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Impacts of biofuel production on biodiversity in Europe

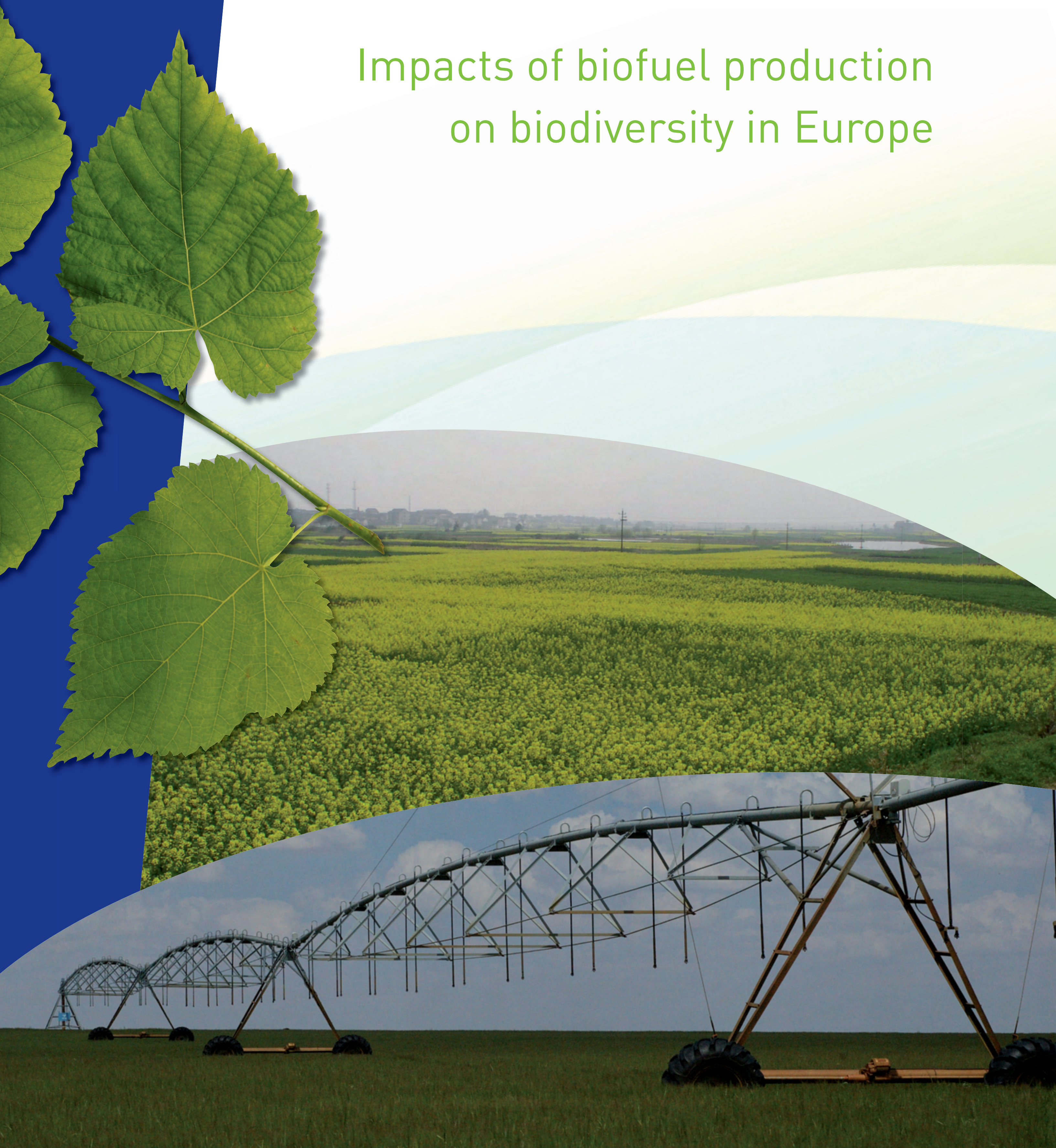

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Table of contents

Impacts of biofuel production on biodiversity in Europe[1]

Headline conclusion and recommendations

A review of current literature, the examination of case studies and interviews with practitioners in Europe illustrate: 1) the potential significance of 2nd generation biofuels for reducing carbon; 2) that they have great untapped potential for contributing positively to biodiversity in Europe. The increase in biomass crop production in Europe should not lead to additional pressure on the environment and, where possible, it should lead to the improvement of biodiversity.

- There is a need for the development of an overall policy and implementation framework that could make agricultural bioenergy production environmentally compatible.
- There is a clear need to draw up codes of practice, memoranda of understanding, criteria for biodiversity friendly production and to deliver (at least) the majority of the recommendations listed in the final section of this paper.
- Urgent research and monitoring is required to demonstrate the values and best practices for biodiversity in European agricultural habitats.

1. Introduction

Using biofuels from renewable sources seems to be attractive, and could potentially reduce greenhouse gas emissions, ensure energy security and support rural development objectives. However, the increasing amount of land in the European Union devoted to the production of biomass for energy use could pose a serious threat to biodiversity in Europe.

This paper[2] will contribute to the discussion on the impacts of the production of second generation biofuels on biodiversity in Europe, defining the policy context and highlighting its positive and negative impacts on biodiversity. Four sources of second generation biofuel production are presented in tabular form in this paper to allow a better understanding and easy comparison of the potentially positive and negative impacts of biofuels on biodiversity at sub-national level in Europe (Table 1). Information on these impacts was obtained by conducting an extensive review of recent relevant literature (see footnote); and through a questionnaire that was sent to the managers of the three selected pilot areas to help collect information about these sites.

This paper is targeted at policy officials who are responsible for the development and the implementation of policies in the EU and pan-European setting that relate to ecosystem sustainability, energy, agriculture and biodiversity, with particular reference to biomass, bioenergy and biofuels. In particular, the analysis and conclusions derived from this report are intended as a contribution towards the Convention on Biological Diversity (CBD) Secretariat, the European Commission DG Energy, DG Agriculture and Rural Development and DG Environment (as it is recognised that the promotion of biofuels for energy production concerns all three policy areas), as well as a broad audience of national and sub-national level policy officials.

[1] This work has been funded by the Manfred-Hermsen-Stiftung, Bremen, Germany

[2] This discussion paper is based on a detailed review and analysis and is therefore not referenced for the sake of brevity. All references and source material can be found in: Biemans, M., Waarts, Y., Nieto, A., Goba, V., Jones-Walters, L and Zöckler, C (In prep) Impacts of biofuel production on biodiversity in Europe, pp. 1-32 ECNC, Tilburg, The Netherlands; which will be available in June 2008.

2. Policy background

The EU is framing its support for bioenergy production in the context of contributing to objectives such as meeting climate change commitments, environmentally-friendly security of supply and the promotion of renewable energy sources. There are also significant economic and employment related drivers. So, for example, transport biofuels have the highest employment intensity and the greatest security of supply benefits and biomass in heating is cheapest (and biomass in electricity has the greatest greenhouse gas benefits). However, there is increasing evidence that the carbon off-set by 1st generation biofuels is not as expected. In reality the conversion of, for example, grassland into biofuel crops releases CO_2 and the time lag to regain these bears no relation to the aim and targets of reducing green house gas emissions.

In 2005 (the most recent figures available), biofuels were used in 17 of the 21 Member States for which data were available. The Commission indicates a significant increase in market share, reaching 1% on average (it has doubled in two years). Nonetheless, this figure is below the reference of 2% as fixed in Directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport. In addition, the advances have been very varied: only Germany (3.8%) and Sweden (2.2%) achieved the reference value. While biodiesel achieved a share of about 1.6% of the diesel market, ethanol achieved a share of only 0.4% of the petrol market. About 90% of biofuel consumption is covered by domestic raw materials, 10% by imports. Out of the EU 25's total arable land of 97 million hectares, about 1.8 million hectares were used for producing raw materials for biofuels in 2005. The rise in the oil price and a growing interest in new markets for agricultural products in the light of the general reform of the Common Agricultural Policy (CAP) – and the sugar regime in particular – have led to a wider appreciation of biofuels' advantages at European level and have provoked widespread discussion in Member States. A discussion that should be further elaborated in the context of the European Commission's recently announced proposal for a CAP 'Health Check'.

Second generation biofuels from wood and wastes are currently more expensive than first generation biofuels from agricultural crops and have not yet been fully explored in their commercial value and potential to contribute to the listed EU policies.

Growing certain types of bioenergy crops is expected to lead to demand for increased areas of agricultural land, and is currently causing highly publicised alarm at the apparently linked rise in food prices. This may cause a consequent demand on land, at present extensively farmed or not farmed at all, and therefore threaten natural and semi-natural habitats; if this threat is realised it could contribute significantly to any potential failure to reach the European target expressed in the Communication from the European Commission in 2006, to: "Halt the loss of biodiversity by 2010 – and beyond". The challenge is to maintain the balance between the two policy targets, one primarily aimed at combating climate change and securing energy supply, the other aimed at safeguarding nature protection interests.

The effect of land use is determined by the difference in biodiversity values of previous land use(s) and the biodiversity value of biofuel crops. The biodiversity balance mostly depends on the actual land that is converted to biofuel crops and the number of years that a particular biofuel crop is grown. The first year of production of second generation biofuel crops may have negative effect of land use on biodiversity. This creates a situation that may be called a "biodiversity debt" (a term intended to provide a conceptual reference to carbon debt). In subsequent years, the positive effect of avoided climate change becomes more important with each harvest cycle, as it has a cumulative effect. When natural habitats (whether grasslands or forests) are used for biofuel crop production, the negative effect of land-use change continues to dominate the positive climate change effect, even up to 2100. At the other extreme, biofuel crop production on recently abandoned land that was under intensive agricultural management will immediately result in positive effects, as the former land use does not normally represent valuable biodiversity.

The category of extensively used grasslands is especially vulnerable, as they may present high values in (agro-)biodiversity. In Europe, such high nature value areas are already under pressure from conversion and intensification. The period up to 2100 is not long enough to compensate for the biodiversity loss due to land-use change. However, there are not enough production data available at the moment to assess the development over time.

3. The impacts of biofuels on biodiversity

The use of first generation biofuels is already increasing and has been the subject of many discussions because the production of biofuels has potentially far-reaching social and environmental impacts (for instance in relation to palm oil in South America or Indonesia, or the loss of set-aside land in the EU) and raises urgent questions about whether they are: an effective or economic way of helping to combat climate change; what their effect on biodiversity is likely to be; and how they will compete with food production.

In general, the production of first generation biofuels implies intensive agricultural practices (such as the high application of fertilizers and pesticides, for example, for rapeseed) and the possible conversion of natural land (forest or grassland) into arable land; and it may compete with food production, leading to increases in food prices.

Second generation biofuels are expected to score better on all these issues; it has been predicted that they will deliver greater reductions in greenhouse gas emissions and it is claimed that they are less competitive with food for land use. However, second generation biofuels are still under development, are not yet promoted commercially and their impacts on the environment and biodiversity have not been widely studied. Furthermore, the construction of biofuel plants is expensive and it is therefore crucial to analyse possible inherent impacts on the environment prior to their establishment. This paper aims to demonstrate the value and contribution of 2nd generation biofuels to carbon off setting without compromising biodiversity and, where possible, to illustrate where biodiversity value can even be enhanced.

Table 1. Impacts of bioenergy production on biodiversity

Bioenergy source		**Positive impacts**	**Negative impacts**
Perennial crops	Short rotation coppice (willow and poplar plantations)	• Relatively low use of agrochemicals (e.g. fertilizers and pesticides) after the establishment period. • Diversity and occurrence of soil micro-organisms and soil fauna higher than in annual food crop cultivations. • Increased presence of soil organisms attract birds and mammals that feed on them. • Spring flowering of willow is beneficial to pollinating insects and insects living on wood. • Timber living larvae of beetles and moths and birds feeding on them • Tree plantations take up lost nutrients from the groundwater and reduce soil runoff. • Tree plantations significantly reduce groundwater and surface-water contamination. • Tree plantations have a shadowing effect on streams and pools, lowering the water temperature and eutrophication.	• The high use of herbicides during the establishment period. • The potential introduction of non-native species as energy crops may displace native species or become pests. • When tree plantations replace woodland or scrub habitats, this will counterproductive by replacing existing high biodiversity value bird populations. • Lowering ground water level in neighbouring habitats.

Table 1: Impacts of bioenergy production on biodiversity: continued

Bioenergy source		Positive impacts	Negative impacts
Perennial crops	*Miscanthus* species and reed canary grass	• Lower use of herbicides, pesticides and fertilizers than annual crops. • Perennial biomass grasses provide a good habitat for many forms of native wildlife (birds, mammals and invertebrate populations). • Lowland disturbance and good ground cover due to *Miscanthus* and reed canary grass cultivation is preferable for small mammal species. • *Miscanthus* fields offer a great diversity of weed flora , rich invertebrate and ground nesting bird fauna.	• *Miscanthus* is not a native European species and may become invasive, causing extinction of native species. • Invading grasses are very difficult to control; proposals to introduce such species should be assessed rigorously.
Waste products from forestry and agriculture	Removal of forestry waste out of forests	• By removing the waste products from forestry, the risk of forest fires can be reduced, which may have a positive impact on biodiversity.	• Forestry waste extraction has often a large negative impact on biodiversity as many woodland species depend on forestry waste being left in woodlands. • The removal of dead wood may lower carbon sequestration in forests. • Species of fungi and beetles are found to be more abundant when there are different volumes of dead wood available in forests. • Bird species are dependent on a variety of arthropods that are facilitated by dead wood.
Waste products from forestry and agriculture	Agricultural, non-food waste products	• Removing grassland cuttings prevents the grasslands turning into a possibly less attractive and diverse ecosystem (natural succession). • Removing plant litter decreases the soil nutrient richness and other soil processes, supporting the increase or maintenance of biodiversity. • Seriously enhance the prospect of wetland extension by allowing a economic usage of wet grassland cuttings	• Removing agricultural waste products requires in some cases a greater use of nitrate fertilizers, which has a detrimental impact on biodiversity and its surrounding water bodies. • Removing agricultural waste products negatively affects soil organisms • Removing agricultural waste products probably accelerates topsoil losses.

4. Case studies

Three pilot areas of existing biofuel production at sub-national level in Europe have been reviewed. These were:

- Bioenergy production from wood chips in the nature area Sonse Heide (the Netherlands);
- Growth of reed canary grass for bioenergy purposes on abandoned peat cutting fields (Finland);
- Reed harvesting for biofuel production in the wetlands of the Narew National Park (Poland).

For each of these cases, site characteristics and current management practices have been described, and positive and negative impacts on biodiversity of harvesting biomass described.

A number of findings (which have informed the recommendations below) have emerged. In particular:

- Although wood chips can contribute significantly to the development of sustainable 2nd generation biofuels, their potential impact on biodiversity (in particular soil organisms and fertility) is uncertain.

- The regeneration of former peat cutting areas potentially points to a huge opportunity for biofuel harvest. However the present design of the crop does not take any impact of biodiversity into consideration. Potentially the positive impact can be huge, but it very much depends on the crop type, design and harvest methods.

- Most promising is the reed or rush cutting from wetlands, primarily in Eastern Europe. It appears to have the best effect on enhancing grassland biodiversity.

It should be noted, however, that in all the case studies above (and in others elsewhere), no research or monitoring has been set up to investigate the potential synergy for carbon reduction and biodiversity.

5. Further conclusions and recommendations

The review and case studies underpinning the current discussion paper suggest the following additional recommendations for urgent consideration:

- The urgent need for an extension of the existing policy frameworks at key decision-making levels in order to provide the basis for integrating decisions about biodiversity and bioenergy production.

- These issues need to be fed in to the general reform of CAP and the European Commission's recently announced proposal for a CAP 'Health Check';

- Establish a common policy (within the CAP, but also within DG Environment and Transport) that acknowledges the contribution and synergies of biofuel production .

- Maintain the second pillar compensation scheme within the CAP and use it to fully support and promote the development of 2nd generation biofuels, preferably in wetlands.

- The current policy frameworks, in particular at national and regional level, that govern the conversion of land for bioenergy crop production should be subject to Strategic Environmental Assessment to establish their potential effect on biodiversity.

Whether biofuels have a positive or negative impact on biodiversity depends on many factors, such as the intensiveness of the biofuel production on how the energy plantations are designed in the landscape, how they are managed and the type of land use prior to conversion. Key issues and recommendations include:

- The conversion of habitats for bioenergy crop production should take into consideration the importance of habitats and species.

- The policy integration proposed above should include an integration of the spatial mapping systems used by the key stakeholders, in order that early warning of potential impacts will be available to all decision-makers.

- All land conversion for bioenergy crop production of a defined scale and significant impact should be subject to mandatory environmental impact assessment.

- If Europe is to reach its biodiversity target it must avoid the production of first generation biofuels, which lead to massive habitat conversion and require intensive agricultural practices and have high impacts on valuable habitats.

- The conversion of land with high biodiversity value into bioenergy crop production should be strictly avoided.

- Policy guidelines need to be developed that ensure the conservation of these areas even outside protected areas or Natura 2000 sites.

- The cultivation of perennial biomass crops is very much favoured for second generation biofuels as they appear to provide considerably more positive benefits to biodiversity than most arable crops.

- Converting land to perennial bioenergy crop production can in certain cases change crop rotation systems in favour of biodiversity conservation or enhancement

Furthermore biofuel production may in addition have social and economic benefits. It may improve the profitability of farmers, contributing to maintaining farming activities that are conservation oriented. This includes the quality and stability of soils and the avoidance of irreversible landslide damage as well as maintaining high levels of biodiversity. Therefore:

- Producing biomass from nature management activities in certain ecosystems where biodiversity is high can have a clear advantage for biodiversity, safeguarding these ecosystems from being taken over by other ecosystems of lesser conservation value.

- In order to further promote the use of the proposed biofuel projects at a wider scale in Europe, we propose the establishment of further case studies, which are also accompanied by biodiversity monitoring schemes that illustrate the benefits in selected biodiversity indicators.

- Policy should be developed to stimulate and promote such studies and to utilise the results in order to further refine the production of 2^{nd} generation biofuels.

Waste products that come from industries related to forestry or agriculture are another promising source for the production of second generation biofuels. Thus:

- Removing biomass from wetlands and other water bodies may enhance the quality of the ecosystems and their related biodiversity. However extracting forest residues from a site, the local soil nutrient balance may be negatively affected, and the risk of erosion may increase.

- Removing branches and other waste from forests may also have implications for those organisms that are dependent on them for their survival.

The regional perspective for the production of biofuels is quite varied in Europe. For instance, the introduction of bioenergy crops in intensive agricultural systems, which are predominant in large parts of Western Europe, will most likely not impose additional pressures on the state of nature and biodiversity. On the other hand, the introduction of biomass crops in the Mediterranean region or in Central and Eastern Europe, characterized by low intensity farming systems and the abundance of abandoned agricultural lands, could pose a threat to farmland biodiversity. However:

- Cultivating bioenergy crops in these areas could also be an opportunity to bring abandoned lands into use again, as long as: sustainability principles are applied; intensive farming practices and preserving semi-natural grassland areas are avoided; and the activities are compliant with the overall conservation vision for the region.

- It is clear that a site by site approach needs to be taken in relation to the conversion of land to buy energy crop production. It is not possible to apply a 'one size fits all approach'.

- National policy, whilst essential in providing a strategic framework at country level, may not be the best place to provide detailed plans for the location and delivery of more energy crops.

- Regions and sub-regions need to be encouraged to produce their own policies (linked to the national frameworks) in order to provide a more subtle and sensitive approach that takes into account local circumstances and fully integrates biodiversity at an ecosystem and site level.

6. Acknowledgments

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