og Natura 2000, LPIS	Yes
Estonia					EELIS data	Yes
Germany					FFH and the German HNV farmland inventory	Yes
Greece						No
Spain					MCA (Mapa de Cultivos y Aprovechamientos) and the Spanish Habitats Atlas and Manual	Only for Navarra region
Finland						Yes
France					Agricultural Census (<i>Recensement Agricole</i>), LPIS, TERUTI (French LUCAS) and ZNIEFF (provided it is considerably up-dated)	Yes
Hungary					MÉTA database, Habitat mappings of National Parks	No
Ireland					Semi-natural grassland Survey, Natura 2000 habitat surveys and	No
Italy					IACS/LPIS and Italian Botanical Society databae on semi-natural habitats of Italy	Yes, only for 2 regions Veneto and Piemonte

Lithuania					
Luxembourg				<i>Cadastre des biotopes protégés</i>	No
Latvia				Biologically Valuable Grasslands of Latvia, EU important grassland, scrub and heathland habitats, Geospatial database of biologically valuable grasslands developed and maintained by Rural Support Service.	No
Malta					
Netherlands				Synbioses, HNV farmland, LPIS (Doorn et al., 2013)	Yes
Poland					
Portugal				RGA (<i>Recenseamento geral Agricola</i>)	Yes
Romania				Veen ecology grassland inventory, Statistical Annual for Agriculture and Silviculture	Yes
Sweden				TUVA and Forest statistics	No
Slovenia					
Slovakia				DAPHNE grassland inventory. Certified grassland for AEP included in LPIS	Yes
UK				Countryside Survey (outside designated sites), Common Standards Monitoring (inside designated sites). Both combined with LPIS to establish agricultural management status	Yes for Scotland
	= not good, many limitations				
	= moderate, but limitations				
	= good, minor limitations				
	= no information				

LPIS data could potentially be a very useful source of information as the spatial resolution at which farm management data is available is either the farm parcel or physical block level, which is the principle level at which a uniform management of and EVG can be expected. However, from most LPIS data there is limited information available on management from which it can be estimated that the field is improved or not. Exceptions to this are LPIS data in Austria, Luxembourg, Latvia, Bulgaria, Denmark, Italy and Netherlands where integration of different sources of ecological and farm management information from IACS have already been made at the parcel level. Furthermore, there seems to be (historic, for more years) data available at parcel and physical block level respectively on farm management practices. This is because the habitat mapping data are fully integrated with the LPIS –IACS registrations and or because different types of permanent grasslands classified according to intensity are also registered (e.g. Bulgaria, Slovakia, Latvia, Italy).

An important limitation of the LPIS-IACS data in general is the very strict rules of access which makes a good analysis of what is potentially possible with LPIS difficult. Furthermore in hampers the possibility to use LPIS as a monitoring tool used by independent evaluators. Another limitation of the LPIS data occurs especially in large countries where the IACS-LPIS is

a regional responsibility. A very scattered availability of IACS-LPIS with likely different interpretation of what grasslands are eligible is a complication particularly in Germany, Belgium, France and Italy.

In some countries an additional complication is also that for the identification integration of agricultural statistical information (best from IACS-LPIS) and ecological information is required. The management of the collection of these different types of data are usually the responsibility of different administrative organisation (e.g. two Ministries or the [paying and control office and voluntary or applied research organisations involved in habitat mapping and species distribution data collection) . Collaboration and exchange of information is then more complicated.

In countries where HNV farmland has been identified there is already more experience with integration of land use, farm management and ecological data and therefore also collaborations between different organisations and institutions has already established. The experience with identifying HNV farmland is a good basis from which further work can done identifying EVG as a sub-group of HNV.

For the proper identification of EVG as a minimum the management data that need to be obtained should provide good figures on stocking densities per LPIS plot and inputs in relation to artificial fertilisers and absence of ploughing (so historic data on management needed). As to stocking density the only LPIS system that now provides this information is in Austria. In most other countries links between LPIS plots and management can only be made at the level of the farm for which stocking density figures are available from the IACS farms that have a link to the field plots in LPIS. So only an average picture can be derived for the whole farm on stocking density. For the estimation of EVG the specific stocking density practices will need to be collected per field or physical block in LPIS.

Irrigation and drainage can generally be expected to be absent in the case permanent grasslands are categorised in the rough grazing class. If categorized in the permanent grassland class this cannot be expected and additional information on this aspect will need to be collected. In several agricultural census data sources irrigation data are collected per farm per crop. An integration of these census results with the LPIS census data would be a good start, but also for these parameters it would be better if they were collected at field level in the future. The same applies for drainage which is a practice on which information is hardly available but is a very disturbing practice which will lead to an immediate loss of biodiversity in EVG if applied.

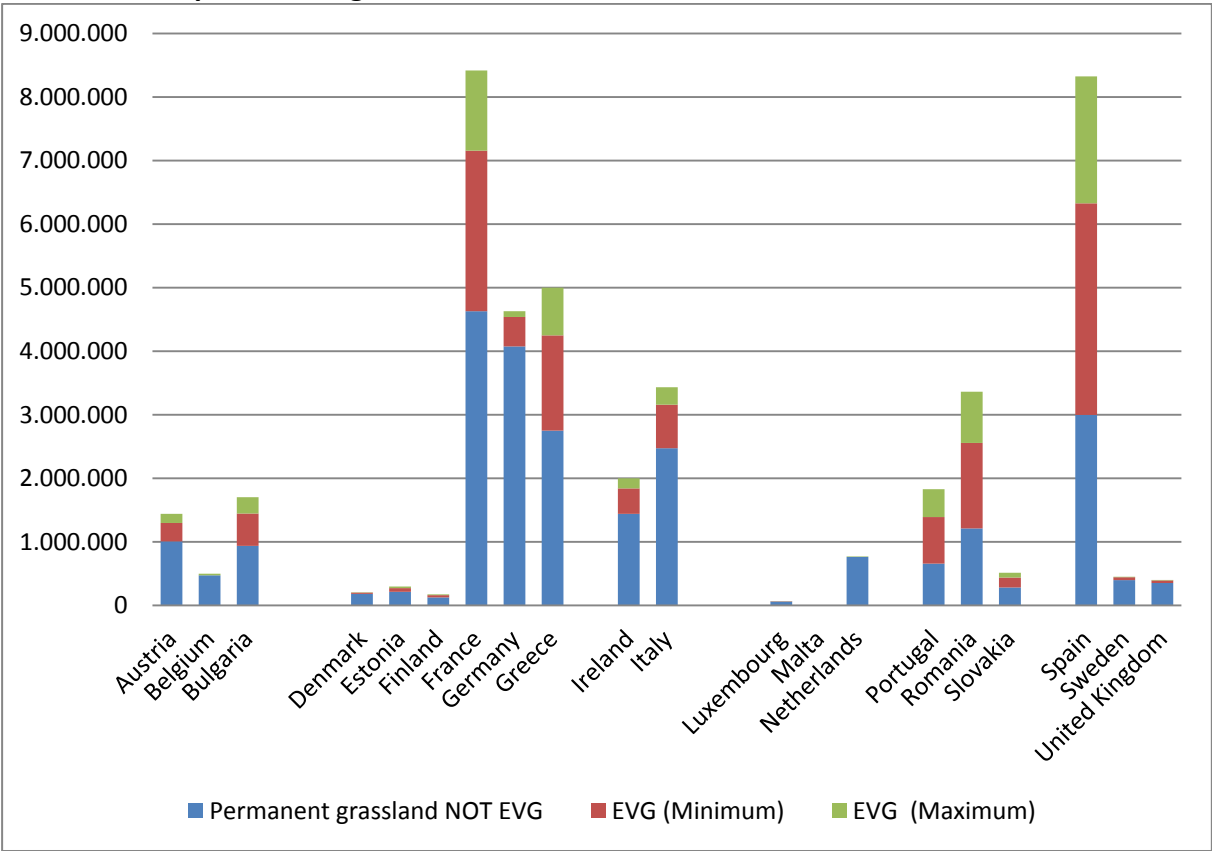
Information on ploughing of grasslands is not collected in statistical sources and therefore it will be very difficult to derive from existing data sources, let alone at the field level. However, with areal photographic and remote sensing interpretations with high temporal and spatial resolution it is possible to establish the long term absence of practices such as ploughing and intensive fertilisation.

As to the quality of habitat mapping and species richness data there seem to be several countries with relatively good data sources for identifying EVG. In the near future it is also expected that this type of information will become of higher quality because of the 6 yearly

obligation to report on semi-natural habitat presence a status under article 17 of the Habitat Directive. Half of the countries have a relatively good database with minor limitations, although almost all need to invest further to up-date the inventories and ensure full country coverage. Relatively good inventory data are available in Hungary, Luxembourg, Ireland, UK, Belgium, Germany, Denmark, Netherlands and Sweden. Countries that have a low score in this respect are France, Greece, Portugal and Italy that rely on old relevé information usually not collected with one uniform methodology and/or not covering the main part of the territory where EVG are likely to occur.

Finally the problem with complete coverage of permanent grasslands that are grassed in the IACS-LPIS and agricultural census data is required. Otherwise these data are not a good source to further identify EVG from. For a proper identification it is therefore very important that more harmonisation of rules regarding integration of farmed land between MS and regions is created. This issue is related to the eligibility rules linked to permanent grasslands definitions. To solve this we follow the recommendation on this issue already made by the EFNCP in a study by Beaufoy et al. (2010) who state that ‘that minimum activity should be the basic criterion for determining if a pasture is eligible to receive direct payments, not whether it is grass, shrub or wood pasture, or whether the proportion of herbaceous vegetation is dominant’.

Figure 4.3 Overview of minimum and maximum area (hectares) of EVG in the total permanent grassland area*



* For detailed data used as input see Annex 14.
Missing: Cyprus, Czech Republic, Hungary, Malta, Poland, Latvia, Lithuania and Slovenia,

Last but not least is the inclusion of fallow land into the statistical agricultural data bases. A good start was made in 2008 with the new regulation obliging all countries to report on their common land used for grazing to Eurostat for FSS and the annual crop statistics. This aspects should however also be addressed for the IACS-LPIS and is basically in line with what is proposed by EFNCP on making all pasture eligible and thus to be registered as part of farmland in IACS-LPIS, when there is a minimum activity.

In spite of all limitations discussed on the proper registration of EVG in existing data sources we have still made an attempt to make a rough estimation of the EVG share per country based on data sources to which access could be derived. The data are presented at national level in Figure 4.3, which does not imply that for these no regionally specific data are published. If this is the case in Annex 12 more information on regional estimates can often be found for a selection of countries for which these data could be accessed as part of this project. Further background information to the estimates presented in Figure 4.3 are given in Annex 14. In this Annex 14 first an overview of the permanent grassland area sizes as reported in FSS 2010 is given. Note that these 2010 FSS data are based on national census data and all these are accessible at Nuts 3 level. The next columns of the Table in Annex 14 provide further details on permanent grassland area types. The minimum and maximum area shares for EVG are given in the last column of Annex 14 and are quantified in absolute area in Table 4.3. The EVG area has only been indicated in ranges between minimum and maximum level as detailed figures were too difficult to assess given data availability and scope of this study.

From the summary overview in Table 4.3 it becomes clear that the countries having the largest areas of EVG are situated in the south and central and eastern parts of Europe. They include Spain, Portugal, Greece, Austria, France, Romania and Bulgaria.

Key messages and conclusions on data availability and needs for identifying EVG

Main conclusions:

- High resolution data for all 3 types of information required to identify EVG are usually absent and or scarce. Management, species and habitat information is required at the level of a field plot of at least at landscape scale.
- The combination of detailed and historic management information at the level of a semi-natural habitat is usually absent. Both types of data are collected in a separate way and it usually remains a challenge to match the two
- Reliable species data is scarce and what is there is usually limited to vegetation, birds and possibly butterflies. Other species strata are not covered which makes the establishment of whether a grassland is species rich and thus EVG more difficult.
- Much work still needs to be done but it can be expected that within a couple of years' time EU wide inventories with RS are possible that deliver relatively reliable information on the spatial distribution of low and high intensity grasslands and of specific Annex 1 grassland habitats with typical structural characteristics. Especially the method of estimating the NDVI is very promising.

Main recommendations:

- The only suitable level for evaluation is the plot/block level used in LPIS. Since the semi-natural grasslands habitats that are experiencing most biodiversity losses, the

LPIS focus is also logical from the perspective of improving the CAP targeting.

- Harmonisation between countries is required in the coverage of permanent grasslands in the IACS-LPIS systems. **All pasture lands that are grazed or cut and thus show evidence of minimum activity should be included in IACS-LPIS in all EU countries.**
- Common land that is grazed should be included in IACS/LPIS.
- As part of the declaration of land use the farmer should also specify additional management information on the grassland plots. These should include: Fertilisation through artificial fertilisers, stocking density on the grassland plots, ploughing practice, irrigation, and drainage presence.
- More types of permanent grasslands should be registered taking the example of Spain and Portugal where shrub and tree coverage is classified
- For the LPIS plots, links should be established with the spatially specific ecological information on semi-natural habitats used for the reporting under Article 17.

5 LAND AT RISK OF ABANDONMENT: DEFINITION AND DATA

Aim and contents of this chapter:

This chapter focusses on the detection of farm land at risk of abandonment. Main drivers and indicators of land at risk of abandonment are discussed, based on the findings of the study of Jean Michel Terres et al (2013). The main data gaps are identified, building on the results of the study of Terres et al. (2013). National experts have been asked through a questionnaire in what way these gaps could be closed with national data sources and information has further been gathered through an inventory of EU wide and National data sources. Based on this main conclusions and recommendations are drawn in the final paragraph as to improving the availability of data for detecting farmland at risk of abandonment.

5.1 General introduction

Over the last decades abandonment of farm land can be observed in several parts of Europe (Pointereau 2008, Brouwer et al 1997 and Pinto Correia 1992). Mainly due to the declining viability of small scale and / or extensive farming systems, farmers are sometimes forced to give up the land management which allows for natural succession, and eventually can lead to an increased dominance of shrubs and forest growth. This process might result in new wilderness, but it can also threaten biodiversity, especially in the so-called High Nature Value (HNV) farmlands, including ecologically valuable grasslands.

These farmlands have been extensively managed for decades and over the years the agro-ecosystem has resulted in valuable semi natural habitats which are often very rich in biodiversity. Abandonment of farming in these systems can cause a steep decline in level of biodiversity as the diverse agro-ecosystems are often replaced by more monotonous types of vegetation offering less diverse habitats to flora and fauna (EEA, 1999; Baldock, et al. 1996; Preiss et al., 1997; MacDonald et al., 2000; Suárez-Seoane et al., 2002; Sirami et al., 2008, Stoate et al., 2009). Another observed risk of farm land abandonment is the increasing vulnerability for wildfires.

When these agro-ecosystems are being abandoned, ownership and responsibility often become unclear and they are no longer managed, or only in a very marginal way. As a consequence, biomass rapidly accumulates which increases the risks for wildfires, especially in Mediterranean systems. There are accounts of land cover changes in Portugal (Breman et al, 2006) where some former agricultural areas that are nowadays abandoned are subject to wildfires every 3 – 4 years as the *maquis* vegetation is the first to invade abandoned lands, but also the first to burn and regenerate. Thus, in terms of rural development, the abandonment of farming leads to rural depopulation and a decline in management of agro-ecosystems, which eventually leads to an increased risk for wildfires which further threatens the biodiversity and overall quality of life in rural areas.

Measures under Pillar 2 stimulating afforestation and agro-forestry activities on these lands could certainly help to decline fire risks and may provide some opportunities for additional

income. However, the effect on rural development will be limited as the ‘newly grown’ vegetation or forests require, once established, very extensive management, so limited labour input. Furthermore, even the fastest growing forest species can only be harvested every 9 – 10 years. Such extensive forms of management will hardly slow down rural abandonment and the industries processing these products are often not or no longer situated in the area itself. Part of the revenues are therefore likely to spill over to other areas.

To anticipate farmland abandonment from an environmental policy point of view, it is useful to know the extent and location of current farm land abandonment as well as the land at risk of abandonment. However, this is not easy, as the process itself is difficult to define, its drivers change over time and important data gaps exist.

5.2 Estimating and modelling the extend of land abandonment.

The current extend of land abandonment in Europe is not known (Pointerau et al 2008). Studies estimating the European wide extent of abandoned farmland or farmland at risk of abandonment have only delivered rough estimates. Pointerau (2008) estimates the annual loss of utilised agricultural area (UAA) of 0,17 % in France and 0,8% in Spain. In eastern Europe it was estimated that 15-20% of cropland has been abandoned in the ‘80s.

Results of recent modelling studies show that the expected land abandonment in Europe over the next 20-30 years varies greatly, depending on the projected scenario, the underlying model assumptions and available data sources. However, estimates range between 0,7% of the farm land being abandoned by 2020 to 6,7% of the land by 2030 (IEEP 2010, quoting Nowicki 2006, and Rienks 2009). Taking all uncertainties of these modelling studies into account a reasonable estimate of the extent of farmland abandonment by 2030 would be 3-4 % of the UAA, corresponding to 126.000 – 168.000 km² (IEEP 2010).

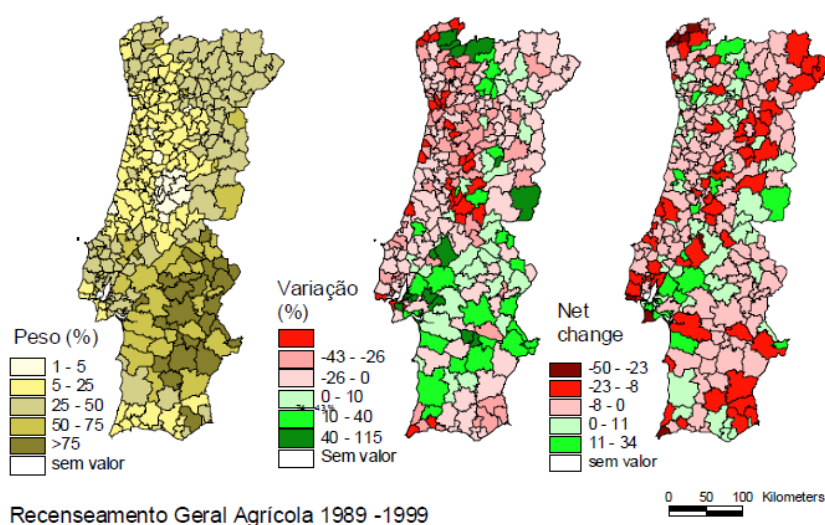
Looking back at the rate of farmland abandonment over the past two decades, the examples from Portugal and Spain show that at least for some countries these estimates are actually quite conservative, as in Portugal there has been a loss of almost 9% of Utilized Agricultural Area of between 1989 and 2009.

Table 5.1 Variation of UAA in Continental Portugal - data from the Portuguese agricultural census (Recenseamento Geral Agricola (1989 – 1999 – 2009))

Decline of UAA in Continental Portugal	1989	1999	2009
Utilized Agricultural Area (in ha.)	3879579	3736140	3542305
% change as compared to 1989		-3.7%	-5.2%
		-8.7%	

Similarly for Spain, in 2010 the UAA represented 47% of the whole territory; a decrease of 9.2% was reported when compared to the results of the previous census²⁷. Still, it is important to realize that these average data on national level can mask even more severe changes at local level. From a detailed study (NUTS 4) on abandonment in Portugal (Pinto-Correia et al., 2006) it can be derived that at a local level there were quite a few municipalities that experienced a decline of over 25% and even up to 50% of UAA in a period of a decade (1989 – 1999). Even when put in perspective, when the UAA is calculated as a percentage of the agricultural surface, the figure on the ‘net change’ of the UAA shows that there are many municipalities affected by (significant) decline in UAA (see Figure 5.1).

Figure 5.1 Utilized Agricultural Area (Weight in 1999, Variation and Net Change, in relation to the total surface of agricultural holdings) (Pinto-Correia et al, 2006)



Similarly, numbers on the change in UAA in Portugal between 1999 and 2009 illustrate that the variation of the UAA is very much dependent on the size of the agricultural holding. Especially the small holdings up to 5 ha. show a decline of UAA of over 40% but even for holdings of up to 50 ha. there are significant (negative) changes in the UAA. Not surprisingly, these change patterns per region and the size distribution of farms show a clear correspondence as the regions with the biggest changes in UAA generally have the smallest average size of farms (see Table 5.2).

²⁷ http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Agricultural_census_in_Spain

Table 5.2 Number of explorations and UAA, in relation to classes of UAA (variation 1999 – 2009) (Agricultural Census, 2009²⁸).

Figura 1.4

Número de explorações e SAU, por classes de SAU (variação 1999-2009)						
Classes de SAU	Explorações		SAU		Variação 1999-2009	
	Nº	(%)	(ha)	(%)	Nº Expl. (%)	SAU (%)
Total	305 266	100,0	3 668 145	100,0	-26,6	-5,0
< 1 ha	66 026	21,6	35 047	1,0	-40,9	-40,0
1 a < 5 ha	164 899	54,0	361 980	9,9	-23,7	-23,7
5 a < 20 ha	52 146	17,1	492 467	13,4	-20,0	-19,4
20 a < 50 ha	11 735	3,8	357 894	9,8	-10,3	-9,7
50 a < 100 ha	4 355	1,4	303 085	8,3	-0,8	0,7
100 a < 500 ha	4 982	1,6	1 097 281	29,9	6,0	5,3
500 a < 1000 ha	857	0,3	579 880	15,8	5,8	5,2
>= 1000 ha	266	0,1	440 512	12,0	-0,4	-0,3

The areas at highest risk of farmland abandonment are in Scandinavia, the north west Iberian Peninsula, central France and the mountainous areas of Europe (Pyrenees, Alps and Apennines (Terres et al 2013)). As for HNV farmland, a recent study (IEEP/Alterra 2010) estimates abandonment rates of almost 20% of arable land identified as HNV, and 28% of grassland identified as HNV. Thus, tackling the issue of abandonment could not only help to contribute to more vital and viable rural areas, but keeping a higher percentage of land in (extensive) agricultural production could also help to create more space for an ambitious percentage of Ecological Focus Areas.

Terres et. al (2013)²⁹ estimated the risk of abandonment for farmland in general in each NUTS2 region of the EU-27, but this information has not been down-scaled to a specific farmland location or areas within a NUTS 2 region. The study of Pointereau (2008) does make estimates of the percentage of the utilised agricultural area which is at risk of abandonment. However the analysis is based on a continuation of the last period trend (where farmland abandonment occurred between the last two Farm Structure Survey censuses). The study results show that 15% of the French UAA, 23% of the Spanish UAA and even up to 50% of the Polish UAA are at risk of abandonment³⁰.

Additional to the indicator development, different models have been elaborated to predict land use changes at a European scale like abandonment of farmland. Roughly two modelling approaches can be distinguished:

- 1) based on land cover change prediction using remote sensing techniques like land cover data from Corine, e.g. CLUE (Verburg and Overmars 2009, Perez Soba et al. 2010 and Verburg 2012);
- 2) based on economic approaches using farm census data (Farm Structural Survey) and (Farm Accountancy Data Network) CAPRI (Nowicki et al 2009).

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http://ra09.ine.pt/xportal/xmain?xpid=RA2009&xpgid=ine_ra2009_publicacao_det&contexto=pu&PUBLICACOESpub_boui=119577123&PUBLICACOESmodo=2&selTab=tab1&pra2009=77999466

29 http://ec.europa.eu/agriculture/external-studies/2013/farmland-abandonment/fulltext_en.pdf

30 For this study, we have built on the study of Terres et al and as a consequence Poland is not included in the analysis.

Both approaches have limitations in predicting accurately and reliably the (farm)land at risk of abandonment. The main difficulties are related to distinguishing between different types of grasslands, fallow land, common lands and levels of intensity of management (Britz et al. 2010, Keenleyside and Tucker 2010, Pointerau et al 2008).

5.3 Detecting farmland at risk of abandonment: three categories of drivers

Farmland at risk of abandonment is included in the 28 Agri-Environment Indicators (AEI). The indicator is defined as farmland where agricultural activities cease to exist and are not being replaced by another activity (such as urbanisation or afforestation) (Pointerau 2008). It is important to stress that the definition does not concern farmland that is currently abandoned, nor does it refer to a past situation, but it emphasizes the probability of the occurrence of land abandonment. As such, the objective of the indicator is to analyse the leading causes more than getting a picture of the farmland already abandoned (Terres et al 2013).

For a consistent approach of the determinants of land abandonment we propose to align with the approaches of Terres et al. (2013), who define three broad categories of drivers of farmland abandonment:

- natural handicaps: poor environmental / biophysical suitability for agricultural activities.
- low farm stability and viability.
- negative drivers in the regional context.

Driver Category 1: poor environmental / biophysical suitability for agricultural activities.

In areas with poor environmental conditions for farming, agricultural production is more difficult because of increased production costs and reduced agricultural opportunities. In consequence these areas have an elevated risk of farm land abandonment.

As for natural constraints, a set of bio-physical criteria recently established by the JRC provides a consistent framework for the delimitation of areas with significant bio-physical constraints (van Orshoven et al 2008).

In Table 5.1 these criteria and data needs are listed. In 2012 the scientific and agronomic rationale for the bio-physical criteria was assessed (Orshoven 2012). Following the Council Conclusions on the EC communication (COM(2009) 161) adopted in 2009, these biophysical criteria have been extensively tested by all EU-member states. The test-results are not yet publicly available, therefore it is not possible to draw conclusions on the extent to which member states have been able to apply the biophysical criteria to their territory, whether the required (spatial) data were available and if the quality was sufficient. However, it is foreseen that these test-results will become available in the short turn, and therefore this report will not deal with the data gaps of driver 1 indicators.

Table 5.3: Bio-physical criteria for the delineation of areas with natural constraints (based on v. Orshoven 2012)

Criterion	Description	Data (source) needed
1 "Low temperature"	The condition in which crop performance or survival is compromised by temperatures during the growing period which are insufficient for optimal growth and development of crops.	A time series of daily meteorological data preferably over 30 (or more) recent years is required to assess the probability of exceedance.
2 "Dryness - Too dry conditions"	Severe limitations to annual precipitation cause yield reductions	A full time series of meteorological data preferably over 30 (or more) recent years is required to assess the probability of exceedance at one location.
Criterion 3 "Limited soil drainage"	Poor drainage reduces the space for the gaseous phase, in particular gaseous oxygen, in the rooting zone. It causes inaccessibility to land and severe yield reductions.	Drainage classes may be inferred from soil classification or directly from soil morphology by national experts
Criterion 3 bis "Excess Soil Moisture Condition"	In conditions where the water content in the soil exceeds field capacity it causes adverse effects on crop growth and / or soil strength	Calculation of duration of the soil water content at field capacity from meteorological data and soil properties
Criterion 4 "Unfavourable Soil Texture and Stoniness"	Sub-optimal conditions of the water-holding capacity and nutrient supply affects workability (ease of tillage), water infiltration, runoff, and movement within the soil (both down and up).	Based on a simple texture classification system, which is possible to apply with data available in most Member States soil databases
Criterion 5 "Shallow Rooting Depth"	Rooting depth which is limited due to hard rock, causes limitations to crop growth.	Observed depths through field survey interpolated with reference to the landscape structure to produce rooting depth estimates for land areas or map units
Criterion 6 "Poor Chemical Properties"	Presence of salts, exchangeable sodium and gypsum in the topsoil	Data on soil properties like pH, salinity, proportion of sodium.
Criterion 7 "Steep Slope"	A slope greater than 15% implies constraints to the workability of the soil.	Digital Elevation Model (DEM)

Driver Category 2: Low farm stability and viability

As for low farm stability and viability the main determinant is the economic situation of the farm. Various indicators can be used to capture the economic situation. For instance the Farm Accountancy Data network (FADN) provides the Farm Net Value Added (FNVA). The IRENA indicator on marginalisation uses the FNVA to identify farms with low profitability. Other possible indicators for the economic situation of the farm might be the share of CAP subsidies in the income of the farmer, the investments on the farm, the standard gross margin per hectare UAA, the farmers' age, etc. (Terres et al,2013).

Driver Category 3: Negative drivers in the regional context

As for the regional context, farm land maybe at risk of abandonment in case the agricultural income is substantially below the rest of the economy in a certain region. Indicators like agricultural income, employment structure over sectors and the price of land are possible indicators.

The main result of the Terres et al (2013) study was a final risk indicator of Farmland Abandonment in which the meaningful indicators were integrated into a composite index. The composite index has been tested on 2 sets of indicators, set 1 includes indicators with a good data availability and representativeness, where set 2 includes indicators that are less analytical sound and/or the data reliability is less robust. Table 5.4 shows an overview of the indicators included in the 2 sets of the composite index.

Table 5.4 The composite index for farmland at risk of land abandonment.

	Low farm stability and viability	Negative drivers from the regional context
Composite index , set 1	Low farm income (D2)	Low population density and remoteness (D7) Rent paid (D1)
Composite index set 2	Low farm income (D2) Lack of investments on farm (D3) Farm holders' age (D4)	Low population density and remoteness (D7) Rent paid (D1)

5.4 Detecting land at risk of abandonment: Data availability at EU level

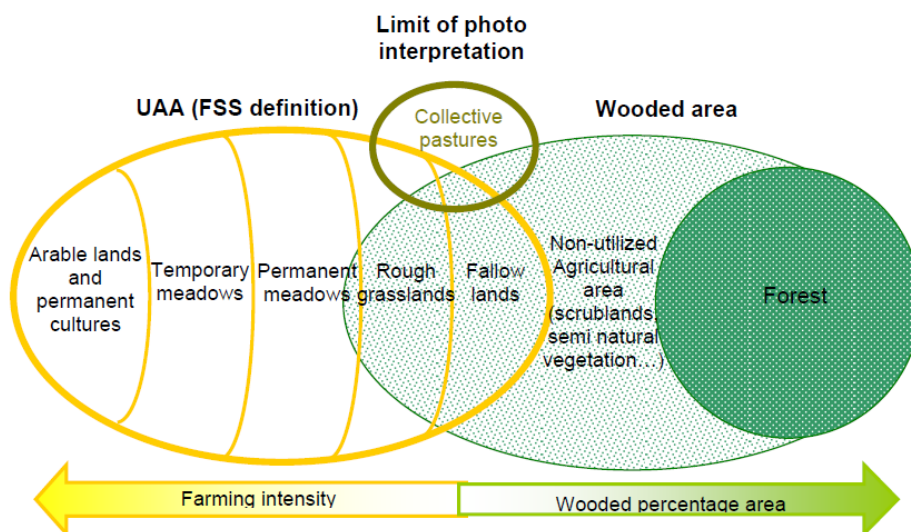
Land Cover Data

Land cover data, like Corine, are a valuable data source to detect land cover and land use. Corine includes several land cover categories that can be related to land (at risk of) abandonment. However, remotely sensed data sources are not capable to distinguish fallow land from land not in agricultural use as it is difficult to capture the gradual transition from agricultural land to shrubs, and eventually forest (see Figure 5.2). Therefore land cover data cannot be used as a single data source to detect land (at risk of) abandonment.

Agricultural Census

The Agricultural Census, based on detailed surveys at farm level and largely standardized throughout the EU, provides detailed information on the socio-economic and agricultural situation up to a NUTS 5 level of detail. The one big disadvantage of this data source is that the census are only carried out once every 10 years and thus are often not very up to date. The most recent census were carried out in 2009 / 2010.

Figure 5.2 The frontier between utilised agricultural land, non-utilised agricultural land and forest (Pointereau et al 2008)



The Farm Structure Survey

In addition to the Agricultural Census, most countries carry out Farm Structure Surveys (FSS) every 2 -3 years. Relevant data that can be derived from FSS indicating farmland at risk of abandonment concern the age of the farmer and farm- and parcel size. However, at EU-level, the farm census data from FSS are only available at an aggregate level and in most countries do not include common grazing lands that are often at particular risk of abandonment (see also Chapter 4). Another limitation of these FSS data is that these usually do not include holdings below a certain size threshold. The finest available scale of this 3 year sample is NUTS2. This scale is in fact less suitable for assessing the risk of land abandonment as farm land abandonment is usually a locally specific problem (see also the example from Figure 5.1 in Portugal).

One category is particularly interesting for detecting land which is at risk of abandonment: F3: permanent grassland and meadows no longer used for production purposes but eligible for CAP payments as long as they are kept in a good agricultural condition according to the GAEC-standards

The Farm Accountancy Data Network

The database of the FADN provides relevant data for indicators like farm income and investments. The Farm Accountancy Data Network is based on a sample of 60.000 holdings. The holdings are selected through a stratified sampling based on farm size and farm type. In fact, FADN is the only source of micro-economic data that is harmonised across EU27 and as such a very valuable database.

However, the field of observation of FADN is delimited by the economic size, as only commercial farms, beyond a certain economic size in ESU are represented in the sample. Farms below this threshold are not represented in FADN. Separate thresholds are specified for each Member State. This delimitation based on economic size leads to a less representative sample. Particularly the smaller sized non-commercial farms are

underrepresented and it is mostly (regions with) this type of farms which have a higher risk of land abandonment because of their marginal locations and low gross margin levels on their products. Thus, although FADN data are the only source of farm accounting / economic data available in a consistent manner over EU27, it seems to be less suitable data set to measure risk on land abandonment for the reasons described above.

Annex 7 and 8 list the most used EU-wide data sources on agriculture and land use /cover. Some of these data sources are relevant for the identification of farmland at risk of abandonment some are less relevant.

The Integrated Administrative and Control System and Land Parcel Information system (IACS/LPIS)

The IACS integrates the control of Community aid systems and generates a wide range of administrative information which can be of potential use for agri-environmental indicators.

The Land Parcel Information system (LPIS) is part of the IACS and is a valuable source of information. The spatial resolution is suitable for detecting declining levels of farm management. The type of information that is available includes crop type, livestock density, input levels and farm subsidies.

Member states have three possibilities to set up their LPIS:

- 1) the most detailed: per farmer, per crop
- 2) per farmers per crop group and
- 3) per one or more farmers per crop group (the so-called physical blocks)

The more detailed the information, thus per farmer per crop, the more valuable the information from LPIS is³¹.

The Rural Development Programme

The monitoring and evaluation of the Rural Development Programmes provides relevant data for the detection of farmland at risk of abandonment, like data on the competitiveness of the agricultural and forestry sector (e.g. number of holdings introducing new products and/or new techniques), and data on the area under successful land management contributing to the avoidance of marginalisation and land abandonment. But, again, the spatial resolution of the source, based on the scale at which the RDP is implemented varies from regional to national, and is too coarse to detect local processes of abandonment.

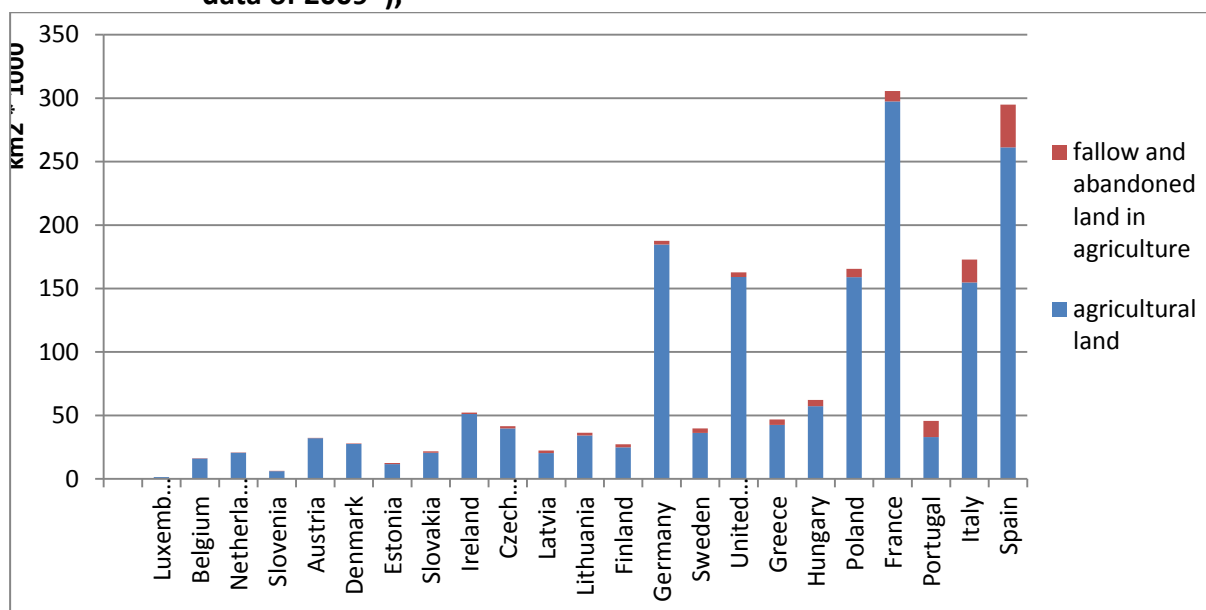
LUCAS (Land Use/Cover Area Frame Statistical Survey)

Firstly, a category of land is registered in LUCAS as a separate land cover class with the title 'Fallow and abandoned land'. The fallow land includes all crop land not included in the crop rotation for at least one year. Abandoned lands are defined as 'all agricultural land that is set aside for a long-term'. The Figure 5.3 summarises the total agricultural area and the area of fallow and abandoned land, coming from LUCAS data of 2009 for most EU countries. According to these data, the share of fallow & abandoned land amounts to 6,6% of the agricultural area. As the countries not included in this overview are expected to have

³¹ For more information see: <http://ies.jrc.ec.europa.eu/our-activities/support-for-member-states/lpis-iacs.html>

relatively high levels of fallow and abandoned land this average figure of 6.6% might be somewhat higher at EU 27 level.

Figure 5.3 Total agricultural area and the area of ‘fallow and abandoned land’ (LUCAS data of 2009*),



Missing: Bulgaria, Romania, Malta, Cyprus

* For the LUCAS 2012 no aggregated figures of these land cover classes are available yet

Next to this, data on the land management (grazed / non-grazed; ploughed / not ploughed), special remarks about the land use (tilled and/or sowed; harvested field; burnt area; etc), hunting regime, type of water management and stoniness are collected in LUCAS.

It is the combination of information on land cover, land use and land management that makes the LUCAS data source especially interesting for analysis on land abandonment processes.

For example, data on the land cover type grassland in combination with data on the land management (e.g. 'non-grazed') gives valuable information about the way the land is (ceased to be) managed. Table 5.5 shows in what way LUCAS-data can be combined to generate valuable information on the risk of land abandonment. From the LUCAS-sample points in Portugal, the sample points with main land use category 'agriculture' and the main land cover category 'grassland with(out) shrub/tree cover' are selected. Within this selection, the land management, i.e. signs or no signs of grazing, are analysed.

It is interesting to notice that more than 40% of the sample points registered as agricultural grassland with shrub/tree cover, does not show any signs of grazing. The same counts for grasslands without shrub / tree cover. The absence of grazing might be an indicator of ceasing land management. It becomes clear this notion cannot be drawn solely from the land cover / land use data, and that detailed data on land management are very valuable to detect the risk of land abandonment.

Despite the observation that the LUCAS data harbour valuable information to detect the risk of land abandonment, one remark has to be made for the application of the data. The LUCAS data are point-data, referring only to a single dot on the 2 km² grid. This makes it hard to extrapolate the data to a full coverage, especially for location specific data like land management, and consequently to draw figures on the total area under a certain land management.

Table 5.5: Example of the way LUCAS-information can be combined to generate information on risk of land abandonment. Numbers in the cells represent the number of sample points present in Portugal for which the combination applies

Land use category	Land management	Signs of grazing	No signs of grazing	total
	Land cover category			
Agriculture	E10 grassland with shrub / tree cover	115	80	195
	E20 grassland without shrub / tree cover	422	292	714

Source: LUCAS, 2012

In addition there are also other categories of land cover and land use that are likely to partly or fully correspond to areas at risk or being abandoned, these are:

- Fallow and abandoned land (as discussed above)
- Agricultural land not used for the entire year for crop production, as part of the field rotation.

However, there are also other categories of land use included in LUCAS that could be related to abandoned farmland such as:

- Crops growing in naturally vegetated areas can be a sign of land that in the past has been in agricultural use;
- Spontaneously re-vegetated surfaces. Mostly agricultural land which has not been cultivated this year or the years before. It has not been prepared for sowing any crop this year;
- Shrubland with sparse tree cover. Areas dominated (more than 20% of the surface) by shrubs and low woody plants, including sparsely occurring trees with a tree-crown area density between 5 and 10 %;
- Shrubland without tree cover. Areas dominated (more than 20% of the surface) by shrubs and low woody plants.

Aggregated data on the area of these categories were not available yet at the moment of writing. LUCAS data can be used to validate CORINE land cover data, e.g. to relate remotely sensed land cover from Corine to field observed information of land use from LUCAS. For this the original LUCAS sample point information is needed and this information is not available publicly, but Eurostat could make the overlay themselves.

5.4.1 Main data gaps identified so far

In a previous study of the JRC (Terres et al, 2013)³², nine indicators have been distinguished, structured into three categories of drivers, to estimate the risk of land abandonment. Based on these nine indicators a composite index for risk of land abandonment has been developed. Also, the main data gaps on (the risk of) land abandonment have been identified (see Table 5.6). As for the first category of drivers, unsuitable biophysical conditions, indicators have been developed by the JRC for the design of the measure on Less Favoured Areas and are not further elaborated in the report of Terres 2013.

As for the second category 'negative drivers in the regional context', the following indicators were identified as key indicators: a weak land market, previous trend of FLA and remoteness and difficult access.

As for the last category of drivers 'low farm stability and viability', a low farm income, low investments in the farm, the age of the farm holder, low farmer qualification, low size of the farm and farm enrolment in specific schemes, were identified as key indicators.

All information about the background, effects on the risk of farmland abandonment and calculation options can be found in Terres et al. (2013). The robustness and data availability of each indicator is also discussed in this report.

Terres et al (2013) draw also some conclusions about the resolution of the required data, as the scientific literature widely agrees that farm land abandonment is a local specific phenomenon, it implies that local data should be available to estimate its risk. However, European data source like FADN or FSS, the resolution of input data is at the most detailed level NUTS3. FSS-micro data do indeed exist, but access to these data is very limited and needs to be arranged at a per country level.

³² Report available at: http://ec.europa.eu/agriculture/external-studies/farmland-abandonment_en.htm

Table 5.6 Indicators to assess risk of farmland abandonment, structured by category of driver and relevance and robustness (based on Terres et al. 2013)

		Relevance & robustness assessment		
		Policy relevant, analytical sound, available data and robust	Policy relevant but reliability low when using EU-datasets	Deficiency in analytical soundness and/or data availability
Categories of drivers	Poor environmental suitability for agricultural activity	Outside the scope of the Terres et al 2013 study		
	Low farm stability and viability	Low farm income (D2, FADN/Eurostat,	Lack of investments on farm (D3,) Farm holders' age (D4,)	Farm manager qualifications (D5,) Low farm size (D8) Commitments of farmers in specific management regimes (D9,)
	Negative drivers from the regional context	Weak land market (D1) Low population density and remoteness (D7)		Previous trend on FLA

5.5 Land at risk of abandonment: national data to fill the data gaps

In this section we discuss the availability of data at national level concerning farmland at risk of abandonment, particularly for filling the data gaps that have been identified in Terres et al. (2013). As this study builds on the study of Terres et al., the focus is on those countries that were identified as having an elevated risk of abandonment in that study: Italy, Bulgaria, Estonia, Latvia, Greece, Spain, France, Finland, Portugal and Sweden. Thus, no extra countries have been included in the analysis, even though the outcome of some other studies (Pointereau, 2008) suggests that there might be more member states within the EU (such as Poland) with a high level of current land abandonment and an elevated risk of future land abandonment.

Table 5.7 Drivers and related sub-indicators for farmland abandonment identified by Terres et al. (2013) as having the biggest deficiency in (EU-wide) data availability

	Driver	Indicator
1	Weak land market	Agricultural Land Prices
2 / 3	Low farm income / Lack of investments on farm	Revenue from touristic activities and other activities outside the farm
4	Age of the farm holder	Age of the farm holder or main responsible of the holding
5	Low farmer qualification	Farmers qualifications
8	Low farm size	Farm and parcel size

Following Terres et al.(2013), in this report the 5 main indicators for farmland at risk of abandonment for which serious data gaps exist in EU-wide data sources are further analysed

(see Table 5.7). This analysis was carried out by means of a questionnaire that was sent out to a national expert on land abandonment for each country. These experts (see Annex 10) have been asked to fill in a questionnaire asking them about the availability of data for each of these indicators. A summary of the results for the five selected indicators is presented in Annex 15. Besides the specific questions with respect to the indicators these experts have also been asked some additional questions on the data on (the risk of) land abandonment. The answers to those questions are also discussed in Annex 15.

5.5.1 Main observations and conclusions

From the analysis and the responses to the questionnaires we can conclude that there are basically two EU wide data sets that can improve the assessment of land at risk of abandonment. Firstly, the LUCAS data provide valuable additional information on land cover classes ‘fallow and abandoned land’ and on land management. The fallow land class is interesting as it indicates the arable lands that are out of production for more than a year. This could be signs of risk for complete abandonment. The abandoned land is no longer at risk as abandonment has already happened. However it could still be a relevant indirect indicator as in a region where abandoned land share is high the chances for the remaining land to become abandoned too are usually higher. So this indicator from LUCAS is relevant and since it is a land cover category for which it is more easy to make real area estimates it is certainly worthwhile to take it into account.

As for the LUCAS additional land management information a relevant indicator for risk of abandonment could be grazing or ploughing status. This kind of information, generates the opportunity to refine the information from land cover and land use with respect to utilisation or more specifically ‘under-utilisation’. It does not directly relate to one of the 5 drivers identified as weak in the Terres et al. (2013) study but it can certainly help to pinpoint to the places in the EU where the process of farmland abandonment is present and or-ongoing.

Secondly, the land parcel information system (LPIS) provides valuable data on parcel and farm size. Access to this data is of course limited, but may be shared with JRC.

Table 5.8 Possible databases to fill the main data gaps of the -indicators for farmland abandonment identified by Terres et al. (2013)

	Driver	Indicator	Best data available to fill data gaps
1	Weak land market	Agricultural Land Prices	National registries on land sales
2 / 3	Low farm income / Lack of investments on farm	Revenue from touristic activities and other activities outside the farm	National agricultural census
4	Age of the farm holder	Age of the farm holder or main responsible of the holding	National agricultural census
5	Low farmer qualification	Farmers qualifications	National agricultural census
8	Low farm size	Farm and parcel size	Land parcel information system

Thirdly, from the inventory of national data (Annex 15) it has become clear there are also two types of data that are well registered and which could be used to further improve the quantification of the drivers of the risk of land abandonment from the Terres et al. (2013) study. Firstly, this concerns national data on land prices. All countries have different registries on land sales and land rents, which can be used to further improve the indicator of agricultural land prices. Secondly, data on farmers' qualifications from national sources are registered in the national census data or other statistical sources. As both types of data are registered in different ways per MS much effort is still to be put in the collection and harmonization of these data.

Finally, in the new CAP (2015-2020) direct payments will be only paid to 'active farmers'. Active farmers are defined by the minimum extent of the agriculture use of the land. Besides, member states may decide to exclude enterprises whose agricultural activities form only an insignificant part of their overall economic activities (art. 9, Regulation (EU) no 1307/2013). To declare the status of 'active farmer' an overview of agricultural and non-agricultural receipts has to be clarified by each recipient of direct payments. These data could potentially be used to calculate the revenue from touristic activities.

As the data sources mentioned above are not yet available (disaggregated data of LUCAS 2013) or are dispersed over member states (national data sources) it was not possible within the lifetime of this project to include concrete figures on the area at risk of land abandonment.

Key messages and conclusions on data availability for identifying land at risk of abandonment:

- As the processes contributing to the risk of land abandonment take place at a local scale, local data to detect the risk are necessary. A valuable local data source is the LPIS in each member state. The limited access to this data source is the main obstacle for its usability.
- Data from LUCAS are potentially valuable for the assessment of land at risk of abandonment, as it provides detailed data on the land management. Data on land management can be used to refine the data on land cover / land use.
- National data sources can complement the European ones, especially national registries on land sales, for data on land prices, and national agricultural census, for data on farmers' qualifications. However, as both types of data are registered in different ways per MS much effort is still to be put in the collection and harmonization of these data.
- Within the scope of the reformed CAP, data on agricultural and non-agricultural receipts will become available, which could potentially be used to calculate the revenue from touristic activities

6 FARMLAND AFFORESTATION IN THE EU

Aim and contents of this chapter:

In this chapter the following aspects are covered:

- The total extent of farmland afforested with CAP aid from 1992 until present
- The stated environmental objectives of farmland afforestation, in the EU regulations and at MS/regional level
- The requirements of the regulations, in terms of mechanisms for preventing negative environmental effects and promoting positive environmental effects
- The way in which individual MS have applied such mechanisms
- The strengths and weaknesses of such mechanisms in practice.

The study aims to gain more knowledge of the environmental effects of farmland afforestation in order to better understand the factors behind successful afforestation in rural development programmes, and the pitfalls to avoid. Minor references are made to related measures such as afforestation of non-agricultural land and forestry measures for Natura 2000, but these were not included in the study aims.

This study was undertaken with limited resources. The methodology consisted of a literature review and a short questionnaire to one expert in selected MS (see below and Annex 16). It was not possible with the resources available to undertake in-depth analysis of the environmental effects of farmland afforestation affecting almost 2 million hectares across the EU over a period of 20 years. Furthermore the analysis was handicapped by the dearth of published scientific research into the environmental effects of farmland afforestation, other than on a few specific sites. The study reports on the main literature available and reviews the main considerations for the environmental effects of farmland afforestation.

The main focus of the study therefore is not on environmental effects as such, but rather on legislative and administrative mechanisms for promoting positive environmental effects and preventing negative environmental effects. These mechanisms are considered in the context of the environmental objectives of the regulations establishing the measures for supporting farmland afforestation.

Given that the objectives of the measure are primarily environmental, a key assumption is that the measure should generate clear environmental benefits that are in line with EU environmental priorities in order to justify the public expenditure – it is not a question of merely preventing negative impacts.

We therefore consider and interpret:

- The stated environmental objectives of farmland afforestation, in the EU regulations and at MS/regional level
- The requirements of the regulations, in terms of mechanisms for preventing negative environmental effects and promoting positive environmental effects
- The way in which individual MS have applied such mechanisms
- The strengths and weaknesses of such mechanisms in practice.

Some MS have made only very limited use of the farmland afforestation measures. At the 23rd May Interim Meeting it therefore was agreed to focus the data gathering on the MS that have made significant use of the farmland afforestation measures since 1992, as well as those for which current EU data is unclear. Questionnaires therefore were sent to experts in the following MS: UK, Spain, Ireland, Italy, Portugal, Greece, Germany, Denmark, Romania, Poland, Hungary, Lithuania, Estonia, Czech Republic and Bulgaria (in this last case for afforestation of non-agricultural land under Article 45 of Regulation 1698/2005 - although not explicitly a focus of this study it was decided to investigate possible implications for EVG that may not be considered agricultural land). After initial consultation with national experts, it was decided not to pursue data for Germany, given the relatively small amount of land afforested, the fact that it seems not to be environmentally controversial, and the difficulties of compiling information from the RDPs of the individual Laender.

From these 15 MS, at least six were to be analysed in more detail with the main focus on legal and administrative mechanisms for pursuing environmental objectives. The aim was to use these examples to illustrate good and less good practice in the design and application of such mechanisms. In practice 11 MS examples are presented: UK, Spain, Romania, Poland, Lithuania, Ireland, Hungary, Estonia, Denmark, Czech Republic and Bulgaria. See Annex 12.

A full review was undertaken of data and literature available at the EU-level. On the basis of the MS questionnaire responses and the literature analysis, the report makes recommendations concerning optimal environmental management of measures for farmland afforestation, as well as the pitfalls to avoid. Recommendations take into account the proposed future EU legislative context.

6.1 Data and literature available at EU level

Data was investigated at EU level, in terms of statistics on the implementation of farmland afforestation measures. Such statistics are available in various reports on the DG AGRI website. There seems to be no single and simply accessed source of such statistics, covering all MS over the period 1992 to the present.

By digging into several different reports it was possible to find data for individual MS for the three periods 1992-1999, 2000-2006, 2007-present. The data for the period 2000-2006 is the most difficult to access in a comprehensive format and there are several obvious and very significant errors in the data for some MS.

In the interests of policy transparency and given the considerable expenditure on these measures and the large-scale of land-use change driven by them, a simple recommendation of the present study is that the Commission website should provide an easily accessible overview of the implementation and effects of farmland afforestation measures from 1992 to the present.

With considerable searching, the EU-level statistics reveal approximately the extent of farmland that has been afforested under the relevant measures. However, they do not show the type of forest that has been established (e.g. tree species, tree density) nor the type of

land that has been planted (e.g. permanent pasture, arable land, abandoned land). This is an important data gap, making it impossible to evaluate environmental effects from the EU level data. The statistics are presented and discussed in section 6.2.1. Proposed improvements to data gathering and monitoring are discussed below.

In addition to the basic data held by the Commission, several EU-level reports have been produced assessing the functioning and/or effects of farmland afforestation measures, including from an environmental perspective in some cases. Notable examples include:

1) IDF (Institut Pour le Développement Forestier), 2001. Evaluation du règlement 2080/92.

Report produced for DG AGRI, to evaluate the impact of this system of aid set up for the EU15 for each of the objectives listed and to assess how the national and regional programmes contributed to their implementation. Judgement criteria and indicators were defined for each of them, and the latter were quantified from the data regarding the European situation collected from the Commission and in 8 target countries representing 96% of the area afforested due to Regulation 2080/92. In addition to the national and European statistics, information was also obtained therefore from maintenance work carried out for 171 beneficiaries carried out by decision-makers and national or regional experts in these 8 countries. The data was collected and processed in each of these countries by a national evaluator. Nevertheless, the complexity and breadth of the matters dealt with, the many sources of data, the absence of monitoring tools common to the Member States, the sometimes patchy nature of the official data and finally the difficulty of assessing results obtained only 6 years ago (which is very little in view of the length of forestry cycles), limit the scope of the analyses and conclusions of this evaluation.

2) Court of Auditors, 2004. SPECIAL REPORT No 9/2004 on Forestry Measures within Rural Development Policy, together with the Commission's replies.

The principal objectives of the Court's audit were to determine:

- whether the forestry measures are based on forestry plans or equivalent instruments,
- how such measures were programmed and financed,
- how they were implemented,
- what was the impact of the measures as regards economy, efficiency and effectiveness.

Audit visits were carried out at the Commission (Directorate-General for Agriculture), where information on the implementation of the strategy was examined. Audits were also carried out of the management of forestry measures and projects by the national, regional and local administrations in the main recipient Member States (Spain, Portugal, Italy, Ireland and France). Thirty four projects, selected on the basis of their financial importance and representativity (sic) of the measures, were visited on the spot.

3) Zanchi, G., Thiel, D., Green, T. and Lindner, M., 2007. SPECIFIC TARGETED RESEARCH PROJECT n°SSPE-CT-2004-503604 on Impact of Environmental Agreements on the CAP, Document number: MEACAP WP4 – Afforestation in Europe.

This report aims to give first an overview of the policy context for activities promoting land conversion to forest. Requirements and rules surrounding forestry activities and the associated legal implications for farmers and countries complying with the rules will be reviewed. Second, dynamic trends of carbon sinks and sources in different forestry activities will be analysed. Third, existing information and databases on conversion to forest land or plantations at the European level will be presented. We conclude with a discussion about quality of available data, gaps and uncertainties and the identification of present and possible future trends in afforestation activities in Europe.

4) Weber N (ed.) 2000. NEWFOR – New forests for Europe: afforestation at the turn of the century; Cesaro, Gato and Pettennella (eds.)

Includes papers on EU policies for afforestation and their impacts in several MS.

5) AFFOREST

A research project in the EU 5th Framework Programme for Research & Technological Development (Energy, Environment and Sustainable Development theme). The project ran for four years during the period 2000-2004 and included partners from four countries: Belgium, the Netherlands, Sweden and Denmark. Knowledge was obtained from literature and existing data sets, completed with field observations in afforestation chronosequences on former agricultural soils. Two oak (*Quercus robur*) and four Norway spruce (*Picea abies*) chronosequences were investigated. The main products are a geographical database, a mechanistic carbon/nitrogen/water process-based metamodel, a GIS-model based on the metamodel and the spatial information, and finally a spatial decision support system (AFFOREST-sDSS) for scenario analyses and decision support.

6.2 Extent of farmland afforestation supported through the EAFRD in the EU

6.2.1 Extent of farmland afforestation by Member State

The total extent of farmland afforested with CAP aid from 1992 to the present (2010-12 depending on data availability per MS) was approximately 1.9 million hectares, equivalent to a little over 1% of the EU27 UAA.

There are very notable variations between MS. The great majority of CAP-funded farmland afforestation is concentrated in a relatively small number of MS. For several MS the percentage of UAA that has been afforested is 0.01% or less (zero in some cases). At the other extreme are Portugal (8.41%), Ireland (5.06%) and Spain (2.83%), with a large part of

this afforestation taking place in the period 1992-1999. The only other MS where the percentage of UAA afforested is above the EU average (1.1%) are the UK (1.73%) and Hungary (1.6%). It is also notable that the pattern has changed considerably over time since the 1990s, as explained below.

Figures vary considerably depending on the source, especially for a given year. Part of the reason is that in some cases data is based on applications approved, and in some cases on projects actually executed. The year of execution may not coincide with the year of approval. In some cases, approved projects are never executed. Applications often continue to be approved beyond the end of a programming period, but may be counted as within the period rather than for the year they are approved/executed.

The data available from the Commission for the period 2000-2006 is especially problematic and correct data had to be investigated through MS questionnaires. For the period 2007-13 the Commission data is not complete for some MS and corrections have been made from the MS questionnaires for the countries that were the focus of this study.

As shown in Table 6.1, the total EU figures for the period 1992-2010/12 do not vary by very large amounts, and a part of the difference is explained by the fact that the higher figure includes data from 2010-12. The table also shows that the overall rate of farmland afforestation at EU level declined considerably after 1999, which is even more striking given that the number of MS increased from 15 to 27 over the whole period. Approximately 1 million ha were afforested in 1992-99 compared with half a million ha in 2000-2006.

Under Regulation 2080/92, in the period 1992-98 (data for 1999 not found on EC website), a total of 1,147,487 hectares of farmland were afforested. The MS that stand out in terms of the hectares of farmland afforested are as follows (note these figures are from EC website and differ from those shown in the table above from IDF 2001):

Spain	548,526
UK	140,455
Ireland	137,240
Portugal	133,646
Italy	77,422
France	45,147
Greece	31,343
Germany	27,000 approx
Finland	23,584

The remainder have less than 5,000 hectares, and mostly very much less than this. Spain stands out as by far the most significant MS, accounting for almost 50% of all the farmland afforestation supported by Regulation 2080/92. UK, Ireland and Portugal together account for almost a further 40% of the total.

Table 6.1 Extent of farmland afforestation (hectares) supported with CAP funds in three periods from 1992 to 2010.

Country	1992-99	2000-6	2007-10	All periods	Total farmland afforestation as % of UAA (2007)	Notes - highlighted rows use data from MS questionnaires
Austria	343	0	54	397	0.01	
Belgium	191	496	130	817	0.06	
Bulgaria		0	0	0	0.00	
Cyprus		13	7	20	0.01	
Czech Republic		1,673	2,628	4,301	0.12	Data to 2012. Considerable planting in 1994-99 using national funds.
Denmark	5,457	7,404	4,912	17,773	0.67	Data to 2011. Only private land, data re public land is not available
Estonia		2,826	0	2,826	0.31	Measure not continued from 2007, but see text re Natura measure
Finland	19,732	0	0	19,732	0.86	
France	45,147	7,000	183	52,330	0.19	
Germany	26,249	8,597	1,662	36,508	0.22	
Greece	16,401	17,207	0	33,608	0.82	Data for 2007-12 - no afforestation reported
Hungary		29,221	38,625	67,846	1.60	Data to 2011
Ireland	98,258	76,514	34,811	209,583	5.06	Data to 2011. From 2007 the afforestation measure is funded as a State aid, not from RDP
Italy	64,162	31,052	3,775	98,989	0.78	
Latvia		0	0	0	0.00	
Lithuania		2,625	2,916	5,541	0.21	
Luxembourg	12	0	0	12	0.01	
Malta		0	0	0	0.00	
Netherlands	2,271	0	5	2,276	0.12	
Poland		40,258	29,181	69,439	0.45	2000-6 column is 2004-6 data. 2007-10 column is to 2011
Portugal	205,768	86,191	0	291,959	8.41	
Romania		115	649	764	0.01	2000-2006 column shows data for SAPARD 2005-7. Data to 2012
Slovakia		29	39	68	0.00	
Slovenia		0	0	0	0.00	
Spain	459,395	218,273	26,627	704,295	2.83	
Sweden	67	0	0	67	0.00	
UK	100,868	117,104	58,921	276,893	1.73	
TOTAL	1,044,321	646,598	205,126	1,896,045	1.10	Total based on mix of data including MS sources
EU total	1,041,589	558,658	128,841	1,729,089		Total based on EC data

Source: IDF 2001 and DG AGRI website (various tables including http://ec.europa.eu/agriculture/agrista/rurdev2007/RD_Report_2007_Chapter4.pdf http://ec.europa.eu/agriculture/agrista/2002/table_en/en362.htm); UAA figures from <http://epp.eurostat.ec.europa.eu>; highlighted rows include data from MS questionnaires

In the rural development programming period 2000-2006, the afforestation rate slowed considerably in Spain, Portugal, Italy, France and Germany, and ceased altogether in Finland. Ireland planned 128,000 ha (similar to 1992-99) but only 76,514 ha were planted in practice according to national data (note that the figure in the table above may be incorrect). Only the UK, Greece and Denmark saw increased afforestation in this period.

In the current RDP period, MS reporting from the three years 2007-2010 showed the largest extent of farmland afforestation taking place in the UK (58,921 ha) followed by Hungary (38,625 ha although some is thought to be from the previous period), Poland (29,181 ha) and Spain (26,627 ha). Italy reports 3,775 ha, considerably reduced from the previous periods. Ireland has afforested 35,000 ha in this period, but the measures have been funded as State aids not through the RDP.

Five MS reported farmland afforestation of between 1,500 and 4,000 ha. Six MS reported less than 200 ha of farmland afforestation and 12 MS reported none in the period 2007-2010.

These figures indicate very significant changes from the patterns of the 1990s. Only the UK and Denmark seem to be maintaining similar rates of farmland afforestation. Spain still has a significant rate, though apparently much reduced from 1992-99.

Finland, France, Greece and Portugal reported no or negligible farmland afforestation in the period 2007-10, in very stark contrast to the large areas planted in the period 1992-99 and in some cases also in 2000-2006. If these figures are correct then there have been some strong shifts in national priorities for rural development spending.

6.2.2 Types of farmland afforested by Member State

In order to assess environmental effects, it is essential to know the previous land cover and use of the land that has been afforested. Considering the main potential effects – biodiversity, soil, carbon – major differences in outcome can be expected depending on whether the land was previously under annual cropping or permanent pasture (see below for further discussion).

However, data on previous landuse is not reported in the EU-level statistics. This is a major data gap from the point of view of assessing the effects of farmland afforestation, not only environmental effects but also effects on agricultural production and landuse change.

The IDF (2001) study examined data for 8 MS for the period 1992-1999 and found that arable land was the predominant previous use in Germany (67% of the total), Denmark (100%) and Italy (82%). Pasture was the predominant previous use in Ireland (95%), UK (74%), Spain (64%) and France (55%) and these MS accounted for about 80% of all farmland afforestation in the period, indicating that pastures were the predominant previous land use for the EU as a whole.

Table 6.2: Previous use of afforested land in countries studied by IDF (2001)

Country		Germany	Denmark	Spain	France	Italy	Ireland	Portugal	UK
Arable land	% of total	67% (60% regional data)	100% (85% beneficiary surveys)	22.4%	34.2%	82	5%	32%	26.3%
	Type			Temporary crops and grasslands 22.26% family gardens 0.16%	Cereals (26.7%), maize (5.9%), oleaginous crops (1.4%) set-aside (0.7%)				Lowlands, DA, SDA
Grassland and grazing	% of total	31% (34% regional data)	0% (15% beneficiary surveys)	49.6%	55.8%	17	95%	37%	73.7%
	Type			Grazing 14.74% Natural grassland 0.73% Erial a pastos (grazed fallow land) 34.25%	Grassland (54.6%) fodder crops (1.2%)		Rough grazing and bogland (76 %)		Improved grassland, unimproved grassland
Other	% of total	2% (6% regional data)		28%	0.9%	1%	0%	4.2%	0%
	Type			open afforested area and dehesas 13.74%, set-aside and other non-occupied land (Barbecho) 9.46%, perennial crops 4.25%, cork oak 0.43%	Vines			Olive groves, orchards, vines	
Not specified	0			0%	9.1%			26.7%	

Source: IDF, 2001

The Court of Auditors (2004) found that:

Varying interpretations were noted in prioritising the land to be afforested taking into account the environment. In some countries low quality and low value land on exposed hills was given priority in order to combat erosion (Spain), thus taking into account the environmental needs but not always complying with the requirement to be agricultural land. In other countries (Italy, Portugal), in which comparable climate conditions were found with similar environmental needs, conversion of high quality and high value agricultural land into forests was noted.

Through the questionnaires to MS experts we explored in more detail the type of land that has been afforested in the MS most affected by farmland afforestation, for example permanent pastures, arable crops and permanent crops. We also looked for data on the afforestation of particular land types such as Annex 1 habitats (Habitats Directive), semi-natural land and EVG.

As shown in Table 6.3, the MS questionnaires indicate that in some cases this data is recorded (e.g. Czech Republic, Greece) and in some cases it is available from samples taken during RDP evaluation studies (e.g. Denmark, Spain). In the UK and in Ireland there is a record of whether afforested land was improved or unimproved farmland, which is of considerable environmental relevance.

Table 6.3: Previous use of afforested land in selected periods (according to data availability) from MS questionnaires (percentages)

MS	Arable	Permanent crops	Grassland	Other	Notes - highlighted rows show MS with questionnaire responses received to date
Czech Republic	51.6		47.8	0.6	
Denmark	91.9	1.1	3.6	3.4	2000-3 MTE report. Previous landuse data not collected systematically.
Estonia					Previous landuse data not collected
Greece	86.0	6.0	8.0		
Hungary	93.5	2.0	4.5		RDP target figures. Previous landuse data not collected
Ireland			>90		Previous landuse data not collected but RDP evaluation says great majority is grazing land
Italy					Previous landuse data not available at MS level
Lithuania	55	2.4	42		Figures for 2004-6 only
Romania					Previous landuse data not reported
Spain	21.0	4.0	40.0	27.0	"Other" is grazing land. From 2000-3 MTE sample survey.
UK					Previous landuse is reported as improved or unimproved land.

From the very few MS that record such data, we can see similar patterns to those referred to by previous studies cited above: some MS with afforestation predominantly on arable land (Denmark, Greece, Hungary according to the RDP intentions, Poland excludes pastures and meadows from afforestation since 2007) and some predominantly on grazing land (Spain, Ireland, also UK although not shown in the table). In the Czech Republic and Lithuania afforestation is divided approximately evenly between arable and grassland.

In the context of the new CAP greening provisions, and the consideration of newly afforested land as potential EFA (ecological focus area), it is of interest to estimate the proportion of arable land that has been afforested in countries for which data are available. For example in Hungary, assuming RDP targets are achieved, approximately 1.63% of arable land is expected to be afforested in the period 2004-12. In Denmark, for the period 1992-2010 the percentage is approximately 0.7% of arable land. In Poland for the period 2007-12 the percentage is approximately 0.26% of arable land. In the Czech Republic for the period 2004-10 the percentage is approximately 0.09% of arable land.

In most MS there is no data available on previous landuse. Recording the previous landuse of afforested land is extremely simple in principle, as this information is available from LPIS. A recommendation of the present study is that MS should be required to record this information and report it to the EC.

In most MS there is no recording of the presence on afforested land of Habitats Directive Annex 1 Habitats or Annex 2 species. Such information is increasingly available from national cartographic data sets and could be incorporated into the application and approval process for afforestation projects in order to assess potential environmental impacts. Recording such information in a data base is not complex and would seem essential given that the overarching objective of the farmland afforestation measure is to improve biodiversity.

Without data of this sort it is very difficult to judge whether afforestation is likely to have been beneficial for local habitats and species, or not.

6.2.3 Types of forest created by Member State

Another significant question is the composition of new forests. Data is collected at MS level on the predominant species used (broadleaved, conifers, mixed). In the period 1992-99, broadleaved species represent 56.8% of the planted areas and cork oak and the evergreen oak stands occupy a dominating position, which is the reverse of the planting trends compared with previous decades. Conifers represent 32.1% of the trees and 4% of the areas have been planted with fast-growing species. Mixtures were predominant in certain countries and regions. (IDF, 2001). See below and Annex 12 for more up-to-date information for individual MS.

6.3 Farmland afforestation in the context of broader changes in the EU forest area

According to the RD Statistical and Economic report (EC, 2011) from 2000 to 2010, the highest average annual increase of Forest and other wooded land (FOWL) was found in Italy (89 700 ha per year), Bulgaria (44 700 ha per year), France (40 700 ha per year), and Spain (39 320 ha per year).

In relative terms, the biggest increase in this same period was seen in Ireland and Bulgaria where the area of FOWL rose by 15% (at an average annual growth rate of 1.42%) and 13% respectively. Large part of this increase took place by a land cover change from agricultural to forest land. However, the drivers vary from country to country – whereas in Ireland, the main driver was grant-aided afforestation, in Bulgaria the main driver was farmland abandonment and natural succession.

FAOSTAT data indicates that the agricultural area in the EU-15 has decreased by 20.9 Mha (or -12.7 per cent) over the period 1961-1994, whereas the forest area has increased by 12.0 M ha (or +11.8 per cent). The greatest change in forest area occurred between 1961 and 1975 and continued at a lower rate.

The highest rates of increase were observed in Western Europe, where the forest area increased by 30 per cent from 1950 to 2000 at a relatively constant rate over the whole period.

While forests have been undergoing considerable expansion, it is notable that permanent grasslands have been in constant decline in the EU since 1975 (EC, 2013). Thus in the context of broad landuse changes, the farmland afforestation measure seems to have been “pushing at an open door”, and providing financial support for a landuse shift from marginal farming to forest that is being driven by wider socio-economic forces. This situation would suggest that an untargeted or “blanket” approach to financing farmland afforestation is not rational, and rather that support should be targeted at the creation of types of woodland and on types of land that are less likely to result from socio-economic forces.

It is also useful to reflect on the future status of the forests that are created through farmland afforestation. This will vary according to the MS, the region and indeed the local afforestation project itself. For example, some afforestation is undertaken with commercial species with a primarily economic vocation, such as spruce in Ireland and Black locust plantations established in Hungary or Greece. On the other hand, a large proportion of afforestation is with slow-growing broadleaves primarily with an environmental vocation. For example the Mid-Term Evaluation report for Spain in 2003 suggests that the economic viability of the plantations will be very limited.

It is beyond the scope of the present study to research the economic viability of forests created through farmland afforestation, but it is clear from the type of plantations created and the land on which they are planted that for a considerable proportion of them the incentive of economic production will not be sufficient to maintain them in management into the future. In all cases there are several years of management for plantation maintenance that is both required and aided by the RDP measure. For these years the maintenance activity should be environmentally positive as well as generating some seasonal employment for the beneficiary or/and for contract workers.

However, beyond the 15 years of maintenance payments (12 years is proposed from 2014-15) it is reasonable to assume that management will cease on many of the least economic plantations. Thus although afforestation supported with public funds may have provided an alternative to the abandonment of low-grade farmland for a time, the end result may be abandoned forests instead. The environmental consequences of such a scenario will depend on local and biogeographic conditions.

6.4 Environmental objectives of farmland afforestation

6.4.1 EU level objectives

Since 1992, the EU regulations establishing measures for farmland afforestation have included environmental objectives. The assessment of environmental impacts should be made in the context of the intended objectives of the measures. Concrete objectives might be expected to be listed in the EU Regulation for a measure that drives significant land use change at considerable public expense.

Under Regulation 2080/92 the only concrete objective was to combat the greenhouse effect and absorb carbon. For the period 2000-2007, the wording was changed considerably, with full references to international and Community undertakings re forestry, and stating that measures should be based on national or subnational forest programmes or equivalent. The specific problems of climate change should be taken in to account. There was a new requirement for RDP documents that also includes general environmental aspects. However, the environmental objectives specified in the Regulation are less concrete than in 1992-99, with the only concrete objective of farmland afforestation being to extend the woodland area (creating more forest is an inevitable result of a measure for farmland afforestation, it is not a meaningful policy objective).

Commission remarks in Court of Auditors (2004) are indicative of the very generalised policy justification for supporting farmland afforestation in the early periods: *Extension of woodland areas promotes the diversification of activities in rural areas, as well as the protection of the environment. This measure may have very positive effects in some specific regions or areas.* The same general affirmations could be made about agriculture, tourism, or several other activities in rural areas. Many such activities “may” have positive effects, the critical question is how to ensure that such effects are realised under a publicly-funded policy instrument.

For the period 2007-12, Regulation 1698/2005 has no concrete objectives for farmland afforestation cited in the Articles. However, the recitals include the following statement:

In order to contribute to the protection of the environment, the prevention of natural hazards and fires, as well as to mitigate climate change, forest resources should be extended and improved by first afforestation of agricultural land and other than agricultural land. Any first afforestation should be adapted to local conditions and compatible with the environment and enhance biodiversity.

Thus for the first time there is a range of concrete environmental objectives. Some aspects are still questionable however. For example, there is no apparent justification for the claim that first afforestation contributes to prevention of fires, in fact forests are inherently a higher fire risk than farmland. Also the wording “compatible with the environment” has very little practical meaning – compatible with environmental policy priorities would have more meaning. Much more significant is the statement that all first afforestation should enhance biodiversity, which is a significantly higher level of ambition than in previous objectives. To achieve this objective requires careful planning and precise targeting and design of afforestation projects.

For the period 2014-20, the new consolidated draft EAFRD regulation dated 26th September 2013 (Interinstitutional File 2011/0282 (COD)) does not set out concrete objectives for afforestation. It states simply that “forestry is an integral part of rural development and support for sustainable and climate friendly land use should encompass forest area development and sustainable management of forests”. However, the regulation establishes over-arching priorities for rural development policy that include elements of direct relevance for farmland afforestation, such as restoring, and preserving and enhancing biodiversity, preventing soil erosion and improving soil management and fostering carbon conservation and sequestration in agriculture and forestry.

6.5 Environmental requirements of the EU Regulations

Since 1992, the EU regulations establishing measures for farmland afforestation have included some requirements on MS to take account of the environment, although mostly quite vague.

Regulation 2080/92 had weak environmental requirements, specifically:

Communicate to EC the measures taken to evaluate and monitor environmental impact and compatibility with land use criteria.

The Regulation also gave MS the option to:

devise zonal afforestation plans reflecting the diversity of environmental situations, natural conditions and environmental structures., including:

- *Setting objectives for afforestation*
- *Conditions on location of areas that can be afforested*
- *Forestry practices to be complied with*
- *Selection of tree species adapted to local conditions*

This option provided a potentially significant mechanism for reducing negative environmental impacts and favouring environmental benefits. Had it been obligatory and implemented with rigour, this approach could have prevented many negative effects and promoted positive effects during the 1990s.

From 1999, MS were required to base their forestry rural development measures on national or sub-national forest programmes or equivalent instruments. In the absence of forestry programmes, the Regulation allowed forestry support to be based on equivalent instruments. The Regulation clearly states that the instrument should be equivalent and thus constitute and justify the link between the EU forestry strategy and the national forestry measures, co-financed by the EU. Rural development plans (RDP) and operational programmes (OP) have been accepted by the Commission as being equivalent to forestry programmes.

The Court of Auditors (2004) noted that the process of developing forest programmes was slow; that there was a vagueness in their formulation; and that, when available, their implementation was fragmented. The study identified the existence of many actors and the vagueness of the concept of sustainability as being amongst the causes of this situation.

The Court of Auditors also found a number of weaknesses in the implementation of forestry measures:

- *varying interpretations were noted in prioritising the land to be afforested,*
- *no clear Community guidelines on how to ensure compatibility with the environment,*
- *unclear project selection criteria,*

- *unsatisfactory arrangements for deciding on eligibility relating to land use, loss of income and whether beneficiaries were farmers,*
- *weak on the spot checks to verify the correctness of claims,*
- *a need to improve control procedures for public contract tendering*

In terms of environmental mechanisms, the Court of Auditors (2004) concluded that:

no clear operational objectives were set nor were guidelines issued on how to prioritise afforestation in order to be compatible with strategy, particularly that part relating to the environment. In three of the five Member States visited, no systematic checks were made prior to project approval to assess compatibility with the environment (Spain, Portugal, France) and in one Member State (Ireland), despite being provided for in the procedures, lack of prior approval was noted in one of the projects visited.

The following recommendations were made:

Various aspects of the support scheme should be reviewed. In particular the Commission should reconsider how the afforestation measure can be better targeted, at a lower cost to the EU budget taking into account the changing public needs and the fact that the emphasis of Community legislation is now on sustainable environmental benefits.

In its replies to the Court of Auditors (2004), the Commission stated.

afforestation strategies are defined by the Member States either at national or at regional level. The Member States indicate in their rural development programmes the type of land to be afforested, the specific priorities to be addressed and the compatibility with the environment of the proposed actions. The Commission services examine these questions during the approval procedure for rural development programmes.

Where systematic checks on compatibility with the environment were left aside, the Commission has already conducted legal proceedings against Member States and will not hesitate to continue the same approach if need be.

The Commission response seems to be concerned with “systematic checks on compatibility with the environment”. In other words, the focus seems to be on preventing negative impacts, rather than mechanisms for targeting positive effects, which was the concern of the Court of Auditors. These two aspects are considered in the context of the MS questionnaire responses, below.

From 2006, there were changes in the EU regulations, as set out by the Commission in its replies to the Court of Auditors (2004). The protection of the environment is established as the explicit objective of afforestation; and first afforestation should be adapted to local conditions and compatible with the environment and enhance biodiversity. Moreover, Member States have to designate areas suitable for afforestation for environmental reasons.

The Commission stated:

A significant improvement of the environmental targeting and compatibility can be expected from the rural development proposals for post 2006 period. Both aspects are significantly reinforced in a way that Member States have to consider clearly environmental aspects as (a) to the design of the measure, and (b) to the implementation of the measure.

The essential tool to verify this ex post is the reinforced monitoring and assessment of the results achieved also in terms of environmental delivery.

In practice, it appears from the questionnaires that the 2007-12 requirement to “designate areas suitable for afforestation for environmental reasons” has been implemented very weakly in most MS, and has not constituted a rigorous targeting mechanism for afforestation. Monitoring and assessment of environmental effects is greatly handicapped by the failure to collect basic data, such as the previous landuse of afforested farmland. The extent to which environmental targeting has been achieved, and monitoring and assessment reinforced, is explored in more detail in the following sections.

For the period 2014-20, the minimum environmental requirements for afforestation funded under RDP measures are to be established in a Delegated Regulation, the most recent text relating to EAFRD being published in C(2014) 1460 final (reproduced in Annex 2, table 4). These include a new and explicit requirement that “the selection of species to be planted, of areas and of methods to be used shall avoid the inappropriate afforestation of sensitive habitats such as peat lands and wetlands and negative effects on areas of high ecological value including areas under high natural value farming”. Grasslands (such as environmentally sensitive or ecologically valuable grasslands) are not mentioned in the context of “sensitive habitats”. There is no longer any requirement to identify land most suitable for afforestation for environmental reasons or to actively target such land.

6.6 Environmental impacts of farmland afforestation

It was not possible with the resources available to this study to undertake in-depth analysis of the environmental effects of farmland afforestation affecting almost 2 million hectares across the EU over a period of 20 years. This would require a major research project. The methodology of the present study consisted of a literature review and a short questionnaire to one expert in selected MS (see below and Annex 16). The study reports on the main literature available and reviews the main considerations for the environmental effects of farmland afforestation.

In terms of environmental effects of farmland afforestation, the aspects to consider include:

- Biodiversity – habitats and species
- Climate – carbon balance, climate mitigation by modifying micro- or mezzo-climate, mitigating heat waves etc.
- Soil – development, conservation, erosion control
- Fire – level of risk and vulnerability
- Water – conservation, run-off control, catchment management

- Air – improvement of air quality

For each of these aspects, the afforestation outcomes should be compared with the counterfactual situation according to the previous land cover (vegetation) and land use (farming type). In many cases, data unfortunately is not available to make such comparisons. In principle the minimum information required would be:

- Previous land cover and land use, landscape context (e.g. low or high % of forest cover)
- Land type, particularly in terms of soil and slope
- The presence of priority habitats and species
- Composition and structure of the newly established forest and its potential evolution over the longer term
- Planting and maintenance techniques

As described above, in practice such data has not been collected except in a few very limited cases. This is a major handicap to effective monitoring and assessment of the effects of farmland afforestation at present and over the past 20 years.

The question of timescale is very relevant to the assessment of afforestation effects. In particular, environmental benefits such as biodiversity, soil protection and carbon storage may be expected to increase over very long time periods of stable forest management. If positive effects materialise over the long term then these might be considered to compensate for some potential short-term negative effects such as habitat loss or soil disturbance resulting from afforestation. However, evaluations of effects are especially difficult over the long term because the future evolution and management of forests cannot be known.

6.6.1 EU-level information and studies on environmental effects

Neither EU-level data on afforestation nor the CMEF indicators reveal significant information on the environmental effects of farmland afforestation. The limited nature of the EU data on afforestation has been referred to above. The most relevant CMEF indicator is tree species composition, but this provides no information on most of the potential environmental effects of farmland afforestation as listed above.

We found no comprehensive assessment of the environmental effects of farmland afforestation at EU level, or for individual MS, for the entire period from 1992 to the present. With the exception of certain localised sites that have been the subject of research projects, there seems to be an absence of scientific evaluations of the effects (positive and negative) of farmland afforestation in the EU. This was a considerable handicap for the present study.

However, several reports have made reference to the issues, and the main findings are summarised in Annex 17. The MS questionnaires also revealed some issues, that are also summarised at the end of this section.

6.6.2 Conclusions from EU-level studies on environmental effects

There are no comprehensive environmental assessments of farmland afforestation over the past 20 years at the EU level, although some studies have looked into the issues, as summarised in Annex 17. There has been some scientific research of environmental effects of certain types of afforestation in specific locations but the findings cannot be extrapolated to all situations.

Overall, the findings summarised indicate that there are clear potential benefits in terms of soil, carbon and biodiversity in the case of afforestation on intensively farmed arable land. The precise benefits, and possible disbenefits, will of course depend greatly on the local conditions and the type of afforestation that is undertaken.

On the other hand, the body of research raises major questions over the potential environmental benefits from afforesting permanent pastures, especially in circumstances where these may themselves be of considerable value in terms of carbon, soil organic matter and biodiversity, and they are not under high erosion risk. These types of farmland generally will coincide with semi-natural pastures (EVG). The negative effects of afforestation may outweigh the benefits in these situations.

Risks of biodiversity loss are also highlighted in the case of afforestation of culturally rich historical small-scale landscapes, that may be under permanent and/or arable crops.

6.6.3 MS-level information on environmental effects

Overall there is a lack of scientific information on the actual environmental effects of farmland afforestation at MS level. There is local research of the effects on specific sites but global assessments of the past 20 years (in the case of EU15) of afforestation are lacking.

The MS questionnaire responses attempted to draw together available information and expert opinions in the limited time available under this study. Some examples of information from the MS questionnaires are given below and in Table 6.4. See Annex 16 for more details.

The overall conclusions from the MS questionnaires are that general environmental benefits from farmland afforestation are assumed in RDPs and evaluations of RDPs, and that this assumption probably is justified in the case of most arable land. Some MS have targeted afforestation onto arable and other cropped land, for example Denmark, Greece and Poland, and for these MS negative effects are not reported in the questionnaires. To a large extent this is also the case for Hungary, although some localised negative impacts are reported.

Table 6.4: Summary of environmental effects reported in questionnaires

	Reported positive effects	Reported negative effects
Bulgaria	Measure implemented is for the afforestation of non-agricultural land. Very small area affected so far, no concrete effects reported.	
Czech Republic	Current RDP reports sequestration potential of the afforested land as total 24.5 Gg of CO ₂	Some valuable meadows have been afforested.
Denmark	The RDP assumes that afforestation in Denmark will absorb approximately 10 tonnes/ha of CO ₂ yearly. This is probably an optimistic goal as this figure is more suitable for afforestation with conifers than for broadleaved species. It is estimated that the loss of N from agriculture will	None reported.

	be reduced by approx. 50 kg N/ha	
Estonia	Indirectly the quality of the soil of afforested areas will increase in time – humus content and organic matter content will increase, general soil health will improve.	A specific concern is that the economic drivers to afforest semi-natural wood pastures are increased because of the absence of CAP support due to eligibility rules. This situation encourages owners of semi-natural habitat to converting potentially valuable farmland habitats into forest.
Hungary	General positive environmental effects of afforestation such as combating erosion and climate change probably are reasonable assumptions in the case of arable land	An afforestation project took place in an area where the rare and endangered great bustard (<i>Otis tarda</i>) occurs. Several cases were reported where forests were planted around valuable wetlands, marshy areas, where they may have a negative impact on hydrology.
Ireland	Creation of native woodlands of potential biodiversity value under the RDP schemes, though on an extremely small scale.	Outside of Natura 2000 sites the planting of woodland on semi-natural habitat (EVG) is common practice. Birdwatch Ireland voiced concerns as late as 2012 on the continuing planting of woodland on semi-natural and species-rich grassland and breeding wader sites.
Lithuania	In cases where afforestation projects have been performed in areas/regions where forest coverage was poor or on large agricultural fields, or on slopes and ravines where water erosion could occur, and where new forest plantations are likely to play a role of biological corridors, afforestation should be considered as very environmentally positive measure of landscape management, which is valuable for stability of agro-ecosystems and for biodiversity.	In cases where afforestation projects have been performed in areas where forest coverage in the region was very high or on rather small agricultural fields surrounded by forests, afforestation should be considered as environmentally negative measure of landscape management, which is also damaging local biodiversity. In Lithuania, there are known cases where valuable meadows have been afforested (even in protected areas). In such situations measure 223 has been an instrument destroying biological values rather than creating them.
Poland	The expected environmental effects of increasing forest cover include: retention and mitigation of conditions of water flow (surface water and groundwater), counteraction of soil degradation and soil erosion, sequestration CO ₂ .	None reported. Exclusion of pastures and meadows from afforestation since 2007 probably has reduced the risks of negative effects.
Romania	Almost no effects to-date due to the very small area planted. The majority was arable land.	Almost no effects to-date due to the very small area planted. The majority was arable land.
Spain	The 2008 evaluation, considering a total area afforested of 218,273 ha, estimated the carbon storage from 2012 at 0.54 million tonnes per year. Potential benefits of soil conservation, especially in the case of afforestation on arable land. Creation of habitats for forest birds and the extension of forest habitat in areas with brown bear populations. Increased connectivity between existing, isolated forests in the case of 18% of the area afforested.	Cases of afforestation on land with pre-existing natural succession (i.e. natural establishment of tree cover), with cases of the natural succession being cleared prior to (re-)planting. This causes release of carbon and destruction of habitats. In some cases the planting and maintenance practices have been too intensive (e.g. ploughing prior to planting and to control invasive vegetation, ploughing up and down the slope), thus negating the potential soil conservation benefits of afforestation. Cases are also reported of fragile habitats with endemic vegetation of high ecological value suffering from “aggressive planting practices”, for example Annex 1 habitats 1410 Mediterranean salt meadows and 1520 Iberian gypsum vegetation.
United Kingdom	Carbon sequestration, especially in the case of afforestation on fertile, low carbon soils. Some creation of new native woodlands.	Loss of semi-natural grazed habitats in uplands, and of some smaller fragments in lowlands.

Standardised benefits are usually quoted by RDPs and RDP evaluations. For example in Denmark a quoted example shows a leaching of an average of 12 kg N/ha/year over a full forest rotation corresponding to a reduction of 82% compared to arable farming. The Danish RDP assumes that afforestation in Denmark will absorb approximately 10 tonnes/ha of CO₂ yearly. This is probably an optimistic goal as this figure is more suitable for afforestation with conifers than for broadleaved species (Vesterdal, 2010). Several other MS also use this standardised approach for estimating benefits. Investigating these assumptions and their applicability at a national level was beyond the resources of this study.

In some cases the affects of afforestation on arable land can be negative for biodiversity, specifically in situations where the current farming system supports populations of species of conservation concern, such as steppeland birds. Cases of such negative effects are reported from Hungary and Spain, although it seems that protection mechanisms have improved in recent years, especially in protected areas such as Natura 2000.

The predominant examples of negative effects relate to the loss of semi-natural grasslands (including wood pastures) or EVG as a result of farmland afforestation. Such effects are reported to a greater or lesser in all of the MS that were researched (other than those targeting cropped land referred to above), and especially in the MS that account for the majority of all farmland afforestation in the EU. Some examples are reported below. As discussed in a later section, it seems that mechanisms to protect valuable habitats have improved in many MS, while the annual extent of new afforestation has declined in some MS, so that the scale of losses may be gradually reduced.

At a general level the data indicates that large areas of semi-natural grasslands have been afforested. For example, a large proportion of the land afforested in Ireland, Spain and the UK has been unimproved grazing land, although the precise area that would correspond to EVG is not known. Overall there is no concrete data on the extent of the loss of semi-natural grasslands or EVG to afforestation. This reflects the fact that in many MS data is not collected on the previous landuse or landcover. It also reflects the fact that data bases do not show the extent and location of semi-natural grasslands in most MS. Generally there are data bases for the most highly valued habitats and sites, such as Natura 2000, but in the wider countryside data is much less complete.

As an example of the data issue, in the Czech Republic it is estimated there is about the same area of valuable grasslands outside protected areas as inside (in total about 40% of all grasslands in the country). The inventory outside the protected areas is still provisional and is not approved as a tool for policy implementation, e.g. to exclude afforestation projects. To-date there have been some losses of EVG but these are thought to be small.

In Ireland the exclusion criteria have prevented planting on some ecologically sensitive sites but have not excluded planting on habitat types such as species-rich dry and wet grasslands, dry and wet heaths. Mechanisms improved from 2010. However, Birdwatch Ireland voiced concerns as late as 2012 on the continuing planting of woodland on semi-natural and species-rich grassland and breeding wader sites. The extent of these impacts is not known.

In Spain the majority of afforestation has taken place on pastures that are predominately semi-natural. The 2003 MTE report mentions that there have been some cases of pastures with pre-existing natural regeneration, including species of ecological value, being cleared prior to afforestation. Cases are also reported of fragile habitats with endemic vegetation of high ecological value suffering from “aggressive planting practices”, for example Annex 1 habitats 1410 Mediterranean salt meadows and 1520 Iberian gypsum vegetation. The report states that the number of cases is not known, but that the environmental effects of such afforestation are negative and should be avoided.

In Hungary cases are reported where forests were planted around valuable wetlands and marshy areas where the hydrology might be negatively impacted. However, new control mechanisms seem to be preventing more negative impacts.

In Lithuania it is reported that positive environmental effects are expected where afforestation has taken place in open arable landscapes with low forest cover, but negative impacts have occurred on semi-natural meadows especially in landscapes with already high woodland cover. The latter seems to have been more as a result of the measure for afforestation of non-agricultural land, as the meadows in question are partly abandoned.

Undoubtedly some of the forests created through the RDP measures will have biodiversity benefits, especially over the longer term, and in some cases the benefits may be considerable. However, there is no way of knowing what proportion will be beneficial with respect to pre-existing habitats. Many RDP evaluations simply assume that new forests bring net biodiversity benefits, and in some cases (Lithuania, Denmark) the new forests are automatically classified as of High Nature Value. In general RDPs and RDP evaluations do not specify the biodiversity gains of farmland afforestation in terms of habitat types or species, but rather in very broad terms of hectares of new forest created. From Denmark it is reported that the mid-term evaluations of the afforestation measures have used farm interviews as the prime method of the evaluation, as also occurs in many other MS. The MTE thus provides information on the effects according to the participants (supplemented by expert knowledge) and mainly on the actions they have taken rather than on the outcomes. There is no monitoring system in place to directly measure and assess the environmental outcome of the farmland afforestation. This is the situation in most MS.

To ensure that all afforestation enhances biodiversity as the current EU regulation intends, a rational strategy would be to focus efforts on the habitat types and species that are most in decline, or most threatened with decline. However, at EU level, these generally are not forest habitat types. Recent information from Habitats Directive Article 17 reporting suggests that semi-natural grassland habitat types are the most threatened, so it could be argued that an EU-level measure for maintaining these habitats is a greater biodiversity priority than the creation of new forest habitats on farmland. Box 6.1 illustrates the potential tensions between afforestation targets and the conservation of priority semi-natural habitats at a MS strategic level.

Box 6.1 Example from UK of inherent tensions between conservation of semi-natural habitats and afforestation targets

UK governments have targets for afforestation, and these are supported in some cases by environmental NGOs, such as the Woodland Trust in England. However, there are also concerns about habitat losses resulting from afforestation. Finding the right balance is a challenge for policy.

For example, the UK Biodiversity Action Plans (BAP) identify expansion of tree cover and tree planting as a significant cause of decline across a range of priority habitats. These include upland and lowland grasslands, hay meadows, acidic and calcareous grasslands, wood pastures, blanket bog, upland and lowland heaths and others. It is estimated that 120,000 ha of former BAP habitats have been lost to afforestation in England alone. Chatter (2013) reminds us that forest biodiversity in the UK is dependent primarily on the maintenance of continuity of “old growth” wood pastures and management of ancient coppices. Conservation management is about keeping open spaces within woodland (e.g. through grazing), rather than filling open spaces with trees. Tree planting in itself does not deliver forest biodiversity priorities. RSPB has summarised its view as “the right trees in the right places”.

The Macaulay Institute has produced a report for the Scottish Government entitled Rationale for Woodland Expansion. An example table in the report illustrates a possible scenario by which the Government’s target of 25% woodland cover could be delivered, involving the loss of 150,000 ha of Habitats Directive Annex 1 shrub heath (insofar as current data bases allow its accurate identification) and 270,000 ha of other semi-natural grasslands (EVG) representing 7% and 17% of the total extent of these habitats in Scotland.

Such losses would have to be reported and justified to the EC.

Land type	Indicative total area of land type in Scotland 000’s ha	A possible woodland creation scenario	
		000’s ha	% of land cover type
Woodland	1110	-	-
Built up	150	10	7%
Arable	730	40	5%
Improved grassland	1030	180	18%
Unimproved grassland/ bracken	1510	270	17%
Shrub heath	2200	150	7%
Bog	400	0	0%
Montane/littoral/water	650	0	0%
		650	

Of course at a local level the situation may be different, especially in intensively farmed landscapes with very limited semi-natural habitat or woodland. There are situations where

the creation of new forest habitats is indeed a biodiversity priority. Farmland afforestation programmes potentially could be designed in order to promote the creation of specific forest habitats in priority locations.

Allowing natural regeneration is also promoted by environmental experts as a positive option for biodiversity in the case of farmland that has already been abandoned, especially if adjacent to a seed source such as existing woodland. Artificial afforestation at public expense may not deliver any more than natural processes in such situations, and if undertaken insensitively it may cause damage in the short term as described in some cases in Spain of existing spontaneous vegetation being cleared prior to afforestation (see Annex 16).

However, in practice most farmland afforestation programmes are not designed to create forest habitat types of biodiversity priority, even in MS where most of the new plantations use native tree species. Even in cases such as Denmark and UK, where farmland afforestation is quite tightly targeted and conditioned by environmental parameters, there are environmental experts who argue that it achieves little for biodiversity. For example some of the questions raised in Denmark include that the time needed to establish valuable nature is very long (Johannesen et al., 2013); nature is not the prime goal of the afforestation projects (Rahbek et al., 2012) and the afforested areas are too small and scattered (Landskabsværkstedet, 2009). Assessments of the effect of the afforestation at the landscape level are not available. For more on the debate in the UK and other MS, see Annex 16).

A specific concern reported from Spain (accounting for 40% of all EU farmland afforestation) is the increased fire risk resulting from afforestation of extensive pastures and the subsequent exclusion of grazing. Forest fires are a significant cause of GHG emissions in southern Europe, as well as causing destruction of soils and habitats. Forest fires are closely linked to rural abandonment and to afforestation programmes since the 1960s. It is estimated that in the period 1990 to 2000 forest fires produced 1% of all GHG emissions in Spain³³. Extensive grazing is consistently shown to be an effective strategy for reducing fire risk in marginal lands (e.g. Beylier et al, 2006; Ministerio de Medio Ambiente y Medio Rural y Marino, 2008), but this landuse is in widespread decline. A concerted strategy to reduce forest fires through preventive grazing may produce greater climate benefits than farmland afforestation, while at the same time maintaining Annex 1 semi-natural habitats that are threatened with abandonment. In contrast the farmland afforestation measures require the *exclusion* of grazing from marginal lands, and thus result in a greatly increased fire risk. This issue has been addressed in the latest Delegated Regulation texts relating to EAFRD (see Annex 2, table 4) stating that the care of afforested land should include “tending, thinnings or grazing as appropriate, in the interest of the future development of the forest and regulating competition with herbaceous vegetation and avoiding the building up of fire prone undergrowth material”.

³³ José Manuel Moreno, 4^o Conferencia Internacional sobre Incendios Forestales, Sevilla 13th-17th May 2077

6.7 Lessons from administrative conditions and environmental measures applied at MS level to ensure environmental objectives of afforestation are achieved - examples of good and bad practices

Since 2005, environmental benefits are the explicit and primary objective of the farmland afforestation measure. All afforestation supported by RDPs should enhance biodiversity. As a publicly funded policy instrument, it is important to have mechanisms in place that ensure as far as reasonably possible that environmental benefits are delivered.

Mechanisms to promote environmental benefits can be divided into four broad categories:

- 1) Setting clear environmental objectives
- 2) Targeting afforestation onto the most appropriate types of land, where environmental benefits are most likely and/or should be greatest.
- 3) Preventing the afforestation of land where this change of use will involve the loss of important environmental values, such as priority habitats or carbon-rich peatlands.
- 4) Ensuring that the types of forest that are planted are of the types most likely to deliver environmental benefits (e.g. species composition, tree density).
- 5) Ensuring that planting techniques have a low environmental impact, especially on soils and biodiversity (e.g. avoiding ploughing, leaving space for open habitats).

6.7.1 Setting objectives

Objectives of farmland afforestation tend to be defined in quite general terms with wording such as the following from the Czech Republic in the period 2007-2013:

- Increase of forest area on agricultural land,
- Sustainable use of forest and agricultural land,
- Improvement of environment and landscape.

As for many MS, the expected outcomes were more concrete in terms of the carbon sequestration potential of the afforested area (24,5 Gg of CO₂) but still very vague in terms of biodiversity („conservation of genetic diversity and biodiversity is secured“).

Lithuania also presents quite vague environmental objectives such as to increase economical, ecological and social value of land holdings and the locality.

There are also examples of more concrete objectives. For example Hungary specifies the establishment of high biodiversity natural forests, through a substantial increase in the ratio of indigenous tree species, particularly in protected areas.

Poland includes the specific objectives of reduction of the fragmentation of forest complexes and the creation of ecological corridors.

The environmental objectives of the nationally funded measure (not RDP) in Ireland in 2012 included:

- To increase the area under forest in Ireland to contribute towards climate change mitigation;
- To provide a sustainable source of wood biomass for energy purposes;
- To provide a sustainable basis for development of the rural economy;
- To increase the area of purpose-designed recreational and amenity forests;
- To improve water quality through riparian planting;
- To increase overall biodiversity by providing woodland habitat which is under-represented in the complex of habitat types.

In the 2000-2006 period in Spain, according to Royal Decree 6/2001, the environmental objectives of farmland afforestation were the following:

- Correcting problems or erosion and desertification affecting certain Spanish zones.
- Conservation and improvement of soils.
- Conservation of fauna and flora.
- Regulation of water catchments.
- Management of natural spaces compatible with the environment.
- Reducing the risk of wild fires and the improvement of natural resources.

Apart from setting concrete objectives, a key question is whether the mechanisms are in place in order to pursue these objectives effectively. See below.

6.7.2 Targeting

The need for better targeting was made strongly by the Court of Auditors in 2004. In response, under the current Regulation 1698/2005, MS are required to *“designate areas suitable for afforestation for environmental reasons, such as protection against erosion, prevention of natural hazards or extension of forest resources contributing to climate change mitigation, and forest areas with a medium to high forest fire risk”*.

Logically this would mean that an RDP should define and designate in some way the types and areas of land with characteristics such as high rates of soil erosion, low content of soil organic matter, or limited biodiversity value. In this way afforestation could be targeted onto such land, thus increasing the likelihood of significant benefits for soil conservation, carbon storage or biodiversity.

In practice, this approach is not taken in the majority of MS researched in this study. In fact in many cases it is very questionable whether they can be considered to comply with the wording *“designate areas suitable for afforestation”*.

In Denmark and Northern Ireland there is a cartographic delineation of land that is environmentally suitable for afforestation (and also land that is not) – see Annex 12. In Denmark afforestation has been part of the land use planning system for more than 20 years. On the basis of Government guidelines the former counties in their regional planning designated areas where afforestation is desirable as well as non-desirable areas for afforestation which generally cannot be afforested. Areas not designated to one of these two groups are called neutral-areas, where afforestation is possible. The designation is based on an assessment of the different interests that are linked to the various areas,

including, for example, interests concerning the protection of drinking water, the availability of urban forests, agricultural interests, ecological corridors in the landscape or other environmental interests. Currently the areas desirable for afforestation comprise approximately 6% of the countryside and the areas non-desirable comprises approximately 21%.

In Scotland, the RSPB has proposed “woodland sensitivity mapping” as a possible tool for refining the targeting of afforestation to take better account of birds and wider biodiversity in the event of large-scale afforestation of extensive grazing lands.

In Romania, permanent grassland is only eligible for afforestation if there is evidence that it is degraded (e.g. soil erosion). In Poland only croplands are eligible for farmland afforestation aid, all pastures and meadows are excluded for environmental reasons.

In Hungary there are quantified targets for different types of afforestation according to the environmental objectives, with a points system designed to favour afforestation projects that are targeted on suitable land, such as arable land suffering from erosion.

However, in several of the MS we looked at, the starting assumption is that all farmland types in all areas are eligible for farmland afforestation, with no positive targeting. Criteria are then added to restrict afforestation in certain situations, on a case-by-case basis. For example, in Ireland there is a list of criteria that exclude land, especially when it is unsuitable for productive forestry. In some Spanish regions the rules state that farmland of high nature value should not be afforested, although it is not clear how such land will be identified. Farmland afforestation in protected areas and Natura 2000 seems to require special permission, or is simply not permitted, in all MS.

In practical terms, this approach of adding exclusion criteria to prevent negative environmental effects is not the same as designating the land that is eligible because it will deliver most benefits (positive targeting for environmental benefits). It means that in principle applications can be made on any land and the unsuitable cases must be detected through a screening process, for which data may not be readily available. It also means that afforestation is not being steered onto land where it will produce the most benefit, and as a result in many cases the benefits may be insignificant or non-existent.

This is a basic point that arises again in the case of RDP evaluations that often claim environmental benefits from afforestation measures across the board without making distinctions between the types of farmland that have been afforested. This contradicts all the research findings that are reviewed above. Thus in Spain, for the specific stated objectives of correcting problems or erosion and desertification, conservation of fauna and flora, regulation of water catchments or reducing the risk of wild fires there seem to be no mechanisms for targeting afforestation at the types of land where these problems are prevalent. The RDP evaluation report of 2008 (TRAGSATEC 2008) assumes that these objectives are achieved generally as a result of afforestation, regardless of the type of land that is affected.

There are several other mechanisms for encouraging afforestation of certain types, and certain types of land. For example, payments are differentiated in several MS, with higher payments for broadleaved species and for more productive farmland. In Spain, one region gives priority to afforestation projects that include an EIA, while another gives priority to planting dehesas on land adjacent to existing dehesas.

Such mechanisms certainly can have an influence on the type of afforestation that occurs, but the final outcome of course depends on the weighting applied to the various criteria. For example, a selection of environmental priority tree species has been used very rarely in Spain, as the incentives are insufficient. Scotland has introduced “Locational Premia”, for example, in an attempt to improve uptake in certain zones and land types other than unimproved grasslands.

More generally, the economic drivers are pushing very strongly in favour of afforestation on poorer grazing land, as the farming systems on such land generate low incomes. Differentiation in payment rates potentially could steer afforestation away from such land and onto more productive farmland, but in practice the differentiation is not always sufficient.

6.7.3 Preventing afforestation of land where negative effects can be expected

Most MS apply restrictions to the afforestation of farmland in protected areas. In some MS, such areas are totally excluded from afforestation. In others, applicants in such areas must provide a more detailed evaluation of effects and must be approved by an environmental authority.

In some MS, there are mechanisms (such as EIA) in place intended to prevent afforestation from damaging valuable habitats outside protected areas, notably EVG. The effectiveness of such mechanisms seems to vary considerably, depending partly on the human resources and data available to the responsible authorities. Applicants normally are required to provide environmental information on the site to be planted, but in many MS this does not include a requirement to provide information on habitats and species present. In some cases data bases exist, for example of Annex 1 habitats in Spain or semi-natural grasslands in Czech Republic, but these are not used in the process of approving afforestation projects except in Natura 2000 sites.

The way that measures are “delivered” to beneficiaries and subsequently controlled on the ground is a critical issue. In the UK it was noted that afforestation grants are delivered by woodland officers who both implement statutory controls and administer grant schemes (including under the RDPs). Such officers have a very important role, and one to which in general they seem to bring a proactive approach to guidance, including adjustments to individual planting projects to ensure maximum environmental benefits. These officers on the ground also provide a very integrated approach to applying the various legal and administrative controls. However, in some MS applications are handled by an administrative officer who does not visit the site or advise on the details of the project, but simply checks compatibility with regulations and maps in the office. This is especially the case outside protected areas.

As the MS reports illustrate (Annex 16) there are several examples of afforestation being prevented in situations where particular environmental values are clearly recognised. In several MS the protection mechanisms seem to be improving over time, as legislation is tightened up and administrative systems gain experience.

However, it is also apparent that very large areas of EVG have been and continue to be afforested under the RDP measures in certain MS (e.g. Ireland, Spain, UK) and smaller areas in other MS, such as Lithuania for example. Generally this is not because protection mechanisms are failing, it is because there is not a clear policy intention to prevent afforestation on such land (even though this may contradict biodiversity policies).

However, in some cases it is also due to lack of data on valuable farmland habitats outside protected areas, and limited human resources for evaluating applications in the field.

The new requirements proposed in the Delegated Regulation relating to EAFRD (reproduced in Annex 2, table 4) to “avoid the inappropriate afforestation of sensitive habitats such as peat lands and wetlands and negative effects on areas of high ecological value including areas under high natural value farming” seem to necessitate an expansion of the protection currently existing in some Member States beyond protected areas such as Natura 2000 sites. To achieve this will require an improvement to data and administrative mechanisms.

6.7.4 Ensuring that the types of forest that are planted are of the types most likely to deliver environmental benefits (e.g. species composition, tree density).

The main emphasis in most MS is to favour (through criteria and payment levels) broadleaved tree species, although not necessarily native species. In some MS, a large proportion of the broadleaved plantations are exotic species (e.g. Black Locust in Greece and Hungary). While non-native woodlands with appropriate management can benefit some species, they generally are not seen as priority habitats that need to be established in order to enhance biodiversity.

In Lithuania, an afforestation project must use deciduous and/or mixed deciduous-coniferous trees only. Deciduous species must cover a minimum of 20% of the area to be afforested.

In Spain it was noted that some 90% of trees planted are of native species, but very often in plantations with a limited number of species and that are not creating forest habitats of a type that are particularly scarce or fragmented.

However, it should also be mentioned that afforestation measure under CR 1698/05 several times already involve the creation of diverse forest edge around of forest plantation, or using the non-productive investment measure existing plantations could be enhanced by establishing biodiverse forest edge. Several programmes provide this support and this investments could create high ecological value habitats.

In some afforestation programmes (e.g. UK, Hungary) it is emphasised that "open spaces" can be kept and they are considered as part of the afforestation because of the high biodiversity value. Therefore, even in a case of large afforestation, open spaces can be kept

and even maintained as part of afforestation. This is a significant improvement in some countries compare with the requirements for "full" covering in the early 1990s.

There is a potential conflict between environmental objectives in the choice of forest plantations – carbon absorption is generally accepted as more effective with fast-growing species (at least in the short term), whereas for biodiversity the general preference is for slow-growing species.

6.7.5 Ensuring that planting techniques have a low environmental impact, especially on soils and biodiversity (e.g. avoiding ploughing, leaving space for open habitats).

All the MS questionnaires indicate that rules are applied to promote environmentally-sensitive afforestation practices, however limited detail has been provided to-date. In Denmark applications are ranked in case of too many applications within the budget frame. The criteria include proposed planting techniques, such as soil preparation and pesticide-free establishment.

6.8 Recommendations for achieving and for monitoring criteria for good environmental practices in afforestation of agricultural land

6.8.1 Implementing good environmental practice

In 2004 the Court of Auditors commented on the lack of *clear Community guidelines on how to ensure compatibility with the environment*. The review of MS questionnaires completed to-date suggests that more guidance is still needed, especially on the question of positive targeting.

For example, guidance could be provided on ensuring compatibility with other areas of EU legislation and policy. Thus, since biodiversity enhancement is stated as an overarching objective of farmland afforestation since 2006, this objective could be linked explicitly to the aims of EU biodiversity policy, and particularly the Habitats and Birds Directives, in order to:

- Prevent afforestation of farmland habitat types from Annex 1 of the habitats Directive that would be damaged by afforestation (approximately one quarter of all Annex 1 habitat types), not only within Natura 2000 sites
- Give priority to the creation of specific Annex 1 forest habitat types that are known to require expansion on the basis of Habitats Directive Article 17 reporting.

Since MS have to designate areas suitable for afforestation for environmental reasons, guidance could be given on how to link the area designations to specific environmental objectives, such as biodiversity, carbon storage, soil conservation and fire resistance. Note that very few MS seem to have designated these areas as required by the current RDP regulations.

Since first afforestation should be adapted to local conditions and compatible with the environment, an explicit reference could be made to harmonisation with other EU policy

instruments that are relevant to preventing environmental impacts of farmland afforestation. The most relevant mechanism for preventing negative environmental impacts of farmland afforestation in this whole period was the EIA Directive, that has explicit requirements on first afforestation since 1985, but surprisingly is not cross-referenced in any of the regulations concerning afforestation, nor is it included as an SMR under cross-compliance.

Mechanisms to prevent afforestation of semi-natural farmland habitats (such as EVG) and/or to prioritise afforestation of land where the greatest environmental benefits could be explained in more detail. Typically the latter would be land types with low biodiversity value, a poor carbon balance, high rates of soil erosion, etc., which generally means land under more intensive agricultural use. Mechanisms can include maps of eligible and non-eligible land, integration of key data on LPIS, requirements for EIA, differentiated payment rates according to the land type, and field visits prior to the approval of projects.

6.8.2 *Monitoring environmental effects*

The data collected at EU-level on farmland afforestation is extremely limited, as discussed above. Data is collected only on the number of beneficiaries and the number of hectares afforested. Data is not collected on the types of land that are afforested, nor on the environmental characteristics of this land (e.g. soil condition, biodiversity values, landscape context, etc.), nor on the types of forest that are created (species composition). It is difficult to see how the environmental effects of afforestation can be monitored without having access at least to this basic information.

Neither do the CMEF indicators reveal information on the environmental effects of farmland afforestation. Probably the most relevant CMEF indicator is on High Nature Value forestry, but this indicator has been little developed and will not continue in the 2014-20 period. There is also a CMEF baseline indicator on tree species composition (distribution of species group by area of FOWL, %coniferous/% broadleaved/%mixed) but trends in this baseline indicator will provide almost no insight into most of the potential environmental effects of farmland afforestation, for example concerning soil, water, biodiversity and landscape, where the land type and landscape context are more significant factors.

The Farmland Bird Index is the other biodiversity indicator under the CMEF, but also appears to be of relatively little relevance to afforestation, other than possibly providing an indication trends in farmland species that may be impacted by afforestation.

EU-level data concerning implementation of afforestation measures is slightly more detailed since 2007, as a result of the CMEF indicators reporting process. In particular, the claimed environmental objectives of individual farmland afforestation projects are reported.

However, this data is of questionable use for a robust assessment of effects, since the source is generally a box ticked on the application form by the applicant. It is a statement of intent and says very little about the effects in practice.

Overall, the conclusions are the same as those of the recent European Court of Auditors report in relation to forestry measure 122 (for improvement of the economic value of forests). The report states (ECA, 2013) “In terms of monitoring, the CMEF is inadequate to appraise the impact of the financial support under measure 122 because the performance indicators and evaluation questions included in the CMEF do not allow a determination of whether the funded investments resulted in an improvement of the economic value of the forests where they were carried out.”. In the same way, the CMEF does not allow a determination of the environmental effects of farmland afforestation.

The Agri-environmental indicator set (COM(2006) 508 final) includes two indicators that, depending on the specific data that is used and how it is applied, have potential to contribute relevant information for regions experiencing significant amounts of farmland afforestation. These are Landuse change (indicator 9) and Landscape state and diversity (indicator 28).

Overall, the current combination of data collection and indicators does not allow for the evaluation of environmental effects of farmland afforestation in the EU. For this to be possible in the future, it will be necessary to collect at EU level data on the previous land use and land characteristics and on the type of forest established, specifically:

- Previous land cover and land use, landscape context (e.g. low or high % of forest cover)
- Land type, particularly in terms of soil and slope
- The presence of priority habitats and species
- Composition and structure of the newly established forest and its potential evolution over the longer term
- Planting and maintenance techniques

Currently there is no systematic collection of this data by the Management Authorities. Such information would provide a basic indication of whether afforestation was likely in principle to have delivered significant benefits for soil, carbon or biodiversity.

Key messages and conclusions on farmland afforestation

Key findings:

- In terms of the environmental effects of farmland afforestation, these are impossible to assess fully for the whole EU over a period of 20 years (in the case of EU15). The effects of a fundamental change of use on 1% of EU farmland are massive and complex. Still there are no full scientific studies of the subject, only some examples of local research.
- Potential environmental benefits depends to a large extent on where trees are planted (which type of land), how they are planed and managed, and which species are used.
- On cropped land: benefits occur specifically reducing soil erosion, improving soil organic matter, increasing carbon sequestration and providing a valued wildlife habitat and/or expanding or connecting existing forest habitats. Exceptions would apply in situations of arable land and permanent crops of high nature value (e.g.

Steppe lands with bird communities of conservation concern and small-scale mosaic landscapes typically of permanent crops)

- On permanent pasture: will have considerable negative effects on soils and wildlife habitats in the short term. The long-term balance for biodiversity will depend on many factors, including the type of habitat that is lost, the landscape context, and the nature and management of the created forest.

Key environmental risks of farmland afforestation:

- The loss of semi-natural farmland and other farmland of high nature value, especially outside protected areas. Some of this farmland corresponds with Habitats Directive Annex 1 habitats and/or supports Annex 2 species.
- Increased fire risk in situations where dry matter accumulates due to exclusion of livestock grazing and where there is a reduced human presence in the landscape due to the withdrawal of farming.
- Longer-term land abandonment in the case of economically unviable forests at the end of the period when forest maintenance payments are available.
- Limited environmental benefits in situations where afforestation has not been targeted on to land most suitable for achieving these benefits, and/or where the forest type/management is not most appropriate to deliver these benefits.

Key recommendations for safeguarding the environmental benefits of afforestation of agricultural lands are:

- The formulations of clear and specific environmental objectives at EU and RDP levels are needed.
- Targeting mechanisms that steer the most suitable forest types onto the most suitable lands for achieving environmental objectives.
- Ban afforestation on types of land that are most likely to entail significant environmental losses, such as EVG and Habitats Directive Annex 1 habitats. The new CAP rules on non-ploughing of environmentally sensitive grasslands are potentially relevant.
- Prioritisation of support for the creation of forest types that are scarce, fragmented and/or deliver a particularly high environmental benefit compared with the previous land use.
- Improvement of data bases on land use, land cover and land condition (including soil, habitats and species) and that make evaluation of changes in these possible in order to enable better targeting and screening.
- Adequate human resources on the ground in the form of trained and pro-active forestry-environmental agents
- Better coherence of policy mechanisms and removal of perverse effects, such as CAP eligibility rules that can drive High Nature Value grazing land out of farming and towards afforestation to facilitate receipt of Pillar 1 payments; and rules that exclude afforested land from grazing even though this can provide benefits for fire prevention and biodiversity.
- The broader use of the improved agroforestry measure which could help to combine benefits from forestry elements and at the same time maintain agricultural production including extensive grazing. This measure could also help to improve environmental services on intensive agricultural (arable) systems.

7 RIPERIAN BUFFER STRIPS

Aim and contents of this chapter:

In this chapter a conceptual framework for the evaluation of the multifunctional effectiveness of different types of Riparian Buffer Strips (RBS) in the EU is presented and it is applied to 4 good-practice-examples. This conceptual approach is then used to provide an overview of the key factors RBS need to fulfil to be able to reach all multifunctional goals pursued with well-designed RBS. Such goals should include the contribution to local biodiversity, enhance ecological connectivity, help reduce nutrient and pesticide load and provide functions such as temporary water storage in wetland RBS, attractiveness and public access. EU wide available descriptions of RBS, and is used as the basis for the selection of the 4 different types of RBS.

7.1 Introduction

In forestry, treed corridors along water bodies have been implemented in Europe since the 1700s, and in the USA since the late 1960s (Lee 2004). Riparian buffer strips have been a historic feature of many landscapes in Europe (Stutter, Chardon et al. 2012). From an agricultural point of view RBS were not suited for primary production, because of their mostly wet and sloping conditions. However, they contributed to the stabilization of the adjacent soils (prevented erosion), provided shielding, fencing and some coppice and fruits, functions nowadays regarded as ecosystem services. RBS have always contributed to both local biodiversity by offering specific habitat types (e.g. McCracken 2012, refs in Dworak, Berglund et al., 2009; Lee 2004) and by increasing unproductive 'green veining' area (Hendrickx 2007; Billeter 2008), because their biophysical conditions are different from surrounding fields. In the Netherlands, Stortelder et al. (2001) coined the adagio "the worst land is the best" to express the potential contribution to biodiversity of less productive farm land. RBS have further contributed to the biodiversity of the wider area by increasing the ecological connectivity of various species groups between existing nature areas (e.g. Tanadini et al., 2011; Shirley, 2006; Meier et al., 2005; Bentrup & Kellerman, 2004; Semlitsch & Bodie, 2003). A mapped inventory of European RBS wider than 25 m., can be found in (Clerici, 2011), who also provide references to the ecological functions of RBS. The resolution of the mapped information layers however limits this inventory to the more natural and wider riparian BS, as opposed to the generally narrower BS in agricultural landscapes. Buffer strips as narrow as 10 m or less can already reduce pollutant loads substantially (Zhang and Eitzel 2010). Most wider RBS are located outside the farm area, so while the new CAP provides more opportunities for installing on farm BS in agricultural landscapes, it will affect maintenance of wider riparian BS to a lesser extent. We therefore focus on multifunctional RBS within agricultural landscapes.

With the growing attention for environmental quality the interest has grown in the functioning of RBS as an ecotone (Haag and Kaupenjohann, 2001), especially as a filter for water flowing from fields to the stream. A vast body of scientific literature (Arora et al., 2010; Barling and Moore, 1994; Dorioz et al., 2006; Dosskey, 2002; Hoffmann, et al., 2009; Mayer et al., 2005, 2007; Muscutt et al., 1993; Noij et al., 2012, 2012a, 2013; Parkyn, 2004; Polyakov et al., 2005; Ranalli and Macalady, 2010; Wenger, 1999; White and Arnold, 2009;

Zhang and Eitzel, 2010) has shown that RBS can reduce material loads via different mechanisms, such as prevention of erosion, denitrification of nitrate, sedimentation of soil particles, adsorption of phosphate and dissolved organic matter to soil particles, and reduction of direct loads resulting from application of fertilizer and/or pesticides. Especially tall vegetation is also known to reduce drift from pesticide spraying. In Dutch agriculture, the wind shield vegetation between the crop (mandatory in fruit orchards and nursery trees) and the adjacent field ditch effectively reduces the amount of pesticide deposited onto the water surface. From the evaluation of the Dutch Policy on Sustainable Agriculture it was concluded that the implementation of spray drift reducing measures led to considerable environmental benefits, although a further reduction of the aquatic risk is needed to meet the surface water quality standards (Van Eerdt 2012; Kruijne 2011). This can be achieved by increasing the width of the uncultivated strip between crop and water course, the use of improved spraying equipment, and by the implementation of buffer strips grown with specific vegetation.

The growing interest in and knowledge about existing RBS as a measure to reduce surface water loads has led to the suggestion to install new RBS as an additional mitigation measure in rural areas where surface water quality does not yet meet the quality goals, both in the EU as elsewhere. This is an important development, especially in deltaic areas, like in the Netherlands, Flanders, Northern Germany and Poland, the Po Valley, la Huerta de Valencia, etc., where the density of water courses is high. RBS might have a large effect in such areas both on load reduction and costs, because of the high density of man-made water courses. However, it may take time for newly installed RBS to develop their full potential in buffering nutrient losses from agricultural land, as shown by modelling (Noij et al., 2012; Heinen et al., 2012) have confirmed the suggestion of (Dosskey, 2002) that the expected additional reduction of nutrient loads by installing new RBS, compared with a reference, is less than the reported nutrient load reduction by existing RBS. On the other hand RBS may become less effective with time either because the maturing vegetation produces less biomass (i.e. assimilates less nutrients and carbon) and debris (providing less energy for denitrification) (Dosskey, Vidon et al. 2010), or due to lack of maintenance (i.e. biomass and sediment removal) (e.g. Parkyn, 2004 and Dosskey, 2007. For Phosphates see Noij et al., 2013; Roberts, 2012 and Stutter et al., 2009).

Moreover, the same body of literature mentioned above shows that the effectiveness of all RBS is quite variable, because it depends on a wide variety of both bio geophysical conditions (especially slope, soil and hydrology) and different types of RBS management (especially biomass and sediment removal). So, while RBS have the potential to become a multifunctional mitigation measure that also contributes to biodiversity and to the beauty of the landscape, their effectiveness depends strongly on local conditions, management and time since installation.

An inventory is therefore needed for policy evaluation of both existing and planned RBS in Europe, which distinguishes between different types of RBS , different local conditions and different goals (biodiversity, erosion prevention, nutrient loads, pesticide loads). Such an inventory requires a clear concept of the functioning of RBS under different conditions and for different goals. A later EU wide inventory will profit by such a concept, providing the right information for evaluating the contribution of RBS to EU goals.

In this study an evaluation framework for the effectiveness of multi-functional buffer strips was designed that is presented in Table 7.1. It consists of objectives on the one hand (rows) and factors governing the effectiveness on the other hand (columns) (See Table 7.1). The framework can be used to evaluate multi-functional buffer strips, designed to reach a combination of objectives which are enhancing higher biodiversity and water quality, adaptation to climate change and increase the landscape attractiveness. For each separate objective, the effect of the different factors (columns) is indicated in the cells of the table (See Table 7.1). Just below the column titles the indicator ranges for each factor are indicated from negative to positive. For example: the design factor 'buffer strip width' ranges from narrow (-, negative effect) to wide (+, positive effect).

To derive the main factors governing BS Effectiveness (BSE) for specific goals a literature study was performed involving both scientific papers and reports. The list of references used is presented in Annex 23 and an extensive review based on this literature was done to elaborate the conceptual framework which is explained in the next. Examples of good recent reviews are from Christen and Dalgaard (2013), Stutter, Chardon et al. (2012)), and Zhang and Eitzel (2010). The main advantage of reviews over original papers is that inconsistencies in the relation between factors and BSE between different original papers have been filtered out. They provide some answers to questions like:

What are the specific effects for a particular location or situation?

What are the generally valid tendencies, and how can differences in BSE be explained by different design, management, and conditions?

Sometimes, differences in reported BSE are not only due to site and management factors, but also to the methodological approach. For instance BSE tends to be overestimated by site measurements, because the measurement sites are not chosen randomly, but are generally focussed on certain stretches where runoff is not necessarily representative for the whole catchment. Both lower and higher (or more concentrated, channelled) runoff flow might lead to lower effectiveness. On a larger (catchment) scale BS are less effective because discharge to the stream is not evenly distributed (see Piechnik, Goslee et al. (2012) and Helmers (2008), who cite Dosskey et al. (2002), Bren, (1998) and Tomer et al. (2003)). A similar effect holds for shorter measurement periods that might exclude storm events, during which the retention capacity of the BS is exceeded.

Another important methodological difference is measuring without, or with a reference, be it a reference period before BS installation, or a reference treatment without BS. (Dosskey, 2002; Heinen et al., 2012; Noij et al., 2012a). With reference, measured BSE will be less because some pollutant retention also occurs without BS, and only the additional retention by the BS can be attributed to the BS treatment. This methodological issue is associated with the type of BS, either existent (natural) or newly installed (manmade). Measuring without reference is acceptable only in the case of existing (R)BS, to assess their actual functioning, without paying attention to the question what their added value would be compared to the situation without (Noij et al., 2012a).

The Conceptual evaluation framework for the effectiveness of multi-functional buffer strips is complex and is described according to the different goals that have to be reached with the same buffers strip.

The biodiversity goals are divided in local terrestrial and aquatic biodiversity goals, because different factors may act differently on land and water species. Functional agrobiodiversity (FAB) was distinguished because of its relation with agricultural practices. FAB mostly relates to control of pests and diseases (natural predators), but sometimes also to pollination of agricultural crops (e.g. bees). We further distinguished connectivity goals, related to the ecological connectivity of species between locations (landscape level, indirect), from local biodiversity goals (field level, direct).

As for landscape quality we distinguished between goals related to the attractiveness itself and the access the landscape provides to visitors. Access comprises ecosystem services related to tourism and recreation.

We selected water quality goals in rural areas according to the most relevant compounds (parameters, substances) for environmental quality in relation to agriculture as a potential source of sediment, nitrogen (N) phosphorus (P), pesticides, other toxicants, and vectors (pathogens). We arranged these substances according to solubility, i.e. the extent to which a substance is transported within the water itself (soluble), or associated with solid particles (solid bound). This character determines the effect of different buffer strip factors on the reduction of loads of these compounds (Vidon 2010). For instance soluble nitrates and hydrophilic toxicants may infiltrate and be transported with groundwater flow, thus potentially by-passing below the active BS soil layers (low BSE), while sediment with associated Phosphates (P) and e.g. hydrophobic pesticides may be trapped in the BS vegetation or top soil. Phosphates, toxicants, pesticides, vectors and N may all be transported both in a soluble and in particle form. While for P sediment bound transport dominates (Borin, Passoni et al. 2010), most N is transported in soluble form, mainly nitrate (Mayer 2007). As for toxicants, pesticides (Arora, Mickelson et al. 2010) and vectors it is less clear what the main transport route is because this highly depends on the chemical character of the substance (hydrophobic, low solubility, strongly adsorbed → sediment bound, and hydrophilic, high solubility, weakly adsorbed → sediment bound), or in the case of a vector, also the behaviour of the organism. This is why we put these substances in between P and N.

The potential effect of buffer strips on climate change may be subdivided (see Annex 18) in the mitigation goals (i.e. prevention) C sequestration in soil organic matter and standing biomass (4.1), and biomass production and harvesting (4.2), and in the adaptation goal (i.e. coping with the effects of climate change) to increase water storage capacity for flood control (Christen and Dalgaard, 2013).

Factors governing effectiveness (see columns in Table 7.1)

We consulted the same reviews on buffer strips (Annex 22) to derive the most important factors governing their effectiveness for different goals (Table 7.1). These include both conditional, and design and management factors. As for the conditional factors it was felt necessary to distinguish between field level and landscape level factors.

Table 7.1 Conceptual evaluation framework for the effectiveness of buffer strips for different goals.

effectivity factors for buffer strips																
Goals	Specified goals		manage- and designable factors						conditional factors			conditional factors				
			design				management		for field level			for landscape level				
			width	placement	profile	vegetation	harvest	fencing	soil	slope	hydrology	land use	stream density	discharge continuity	ecological network	
-	narrow	standard	abrupt/dry	short/prod.	zero	no	light/heavy	flat/steep	deep	grass	sparse	ephemeral	sparse			
+	wide	tailored	gradual/wet	tall/various	frequent	yes	moderate	moderate	shallow ¹	arable	dense	continuous	dense			
1 Biodiversity	1.1 local terrestrial														1.1 local	
	1.2 functional agrobiodiversity														1.2 FAB	
		1.2.1 pest control													1.2.1 pest c	
		1.2.2 pollination													1.2.2 poll	
	1.3 aquatic														1.3 aquatic	
	1.4 connectivity													1.4 connect		
2 Landscape quality	2.1 attractivity														2.1 attractivity	
	2.2 access														2.2 access	
3 Load reduction =water quality	3.1 solid bound	3.1.1 sediment													3.1.1 sediment	
		3.1.2 P													3.1.2 P	
		3.1.3 toxicants														3.1.3 toxicants
		3.1.4 pesticides														3.1.4 pesticides
	3.2 soluble	3.2.1 vectors														3.2.1 vectors
		3.2.2 N														3.2.2 N
4 Climate change	4.1 C sequestration (mitigation)														4.1 C-seq	
	4.2 biomass harvesting (mitigation)														4.2 harvest	
	4.3 water storage capacity (adaptation)														4.3 storage	
			width	placement	profile	vegetation	harvest	fencing	soil	slope	hydrology	land use	stream density	discharge continuity	ecological network	
			-	narrow	standard	abrupt/dry	short	zero	no	light	flat	deep	grass	sparse	ephemeral	sparse
			+	wide	tailored	gradual/wet	tall	frequent	yes	heavy	steep	shallow	arable	dense	continuous	dense
Notes																
1 too shallow is disadvantageous, e.g. optimal aquifer depth for nitrate retention is 1-3 m below surface (Hill 1996; Noij et al., 2012)																

Field level conditions are more closely related to agricultural practices, while landscape conditions depend on policies and natural resource management for larger spatial scales.

The first main column comprises the factors that can be directly influenced by man. The design factors determine the lay out of the buffer strip (one time at the start), and the management factors how they are going to be maintained.

For all objectives it holds “the wider the better”. Considerations of cost effectiveness were beyond the scope of this study. Clearly the added value of increasing **width** is different for different objectives. For instance from an ecological point of view one might establish a minimum width for certain species (McCracken 2012, Semlitsch & Bodie 2003) whereas the relation between the reduction of nutrient loads with width follows a typical saturation curve reaching a plateau at a width of several meters (Zhang and Eitzel 2010). For pollutant load reduction there is a maximum effectiveness that cannot be increased by widening the BS. Width both refers to absolute width and relative width, the latter referring to the ratio between the upstream source area and the BS area (Piechnik, Goslee et al. 2012); (Noij 2012); (Helmers 2008), who cite Dosskey et al., 2002; Bren, 1998 and Tomer et al., 2003).

A gradual or wet **profile** (see figures in Table 7.5) is advantageous both for water quality and ecology. Whereas some substances (like sediment and P) are better retained in dry buffer strips, others (like NO₃-N) are better retained in wet buffers (denitrification). Other more complex substances may be more easily decomposed by alternating aerobic and anaerobic decomposition steps (e.g. the pesticide HCH, Langenhoff et al., 2013). A buffer strip that combines wet and dry is considered superior, because it can tackle pollutants based on different retention processes. A more gradual wetness gradient is also an advantage for biodiversity, because it will normally mean a wider and less steep riparian zone and, largely due to the expected more frequent flooding of such systems, a more dynamic and various environment. This in turn will provide larger variations in refuge, opportunities and food supplies for e.g. invertebrates, amphibians and fish (e.g. Gregory et al., 1991; Tanadini et al., 2012).

(Dosskey, Vidon et al. 2010) show that the influence of vegetation type on pollutant retention is not consistent. Short and productive **vegetation** in the buffer strip may be positive for the environmental goals (nutrient retention, C sequestration). Particularly stiff stemmed vegetation is good for intercepting surface runoff (Christen and Dalgaard, 2013, who cite et al., 2009). Shorter vegetation is generally more productive and therefore assimilates more nutrients and carbon (Christen and Dalgaard 2013; Borin, Passoni et al., 2010). In order to take advantage of productive vegetation for water quality, it is better to harvest frequently, because many species will otherwise leave litter and/or remobilize nutrients from leaves to roots. **Harvesting** withdraws nutrients from the system thus reducing loads, which is advantageous for the environmental goals, but not for biodiversity. On the other hand taller vegetation may develop deeper roots, which may be good for intercepting pollutants from upper groundwater flow (e.g. Balestrini, Arese et al. 2011). Probably the preference for either short or tall depends on the transport pathway: short for superficial and tall for deeper flow paths.

Short productive vegetation is less positive for the biodiversity goals. Harvesting will disturb species and reduce food availability. Taller vegetation may provide shadow and food (leaves) to the stream (aquatic biodiversity) and, especially combined with lower vegetation storeys, may host and provide shelter and migration paths to a larger number of species (both terrestrial biodiversity and ecological connectivity). A gradient with lower and taller vegetation is therefore ideal for biodiversity goals (Meier 2005; McCracken 2012). Also the attractiveness of the landscape will be positively related with this combination (Christen and Dalgaard 2013; Borin, Passoni et al. 2010).

Fencing off the buffer strip prevents farm animals and hence their excreta from entering the stream. Livestock grazing negatively affects water quality, stream channel morphology, hydrology, riparian soils, instream and streambank vegetation and aquatic and riparian wildlife (Parkyn, 2004, citing Belsky et al. , 1999). Fencing can restore infiltration capacity of the riparian soil. Fencing is therefore certainly advantageous for water quality and aquatic biodiversity goals. As for terrestrial biodiversity the role of fencing is less clear. In Scotland, dense grass swards due to lack of grazing proved less advantageous for birds, but on the other hand the number of invertebrate species increased with fencing if the margins were sufficiently wide (>5.4m; McCracken 2012). Fences will also reduce the access of larger wild life animals to the stream.

Soil, slope and hydrology are the main conditional factors at field level for determining the effectiveness for water quality (Burt, Pinay et al. 2002; Sabater, Butturini et al. 2003; Vidon and Hill, 2004; Mayer, 2007; Borin, Passoni et al. 2010; Ranalli and Macalady 2010; Noij et al., 2012). These three factors determine the depth of transport (surface runoff, subsurface or interflow, deep groundwater flow) and the travel time from field to stream and hence the interaction with the active soil layers of the buffer strip. Deep groundwater flow (including pipe drainage) tends to reduce the effectiveness of buffer strips due to a bypass below the active layer. So does very fast superficial transport (trenches, surface channels), which creates a short cut that also prevents interaction with the buffer strip. A meta-analysis (Zhang and Eitzel 2010) shows a 10% slope is ideal for intercepting runoff. As for soils an optimum is expected for medium textured soils. On lighter soils infiltration and leaching are not hampered. Therefore relatively deep groundwater transport may be expected. On heavy soils fast surface runoff reduces BS effectiveness. Moderate surface runoff and shallow groundwater transport are considered best for BSE.

At landscape level the surrounding **land use** is relevant, because this partly determines the composition of the runoff loads (grass without or with less sediment, but in case of grazing with pathogens). The influence of **stream density** is rather straightforward: more buffer strips is more effect. Stream density determines the hydrological connectivity (distance) between source areas and surface water, and the relative area of buffer strips (BS area/source area), which is related with width. The influence of **discharge continuity** is similar, but now with respect to the time period for buffer strips to exert their function. During zero flow periods buffer strips cannot protect water quality because there is no or very little water. Finally the contribution of buffer strips to the **ecological network** (connectivity) depends on the spatial arrangement or structure of the existing ecological network (Semlitsch 2003; Meier 2005; Shirley 2006; Hendrickx 2007; Billeter 2008; McCracken 2012).

Application to Europe, selection of examples, geographical context

The conceptual evaluation framework shows that buffer strip effectiveness (BSE) can be judged along the lines of one cluster of (local level) design and management options, one cluster of local conditional variables, and finally a cluster of landscape factors that act at a higher spatial level. Ideally, we would recommend applying a GIS analysis to evaluate the landscape factors on BSE within the regional context. Combined with the local conditions, such an analysis could provide a BS suitability map for different goals. This is however beyond the scope of this study and hence the extent to which we will be able to include landscape factors in our evaluation of examples depends on the available information.

Obviously, it is impossible to cover the complete variation of BS factors within Europe with only 4 examples. In theory, one example each for low (-) and high (+) effectiveness for 12 factors would already yield 24 examples, and all theoretical combinations 4096 (2^{12}). However, Europe is no factorial experiment and geographical reality limits the variation. Therefore we derived two larger EU landscape clusters and two larger management and design clusters with to some extent similar BS conditions and effectiveness (Table 7.2, 7.3 and 7.4).

Table 7.2: Two EU landscape clusters associated with slope and elevation

Conditional (Table 7.1)	BS factor	L(owland)	versus	S(lope)
Slope		Flat lowlands	versus	Sloping areas
Soil		Deep lighter soils	versus	Shallow heavier soils
Hydrology		Deep groundwater flow	versus	Surface runoff and shallow groundwater flow
Hydrology		Largely artificially drained: mainly well drained		Largely naturally drained: both wet and dry areas
Stream density		High stream density	versus	Sparse streams
Discharge continuity		Continuous discharge	versus	Ephemeral streams
Ecological network		Sparse	versus	Dense
Land use		More arable	versus	More grass

The field ad landscape conditions can be clustered into two geographical categories:

1. flat Lowlands in river deltas, relatively near to the sea (e.g. SW England, Netherlands and Flanders, North Germany and Poland, westerns deltas of France, deltas of the Iberian Peninsula and Italy, particularly the Po valley), with relatively deeply permeable soils and manmade drainage systems that allow for deeper groundwater transport and relatively little surface runoff. Heavier soils will be pipe drained.
2. Sloping landscapes with smaller and bigger stream valleys in between hills and mountains, with relatively shallow and less permeable soils, prone to surface runoff and erosion.

We recognize this is a strong simplification of circumstances, e.g. heavy clay in a flat delta with superficial trenches also generates more surface runoff than groundwater discharge, but this must be seen as a compromise in order to limit to 2 landscape clusters.

Next we made logical combinations of management and design factors (Table 7.3). Although width is not a very distinctive design factor from a geographical point of view, we did include it in Table 2. The rule of thumb “the wider the better” practically holds for any case, goal and location. The desired width will have to be determined based on weighting costs and

effectiveness. Still, we expect wider BSs in the T cluster, because these BSs are more “natural” and did not have to be withdrawn from agricultural use, in contrast to the S cluster, where we will find more recently installed BSs (“age”). The manage- and designable BSE factors range from an abrupt to a gradual dry-wet transition, from frequently harvested, short, productive short species vegetation (grass, reed) to unharvested variable vegetation, including taller and woody species. We consider the combinations dry, and short, and wet and tall, more probable than the alternative dry and tall, and wet and short, although there are exceptions to this rule. For instance a monoculture wet reed BS, or a woody BS on the edge of an abrupt dry profile that stabilizes the stream bank. Again this is a compromise to reach the $2 \times 2 = 4$ subdivision of geographical circumstances in Table 7.4.

Table 7.3: Two BS management and design clusters associated with vegetation (S&T)

Conditional factor (Annex 18)	Two management and design clusters		
	Short	versus	Tall
Width	Narrow	Versus	Wide
Profile	Dry	Versus	Wet
Profile/gradient	Abrupt	Versus	Gradual
Vegetation	Productive shorter vegetation (grass, reed)	Versus	Tall vegetation, incl. woody species
Vegetation	Monoculture	Versus	Various species
Vegetation	High productivity	versus	Low productivity
Harvest	Frequent	Versus	Zero

Gradual wet profiles are natural in valleys of sloping landscapes, whereas they need to be constructed under flat conditions, which makes them rare under lowland conditions. While relatively productive and eventually harvested short vegetative strips with single or low species richness are more likely to occur under flat or gently sloping conditions (LDP), vegetative strips with more varied species, including tall and woody, are more likely to occur in sloping landscapes, and tend to be unharvested (SWT). Whereas in densely populated deltaic lowlands the latter type has to compete with alternative spatial functions, especially agriculture, it “comes natural” in the valleys of sloping landscapes, because the wetter conditions are not suited for the alternative spatial function. So, the occurrence of abrupt/dry/productive versus gradual/wet/tall is also associated with the geographical distinction between landscape types. By consequence, the LDP and SWT clusters are expected to be more frequent, compared to LWT and SDP.

The traditional buffer strips in the Po valley are an interesting exception to this subdivision ((Balestrini, Arese et al. 2011),(Borin, Passoni et al. 2010),(Borin 2002; Borin 2005)). It is a gently sloping area with traditional ditches bordered by a strip divided in two: a grassed BS of about 5 m and a tree row on the bank. We feel it comes closest to the SDP cluster, but with trees on the bank that contribute to their stabilization, and to the retention of nitrates passing below the grass strip ((Balestrini, Arese et al. 2011), (Borin 2002)). This line element contributes to the attractiveness of the landscape (Borin, Passoni et al. 2010), probably also to the ecological network, and the trees provide shadow to the surface water.

Table 7.4: Four relevant landscape and management and design clusters with respect to expected buffer strip effectiveness.

Management and design	Landscape Conditions	
	Lowland (L)	Sloping (S)
Abrupt or Short harvested (D)ry profile and (P)roductive vegetation	<p>A typical example can be found in the Netherlands or another deltaic region of Europe, where field edges and buffer strips are commonly dry and abrupt with grass or flower rich herbs for attractiveness or FAB. In the Po valley traditionally grass with a row of trees or shrubs on the bank.</p> <p style="text-align: right;">LDP</p>	<p>This type of dry buffer strips can be found in several parts of Europe with slopes where they are established or maintained to filter surface runoff and stabilize banks. However in most cases they are not harvested.</p> <p style="text-align: right;">SDP</p>
Gradual or Various including (T)all & woody vegetation (W)et profile	<p>We know of some examples of newly established wet buffer strips in the NL (left). We have not yet come across examples from other lowland areas. The gradual profile type (right) is probably hardest to find because it requires sufficient width for riparian vegetation. We could specifically look for examples in natural flood plains of larger lowland streams.</p> <p style="text-align: right;">LWT</p>	<p>The right hand is the “traditional” or “natural” riparian buffer strip you can find in various sloping landscapes of Europe with a high potential nature value</p> <p style="text-align: right;">SWT</p>

7.2 Optimal design and conditions for reaching specific goals buffer strip management

In Table 7.5 the optimal conditions, design and management practices are filled in for reaching the multi-functional goals distinguished in the evaluation framework. It thus shows where buffer strips can be best localized (conditions) and how they can be best designed and managed to reach a specific goal. In principle it is possible to tailor designs to get the best expected effectiveness for a selected prime goal. From Table 7.5 it can be concluded that there is no size fits all, tailor made designs are necessary for different goals and conditions. Once the priority is set, one can still strive for multi-functionality in design and management. This approach is not necessarily inconsistent with the objective of multi-functionality; it just recognizes that buffer strip design cannot equally address all potential objectives. “Rather, the need for weighting of different priorities should be consistently highlighted in policy design” (Polakova, et al., 2011, IEEP, p. 66). So in case a BS is considered particularly in relation to one or a limited number of goals the table can serve as a check list for developing the right design.

However the ambition of this project is to find best practices for multifunctional BS. One can strive for multiple goals, but in many cases required conditions, design and management requirements for reaching one goal can be contra productive for reaching another goal. Therefore, multiple zone buffer strips have been suggested both in the EU (Stutter, Chardon et al., 2012; Christen and Dalgaard, 2013) and in the USA (Schultz et al., 1995; Schultz et al., 1997; Bentrup, 2008; Welsch, 1991, cited by Fischer and Fischenich, 2000). A double strip may be considered, one focusing on biodiversity with more variation in vegetation and taller species near the stream, the other on load reduction, with shorter more productive harvested grass between the first strip and the agricultural fields to filter out contaminants. The first one can be wetter and with more ecological and hydrological, biochemical and soil gradients. The second dry one is better for intercepting surface runoff and can be more easily maintained (i.e. harvested for deliberate impoverishment of soil fertility, eventually removal of excess sediment and biomass production).

Recently Christen and Dalgaard (2013) have suggested a three zone buffer design (Figure 7.1), taken over from the USA (they cite Schultz et al., 1995, but similar suggestions can be found in Schultz et al., 1997, Bentrup, 2008 and Fischer and Fischenich, 2000, with a figure dating back to Welsch, 1991). They provide best perspectives for meeting combined goals, and were already proposed in the US at the beginning of the nineteen nineties. Applying three different zones provides the opportunity to reconcile different goals. It comprises, from field to stream, a grassland strip, a shrubs or short rotation woodland strip, and an undisturbed zone with tall vegetation on the bank. The grassland strip is particularly suitable for abating surface runoff sediment and pollutant load and may produce some biomass. The next zone with shrubs or short rotation woodland with deeper roots allows for further infiltration of surface runoff and uptake of nutrients from subsurface flow and upper groundwater, and for denitrification due to high organic matter input. It can produce high biomass yields (C sequestration). The last one closest to the stream stabilizes the bank and the buffer strip during floods and can still contribute to interception of groundwater flow and denitrification. It will provide shade and litter to the stream.

Table 7.5: optimal conditions, design and management of buffer strips for specific goals (notes between brackets refer to next page).

effectivity factors for buffer strips ☒																	
Goals	Specified goals		manage- and designable factors						conditional factors			conditional factors					
			design				management		for field level			for landscape level					
			width (1)	placement	profile	vegetation	harvest frequency	fencing	soil	slope	hydrology	land use	stream density	discharge continuity	ecological network		
			-	narrow	standard	abrupt/dry	short	zero	no	light	flat	deep	grass	sparse	ephemeral	sparse	
			+	wide	tailored	gradual/wet	tall	frequent	yes	heavy	steep	shallow	arable	dense	continuous	dense	
1 Biodiversity	1.1 local terrestrial			wide→	tailored	gradual	both	zero						dense		dense	
	1.2 functional agrobiodiversity			wide→	tailored		both (2)	low (2)									
		1.2.1 pest control			→	tailored		both (2)	low (2)					arable	dense		1
		1.2.2 pollination			→	tailored		both (2)	low (2)					arable	dense		1
		1.3 aquatic			→	tailored	gradual	tall (3)	zero	yes (11)					dense	continuous	dense
	1.4 connectivity			wide→	tailored	gradual	both	zero	no					dense	continuous	dense	
2 Landscape quality	2.1 attractivity			wide→	tailored	gradual	both	zero (19)	no					both	dense		
	2.2 access				→	tailored	dry	short	frequent	no					dense		
3 Load reduction =water quality	3.1 solid bound		3.1.1 sediment	wide →	tailored	dry	dense&stiff	frequent(4)	yes (11)	loamy	moderate	shallow	arable	dense	(12)	3	
			3.1.2 P	wide→	tailored	dry	dense&stiff	frequent(4)	yes (11)	loamy	moderate	shallow	arable	dense	(12)	3	
			3.1.3 toxicants	wide→	tailored	both (7)	both	zero (9)	yes (11)	loamy	moderate	shallow	arable	dense	(12)	3	
			3.1.4 pesticides	wide→	tailored	both (7)	tall or both (5)	zero (9)		loamy	moderate	shallow	arable	dense	(12)	3	
			3.2.1 vectors	wide→	tailored	dry (7)	both	zero (9)	yes (11)				grass(11)	dense	(12)	3	
		3.2 soluble	3.2.2 N	wide→	tailored	wet	tall (8)		-6 yes (11)	light	moderate	inter (10)		dense	(12)	3	
4 Climate change	4.1 C sequestration (mitigation)			wide	tailored	wet	both	low		not lt	flat	deep		dense	(12)		
	4.2 biomass harvesting (mitigation)			wide	tailored	dry (14)	short	frequent	no (13)		flat	deep	grass(16)	dense	(12)		
	4.3 water storage capacity (adaptation)			wide	tailored	gradual (15)	tall (18)	?			flat	deep		dense	(17)		
				width	placement	profile	vegetation	harvest frequency	fencing	soil	slope	hydrology	land use	stream density	discharge continuity	ecological network	
			-	narrow	standard	abrupt/dry	short	zero	no	light	flat	deep	grass	sparse	ephemeral	sparse	
			+	wide	tailored	gradual/wet	tall	frequent	yes	heavy	steep	shallow	arable	dense	continuous	dense	

Table 7.5: notes

- 1 FAB species
- 2 to maintain specific species (FAB, pollination)
- 3 light and temperature control
- 4 "harvest" refers to biomass removal 0-3/yr in case of pollutants, but in case of sediment trapping also to sediment removal in the order of once per 5-25 years
- 5 for drift reduction
- 6 harvest improves nutrient retention capacity, certainly for P, and potentially also for N, unless organic C input through litter becomes insufficient for denitrification
- 7 based on the assumption that under aerated conditions heavy metals are better adsorbed, organic micropollutants are better decomposed and parasites will be more easily preyed on
- 8 based on the assumption that tall vegetation roots deeper
- 9 based on the assumption that organic toxicants and pathogens are more efficiently retained in case of high organic matter turnover
- 10 according to Hill, 1996 the optimal aquifer depth range is 1-3 m below surface, here nominated intermediate
- 11 fencing prevents direct faecal pollution by grazing ruminants (N, P, BOD, pathogens), and bank erosion and soil compaction by treading
- 12 In theory the effectiveness of buffer strips adjoining ephemeral streams is temporally restricted to the discharge (winter) period, but this does not necessarily mean that the accumulated load reduction is less, as long as the retention capacity is not exceeded during the concentrated discharge period. Moreover ephemeral streams primarily occur in Mediterranean and land climates, where irrigation back flow may play an important role in summer. A generic judgement is therefore impossible
- 13 fencing blocks access for harvesting
- 14 harvesting is easier when dry (e.g. grass) but not impossible when wet (e.g. reed)
- 15 natural valley profile with flood plain, or gentle manmade slope or two phase profile
- 16 it is easier to harvest short vegetation in a grassland area, where suitable equipment is available
- 17 water storage capacity of buffer strips can contribute to buffering of stream flow
- 18 deeply rooting species, generally associated with taller species, highly contribute to infiltration and storage of excess water (Christen and Dalgaard, 2013: refs 18-24, 31)
- 19 unless pruning and/or cutting is necessary for maintaining species richness and/or landscape structure

Figure 7.1: (directly copied from Christen and Dalgaard (2013)) Implementation options for productive three zone buffers between arable fields and water courses. Suggested zone-width is adjusted for standard harvesting equipment, production goal and buffer function.

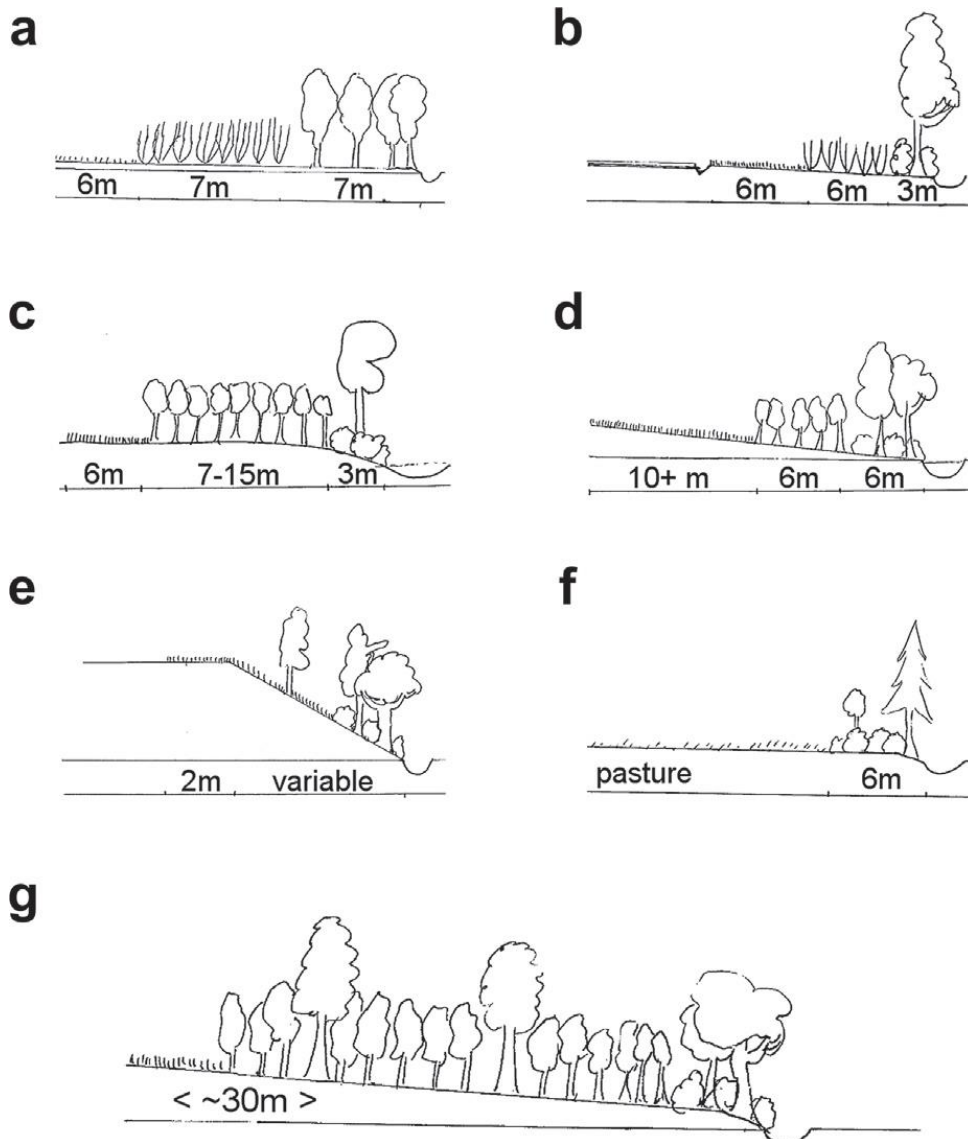


Fig. a: high energy yield buffer with energy grass, willow/alder SRC (short rotation coppice) and SRF (short rotation forest) on very low slope optimized for fully mechanized harvesting on areas with low erosion risk, therefore very small undisturbed zone; Fig. b: ditch for drainage water retention, high yield energy grass, poplar/alder SRC/SRF and undisturbed zone; Figs. c and d: multipurpose buffers on varying slopes with grass mixtures and multi-species SRF; Figs. e and f: extensive systems for limited grazing/browsing and firewood production for on-farm use, Fig. g: multipurpose woodland buffer with long-term focus on forestry options consisting of grass mixture, multispecies SRF and combined higher value timber production (e.g. ash, cherry, sycamore, other hardwoods).

7.3 Best practices in multifunctional buffer strip design and management in the EU

7.3.1 Selection of examples

For the selection of 4 examples of multifunctional buffer strip application in Europe three different steps were followed:

1. To delineate the collection to select from, an inventory of the use of buffer strips for different policies in the EU was made first (Annex 20, 21 and 22).
2. Much attention was paid in the selection to the European variation in both conditions, and design and management options that determine buffer strip effectiveness for different goals. Therefore the selected examples should sufficiently represent the variation in conditions, design and management options from the conceptual evaluation framework for the effectiveness of buffer strips. Therefore the evaluation framework was first elaborated to understand what the expected variation could be.
3. The final step was then the selection of the best practice examples of multi-functional buffer strips in different parts of Europe (). In this selection priority had to be given to multi-functionality above representativeness, but also to cover the main regions of Europe (North, South, East and West). As a minimum it was decided that the selected best practice examples at least had to meet water quality and biodiversity goals. These goals were considered decisive while climate change and landscape goals were considered as secondary for multi-functionality and therefore also for the selection.

7.3.2 Inventory

The consulted IEEP documents (Poláková et al., 2011; Mazza et al., 2011; Farmer et al., 2008) contain a lot of general information on the functions of BS but lack MS specific information enabling an inventory of BS under CAP/Nature policies. The most recent (4th) MS reports on the nitrates directive national action plans (NAP) only provide updated information (compared with the former; Annex 18). In order to get a complete picture of the actual situation, an additional historic inventory of the other 3 NAPs would have been necessary, but this was considered beyond the scope of this study. The information of the River Basin Network gathered for the WFD is restricted to 21 catchments and 14 MSs (Somma, 2013; Annex 20). The available information derived from this network also proved insufficient for applying the evaluation framework developed in this study. As for the sustainable pesticide use directive, until now (last accessed September 9 2013, last update April 18, 2013), 14 MS have submitted their action plans for the sustainable use directive to the corresponding website (Annex 20). The information is not very specific with regard to the implementation of BS, although some differences between MS can be detected. Dworak et al. (2009) also provide an inventory of buffer strips regulations, mainly on a voluntary basis, in a considerable number of European countries.

In order to find best practice examples we sent an email with explanation of our request to a large number of researchers and policy makers around Europe. The response was very low, but eventually we got positive answers from a couple of countries. Based on the requirement to select multifunctional RBS and to ensure representation from the different regions in the EU we made the final selection of examples. The first was the '*Actief Randenbeheer Brabant*' project

(www.randenbeheerbrabant.nl) based in the South of The Netherlands. This case represents the LDP cluster from Table 7.4, and Western Europe. The second case selected is from Denmark and is the nation-wide 10 meter-wide buffer strips project representing the SDP or SWT cluster in Table 7.4 and the North of Europe. The third is the southern European example and concerns the evaluation of RPB in the Po Valley. This case fits the SDP cluster in Table 7.4, although traditionally there are trees and shrubs incorporated in the BS. The last example is from Estonia, representing Northeastern Europe And fitting with the SWT Cluster in Table 7.4, which is very different from the other three examples.

7.4 Evaluation of examples

The four best practice cases are described in this section. In the following first a description is given on data availability to apply the evaluation framework for the assessment of the effectiveness of multi-functional buffer strips in the four selected cases (7.4.1). In Section 7.4.2 a general description is given of the RBS followed by a detailed and schematic description of how the evaluation framework developed in this study works out for each case. This is then followed by a discussion of the integrated outcomes of the four best practice examples, and of the main lessons to be learned from them for future effective EU policy development.

7.4.1 Availability of data for and usefulness of the evaluation framework

As it proved rather difficult to find best practice examples and experts to provide the necessary data on a voluntary basis, we could not short list examples based on data availability from a longer list of examples. From the point of view of data availability the resulting selection can be considered a random one. This gives confidence in the feasibility of applying the evaluation framework to other examples or for a more comprehensive analysis of European RBSs, provided cooperation from local experts is committed to the project from the beginning.

However, filling in the table proved to be difficult without personal contact. This was only possible within the scope of this project with the project leader of the Dutch buffer strip and example. So, this was the only expert who filled in the table by himself. In the other cases of Italy, Estonia and Denmark, information was provided and we had to fill in the tables by ourselves. It is simply not easy to fill in the tables, because one tends to confuse the effectiveness of a condition or management factor (columns) for a certain goal (rows) with the effectiveness of the entire buffer strip. And indeed, it is rather abstract to judge the effectiveness of a certain condition or management practice without taking into account the integrated functioning of the buffer strip example. This was nevertheless necessary in order to distinguish the effectiveness of separate design factors for more generic recommendations.

7.4.2 Description of the four best practice examples

Denmark

In Denmark the Law of buffer zones, the so-called 'Border Zone Act', came into force on 1 September 2012 and states that there shall be established buffer zones along lakes in rural areas with an area of over 100 m² and open streams in the agricultural areas³⁴. Buffer zones are up to 10 meters wide zones and buffer zones are not allowed to be fertilized, sprayed with pesticides or cultivated. The purpose of the buffer zones is to reduce leaching of nitrogen, and protect from pesticide and phosphorus loss from agricultural fields.

The buffer zone law is the case of "general compensation regulation", and it means that a farmer is not entitled to compensation for the seizure of buffer zones. The government has, however, decided that farmers should be compensated for establishing buffer zones on their farm. The compensation is given in the form of an annual grant. For further details on the implementation of the Buffer Zone Law see Box 7.1.

Box 7.1 Further details on the Buffer Zone Law (also called the Border Zone Act)

Definition of streams

A watercourse is covered by the Buffer Zone law, if it is a watercourse by definition in Watercourse Act. A watercourse will in most cases be clearly defined terrain depressions, which are water-bearing most of the year. That a stream is water-carrying means that the water is transferred from one place to another and is not stagnant. A ditch with standing water is not, for example water-bearing and is not a watercourse in the Watercourse Act.

A stream may dry up during a dry period, such as during a drought summer period. Such a naturally occurring phenomenon does not mean that it is not a watercourse. Road ditches and culverted streams are not covered by the Buffer Zone Act.

Definition of lakes

The general rule is that all lakes in the agricultural zone with an area of over 100 m² are covered by the Buffer Zone Act. The so-called one-man lake, that is lakes located on a single property, without inlet or outlet from neighboring properties, is also subject to the buffer zone Act. Technical plants in rural areas such as fire ponds, detention ponds and ochre lakes are also subject to the Buffer Zone Act, if the area is larger than 100 m². Lakes that only exceptionally dry out in summer are also covered by marginal zone law.

Exceptions

Production facilities such as slurry tanks, manure tanks, rainwater tanks for irrigation, fish farming ponds, wastewater treatment systems (including retention basins) and potato water ponds are not covered by the Buffer Zone Act. Ditches with stagnant water are not considered as lakes, regardless of whether the area is over 100 m². Constructed wetlands are generally covered by the Act but for use in research or demonstrations projects dispensation may be granted.

³⁴ The buffer zone act applies to land adjacent to the watercourses and lakes in rural areas of a size larger than 100 m². Conversely, buffer zones along existing lakes or streams may be cancelled if the lakes or streams legally are culverted or closed. If there already exist a 2-meter buffer strip along a stream or a lake, there must always be established a wider buffer zone so the total width is 10 meters.

Areas exempted from the provisions of the Act?

In Darum-Tjæreborg Marsh, Ribe Marsh, Rejsby Marsh, Ballum marshes and Tøndermarsken the rules of the Buffer Zone Act apply only for the watercourses that are included in the EU Water Framework Directive River Basin Plans in southern Jutland. The Buffer Zone Act does not include lakes and watercourses in gardens and parks. The Act shall also not apply to land used for forestry.

What is allowed in the marginal zone?

After 1st of September 2012 the buffer zone areas can be used as follows:

- Permanent grass is allowed in the buffer zone, whichever occurs without fertilization, spraying or tillage, and if it is not otherwise inconsistent with other legislation. Grassland in the marginal zone can be used for both cutting and grazing.
- The permanent grass in the buffer zone can be converted every 7 years.
- Fighting giant hogweed in the marginal zone, not only with eg. root cutting or topping, but also by targeted spraying to the extent that is needed is allowed without exemption from the Act.
- It is also permitted to perform maintenance of watercourses, including holding and spreading of the material in the buffer zone. It is also allowed to plough down excavated material from the watercourse in the buffer zone when soil tillage is not for cultivation purposes. This is irrespective of the rule that tillage in the marginal zone is not allowed.
- There are also a number of options for organizing events and other activities in buffer zones.

Reduction of buffer zone width (5 per cent rule)

The Act includes the possibility of reduced buffer zone land in farms where the buffer zone area is covering more than 5% of the total area of the farm.

Public access

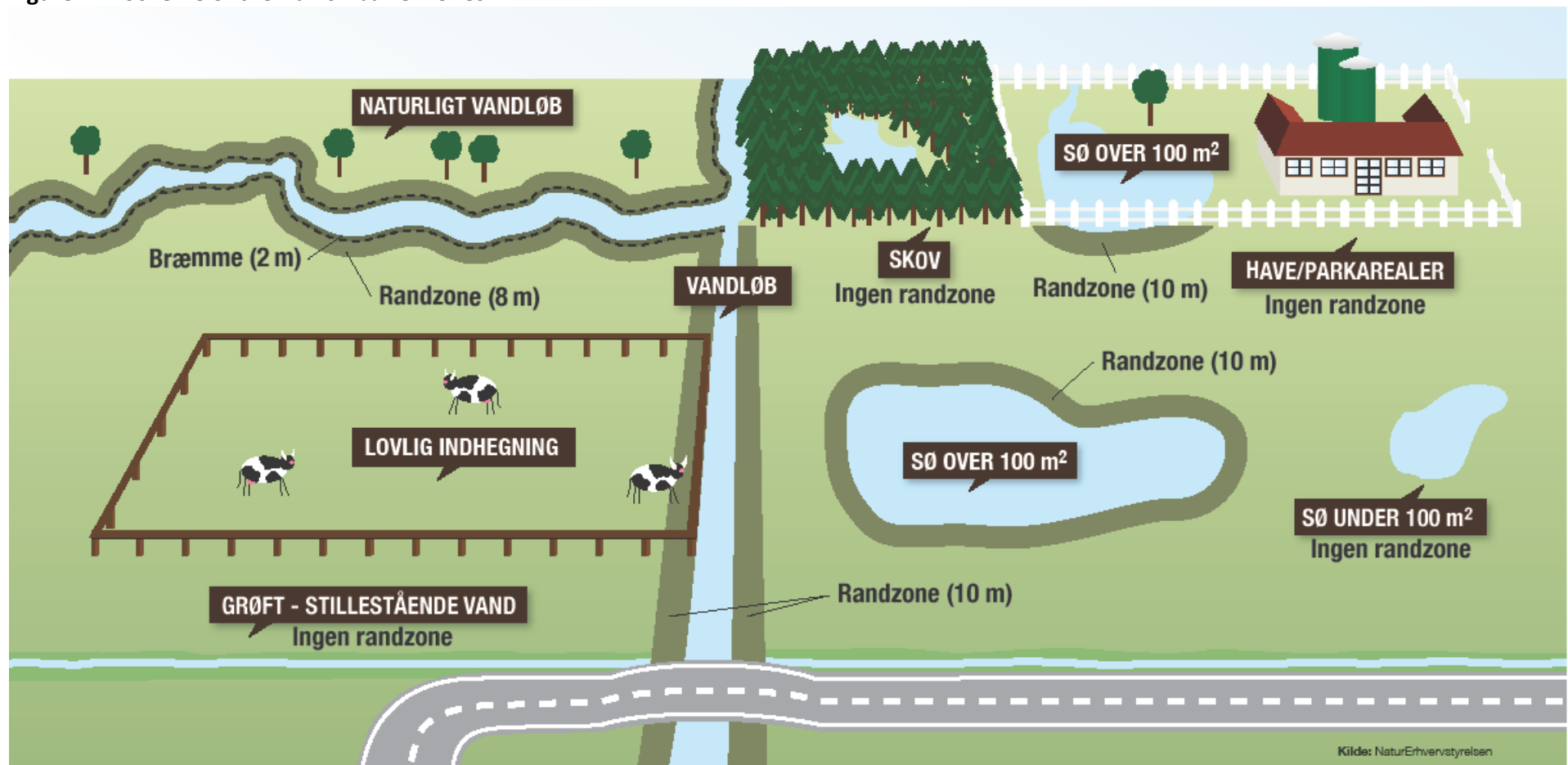
The rules governing public access to the buffer zones are no different from the rules that apply to other agricultural areas. Nature Protection Act gives the public access to uncultivated land and therefore the buffer zones will generally be available for the public when they appear as an uncultivated area in the sense of the Nature Protection Act. An area can be considered uncultivated under the Nature Protection Act, based on the following assessments:

- Existence of a versatile plant growth (many kinds of grasses and/or high weeds) suggests that the land is uncultivated
- If the crop (typically grass) after mowing is not used, but simply left on the field, it may indicate that the land is uncultivated.

Important rules for traffic in buffer zones

If there is legal access to land, citizens must move on foot in buffer zones that are uncultivated. Dogs must always be leashed. Lawful access means that one does not first have to go through a cultivated area, such as a cereal or oilseed rape field to get to the buffer zone. There is no access to the buffer zones if they are fenced, or when there is grazing livestock on the land. There is no access to the buffer zones where there is agricultural work going on. It is possible in some cases for farmers to apply for permission to legally close their buffer zones for public access.

Figure 7.2: Scheme of the Danish buffer zones



RANDZONER ILLUSTRERET Grafikken illustrerer hovedprincipperne i lov om randzoner, som træder i kraft 1. september 2012. Herefter må landmænd ikke længere gøde, sprøjte eller dyrke i en 10 meter zone omkring alle åbne vandløb og søer over 100 m². Landmænd får økonomisk kompensation for at have randzoner. Etableringen af randzoner vil sikre et forbedret vandmiljø ved at reducere udledningen af kvælstof, fosfor og pesticider. Læs mere om randzoner på NaturErhvervstyrelsens hjemmeside: www.naturerhverv.dk

Buffer zones and biodiversity on land and in the watercourse

Based on the experience since 1992 with the earlier two meter buffer strips in Denmark, it is expected to have in most places monotonous vegetation with the same species dominating in the whole country, particularly nettle, burdock bedstraw and meadow grasses. This is due to high nutrient content of the soils in buffer strips and the fact that the streams are deeply incised, and that the land in the buffer zone therefore is normally dry. However, the new wider buffer zones (10 m) may become an asset in relation to increasing diversity. First and most importantly because agricultural impacts will decrease the farther we get away from the field, giving nature a better opportunity to unfold over time. From previous studies we know that there are more and other species in areas with wide buffer zones along watercourses and that species composition changes with decreasing influence from nearby agricultural activities. If buffer zones are established where there is undisturbed nature nearby, there will also be the possibility that species can migrate to and from the established buffer zones.

Water management

It would be most appropriate to plan the establishment of buffer zones together with watercourse restoration or channel management changes. Transition zones between land and water could be efficient for storing higher water levels in the channel, nitrate removal processes and biodiversity in both channel and buffer strip. It was advised to the Government to allow tree planting for reducing bank erosion, improving stream and BS ecology, and climate change adaptation (temperature control) and mitigation (biomass production), but this was not effectuated because it is not yet allowed to receive EU funds for agricultural fields with trees. Planning of buffer zones should best be based on local evidence including information on local landscape features and soil types, local nature interests and local watercourse ecological conditions, but up till now it is one size fits all.

Application of the evaluation framework

Table 1 in Annex 21 presents the extensive evaluation framework filled in for the Danish case. In this evaluation table the design, management or condition described in the columns can be rated in three categories: highly (H), moderately (M for Medium) or less (L for Low) effective for reaching the goals described in the rows. In summary the evaluation of the Danish buffer strips can be characterised as follows:

In Denmark uniform 10 m wide grassed buffer strips have recently been prescribed to protect surface waters against nutrient and pesticide pollution. So in this respect the example of Denmark is different from the other three examples as the best practice example refers to buffer strips designed and established following the prescriptions of Law that is already in force.

In the Danish buffer strips vegetation is kept short by cutting every 2nd year, but is not removed, so biomass (nutrients and carbon) is not withdrawn from the system. This is less favourable for nutrient, particularly P, load protection, and the same

holds for climate change (no sequestration). This explains the score L and M score on management in relation to load reduction.

Although field conditions in terms of soil, slope and hydrology are variable (over whole country), the buffer strips are generally dry, and the profile is abrupt, which is less favourable for biodiversity.

Arable land use is predominant in Denmark, which is favourable for the effectiveness of the BS for water quality, because of the associated pesticide use and risk of sediment loads. The BSs are sufficiently wide for water quality purposes but the uniform grass vegetation leaves room for improvement for biodiversity goals and landscape attractiveness. Trees are not allowed, although they could also play a useful role in bank stabilization.

Italian example Po-valley

In the North-Eastern Po Valley, BS (the Italian researchers prefer the words Vegetative Filter Strips, VFS) between fields are mainly made of grass, and more rarely made by grass, trees and shrubs. The traditional BS with trees and shrubs are considered in the evaluation because of their added value (best practice example) in comparison with the more common grass strips, like in the NL and Denmark.

Generally speaking, two types of BS are possible in Po Valley:

- 1) in-farm VFS, 1-5 m wide, to protect ditch or farms buildings; ditches can have intermittent water flowing (ephemeral streams). Those VFS are made of farm/country path, and can be with grass, at least partially. They are more frequent, and can be found (or suggested) in most of the main commercial farms.
- 2) basin (multi-farm) scale VFS to protect streams or rivers with permanent water flowing or residential areas. Those VFS are sometime with trees (es. *Platanus* spp., *Acer campestre*, *Salix alba*, *Populus alba*, *Populus nigra*) and were planted for wood production. Those VFS are less frequent than the previous, but I cannot give you a reliable estimation.

When looking at Table 7.4 (Four relevant landscape and management and design clusters with respect to expected buffer strip effectiveness), the Padovan example belongs to the LDP cluster, Lowland, with short harvested productive (grass) vegetation, traditionally but not commonly also with woody vegetation. The Po Valley is wet in winter and dry in summer, with sometimes large water table fluctuations (+/-50-70 cm). The BS profile is confined to the largely artificial ditch borders, so abrupt/dry is most appropriate qualification (see photos in Annex 21).

Most of the information below is acquired from the Experimental site in Padova for BS comparison, where effectiveness of BS is measured in removing pollutants in runoff from a cultivated field. The outcomes of the experimental site can be used:

- 1) to quantify effectiveness of existing BS in Po Valley
- 2) to support the implementation of BS in environmental schemes, i.e. to help in the selection for the “best BS for a given place”. The BS under comparison in the experimental site include all the main type of BS in the North-eastern part of Po Valley, from the more frequent and simple (3 m grass strip), to the complex (6 m wide buffer

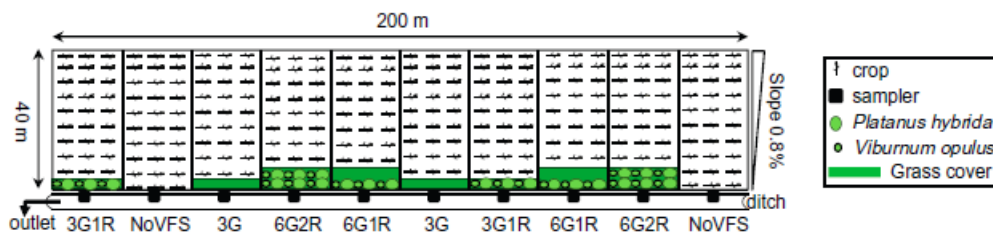
with two rows of trees and shrubs. The experimental site provides information from all the main type of VFS in the North-eastern part of Po Valley.

Experimental site information (from Otto et al., 2012).

The site is at the Padova University Experimental Farm in the Po Valley, north-east Italy. The average annual rainfall is 845 mm (last 19 years average), annual evapotranspiration is 940 mm, and the water balance is negative (280 mm) in spring summer, when rainfall is 466 ± 67 mm (mean \pm st. dev. from 1st April to 1st October). The soil is classified as Fulvi–Calcaric Cambisol (FAO-UNESCO, 1990). It is silty-loam textured (11.8% clay, 44.9% silt, 43.3% sand), rich in limestone, with sub-basic pH (pH = 8.11), good organic carbon content (0.92%) and medium–low hydraulic conductivity ($4.7 \times 10^{-4} \text{ cm s}^{-1}$).

The experimental site is a rectangular field of 200 X 40 m, with a 0.8% slope down towards a ditch (Figure 7.3). Four types of BS, between cropland and ditch, are compared with a plot without BS (NoBS) cultivated to the edge of the ditch. The BS differ in width and composition: (a) 3 m wide buffer formed by grass cover only (3G), (b) 3 m wide buffer with grass cover and a shrub and tree row (3G1R), (c) 6 m wide buffer with a shrub and tree row (6G1R) and (d) 6 m wide buffer with two rows of trees and shrubs (6G2R). The rows are 1.5 and 4.5 from the ditch. The initial herbaceous cover is *Festuca arundinacea* Schreber and the rows are of regularly alternating *Viburnum opulus* L. shrubs and *Platanus hybrid* Brot. trees. The plots are 20 X 35 m and the five treatments have two replicates.

Figure 7.3 Layout of the experimental field with the five types of vegetated filter strips (BS) with two replicates.



NoBS: plot without BS; 3G: 3 m wide buffer formed by grass cover only; 3G1R: 3 m wide buffer formed by grass cover and a shrub and tree row; 6G1R: 6 m wide buffer with a shrub and tree row; 6G2R: 6 m wide buffer with two rows of trees and shrubs.

Application of the evaluation framework

Table 3 in Annex 21 provides the evaluation framework filled in for the Italian case. Although single grass BS of 1-5 m are more frequent in the Po valley we chose to evaluate the more traditional combined 6 m wide frequently harvested grass BSs with a tree or shrubs row beside the stream, because these provide multifunctional advantages in terms of biodiversity, landscape attractiveness, bank stabilization and eventually deeper subsurface flow interception by roots. Compared to Denmark and Estonia, these buffer strips are relatively narrow, but evidence shows they are still effective in reducing pollutant loads, which can be explained by relatively favourable conditions for BS effectiveness. The Po valley is gently sloping lowland with medium textured soils used for arable production (sediment, pesticides). Although fields are predominantly drained by relatively deep flow paths, surface runoff is relevant. The stream-BS profile is abrupt, with dry BS. Compared to the Netherlands and Denmark, we expect better contribution

to biodiversity goals because of the two-zone design (tree or shrubs row). Harvested biomass is not removed, so little impact on climate change occurs.

No specific information on BS has been reported by Italy in Annexes 18 (Nitrates) & 19 (Pesticides), but we can compare the best practice example with the ones mentioned in Annex 20 (RBMP) for the Arno, Liri and Serchio Basins. For Arno, 3 or 5 m wide grass or tree buffer strips without agricultural production are compulsory, except for olive groves and permanent grassland. For Liri buffer strip widths range from 0.5-5 m, and for Serchio no width is reported, because the focus is on maintenance of riparian vegetation and native species protection. It is hard to compare the effectiveness of these examples with the 6m wide BS selected in the central evaluation because we lack more information on the management factors and conditions in the evaluation framework. Purely based on width, it seems the example from the Po valley is indeed a best practice example, because its traditional BS is widest (6 m). Moreover, the conditions for contributing to water protection are favourable (soil, slope, hydrology, arable land use), but we do not know the circumstances in the other basins. The Serchio basin apparently contains natural riparian buffer strips, and like we recommend, priority is given to maintenance and protection of these existing natural riparian zones, which is most favourable for biodiversity goals.

Netherlands

Actief Randenbeheer Brabant (ARB; Active border control Noord-Brabant):

In the province of Noord-Brabant, buffer strips are considered to be a useful way of improving water quality and biodiversity. The province is located in the south of the Netherlands near the Belgian border in the river basins of the rivers Meuse and Scheldt. The buffer strips can easily be incorporated into normal farm operations. The approach in Noord-Brabant has provided a significant stimulus for national developments. To date, approximately 1,400 kilometres of riparian buffer strips (RBS) have been created on the banks of the watercourses in Noord-Brabant, almost 1000 km along arable fields, the remainder on grasslands. The buffer strips reduce the leaching and run off of minerals. The drift of pesticides towards ditches is reduced by 95%. Direct loads of spray-applied agents to the surface water are reduced to zero. At the same time they provide landscape quality by introducing flowering borders along the fields and meadows. Consequently, ecologists, farmers and residents are all very enthusiastic as evaluation of the project confirms. Participants in the scheme are paid € 0.35 per linear metre for creating buffer strips on grassland and € 0.70 per linear metre for herbaceous strips on arable lands. Participation by the 550 farmers is on a voluntary basis. The width of the strips is 4 meters, directly adjoining permanent ditches according to the definition of the *Algemene Maatregel van Bestuur (AMvB) Openteelt en veehouderij* (Dutch regulation). With 'permanent' it is referred to permanently discharging or at least containing water. Use of chemical pesticides, manure and fertilisers is not allowed. The strips are sown with permanent grass and an herb mixture. Cutting is not allowed before the 15th of June. The first phase of the ARB project started in 2001

and was continued in 2007 with a second phase that will end in 2014. The duration of contracts with the farmers is 6 years.

Background information

The current *Actief Randenbeheer Brabant* scheme, running from 2007 to the end of 2014, has a budget of 10 million euros, of which 47% is paid by the government (Investment Budget for Rural Areas) and 53% by the project partners. The partners comprise of the Province of Noord-Brabant, ZLTO (regional southern farmers association), and all 4 Water Boards in Noord-Brabant: *Waterschap Rivierenland*, *Waterschap de Dommel*, *Waterschap Aa en Maas* and *Waterschap Brabantse Delta*. *Waterschap Brabantse Delta* is the leading partner for the project and ZLTO is responsible for the project management.

The width of the bufferstrip is determined by the type of soil involved (see Figure 7.4 and Table 7.6).

Figure 7.4 Different soil types in Noord-Brabant (red:clay, green: sand, orange:loam, grey: organic/sandy soils, black: urban areas)

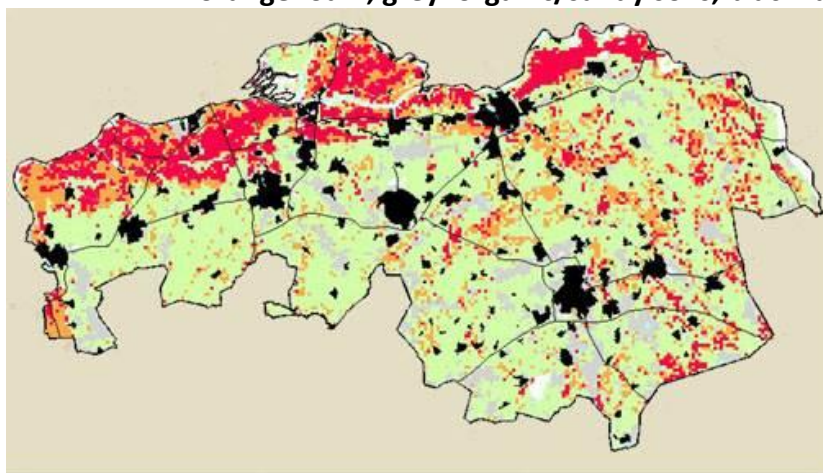


Table 7.6 Buffer strip area (% of total) in case of generic implementation in the Netherlands (*Noord-Brabant) on both sides of the stream, as derived from stream density.

Landscape region	Buffer strip width		
	2 m	5 m	10 m
Sandy soil area, the Netherlands ¹	0,5	1,3	2,6
Sandy soil area, the Netherlands ²	2,0	5,1	10,2
*Sandy soil area Noord-Brabant ²	2,5	6,2	12,4
Sandy soil area Gelderland ²	1,6	4,0	8,0
Moraines	0	0	0
Boulder clay	0,6	1,5	2,9
*Central rivers area	1,3	3,3	6,5
*Sea clay area	2,0	5,1	10,1
Low moorland area	3,9	9,9	19,7
High moorland area	1,6	4	8

¹ excluding ephemeral ditches

² including ephemeral ditches

* Landscape regions occurring in Noord-Brabant

Application of evaluation framework

In Annex 21 Table 3 is the evaluation framework filled in for the Dutch case. In the Dutch example the introduction of BS is stimulated. The BS are uniform 4 m wide with frequently harvested grass located next to ditches in a completely flat landscape with light to heavy textured, but generally well drained soils. By consequence, the profile is abrupt and the BS is dry. The rainfall surplus is drained via relatively deep flow paths, and surface runoff is rare compared to the other examples, which makes these BSs less effective in reducing nutrient loads, as shown by scientific evidence from a nationwide study. Although relatively narrow, we still expect a positive contribution to prevent pesticide drift and direct spilling of agrochemicals, and to reduce the (relatively low) risk of surface runoff (with or without sediment). Removal of grass should contribute a little to carbon sequestration, but may as well have an adverse effect on biodiversity, although cutting is not allowed before 15th of June. The BSs are not fenced off, which is relevant for the grassland area (<30%), where grazing cattle may enter the BS, which is less favourable for water protection. Although stream density is very high the contribution to ecological connectivity is limited because farmers participate on a voluntary basis, which leads to fragmented installation of BSs at landscape level.

In the Netherlands the currently implemented nationwide legal obligation is implemented through the Nitrate Directive (Annex 18) prescribed to maintain very narrow uncultivated (i.e. no fertilizers nor pesticides) BS of 0.25 m for grassland, 0.5-1.5 m for arable fields, width depending on the crop, and 5 m for fruit trees. A manure free zone of 5 m is obliged for some natural streams in higher parts (on the sandy soils) of the Netherlands. Clearly, the best practice example (4 m wide) provides a better protection for surface water quality, especially against pesticide drift, and also a higher potential contribution to biodiversity and climate goals, compared with the legal narrowest uncultivated zones (<1.5 m). We should however not be too optimistic about the potential added value of widening uncultivated strips to 4 m, because 4 m is still quite narrow for biodiversity goals, and it is questionable whether it makes sense to widen a narrow uncultivated strip to prevent direct spilling of agrochemicals, and to reduce the risk of surface runoff. Rather, it would be more cost-effective to prescribe specific measures to prevent surface runoff, e.g. a small trench and/or elevated ridge just before the ditch to store or block surface runoff. Also, it is more cost-effective to install measures right on the hot-spot, where surface runoff occurs, instead of applying them along the full length of the ditch. Nationwide introduction of wider buffer strips could of course contribute to reduction of the fragmented character of the regionally and voluntarily introduced buffer strips, thus improving ecological connectivity.

Estonia

The Porijõgi buffer zone area represents a grey alder stand (Fig 1). It is situated in the moraine plain of southeast Estonia (Tartu County, see figures in Annex 21), in the riparian zone of a small river, the Porijõgi, which flows in a primeval valley where agricultural activities ceased in 1992. However, the information presented on nutrient retention (Mander et al., 1997; Tables 7.7 -7.9) belongs to the period with agricultural activity. The landscape study transect in this valley crosses several plant communities: an abandoned field (last cultivated in 1992) on Planosols and

Podzoluvisols; an abandoned cultivated grassland (last mown in 1993) on Colluvic Albeluvisol (dominated by *Dactylis glomerata* and *Alopecurus pratensis*); an 11-m wide wet grassland on Gleysol (two parallel communities, one dominated by *Filipendula ulmaria*, another by *Aegopodium podagraria*), and a 20-m wide grey alder stand on Thapto-Mollic (Endogleic) Gleysol. In the grey alder stand, 3 sites: Edge, Wet and Dry were chosen for emission and soil analyses (Soosaar et al., 2011) (Figure 7.5). The river discharge varies from 2000 in summer to 11000 m³day⁻¹ in winter.

In this report we discuss results of two study periods for the Estonian examples: 14 year old riparian alder forest (Mander et al., 1997) and 33 year old riparian alder forest (Soosaar et al., 2011).

Figure 7.5 Study transects in complex riparian buffer zones in southern Estonia. Microsites in Porijõgi: I – edge, II – dry, III – wet (Kuusemets et al., 2001). The edge (II) is also relatively dry. Both deep and shallow lateral flow occur.

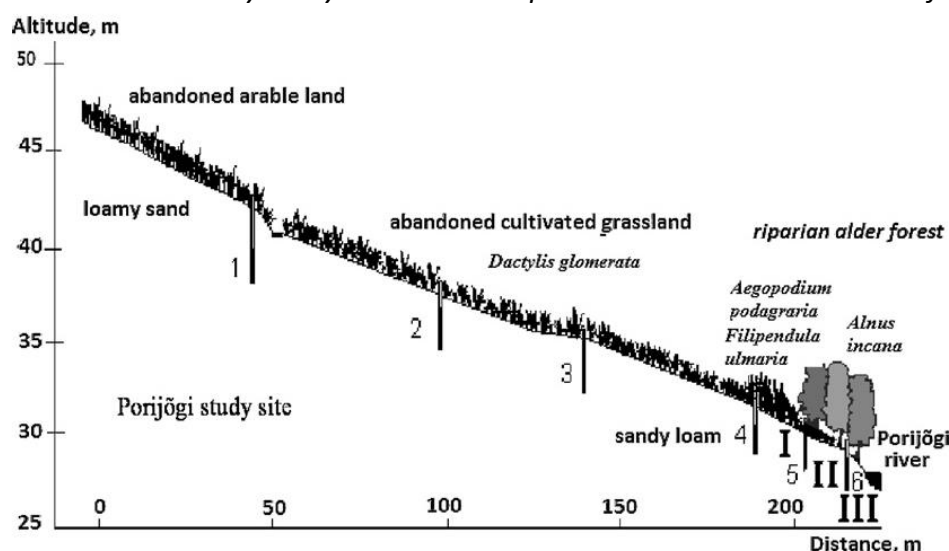


Table 7.8 Nutrient loading characteristics of Porijõgi study sites at the end of the 1990s (Mander et al., 1997).

Site	Total nitrogen			
	Groundwater inlet concentration (mg L ⁻¹)	Groundwater outlet concentration (mg L ⁻¹)	Lateral inflow (groundwater + overland flow) (kg ha ⁻¹ yr ⁻¹)	Lateral outflow (groundwater + overland flow) (kg ha ⁻¹ yr ⁻¹)
Porijõgi	2.3±0.4	1.5±0.2	25.6	13.2

Site	Total phosphorus			
	Groundwater inlet concentration (mg L ⁻¹)	Groundwater outlet concentration (mg L ⁻¹)	Lateral inflow (groundwater + overland flow) (kg ha ⁻¹ yr ⁻¹)	Lateral outflow (groundwater + overland flow) (kg ha ⁻¹ yr ⁻¹)
Porijõgi	0.09±0.03	0.06±0.005	1.8	0.6

Nitrogen and phosphorus flux and cycling in Porijõgi riparian alder forest (age 14 years) is presented in table 7.8; values of the removal efficiency, specific removal

and retention for riparian grey alder forests are presented in table 7.7. The specific removal of N was decreased downhill which coincides with the edge effect. The 50-60 m wide complex buffer zone was able to retain and transform most of the nitrogen and phosphorus entering the buffer (Mander et al., 1997).

Table 7.9 Nitrogen and phosphorus flux and cycling in riparian forest (kg ha⁻¹ yr⁻¹) (Mander et al., 1997).

	Porijõgi (age 14 yr)	
	N	P
Input, included	110.4	2.5
Precipitation	6.4	0.7
Nitrogen fixation	36	-
Overland and subsurface flow	68	1.8
Transformation		
Accumulation in tree biomass	204.8	15.1
Litter	82	4.0
Denitrification	8.5	-
Active soil Exchange	-34.1	-9.2
Output into stream	13.2	0.62

Table 7.10 Removal efficiency, specific removal and retention of nitrogen and phosphorus in grey alder test sites (Mander et al., 1997)

	Porijõgi (age 14 yr)	
	N	P
Removal efficiency (%)	81	67
Specific removal (% m⁻¹)	4.1	3.4
Retention (kg ha⁻¹ yr⁻¹)	20.9	1.2

The emission of all GHG gases varied remarkably at both temporal and spatial scales. The values of carbon dioxide, methane, dinitrogen and nitrous oxide fluxes averaged over microsites varied between 2 and 198mg CO₂-C m⁻² h⁻¹, -6 and 551µg CH₄-C m⁻² h⁻¹, 0.1 and 4.7mg N₂-N m⁻² h⁻¹, and -0.6 and 87µg N₂O-N m⁻² h⁻¹ in Porijõgi. The median values of cumulative annual fluxes of CO₂-C, CH₄-C, N₂-N, and N₂O-N are 4100, 0.9, 153 and 0.4 kg ha⁻¹ yr⁻¹ in Porijõgi. Dinitrogen emission has been found to be the most important component of N retention within the Porijõgi riparian grey alder forest.

Carbon dioxide constitutes the largest proportion of the total GWP of riparian alder forests, showing median values of 4168 and 3862 kg CO₂ eq ha⁻¹ yr⁻¹ in Porijõgi (Soosaar et al., 2011).

Riparian grey alder forests are effective buffering ecosystems with relatively high GWP due to high carbon dioxide and nitrous oxide emission. Higher water table in riparian forests benefits lower GWP because of decreasing CO₂ and N₂O emissions; increasing CH₄ emission plays a less significant role (Soosaar et al., 2011).

Application of the evaluation framework

In Table 5 in Annex 21 is the evaluation framework is filled in for Estonian riparian buffer strips. The Estonian example is the only one with a natural riparian buffer and a gradual wet profile. It is therefore also the widest BS with two different parallel vegetation zones with short (11m grass) and tall vegetation (20 m grey alder) next to the stream. Due to the hydrological and vegetation gradients perpendicular to the stream it provides ample opportunities for stimulating biodiversity. The combination of short grass (dry) and wetter Grey Alder stand is perfect for intercepting non-point pollutant loads. There is no biomass removal, but this system contributes to carbon sequestration due to litter storage in the wetter zone near the stream. The same zone may contribute to water storage during excess water periods (climate adaptation). The conditions are good for water protection goals: moderately textured soils with an ideal slope and both shallow and deep flows for draining the adjacent land.

The Estonian example is much more effective than the currently prescribed BS specifications in the Nitrate Directive. Now there need to be 1m BS along man made drains (Annex 18), 10 m along other water bodies and 20 m along large water bodies like lakes, the coast, rivers, canals, reservoirs and alike. We assume the obligatory buffer strips that have been or will be installed are manmade, most probably with grass. In case of natural riparian zones as present, we suppose these will be maintained in order to comply with the law. The best-practice example is a 31 m wide natural riparian buffer strip along a river, which is a bit wider than the ones prescribed for larger water bodies. Therefore a somewhat better contribution of the best practice example may be expected to multifunctional goals in the cases where the legal BS originate from natural riparian strips, and a much better performance where the legal BS are manmade.

7.4.3 Comparative evaluation of the design and management factors from the four examples

The **width** of the buffers strips is judged lowest (L) for the Netherlands (4 m) and highest (H) for Estonia (31 m) for most of the goals. Clearly, Denmark with 10 meter BS falls in between (M). The Italian case (5-6m) is less straightforward. It is judged M although they are only slightly wider than the Dutch buffer strips. The Italian research, however, showed good results for pollutant retention, especially for pesticides, while the buffer strip effectiveness for nutrient load reduction was rather low according to the Dutch research results. This paradox requires further inquiry and inter-calibration. The contribution to ecological goals (1), including attractiveness (2.1) (see Table 7.5), is considered better in the Po valley, because the

traditional buffer strips include trees or shrubs close to the stream. Width as a design criterion always needs to be weighted with opportunity costs, because if not, it is always “the wider the better” (although there appears to be a width beyond which effectiveness for pollutant retention does not increase anymore (see Table 7.5). In this respect there is a difference between maintaining existing natural riparian buffers strips and installing new buffer strips next to manmade ditches. In the first case environmental policy should be aiming at maintenance of the existing buffer strips extension. Given the fact that these strips are less suitable for agricultural production such policies do not require compensation of opportunity costs, unless complete removal of riparian buffer strips is considered for a rational reshaping of the entire agricultural landscape, including intensified drainage, like was done before in the Netherlands during the 60s, 70s and 80s. Only the costs of maintenance (cutting, pruning, sediment removal) need to be taken into consideration.

According to the information obtained from Italy, the traditional 2-zone buffer strips in the Po valley with trees or shrubs along the stream are increasingly being replaced by pure grass (one-zone) buffer strips. The information from Denmark shows clear benefits of maintaining elevated vegetation next to the stream for bank stabilization (goal 3.1.1 in Table 7.5), but this is not effectuated in the Danish buffer zone project. Installing such an elevated vegetation row would also contribute to ecological goals (1) including attractiveness of the landscape (Goal 2.1 in Table 7.5). If weighting costs and effectiveness should lead to setting a specified width we recommend considering at least a 2 zone buffer strip within this specified width because the combination of short and tall vegetation is clearly beneficial for both water quality (Goal 3 in Annex 18) and ecology (Goal 1/2.1 in Table 7.5). In other words multiple zone buffer strips tend to be more cost effective (See section 7.2).

In none of the examples **placement** of the buffer strip is specifically tailored to circumstances or goals. In Estonia it is a natural buffer strip, while the placement in the other countries was based on a generic rule, holding for the complete area. Theoretically, tailoring the design to the circumstances or to a specific goal improves cost-effectiveness. The buffer strip is then planned wider where a higher pollutant load is expected and narrower where these loads are smaller (Sebti and Rudra, 2010; Polyakov et al., 2005; Piechnik, Goslee, et al. (2012) This prevents costs for wider buffer strips where they are less effective. Section 7.2 provided the optimal design criteria for specific goals (Table 7.5)

Only the Estonian buffer strip had the advantage of a gradual wet **profile** (Table 3 SWT in Table 7.4) with various **vegetation** (short and tall). These design factors are almost automatically coupled with the maintenance of natural riparian buffer strips (see paragraph on width above). The same holds for **harvesting** and **fencing**, except for pruning, thinning, and sometimes fencing if the natural buffer strip should provide access to grazing animals. A wet-dry and short-tall gradient is advantageous both for biodiversity and water quality goals. Short vegetation is good for retaining sediment bound pollutants, whereas taller vegetation may contribute to retention of dissolved pollutants in deeper flow paths. Additionally, tall vegetation reduces

pesticide drift. As decomposition of some pollutants requires dry or wet or intermediate circumstances varying wetness along the potential flow path will stimulate retention of variable pollutants. So gradients, like in natural riparian buffer strips are an asset to the multifunctionality of buffer strips. This calls for preserving the natural character of many riparian buffer strips, or in other words, for building on the ecosystems services they provide, for reaching both water quality and biodiversity goals. Without gradients, take for instance an abrupt dry profile with short vegetation like in the NL, DK and in the Po valley (except for the traditional tree row), there is an advantage for some goals (Table 7.5: goals 2.2, 3.1.1, 3.1.2, 3.2.1, 4.2) but a disadvantage for others (Table 7.5 goals 3.1.4, 3.2.2, 4.1).

The conditional factors can seldom be influenced (i.e. “designed”), but they can be taken into account for tailoring the design to the circumstances or for evaluating the expected effectiveness.

As the Danish example holds for practically the entire country, and the Dutch example for a large part of one Province, we could not judge their effectiveness for fixed conditions here, leading to many Ms that are then a compromise between L(ow) for one type of soil, hydrology, slope, discharge continuity and ecological network, and H(igh) for the other types that occur as well. Land use was judged for arable in Denmark because it is predominant there. As for soil, this condition is practically indistinctive for goals 1,2 and 4 (except clay may be good for C sequestration (goal 4.1) because it stabilizes soil organic matter). However, better effectiveness for water quality goals may be expected for medium textured soils with good infiltration capacity (Table 7.5, goal 3) particularly in combination with shallow and surface flow, and moderate slope (10%). In most examples soils had a relatively good infiltration capacity, except for some Danish and Dutch areas, where it was variable, as explained above. Slope was ideal in the Estonian case (10%), which was reflected in very good retention results for nutrients. The Dutch example is completely flat and the Po area is only very gently sloping. The type of hydrology is very much correlated with soil and slope (hydrogeology), i.e. the form of landscape. In the flat Dutch delta flow depth is mainly determined by stream density (Noij, 2012), so the effectiveness of pollutant load reduction increases with stream density, not just because of the density of surface water as such, but also because it is correlated with shallower flow paths. The most important distinction with regard to hydrology, however, is between surface runoff which implies sediment bound transport, and groundwater flow with dissolved pollutants. Retention of sediment bound transport requires dense buffer vegetation like grass and a high soil infiltration capacity to allow settlement of the sediment (good infiltration zones with shrubs are reported as well, see section 7.2). Most sediment bound pollutants could be expected for the Estonian case with considerable slope and next in Italy where a gentle slope was combined with mainly arable land use and loamy soil. Both examples integrated a grass strip at the outer edge of the buffer zone, which is fit for intercepting sediment. Sediment was irrelevant for the Dutch case, and again this was variable for Denmark, although a 10 meter grass strip should be sufficient to reduce sediment load.

A dense stream and ecological network favours multiple goal effectiveness of buffer strips at landscape level in absolute terms, but not necessarily on a relative or specific basis (per meter buffer strip length). Selecting hot spots for locating buffer strips is then more cost effective (just like tailoring buffer strip width to loads). One could draw maps with more and less favourable conditions for buffer strip effectiveness for cost effective localisation. For the water quality goals these should include information on hydrogeology, soils, slope and land use, whereas for the biodiversity goals land use and ecological network (connectivity) would be most important.

For the Italian case some interesting outcomes were produced on discharge continuity. One should expect that continuous flow is better for effectiveness for water quality goals, but the Italian experts stress the importance of maintaining buffers strips next to ephemeral streams referring to the rule “keep pollution close to the source”. These field buffer strips next to dry ditches become effective as soon as autumn rains begin and are then “the first line of defense” for the surface water system.

7.4.4 Lessons learned from the four examples

Selected best practice examples of buffer strips are wider than legally obliged generic buffer strips as part of Nitrate Directive and WFD measures. They therefore provide better opportunities for multi-functionality.

Buffer strips derived or developed from natural riparian buffer strips provide better opportunities for multi-functionality, for a number of reasons related to their conditions: they combine wet and dry zones, and tall and short vegetation, in other words they provide gradients, which is advantageous for both biodiversity and water quality (See Table 7.5 on profile and vegetation, for explanation). Therefore preserving natural or similar riparian buffer strips should be a priority for reaching multifunctional buffer strips. If newly installed buffer strips are to be considered it is possible to include gradients in their design (e.g. Table 7.4, LWT, right hand), although this will require more space (width). Sufficient width is really an asset to multifunctional buffer strips, because it gives the opportunity to install multiple buffer zones that provide variation in circumstances (gradients), just like the natural ones. However, although the Danish buffer strips (10 m) are wide compared to Italy (5-6 m) and the Netherlands (4 m), the legislation only allows for a one zone grass strip. A two zone buffer strip would be better for multi-functionality, even without widening the strip.

The costs of wider buffer strips might be restricted by integrating them in the Ecological Focus Areas of the newly adopted CAP. Table 7.5 provides a checklist that can be used for tailoring buffer strips design and management to specified goals. As the conditional factors can hardly be influenced by management or design, these factors should be used for the ex-ante assessment of the expected effectiveness for the different goals.

Key messages and conclusions on RBBs

In the new CAP 2014-2020 riparian buffer strips have also been identified as elements that can become part of 'Ecological Focus Areas'. Creation and/or maintenance of RBS is also a measure taken by Member States under the Nitrogen Directive and through National Action Plans (NAP) for Sustainable Pesticide Use. In this context RBS enhance the mitigation of emissions from fields to water courses and protect surface water quality and aquatic ecology. Although RBS are primarily motivated for their contribution to the protection of surface waters, they also contribute to biodiversity. Their function can therefore be multifunctional. To which extend they are multi-functional and how they need to be designed to make them as multi-functional as possible has been investigated and the main conclusions are presented here.

There is no size fits all in RBS design as tailor made designs are necessary for different goals and conditions. One can strive for multiple goals, but in many cases required conditions, design and management requirements for reaching one goal can be contra productive for reaching another goal. Therefore multiple zone buffer strips are best for reaching multiple goals with RBS management. In the case of a double strip, one zone provide more biodiversity services with more variation in vegetation and taller species near the stream, the other zone is more for load reduction, with shorter more productive harvested grass between the first strip and the agricultural fields to filter out contaminants. The first one can be wetter and with more ecological and hydrological, biochemical and soil gradients. The second can be dry which is better for intercepting surface runoff.

Another option is a three-zone RBS. It comprises, from field to stream, a grassland strip, a shrubs or short rotation woodland strip, and an undisturbed zone with tall vegetation on the bank. The grassland strip is for abating surface runoff sediment and pollutant load and may produce some biomass. The next zone with shrubs or short rotation woodland with deeper roots allows for further infiltration of surface runoff and uptake of nutrients from subsurface flow and upper groundwater, and for denitrification due to high organic matter input. It can produce high biomass yields. The last one closest to the stream stabilizes the bank and the buffer strip during floods and can still contribute to interception of groundwater flow and denitrification.

Because of the wider width and the large structural diversity in vegetation the ecological functions of the 2- and especially to of the 3-zone BS is larger than that of the 1 zone grassland buffer strip.

Short vegetation is good for retaining sediment bound pollutants, whereas taller vegetation may contribute to retention of dissolved pollutants in deeper flow paths. Additionally, tall vegetation reduces pesticide drift. As decomposition of some pollutants requires dry or wet or intermediate circumstances varying wetness along the potential flow path will stimulate retention of variable pollutants. So gradients, like in natural riparian buffer strips, seen in the Estonian case, are an asset to the

multifunctionality of buffer strips. This calls for preserving the natural character of many riparian buffer strips, or in other words, for building on the ecosystems services they provide, for reaching both water quality and biodiversity goals. Without gradients, take for instance an abrupt dry profile with short vegetation like in the Danish, Dutch and part of the Po valley cases, there is an advantage for some goals but a disadvantage for reaching others.

Overall we conclude that buffer strips derived or developed from natural riparian buffer strips provide better opportunities for multi-functionality, for a number of reasons related to their conditions: they combine wet and dry zones, and tall and short vegetation, in other words they provide gradients, which is advantageous for both biodiversity and water quality.

The main recommendations are therefore that preserving natural or similar riparian buffer strips should be a priority for reaching multifunctional buffer strips. If newly installed buffer strips are to be considered it is possible to include gradients in their design, although this will require more space (width). Sufficient width is really an asset to multifunctional buffer strips, because it gives the opportunity to install multiple buffer zones that provide variation in circumstances (gradients), just like the natural ones. If a wide bufferstrip (> 10 meters) cannot be realised it is best to still create a two zone buffer strip which will enhance the multi-functionality of the strip.

8 MAIN CONCLUSIONS AND RECOMMENDATIONS

Aim and contents of this chapter:

This chapter presents the main conclusions and recommendations of this study. It first presents the main conclusions regarding data gaps and data needs for identifying Ecologically Valuable Grasslands (EVG) and land at risk of abandonment in the EU.

This is followed by a presentation of the main conclusions and recommendations identified in this study when evaluating the best/less good practice examples in relation to the environmental impacts of farmland afforestation especially in order to underpin the present and future policy process and environmental policy objectives. The main focus in relation to afforestation is on legislative and administrative targeting mechanisms for promoting positive environmental effects and for preventing negative environmental effects.

Next the key factors determining an optimal multifunctional Riparian Buffer Strip (RBS) performance are presented and main recommendations are made for creating and/or maintaining such RBS.

At the end the joint conclusions and recommendations are presented that result from this study.

8.1 Conclusions

8.1.1 *Data gaps and data needs for ecologically valuable grasslands*

For the purpose of this study, we assume that the intention of the policy is to include all agricultural land. This implies that it should include beside arable land all uncultivated land with vegetation that is grazed and/or cut for fodder or biomass, including herbaceous and non-herbaceous species.

Within the broad definition of grassland and the assumption that some grasslands have higher ecological values EVG are therefore understood to mean:

*grasslands that are notable, within the overall context of agricultural grasslands, for their ecological value. EVG have a spectrum of values depending on management but focus on biodiversity value and there is often a strong relation between high biodiversity value and other services. **The EVG are semi-natural and natural grasslands that are not agriculturally-improved (e.g. through cultivation, reseeding, fertilisation, irrigation and drainage) of long standing and species-rich (taking account of all taxa not only higher plants).***

It should be clear that EVG are not the same as HNV farmland, although they overlap in the HNV type 1. The mis-match occurs in the HNV type 3 category where there is presence of improved grasslands which are relatively species poor but still harbour populations of species of (European) conservation interest.

The inventory of EU wide and National data sources have learned us that there are sufficient data sources available both at EU and national level that provide

information on one of the three main aspects according to which EVG are characterised. These 3 aspects are:

- 1) Semi-natural habitat status
- 2) Unimproved status (lack cultivation, reseeded, artificial fertilisation although low manuring through low intensity grazing is allowed , irrigation and/or drainage)
- 3) species richness

As for the first aspect there is an increasing improvement in the systematic collection of ecological data on national level especially, but also at EU level, to identify the location, extent and status of semi-natural habitats included in the Annex 1 of the habitat Directive. This improvement is also supporting the elaboration of data sources according to which the EVG can be identified. It is enhanced through the introduction of the article 17 reporting obligation but also the targeting of HNV farmland in RDP which also requires identification and evaluation of HNV farmland indicators within the frame of the CMEF. The first reporting under Article 17 was in 2008 and the next reporting is due by end of 2013. So since 2008 much effort has been invested in most of the EU countries to create new data base and improve existing databases that form the basis of reporting under Article 17.

Also at EU level much effort is invested lately in improving the identification of semi-natural habitats, especially the agriculturally used and/or species rich grasslands specifically using high resolution remote sensing information. Much work still needs to be done but it can be expected that within a couple of years time EU wide inventories with RS are possible that deliver relatively reliable information on the spatial distribution of low and high intensity grasslands and of specific Annex 1 grassland habitats with low input and typical structural characteristics. Especially the method of estimating the NDVI is very promising. It will still remain a challenge however to separate the completely unimproved grasslands from the low to medium intensive fertilised grasslands however. Also the real species richness of an habitat cannot be observed using remote sensing information only.

Data on species presence is usually coupled to the Annex 1 habitat information as usually their identification was done based on presence of indicator species. Overall it turns out that vegetation, birds and butterfly species data are often available, but other species data is much more rare in most regions of Europe. Furthermore the existing data often have limitations:

- 1) The data are old (old releve and species count information)
- 2) Based on data collection methodologies that are inconsistent and therefore data are not comparable
- 3) The spatial resolution level at which the species data are available are too coarse which makes it impossible to reliably link the data to the grassland plot that may be potentiall EVG.

In spite of this there are several countries with relatively good data sources for identifying EVG. Half of the countries have a relatively good database with minor limitations, although almost all need to invest further to up-date the inventories and

ensure full country coverage. Relatively good inventory data are available in Hungary, Luxembourg, Ireland, UK, Belgium, Germany, Denmark, Netherlands and Sweden. Countries that have a low score in this respect are France, Greece, Portugal and Italy that rely on old relevé information usually not collected with one uniform methodology and/or not covering the main part of the territory where EVG are likely to occur.

EU wide statistical data sources and EVG:

From the inventory of EU wide data sources it has become clear that data gaps in relation to identifying location and distribution of EVG are large. Overall there is no EU wide data systems that enables to directly identify EVG. It turns out that the EU wide data sources evaluated do provide information on extend of grassland per class (e.g. permanent grassland and meadow, rough grazing and permanent grassland and meadows no longer used for production purposes and eligible for the payment of subsidies) but the classification is not sufficiently based on parameters of agricultural improvement and management parameters are only provided for regional averages. So also spatially the information is too coarse to point us to the exact locations of EVG concentration areas.

For all data sources identified further work also needs to be done to obtain information on the completeness of the coverage in relation to all grassland classes. Many statistical data bases only cover the agricultural areas that are eligible for payments, and or fall in the definition of agricultural land according to CAP and therefore often exclude classes of land used for grazing which have a coverage with trees and/or shrubs above the threshold for agricultural land in the particular database.

However since 2010 the Eurostat agricultural land use statistics do include common lands. Since most of these lands are permanent grasslands the coverage of these has improved significantly. But also with these lands the problem remains for pasture lands that do not comply with the agricultural land definition because of too high coverage with trees and shrubs. This definition of grassland is however interpreted differently per MS. Since the data for the EU wide statistical data sources investigated are reported from national sources the representation of permanent grasslands still remains inconsistent in the EU sources.

National statistical data sources and EVG:

When looking deeper into the national statistical data sources both agricultural survey and census data but also IACS-LPIS sources we conclude the following:

The suitability of agricultural land use statistics for identifying ecologically valuable grasslands is generally limited and overall it cannot be used as the single source of information to identify EVG with. There are several reasons for this:

- 1) Most countries only include part of the lands used for grazing in their agricultural land use statistics. This has 2 main reasons:
 - a. The definition of grasslands is too limited to include all land used for grazing. Usually only grasslands are included which have a maximum tree crown cover (sometimes set at 75% of area coverage, but often much

lower thresholds are used). The thresholds for inclusion differs per country and also between data sets within a country (e.g. differences exist between agricultural land use statistics, IACS-LPIS, land cover and other national data sources). Because of this maximum threshold especially large part of the EVG are excluded from the statistics as these are more often characterised by higher shrub or tree cover than the intensively managed permanent grasslands. The inconsistency between countries on which share of the permanent grasslands are reported is also related to the fact the countries report from different sources to Eurostat. Some countries have a 2 yearly survey and a 10-yearly census which they use to report from, while other use their IACS-LPIS data as the main source.

- b. Common land, which mainly consists of permanent grasslands in most of the countries, are not or only partly included in the statistics. Because of this large parts of the permanent grasslands are not registered particularly in IACS-LPIS which often follow the strict rules of eligibility linked to the tight definition of permanent grasslands. Exceptions of countries that allow for higher shares on shrub and trees in the registered and eligible grasslands are most Mediterranean countries.
 - c. A minimal economic size threshold is applied for inclusion of farms into the national statistics which excludes small farms and therefore also some part of the permanent grasslands. The extensive grasslands are however more likely to be managed by smaller and more marginal farms.
- 2) Countries do not consistently register more extensive sub-categories of permanent grasslands such as rough grazing land or extensive grassland. Although countries according to the most recent requirements are obliged to report on the three sub-categories of permanent grasslands and meadows to Eurostat for inclusion in both FSS and the Annual crop statistics they do not always do it or provide a figure that often excludes the most extensively managed grasslands (e.g. rough grazing):
- F. Permanent grassland and meadows:
 - F/1 Pasture and meadow, excluding rough grazing
 - F/2 Rough grazing
 - F/3 Permanent grassland and meadows no longer used for production purposes and eligible for the payment of subsidies

- 3) Although some countries register intensive and extensive grasslands separately it is not always clear which definitions and threshold values were used to make this distinction and if clear the definition of extensive grasslands does not always fit to the definition of EVG as specified in this report. Furthermore in most cases land management practices are not known for the different grassland categories registered which makes it impossible to established whether they are unimproved, of long standing and species rich.

In many countries however no more than 1 or 2 permanent grassland types are registered in statistical sources. Good exceptions are Portugal, Italy and Spain. In

other countries, e.g. the Nordic, CEEC and western countries, the types of grasslands separately registered in different statistical sources is more limited. Although some do register one type of pasture with trees or alpine or common land pastures separately, depending on the importance of these types of grassland categories in the specific countries.

When only looking at IACS-LPIS sources, which provide information at the most relevant spatial detail to enable identifying EVG, there is also very limited information on land management. Some countries do distinguish categories that are clearly unimproved, but for the rest of the permanent grasslands in most countries it cannot be established how intensively/extensively they are managed and to which extent they have been improved. The only exception to this is the Austrian LPIS information in which stocking density can be obtained per plot in combination with a whole range of information on different types of traditional permanent grassland categories and AEP management practices applicable. Austria is however the only country with this level of information included in LPIS. This country is also exceptional as the number of farmers included in AEP schemes is very high covering a large part of the permanent grasslands. Overall it can be concluded from the former that the most crucial information on farm management to identify EVG from LPIS is stocking density and absence of irrigation, drainage and ploughing for at least 10 years or longer. A distinction between irrigated and dry grasslands is made in most LPIS systems in Mediterranean countries. Information on the other factors is not collected in any LPIS system. However, links should be possible between IACS and census registrations and the LPIS plots/blocks. The match still provides data on an average farming situation, but if ecological data are also combined at the plot level the combined information enables to separate the EVG from the rest of the grasslands.

For the proper identification of EVG as a minimum the management data that need to be obtained should provide good figures on stocking densities per LPIS plot and inputs in relation to artificial fertilisers and absence of ploughing (so historic data on management needed). As to stocking density the only LPIS system that now provides this information is in Austria. In most other countries links between LPIS plots and management can only be made at the level of the farm for which stocking density figures are available from the IACS farms that have a link to the field plots in LPIS. So only an average picture can be derived for the whole farm on stocking density. For the estimation of EVG the specific stocking density practices will need to be collected per field or physical block in LPIS.

Irrigation and drainage can generally be expected to be absent in the case permanent grasslands are categorised in the rough grazing class. If categorized in the permanent grassland class this cannot be expected and additional information on this aspect will need to be collected. In several agricultural census data sources irrigation data are collected per farm per crop. An integration of these census results with the LPIS census data would be a good start, but also for these parameters it would be better if they were collected at field level in the future. The same applies for drainage which is a practice on which information is hardly available but is a very

disturbing practice which will lead to an immediate loss of biodiversity in EVG if applied.

Information on ploughing of grasslands is not collected in statistical sources and therefore it will be very difficult to derive from existing data sources, let alone at the field level. However, with areal photographic and remote sensing interpretations with high temporal and spatial resolution it is possible to establish the long term absence of practices such as ploughing and intensive fertilisation.

In conclusion:

- 1) High resolution data for all 3 types of information required to identify EVG are usually absent and or scarce. Management, species and habitat information is required at the level of a field plot of at least at landscape scale.
- 2) The combination of detailed and historic management information at the level of a semi-natural habitat is usually absent. Both types of data are collected in a separate way and it usually remains a challenge to match the two
- 3) Reliable species data is scarce and what is there is usually limited to vegetation, birds and possibly butterflies. Other species strata are not covered which makes the establishment of whether a grassland is species rich and thus EVG more difficult.

8.1.2 Recommendations for data improvement to identify EVG

Identification of EVG needs to be done at the level of a plot and/or at landscape level. At this level information needs to become available on:

- 1) Semi-natural status
- 2) Unimproved status (lack cultivation, reseeded, artificial fertilisation although low manuring through low intensity grazing is allowed , irrigation and/or drainage)
- 3) Are species rich

Therefore the only suitable level for evaluation is the plot/block level used in LPIS. Since the semi-natural grasslands habitats that are experiencing most biodiversity losses, the LPIS focus is also logical from the perspective of improving the CAP targeting.

In order to establish and improve the data availability towards EVG identification, CAP policy targeting and evaluation the following recommendations can be made:

- 1) A further harmonisation between countries is required in the coverage of permanent grasslands in national and EU data sources, particularly in the IACS-LPIS systems. This issue is related to the eligibility rules linked to permanent grasslands definitions. To solve this we follow the recommendation on this issue already made by the EFNCP in a study by Beaufoy et al. (2010) who state that 'that minimum activity should be the

basic criterion for determining if a pasture is eligible to receive direct payments, not whether it is grass, shrub or wood pasture, or whether the proportion of herbaceous vegetation is dominant'. Therefore all pasture lands that are grazed or cut and thus show evidence of minimum activity should be included in IACS-LPIS in all EU countries.

- 2) Common land that is grazed should be included in LPIS and linked to the user so that information on management practices by the user can be linked.
- 3) As part of the declaration of land use the farmer should also specify additional management information on the grassland plots. These should at a minimum include:
 - a. Fertilisation through artificial fertilisers. Preferably in terms of classes (no fertiliser input, <50 kg/ha, etc.)
 - b. Stocking density on the grassland . Preferably specified for classes 0.1< and < 0.5 LU/Ha, 0.5-1 LU/ha etc.)
 - c. Ploughing practice
 - d. Irrigation
 - e. Drainage
- 4) More types of permanent grasslands should be registered taking the example of Spain and Portugal where shrub and tree coverage is classified for the LPIS plots, links should be established with the spatially specific ecological information on semi-natural habitats used for the reporting under article 17. With this information it can be established whether the LPIS plots indeed coincide with semi-natural habitats included in the Annex 1 of the Habitat Directive and whether they are species rich.

8.1.3 Data gaps and data needs for land at risk of abandonment

We can conclude that there are basically two EU wide data sets that can improve the assessment of land at risk of abandonment. Firstly, the LUCAS data provide valuable additional information on land cover classes 'fallow and abandoned land' and on land management. This indicator could still be a relevant indirect indicator as in a region where abandoned land share is high the chances for the remaining land to become abandoned too are generally higher. As for the LUCAS additional land management information relevant indicators for risk of abandonment could be grazing or ploughing, tilling and/or sowed sowing status; harvested field; burnt area, hunting regime, type of water management and stoniness. All these indicators which are registered per land class if relevant could be an indication on risk for abandonment, especially if changes in these registrations can be assessed in time for similar LUCAS points. The use of LUCAS point information should therefore further be explored for improving the EU wide assessment of Terres et al (2013).

As to the national data sources it has become clear there are also two types of data that are well registered and which could be used to further improve the quantification of the drivers of the risk of land abandonment from the Terres et al. (2013) study. Firstly, this concerns national data on land prices. All countries have different registries on land sales and land rents, which can be used to further improve the indicator of agricultural land prices. Secondly, data on farmers' qualifications from national sources are registered in the national census data or

other statistical sources. As both types of data are registered in different ways per MS much effort is still to be put in the collection and harmonization of these data.

These national data are mostly useful for more profound analysis at a national level. Such a national analysis can be worthwhile, especially as the new CAP seems to offer more possibilities to develop specific measures at a national level to support specific farming systems such as HNV farms, low productive systems, ecological systems which are often located in more marginal areas where the risk for abandonment is much larger. More detailed information at national level can help to design and target these specific CAP measures towards systems in areas with a high risk for farmland abandonment.

It is also worthwhile to investigate whether the available FADN data at a national level are more detailed or include a bigger sample than the FADN data used at EU level. If so, it would be relatively easy to include those national data in the farmland at risk of abandonment analysis. However, even if the data contain a bigger sample, they would probably still miss out the economically smaller farms which are more likely to operate in areas where abandonment is a much larger risk. So the additional added value of national FADN data to improve the assessment in Terres et al. (2013) is evaluated as relatively minor.

It should also be mentioned that data from national sources do not seem to provide a basis for overall EU wide analysis of land at risk of abandonment. Overall they are too diverse in terms of methodology used to collect them and the comparability of answers at EU scale is complicated. However, if effort is to be invested it is likely to be most effective to do this for the two indicators mentioned before and these are land prices and farmers qualifications. For these two there is much national information available and one could consider to invest time to create more harmonization in the data that is there by analysing and creating comparable result through post-analysis. This will of course require a significant time investment to systematically assess the different land price data information sources for all EU countries and determine how they can be harmonized to be integrated in an EU wide indicator.

The answers derived from the experts involved were very valuable, but of course represent the opinion of only one expert, while the issues addressed were quite diverse and additional expert consultation would still be valuable to derive a more detailed overview of the best way forward to collecting and harmonizing national data. This would be particularly advisable for land prices and farmers qualifications that seem to have the best prospects to deliver added value to the EU wide assessment.

However, overall it has also become clear that the identification of (the risk of) abandonment of the land is a complex and challenging task. In some cases abandonment might be the result of an active decision – to stop practising agriculture or to leave a rural area for example – but in many cases abandonment will be the outcome of a more passive and gradual development following the lack of

investment or renewal. In these latter cases it will be difficult to judge or predict the actual moment or state of abandonment.

A useful clarification can be made by distinguishing the concepts of marginalisation and abandonment. Where abandonment can be understood as a state, as the outcome of a final process, marginalisation relates to the process itself (Pinto-Correia & Breman, 2008). Thus, when trying to assess the risk of land abandonment, it is crucial to look at the underlying processes, and to analyse dynamics over time.

Besides that, certainly in the more peripheral regions of Europe such as parts of the Mediterranean or Scandinavia, the abandonment of land can hardly be seen as exclusively related to farmland or farming activity. On the contrary, it is not only the land, but also the agricultural activity and the rural communities that can be seen as marginalising. The abandonment of land is the outcome of a wider process of marginalisation where broader (regional) dynamics of rural society play an equally important role.

As these underlying (marginalisation) processes of land abandonment are so complex, it is not very likely that one, or even a few (snapshot) indicator(s) for a fixed moment in time can offer sufficient insight to predict the (risk of) abandonment of land. As we mentioned before, land cover data like Corine can be a very valuable source, however, as isolated data they are not capable to offer sufficient understanding of what is going on. Similarly, data from revenues of activities outside the farm can help to understand what is going on, but only in combination with other indicators.

Understanding the risk of land abandonment asks for a territorial perspective and the analysis of the underlying (regional) processes of marginalisation implicitly requires the integration of a wider range of spatial, socio-economic and sectoral indicators as well as an analysis of these indicators over time.

Box 8.1: Net Change and Variation

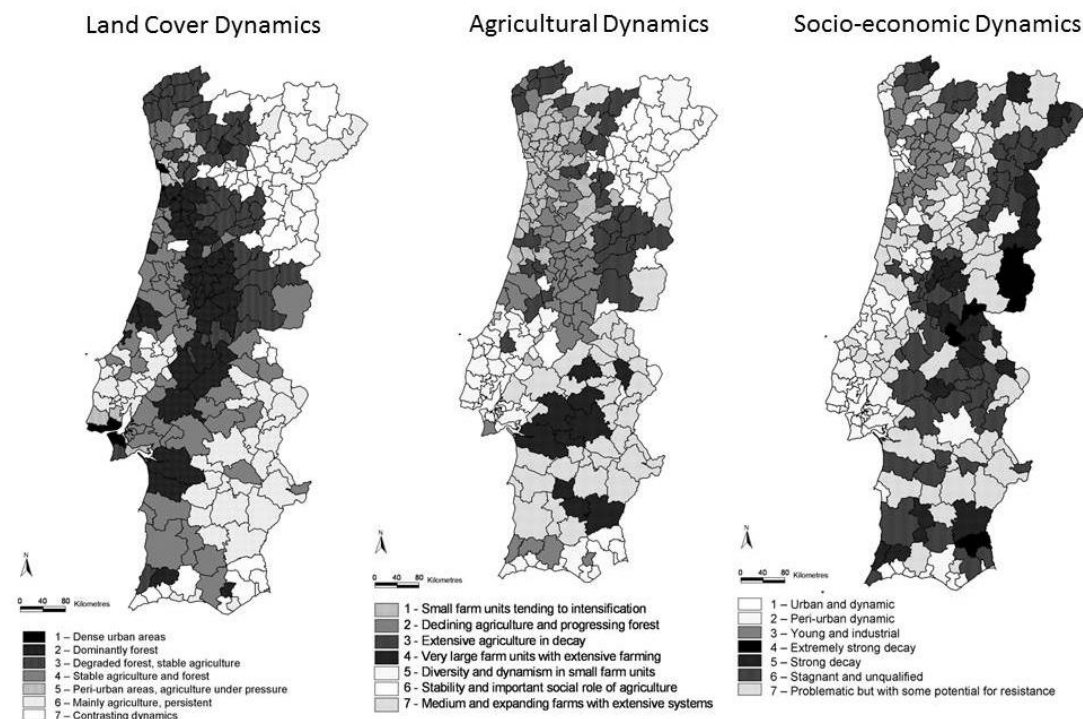
Net change is a concept used in the field of spatial analysis (Pontius et al., 2004). It is a relative index that reflects the difference in weight of an indicator between one year and another. It shows the relative dynamics between two time moments in time, being the change evaluated in relation to a frame of reference that has to be the same in each moment of analysis. Thus, for example, where the agricultural population could have a weight of 20% in 1989 and 10% in 1999, the 'net change' would be -10.

The Variation usually reveals the relative change of the value of an indicator between two years. Although this is a useful concept to understand certain trends and developments, it has the disadvantage that it is not weighed which makes it difficult to compare data and trends of different municipalities. Thus, in the example above, the change from an agricultural population of 20% in one year to 10% in another year would be -50%. However, a change in population from 2% to 1% would also be qualified as -50% whereas both changes can represent completely different dynamics.

The focus on the processes rather than the outcome at a given moment in time means that it can be quite valuable to study the changes for (a combination of) indicators between 2 or more census data. In a sense, when looking at the processes of marginalisation over a longer period of time, the disadvantage of the fact that the Agricultural Census data are only available with an interval of 10 years is largely compensated by the fact that these data are available over a longer period of time and at a very detailed level.

An example of such a study is the analysis of abandonment processes in Portugal that we have referred to before in this chapter (Pinto-Correia et al., 2006). In this study an analysis of dynamics over time was carried out at NUTS IV level using a combination of both spatial (CORINE Land Cover), sectoral (Agricultural Census) and socio-economic (National Statistics) data that were integrated based on a weighed analysis using the concept of ‘net change’ and variation (see Box 8.1). For each of these sources data were available for two more or less similar moments in time (1989/1990 & 1999/2000) (see Figure 8.1).

Figure 8.1 Comparing dynamics at municipality level in Portugal for both Land Cover, Agriculture and Socio-economic dynamics.



What the outcomes of this project have shown is that the integration of spatial, socio-economic and sectoral data and methods can significantly enhance the understanding of marginalisation processes and following these, also land abandonment. As these methods can easily be applied to other regions as well they might prove to be a valuable support for tailor-made rural development policies throughout Europe and an added value to the analysis made in Terres et al. (2013).

8.1.4 Key environmental risk of farmland afforestation and key safeguards for achieving positive environmental effects

The aim of this part of the study was to gather existing data and provide best/less good practice examples in relation to the environmental impacts of farmland afforestation, in order to underpin the present and future policy process and environmental policy objectives. The main focus was on legislative and administrative targeting mechanisms for promoting positive environmental effects and for preventing negative environmental effects.

Farmland afforestation became a very significant, pan-EU measure when Regulation 2080/92 was introduced as obligatory for MS to implement. It was not compulsory at farm level, land owners were free to enter the scheme or not. Part of the argumentation was that afforestation would, alongside the set-aside mechanism, help to address agricultural production surpluses, which was a key issue of the 1992 CAP reform.

However, mechanisms were not put in place to pursue effectively the goal of reducing agricultural production through afforestation. Afforestation was not targeted on more productive land, and in fact took place predominantly on marginal grazing land of low productivity. Institut Pour le Développement Forestier (2001) found that *“as regards the reduction of agricultural surpluses, the impact of Regulation 2080 is negligible”*.

The production-control justification of the CAP afforestation measures was abandoned after 1999 and the objectives thereafter were shifted towards simply expanding the forest area, with a mix of quite general socio-economic and environmental objectives. From 2005 the primary objective has been explicitly environmental, and all afforestation supported by RDPs is intended to *“enhance biodiversity”*.

The present study focuses on environmental effects. Farmland afforestation can also have social and economic effects including benefits but these were not included in the study brief. Climate change mitigation was not a focus of the study.

The study had only limited resources and could not assess the environmental effects of farmland afforestation for the whole EU over a period of 20 years (in the case of EU15). The effects of a fundamental change of use on almost 2 million hectares (1.1% of EU farmland) are massive and complex and there are no full scientific studies of the subject, only some examples of local research. An in-depth research project is recommended in order to evaluate the environmental and wider multifunctional effects of farmland afforestation over the past 20 years. However, the failure to monitor the type of land afforested over the past 20 years is a major handicap to effective evaluation of effects.

From the available literature it appears to be widely accepted that farmland afforestation has several potential environmental benefits, specifically reducing soil erosion, improving soil organic matter, increasing carbon sequestration and

providing a valued wildlife habitat and/or expanding or connecting existing forest habitats. Delivering these benefits depends to a large extent on where trees are planted, how they are planted and managed, and which species are used.

In the case of cropped land (including intensively cultivated grassland), and assuming the use of locally adapted tree species and sensitive planting and maintenance techniques, all of the above-mentioned benefits should occur to a greater or lesser extent. Some positive mix of environmental benefits can reasonably be assumed. Exceptions would apply in situations of arable land and permanent crops of high nature value, for example steppelands with bird communities of conservation concern and small-scale mosaic landscapes typically of permanent crops, where the losses of priority species and landscapes may outweigh the expected benefits for soils or carbon. If farmland afforestation were limited to arable land then the question of evaluating effects would be far simpler and there would be few environmental concerns.

In the case of permanent pasture (including shrub and wood pastures), the benefits are much less clear cut. Especially under extensive farming use, permanent pastures offer relatively good soil protection and relatively high organic matter and stable carbon storage. In southern Europe especially, such land provides essential fire breaks in marginal lands that are at extremely high risk of damaging forest fires. If they are in a semi-natural condition (EVG) such pastures are of high nature value and often coincide with Habitats Directive Annex 1 habitats that are in decline across the EU.

Afforestation of such land is by no means guaranteed to deliver an overall environmental benefit, in fact there may be considerable negative effects on soils and wildlife habitats in the short term. The long-term balance for biodiversity will depend on many factors, including the type of habitat that is lost, the landscape context, and the nature and future management of the created forest. The precautionary principle would advise against destroying habitat types that are valued and declining in order to establish new habitats, except perhaps if these new habitats are of a type that is regarded as a key biodiversity priority or that are intended for priority functions such as ecological corridors.

With appropriate techniques and in the right conditions, there may be some long-term carbon sequestration resulting from afforestation of permanent pastures, but this will be limited compared to the benefits of afforesting arable land and may not offset the loss of biodiversity. Furthermore, carbon sequestration in the case of forests planted on permanent pasture will be largely in the biomass above ground, and may be released at a later date depending on the use to which the trees are put, or on events such as wild fires. Carbon sequestration in some permanent pastures is primarily in the soil, which is more stable and potentially longer term, and can be increased through appropriate management.

Thus the MEACAP study (Zanchi, Thiel, Green and Lindner, 2007) concluded that the effects on grassland soils of afforestation may be positive in some cases over the

long term, but in some other cases the effects may be negative. Large scale afforestation of natural grasslands or culturally rich historical small scale landscapes could lead to the loss of specific species, while afforestation of intensively used agricultural areas could enhance biodiversity.

The AFFOREST research project concluded that afforestation does not necessarily lead to an improvement of the environmental quality, in relation to groundwater recharge and soil erosion reduction, afforestation of pasture and non-cultivated land leads to negative effects. For carbon sequestration it would still work out positively however. Afforestation of arable lands was found to lead to environmental improvements in all three environmental issues considered.

From the review of MS expert questionnaires, it appears that there is a continuing process of afforestation on semi-natural grasslands in some MS, although the extent of losses of EVG are not known. Many MS do not have effective mechanisms in place to prevent the afforestation of EVG outside protected areas. Partly this is due to incomplete data bases of such habitats and the fact that they are not recorded on LPIS. Smaller projects tend to fall below nationally established thresholds for EIA in the case of afforestation of semi-natural land. Without such mechanisms, and without tight targetting of afforestation onto the most suitable land, it is inevitable that there are cases of semi-natural grasslands in landscapes with already high woodland cover being lost to this change of use. For protected areas (e.g. Natura 2000) it seems that reasonably effective mechanisms are in place to prevent afforestation of valuable habitats.

It is clear that, in order to deliver the environmental benefits intended by policy, there must be effective targetting of afforestation onto the types of land where environmental benefits can be expected. A key conclusion of the present study is that for the EU as a whole there has not been effective targetting and as a result the environmental objectives of farmland afforestation have not been pursued effectively. The same failure occurred with the production-control objective of afforestation in the 1990s. There are exceptions in the case of a small number of MS that apply targetting mechanisms, and there also seem to have been gradual improvements in targetting over the years since 1992.

A large proportion of farmland afforestation is assumed by RDP evaluations to have generated environmental benefits such as tackling soil erosion, enhancing biodiversity or preventing forest fires without having been targeted on land where such benefits can be expected.

Other than an optional targetting approach in Regulation 2080/92, the EU Regulations providing for afforestation aids have not proposed targetting mechanisms. Under the current Regulation 1698/2005, MS are required to *“designate areas suitable for afforestation for environmental reasons, such as protection against erosion, prevention of natural hazards or extension of forest resources contributing to climate change mitigation, and forest areas with a medium*

to high forest fire risk” but this has not been done in most of the MS that were researched, with two or three notable exceptions.

In 2004 the Court of Auditors commented on the lack of *clear Community guidelines on how to ensure compatibility with the environment*. The present study concludes that clear guidelines still have not been given. MS are instructed to ensure compatibility but there are no suggestions as to how this should be done. It is notable in this context that the Regulations providing for afforestation aids make no reference to the EIA Directive that itself provides an explicit mechanism in relation to afforestation of semi-natural land.

Rather than positive targeting in pursuit of environmental objectives, the general focus of “environmental compatibility” has been on preventing negative impacts of afforestation, by not incentivising fast-growing, intensive plantations, and by putting controls on afforestation within protected areas. In a very small number of MS afforestation of permanent grasslands is excluded by the national regulations.

For the new EAFRD period, the latest Delegated Regulation introduces explicit requirements to avoid the inappropriate afforestation of sensitive habitats such as peat lands and wetlands and negative effects on areas of high ecological value including areas under high natural value farming. Grasslands are not mentioned, although the new CAP rules on non-ploughing of environmentally sensitive grasslands are potentially relevant. The protection requirements are more concrete and wider in scope than in previous periods. However, the new rules do not require the identification of land suitable for afforestation for environmental purposes as in the 2007-12 period, nor the use of mechanisms for targeting afforestation onto such land as have been applied in a small number of Member States.

Farmland afforestation is a policy funded with considerable public resources to pursue a specific set of public goods, in this case environmental benefits. It is reasonable to expect that targeting mechanisms will be put in place to ensure as far as possible that these benefits are delivered. It is not a question of merely preventing damaging effects.

Linked to the lack of clear guidelines on how to ensure compatibility with the environment is the absence of clearly presented environmental objectives for farmland afforestation at the EU level. EU forestry policy communications, such as those on the EU Forest Action Plan (COM(2006) 302 final) and A new EU Forest Strategy (COM(2013) 659 final) are focused on enhancing sustainable forest management and the multifunctional role of forests, rather than on expanding the forest area.

In rural development policy, there has been a shifting and rather imprecise picture of the objectives of farmland afforestation since 1992. Regulation 1698/2005 only refers to objectives in the Recitals, and these are worded in a rather generalised and unstructured way.

For the period 2014-20, the new consolidated draft EAFRD regulation dated 26th September 2013 (Interinstitutional File 2011/0282 (COD)) does not set out concrete objectives for afforestation. It states simply that “forestry is an integral part of rural development and support for sustainable and climate friendly land use should encompass forest area development and sustainable management of forests”. However, the regulation establishes over-arching priorities for rural development policy that include elements of direct relevance for farmland afforestation, such as restoring, and preserving and enhancing biodiversity, preventing soil erosion and improving soil management and fostering carbon conservation and sequestration in agriculture and forestry.

In some national and regional RDPs there are quite precise objectives for farmland afforestation, while some others present only very vague objectives. The concrete and distinct environmental objectives of afforestation should be made clear at EU level and MS should then develop these in more detail for the national territory. For example, if one EU objective is to enhance biodiversity, then RDPs should specify the habitats and functions that afforestation aims to deliver, in relation to EU and national biodiversity priorities (e.g. which forest habitat types will be created, which landscapes require an increase in these habitats or in improved connectivity). This is an essential basis for the design of effective targeting and protection mechanisms.

The EU regulations should provide clear guidelines for targeting afforestation in order to promote established environmental objectives. Targeting should stem from the objectives. Thus if for example tackling soil erosion is an objective of afforestation, RDPs should identify which types of land are most suitable for achieving this objective, and should establish mechanisms for targeting afforestation onto this land for this objective.

It may be considered whether afforestation of all types of farmland is a rational environmental objective in itself. On some types of land covering very large areas (taking the EU as a whole), such as EVG, the range of environmental goals to which afforestation is intended to contribute may be pursued more efficiently by other uses. There may also be greater synergies to be achieved through measures that favour climate and biodiversity aims under other types of land management, for example extensive farming systems, whereas farmland afforestation often presents a dilemma of choosing one or other of these aims. Forests can also be multifunctional and provide various ecosystem services, therefore a due analysis is required assessing the costs and benefits both in short and long term. Targeting and protection mechanisms need to take account of such analysis.

Considering biodiversity, a rational strategy would be to focus efforts on the habitat types and species that are most in decline, or most threatened with decline. At EU level, these generally are not forest habitat types. Recent information from Article 17 reporting suggests that semi-natural grassland habitat types are the most threatened, so it could be argued that an EU-level measure for maintaining these habitats is a greater biodiversity priority than the creation of new forest habitats on farmland.

However, at a local level the situation may be different, especially in intensively farmed landscapes with very limited semi-natural habitat or woodland. There are situations where the creation of new forest habitats and ecological corridors is indeed a biodiversity priority. Farmland afforestation programmes potentially could be designed in order to promote the creation of specific forest habitats in priority locations. However, in practice this is not how they are designed in the majority of MS.

Forest fires are a significant cause of GHG emissions in southern Europe, as well as causing destruction of soils and habitats. Forest fires are closely linked to rural abandonment and to afforestation programmes since the 1960s. It is estimated that in the period 1990 to 2000 forest fires produced 1% of all GHG emissions in Spain. Extensive grazing is consistently shown to be an effective strategy for reducing fire risk in marginal lands, but this land use is in widespread decline. A concerted strategy to reduce forest fires through preventive grazing may produce greater climate benefits than farmland afforestation, while at the same time maintaining Annex 1 semi-natural habitats that are threatened with abandonment. In contrast the farmland afforestation measures until now required the *exclusion* of grazing from marginal lands, and thus result in a greatly increased fire risk, although the latest Delegated Regulation addresses this problem and does allow grazing as part of appropriate maintenance.

The situation today is quite different from in 1992 when farmland afforestation was introduced as a key rural development measure across the EU. Today extensive grazing systems are in decline in many of the EU's more marginal landscapes, a process driven by the lack of economic viability of the farming systems and accelerated by the decoupling of CAP support. This decline has been identified as the main threat to Natura 2000 at EU level. Economic forces indicate that incentives for farmland afforestation are most likely to be taken up on such land as an alternative to total abandonment. However, the afforestation maintenance and compensation payments only last for a number of years. If the new forests are not economic (as appears to be the case in most MS) then abandonment will follow. MS have also reported that more environmental restrictions introduced concerning forest management can lead towards decreasing the economic value of forest and increasing the risk of abandonment.

However, some aspects of policy are now more favourable to afforestation than to maintenance of grazing systems on EVG. From 2009 land afforested under measures existing since 1999 became eligible for the Pillar 1 Single Payment Scheme (SPS) (such land was eligible for set-aside entitlements from 2005). From 2014-15, land afforested since 1999 will be eligible for the new Pillar 1 direct payments. This constitutes a significant incentive to farmers with low-income or negative-income farming systems to abandon the activity in favour of afforestation. For example, many farming systems based on EVG grasslands have been shown to be uneconomic in the absence of Pillar 1 support payments. Afforestation offers the opportunity to

claim the same payments while avoiding the costs of farming, plus the addition of afforestation payments to compensate a supposed loss of farming income.

There is some policy incoherence in the fact that land in active grazing use but with more than a certain density of trees can be excluded from Pillar 1 payments under current eligibility rules because of the presence of trees, while land that is newly planted with the same tree density but NOT under grazing is eligible for both afforestation payments and Pillar 1 direct payments.

Data is an overall focus of the present study. Data availability in relation to farmland afforestation is extremely limited and presents a major handicap to robust evaluation of environmental effects. Even basic data on the extent of land afforested under RDP measures since 1992 is not available in an easily accessible way at EU level. For the period 2000-2006 data is particularly difficult to access and data on the EC website includes some significant errors. Data should be corrected and presented in an easily accessed way.

Data on the previous land cover (e.g. arable or permanent pasture) and other characteristics, such as presence of Annex 1 habitats and Annex 2 species, or soils identified as highly eroded, is not collected by national authorities in relation to farmland afforestation and has not been required by the EC. Such data is essential for evaluating the environmental effects of farmland afforestation programmes and should be collected for all programmes and reported to the EC. The failure to gather such data for the past 20 years is a major defect of the evaluation and monitoring system.

In the absence of data, there is a tendency for the policy objectives of farmland afforestation and the evaluation of the measures to follow a rather circular process. A series of environmental benefits are assumed from the outset in the objectives at EU and RDP levels, and evaluations then confirm that these objectives have been met, based partly on the views of the beneficiaries of the funding, and partly by repeating the assumptions that afforestation is generally beneficial for the environment.

Data bases of environmentally important land cover outside protected areas, such as semi-natural farmland habitats or EVG, are inadequate to a greater or lesser degree in all MS. This makes it difficult to apply screening mechanisms in order to exclude such land from afforestation. However, even where such data does exist it is not always used for this purpose. Data of this sort should be improved in all MS and could be integrated with LPIS in order to provide an efficient tool for screening afforestation projects and other landuse changes supported by the CAP.

Implementing effective targeting and protection mechanisms requires adequate data bases of land cover and land condition, but also adequate human resources on the ground in the form of trained and pro-active forestry-environmental agents who can visit proposed sites, assess the suitability of proposed projects and introduce changes to suit local environmental conditions where necessary.

Overall, the key environmental risks of farmland afforestation emerging from this study can be summarised as:

- The loss of semi-natural farmland and other farmland of high nature value, especially outside protected areas. Some of this farmland corresponds with Habitats Directive Annex 1 habitats and/or supports Annex 2 species.
- Increased fire risk in situations where dry matter accumulates due to exclusion of livestock grazing and where there is a reduced human presence in the landscape due to the withdrawal of farming.
- Longer-term land abandonment in the case of economically unviable forests at the end of the period when forest maintenance payments are available.
- Limited environmental benefits in situations where afforestation has not been targeted on to land most suitable for achieving these benefits, and/or where the forest type/management is not most appropriate to deliver these benefits.

The key safeguards for achieving positive environmental effects emerging from this study can be summarised as:

- Clear and specific environmental objectives at EU and RDP levels, with each objective quantified as far as possible and cross-referencing to environmental policy objectives.
- Targeting mechanisms that build on objectives and steer the most suitable forest types onto the most suitable land for achieving environmental objectives, as already applied in a small minority of Member States. This probably means less afforestation but better targeted so that environmental benefits will be greatest.
- Exclusion from afforestation of types of land that are most likely to entail significant environmental losses, such as EVG and Habitats Directive Annex 1 habitats.
- Prioritisation of support for the creation of forest types that are scarce, fragmented and/or deliver a particularly high environmental benefit compared with the previous land use.
- Improvement of data bases on land use, land cover and land condition (including soil, habitats and species) in order to enable better targeting and screening of afforestation. Integrating such information on LPIS would greatly facilitate targeting.
- Improvement of data recording in relation to afforestation projects in order to enable monitoring and evaluation of land use change, habitats change, environmental issues addressed (e.g. eroded land). Integrating such information on LPIS would greatly facilitate monitoring.
- Adequate human resources on the ground in the form of trained and proactive forestry-environmental agents
- Better coherence of policy mechanisms and removal of perverse effects, such as CAP eligibility rules that can drive High Nature Value grazing land out of farming and towards afforestation to facilitate receipt of Pillar 1 payments; and rules that exclude afforested land from grazing even though this can provide benefits for fire prevention and biodiversity.

- The broader use of the improved agroforestry measure which could help to combine benefits from forestry elements and at the same time maintain agricultural production including extensive grazing. This measure could also help to improve environmental services on intensive agricultural (arable) systems.

8.1.5 *Best ways to achieve positive multifunctional effects for environment from riparian buffer strip management*

In the new CAP 2014-2020 riparian buffer strips have also been identified as elements that can become part of 'Ecological Focus Areas'. The creation of new, and the maintenance of existing RBS may well be further enhanced by the obligation to create an EFA on arable land. Creation and/or maintenance of RBS is also a measure taken by Member States under the Nitrogen Directive and through National Action Plans (NAP) for Sustainable Pesticide Use. In this context they enhance the mitigation of emissions from fields to water courses and to protect surface water quality and aquatic ecology. These policies may either refer to the maintenance of existing RBS next to natural streams or to the introduction of newly installed RBS next to manmade water courses or highly modified streams. Although they are primarily motivated for their contribution to the protection of surface waters, they also contribute to biodiversity. Their function can therefore be multifunctional. To which extend they are multi-functional and how they need to be designed to make them as multi-functional as possible has been investigated.

For this an evaluation framework for the effectiveness of multi-functional buffer strips was designed. The framework was then tested in four best practice examples in the EU. These were:

- 1) RBS in the South of the Netherlands where field edges and buffer strips are commonly dry and abrupt with grass or flower rich herbs typically from lowland deltaic regions.
- 2) the nation-wide 10 meter-wide buffer strips project in Denmark representing dry buffer strips which can be found in several parts of Europe with slopes where they are established or maintained to filter surface runoff and stabilize banks.
- 3) the Po Valley buffer strips which also include dry buffer strips with slopes of sometimes covered with grass or flower rich herbs but often also including the trees and shrubs that have been characteristics for the traditional BS in this region.
- 4) The last example is from Estonia, representing Northeastern Europe example which includes the most natural the "traditional" or "natural" riparian buffer strip one can find in various sloping landscapes with a high potential nature value.

From the wider literature research and the application of the evaluation framework in the four examples the following conclusion can be drawn:

Overall there are several factors in both design and management that determine the effectiveness of BS for reaching specific goals. These include factors like width, profile, type of vegetation, harvesting of biomass, fencing, soil, slope and hydrology, land use, stream density, discharge continuity and integration with the existing ecological network. Overall mechanisms with regard to these factors are as follows:

- 1) As to width it is clear that for reaching ecological goals the wider is the better. For reduction of nutrient loads with width follows a typical saturation curve reaching a plateau at a width of several meters. For pollutant load reduction there is a maximum effectiveness that cannot be increased by widening the BS.
- 2) A buffer strip that combines wet and dry is considered superior, because it can tackle pollutants based on different retention processes. A more gradual wetness gradient is also an advantage for biodiversity, as it provides a more dynamic and diverse environment. So a gradual or wet profile is better for both for water quality and ecology. However, some substances are better retained in dry buffer strips, others in wet buffers.
- 3) Short and productive vegetation in the buffer strip is generally more effective nutrient retention and carbon sequestration. Shorter vegetation is generally more productive and therefore assimilates more nutrients and carbon. On the other hand taller vegetation may develop deeper roots, which may be good for intercepting pollutants from upper groundwater flow. So short vegetation is for filtering the superficial and tall vegetation for the deeper flow paths.
In order to take advantage of productive vegetation for water quality, it is better to harvest frequently. On the other hand harvesting activities are not good for biodiversity as they will disturb species and reduce food availability. A gradient with lower and taller vegetation is therefore ideal for biodiversity goal and enhances the landscape attractiveness.
- 4) Since livestock grazing negatively affects water quality (through manuring), stream channel morphology, hydrology, riparian soils, streambank vegetation fencing can to maintain and restore the infiltration capacity of the riparian soil and may be positive for invertebrate biodiversity. On the other hand fences will also reduce the access of larger wild life animals to the stream.
- 5) Soil, slope and hydrology are the main conditional factors at field level for determining the effectiveness of RBS for water quality. These determine the depth of transport (surface runoff, subsurface or interflow, deep groundwater flow) and the travel time of nutrient and pesticides from field to stream. The best for intercepting run off is a 10% slope and medium textured soils. Moderate surface runoff and shallow groundwater transport are considered best for BSE.
- 6) the contribution of a BS to the ecological network (connectivity) depends on the spatial arrangement or structure of the existing ecological network

Overall it became clear that there is no size fits all in RBS design as tailor made designs are necessary for different goals and conditions. One can strive for multiple goals, but in many cases required conditions, design and management requirements for reaching one goal can be contra productive for reaching another goal. Therefore

multiple zone buffer strips are best for reaching multiple goals with RBS management. In the case of a double strip, one zone provide more biodiversity services with more variation in vegetation and taller species near the stream, the other zone is more for load reduction, with shorter more productive harvested grass between the first strip and the agricultural fields to filter out contaminants. The first one can be wetter and with more ecological and hydrological, biochemical and soil gradients. The second can be dry which is better for intercepting surface runoff.

Another option is a three-zone RBS. It comprises, from field to stream, a grassland strip, a shrubs or short rotation woodland strip, and an undisturbed zone with tall vegetation on the bank. The grassland strip is for abating surface runoff sediment and pollutant load and may produce some biomass. The next zone with shrubs or short rotation woodland with deeper roots allows for further infiltration of surface runoff and uptake of nutrients from subsurface flow and upper groundwater, and for denitrification due to high organic matter input. It can produce high biomass yields. The last one closest to the stream stabilizes the bank and the buffer strip during floods and can still contribute to interception of groundwater flow and denitrification.

Because of the wider width and the large structural diversity in vegetation the ecological functions of the 2- and especially to of the 3-zone BS is larger than that of the 1 zone grassland buffer strip. In the example of the Po valley this was further confirmed. The traditional 2-zone buffer strips from the Po valley including grass, trees or shrubs close to the stream contribution better to ecological goals than the southern Dutch buffertstrips which are less wide and have grass cover only. The maintenance of these traditional 2-zone buffer strips should therefore be enhanced and trends towards replacing the trees and shrubs by pure grass should be further prevented.

The information from Denmark shows clear benefits of maintaining elevated vegetation next to the stream for bank stabilization. Installing such an elevated vegetation row would also contribute to ecological goals. If weighting costs and effectiveness should lead to setting a specified width we recommend considering at least a 2 zone buffer strip within this specified width because the combination of short and tall vegetation is clearly beneficial for both water quality and ecology. In other words multiple zone buffer strips tend to be more cost effective.

Short vegetation is good for retaining sediment bound pollutants, whereas taller vegetation may contribute to retention of dissolved pollutants in deeper flow paths. Additionally, tall vegetation reduces pesticide drift. As decomposition of some pollutants requires dry or wet or intermediate circumstances varying wetness along the potential flow path will stimulate retention of variable pollutants. So gradients, like in natural riparian buffer strips, seen in the Estonian case, are an asset to the multifunctionality of buffer strips. This calls for preserving the natural character of many riparian buffer strips, or in other words, for building on the ecosystems services they provide, for reaching both water quality and biodiversity goals. Without gradients, take for instance an abrupt dry profile with short vegetation like

in the Danish, Dutch and part of the Po valley cases, there is an advantage for some goals but a disadvantage for reaching others.

The most important distinction with regard to hydrology is between surface runoff which implies sediment bound transport, and groundwater flow with dissolved pollutants. Retention of sediment bound transport requires dense buffer vegetation like grass and also shrubs and a high soil infiltration capacity to allow settlement of the sediment. Most sediment bound pollutants could be expected for the Estonian case with considerable slope and next in Italy where a gentle slope was combined with mainly arable land use and loamy soil. Both examples integrated a grass strip at the outer edge of the buffer zone, which is fit for intercepting sediment. Sediment was irrelevant for the Dutch case, and again this was variable for Denmark, although a 10 meter grass strip should be sufficient to reduce sediment load.

A dense stream and ecological network favours multiple goal effectiveness of buffer strips at landscape level in absolute terms, but not necessarily on a relative or specific basis (per meter buffer strip length). Selecting hot spots for locating buffer strips is then more cost effective. Therefore a spatial assessment identifying the more and less favourable conditions for buffer strip effectiveness could be used to identify the most cost effective localisation for allocation of new RBSs. For the water quality goals these should include information on hydrogeology, soils, slope and land use, whereas for the biodiversity goals land use and ecological network (connectivity) would be most important. This implies that for making a BS optimally contribute to connectivity account should be carefully taken of the existing ecological network.

From the Italian case it became clear that the importance of maintaining buffers strips next to ephemeral streams referring to the rule “keep pollution close to the source” works better for reaching water quality goals. This is because in the Italian case experience showed that the field buffer strips next to dry ditches become effective as soon as autumn rains begin and are then “the first line of defense” for the surface water system.

Overall we conclude that buffer strips derived or developed from natural riparian buffer strips provide better opportunities for multi-functionality, for a number of reasons related to their conditions: they combine wet and dry zones, and tall and short vegetation, in other words they provide gradients, which is advantageous for both biodiversity and water quality.

The main recommendation is therefore that preserving natural or similar riparian buffer strips should be a priority for reaching multifunctional buffer strips. If newly installed buffer strips are to be considered it is possible to include gradients in their design, although this will require more space (width). Sufficient width is really an asset to multifunctional buffer strips, because it gives the opportunity to install multiple buffer zones that provide variation in circumstances (gradients), just like the natural ones. If a wide bufferstrip (> 10 meters) cannot be realised it is best to still create a two zone buffer strip which will enhance the multi-functionality of the strip.

8.1.6 Combined conclusions

EVG in Europe are a sub-class of HNV farmland. They are usually concentrated in HNV farmland type 1 and 2 and less with type 3. Actually EVG can be seen as the highest quality HNV farmland areas we have in Europe. Their conservation is very important for maintaining farmland biodiversity, particularly those habitats and species that are specified in the Annex 1 and 2 of the Habitat Directive. Both afforestation of these EVG as abandonment forms a serious threat to their conservation and should be prevented.

There are some significant areas of overlap between farmland afforestation, abandonment and particularly ecologically valuable grasslands (EVG). More specifically the following observations can be made:

- From the afforestation analysis it became clear that in some countries there was a strong overlap between land afforested with RDP support and EVG. This is a logical result of the fact that, although not the initial objective when the measure came into force, it is more attractive to use low productive land for this measure. In fact results show that it took place predominantly on marginal grazing land of low productivity.
- Aids for afforestation play a role in encouraging the abandonment of farming activity. This again may lead to ceasing of important low intensity management of semi-natural habitats which may lead to loss of EVG.
- The inventory of studies in this report showed that in areas where abandonment is particularly an issue coincide strongly with where HNV farmland areas, which overlap strongly (but not entirely) with where EVG are. Thus, tackling the issue of abandonment could not only help to contribute to more vital and viable rural areas, but keeping EVG in good ecological status and maintaining enough elements contributing to the ambitious network of green infrastructure.
- In addition most of the EVG are situated in the more remote and marginal part of the EU, with a strong concentration in up-lands, Natura 2000 areas, High Nature Value farmlands, LFAs. In these type of areas farmers cope with many more natural handicaps that make farming more complicated both in terms of physical efforts and in relation to earning a good income. There are also many more problems in these type of regions of which the main are de-population and ageing of local populations, loss of services. The chances that EVG therefore get abandoned and their management and thus conservation lost are larger.
- Afforestation on EVG is by no means guaranteed to deliver an overall environmental benefit. It is clear that valuable Annex I habitats are destroyed by it directly. The long-term balance for biodiversity will depend on many factors, including the type of habitat that is lost, the landscape context, and the nature and management of the created forest. The precautionary principle would advise against destroying habitat types that are of EVG for afforestation.

- However, whether this is the best measure to prevent further abandonment is doubted. It is expected that the effect on rural development will be limited, at least on the short run, as the 'newly grown' vegetation or forests require, once established, very extensive management, so limited labour input. Furthermore, even the fastest growing forest species can only be harvested every 9 – 10 years. Such extensive forms of management will hardly slow down rural abandonment and the industries processing these products are often not or no longer situated in the area itself. Part of the revenues are therefore likely to spill over to other areas. On the other hand afforestation and agro-forestry on abandoned lands could certainly help to decline fire risks and may provide some opportunities for additional income.
- Since 2007 also non-agricultural lands have become eligible for afforestation aids. Hence land could also include pasture lands that are non-eligible for 1st Pillar payments certainly given the fact that there is an over representation of EVG that are non-eligible for 1st pillar support because of the application of the strict permanent grassland definition criteria in many countries. This implies the EVG have become at higher risk of being completely lost through afforestation activities.
- Another effect may be that in some MS land classified as non-agricultural may in fact be extensive grazing land and EVG, and may not be eligible for CAP support, but following afforestation it can become eligible. Whether this will have beneficial environmental effects is not clear. At least on the short run it will lead to a loss of species rich EVG.
- RBS can be used as extra protection for maintenance of EVG if they are surrounded by areas of intensive agriculture and clearly form a minor land use. In these cases RBS may help to prevent pollutants to reach the EVG and cause the overall environmental quality to go down leading to species loss.

That there is a strong link between abandonment and loss of EVG is clear. Abandonment of rural areas and agricultural management will lead to loss in the ecological value of EVG that depend on farm management for maintenance of the biodiversity values. Whether afforestation is an effective measure to stop land abandonment is very much the question however as the effects on employment and incomes are limited, at least on the short run, while if it is developed on EVG it will have adverse effects for farmland biodiversity, particularly if the EVG is still in use for extensive pasture activities.

Overall one can therefore conclude that a good spatial identification of EVG in combination with the places that are at highest risk of abandonment will have many advantages for better targeting 1st and 2nd pillar payments. This better targeting is particularly relevant.

Firstly it will help to understand better which types of land need to be targeted by 1st and 2nd pillar payments to avoid the ceasing of management of EVG which is crucial for keeping them in good ecological status.

Secondly it will help to identify the specific areas where afforestation is not a good measure as it will lead to loss of valuable EVG that are included in the Annex 1 of the habitat Directive and which need to be conserved.

Thirdly it also help to identify the rural areas in Europe where additional efforts will need to be made to prevent further abandonment while it is still possible and where it is most important from both a socio-economic and environmental perspective.

Key combined conclusions and recommendations:

Conclusions:

- EVG can be seen as the highest quality HNV farmland areas we have in Europe. Their conservation is very important for maintaining farmland biodiversity, particularly those habitats and species that are specified in the Annex 1 and 2 of the Habitat Directive. Both afforestation of these EVG as abandonment forms a serious threat to their conservation and should be prevented.
- Some countries have strong overlap between land afforested and EVG. This is a logical result of the fact that, although not the initial objective, it is more attractive to use low productive land for this measure.
- Effect of afforestation on prevention of abandonment is limited. Limited employment and local income opportunities, certainly on short-medium term
- Afforestation on EVG is by no means guaranteed to deliver an overall environmental benefit. Valuable Annex I habitats are destroyed by it directly. The long-term balance for biodiversity will depend on many factors. The precautionary principle would advise against destroying habitat types that are of EVG for afforestation.
- Since 2007 also non-agricultural lands have become eligible for afforestation aids. These lands could also include EVG that are non-eligible for CAP payments. This implies the EVG have become at higher risk of being completely lost through afforestation activities.

Recommendations:

- A good spatial identification of EVG in combination with the places that are at highest risk of abandonment will have many advantages for better targeting 1st and 2nd pillar payments:
 - 1) it will help to understand better which types of land need to be targeted to avoid the ceasing of management of EVG crucial for good ecological status.
 - 2) it will help to identify the specific areas where afforestation is a good and not a good measure
 - 3) it will help to identify the rural areas in Europe where additional efforts will need to be made to prevent further abandonment while it is still possible and where it is most important from both a socio-economic and environmental perspective to turn this process around.



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